

SOUTH CAROLINA PORTS AUTHORITY



**SOUTH
CAROLINA
PORTS**

Continuous Air Monitoring Station for the Union
Pier Terminal

Q1 2023 Quarterly Report and Annual
Summary

June 2023

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

**Q1 2023 Quarterly Report and Annual
Summary**

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CONTENTS

1	Executive Summary	1
2	Project Description	2
2.1	Quarterly Results	2
3	Comparison to NAAQS	9
3.1	NO ₂	9
3.2	SO ₂	9
3.3	PM _{2.5}	10
4	Quality Assurance/Quality Control	11
4.1	Daily and Quarterly QC/Validation	11

TABLES

Table 2-1.	24-Hour Averages and daily maximums	2
Table 2-2.	Quarterly Statistics	5
Table 2-3.	National Ambient Air Quality Standards	6
Table 2-4.	Monthly Statistics for the Eighth Monitoring Year	7
Table 2-5.	NO ₂ NAAQS Calculations for Union Pier Terminal	9
Table 2-6.	SO ₂ NAAQS Calculations for Union Pier Terminal	9
Table 2-7.	PM _{2.5} NAAQS Calculations for Union Pier Terminal	10

FIGURES

Figure 2-1.	24-hour Averages	6
Figure 2-2.	Max 1-hour Averages	7
Figure 2-3.	Monthly Averages.....	8
Figure 2-4.	Monthly Max 1-hour Averages	8

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 33rd quarterly data report (first quarterly report in year nine 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, 2023 through March 31, 2023 as well as an annual summary of the eighth complete year of operations (Quarter 2, 2022 through Quarter 1, 2023).

2 PROJECT DESCRIPTION

SCPA requested a system to provide ambient air quality data including particulate matter less than 2.5 microns (PM_{2.5}), SO₂, and NO₂ 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 SO₂ as defined by the U.S. Environmental Protection Agency.

2.1 Quarterly Results

The 24-hr daily averages for PM_{2.5}, NO, NO₂, NO_x, and SO₂ and the maximum daily values for NO₂ (1-hr average) and SO₂ (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 NO₂ and SO₂ are shown in Figure 2-2.

Statistics for the eighth 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 NO₂ and SO₂ averaged across the respective month.

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

Date	24-hour Averages					Daily Max 1-hr Avg.		Daily Max 3-hr Avg.
	PM _{2.5} (µg/m ³)	NO (ppb)	NO ₂ (ppb)	NO _x (ppb)	SO ₂ (ppb)	NO ₂ (ppb)	SO ₂ (ppb)	SO ₂ (ppb)
1/1/23	*	0.64	2.29	2.92	0.13	4.31	0.21	0.17
1/2/23	17.58	4.55	7.01	11.55	0.19	13.68	0.46	0.37
1/3/23	8.77	6.02	4.47	10.30	0.22	14.29	0.43	0.30
1/4/23	7.89	0.57	0.09	0.22	0.13	1.28	0.57	0.28
1/5/23	4.84	1.61	3.62	5.06	0.10	5.65	0.42	0.23
1/6/23	7.77	0.96	6.00	6.84	0.23	14.08	0.52	0.29
1/7/23	12.31	3.14	9.90	13.01	0.29	22.80	0.55	0.46
1/8/23	12.75	3.03	8.85	11.86	0.29	24.59	0.60	0.44
1/9/23	8.36	0.57	5.89	6.41	0.30	14.62	0.63	0.49
1/10/23	11.83	8.45	10.39	18.83	0.34	21.62	0.72	0.58

Q1 2023 Report and Annual Summary

24-hour Averages						Daily Max 1-hr Avg.		Daily Max 3-hr Avg.
Date	PM _{2.5} (µg/m ³)	NO (ppb)	NO ₂ (ppb)	NO _x (ppb)	SO ₂ (ppb)	NO ₂ (ppb)	SO ₂ (ppb)	SO ₂ (ppb)
1/11/23	18.88	1.28	7.42	8.64	0.37	14.15	0.74	0.67
1/12/23	9.48	1.19	3.70	4.80	0.32	7.75	0.75	0.57
1/13/23	3.28	0.64	2.90	3.49	0.21	4.42	0.28	0.24
1/14/23	4.67	0.34	3.26	3.58	0.30	5.19	0.52	0.43
1/15/23	7.56	0.81	7.40	8.20	0.62	18.45	1.48	1.03
1/16/23	7.88	3.25	8.99	12.18	0.51	15.92	1.22	0.72
1/17/23	10.23	0.88	5.20	6.06	0.46	11.17	0.79	0.72
1/18/23	10.00	1.34	4.14	5.36	0.28	7.66	0.38	0.36
1/19/23	13.73	0.47	2.66	3.10	0.27	5.85	0.45	0.42
1/20/23	7.32	0.95	4.60	5.48	0.27	9.28	0.40	0.28
1/21/23	8.21	0.87	4.02	4.85	0.30	7.27	0.50	0.37
1/22/23	8.27	1.30	4.99	6.28	0.26	13.18	0.40	0.32
1/23/23	3.68	1.09	3.19	4.14	0.25	5.96	0.32	0.30
1/24/23	5.22	1.04	4.80	5.82	0.35	15.06	0.62	0.49
1/25/23	10.98	0.57	2.97	3.49	0.23	18.79	0.42	0.31
1/26/23	3.21	2.38	3.58	5.60	0.24	6.43	0.29	0.27
1/27/23	8.40	1.01	5.98	6.96	0.31	13.31	0.53	0.34
1/28/23	8.89	1.42	8.95	10.35	0.62	20.26	2.45	1.87
1/29/23	9.97	0.49	5.83	6.30	0.37	11.51	0.64	0.58
1/30/23	6.67	5.58	10.40	15.95	0.30	18.88	0.42	0.37
1/31/23	8.12	2.89	6.54	9.35	0.25	13.58	0.43	0.35
2/1/23	7.57	1.33	3.25	4.54	0.21	8.15	0.30	0.29
2/2/23	6.60	2.43	4.32	6.74	0.23	9.51	0.33	0.29
2/3/23	4.61	1.44	8.16	9.59	0.42	17.81	0.91	0.72
2/4/23	5.11	0.91	3.55	4.43	0.48	7.91	1.14	0.78
2/5/23	4.69	1.11	5.77	6.86	0.29	10.52	0.38	0.32
2/6/23	7.59	1.50	7.38	8.87	0.54	19.77	2.35	1.28
2/7/23	10.37	11.57	11.10	22.66	0.50	23.28	0.93	0.78
2/8/23	8.83	10.06	11.00	21.06	0.51	24.36	1.16	0.97
2/9/23	7.48	2.93	5.95	8.79	0.31	21.44	0.58	0.38
2/10/23	8.13	0.87	0.98	1.74	0.27	2.70	0.40	0.38
2/11/23	3.12	0.34	2.06	2.35	0.22	7.54	0.33	0.29
2/12/23	3.41	0.27	2.05	2.28	0.24	4.37	0.37	0.27
2/13/23	8.49	3.09	5.01	7.71	0.35	8.02	0.54	0.47
2/14/23	7.58	1.76	6.86	8.58	0.39	21.20	0.80	0.59

Q1 2023 Report and Annual Summary

24-hour Averages						Daily Max 1-hr Avg.		Daily Max 3-hr Avg.
Date	PM _{2.5} (µg/m ³)	NO (ppb)	NO ₂ (ppb)	NO _x (ppb)	SO ₂ (ppb)	NO ₂ (ppb)	SO ₂ (ppb)	SO ₂ (ppb)
2/15/23	8.19	5.41	7.79	13.07	0.35	30.72	0.62	0.49
2/16/23	5.78	0.79	3.47	4.17	0.26	9.28	0.39	0.33
2/17/23	6.22	0.74	2.45	3.12	0.23	3.53	0.33	0.29
2/18/23	5.17	4.06	3.64	7.63	0.35	16.79	0.71	0.44
2/19/23	8.80	0.24	3.97	4.17	0.35	10.70	0.57	0.49
2/20/23	10.02	0.70	3.68	4.35	0.43	8.92	0.74	0.70
2/21/23	13.71	0.81	3.12	3.85	0.33	5.20	0.41	0.38
2/22/23	11.98	1.06	2.70	3.65	0.31	5.86	0.44	0.39
2/23/23	14.08	1.61	3.08	4.52	0.34	6.04	0.57	0.51
2/24/23	16.32	1.37	4.92	6.24	0.35	14.63	0.85	0.63
2/25/23	9.91	1.19	4.78	5.94	0.26	11.89	0.45	0.38
2/26/23	12.49	1.49	3.03	4.48	0.24	9.69	0.33	0.30
2/27/23	9.62	8.08	4.35	12.29	0.30	15.44	0.96	0.63
2/28/23	15.69	1.01	3.62	4.52	0.25	6.62	0.33	0.31
3/1/23	19.46	2.54	4.58	6.97	0.30	14.16	0.53	0.46
3/2/23	9.99	2.73	3.99	6.24	0.29	8.31	0.45	0.40
3/3/23	16.75	2.35	2.91	4.86	0.30	7.67	0.51	0.43
3/4/23	8.43	1.35	3.41	4.66	0.29	6.90	0.39	0.35
3/5/23	6.39	0.90	2.23	3.10	0.35	5.32	0.46	0.43
3/6/23	8.20	0.80	2.74	3.51	0.28	7.74	0.36	0.34
3/7/23	13.39	1.09	5.45	6.32	0.39	17.71	0.93	0.60
3/8/23	10.48	0.72	3.75	4.44	0.49	18.10	0.89	0.78
3/9/23	8.02	4.37	5.05	9.39	0.49	18.10	0.67	0.56
3/10/23	12.55	2.80	2.56	5.18	0.32	6.05	0.47	0.41
3/11/23	18.05	0.78	4.68	5.30	0.47	12.99	1.46	1.06
3/12/23	11.03	0.10	1.68	1.71	0.31	4.68	0.47	0.38
3/13/23	5.13	1.10	4.44	5.50	0.06	9.41	0.27	0.05
3/14/23	8.81	0.91	5.12	5.97	0.18	11.37	1.05	0.49
3/15/23	11.09	1.02	7.09	8.10	0.25	27.25	1.34	0.71
3/16/23	19.33	4.00	10.49	14.48	0.23	27.71	0.98	0.66
3/17/23	10.58	0.57	2.37	2.86	0.06	4.24	0.11	0.09
3/18/23	4.14	0.89	2.15	2.93	0.02	3.94	0.04	0.03
3/19/23	6.78	0.33	2.82	3.15	0.17	8.04	0.87	0.45
3/20/23	15.88	0.39	2.62	3.01	0.14	5.59	0.64	0.31
3/21/23	12.68	0.67	3.41	4.07	0.08	9.93	0.19	0.13

24-hour Averages						Daily Max 1-hr Avg.		Daily Max 3-hr Avg.
Date	PM _{2.5} (µg/m ³)	NO (ppb)	NO ₂ (ppb)	NO _x (ppb)	SO ₂ (ppb)	NO ₂ (ppb)	SO ₂ (ppb)	SO ₂ (ppb)
3/22/23	10.50	0.98	5.33	6.30	0.05	13.86	0.08	0.07
3/23/23	5.94	3.54	4.26	7.61	0.03	22.11	0.07	0.07
3/24/23	10.99	1.29	2.34	3.49	0.04	5.71	0.11	0.09
3/25/23	14.25	0.28	1.32	1.59	0.02	1.87	0.04	0.02
3/26/23	^	^	^	^	^	^	^	^
3/27/23	7.34	4.72	3.84	8.26	0.03	8.35	0.15	0.06
3/28/23	8.87	1.77	3.88	5.62	0.02	14.85	0.04	0.03
3/29/23	6.61	0.31	2.05	2.35	0.02	4.84	0.04	0.03
3/30/23	10.08	1.81	7.58	9.36	0.30	26.95	0.96	0.68
3/31/23	9.24	0.83	4.40	5.23	0.14	12.81	0.20	0.16

* 5014i instrument failure

^ Data acquisition error due to computer software update

Table 2-2. Quarterly Statistics

24-hour Averages						Daily Max 1-hr Avg.		Daily Max 3-hr Avg.
Date	PM _{2.5} (µg/m ³)	NO (ppb)	NO ₂ (ppb)	NO _x (ppb)	SO ₂ (ppb)	NO ₂ (ppb)	SO ₂ (ppb)	SO ₂ (ppb)
Average	9.42	1.95	4.73	6.59	0.28	12.02	0.59	0.44
Minimum	3.12	0.10	0.09	0.22	0.02	1.28	0.04	0.02
Maximum	19.46	11.57	11.10	22.66	0.62	30.72	2.45	1.87

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 NO₂ 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.

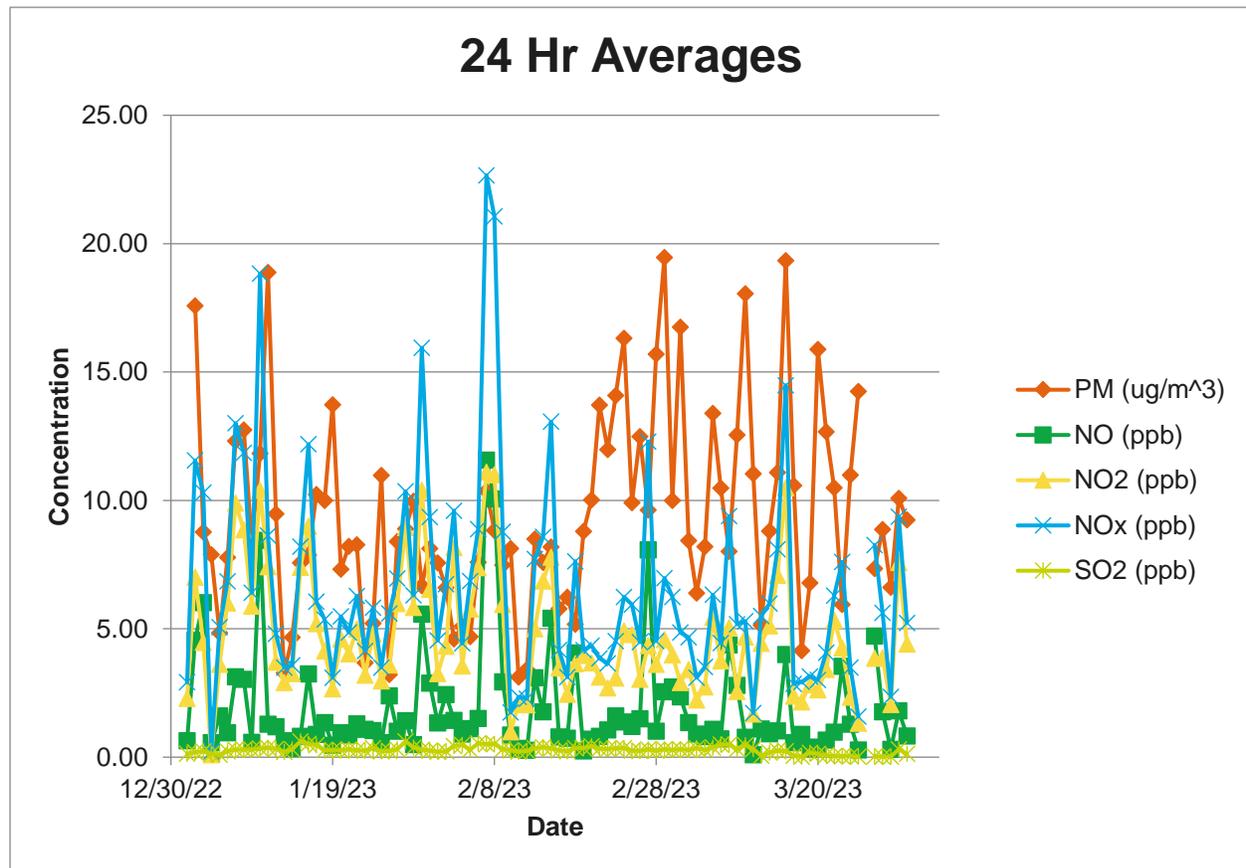


Figure 2-1. 24-hour Averages

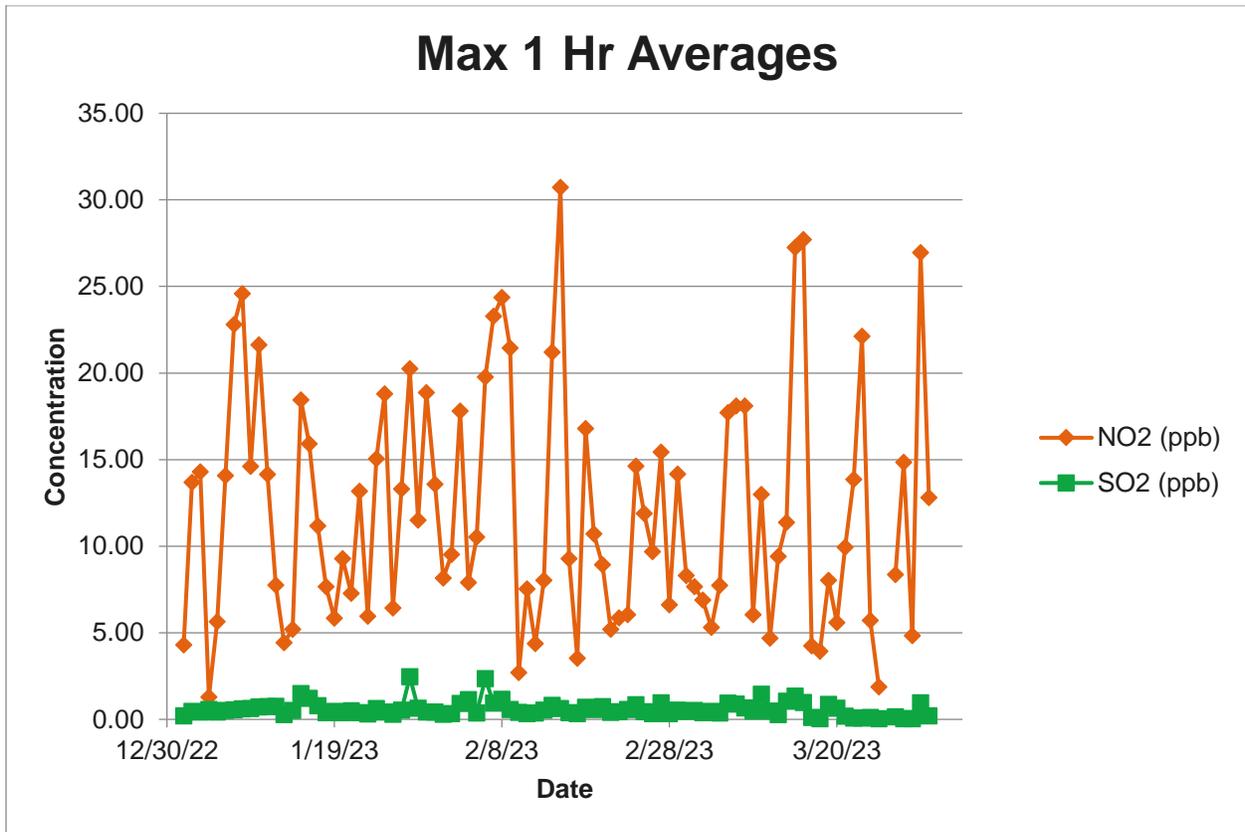


Figure 2-2. Max 1-hour Averages

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

Month	Monthly Averages					Monthly Daily Max 1-hr Avg.		Daily Max 3-hr Avg.
	PM _{2.5} (µg/m ³)	NO (ppb)	NO ₂ (ppb)	NO _x (ppb)	SO ₂ (ppb)	NO ₂ (ppb)	SO ₂ (ppb)	SO ₂ (ppb)
4/22	7.48	1.89	4.06	5.89	0.39	11.99	0.80	0.57
5/22	8.74	1.86	3.25	5.05	0.15	8.13	0.39	0.26
6/22	7.71	1.61	3.16	4.70	0.23	10.84	0.90	0.49
7/22	7.32	1.21	2.21	3.36	0.30	5.88	0.50	0.41
8/22	8.31	1.81	3.35	5.09	0.45	9.37	1.10	0.78
9/22	7.39	1.26	3.74	4.94	0.51	10.84	0.80	0.65
10/22	9.42	2.33	6.09	8.37	0.77	16.04	1.37	1.11
11/22	8.45	1.59	5.44	7.00	0.36	12.55	0.71	0.54
12/22	7.77	2.06	5.86	7.89	0.31	13.72	0.69	0.48
1/23	8.89	1.91	5.48	7.32	0.30	12.29	0.62	0.47
2/23	8.63	2.44	4.72	7.08	0.33	12.21	0.65	0.50
3/23	10.70	1.53	3.95	5.39	0.20	11.55	0.49	0.34

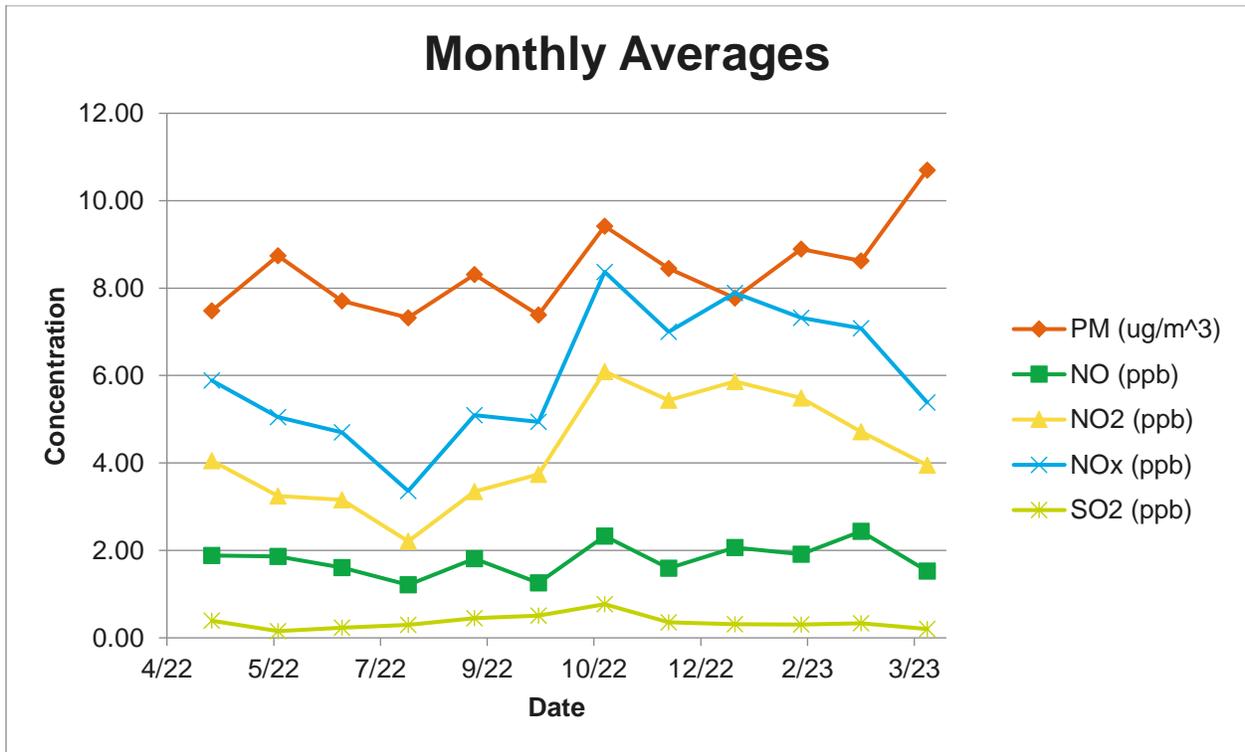


Figure 2-3. Monthly Averages

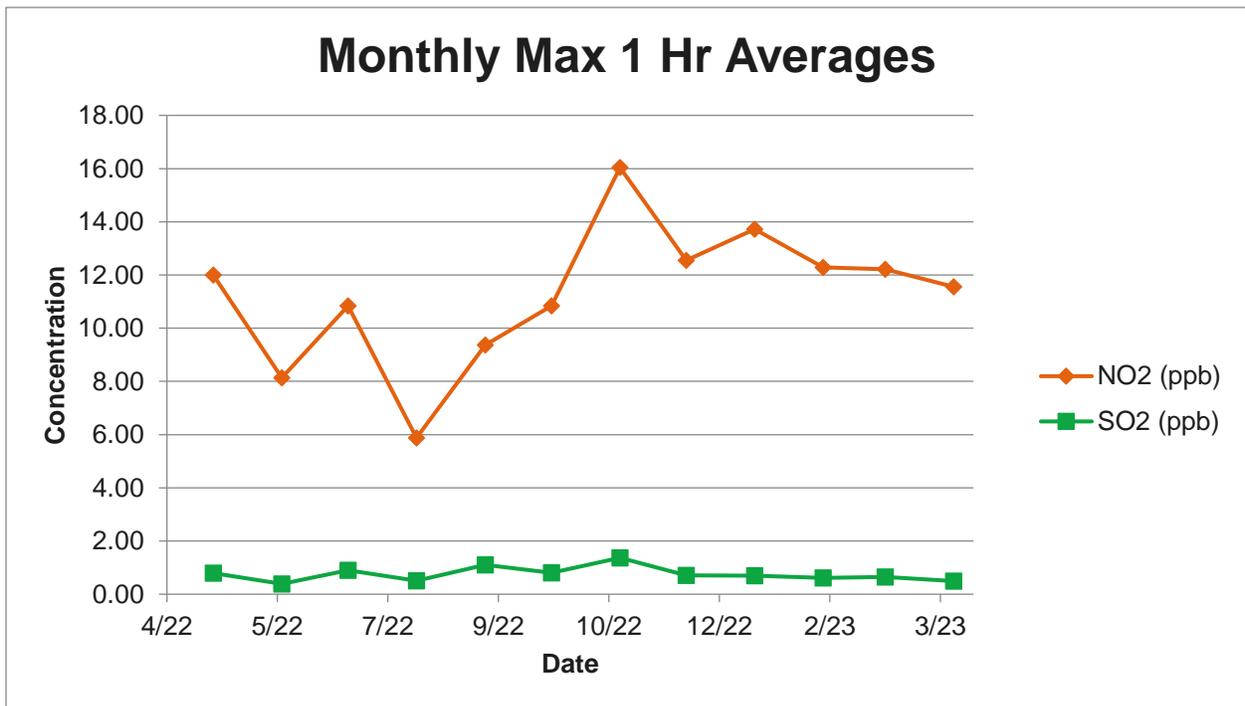


Figure 2-4. Monthly Max 1-hour Averages

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 ninth 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 NO₂

The primary standard for NO₂ 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 eighth year of monitoring (as they were for all previous years of monitoring). Table 2-5 presents the NO₂ NAAQS calculations for each standard.

Table 2-5. NO₂ 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	28.5 ppb
NO ₂	Primary and Secondary	Annual	53 ppb	Annual Mean	Year 6: 3.7 ppb Year 7: 3.7 ppb Year 8: 4.3 ppb

3.2 SO₂

The primary standard for SO₂ 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 SO₂ 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 eighth 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 SO₂ NAAQS calculations for each standard.

Table 2-6. SO₂ 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	4.9 ppb
SO ₂	Secondary	3-hour	0.5 ppm (500 ppb)	Not to be exceeded more than once per year	5.4 ppb*

* Maximum from 4/1/2022 to 3/31/2023.

3.3 PM_{2.5}

The primary standard for PM_{2.5} is 12.0 µg/m³ (annual arithmetic average; 3-year average of the weighted annual mean PM_{2.5} concentration must not exceed 12.0 µg/m³) or 35.0 µg/m³ (24-hour average; 3-year average of the 98th percentile of the 24-hour concentrations must not exceed 35.0 µg/m³). The secondary standard for PM_{2.5} is 15.0 µg/m³ (annual arithmetic average; 3-year average of the weighted annual mean PM_{2.5} concentration must not exceed 15.0 µg/m³). 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	9.2 µg/m ³
PM _{2.5}	Secondary	Annual	15 µg/m ³	Annual mean, averaged over 3 years	9.2 µg/m ³
PM _{2.5}	Primary and Secondary	24-hour	35 µg/m ³	98th Percentile, averaged over 3 years	21.1 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 SO₂ 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, NO₂ Daily Max 1-hour average, SO₂ Daily Max 1-hour average, and the 24-hour averages for PM, NO, NO₂, NO_x, and SO₂ were checked during each validation. Four random hourly average ranges for PM, NO, NO₂, NO_x, and SO₂ were also checked during each validation.

The quarterly data was assessed as follows:

- Percent completeness for Quarter 1 was 96.54%.
- 100% of the validated Quarter 1 data was flagged as "good".

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