SOUTH CAROLINA PORTS AUTHORITY

Continuous Air Monitoring Station for the Union Pier Terminal

Q1 2022 Quarterly Report and Annual Summary

May 2022

SOUTH CAROLINA PORTS AUTHORITY – CONTINUOUS AIR MONITORING STATION FOR THE UNION PIER TERMINAL

Q1 2022 Quarterly Report and Annual Summary

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1 EXECUTIVE SUMMARY

Arcadis was contracted in late October 2014 to provide Continuous Air Monitoring Services to the South Carolina Ports Authority (SCPA) at the Union Pier Terminal in Charleston, SC. Arcadis has followed through on the planned schedule and activities since that award. The major accomplishments were to complete the Quality Assurance Project Plan (QAPP), purchase the instruments, complete the site setup, and then to begin acquiring data. Installation was completed in mid-February 2015 and data acquisition began on February 25. This report is the 29th quarterly data report (first quarterly report in year eight of operations) and presents the data summaries requested by SCPA and described in the work scope. This report encompasses a period corresponding to data taken during the period from January 1, 2022 through March 31, 2022 as well as an annual summary (Quarter 2, 2021 through Quarter 1, 2022).

2 PROJECT DESCRIPTION

SCPA requested a system to provide ambient air quality data including particulate matter less than 2.5 microns (PM2.5), SO_2, and NO_2 at the Union Pier Terminal of the port of Charleston. Arcadis will maintain the monitoring instruments, stock consumables such as filters and calibration gases, and order spare parts such that downtime will be minimized. Arcadis has established standard operating procedures to perform daily downloads and to provide Level 1 data validation for the resulting data. This monitoring project setup was relatively straightforward, has proven to be reliable, and is generating valid high-quality data suitable for use in dispersion modeling or other potential purposes.

The QAPP may be updated periodically to reflect improvements to the basic operating procedures or to document changes in the air quality standards. This QAPP is written consistent with the current ambient air quality standards for PM, NO_X and SO_2 as defined by the U.S. Environmental Protection Agency.

2.1 Quarterly Results

The 24-hr daily averages for $PM_{2.5}$, NO, NO_2, NO_X, and SO_2 and the maximum daily values for NO_2 (1-hr average) and SO_2 (1-hr and 3-hr average) for this period are shown in Table 2-1. Quarterly statistics showing averages, minimums and maximums for all parameters are summarized in Table 2-2, with the corresponding NAAQS limits shown in Table 2-3. 24-hr averages for all constituents are also shown graphically in Figure 2-1. Maximum 1-hr averages for NO_2 and SO_2 are shown in Figure 2-2.

Statistics for the seventh monitoring year are broken down by months and summarized in Table 2-4. Annual summaries are graphed in Figures 2-3 and 2-4 showing the monthly averages for all constituents and the daily maximum 1-hr averages for NO_2 and SO_2 averaged across the respective month.

Table 2-1. 24-Hour Averages and daily maximums

24-hour Averages						Daily Max 1-hr Avg.		Daily Max 3-hr Avg.
Date	$PM_{2.5}$ ($\mu g/m^3$)	NO (ppb)	NO_2 (ppb)	NO_X (ppb)	SO_2 (ppb)	NO_2 (ppb)	SO_2 (ppb)	SO_2 (ppb)
1/1/22	7.70	0.27	0.06	0.14	0.23	0.73	0.54	0.30
1/2/22	8.64	0.18	0.23	0.28	0.21	4.25	0.34	0.26
1/3/22	6.98	1.40	2.20	3.45	0.25	10.39	0.43	0.29
1/4/22	6.55	1.72	2.73	4.44	0.89	9.24	3.59	1.43
1/5/22	10.30	4.02	7.32	11.26	0.32	17.33	2.16	0.78
1/6/22	12.74	1.69	4.78	6.41	0.40	13.03	2.06	0.97
1/7/22	7.62	1.53	4.75	6.19	0.03	24.51	0.42	0.16
1/8/22	7.36	1.04	2.45	3.38	1.57	11.66	7.31	4.63
1/9/22	12.15	1.42	2.88	4.25	1.01	10.70	3.65	2.04
1/10/22	6.55	1.60	5.28	6.85	0.04	24.19	0.28	0.01

24-hour Averages						Daily Max 1-hr Avg.		Daily Max 3-hr Avg.
Date	$PM_{2.5}$ ($\mu g/m^3$)	NO (ppb)	NO_2 (ppb)	NO_X (ppb)	SO_2 (ppb)	NO_2 (ppb)	SO_2 (ppb)	SO_2 (ppb)
1/11/22	8.93	4.37	6.38	10.71	0.24	26.85	3.89	0.20
1/12/22	6.53	2.60	8.14	10.71	1.40	25.48	4.34	2.68
1/13/22	12.11	7.68	14.20	21.86	1.21	28.05	7.78	2.95
1/14/22	15.91	3.08	11.20	14.24	0.93	31.24	4.87	3.01
1/15/22	15.98	2.22	5.63	7.83	0.25	23.47	3.97	0.08
1/16/22	5.58	0.32	0.49	0.73	0.46	2.47	4.18	2.20
1/17/22	5.53	1.46	1.48	2.83	0.51	4.58	4.17	1.03
1/18/22	9.59	2.55	7.96	10.46	0.89	25.87	3.01	1.47
1/19/22	13.86	16.63	12.94	29.58	1.39	23.53	8.18	4.20
1/20/22	8.79	2.46	7.13	9.40	0.70	19.25	7.23	2.52
1/21/22	5.39	0.56	1.79	2.32	0.30	6.99	2.27	0.88
1/22/22	6.79	0.70	3.48	4.14	0.87	15.63	2.82	1.46
1/23/22	9.24	3.03	7.66	10.67	0.02	23.61	0.25	0.00
1/24/22	9.15	2.03	6.18	8.20	0.54	13.53	3.39	1.65
1/25/22	16.47	2.70	9.42	12.07	0.13	21.74	0.50	0.34
1/26/22	17.99	2.55	5.74	8.29	0.91	22.39	2.15	1.90
1/27/22	7.53	2.46	6.90	9.34	1.11	32.59	5.12	3.05
1/28/22	10.67	2.87	12.28	15.14	1.44	19.69	4.29	3.75
1/29/22	7.28	0.42	2.62	3.04	0.00	11.60	0.01	0.00
1/30/22	7.07	0.61	3.62	4.21	0.02	12.61	0.37	0.16
1/31/22	10.55	10.77	7.99	18.74	0.08	23.04	1.33	0.51
2/1/22	10.57	0.86	3.82	4.65	0.00	18.53	0.00	0.00
2/2/22	7.39	0.94	2.12	3.02	0.00	11.85	0.00	0.00
2/3/22	5.81	0.39	1.58	1.92	0.00	12.07	0.00	0.00
2/4/22	6.83	0.16	1.41	1.05	0.43	3.34	1.13	0.92
2/5/22	4.19	1.24	0.76	1.61	0.63	4.04	0.87	0.72
2/6/22	6.24	0.32	0.34	0.55	0.78	3.41	0.89	0.83
2/7/22	6.31	0.80	1.02	1.76	0.68	3.90	0.79	0.74
2/8/22	11.89	2.58	4.48	7.03	0.86	14.90	1.72	1.23
2/9/22	12.31	2.50	6.30	8.80	0.90	14.10	1.53	1.18
2/10/22	13.00	3.60	5.64	9.16	0.78	22.78	1.06	0.94
2/11/22	16.23	1.91	5.69	7.56	1.03	18.00	1.90	1.55
2/12/22	17.74	1.99	10.49	12.47	1.08	24.47	1.45	1.31
2/13/22	19.33	0.26	0.69	0.82	0.89	10.32	1.22	1.17
2/14/22	8.62	2.98	6.32	9.00	0.96	29.88	1.64	1.29

24-hour Averages						Daily Max 1-hr Avg.		Daily Max 3-hr Avg.
Date	$PM_{2.5}$ ($\mu g/m^3$)	NO (ppb)	NO_2 (ppb)	NO_X (ppb)	SO_2 (ppb)	NO_2 (ppb)	SO_2 (ppb)	SO_2 (ppb)
2/15/22	12.55	1.34	4.81	5.99	0.99	23.17	1.83	1.38
2/16/22	5.85	1.17	3.10	4.21	0.79	15.52	1.00	0.90
2/17/22	6.57	1.32	2.79	3.90	0.76	19.77	1.01	0.94
2/18/22	8.76	0.91	0.16	0.52	0.63	0.94	0.87	0.79
2/19/22	7.92	0.79	1.95	2.57	0.98	7.48	1.81	1.33
2/20/22	8.72	1.41	1.41	2.70	0.92	6.68	1.18	1.09
2/21/22	5.78	2.48	1.86	4.22	0.90	12.44	1.29	1.15
2/22/22	5.39	0.82	1.48	2.17	0.85	10.77	1.00	0.93
2/23/22	8.70	0.74	0.09	0.41	0.90	1.07	1.28	1.18
2/24/22	7.98	2.12	0.58	2.20	0.46	3.27	0.85	0.73
2/25/22	8.73	1.02	0.26	0.93	0.40	2.02	0.68	0.60
2/26/22	11.03	0.29	0.22	0.37	0.45	1.37	1.87	1.02
2/27/22	10.25	1.63	2.80	4.36	0.52	12.87	0.77	0.67
2/28/22	8.77	3.04	3.05	5.91	0.70	11.99	1.29	0.83
3/1/22	11.37	0.67	1.17	1.62	0.61	5.34	0.99	0.81
3/2/22	13.06	1.87	3.18	4.88	0.67	9.56	0.90	0.81
3/3/22	19.95	1.37	1.41	2.67	0.81	6.76	1.23	0.99
3/4/22	18.43	0.52	0.38	0.74	0.63	1.84	1.12	0.95
3/5/22	10.21	0.86	1.00	1.67	0.46	5.62	0.65	0.59
3/6/22	6.22	0.32	0.35	0.44	0.41	2.91	0.61	0.50
3/7/22	7.38	1.27	0.18	0.86	0.38	1.64	0.49	0.43
3/8/22	11.48	0.96	0.85	1.56	0.43	4.02	0.60	0.57
3/9/22	9.90	0.94	2.78	3.47	0.86	7.01	1.13	0.93
3/10/22	7.87	0.73	3.02	3.75	0.85	6.26	1.06	0.89
3/11/22	6.26	1.85	4.93	6.77	0.91	12.92	1.25	0.99
3/12/22	6.95	0.39	1.67	2.06	0.18	5.57	0.85	0.24
3/13/22	5.96	0.46	4.14	4.60	0.62	19.78	1.93	1.75
3/14/22	10.15	8.35	13.51	21.86	0.47	38.24	1.28	0.91
3/15/22	5.48	2.88	9.23	12.11	0.20	20.21	0.59	0.32
3/16/22	5.35	2.59	7.07	9.65	0.12	15.69	0.28	0.18
3/17/22	7.76	1.64	4.60	6.22	0.16	13.13	0.68	0.40
3/18/22	8.42	1.60	6.30	7.90	0.09	18.42	0.16	0.11
3/19/22	7.73	0.97	1.93	2.87	0.10	4.59	0.16	0.14
3/20/22	3.90	0.52	3.05	3.57	0.12	9.70	0.59	0.24
3/21/22	7.78	1.03	5.55	6.58	0.18	14.01	0.41	0.31

24-hour Averages						Daily Max 1-hr Avg.		Daily Max 3-hr Avg.
Date	$PM_{2.5}$ ($\mu g/m^3$)	NO (ppb)	NO_2 (ppb)	NO_X (ppb)	SO_2 (ppb)	NO_2 (ppb)	SO_2 (ppb)	SO_2 (ppb)
3/22/22	6.64	3.09	9.44	12.53	0.15	18.00	0.33	0.19
3/23/22	7.58	1.03	1.21	2.20	0.09	3.49	0.18	0.12
3/24/22	7.45	4.15	5.12	9.20	0.75	10.83	0.89	0.83
3/25/22	7.85	1.61	3.45	4.90	0.92	6.42	1.29	0.99
3/26/22	5.63	0.34	3.12	3.46	0.19	5.39	0.88	0.14
3/27/22	5.55	0.26	2.57	2.82	0.13	5.97	0.30	0.17
3/28/22	9.10	2.79	7.11	9.88	0.31	17.93	0.61	0.44
3/29/22	8.25	0.72	3.29	4.01	0.25	7.51	0.71	0.46
3/30/22	11.56	0.65	2.35	2.99	0.12	7.67	0.28	0.16
3/31/22	14.92	0.57	1.00	1.55	0.06	2.36	0.16	0.10

Table 2-2. Quarterly Statistics

24-hour Averages						Daily Max 1-hr Avg.		Daily Max 3-hr Avg.
Date	$PM_{2.5}$ ($\mu g/m^3$)	NO (ppb)	NO_2 (ppb)	NO_X (ppb)	SO_2 (ppb)	NO_2 (ppb)	SO_2 (ppb)	SO_2 (ppb)
Average	9.30	1.93	4.07	5.89	0.55	13.00	1.65	0.97
Minimum	3.90	0.16	0.06	0.14	0.00	0.73	0.00	0.00
Maximum	19.95	16.63	14.20	29.58	1.57	38.24	8.18	4.63

Table 2-3. National Ambient Air Quality Standards

Pollutant	Primary/ Secondary	Averaging Time	Level	Form
NO_2	Primary	1-hour	100 ppb	98th Percentile, averaged over 3 years
	Primary and Secondary	Annual	53 ppb (1)	Annual Mean
SO_2	Primary	1-hour	75 ppb (2)	99th Percentile of 1-hour daily maximum concentrations, averaged over 3 years
	Secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year
$PM_{2.5}$	Primary	Annual	12 µg/m^3	Annual mean, averaged over 3 years
	Secondary	Annual	15 µg/m^3	Annual mean, averaged over 3 years
	Primary and Secondary	24-hour	35 µg/m^3	98th Percentile, averaged over 3 years

(1) The level of the annual NO_2 standard is 0.053 ppm. It is shown here in terms of ppb for the purposes of clearer comparison to the 1-hour standard level.

(2) The previous SO2 standards (0.14 ppm 24-hour and 0.03 ppm annual) will additionally remain in effect in certain areas: (1) any area for which it is not yet 1 year since the effective date of designation under the current (2010) standards, and (2)any area for which an implementation plan providing for attainment of the current (2010) standard has not been submitted and approved and which is designated nonattainment under the previous SO2 standards or is not meeting the requirements of a SIP call under the previous SO2 standards (40 CFR 50.4(3)). A SIP call is an EPA action requiring a state to resubmit all or part of its State Implementation Plan to demonstrate attainment of the required NAAQS.

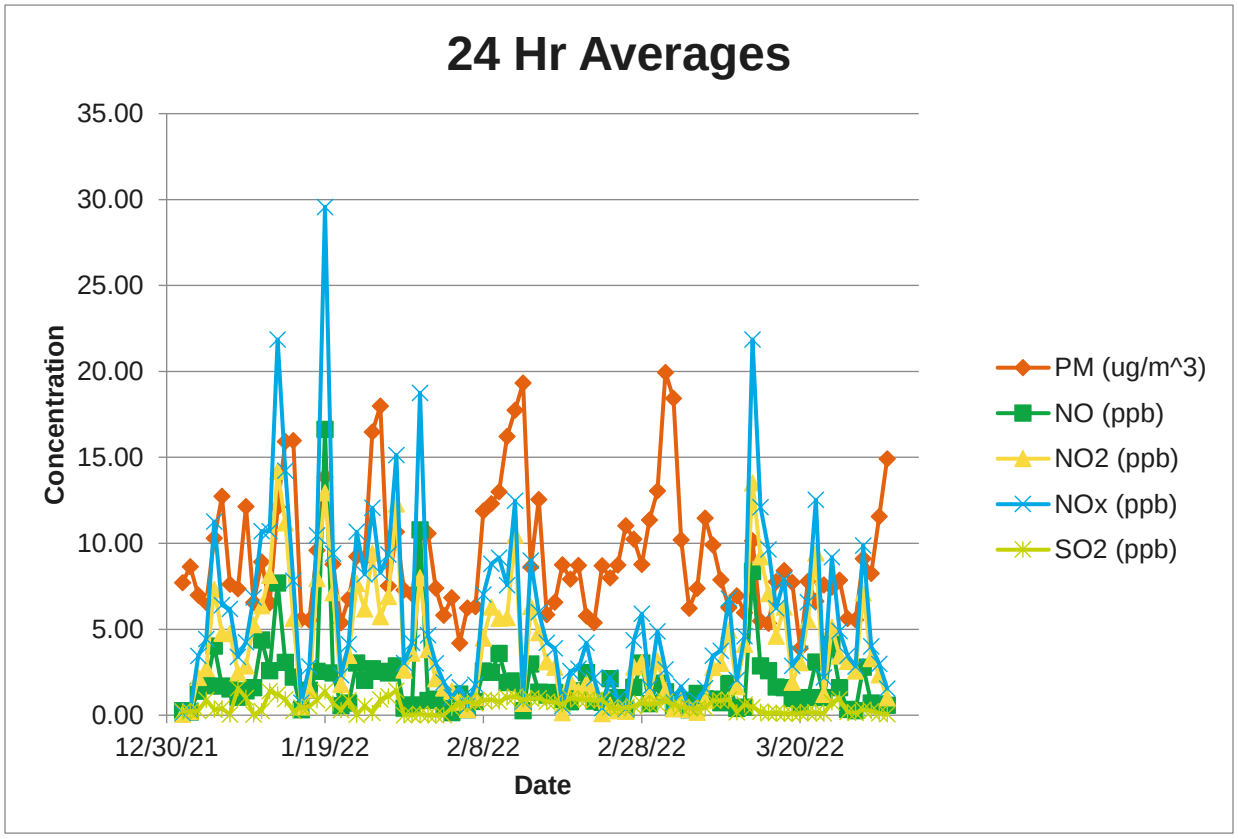

Figure 2-1. 24-hour Averages

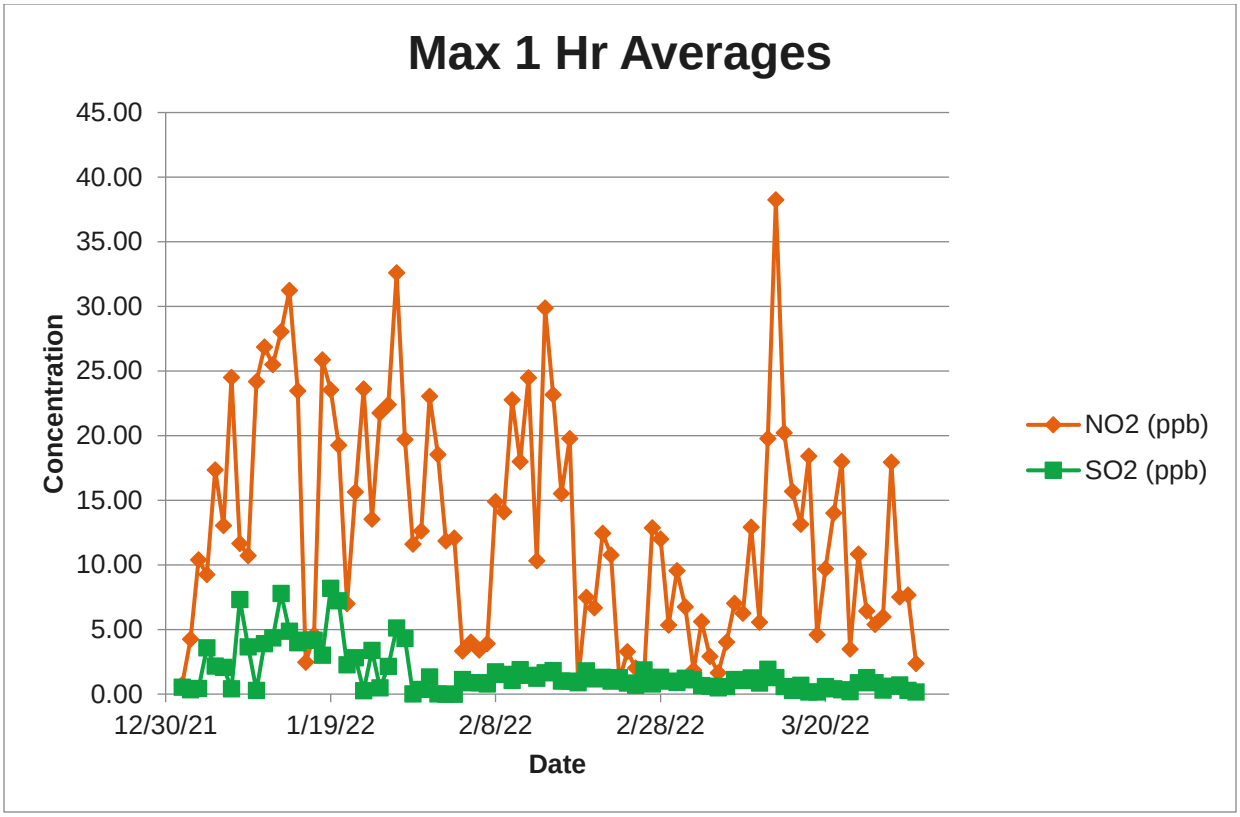

Figure 2-2. Max 1-hour Averages

Table 2-4. Monthly Statistics for the Seventh Monitoring Year

Monthly Averages						Monthly Daily Max 1-hr Avg.		Daily Max 3-hr Avg.
Month	$PM_{2.5}$ ($\mu g/m^3$)	NO (ppb)	NO_2 (ppb)	NO_X (ppb)	SO_2 (ppb)	NO_2 (ppb)	SO_2 (ppb)	SO_2 (ppb)
4/21	9.50	0.90	3.44	4.26	0.06	9.63	0.26	0.17
5/21	11.24	0.70	2.99	3.59	0.33	8.40	1.70	0.91
6/21	8.27	1.07	2.94	3.91	0.15	7.57	0.25	0.20
7/21	8.36	0.89	2.40	3.22	0.12	6.62	0.28	0.21
8/21	9.04	0.86	2.24	3.07	0.19	6.69	0.36	0.26
9/21	7.91	1.18	4.61	5.76	0.36	12.65	0.72	0.56
10/21	6.95	1.36	5.06	6.39	0.20	14.16	0.39	0.30
11/21	9.00	2.19	4.64	6.65	0.21	13.10	0.59	0.43
12/21	10.49	2.07	3.59	5.57	0.31	11.19	0.89	0.62
1/22	9.60	2.81	5.67	8.43	0.59	17.43	3.06	1.45
2/22	9.41	1.41	2.69	3.92	0.69	11.46	1.10	0.91
3/22	8.91	1.52	3.71	5.14	0.39	9.96	0.73	0.54

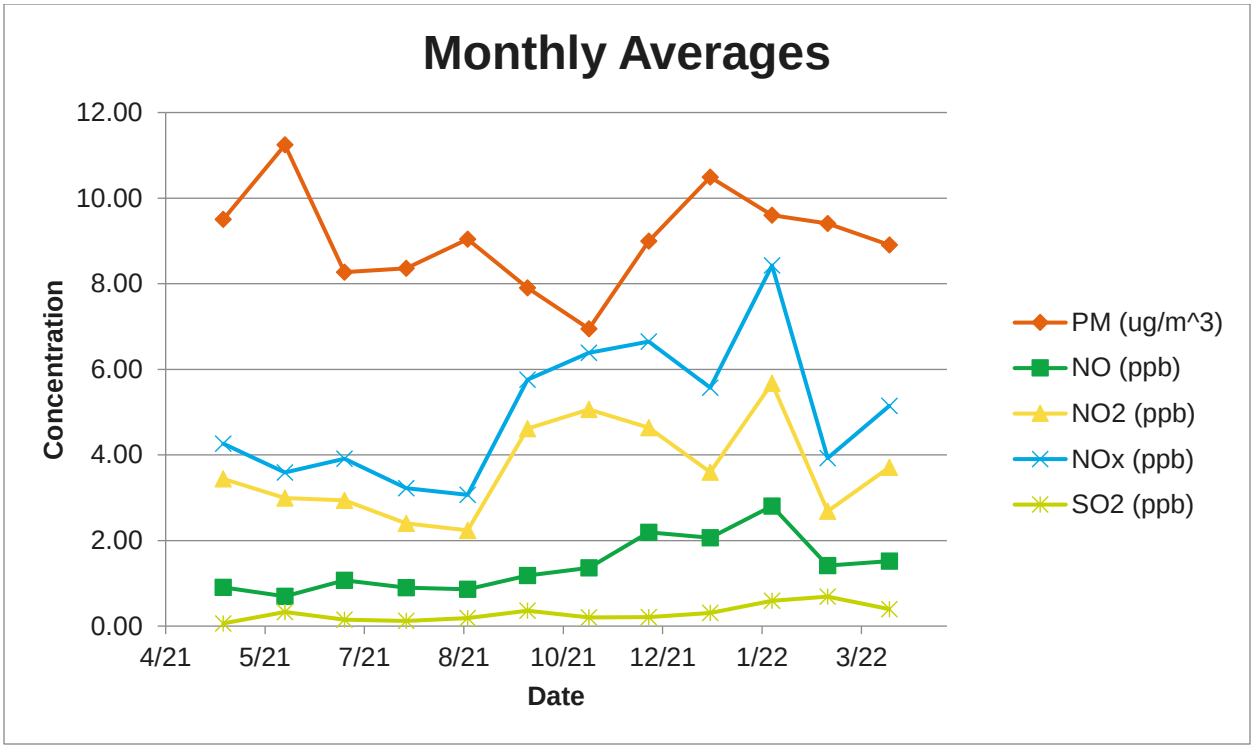

Figure 2-3. Monthly Averages

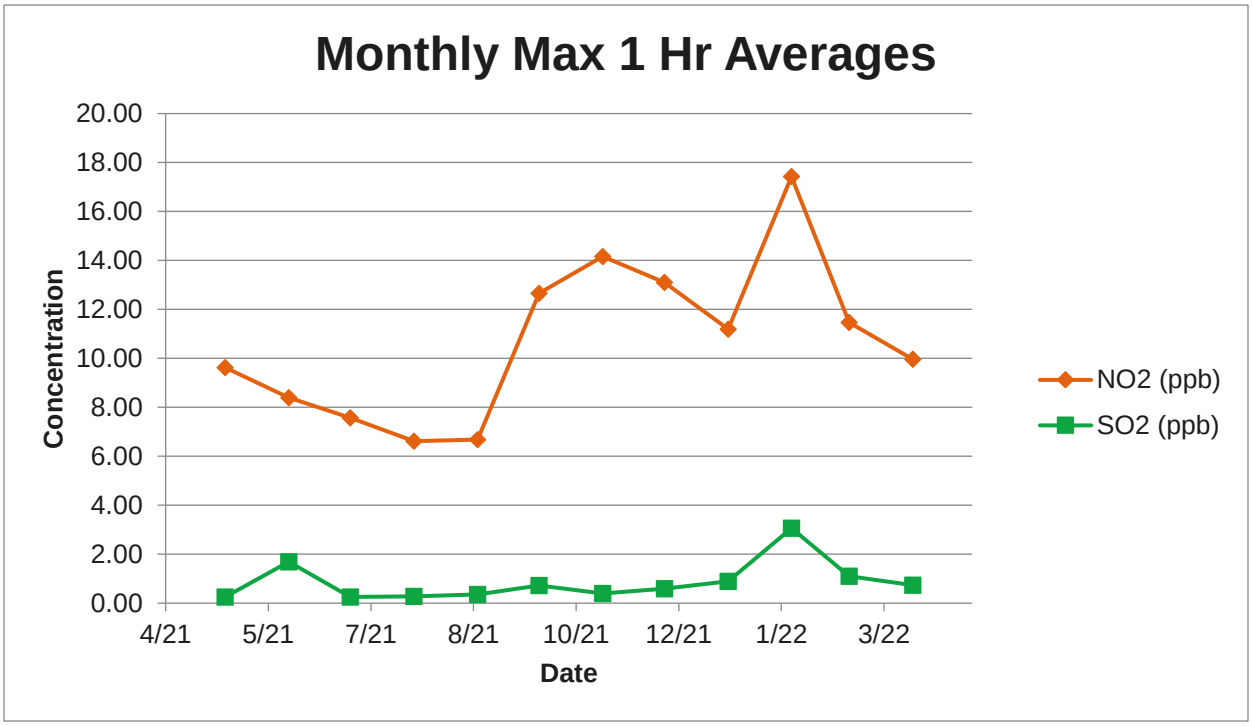

Figure 2-4. Monthly Max 1-hour Averages

3 COMPARISON TO NAAQS

Pollutant levels for all measured components at the Union Pier ambient air monitoring station are below the National Ambient Air Quality Standards (NAAQS). This report marks the start of the eighth year of the Union Pier monitoring station. Many of the NAAQS levels are based on three-year averages. These values have been calculated from the Union Pier data for comparison to the standard.

3.1 NO_2

The primary standard for NO_2 is 53 ppb (annual arithmetic average) or 100 ppb (3-year average of the 98th percentile of the daily maximum 1-hour average must not exceed 100 ppb). Table 2-4 and Figures 2-3 and 2-4 show that the monthly averages and monthly daily maximum 1-hr averages were below 53 ppb for this seventh year of monitoring (as they were for all previous years of monitoring). Table 2-5 presents the NO_2 NAAQS calculations for each standard.

Table 2-5. NO_2 NAAQS Calculations for Union Pier Terminal

Pollutant	Primary/ Secondary	Averaging Time	Level	Form	Union Pier
NO_2	Primary	1-hour	100 ppb	98th Percentile, averaged over 3 years	28.3 ppb
NO_2	Primary and Secondary	Annual	53 ppb	Annual Mean	Year 5: 3.7 ppb Year 6: 3.7 ppb Year 7: 3.7 ppb

3.2 SO_2

The primary standard for SO_2 is 75 ppb (3-year average of the 99th percentile of the daily maximum 1-hour average must not exceed 75 ppb). The secondary standard for SO_2 is 0.5 ppm (500 ppb; 3-hour average not to be exceeded more than once per year). Table 2-4 and Figures 2-3 and 2-4 show that the monthly averages and monthly daily maximum 1-hr averages were below 75 ppb for this seventh year of monitoring (as they were for all previous years of monitoring), and that the secondary standard was never exceeded. Table 2-6 presents the SO_2 NAAQS calculations for each standard.

Table 2-6. SO_2 NAAQS Calculations for Union Pier Terminal

Pollutant	Primary/ Secondary	Averaging Time	Level	Form	Union Pier
SO_2	Primary	1-hour	75 ppb	99th Percentile of 1-hour daily maximum concentrations, averaged over 3 years	4.8 ppb
SO_2	Secondary	3-hour	0.5 ppm (500 ppb)	Not to be exceeded more than once per year	19.8 ppb*

* Maximum from 4/1/2021 to 3/31/2022.

3.3 $PM_{2.5}$

The primary standard for $PM_{2.5}$ is 12.0 µg/m^3 (annual arithmetic average; 3-year average of the weighted annual mean $PM_{2.5}$ concentration must not exceed 12.0 µg/m^3) or 35.0 µg/m^3 (24-hour average; 3-year average of the 98th percentile of the 24-hour concentrations must not exceed 35.0 µg/m^3). The secondary standard for $PM_{2.5}$ is 15.0 µg/m^3 (annual arithmetic average; 3-year average of the weighted annual mean $PM_{2.5}$ concentration must not exceed 15.0 µg/m^3). Table 2-7 presents the $PM_{2.5}$ NAAQS calculations for each standard and shows that the Union Pier Terminal had no exceedances.

Table 2-7. $PM_{2.5}$ NAAQS Calculations for Union Pier Terminal

Pollutant	Primary/ Secondary	Averaging Time	Level	Form	Union Pier
$PM_{2.5}$	Primary	Annual	12 µg/m^3	Annual mean, averaged over 3 years	9.5 µg/m^3
$PM_{2.5}$	Secondary	Annual	15 µg/m^3	Annual mean, averaged over 3 years	9.5 µg/m^3
$PM_{2.5}$	Primary and Secondary	24-hour	35 µg/m^3	98th Percentile, averaged over 3 years	21.4 µg/m^3

4 QUALITY ASSURANCE/QUALITY CONTROL

QA/QC procedures applied to this project are described in a Quality Assurance Plan titled Continuous Air Monitoring Station for the Union Pier Terminal (February 2015, Revision 0).

4.1 Daily and Quarterly QC/Validation

According to the QAP prepared for this work, results are reviewed for anomalies and validated daily. These validations are recorded on QA/QC Daily Comment Sheets. The occurrence and duration of normal calibration and maintenance activities are also recorded.

Daily QC checks were performed in accordance with section 5.1 of the QAPP. The PAC Display data logging software is remotely accessed from the ARCADIS office in Durham, NC where the instrumentation is monitored for alarms and the data trends are reviewed for irregularities. NO_x and SO_2 zero and calibration values displayed on the PAC Display screen from the previous calibration event are recorded in the QC Log Book. After checking the PAC Display system for any anomalies, the H05 raw data file from the previous day is downloaded to Arcadis' Durham, NC server. The data file is saved to the project folder on the server and then processed by a Microsoft Excel macro. The resulting Excel file provides values for daily averages and maxima as well as alarm and calibration information. This information is recorded on the daily QC log sheet. Comments and observations regarding data quality are noted on the QC log sheet and are also entered on the SCPA QA/QC Daily Comment Sheet. The Project Manager is notified of any issues immediately.

Percent completeness for Quarter 1 was calculated by dividing both the number of hours flagged by the macro as "Insufficient Data" as well as hours for which no data was obtained by the total number of hours in the quarter. Each of the three instruments (5014i, 42i, and 43i) typically produces 24 hours of data each day, for a total of 72 hours per day of recorded data. One daily Excel file per week was validated by verifying the formulas and inputs used in the Microsoft Excel macro calculations are correct. The ranges used to calculate the $PM_{2.5}$ 24-hour average, NO_2 Daily Max 1-hour average, SO_2 Daily Max 1-hour average, and the 24-hour averages for PM, NO, NO_2, NO_x, and SO_2 were checked during each validation. Four random hourly average ranges for PM, NO, NO_2, NO_x, and SO_2 were also checked during each validation.

The quarterly data was assessed as follows:

- Percent completeness for Quarter 1 was 98.94%.
- 100% of the validated Quarter 1 data was flagged as "good

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