Quarterly Report of Air Quality Monitoring January 1 to September 30, 2023, 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

TEXAS
The University of Texas at Austin

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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 four years at the Gregory Fresnos station and more than three and a half years at the other two 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) have the lowest NAAQS concentrations in the state over the 2020 to 2022 period, and average hydrocarbon concentrations are among the lowest of the Texas automated gas chromatograph monitors (auto-GCs) 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 October 2023).

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 January 1 to September 30, 2023, with some comparisons to earlier data.

2.0 Summary of Activities January 1 through September 30, 2023

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.

Earlier this year the United States Environmental Protection Agency (EPA) announced a proposed decision to change their annual PM2.5 standard from its current level of 12.0 micro-grams per cubic meter (µg/m^3) to somewhere in the range of 9.0 to 10.0 µg/m^3.[1] The EPA's Air Quality Analysis Group reported on Oct. 3, 2023, that "the final rule is currently under the Office of Management and Budget (OMB) review after being received on 9/22/2023…When the final rule is signed by the EPA Administrator, it will be accompanied by a big press release and will be published in the Federal Register a few days after."[2]. Future reports and the website will provide updates once a final decision is made by the EPA. Currently, the three-year average concentrations at all three stations have been lower than the 9.0 µg/m^3 level mentioned above.

This report focuses on the data collected at the three air monitoring stations during the period January 1 through September 30, 2023, but also 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[3]. Also shown in Figure 1 are the locations of the Cheniere liquefied natural gas facility and the GCGV ethane-cracker facility.

[1] https://www.epa.gov/pm-pollution/national-ambient-air-quality-standards-naaqs-pm , accessed October 2023.
[2] Email correspondence.
[3] This image date March 2022; a more recent June 2023 image shows too many clouds blocking views of the surface.

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	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 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.

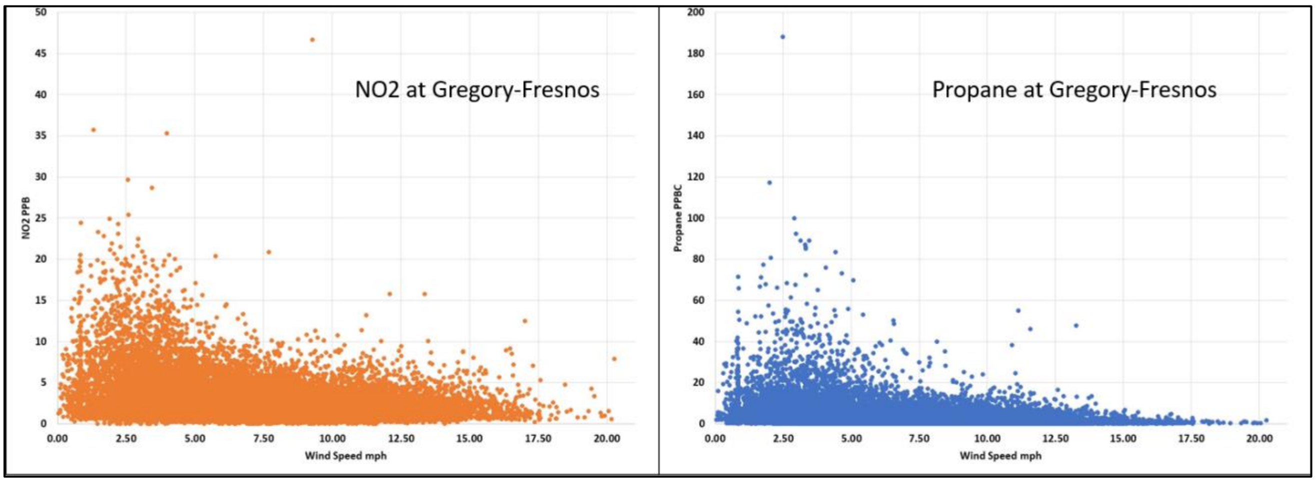

Figure 2. Effect of wind speed on primary pollutants

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 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. For this report, auto-GC and EtO data are available through July 31, 2023, and all other data were available through September 30, 2023.

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, 2023, through July 31, 2023 (7 months). The date and concentration of the highest value in the graph is shown in the graph. Benzene concentrations in the air can be of health concern but to date their 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 at https://www.tceq.texas.gov/cgi-bin/compliance/monops/agc_amcvs.pl (accessed October 2023). Note that a straight line or a gap in a time series graph 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, with the peak one-hour concentration, maximum 24-hour day concentration, and the January 1 through July 31, 2023, 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[4]:

> "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 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."

Total nonmethane hydrocarbons (TNMHC), total nonmethane target compounds (TNMTC), ethane, propane, and propylene do not have AMCVs and the table shows "N/A" in the AMCV cells for these species.

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 95 percent data completeness of the planned collection hours for the first 5 months of 2023.

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 October 2023). To make a request, contact Dr. Dave Sullivan at sullivan231@mail.utexas.edu or 512-471-7805.

[4] https://www.tceq.texas.gov/cgi-bin/compliance/monops/agc_amcvs.pl accessed October 2023.

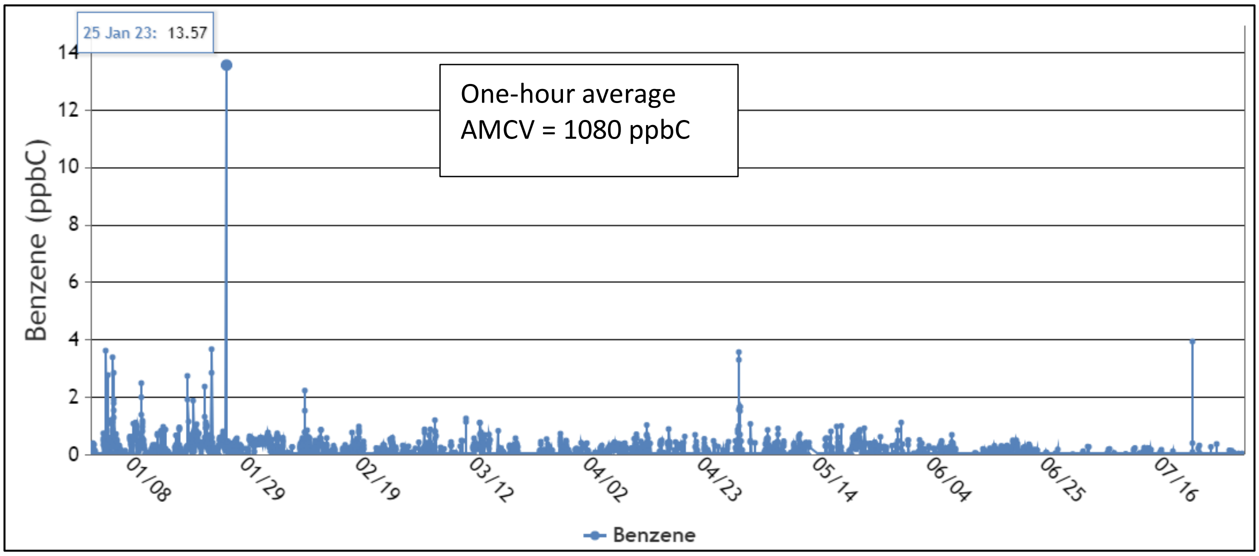

Figure 3. Hourly benzene concentrations at GF station, Jan. 1, 2023 – July 31, 2023, ppbC units

Table 2. Gregory-Fresnos Auto-GC statistics for January 1 – July 31, 2023

Species	Num. Samples	Peak 1-hr ppbC	Peak 24-hr ppbC	Short-term AMCV	Mean ppbC	Long-term AMCV
TNMHC	4,439	2214.0	197.88	N/A	36.702	N/A
TNMTC	4,439	2079.2	188.84	N/A	34.149	N/A
Ethane	4,440	561.6	54.88	N/A	9.952	N/A
Ethylene	4,440	78.5	5.09	1,000,000	0.676	10,600
Propane	4,440	431.6	45.93	N/A	7.582	N/A
Propylene	4,440	22.6	3.27	N/A	0.589	N/A
Isobutane	4,440	151.0	18.05	132,000	2.454	40,000
n-Butane	4,440	224.5	24.11	368,000	4.499	40,000
Acetylene	4,440	10.1	1.31	50,000	0.397	5,000
trans-2-Butene	4,440	0.5	0.10	60,000	0.043	2,800
1-Butene	4,440	4.8	0.45	108,000	0.140	9,200
cis-2-Butene	4,440	1.3	0.24	60,000	0.017	2,800
Cyclopentane	4,440	10.2	0.77	29,500	0.121	2,950
Isopentane	4,440	151.5	13.10	340,000	2.249	40,500
n-Pentane	4,440	132.8	10.82	340,000	1.921	40,500
1,3-Butadiene	4,440	2.9	0.35	6,800	0.038	36
trans-2-Pentene	4,440	0.7	0.11	60,000	0.011	2,800
1-Pentene	4,440	1.9	0.22	60,000	0.033	2,800
cis-2-Pentene	4,440	0.8	0.14	60,000	0.008	2,800
2,2-Dimethylbutane	4,440	13.3	0.76	32,400	0.106	1,140
Isoprene	4,440	2.5	0.42	7,000	0.084	700
n-Hexane	4,440	65.6	4.25	32,400	0.510	1,140
Methylcyclopentane	4,440	28.6	1.81	4,500	0.221	450
2,4-Dimethylpentane	4,440	7.1	0.38	58,100	0.030	15,400
Benzene	4,440	13.6	1.03	1,080	0.126	8.4
Cyclohexane	4,440	48.7	2.63	6,000	0.232	600
2-Methylhexane	4,440	14.7	0.71	58,100	0.034	15,400
2,3-Dimethylpentane	4,440	7.5	0.34	58,100	0.006	15,400
3-Methylhexane	4,440	15.7	0.85	58,100	0.064	15,400
2,2,4-Trimethylpentane	4,440	8.0	0.79	32,800	0.080	3,040
n-Heptane	4,440	31.5	1.73	58,100	0.126	15,400
Methylcyclohexane	4,440	45.6	2.54	28,000	0.281	2,800
2,3,4-Trimethylpentane	4,440	2.0	0.15	32,800	0.007	3,040
Toluene	4,440	17.8	1.88	28,000	0.248	7,700
2-Methylheptane	4,440	4.6	0.45	32,800	0.027	3,040
3-Methylheptane	4,440	3.2	0.32	32,800	0.019	3,040
n-Octane	4,440	12.4	0.83	32,800	0.082	3,040
Ethyl Benzene	4,440	1.1	0.28	160,000	0.025	3,520
p-Xylene + m-Xylene	4,440	4.6	1.42	13,600	0.209	1,120
Styrene	4,440	0.3	0.01	41,600	0.000	880
o-Xylene	4,440	1.4	0.38	13,600	0.031	1,120
n-Nonane	4,440	3.0	0.30	27,000	0.027	2,520
Isopropyl Benzene -	4,440	1.3	0.25	4,590	0.002	459
n-Propylbenzene	4,440	1.0	0.15	4,590	0.004	459
1,3,5-Trimethylbenzene	4,440	0.7	0.10	27,000	0.003	333
1,2,4-Trimethylbenzene	4,439	1.4	0.41	27,000	0.152	333
n-Decane	4,440	3.1	0.49	10,000	0.079	1,900
1,2,3-Trimethylbenzene	4,440	2.1	0.19	27,000	0.024	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, 2023, through July 31, 2023. The 49.3 ppbC concentration at the PBG station on April 29, 2023, is the highest benzene concentration measured at the three stations in San Patricio County to date. It was measured at 11 p.m. CST with the wind direction changing from west through south to southeast under very light and variable wind conditions.

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 1 through July 31, 2023. Also shown in the two tables are the TCEQ's AMCVs. Total nonmethane hydrocarbons (TNMHC), total nonmethane target compounds (TNMTC), ethane, propane, and propylene do not have AMCVs. Table 3 and Table 4 show "N/A" in the AMCV cells for these species.

Based on the 22 hours per day planned ambient measurements, the PBG station has collected data with a 94 to 96 percent data completeness based on planned collection hours for the first seven months of 2023, except for data completeness for 1,2,3-Trimethylbenzene, which had not been in the reported Portland stations' data sets until February 2023 but is 69% for January 1 through July 31, 2023, and 81% for Feb. through July. The PBway station has between 84 and 92 percent data completeness of the planned collection hours over the first seven months of 2023, except for a lower 35 percent data completeness for Acetylene, which has only been reported off and on during 2023, and data completeness for 1,2,3-Trimethylbenzene, which is 75% for January 1 through July 31, 2023, and 88% for February 1 through July 31, 2023.

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.

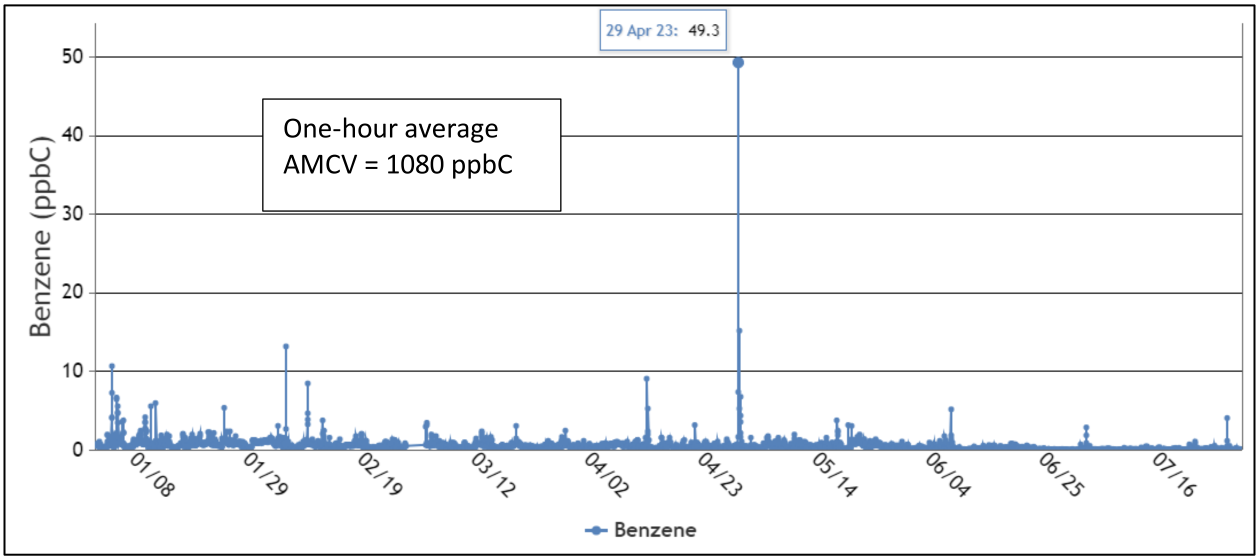

Figure 4. Hourly benzene concentrations at PBG station, Jan. 1, 2023 – July 31, 2023, ppbC units

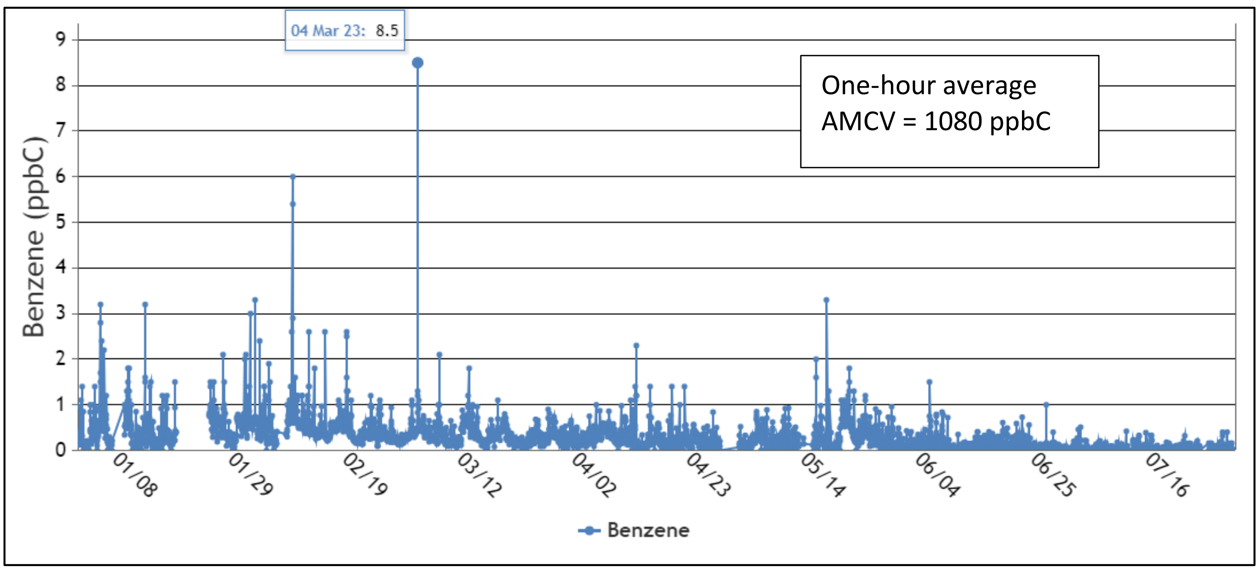

Figure 5. Hourly benzene concentrations at PBway station, Jan. 1, 2023 – July 31, 2023, ppbC units

Table 3. PBG Auto-GC statistics for January 1 – July 31, 2023

Species	Num. Samples	Peak 1-hr ppbC	Peak 24-hr ppbC	Short-term AMCV	Mean ppbC	Long-term AMCV
TNMHC	4,461	5,135.2	342.39	N/A	47.146	N/A
TNMTC	4,461	4,905.5	326.77	N/A	43.789	N/A
Ethane	4,461	1,063.0	70.42	N/A	12.291	N/A
Ethylene	4,455	88.8	5.04	1,000,000	0.863	10,600
Propane	4,461	1,327.0	88.76	N/A	9.165	N/A
Propylene	4,461	50.7	3.62	N/A	0.540	N/A
Isobutane	4,461	624.0	39.86	132,000	3.101	40,000
n-Butane	4,461	740.0	48.76	368,000	5.362	40,000
Acetylene	4,441	11.1	1.84	50,000	0.381	5,000
trans-2-Butene	4,460	1.7	0.53	60,000	0.093	2,800
1-Butene	4,455	6.2	0.54	108,000	0.279	9,200
cis-2-Butene	4,461	4.3	0.26	60,000	0.056	2,800
Cyclopentane	4,461	17.7	0.99	29,500	0.150	2,950
Isopentane	4,461	410.0	26.23	340,000	2.756	40,500
n-Pentane	4,461	275.0	18.29	340,000	2.224	40,500
1,3-Butadiene	4,461	2.9	0.38	6,800	0.084	36
trans-2-Pentene	4,374	2.6	0.15	60,000	0.017	2,800
1-Pentene	4,374	1.2	0.20	60,000	0.044	2,800
cis-2-Pentene	4,374	0.9	0.06	60,000	0.005	2,800
2,2-Dimethylbutane	4,374	27.3	1.58	32,400	0.081	1,140
Isoprene	4,374	2.7	0.97	7,000	0.201	700
n-Hexane	4,461	132.0	7.07	32,400	0.603	1,140
Methylcyclopentane	4,461	56.8	2.94	4,500	0.229	450
2,4-Dimethylpentane	4,461	16.8	0.84	58,100	0.006	15,400
Benzene	4,461	49.3	2.86	1,080	0.545	8.4
Cyclohexane	4,461	106.0	5.56	6,000	0.422	600
2-Methylhexane	4,461	35.2	1.92	58,100	0.168	15,400
2,3-Dimethylpentane	4,461	17.5	0.91	58,100	0.059	15,400
3-Methylhexane	4,461	43.0	2.37	58,100	0.228	15,400
2,2,4-Trimethylpentane	4,461	19.4	1.26	32,800	0.275	3,040
n-Heptane	4,461	76.5	4.19	58,100	0.378	15,400
Methylcyclohexane	4,461	131.0	6.91	28,000	0.545	2,800
2,3,4-Trimethylpentane	4,461	1.8	0.24	32,800	0.040	3,040
Toluene	4,461	82.2	4.90	28,000	0.819	7,700
2-Methylheptane	4,461	14.3	0.80	32,800	0.095	3,040
3-Methylheptane	4,461	10.0	0.63	32,800	0.070	3,040
n-Octane	4,461	30.1	1.71	32,800	0.210	3,040
Ethyl Benzene	4,461	6.4	0.53	160,000	0.100	3,520
p-Xylene + m-Xylene	4,461	21.1	1.50	13,600	0.309	1,120
Styrene	4,418	0.7	0.37	41,600	0.073	880
o-Xylene	4,419	9.5	0.53	13,600	0.090	1,120
n-Nonane	4,419	7.8	0.65	27,000	0.102	2,520
Isopropyl Benzene -	4,419	2.9	0.33	4,590	0.017	459
n-Propylbenzene	4,419	10.9	0.59	4,590	0.030	459
1,3,5-Trimethylbenzene	4,419	23.3	1.31	27,000	0.033	333
1,2,4-Trimethylbenzene	4,461	41.9	2.36	27,000	0.180	333
n-Decane	4,461	12.9	0.97	10,000	0.348	1,900
1,2,3-Trimethylbenzene	3,228	13.5	0.75	27,000	0.071	333

Table 4. PBway Auto-GC statistics for January 1 – July 31, 2023

Species	Num. Samples	Peak 1-hr ppbC	Peak 24-hr ppbC	Short-term AMCV	Mean ppbC	Long-term AMCV
TNMHC	4,126	934.1	180.45	N/A	37.333	N/A
TNMTC	4,126	894.3	173.42	N/A	34.600	N/A
Ethane	4,027	164.0	50.00	N/A	10.979	N/A
Ethylene	4,026	16.7	3.62	1,000,000	0.747	10,600
Propane	4,274	256.0	39.68	N/A	7.420	N/A
Propylene	4,274	19.6	3.25	N/A	0.792	N/A
Isobutane	4,274	72.8	14.09	132,000	2.570	40,000
n-Butane	4,274	187.0	24.62	368,000	4.760	40,000
Acetylene	1,652	4.4	1.10	50,000	0.421	5,000
trans-2-Butene	4,274	67.3	5.10	60,000	0.228	2,800
1-Butene	4,274	3.2	0.96	108,000	0.253	9,200
cis-2-Butene	4,274	1.5	0.32	60,000	0.074	2,800
Cyclopentane	4,274	3.7	0.60	29,500	0.140	2,950
Isopentane	4,274	66.5	11.51	340,000	2.381	40,500
n-Pentane	4,274	79.1	8.81	340,000	1.902	40,500
1,3-Butadiene	4,274	8.5	0.50	6,800	0.068	36
trans-2-Pentene	4,274	1.6	0.25	60,000	0.026	2,800
1-Pentene	4,274	1.1	0.32	60,000	0.062	2,800
cis-2-Pentene	4,273	0.8	0.13	60,000	0.007	2,800
2,2-Dimethylbutane	4,270	3.5	0.58	32,400	0.089	1,140
Isoprene	4,266	5.0	1.44	7,000	0.406	700
n-Hexane	4,126	27.0	2.50	32,400	0.420	1,140
Methylcyclopentane	4,126	10.0	1.65	4,500	0.165	450
2,4-Dimethylpentane	4,126	1.5	0.34	58,100	0.003	15,400
Benzene	4,126	8.5	1.59	1,080	0.290	8.4
Cyclohexane	4,126	11.6	2.11	6,000	0.231	600
2-Methylhexane	4,126	3.1	1.08	58,100	0.053	15,400
2,3-Dimethylpentane	4,126	1.7	0.45	58,100	0.021	15,400
3-Methylhexane	4,126	3.4	1.02	58,100	0.077	15,400
2,2,4-Trimethylpentane	4,126	8.1	1.42	32,800	0.134	3,040
n-Heptane	4,126	6.8	1.29	58,100	0.125	15,400
Methylcyclohexane	4,126	11.2	2.27	28,000	0.249	2,800
2,3,4-Trimethylpentane	4,126	3.8	0.31	32,800	0.026	3,040
Toluene	4,123	15.6	2.72	28,000	0.479	7,700
2-Methylheptane	4,126	1.9	0.40	32,800	0.033	3,040
3-Methylheptane	4,126	1.5	0.26	32,800	0.022	3,040
n-Octane	4,126	3.3	0.80	32,800	0.071	3,040
Ethyl Benzene	4,126	5.7	0.43	160,000	0.024	3,520
p-Xylene + m-Xylene	4,126	20.0	1.76	13,600	0.200	1,120
Styrene	4,126	0.5	0.28	41,600	0.008	880
o-Xylene	4,126	4.0	0.53	13,600	0.028	1,120
n-Nonane	4,125	2.5	0.35	27,000	0.028	2,520
Isopropyl Benzene -	4,125	2.4	0.13	4,590	0.008	459
n-Propylbenzene	4,126	9.5	0.49	4,590	0.008	459
1,3,5-Trimethylbenzene	4,093	13.3	0.69	27,000	0.010	333
1,2,4-Trimethylbenzene	3,940	28.4	1.75	27,000	0.250	333
n-Decane	4,052	3.3	0.29	10,000	0.046	1,900
1,2,3-Trimethylbenzene	3,499	3.1	0.17	27,000	0.016	333

4.3 Ethylene Oxide Measurements

As was noted earlier in this report, the GCGV ethylene-cracking industrial facility began operating in late 2021 through early 2022. As shown in Figure 6 through Figure 9, the levels of EtO measured at the two GCGV stations have remained low for the period January 1 through July 31, 2023, with no discernable trends. 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. (https://www.tceq.texas.gov/downloads/toxicology/dsd/final/eto.pdf, accessed October 2023). It is notable that there has been essentially no change in concentrations over the past two years while the GCGV industrial facility has been in operation.

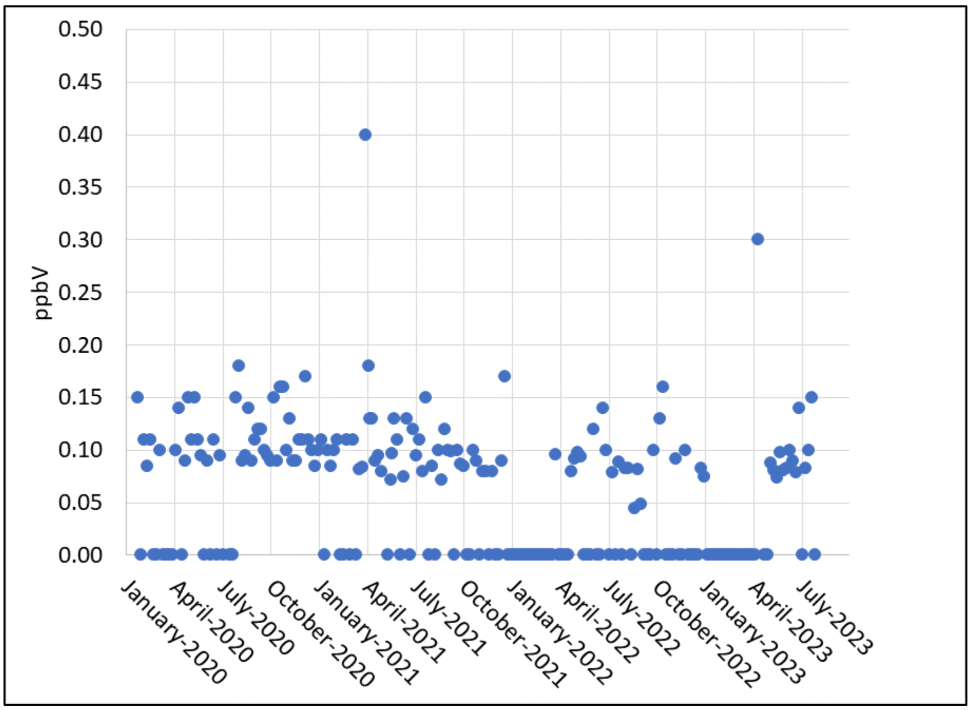

Figure 6. PBG EtO concentrations, every 6th day samples Jan. 1, 2020, through July 31, 2023

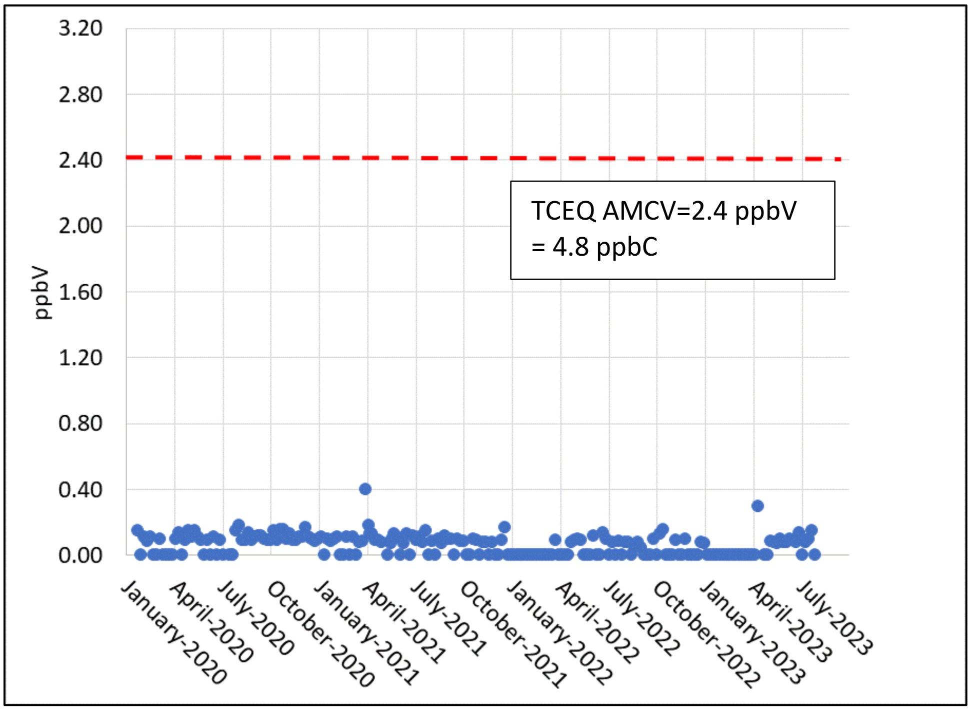

Figure 7. PBG EtO concentrations, every 6th day samples January 1, 2020 through July 31, 2023, in comparison to TCEQ Air Monitoring Comparative Value

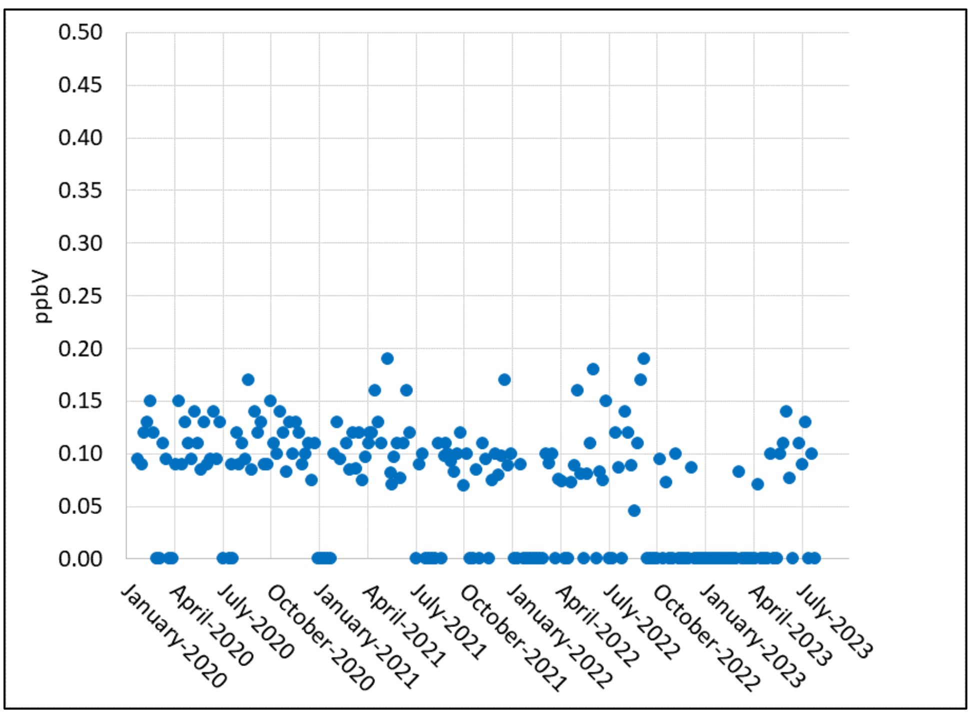

Figure 8. PBway EtO concentrations, every 6th day samples January 1, 2020, through July 31, 2023

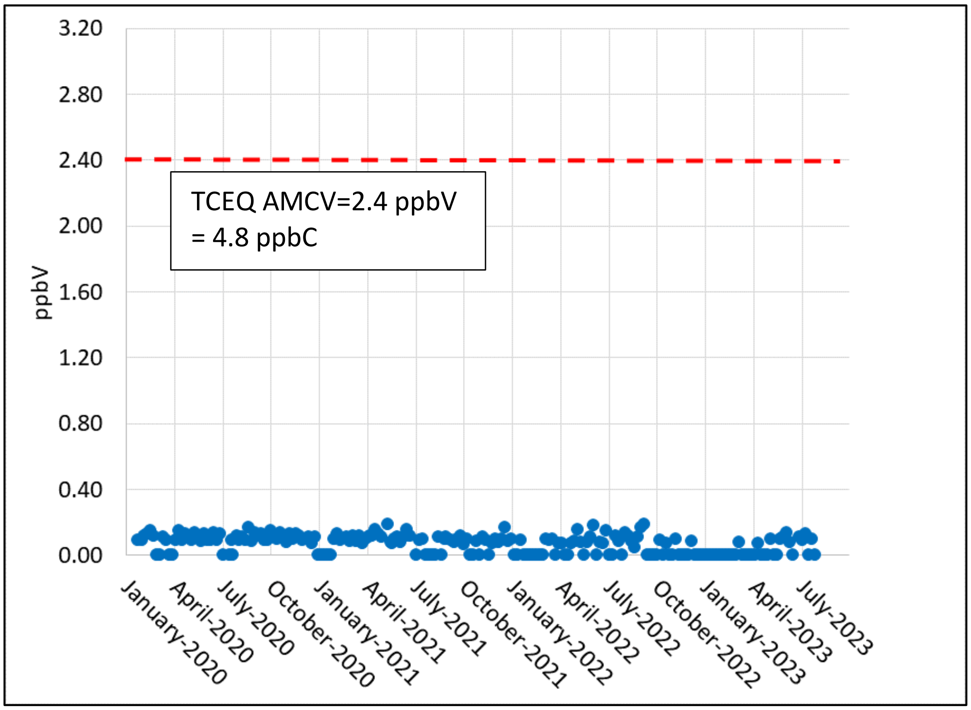

Figure 9. PBway EtO concentrations, every 6th day samples January 1, 2020, through July 31, 2023, in comparison to TCEQ Air Monitoring Comparative Value

4.4 Comparing Hydrocarbon Data between Stations

Figure 10 shows a bar graph comparison between the average concentrations for the first seven months of 2023 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 Ganem (PBG) is trending higher than the other two stations. A closer examination of PBG concentrations is presented in Section 5.1. 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. Some ethane and propane are likely transported into the region from nearby oil and gas extraction fields.

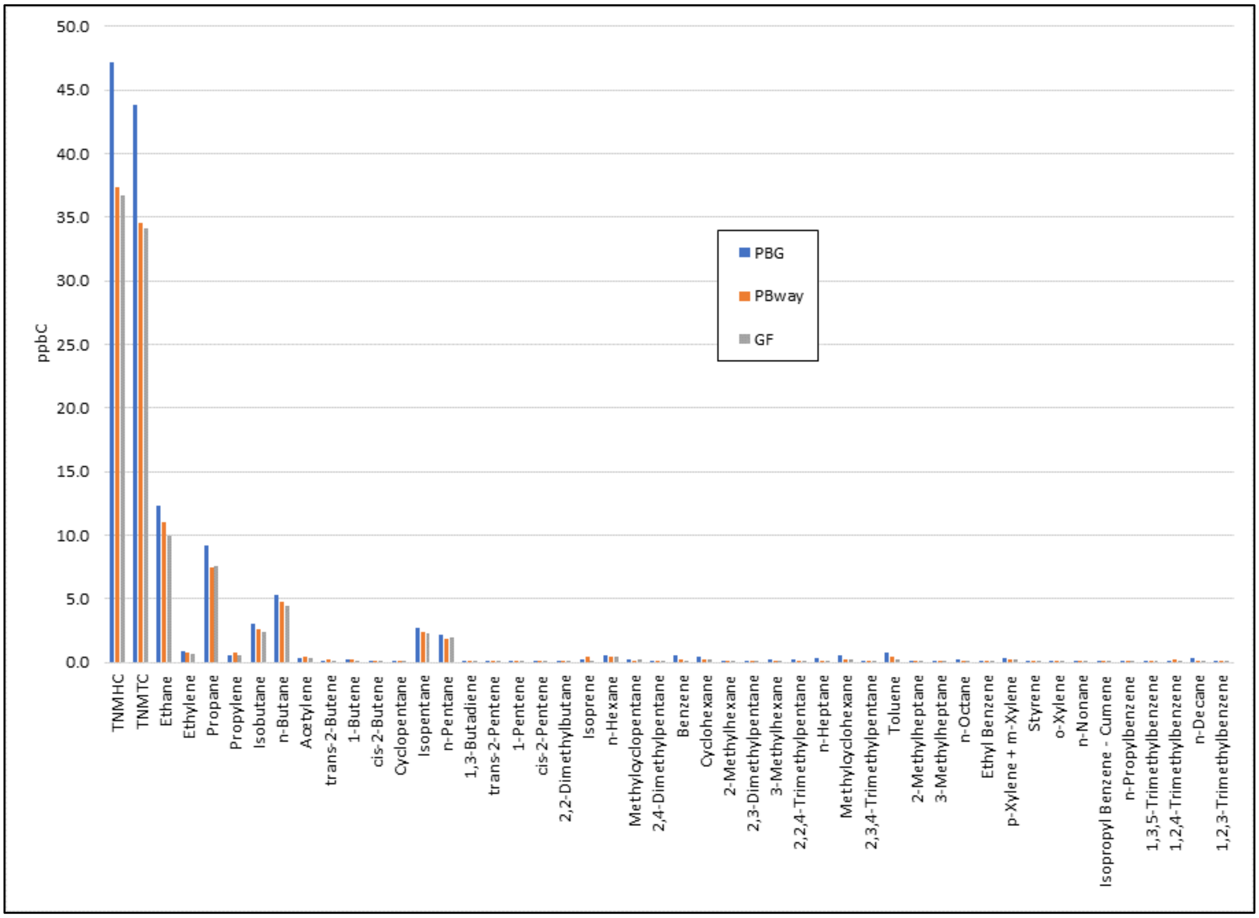

Figure 10. January 1 through July 31, 2023, mean concentrations of TNMTC, TNMHC, and hydrocarbon species at three stations.

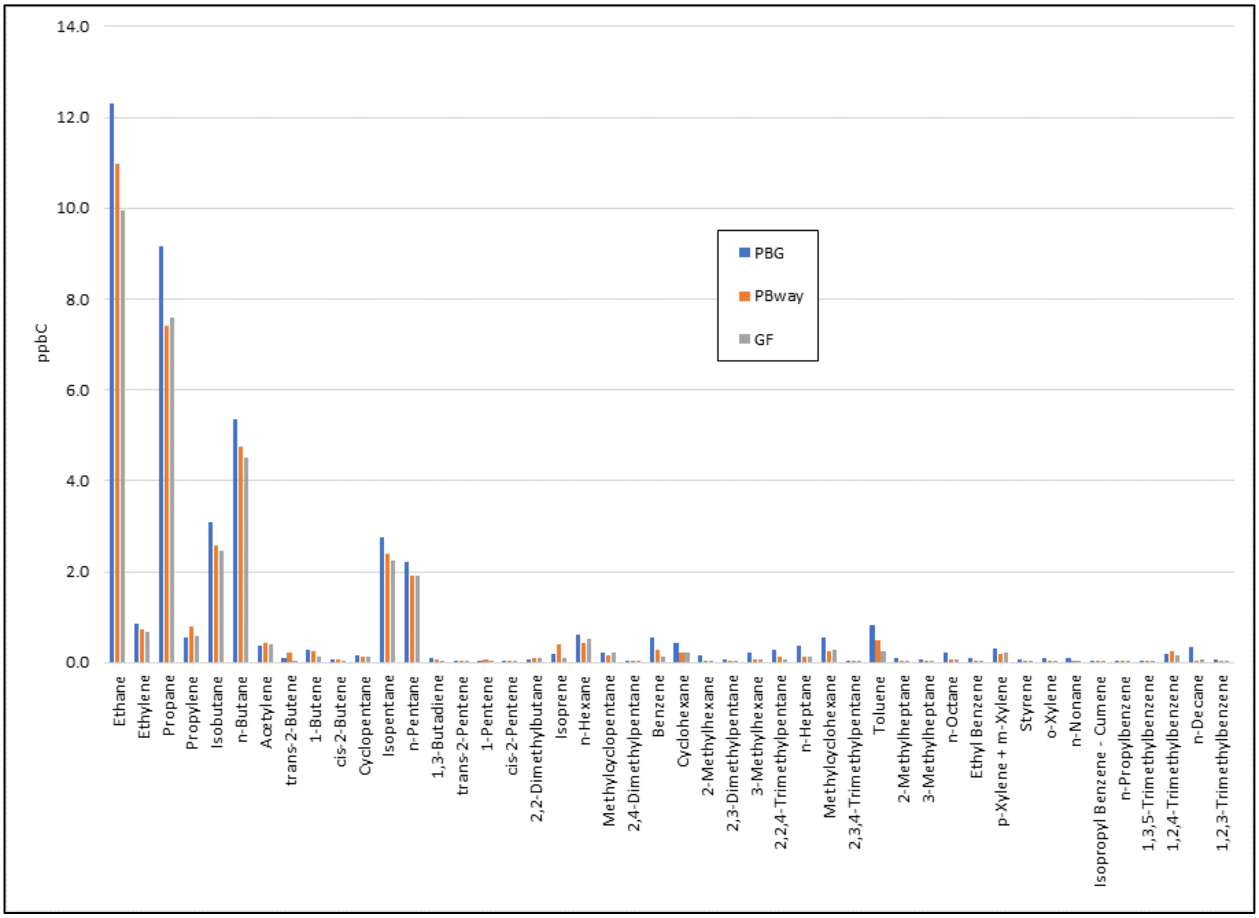

Figure 11. January 1 through July 31, 2023, mean concentrations of hydrocarbon species at three air monitoring stations.

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 12 $\mu g/m^3$.
- The NAAQS for NO_2 is for the one-hour values to average less than 53 ppb in a calendar year 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 at levels that 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 (12 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 2022 was 8.1 μg/m^3. Table 5 lists the annual mean PM2.5 concentration from each of the past three years and the three-year average for the GF station. The average PM2.5 concentration for the first three quarters of 2023 was 9.3 μg/m^3. No 24-hour averages in 2023 at Gregory Fresnos have exceeded the level of the NAAQS.

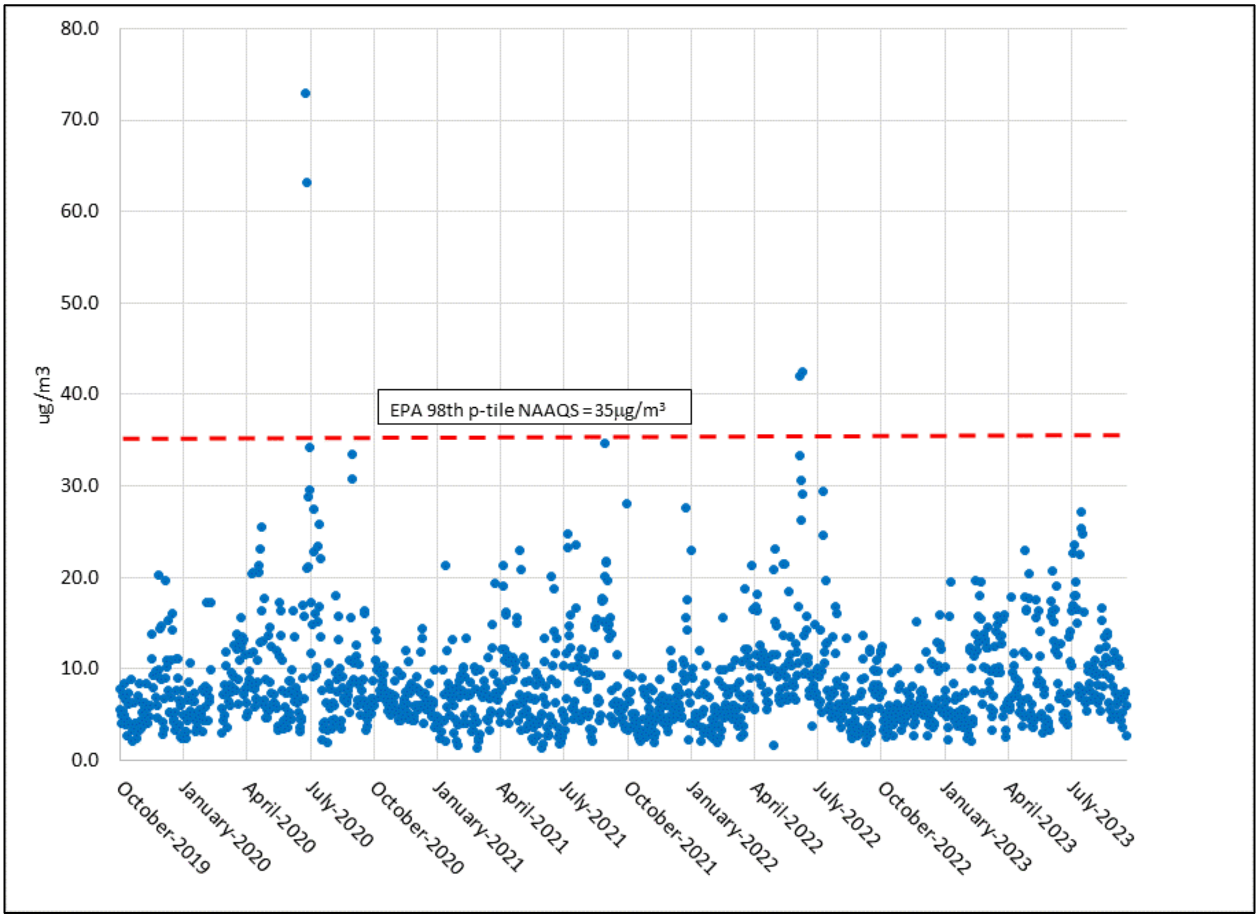

Figure 12. Averaged 24-Hour PM2.5 at GF, Oct. 1, 2019 – Sept. 30, 2023, with NAAQS

Table 5. GF PM2.5 annual means and three-year average 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	8.9		27.4	
2021	7.6		21.7	
2022	8.1		24.3	
3-year average	8.2	12.0	24.4	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 September 30, 2023. The figure also shows the 24-hour 100 ppb NAAQS level. The figure shows concentrations well below the level of the NAAQS.

Table 6 lists for the past three years the NO_2 annual 98th percentile and the annual averages showing NAAQS compliance of these standards by large margins.

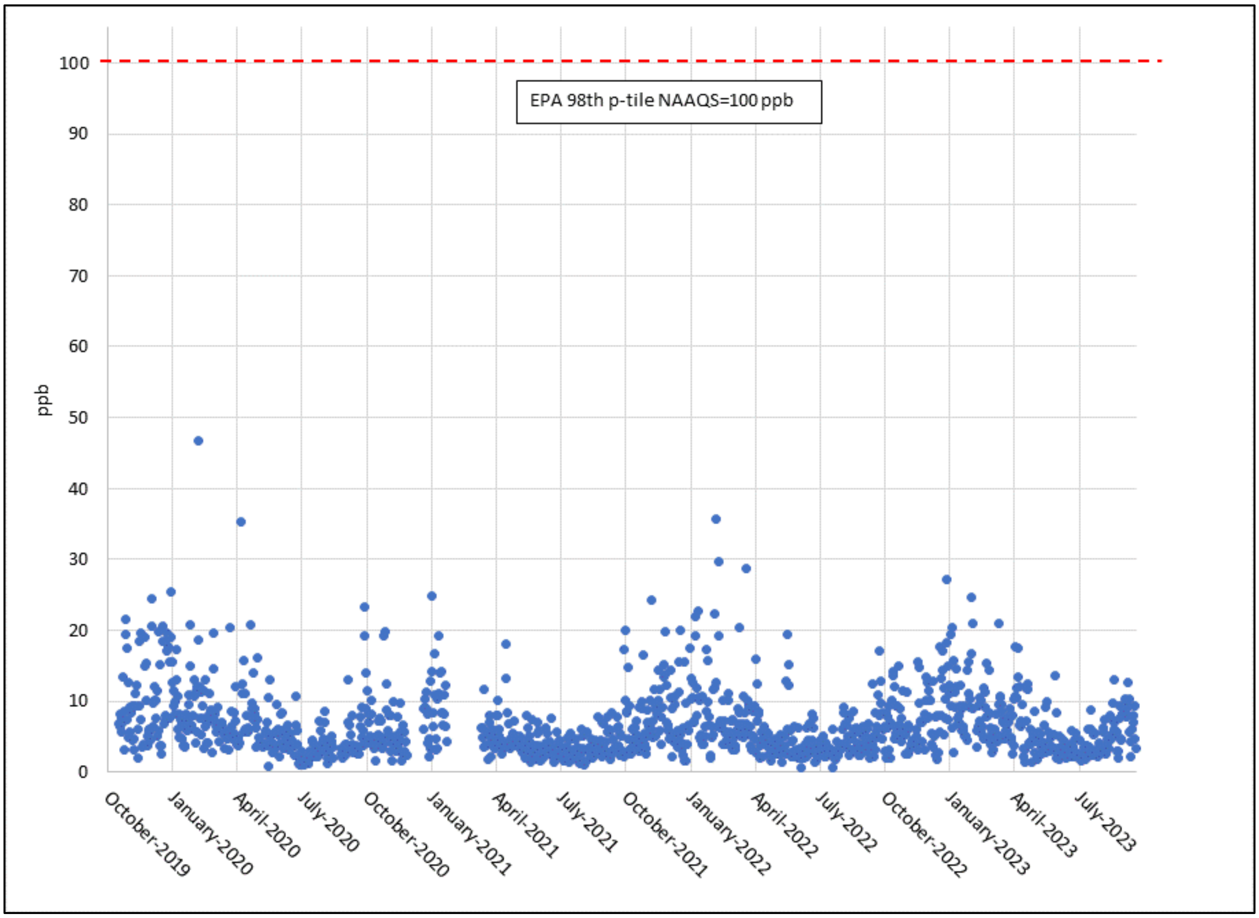

Figure 13. Daily maximum NO_2 at GF, ppb units, Oct. 1, 2019 – Sept. 30, 2023, with NAAQS

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

Year	Annual Average Values, ppb	NAAQS Annual Average Value, ppb	Annual 98^{th} percentile ppb	NAAQS 3-Year 98^{th} Percentile Average Value, ppb
2020	6.3		19.7	
2021	5.6	53	17.9	
2022	6.2		19.4	
3-year Average	6.0		19.0	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 more than 70 ppb.

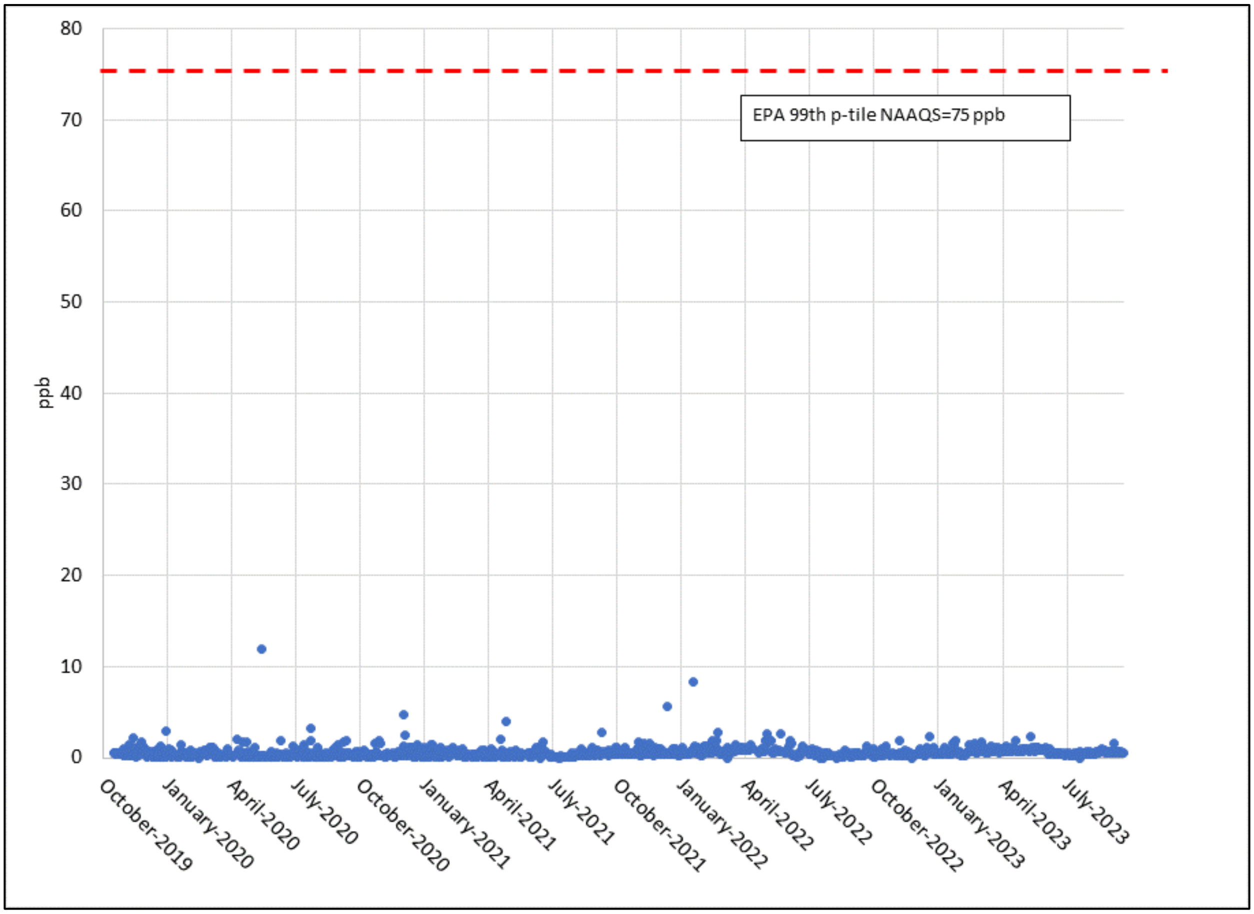

Figure 14. Daily maximum SO_2 at GF, Oct. 1, 2019 – Sept. 30, 2023, with NAAQS at 75 ppb

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	2.6	
3-year Average	2.3	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 1, 2020, through September 30, 2023, and Figure 16 shows the same time series for the PBway site. The 3-year average concentration PBG is 7.1 μg/m^3 and is 8.2 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. The average PM2.5 concentration for the first three quarters of 2023 was 8.9 μg/m^3 at PBway and was 7.9 μg/m^3 at PBG.

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. 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. No 24-hour averages in 2023 at Portland stations have exceeded the level of the NAAQS.

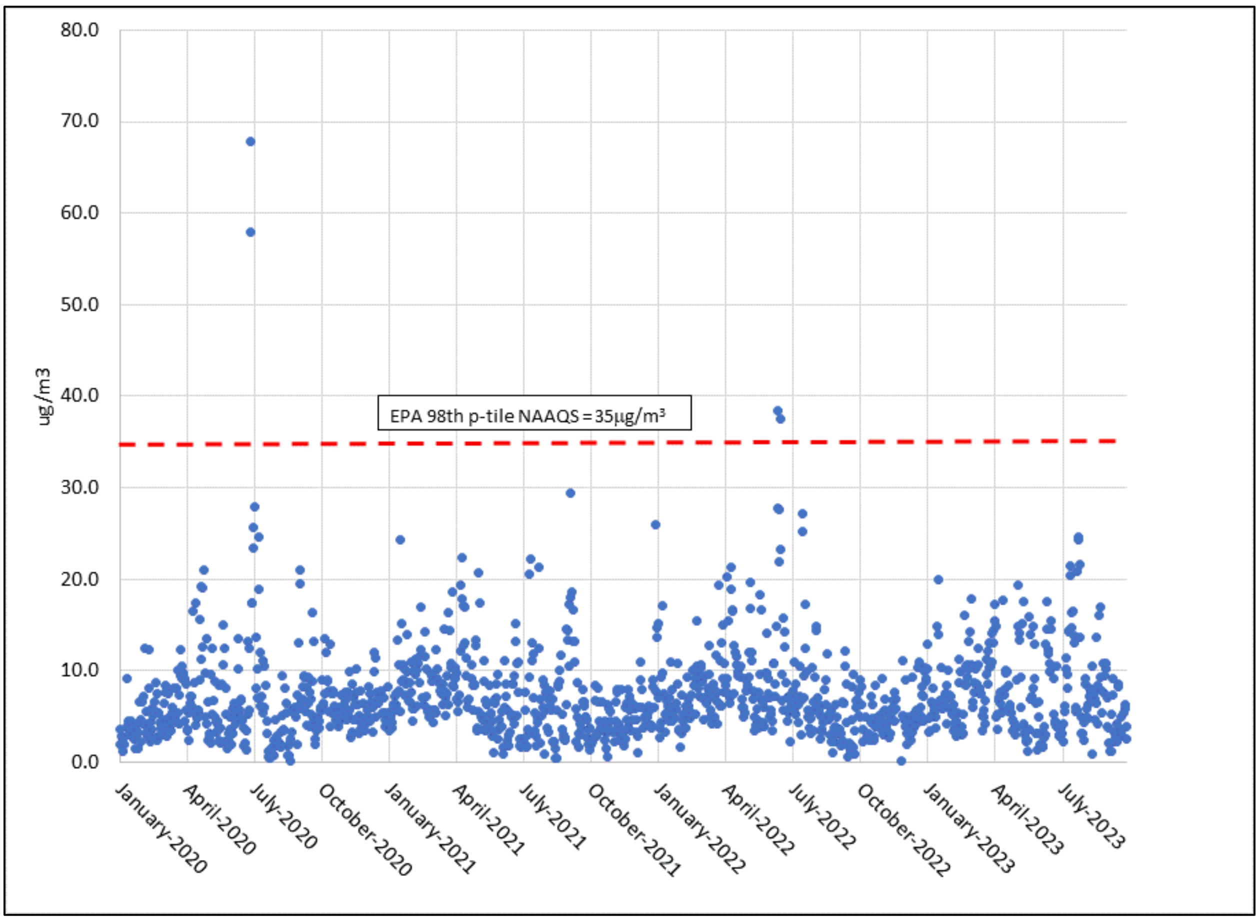

Figure 15. Mean 24-Hour PM2.5 at PBG, Jan. 1, 2020 – Sept. 30, 2023, NAAQS scale.

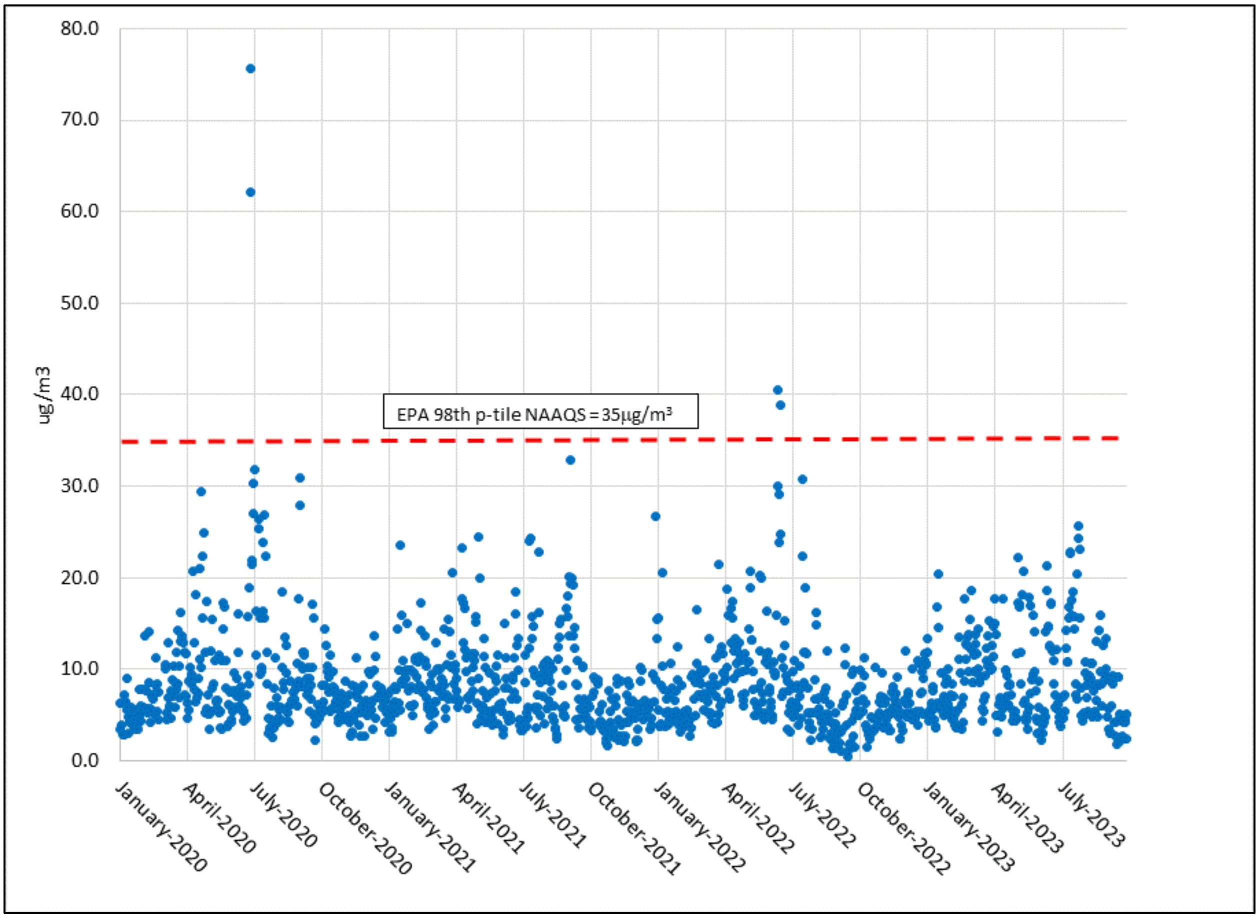

Figure 16. Mean 24-Hr PM2.5 at PBway, Jan. 1, 2020 – Sept. 30, 2023, with NAAQS value.

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

Year	Annual Mean µg/m³	NAAQS 3-Year Annual Average Value, µg/m³	Annual 98th Percentile Value µg/m³	NAAQS 3-Year 98th Percentile Average Value, µg/m³
2020	6.6		20.6	
2021	7.2		20.4	
2022	7.4		21.9	
3-year Average	7.1	12.0	20.9	35.0

Table 9. PBway PM2.5 annual means and 3-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	8.7		26.9	
2021	8.2		22.4	
2022	7.6		22.3	
3-year Average	8.1	12.0	23.8	35.0

5.0 Data Analysis

5.1 North African Dust

Each summer, dust from the desert areas in North Africa is picked up by westerly winds, lifted high in the atmosphere, and later affecting the Gulf of Mexico with elevated fine particulate matter. These clouds of dust are visible to satellites, and images such as Figure 17 below are among the tools the TCEQ Monitoring Division staff uses to forecast air quality several days ahead. Although summer is the period in which North African dust tend to affect Texas, the earliest and latest TCEQ forecast varies from year to year. An examination of the TCEQ e-mail forecasts resulted in Table 10 showing the range of dates during which North African dust causing elevated PM2.5 along the Gulf Coast were mentioned. Note that many summer day forecasts do not mention North African dust.

Table 10. TCEQ Forecasts for North African Dust Impacts on Texas

Year	Earliest Forecast	Latest Forecast
2021	June 22	Sept. 21
2022	May 18	Sept. 2
2023	June 19	Aug. 25

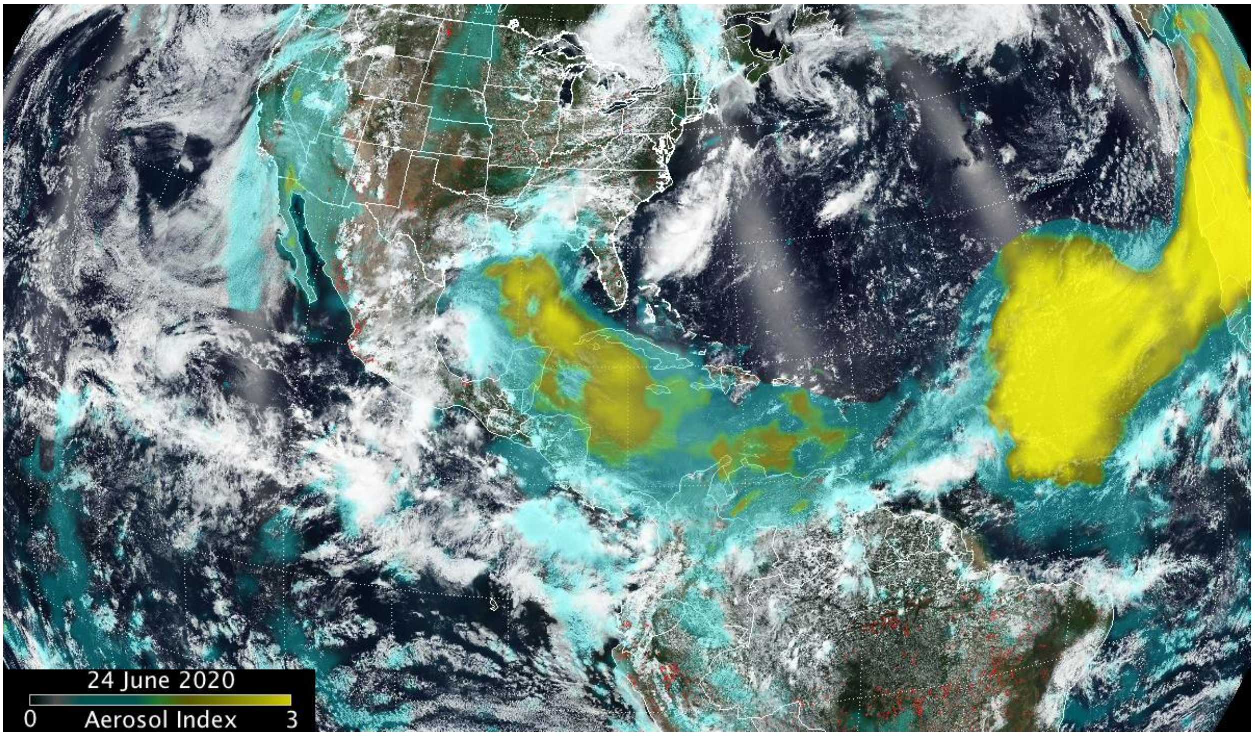

Figure 17. NASA Photo of wind-blown dust moving east to west across the Atlantic Ocean, from [Dust in the Wind – We Were Wondering: a TCEQ Blog (texas.gov)] (accessed October 2023)

5.2 Why does the Buddy Ganem Station Have Higher Concentrations?

Benzene concentrations at the Portland Buddy Ganem station have been higher than at the Portland Broadway and Gregory Fresnos stations, as have been several other hydrocarbon species, as shown earlier in Figure 10 and Figure 11. Table 11 shows the mean concentrations of benzene over the three-year period 2020 through 2022 at the three stations, and Table 12 shows data over the same period only for hours in which all three stations had data. Table 11 also shows the data completeness over three years, both based on a 24-hour day and based only on the 22 hours during which daily routine quality assurance runs are excluded.

Table 11. Mean benzene and other statistics 2020-2022

Station	PBG	PBway	GF
Mean benzene ppbC	0.630	0.439	0.288
Number of obs.	21,799	21,744	21,702
% complete w 24hr/day	82.9%	82.7%	82.5%
% complete w 22hr/day	90.4%	90.2%	90.0%

Table 12. Mean benzene and other statistics 2020-2022

Station	PBG	PBway	GF
Mean benzene ppbC	0.619	0.447	0.282
Number of obs.	16,891	16,891	16,891

In the graphs that follow, some of the characteristics of the benzene concentrations are shown relative to temporal and meteorological factors. In addition, some of the characteristics of the meteorological variables are displayed. Figure 18 shows the mean concentration by month of the year, using three years of data (2020 – 2022), and July has the lowest average concentration, with the average concentration increasing as winter approaches and decreasing as summer approaches.

Using data from all months over three years, Figure 19 shows that the highest concentration come early in the morning and the lowest concentrations are in the afternoons. Figure 20 shows the average concentrations by day of the week, which fails to show any particular weekday/weekend pattern that is often seen in urban environments.

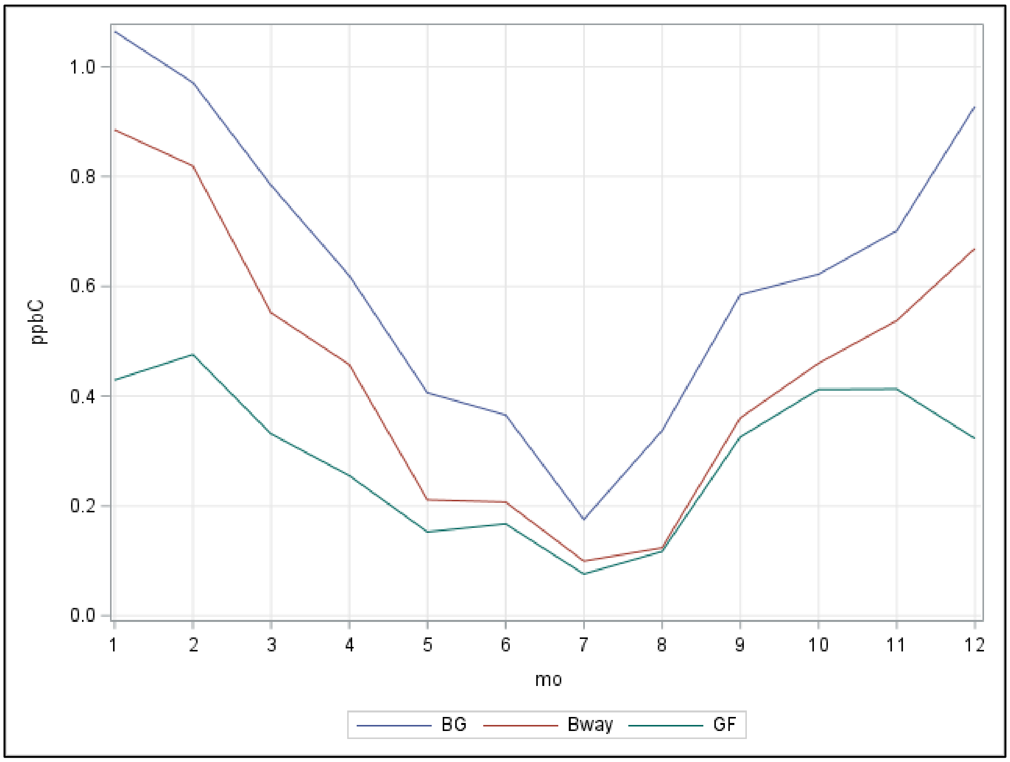

Figure 18. Mean benzene concentrations measured at the three stations by month of the year. (Jan. = 1, Dec. =12)

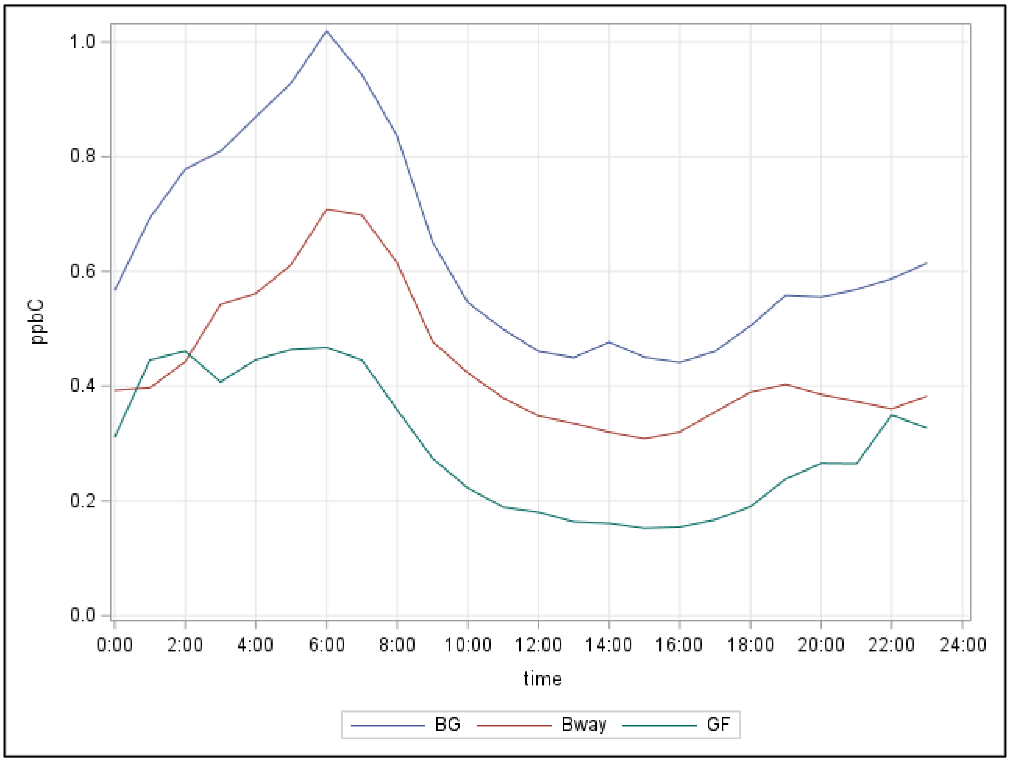

Figure 19. Mean benzene concentrations measured at the three stations by hour of the day. (Central Standard Time)

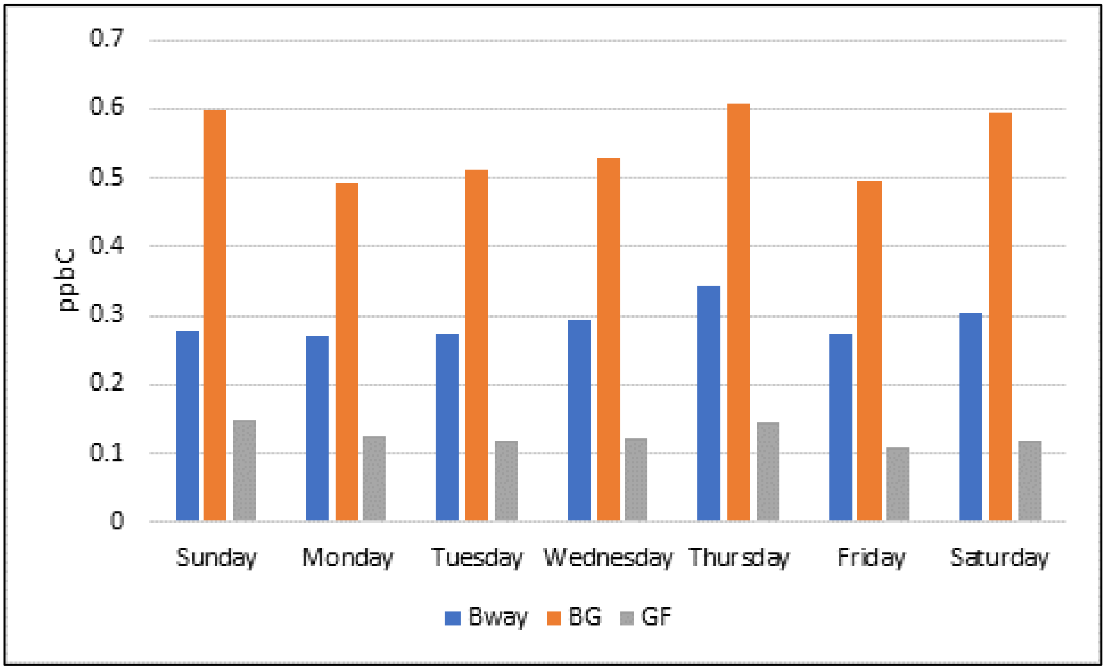

Figure 20. Mean benzene concentrations measured by day of the week at three stations.

Figure 21 shows the average concentration of benzene at the Portland Buddy Ganem (PBG) station by wind direction using 30-degree wind bins. These wind direction bins are constructed so that winds from 345 degrees through 360 degrees and 0 degrees though 15 degrees are combined for the 0 degree and 360 degree wind direction bins, 15 to 45 degree winds go in the 30 degree wind direction bin, etc. The figure shows that the highest average concentration is associated with westerly winds at 270 degrees (255 to 285 degrees), and the lowest concentrations are associated with southerly winds at 150 degree (135 to 165 degrees) and 180 degree (165 to 195 degrees) wind direction bins. Figure 22 shows the average benzene concentration at PBG by wind speed, where the wind speeds are grouped by 5 mile pre hour wind speeds. All winds 17.5 mph and above are included in the 20 mph bin, and the 0 mph bin is only winds between 0 and 2.5 mph. As was shown earlier in this report, emissions tend to be diluted and dispersed more in higher speed winds than under low speed and stagnant winds. Figure 23 shows the mean wind speed at PBG by wind direction. The highest average wind speed is at 150 degrees, which offers a possible explanation for the lowest concentrations in Figure 21. Furthermore, the lowest speed winds are westerly winds, which offers a possible explanation for the highest average concentrations in Figure 21. One way to adjust the concentration to account for wind speed is to multiply the concentration by wind speed and divide by the average wind speed. The result is shown in Figure 24. In this figure, the peak concentration is still at 270 degrees but has been lowered from 2.6 ppbC to 1.2 ppbC, while the relative contribution from northerly winds has only decreased a little and now stands out as a second key upwind source direction.

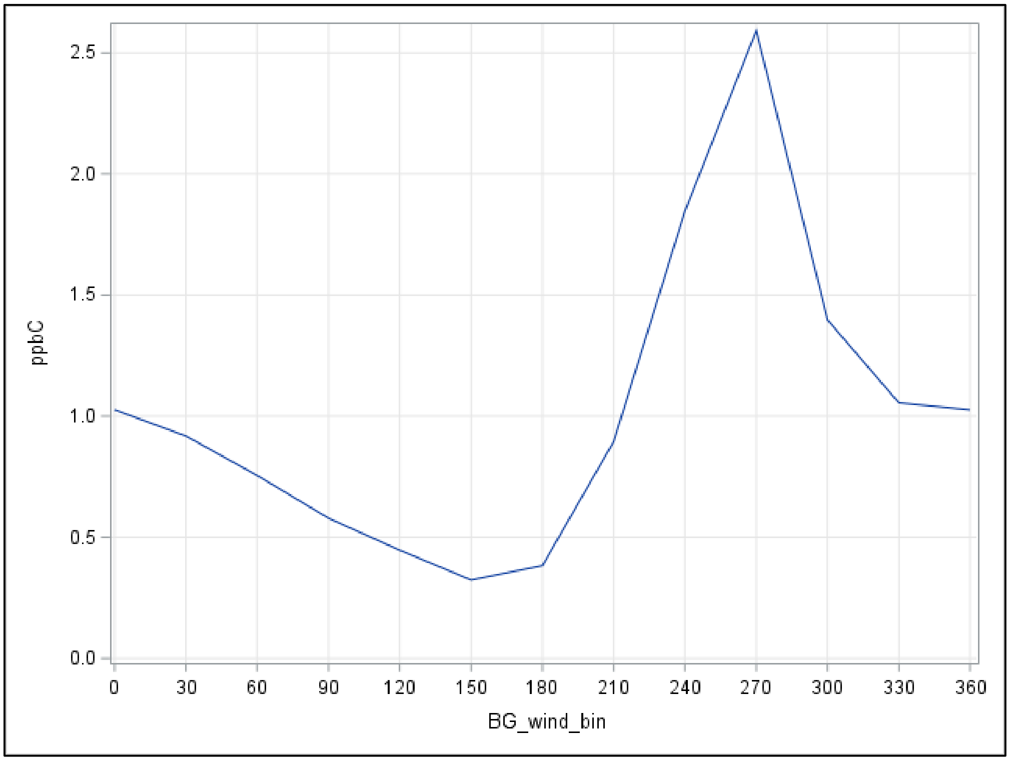

Figure 21. Mean benzene concentrations measured at the Buddy Ganem station by wind direction.

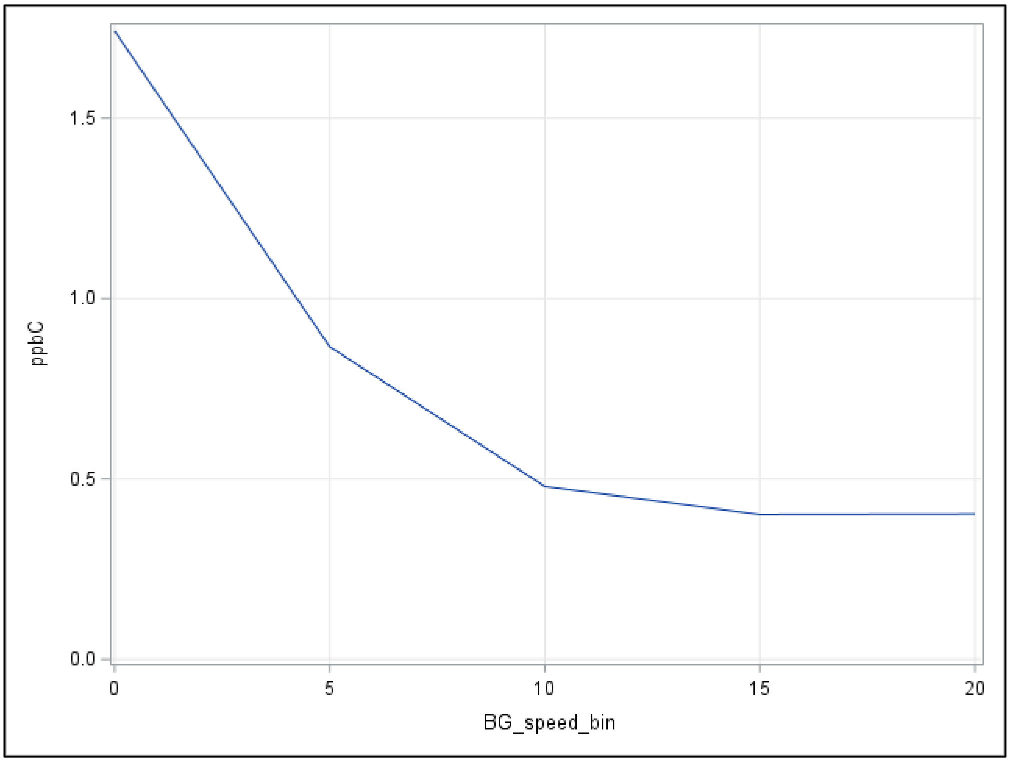

Figure 22. Mean benzene concentrations measured at the Buddy Ganem station by wind speed (miles per hour)

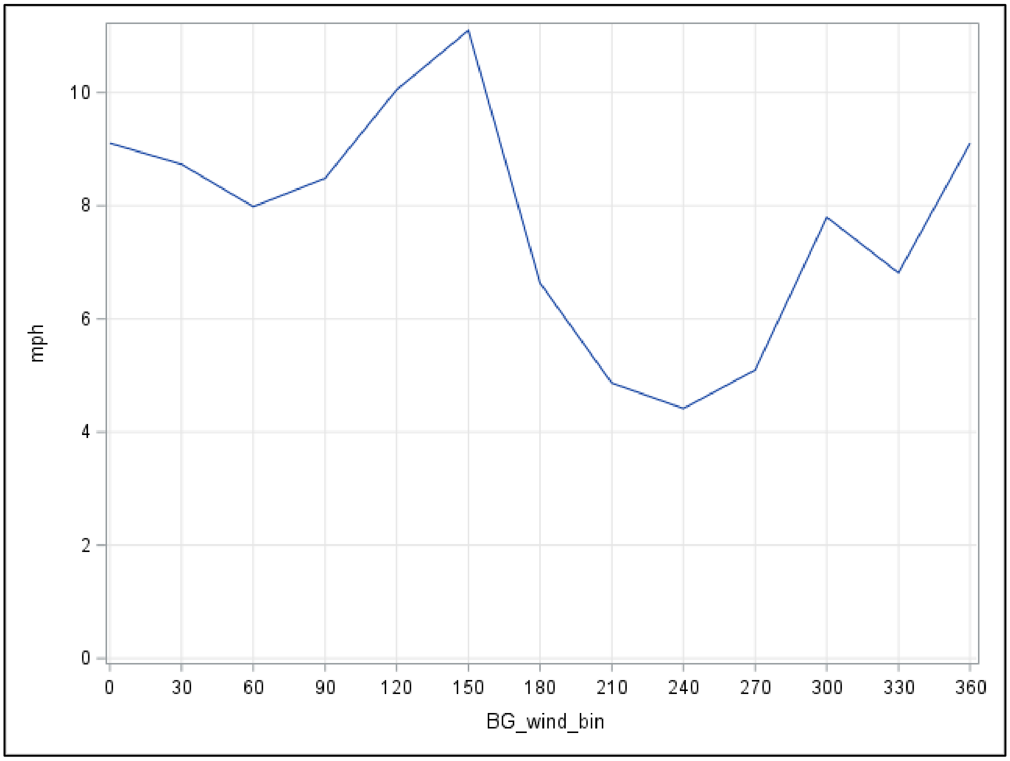

Figure 23. Mean wind speeds measured at the Buddy Ganem station by wind direction.

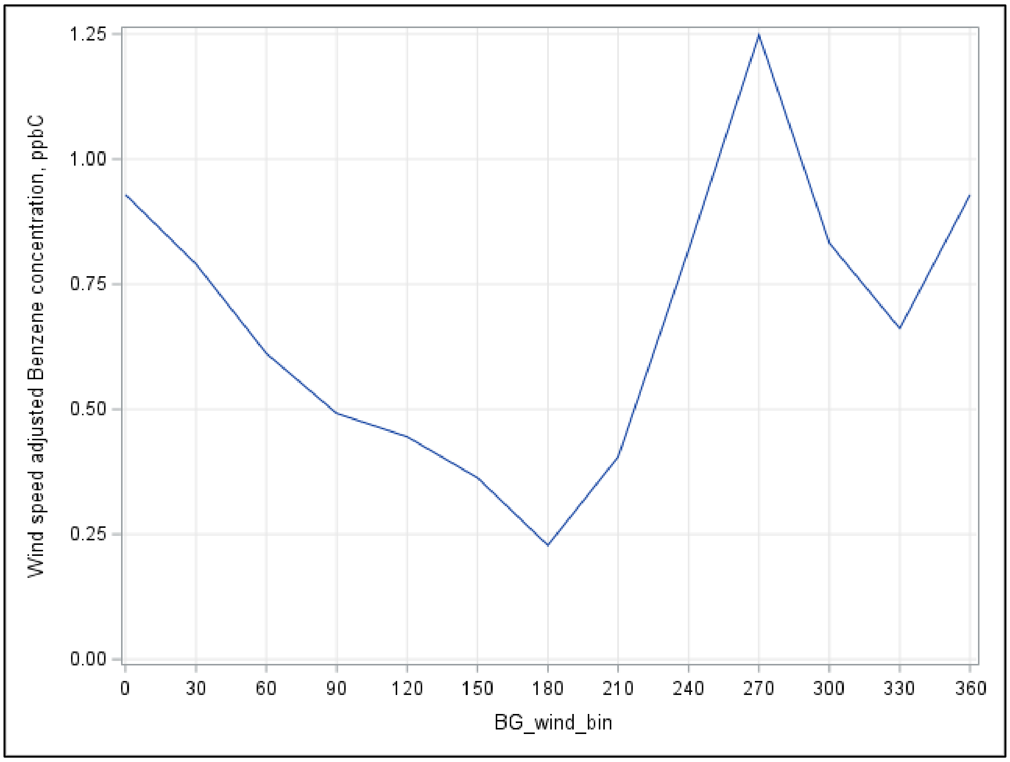

Figure 24. Mean wind speed adjusted benzene concentrations for the Buddy Ganem station by wind direction.

A similar series of graphs follow for the Portland Broadway station and the Gregory Fresnos station follow. Figure 25 for Broadway and Figure 29 for Gregory Fresnos both show the highest concentration of benzene also being associated with westerly winds. Figure 26 for Broadway and Figure 30 for Gregory Fresnos both show the decline in mean concentration with increasing wind speed, although there is a small uptick at the Broadway site with faster winds. Figure 27 for Broadway and Figure 31 for Gregory Fresnos both show the relationship of wind speed and wind direction, with the lowest mean wind speed from the west and the highest from the south. Finally, Figure 28for Broadway and Figure 32 for Gregory Fresnos show the wind-speed adjusted benzene concentrations by wind direction. As was the case with the Buddy Ganem station, the adjusted maximum average concentrations are lower, but remain the peak directionality is still westerly but slightly to the north. Figure 33 and Figure 34 show the graphs for all three stations for mean benzene concentrations by wind direction and mean wind-speed-adjusted-benzene concentrations for easier comparisons between the stations.

After this review of the temporal and meteorological factors, there does not appear to be an easy answer to the question of why the Buddy Ganem station measures higher concentrations of benzene. More work will be done to try to answer this question. One approach will be to use multivariate analysis tools applied to all the hydrocarbons to see what factors contribute to the measured concentrations, which could show a unique factor at one site and not others. Another approach will be to look for a source near the Buddy Ganem site that is not obvious from overhead views or visits to the station. The Texas Railroad Commission Website has a geographic information system (GIS) map[5] showing wells, capped wells, and pipelines, and the Buddy Ganem site is closer to such features, which could be one explanation.

[5] See https://gis.rrc.texas.gov/GISViewer/ accessed October 2023.

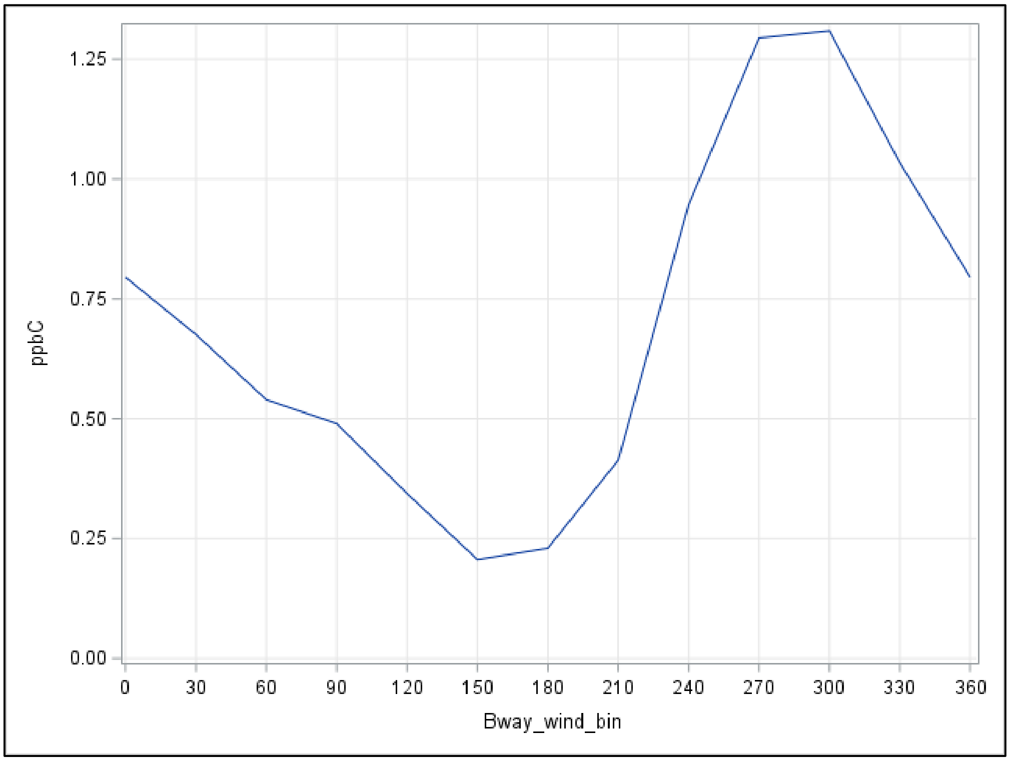

Figure 25. Mean benzene concentrations measured at the Broadway station by wind direction.

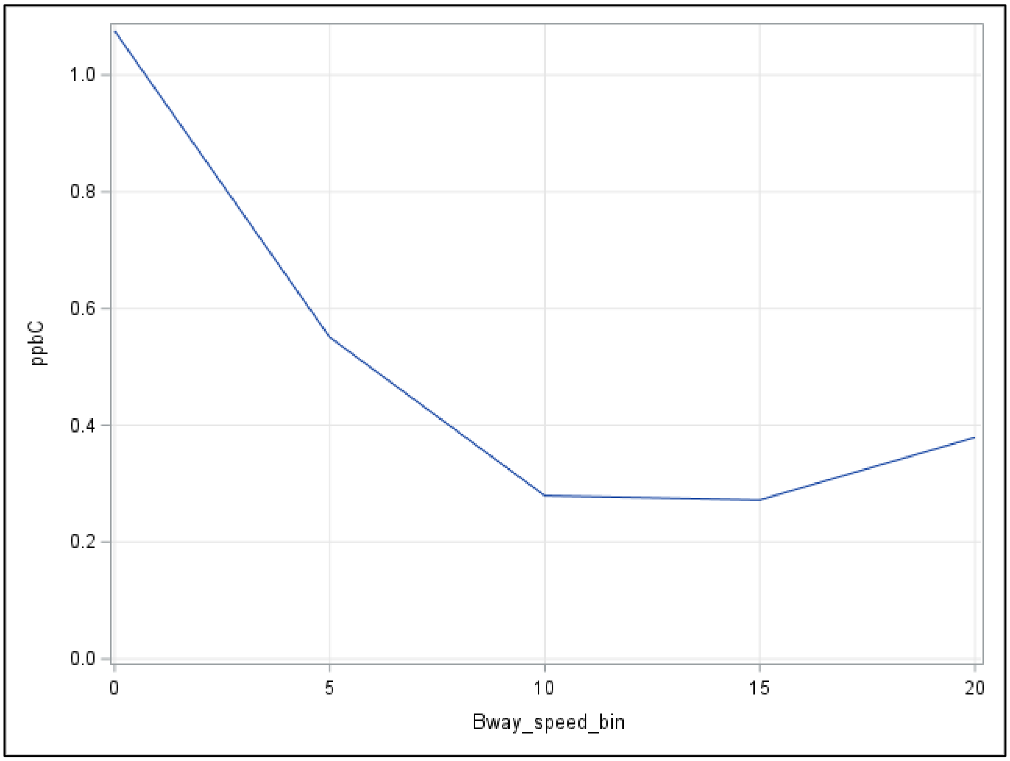

Figure 26. Mean benzene concentrations measured at the Broadway station by wind speed (miles per hour).

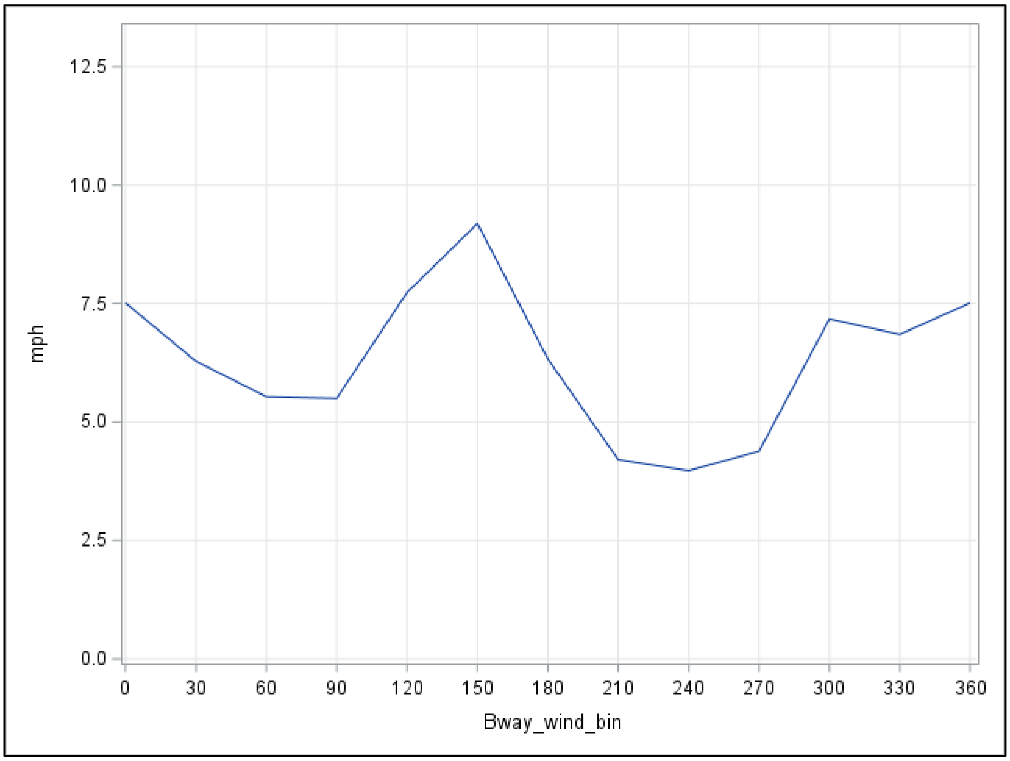

Figure 27. Mean wind speeds measured at the Broadway station by wind direction.

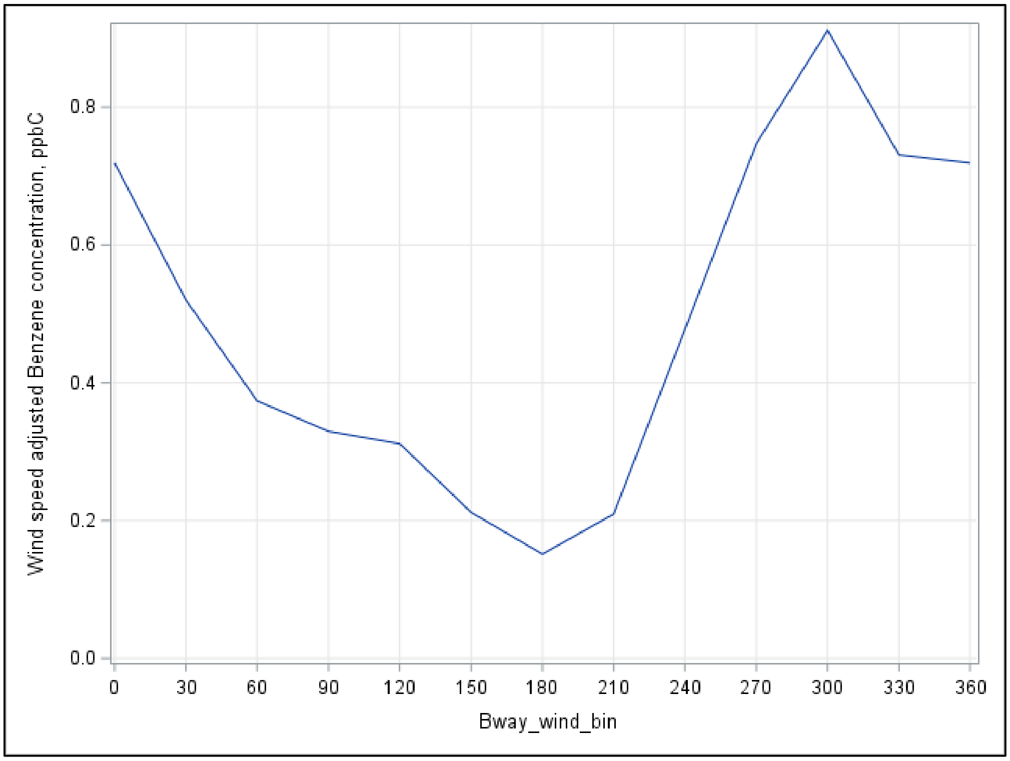

Figure 28. Mean wind speed adjusted benzene concentrations measured for the Broadway station by wind direction.

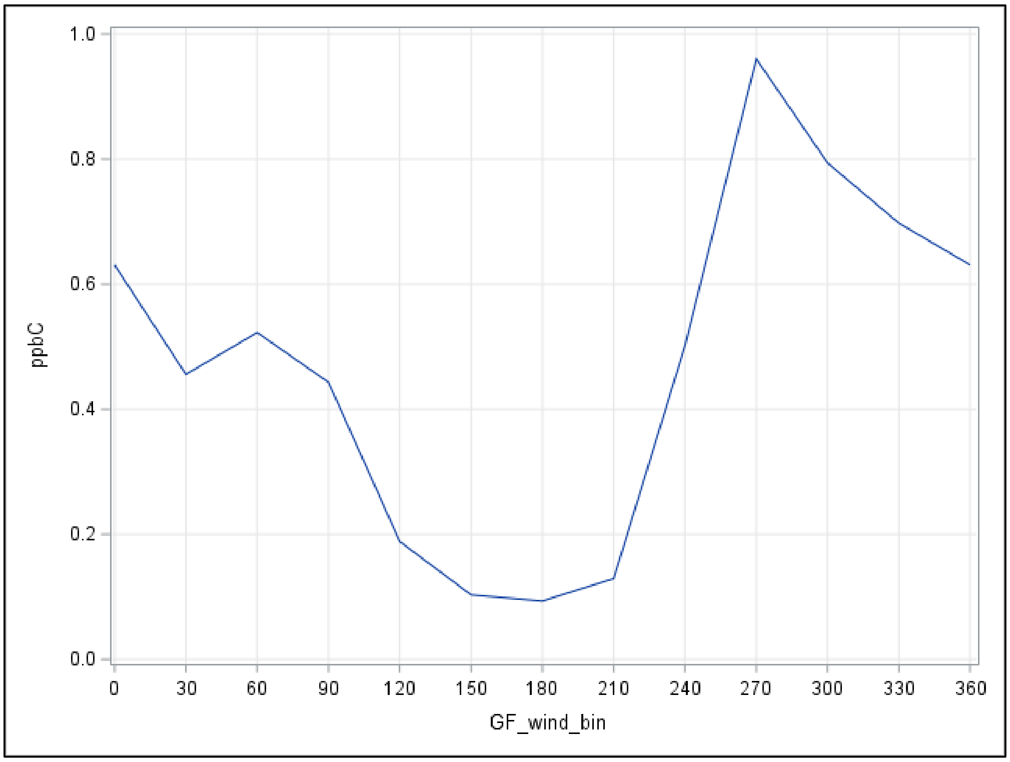

Figure 29. Mean benzene concentrations measured at the Gregory Fresnos station by wind direction.

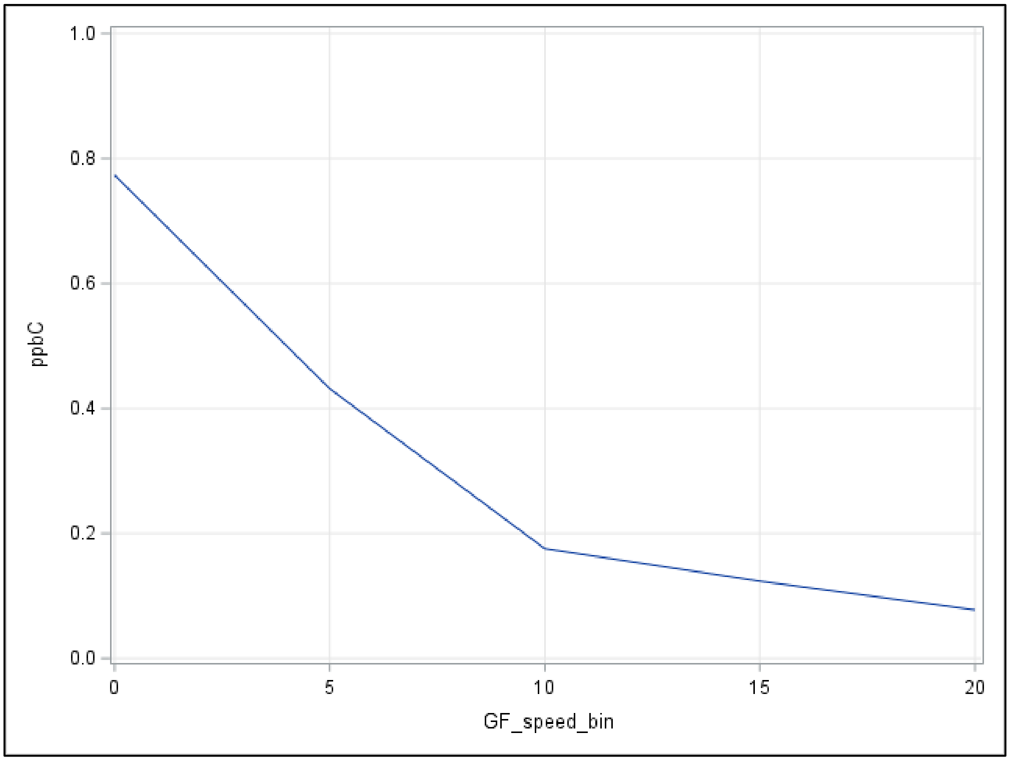

Figure 30. Mean benzene concentrations measured at the Gregory Fresnos station by wind speed (miles per hour)

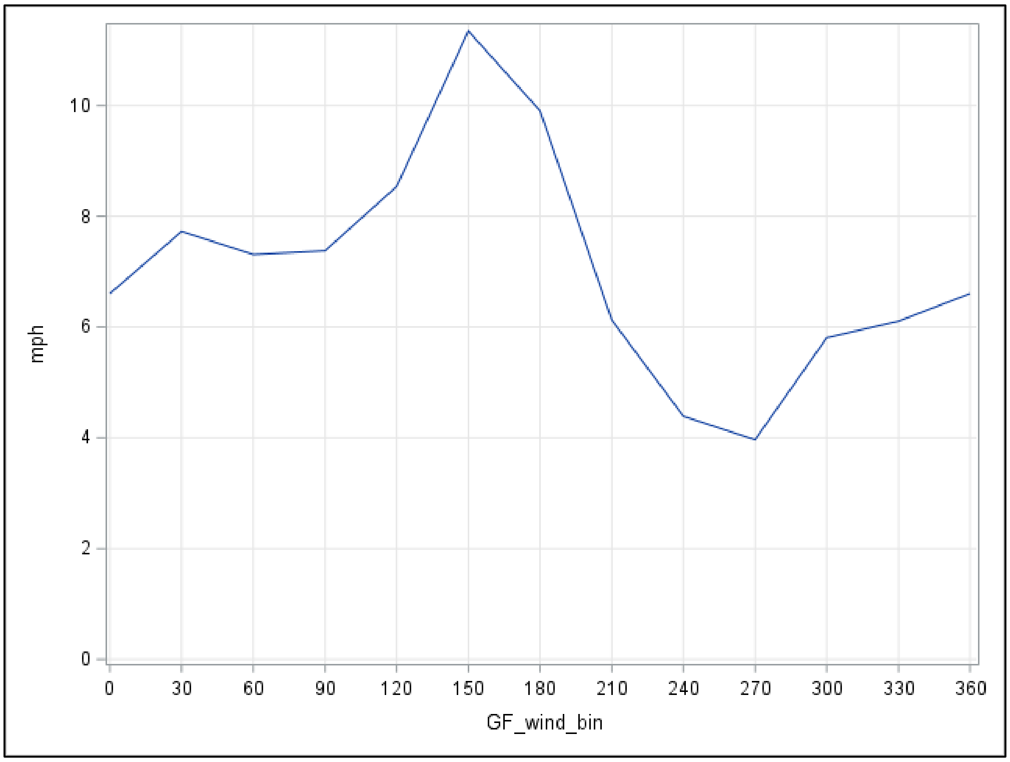

Figure 31. Mean wind speeds measured at the Gregory Fresnos station by wind direction.

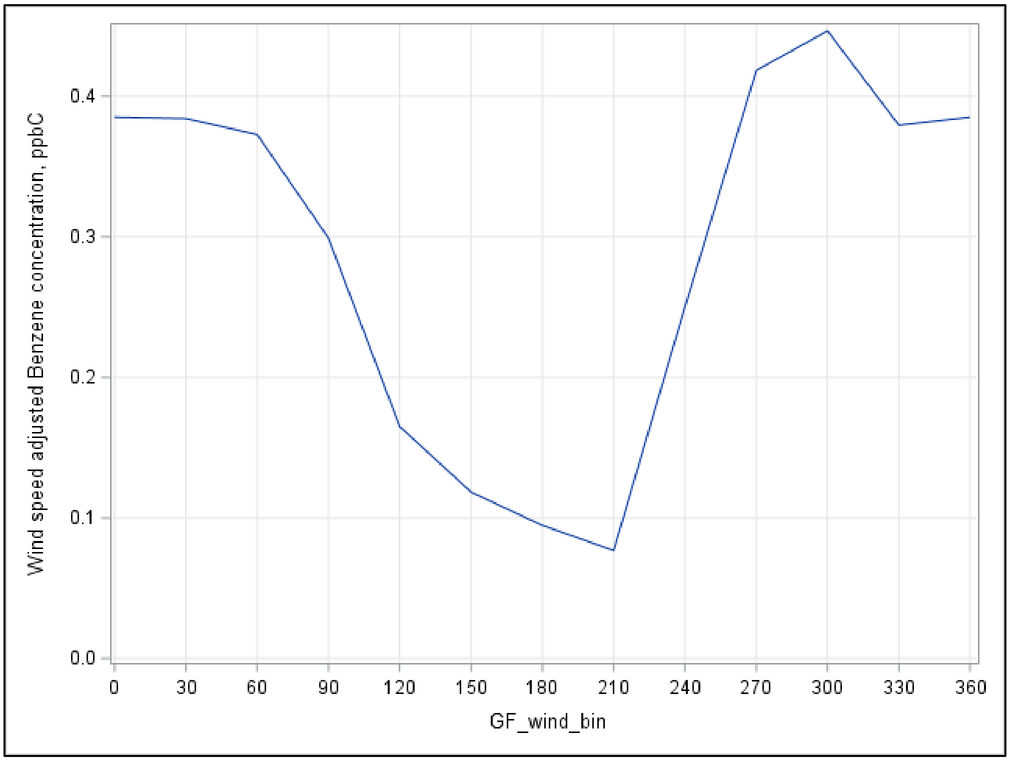

Figure 32. Mean wind speed adjusted benzene concentrations for the Gregory Fresnos station by wind direction.

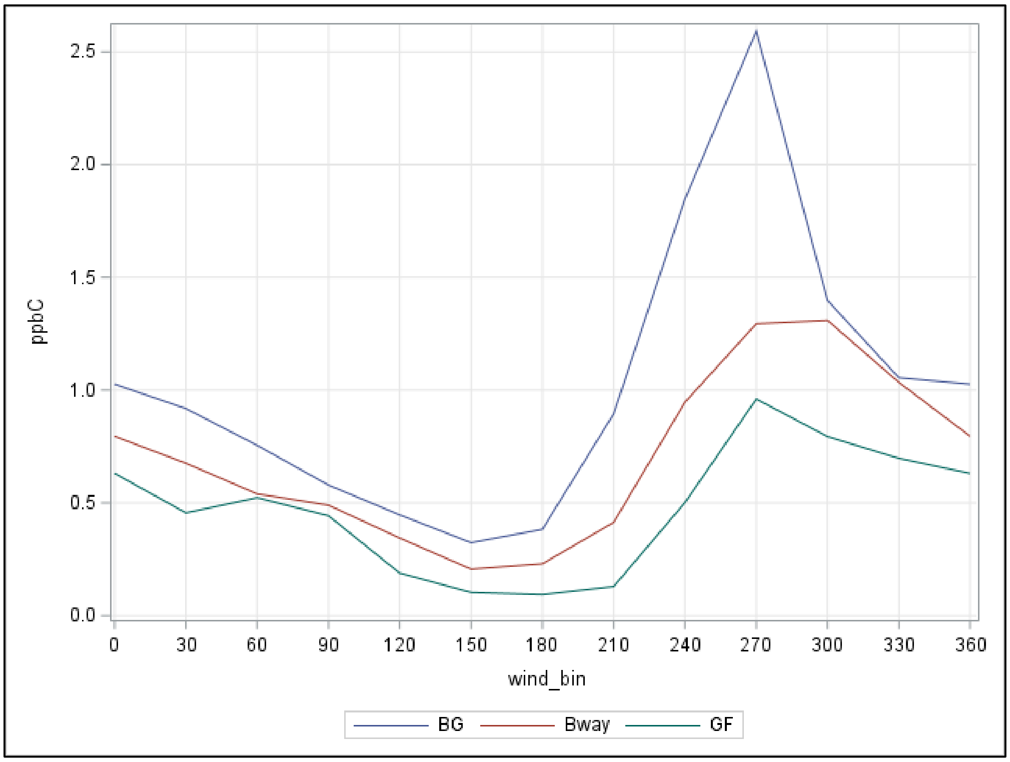

Figure 33. Comparing benzene mean concentration wind directionality among the 3 stations

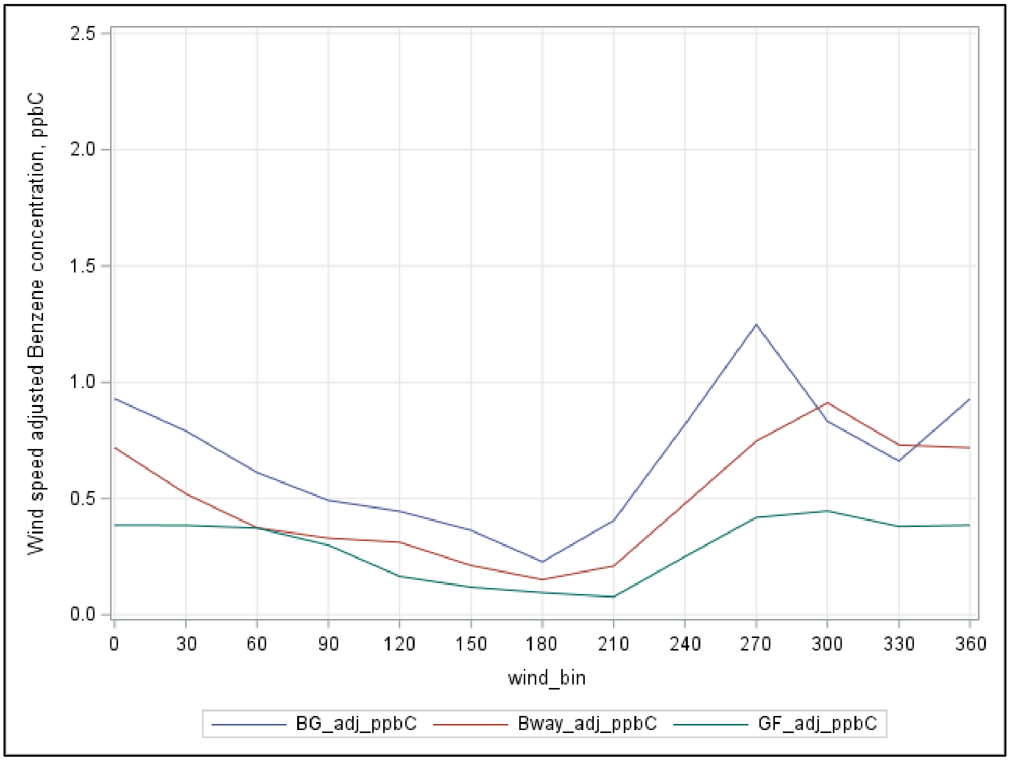

Figure 34. Comparing wind speed adjusted-benzene wind directionality among 3 stations

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 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	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 35. 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 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 January 2023). 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 January 2023)

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 SO2 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.