Quarterly Report of Air Quality Monitoring at the Gregory – Portland Community Air Monitoring Stations for the Quarter Ending June 30, 2021

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Executive Summary

There are three air monitoring stations in the Gregory-Portland area in operation. 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.

A large-scale slowdown in the world economy owing to the COVID 19 pandemic has 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.

In mid-February 2021, a significant cold weather event in Texas and much of America led to a suspension of operations at all three sites for a few days.

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).

Since monitoring began, some measured pollutant concentrations have exceeded the concentration levels of National Ambient Air Quality Standards (NAAQS); however, these high values have not been sustained long enough or measured often 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 (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 quality assured data collected to date in 2021. This allows a meaningful understanding of recent data based on four and six months of data. Because air quality standards are generally based on annual statistics, reporting from January 1 allows one to track compliance within the current year. Other reports may cover longer periods based on the availability of data and requests from the community.

2.0 Summary of Activities January 1 through June 30, 2021

The international COVID 19 pandemic has caused a large-scale slowdown in a wide range of activities since March 2020. While this has had no impact on air monitoring operations, it may have had some effect on activities in the community, which could have effects on air quality. As was recorded in recent UT quarterly reports for this project, the TCEQ recorded significantly fewer ozone exceedance days in 2020 compared to recent years, and hydrocarbon concentrations in nearby Corpus Christi measured at the TCEQ Palm station in the Hillcrest neighborhood were generally lower in average concentrations from April through December 2020 as compared with April through December 2019. Year-to-year differences can be caused by combinations of human activity and weather. However, as was reported in the previous quarter, published research has appeared that suggests lower pollution concentrations in many parts of the world in 2020 was owing to reduced emissions associated with activity changes brought on by responses to the pandemic[1]. To a large extent, the Texas economy has rebounded in the first half of 2021.

Periodically each year, there will be a few days when data will be missing due to annual equipment maintenance.

As was reported in the last quarterly report, in mid-February 2021 a significant cold weather event in Texas and much of America led to a suspension of operations and reporting of data at all three sites for a few days as follows.

- The Portland Buddy Ganem (PBG) station auto-GC: February 15 - 19.
- The Portland Broadway (PBway) station auto-GC: February 15 - 19.
- The Gregory Fresnos (GF) station auto-GC: February 15 - 18.

There have not been any long-term problems found with monitoring equipment associated with this cold weather event.

The public website developed as the community's source for information about the community

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[1] See https://cen.acs.org/environment/atmospheric-chemistry/COVID-19-lockdowns-had-strange-effects-on-air-pollution-across-the-globe/98/i37
https://www.nature.com/articles/s41893-020-0581-y
https://www.sciencedirect.com/science/article/pii/S0048969720350506

air monitors continues to provide information about air quality and monitoring data from the three air monitoring stations (https://gpair.ceer.utexas.edu).

This report focuses on the data collected at the three air monitoring stations during the period January 1 through late June 2021.

3.0 Air Monitoring Station Locations & Information

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 in Figure 1. Also shown in Figure 1 are the locations of the Cheniere liquefied natural gas facility under expansion and the under-construction GCGV olefins, derivative, and utilities 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

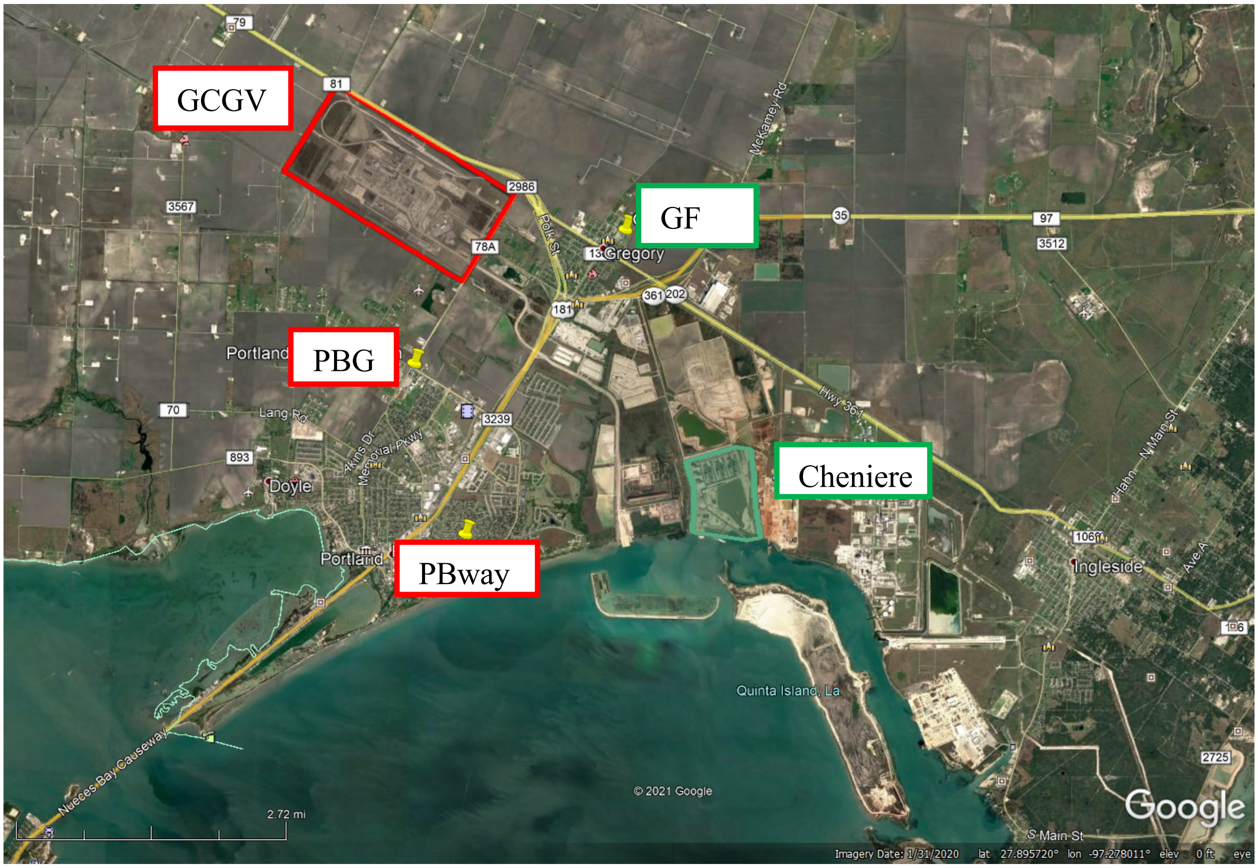

Figure 1. Location of Gregory-Fresnos Community Air Monitoring Station (GF), and two Portland community stations on GPISD campuses on Buddy Ganem (PBG) and on Broadway (PBway) and the Cheniere Energy and GCGV industrial facilities

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 a 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 or not 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 of 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 quality assured data available at the time this report was written will not all have the same date ranges. For this report, auto-GC and EO quality assured data were available through April 30, 2021 and all other data were available through June 27, 2021.

4.1 Gregory Fresnos Station Hydrocarbon Data

Figure 2 shows the time series for hourly concentrations of benzene at the Gregory-Fresnos (GF) station. The figure shows benzene hourly average concentrations for each hour from January 1 through April 30, 2021. 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 2021). 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. It is clear from the graph the effect of the mid-February 2021 winter storms, which led to shutdowns across the state for several days.

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 2021 average concentration for each species through April 30. 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. Time series graphs of other hydrocarbon species are also available upon request and any graphs can be made with time-scale (x-axis) or concentration-scale (y-axis) adjustments. Also, concentrations can be averaged by day, month, or other time period upon request. To make a request, contact Dr. Dave Sullivan at sullivan231@mail.utexas.edu or 512-471-7805.

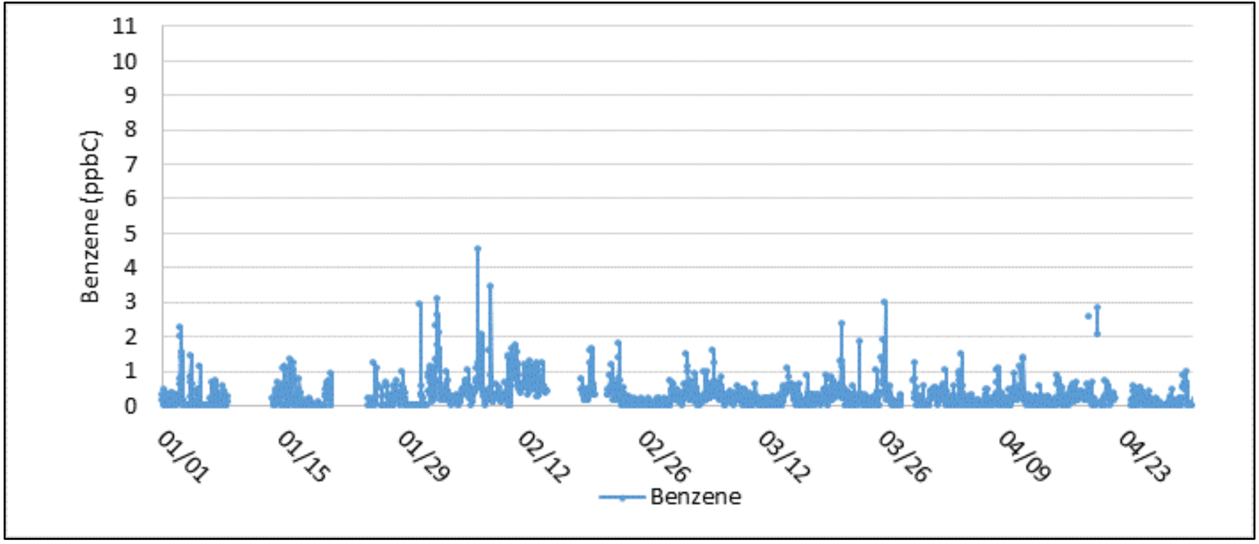

Figure 2. Hourly benzene concentrations at GF station, January 1 – April 30, 2021, ppbC units

Table 2. Gregory-Fresnos Auto-GC statistics for 2021 (through April 30)

Species	Num. Samples	Peak 1-hr ppbC	Peak 24-hr ppbC	Mean ppbC
TNMTC	2,147	932.81	155.91	53.17
TNMHC	2,147	1,004.85	170.28	57.78
Ethane	2,269	446.22	81.01	17.25
Ethylene	2,269	30.54	6.59	0.97
Propane	2,269	204.89	69.29	13.47
Propylene	2,269	29.73	2.66	0.94
Isobutane	2,269	151.04	35.60	4.43
n-Butane	2,269	141.42	47.75	7.59
Acetylene	2,269	7.28	1.42	0.65
trans-2-Butene	2,269	0.60	0.11	0.06
1-Butene	2,268	2.77	0.44	0.18
cis-2-Butene	2,263	0.66	0.13	0.05
Cyclopentane	2,269	3.24	0.71	0.20
Isopentane	2,269	66.35	19.14	3.57
n-Pentane	2,269	51.10	17.24	4.00
1,3-Butadiene	2,269	2.04	0.25	0.10
trans-2-Pentene	2,269	2.52	0.23	0.04
1-Pentene	2,269	16.83	1.36	0.08
cis-2-Pentene	2,269	4.24	0.37	0.03
2,2-Dimethylbutane	2,269	3.70	0.96	0.16
Isoprene	2,269	0.75	0.10	0.01
n-Hexane	2,165	29.75	3.30	0.92
Methylcyclopentane	2,164	30.32	4.17	0.41
2,4-Dimethylpentane	2,145	11.31	1.16	0.09
Benzene	2,165	4.54	0.96	0.27
Cyclohexane	2,165	21.30	2.72	0.46
2-Methylhexane	2,165	5.73	0.46	0.10
2,3-Dimethylpentane	2,150	4.89	0.43	0.11
3-Methylhexane	2,165	8.21	0.72	0.15
2,2,4-Trimethylpentane	2,165	5.34	0.84	0.20
n-Heptane	2,165	15.07	1.00	0.20
Methylcyclohexane	2,161	23.34	3.05	0.47
2,3,4-Trimethylpentane	2,165	0.97	0.12	0.02
Toluene	2,165	5.92	1.31	0.40
2-Methylheptane	2,165	2.51	0.23	0.04
3-Methylheptane	2,165	1.76	0.19	0.03
n-Octane	2,165	9.09	0.61	0.13
Ethyl Benzene	2,165	1.22	0.12	0.03
p-Xylene + m-Xylene	2,165	4.33	0.81	0.28
Styrene	2,165	0.54	0.04	0.00
o-Xylene	2,165	1.43	0.16	0.04
n-Nonane	2,165	3.96	0.30	0.06
Isopropyl Benzene - Cumene	2,165	0.43	0.06	0.00
n-Propylbenzene	2,165	0.84	0.47	0.06
1,3,5-Trimethylbenzene	2,165	0.56	0.06	0.01
1,2,4-Trimethylbenzene	2,147	1.30	0.57	0.17
n-Decane	2,165	2.03	0.27	0.15
1,2,3-Trimethylbenzene	2,165	1.11	0.26	0.02

4.2 Portland Buddy Ganem & Portland Broadway Stations Hydrocarbon Data

Figure 3 shows the time series for hourly concentrations of benzene at the Portland Buddy Ganem (PBG) station, and Figure 4 shows the time series for the hourly concentrations of benzene at the Portland Broadway (PBway) station. Both figures show benzene hourly average concentrations for each hour from January 1 through April 30, 2021. As was mentioned with regard to the Gregory Fresnos benzene graph, the effect of the mid-February 2021 winter storms is evident in the graphs, in addition to equipment outage due to annual maintenance in Figure 4.

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 calendar year 2021 through April 30. 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.

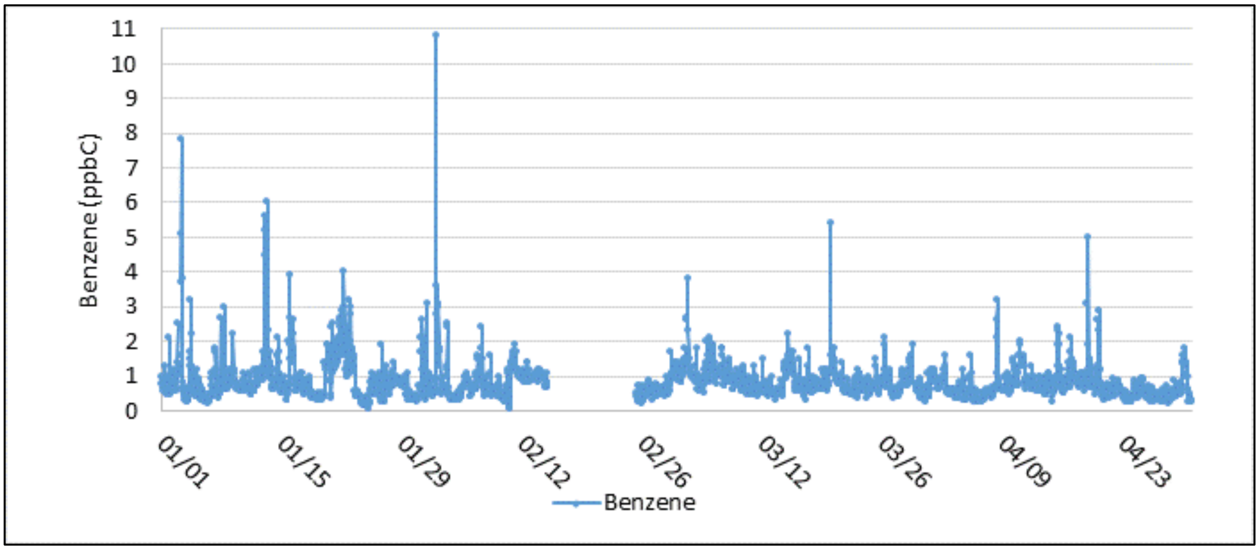

Figure 3. Hourly benzene concentrations at PBG station, January 1 – April 30, 2021, ppbC units

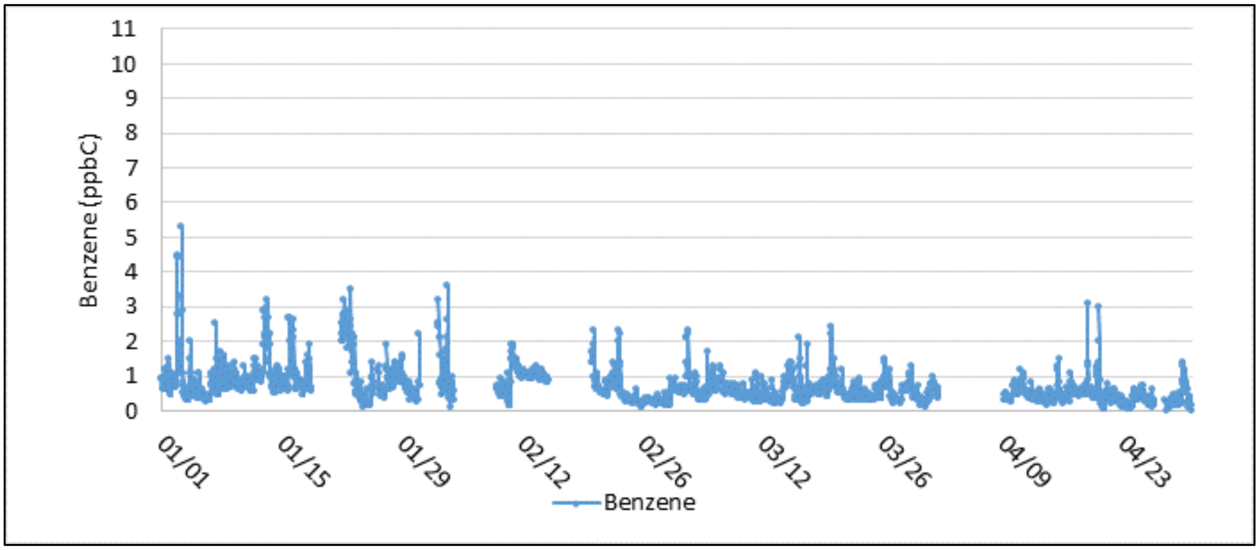

Figure 4. Hourly benzene concentrations at PBway station, January 1 – April 30, 2021, ppbC units

Table 3. PBG Auto-GC statistics for 2021 (through April 30)

Species	Num. Samples	Peak 1-hr ppbC	Peak 24-hr ppbC	Mean ppbC
TNMTC	2,337	932.10	355.36	62.68
TNMHC	2,337	975.80	368.74	67.65
Ethane	2,337	249.00	83.53	16.55
Ethylene	2,337	20.80	3.50	1.04
Propane	2,337	236.00	100.90	15.22
Propylene	2,337	4.80	1.48	0.56
Isobutane	2,337	166.00	36.75	4.95
n-Butane	2,337	142.00	60.66	8.55
Acetylene	2,321	4.50	1.56	0.74
trans-2-Butene	2,337	1.80	0.22	0.12
1-Butene	2,337	6.50	0.55	0.22
cis-2-Butene	2,336	2.60	0.60	0.11
Cyclopentane	2,337	2.70	0.92	0.25
Isopentane	2,337	76.20	24.74	3.90
n-Pentane	2,337	55.80	20.47	2.98
1,3-Butadiene	2,337	1.30	0.20	0.10
trans-2-Pentene	2,337	0.96	0.14	0.04
1-Pentene	2,337	2.00	0.28	0.08
cis-2-Pentene	2,337	0.55	0.07	0.01
2,2-Dimethylbutane	2,337	2.80	0.57	0.12
Isoprene	2,337	2.40	0.29	0.07
n-Hexane	2,337	21.90	5.28	0.87
Methylcyclopentane	2,337	7.90	2.06	0.56
2,4-Dimethylpentane	2,337	3.70	0.67	0.04
Benzene	2,337	10.80	2.07	0.85
Cyclohexane	2,337	14.50	2.39	0.52
2-Methylhexane	2,337	4.40	0.94	0.19
2,3-Dimethylpentane	2,337	3.30	0.70	0.08
3-Methylhexane	2,337	5.90	1.38	0.32
2,2,4-Trimethylpentane	2,337	8.30	1.40	0.38
n-Heptane	2,337	10.90	2.06	0.41
Methylcyclohexane	2,337	16.80	2.79	0.59
2,3,4-Trimethylpentane	2,337	1.70	0.25	0.07
Toluene	2,337	12.50	2.56	0.73
2-Methylheptane	2,337	2.00	0.54	0.10
3-Methylheptane	2,337	1.90	0.41	0.07
n-Octane	2,337	7.10	0.94	0.21
Ethyl Benzene	2,337	1.20	0.27	0.09
p-Xylene + m-Xylene	2,337	3.50	0.92	0.29
Styrene	2,337	0.77	0.34	0.06
o-Xylene	2,337	1.40	0.24	0.07
n-Nonane	2,337	2.60	0.33	0.08
Isopropyl Benzene - Cumene	2,337	0.62	0.08	0.01
n-Propylbenzene	2,337	0.34	0.07	0.02
1,3,5-Trimethylbenzene	2,337	0.49	0.19	0.02
1,2,4-Trimethylbenzene	2,337	1.80	0.24	0.09
n-Decane	2,296	1.20	0.45	0.27

Table 4. PBway Auto-GC statistics for 2021 (through April 30)

Species	Num. Samples	Peak 1-hr ppbC	Peak 24-hr ppbC	Mean ppbC
TNMTC	2,087	600.60	378.54	61.87
TNMHC	2,087	638.80	404.67	66.65
Ethane	2,069	164.00	112.51	19.33
Ethylene	2,052	13.80	4.09	1.35
Propane	2,087	156.00	100.12	13.73
Propylene	2,087	6.00	2.29	0.79
Isobutane	2,087	65.90	27.70	4.18
n-Butane	2,087	119.00	56.16	8.24
Acetylene	1,801	2.60	1.02	0.48
trans-2-Butene	2,086	0.95	0.29	0.14
1-Butene	2,080	2.90	0.58	0.33
cis-2-Butene	2,087	0.95	0.20	0.07
Cyclopentane	2,087	4.70	0.85	0.21
Isopentane	2,087	61.90	22.37	3.69
n-Pentane	2,087	49.40	20.35	2.80
1,3-Butadiene	2,087	1.20	0.22	0.10
trans-2-Pentene	2,087	0.83	0.13	0.03
1-Pentene	2,086	1.30	0.34	0.08
cis-2-Pentene	2,083	6.30	0.52	0.02
2,2-Dimethylbutane	2,086	2.00	0.51	0.09
Isoprene	2,086	1.80	0.65	0.06
n-Hexane	2,087	13.80	8.18	1.06
Methylcyclopentane	2,087	10.70	2.24	0.47
2,4-Dimethylpentane	2,087	1.40	0.17	0.01
Benzene	2,033	5.30	2.44	0.71
Cyclohexane	2,087	7.80	2.12	0.43
2-Methylhexane	2,087	3.00	1.21	0.17
2,3-Dimethylpentane	2,087	1.50	0.60	0.07
3-Methylhexane	2,087	3.20	1.60	0.24
2,2,4-Trimethylpentane	2,087	10.30	1.39	0.45
n-Heptane	2,087	5.70	2.17	0.35
Methylcyclohexane	2,086	8.90	2.43	0.47
2,3,4-Trimethylpentane	2,087	2.60	0.30	0.09
Toluene	2,087	14.10	2.87	0.80
2-Methylheptane	2,087	1.60	0.94	0.06
3-Methylheptane	2,087	0.99	0.47	0.04
n-Octane	2,087	2.70	0.89	0.13
Ethyl Benzene	2,087	1.40	0.30	0.06
p-Xylene + m-Xylene	2,087	6.80	0.96	0.31
Styrene	2,087	0.68	0.29	0.03
o-Xylene	2,087	1.80	0.22	0.05
n-Nonane	2,087	1.50	0.36	0.06
Isopropyl Benzene - Cumene	2,087	0.95	0.11	0.01
n-Propylbenzene	2,087	0.90	0.13	0.02
1,3,5-Trimethylbenzene	1,403	1.30	0.34	0.02
1,2,4-Trimethylbenzene	1,397	1.80	0.66	0.16
n-Decane	1,403	1.20	0.65	0.20

4.3 Comparing Hydrocarbon Data between Stations

Figure 5 shows a comparison between the average concentrations for 2021 through April 30 of hydrocarbons including TNMTC and TNMHC among the three stations. The graph shows relatively close agreement among the three stations. Figure 6 is a similar graph excluding TNMTC and TNMHC and 1,2,3-Trimethylbenzene (only measured at the GF station). This second graph allows a better illustration of the similarity among the stations.

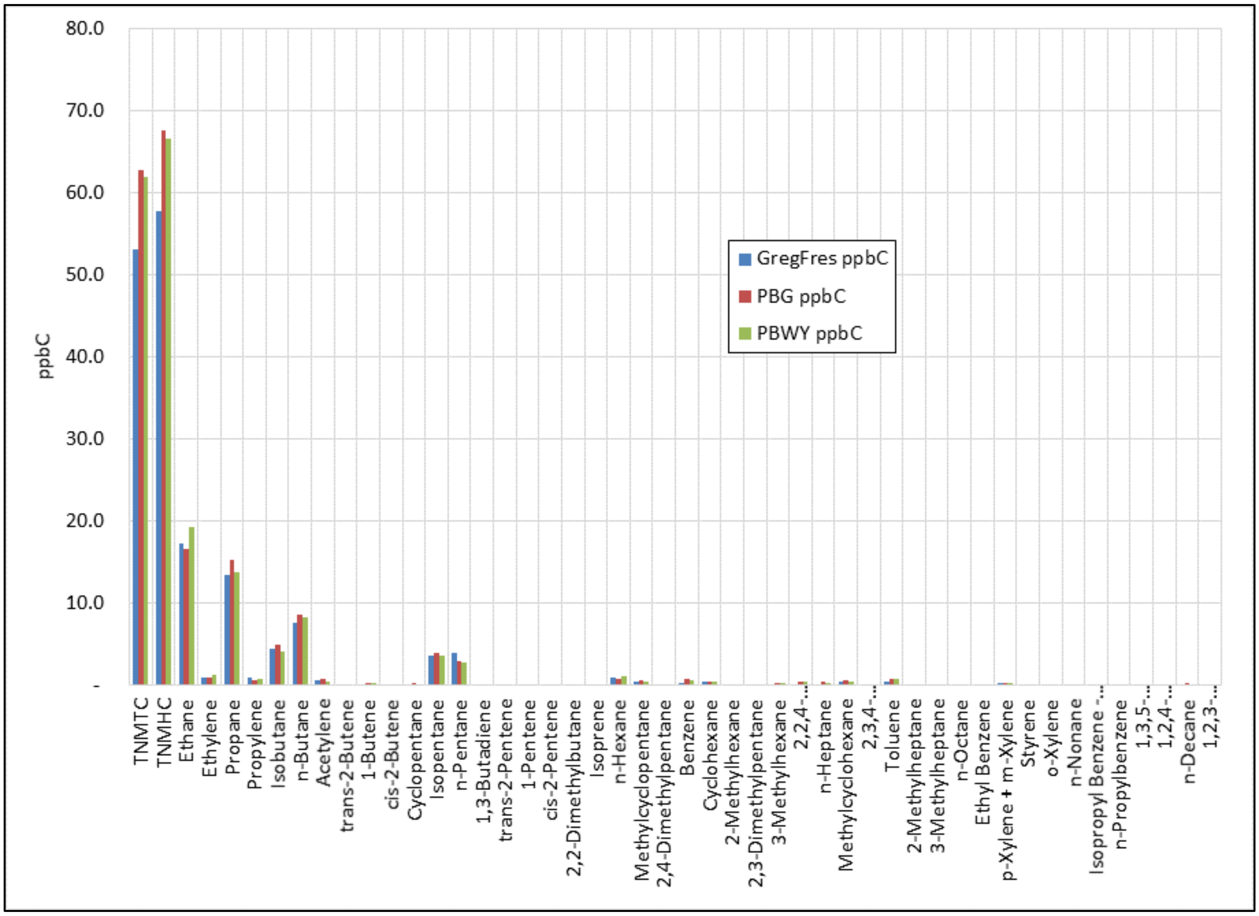

Figure 5. Mean concentrations of TNMTC, TNMHC, and 46 hydrocarbon species at three stations, Jan. – Apr. 2021

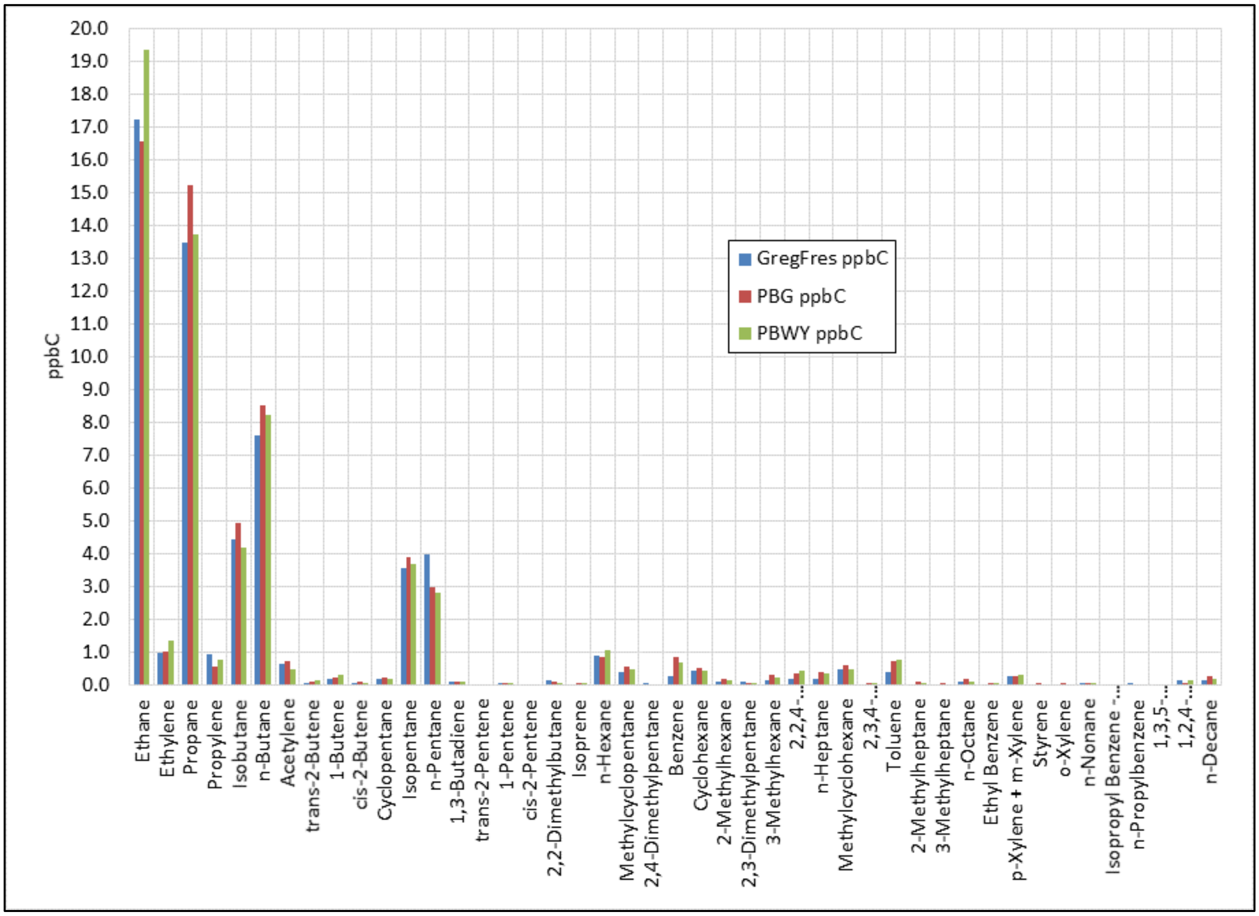

Figure 6. Mean concentrations of 45 hydrocarbon species at three stations, Jan. – Apr. 2021

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). Some National Ambient Air Quality Standards (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) 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 98th 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 99th 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, 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 National Ambient Air Quality Standards (NAAQS) have been seen at the GF station. Several recorded PM2.5 1-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 7 shows the hourly average time series for PM2.5 at the GF station from January 1 through June 27, 2021. The average concentration for the first six months of 2021 was 7.4 μg/m^3 compared with the primary one-year NAAQS value (annual mean averaged over three years) of 12 μg/m^3. A statistical outlier concentration of 282 μg/m^3 was recorded at 8 CST (9 CDT) on June 18. A graph showing concentrations on that day and the day before and after appears in Figure 8. It shows that the elevated concentration was restricted to one hour. In response to a query about the unusually high concentration of PM2.5 at 8:00 CST (9 am CDT) on Friday, June 18, the GF station operator reported *"There's a lot of work being done next to the site at the school. I was onsite later that morning and saw bulldozers driving through the parking lot."* Thus, a preliminary hypothesis is that nearby dust and/or nearby off-road heavy-duty equipment emissions caused this elevated concentration. Averaging the measurements over 24 hours on June 18 produced 20.2 μg/m^3 concentration, well below the 98th percentile level of the NAAQS at 35 μg/m^3.

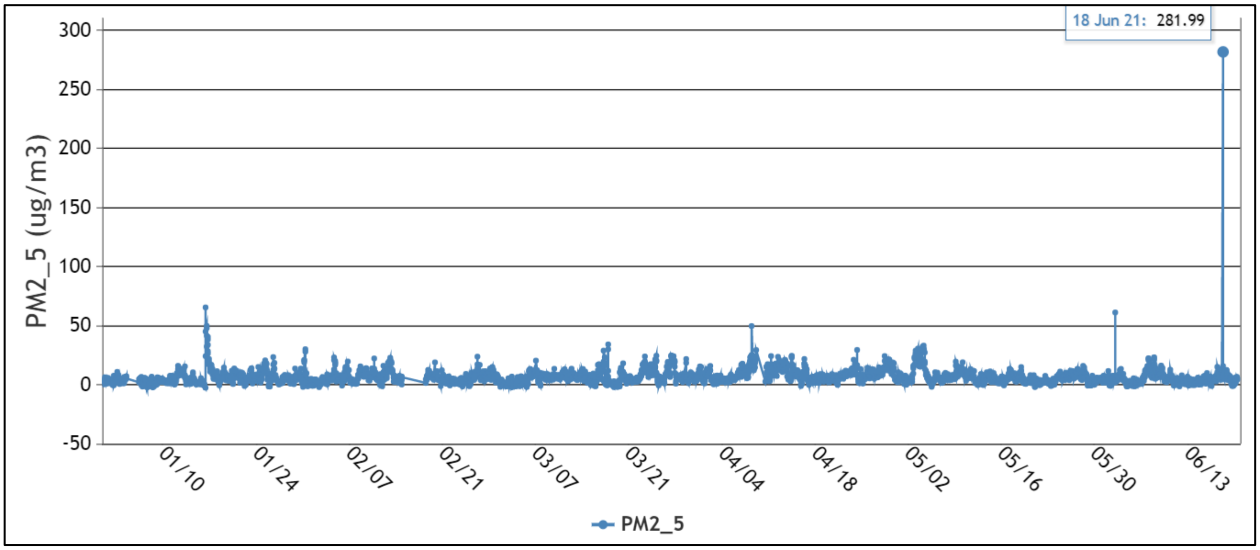

Figure 7. Hourly average PM2.5 at GF, μg/m^3, January 1 – June 27, 2021

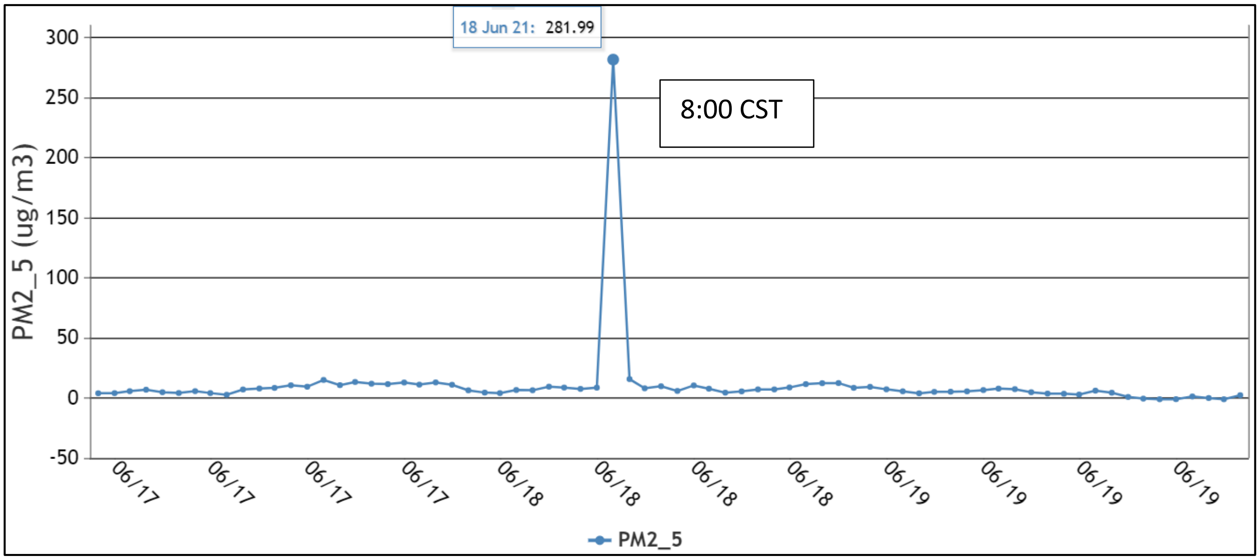

Figure 8 Hourly average PM2.5 at GF, µg/m^3, June 17– 19, 2021

Figure 9 shows the hourly average time series for NO_2 at the Gregory Fresnos station from January 1 through June 27, 2021. The average NO_2 concentration at the Gregory Fresnos station through late June 2021 was 2.5 ppb, and the highest daily maximum, shown in Figure 9, was 24.9 ppb. The NOx instrument had been out of service in late November into late December 2020, and again had stability of performance problems beginning January 24. On March 15, 2021, a replacement instrument began operating at the station.

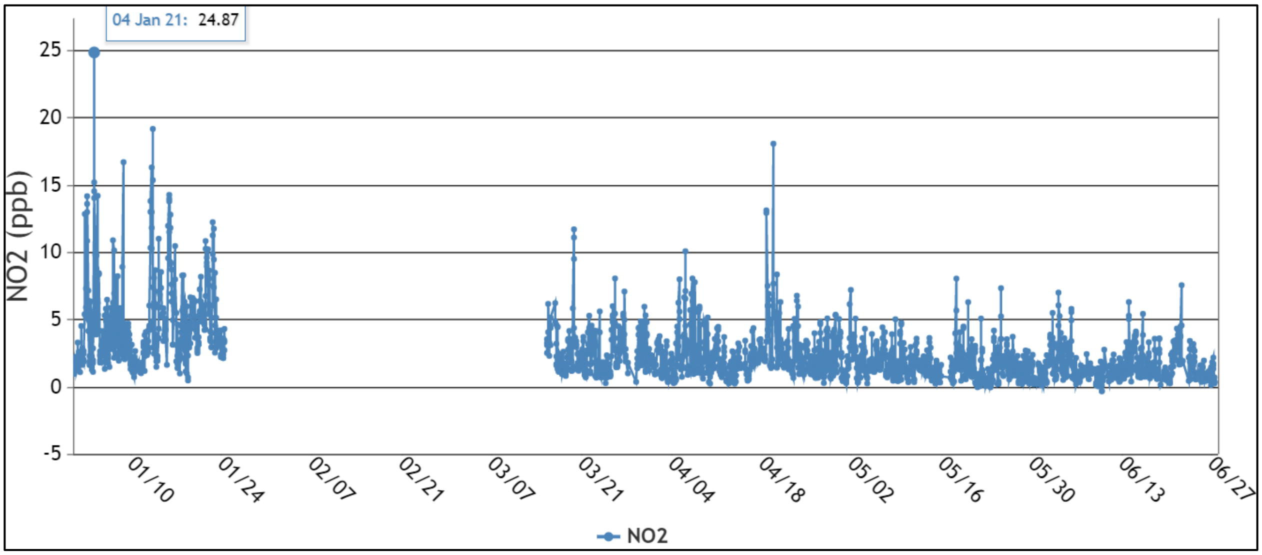

Figure 9. Hourly NO_2 at GF, ppb units, January 1 – June 27, 2021

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. Generally, SO_2 concentrations 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 for SO_2 at the GF station is shown in Figure 10. The graph is scaled to illustrate how low the concentrations have been compared to the 75 ppb level of the NAAQS. Data in late May 2021 are missing because of unacceptable zero drift in the SO_2 analyzer. The instrument was out of service until it could be replaced.

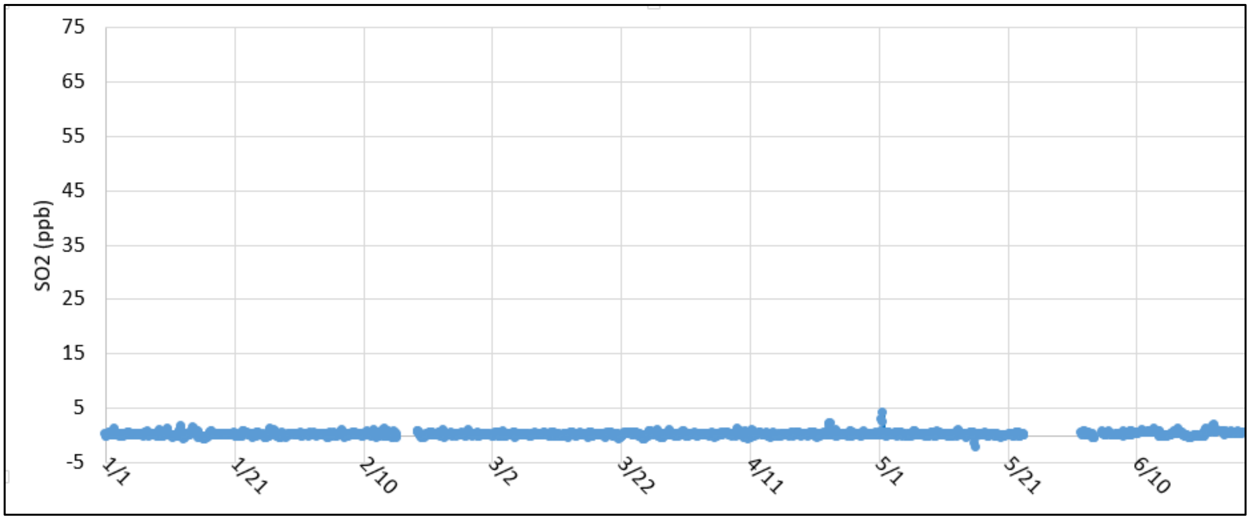

Figure 10. Hourly average SO_2 at GF, ppb units, January 1 – June 27, 2021

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 11 shows the recent 2021 hourly concentrations of PM2.5 at the PBG site and Figure 12 shows the same for the PBway site. The average concentration in 2021 through late June at PBG was 8.3 µg/m^3 and was 8.9 µg/m^3 at PBway.

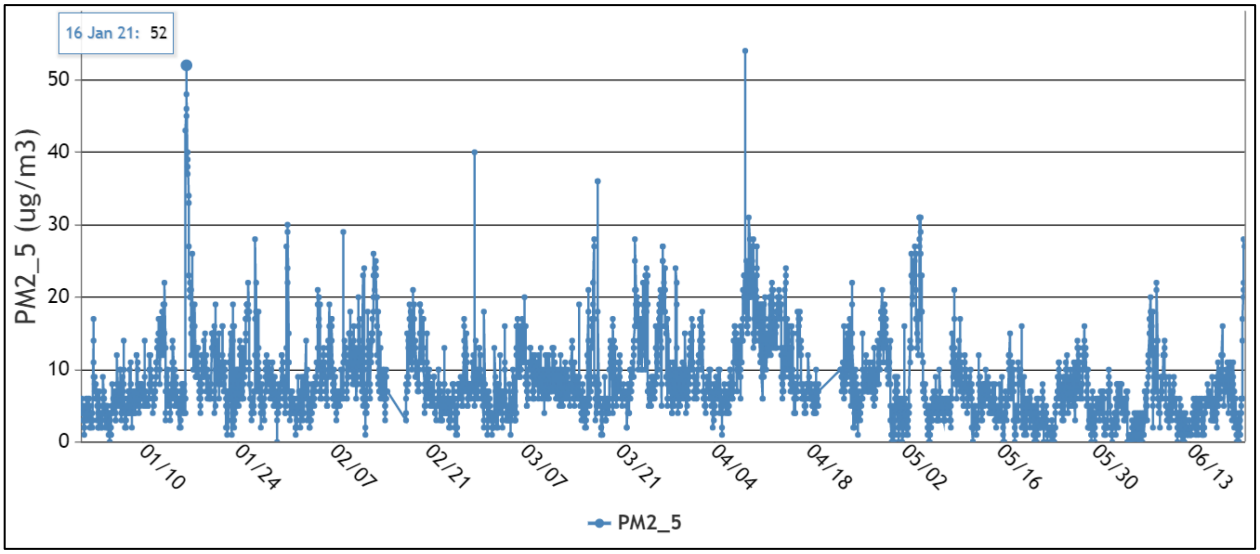

Figure 11. Hourly average PM2.5 at PBG, µg/m^3, January 1 – June 27, 2021

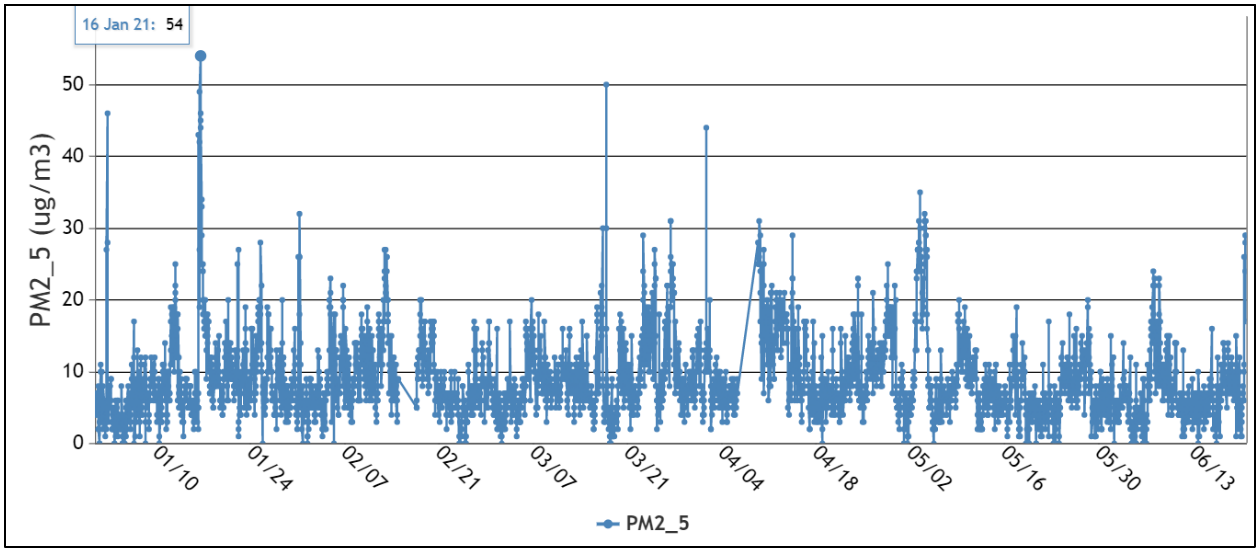

Figure 12. Hourly average PM2.5 at PBway, µg/m^3, January 1 – June 27, 2021

5.0 Data Analysis

As was shown earlier, the GF station recorded an elevated PM2.5 concentration on June 18, and because no other monitoring station had high concentrations that day and observations at the station suggested local activity could have caused the elevated concentration, this was likely a short-term local event. In general, PM2.5 concentrations are a combination of local dust, smoke, and results of air pollution chemistry, plus transported dust, smoke, and chemicals emitted farther away. For example, the Texas Gulf Coast historically has been affected annually by agricultural fires in Mexico and Central America in the spring season and North African wind-blown dust in the summer season. In addition, concentrations of PM2.5 can be contributed from domestic coal or oil burning power plants and far away urban areas. As a result, PM2.5 concentrations within a given urban area are often very highly correlated. For example, this is illustrated in the following graphs. Figure 13 to Figure 15 show comparisons between the three stations, comparing two at a time. Each graph shows the hourly PM2.5 concentration scatterplot with a linear regression showing relatively close agreement and statistically significant R^2 values ($p < 0.001$). As might be expected the two sites in Portland have a higher R^2 at 67 percent compared to the graphs with the one Gregory station with R^2 at 58 and 61 percent. The scatter in these three graphs may represent the local effects on the concentrations. The one outlier value at GF from June 18 is not included in these graphs. Following the first three scatterplots are three more in Figure 16 through Figure 18. For these graphs, the hourly values were averaged by date. Only days with 75 percent (18 hours) of data were used. The agreements are much better with the daily average approach, with all R^2 values greater than 81 percent.

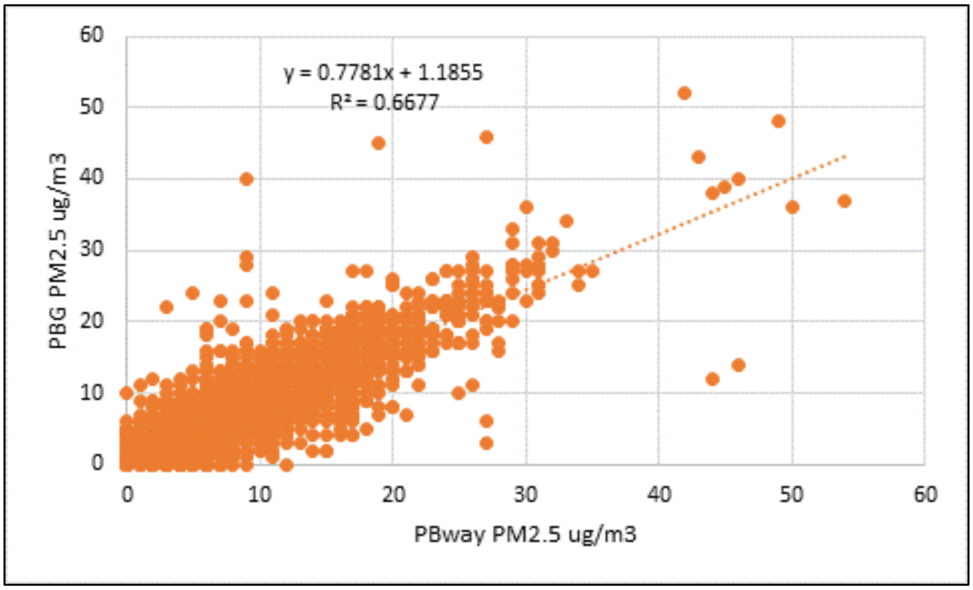

Figure 13. Hourly PM2.5 at PBG vs PBway, Jan. – June 2021 data

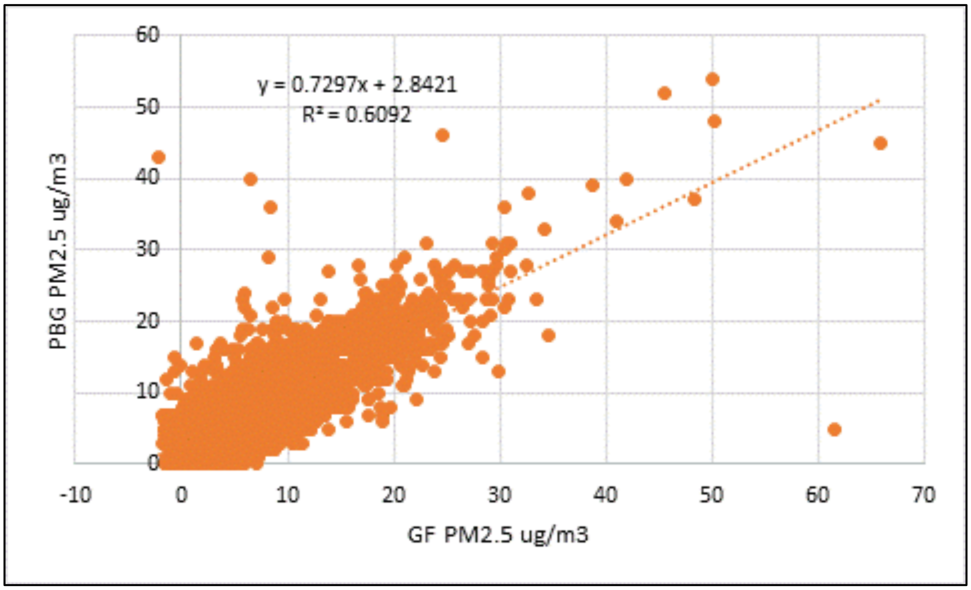

Figure 14. Hourly PM2.5 at PBG vs GF, Jan. – June 2021 data

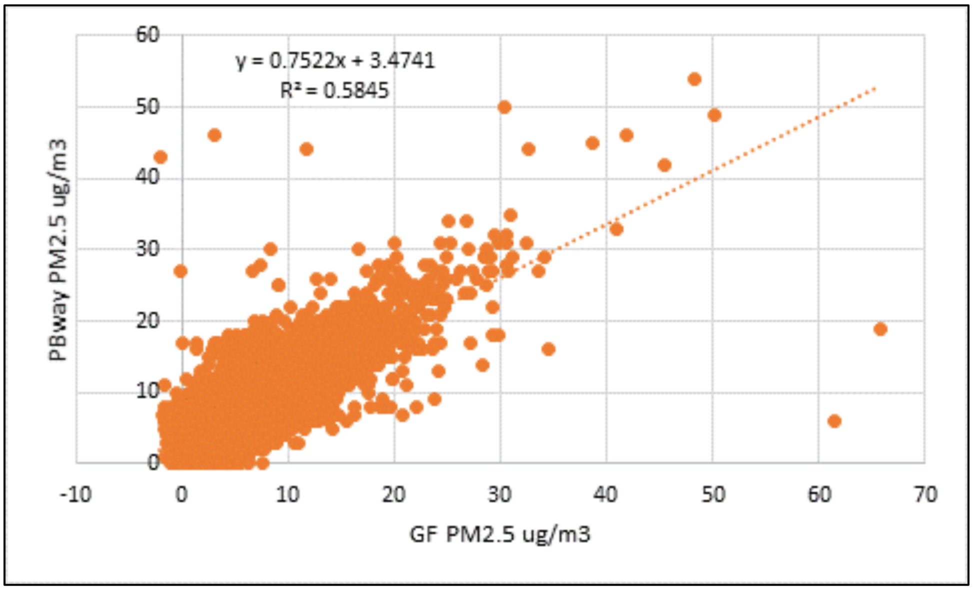

Figure 15. Hourly PM2.5 at PBway vs GF, Jan. – June 2021 data

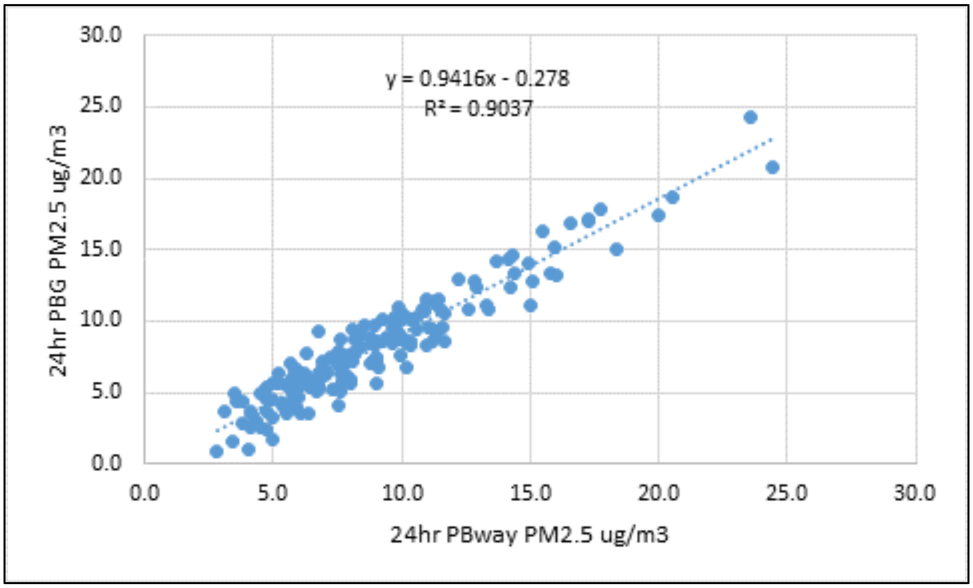

Figure 16. Mean 24-hour PM2.5 at PBG vs PBway, Jan. – June 2021 data

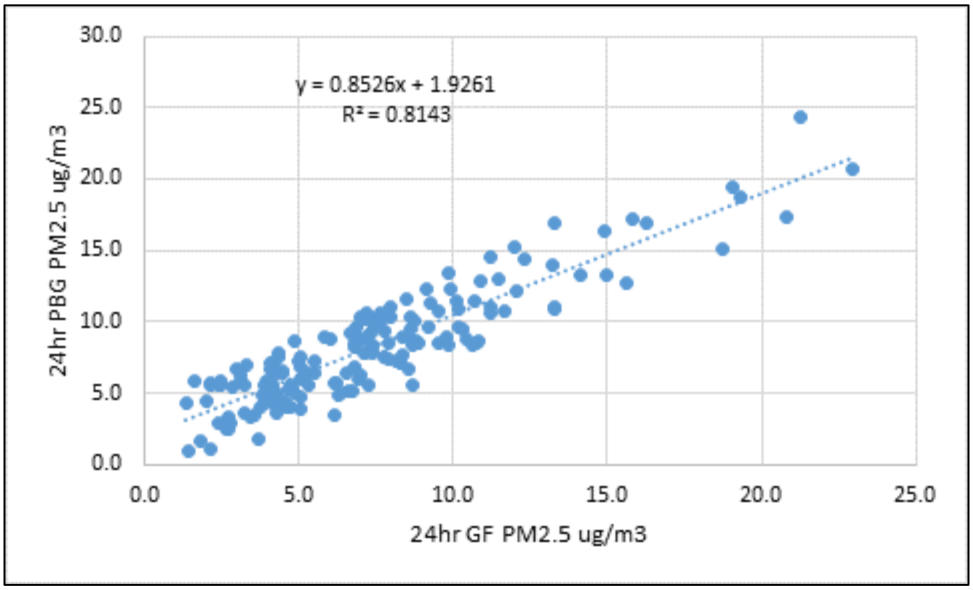

Figure 17. Mean 24-hour PM2.5 at PBG vs GF, Jan. – June 2021 data

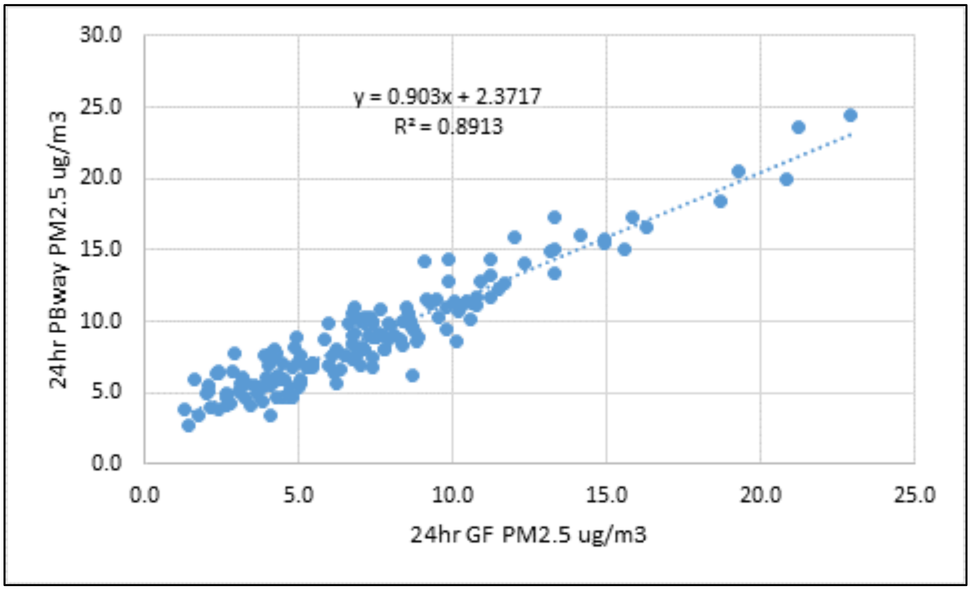

Figure 18. Mean 24-hour PM2.5 at PBway vs GF, Jan. – June 2021 data

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

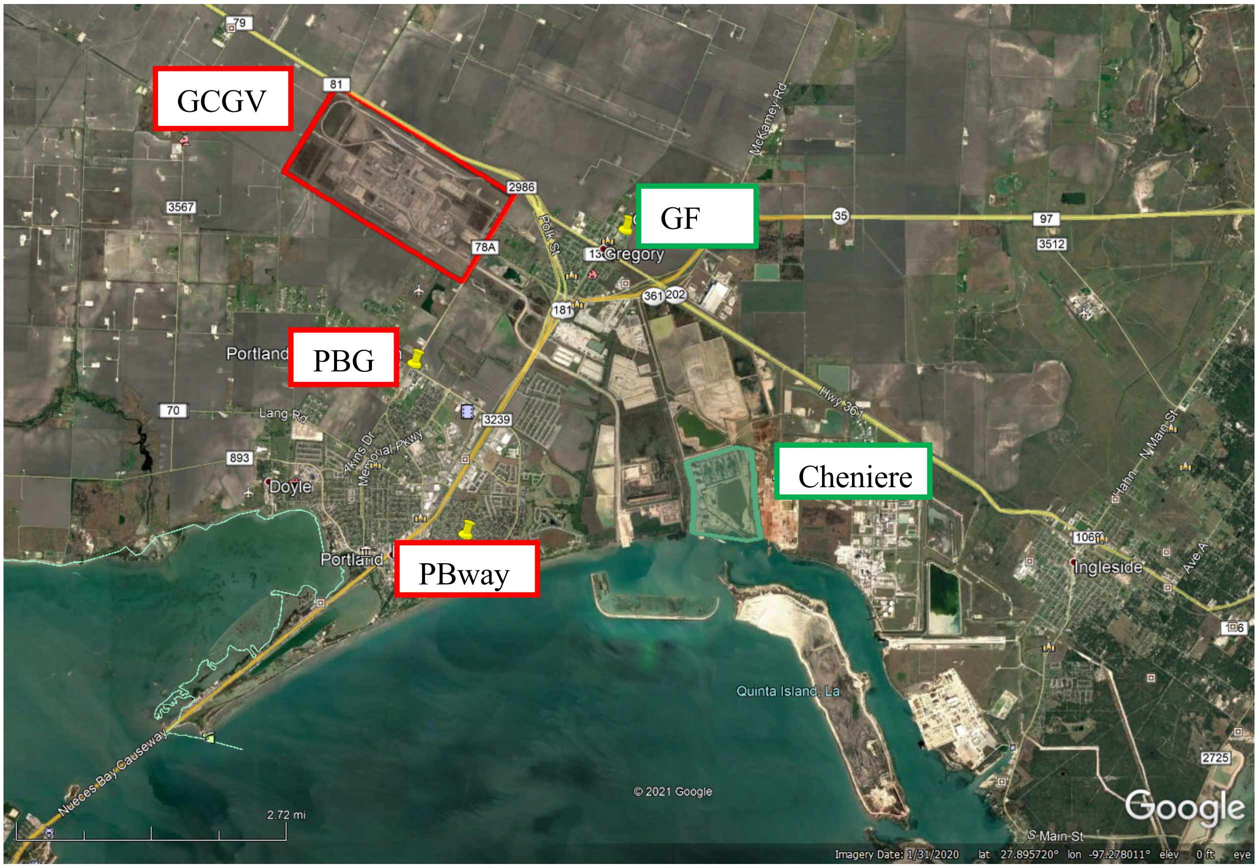

Figure 19. Location of Gregory-Fresnos Community Air Monitoring Station (GF), and two Portland community stations on GPISD campuses on Buddy Ganem (PBG) and on Broadway (PBway) and the Cheniere Energy and GCGV industrial facilities

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 (ppbC) (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, hydrocarbon concentrations may be converted to 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 and analyzed in a laboratory.

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 2021). 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 July 2021)

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.