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South Carolina State Ports Authority – Continuous Air Monitoring Station for the Wando Welch Terminal

Q1 2014 Quarterly Report and Annual Summary

April 2014

South Carolina State Ports Authority - Continuous Air Monitoring Station for the Wando Welch Terminal

Q1 2014 Quarterly Report and Annual Summary

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Date:
April 2014

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ARCADIS

1. Introduction

1.1 Scope

ARCADIS U.S., Inc. (ARCADIS) was contracted in late December 2010 to provide Continuous Air Monitoring Services to the South Carolina State Ports Authority (SCSPA) at the Wando Welch Terminal in Mt. Pleasant, SC. ARCADIS has followed through on the planned schedule and activities since that award. The major accomplishments were to complete the Quality Assurance Plan (QAP), purchase the instruments, complete the site setup, and then to begin acquiring data. This report is the 12th quarterly data report (fourth quarterly report in year three of operations) and presents the data summaries requested by SCSPA and described in the work scope. The data acquisition was started on May 6, 2011 in line with the court mandated start date. This report encompasses a period corresponding to data taken during the period from January 1, 2014 through March 31, 2014, and includes a summary of the third year of operations.

1.2 Project Description

SCSPA requested a system to provide ambient air quality data including particulate matter less than 2.5 microns ($PM_{2.5}$), SO_2, and NO_2 for a period of 5 years at the Wando Welch 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 and has proven to be reliable and is generating valid high quality data suitable for use in dispersion modeling or other potential purposes.

The QAP is updated periodically to reflect improvements to the basic operating procedures or to document changes in the air quality standards. An update was performed on September 20, 2012, following the annual maintenance program and an on-site audit by the S.C. Department of Health and Environmental Control (conducted June 14-15, 2012) to reflect actual procedures at the end of the first year of operation. An update was also performed on October 17, 2013, to reflect changes to the National Ambient Air Quality Standards (NAAQS) for $PM_{2.5}$. This QAP 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. Excursions beyond these standards have not been observed, but a few daily spikes and rises have been noted and correlating local

conditions are investigated in local media outlets and recorded when seen. These observations are tabulated and presented in the quarterly reports.

The location selected for sampling and the sampling equipment has proven to be well-suited for the project as it is centrally located to the port activities and has proven to be very responsive to local equipment air emissions and the local meteorological conditions. Although this is not a typical fence line site, it has shown high value in permitting the evaluation of port activities and related air quality effects. ARCADIS has been able to remotely access the control computer and reliably interact with the instruments. The instruments are very responsive to events such as container handling equipment and the morning openings of the front gates to entering truck traffic. These patterns can be reviewed in the archived data any time in the future.

2. Quarterly Results

The 24-hr daily averages for $PM_{2.5}$, NO, NO_2, NO_X, and SO_2 and the maximum daily value (1-hr average) for NO_2 and SO_2 for this period are shown in Table 2-1. No exceedances were indicated this quarter. Quarterly statistics showing averages, minimums and maximums for all parameters are summarized in Table 2-2, with the corresponding NAAQS 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 provided 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

24-hour Averages						Daily Max 1-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)
1/1/14	14.66	0.11	3.37	3.47	0.27	9.15	1.22
1/2/14	8.25	49.55	18.99	68.53	0.86	41.70	2.68
1/3/14	5.46	7.62	7.27	14.88	0.74	12.77	1.93
1/4/14	4.85	0.08	2.01	2.06	0.50	3.96	1.89
1/5/14	8.33	0.72	5.22	5.93	0.26	12.71	1.68
1/6/14	4.19	26.86	7.66	68.68	1.61	16.60	8.72
1/7/14	6.84	6.95	7.99	14.69	1.50	18.44	3.18
1/8/14	7.23	4.56	11.54	15.94	0.17	27.17	0.79
1/9/14	6.39	3.33	8.83	11.99	0.55	18.77	1.64
1/10/14	8.50	3.93	7.81	11.52	0.15	17.96	1.45
1/11/14	4.45	2.81	3.94	6.47	0.67	25.84	4.83
1/12/14	9.61	3.38	9.89	13.08	3.48	17.19	14.10
1/13/14	15.73	46.98	25.98	72.94	0.75	54.34	4.03
1/14/14	6.51	9.61	17.26	26.80	0.19	26.40	2.24
1/15/14	6.65	27.20	16.86	44.03	0.59	30.78	2.19
1/16/14	6.94	8.17	12.90	21.04	2.24	25.70	9.72

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24-hour Averages						Daily Max 1-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)**
1/17/14	7.34	10.54	14.03	24.55	0.95	28.45	2.43
1/18/14	6.87	8.35	13.14	21.48	5.00	27.33	11.88
1/19/14	9.41	4.78	12.56	17.32	3.63	33.80	10.15
1/20/14	10.90	9.34	13.94	23.25	3.34	29.80	9.41
1/21/14	11.75	8.30	14.10	22.38	1.63	25.19	5.09
1/22/14	11.63	8.00	13.54	21.53	2.64	21.07	6.60
1/23/14	14.56	10.37	11.12	21.45	5.77	65.27	57.74
1/24/14	9.59	7.74	10.00	17.62	1.30	25.54	9.33
1/25/14	11.75	3.65	11.49	15.13	0.98	34.19	3.66
1/26/14	8.44	6.13	9.75	15.87	2.68	26.52	9.53
1/27/14	10.65	10.35	15.56	25.89	2.02	30.87	7.35
1/28/14	8.13	2.04	7.85	9.85	0.20	24.05	2.27
1/29/14	6.50	0.05	2.43	2.42	0.27	6.18	1.71
1/30/14	7.64	2.29	5.98	8.22	0.56	18.16	2.02
1/31/14	12.10	22.12	20.31	42.41	1.03	52.72	3.60
2/1/14	8.29	2.61	7.64	10.23	0.17	16.58	2.13
2/2/14	14.46	2.07	7.38	9.45	0.84	12.40	4.14
2/3/14	8.71	15.12	13.94	29.05	0.37	26.50	3.53
2/4/14	6.80	5.47	8.14	13.60	0.06	14.01	1.01
2/5/14	8.51	10.19	10.21	20.39	0.25	16.40	2.60
2/6/14	7.63	3.02	6.69	9.69	0.32	13.18	0.75
2/7/14	8.85	3.88	8.11	11.96	0.18	16.00	1.31
2/8/14	10.85	1.37	7.08	8.44	0.14	20.36	0.68
2/9/14	17.29	1.41	6.68	8.08	0.46	17.47	2.12
2/10/14	15.02	12.66	15.88	28.52	1.27	34.38	5.09
2/11/14	8.28	3.41	7.93	11.30	0.19	18.08	1.44
2/12/14	9.56	2.41	6.26	8.65	0.10	15.96	1.76
2/13/14	12.20	7.40	12.20	19.58	1.99	28.24	8.65
2/14/14	12.59	9.64	15.61	25.25	4.27	28.50	12.66

24-hour Averages						Daily Max 1-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)**
2/15/14	8.87	7.37	13.31	20.67	2.48	36.98	8.52
2/16/14	11.54	2.02	9.42	11.44	1.04	19.45	4.05
2/17/14	13.11	2.82	8.64	11.46	0.27	22.66	1.34
2/18/14	20.00	21.76	17.12	38.88	0.68	60.73	3.43
2/19/14	10.41	8.69	13.95	22.64	0.52	32.13	1.58
2/20/14	10.64	8.85	13.05	21.90	0.23	36.68	1.54
2/21/14	3.59	9.88	13.21	23.09	1.66	30.95	8.74
2/22/14	4.31	0.73	6.00	6.71	0.31	17.36	2.07
2/23/14	8.31	0.88	5.31	6.17	0.16	13.52	1.07
2/24/14	10.56	4.74	10.69	15.43	0.43	19.25	1.55
2/25/14	14.77	19.82	19.41	39.22	0.74	55.87	1.54
2/26/14	12.16	6.14	13.96	20.09	0.08	25.43	0.89
2/27/14	11.64	8.08	12.74	20.80	1.09	26.34	4.23
2/28/14	11.41	3.05	9.71	12.76	0.71	19.90	2.40
3/1/14	10.93	0.67	4.76	5.43	0.13	12.48	1.12
3/2/14	17.25	1.01	5.03	6.03	0.34	13.21	1.39
3/3/14	10.12	7.18	13.20	20.37	0.40	29.28	1.74
3/4/14	6.98	2.54	6.74	9.27	0.07	14.54	1.11
3/5/14	7.74	4.61	8.70	13.30	0.05	18.07	0.75
3/6/14	7.45	3.49	8.42	11.89	0.12	17.85	1.44
3/7/14	2.42	3.67	7.77	11.43	0.12	16.96	2.02
3/8/14	7.70	1.53	7.37	8.88	1.29	14.03	6.68
3/9/14	11.12	4.51	10.61	15.11	2.48	29.37	9.37
3/10/14	15.11	8.59	16.08	24.66	1.99	31.78	13.71
3/11/14	23.38	10.25	17.41	27.65	1.54	40.67	5.77
3/12/14	12.95	11.59	16.33	27.91	1.74	45.52	5.82
3/13/14	4.80	3.99	9.40	13.38	0.58	21.16	2.45
3/14/14	8.49	17.85	18.95	36.80	0.25	41.45	0.94
3/15/14	11.37	1.97	10.42	12.38	1.43	22.03	6.02

24-hour Averages						Daily Max 1-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)**
3/16/14	12.06	0.17	4.68	4.82	0.19	15.53	0.81
3/17/14	4.62	5.94	11.12	17.04	0.15	28.86	2.65
3/18/14	4.63	5.08	6.75	11.80	0.11	15.49	2.11
3/19/14	7.44	7.04	9.96	16.99	0.42	20.41	1.46
3/20/14	11.39	11.70	15.80	27.50	0.83	28.21	3.12
3/21/14	9.69	3.29	11.40	14.69	0.27	29.00	1.60
3/22/14	13.61	3.90	8.45	12.35	0.22	18.33	1.81
3/23/14	14.80	0.49	5.19	5.67	0.33	11.93	2.71
3/24/14	14.80	3.00	6.83	9.82	0.13	15.44	0.57
3/25/14	14.80	3.10	8.47	11.53	0.17	26.18	1.49
3/26/14	15.64	4.20	10.47	14.64	1.14	20.76	3.20
3/27/14	14.40	19.94	20.50	40.44	0.16	49.37	1.10
3/28/14	11.33	19.96	19.92	39.86	0.17	53.83	1.68
3/29/14	5.60	0.18	2.80	2.97	0.20	4.85	3.52
3/30/14	3.44	2.27	6.08	8.33	1.15	12.45	4.44
3/31/14	9.29	8.60	18.38	26.97	1.64	35.95	5.09

Table 2-2. Quarterly Statistics

24-hour Averages						Daily Max 1-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)**
Average	9.97	7.60	10.79	18.74	0.97	25.10	4.37
Minimum	2.42	0.05	2.01	2.06	0.05	3.96	0.57
Maximum	23.38	49.55	25.98	72.94	5.77	65.27	57.74

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.

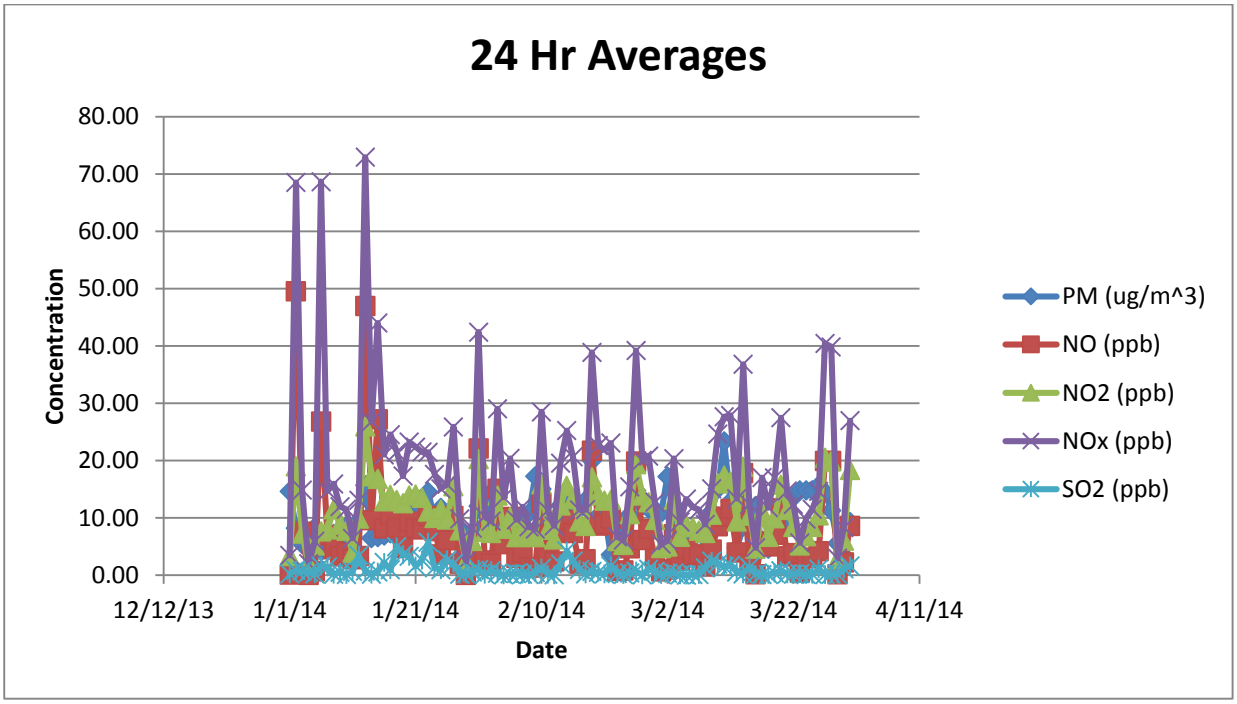

Figure 2-1. 24-hour Averages

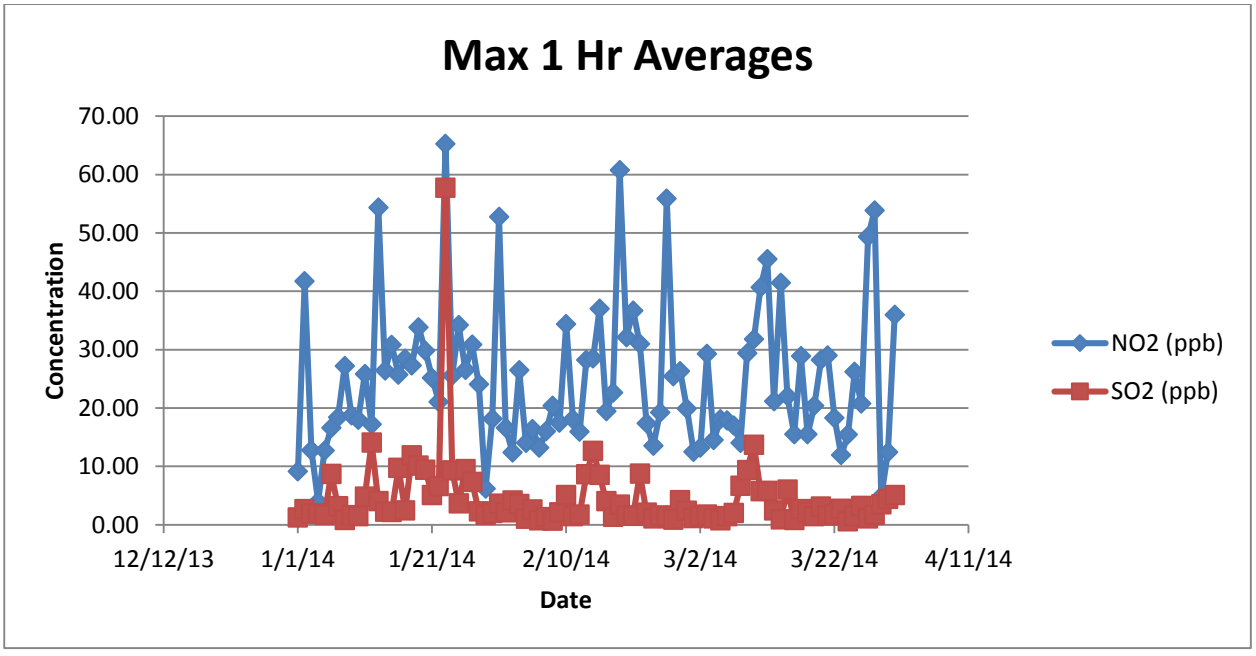

Figure 2-2. Max 1-hour Averages

Table 2-4. Monthly Statistics for All Four Quarters of the Third Monitoring Year

Monthly Averages						Monthly Daily Max 1-hr Avg.	
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)**
April 2013	8.51	4.25	6.83	11.06	0.25	18.36	1.90
May 2013	8.11	4.90	7.24	12.09	0.46	18.70	2.67
June 2013	7.99	4.68	4.96	8.63	0.85	13.75	2.66
July 2013	7.83	6.18	4.30	10.25	0.28	12.49	2.18
August 2013	8.60	4.81	5.55	10.32	0.46	14.75	3.35
September 2013	9.40	2.84	6.60	9.42	0.32	16.66	1.98
October 2013	9.15	5.54	8.54	14.07	0.51	19.95	2.54
November 2013	7.57	4.09	6.38	10.46	0.53	16.27	2.33
December 2013	8.79	8.92	10.34	19.26	0.88	21.66	3.65
January 2014	8.77	10.19	11.07	22.30	1.50	26.08	6.62
February 2014	10.73	6.63	10.72	17.34	0.75	24.83	3.24
March 2014	10.50	5.88	10.58	16.45	0.64	24.36	3.15

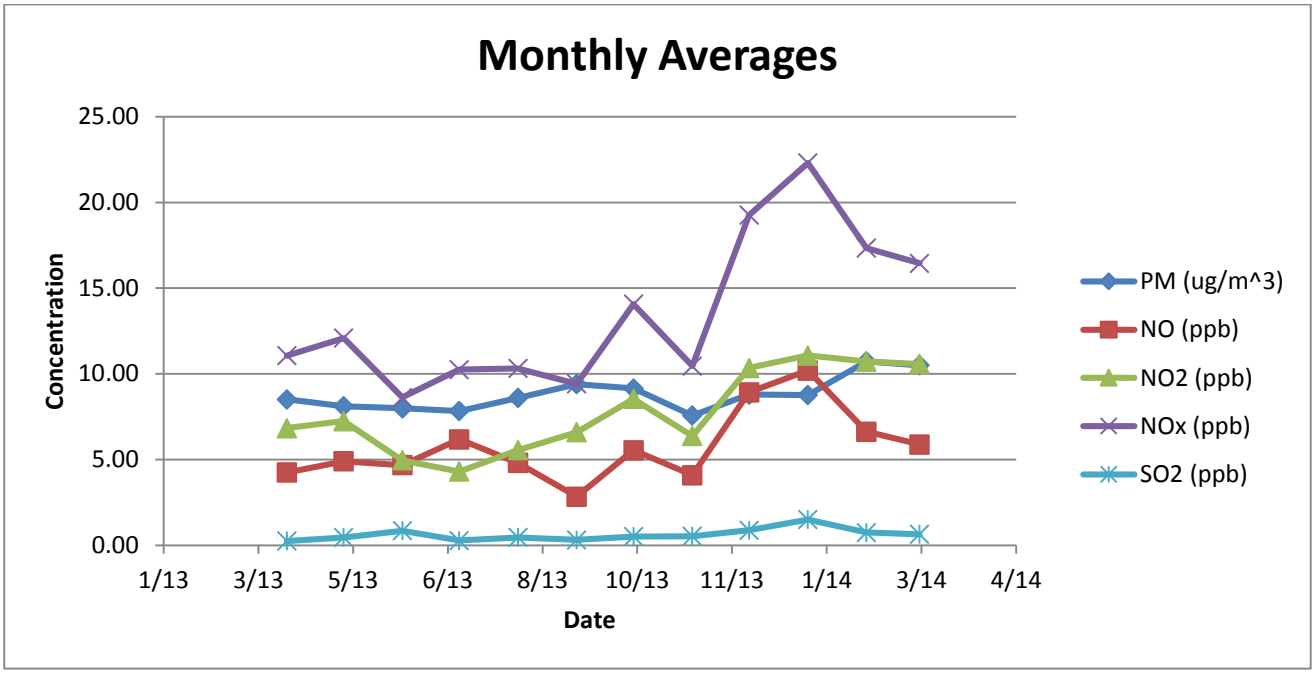

Figure 2-3. Monthly Averages

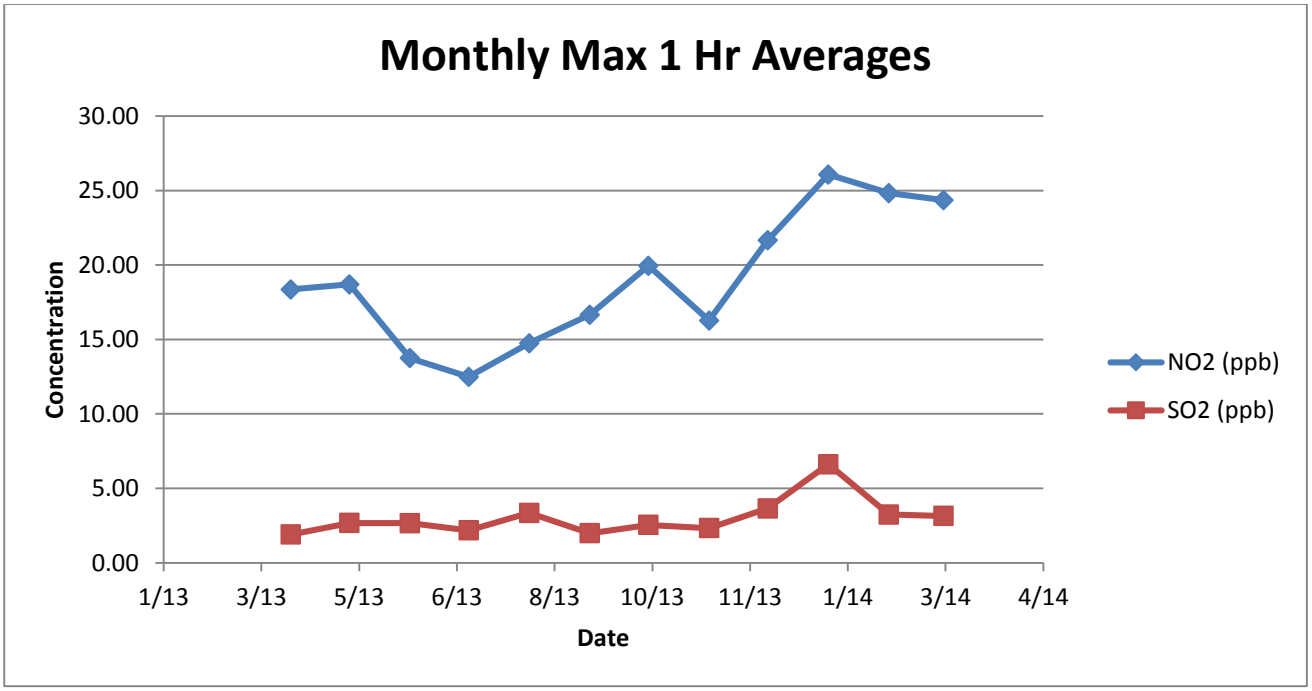

Figure 2-4. Monthly Max 1-hour Averages

2.1 Comparison to NAAQS

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

2.1.1 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 third year of monitoring (as they were for the first and second year of monitoring). Table 2-5 presents the NO_2 NAAQS calculations for each standard.

Table 2-5. NO_2 NAAQS Calculations for Wando Welch Terminal

Pollutant	Primary/ Secondary	Averaging Time	Level	Form	Wando Welch
NO_2	Primary	1-hour	100 ppb	98th Percentile, averaged over 3 years	26 ppb
NO_2	Primary and Secondary	Annual	53 ppb	Annual Mean	Year 1: 7 ppb Year 2: 8 ppb Year 3: 8 ppb

2.1.2 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 the first and second year 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 Wando Welch Terminal

Pollutant	Primary/ Secondary	Averaging Time	Level	Form	Wando Welch
SO_2	Primary	1-hour	75 ppb	99th Percentile of 1-hour daily maximum concentrations, averaged over 3 years	33 ppb
SO_2	Secondary	3-hour	0.5 ppm (500 ppb)	Not to be exceeded more than once per year	Not calculated*
SO_2	---	1-hour	---	---	87 ppb

* 3-hour averages were not calculated, however, the1-hour average maximum for all three years was only 87 ppb – well below the secondary standard of 0.5 ppm (500 ppb).

2.1.3 $PM_{2.5}$

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 2-4 and Figure 2-3 show the monthly averages never exceed 10.73 µg/m^3. Table 2-7 presents the $PM_{2.5}$ NAAQS calculations for each standard, and shows that the Wando Welch Terminal had no exceedances.

Table 2-7. $PM_{2.5}$ NAAQS Calculations for Wando Welch Terminal

Pollutant	Primary/ Secondary	Averaging Time	Level	Form	Wando Welch
$PM_{2.5}$	Primary	Annual	12 µg/m^3	Annual mean, averaged over 3 years	10.3 µg/m^3
$PM_{2.5}$	Secondary	Annual	15 µg/m^3	Annual mean, averaged over 3 years	10.3 µg/m^3
$PM_{2.5}$	Primary and Secondary	24-hour	35 µg/m^3	98th Percentile, averaged over 3 years	23 µg/m^3

2.2 Specific Data Notes

Normal maintenance and instrument calibration procedures were performed several times this quarter. Additional notes can be found in the QA/QC Daily Comment Sheet summary shown in Table 3-1.

3. 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 Wando Welch Terminal* (October 17, 2013, Revision 3).

3.1 Daily QC/Validation

According to the QAP prepared for this work, results were reviewed for anomalies and validated on a daily basis. These validations are recorded on QA/QC Daily Comment Sheets and are summarized in Table 3-1. This table contains a description of any anomalies that occurred over the past quarter along with a record of normal calibration and maintenance activities and the date of occurrence.

Table 3-1. QA/QC Daily Comment Sheet

Date	Comment
1/2/2014	System Maintenance from 12:30 to 14:55.
1/3/2014	Insufficient data 2:00 - 6:00 due to SO_2 and NOx calibration.
1/6/2014	System maintenance from 12:10 to 15:23.
1/7/2014	Insufficient data 2:00 - 6:00 and 8:00 - 13:00 due to SO_2 and NOx calibration events.
1/8/2014	Insufficient data 2:00 - 4:00 due to SO_2 calibration.
1/9/2014	Insufficient data 2:00 - 4:00 due to SO_2 calibration.
1/15/2014	Insufficient data 4:00 - 6:00 due to NOx calibration.
1/21/2014	Insufficient data 4:00 - 6:00 due to NOx calibration.
1/23/2014	Insufficient data 2:00 - 4:00 due to SO_2 calibration. Insufficient data 15:00 - 17:00 due to system maintenance.
1/24/2014	Insufficient data 4:00 - 6:00 due to NOx calibration.
2/12/2014	Insufficient data 4:00 - 6:00 due to NOx calibration.
3/5/2014	Insufficient data 4:00 - 6:00 due to NOx calibration.
3/6/2014	Insufficient data 2:00 - 3:00 due to daylight savings time adjustment.
3/24/2014	Insufficient data 4:00 - 6:00 due to NOx calibration.

3.2 Quarterly Data Validation

The quarterly data were assessed as follows: 100% of the validated Quarter 4 data were flagged as "good". Percent completeness for Quarter 4 was calculated by dividing the number of hours flagged by the macro as "Insufficient Data" for any parameter by the total number of hours in the quarter. Percent completeness for Quarter 4 was 98.52%.

The QAP stated a completeness goal of 90% for $PM_{2.5}$, SO_2 and NO_X. The data collected from April 1, 2013 through March 31, 2014 exceeded this goal.

3.3 Equipment Calibration

As stated in the QAP, daily zero/span checks were performed on the gas analyzers (SO_2 and NO_2), and a full calibration is performed if any instrument does not pass the zero/span check. Calibration of the $PM_{2.5}$ monitor using the mass foil kit provided by the manufacturer was performed during the scheduled annual maintenance in June 2013. An automatic zero adjustment of the mass signal is performed at the start of a new measurement cycle following a filter change (every 8 hours).

3.4 Meteorological Data

The QAP stated a completeness goal of 90% for ambient temperature, relative humidity, wind speed, wind direction, and barometric pressure. The data collected from April 1, 2013 through March 31, 2014 exceeded this goal. The sensors were checked during the scheduled annual maintenance visit in June 2013 to ensure they were consistently providing accurate data.