

**Quarterly Report of Air Quality Monitoring
at the
Gregory – Portland
Community Air Monitoring Stations
for the Quarter Ending September 30, 2022**

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Executive Summary

There are three continuous air quality monitoring stations operating in the Gregory-Portland area. The Gregory Fresno Community Air Monitoring Station on Fresno St. began continuous monitoring operations October 1, 2019. Two additional air-monitoring stations in Portland, TX near the intersection of Buddy Ganem Dr. and Wildcat Dr. on the campus of the Gregory-Portland High School and on Broadway Blvd. on the campus of the old East Cliff Elementary School began operations on January 1, 2020.

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 2022).

Since monitoring began, some measured pollutant concentrations have exceeded the concentration levels of National Ambient Air Quality Standards (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).

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 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 Fresno (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 to date in 2022 with some comparisons with earlier data.

2.0 Summary of Activities January 1 through September 30, 2022

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 level in excess of 75%. However, the Portland Buddy Ganem station auto-gas chromatograph (auto-GC) underwent maintenance during much of March 2022 and thus had a 63% data completeness for the first quarter of 2022, although for several species the data completeness was 76%. In the second quarter, data completeness was 79%. The other two auto-GCs meet a 75% data completion rate for the first and second quarters of 2022. The data completion rates for 2.5 micron-sized particulate matter (PM_{2.5}), oxides of nitrogen (NO_x), and sulfur dioxide (SO₂) all exceed 75% through late September 2022.

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>).

As was noted in the last quarterly report, AECOM reported in April 2022 that the GCGV ethane-cracking facility became fully operational (all units producing product) in January 2022. Some GCGV processes began on September 15, 2021, with other processes beginning up through January 2022.

This report focuses on the data collected at the three air monitoring stations during the period July 1 through September 30, 2022, but also includes some summaries from earlier monitoring.

3.0 Air Monitoring Station Locations & Information

As noted earlier in this report, currently 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 (latest available image date March 2022) in Figure 1. Also shown in Figure 1 are the locations of the Cheniere liquefied natural gas facility under expansion and the GCGV ethane-cracker facility.

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

Air Monitoring Station Name & Address	Volatile Organic Compounds (VOCs) 46 compounds	Ethylene oxide (EO) 24 hr canister every 6 th day	Nitrogen Oxides (NO _x , 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 a 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 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. 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.

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

- NO_x, NO, & NO₂, SO₂, PM_{2.5} & Met measurements – weekly;
- Auto-GC VOC measurements – within 90 days of the measurement; and
- EO canister data – within 60 days of the date the sample was collected.

Although all these measurements, except EO, are made in near-real time, the nature of the complexity in quality assuring the 46 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 EO data are collected at the station and then sent to a laboratory where EO 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 EO data were available through July 31, 2022, and all other data were available through September 25, 2022, or later.

4.1 Gregory Fresnos Station Hydrocarbon Data

Figure 2 shows the time series graph for hourly concentrations of benzene at the Gregory-Fresnos (GF) station. The graph shows benzene hourly average concentrations for each hour from January 1 through July 31, 2022. Benzene concentrations in the air can be of health concern but to date their concentrations have been much lower than the TCEQ Air Monitoring Comparison Value (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 2022). 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, 2022 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.

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 46 individual hydrocarbon compounds for 90 to 92 percent data completion of the planned collection hours over the first seven months of 2022.

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 2022). To make a request, contact Dr. Dave Sullivan at sullivan231@mail.utexas.edu or 512-471-7805.

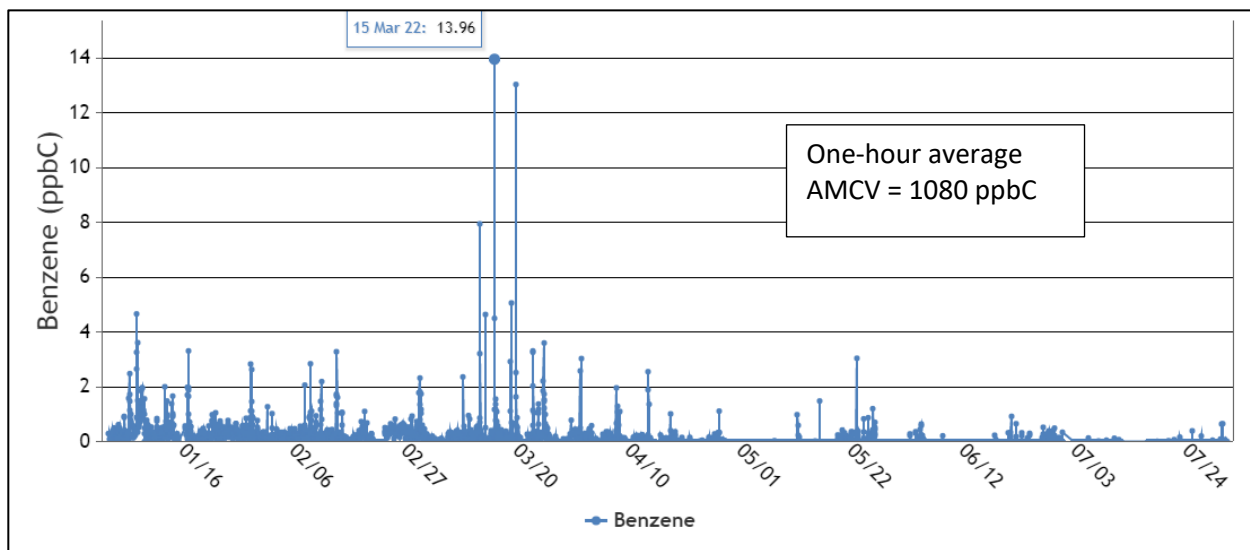


Figure 2. Hourly benzene concentrations at GF station, Jan. 1, 2022 – July 31, 2022, ppbC units

Table 2. Gregory-Fresnos Auto-GC statistics for Jan. - July 2022

Species	Num. Samples	Peak 1-hr ppbC	Peak 24-hr ppbC	Mean ppbC
TNMHC	4,188	782.08	184.14	35.50
TNMTC	4,188	748.97	175.76	32.79
Ethane	4,188	195.41	47.62	9.32
Ethylene	4,188	15.49	3.99	0.61
Propane	4,188	202.50	41.94	7.36
Propylene	4,188	4.03	1.39	0.33
Isobutane	4,188	86.79	16.31	2.40
n-Butane	4,188	98.21	25.35	4.28
Acetylene	4,188	8.17	1.77	0.49
trans-2-Butene	4,186	21.99	1.62	0.15
1-Butene	4,188	3.81	0.47	0.15
cis-2-Butene	4,181	5.77	0.49	0.07
Cyclopentane	4,188	2.25	0.56	0.13
Isopentane	4,188	53.29	12.42	2.17
n-Pentane	4,188	38.10	9.81	1.83
1,3-Butadiene	4,188	9.86	0.48	0.06
trans-2-Pentene	4,188	0.64	0.13	0.02
1-Pentene	4,188	1.41	0.20	0.04
cis-2-Pentene	4,188	0.38	0.04	0.00
2,2-Dimethylbutane	4,188	3.73	0.61	0.11
Isoprene	4,188	1.07	0.25	0.04
n-Hexane	4,269	12.61	3.38	0.52
Methylcyclopentane	4,269	5.33	1.15	0.21
2,4-Dimethylpentane	4,269	1.99	0.45	0.08
Benzene	4,269	13.96	1.14	0.16
Cyclohexane	4,269	16.54	2.61	0.26
2-Methylhexane	4,269	3.06	0.40	0.03
2,3-Dimethylpentane	4,269	2.56	0.31	0.01
3-Methylhexane	4,269	4.28	0.61	0.05
2,2,4-Trimethylpentane	4,269	5.10	0.71	0.08
n-Heptane	4,269	6.66	1.03	0.11
Methylcyclohexane	4,269	12.40	1.88	0.28
2,3,4-Trimethylpentane	4,269	1.39	0.14	0.01
Toluene	4,269	5.25	1.66	0.23
2-Methylheptane	4,269	1.82	0.30	0.02
3-Methylheptane	4,269	1.31	0.26	0.02
n-Octane	4,269	3.42	0.79	0.07
Ethyl Benzene	4,269	1.33	0.23	0.02
p-Xylene + m-Xylene	4,269	5.98	1.04	0.17
Styrene	4,269	0.25	0.03	0.00
o-Xylene	4,269	2.08	0.26	0.03
n-Nonane	4,269	2.70	0.38	0.04
Isopropyl Benzene - Cumene	4,269	1.92	0.34	0.01
n-Propylbenzene	4,269	0.97	0.15	0.01
1,3,5-Trimethylbenzene	4,269	1.60	0.20	0.01
1,2,4-Trimethylbenzene	4,229	3.81	0.56	0.13
n-Decane	4,269	6.84	0.91	0.09
1,2,3-Trimethylbenzene	4,269	2.57	0.33	0.03

4.2 Portland Buddy Ganem & Portland Broadway Stations Hydrocarbon Data

Figure 3 shows the time series graph for hourly concentrations of benzene at the Portland Buddy Ganem (PBG) station, and Figure 4 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 through July 31, 2022.

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, 2022.

Based on the 22 hours per day planned ambient measurements, the PBG station has collected data with 80 percent data completeness for 19 hydrocarbon compounds and 90 percent data completeness for 26 hydrocarbon species based on planned collection hours for the first seven months of 2022, and the PBway station has 91 percent data completeness of the planned collection hours over the same period.

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.

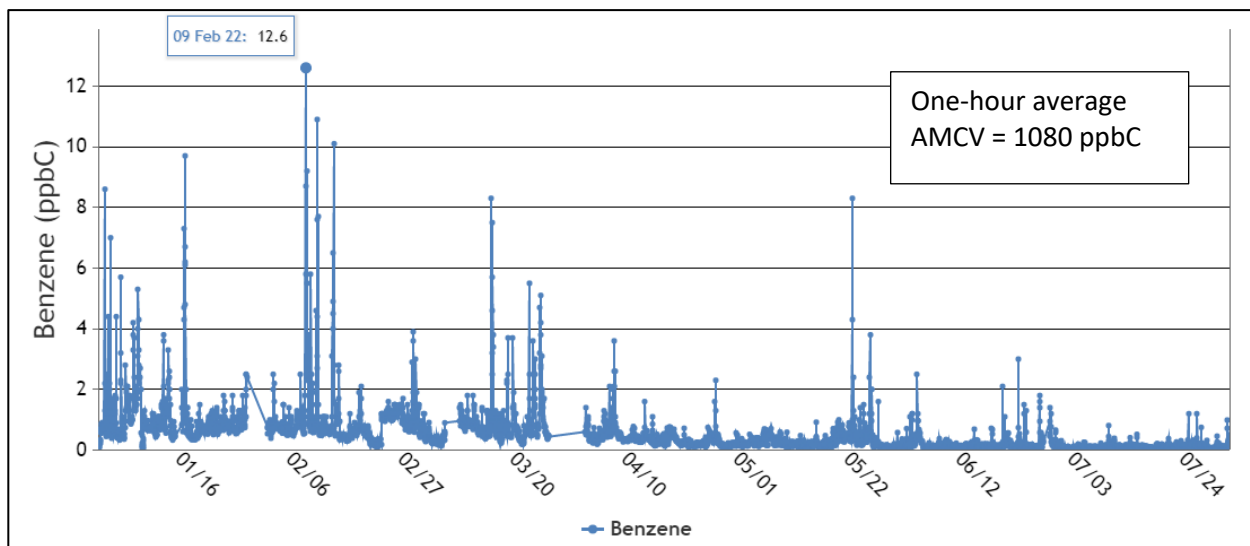


Figure 3. Hourly benzene concentrations at PBG station, Jan. 1, 2022 – July 31, 2022, ppbC units

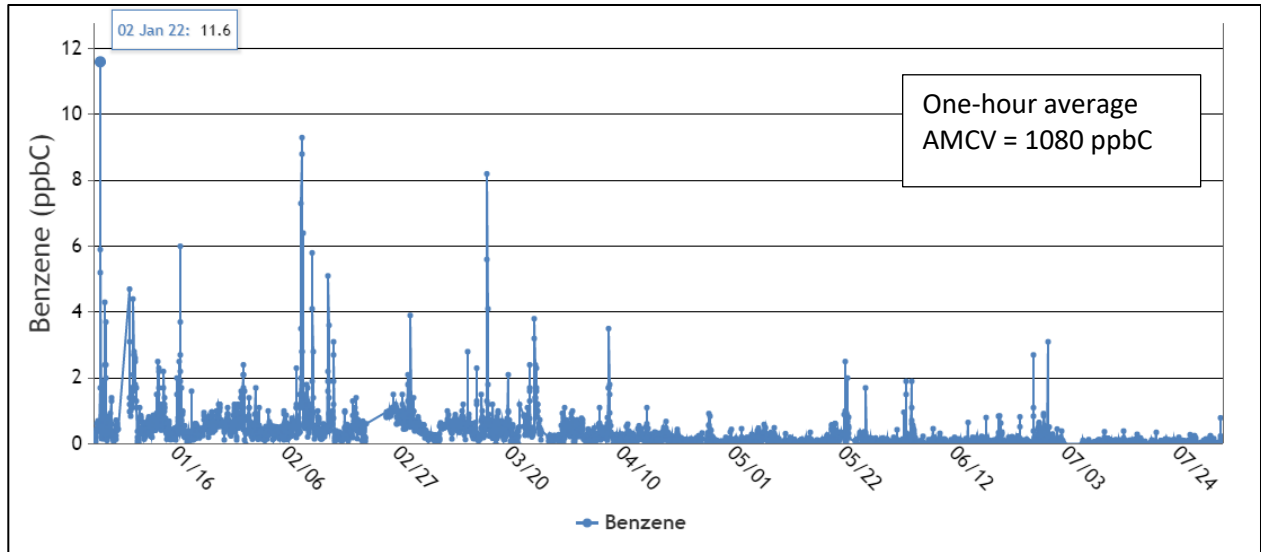


Figure 4. Hourly benzene concentrations at PBway station, Jan. 1, 2022 – July 31, 2022, ppbC units

Table 3. PBG Auto-GC statistics for Jan. - July 2022

Species	Num. Samples	Peak 1-hr ppbC	Peak 24-hr ppbC	Mean ppbC
TNMHC	3,724	1,112.76	238.19	38.85
TNMTC	3,724	1,043.57	224.71	35.49
Ethane	3,724	250.0	54.58	9.32
Ethylene	3,724	54.70	8.82	0.65
Propane	3,724	251.0	54.12	8.00
Propylene	3,724	9.30	1.70	0.43
Isobutane	3,724	145.0	26.55	2.57
n-Butane	3,724	127.0	33.31	4.35
Acetylene	3,724	4.80	1.48	0.30
trans-2-Butene	3,724	1.90	0.29	0.20
1-Butene	3,723	26.90	1.84	0.23
cis-2-Butene	3,724	1.00	0.11	0.06
Cyclopentane	3,724	4.20	0.88	0.11
Isopentane	3,724	75.30	15.89	2.19
n-Pentane	3,722	61.40	12.79	1.71
1,3-Butadiene	3,724	32.60	1.64	0.10
trans-2-Pentene	3,724	0.47	0.07	0.01
1-Pentene	3,722	1.20	0.11	0.03
cis-2-Pentene	3,724	0.51	0.04	0.00
2,2-Dimethylbutane	3,724	3.90	0.73	0.07
Isoprene	3,724	16.40	0.86	0.26
n-Hexane	4,196	41.10	5.78	0.64
Methylcyclopentane	4,196	15.60	2.46	0.25
2,4-Dimethylpentane	4,196	4.10	0.24	0.01
Benzene	4,196	12.60	3.06	0.55
Cyclohexane	4,196	25.60	3.27	0.32
2-Methylhexane	4,196	10.70	1.24	0.12
2,3-Dimethylpentane	4,196	4.80	0.51	0.05
3-Methylhexane	4,196	11.30	1.38	0.18
2,2,4-Trimethylpentane	4,196	5.90	1.25	0.21
n-Heptane	4,196	27.10	2.64	0.28
Methylcyclohexane	4,196	36.70	3.45	0.35
2,3,4-Trimethylpentane	4,196	1.40	0.19	0.03
Toluene	4,196	20.40	3.13	0.60
2-Methylheptane	4,196	4.20	0.58	0.07
3-Methylheptane	4,196	2.90	0.48	0.05
n-Octane	4,196	8.80	1.05	0.14
Ethyl Benzene	4,196	17.00	0.88	0.08
p-Xylene + m-Xylene	4,196	75.10	3.73	0.27
Styrene	4,196	1.40	0.85	0.09
o-Xylene	4,196	20.30	1.03	0.08
n-Nonane	4,196	4.80	2.25	0.10
Isopropyl Benzene - Cumene	4,196	1.70	0.42	0.01
n-Propylbenzene	4,196	1.10	0.34	0.03
1,3,5-Trimethylbenzene	4,187	2.60	1.03	0.04
1,2,4-Trimethylbenzene	4,196	5.50	0.95	0.16
n-Decane	4,196	8.20	3.62	0.36

Table 4. PBway Auto-GC statistics for Jan. - July 2022

Species	Num. Samples	Peak 1-hr ppbC	Peak 24-hr ppbC	Mean ppbC
TNMHC	4,228	921.25	273.99	41.50
TNMTC	4,228	864.17	264.45	38.35
Ethane	4,228	190.0	73.49	12.56
Ethylene	4,228	84.30	8.53	1.16
Propane	4,228	157.0	60.55	7.64
Propylene	4,228	6.50	2.69	0.53
Isobutane	4,228	127.0	30.77	2.70
n-Butane	4,228	115.0	40.13	4.91
Acetylene	4,228	5.80	1.15	0.34
trans-2-Butene	4,226	10.40	0.95	0.09
1-Butene	4,228	25.10	1.47	0.24
cis-2-Butene	4,228	4.30	0.26	0.05
Cyclopentane	4,228	4.90	0.85	0.13
Isopentane	4,228	172.0	19.94	2.48
n-Pentane	4,228	144.0	15.02	1.86
1,3-Butadiene	4,228	200.0	9.26	0.10
trans-2-Pentene	4,228	3.30	0.19	0.03
1-Pentene	4,228	6.50	1.22	0.07
cis-2-Pentene	4,224	1.20	0.23	0.01
2,2-Dimethylbutane	4,228	4.60	0.77	0.09
Isoprene	4,228	3.60	1.33	0.37
n-Hexane	4,228	24.70	5.24	0.35
Methylcyclopentane	4,228	10.40	2.49	0.14
2,4-Dimethylpentane	4,228	2.40	0.12	0.00
Benzene	4,228	11.60	2.71	0.33
Cyclohexane	4,228	16.70	3.00	0.20
2-Methylhexane	4,228	4.60	0.75	0.03
2,3-Dimethylpentane	4,228	3.20	0.57	0.02
3-Methylhexane	4,228	6.10	0.97	0.06
2,2,4-Trimethylpentane	4,228	21.80	1.85	0.14
n-Heptane	4,228	10.00	1.96	0.10
Methylcyclohexane	4,228	16.00	3.42	0.21
2,3,4-Trimethylpentane	4,228	6.20	0.54	0.03
Toluene	4,228	13.60	3.29	0.43
2-Methylheptane	4,228	3.30	0.56	0.04
3-Methylheptane	4,228	1.70	0.27	0.03
n-Octane	4,228	4.60	0.88	0.06
Ethyl Benzene	4,228	1.00	0.19	0.02
p-Xylene + m-Xylene	4,228	5.00	1.49	0.15
Styrene	4,228	0.33	0.04	0.01
o-Xylene	4,228	1.90	0.29	0.02
n-Nonane	4,228	1.40	0.34	0.02
Isopropyl Benzene - Cumene	4,228	0.88	0.19	0.01
n-Propylbenzene	4,228	0.42	0.06	0.01
1,3,5-Trimethylbenzene	4,228	1.30	0.10	0.01
1,2,4-Trimethylbenzene	4,098	3.50	0.97	0.41
n-Decane	4,228	1.10	0.34	0.09

4.3 Ethylene Oxide Measurements

As was noted earlier in this report, the GCGV ethylene-cracking industrial facility began operating in late 2021 and early 2022. As shown in Figure 5 through Figure 8, the levels of EO measured at the two GCGV stations have remained low, 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) for chronic exposure to EO is 2.4 ppbV or 4.8 ppbC. An ESL is defined in Appendix A.2. (<https://www.tceq.texas.gov/downloads/toxicology/dsd/final/eto.pdf>, accessed October 2022).

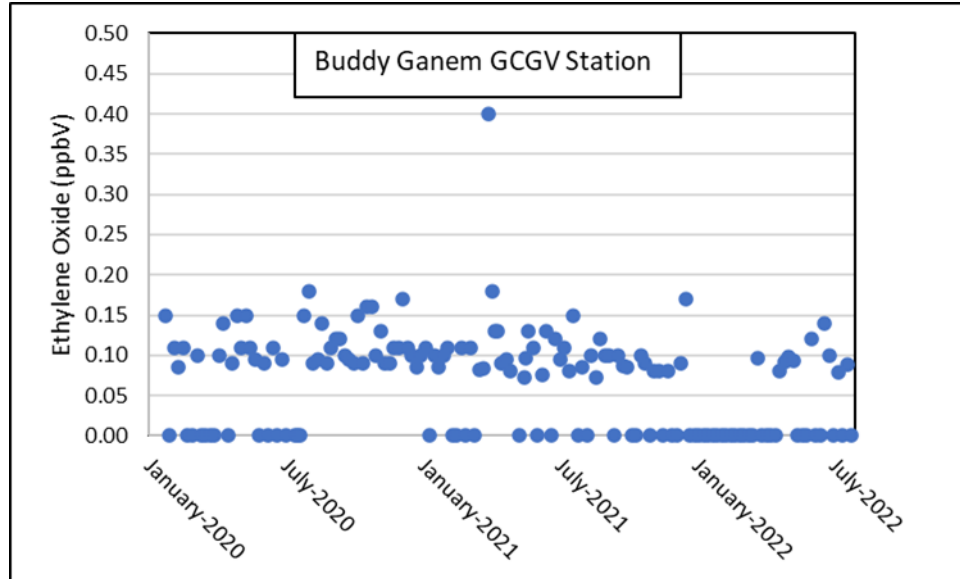


Figure 5. PBG EO concentrations, every 6th day samples Jan. 2020 through July 2022

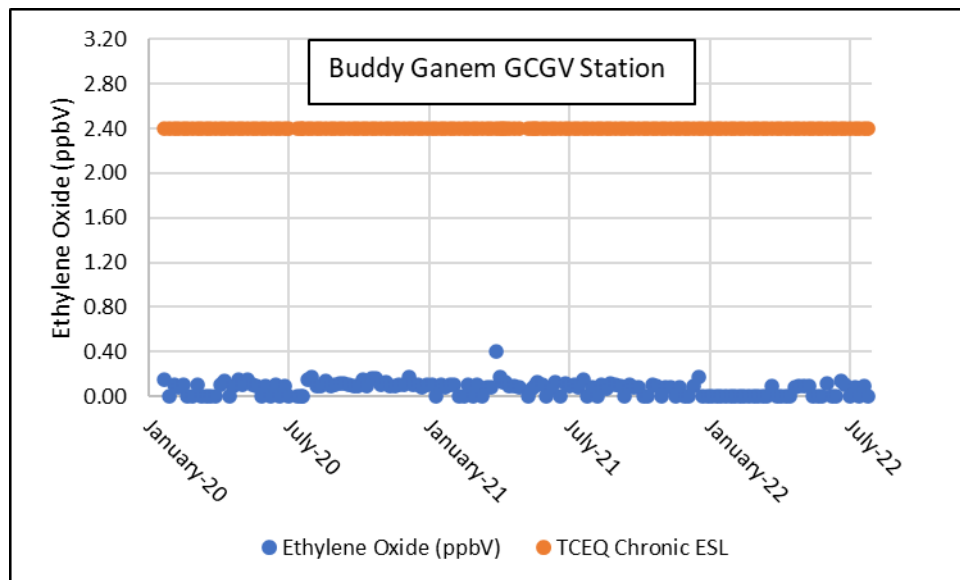


Figure 6. PBG EO concentrations, every 6th day samples Jan. 2020 through July 2022 in comparison to TCEQ Effect Screening Level

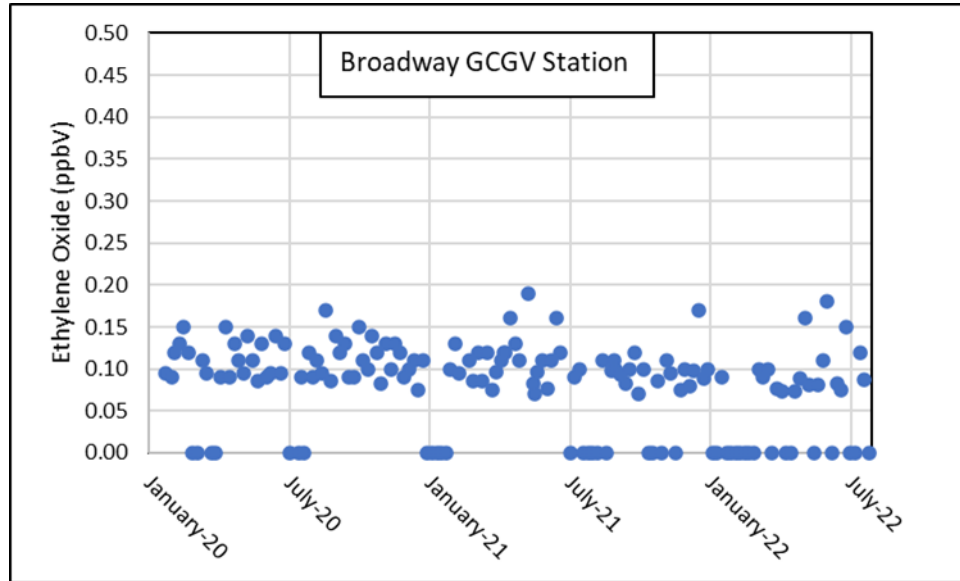


Figure 7. PBway EO concentrations, every 6th day samples Jan. 2020 through July 2022

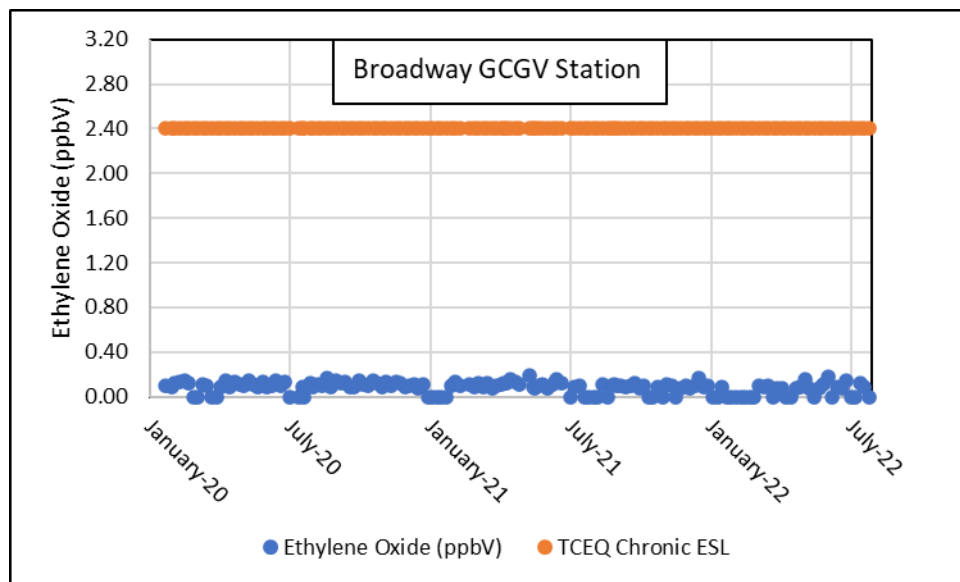


Figure 8. PBway EO concentrations, every 6th day samples Jan. 2020 through July 2022 in comparison to TCEQ Effect Screening Level

4.4 Comparing Hydrocarbon Data between Stations

Figure 9 shows a bar graph comparison between the average concentrations for the first seven months of 2022 of hydrocarbons including TNMTC and TNMHC among the three stations. The graph shows relatively close agreement among the three stations. Figure 10 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.

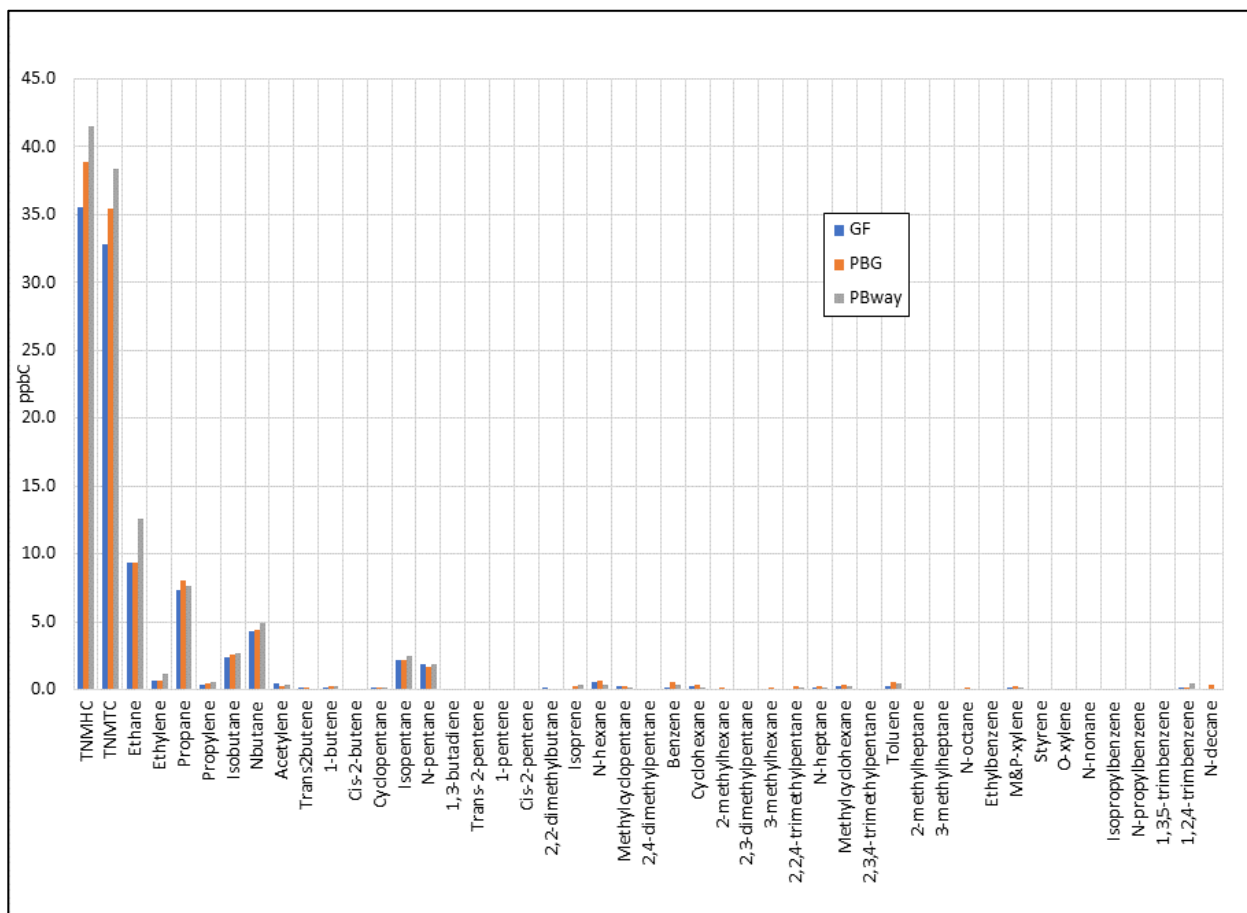


Figure 9. January through July 2022 mean concentrations of TNMTC, TNMHC, and hydrocarbon species at three stations

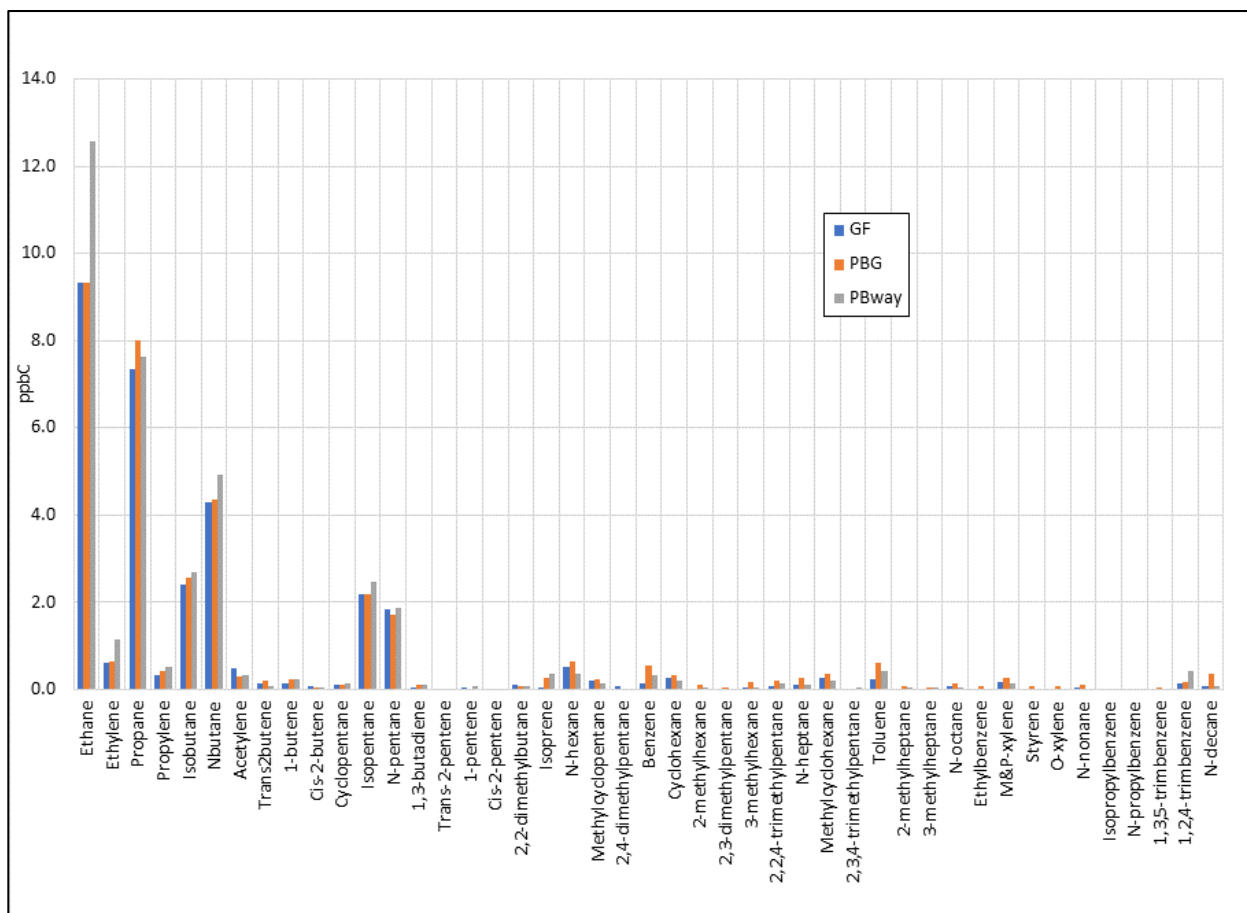


Figure 10. January through July 2022 mean concentrations of hydrocarbon species at the three air monitoring stations

4.4 Gregory Fresno Station Criteria Pollutant Data

Sulfur dioxide (SO₂), fine particulate matter (PM_{2.5}), and nitrogen dioxide (NO₂) 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.

- PM_{2.5} has both an annual average NAAQS and 24-hour NAAQS. For the PM_{2.5} 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 (µg/m³). The annual average, calculated by first averaging 24-hour averages by quarter and then averaging the four quarters, must be less than 12 µg/m³.
- The NAAQS for NO₂ is for the values to average less than 53 ppb in a calendar year and for the 98th percentile daily maximum value to be less than 100 ppb.
- SO₂ 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, which must be less than 75 ppb.

- With PM_{2.5}, SO₂, and NO₂, the 98th/99th percentile values are averaged with the similar statistic from the previous two years and then compared to the level of the NAAQS. For PM_{2.5} and NO₂, the annual average is averaged with the similar statistic from the previous two years and then compared to the level of the NAAQS.

No concentrations at levels that violate the NAAQS have been seen at the GF station. Several recorded PM_{2.5} one-hour values exceeded the level of the 24-hour NAAQS, 35 µg/m³, 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/m³).

Figure 11 shows the hourly average time series graph for PM_{2.5} at the GF station from January 1 through September 25, 2022. The average concentration for the first nine months of 2022 was 8.4 µg/m³. Occasional elevated concentrations have been measured for a one or two-hour period. Despite the elevated short-term concentrations, the 24-hour average concentration on these dates were modest. Figure 12 shows the 24-hour averaged daily PM_{2.5} concentrations since the start of monitoring in October 2019. This graph is provided to illustrate the roughly seasonal pattern of PM_{2.5}, with higher concentrations in the summers associated with transported dust from Northern Africa.

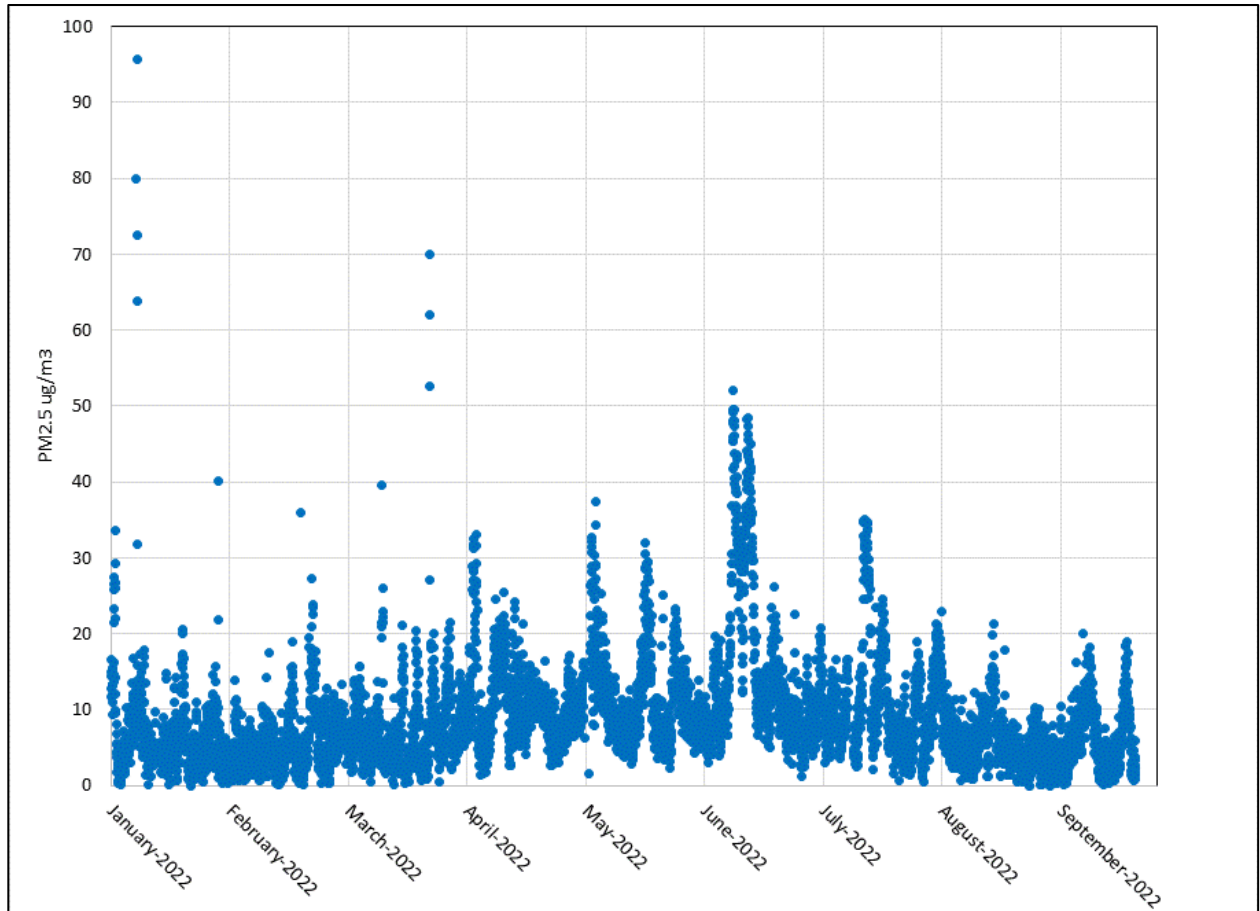


Figure 11. Hourly average PM2.5 at GF, $\mu\text{g}/\text{m}^3$, Jan. 1 – Sept. 25, 2022

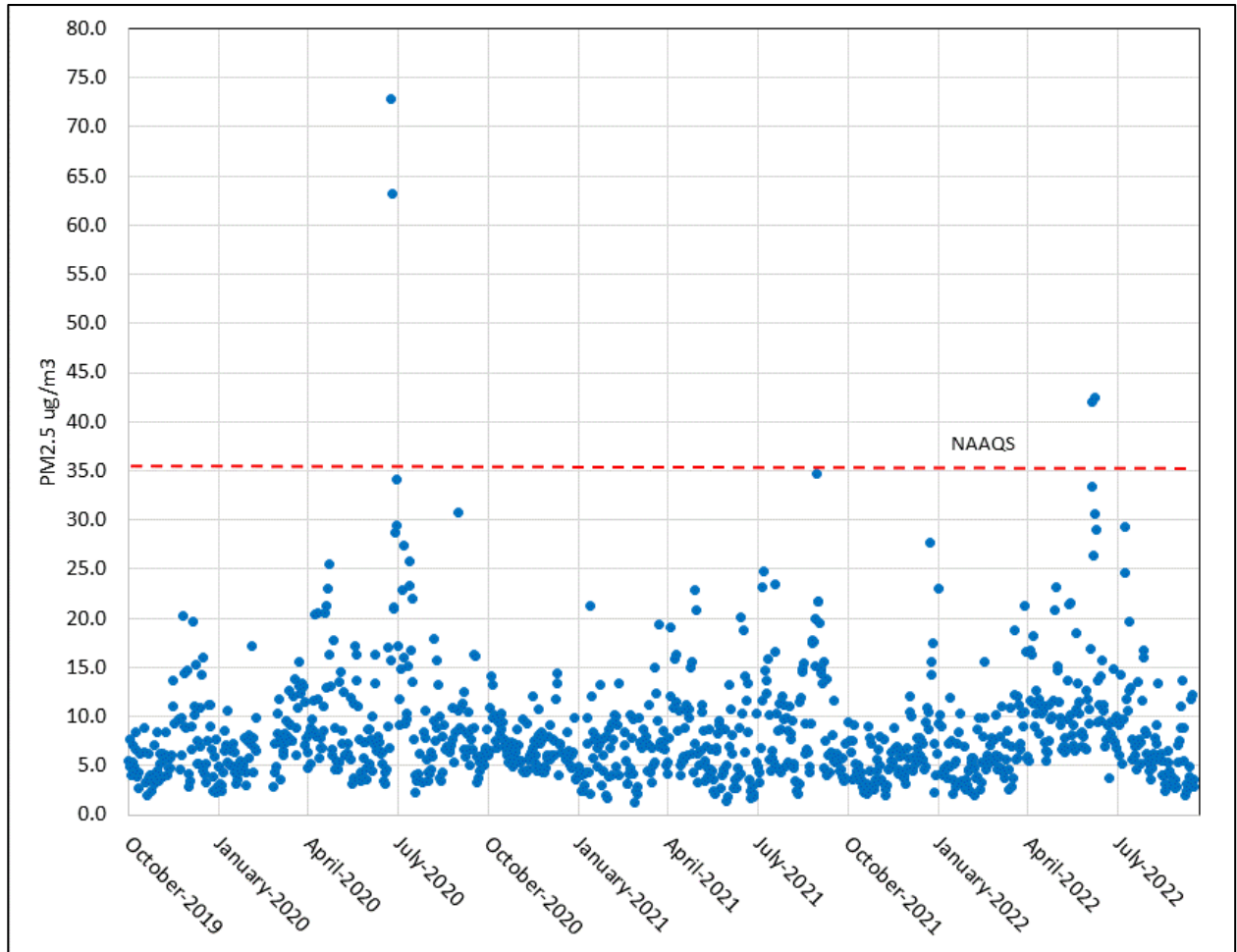


Figure 12. Averaged 24-Hour PM2.5 at GF, Oct. 2019 – Sept. 2022, with NAAQS value

Figure 13 shows the hourly average time series graph for NO₂ at the Gregory Fresnos station from January 1 through September 25, 2022. The figure also shows the 24-hour 100 ppb NAAQS level.

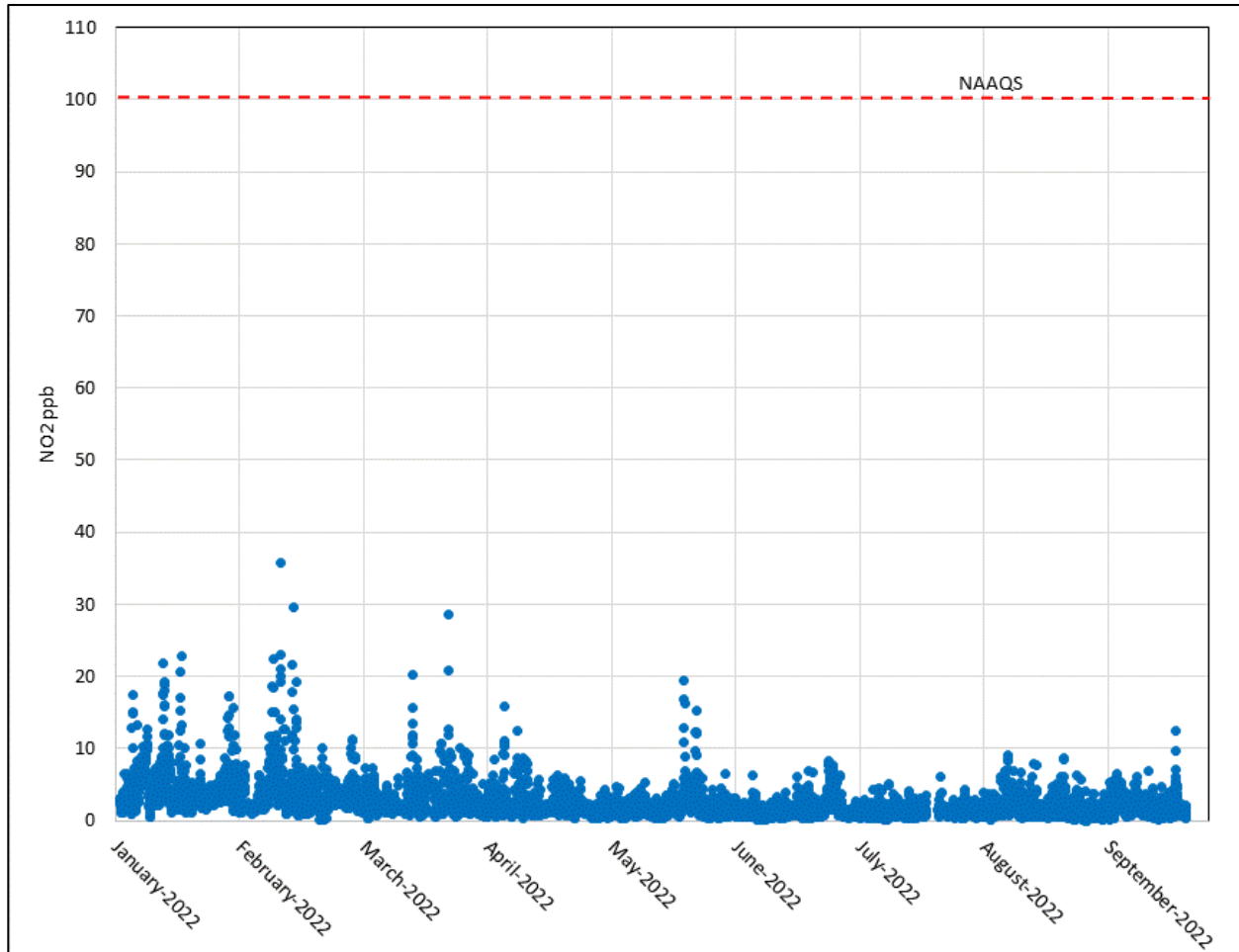


Figure 13. Hourly NO₂ at GF, ppb units, Jan. 1 – Sept. 25, 2022, with NAAQS value

SO₂ is rarely found in ambient air, and the SO₂ instruments are calibrated to accurately measure high concentrations that are a risk to public health. As a result, the large majority of SO₂ 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 the first nine months of 2022 SO₂ 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. The only likely actual SO₂ plume was an 8 ppb concentration earlier in the year on January 23.

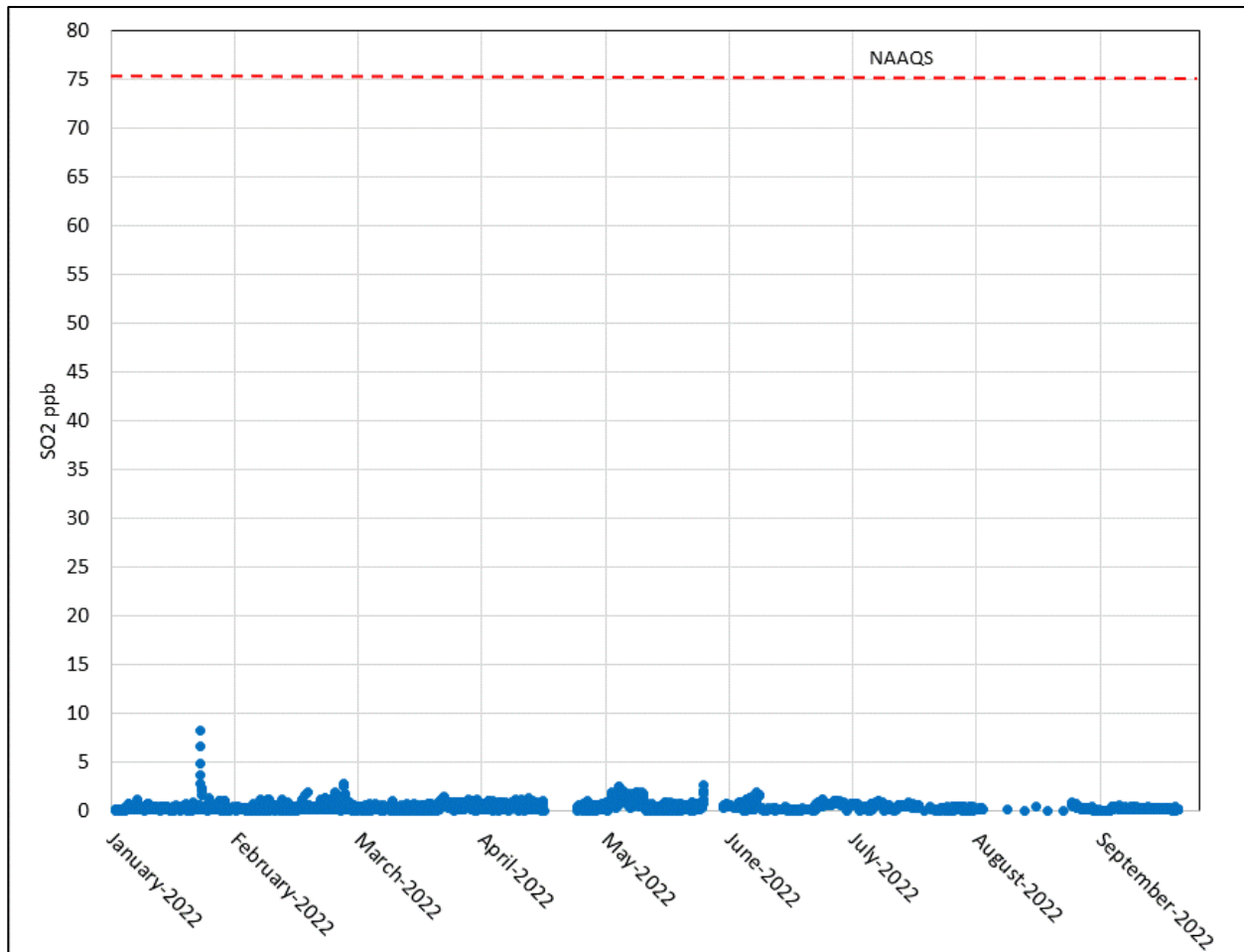


Figure 14. Hourly average SO₂ at GF, Jan. 1 – Sept. 25, 2022, with NAAQS value

4.5 Portland Buddy Ganem & Portland Broadway Stations Criteria Pollutant Data

Fine particulate matter (PM_{2.5}) is the only NAAQS-regulated pollutant measured at the PBG and PBway stations. Hourly concentrations that exceed the NAAQS 24-hour average value have been seen at the two stations, but no violations of the standard have occurred. Figure 15 shows the first six months of 2022 hourly concentrations time series graph of PM_{2.5} and Figure 16 shows the 24-hour average concentrations at the PBG site, and Figure 17 and Figure 18 show the same time series for the PBway site. The average concentration in the first half at PBG was 9.0 µg/m³ and was 9.4 µg/m³ at PBway. As was the case with the GF station, there were periods of elevated PM_{2.5} in June associated with transported dust from Northern Africa.

To a large extent, PM_{2.5} 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 an example, all three stations exceeded the 35 µg/m³ 24-hour NAAQS on the same two dates, June 12 and June 16, owing to the transported North African dust. Across the State of Texas, with 66 regulatory PM_{2.5} monitors, 22 stations had June 12 in the top four highest days in the first six months of 2022, and 48 stations had June 16 in the top four highest days in the first six months of 2022. Among TCEQ regions, all parts of the state had some elevated concentrations between June 12 and June 16.

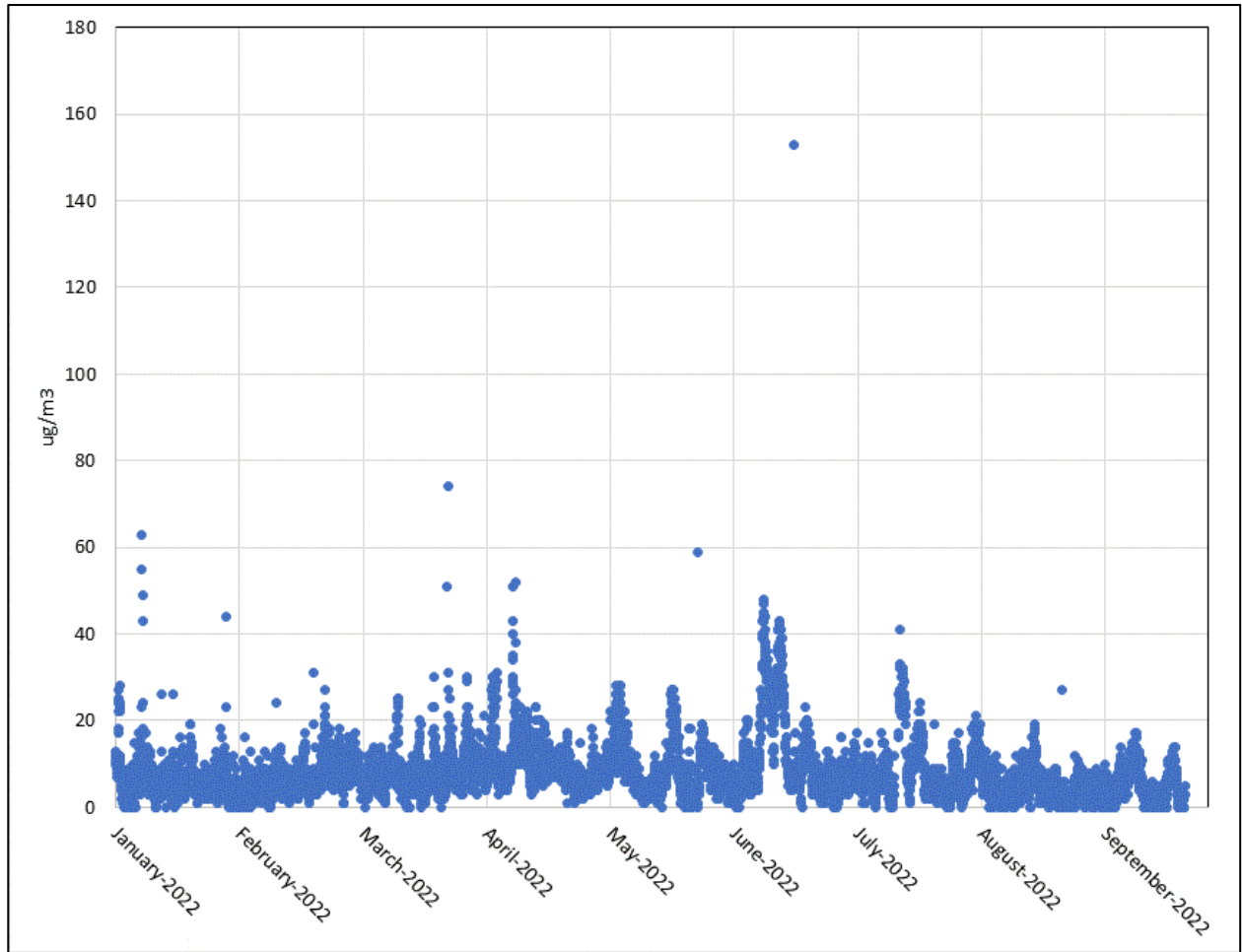


Figure 15. Hourly average PM2.5 at PBG, Jan. 1 – Sept. 25, 2022

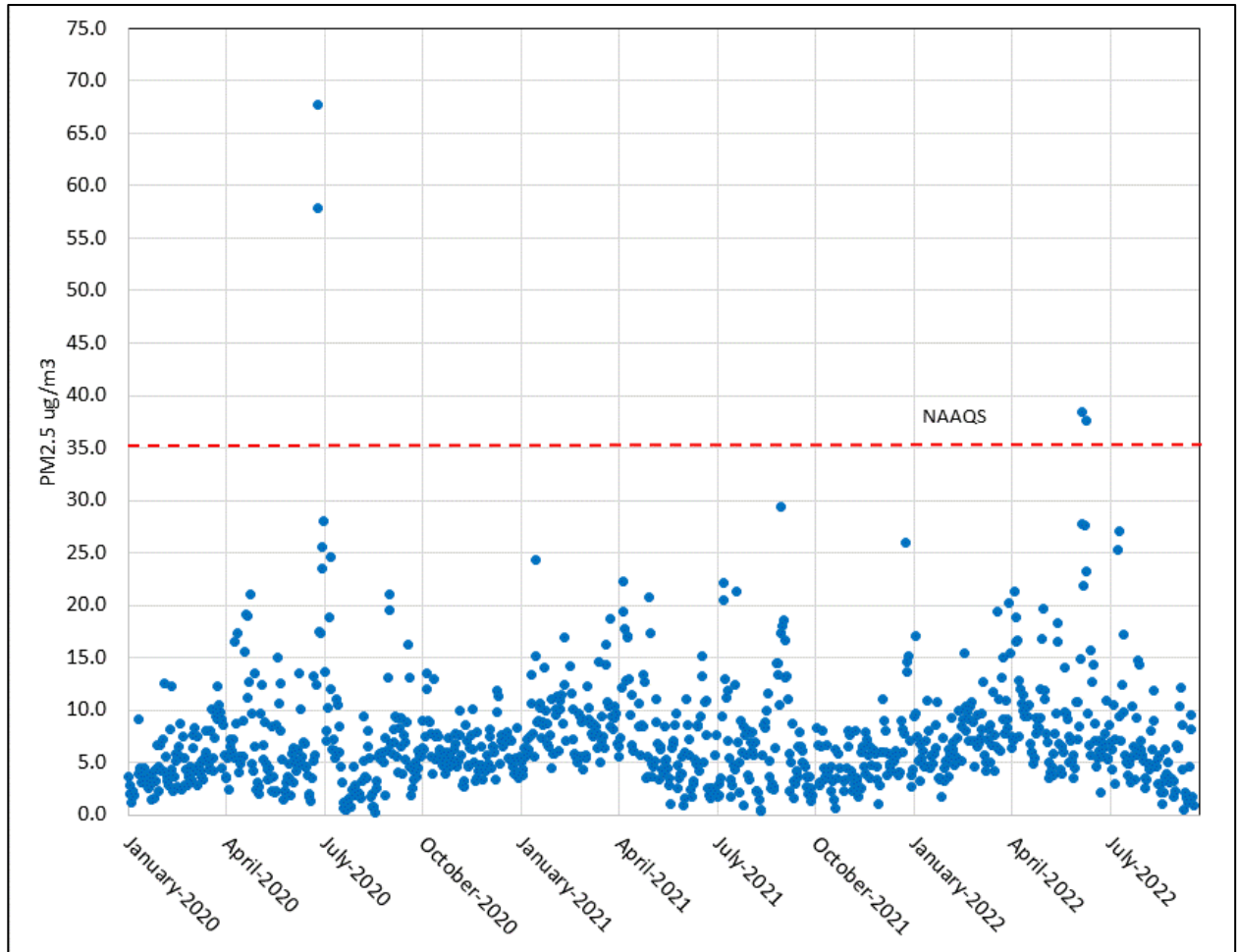


Figure 16. Averaged 24-Hour PM_{2.5} at PBG, Jan. 1, 2020 – Sept. 25, 2022, NAAQS scale

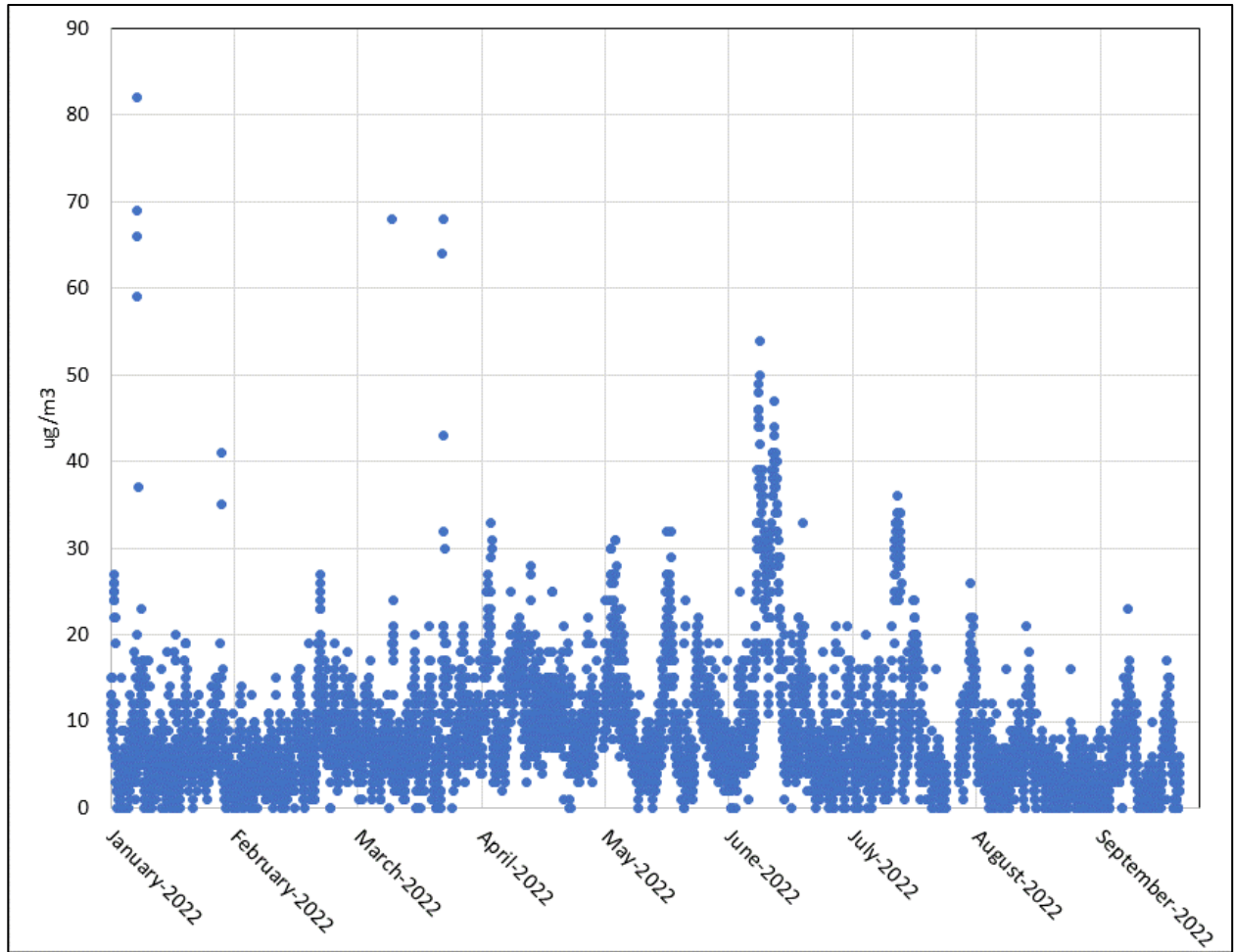


Figure 17. Hourly average PM2.5 at PBway, Jan. 1 – Sept. 25, 2022

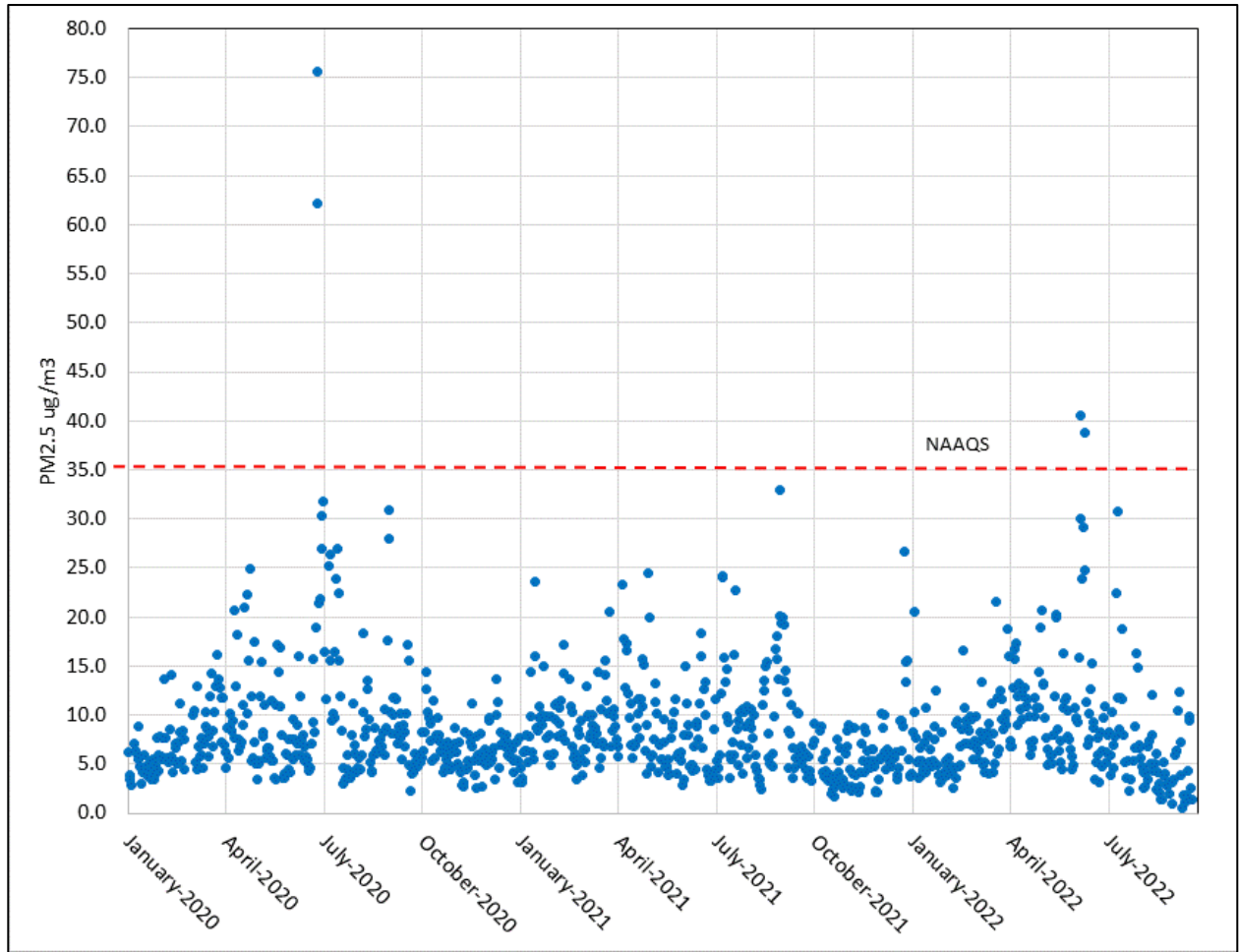


Figure 18. Averaged 24-Hour PM2.5 at PBway, Jan. 1, 2020 – Sept. 25, 2022, with NAAQS value

5.0 Data Analysis

A comparison of Texas average hourly benzene concentrations in 2021 appears in Figure 19. The bar chart is ranked high to low and shows that the Gregory-Portland stations are on the low end, with the Gregory Fresno station having the absolute lowest mean concentration. The stations are labeled by the numbering scheme used by the Environmental Protection Agency, and stations can be looked up on the TCEQ's Website at <https://www.tceq.texas.gov/airquality/monops/sites/air-mon-sites> (accessed October 2022). With the EPA nomenclature, the first two numbers represent the state, and "48" is for Texas, with the following three numbers for the county, and "355" is for Nueces County, and the last four numbers indicate the specific monitoring station. The TCEQ's Galena Park site (482010057) in Houston had the highest average benzene concentration in 2021. The Corpus Christi Palm station (483550083) is in the center of the graph below. Only stations with complete data (greater than 75% data completeness) are shown in this comparison.

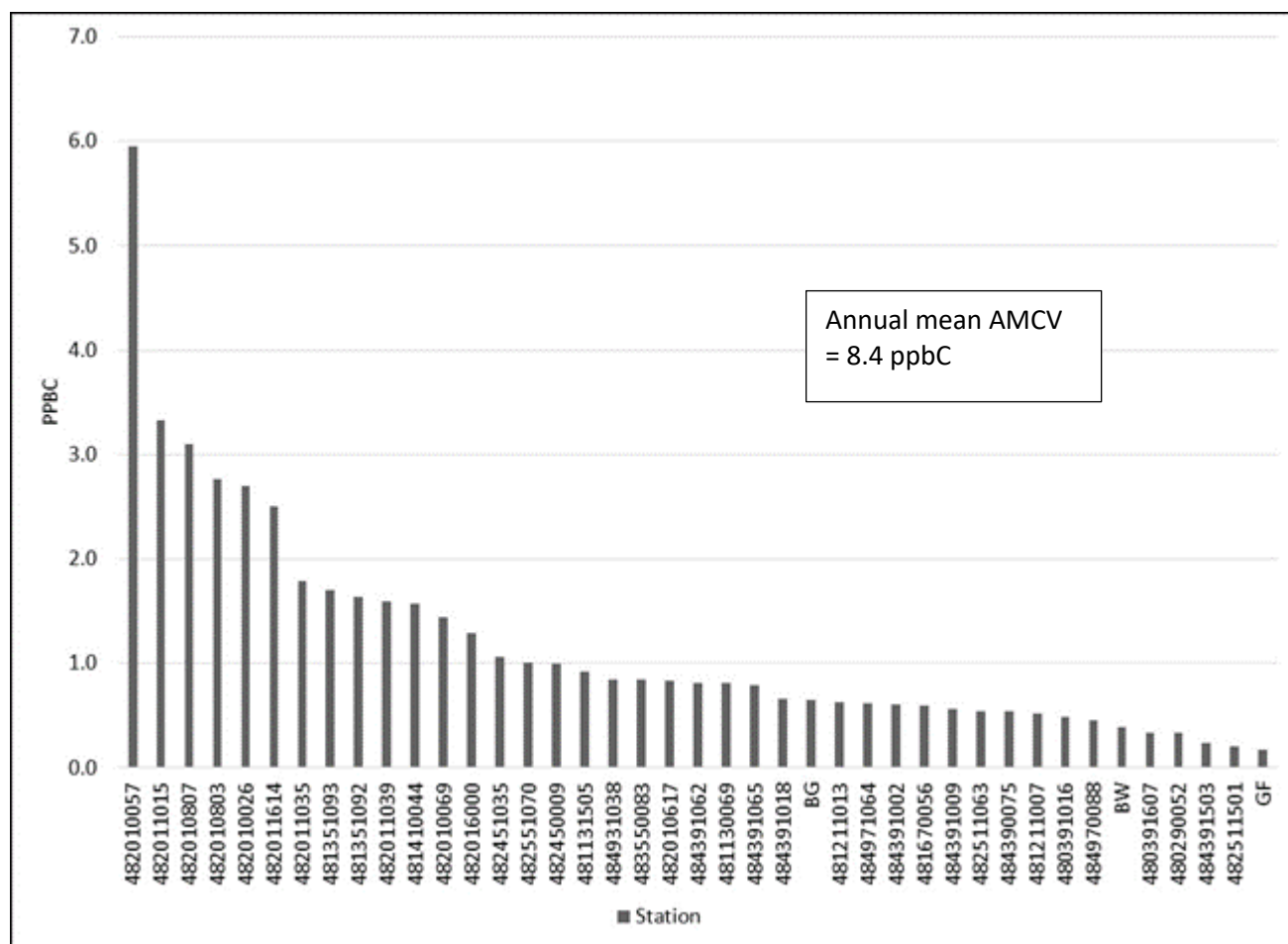


Figure 19. Mean hourly benzene concentrations in 2021 among Texas auto-GCs operated by TCEQ and by UT and AECOM

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. 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 (EO) 24 hr canister every 6 th day	Nitrogen Oxides (NO _x , 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 Fresno Stephen Austin Elementary 401 Fresno 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



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 (ppmV) or ppb-volume (ppbV) 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 unspiciated 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 air samples when an independent sensor detects that *elevated* (see below) levels of hydrocarbons (TNMHC) are present. 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 <http://www.tceq.texas.gov/toxicology/AirToxics.html> (accessed October 2022). 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.

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 pollutants 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 (PM_{2.5}) 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 October 2022)

One species measured by this project and regulated by a NAAQS is sulfur dioxide (SO₂). EPA set the SO₂ 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 SO₂ 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 SO₂, 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 SO₂, 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.