ARCADIS Design & Consultancy for natural and built assets

SOUTH CAROLINA PORTS AUTHORITY

SOUTH CAROLINA PORTS

Continuous Air Monitoring Station for the Union Pier Terminal

Q1 2018 Quarterly Report and Annual Summary

May 2018

,

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

Q1 2018 Quarterly Report and Annual Summary

Prepared for:

South Carolina Ports Authority

176 Concord Street

Charleston

South Carolina 29401

Prepared by:

Arcadis U.S., Inc.

4915 Prospectus Drive

Suite F

Durham

North Carolina 27713

Tel 919 544 4535

Fax 919 544 5690

Our Ref.:
RN006310

Date:
May 2018

CONTENTS

TABLES

FIGURES

1 EXECUTIVE SUMMARY

Arcadis was contracted in late October 2014 to provide Continuous Air Monitoring Services to the South Carolina State Ports Authority (SCSPA) 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 13th quarterly data report (first quarterly report in year four of operations) and presents the data summaries requested by SCSPA and described in the work scope. This report encompasses a period corresponding to data taken during the period from January 1, 2018 through March 31, 2018 as well as an annual summary.

2 PROJECT DESCRIPTION

SCSPA requested a system to provide ambient air quality data including particulate matter less than 2.5 microns (PM2.5), SO2, and NO2 for a period of 2 years (to be decommissioned no later than February 15, 2017) 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, NOX 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, 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 are broken down by months and summarized in Table 2-4.

Statistics for the third 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)
1/1/18	6.26	0.03	1.30	1.22	0.25	2.20	0.35	0.31
1/2/18	9.88	1.04	4.21	5.21	0.37	6.63	0.84	0.52
1/3/18	6.37	0.64	5.52	6.16	0.31	11.48	0.54	0.46
1/4/18	12.32	2.48	7.62	10.07	0.39	11.62	0.67	0.64
1/5/18	11.38	7.57	13.14	20.50	0.44	35.26	1.71	0.77
1/6/18	9.26	1.79	7.34	9.11	0.57	17.27	1.74	1.47
1/7/18	5.50	0.76	4.36	5.05	0.48	12.01	1.04	0.73
1/8/18	7.14	2.49	10.42	12.87	0.38	16.73	1.28	0.87
1/9/18	6.85	4.34	9.47	13.79	0.28	18.81	0.57	0.53

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)
1/10/18	6.67	0.92	4.05	4.94	0.14	12.34	0.17	0.16
1/11/18	4.72	2.40	2.73	5.08	0.12	9.37	0.21	0.16
1/12/18	4.87	1.11	3.48	4.46	0.09	10.00	0.14	0.10
1/13/18	7.12	1.65	3.98	5.43	0.14	11.38	0.24	0.18
1/14/18	5.34	0.82	3.51	4.32	0.24	8.22	0.61	0.40
1/15/18	9.09	1.83	7.21	9.02	0.63	17.94	1.83	1.20
1/16/18	12.59	1.91	9.15	11.05	0.34	19.51	0.98	0.68
1/17/18	13.77	10.12	12.59	22.63	0.31	26.50	0.70	0.59
1/18/18	9.49	2.19	9.72	11.79	0.29	29.12	0.62	0.48
1/19/18	13.09	2.83	9.41	12.03	0.32	18.82	0.72	0.53
1/20/18	17.17	2.83	8.25	10.66	0.54	13.05	1.00	0.80
1/21/18	26.22	2.32	11.50	13.81	0.77	29.40	2.65	1.70
1/22/18	21.95	6.41	12.72	19.09	0.30	24.15	0.60	0.51
1/23/18	6.45	1.83	3.67	5.13	0.16	8.57	0.28	0.20
1/24/18	8.20	2.22	6.43	8.52	0.51	16.51	3.69	2.30
1/25/18	6.89	0.86	5.96	6.81	0.37	10.83	1.19	0.70
1/26/18	8.19	1.61	6.70	8.29	0.28	15.19	0.40	0.38
1/27/18	4.55	1.46	6.41	7.85	0.27	12.05	0.46	0.39
1/28/18	3.62	0.89	6.26	7.14	0.19	15.39	0.26	0.22
1/29/18	6.23	0.91	5.57	6.43	0.21	11.13	0.30	0.28
1/30/18	7.17	1.62	8.98	10.54	0.66	26.88	1.72	1.35
1/31/18	7.87	2.82	9.42	12.13	0.38	32.34	0.89	0.69
2/1/18	*	11.98	12.92	24.71	0.39	29.89	0.69	0.56
2/2/18	*	0.75	4.35	5.04	0.50	11.36	2.65	1.48
2/3/18	*	0.97	2.87	3.82	0.31	5.10	0.55	0.44
2/4/18	*	0.29	2.32	2.59	0.22	8.52	0.27	0.24
2/5/18	*	1.53	4.53	6.00	0.36	7.68	1.82	1.07
2/6/18	*	16.64	12.61	29.12	0.04	23.38	0.24	0.07
2/7/18	*	0.36	1.35	1.58	0.23	7.76	0.33	0.31
2/8/18	*	0.85	2.05	2.84	0.25	5.80	0.38	0.32
2/9/18	*	0.83	2.86	3.59	0.26	8.89	0.32	0.31
2/10/18	*	0.42	1.25	1.58	0.24	5.00	0.29	0.28
2/11/18	*	0.50	0.22	0.52	0.20	1.26	0.25	0.22
2/12/18	*	2.15	4.92	6.99	0.22	9.56	0.28	0.24
2/13/18	*	2.28	5.06	7.35	0.23	11.63	0.30	0.29
2/14/18	*	4.02	7.77	11.70	0.75	14.02	5.21	2.96

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)
2/15/18	*	1.62	3.67	5.09	0.39	6.62	0.77	0.74
2/16/18	*	1.98	3.53	5.34	0.28	6.31	0.41	0.35
2/17/18	*	0.86	2.82	3.67	0.04	5.34	0.29	0.01
2/18/18	*	1.00	2.48	3.47	0.01	8.42	0.06	0.04
2/19/18	*	1.40	5.09	6.47	0.02	11.85	0.04	0.03
2/20/18	*	1.78	4.38	6.13	0.16	10.42	0.25	0.19
2/21/18	*	3.88	4.08	7.88	0.10	11.83	0.18	0.12
2/22/18	*	1.37	3.79	5.06	0.10	9.22	0.15	0.13
2/23/18	1.07	3.48	3.88	7.30	0.96	14.47	1.24	1.13
2/24/18	3.65	0.40	0.40	0.64	0.19	2.20	0.95	0.15
2/25/18	6.28	0.33	0.93	1.12	0.14	5.71	0.24	0.20
2/26/18	8.98	3.01	6.21	9.09	0.21	15.76	0.59	0.47
2/27/18	5.57	0.67	0.74	1.33	0.17	4.24	0.30	0.24
2/28/18	5.45	0.97	3.37	4.30	0.16	16.96	0.25	0.20
3/1/18	8.76	1.28	0.54	1.38	0.13	2.43	0.18	0.17
3/2/18	5.88	1.34	3.22	4.34	0.19	14.04	0.75	0.41
3/3/18	7.16	0.81	3.27	4.02	0.40	15.49	0.83	0.63
3/4/18	11.41	1.45	7.67	9.11	0.48	28.63	0.73	0.62
3/5/18	14.60	3.67	10.54	14.18	0.52	28.25	3.19	1.86
3/6/18	7.96	1.37	2.35	3.48	0.21	8.20	0.35	0.30
3/7/18	8.96	1.41	1.84	2.99	0.59	4.68	0.74	0.70
3/8/18	13.45	1.53	3.62	5.04	0.77	8.35	1.63	1.42
3/9/18	17.27	1.81	3.29	4.76	0.70	9.61	0.94	0.84
3/10/18	13.62	1.62	3.34	4.78	0.78	9.15	1.45	1.19
3/11/18	7.95	4.46	9.68	14.12	0.73	23.83	1.38	1.04
3/12/18	9.14	1.11	2.08	3.12	0.53	6.26	0.60	0.55
3/13/18	10.22	3.81	5.13	8.17	0.77	14.34	3.11	1.72
3/14/18	9.12	2.04	3.05	4.73	0.64	7.37	0.94	0.83
3/15/18	9.86	3.77	3.74	6.81	0.76	12.76	1.07	0.98
3/16/18	27.15	1.22	3.75	4.76	0.37	8.34	1.05	0.38
3/17/18	25.11	0.52	2.80	3.30	0.32	13.80	0.69	0.56
3/18/18	13.42	0.71	1.05	1.67	0.19	4.63	0.74	0.60
3/19/18	5.52	0.52	2.02	2.49	0.08	7.13	0.12	0.10
3/20/18	8.42	1.29	0.75	1.76	0.07	4.32	0.12	0.09
3/21/18	6.77	1.59	1.21	2.27	0.08	4.74	0.12	0.10
3/22/18	8.33	1.98	3.64	5.40	0.12	10.20	0.19	0.17

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)
3/23/18	11.86	1.28	5.59	6.63	0.20	16.49	0.65	0.37
3/24/18	11.99	0.58	2.03	2.56	0.17	9.20	0.33	0.28
3/25/18	9.62	0.65	1.16	1.75	0.11	5.37	0.23	0.20
3/26/18	8.16	0.88	1.06	1.85	0.12	4.33	0.21	0.18
3/27/18	13.08	0.64	1.35	1.95	0.11	4.33	0.15	0.13
3/28/18	8.07	1.21	2.30	3.19	0.12	9.37	0.26	0.18
3/29/18	5.36	1.46	1.00	1.93	0.10	5.24	0.15	0.14
3/30/18	8.49	2.02	1.49	3.04	0.08	5.41	0.12	0.10
3/31/18	7.13	0.66	1.57	2.13	0.12	13.03	0.16	0.14

* Pump failure.

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	9.58	2.09	4.75	6.70	0.32	12.32	0.79	0.56
Minimum	1.07	0.03	0.22	0.52	0.01	1.26	0.04	0.01
Maximum	27.15	16.64	13.14	29.12	0.96	35.26	5.21	2.96

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 official level of the annual NO2 standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard.

(2) Final rule signed June 2, 2010. The 1971 annual and 24-hour SO2 standards were revoked in that same rulemaking. However, these standards remain in effect until one year after an area is designated for the 2010 standard, except in areas designated nonattainment for the 1971 standards, where the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standard are approved.

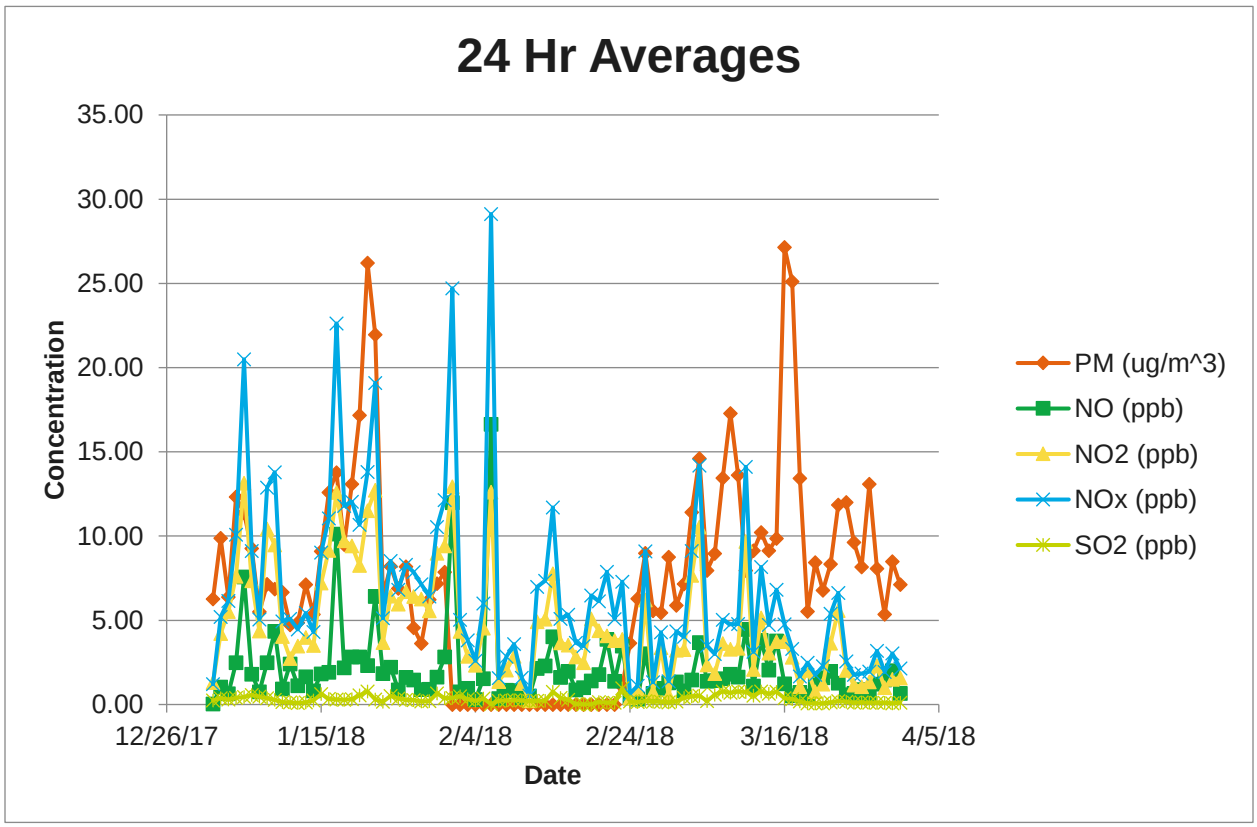

Figure 2-1. 24-hour Averages

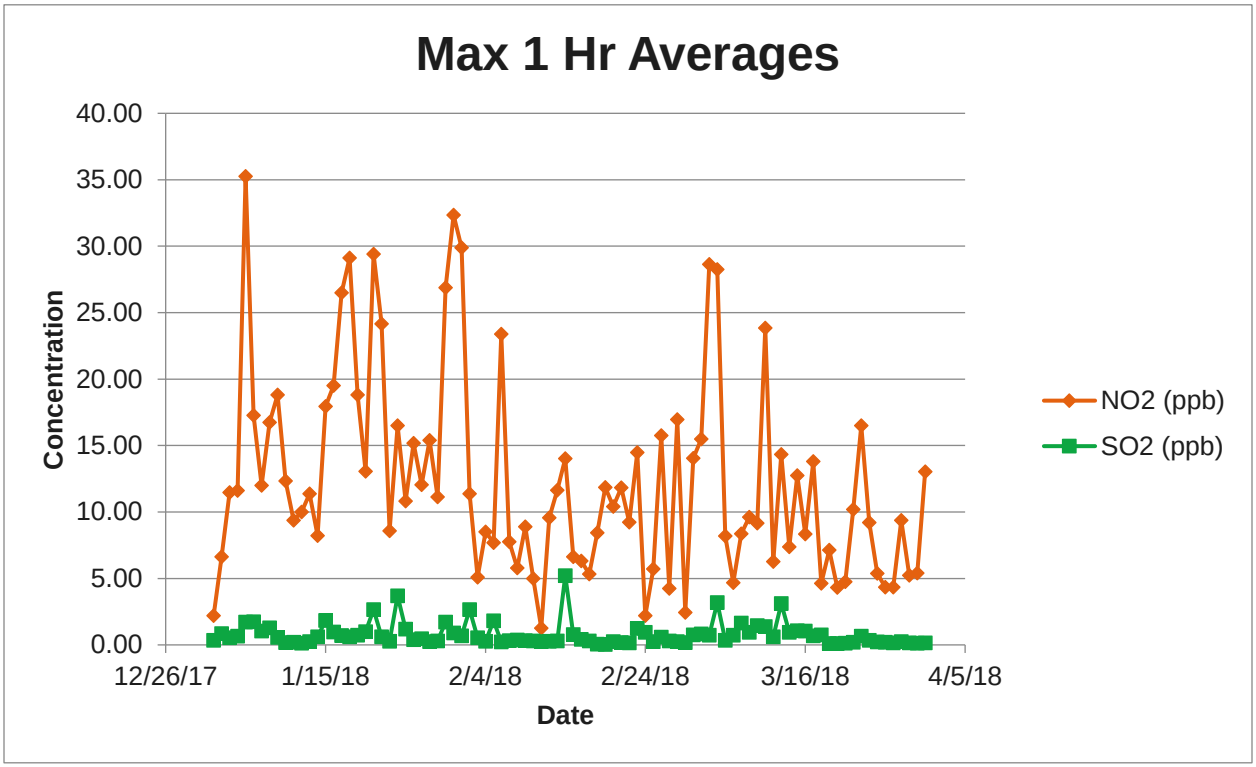

Figure 2-2. Max 1-hour Averages

Table 2-4. Monthly Statistics for All Four Quarters of the Third 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)
4/17	7.63	2.60	4.32	6.85	0.35	12.26	1.01	0.69
5/17	9.71	1.57	3.61	5.08	0.44	9.24	0.88	0.63
6/17	7.46	1.95	2.98	4.77	0.63	8.56	1.03	0.88
7/17	8.05	0.68	2.65	3.21	0.58	6.54	0.80	0.70
8/17	7.74	1.11	2.77	3.82	0.29	7.28	0.48	0.41
9/17	10.10	1.61	3.96	5.47	0.60	9.78	1.30	0.97
10/17	6.74	1.42	3.45	4.80	0.28	9.80	0.47	0.36
11/17	10.43	3.04	5.36	8.35	0.28	14.66	1.50	0.82
12/17	11.01	2.18	6.03	8.07	0.23	13.58	0.66	0.47
1/18	9.23	2.35	7.13	9.39	0.35	16.47	0.92	0.66
2/18	5.17	2.37	3.95	6.23	0.25	9.97	0.69	0.46
3/18	10.77	1.57	3.10	4.44	0.34	10.30	0.75	0.55

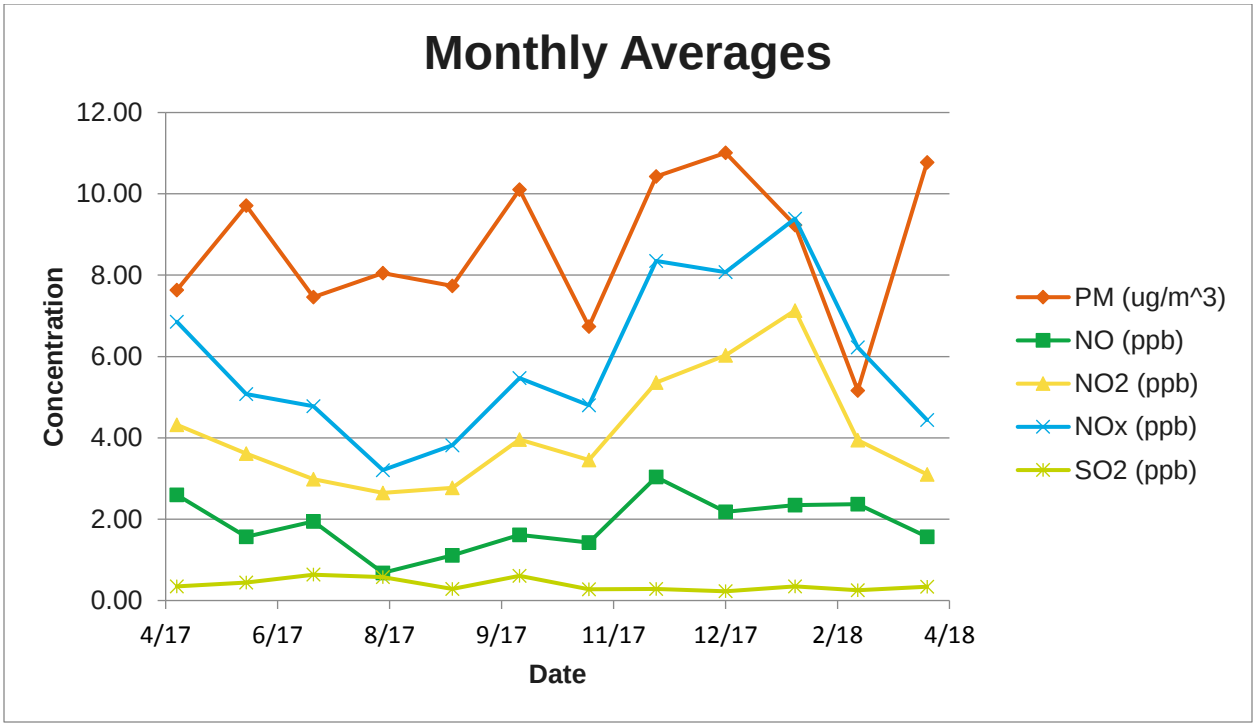

Figure 2-3. Monthly Averages

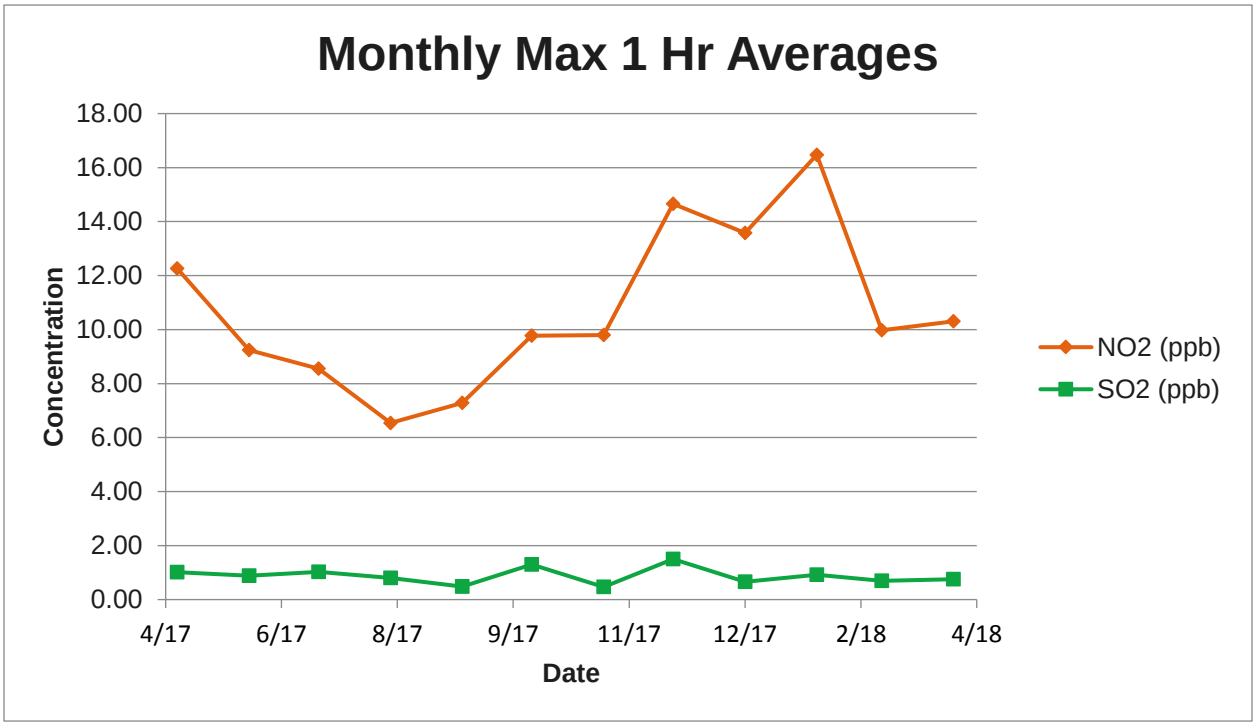

Figure 2-4. Monthly Max 1-hour Averages

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 fourth 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 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 third 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. 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	34.0 ppb
NO_2	Primary and Secondary	Annual	53 ppb	Annual Mean	Year 1: 4 ppb Year 2: 5 ppb Year 3: 4 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 third 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	3.4 ppb
SO_2	Secondary	3-hour	0.5 ppm (500 ppb)	Not to be exceeded more than once per year	1.93 ppb

* Maximum since 4/15.

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	9.1 µg/m^3
$PM_{2.5}$	Secondary	Annual	15 µg/m^3	Annual mean, averaged over 3 years	9.1 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 QAPP prepared for this work, results were reviewed for anomalies, validated on a daily basis, and recorded on QA/QC Daily Comment Sheets for quarterly data review and assessments. The occurrence and duration of normal calibration and maintenance activities was also recorded.

Daily QC checks were performed in accordance with section 5.1 of the QAPP. The data acquisition system (Opto 22's PAC Display) was remotely accessed from the Arcadis office located in Durham, NC, where instrumentation and trends were monitored for alarms and other irregularities. NOx and SO2 zero and calibration values displayed by the system from the previous calibration event were recorded in the QC Log Book. After checking for irregularities, the data file from the previous day was sent via email to the Durham, NC office. The file was saved to a common folder on the Durham office's server and then post processed with a Microsoft Excel macro. The resulting Excel file provides values for daily averages and maxima, and also alarm and calibration information. This information was recorded on the daily QC log sheet. Comments and observations regarding data quality were noted on the QC log sheet and were also entered into the SCSPA QA/QC Daily Comment Sheet. The Project Manager was 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 records 24 hours of data each day, for a total of 72 hours of data per day. Problems with the data acquisition system, normal calibration

periods for the NOx and SO2 instruments and normal maintenance of the instruments result in instances of incomplete or invalid data.

The quarterly data was assessed as follows:

- 100% of the validated Quarter 1 data was flagged as “good”.
- Percent completeness for Quarter 1 was 90.91%.

Arcadis U.S., Inc.

4915 Prospectus Drive

Suite F

Durham, North Carolina 27713

Tel 919 544 4535

Fax 919 544 5690

www.arcadis.com