ATTACHMENT A
CPI Southport SO_2 Modeling

CPI USA North Carolina LLC
1281 Powerhouse Dr. SE
Southport, NC 28461
T 910-343-6700 F 910-343-6710

Capital Power Corporation

June 30, 2015

Ms. Sheila Holman
Director
North Carolina Division of Air Quality
Central Office
217 West Jones Street
Raleigh, NC 27603

Re: CPI USA North Carolina, Southport Facility
1-Hour SO_2 NAAQS Modeling Analysis

Dear Ms. Holman:

As you are aware, on March 2, 2015 the United States (U.S.) District Court for the Northern District of California entered a consent decree between plaintiffs the Sierra Club and the Natural Resources Defense Council and the U.S. Environmental Protection Agency (USEPA) which specified a schedule for USEPA to complete remaining area designations for the rest of the country under the 1-hour sulfur dioxide (SO_2) National Ambient Air Quality Standard (NAAQS). Under the consent decree, an initial designation deadline of July 2, 2016 was established for areas with either a) newly monitored violations of the 2010 SO_2 NAAQS or b) any stationary source with 2012 emissions in excess of 16,000 tons per year (tpy) of SO_2 *or* 2,600 tpy with an average annual emission rate of at least 0.45 pounds SO_2 per MMBtu (lb/MMBtu) that has not been announced for retirement.

Capital Power Incorporated (CPI) operates an electric generating station in Southport, North Carolina. The Southport facility reported 2012 emissions of 2,923 tpy at an average annual emission rate of 0.74 lb/MMBtu, and as such, is subject to the terms of the consent decree. As agreed upon at a meeting we had on June 1, 2015, CPI has completed an air dispersion modeling analysis in order to demonstrate compliance with the 1-hour SO_2 NAAQS. Enclosed, please find a modeling report that was prepared on our behalf by Trinity Consultants. The report describes the data resources and modeling methodologies utilized in the analysis. A CD-ROM containing the electronic modeling files is also included with this report.

Please feel free to contact me or Jonathan Hill of Trinity Consultants at 919-462-9693 with any questions regarding this submittal.

Sincerely,

Virginia Grace

Virginia Grace
Senior Advisor, Environment

Enclosures

1-HOUR SO_2 NAAQS MODELING ANALYSIS

CAPITAL POWER USA NORTH CAROLINA, LLC.

SOUTHPORT, NORTH CAROLINA

Prepared By:

TRINITY CONSULTANTS
TRINITY CONSULTANTS
One Copley Parkway, Suite 310
Morrisville, North Carolina 27560
919.462.9693
Fax: 919.462.9694
trinityconsultants.com

June 2015

Project 153401.0059

Environmental solutions delivered uncommonly well

TABLE OF CONTENTS

1. INTRODUCTION

Capital Power Corporation USA North Carolina, LLC. (CPI) operates two electric generating units (EGUs) at the Southport, North Carolina facility that are permitted to combust a variety of solid fuels, including coal, woody biomass fuels, and tire derived fuel (TDF). The two EGUs are each comprised of three (3) boilers, nominally operating at 223 million British thermal units per hour (MMBtu/hr). Each-boiler EGU exhausts from a single stack.

On March 2, 2015 the United States (U.S.) District Court for the Northern District of California entered a consent decree between plaintiffs the Sierra Club and the Natural Resources Defense Council and the U.S. Environmental Protection Agency (USEPA) which specified a schedule for USEPA to complete remaining area designations for the rest of the country under the 1-hour sulfur dioxide (SO2) National Ambient Air Quality Standard (NAAQS). Under the consent decree, an initial designation deadline of July 2, 2016 was established for areas with either a) newly monitored violations of the 2010 SO2 NAAQS or b) any stationary source with 2012 emissions in excess of 16,000 tons per year (tpy) of SO_2 or 2,600 tpy with an average annual emission rate of at least 0.45 pounds SO_2 per MMBtu (lb/MMBtu) that has not been announced for retirement.

The CPI Southport facility had 2012 emissions of 2,923 tpy at an average annual emission rate of 0.74 lb/MMBtu, and as such, is subject to the terms of the consent decree. Since the deadline established in the consent decree does not allow sufficient time for designations to be based on data from new ambient monitors, these initial designations will largely be based on source-specific air dispersion modeling. USEPA has issued guidance on the use of modeling for this purpose in the SO2 NAAQS Designations Modeling Technical Assistance Document (TAD).[1]

CPI Southport utilized the TAD guidance to conduct 1-hour SO2 NAAQS modeling for their facility. The only substantial SO_2 source within the vicinity of CPI Southport is Archer Daniels Midland (ADM), less than 2 km to the east. Given the relative proximity of that facility, CPI Southport also included ADM sources in the 1-hour SO_2 NAAQS Analysis.

The remainder of this report documents the air dispersion modeling methodology, data resources and results used to support the North Carolina Division of Air Quality's (NCDAQ's) attainment designation process for the area.

[1] http://www.epa.gov/airquality/sulfurdioxide/pdfs/SO2ModelingTAD.pdf

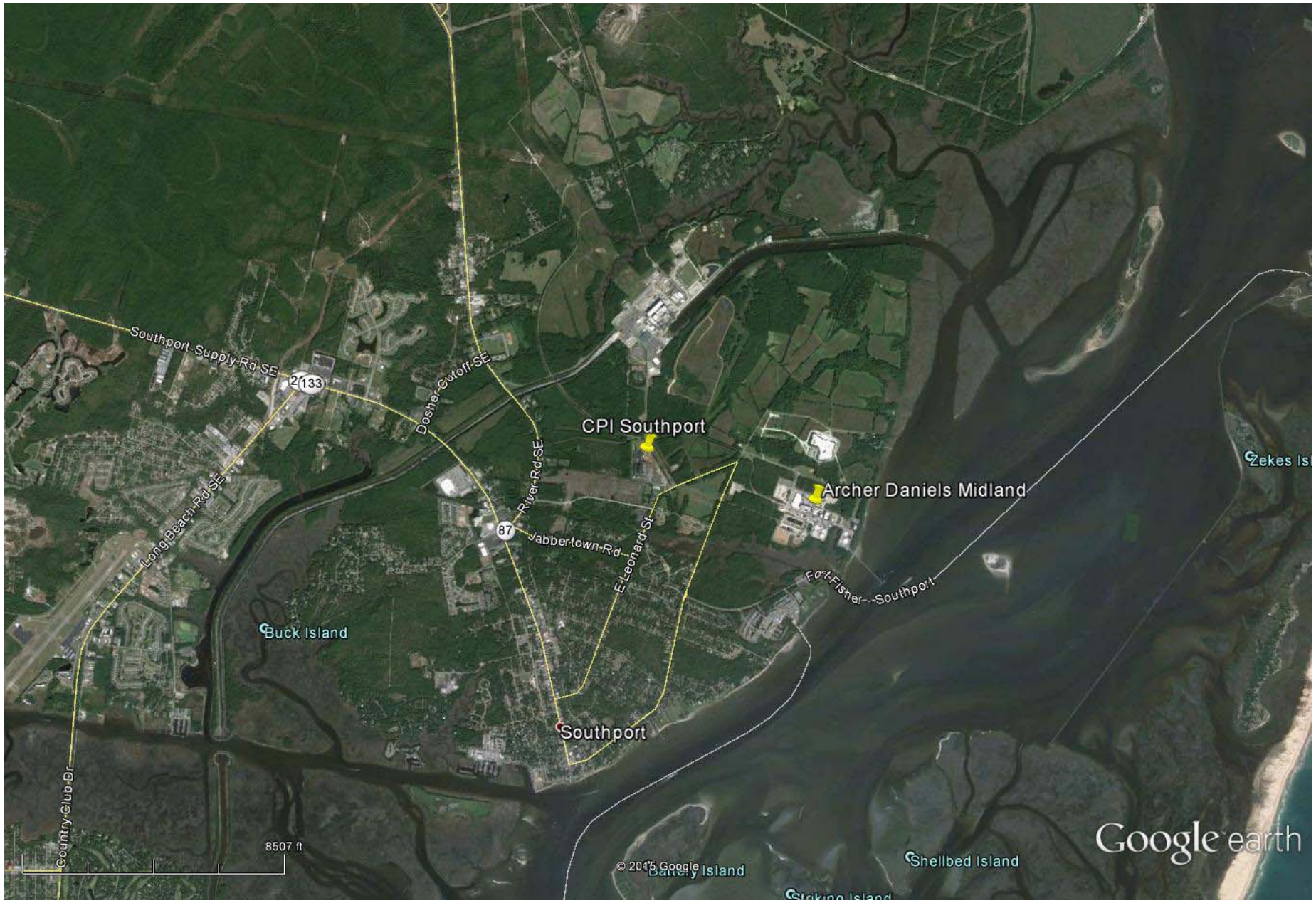
This section presents a description of the CPI Southport facility location and site characteristics required as part of the air dispersion modeling evaluation.

2.1. FACILITY LOCATION

CPI operates two EGU's at their Southport, NC facility. Figure 2-1 provides a map of the area surrounding the Southport property. The approximate central Universal Transverse Mercator (UTM) coordinates of the facility are 221.7 kilometers (km) east and 3,760.1 km north in Zone 18 (NAD 83).

For modeling purposes, the appropriate urban/rural land use classification for the area was determined using the Auer technique, which is recommended in the *Guideline on Air Quality Models.* In accordance with this technique, the area within a 3-km radius of the facility was identified on US Geological Survey (USGS) topographic maps (and was delineated by land use type). More than 50 percent of the surrounding land use can be classified as undeveloped rural (i.e., Auer's A4 classification), therefore the area is classified as rural.

FIGURE 2-1. AERIAL MAP OF THE CPI SOUTHPORT AREA



This section presents the input data and modeling methodology utilized in the SO_2 NAAQS modeling demonstration. The modeling methodology conforms to the USEPA's TAD document and generally with NCDAQ's PSD Modeling Guidance (January 2012) and more recent changes posted on NCDAQ's Air Quality Analysis Branch (AQAB) website.

3.1. MODEL SELECTION

The AERMOD dispersion model (version 14134) was used to calculate off-property concentrations in the modeling analysis. AERMOD was promulgated as the preferred model in 40 CFR 51, Appendix W on November 9, 2005 and is recommended by the NCDAQ for evaluating criteria and air pollutant concentrations from industrial facilities such as CPI's Southport facility.[2] AERMOD was run using the regulatory default option, which automatically implements NCDAQ and U.S. EPA recommended model options.

3.2. SOURCE DESCRIPTION

Table 3-1 presents a table of the modeled sources and their locations. UNIT1 and UNIT2 are the 2 EGU stacks at the Southport Facility. All locations are expressed in UTM Zone 18 (NAD83) coordinates.

TABLE 3-1. MODELED SOURCE LOCATIONS

Model ID	Description	UTM-E (m)	UTM-N (m)	Elevation (m)
EU23	ADM Source	223,450.0	3,759,465.0	7.62
EU21	ADM Source	223,473.8	3,759,462.0	7.62
EU22	ADM Source	223,451.4	3,759,471.3	7.62
WHB21	ADM Source	223,457.3	3,759,441.5	7.62
WHB22	ADM Source	223,449.3	3,759,446.0	7.62
EU48	ADM Source	223,449.2	3,759,500.5	7.62
UNIT1	CPI Southport Boilers 1-3	221,576.9	3,760,059.3	7.62
UNIT2	CPI Southport Boilers 4-6	221,579.2	3,760,099.0	7.62

Table 3-2 presents the stack parameters input to the model for each of the sources.

[2] 40 CFR 51, Appendix W–*Guideline on Air Quality Models*, Appendix A.1– AMS/EPA Regulatory Model (AERMOD).

TABLE 3-2. MODELED SOURCE PARAMETERS

Model ID	Stack Height (m)	Stack Temperature (K)	Exit Velocity (m/s)	Stack Diameter (m)
EU23	18.90	380.00	23.50	2.44
EU21	18.29	773.15	19.39	2.83
EU22	18.29	790.93	20.71	2.83
WHB21	18.29	386.48	24.34	2.53
WHB22	20.73	384.82	20.37	2.53
EU48	3.05	810.93	35.66	0.24
UNIT1	60.35	449.82	22.49	2.64
UNIT2	60.35	449.82	22.49	2.64

3.3. MODELED EMISSION RATES

As described in the USEPA's TAD document, attainment modeling demonstrations are intended to represent actual facility emissions. CPI Southport operates SO_2 continuous emissions monitoring systems (CEMS) on both EGUs. The facility has archived data from the 2010-2014 period. The TAD document indicates that the most recent 3 years of CEMS data should be modeled to represent the typical design value from an ambient monitor. As such, 2012-2014 CEMS data were used in the model. To further inform the process, the 5 year period (2010-2014) was also evaluated to represent the modeled design value. The SO HOUREMIS option in AERMOD was utilized to supply the varying hourly emissions estimates for each unit to the model. The CD-ROM included in Appendix A of this report contains the hourly CEMS data from the site.

3.4. BACKGROUND CONCENTRATIONS

NAAQS modeling demonstrations typically include impacts from the applicant's facility and a background concentration from a representative ambient monitor. In some cases, sources at other nearby locations may be included in the modeling analysis as well. When including background concentrations along with offsite inventory sources, the potential for double-counting exists, where impacts from explicitly modeled sources may also be included in the concentration measured by the ambient monitor.

Since the 1-hour NAAQS are much more stringent than the older standards, and the regulatory models show significant sensitivity in predicting short-term impacts, the U.S. EPA prepared a new guidance document, Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard (herein referred to as 1-hour NO_2 Guidance), which specifically addressed many aspects of the 1-hour NAAQS modeling (both NO_2 and SO_2) that deviate from the previous air dispersion modeling guidance documents which were developed prior to promulgation of the new, short-term standards. One of those deviations is with respect to the development of an appropriate set of regional inventory sources.

In their 1-hour NO_2 Guidance, U.S. EPA provides a general "rule-of-thumb" for estimating the area over which regional inventory sources should be included. That section of the guidance goes on to suggest that for most applications, the inclusion of nearby sources within about 10 kilometers (km) would be sufficient. This guidance is based on the concept of "significant concentration gradient" in which modeled impacts from a given facility are reviewed to determine how quickly concentrations diminish out from the site. The only substantial SO_2 source within the vicinity of CPI Southport is Archer Daniels Midland (ADM), less than 2 km to the east. Given the relative proximity of that facility, CPI Southport included ADM sources in the 1-hour SO_2 NAAQS Analysis.

In addition to explicitly modeling the ADM facility, the North Carolina Department of Air Quality (DAQ) recommended including an ambient background value in the analysis in order to capture other SO_2 present in the local area. Ambient SO_2 data from the New Hanover County, NC background monitor was thus included in the analysis. There have been significant reductions in SO_2 concentrations in the area, due to the shutdowns of major industrial facilities along with power plant conversions from coal to natural gas. The most recent background concentration from the New Hanover monitor is 7.9 $\mu g/m^3$, which was added to the modeled impacts prior to comparing results to the NAAQS.[3]

3.5. METEOROLOGICAL DATA

The AERMOD modeling results were based on sequential hourly surface observations from Wilmington, NC and upper air data from Newport, NC. These stations are recommended by NCDAQ for modeling facilities located in Brunswick County.[4] The base elevation for the surface station is 12 m.[5]

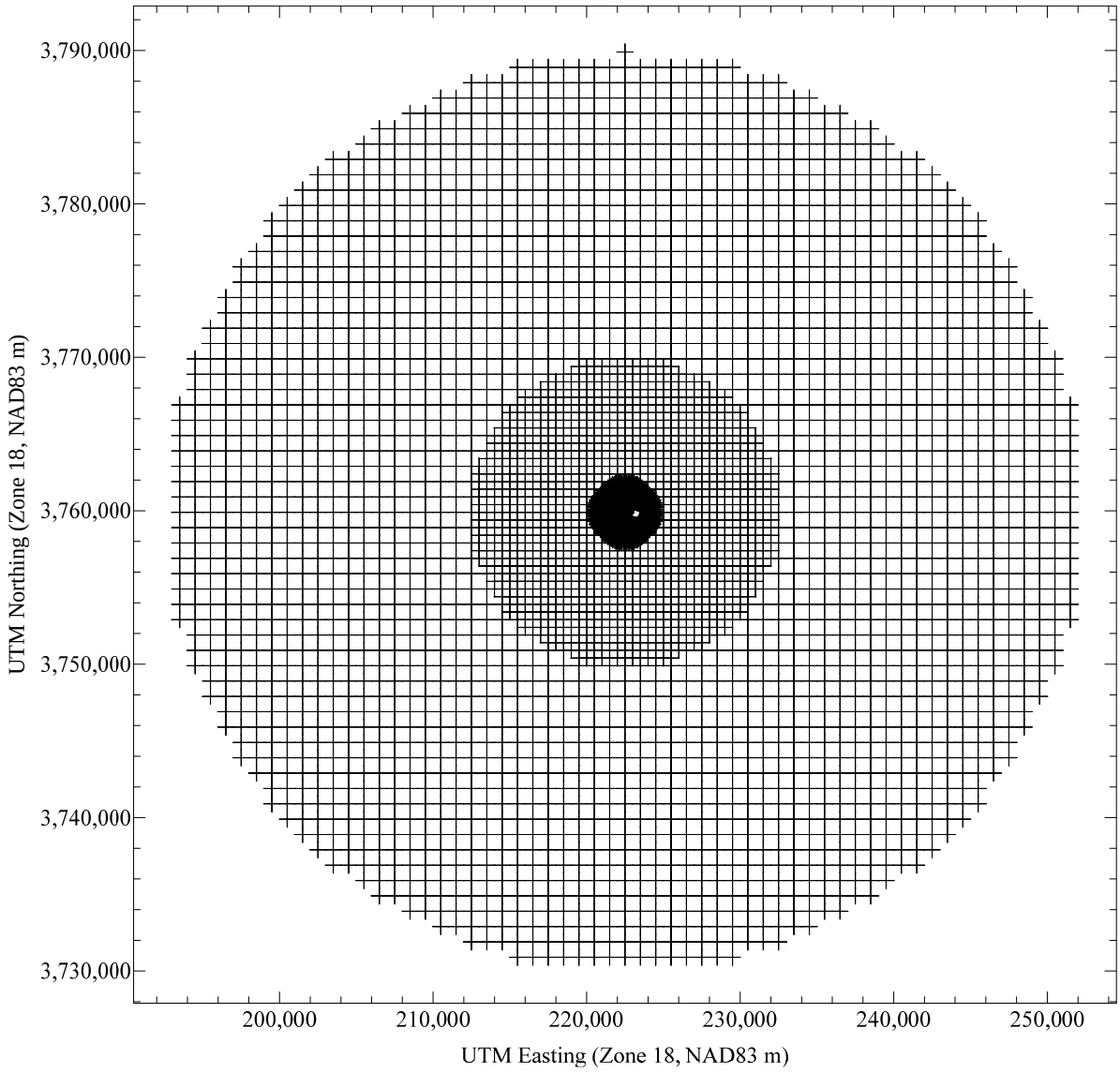
The 5 most recent years of meteorological data (2010-2014) were downloaded from NCDAQ's website and input to AERMOD. Since the SO_2 1-hour NAAQS is a probabilistic standard based on multi-year averages of the daily max hourly concentrations, modeling analyses utilized all 3 data years in a single, concatenated file. The analysis was conducted using both a 3-year average (2012-2104) to represent the monitored design value as well as a 5-year average (2010-2014) to represent the modeled design value.

3.6. MODELED RECEPTORS

The receptors included in the modeling analysis consisted of property line receptors, spaced 25 meters (m) apart around both the CPI Southport and ADM facilities. Cartesian receptor points spaced every 100 m where included to a distance of 2 kilometers (km), 500 m out to 10 km and 1,000 m out 30 km from the center of the facility. The impacts were reviewed to ensure that the maximum impacts were captured within the 100 m spaced grid. Figure 3-2 shows the receptors included in the modeling analysis.

[3] Background Concentration provided by Tom Anderson (NCDAQ) at SO_2 Modeling Meeting on June 1, 2015.
[4] http://www.ncair.org/permits/mets/Metdata.pdf
[5] http://www.ncair.org/permits/mets/ProfileBaseElevations.pdf

FIGURE 3-2. MODELED RECEPTOR GRID



The AERMOD model is capable of handling both simple and complex terrain. Through the use of the AERMOD terrain preprocessor (AERMAP), AERMOD incorporates not only the receptor heights, but also an effective height (hill height scale) that represents the significant terrain features surrounding a given receptor that could lead to plume recirculation and other terrain interaction.[6]

Receptor terrain elevations input to the model were interpolated from National Elevation Database (NED) data obtained from the USGS. NED data consist of arrays of regularly spaced elevations. The array elevations are at a resolution of 1 arcsecond (approximately 30 m intervals) and were interpolated using the latest version of AERMAP (version 11103) to determine elevations at the defined receptor intervals. The data obtained from the NED files were checked for completeness and spot-checked for accuracy against elevations on corresponding USGS 1:24,000 scale

[6] US EPA, *Users Guide for the AERMOD Terrain Preprocessor (AERMAP)*, EPA-454/B-03-003, Research Triangle Park, NC.

topographical quadrangle maps. AERMAP was also used to establish the base elevation of all Enviva structures and emission sources.

3.7. BUILDING DOWNWASH

AERMOD incorporates the Plume Rise Model Enhancements (PRIME) downwash algorithms. Direction specific building parameters required by AERMOD are calculated using the BPIP-PRIME preprocessor (version 04274).

EPA has promulgated stack height regulations that restrict the use of stack heights in excess of "Good Engineering Practice" (GEP) in air dispersion modeling analyses. Under these regulations, that portion of a stack in excess of the GEP height is generally not creditable when modeling to determine source impacts. This essentially prevents the use of excessively tall stacks to reduce ground-level pollutant concentrations. The minimum stack height not subject to the effects of downwash, called the GEP stack height, is defined by the following formula:

$H_{GEP} = H + 1.5L$, where:

H_{GEP} = minimum GEP stack height,
H = structure height, and
L = lesser dimension of the structure (height or projected width).

This equation is limited to stacks located within 5L of a structure. Stacks located at a distance greater than 5L are not subject to the wake effects of the structure. The wind direction-specific downwash dimensions and the dominant downwash structures used in this analysis are determined using BPIP. In general, the lowest GEP stack height for any source is 65 meters by default.[7] None of the emission units at the Southport facility exceed GEP height.

[7] 40 CFR §51.100(ii)

This section presents the results of the SO_2 NAAQS dispersion modeling analysis conducted for the CPI Southport facility.

4.1. SO_2 MODELING RESULTS

Table 4-1 presents the results for the 1-hour SO_2 NAAQS Modeling analysis. As previously described, the results include impacts from the nearby Archer Daniels Midland facility. The results also include the most recent ambient background concentration from the New Hanover County monitor. Given the inclusion of the nearby sources and the ambient background, these modeled impacts are conservative in nature. Results are presented for both a 3-year meteorological period (2012-2014) that would represent a monitoring approach as well as a 5-year meteorological period (2010-2014) that would represent a typical dispersion modeling approach.

TABLE 4-1. SO_2 MODELING RESULTS

Modeled Design Value	UTM-E (m)	UTM-N (m)	Modeled Years	Modeled Conc. ($\mu g/m^3$)	Background Conc.[1] ($\mu g/m^3$)	Total Conc. ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)	Exceeds NAAQS? (Yes/No)
3 Year Average of High-4th-High Daily Max 1-Hour Conc.	221,100.0	3,759,800.0	2012-2014	187.7	7.9	195.6	196.3	No
5 Year Average of High-4th-High Daily Max 1-Hour Conc.	221,100.0	3,759,800.0	2010-2014	169.9	7.9	177.8	196.3	No

[1] Background Concentrations provided in email from Tom Anderson (NCDAQ) to Jon Hill (Trinity) on June 1, 2015.

As shown, all modeled impacts were below the NAAQS and as such, the area around the CPI Southport facility was shown to be in attainment with the 1-hour SO_2 NAAQS. The electronic modeling files used in the modeling analysis are contained on the CD-ROM in Appendix A.

APPENDIX A – ELECTRONIC MODELING FILES