

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

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October 19, 2021

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Executive Summary

There are three continuous air 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.

As described in earlier reports, 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.

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 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 2021.

2.0 Summary of Activities January 1, 2021 through September 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.

The three air monitoring stations reported quality assured data during the third quarter of 2021 at a level in excess of 75%, the minimum reporting level. The three auto-GC meet a 75% data completion rate from January through July 31, assuming the dates associated with Winter Storm Uri and its aftermath (Feb. 15 – 25) are excluded. Periodically each year however, there will be a few days when data will be missing due to annual equipment maintenance, in addition to the daily, weekly, monthly and quarterly routine quality assurance activities, when equipment is also offline while it is being checked.

Although the GF station sulfur dioxide (SO₂) instrument was operating within specifications, it was showing some degradation and was replaced with a new instrument on August 12, 2021 as a precaution.

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>).

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

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 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 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-Fresno 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: 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 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 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, 2021 and all other data were available through September 26, 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, 2021 through July 31, 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/agg_amcvs.pl (accessed October 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.

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 July 31. 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.

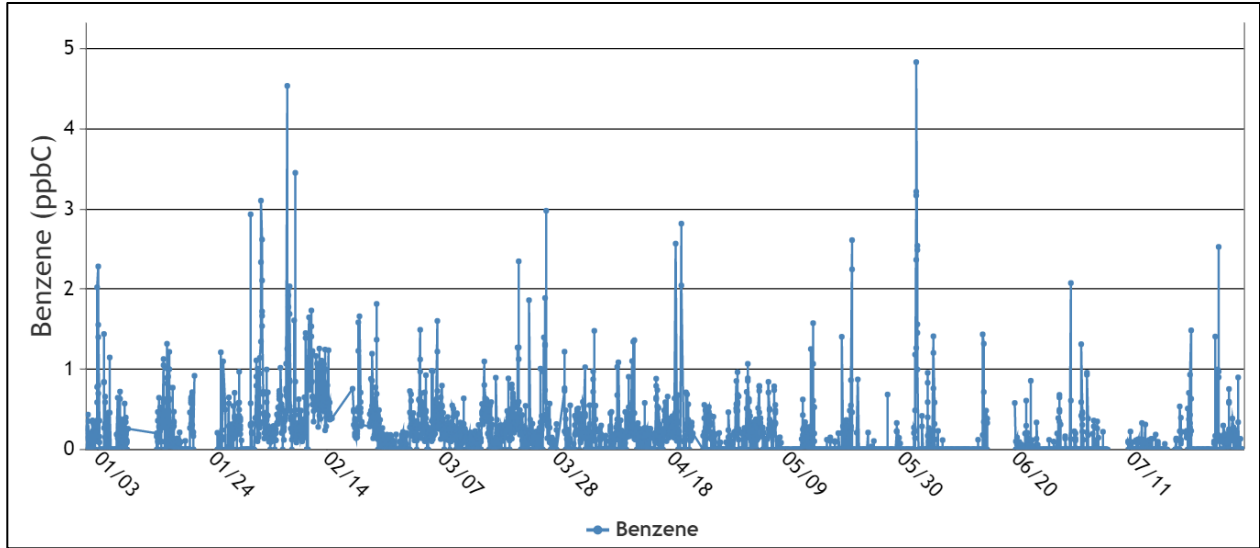


Figure 2. Hourly benzene concentrations at GF station, Jan. 1, 2021 – July 31, 2021, ppbC units

Table 2. Gregory-Fresnos Auto-GC statistics for 2021 (through July 31)

Species	Num. Samples	Peak 1-hr ppbC	Peak 24-hr ppbC	Mean ppbC
TNMTC	3,816	972.1	155.91	41.00
TNMHC	3,816	1004.9	170.28	44.87
Ethane	3,999	446.2	81.01	12.11
Ethylene	3,999	881.7	94.32	1.28
Propane	3,999	213.3	69.29	9.22
Propylene	3,999	29.7	2.66	0.78
Isobutane	3,999	151.0	35.60	3.19
n-Butane	3,999	170.2	47.75	5.39
Acetylene	3,999	7.3	1.42	0.48
trans-2-Butene	3,999	0.6	0.11	0.05
1-Butene	3,998	5.1	0.81	0.18
cis-2-Butene	3,993	10.1	1.03	0.05
Cyclopentane	3,999	3.3	0.71	0.14
Isopentane	3,999	66.4	19.14	2.71
n-Pentane	3,999	51.1	17.24	3.88
1,3-Butadiene	3,999	2.0	0.25	0.07
trans-2-Pentene	3,999	2.5	0.23	0.04
1-Pentene	3,999	16.8	1.36	0.06
cis-2-Pentene	3,999	4.2	0.37	0.03
2,2-Dimethylbutane	3,999	4.0	0.96	0.13
Isoprene	3,999	1.9	0.39	0.07
n-Hexane	3,867	29.8	3.30	0.67
Methylcyclopentane	3,866	34.1	4.22	0.35
2,4-Dimethylpentane	3,818	12.8	1.79	0.08
Benzene	3,867	4.8	0.96	0.19
Cyclohexane	3,867	21.3	2.72	0.37
2-Methylhexane	3,867	5.7	0.46	0.08
2,3-Dimethylpentane	3,847	4.9	0.43	0.09
3-Methylhexane	3,867	8.2	0.72	0.12
2,2,4-Trimethylpentane	3,867	11.8	0.89	0.17
n-Heptane	3,867	15.1	1.00	0.16
Methylcyclohexane	3,863	23.3	3.05	0.38
2,3,4-Trimethylpentane	3,867	3.2	0.23	0.02
Toluene	3,867	5.9	1.31	0.32
2-Methylheptane	3,867	2.5	0.24	0.03
3-Methylheptane	3,867	1.8	0.22	0.03
n-Octane	3,867	9.1	0.61	0.10
Ethyl Benzene	3,867	1.2	0.15	0.02
p-Xylene + m-Xylene	3,867	4.3	0.96	0.28
Styrene	3,867	0.5	0.04	0.00
o-Xylene	3,867	1.4	0.21	0.04
n-Nonane	3,867	4.0	0.30	0.05
Isopropyl Benzene - Cumene	3,867	10.9	0.73	0.01
n-Propylbenzene	3,867	2.3	0.63	0.05
1,3,5-Trimethylbenzene	3,867	0.7	0.07	0.01
1,2,4-Trimethylbenzene	3,849	3.2	0.88	0.18
n-Decane	3,867	2.0	0.32	0.13
1,2,3-Trimethylbenzene	3,867	2.2	0.39	0.05

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, 2021 through July 31, 2021. At the PBG station data are missing for the first three weeks in July. The AECOM operators reported :

“Data from 7/1-7/23 are invalid due to frequent electronic interference attributed to a malfunction of the compressor’s auto-drain solenoid valve and associated troubleshooting of the issue.”

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 July 31. 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. Neither station reports 1,2,3-Trimethylbenzene.

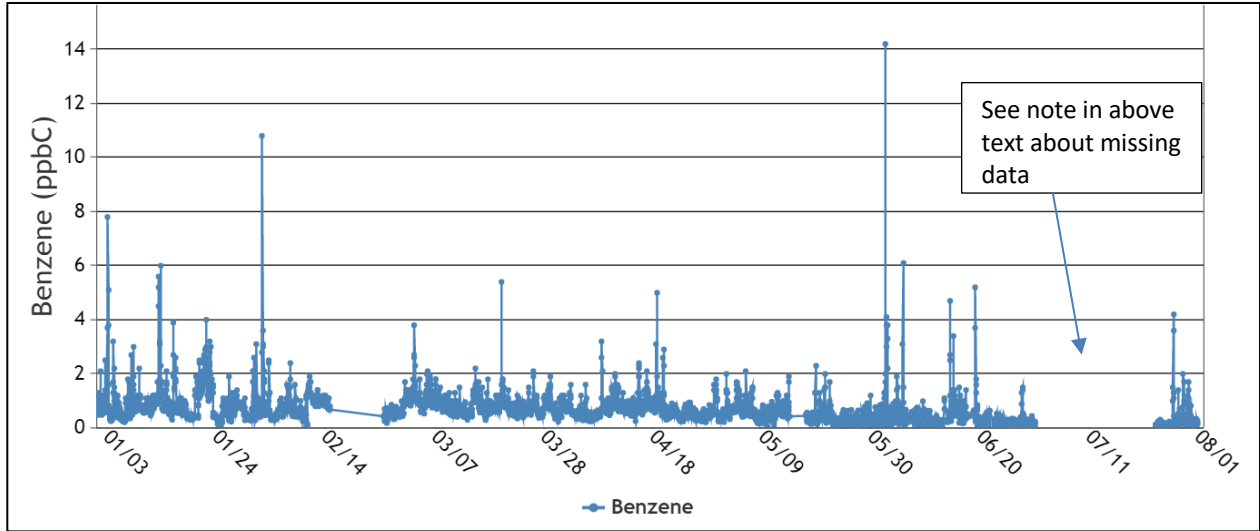


Figure 3. Hourly benzene concentrations at PBG station, Jan. 1, 2021 – July 31, 2021, ppbC units

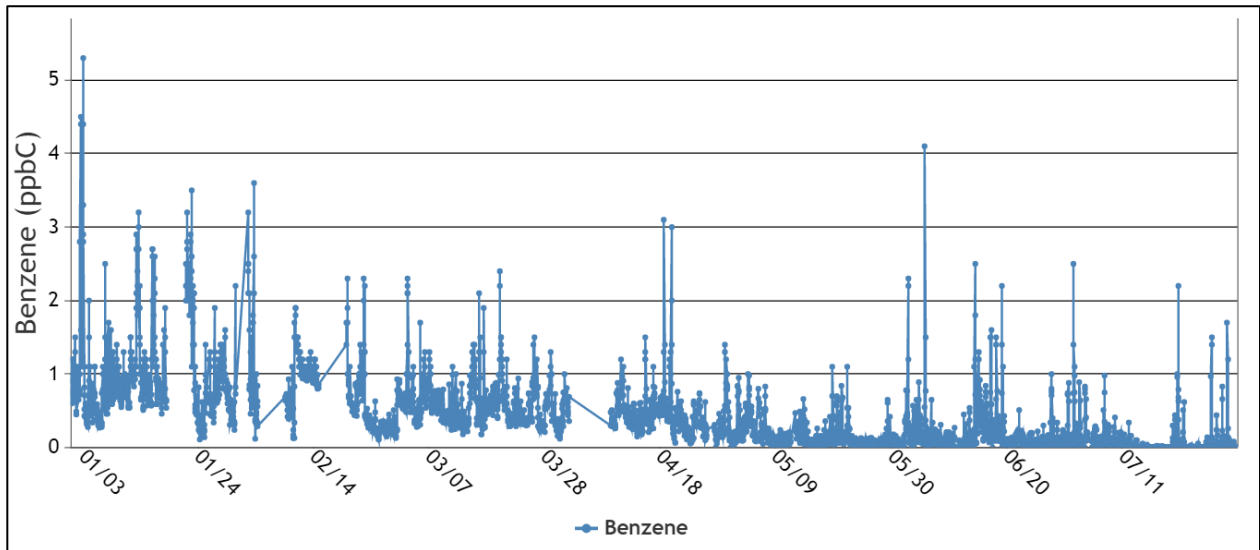


Figure 4. Hourly benzene concentrations at PBway station, Jan. 1, 2021 – July 31, 2021, ppbC units

Table 3. PBG Auto-GC statistics for 2021 (through July 31)

Species	Num. Samples	Peak 1-hr ppbC	Peak 24-hr ppbC	Mean ppbC
TNMTC	3,595	932.1	355.36	50.37
TNMHC	3,595	975.8	368.74	56.69
Ethane	3,637	249.0	83.53	13.17
Ethylene	3,640	20.8	3.50	0.86
Propane	3,638	236.0	100.90	11.58
Propylene	3,640	4.8	1.48	0.49
Isobutane	3,637	166.0	36.75	3.83
n-Butane	3,639	142.0	60.66	6.53
Acetylene	3,619	4.5	1.56	0.60
trans-2-Butene	3,636	1.8	0.49	0.15
1-Butene	3,635	6.5	0.55	0.23
cis-2-Butene	3,639	2.6	0.60	0.10
Cyclopentane	3,641	2.7	0.92	0.21
Isopentane	3,640	76.2	24.74	3.16
n-Pentane	3,640	55.8	20.47	2.40
1,3-Butadiene	3,640	1.3	0.25	0.10
trans-2-Pentene	3,640	1.1	0.22	0.05
1-Pentene	3,640	2.0	0.28	0.08
cis-2-Pentene	3,639	1.3	0.14	0.02
2,2-Dimethylbutane	3,639	2.8	0.57	0.11
Isoprene	3,639	2.4	0.87	0.20
n-Hexane	3,629	21.9	5.28	0.70
Methylcyclopentane	3,635	7.9	2.06	0.45
2,4-Dimethylpentane	3,635	3.7	0.67	0.03
Benzene	3,635	14.2	2.07	0.72
Cyclohexane	3,635	14.5	2.39	0.44
2-Methylhexane	3,635	4.4	0.94	0.17
2,3-Dimethylpentane	3,634	3.3	0.70	0.08
3-Methylhexane	3,634	5.9	1.38	0.28
2,2,4-Trimethylpentane	3,632	8.3	1.40	0.35
n-Heptane	3,636	10.9	2.06	0.35
Methylcyclohexane	3,632	16.8	2.79	0.52
2,3,4-Trimethylpentane	3,636	1.7	0.25	0.07
Toluene	3,634	12.5	2.56	0.66
2-Methylheptane	3,632	9.7	0.63	0.09
3-Methylheptane	3,634	10.8	0.67	0.07
n-Octane	3,635	26.2	1.60	0.19
Ethyl Benzene	3,635	2.3	0.27	0.09
p-Xylene + m-Xylene	3,635	10.1	0.92	0.28
Styrene	3,635	2.7	0.34	0.05
o-Xylene	3,635	4.6	0.40	0.07
n-Nonane	3,636	17.6	1.21	0.09
Isopropyl Benzene - Cumene	3,636	2.0	0.10	0.01
n-Propylbenzene	3,636	0.5	0.12	0.02
1,3,5-Trimethylbenzene	3,636	1.2	0.19	0.03
1,2,4-Trimethylbenzene	3,636	2.6	0.32	0.10
n-Decane	3,594	4.1	0.65	0.28

Table 4. PBway Auto-GC statistics for 2021 (through July 31)

Species	Num. Samples	Peak 1-hr ppbC	Peak 24-hr ppbC	Mean ppbC
TNMTC	4,002	600.6	378.54	41.75
TNMHC	4,002	638.8	404.67	45.23
Ethane	3,984	164.0	112.51	13.02
Ethylene	3,967	13.8	4.09	1.16
Propane	4,002	156.0	100.12	8.56
Propylene	4,002	6.0	2.29	0.60
Isobutane	4,002	65.9	27.70	2.71
n-Butane	4,002	119.0	56.16	5.22
Acetylene	3,629	3.7	1.02	0.30
trans-2-Butene	3,992	1.0	0.32	0.15
1-Butene	3,995	2.9	0.58	0.33
cis-2-Butene	4,001	1.1	0.20	0.06
Cyclopentane	4,002	4.7	0.85	0.15
Isopentane	4,002	79.5	22.37	2.62
n-Pentane	4,002	49.4	20.35	1.85
1,3-Butadiene	4,002	1.2	0.22	0.08
trans-2-Pentene	4,002	5.2	0.32	0.02
1-Pentene	4,001	7.5	0.37	0.06
cis-2-Pentene	3,998	6.3	0.52	0.01
2,2-Dimethylbutane	4,001	2.0	0.51	0.08
Isoprene	4,001	4.0	1.68	0.35
n-Hexane	4,002	13.8	8.18	0.68
Methylcyclopentane	4,002	10.7	2.24	0.33
2,4-Dimethylpentane	4,002	5.2	0.33	0.01
Benzene	3,948	5.3	2.44	0.43
Cyclohexane	4,002	7.8	2.12	0.30
2-Methylhexane	4,002	3.0	1.21	0.11
2,3-Dimethylpentane	4,002	3.0	0.60	0.05
3-Methylhexane	4,002	3.3	1.60	0.16
2,2,4-Trimethylpentane	4,002	34.0	2.55	0.36
n-Heptane	4,002	5.8	2.17	0.24
Methylcyclohexane	4,001	9.0	2.43	0.33
2,3,4-Trimethylpentane	4,002	6.8	0.51	0.07
Toluene	4,002	14.1	2.87	0.61
2-Methylheptane	4,002	2.0	0.94	0.04
3-Methylheptane	4,002	1.1	0.47	0.03
n-Octane	4,001	3.0	0.89	0.09
Ethyl Benzene	4,001	1.4	0.30	0.04
p-Xylene + m-Xylene	4,002	6.8	0.96	0.24
Styrene	4,002	4.2	0.29	0.02
o-Xylene	4,002	1.8	0.22	0.04
n-Nonane	4,002	1.5	0.36	0.04
Isopropyl Benzene - Cumene	4,002	3.8	0.19	0.01
n-Propylbenzene	4,002	0.9	0.13	0.01
1,3,5-Trimethylbenzene	3,319	1.3	0.34	0.01
1,2,4-Trimethylbenzene	3,313	1.8	0.66	0.11
n-Decane	3,319	2.0	0.65	0.12

4.3 Comparing Hydrocarbon Data between Stations

Figure 5 shows a comparison between the average concentrations for 2021 through July 31 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.

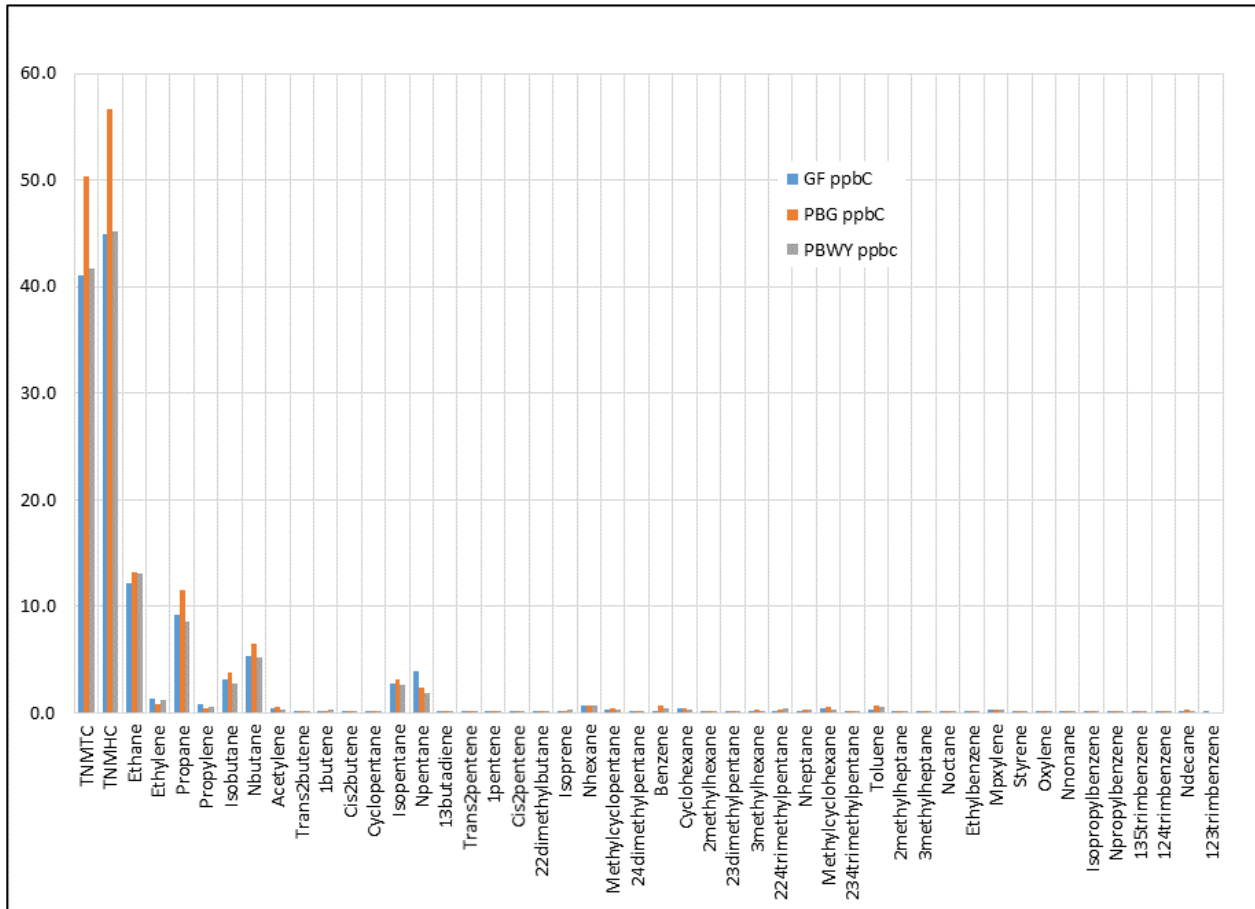


Figure 5. Mean concentrations of TNMTC, TNMHC, and 46 hydrocarbon species at three stations

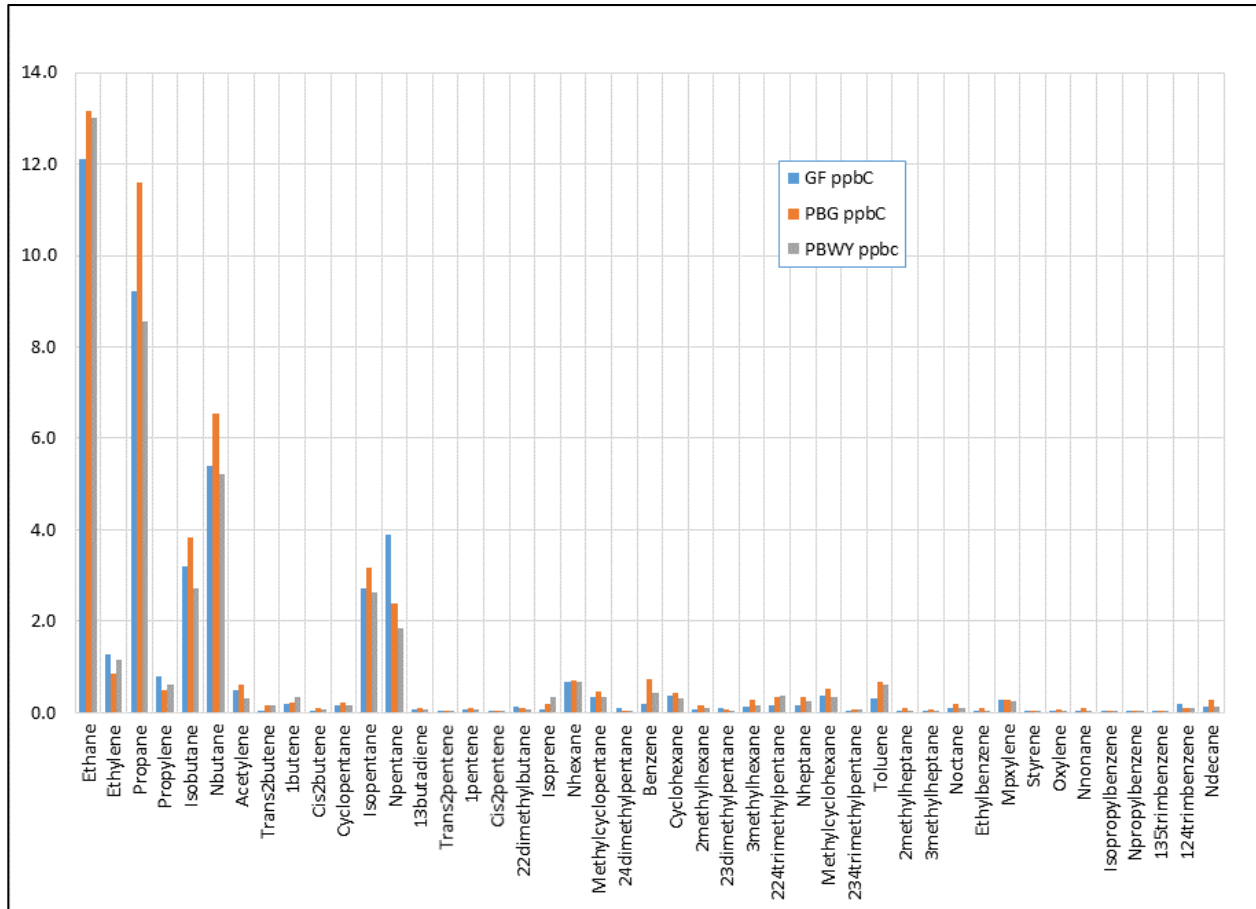


Figure 6. Mean concentrations of 45 hydrocarbon species at the three air monitoring stations

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). 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.

- 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) 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 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 $\mu\text{g}/\text{m}^3$, 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 $\mu\text{g}/\text{m}^3$).

Figure 7 shows the hourly average time series for PM2.5 at the GF station from January 1 through September 26, 2021. The average concentration for the first nine months of 2021 was 8.25 $\mu\text{g}/\text{m}^3$ compared with the primary one-year NAAQS value (annual mean averaged over three years) of 12 $\mu\text{g}/\text{m}^3$. In the previous quarterly report, an explanation (nearby construction work) was given for an apparent statistical outlier concentration of 282 $\mu\text{g}/\text{m}^3$ recorded at 8 a.m. CST (9 a.m. CDT) on June 18. More recently, another unusually high concentration at 203 $\mu\text{g}/\text{m}^3$ was measured on September 11 at 8 p.m. CST (9 p.m. CDT). The GF station operator reported that a fireworks trailer had been set up next to the GF station, and the local news media reported on a September 11 patriotic event beginning at 8:30 p.m. at Stephen F. Austin Elementary School. The current hypothesis is that the elevated PM2.5 concentration was caused by fireworks. Despite the high one-hour concentration, the 24-hour average concentration on Sept. 11 was 15.6 $\mu\text{g}/\text{m}^3$. Figure 8 shows the hourly average PM2.5 concentration on Sept. 10 – 12, 2021. Figure 9 shows the 24-hour averaged daily PM2.5 concentrations for the current year to September 26.

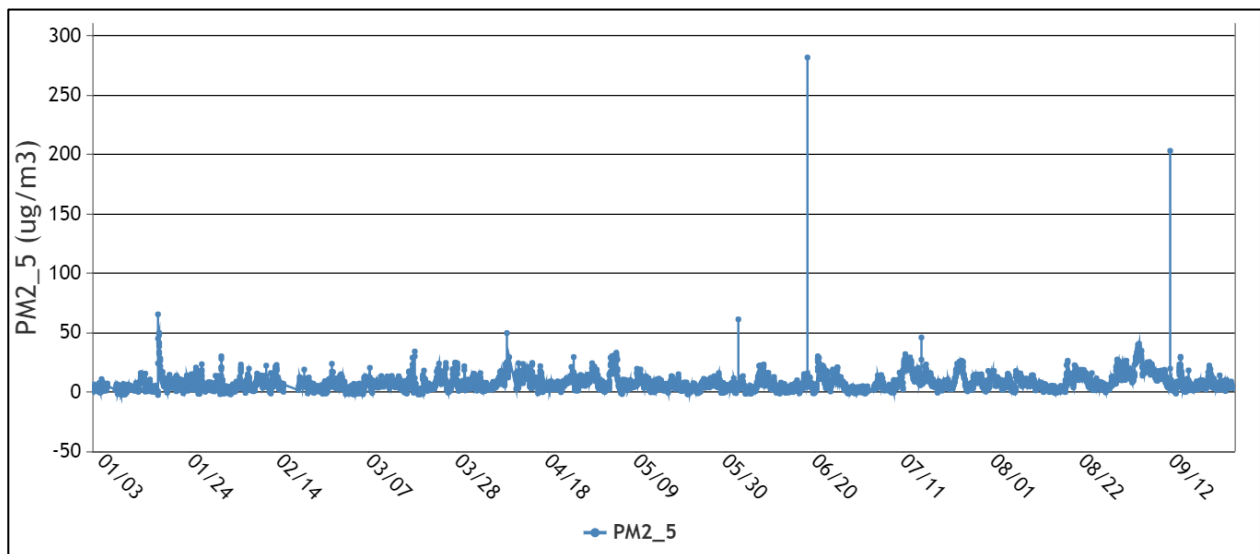


Figure 7. Hourly average PM2.5 at GF, $\mu\text{g}/\text{m}^3$, Jan. 1, 2021 – Sept. 26, 2021

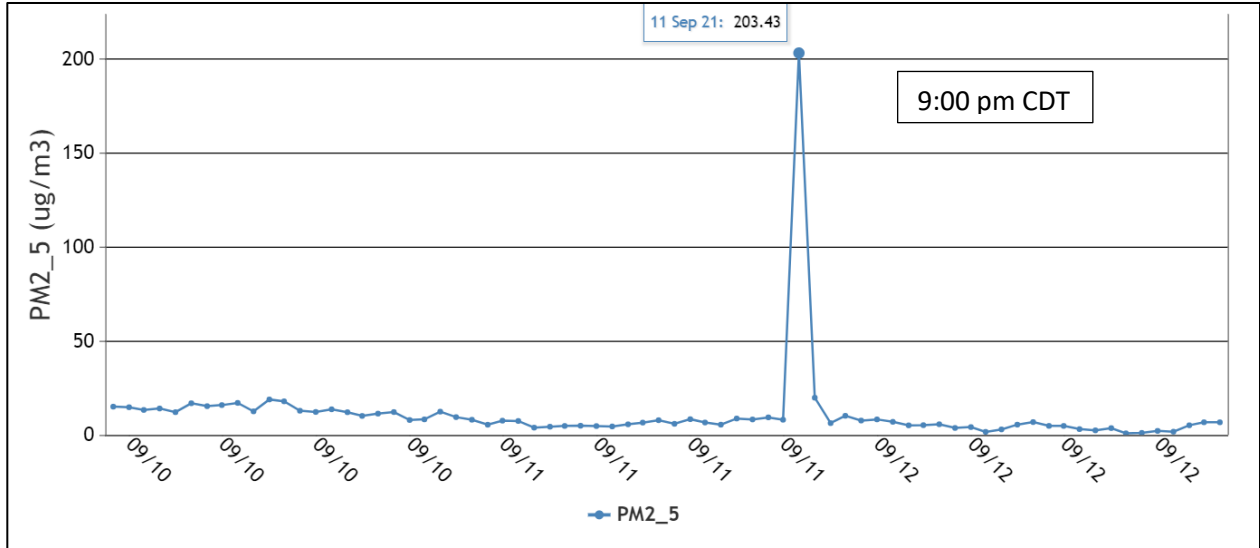


Figure 8. Hourly average PM2.5 at GF, $\mu\text{g}/\text{m}^3$, Sept. 10– 12, 2021

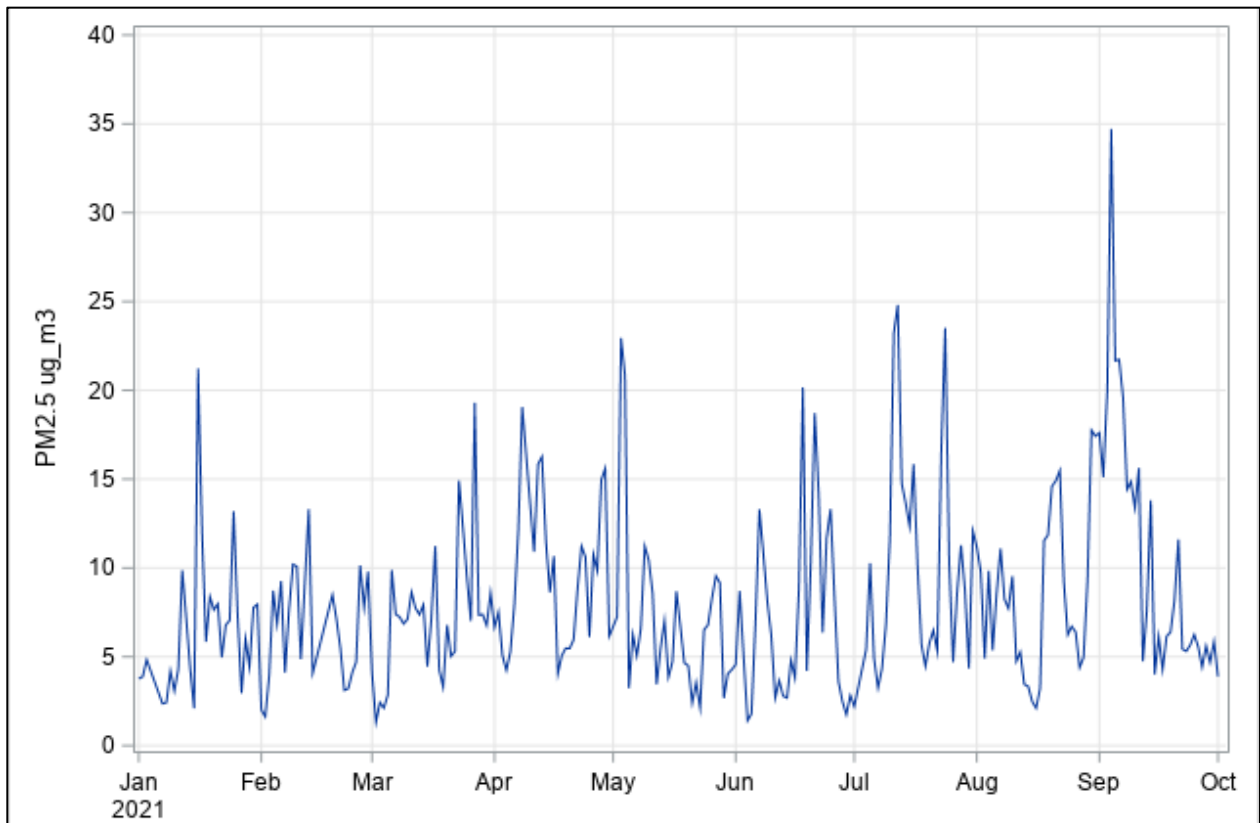


Figure 9. Averaged 24-Hour PM2.5 at GF, $\mu\text{g}/\text{m}^3$, Jan. 1 – Sept. 26, 2021

Figure 10 shows the hourly average time series for NO₂ at the Gregory Fresnos station from January 1 through September 26, 2021. The average NO₂ concentration at the Gregory Fresnos station through late September 2021 was 2.0 ppb, and the highest daily maximum, shown in Figure 10, was 24.9 ppb. The NO_x 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.

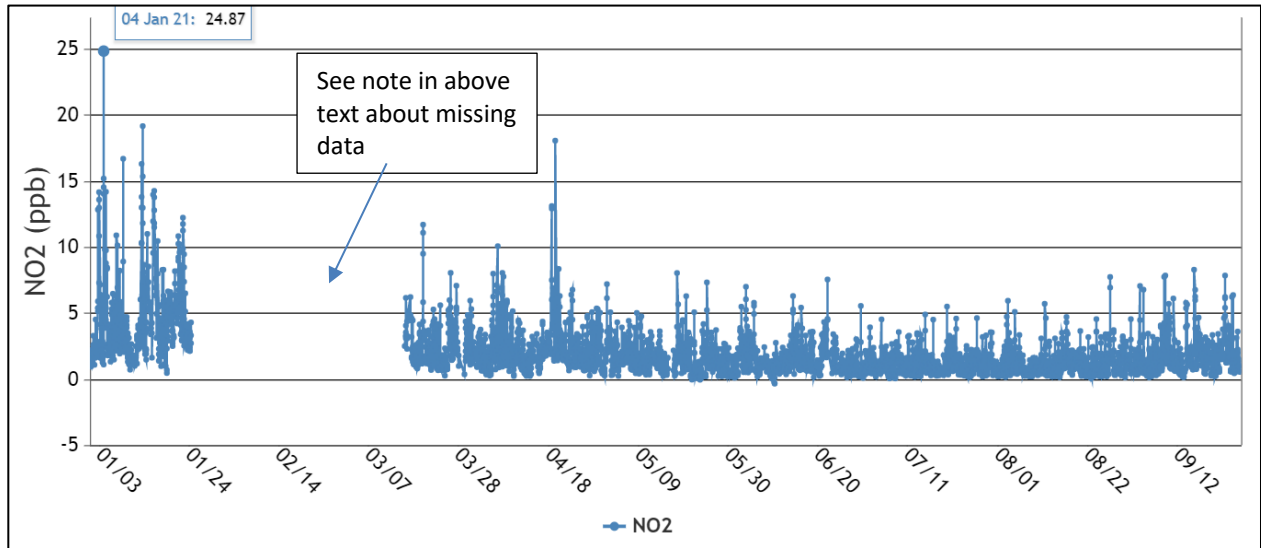


Figure 10. Hourly NO₂ at GF, ppb units, Jan. 1, 2021 – Sept. 26, 2021

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 for SO₂ at the GF station is shown in Figure 11. The graph is scaled to illustrate how low the concentrations have been compared to the 75 ppb level of the NAAQS.

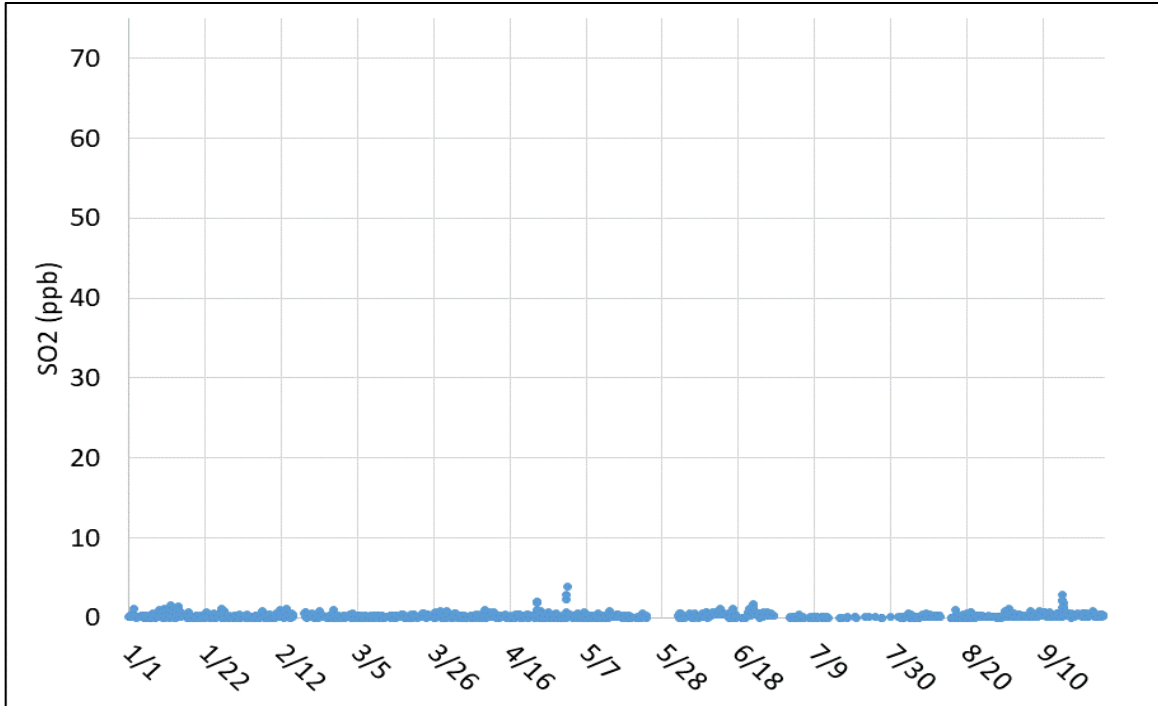


Figure 11. Hourly average SO₂ at GF, ppb units, Jan. 1, 2021 – Sept. 26, 2021

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 12 shows the 2021 hourly concentrations of PM_{2.5} and Figure 13 shows the 24-hour average concentrations at the PBG site, and Figure 14 and Figure 15 show the same time series for the PBway site. The average concentration in 2021 through late September at PBG was 7.9 µg/m³ and was 9.1 µg/m³ at PBway.

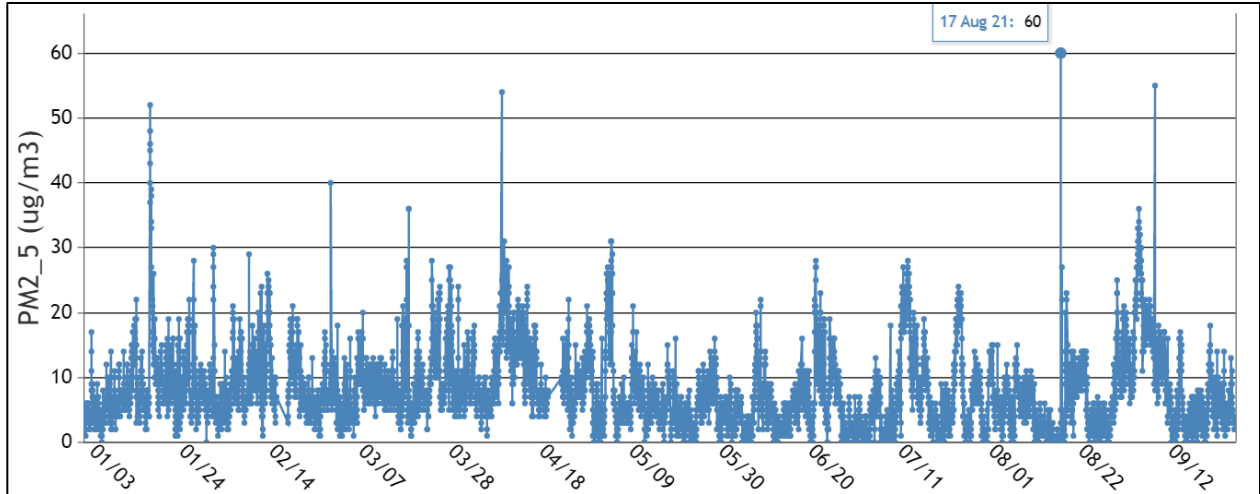


Figure 12. Hourly average PM2.5 at PBG, $\mu\text{g}/\text{m}^3$, Jan. 1, 2021 – Sept. 26, 2021

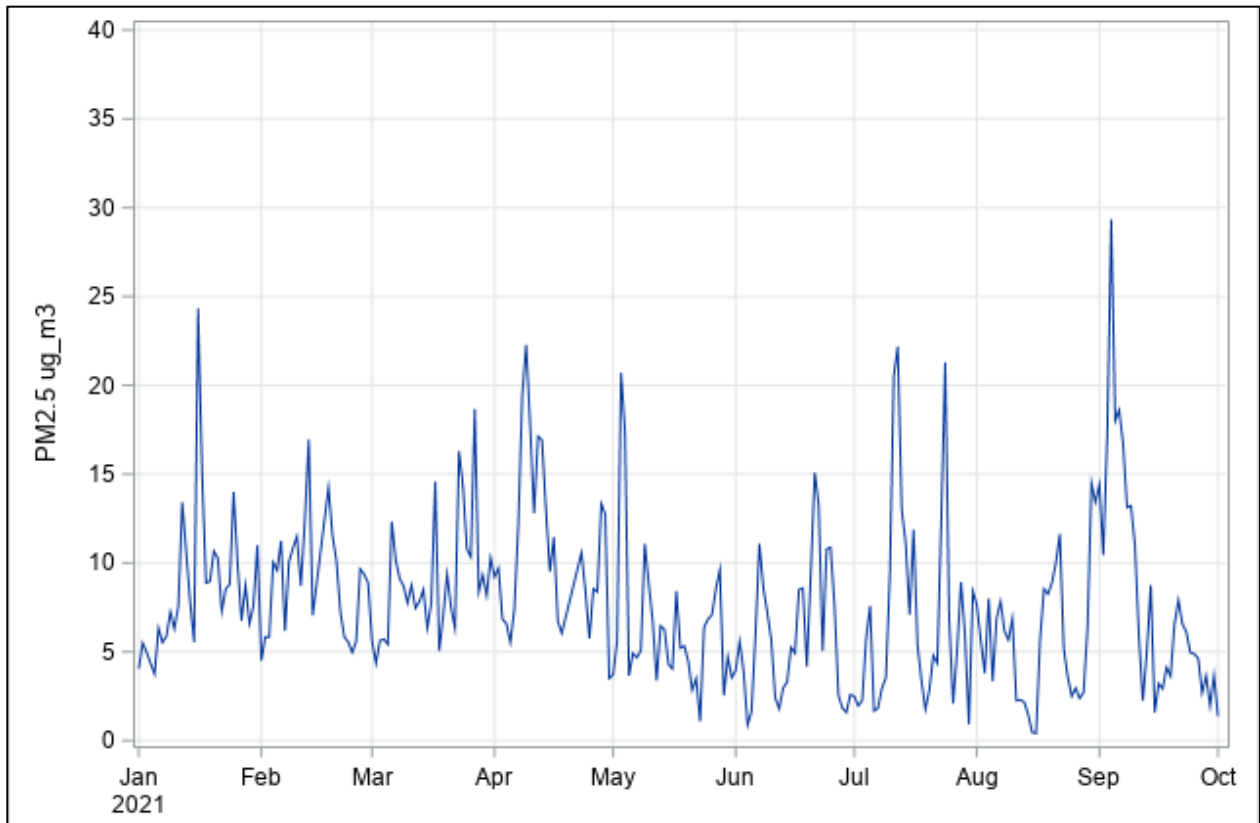


Figure 13. Averaged 24-Hour PM2.5 at PBG, $\mu\text{g}/\text{m}^3$, Jan. 1 – Sept. 26, 2021

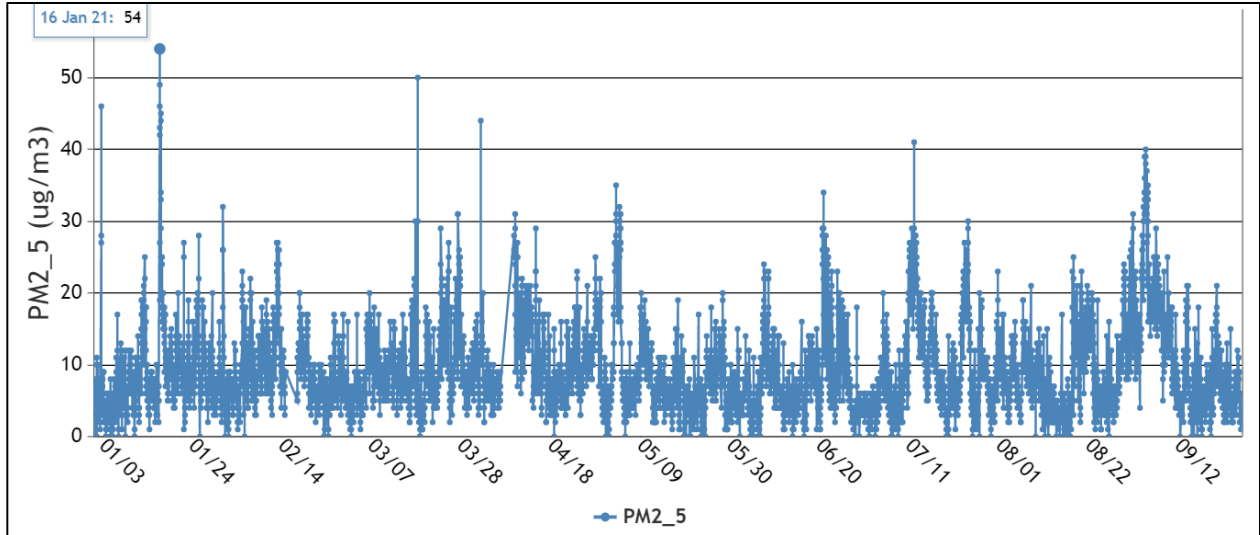


Figure 14. Hourly average PM2.5 at PBway, $\mu\text{g}/\text{m}^3$, Jan. 1, 2021 – Sept. 26, 2021

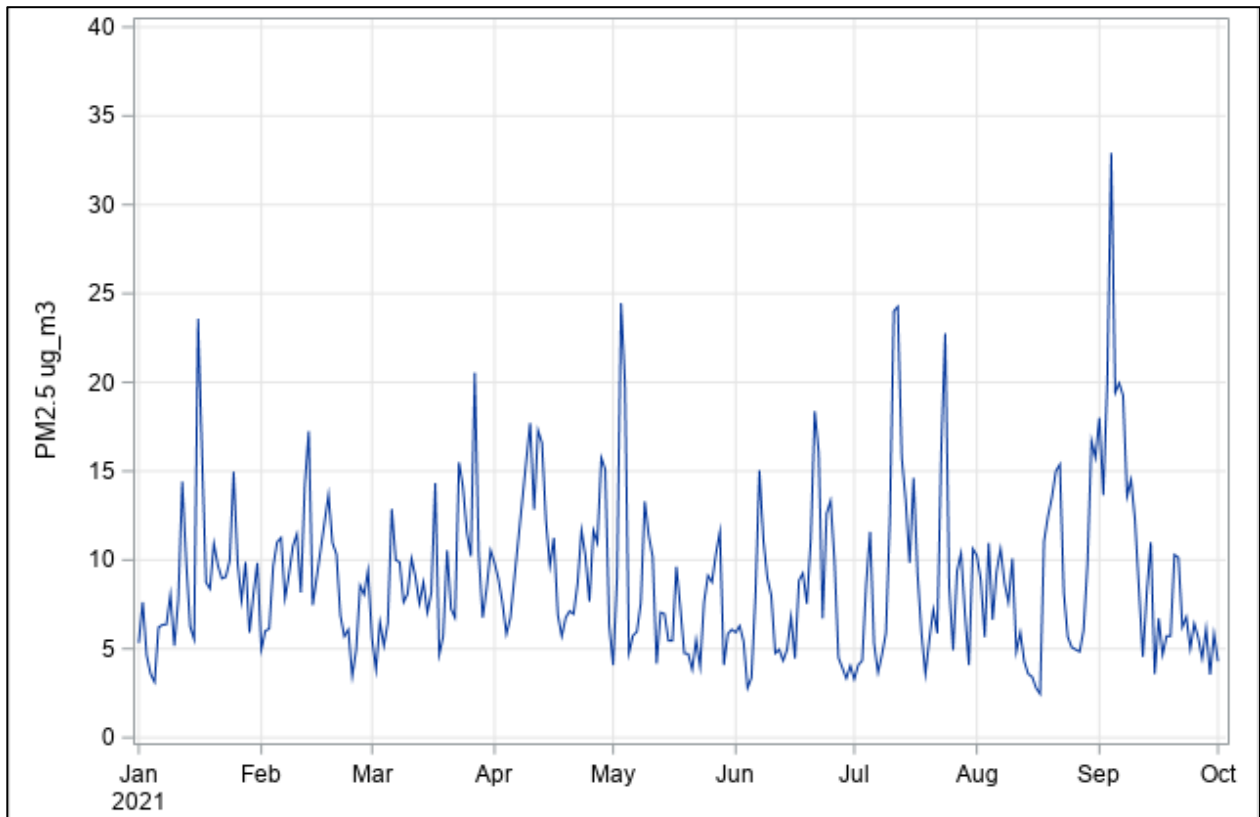


Figure 15. Averaged 24-Hour PM2.5 at PBway, $\mu\text{g}/\text{m}^3$, Jan. 1 – Sept. 26, 2021

5.0 Data Analysis

In the figures shown earlier for PM_{2.5}, there appears to be some common features in the time series. In a recent quarterly report, the fact that PM_{2.5} is both a local pollutant, as when nearby smoke or dust affects one station and not others, and a regional pollutant affected by the long-distance transport of smoke from large fires or large dust clouds. The three graphs below in Figure 16, Figure 17, and Figure 18 for the August to mid-September periods at the three stations show elevated PM_{2.5} with concentrations greater than 15 $\mu\text{g}/\text{m}^3$ over the course of several days during mid August to mid September. The highest concentrations during this period were measured on Saturday, September 4. On the previous day the Texas Commission on Environmental Quality had forecast elevated PM_{2.5} for much of South Texas based on a combination of factors including transported dust. The exact forecast language received by e-mail delivery on September 3 from the Texas Commission on Environmental Quality tceq@service.govdelivery.com was as follows:

“Southerly winds are expected to continue steering light to moderate amounts of African dust from the Gulf into South Texas while persisting across much of the state at varying intensities, with the exception of the Texas Panhandle and Far West Texas. Overall, depending on the density and coverage of the dust, the daily PM_{2.5} AQI is forecast to reach the middle to upper end of the "Moderate" range in parts of the Brownsville-McAllen, Corpus Christi, Laredo, and Victoria areas; the lower to middle end of the "Moderate" range in parts of the Austin, Beaumont-Port Arthur, Bryan-College Station, Dallas-Fort Worth, Houston, San Antonio, Tyler-Longview, and Waco-Killeen areas; and the lower end of the "Moderate" range in parts of the Midland-Odessa area.”

To reflect the widespread nature of the elevated PM_{2.5}, Figure 19 shows the August to mid-September period for the regional average concentrations of PM_{2.5} from the Houston Region (8 stations), the Corpus Christi Region (2 stations), and the Lower Rio Grande Valley Region (3 stations) by hour, and a similar peak average concentration on September 4, 2021.

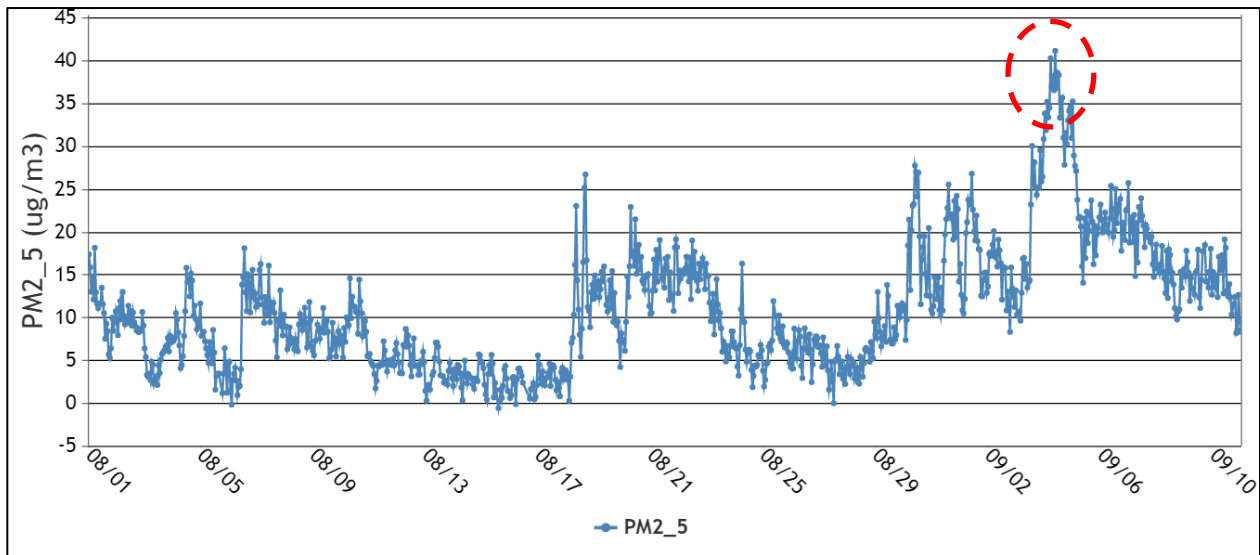


Figure 16. Hourly average PM_{2.5} at GF, $\mu\text{g}/\text{m}^3$, Aug. 1, 2021 – Sept. 10, 2021, Sept. 4 noted with dashed oval

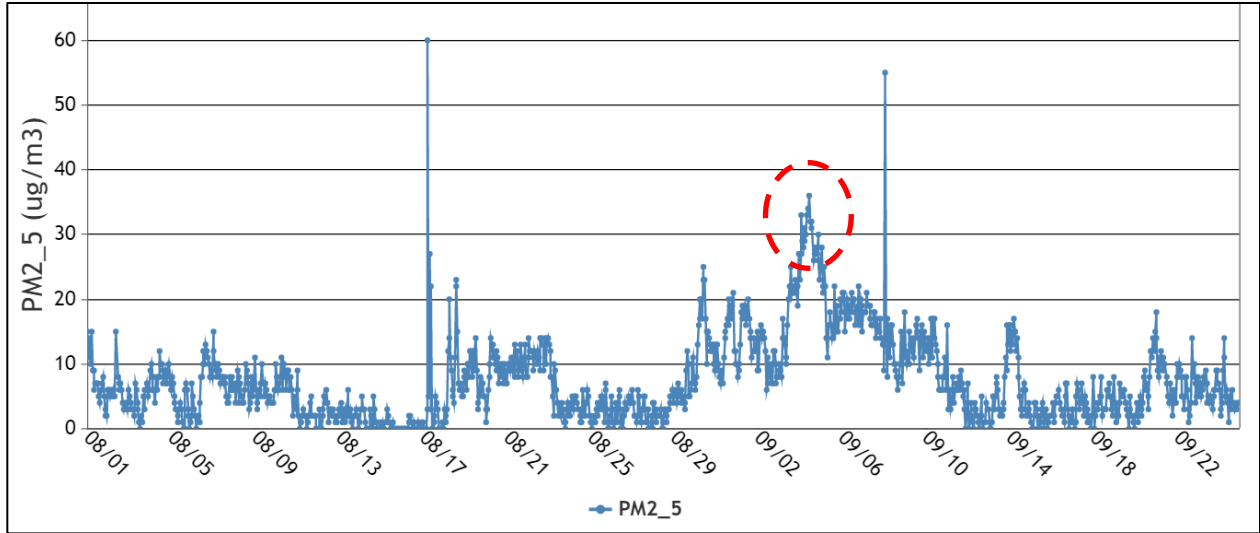


Figure 17. Hourly average PM2.5 at PBG, $\mu\text{g}/\text{m}^3$, Aug. 1, 2021 – Sept. 24, 2021, Sept. 4 noted with dashed oval

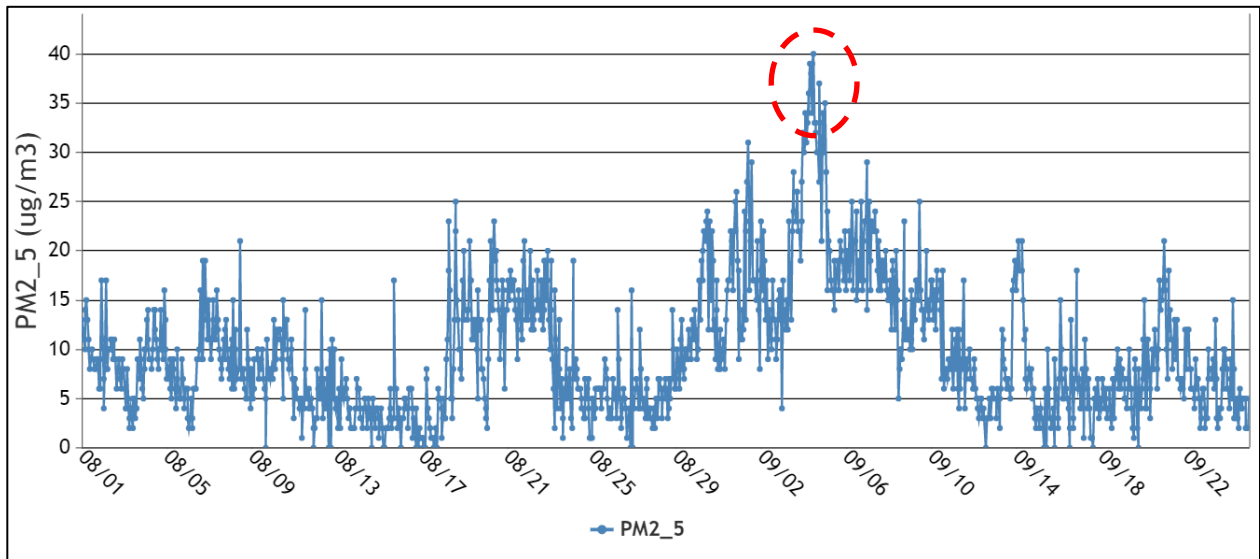


Figure 18. Hourly average PM2.5 at PBway, $\mu\text{g}/\text{m}^3$, Aug. 1, 2021 – Sept. 24, 2021, Sept. 4 noted with dashed oval

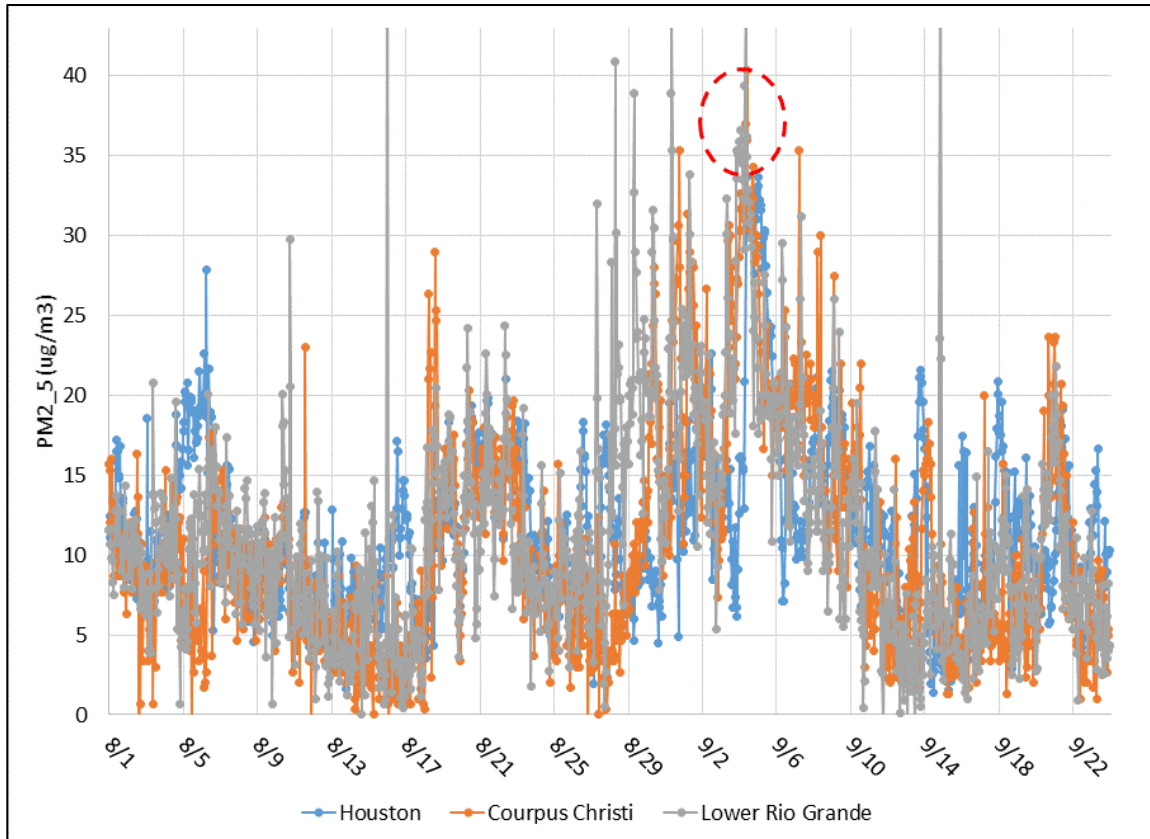


Figure 19. Average hourly concentrations at TCEQ Houston Region (combined), Corpus Christi Region (combined), and Lower Rio Grande Valley Region (combined) stations, Aug. 1 – Sept. 24 2021

Figure 20 shows a modeled upper air back-trajectory image simulating air movement 15 days back in time from 10 a.m. CST (16 UTC or Greenwich Mean Time) on September 4, 2021, suggesting that North African dust may explain the elevated PM2.5, but other possible explanations could be fires in Central America or Southern Mexico. One clue to the source of PM2.5 is in examining the particles in a laboratory for chemical composition. The TCEQ carries out such an examination with PM2.5 data collected at the Dona Park station in Corpus Christi. These chemically speciated results take several months to be made available, and currently the most recent available data are from June 2021.

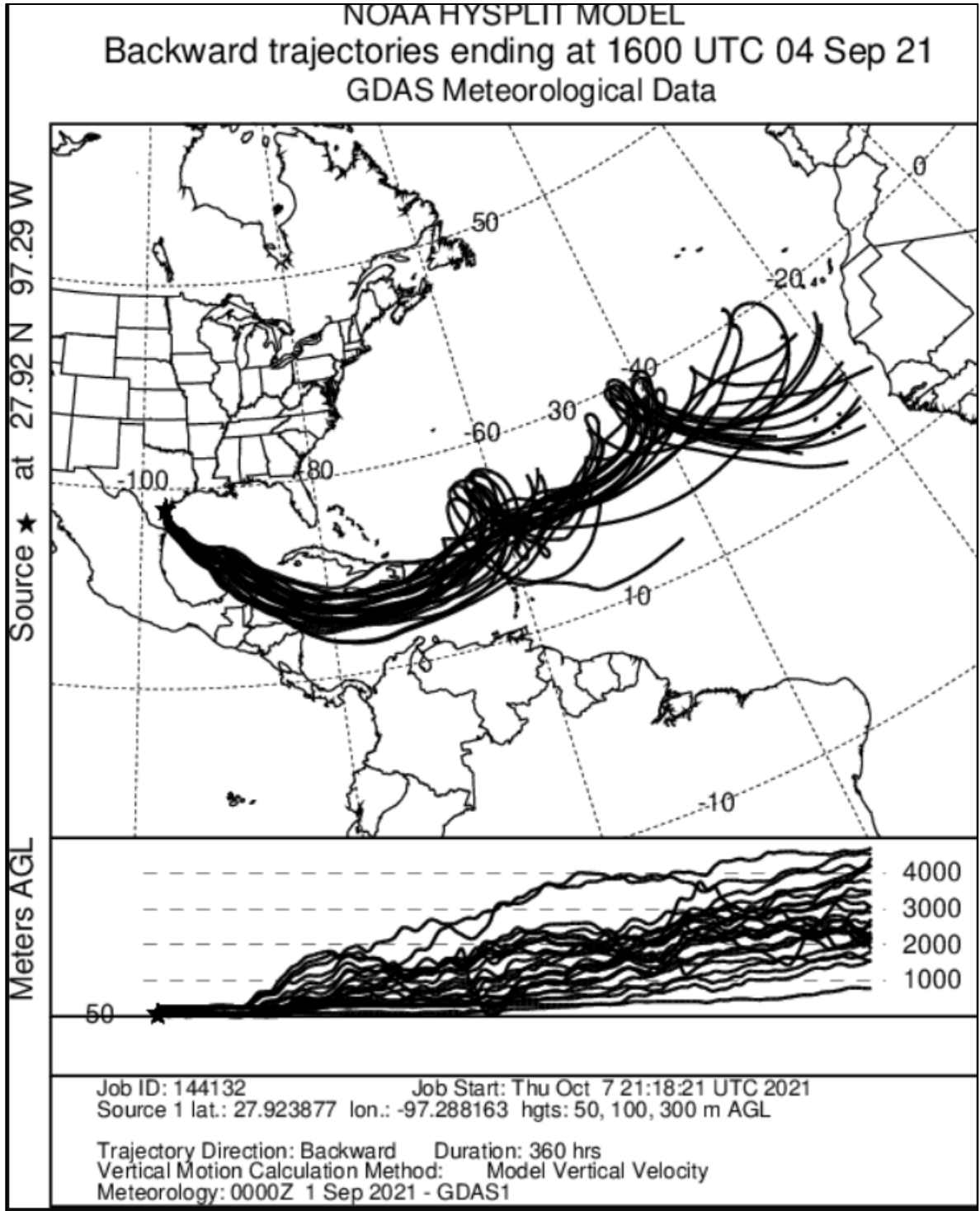


Figure 20. Ensemble back-trajectories from San Patricio County associated with elevated PM2.5 in Figure 16, Figure 17, and Figure 18

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 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

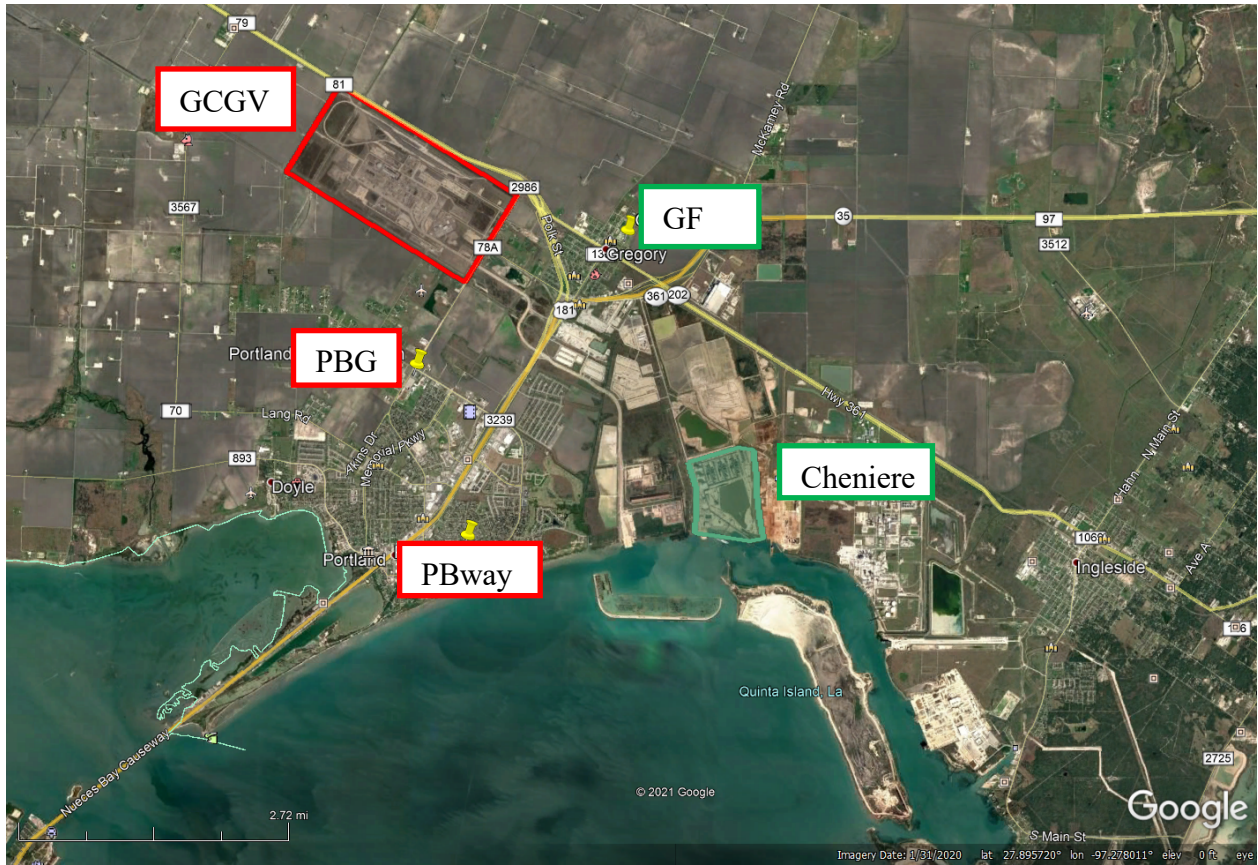


Figure 21. Location of Gregory-Fresnos Community Air Monitoring Station (GF), and two Portland community stations on GPISD campuses on Buddy Ganem (PBG) and on Broadway (PBway) and the Cheniere Energy and GCGV industrial facilities

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 (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 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 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 2021)

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.