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

Prepared by

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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 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.

As described in earlier reports over the past two years, a large-scale slowdown in the world economy owing to the COVID 19 pandemic had been underway since early 2020, but this has had minimal impact on air monitoring operations. The instruments in the stations operate automatically and can be accessed remotely. Station operators are locally based and need only travel a short distance to conduct standard operations and maintenance. The University of Texas at Austin (UT Austin) personnel have been working from home and from the office with no loss of effectiveness. Section 5.0 Data Analysis discusses changes suggesting the economic slowdown has passed.

The public website developed as the community's source for information about the community air monitors continues to provide information about air quality and monitoring data from the three air monitoring stations (https://gpair.ceer.utexas.edu accessed July 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 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 to date in 2022 with some comparisons with earlier data.

2.0 Summary of Activities January 1 through June 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 67% data completeness for 2022 through April for several hydrocarbon species. The other two auto-GCs meet a 75% data completion rate through April 2022. The GCGV 2.5 micron-sized particulate matter (PM2.5) and UT PM2.5, oxides of nitrogen (NOx), and sulfur dioxide (SO_2) all exceed 75% data completeness through late June 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).

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.

In April 2022, UT received an inquiry from a Reuters News Agency reporter about air quality trends in the Portland/Gregory area. She asked specifically about changes since 2018, citing concerns she had heard from local residents about declining air quality. She was directed to the project website. She was informed AECOM operates the other two monitoring stations and was provided their contact information. UT also provided her with correspondence from TxDOT about road repaving that could create odor concerns, described in Section 5.0 Data Analysis.

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

3.0 Air Monitoring Station Locations & Information

As mentioned above, 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 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 6th day	Nitrogen Oxides (NOx, NO, & NO2)	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:

- NOx, NO, & NO_2, SO_2, PM2.5 & 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 April 30, 2022, and all other data were available through June 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, 2022, through April 30, 2022. 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 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 July 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 through April 2022 average 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 94 percent of the planned collection hours.

Time series graphs of other hydrocarbon species are also available upon request and any graphs can be made with timescale (x-axis) or concentration-scale (y-axis) adjustments. Also, concentrations can be averaged by day, month, or other time period upon request. A user can also make graphs of data on the project website at https://gpair.ceer.utexas.edu/custom-data-request.php (accessed July 2022). To make a request, contact Dr. Dave Sullivan at sullivan231@mail.utexas.edu or 512-471-7805.

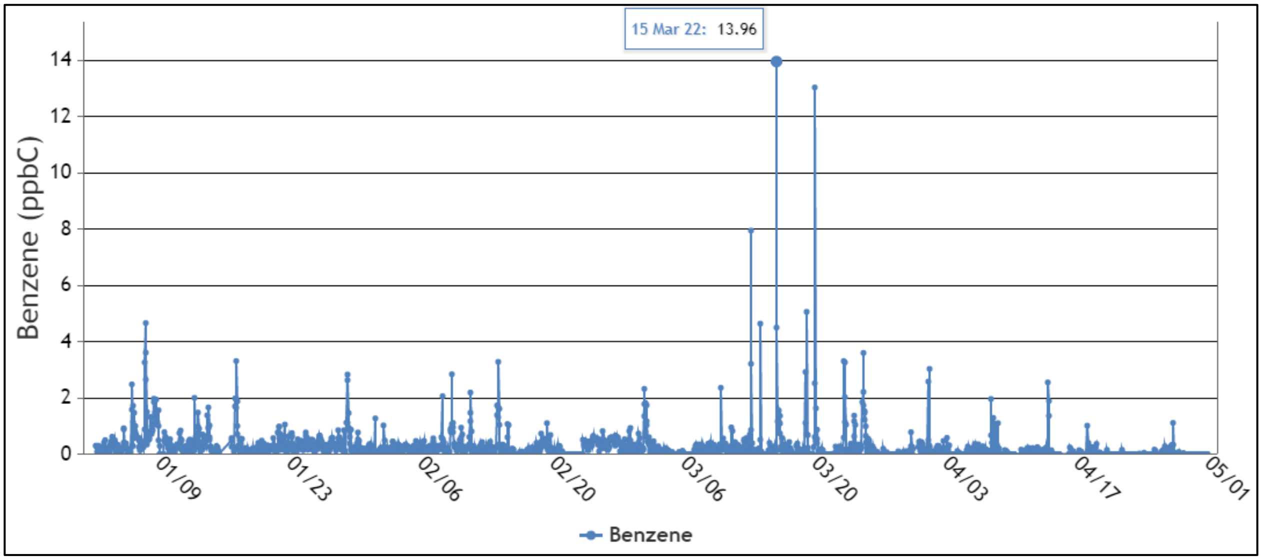

Figure 2. Hourly benzene concentrations at GF station, Jan. 1, 2022 – Apr. 30, 2022, ppbC units

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

Species	Num. Samples	Peak 1-hr ppbC	Peak 24-hr ppbC	Mean ppbC
TNMHC	2,476	782.08	184.139	50.829
TNMTC	2,476	748.97	175.759	47.869
Ethane	2,476	195.41	47.621	13.970
Ethylene	2,476	15.49	3.987	0.826
Propane	2,476	202.50	41.938	11.110
Propylene	2,476	4.03	1.393	0.369
Isobutane	2,476	86.79	16.312	3.607
n-Butane	2,476	98.21	25.347	6.332
Acetylene	2,476	8.17	1.772	0.663
trans-2-Butene	2,474	21.99	1.620	0.165
1-Butene	2,476	3.81	0.468	0.168
cis-2-Butene	2,469	0.63	0.109	0.061
Cyclopentane	2,476	2.25	0.559	0.168
Isopentane	2,476	53.29	12.422	2.980
n-Pentane	2,476	38.10	9.811	2.495
1,3-Butadiene	2,476	7.03	0.400	0.075
trans-2-Pentene	2,476	0.64	0.129	0.028
1-Pentene	2,476	1.29	0.198	0.052
cis-2-Pentene	2,476	0.38	0.041	0.004
2,2-Dimethylbutane	2,476	3.73	0.614	0.163
Isoprene	2,476	0.59	0.115	0.005
n-Hexane	2,476	12.61	3.378	0.774
Methylcyclopentane	2,476	5.08	1.148	0.304
2,4-Dimethylpentane	2,476	1.59	0.453	0.110
Benzene	2,476	13.96	1.136	0.253
Cyclohexane	2,476	9.19	1.502	0.365
2-Methylhexane	2,476	3.06	0.396	0.040
2,3-Dimethylpentane	2,476	2.56	0.306	0.017
3-Methylhexane	2,476	4.28	0.611	0.080
2,2,4-Trimethylpentane	2,476	5.10	0.750	0.122
n-Heptane	2,476	6.66	1.029	0.165
Methylcyclohexane	2,476	12.40	1.880	0.424
2,3,4-Trimethylpentane	2,476	1.39	0.207	0.015
Toluene	2,476	5.25	1.655	0.332
2-Methylheptane	2,476	1.82	0.295	0.036
3-Methylheptane	2,476	1.31	0.265	0.029
n-Octane	2,476	3.42	0.786	0.113
Ethyl Benzene	2,476	0.74	0.234	0.026
p-Xylene + m-Xylene	2,476	3.47	1.035	0.194
Styrene	2,476	0.25	0.034	0.002
o-Xylene	2,476	1.06	0.261	0.040
n-Nonane	2,476	2.70	0.380	0.055
Isopropyl Benzene - Cumene	2,476	1.92	0.336	0.009
n-Propylbenzene	2,476	0.72	0.140	0.018
1,3,5-Trimethylbenzene	2,476	1.60	0.204	0.014
1,2,4-Trimethylbenzene	2,476	3.09	0.563	0.148
n-Decane	2,476	6.84	0.913	0.138
1,2,3-Trimethylbenzene	2,476	2.57	0.330	0.027

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, 2022, through April 30, 2022.

As was the case at the Gregory Fresnos station, hydrocarbon concentrations to date are much lower than TCEQ AMCVs or ESLs. 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 concentration for each species for January through April 2022.

Based on the 22 hours per day planned ambient measurements, the PBG station has collected data with between with between 67 and 85 percent of planned collection hours depending on the species, and the PBway station has collected data for 90 percent of the planned collection hours.

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.

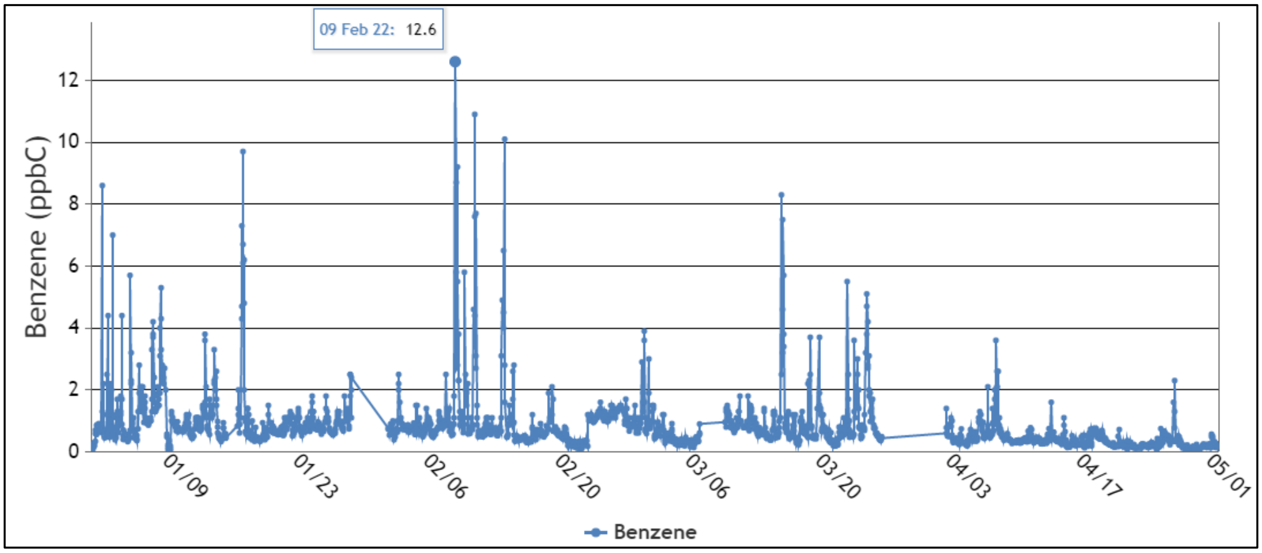

Figure 3. Hourly benzene concentrations at PBG station, Jan. 1, 2022 – Apr. 30, 2022, ppbC units

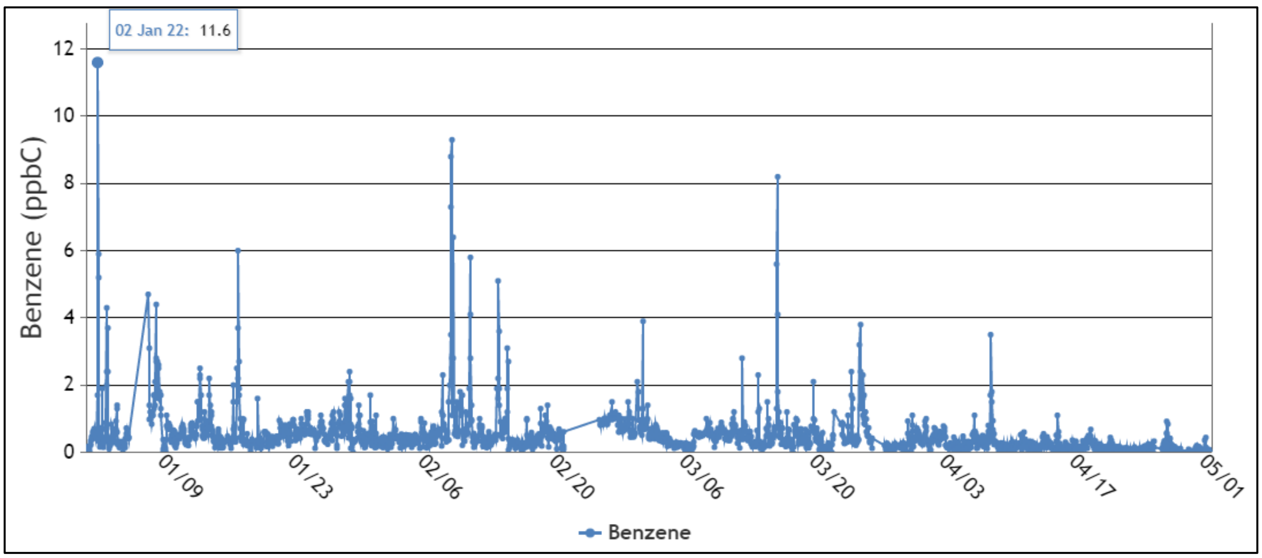

Figure 4. Hourly benzene concentrations at PBway station, Jan. 1, 2022 – Apr. 30, 2022, ppbC units

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

Species	Num. Samples	Peak 1-hr ppbC	Peak 24-hr ppbC	Mean ppbC
TNMHC	1,775	1,112.76	238.185	63.399
TNMTC	1,775	1,043.57	224.712	59.167
Ethane	1,775	192.00	54.580	15.820
Ethylene	1,775	54.70	8.815	1.181
Propane	1,775	251.00	54.123	14.350
Propylene	1,775	9.30	1.700	0.490
Isobutane	1,775	145.00	26.546	4.495
n-Butane	1,775	127.00	33.305	7.508
Acetylene	1,775	4.20	1.477	0.525
trans-2-Butene	1,775	1.20	0.267	0.195
1-Butene	1,774	26.90	1.836	0.223
cis-2-Butene	1,775	0.41	0.115	0.055
Cyclopentane	1,775	4.20	0.881	0.182
Isopentane	1,775	75.30	15.890	3.563
n-Pentane	1,773	61.40	12.785	2.779
1,3-Butadiene	1,775	6.10	0.760	0.106
trans-2-Pentene	1,775	0.31	0.051	0.008
1-Pentene	1,773	1.20	0.087	0.024
cis-2-Pentene	1,775	0.14	0.019	0.002
2,2-Dimethylbutane	1,775	3.90	0.731	0.122
Isoprene	1,775	16.40	0.858	0.058
n-Hexane	2,247	41.10	5.780	1.040
Methylcyclopentane	2,247	15.60	2.464	0.402
2,4-Dimethylpentane	2,247	4.10	0.239	0.012
Benzene	2,247	12.60	3.061	0.851
Cyclohexane	2,247	25.60	3.274	0.495
2-Methylhexane	2,247	10.70	1.244	0.193
2,3-Dimethylpentane	2,247	4.80	0.510	0.076
3-Methylhexane	2,247	11.30	1.375	0.272
2,2,4-Trimethylpentane	2,247	5.90	1.254	0.298
n-Heptane	2,247	27.10	2.641	0.428
Methylcyclohexane	2,247	36.70	3.445	0.551
2,3,4-Trimethylpentane	2,247	1.40	0.193	0.037
Toluene	2,247	20.40	3.125	0.829
2-Methylheptane	2,247	4.20	0.577	0.112
3-Methylheptane	2,247	2.90	0.484	0.082
n-Octane	2,247	8.80	1.046	0.220
Ethyl Benzene	2,247	17.00	0.882	0.117
p-Xylene + m-Xylene	2,247	75.10	3.729	0.382
Styrene	2,247	1.40	0.845	0.107
o-Xylene	2,247	20.30	1.025	0.119
n-Nonane	2,247	2.20	0.509	0.113
Isopropyl Benzene - Cumene	2,247	1.70	0.417	0.020
n-Propylbenzene	2,247	1.10	0.131	0.038
1,3,5-Trimethylbenzene	2,238	1.80	0.212	0.054
1,2,4-Trimethylbenzene	2,247	5.50	0.527	0.165
n-Decane	2,247	2.20	0.821	0.350

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

Species	Num. Samples	Peak 1-hr ppbC	Peak 24-hr ppbC	Mean ppbC
TNMHC	2,371	921.25	273.994	61.297
TNMTC	2,371	864.17	264.451	57.197
Ethane	2,371	190.00	73.490	18.670
Ethylene	2,371	84.30	8.528	1.623
Propane	2,371	157.00	60.545	12.204
Propylene	2,371	6.50	2.691	0.704
Isobutane	2,371	127.00	30.768	4.253
n-Butane	2,371	115.00	40.130	7.574
Acetylene	2,371	5.80	1.151	0.518
trans-2-Butene	2,371	6.50	0.504	0.104
1-Butene	2,371	25.10	1.470	0.254
cis-2-Butene	2,371	4.30	0.265	0.066
Cyclopentane	2,371	3.00	0.848	0.188
Isopentane	2,371	72.50	19.935	3.637
n-Pentane	2,371	49.70	15.015	2.751
1,3-Butadiene	2,371	200.00	9.257	0.150
trans-2-Pentene	2,371	3.30	0.191	0.031
1-Pentene	2,371	6.50	1.221	0.078
cis-2-Pentene	2,370	1.20	0.226	0.017
2,2-Dimethylbutane	2,371	4.60	0.771	0.128
Isoprene	2,371	1.30	0.471	0.072
n-Hexane	2,371	24.70	5.239	0.545
Methylcyclopentane	2,371	10.40	2.493	0.209
2,4-Dimethylpentane	2,371	2.40	0.124	0.002
Benzene	2,371	11.60	2.706	0.521
Cyclohexane	2,371	13.10	3.002	0.286
2-Methylhexane	2,371	4.60	0.747	0.053
2,3-Dimethylpentane	2,371	3.20	0.568	0.024
3-Methylhexane	2,371	6.10	0.970	0.089
2,2,4-Trimethylpentane	2,371	21.80	1.848	0.211
n-Heptane	2,371	10.00	1.963	0.160
Methylcyclohexane	2,371	16.00	3.418	0.321
2,3,4-Trimethylpentane	2,371	6.20	0.538	0.042
Toluene	2,371	13.60	3.291	0.603
2-Methylheptane	2,371	3.30	0.562	0.048
3-Methylheptane	2,371	1.70	0.272	0.041
n-Octane	2,371	4.60	0.877	0.086
Ethyl Benzene	2,371	1.00	0.191	0.024
p-Xylene + m-Xylene	2,371	5.00	1.485	0.223
Styrene	2,371	0.33	0.038	0.007
o-Xylene	2,371	1.90	0.289	0.029
n-Nonane	2,371	1.40	0.341	0.038
Isopropyl Benzene - Cumene	2,371	0.88	0.190	0.010
n-Propylbenzene	2,371	0.42	0.058	0.007
1,3,5-Trimethylbenzene	2,371	1.30	0.095	0.009
1,2,4-Trimethylbenzene	2,371	3.50	0.967	0.380
n-Decane	2,371	1.10	0.343	0.105

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 and Figure 6, the levels of EO measured at the two GCGV stations have remained low. 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 July 2022).

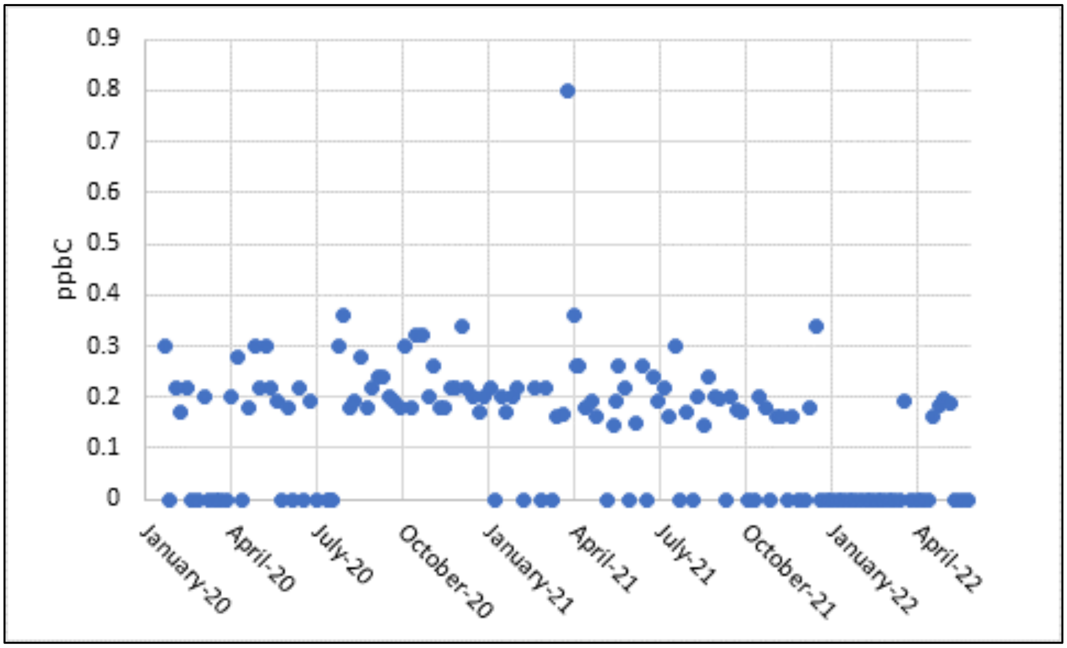

Figure 5. PBG EO concentrations, every 6th day samples Jan. 2020 through Apr. 2022

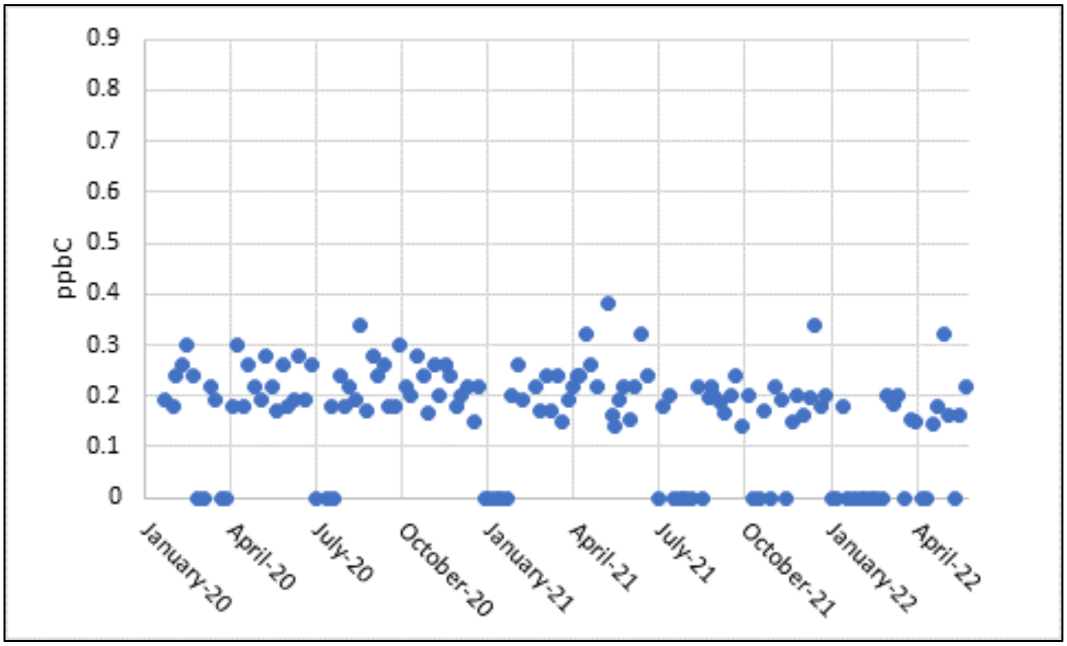

Figure 6. PBway EO concentrations, every 6th day samples Jan. 2020 through Apr. 2022

4.4 Comparing Hydrocarbon Data between Stations

Figure 7 shows a bar graph comparison between the average concentrations for the first 4 months of calendar year 2022 of hydrocarbons including TNMTC and TNMHC among the three stations. The graph shows relatively close agreement among the three stations. Figure 8 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.

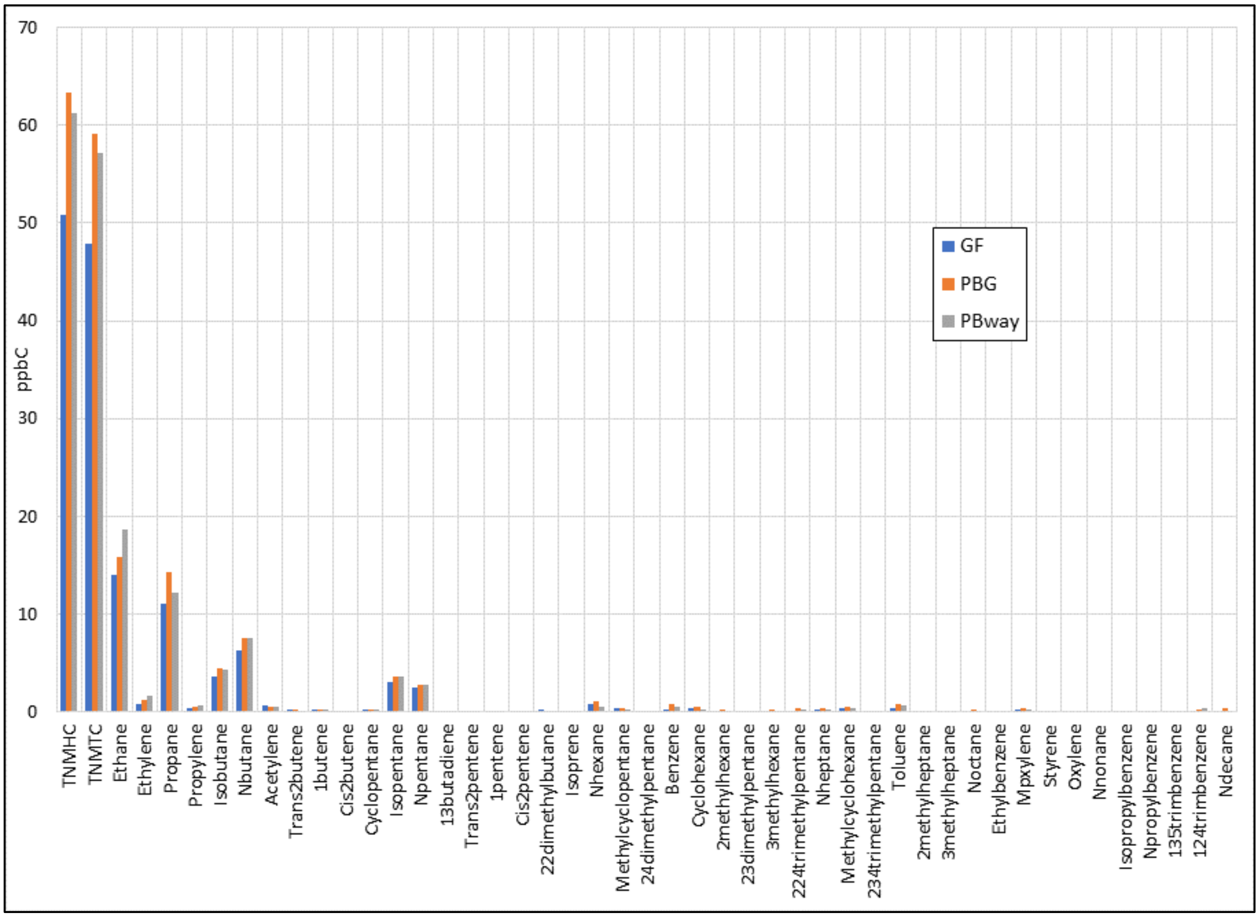

Figure 7. January through April 2022 mean concentrations of TNMTC, TNMHC, and hydrocarbon species at three stations

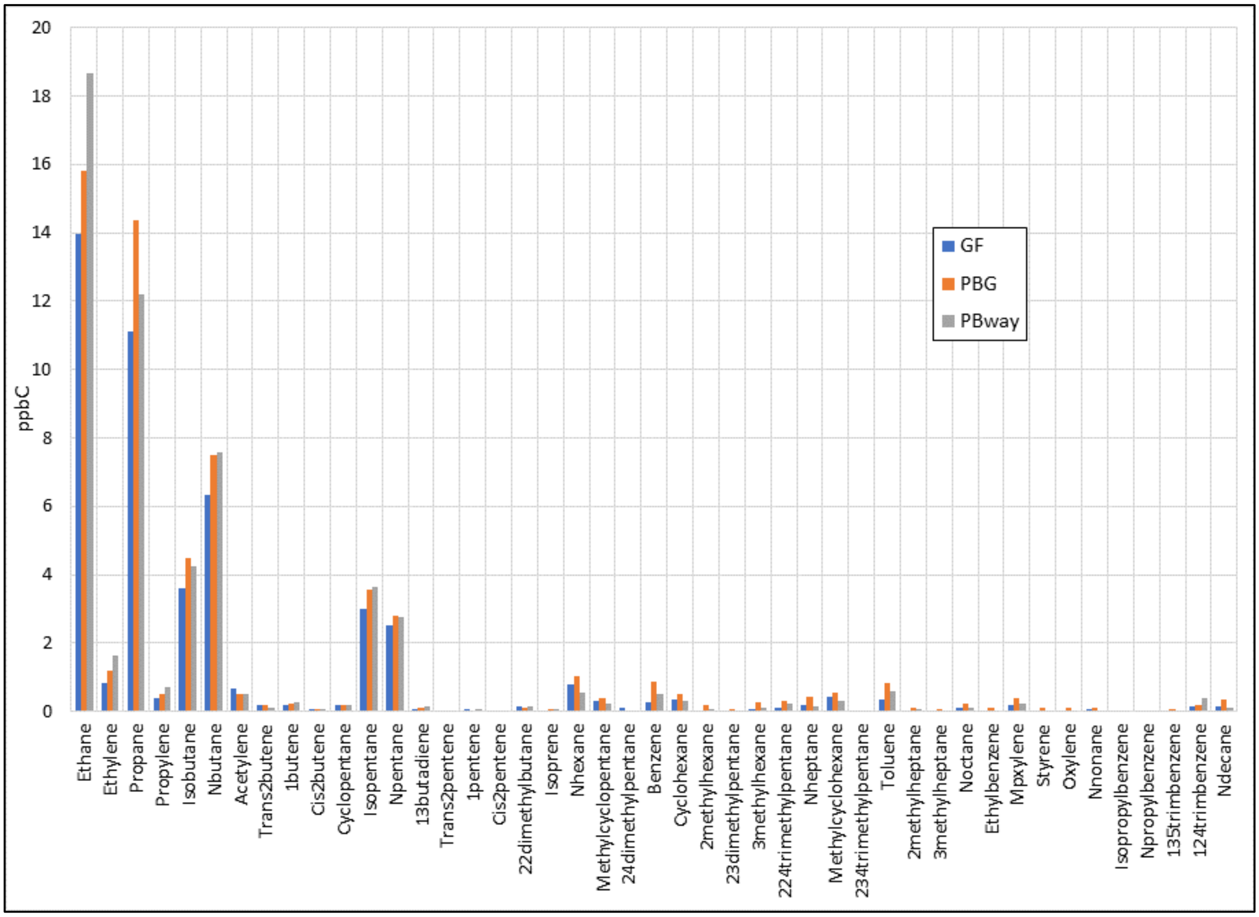

Figure 8. January through April 2022 mean concentrations of hydrocarbon species at the three air monitoring stations

4.4 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 98^{th} 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, 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 values to average less than 53 ppb in a calendar year and for the 98^{th} percentile daily maximum value 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 99^{th} percentile daily maximum, which must be less than 75 ppb.

- With PM2.5, SO_2, and NO_2, 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 PM2.5 and NO_2, 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 PM2.5 one-hour values exceeded the level of the 24-hour NAAQS, 35 $\mu g/m^3$, 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 $\mu g/m^3$).

Figure 9 shows the hourly average time series graph for PM2.5 at the GF station from January 1 through June 26, 2022. The average concentration for the first half of 2022 was 9.5 $\mu g/m^3$. 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 10 shows the 24-hour averaged daily PM2.5 concentrations for early 2022. There were periods of elevated PM2.5 in June associated with transported dust from Northern Africa, and the figure shows two of those days exceeded the 24-hour 35 $\mu g/m^3$ NAAQS for PM2.5.

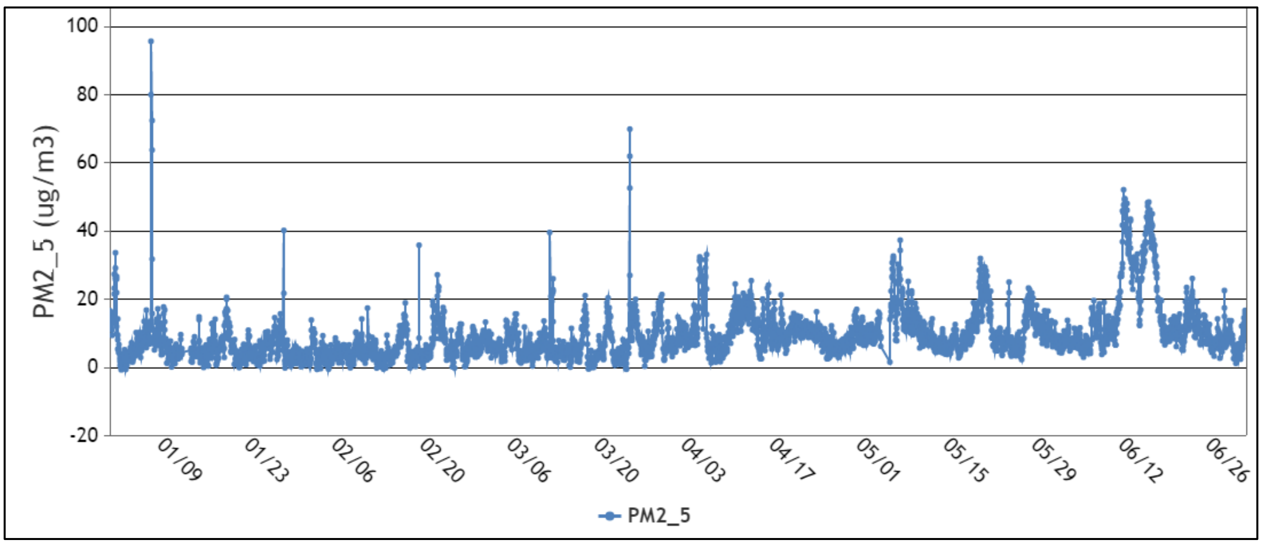

Figure 9. Hourly average PM2.5 at GF, $\mu g/m^3$, Jan. 1 – Jun. 27, 2022

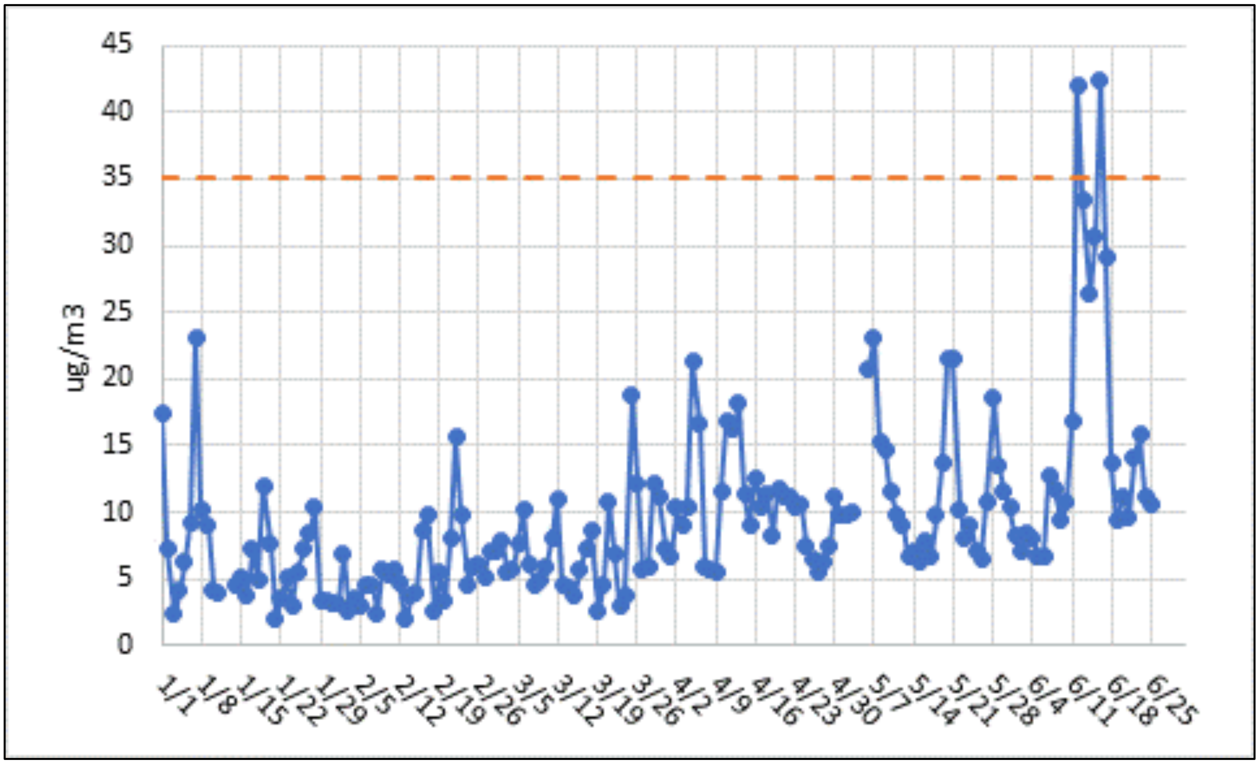

Figure 10. Averaged 24-Hour PM2.5 at GF, µg/m^3, Jan. 1 – Jun. 25, 2022, and NAAQS value (dashed line)

Figure 11 shows the hourly average time series graph for NO_2 at the Gregory Fresnos station from January 1 through June 27, 2022. The figure also shows the 24-hour 100 ppb NAAQS value.

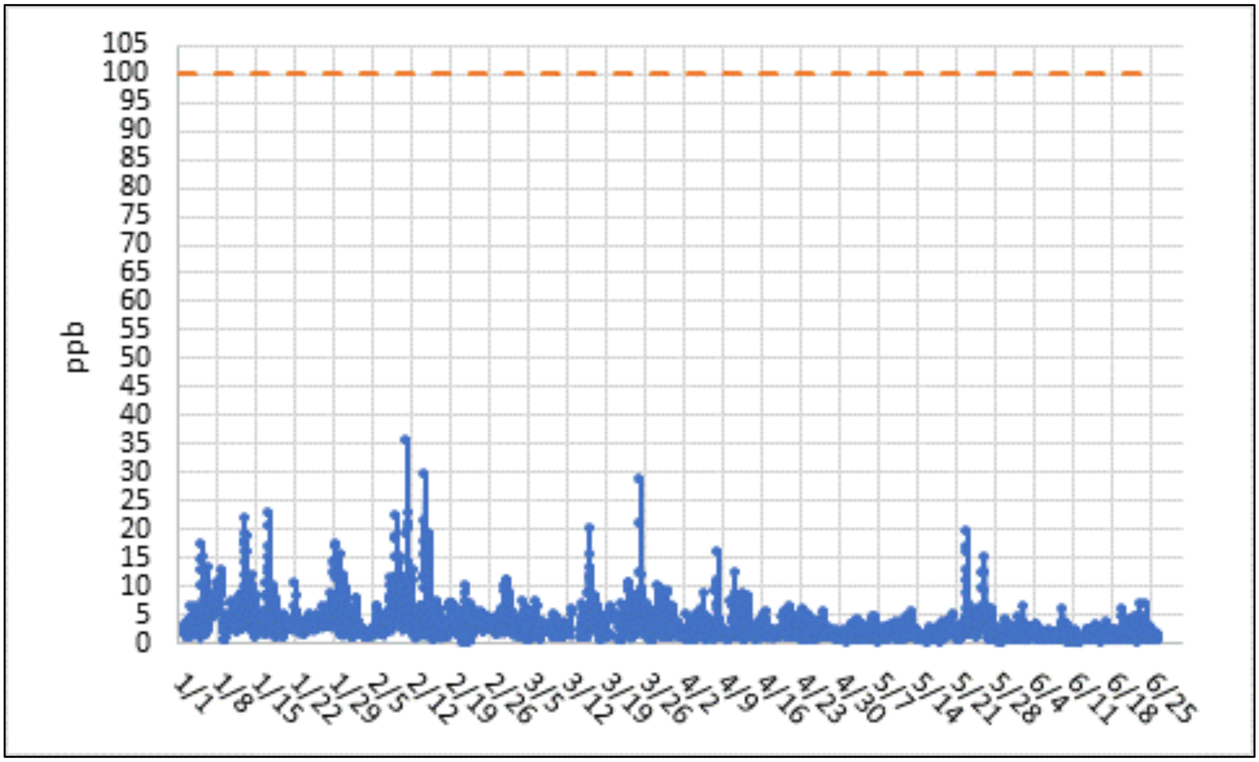

Figure 11. Hourly NO_2 at GF, ppb units, Jan. 1 – June. 27, 2022, and NAAQS value (dashed line)

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 the first six months of 2022 SO_2 at the GF station is shown in Figure 12. The graph is scaled to illustrate how low the concentrations have been compared to the 75-ppb level of the NAAQS. Figure 13 shows the 2022 time series for SO_2 reflecting the range of observed concentrations. Some irregularities in the concentrations are evident, and the instrument was replaced in early June and since then has had more stable performance.

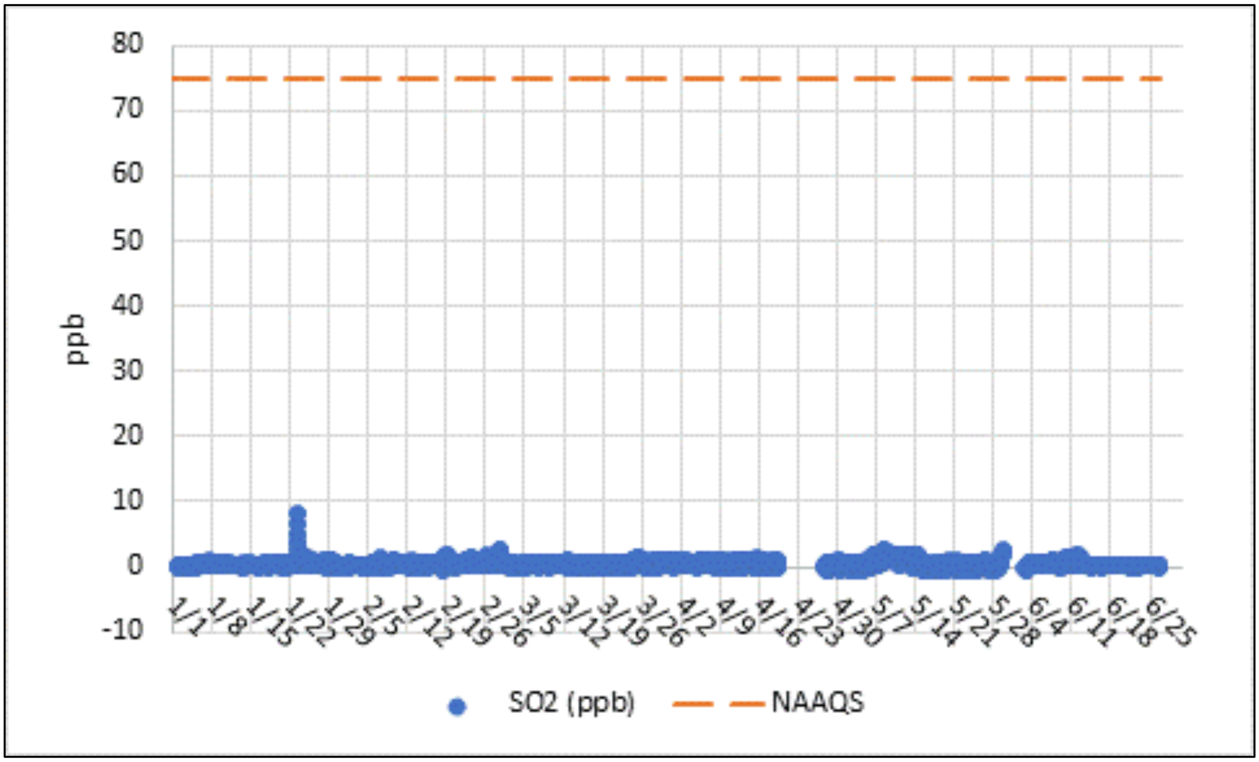

Figure 12. Hourly average SO_2 at GF, ppb units, Jan. 1 – June. 27, 2022, and NAAQS value

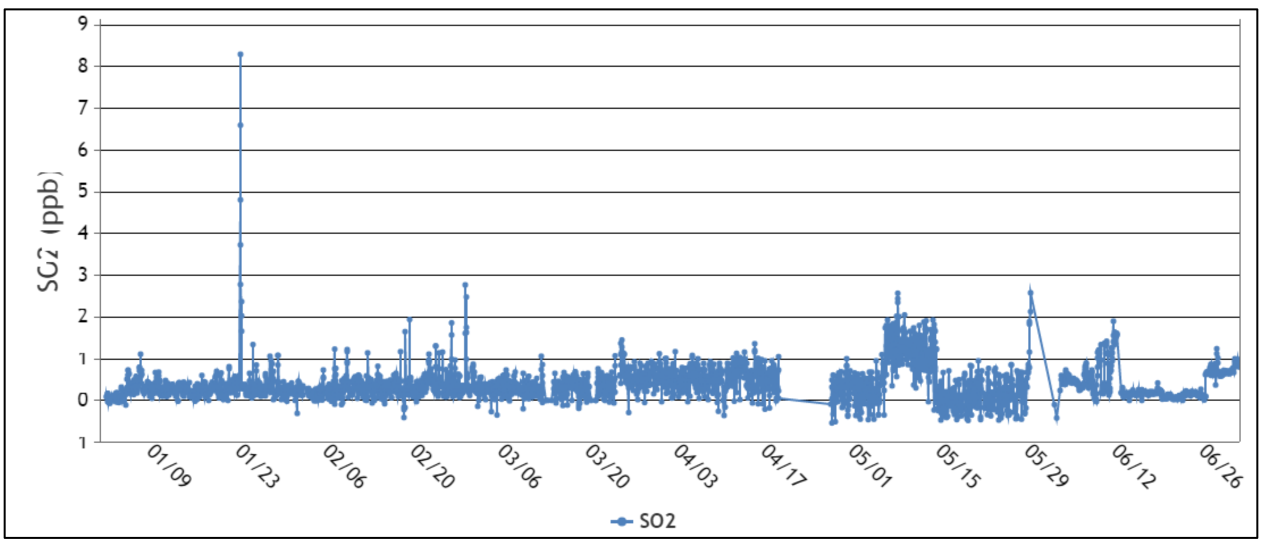

Figure 13. Hourly average SO_2 at GF, ppb units, Jan. 1 – June. 27, 2022

4.5 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. 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 14 shows the first six months of 2022 hourly concentrations time series graph of PM2.5 and Figure 15 shows the 24-hour average concentrations at the PBG site, and Figure 16 and Figure 17 show the same time series for the PBway site. The average concentration in the first half at PBG was 9.0 μg/m^3 and was 9.4 μg/m^3 at PBway. As was the case with the GF station, there were periods of elevated PM2.5 in June associated with transported dust from Northern Africa.

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 an example, all three stations exceeded the 35 μg/m^3 24-hour NAAQS on the same two dates, June 12 and June 16, owing to the transported Nort African dust. Across the State of Texas, with 66 regulatory PM2.5 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.

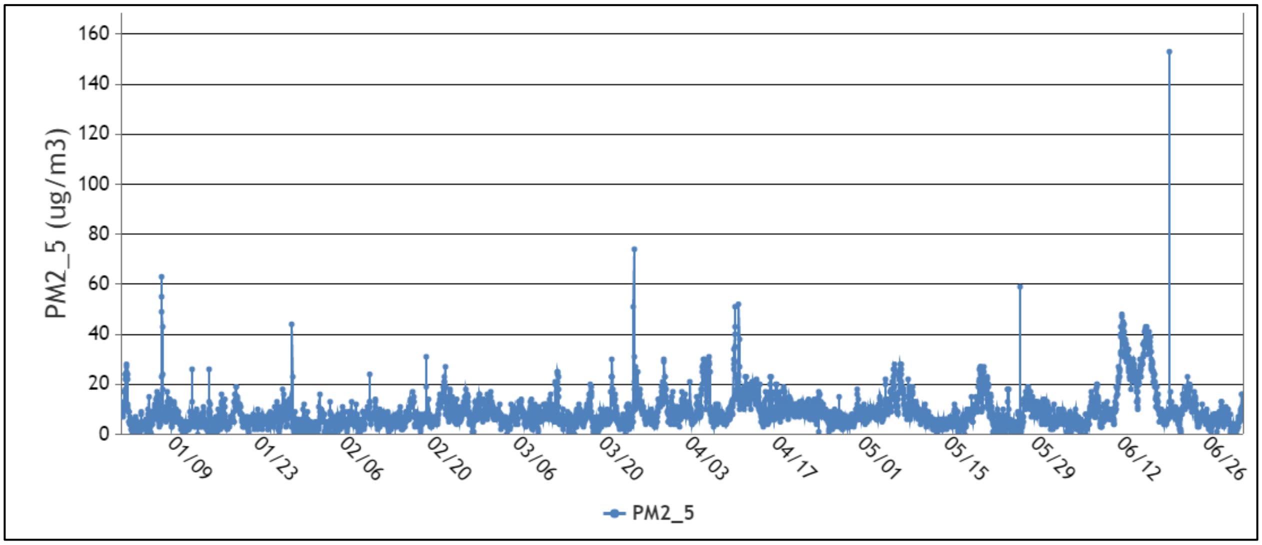

Figure 14. Hourly average PM2.5 at PBG, µg/m^3, Jan. 1 – June. 26, 2022

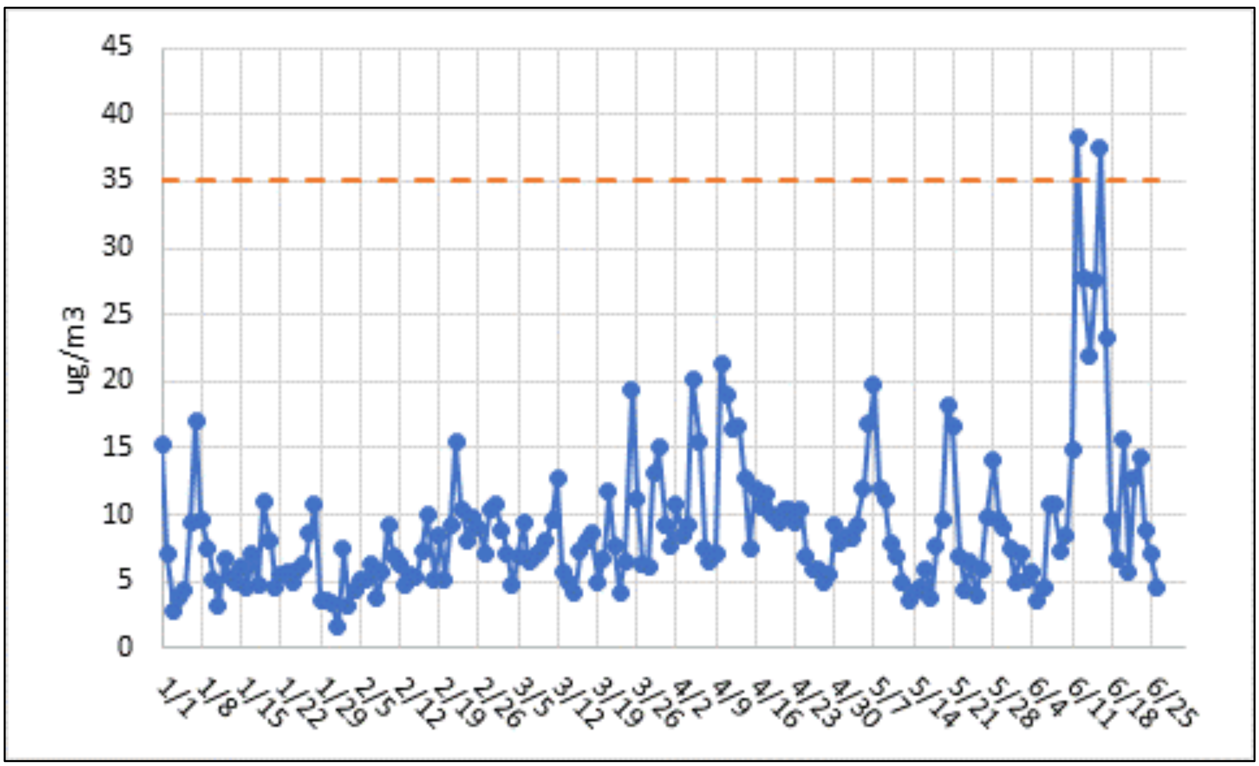

Figure 15. Averaged 24-Hour PM2.5 at PBG, µg/m^3, Jan. 1 – June. 26, 2022, and NAAQS value (dashed line)

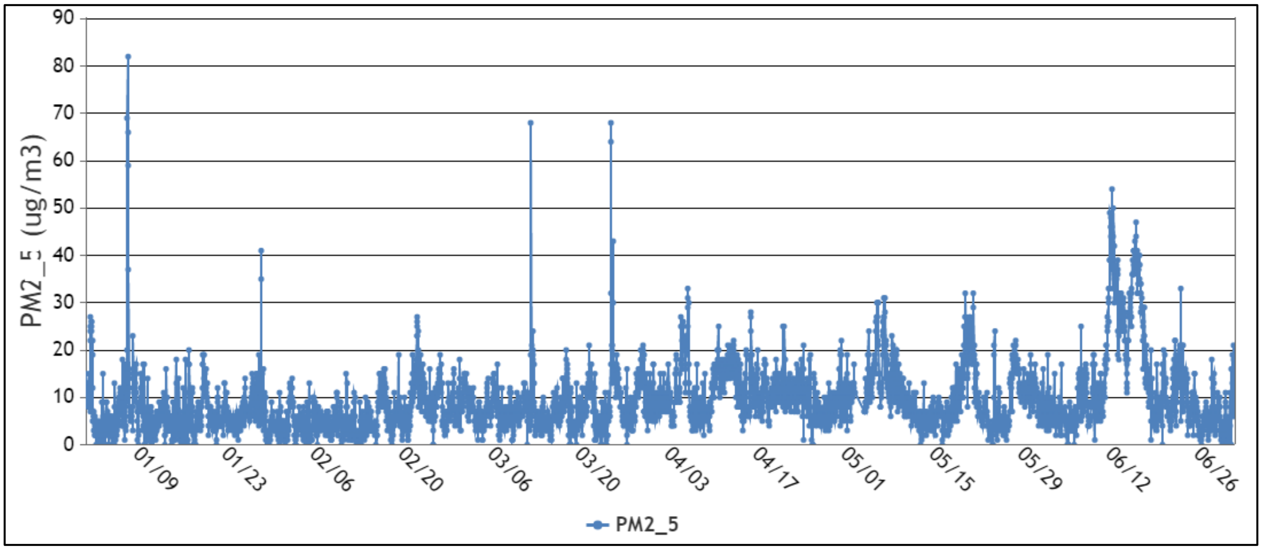

Figure 16. Hourly average PM2.5 at PBway, μg/m³, Jan. 1 – June. 26, 2022

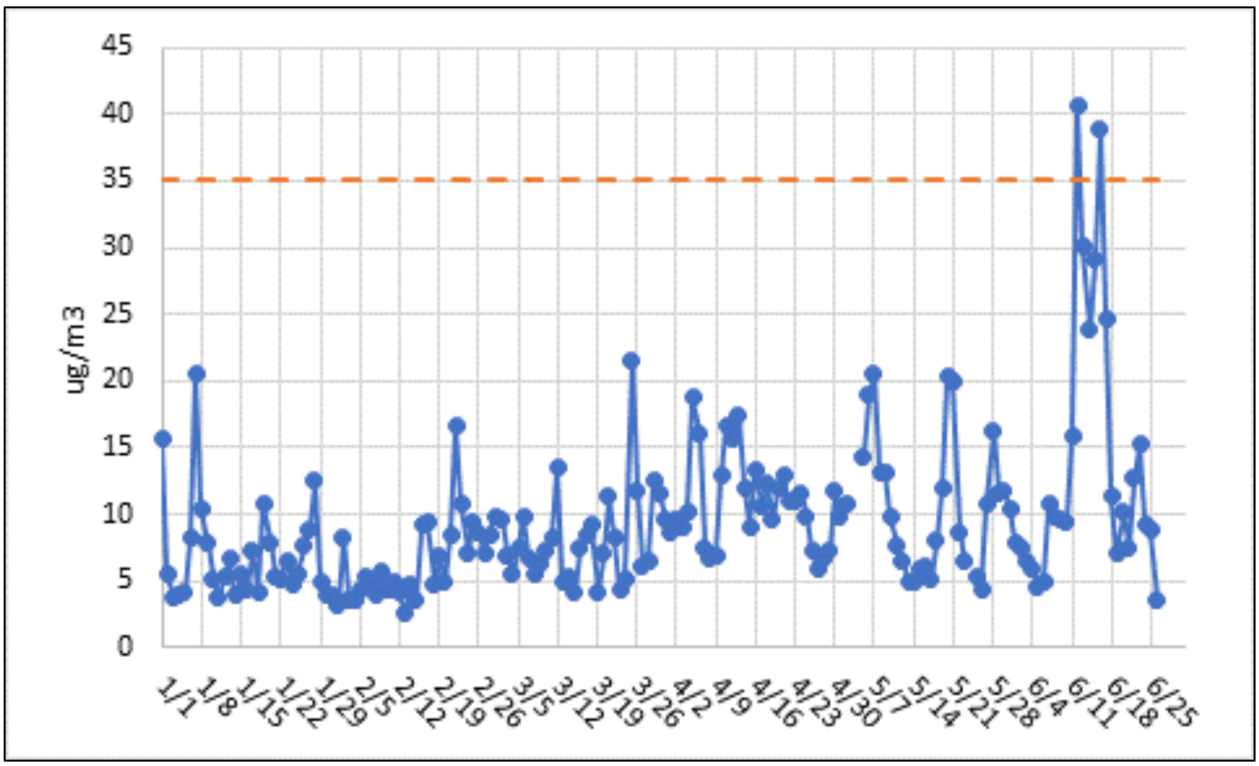

Figure 17. Averaged 24-Hour PM2.5 at PBway, μg/m³, Jan. 1 – June 26, 2022, and NAAQS value (dashed line)

5.0 Data Analysis

COVID Pandemic Recovery
As an indication of the changes in human activity over the past two plus years, the Federal Highway Administration (FHWA) publishes motor vehicle traffic volume changes from month to month and year to year. The most recent statistics are for April 2022 (https://www.fhwa.dot.gov/policyinformation/travel_monitoring/tvt.cfm accessed July 2022). FHWA reported the following year-to-year changes in motor vehicle miles traveled in Aprils for the South Region of the United States including Texas and seven other states:

- April 2019 to April 2020: -35.9%
- April 2020 to April 2021: +49.5%
- April 2021 to April 2022: +0.9%

This is one indication that the economy is largely recovered from the COVID-19 pandemic.

The United States Federal Reserve Bank (https://fred.stlouisfed.org/series/TXNGSP accessed July 2022) tabulates total annual money flows by state by year. Figure 18 shows the time series over the past ten years through 2021 for gross domestic product for Texas, with the significant dip in 2020 and subsequent recovery over 2021.

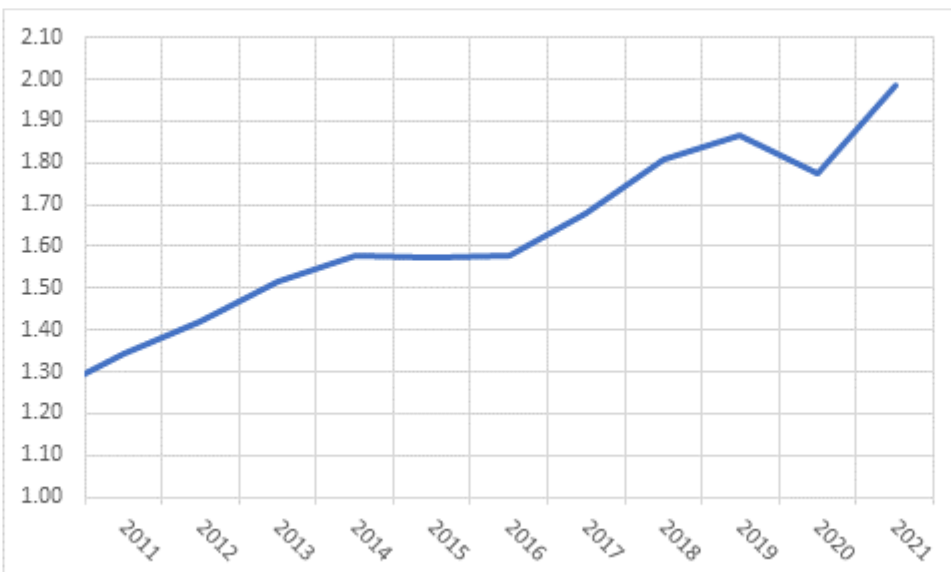

Figure 18. Annual Gross Domestic Product for the State of Texas, trillions of dollars

Texas Department of Transportation Activity
On Friday morning March 25, elevated concentrations of fine particulate matter, oxides of nitrogen, and some hydrocarbon species were measured at the Gregory Fresnos station. Winds were southwesterly, and the station operator suggested there may have been fresh asphalt being applied as part of the U.S 181 and SH35 work going on. An enquiry was addressed to the local Texas Department of Transportation (TXDOT) on March 28, and TXDOT responded on Friday, April 15, 2022:

> It looks like both US 181 jobs in the Gregory-Portland area were placing prime coat in small areas

that day. The approximate locations are marked off in the pictures below. On the Gregory job the operation was only about 700 gallons and covered about 900 ft of the new main lanes on the northbound side. The Portland job placed prime coat on the Buddy Ganem/Broadway turnaround and the new SB entrance ramp south of Buddy Ganem, for an approximate total of 1500 gallons placed. This work would have happened throughout the day and not necessarily from 6-9 AM, but I would guess some of it occurred during that time period (I can ask to pinpoint a more accurate time window if you need it).

Not sure if these placements caused the readings Dr. Sullivan found below, but those were the only asphalt operations we had going on those projects that day.

Figure 19 shows the time series for PM2.5 and wind direction on March 25, 2022, with the elevated concentrations appearing 5 to 7 am CST under winds around 195 degrees (southwesterly), and Figure 20 shows the two-day period March 24 and 25, 2022 for PM2.5, NOx, SO_2, and several reactive hydrocarbon species. Less reactive alkane species were not particularly elevated on March 25. Figure 21 through Figure 23 are figures provided by TxDOT showing the locations of their repaving operations and Figure 24 is a compilation of the TxDOT repaving locations and the three monitoring stations.

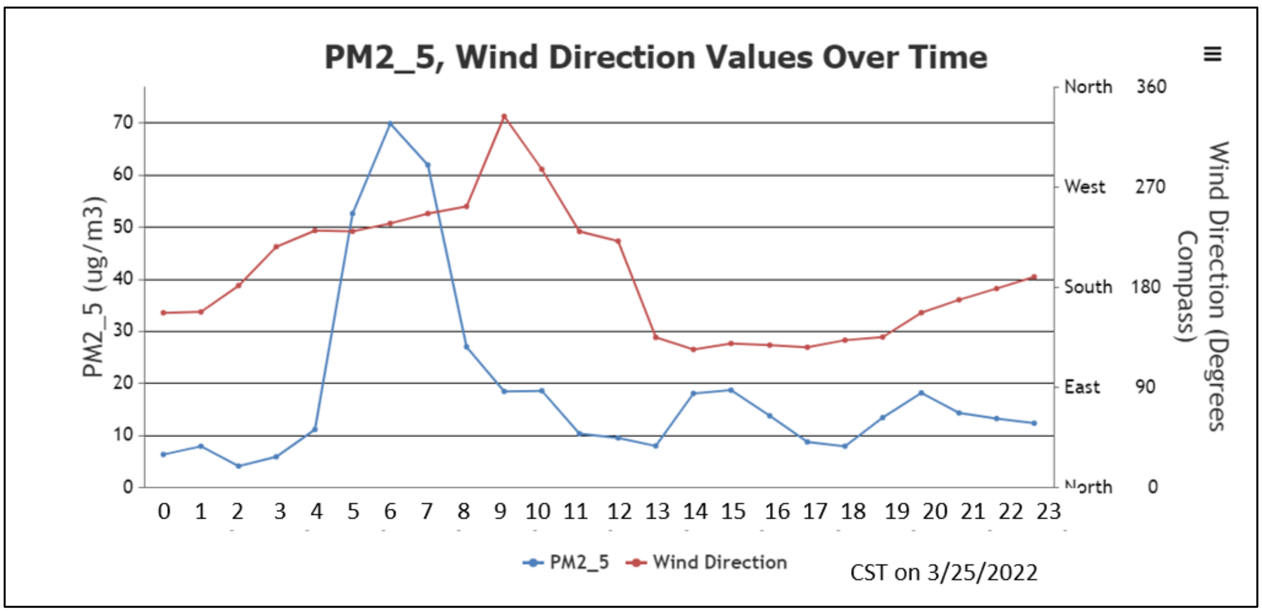

Figure 19. Elevated PM2.5 on March 25, 2022, under southwesterly winds

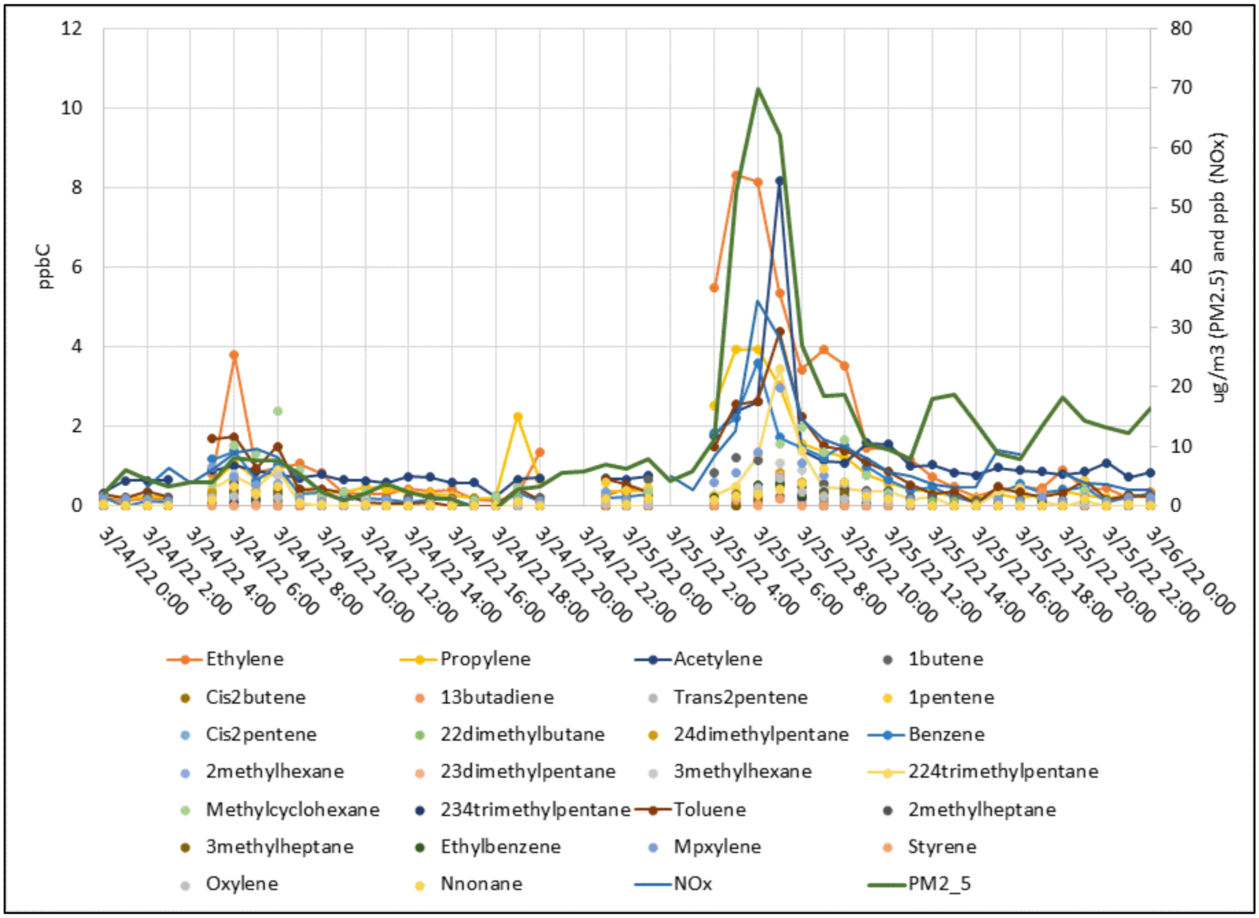

Figure 20. Gregory Fresnos PM2.5, NOx and several reactive hydrocarbon species elevated on the morning of March 25, 2022, under southwest winds

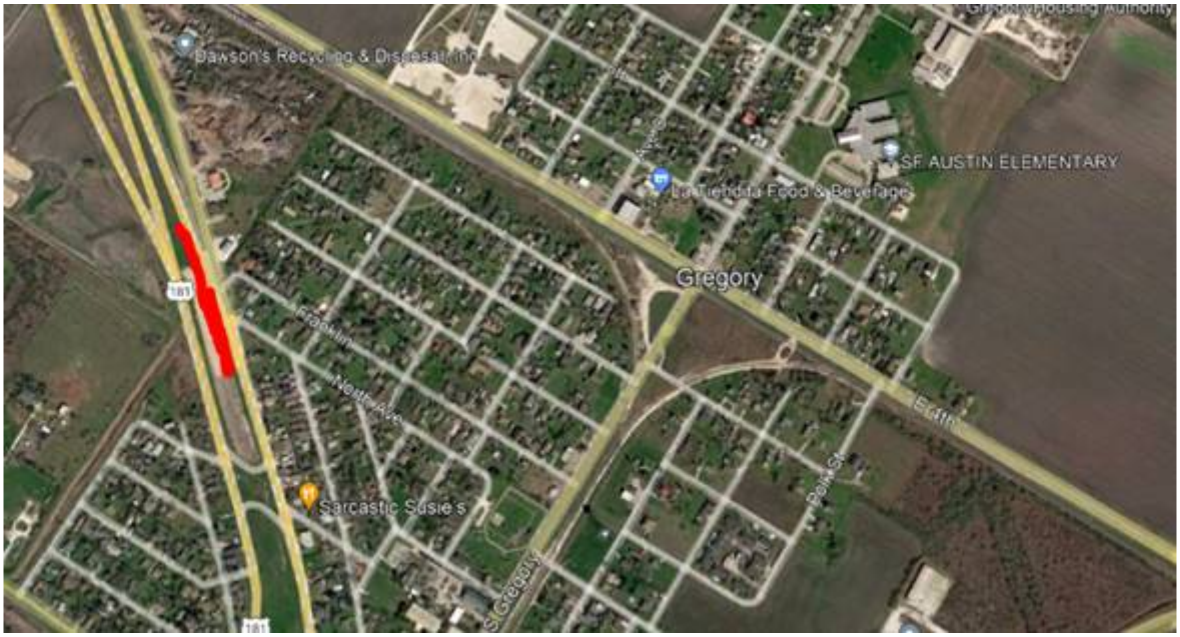

Figure 21. TxDOT repaving west of GF station on March 25, 2022

Figure 22. TxDOT repaving point 2 south of monitoring stations

Figure 23. TxDOT repaving

Figure 24. Three TxDOT repaving locations (yellow pins) on March 25, 2022, relative to the three monitoring stations

An Unexplained C4 (Four Carbon Compound Event

On March 10, 2022, at 10 pm CST, the Portland Broadway auto-GC recorded a 200 ppbC 1,3-butadiene concentration, and n-butane, trans-2-butene, 1-butene, and cis-2-butene (all C4 species) were all unusually high. Winds were from the east. The data were re-examined, and no problems were detected, and the possible source is under investigation. A time series of the auto-GC data, excluding ethane and propane, appears in Figure 25. The TCEQ air monitoring comparison values for 1,3-butadiene are 920 ppbC for odor detections and 6800 ppbC for short term health effects.

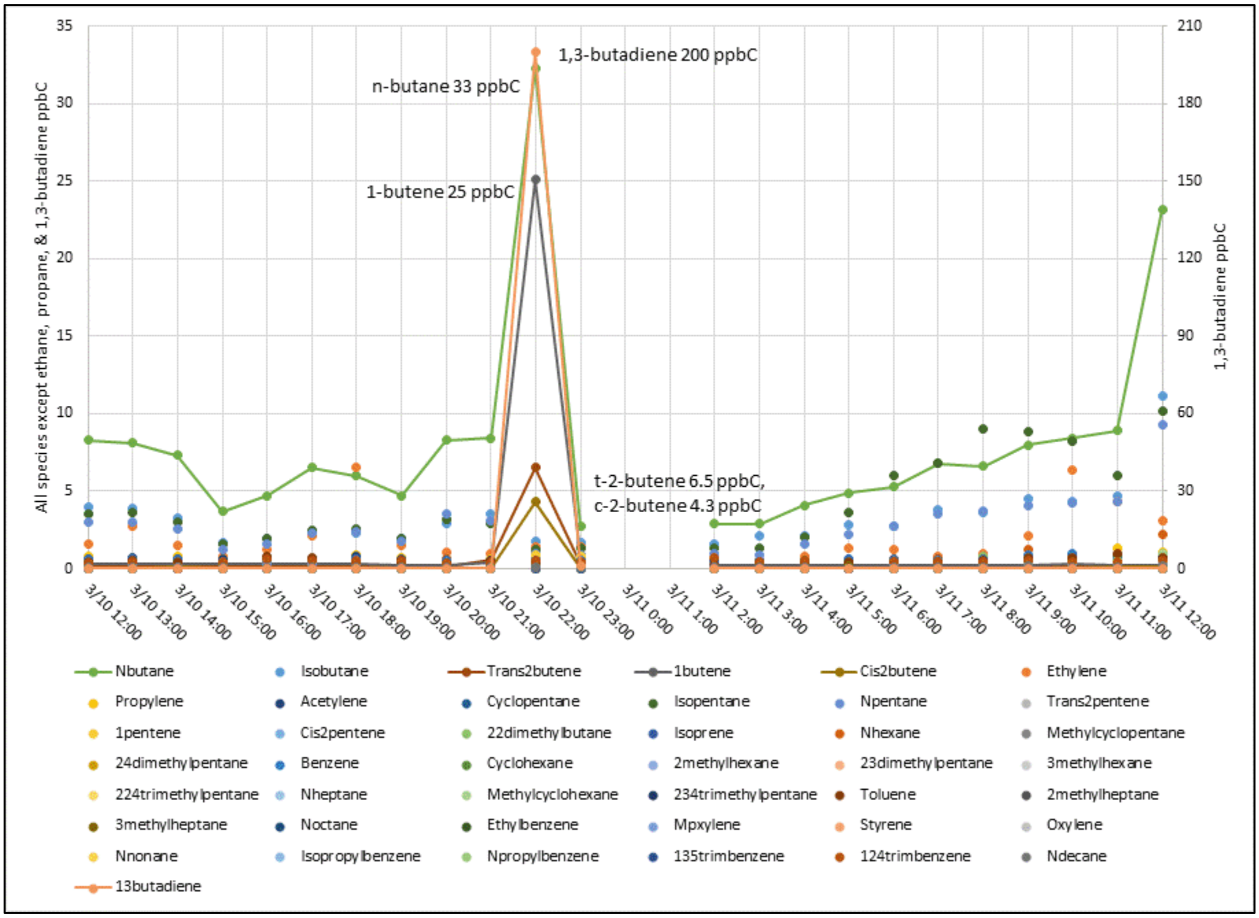

Figure 25. PBway auto-GC species with elevated C4 species on March 10, 2022, under easterly winds

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 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 26. 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 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 July 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 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 ($PM_{2.5}$) 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 April 2022)

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.