CLASS II AIR QUALITY MODELING REPORT

Knauf Insulation, Inc. > Inwood Facility

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Project Number: 153901.0131

Trinity Consultants

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1. INTRODUCTION

Knauf Insulation, Inc (Knauf) owns and operates an existing fiberglass insulation manufacturing facility located in Inwood, West Virginia (Inwood Facility). Knauf is proposing to upgrade the second fiberglass insulation production line (Line 2) at the Inwood Facility. The upgrades to Line 2 include, but are not limited to, a new melter, upgrades to the forming section, expansion of the curing oven, potential changes to the cooling section, and new packaging equipment. The project triggered New Source Review (NSR) Prevention of Significant Deterioration (PSD) major modification permitting for particulate matter (PM), particulate matter with an aerodynamic diameter less than 10 micrometers (PM_{10}), particulate matter with an aerodynamic diameter less than 2.5 micrometers ($PM_{2.5}$), and nitrogen dioxide (NO_2). The West Virginia Department of Environmental Protection (WVDEP) has adopted the federal PSD permitting program by reference in Title 45 of the West Virginia Code of State Rules (45 CSR) Section 14 and has full authority to implement this program through its United States Environmental Protection Agency (U.S. EPA) authorized State Implementation Plan (SIP). A 45 CSR 14 (R14) New Source Review permit application for the project was received by WVDEP on November 3, 2016.

The Inwood Facility is located in Berkeley County, which is designated by U.S. EPA as “unclassifiable” and/or “attainment” for the National Ambient Air Quality Standards (NAAQS) for ozone, PM_{10}, $PM_{2.5}$, and NO_2.[1] To demonstrate compliance with the NAAQS, Knauf conducted an air quality analysis for these pollutants. Note that since there is no NAAQS standard for PM, modeling of this pollutant was not required.

This modeling report outlines the methodologies used to conduct the air dispersion modeling analysis required under PSD permitting for the proposed project. Air dispersion modeling was relied upon to demonstrate that the proposed project complies with the applicable NAAQS and PSD Class II Increments for the pollutants subject to PSD review.

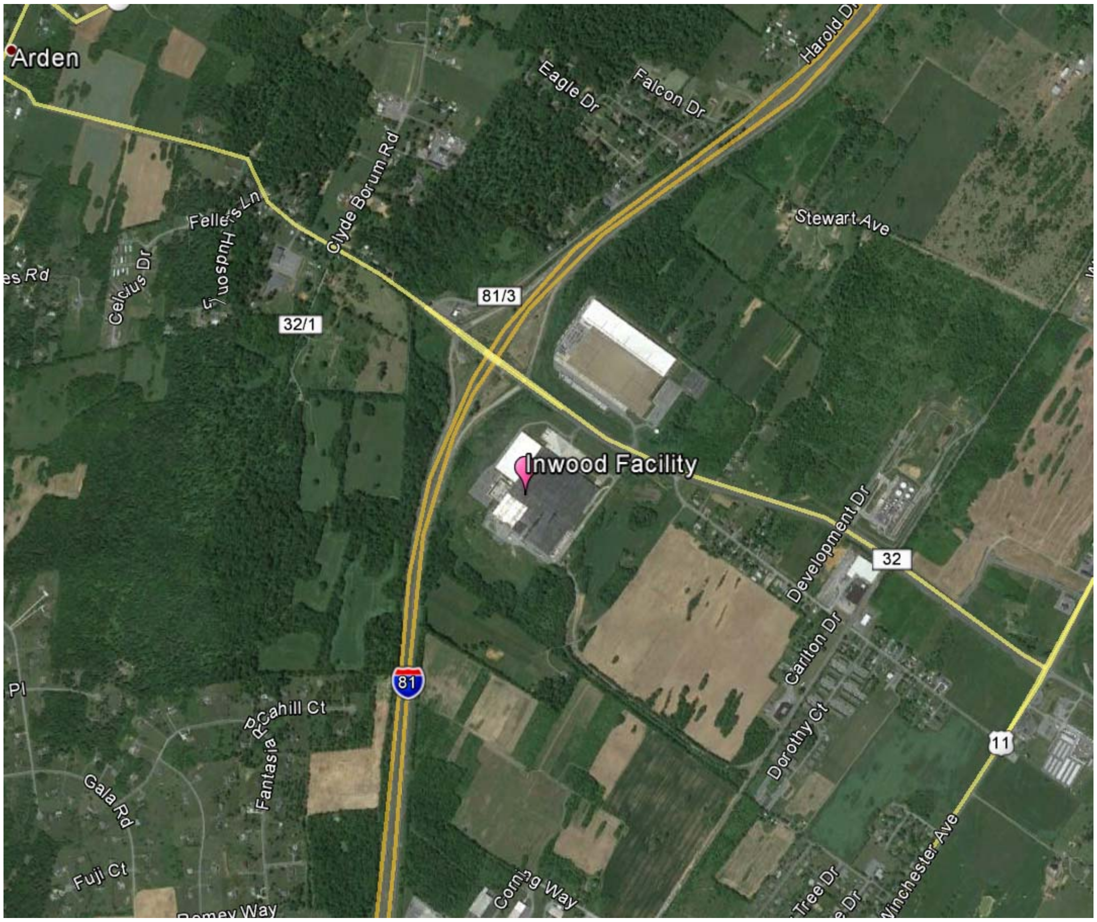
With the submittal of this PSD air dispersion modeling report, Knauf is including a CD containing all the files associated with the PSD air dispersion modeling analysis of the Inwood Line 2 project. This CD, under as Appendix A, includes those files associated with importing terrain elevations, building downwash, meteorological data, and AERMOD. The CD also contains a copy of the application that was received by WVDEP on November 3, 2016.

1.1. FACILITY LOCATION

The Inwood Facility is located at approximately 200 meters east of Interstate 81 near Tabler-Station Road in Berkeley County, West Virginia. Figure 1.1-1 presents an aerial image indicating the location of the facility. This area map shows the location of the plant relative to surrounding terrain and other features, such as roads and rivers.

[1] 40 CFR §81.349.

Figure 1.1-1 Inwood Facility and Surrounding Area



The following is the company contact information for the Inwood Facility:

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1.2. PROJECT OVERVIEW

The Line 2 project will include installation of a new gas oxygen-fueled (gas-oxy) melting furnace, a new canal/channel and forehearth, new fiber forming equipment, and new packaging equipment. The project also involves modification of the existing curing oven and glass raw material handling and storage facilities and calls for the installation of a new emergency generator. The proposed project will also increase the processing capacity of Line 2.

With regard to the emissions control strategy for the proposed project, Knauf is planning to implement several options. The proposed gas-oxy furnace substitutes oxygen for air in the combustion process. This substitution significantly reduces emissions of NO_X due to the reduction in nitrogen being consumed during combustion. Emissions from the furnace will be controlled by a baghouse to reduce emissions of PM, PM_{10}, and $PM_{2.5}$. Emissions from the fiber forming spinners will be controlled by drop-out boxes and mixing chamber for reduction of PM, PM_{10}, and $PM_{2.5}$ emissions. Overall, total emissions are calculated to be above the applicable NSR major modification thresholds for NO_2, PM, PM_{10}, and $PM_{2.5}$.

2. MODELING PROCEDURES

The air dispersion modeling analysis was conducted in a manner that was consistent with U.S. EPA's Appendix W of Title 40 of the Code of Federal Regulations Part 51 (40 CFR 51), the *Guideline on Air Quality Models (Guideline)*[2], promulgated on November 9, 2005, and Knauf's Air Quality Modeling Protocol submitted on October, 13 2016. Knauf's protocol was predicated on the current version of the *Guideline*, however it is noted that U. S. EPA proposed changes to the *Guideline* in July 2015.[3] Knauf has also incorporated comments and suggested changes from WVDEP's review of the modeling protocol into this report.[4] A copy of the accepted protocol and related correspondence between Knauf and WVDEP is included as Appendix B.

2.1. SIGNIFICANCE ANALYSIS

As a first step to the PSD modeling assessment, a significant impact analysis was conducted to determine if the calculated emissions resulting from the proposed project resulted in a significant impact upon the area surrounding the Inwood Facility.

Before a significant impact analysis was performed, a project emissions assessment was made to determine for which pollutants modeling was necessary. To make this determination, Knauf compared the annual emission increases from the proposed project to the PSD Significant Emission Rates (SERs) presented in Table 2.1-1. A significance analysis is required for each pollutant associated only with the project increase that is emitted at annual rates above the SERs for which ambient air quality standards or PSD Increments apply including CO, NO_2, PM_{10}/$PM_{2.5}$, and SO_2. If the net annual emission increases did not exceed a SER or if no ambient air quality standards existed for the pollutant, no modeling analysis was required for that pollutant. The proposed project required a significance analysis for NO_2, PM_{10}, and $PM_{2.5}$. Although the project required PSD permitting for PM, since there are no modeling standards for PM [Significant Impact Levels (SILs), Increment, or NAAQS], no air quality modeling analysis was performed for this pollutant. Ozone impacts as a result of NO_2 emissions are further addressed in Section 5.

Table 2.1-1 PSD Significant Emission Rates

Pollutant	Significant Emission Rate (Tons/Year)[5]
CO	100
NO_2	40
SO_2	40
VOC	40
GHGs [6]	75,000
PM	25
PM_{10}	15
$PM_{2.5}$	10

[2] 70 *Federal Register* 68218, November 9, 2005.
[3] https://www3.epa.gov/ttn/scram/11thmodconf/9930-11-OAR_AppendixW_Proposal.pdf
[4] Comments received via e-mail from Jon McClung (WVDEP) to Ian Donaldson (Trinity Consultants) on November 13, 2016.
[5] The Inwood Facility is an existing PSD major source. Once over this threshold, any criteria pollutant that exceeds its respective significant emission rate will also be subject to PSD review.
[6] Per the June 23, 2014 U. S. Supreme Court decision in the case of *Utility Air Regulatory Group v. EPA*, GHGs alone cannot trigger PSD, but remain subject to regulation for sources which otherwise trigger PSD requirements.

2.1.1. Significant Impact Analysis

A significant impact analysis was performed for each pollutant with an annual emissions increase from the proposed project greater than the SER which has established ambient air quality standards and/or PSD Increments. Modeled stack parameters and emission rates for Knauf emission sources in the significance analysis are included as Appendix C, Tables C-1 and C-3. "Significant" impacts are defined by ambient concentration thresholds commonly referred to as the SILs, which represent a fraction of the NAAQS and PSD Increment standards and are commonly interpreted to indicate the level above which a particular facility causes or contributes to air quality degradation.[7] In the significant impact analysis, the maximum-modeled ground-level concentrations were compared to the appropriate SIL established by U.S. EPA (shown in Table 2.1-2). If a significant impact (i.e., an ambient impact above the SIL for a given pollutant and averaging period) was not demonstrated through this initial modeling and it was demonstrated that the background concentration of a given pollutant was sufficiently below the applicable NAAQS, no further modeling analysis was needed for demonstrating compliance with the NAAQS or the PSD Class II Increments. If a significant impact was demonstrated through the initial modeling, a full impacts analysis with a regional source inventory was required to demonstrate that the proposed project does not cause or significantly contribute to a violation of the NAAQS or consume more than the available PSD Class II Increments. Note that in the significant impact analysis, the highest first-high (H1H) modeled impacts were generally used for comparison against the SIL. However, for 1-hour NO_2, the impact is to be reported as the "the highest of the [five]-year averages of the maximum modeled 1-hour NO_2 concentrations predicted each year at each receptor."[8] This was taken to mean that the model was to output the H1H 1-hour impact for each receptor for each of the five modeled years, then the five H1H values at each receptor were averaged, and finally the maximum value was compared to SIL. For $PM_{2.5}$, the highest of the 5-year averages of the maximum modeled 24-hour or annual $PM_{2.5}$ concentrations predicted each year at each receptor was used for comparison with the SILs.

Table 2.1-2 Applicable Significant Impact Levels [9]

PSD Pollutant	Averaging Period	Federal Class II Significant Impact Level (µg/m³)
PM_{10}	24-hour	5
	Annual	1
$PM_{2.5}$ [a]	24-hour	1.2
	Annual	0.3
NO_2	Annual	1
	1-hour [b]	7.5
Ozone	8-hour	--

[a] The $PM_{2.5}$ SILs were effectively remanded and vacated as a result of a United States Court of Appeals decision, *Sierra Club v. EPA,* No. 1—1413. However, WVDEP has generally accepted the previously established SILs for the purpose of significance modeling when there is adequate (i.e., greater than the SIL) difference between the NAAQS and existing ambient background concentrations. In addition, on August 1, 2016 EPA proposed guidance related to drafting of SILs for $PM_{2.5}$ and ozone. This includes a proposed lowering of the annual average $PM_{2.5}$ SIL to 0.2 µg/m³.

[b] The 1-hour NO_2 SIL has not been formally proposed. Knauf used the interim SIL of 4 ppb (or 7.5 µg/m³) presented in the June 28, 2010 Wood memo.[10]

2.1.2. Ambient Monitoring Requirements

Under current U.S. EPA policies, the maximum impacts attributable to the emissions increases from a project must be assessed against monitoring *de minimis* levels to determine whether pre-construction monitoring should be considered. A pre-construction air quality analysis using continuous monitoring data can be required for pollutants

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[7] U.S. EPA Memorandum from Gerald Emison to Thomas Maslany, July 8, 1988.

[8] U.S. EPA Memorandum from Anna Marie Wood, *General Guidance for Implementing the 1-hour NO_2 National Ambient Air Quality Standard in Prevention of Significant Deterioration Permits, Including an Interim 1-hour NO2 Significant Impact Level*, June 28, 2010.

[9] U.S. EPA Memorandum from John Calcagni to Thomas Maslany, September 10, 1991.

[10] Ibid.

subject to PSD review per 40 CFR § 52.21(m). The monitoring *de minimis* levels for ozone, PM_{10}, $PM_{2.5}$, and NO_2 are provided in 40 CFR § 52.21(i)(5)(i) and are listed in Table 2.1-3. If either the predicted modeled impact from the proposed project or the existing ambient concentration is less than the monitoring *de minimis* concentration, the permitting agency has the discretionary authority to exempt an applicant from pre-construction ambient monitoring.

Table 2.1-3 Applicable Monitoring de minimis Levels[11]

PSD Pollutant	Averaging Period	Monitoring *de minimis* Levels (μg/m³)
PM_{10}	24-hour	10
$PM_{2.5}$ [a]	24-hour Annual	4 --
Ozone[b]	8-hour	--
NO_2	1-hour Annual	-- 14

[a] The $PM_{2.5}$ monitoring de minimis levels were effectively remanded and vacated as a result of a United States Court of Appeals decision, *Sierra Club v. EPA,* No. 1—1413.
[b] Per 40 CFR 52.21(i)(5)(i)(f), there is no de minimis level for ozone. However, only net emissions increases of 100 tpy or more of VOC or NO_X that are subject to PSD are required to perform an ambient impact analysis, including the gathering of ambient air quality data.

When not exempt, an applicant may provide existing data representative of ambient air quality in the affected area or, if such data are not available, collect background air quality data.[12] However, this requirement can be waived if representative background data have been collected and are available.

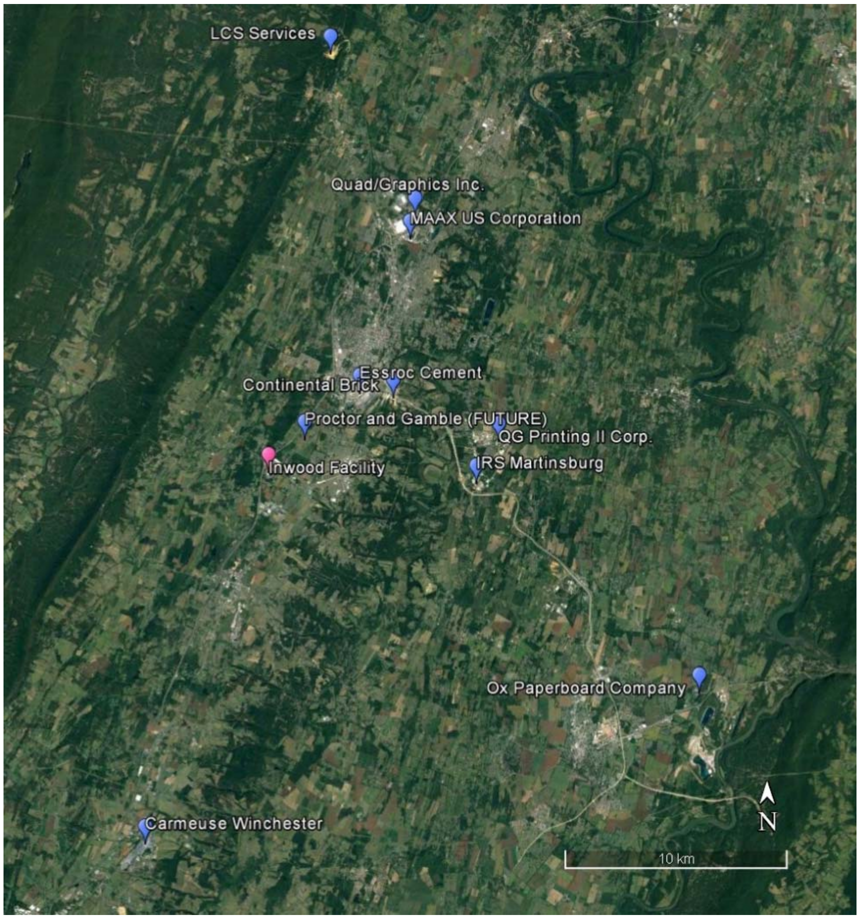
As noted in the model protocol, to satisfy the PSD pre-construction monitoring requirements, Knauf presumes that existing monitoring data provides reasonable estimates of the background pollutant concentrations for pollutants of concern (ozone, $PM_{2.5}$, PM_{10}, and NO_2). The representativeness of existing monitoring data is outlined further in Section 2.2. For this reason, Knauf believes that pre-construction monitoring is not required for this project.

2.1.3. Significant Impact Area and Regional Source Inventories

The procedures for determining the significant impact area (SIA) and regional source inventories are outlined in this section. If any off-site pollutant impact calculated in the significant impact analysis exceeded the SIL, a SIA was determined. The SIA encompasses a circle centered on the site with a radius extending out to either: (1) the farthest location where the emissions increase of a pollutant from the project causes a significant ambient impact (called the radius of influence [ROI]), or (2) a distance of 50 kilometers (km), whichever is less. Per discussion with WVDEP at pre-application meetings, Knauf reviewed regional source inventories within a 20 km radius of the Inwood Facility. All sources of the pollutant in question within this 20 km radius were assumed to potentially contribute to ground-level concentrations and were evaluated for possible inclusion in the NAAQS and PSD Increment analyses, where required. Sources outside of this area that are between 20 and 30 km away were reviewed on a case by case basis weighing both proximity, expected stack dispersion and overall emissions. Facilities determined to be included in the regional source inventory are depicted in Figure 2.1-1.

[11] 40 CFR §52.21(i)(5)(i).
[12] U.S. EPA New Source Review Workshop Manual (Draft, 1990), pages C.18–19.

Figure 2.1-1 Regional Source Inventory Locations



Separate NO_2, PM_{10} and $PM_{2.5}$ regional source inventories were compiled for the NAAQS and PSD Increment analyses. Source locations, stack parameters, annual operating hours, and potential emissions data were obtained from WVDEP, the Maryland Department of Environmental Protection (MDE), the Virginia Department of Environmental Quality (VDEQ), and/or file reviews of specific facilities. Knauf coordinated with WVDEP to develop the regional source inventory considering all sources within the aforementioned area. The regional source inventory is shown under Appendix D, including modeled emission rates and stack parameters. Furthermore, Appendix D also identifies the regional sources excluded from modeling and the rationale for excluding them.

2.2. NAAQS ANALYSIS

The procedures for conducting a NAAQS analysis are outlined in this section. For a given pollutant, if the maximum impact calculated in the significance impact analysis exceeds the corresponding SIL at an off-property receptor, a NAAQS analysis is required. For pollutants that do not result in a modeled significant impact at an off-property receptor, no NAAQS modeling is required.

The objective of the NAAQS analysis is to demonstrate through dispersion modeling that emissions from the proposed project will not cause or significantly contribute to a violation of the primary or secondary NAAQS. The primary NAAQS are the maximum concentration ceilings, measured in terms of total concentration of a pollutant in the atmosphere, which define the "levels of air quality which the U.S. EPA judges are necessary, with an adequate margin of safety, to protect the public health."[13] Secondary NAAQS define the levels that "protect the public welfare from any known or anticipated adverse effects of a pollutant." The primary and secondary NAAQS are listed in Table 2.2-1.

Table 2.2-1 National Ambient Air Quality Standards (NAAQS) [14]

		Primary		Secondary	
PSD Pollutant	**Averaging Period**	**(μg/m³)**	**(ppm)**	**(μg/m³)**	**(ppm)**
$PM_{2.5}$	24-hour	35	--	35	--
	Annual	12	--	15	--
Ozone	8-hour	--	0.070	--	0.070
PM_{10}	24-hour	150	--	150	--
NO_2	1-hour	(188)	0.1	--	--
	Annual	(100)	0.053	(100)	0.053

The NAAQS analysis for this project includes the potential emissions from the existing and proposed emission sources at the Inwood Facility and the emissions of sources that were included in the regional source inventory. Modeled stack parameters and emission rates for Knauf emission sources are included as Appendix C, Tables C-1 and C-2. Modeled stack parameters and emission rates for the regional source inventory are included as Appendix D. The modeled impacts, added to appropriate background concentrations, were assessed against the applicable NAAQS to demonstrate compliance. The background concentrations were based on state/federal data.

Background concentrations of $PM_{2.5}$ for inclusion in the NAAQS demonstration were provided to Knauf by WVDEP. Data from a WVDEP-operated monitoring station in Martinsburg, WV (approximately 7 km from the facility) were used to represent background concentrations at the Inwood Facility.

Background concentrations for the 24-hour PM_{10} standard are from the Tucker Elementary School monitor located in Fairfax County, VA (AQ ID 51-510-0020). The closest PM_{10} monitoring station to the facility is the Winchester Courts Building, which is approximately 30 km from the facility. However, PM_{10} data counts for this station are low. The Tucker monitor is located approximately 103 km from the Inwood Facility, and is near the Washington D.C. metropolitan area. Given the urban location of the monitor, it provides a conservative estimate of PM_{10} background concentrations which is also in line with the limited data available from Winchester, VA. Additionally, the monitoring station has high data counts for this pollutant.

Background concentrations of NO_2 for both the 1-hour and annual standards are from the Rockingham County Virginia Department of Transportation (VDOT) monitoring station (AQ ID 51-165-0003) in Rockingham County, Virginia. While the Rockingham monitor is not the closest monitor to the Inwood Facility (Broad Run High School and James S. Long Park in VA are closer), the site's similar setting makes it the most representative choice. The Rockingham station is similarly located along Interstate 81 and is also located in a valley along the Appalachian Mountains. The populations for the counties are similar (approximately 100,000 for Berkley County and 75,000 for Rockingham County from the 2010 census). The background NO_2 values are also higher than those of closer monitoring stations, making it a conservative choice.

Background concentrations for the 8-hour ozone standard are from a monitor located in Frederick County, Virginia (AQ ID 51-069-0010). While there is a monitor situated in closer proximity in Martinsburg, West Virginia (AQ ID 54-003-0003), the Frederick County monitor is preferable due to its location upwind of the Inwood Facility and data counts. Note that both monitors are included in the ozone analysis provided for in Section 5.

For each site, the most recent three years of data (2013-2015) were evaluated. For the one-hour NO_2 standard, the average of the 98th percentile value of the most recent 3 years was selected to match the form of the NAAQS. For the

[13] 40 CFR §50.2(b).
[14] The values in parentheses have been converted from ppm to μg/m³.

annual averaging period, the highest annual average over the most recent 3 years was used. The final background values for each pollutant are summarized in Table 2.2-2.

Table 2.2-2 Background Concentrations

PSD Pollutant	Averaging Period	Background Value ($\mu g/m^3$)	Year
$PM_{2.5}$	24-hour	26	2013-2015
	Annual	10.3	2013-2015
Ozone	8-hour	60 ppb	2013-2015
PM_{10}	24-hour	23	2013-2015
NO_2	1-hour	77.5	2013-2015
	Annual	16.7	2014

To demonstrate compliance with the annual NO_2 standard, the maximum-modeled annual arithmetic mean was compared to the NAAQS. For demonstrating compliance with the 1-hour standard for NO_2, the highest eighth-high modeled 1-hour daily maximum concentrations averaged over five years was compared to the NAAQS. For demonstrating compliance with the 24-hour PM_{10} standard, the highest sixth-high modeled 24-hour concentration over the entire 5-year meteorological period was compared to the NAAQS. For demonstrating compliance with the 24-hour $PM_{2.5}$ standard, the highest eighth-high modeled 24-hour concentration averaged over the entire 5-year meteorological period was compared to the NAAQS. For demonstrating compliance with the annual $PM_{2.5}$ standard, the highest first-high modeled concentration averaged over five years was compared to the NAAQS.

2.2.1. Ozone Consideration

Note that the project triggers PSD permitting for a precursor of ozone (i.e., NO_X), which is designated as attainment. Knauf evaluated the project's impact on the new 8-hour average ozone standard (70 ppb). This evaluation involved a qualitative and quantitative discussion that included the use of past regional scale modeling efforts (e.g., Cross State Air Pollution Rule and NEI data). Further ozone impact analysis is provided in Section 5.

2.3. PSD INCREMENT ANALYSIS

The procedures for conducting a PSD Increment analysis are outlined in this section. The PSD Increments were established to "prevent deterioration" of air quality in certain areas of the country where air quality was better than the NAAQS. The sum of the PSD Increment concentration and a baseline concentration defines a "reduced" ambient standard, either lower than or equal to the NAAQS that must be met in an attainment area. To prevent the deterioration of "clean areas", U.S. EPA established PSD Increments as provided in Table 2.3-1 for applicable pollutants. Note that there is no PSD Increment identified for ozone.

Table 2.3-1 PSD Increments [15]

PSD Pollutant	Averaging Period	PSD Increments ($\mu g/m^3$)	
		Class I	Class II
PM_{10}	24-hour	8	30
	Annual	4	17
$PM_{2.5}$	24-hour	2	9
	Annual	1	4
NO_2 [a]	1-hour	--	--
	Annual	2.5	25

[a] PSD Increments have not yet been proposed for the 1-hour NO_2 standard.

U.S. EPA has defined three classes of areas protected by PSD Increment standards: Class I areas (national parks, national wildlife areas, etc.), which require additional levels of protection; Class II areas; and Class III areas. The project site and its surroundings are situated in a Class II area and therefore, any pollutant that required a PSD analysis was compared to the Class II Increments. Class I areas in West Virginia include Dolly Sods Wilderness and Otter Creek Wilderness. Class I areas in neighboring Virginia include James River Face Wilderness and Shenandoah National Park.

A PSD Class II area Increment analysis was carried out for $PM_{2.5}$, PM_{10} and NO_2 for this project.[16] The PSD Increment analysis includes the emissions from the proposed project and regional increment-consuming sources. Modeled stack parameters and emission rates for Knauf emission sources are included as Appendix C, Tables C-1 and C-2. Modeled stack parameters and emission rates for the regional source inventory are included as Appendix D, which includes an indication of which sources are increment consuming. For the annual average standards, the highest incremental impact modeled was used. For compliance with the short-term standards, the highest second-high modeled concentrations was used.

The determination of whether an emissions change at a given source consumes or expands a PSD Increment is based on the source definition and the time the change occurs in relation to baseline dates. Emission changes at major sources that occur after the major source baseline date affect PSD Increment. In contrast, emission changes at minor sources only affect PSD Increment after the minor source baseline date, which is set at the time when the first PSD application is completed in a given area, usually arranged on a county-by-county basis. Since the Inwood Facility is a major source, emission changes that occur after the baseline date will affect PSD Increment. The following table provides a list of the major source and minor source baseline dates for Berkeley County.

Table 2.3-2 PSD Increment Baseline Dates for Berkeley County, WV

Date	NO_2	PM_{10}	$PM_{2.5}$
Major Source Baseline	2/8/1988	1/6/1975	10/20/2010
Minor Source Baseline	6/4/2001	12/27/2001	Not yet established

Note that specific to PM_{10} Increment and the ESSROC Cement plant in Martinsburg, the plant underwent significant modernization in the mid-2000s. The projects did not trigger PSD or nonattainment New Source Review (e.g., the project netting analysis showed a net decrease in emissions as a result of the project). Furthermore, a review of the Fact Sheet for the plant's Title V operating permit shows that there has been a 60 tpy decrease in potential PM_{10}

[15] 40 CFR §52.21(c).

[16] As with the NAAQS analysis, a PSD Increment analysis was only conducted for those pollutants with a significant net emissions increase and significant impacts, as determined in the significant impact analysis outlined in Section 2.1.1 of this report.

emissions. As such, there has been no net emission increase at the plant that would consume Increment, if anything there would likely be Increment expansion.

With regard to Class I area Increment, WVDEP indicated that Knauf needed to perform a screening level Class I area Increment analysis to determine the need for a more refined analysis. The screening level Class I area Increment analysis is provided in Section 9.

3. MODELING METHODOLOGY

The air dispersion modeling analyses were generally conducted in accordance with the following guidance documents:

- U.S. EPA's *Guideline on Air Quality Models* 40 CFR Part 51, Appendix W (Revised, November 9, 2005) (*Guideline*);
- U.S. EPA's *AERMOD Implementation Guide* http://www.epa.gov/scram001/7thconf/aermod/aermod_implmtn_guide_19March2009.pdf;
- U.S. EPA's *New Source Review Workshop Manual* (Draft, October, 1990);
- U.S. EPA, Office of Air Quality Planning and Standards, Memorandum from Mr. Tyler Fox to Regional Air Division Directors. *Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard* (March 1, 2011);
- U.S. EPA, Office of Air Quality Planning and Standards, *Guidance for $PM_{2.5}$ Permit Modeling* (May 2014);
- U.S. EPA, Office of Air Quality Planning and Standards, Memorandum from Mr. Tyler Fox to Regional Air Division Directors. *Applicability of Appendix W Modeling Guidance for the 1-hour SO_2 National Ambient Air Quality Standard* (August 23, 2010); and
- U.S. EPA, Office of Air Quality Planning and Standards, Memorandum from Mr. R. Chris Owen and Roger Brode to Regional Air Modeling Contacts. *Clarification on the Use of AERMOD Dispersion Modeling for Demonstrating Compliance with the NO_2 National Ambient Air Quality Standard* (September 30, 2014).

3.1. MODEL SELECTION

The AERMOD modeling system is composed of three modular components: AERMAP, the terrain preprocessor; AERMET, the meteorological preprocessor; and AERMOD, the control module and modeling processor. The development of AERMOD began in 1991 when the American Meteorological Society/U.S. EPA Regulatory Model Improvement Committee (AERMIC) was formed to promote the interests of creating a new regulatory air quality model based on up-to-date scientific principles to replace the long-standing Industrial Source Complex Short-Term Version 3 (ISCST3) model. Nearly a decade after the inception of AERMIC, the U.S. EPA formally designated AERMOD as the preferred regulatory air quality model by promulgating revisions to the *Guideline* on November 9, 2005.

Knauf utilized the most recent version of AERMOD (dated 15181), AERMET (dated 15181), and AERMAP (dated 11103) to estimate impacts from the proposed project. Following procedures outlined in the *Guideline*, the AERMOD modeling was performed using regulatory default options as outlined in the approved modeling protocol.[17,18]

Table 3.1-2 summarizes the model control options that were utilized in this analysis. Note that with regards to the use of the rural option in AERMOD (as indicated in Table 3.1-2), Knauf analyzed the land cover around the facility, using the National Land Cover Database (NLCD) dataset. In the land cover data category, only NLCD 1992 land cover codes 22 and 23 are classified as "Urban". As depicted below in Table 3.1-1, which summarizes the land cover surrounding the facility using the NLCD dataset, the area surrounding the site is almost entirely "Rural". This finding confirms the use of the rural option in AERMOD.

[17] Knauf utilized the *BREEZE®-AERMOD GIS Pro* software interface for running all applicable executables: AERMOD, AERMAP, and AERMET. However, the BREEZE software was only be utilized for the interface and the actual U.S. EPA executables were utilized for the modeling runs.
[18] Regulatory default options also include the urban option being switched off.

Table 3.1-1 Land Use Procedure for Rural / Urban Selection in Air Quality Models

Code	Description	Code Count	Code Percent of Total
0	Missing, Out-of-Bounds, or Undefined	0	0.00
11	Open Water	31	0.10
12	Perennial Ice/Snow	0	0.00
21	Low Intensity Residential	709	2.26
22	High Intensity Residential	0	0.00
23	Commercial/Industrial/Transp.	938	2.99
31	Bare Rock/Sand/Clay	0	0.00
32	Quarries/Strip Mines/Gravel	73	0.23
33	Transitional	57	0.18
41	Deciduous Forest	5607	17.86
42	Evergreen Forest	174	0.55
43	Mixed Forest	4097	13.05
51	Shrubland	0	0.00
61	Orchards/Vineyard/Other	0	0.00
71	Grasslands/Herbaceous	0	0.00
81	Pasture/Hay	17360	55.29
82	Row Crops	2075	6.61
83	Small Grains	0	0.00
84	Fallow	0	0.00
85	Urban/Recreational Grasses	271	0.86
91	Woody Wetlands	1	0.00
92	Emergent Herbaceous Wetlands	6	0.02
	Total	31,300	100
	Total Urban	**938**	**3.0**

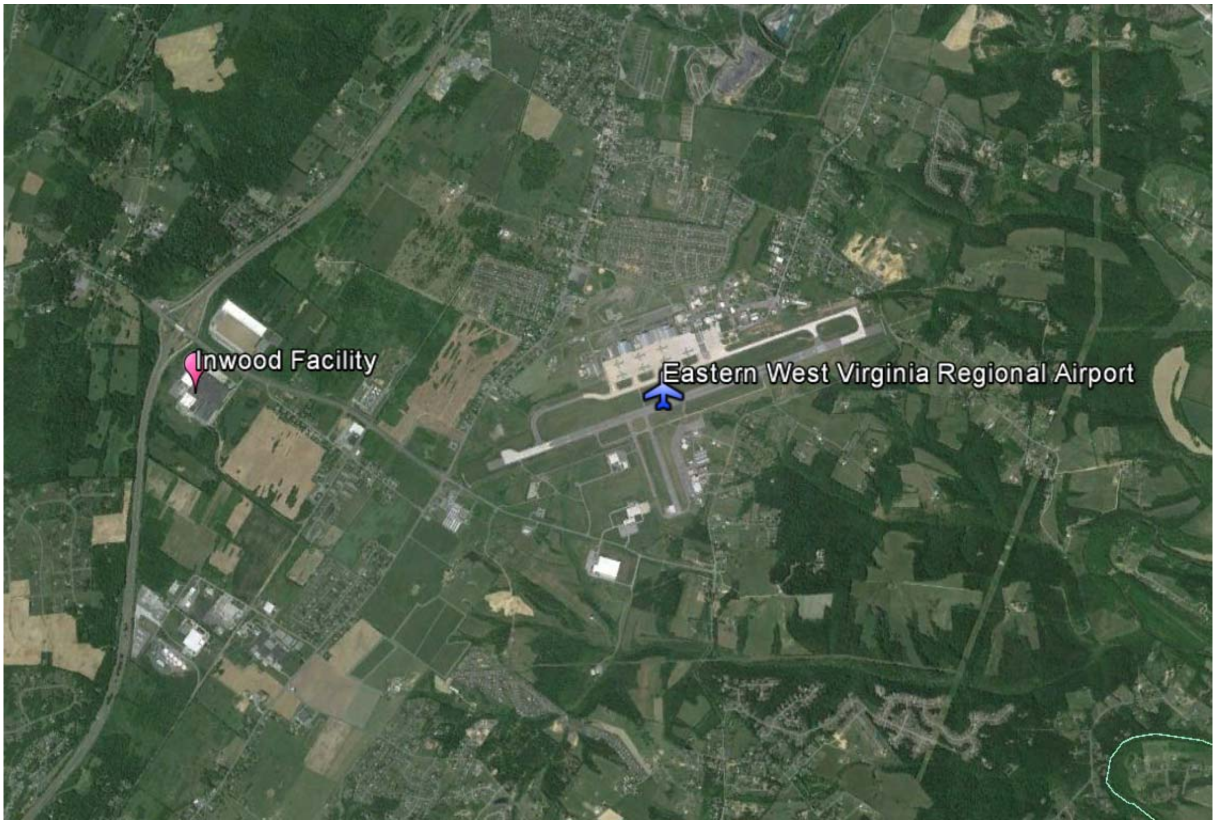
Table 3.1-2 Model Selection Options

Control Options	Option Selected	Justification
Pollutant ID	NO_2, PM_{10}, $PM_{2.5}$	-
Terrain	Elevated, Meters	The receptor grid covers varying terrain elevations; as such, the elevated option was selected.
Flagpole Receptors	N/A	-
Run or Not	Run	-
Averaging Times	1-hour, 24-hour and/or Annual	Knauf selected the appropriate averaging periods for each pollutant triggering PSD.
Model	PRIME	The PRIME algorithms are default.
Dispersion	Concentration, Rural, Regulatory Default Option	This modeling analysis is assessing compliance with concentration standards. Knauf is located in a predominantly rural area. The regulatory default option was selected.
NO_2 Model Options	See discussion in Section 4.0	See discussion in Section 4.0
Particulate Model Options	Concentration	Knauf opted to not use particle deposition and/or depletion options for $PM_{2.5}$ PM_{10}, since they will not have a significant impact in the results.
Output Files	.aml	Model output file from Breeze User Interface (contained in zip files [.amz])

3.2. METEOROLOGICAL DATA

AERMOD modeling analyses require the use of meteorological data that has been collected at a location with similar land use and topographic settings to the project site (deemed representative). The Inwood Facility fence line is located approximately 3.8 kilometers (km) from the monitor at the Eastern West Virginia Regional Airport in Martinsburg, WV. Figure 3.2-1 shows the relative location of the Eastern West Virginia Regional Airport to the Inwood Facility.

Figure 3.2-1 Meteorological Station for Inwood



The *Guideline* lists the following important criteria for determining meteorological data representativeness:

- The proximity of the meteorological monitoring site to the area under consideration;
- The complexity of the terrain;
- The exposure of the meteorological monitoring site; and
- The period of time during which data are collected.

Given the proximity to the Inwood Facility, and the resulting similar topographic settings, Knauf determined that the Eastern West Virginia Regional Airport should be considered as representative of the Inwood Facility. To further support this conclusion, Knauf performed an AERSURFACE analysis as well as other qualitative analyses to compare the land use and topography of Eastern West Virginia Regional Airport to Inwood.

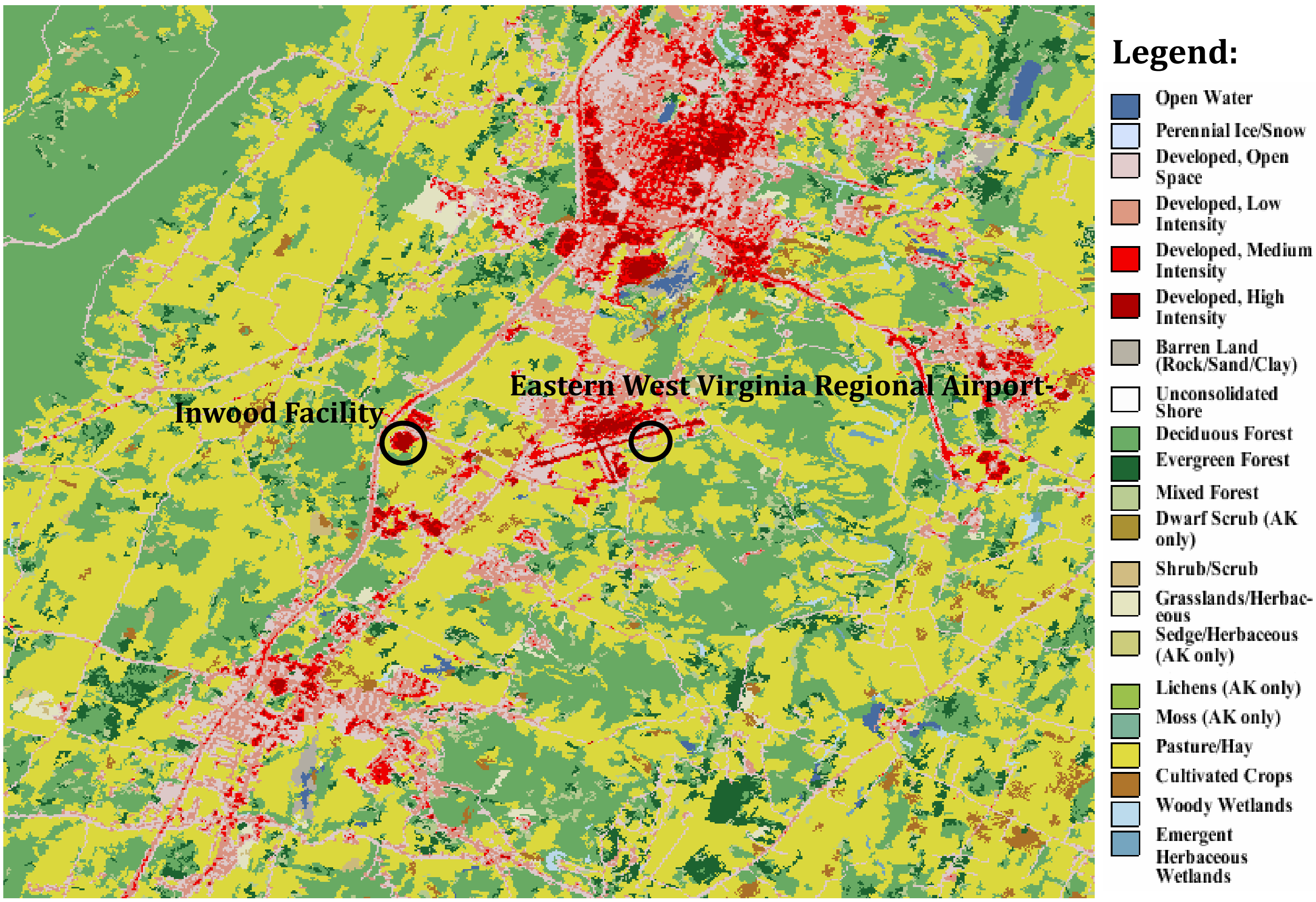
3.2.1. Site Location and Surface Characteristics

As described in the *Guideline*, the proximity of the meteorological data station and the Inwood facility is an important consideration in determining representativeness. As described above, the Inwood Facility is in close proximity (approximately 3.8 km) from the Eastern West Virginia Airport meteorological station.

AERSURFACE (version 13016) was used as an objective method for evaluating land use characteristics and their associated micrometeorological parameters for a given location. AERSURFACE was used to create seasonal values of albedo, Bowen ratio and surface roughness, across 12 directional sectors (e.g. 0-30 degrees). The seasonal parameters correspond to the calendar months in which they occur (i.e. winter values for December-February). The albedo and Bowen ratio values were determined from taking the geometric mean over a 10 kilometer (km) area out from the location of interest. The surface roughness values assigned by AERSURFACE were based on a 1 km radius out from the site.

The figures in Appendix A of the modeling protocol (Appendix B of this document) illustrate the relative insignificant magnitude of the micrometeorological differences between the Eastern West Virginia and Inwood sites, as determined by AERSURFACE. All three micrometeorological parameters show reasonable agreement across the directional sectors. Figure 3.2-2 shows the land use surrounding the Inwood Facility and the Eastern West Virginia Regional Airport.

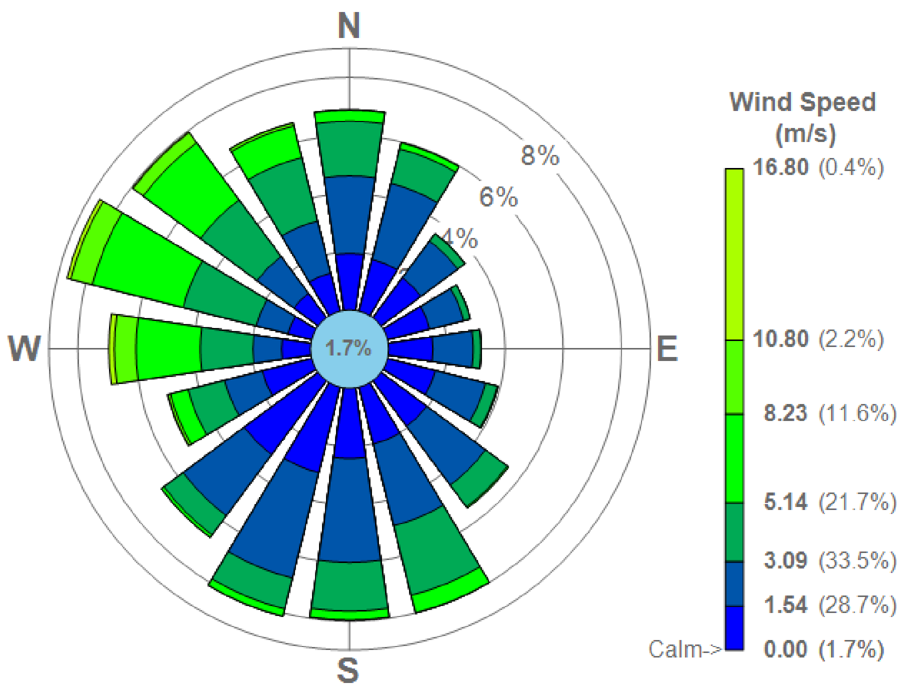
Figure 3.2-2 Land Use Surrounding the Inwood Facility and Eastern WV Regional Airport



3.2.2. Topographic Setting

The complexity of the terrain is another important consideration in determining data representativeness. In addition to the land use similarities shown above, the Eastern West Virginia airport and Inwood Facility are at approximately the same elevation (~178 meters for the facility and ~165 meters for the tower) without significant terrain features between the sites or surrounding the individual locations. Figure 3.2-3 provides a wind rose for the Eastern West Virginia Regional Airport for the data period of 2011 to 2015.

Figure 3.2-3 Eastern West Virginia Regional Airport Wind Rose



As shown in Figure 3.2-3, wind is largely from the northwest and south at Eastern West Virginia airport. There are no significant terrain features as such mountains or rivers which would suggest that this wind pattern would not also be true for the facility site. The airport and facility sits in a valley along the Appalachian Mountain Range, but other than that localized decrease in elevation, the terrain is rolling throughout the immediate vicinity.

3.2.3. Data Quality

The Eastern West Virginia Regional Airport meteorological data was processed through the latest version of AERMET (version 15181) to include upper air measurements from the Dulles International Airport site (IAD). Per EPA guidance, 1-minute Automated Surface Observing System (ASOS) wind data was also incorporated in the processing, using AERMINUTE (version 15272). A base elevation of 162.8 meters was used for the meteorological tower in the modeling analysis. The *Guideline* lists meteorological station siting (or exposure) and the data observation period as two additional important considerations for determining representativeness. Since the East West Virginia Regional Airport is a NWS station, it was sited and installed based on well-defined meteorological criteria and judgment.[19] The instrumentation also undergoes a high level of inspection and calibration. Once a site is deemed representative, one of the key factors in determining suitability of a meteorological station's data is the quality and quantity of observations. Based on the *Guideline* definitions of representativeness, the Eastern WV airport weather station is representative of the Inwood Facility location assuming that five, quality years of data (at least 90 percent complete per calendar quarter) are available. The period from 2011 to 2015 was evaluated and determined to have a data capture well above 90 percent. Table 3.2-1 presents a completeness summary for those years.

[19] National Oceanic and Atmospheric Administration (NOAA), *Federal Standards for Siting Meteorological Sensors at Airports,* August 1994.

Table 3.2-1 Eastern West Virginia Regional Airport Data Completeness Test

2011			
Data Type	**Total Hours**	**Missing Hours**	**% Accepted**
Pressure	8768	0	100.00
Sky Cover	8768	72	99.18
Temperature	8768	3	99.97
Wind Direction	8768	255	97.09
Wind Speed	8768	4	99.95

2012			
Data Type	**Total Hours**	**Missing Hours**	**% Accepted**
Pressure	8752	13	99.85
Sky Cover	8752	47	99.46
Temperature	8752	13	99.85
Wind Direction	8752	282	96.78
Wind Speed	8752	6	99.93

2013			
Data Type	**Total Hours**	**Missing Hours**	**% Accepted**
Pressure	8764	8	99.91
Sky Cover	8764	2498	71.50
Temperature	8764	4	99.95
Wind Direction	8764	299	96.59
Wind Speed	8764	2	99.97

2014			
Data Type	**Total Hours**	**Missing Hours**	**% Accepted**
Pressure	8767	1	99.99
Sky Cover	8767	3725	57.51
Temperature	8767	2	99.98
Wind Direction	8767	336	96.17
Wind Speed	8767	25	99.71

2015			
Data Type	**Total Hours**	**Missing Hours**	**% Accepted**
Pressure	8784	8	99.91
Sky Cover	8784	3256	62.93
Temperature	8784	8	99.91
Wind Direction	8784	368	95.81
Wind Speed	8784	33	99.62

Given the demonstrated similarities of the Eastern West Virginia airport site and the Inwood Facility as well as the overall data quality, the years 2011-2015 was combined with upper air data from the Dulles International Airport (i.e., Sterling, VA) site for use in the AERMOD dispersion modeling analysis.

Note that the base elevation of the Eastern West Virginia Regional airport meteorological station is 162.8 meters. This was used as the PROFBASE keyword in the ME pathway of the AERMOD input files in this analysis.

3.3. TREATMENT OF TERRAIN

The terrain surrounding the project site consists of *simple terrain* (terrain below stack top) and *complex terrain* (terrain above stack top). A designation of terrain at a particular receptor is source-dependent, since it depends on an individual source's effective plume height. AERMOD is capable of estimating impacts in both simple terrain and complex terrain, and as such, no special treatment of terrain was required. Terrain elevation data was imported into the model using the AERMAP utility, as described in Section 3.4.

3.4. TERRAIN ELEVATIONS

Receptor terrain elevations input to the model were interpolated from National Elevation Dataset (NED) data obtained from the USGS with a resolution of one-third arc-second. The data was interpolated using the AERMAP preprocessor (version 11103, the most recent version issued) to determine elevations at the defined receptor intervals. The site-grade elevation of the facility was used for Knauf's sources, while boundary receptor elevations were determined using AERMAP. For all other receptors, AERMAP was used to estimate the elevation. In addition, Knauf reviewed the NED data for any missing data, as well as imported elevation data to check for any skewed data.

In addition to the receptor elevation, AERMOD's terrain modeling algorithms require an additional parameter called the hill height scale. AERMOD computes the hill height scale value at a receptor as a weighted interpolation between horizontal and terrain-following states using a critical dividing streamline approach. This scheme assumes that part of the plume mass will have enough energy to ascend and traverse over a terrain feature and the remainder will impinge and traverse around a terrain feature under certain meteorological conditions. The hill height scale was computed by the AERMAP terrain preprocessor for each receptor as a measure of the one terrain feature in the modeling domain that would have the greatest effect on plume behavior at that receptor. The hill height scale does not represent the critical dividing streamline height itself, but supplies the computational algorithms with an indication of the relative relief within the modeling domain for the determination of the critical dividing streamline height for each hour of meteorological data.

Knauf conducted the AERMAP terrain processing by selecting an appropriate hill height boundary within which all receptors were located and all possibly relevant terrain features were included. The "10 percent slope rule" was utilized to determine the size of the domain (i.e., the size of the NED file used). This involved the use of the same simple computational algorithm AERMAP uses to disregard all elevation data points that are not likely to have an effect. This approach disregards points having a slope of less than 10 percent from a particular receptor, computed as the difference in elevation divided by the distance between points, under the presumption that such small terrain differences would not have an effect on plume transport. This analysis was performed with AERMAP and documented to prove that no relevant terrain features were omitted from the AERMAP domain. A worst-case scenario was considered in which the highest terrain elevation within West Virginia was used to determine the delta y and its respective delta x based on the 10 percent slope rule. Based on the calculated worst-case delta x, it was then determined what the appropriate domain was for this modeling analysis.

3.5. RECEPTOR GRIDS

For this air dispersion modeling analysis, ground-level concentrations were calculated along the property line and also within Cartesian receptor grids. The size and resolution of the Cartesian grids were selected so that the maximum concentrations were captured within the 100 meter-spaced region. Table 3.5-1 provides the receptor spacing that was used in this analysis. Figure 3.5-1 and Figure 3.5-2 depict these receptor grids.

Table 3.5-1 Receptor Spacing

Sub-Grid Type	Distance Range (kilometers)	Receptor Spacing (meters)
Ambient air boundary	--	25
Extra fine	0 – 1	50
Fine	1 – 5	100
Coarse	5 – 25	500

Figure 3.5-1 Receptor Grid

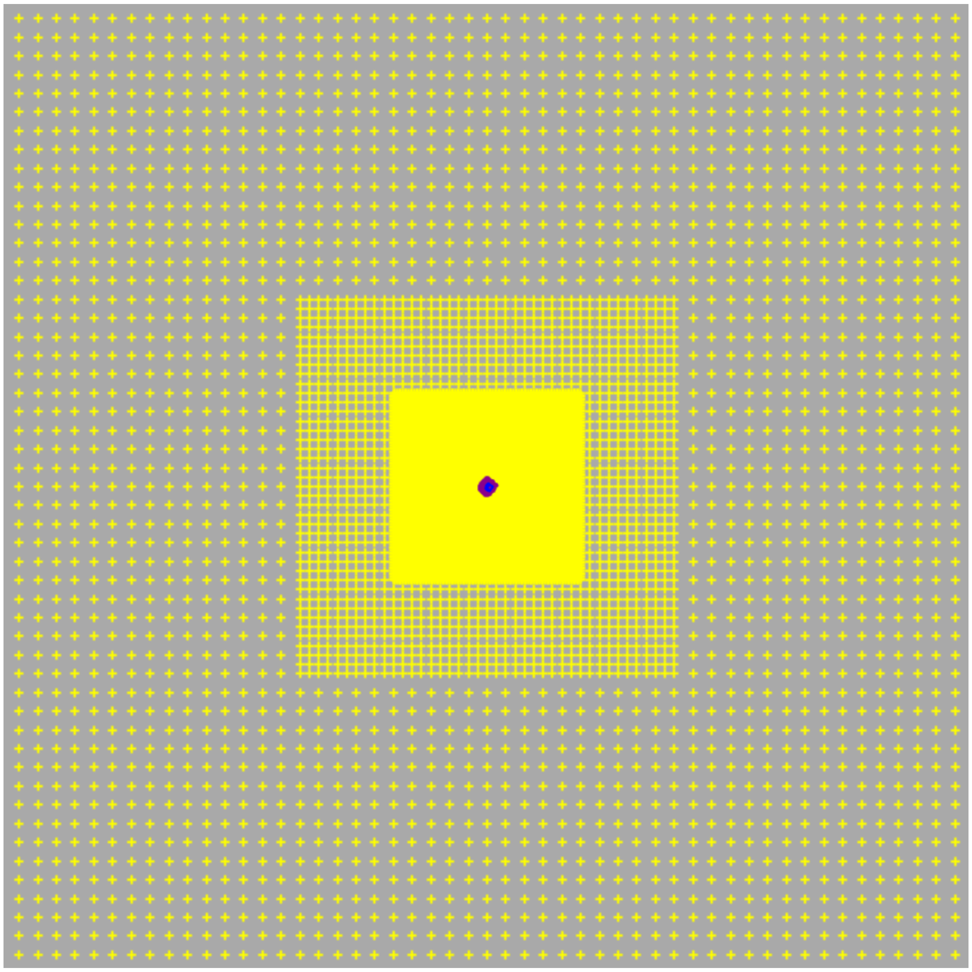
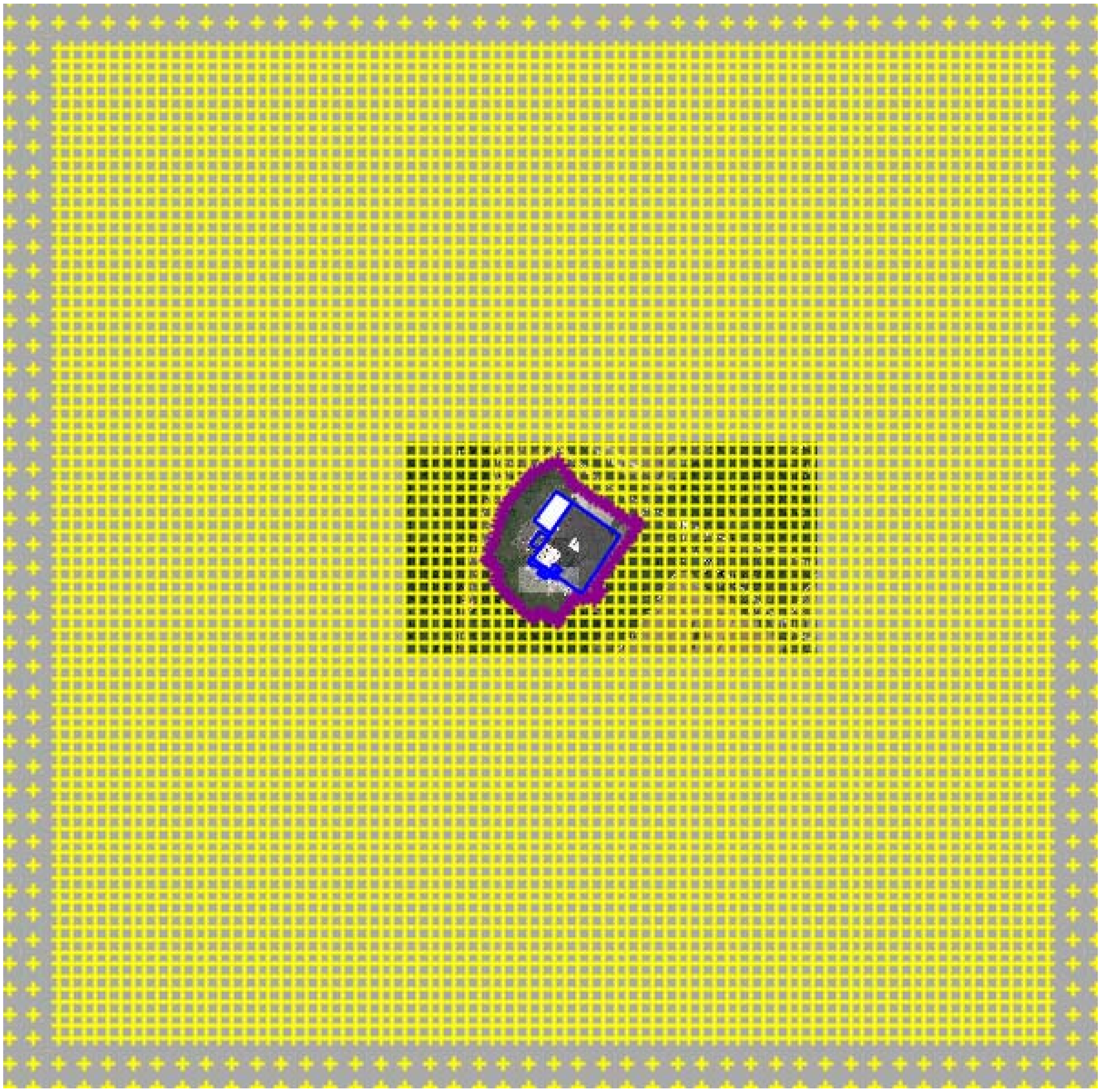


Figure 3.5-2 Receptor Grid (Zoom In)



3.6. BUILDING DOWNWASH

The emission units at the Inwood Facility were evaluated in terms of their proximity to nearby structures. The existing and project site buildings were digitized from detailed project drawings. The purpose of the building downwash evaluation is to determine if stack discharges could become caught in the turbulent wakes of these structures, leading to downwash of the plumes. Wind blowing around a building creates zones of turbulence that are greater than if the building were absent.

All stacks modeled in this analysis were evaluated for cavity and wake effects from building downwash. The current version of the AERMOD dispersion model treats the trajectory of the plume near the building and uses the position of the plume relative to the building to calculate interactions with the building wake. AERMOD calculates fields of turbulence intensity, wind speed, and slopes of the mean streamlines as a function of the projected building dimensions.

The direction-specific building dimensions used as input to the AERMOD model was calculated using the Building Profile Input Program PRIME (BPIP-PRIME) (version 04274, the most recent version issued).[20] BPIP-PRIME is sanctioned by U.S. EPA and is designed to incorporate the concepts and procedures expressed in the GEP Technical Support document, the Building Downwash Guidance document, and other related documents.[21]

3.7. GEP STACK HEIGHT ANALYSIS

For those sources being assessed in the air quality analysis, a good engineering practice (GEP) stack height analysis was performed. The analysis discusses the requirements and methodology used to determine the creditable stack heights used in the dispersion model.

Section 123 of the Clean Air Act (CAA) and 45CSR20-2 defines GEP, with respect to stack heights, as "the height necessary to ensure that emissions from the stack do not result in excessive concentrations of any air pollutant in the immediate vicinity of the source as a result of atmospheric downwash, eddies, or wakes which may be caused by the source itself, nearby structures, or terrain obstacles." Simply stated, GEP is a guideline criterion for determining stack height equal to the greater of:

$H_g = H + [1.5 \times (L)]$ **OR** 65 meters

Where:
H_g = GEP stack height
H = height of nearby structure
L = lesser dimension, height or projected width, of nearby structure

This formula is often simplified to 2.5 times the nearby structure height. Although this simplification may be used as a "rule of thumb," it may only be employed for stacks in existence on or before January 12, 1979, per CAA Section 123. Therefore, GEP determinations for new stacks must utilize the equation above. All structures within a distance of 5L from a stack are considered in a downwash analysis. Structures located outside a distance of 5L from a stack are determined to not contain the stack inside their zone of influence and are, therefore, excluded from the downwash analysis for that stack. Each structure within the 5L distance of a stack is used to calculate a respective GEP stack height. The greatest GEP stack height calculated from each structure is then determined to be the required GEP height for the stack. Note that multiple nearby structures may act as one larger structure and create a greater downwash effect.

CAA Section 123 and 45CSR20-2 also specify that GEP stack height shall not exceed 2.5 times the height of the source (or 65 meters), unless a demonstration is performed justifying a higher stack. This is frequently referred to as the tall stack regulation. GEP only regulates stack height credit to be used in dispersion modeling analyses, not actual stack heights. A source may construct a stack that exceeds GEP, but will be limited to the GEP stack height in the air quality analysis demonstration. All stacks at the Inwood Facility comply with these requirements.

[20] U.S. EPA, *User's Guide to the Building Profile Input Program,* (Research Triangle Park, NC: U.S. EPA), EPA-454/R-93-038.
[21] U.S. EPA, Office of Air Quality Planning and Standards, *Guidelines for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations) (Revised),* (Research Triangle Park, NC: U.S. EPA), EPA 450/4-80-023R, June 1985.

3.8. REPRESENTATION OF EMISSION SOURCES

3.8.1. Coordinate System

The location of emission sources, structures, and receptors are represented in the Universal Transverse Mercator (UTM) coordinate system in the North American Datum (NAD) 1983 datum. The UTM grid divides the world into coordinates that are measured in north meters (measured from the equator) and east meters (measured from the central meridian of a particular zone, which is set at 500 km). UTM coordinates for the sources in this analysis are based on UTM Zone 17.

3.8.2. Source Types

The AERMOD dispersion model allows for emission units to be represented as point, area, or volume sources. Point sources were used to represent stacks at the facility.

If an emission unit has an unobstructed vertical release, the source was modeled based on the methods in the AERMOD Implementation Guide. Emission units with obstructed or non-vertical discharge orientations (i.e., roof vents, horizontal discharge stacks, and rain-capped stacks) were represented in the model as point sources with an exit velocity of 0.001 meter per second (V_s') while all other stack parameters (diameter, temperature, and height) were based on the actual conditions.

For the point sources, stack parameters (i.e., height, diameter, exhaust gas temperature, and gas exit velocity) used in the modeling analyses were based on maximum design values. Site-specific topographic data from facility design plans was used for estimating source and building elevations.

3.8.3. Source Parameters and Emission Rates

The final list of Knauf sources to be modeled in this analysis are listed below in Table 3.8-1. Emissions sources include both existing sources at the facility (associated with the Line 1 production line) and new and modified sources associated with the Line 2 project. Per Tables 8-1 and 8-2 of the *Guideline*, short term maximum potential or allowable emission rates are to be used in the short term standard evaluation while a long term actual emissions or annual permit restriction could be used in the long term standard analysis. Furthermore, using U.S. EPA guidance, Knauf excluded emergency engines (e.g., fire pumps and generators) from the 1-hr NO_2 analysis (although the emission units remain in the annual average analysis).

The *Guideline* states that modeling should contain sufficient detail to determine the maximum ambient concentration of the pollutant under consideration, and that this likely will likely involve modeling several operating loads or production rates. Based on the nature of these operations, however, a load analysis was not an applicable consideration for the Line 2 project.

The melting furnace startup and shutdown occurrences will occur on an infrequent basis and will not typically have an impact on emissions above normal production emissions. The startup will involve a pre-heat stage where only natural gas combustion is exhausting through a bypass, then through the baghouse fan and out the stack. Once operational temperatures are reached and raw materials (batching) are fed into the melter, the bypass will be isolated and the baghouse will be online.

A formal list of Knauf emission sources, emissions and parameters are included as Appendix C. Regional inventory source information is provided as Appendix D.

Table 3.8-1 Knauf Emission Sources

Source Description	Stack Description	Pollutant Type
Line 1 Melting Furnace (Existing)	Line 1 – Melting and Refining Baghouse Stack	NO_2 , PM_{10}, $PM_{2.5}$
Line 1 Refining Hearth (Existing)	Line 1 – Melting and Refining Baghouse Stack	NO_2 , PM_{10}, $PM_{2.5}$
Line 1 Fiber Forming Spinners (Existing, revised stack height)	Line 1 – Forming and Collection Stack	PM_{10}, $PM_{2.5}$
Line 1 Curing Oven and Cooling Conveyor (Existing)	Line 1 – Curing and Cooling Stack	NO_2 , PM_{10}, $PM_{2.5}$
Line 2 Gas-Oxy Melting Furnace (New), included with Line 2 Forming and Collection stack	N/A	NO_2 , PM_{10}, $PM_{2.5}$
Line 2 Refining Hearth (New), included with Line 2 Forming and Collection Stack	N/A	NO_2 , PM_{10}, $PM_{2.5}$
Line 2 Fiber Forming Spinners (New)	Line 2 – Forming and Collection Stack	PM_{10}, $PM_{2.5}$
Line 2 Curing Oven and Cooling Conveyor (Modified)	Line 2 – Curing and Cooling Stack	NO_2 , PM_{10}, $PM_{2.5}$
Emergency Generator (ESDG12) (Existing)	Emergency Generator (ESDG12)	NO_2 , PM_{10}, $PM_{2.5}$
Emergency Generator (ESDG13) (Existing)	Emergency Generator (ESDG13)	NO_2 , PM_{10}, $PM_{2.5}$
Emergency Generator (New)	Emergency Generator	NO_2 , PM_{10}, $PM_{2.5}$
Fire Water Engine (ESFW11) (Existing)	Fire Water Engine (ESFW11)	NO_2 , PM_{10}, $PM_{2.5}$
Raw Material Handling (FP11) (Modified), included with Line 2 Forming and Collection Stack	N/A	PM_{10}, $PM_{2.5}$
Sizing and Packaging Area (FP15) (Modified), included with Line 2 Forming and Collection Stack	N/A	PM_{10}, $PM_{2.5}$
Two (2) Batch Day Bins (New)	Two Bin Vents	PM_{10}, $PM_{2.5}$

4. NO_2 MODELING OPTIONS

Modeling of NO_2 emissions in AERMOD can follow one of several application methods (Tier 1, Tier 2, and Tier 3), each outlined in Section 5.2.4 of the Guideline on Air Quality Models (GAQM). Knauf utilized the Tier 2 approach for this modeling analysis.

Historically, the Ambient Ratio Method (ARM), Tier 2, has been used for refined NO_2 modeling. Over time due to photochemical reactions in the ambient atmosphere where nitrogen oxide (NO) converts to NO_2, the NO-NO_2 ratio will settle out to the ambient atmospheric ratio, which is 80% NO_2 on a one-hour basis and 75% NO_2 on an annual basis. Because the NAAQS is for the pollutant NO_2, only modeled concentrations of NO_2 should be compared to the NAAQS. As such, under Tier 2 the ARM applies the ambient atmospheric ratio to modeled concentrations of NO_X, where 80% are assumed to be NO_2 concentrations on a one-hour basis and 75% are assumed on an annual basis.

If Tier 2 modeled concentrations are greater than the NAAQS design values, the more refined Tier 3 approach (i.e., the Plume Volume Molar Ratio Method [PVMRM] or the Ozone Limiting Method [OLM]) may be used. Historically, PVMRM has been proposed by the U.S. EPA in AERMOD as a non-regulatory (Tier 3) default method and has been presented in a model evaluation study on the U.S. EPA Support Center for Regulatory Air Models (SCRAM) website.[22] The study concluded that PVMRM provided an unbiased estimate of NO_2 model concentrations for each of the evaluated cases. PVMRM considers the conversion of NO_X emissions to NO_2 in the atmosphere on an hour-by-hour basis. For each hour, the volume of the source-specific plume is calculated for that hour's meteorological conditions. Emissions of NO_X predominately consist of nitric oxide (NO) which is oxidized into NO_2. The limiting factor in this reaction is an equilibrium state that is usually established among NO, NO_2, and ozone concentrations in the atmosphere. It is of fundamental importance that an ozone-limited atmosphere will limit the amount of conversion of NO to NO_2.[23] The amount of available NO_X, NO, and ozone and the eventual conversion to NO_2 is determine by the plume volume.

Knauf utilized the Tier 2 approach for this analysis. A refined Tier 3 or ARM2 approach was not required.

[22] *Evaluation of Bias in AERMOD-PVMRM*, Alaska DEC Contract No. 18-9010-12, June 2005, http://www.epa.gov/scram001/7thconf/aermod/pvmrm_bias_eval.pdf

[23] Addendum – User's Guide for the AMS/EPA Regulatory Model – AERMOD (EPA-454 / B-03-001, September 2004).

As noted in Section 1.2, the Project triggers PSD review for one (1) ozone precursor: NO_X. This section outlines the methodology for evaluating ozone concentrations as it relates to existing conditions and to the project.

5.1. EXISTING OZONE CONCENTRATIONS

In order to evaluate the potential impact from the project with respect to ozone concentrations, it is first necessary to understand existing ambient background ozone concentrations. There are two monitors within close proximity of the Project. These monitors are Monitor #51-069-0010 in Frederick County, VA (approximately 15 km to the south) and Monitor #54-003-0003 in Berkeley County, WV (approximately 7 km to the northeast). The design value concentrations for the most recent three years of certified data, which were obtained via EPA's AirData database are depicted in Table 5.1-1 below.[24]

Table 5.1-1 Design Value Ozone Concentrations at Nearby Monitors

Year	Frederick County Monitored 4th Highest Daily Maximum 8-hour Concentration (ppb)	Berkeley County Monitored 4th Highest Daily Maximum 8-hour Concentration (ppb)
2013	60	63
2014	59	64
2015	61	66
Design Value	60	63

Considering the current 8-hour average ozone NAAQS is 70 ppb, both monitors suggest that there is substantial margin between current monitored values and the NAAQS. The difference between monitored values and the NAAQS is paramount in the further evaluation of potential ozone impacts provided in the following sections.

5.2. REVIEW OF EXISTING INVENTORIES

In order to put into context the magnitude of Project emissions increases, as it related to ozone formation, a review of county and regional emissions of ozone precursors was performed. The EPA's 2011 National Emissions Inventory (NEI) Data was consulted in conducting the review.[25, 26] In evaluating which counties to review as part of the region, the wind rose in Figure 3.2-3 was consulted. Table 5.2-1 outline the regional emissions of NO_X.

Compared to the magnitude of ozone precursor emissions in the region, the Project's NO_X emissions increases (estimated at 102 tpy) are a small fraction. To point, the NO_X emissions increases represent 2% of the total county emissions and less than 0.3% of the region's emissions

[24] https://www3.epa.gov/airdata/ad_maps.html
[25] https://www.epa.gov/air-emissions-inventories/2011-national-emissions-inventory-nei-data
[26] Knauf is aware that the 2014 NEI data was posted on September 27, 2016. While Knauf will review the 2014 data, it is our expectation that the use of 2014 data will have limited to no impact on the conclusions of this analysis.

Table 5.2-1 Regional NO_X (Ozone Precursor) Emissions (tpy) from 2011 NEI

County	Fuel Comb. Elec. Util.	Fuel Comb. Industrial	Fuel Comb. Other	Chemical & Allied Product Mfg.	Petroleum & Related Industries	Other Industrial Processes	Solvent Utilization	Waste Disposal & Recycling	Highway	Off-Highway	Misc.	County Total
Allegany, MD	675	3192	195	0	7	466	0	30	1411	601	2	**6579**
Frederick, MD	5	148	375	0	13	9	1	61	4354	1559	6	**6530**
Washington, MD	165	129	328	0	5	1625	1	30	4720	843	5	**7852**
Clarke, VA	0	7	16	0	0	0	0	7	375	207	3	**616**
Shenandoah, VA	0	31	69	0	0	127	0	20	2923	219	31	**3420**
Warren, VA	0	11	48	0	0	0	0	13	1057	265	111	**1505**
Winchester City, VA	0	33	56	0	0	0	0	2	335	85	1	**512**
Frederick, VA	0	75	94	1	0	0	0	51	3015	774	16	**4026**
Berkeley, WV	0	92	179	0	0	1507	0	107	2411	821	5	**5122**
Hampshire, WV	0	5	20	0	0	0	0	26	439	413	2	**905**
Jefferson, WV	0	80	44	0	0	0	0	40	787	737	5	**1693**
Morgan, WV	0	5	19	0	0	0	0	16	386	740	1	**1169**
Total	**845**	**3808**	**1444**	**1**	**25**	**3734**	**2**	**403**	**22213**	**7264**	**187**	**39928**

5.3. REVIEW OF RULE DEVELOPMENT DATA

To further understand the potential impact of the Project emissions on ozone concentrations, technical support data from the Cross State Air Pollution Rule (CSAPR) was reviewed and applied to project emission increases.[27] The purpose of the analysis is to illustrate quantitatively the minimal impact of the Project through use of CSAPR development emissions data and monitor model results. Table 5.3-1 provides the NO_X emissions data utilized by EPA during rule development. Only states that are likely to contribute to ozone concentrations in the project area were evaluated.

Table 5.3-1 Evaluated Emissions Cases (tpy) during CSAPR Development

State	2005 Base NO_X	2012 Base	2014 Base	2014 Remedy	2012 Base minus 2005 Base		2014 Base minus 2012 Base		2014 Remedy minus 2014 Base	
					Difference	% Diff.	Difference	% Diff.	Difference	% Diff.
MD	312,230	197,441	181,909	181,533	-114,789	-36.8%	-15,533	-7.9%	-375	-0.2%
VA	488,263	359,907	334,720	333,985	-128,355	-26.3%	-25,187	-7.0%	-735	-0.2%
WA	308,655	172,143	166,094	155,245	-136,512	-44.2%	-6,049	-3.5%	-10,849	-6.5%

Table 5.3-2 provides EPA's ozone modeling results for the two monitor locations previously reviewed in Section 5.1.

Table 5.3-2 Modeled Values during CSAPR Development

Monitor ID	State	County	2003-2007 Maximum Ambient Value	2012 Base Case Maximum Values	2014 Base Case Maximum Values	2014 Remedy Maximum Values
510690010	VA	Frederick	73.0	64.4	63.0	62.9
540030003	WA	Berkeley	76.0	67.8	66.2	65.9

With the input emissions data and output modeled values in Tables 5.3-1 and 5.3-2, a factor was developed that illustrates how ozone model output concentrations vary with respect to changes in NO_X emissions. The computation of tons of NO_X per ppb ozone concentration reduction is outlined in Tables 5.3-3 and 5.3-4 for the Berkeley County and Frederick County monitor locations, respectively.

[27] https://www3.epa.gov/crossstaterule/techinfo.html

Table 5.3-3 Comparison of CSAPR Modeled Emissions Reductions and Monitor Design Value Reductions (Berkeley County, WV)

State	Case	Statewide NO_X Emissions Reduction (tpy)	Berkeley Monitor Reduction (ppb)	Reduction Rate (ton/ppb)
WV	2005 Base Case to 2012 Base	136,512	7.2	18,960
MD		114,789	7.2	15,943
VA		128,355	7.2	17,827
WV	2012 Base Case to 2014 Base	6,049	1.6	3,781
MD		15,533	1.6	9,708
VA		25,187	1.6	15,742
WV	2014 Base Case to 2014 Remedy Base	10,849	0.3	36,163
MD		375	0.3	1,252
VA		735	0.3	2,451
			Minimum	**1,252**

Table 5.3-4 Comparison of CSAPR Modeled Emissions Reductions and Monitor Design Value Reductions (Frederick County, VA)

State	Case	Statewide NO_X Emissions Reduction (tpy)	Frederick Monitor Reduction (ppb)	Reduction Rate (ton/ppb)
WV	2005 Base Case to 2012 Base	136,512	7.9	17,280
MD		114,789	7.9	14,530
VA		128,355	7.9	16,248
WV	2012 Base Case to 2014 Base	6,049	1.4	4,321
MD		15,533	1.4	11,095
VA		25,187	1.4	17,991
WV	2014 Base Case to 2014 Remedy Base	10,849	0.1	108,488
MD		375	0.1	3,755
VA		735	0.1	7,352
			Minimum	**3,755**

A ton/ppb factor was developed for each of the CSAPR cases and for each of the three (3) states considered in the analysis. The minimum factor (i.e., the case demonstrating the most ozone concentration sensitivity to NO_X emissions) was identified as Maryland emissions sources between the 2014 base case and the 2014 remedy case at the Berkeley County monitor. Given this factor (1,252 ton/ppb) and the project emission increase of approximately 102 tons of NO_X, it was deduced that a model response in the order of approximately 0.08 ppb ozone would be expected as a result of the Project. Even though this calculation is meant to serve as a high-level, order of magnitude demonstration, it helps to highlight that the Project emissions would have a limited impact on ozone concentrations that are already on the order of approximately 60 ppb.

5.4. OZONE IMPACTS ANALYSIS SUMMARY

The Project is not expected to cause or contribute to an exceedance of the ozone NAAQS. As outlined in Section 5.1, there is substantial margin between current monitored ozone concentrations and the NAAQS. Taking into considering the magnitude of Project emissions increases in comparison with existing regional emissions (Section 5.2) and the negligible ozone concentration increase that may result due to the Project (Section 5.3), compliance with the ozone NAAQS will not be jeopardized as a result of the Project.

The U.S. EPA has recently published guidance for $PM_{2.5}$ permit modeling that addresses secondary formation of $PM_{2.5}$ from $PM_{2.5}$ precursors.[28] The primary $PM_{2.5}$ precursor pollutant that will be emitted as a result of this project is NO_X. Per the U.S. EPA guidance document and conversations with WVDEP, Knauf addressed secondary formation of $PM_{2.5}$ with a combined qualitative and quantitative approach. Given the Project triggers PSD for both direct $PM_{2.5}$ and NO_X, a hybrid qualitative/quantitative analysis was the recommended approach to address secondary impacts (Case 3 in the May 2014 guidance document). Primary impacts were addressed through modeling of direct $PM_{2.5}$ emissions using AERMOD as outlined elsewhere in this report. This section outlines analyses regarding secondary formation of $PM_{2.5}$.

6.1. EXISTING $PM_{2.5}$ CONCENTRATIONS AND SPECIATION

As outlined in Section 2.2, Knauf proposes to utilize $PM_{2.5}$ ambient background concentrations from the monitor located in Martinsburg, West Virginia. The 2013 through 2015 design values from this monitor are include in Table 6.1-1.

Table 6.1-1 PM2.5 Background Concentrations

PSD Pollutant	Averaging Period	Background Value (μg/m³)	Year	NAAQS (μg/m³)
$PM_{2.5}$	24-hour Annual	26 10.3	2013-2015 2013-2015	35 12

In order to better understand the impact of secondary $PM_{2.5}$ formation, the speciation of $PM_{2.5}$ at ambient monitors needs to be reviewed. WVDEP operates three (3) $PM_{2.5}$ speciation monitors. Given that $PM_{2.5}$ is viewed as a regional air pollutant, the use of this speciation is appropriate despite the monitors not being situated in Berkeley County. The 2010 WVDEP Air Quality Report showed that $PM_{2.5}$ is comprised of 16-20% organic carbon, 24-29% sulfate, and 5-10% nitrate.[29] The balance of the speciation mass is comprised of ammonium, elemental carbon, crustal components, and other components. Additionally, a monitor located in Piney Creek, Maryland (AQ ID 24-023-0002) observes a similar speciation (e.g., 24% organic carbon, 28% sulfate, and 8% nitrate). This speciation data demonstrates that nitrates do not play a substantial role in contributing to ambient levels of $PM_{2.5}$ in the state, however this limited role can be further estimated. Furthermore, given the insignificant profile of SO_2 emissions from the Inwood Facility, the Projects impact with respect to sulfates was not evaluated further in this analysis.

6.2. HYBRID QUALITATIVE/QUANTITATIVE $PM_{2.5}$ SECONDARY FORMATION REVIEW

Berkeley County and the Martinsburg area were recently redesignated as in attainment for $PM_{2.5}$. The recent redesignation request and maintenance plan published by WVDEP contains a summary of emissions for the years 2005 and 2007.[30] These total emissions are summarized in Table 6.2-1.

[28] US EPA, *Guidance for $PM_{2.5}$ Permit Modeling*, (Research Triangle Park, NC: U.S. EPA), EPA-454/B-14-001, May 2014.
[29] http://www.dep.wv.gov/daq/air-monitoring/Documents/2010%20Annual%20Report%20Final.pdf
[30] WVDEP, *PM2.5 Redesignation Request & Maintenance Plan*, Martinsburg, WV, 2012.

Table 6.2-1 $PM_{2.5}$ Redesignation Request Emissions Inventories

Pollutant	2005 Emissions (tpy)	2007 Emissions (tpy)	Decrease (tpy)	Decrease (%)
NO_X	10875	8473	2402	22.1
$PM_{2.5}$	2059	1154	905	44.0
SO_2	2462	1833	629	25.5

As shown in Table 6.2-1, total emissions from all sources in Berkeley County decreased by 22.1%, 44% and 25.5% for NO_X, $PM_{2.5}$ and SO_2, respectively. Given the large contribution of sulfates to $PM_{2.5}$ formation, the decrease in SO_2 emissions (which was slightly larger than the decrease in NO_X emissions) and the significant reduction in $PM_{2.5}$ emissions are likely responsible for the corresponding decrease in $PM_{2.5}$ concentrations observed from 2005 to 2007 at the Martinsburg monitor, which are shown in Table 6.2-2.

Table 6.2-2 Historical PM2.5 Background Concentrations

Pollutant	Annual Average (μg/m^3)	24-Hour Average (μg/m^3)
2005	16.9	37.3
2006	14.9	31.4
2007	15.6	31.4
Average	15.8	33.4
Decrease	1.3	5.9

Applying the high end of range of nitrate contributions from the 2010 WVDEP Air Quality Report (i.e., 10%) to observed $PM_{2.5}$ background concentrations in West Virginia, and assuming that the nitrate contribution also applies to the decrease in observed $PM_{2.5}$ background concentrations (i.e., 1.3 μg/m^3), the decrease in nitrate concentration can be estimated at 0.13 μg/m^3.

Considering the NO_X emissions decrease outlined in the redesignation request, a theoretical concentration reduction rate can be estimate as 5.4E-5 μg/m^3 per ton of NO_X reduction (0.13 μg/m^3 divided by 2402 tons). This rate was applied to the Project emissions increases, which gave a theoretical maximum concentration due to the secondary formation of $PM_{2.5}$ from the Project as 0.006 μg/m^3. This value represents approximately 2% of the previously established annual average SIL (and less than 0.1% of the annual average NAAQS) and demonstrates the insignificant impact of the Project's $PM_{2.5}$ precursor emissions on secondary formation.

Furthermore, it is important to note that, as expected, the maximum model output concentrations resulting from direct $PM_{2.5}$ did not coincide with where secondary formation occurred as a result of Project NO_X emissions. The formation of particulate nitrate requires time in the atmosphere (i.e., downwind distance from the facility) and maximum model output concentrations resulting from the Project were within close proximity to the Inwood Facility. Maximum impacts of $PM_{2.5}$ from the Project are depicted in Figures 6.2-1 and 6.2-2.

Figure 6.2-1 Maximum Project Impacts for $PM_{2.5}$ Annual Averaging Period

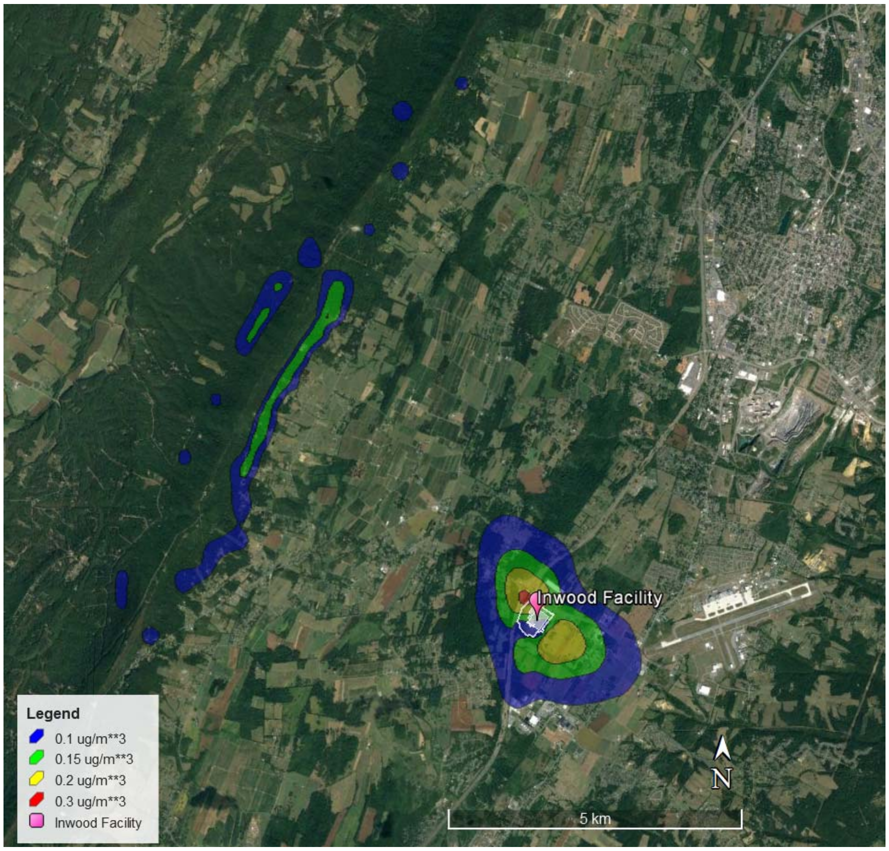
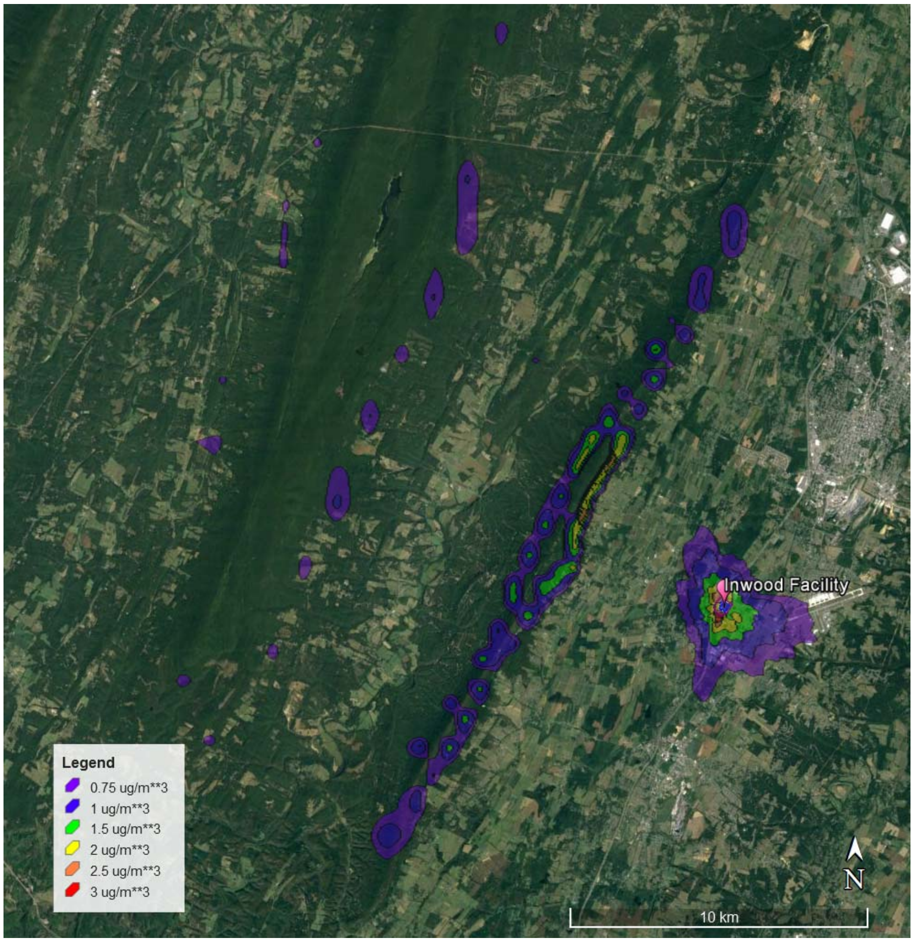


Figure 6.2-2 Maximum Project Impacts for $PM_{2.5}$ 24-hour Averaging Period



6.3. SECONDARY $PM_{2.5}$ FORMATION ANALYSIS SUMMARY

In keeping with EPA's requirements for addressing secondary $PM_{2.5}$ formation impacts, a hybrid qualitative/quantitative analysis was performed as outlined in Sections 6.1 and 6.2. These analyses illustrate the insignificant formation of secondary $PM_{2.5}$ as a result of the Project. No further assessment of secondary $PM_{2.5}$ formation was necessary based on this conclusive analysis. As such, Knauf demonstrated compliance with the $PM_{2.5}$ air quality standards through modeling direct $PM_{2.5}$ emissions to address primary impacts as shown in Section 7.

This section presents the results of the Class II Significant Impact, NAAQS and Class II Increment modeling analyses performed following the procedures outlined in Sections 2 and 3. Electronic input and output files for all AERMOD model runs are included in Appendix A.

7.1. SIGNIFICANT IMPACT ANALYSIS RESULTS

The potential emissions from the Project were modeled and compared to the appropriate SILs. The SILs are used to determine the level of impact associated with the Project. This analysis was conducted to determine if refined NAAQS and PSD Increment modeling analyses would be required.

The results of the Significant Impact analysis are shown in Table 7.1-1. Modeled project concentrations were compared to the Class II SILs.

Table 7.1-1 AERMOD Significant Impact Analysis Results

Pollutant	Averaging Period	Class II Modeling Significance Level (μg/m³)	Maximum Modeled Concentration (μg/m³)	Maximum Concentration Location UTM X Coordinate (m)	Maximum Concentration Location UTM Y Coordinate (m)	Distance to Maximum Concentration (km)
PM_{10}	24-hour	5	7.79	756,260.1	4,365,402.8	0.17
	Annual	1	0.39	756,174.4	4,365,987.1	0.44
NO_2	1-hour	7.5	35.42	751,624.4	4,368,987.1	5.80
	Annual	1	2.30	756,244.8	4,365,392.4	0.18
$PM_{2.5}$	24-hour	1.2	6.51	756,244.8	4,365,392.4	0.18
	Annual	0.2	0.33	756,174.4	4,365,987.1	0.44

[A] The 1-hour NO_2 concentrations listed represent maximum 5-year average values.

As shown above in Table 7.1-1, the maximum modeled concentrations were above the SILs for $PM_{2.5}$, NO_2 and PM_{10}. As such, a cumulative impact analysis was conducted for all applicable averaging periods for these pollutants. The regional source inventories used in these analyses are included in Appendix D.

The SIA was determined for all applicable averaging periods for each pollutant. Table 7.1-2 summarizes the SIA results.

Table 7.1-2 Significant Impact Areas

Pollutant	Averaging Period	Distance (km)
PM_{10}	24-hour	0.3
	Annual	NA
NO_2	1-hour	30.5
	Annual	0.4
$PM_{2.5}$	24-hour	13.5
	Annual	6.3

7.2. NAAQS RESULTS

Following the procedures and methods discussed in this report, Table 7.2-1 summarizes the results from the NAAQS modeling runs. Detailed results are also provided as Appendix E.

Table 7.2-1 NAAQS Analysis Results

Pollutant	Averaging Period	Modeled Maximum Concentration (μg/m³) [a]	Background Concentration (μg/m³)	Total Concentration (μg/m³)	NAAQS (μg/m³)
$PM_{2.5}$	24-hour	8.99	26	34.99	35
	Annual	1.69	10.3	11.99	12
PM_{10}	24-hour	126.99	23	149.99	150
NO_2 [b]	1-hour	110.06	77.5	187.58	188
	Annual	7.68	16.7	24.38	100

[a] Appendix E includes detail information that clearly demonstrates that Knauf does not cause or contribute to an exceedance of the NAAQS.
[b] NO_2 maximum concentrations were modeled using the Ambient Ratio Method (ARM) as stated in Section 4 of this report, where 80% of NO_X are assumed to be NO_2 concentrations on a one-hour basis and 75% are assumed on an annual basis.

The results of the analysis indicate that the predicted ambient concentrations are lower than the NAAQS for $PM_{2.5}$, PM_{10} and NO_2. Note that $PM_{2.5}$ analyses considered an allowance for secondary formation of $PM_{2.5}$ of 0.006 μg/m³, as discussed in Section 6.

For the $PM_{2.5}$ 24-hour standard, six (6) exceeding receptors were identified to be on-site at the Essroc facility and one (1) was on-site at the Continental Brick facility (see Figure 7.2-1). In order to demonstrate that Knauf did not cause or contribute to this exceedance, the receptors for each facility were modeled in separate files with zero emission rates from each respective regional facility (i.e., Essroc and Continental Brick). The resulting concentrations were well below the NAAQS, demonstrating that there were no modeled events at these locations. The results are included in Table 7.2-2 below.

Figure 7.2-1 $PM_{2.5}$ 24-hour Exceeding Receptors On-site at Essroc and Continental Brick

Table 7.2-2 Knauf Culpability at Essroc and Continental Brick On-Site Receptors

Facility	UTM Easting (m)	UTM Northing (m)	Elevation (m)	Modeled Maximum Concentration (μg/m³)
Essroc	760024.4	4369387.1	152.64	3.35
Essroc	760024.4	4369487.1	151.69	3.43
Essroc	760124.4	4369187.1	161.16	3.88
Essroc	760124.4	4369387.1	153.81	3.48
Essroc	760124.4	4369487.1	151.43	3.58
Essroc	760224.4	4369287.1	152.65	3.54
Continental Brick	761824.4	4369187.1	154.36	3.58

7.3. INCREMENT RESULTS

Table 7.3-1 summarizes the results from the PSD Class II Increment runs. Detailed results are also provided as Appendix F.

Table 7.3-1 Class II Increment Analysis Results

Pollutant	Averaging Period	Modeled Maximum Concentration [a]($\mu g/m^3$)	Increment ($\mu g/m^3$)
PM_{10}	24-hour	29.99	30
	Annual	16.50	17
$PM_{2.5}$	24-hour	7.06	9
	Annual	0.99	4
NO_2 [b]	Annual	6.67	25

[a] Appendix F includes detail information that clearly demonstrates that Knauf does not cause or contribute to an exceedance of the PSD Increment.
[b] NO_2 maximum concentrations were modeled using the Ambient Ratio Method (ARM) as stated in Section 4 of this report, where 75% of NO_X are assumed to be NO_2 concentrations on an annual basis.

As shown above in Table 7.3-1, the results of this analysis indicate that the predicted ambient concentrations are lower than the PSD Class II Increment for $PM_{2.5}$, PM_{10} and NO_2. Note that $PM_{2.5}$ analyses considered an allowance for secondary formation of $PM_{2.5}$ of 0.006 $\mu g/m^3$, as discussed in Section 6.

7.4. CONCLUSIONS

This analysis, including the results in this section and in Appendices E and F, demonstrates that $PM_{2.5}$, PM_{10} and NO_2 emissions from the Project had maximum estimated concentrations below the NAAQS and PSD Class II Increment levels. In accordance with U.S. EPA guidance, this modeling analysis demonstrates compliance with PSD permit requirements for the Project.

8.1. GROWTH ANALYSIS

The purpose of the growth analysis is to quantify associated growth; that is, to predict how much new growth is likely to occur in order to support the source or modification under review, and then to estimate the air quality impacts from this growth. First, an assessment was made regarding the amount of residential growth the proposed project will bring to the area. The amount of residential growth will depend on the size of the available work force, the number of new employees, and the availability of housing in the area. Associated commercial and industrial growth consists of new sources providing goods and services to the new employees and to the modified source itself.

The proposed Line 2 project is not expected to cause an appreciable increase in population. The plant will be staffed either with existing employees or additional employees from the current population. In addition, there are no anticipated increases in industrial, commercial, and residential growth as a result of the proposed project. Thus, there will be no perceptible, negative growth impacts resulting from the project.

8.2. SOILS AND VEGETATION ANALYSIS

The U.S. EPA developed the secondary NAAQS in order to protect certain air quality-related values (i.e., soil and vegetation) that were not sufficiently protected by the primary NAAQS. The secondary NAAQS represent levels below which most types of soil and vegetation are unaffected by criteria pollutants. If ambient concentrations are found to be less than the secondary NAAQS, emissions from a proposed modification will not result in harmful effects to either soil or vegetation.[31] Modeled concentrations resulting from the proposed project were compared with, and found to be lower than, the secondary NAAQS to demonstrate insignificant impacts upon local soils and vegetation. Given that the primary NAAQS for NO_2, PM_{10}, and $PM_{2.5}$ are at least equal to or more stringent than the secondary NAAQS for each respective pollutant and averaging period, there was no need for further analysis against low levels of pollutants for which there are no NAAQS.

8.3. VISIBILITY ANALYSIS

A typical visibility impairment analysis will consider the impacts that occur within the impact area of the source. A visibility analysis required as part of an additional impacts analysis will consider issues similar to the Class I area visibility analysis requirements. Since NO_2, $PM_{2.5}$, and PM_{10} emissions trigger PSD modeling and are known to impair visibility, these pollutants were considered in visibility analyses. The U.S. EPA-suggested components of the visibility impairment analysis consist of (1) a determination of the visual quality of the area based on an actual historical evaluation, (2) an initial screening of emissions sources to assess the possibility of visibility impairment, and (3) if warranted, a more in-depth analysis involving computer models.

As required by WVDEP, Knauf utilized the U.S. EPA VISCREEN model following the guidelines published in the *Workbook for Plume Visual Impact Screening and Analysis*[32] to determine potential project impacts at the nearest state park (Fort Frederick State Park) and ensure that no adverse impacts will result. Figure 8.3-1 below depicts the location of the project site with respect to the nearby state parks. Knauf conducted a Level 1 screening analysis and compared the model output to the Class I screening criteria (e.g., 2.0 for color difference index and 0.05 for contrast), which are more conservative than similar criteria for Class II areas. The final values in the Level 1 analysis did not exceed the Class I screening criteria. As such, a Level 2 analysis was not required. The inputs used for VISCREEN were selected in accordance with the VISCREEN workbook and are summarized in Table 8.3-1. The results of this analysis are included in Table 8.3-2.

[31] U.S. EPA, Office of Air Quality Planning and Standards, *New Source Review Workshop Manual*, Research Triangle Park, North Carolina, October 1990.
[32] U.S. EPA, Workbook for Plume Visual Impact Screening and Analysis, EPA-450/4-88-015, 1988.

Figure 8.3-1 Plot of Inwood Facility and Nearby State Parks

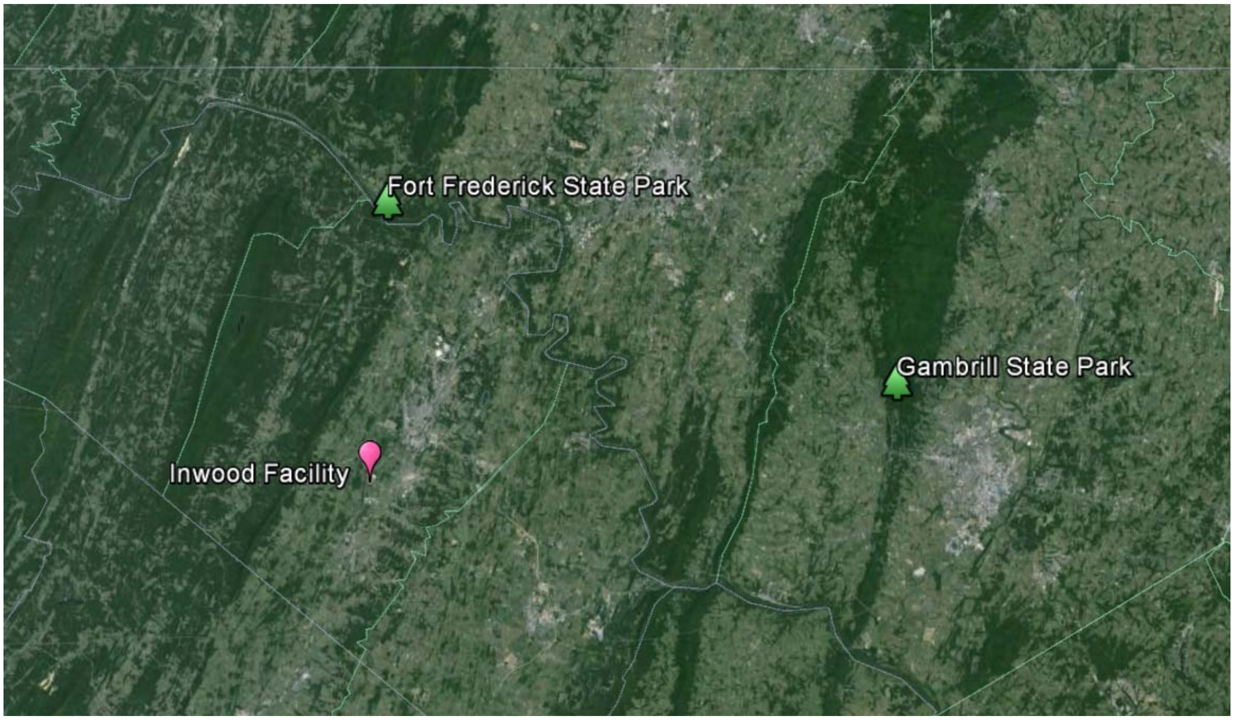


Table 8.3-1 Inputs to VISCREEN Executable

Input	Value	Notes
Nearest Potentially Sensitive Class II Area:	Fort Frederick State Park	---
PM Emissions (g/s):	25.83	Maximum short term emission rate for all sources in the project
NO_X Emissions (g/s):	37.65	Maximum short term emission rate for all sources in the project
Primary NO2, Soot, Sulfate Emission rate (g/s):	0	Default value
Distance (d) between emissions source and observer (km):	22.5	Distance between the emission source and the closest boundary of the area of interest
Distance between emissions source and closest sensitive Class II area boundary (km):	22.5	Set equal to d for conservatism
Distance between emissions source and most distant sensitive Class II area boundary (km):	254	Distance between the emission source and the furthest boundary of the area of interest
Background visual range (km):	25	From Figure 9 of VISCREEN Workbook
Use Level 1 default parameters?	Y	---
Use default screening threshold?	Y	---

Table 8.3-2 VISCREEN Results for Level I Screening of Nearest Class II Area to Knauf Inwood

Background	Theta	Azimuthal	Distance (km)	Alpha	Delta E			Contrast		
					Criteria	Plume	Criteria Exceeded?	Criteria	Plume	Criteria Exceeded?
Inside Class I Area:										
Sky	10	103	24.0	66	2.00	0.821	No	0.05	0.007	No
Sky	140	103	24.0	66	2.00	0.237	No	0.05	-0.006	No
Terrain	10	84	22.5	84	2.00	0.648	No	0.05	0.008	No
Terrain	140	84	22.5	84	2.00	0.113	No	0.05	0.005	No
Outside Class I Area:										
Sky	10	1	1.0	168	2.00	1.017	No	0.05	0.010	No
Sky	140	1	1.0	168	2.00	0.108	No	0.05	-0.005	No
Terrain	10	1	1.0	168	2.00	1.239	No	0.05	0.013	No
Terrain	140	1	1.0	168	2.00	0.345	No	0.05	0.013	No

9.1. CLASS I AREA AIR QUALITY RELATED VALUES ANALYSIS

With regard to Class I area air quality related values (AQRVs), the analysis was conducted with respect to all Class I areas located within 200 km of the facility. There are three Class I areas within 200 km of the Inwood Facility:

- Otter Creek Wilderness (approximately 142 km southwest);
- Dolly Sods Wilderness (approximately 120 km southwest); and
- Shenandoah National Park (approximately 58 km southwest).

The Federal Land Managers (FLMs) are responsible for determining if a Class I AQRV analysis is required.[33] In order to make such a determination, a "Q/d" analysis is typically used where "Q" is the emissions increase of combined NO_X, PM_{10}, SO_2, and H_2SO_4 mist (tons per year) and "d" is the distance to the nearest Class I area (kilometers). "Q" has to be calculated using the maximum 24-hour emission rate for each source. All the major project emission sources (furnace, forming, curing and cooling) will operate in a fairly steady state throughout the year. As such, the estimated annual emission rate will be practically the same as calculating "Q" on a maximum 24-hour basis. For all the remaining sources, the maximum 24-hour emission rate was use as the basis of calculating "Q." Traditionally, if the quotient of these values is less than 10 a Class I analysis is not required; however, this is not a steadfast rule and others may be required on a case-by-case basis.[34] The emission rates used in the Q/d analysis are based on project emissions increase calculations, which account for baseline and isolates emissions exclusively due to the project. Based on the final project emissions, Knauf determined that the "Q/d" values for the proposed project are relatively low (approximately 4.1) and will not require a Class I AQRV analysis. The following are the final project emissions increases (in tpy) of the pollutants of concern:

- NO_X – 102 tpy
- PM_{10} – 110 tpy
- SO_2 – 24 tpy
- Total of Above – 237 tpy

Knauf understands, per conversations with WVDEP, that WVDEP has contacted the FLMs of these Class I areas to determine if they would require a Class I analysis. If the FLMs request that a Class I area analysis be conducted for this proposed project, Knauf will submit a separate modeling protocol to the WVDEP and appropriate FLMs outlining the proposed methodology for that analysis.

9.2. CLASS I AREA SIGNIFICANCE ANALYSIS

Class I area Increment standards and SILs have been defined for the following pollutants and averaging periods: annual average NO_2, 24-hour PM_{10}, annual average PM_{10}, 24-hour $PM_{2.5}$, and annual average $PM_{2.5}$. For all other pollutants and averaging periods for which the project triggered PSD review, there is either no established Class I area PSD Increment standard or SIL and therefore no further analysis was necessary. The Class I area SILs are listed in Table 9.2-1.

[33] 40 CFR§52.21(p)

[34] Section 3.2 (Initial Screening Criteria) of the "Federal Land Managers' Air Quality Related Values Work Group (FLAG) Phase I Report – Revised 2010".

Table 9.2-1. Class I Significant Impact Levels

PSD Pollutant	Averaging Period	Federal Class I Significant Impact Level (μg/m³)	Proposed Class I Significant Impact Level (μg/m³)
PM_{10}	24-hour	0.32	0.32
	Annual	0.2	0.2
$PM_{2.5}$	24-hour	0.07	0.27
	Annual	0.06	0.05
NO_2	Annual	0.1	0.1

[A] On August 1, 2016 EPA proposed guidance related to drafting of SILs for $PM_{2.5}$ and ozone. This includes a proposed lowering of the annual average $PM_{2.5}$ SIL to 0.2 μg/m³.

9.2.1 Screening Class I Area Significance Analysis

In order to ensure that the Project does not contribute to exceedances of the Class I Increment standards at any of the Class I areas located within 200 km of the facility, Knauf performed a screening analysis for Class I Increments. Knauf initially built an arc of receptors located approximately 50 km from the Project location (i.e., 50 km is the maximum recommended range for use of AERMOD). As the distance of 50 km is closer to the Project location than all Class I areas, the model output concentrations should be over predicted compared to those expected at the actual distances.

The receptor grid was reduced to only include those receptors that were located directly between the Project and any of the particular receptors that comprised the Class I areas. Figure 9.2-1 provides a snapshot of the receptors that were included in the analysis, with annotations depicting the locations of the Class I areas and delineation of chosen receptors to align with the Class I area boundaries. The receptors located to the southwest of the Project were artificially raised to the maximum elevation of all Class I areas in that general direction (i.e., Otter Creek Wilderness Area, Dolly Sods Wilderness Area, Shenandoah National Park). All maximum Class I receptor heights were derived based on maximum receptor heights for each Class I area as provided by the National Park Service (NPS). Hill height scale values were set to equal base elevations. This methodology provides a conservative assessment of maximum Class I impacts. The H1H model concentrations using AERMOD at a distance of 50 km from the Project were compared to the Class I area SILs as shown in Table 9.2-2.

Figure 9.2-1. Class I Screening Receptors

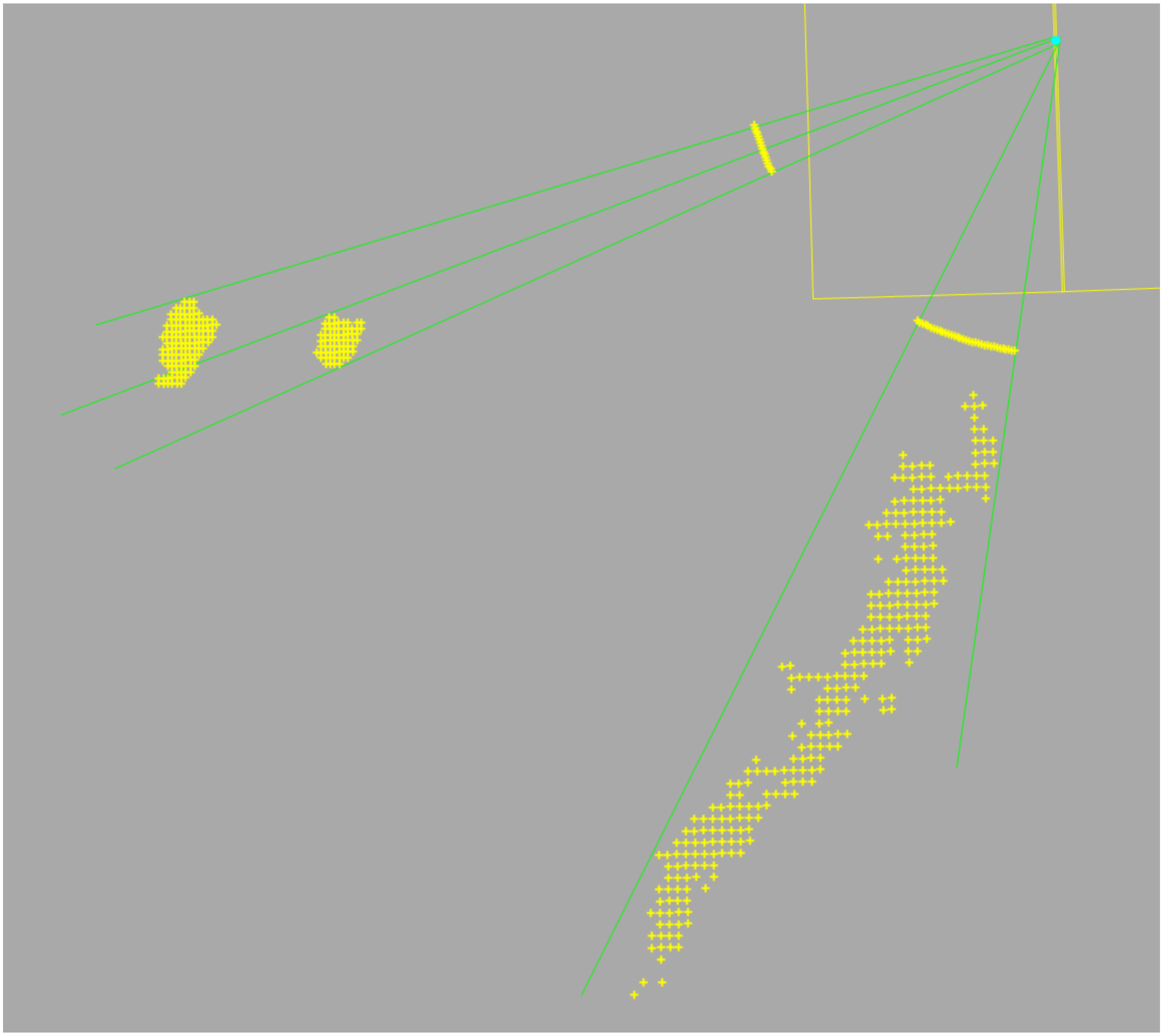


Table 9.2-2 Class I Significance Analysis

Pollutant	Averaging Period	Concentration at 50 km ($\mu g/m^3$)					Max Concentration ($\mu g/m^3$)	SIL ($\mu g/m^3$)
		2011	**2012**	**2013**	**2014**	**2015**		
NO_2 [a]	Annual	0.0016	0.0014	0.0016	0.0013	0.0016	0.0016	0.1
$PM_{2.5}$	24-hour	0.041	0.026	0.041	0.030	0.033	0.041	0.27
	Annual	0.0023	0.0021	0.0025	0.0019	0.0025	0.0025	0.05
PM_{10}	24-hour	0.041	0.026	0.041	0.030	0.033	0.041	0.32
	Annual	0.0023	0.0021	0.0025	0.0019	0.0025	0.0025	0.2

[a] NO_2 concentrations account for ARM.

9.2.2 Class I Area Significance Analysis Conclusions

This analysis indicates that $PM_{2.5}$, PM_{10} and NO_2 emissions from the Project have estimated concentrations far below (20% or less of) the corresponding Class I area SILs at the nearest Class I area. Moreover, even at a distance of 50 km from the Project site (nearer than the nearest Class I area which is 58 km distant) the results are below the Class I area SILs. Since the nearest Class I area is 58 km from the site, the concentrations would be expected to be even lower than those shown in Table 9.2-2. As such, the Project cannot be reasonably expected to cause or contribute to an exceedance of the PSD Class I Increment standard for $PM_{2.5}$, PM_{10} or NO_2.

APPENDIX A: MODEL FILES CD

APPENDIX B: MODEL PROTOCOLS AND CORRESPONDENCE

Air Dispersion Modeling Protocol (October 13, 2016).
WVDEP Modeling Protocol Approval (Email from November 13, 2016).

CLASS II AIR QUALITY MODELING PROTOCOL

Knauf Insulation, Inc. > Inwood Facility

TRINITY CONSULTANTS
4500 Brooktree Road
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Project Number: 153901.0131

Environmental solutions delivered uncommonly well

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1. INTRODUCTION

Knauf Insulation, Inc (Knauf) owns and operates an existing fiberglass insulation manufacturing facility located in Inwood, West Virginia (Inwood Facility). Knauf is proposing to upgrade the second fiberglass insulation production line (Line 2) at the Inwood Facility. The upgrades to Line 2 include, but are not limited to, a new melter, upgrades to the forming section, expansion of the curing oven, potential changes to the cooling section, and new packaging equipment. The project is expected to trigger New Source Review (NSR) Prevention of Significant Deterioration (PSD) permitting for particulate matter (PM), particulate matter with an aerodynamic diameter less than 10 micrometers (PM_{10}), particulate matter with an aerodynamic diameter less than 2.5 micrometers ($PM_{2.5}$), and nitrogen dioxide (NO_2). The West Virginia Department of Environmental Protection (WVDEP) has adopted the federal PSD permitting program by reference in Title 45 of the West Virginia Code of State Rules (45 CSR) Section 14 and has full authority to implement this program through its United States Environmental Protection Agency (U.S. EPA) authorized State Implementation Plan (SIP).

The Inwood Facility is located in Berkeley County, which is designated by U.S. EPA as "unclassifiable" and/or "attainment" for the National Ambient Air Quality Standards (NAAQS) for ozone, PM_{10}, $PM_{2.5}$, and NO_2.[1] To demonstrate compliance with the NAAQS, Knauf is proposing to conduct air quality dispersion modeling for these pollutants. Note that since there is no NAAQS standard for PM, modeling of this pollutant is not required.

This modeling protocol outlines the methodologies that will be used to conduct the air dispersion modeling analysis required under PSD permitting for the proposed project. Air dispersion modeling is relied upon to demonstrate that the proposed project complies with the applicable NAAQS and PSD Class II Increments for the pollutant(s) subject to PSD review.[2]

With the submittal of the final New Source Review 45CSR14 (R14) application for this project, Knauf will include a CD containing all the files associated with the PSD air dispersion modeling analysis of the Inwood Line 2 project. This CD will include those files associated with importing terrain elevations, building downwash, meteorological data, and AERMOD. Knauf will also provide to WVDEP a PSD air dispersion modeling report that includes plots indicating the location of the facility fence line and facility layout.

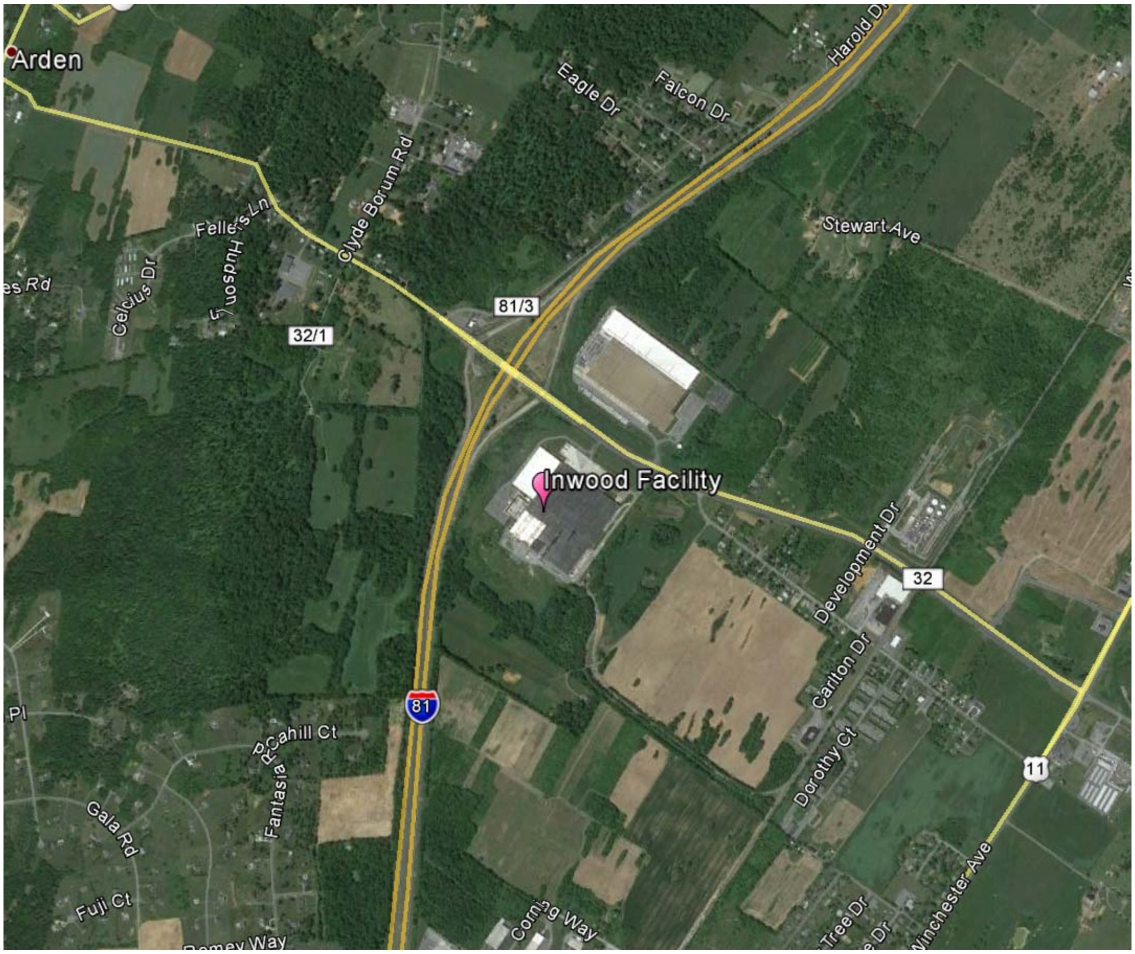
1.1. FACILITY LOCATION

The Inwood Facility is located at approximately 200 meters east of Interstate 81 near Tabler-Station Road in Berkeley County, West Virginia. Figure 1.1-1 presents an aerial image indicating the location of the facility. This area map shows the location of the plant relative to surrounding terrain and other features, such as roads and rivers.

[1] 40 CFR §81.349.

[2] If a PSD Class I Increment analysis is required, a modeling protocol will be submitted under separate cover to WVDEP and the Federal Land Managers (FLMs) for the respective Class I areas.

Figure 1.1-1 Inwood Facility and Surrounding Area



The following is the company contact information for the Inwood Facility:

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Shelbyville, IN 46176

1.2. PROJECT OVERVIEW

The Line 2 project will include installation of a new gas oxygen-fueled (gas-oxy) melting furnace, a new canal/channel and forehearth, new fiber forming equipment, and new packaging equipment. The project also involves modification of the existing curing oven and glass raw material handling and storage facilities and calls for the installation of a new emergency generator. The proposed project will also increase the processing capacity of Line 2.

With regard to the emissions control strategy for the proposed project, Knauf is planning to implement several options. The proposed gas-oxy furnace substitutes oxygen for air in the combustion process. This substitution significantly reduces emissions of NO_X due to the reduction in nitrogen being consumed during combustion. Emissions from the furnace will be controlled by a baghouse to reduce emissions of PM, PM_{10}, and $PM_{2.5}$. Emissions from the fiber forming spinners will be controlled by drop-out boxes and mixing chamber for reduction of PM, PM_{10}, and $PM_{2.5}$ emissions. Overall, total emissions are expected to be above the applicable NSR major source thresholds for NO_2, PM, PM_{10}, and $PM_{2.5}$.

The air dispersion modeling analysis will be conducted in a manner that is consistent with U.S. EPA's Appendix W of Title 40 of the Code of Federal Regulations Part 51 (40 CFR 51), the *Guideline on Air Quality Models (Guideline)*[3], promulgated on November 9, 2005, and this modeling protocol. Knauf's protocol is predicated on the current version of the *Guideline*, however it is noted that U. S. EPA proposed changes to the *Guideline* in July 2015.[4]

2.1. SIGNIFICANCE ANALYSIS

As a first step to the PSD modeling assessment, a significant impact analysis will be conducted to determine if the calculated emissions resulting from the proposed project result in a significant impact upon the area surrounding the Inwood Facility.

Before a significant impact analysis is performed, a project emissions assessment will be made to determine for which pollutants modeling may be necessary. To make this determination, Knauf will compare the annual emission increases from the proposed project to the PSD Significant Emission Rates (SERs) presented in Table 2.1-1. A significance analysis is required for each pollutant associated only with the project increase that is emitted at annual rates above the SERs for which ambient air quality standards or PSD Increments apply, including CO, NO_2, PM_{10}/$PM_{2.5}$, and SO_2. Generally, if the net annual emission increases do not exceed a SER or if no ambient air quality standards exist for the pollutant, no modeling analysis is required for that pollutant. Knauf expects the project to require a significance analysis for NO_2, PM_{10}, and $PM_{2.5}$. Although the project is expected to require PSD permitting for PM, since there are no modeling standards for PM [Significant Impact Levels (SILs), Increment, or NAAQS], no air quality modeling analysis will be performed for this pollutant. Ozone impacts as a result of NO_2 emissions are further addressed in Section 7.

Table 2.1-1 PSD Significant Emission Rates

Pollutant	Significant Emission Rate (Tons/Year)[5]
CO	100
NO_2	40
SO_2	40
VOC	40
GHGs [6]	75,000
PM	25
PM_{10}	15
$PM_{2.5}$	10

2.1.1. Significant Impact Analysis

A significant impact analysis will be performed for each pollutant with an annual emissions increase from the proposed project greater than the SER which has established ambient air quality standards and/or PSD Increments. "Significant" impacts are defined by ambient concentration thresholds commonly referred to as the SILs, which

[3] 70 *Federal Register* 68218, November 9, 2005.
[4] https://www3.epa.gov/ttn/scram/11thmodconf/9930-11-OAR_AppendixW_Proposal.pdf
[5] The Inwood Facility is an existing PSD major source. Once over this threshold, any criteria pollutant that exceeds its respective significant emission rate will also be subject to PSD review.
[6] Per the June 23, 2014 U. S. Supreme Court decision in the case of *Utility Air Regulatory Group v. EPA*, GHGs alone cannot trigger PSD, but remain subject to regulation for sources which otherwise trigger PSD requirements.

represent a fraction of the NAAQS and PSD Increment standards and are commonly interpreted to indicate the level above which a particular facility causes or contributes to air quality degradation.[7] In the significant impact analysis, the maximum-modeled ground-level concentrations will be compared to the appropriate SIL established by U.S. EPA (shown in Table 2.1-2). If a significant impact (i.e., an ambient impact above the SIL for a given pollutant and averaging period) is not demonstrated through this initial modeling and it is demonstrated that the background concentration of a given pollutant is sufficiently below the applicable NAAQS, no further modeling analysis will be needed for demonstrating compliance with the NAAQS or the PSD Class II Increments. If a significant impact is demonstrated through the initial modeling, a full impacts analysis with a regional source inventory will be required to demonstrate that the proposed project does not cause or significantly contribute to a violation of the NAAQS or consume more than the available PSD Class II Increments. Note that in the significant impact analysis, the highest first-high (H1H) modeled impacts are generally used for comparison against the SIL. However, for 1-hour NO_2, the impact is to be reported as the "the highest of the [five]-year averages of the maximum modeled 1-hour NO_2 concentrations predicted each year at each receptor."[8] This is taken to mean that the model is to output the H1H 1-hour impact for each receptor for each of the five modeled years, then the five H1H values at each receptor are to be averaged, and finally the maximum value is compared to SIL. For $PM_{2.5}$, the highest of the 5-year averages of the maximum modeled 24-hour or annual $PM_{2.5}$ concentrations predicted each year at each receptor will be used for comparison with the SILs.

Table 2.1-2 Applicable Significant Impact Levels [9]

PSD Pollutant	Averaging Period	Federal Class II Significant Impact Level (μg/m³)
PM_{10}	24-hour	5
	Annual	1
$PM_{2.5}$ [a]	24-hour	1.2
	Annual	0.3
NO_2	Annual	1
	1-hour [b]	7.5
Ozone	8-hour	--

[a] The $PM_{2.5}$ SILs were effectively remanded and vacated as a result of a United States Court of Appeals decision, *Sierra Club v. EPA,* No. 1—1413. However, WVDEP has generally accepted the previously established SILs for the purpose of significance modeling when there is adequate (i.e., greater than the SIL) difference between the NAAQS and existing ambient background concentrations. In addition, on August 1, 2016 EPA proposed guidance related to drafting of SILs for $PM_{2.5}$ and ozone. This includes a proposed lowering of the annual average $PM_{2.5}$ SIL to 0.2 μg/m³.

[b] The 1-hour NO_2 SIL has not been formally proposed. Knauf proposes to use the interim SIL of 4 ppb (or 7.5 μg/m³) presented in the June 28, 2010 Wood memo.[10]

2.1.2. Ambient Monitoring Requirements

Under current U.S. EPA policies, the maximum impacts attributable to the emissions increases from a project must be assessed against monitoring *de minimis* levels to determine whether pre-construction monitoring should be considered. A pre-construction air quality analysis using continuous monitoring data can be required for pollutants subject to PSD review per 40 CFR § 52.21(m). The monitoring *de minimis* levels for ozone, PM_{10}, $PM_{2.5}$, and NO_2 are provided in 40 CFR § 52.21(i)(5)(i) and are listed in Table 2.1-3. If either the predicted modeled impact from the proposed project or the existing ambient concentration is less than the monitoring *de minimis* concentration, the permitting agency has the discretionary authority to exempt an applicant from pre-construction ambient monitoring.

[7] U.S. EPA Memorandum from Gerald Emison to Thomas Maslany, July 8, 1988.

[8] U.S. EPA Memorandum from Anna Marie Wood, *General Guidance for Implementing the 1-hour NO_2 National Ambient Air Quality Standard in Prevention of Significant Deterioration Permits, Including an Interim 1-hour NO2 Significant Impact Level*, June 28, 2010.

[9] U.S. EPA Memorandum from John Calcagni to Thomas Maslany, September 10, 1991.

[10] Ibid.

Table 2.1-3 Applicable Monitoring de minimis Levels[11]

PSD Pollutant	Averaging Period	Monitoring *de minimis* Levels (μg/m³)
PM_{10}	24-hour	10
$PM_{2.5}$ [a]	24-hour Annual	4 --
Ozone[b]	8-hour	--
NO_2	1-hour Annual	-- 14

[a] The $PM_{2.5}$ monitoring de minimis levels were effectively remanded and vacated as a result of a United States Court of Appeals decision, *Sierra Club v. EPA,* No. 1—1413.

[b] Per 40 CFR 52.21(i)(5)(i)(f), there is no de minimis level for ozone. However, only net emissions increases of 100 tpy or more of VOC or NO_X that are subject to PSD are required to perform an ambient impact analysis, including the gathering of ambient air quality data.

When not exempt, an applicant may provide existing data representative of ambient air quality in the affected area or, if such data are not available, collect background air quality data.[12] However, this requirement can be waived if representative background data have been collected and are available.

To satisfy the PSD pre-construction monitoring requirements, Knauf will presume that existing monitoring data provides reasonable estimates of the background pollutant concentrations for pollutants of concern (ozone, $PM_{2.5}$, PM_{10}, and NO_2). The representativeness of existing monitoring data is outlined further in Section 2.2. For this reason, Knauf believes that pre-construction monitoring will not be required for this project.

2.1.3. Significant Impact Area and Regional Source Inventories

Knauf assumes that this project will not trigger a full impact analysis for all pollutants. However, if required, the procedures for determining the significant impact area (SIA) and regional source inventories are outlined. If any off-site pollutant impact calculated in the significance impact analysis exceeds the SIL, a SIA will be determined. The SIA encompasses a circle centered on the site with a radius extending out to either: (1) the farthest location where the emissions increase of a pollutant from the project causes a significant ambient impact (called the radius of influence [ROI]), or (2) a distance of 50 kilometers (km), whichever is less. Per discussion with WVDEP at pre-application meetings, Knauf will review regional source inventories within a 20 km radius of the Inwood Facility. All sources of the pollutant in question within this 20 km radius are assumed to potentially contribute to ground-level concentrations and will be evaluated for possible inclusion in the NAAQS and PSD Increment analyses, where required. Sources outside of this area that are between 20 and 30 km away will be reviewed on a case by case basis weighing both proximity, expected stack dispersion and overall emissions.

As needed, separate NO_2, PM_{10} and $PM_{2.5}$ regional source inventories may be compiled for the NAAQS and PSD Increment analyses. Source locations, stack parameters, annual operating hours, and potential emissions data will be obtained from WVDEP, the Maryland Department of Environmental Protection (MDE), the Virginia Department of Environmental Quality (VDEQ), and/or file reviews of specific facilities. Prior to completing the analyses, Knauf may request the WVDEP's acceptance of the regional source inventories. This data will be compiled and the distance of each source from the site will be calculated. In general, Knauf will work with WVDEP in finalizing regional inventories compiled for this modeling analysis.

2.2. NAAQS ANALYSIS

If a full impact analysis is triggered, the procedures for conducting a NAAQS analysis are outlined in this section. For a given pollutant, if the maximum impact calculated in the significance impact analysis exceeds the corresponding SIL at

[11] 40 CFR §52.21(i)(5)(i).
[12] U.S. EPA New Source Review Workshop Manual (Draft, 1990), pages C.18–19.

an off-property receptor, a NAAQS analysis will be required. For pollutants that do not result in a modeled significant impact at an off-property receptor, no NAAQS modeling will be required.

The objective of the NAAQS analysis is to demonstrate through dispersion modeling that emissions from the proposed project will not cause or significantly contribute to a violation of the primary or secondary NAAQS. The primary NAAQS are the maximum concentration ceilings, measured in terms of total concentration of a pollutant in the atmosphere, which define the "levels of air quality which the U.S. EPA judges are necessary, with an adequate margin of safety, to protect the public health."[13] Secondary NAAQS define the levels that "protect the public welfare from any known or anticipated adverse effects of a pollutant." The primary and secondary NAAQS are listed in Table 2.2-1.

Table 2.2-1 National Ambient Air Quality Standards (NAAQS) [14]

PSD Pollutant	Averaging Period	Primary		Secondary	
		(μg/m³)	(ppm)	(μg/m³)	(ppm)
$PM_{2.5}$	24-hour	35	--	35	--
	Annual	12	--	15	--
Ozone	8-hour	--	0.070	--	0.070
PM_{10}	24-hour	150	--	150	--
NO_2	1-hour	(188)	0.1	--	--
	Annual	(100)	0.053	(100)	0.053

If required, the NAAQS analysis for this project will include the potential emissions from the existing and proposed emission sources at the Inwood Facility and the emissions of sources that will be included in the regional source inventory. The modeled impacts, added to appropriate background concentrations, will be assessed against the applicable NAAQS to demonstrate compliance. The background concentrations will be based on state/federal data.

Background concentrations of and $PM_{2.5}$ for inclusion in the NAAQS demonstration were provided to Knauf by WVDEP. Data from a WVDEP-operated monitoring station in Martinsburg, WV (approximately 7 km from the facility) will be used to represent background concentrations at the Inwood Facility.

Background concentrations for the 24-hour PM_{10} standard are from the Tucker Elementary School monitor located in Fairfax County, VA (AQ ID 51-510-0020). The closest PM_{10} monitoring station to the facility is the Winchester Courts Building, which is approximately 30 km from the facility. However, PM_{10} data counts for this station are low. The Tucker monitor is located approximately 103 km from the Inwood Facility, and is near the Washington D.C. metropolitan area. Given the urban location of the monitor, it provides a conservative estimate of PM_{10} background concentrations which is also in line with the limited data available from Winchester, VA. Additionally, the monitoring station has high data counts for this pollutant.

Background concentrations of NO_2 for both the 1-hour and annual standards are from the Rockingham County Virginia Department of Transportation (VDOT) monitoring station (AQ ID 51-165-0003) in Rockingham County, Virginia. While the Rockingham monitor is not the closest monitor to the Inwood Facility (Broad Run High School and James S. Long Park in VA are closer), the site's similar setting make it the most representative choice. The Rockingham station is similarly located along Interstate 81 and is also located in a valley along the Appalachian Mountains. The populations for the counties are similar (approximately 100,000 for Berkley County and 75,000 for Rockingham County from the 2010 census). The background NO_2 values are also higher than those of closer monitoring stations, making it a conservative choice.

Background concentrations for the 8-hour ozone standard are from a monitor located in Frederick County, Virginia (AQ ID 51-069-0010). While there is a monitor situated in closer proximity in Martinsburg, West Virginia (AQ ID 54-

[13] 40 CFR §50.2(b).
[14] The values in parentheses have been converted from ppm to μg/m³.

003-0003), the Frederick County monitor is preferable due to its location upwind of the Inwood Facility and data counts. Note that both monitors are included in the ozone analysis provided for in Section 7.

For each site, the most recent three years of data (2013-2015) were evaluated. For the one-hour NO_2 standard, the average of the 98th percentile value of the most recent 3 years was selected to match the form of the NAAQS. For the annual averaging period, the highest annual average over the most recent 3 years was used. The proposed background values for each pollutant are summarized in Table 2.2-2.

Table 2.2-2 Background Concentrations

PSD Pollutant	Averaging Period	Background Value (µg/m³)	Year
$PM_{2.5}$	24-hour	26	2013-2015
	Annual	10.3	2013-2015
Ozone	8-hour	60 ppb	2013-2015
PM_{10}	24-hour	23	2013-2015
NO_2	1-hour	68.8	2013-2015
	Annual	16.7	2014

Knauf reserves the right to modify the background concentrations listed in Table 2.2-2 according to U.S. EPA-approved procedures. Specifically, Knauf may refine the NO_2 background concentration value for inclusion in the 1-hour NAAQS. For example, Knauf may opt to utilize multiyear averages of the 98th percentile of the available concentrations by season and hour-of-day.[15] Additional variations of the background concentration of $PM_{2.5}$ may also be explored (e.g., seasonal basis).

To demonstrate compliance with the annual NO_2 standard, the maximum-modeled annual arithmetic mean will be compared to the NAAQS. For demonstrating compliance with the 1-hour standard for NO_2, the highest eighth-high modeled 1-hour daily maximum concentrations averaged over five years will be compared to the NAAQS.[16] For demonstrating compliance with the 24-hour PM_{10} standard, the highest sixth-high modeled 24-hour concentration over the entire 5-year meteorological period will be compared to the NAAQS. For demonstrating compliance with the 24-hour $PM_{2.5}$ standard, the highest eighth-high modeled 24-hour concentration averaged over the entire 5-year meteorological period will be compared to the NAAQS. For demonstrating compliance with the annual $PM_{2.5}$ standard, the highest first-high modeled concentration averaged over five years will be compared to the NAAQS.

2.2.1. Ozone Consideration

Note that the project will trigger PSD permitting for a precursor of ozone (i.e., NO_X), which is designated as attainment. Knauf will evaluate the project's impact on the new 8-hour average ozone standard (70 ppb). This evaluation will involve a qualitative and quantitative discussion that may include, but is not limited to, use of past regional scale modeling efforts (e.g., Cross State Air Pollution Rule and NEI data). Further ozone impact analysis is provided in Section 7.

2.3. PSD INCREMENT ANALYSIS

If a full impact analysis is triggered, the procedures for conducting a PSD Increment analysis are outlined in this section. The PSD Increments were established to "prevent deterioration" of air quality in certain areas of the country where air quality was better than the NAAQS. The sum of the PSD Increment concentration and a baseline concentration defines a "reduced" ambient standard, either lower than or equal to the NAAQS that must be met in an

[15] U.S. EPA Memorandum from Tyler Fox, *Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard*, March 1, 2011.
[16] Knauf reserves the right to use other refinements for comparing modeled concentrations to the 1-hour NAAQS including averaging results over the modeled 5-year period per the procedures in U.S. EPA Memorandum from Tyler Fox, *Applicability of Appendix W Modeling Guidance for the 1-hout NO_2 National Ambient Air Quality Standard*, June 28, 2010.

attainment area. To prevent the deterioration of "clean areas", U.S. EPA established PSD Increments as provided in Table 2.3-1 for applicable pollutants. Note that there is no PSD Increments identified for ozone.

Table 2.3-1 PSD Increments [17]

PSD Pollutant	Averaging Period	PSD Increments ($\mu g/m^3$)	
		Class I	Class II
PM_{10}	24-hour	8	30
	Annual	4	17
$PM_{2.5}$	24-hour	2	9
	Annual	1	4
NO_2 [a]	1-hour	--	--
	Annual	2.5	25

[a] PSD Increments have not yet been proposed for the 1-hour NO_2 standard.

U.S. EPA has defined three classes of areas protected by PSD Increment standards, Class I areas (national parks, national wildlife areas, etc.), which require additional levels of protection, Class II areas, and Class III areas. The project site and its surroundings are situated in a Class II area and therefore, any pollutant requiring a PSD analysis will be compared to the Class II Increments. Class I areas in West Virginia include Dolly Sods Wilderness and Otter Creek Wilderness. Class I areas in neighboring Virginia include James River Face Wilderness and Shenandoah National Park.

If necessary, a PSD Increment analysis will be carried out for $PM_{2.5}$, PM_{10} and NO_2 for this project.[18] The PSD Increment analysis will include the emissions from the proposed project and regional increment-consuming sources. For the annual average standards, the highest incremental impact modeled will be used. For compliance with the short-term standards, the highest second-high modeled concentrations will be used.

The determination of whether an emissions change at a given source consumes or expands a PSD Increment is based on the source definition and the time the change occurs in relation to baseline dates. Emission changes at major sources that occur after the major source baseline date affect PSD Increment. In contrast, emission changes at minor sources only affect PSD Increment after the minor source baseline date, which is set at the time when the first PSD application is completed in a given area, usually arranged on a county-by-county basis. Since the Inwood Facility is a major source, emission changes that occur after the baseline date will affect PSD Increment. The following table provides a list of the major source and minor source baseline dates for Berkeley County.

Table 2.3-3 Preliminary Project Profile

Date	NO_2	PM_{10}	$PM_{2.5}$
Major Source Baseline	2/8/1988	1/6/1975	10/20/2010
Minor Source Baseline	6/4/2001	12/27/2001	Not yet established

With regard to Class I area Increment, Knauf understands that per 40 CFR 52.21(k) it is WVDEP's responsibility for determining the need for an analysis. To help facilitate this determination, which will occur at a later time, Knauf is providing the following preliminary design stack parameters and emission rates for project sources, as presented in Table 2.3-4.

[17] 40 CFR §52.21(c).

[18] As with the NAAQS analysis, a PSD Increment analysis will only be conducted for those pollutants with a significant net emissions increase and significant impacts, as determined in the significant impact analysis outlined in Section 2.1.1 of this report.

Table 2.3-4 Preliminary Project Profile[a]

Stack	Estimated NO_X Emissions (lb/hr)	Estimated PM_{10} Emissions (lb/hr)	Estimated $PM_{2.5}$ Emissions (lb/hr)	Release Height (m)	Exit Temperature (K)	Exit Velocity (m/s)	Exit Diameter (m)
Line 2 – Melting and Refining Baghouse Stack	Routed through Forming and Collection stack						
Line 2 – Forming and Collection Stack (including raw material handling and facing/packaging emissions)	21.4	23.9	23.9	60.66	333.15	20.65	2.90
Line 2 – Curing and Cooling Stack	3.9	7.3	7.3	36.58	449.82	20.01	1.45
New Batch Day Bin Silo 1 [b]	N/A	0.01	0.01	25.46	294.26	0.001	0.10
New Batch Day Bin Silo 2 [b]	N/A	0.01	0.01	25.46	294.26	0.001	0.10
New Emergency Generator[c]	12.32	0.18	0.18	4.27	807.76	50.00	0.10

[a] All stack design parameters are subject to finalization, particularly those associated with ancillary equipment (bin vents and generator).
[b] Exit velocity for the batch day bin vents was restricted to 0.001 m/s to reflect the horizontal discharge.
[c] Emergency generator rates listed are short-term (hourly average values). Unit will be limited to 500 hours of operation per year. Exit velocity was restricted to 50 m/s for model constraints, however, the calculated exit velocity may exceed this pending finalized design of generator stack.

The air dispersion modeling analyses were generally conducted in accordance with the following guidance documents:

- U.S. EPA's *Guideline on Air Quality Models* 40 CFR Part 51, Appendix W (Revised, November 9, 2005) (*Guideline*);
- U.S. EPA's *AERMOD Implementation Guide* http://www.epa.gov/scram001/7thconf/aermod/aermod_implmtn_guide_19March2009.pdf;
- U.S. EPA's *New Source Review Workshop Manual* (Draft, October, 1990);
- U.S. EPA, Office of Air Quality Planning and Standards, Memorandum from Mr. Tyler Fox to Regional Air Division Directors. *Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard* (March 1, 2011);
- U.S. EPA, Office of Air Quality Planning and Standards, *Guidance for $PM_{2.5}$ Permit Modeling* (May 2014);
- U.S. EPA, Office of Air Quality Planning and Standards, Memorandum from Mr. Tyler Fox to Regional Air Division Directors. *Applicability of Appendix W Modeling Guidance for the 1-hour SO_2 National Ambient Air Quality Standard* (August 23, 2010); and
- U.S. EPA, Office of Air Quality Planning and Standards, Memorandum from Mr. R. Chris Owen and Roger Brode to Regional Air Modeling Contacts. *Clarification on the Use of AERMOD Dispersion Modeling for Demonstrating Compliance with the NO_2 National Ambient Air Quality Standard* (September 30, 2014).

3.1. MODEL SELECTION

The AERMOD modeling system is composed of three modular components: AERMAP, the terrain preprocessor; AERMET, the meteorological preprocessor; and AERMOD, the control module and modeling processor. The development of AERMOD began in 1991 when the American Meteorological Society/U.S. EPA Regulatory Model Improvement Committee (AERMIC) was formed to promote the interests of creating a new regulatory air quality model based on up-to-date scientific principles to replace the long-standing Industrial Source Complex Short-Term Version 3 (ISCST3) model. Nearly a decade after the inception of AERMIC, the U.S. EPA formally designated AERMOD as the preferred regulatory air quality model by promulgating revisions to the *Guideline* on November 9, 2005.

Knauf will utilize the most recent version of AERMOD (dated 15181), AERMET (dated 15181), and AERMAP (dated 11103) to estimate impacts from the proposed project. Following procedures outlined in the *Guideline*, the AERMOD modeling will be performed using regulatory default options and potentially the refinements addressed in this modeling protocol.[19,20]

Table 3.1-2 summarizes the model control options that will be utilized in this analysis. Note that with regards to the use rural option in AERMOD (as indicated in Table 3.1-2), Knauf has analyzed the land cover around the facility, using the NLCD dataset. In the land cover data category, only NLCD 1992 land cover codes 22 and 23 are classified as "Urban". As depicted below in Table 3.1-1, which summarizes the land cover surrounding the facility using the NLCD dataset, the area surrounding the site is almost entirely "Rural". This finding confirms the use of the rural option in AERMOD.

[19] Trinity and Knauf will utilize the *BREEZE®-AERMOD GIS Pro* software interface for running all applicable executables: AERMOD, AERMAP, and AERMET. However, the BREEZE software will only be utilized for the interface and the actual U.S. EPA executables will be utilized for the modeling runs.
[20] Regulatory default options also include the urban option being switched off.

Table 3.1-1 Land Use Procedure for Rural / Urban Selection in Air Quality Models

Code	Description	Code Count	Code Percent of Total
0	Missing, Out-of-Bounds, or Undefined	0	0.00
11	Open Water	31	0.10
12	Perennial Ice/Snow	0	0.00
21	Low Intensity Residential	709	2.26
22	High Intensity Residential	0	0.00
23	Commercial/Industrial/Transp.	938	2.99
31	Bare Rock/Sand/Clay	0	0.00
32	Quarries/Strip Mines/Gravel	73	0.23
33	Transitional	57	0.18
41	Deciduous Forest	5607	17.86
42	Evergreen Forest	174	0.55
43	Mixed Forest	4097	13.05
51	Shrubland	0	0.00
61	Orchards/Vineyard/Other	0	0.00
71	Grasslands/Herbaceous	0	0.00
81	Pasture/Hay	17360	55.29
82	Row Crops	2075	6.61
83	Small Grains	0	0.00
84	Fallow	0	0.00
85	Urban/Recreational Grasses	271	0.86
91	Woody Wetlands	1	0.00
92	Emergent Herbaceous Wetlands	6	0.02
	Total	31,300	100
	Total Urban	**938**	**3.0**

Table 3.1-2 Model Selection Options

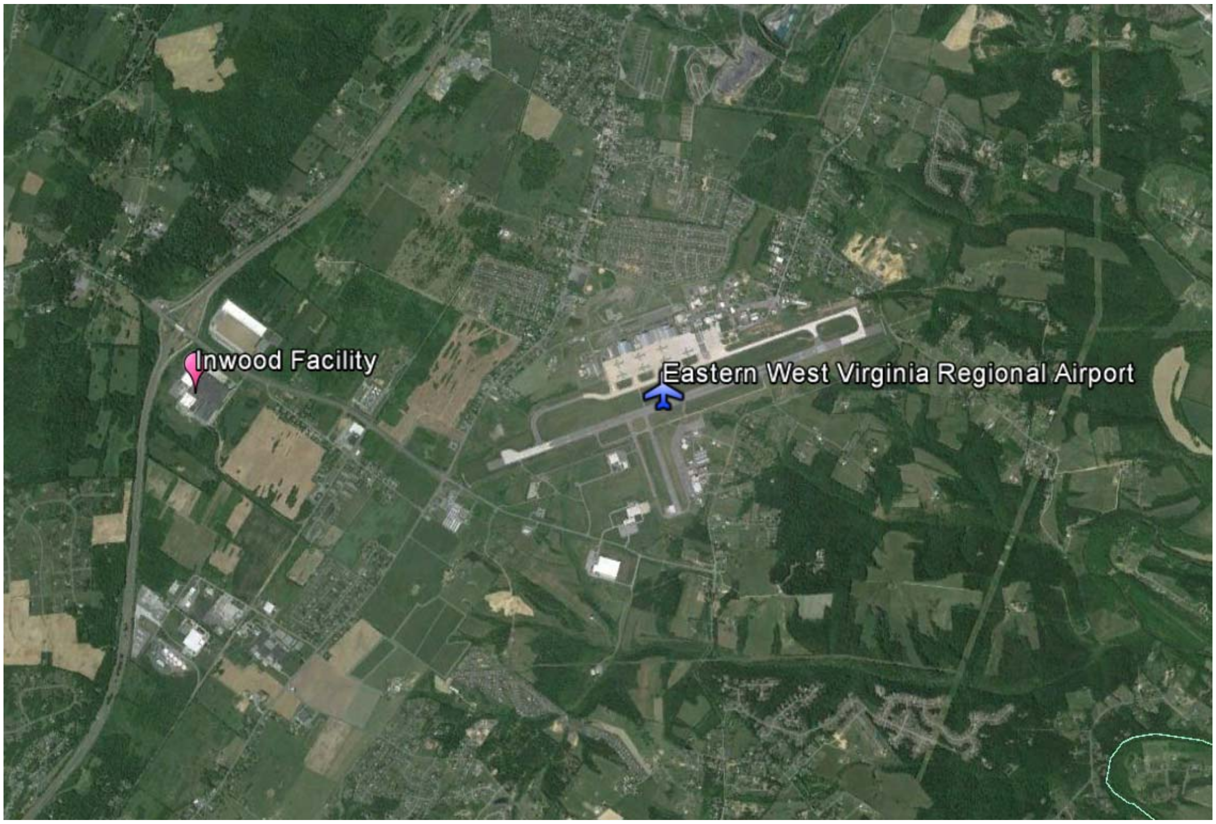
Control Options	Option Selected	Justification
Pollutant ID	NO_2, PM_{10}, $PM_{2.5}$	-
Terrain	Elevated, Meters	The receptor grid covers varying terrain elevations; as such, the elevated option will be selected.
Flagpole Receptors	N/A	-
Run or Not	Run	-
Averaging Times	1-hour, 24-hour and/or Annual	Knauf will select the appropriate averaging periods for each pollutant triggering PSD.
Model	PRIME	The PRIME algorithms are default.
Dispersion	Concentration, Rural, Regulatory Default Option	This modeling analysis is assessing compliance with concentration standards. Knauf is located in a predominantly rural area. The regulatory default option will be selected.
NO_2 Model Options	See discussion in Section 4.0	See discussion in Section 4.0
Particulate Model Options	Deposition and/or Depletion	Knauf may choose to use particle deposition and/or depletion options for $PM_{2.5}$ PM_{10}.[21]
Output Files	.aml	Model output file from Breeze User Interface (contained in zip files [.amz])

3.2. METEOROLOGICAL DATA

AERMOD modeling analyses require the use of meteorological data that has been collected at a location with similar land use and topographic settings to the project site (deemed representative). The Inwood Facility fence line is located approximately 3.8 kilometers (km) from the monitor at the Eastern West Virginia Regional Airport in Martinsburg, WV. Figure 3.2-1 shows the relative location of the Eastern West Virginia Regional Airport to the Inwood Facility.

[21] The use of a "Method 1" analysis using particle deposition in AERMOD is a regulatory default option. If utilizing this option Knauf would work with WVDEP to quantify the particle size distribution in accordance with Section 1.2 of the February 2012 addendum to the "User's Guide for the AMS/EPA Regulatory Model – AERMOD" (EPA-454/B-03-001, 9/2004). The use of a "Method 2" analysis using particle deposition in AERMOD is a non-regulatory default option. Prior to using this method, Knauf will apply for the necessary approval of a non-regulatory option from WVDEP and U.S. EPA Region III.

Figure 3.2-1 Candidate Meteorological Station for Inwood



The *Guideline* lists the following important criteria for determining meteorological data representativeness:

- The proximity of the meteorological monitoring site to the area under consideration;
- The complexity of the terrain;
- The exposure of the meteorological monitoring site; and
- The period of time during which data are collected.

Given the proximity to the Inwood Facility, and the resulting similar topographic settings, Knauf determined that the Eastern West Virginia Regional Airport should be considered as representative of the Inwood Facility. To further support this conclusion, Knauf performed an AERSURFACE analysis as well as other qualitative analyses to compare the land use and topography of Eastern West Virginia Regional Airport to Inwood.

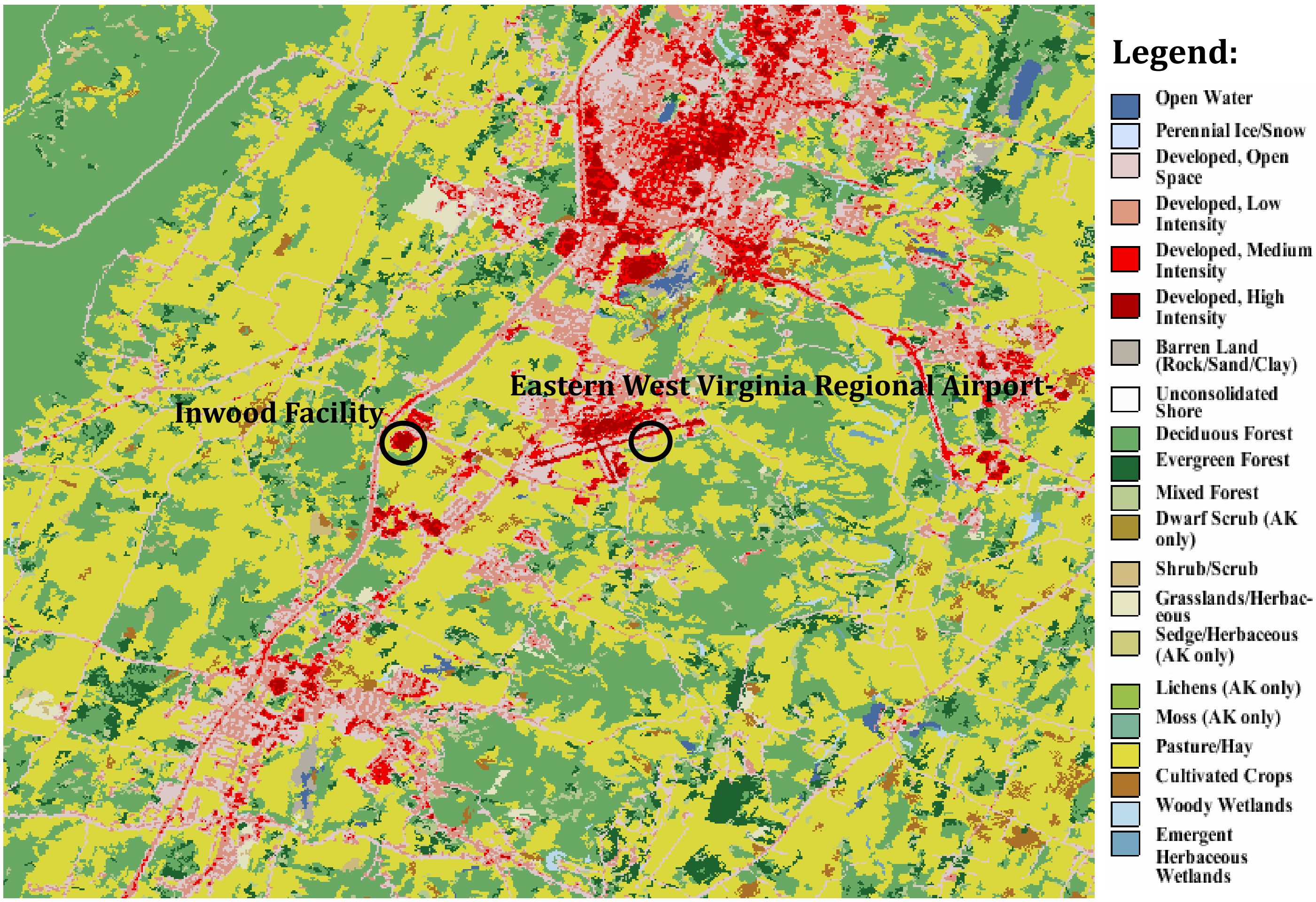
3.2.1. Site Location and Surface Characteristics

As described in the *Guideline*, the proximity of the meteorological data station and the application site is an important consideration in determining representativeness. As described above, the Inwood Facility is in close proximity (approximately 3.8 km) from the Eastern West Virginia Airport meteorological station.

AERSURFACE (version 13016) was used as an objective method for evaluating land use characteristics and their associated micrometeorological parameters for a given location. AERSURFACE was used to create seasonal values of albedo, Bowen ratio and surface roughness, across 12 directional sectors (e.g. 0-30 degrees). The seasonal parameters correspond to the calendar months in which they occur (i.e. winter values for December-February). The albedo and Bowen ratio values were determined from taking the geometric mean over a 10 kilometer (km) area out from the location of interest. The surface roughness values assigned by AERSURFACE were based on a 1 km radius out from the site.

The figures in Appendix A illustrate the relative insignificant magnitude of the micrometeorological differences between the Eastern West Virginia and Inwood sites, as determined by AERSURFACE. All three micrometeorological parameters show reasonable agreement across the directional sectors. Figure 3.2-2 shows the land use surrounding the Inwood Facility and the Eastern West Virginia Regional Airport.

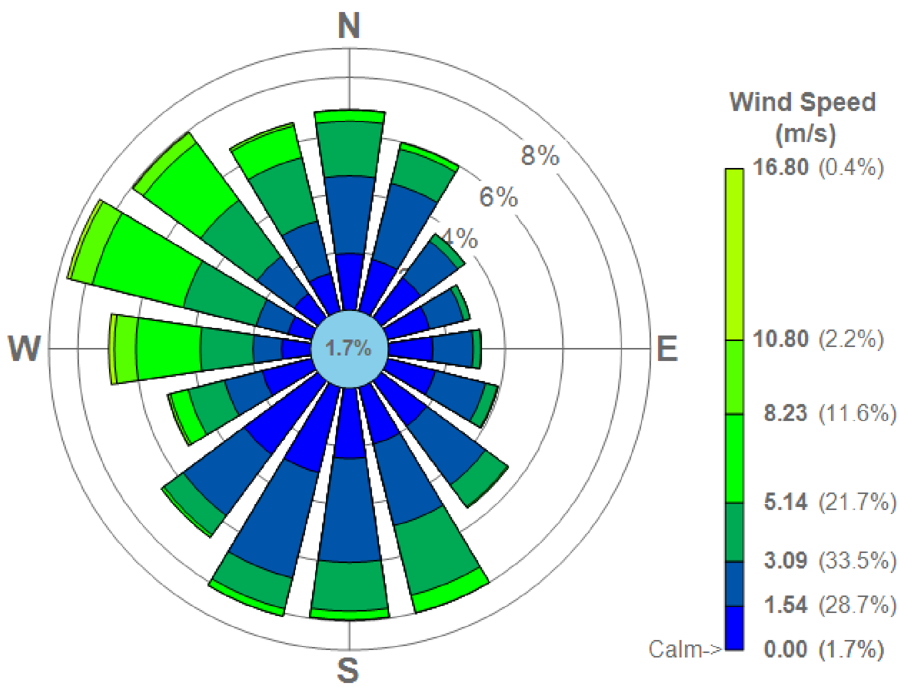
Figure 3.2-2 Land Use Surrounding the Inwood Facility and Eastern WV Regional Airport



3.2.2. Topographic Setting

The complexity of the terrain is another important consideration in determining data representativeness. In addition to the land use similarities shown above, the Eastern West Virginia airport and Inwood Facility are at approximately the same elevation (~178 meters for the facility and ~165 meters for the tower) without significant terrain features between the sites or surrounding the individual locations. Figure 3-3 provides a wind rose for the Eastern West Virginia Regional Airport for the data period of 2011 to 2015.

Figure 3.2-3 Eastern West Virginia Regional Airport Wind Rose



As shown in Figure 3.2-3, wind is largely from the northwest and south at Eastern West Virginia airport. There are no significant terrain features as such mountains or rivers which would suggest that this wind pattern would not also be true for the facility site. The airport and facility sits in a valley along the Appalachian Mountain Range, but other than that localized decrease in elevation, the terrain is rolling throughout the immediate vicinity.

3.2.3. Data Quality

The Eastern West Virginia Regional Airport meteorological data was processed through the latest version of AERMET (version 15181) to include upper air measurements from the Dulles International Airport site (IAD). Per EPA guidance, 1-minute Automated Surface Observing System (ASOS) wind data was also incorporated in the processing, using AERMINUTE (version 15272). A base elevation of 162.8 meters was used for the meteorological tower in the modeling analysis. The *Guideline* lists meteorological station siting (or exposure) and the data observation period as two additional important considerations for determining representativeness. Since the East West Virginia Regional Airport is a NWS station, it was sited and installed based on well-defined meteorological criteria and judgment.[22] The instrumentation also undergoes a high level of inspection and calibration. Once a site is deemed representative, one of the key factors in determining suitability of a meteorological station's data is the quality and quantity of observations. Based on the *Guideline* definitions of representativeness, the Eastern WV airport weather station is representative of the Inwood Facility location assuming that five, quality years of data (at least 90 percent complete per calendar quarter) are available. The period from 2011 to 2015 was evaluated and determined to have a data capture well above 90 percent. Table 3.2-1 presents a completeness summary for those years.

[22] National Oceanic and Atmospheric Administration (NOAA), *Federal Standards for Siting Meteorological Sensors at Airports,* August 1994.

Table 3.2-1 Eastern West Virginia Regional Airport Data Completeness Test

2011			
Data Type	**Total Hours**	**Missing Hours**	**% Accepted**
Pressure	8768	0	100.00
Sky Cover	8768	72	99.18
Temperature	8768	3	99.97
Wind Direction	8768	255	97.09
Wind Speed	8768	4	99.95

2012			
Data Type	**Total Hours**	**Missing Hours**	**% Accepted**
Pressure	8752	13	99.85
Sky Cover	8752	47	99.46
Temperature	8752	13	99.85
Wind Direction	8752	282	96.78
Wind Speed	8752	6	99.93

2013			
Data Type	**Total Hours**	**Missing Hours**	**% Accepted**
Pressure	8764	8	99.91
Sky Cover	8764	2498	71.50
Temperature	8764	4	99.95
Wind Direction	8764	299	96.59
Wind Speed	8764	2	99.97

2014			
Data Type	**Total Hours**	**Missing Hours**	**% Accepted**
Pressure	8767	1	99.99
Sky Cover	8767	3725	57.51
Temperature	8767	2	99.98
Wind Direction	8767	336	96.17
Wind Speed	8767	25	99.71

2015			
Data Type	**Total Hours**	**Missing Hours**	**% Accepted**
Pressure	8784	8	99.91
Sky Cover	8784	3256	62.93
Temperature	8784	8	99.91
Wind Direction	8784	368	95.81
Wind Speed	8784	33	99.62

Given the demonstrated similarities of the Eastern West Virginia airport site and the Inwood Facility as well as the overall data quality, the years 2011-2015 will be combined with upper air data from the Dulles International Airport (i.e., Sterling, VA) site for use in the AERMOD dispersion modeling analysis.

Note that the base elevation of the Eastern West Virginia Regional airport meteorological station is 162.8 meters. This will be used as the PROFBASE keyword in the ME pathway of the AERMOD input files in this analysis.

3.3. TREATMENT OF TERRAIN

The terrain surrounding the project site consists of *simple terrain* (terrain below stack top) and *complex terrain* (terrain above stack top). A designation of terrain at a particular receptor is source-dependent, since it depends on an individual source's effective plume height. AERMOD is capable of estimating impacts in both simple terrain and complex terrain, and as such, no special treatment of terrain will be required. Terrain elevation data will be imported into the model using the AERMAP utility, as described in Section 3.4.

3.4. TERRAIN ELEVATIONS

Receptor terrain elevations input to the model will be interpolated from National Elevation Dataset (NED) data obtained from the USGS with a resolution of one-third arc-second. The data will be interpolated using the AERMAP preprocessor (version 11103, or the most recent version issued) to determine elevations at the defined receptor intervals. The site-grade elevation of the facility will be used for sources and receptors at and within the fence line of the facility. For all other receptors, AERMAP will be used to estimate the elevation. In addition, Knauf will review the NED data for any missing data, as well as imported elevation data to check for any skewed data.

In addition to the receptor elevation, AERMOD's terrain modeling algorithms require an additional parameter called the hill height scale. AERMOD computes the hill height scale value at a receptor as a weighted interpolation between horizontal and terrain-following states using a critical dividing streamline approach. This scheme assumes that part of the plume mass will have enough energy to ascend and traverse over a terrain feature and the remainder will impinge and traverse around a terrain feature under certain meteorological conditions. The hill height scale is computed by the AERMAP terrain preprocessor for each receptor as a measure of the one terrain feature in the modeling domain that would have the greatest effect on plume behavior at that receptor. The hill height scale does not represent the critical dividing streamline height itself, but supplies the computational algorithms with an indication of the relative relief within the modeling domain for the determination of the critical dividing streamline height for each hour of meteorological data.

Knauf will conduct the AERMAP terrain processing by selecting an appropriate hill height boundary within which all receptors are located and all possibly relevant terrain features are included. The "10 percent slope rule" will be utilized to determine the size of the domain (i.e., the size of the NED file used). This involves the use of the same simple computational algorithm AERMAP uses to disregard all elevation data points that are not likely to have an effect. This approach disregards points having a slope of less than 10 percent from a particular receptor, computed as the difference in elevation divided by the distance between points, under the presumption that such small terrain differences would not have an effect on plume transport. This analysis will be performed with AERMAP and documented to prove that no relevant terrain features are omitted from the AERMAP domain. A worst-case scenario will be considered in which the highest terrain elevation within West Virginia may be used to determine the delta y (assuming the change of elevation from these points is to sea level, or 0 meters) and its respective delta x based on the 10 percent slope rule. Based on the calculated worst-case delta x, it will then be determined what the appropriate domain would be for this modeling analysis.

3.5. RECEPTOR GRIDS

For this air dispersion modeling analysis, ground-level concentrations will be calculated along the property line and also within Cartesian receptor grids. The Cartesian grids will cover a region extending from all edges of the property boundary to the point where impacts from the project are no longer shown to be significant. The size and resolution of the Cartesian grid(s) will be selected so that the maximum concentrations are captured within the 100 meter-spaced region. Should the maximum concentration occur in complex terrain alternative, reduced spaced receptors may be considered. Table 3.5-1 provides the receptor spacing that will be used as a starting point in this analysis. Note that this spacing may change based on the results of the analysis to provide a finer grid in areas of concern or a more coarse grid in areas with low modeled concentrations. In addition, the extent of the grid used for NAAQS and PSD Increment modeling, if necessary, shall be limited to the extent of the SIA.

Table 3.5-1 Receptor Spacing

Sub-Grid Type	Distance Range (kilometers)	Receptor Spacing (meters)
Ambient air boundary	--	25
Extra fine	0 – 1	50
Fine	1 – 5	100
Coarse	5 – 25	500

3.6. BUILDING DOWNWASH

The emissions units at the Inwood Facility will be evaluated in terms of their proximity to nearby structures. The existing and project site buildings will be digitized from detailed project drawings. The purpose of the building downwash evaluation is to determine if stack discharges might become caught in the turbulent wakes of these structures, leading to downwash of the plumes. Wind blowing around a building creates zones of turbulence that are greater than if the building were absent.

All stacks modeled in this analysis will be evaluated for cavity and wake effects from building downwash. The current version of the AERMOD dispersion model treats the trajectory of the plume near the building and uses the position of the plume relative to the building to calculate interactions with the building wake. AERMOD calculates fields of turbulence intensity, wind speed, and slopes of the mean streamlines as a function of the projected building dimensions.

The direction-specific building dimensions used as input to the AERMOD model will be calculated using the Building Profile Input Program PRIME (BPIP-PRIME) (version 04274, or the most recent version issued).[23] BPIP-PRIME is sanctioned by U.S. EPA and is designed to incorporate the concepts and procedures expressed in the GEP Technical Support document, the Building Downwash Guidance document, and other related documents.[24]

3.7. GEP STACK HEIGHT ANALYSIS

For those sources being assessed in the air quality analysis, a good engineering practice (GEP) stack height analysis will be performed. The analysis discusses the requirements and methodology used to determine the creditable stack heights used in the dispersion model.

Section 123 of the Clean Air Act (CAA) and 45CSR20-2 defines GEP, with respect to stack heights, as "the height necessary to ensure that emissions from the stack do not result in excessive concentrations of any air pollutant in the immediate vicinity of the source as a result of atmospheric downwash, eddies, or wakes which may be caused by the source itself, nearby structures, or terrain obstacles." Simply stated, GEP is a guideline criterion for determining stack height equal to the greater of:

$$H_g = H + [1.5 \times (L)]$$ **OR** 65 meters

Where:
H_g = GEP stack height
H = height of nearby structure
L = lesser dimension, height or projected width, of nearby structure

[23] U.S. EPA, *User's Guide to the Building Profile Input Program,* (Research Triangle Park, NC: U.S. EPA), EPA-454/R-93-038.
[24] U.S. EPA, Office of Air Quality Planning and Standards, *Guidelines for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations) (Revised),* (Research Triangle Park, NC: U.S. EPA), EPA 450/4-80-023R, June 1985.

This formula is often simplified to 2.5 times the nearby structure height. Although this simplification may be used as a "rule of thumb," it may only be employed for stacks in existence on or before January 12, 1979, per CAA Section 123. Therefore, GEP determinations for new stacks must utilize the equation above. All structures within a distance of 5L from a stack are considered in a downwash analysis. Structures located outside a distance of 5L from a stack are determined to not contain the stack inside their zone of influence and are, therefore, excluded from the downwash analysis for that stack. Each structure within the 5L distance of a stack is used to calculate a respective GEP stack height. The greatest GEP stack height calculated from each structure is then determined to be the required GEP height for the stack. Note that multiple nearby structures may act as one larger structure and create a greater downwash effect.

CAA Section 123 and 45CSR20-2 also specify that GEP stack height shall not exceed 2.5 times the height of the source (or 65 meters), unless a demonstration is performed justifying a higher stack. This is frequently referred to as the tall stack regulation. GEP only regulates stack height credit to be used in dispersion modeling analyses, not actual stack heights. A source may construct a stack that exceeds GEP, but will be limited to the GEP stack height in the air quality analysis demonstration. All stacks at the Inwood Facility will comply with these requirements.

3.8. REPRESENTATION OF EMISSION SOURCES

3.8.1. Coordinate System

The location of emission sources, structures, and receptors will be represented in the Universal Transverse Mercator (UTM) coordinate system in the North American Datum (NAD) 1983 datum. The UTM grid divides the world into coordinates that are measured in north meters (measured from the equator) and east meters (measured from the central meridian of a particular zone, which is set at 500 km). UTM coordinates for the sources in this analysis will be based on UTM Zone 17. Note that some receptors and regional inventory sources for the project may fall outside zone 17.

3.8.2. Source Types

The AERMOD dispersion model allows for emission units to be represented as point, area, or volume sources. Point sources will be used to represent stacks at the facility.

If an emission unit has an unobstructed vertical release, the source will be modeled based on the methods in the AERMOD Implementation Guide. Emission units with obstructed or non-vertical discharge orientations (i.e., roof vents, horizontal discharge stacks, and rain-capped stacks) will be represented in the model as point sources with an exit velocity of 0.001 meter per second (V_s') while all other stack parameters (diameter, temperature, and height) will be based on the actual conditions.

For the point sources, stack parameters (i.e., height, diameter, exhaust gas temperature, and gas exit velocity) used in the modeling analyses will be based on maximum design values. Site-specific topographic data from facility design plans will be used for estimating source and building elevations.

3.8.3. Source Parameters and Emission Rates

The preliminary list of sources to be modeled in this analysis are listed below in Table 3.8-1. Emissions sources include both existing sources at the facility (associated with the Line 1 production line) and new and modified sources associated with the Line 2 project. Per Tables 8-1 and 8-2 of the *Guideline*, short term maximum potential or allowable emission rates are to be used in the short term standard evaluation while a long term actual emissions or annual permit restriction could be used in the long term standard analysis. Furthermore, Knauf will, upon final project design, give consideration to the treatment of intermittent emissions (e.g., fire pump and emergency generator) in the 1-hour NO_2 modeling analysis. Using U.S. EPA guidance, it may be appropriate to exclude or refine (e.g., limit to certain times of day, develop an average hourly emission rate, etc.) emissions from these intermittent sources.[25] As such, Knauf is proposing to exclude emergency engines (e.g., fire pumps and generators) from the 1-hr NO_2 analysis (although the emission units will remain in the annual average analysis).

The *Guideline* states that modeling should contain sufficient detail to determine the maximum ambient concentration of the pollutant under consideration, and that this will likely involve modeling several operating loads or production rates. A load analysis is not an applicable consideration for the Line 2 project. There will be no variation in the operating load of the emission sources associated with Line 2.

The melting furnace startup and shutdown occurrences will occur on an infrequent basis and will not typically have an impact on emissions above normal production emissions. The startup will involve a pre-heat stage where only natural gas combustion is exhausting through a bypass, then through the baghouse fan and out the stack. Once operational temperatures are reached and raw materials (batching) are fed into the melter, the bypass will be isolated and the baghouse will be online.

A formal list of emission sources, emissions and parameters will be included in the final modeling report attached to the R14 application.

[25] U.S. EPA Memorandum from Tyler Fox, *Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 national Ambient Air Quality Standard*, March 1, 2011.

Table 3.8-1 Proposed Emission Sources

Source Description	Stack Description	Pollutant Type
Line 1 Melting Furnace (Existing)	Line 1 – Melting and Refining Baghouse Stack	NO_2 , PM_{10}, $PM_{2.5}$
Line 1 Refining Hearth (Existing)	Line 1 – Melting and Refining Baghouse Stack	NO_2 , PM_{10}, $PM_{2.5}$
Line 1 Fiber Forming Spinners (Existing, revised stack height)	Line 1 – Forming and Collection Stack	PM_{10}, $PM_{2.5}$
Line 1 Curing Oven and Cooling Conveyor (Existing)	Line 1 – Curing and Cooling Stack	NO_2 , PM_{10}, $PM_{2.5}$
Line 2 Gas-Oxy Melting Furnace (New), included with Line 2 Forming and Collection stack	N/A	NO_2 , PM_{10}, $PM_{2.5}$
Line 2 Refining Hearth (New), included with Line 2 Forming and Collection Stack	N/A	NO_2 , PM_{10}, $PM_{2.5}$
Line 2 Fiber Forming Spinners (New)	Line 2 – Forming and Collection Stack	PM_{10}, $PM_{2.5}$
Line 2 Curing Oven and Cooling Conveyor (Modified)	Line 2 – Curing and Cooling Stack	NO_2 , PM_{10}, $PM_{2.5}$
Emergency Generator (ESDG12) (Existing)	Emergency Generator (ESDG12)	NO_2 , PM_{10}, $PM_{2.5}$
Emergency Generator (ESDG13) (Existing)	Emergency Generator (ESDG13)	NO_2 , PM_{10}, $PM_{2.5}$
Emergency Generator (New)	Emergency Generator (TBD)	NO_2 , PM_{10}, $PM_{2.5}$
Fire Water Engine (ESFW11) (Existing)	Fire Water Engine (ESFW11)	NO_2 , PM_{10}, $PM_{2.5}$
Raw Material Handling (FP11) (Modified), included with Line 2 Forming and Collection Stack	N/A	PM_{10}, $PM_{2.5}$
Sizing and Packaging Area (FP15) (Modified), included with Line 2 Forming and Collection Stack	N/A	PM_{10}, $PM_{2.5}$
Two (2) Batch Day Bins (New)	Two Bin Vents	PM_{10}, $PM_{2.5}$

Modeling of NO_2 emissions in AERMOD can follow one of several application methods (Tier 1, Tier 2, and Tier 3), each outlined in Section 5.2.4 of the Guideline on Air Quality Models (GAQM). Knauf reserves the right to utilize Tier 1, Tier 2, or Tier 3 methods for NO_2 modeling based on preliminary model results.

Historically, the Ambient Ratio Method (ARM), Tier 2, has been used for refined NO_2 modeling. Over time due to photochemical reactions in the ambient atmosphere where nitrogen oxide (NO) converts to NO_2, the NO-NO_2 ratio will settle out to the ambient atmospheric ratio, which is 80% NO_2 on a one-hour basis and 75% NO_2 on an annual basis. Because the NAAQS is for the pollutant NO_2, only modeled concentrations of NO_2 should be compared to the NAAQS. As such, under Tier 2 the ARM applies the ambient atmospheric ratio to modeled concentrations of NO_X, where 80% are assumed to be NO_2 concentrations on a one-hour basis and 75% are assumed on an annual basis.

If Tier 2 modeled concentrations are greater than the NAAQS design values, the more refined Tier 3 approach (i.e., the Plume Volume Molar Ratio Method [PVMRM] or the Ozone Limiting Method [OLM]) may be used. Historically, PVMRM has been proposed by the U.S. EPA in AERMOD as a non-regulatory (Tier 3) default method and has been presented in a model evaluation study on the U.S. EPA Support Center for Regulatory Air Models (SCRAM) website.[26] The study concluded that PVMRM provided an unbiased estimate of NO_2 model concentrations for each of the evaluated cases. PVMRM considers the conversion of NO_X emissions to NO_2 in the atmosphere on an hour-by-hour basis. For each hour, the volume of the source-specific plume is calculated for that hour's meteorological conditions. Emissions of NO_X predominately consist of nitric oxide (NO) which is oxidized into NO_2. The limiting factor in this reaction is an equilibrium state that is usually established among NO, NO_2, and ozone concentrations in the atmosphere. It is of fundamental importance that an ozone-limited atmosphere will limit the amount of conversion of NO to NO_2.[27] The amount of available NO_X, NO, and ozone and the eventual conversion to NO_2 is determine by the plume volume.

At this time, Knauf intends to utilize the Tier 2 approach. Should a refined Tier 3 or ARM2 approach be required for the analysis, then Knauf will supply additional information regarding the proposed approach and work with WVDEP to obtain the appropriate authorizations.

[26] *Evaluation of Bias in AERMOD-PVMRM*, Alaska DEC Contract No. 18-9010-12, June 2005, http://www.epa.gov/scram001/7thconf/aermod/pvmrm_bias_eval.pdf

[27] Addendum – User's Guide for the AMS/EPA Regulatory Model – AERMOD (EPA-454 / B-03-001, September 2004).

5. SECONDARY FORMATION OF $PM_{2.5}$

The U.S. EPA has recently published guidance for $PM_{2.5}$ permit modeling that addresses secondary formation of $PM_{2.5}$ from $PM_{2.5}$ precursors.[28] The primary $PM_{2.5}$ precursor pollutant that will be emitted as a result of this project is NO_X. Per the U.S. EPA guidance document and conversations with WVDEP, Knauf will address secondary formation of $PM_{2.5}$ with a combined qualitative and quantitative approach. Given the Project will trigger PSD for both direct $PM_{2.5}$ and NO_X, a hybrid qualitative/quantitative analysis is a recommended approach to address secondary impacts (Case 3 in the May 2014 guidance document). Primary impacts will be addressed through modeling of direct $PM_{2.5}$ emissions using AERMOD as outlined elsewhere in this protocol. This section outlines preliminary analyses regarding secondary formation of $PM_{2.5}$.

5.1. EXISTING $PM_{2.5}$ CONCENTRATIONS AND SPECIATION

As outlined in Section 2.2, Knauf proposes to utilize $PM_{2.5}$ ambient background concentrations from the monitor located in Martinsburg, West Virginia. The 2012 through 2014 design values from this monitor are include in Table 5.1-1.

Table 5.1-1 $PM_{2.5}$ Background Concentrations

PSD Pollutant	Averaging Period	Background Value (μg/m³)	Year	NAAQS (μg/m³)
$PM_{2.5}$	24-hour	26	2013-2015	35
	Annual	10.3	2013-2015	12

In order to better understand the impact of secondary $PM_{2.5}$ formation, the speciation of $PM_{2.5}$ at ambient monitors needs to be reviewed. WVDEP operates three (3) $PM_{2.5}$ speciation monitors. Given that $PM_{2.5}$ is viewed as a regional air pollutant, the use of this speciation is appropriate despite the monitors not being situated in Berkeley County. The 2010 WVDEP Air Quality Report showed that $PM_{2.5}$ is comprised of 16-20% organic carbon, 24-29% sulfate, and 5-10% nitrate.[29] The balance of the speciation mass is comprised of ammonium, elemental carbon, crustal components, and other components. Additionally, a monitor located in Piney Creek, Maryland (AQ ID 24-023-0002) observes a similar speciation (e.g., 24% organic carbon, 28% sulfate, and 8% nitrate). This speciation data demonstrates that nitrates do not play a substantial role in contributing to ambient levels of $PM_{2.5}$ in the state, however this limited role can be further estimated. Furthermore, given the insignificant profile of SO_2 emissions from the Inwood Facility, the Projects impact with respect to sulfates will not be evaluated further in this analysis.

5.2. HYBRID QUALITATIVE/QUANTITATIVE $PM_{2.5}$ SECONDARY FORMATION REVIEW

Berkeley County and the Martinsburg area were recently redesignated as in attainment for $PM_{2.5}$. The recent redesignation request and maintenance plan published by WVDEP contains a summary of emissions for the years 2005 and 2007.[30] These total emissions are summarized in Table 5.2-1.

[28] US EPA, *Guidance for $PM_{2.5}$ Permit Modeling*, (Research Triangle Park, NC: U.S. EPA), EPA-454/B-14-001, May 2014.
[29] http://www.dep.wv.gov/daq/air-monitoring/Documents/2010%20Annual%20Report%20Final.pdf
[30] WVDEP, *PM2.5 Redesignation Request & Maintenance Plan*, Martinsburg, WV, 2012.

Table 5.2-1 $PM_{2.5}$ Redesignation Request Emissions Inventories

Pollutant	2005 Emissions (tpy)	2007 Emissions (tpy)	Decrease (tpy)	Decrease (%)
NO_X	10875	8473	2402	22.1
$PM_{2.5}$	2059	1154	905	44.0
SO_2	2462	1833	629	25.5

As shown in Table 5.2-1, total emissions from all sources in Berkeley County decreased by 22.1%, 44% and 25.5% for NO_X, $PM_{2.5}$ and SO_2, respectively. Given the large contribution of sulfates to $PM_{2.5}$ formation, the decrease in SO_2 emissions (which was slightly larger than the decrease in NO_X emissions) and the significant reduction in $PM_{2.5}$ emissions are likely responsible for the corresponding decrease in $PM_{2.5}$ concentrations observed from 2005 to 2007 at the Martinsburg monitor, which are shown in Table 5.2-2.

Table 5.2-2 Historical $PM_{2.5}$ Background Concentrations

Pollutant	Annual Average (μg/m³)	24-Hour Average (μg/m³)
2005	16.9	37.3
2006	14.9	31.4
2007	15.6	31.4
Average	15.8	33.4
Decrease	1.3	5.9

Applying the high end of range of nitrate contributions from the 2010 WVDEP Air Quality Report (i.e., 10%) to observed $PM_{2.5}$ background concentrations in West Virginia, and assuming that the nitrate contribution also applies to the decrease in observed $PM_{2.5}$ background concentrations (i.e., 1.3 μg/m³), the decrease in nitrate concentration can be estimated at 0.13 μg/m³.

Considering the NO_X emissions decrease outlined in the redesignation request, a theoretical concentration reduction rate can be estimate as 5.4E-5 μg/m³ per ton of NO_X reduction (0.13 μg/m³ divided by 2402 tons). If this rate is applied to the Project emissions increases, then the theoretical maximum concentration due to the secondary formation of $PM_{2.5}$ from the Project can be estimated as 0.006 μg/m³. This value represents approximately 2% of the previously established annual average SIL (and less than 0.1% of the annual average NAAQS) and demonstrates the insignificant impact of the Project's $PM_{2.5}$ precursor emissions on secondary formation.

Furthermore, it is important to note that it is highly unlikely for maximum model output concentrations resulting from direct $PM_{2.5}$ to coincide with where secondary formation would occur as a result of Project NO_X emissions. The formation of particulate nitrate requires time in the atmosphere (i.e., downwind distance from the facility) and maximum model output concentrations resulting from the Project are expected to be within close proximity to the Inwood Facility.

5.3. SECONDARY $PM_{2.5}$ FORMATION ANALYSIS SUMMARY

In keeping with EPA's requirements for addressing secondary $PM_{2.5}$ formation impacts, a hybrid qualitative/quantitative analysis was performed as outlined in Sections 5.1 and 5.2. These analyses illustrate the insignificant formation of secondary $PM_{2.5}$ that can be expected as a result of the Project. No further assessment of secondary $PM_{2.5}$ formation is necessary based on this conclusive analysis. As such, Knauf proposes to demonstrate compliance with the $PM_{2.5}$ air quality standards through modeling direct $PM_{2.5}$ emissions to address primary impacts. The results of modeling these emissions will be compared to the appropriate standards, directly, and the qualitative/quantitative analysis will be supplied as part of the final modeling report.

6.1. GROWTH ANALYSIS

The purpose of the growth analysis is to quantify associated growth; that is, to predict how much new growth is likely to occur in order to support the source or modification under review, and then to estimate the air quality impacts from this growth. First, an assessment will be made regarding the amount of residential growth the proposed project will bring to the area. The amount of residential growth will depend on the size of the available work force, the number of new employees, and the availability of housing in the area. Associated commercial and industrial growth consists of new sources providing goods and services to the new employees and to the modified source itself.

The proposed Line 2 project is not expected to cause an appreciable increase in population. The plant will be staffed either with existing employees or additional employees from the current population. In addition, there are no anticipated increases in industrial, commercial, and residential growth as a result of the proposed project. Thus, there will be no perceptible, negative growth impacts resulting from the project. However, this will be evaluated further upon submittal of the final modeling analysis.

6.2. SOILS AND VEGETATION ANALYSIS

The U.S. EPA developed the secondary NAAQS in order to protect certain air quality-related values (i.e., soil and vegetation) that were not sufficiently protected by the primary NAAQS. The secondary NAAQS represent levels below which most types of soil and vegetation are unaffected by criteria pollutants. If ambient concentrations are found to be less than the secondary NAAQS, emissions from a proposed modification will not result in harmful effects to either soil or vegetation.[31] Modeled concentrations resulting from the proposed project will be compared with the secondary NAAQS to demonstrate insignificant impacts upon local soils and vegetation. If necessary, local vegetation species that are considered to be sensitive to low levels of pollutants for which there are no NAAQS will be analyzed separately as identified by WVDEP.

6.3. VISIBILITY ANALYSIS

A typical visibility impairment analysis will consider the impacts that occur within the impact area of the source. A visibility analysis required as part of an additional impacts analysis will consider issues similar to the Class I area visibility analysis requirements. Since NO_2, $PM_{2.5}$, and PM_{10} emissions have the potential to trigger PSD modeling and are known to impair visibility, these pollutants are typically considered in visibility analyses. The U.S. EPA-suggested components of the visibility impairment analysis consist of (1) a determination of the visual quality of the area based on an actual historical evaluation, (2) an initial screening of emissions sources to assess the possibility of visibility impairment, and (3) if warranted, a more in-depth analysis involving computer models.

As required by WVDEP, Knauf will utilize the U.S. EPA VISCREEN model following the guidelines published in the *Workbook for Plume Visual Impact Screening and Analysis*[32] to determine potential project impacts at the nearest state park (Fort Frederick State Park) and ensure that no adverse impacts will result. Figure 6.3-1 below depicts the location of the project site with respect to the nearby state parks. Knauf will initially conduct a Level 1 screening analysis and compare the model output to the Class I screening criteria (e.g., 2.0 for color difference index and 0.05 for contrast), which are more conservative than similar criteria for Class II areas. If these values are exceeded in the Level 1 analysis, Knauf will then conduct a Level 2 analysis utilizing the guidelines published in U.S. EPA's *Workbook for Plume Visual Impact Screening and Analysis (Revised)*.[33] The results of this analysis would be included with the R14 application.

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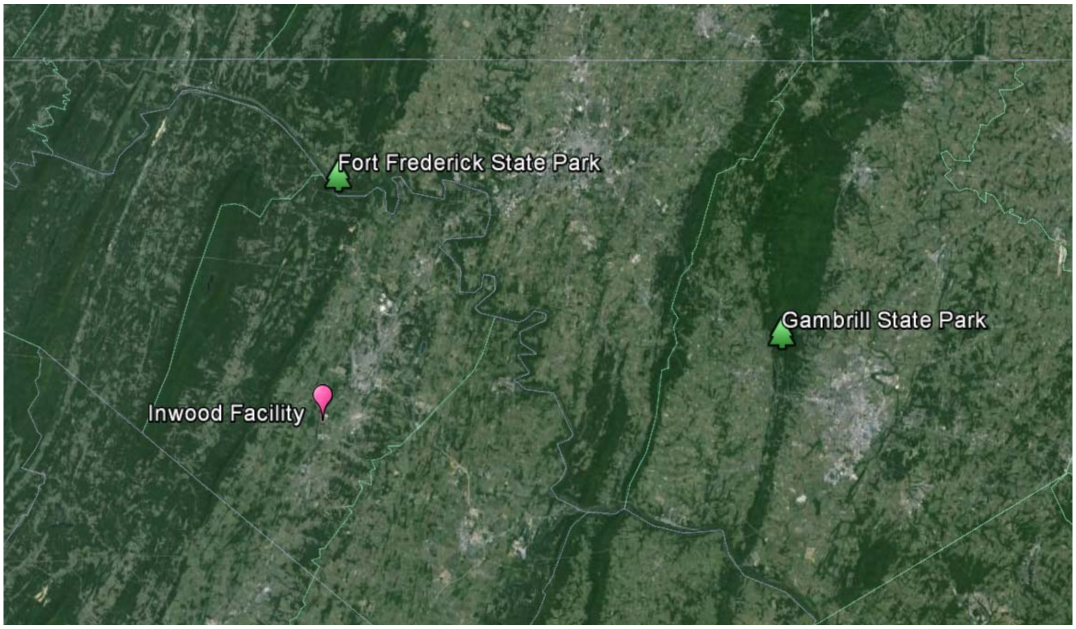
[31] U.S. EPA, Office of Air Quality Planning and Standards, *New Source Review Workshop Manual*, Research Triangle Park, North Carolina, October 1990.
[32] U.S. EPA, Workbook for Plume Visual Impact Screening and Analysis, EPA-450/4-88-015, 1988.
[33] U.S. EPA, Workbook for Plume Visual Impact Screening and Analysis (Revised), EPA-454/R-92-023, 1992.

Figure 6.3-1 Plot of Inwood Facility and Nearby State Parks



As noted in Section 1.2, the Project triggers PSD review for one (1) ozone precursor: NO_X. This section outlines the methodology for evaluating ozone concentrations as it relates to existing conditions and to the project.

7.1. EXISTING OZONE CONCENTRATIONS

In order to evaluate the potential impact from the project with respect to ozone concentrations, it is first necessary to understand existing ambient background ozone concentrations. There are two monitors within close proximity of the Project. These monitors are Monitor #51-069-0010 in Frederick County, VA (approximately 15 km to the south) and Monitor #54-003-0003 in Berkeley County, WV (approximately 7 km to the northeast). The design value concentrations for the most recent three years of certified data, which were obtained via EPA's AirData database are depicted in Table 7.1-1 below.[34]

Table 7.1-1 Design Value Ozone Concentrations at Nearby Monitors

Year	Frederick County Monitored 4th Highest Daily Maximum 8-hour Concentration (ppb)	Berkeley County Monitored 4th Highest Daily Maximum 8-hour Concentration (ppb)
2013	60	63
2014	59	64
2015	61	66
Design Value	60	63

Considering the current 8-hour average ozone NAAQS is 70 ppb, both monitors suggest that there is substantial margin between current monitored values and the NAAQS. The difference between monitored values and the NAAQS is paramount in the further evaluation of potential ozone impacts provided in the following sections.

7.2. REVIEW OF EXISTING INVENTORIES

In order to put into context the magnitude of Project emissions increases, as it related to ozone formation, a review of county and regional emissions of ozone precursors was performed. The EPA's 2011 National Emissions Inventory (NEI) Data was consulted in conducting the review.[35, 36] In evaluating which counties to review as part of the region, the wind rose in Figure 3.2-3 was consulted. Table 7.2-1 outline the regional emissions of NO_X.

Compared to the magnitude of ozone precursor emissions in the region, the Project's NO_X emissions increases (estimated at 102 tpy) are a small fraction. To point, the NO_X emissions increases represent 2% of the total county emissions and less than 0.3% of the region's emissions

[34] https://www3.epa.gov/airdata/ad_maps.html
[35] https://www.epa.gov/air-emissions-inventories/2011-national-emissions-inventory-nei-data
[36] Knauf is aware that the 2014 NEI data was posted on September 27, 2016. While Knauf will review the 2014 data, it is our expectation that the use of 2014 data will have limited to no impact on the conclusions of this analysis.

Table 7.2-1 Regional NO_X (Ozone Precursor) Emissions (tpy) from 2011 NEI

County	Fuel Comb. Elec. Util.	Fuel Comb. Industrial	Fuel Comb. Other	Chemical & Allied Product Mfg.	Petroleum & Related Industries	Other Industrial Processes	Solvent Utilization	Waste Disposal & Recycling	Highway	Off-Highway	Misc.	County Total
Allegany, MD	675	3192	195	0	7	466	0	30	1411	601	2	**6579**
Frederick, MD	5	148	375	0	13	9	1	61	4354	1559	6	**6530**
Washington, MD	165	129	328	0	5	1625	1	30	4720	843	5	**7852**
Clarke, VA	0	7	16	0	0	0	0	7	375	207	3	**616**
Shenandoah, VA	0	31	69	0	0	127	0	20	2923	219	31	**3420**
Warren, VA	0	11	48	0	0	0	0	13	1057	265	111	**1505**
Winchester City, VA	0	33	56	0	0	0	0	2	335	85	1	**512**
Frederick, VA	0	75	94	1	0	0	0	51	3015	774	16	**4026**
Berkeley, WV	0	92	179	0	0	1507	0	107	2411	821	5	**5122**
Hampshire, WV	0	5	20	0	0	0	0	26	439	413	2	**905**
Jefferson, WV	0	80	44	0	0	0	0	40	787	737	5	**1693**
Morgan, WV	0	5	19	0	0	0	0	16	386	740	1	**1169**
Total	**845**	**3808**	**1444**	**1**	**25**	**3734**	**2**	**403**	**22213**	**7264**	**187**	**39928**

7.3. REVIEW OF RULE DEVELOPMENT DATA

To further understand the potential impact of the Project emissions on ozone concentrations, technical support data from the Cross State Air Pollution Rule (CSAPR) was reviewed and applied to project emission increases.[37] The purpose of the analysis is to illustrate quantitatively the minimal impact of the Project through use of CSAPR development emissions data and monitor model results. Table 7.3-1 provides the NO_X emissions data utilized by EPA during rule development. Only states that are likely to contribute to ozone concentrations in the project area were evaluated.

Table 7.3-1 Evaluated Emissions Cases (tpy) during CSAPR Development

State	2005 Base NO_X	2012 Base	2014 Base	2014 Remedy	2012 Base minus 2005 Base		2014 Base minus 2012 Base		2014 Remedy minus 2014 Base	
					Difference	% Diff.	Difference	% Diff.	Difference	% Diff.
MD	312,230	197,441	181,909	181,533	-114,789	-36.8%	-15,533	-7.9%	-375	-0.2%
VA	488,263	359,907	334,720	333,985	-128,355	-26.3%	-25,187	-7.0%	-735	-0.2%
WA	308,655	172,143	166,094	155,245	-136,512	-44.2%	-6,049	-3.5%	-10,849	-6.5%

Table 7.3-2 provides EPA's ozone modeling results for the two monitor locations previously reviewed in Section 7.1.

Table 7.3-2 Modeled Values during CSAPR Development

Monitor ID	State	County	2003-2007 Maximum Ambient Value	2012 Base Case Maximum Values	2014 Base Case Maximum Values	2014 Remedy Maximum Values
510690010	VA	Frederick	73.0	64.4	63.0	62.9
540030003	WA	Berkeley	76.0	67.8	66.2	65.9

With the input emissions data and output modeled values in Tables 7.3-1 and 7.3-2, a factor can be developed that illustrates how ozone model output concentrations vary with respect to changes in NO_X emissions. The computation of tons of NO_X per ppb ozone concentration reduction is outlined in Tables 7.3-3 and 7.3-4 for the Berkeley County and Frederick County monitor locations, respectively.

[37] https://www3.epa.gov/crossstaterule/techinfo.html

Table 7.3-3 Comparison of CSAPR Modeled Emissions Reductions and Monitor Design Value Reductions (Berkeley County, WV)

State	Case	Statewide NO_X Emissions Reduction (tpy)	Berkeley Monitor Reduction (ppb)	Reduction Rate (ton/ppb)
WV	2005 Base Case to 2012 Base	136,512	7.2	18,960
MD		114,789	7.2	15,943
VA		128,355	7.2	17,827
WV	2012 Base Case to 2014 Base	6,049	1.6	3,781
MD		15,533	1.6	9,708
VA		25,187	1.6	15,742
WV	2014 Base Case to 2014 Remedy Base	10,849	0.3	36,163
MD		375	0.3	1,252
VA		735	0.3	2,451
			Minimum	**1,252**

Table 7.3-4 Comparison of CSAPR Modeled Emissions Reductions and Monitor Design Value Reductions (Frederick County, VA)

State	Case	Statewide NO_X Emissions Reduction (tpy)	Frederick Monitor Reduction (ppb)	Reduction Rate (ton/ppb)
WV	2005 Base Case to 2012 Base	136,512	7.9	17,280
MD		114,789	7.9	14,530
VA		128,355	7.9	16,248
WV	2012 Base Case to 2014 Base	6,049	1.4	4,321
MD		15,533	1.4	11,095
VA		25,187	1.4	17,991
WV	2014 Base Case to 2014 Remedy Base	10,849	0.1	108,488
MD		375	0.1	3,755
VA		735	0.1	7,352
			Minimum	**3,755**

A ton/ppb factor was developed for each of the CSAPR cases and for each of the three (3) states considered in the analysis. The minimum factor (i.e., the case demonstrating the most ozone concentration sensitivity to NO_X emissions) was identified as Maryland emissions sources between the 2014 base case and the 2014 remedy case at the Berkeley County monitor. Given this factor (1,252 ton/ppb) and the draft project emission increase of approximately 102 tons of NO_X, it could be deduced that a model response in the order of approximately 0.08 ppb ozone would be expected as a result of the Project. Even though this calculation is meant to serve as a high-level, order of magnitude demonstration, it helps to highlight that the Project emissions would have a limited impact on ozone concentrations that are already on the order of approximately 60 ppb.

7.4. OZONE IMPACTS ANALYSIS SUMMARY

The Project is not expected to cause or contribute to an exceedance of the ozone NAAQS. As outlined in Section 7.1, there is substantial margin between current monitored ozone concentrations and the NAAQS. Taking into considering the magnitude of Project emissions increases in comparison with existing regional emissions (Section 7.2) and the negligible ozone concentration increase that may result due to the Project (Section 7.3), compliance with the ozone NAAQS will not be jeopardized as a result of the Project.

8. CLASS I AREA AIR QUALITY RELATED VALUES ANALYSES

With regard to Class I area air quality related values (AQRVs), typically an analysis will need to be conducted if a facility is within 300 km of a Class I area. There are four Class I areas within 300 km of the Inwood Facility:

- Otter Creek Wilderness (approximately 145 km southwest);
- Dolly Sods Wilderness (approximately 120 km southwest);
- Shenandoah National Park (approximately 65 km southwest); and
- James River Face Wilderness (approximately 235 km southwest).

The Federal Land Managers (FLMs) are responsible for determining if a Class I AQRV analysis is required.[38] In order to make such a determination, a "Q/d" analysis is typically used where "Q" is the emissions increase of combined NO_X, PM_{10}, SO_2, and H_2SO_4 mist (tons per year) and "d" is the distance to the nearest Class I area (kilometers). Traditionally, if the quotient of these values is less than 10 a Class I analysis is not required, however, this is not a steadfast rule and others may be required on a case-by-case basis.[39] Based on preliminary project emissions estimates, Knauf anticipates that the "Q/d" values for the proposed project will be relatively low (approximately 3.6) and will not require a Class I AQRV analysis. The following are the preliminary project emissions increases (in tpy) of the pollutants of concern:

- NO_X – 102 tpy
- PM_{10} – 110 tpy
- SO_2 – 24 tpy
- Total of Above – 237 tpy

Knauf understands, per conversations with WVDEP, that WVDEP will be responsible for contacting the FLMs of these Class I areas to determine if they would require a Class I analysis. If the FLMs request that a Class I area analysis be conducted for this proposed project, Knauf will submit a separate modeling protocol to the WVDEP and appropriate FLMs outlining the proposed methodology for that analysis.

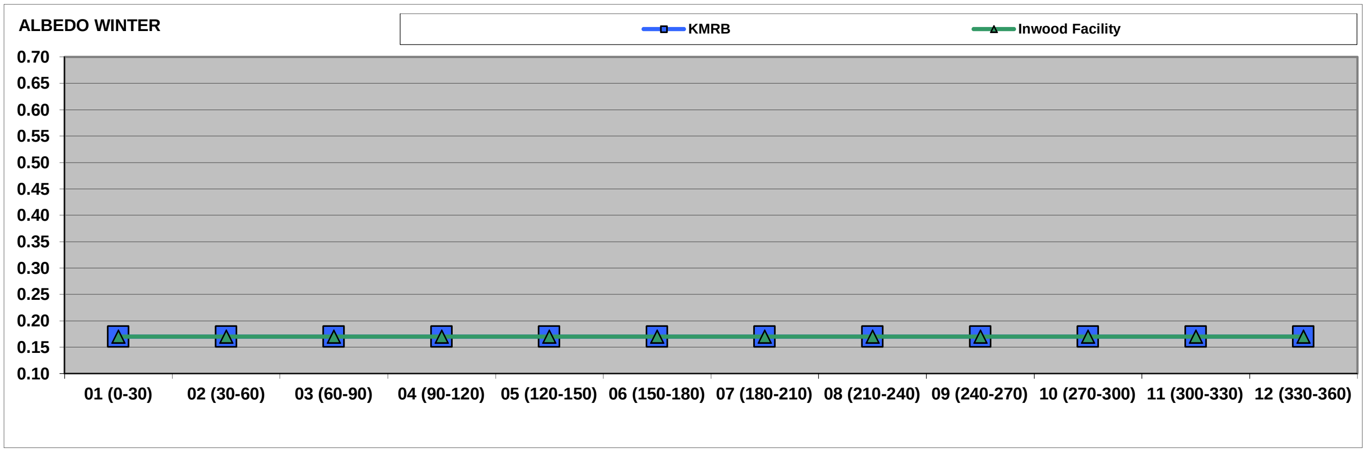
[38] 40 CFR§52.21(p)

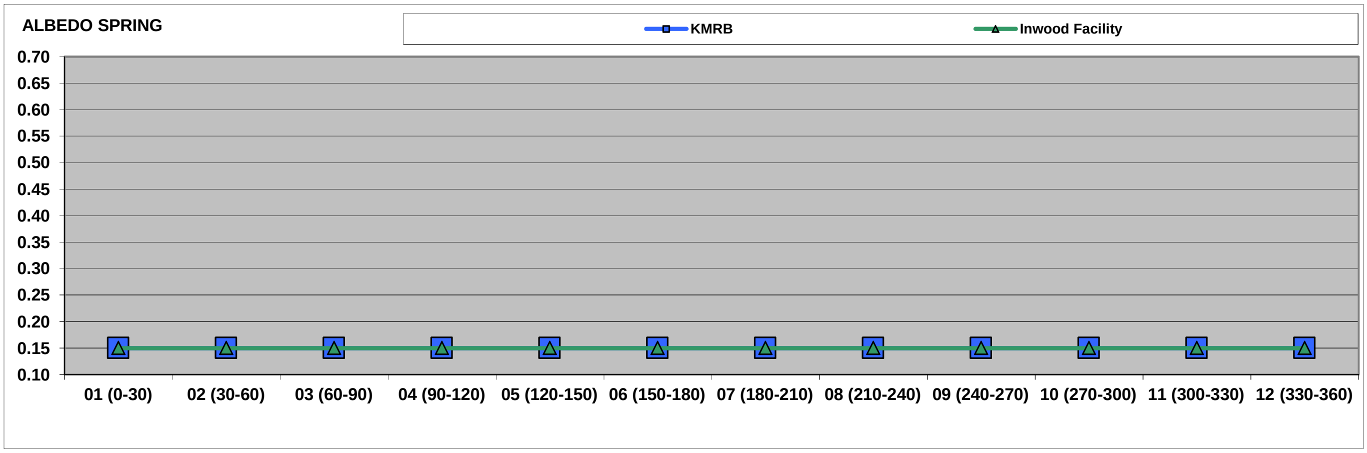
[39] Section 3.2 (Initial Screening Criteria) of the "Federal Land Managers' Air Quality Related Values Work Group (FLAG) Phase I Report – Revised 2010".

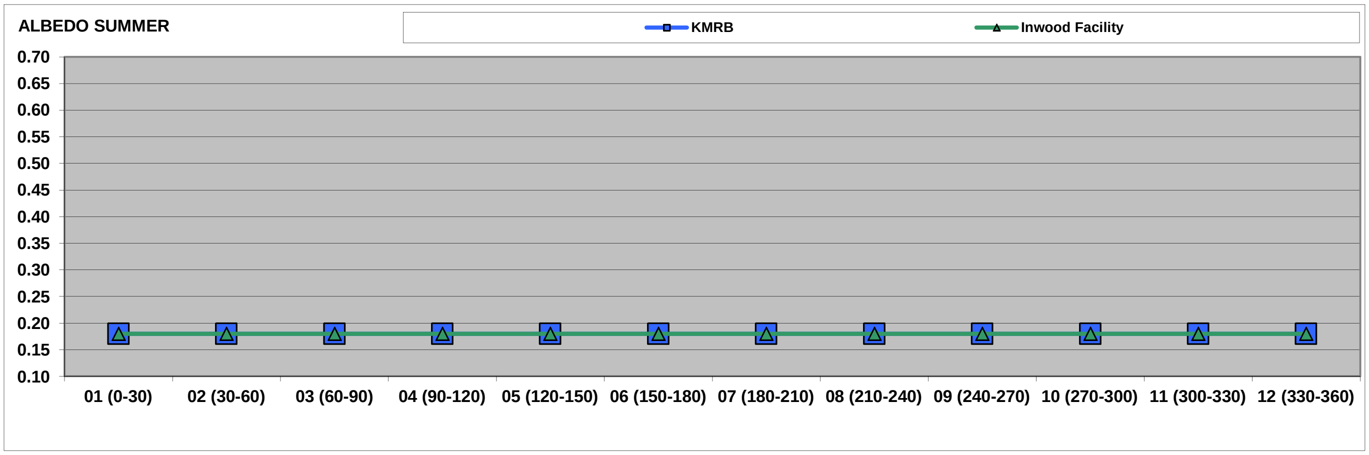
APPENDIX A

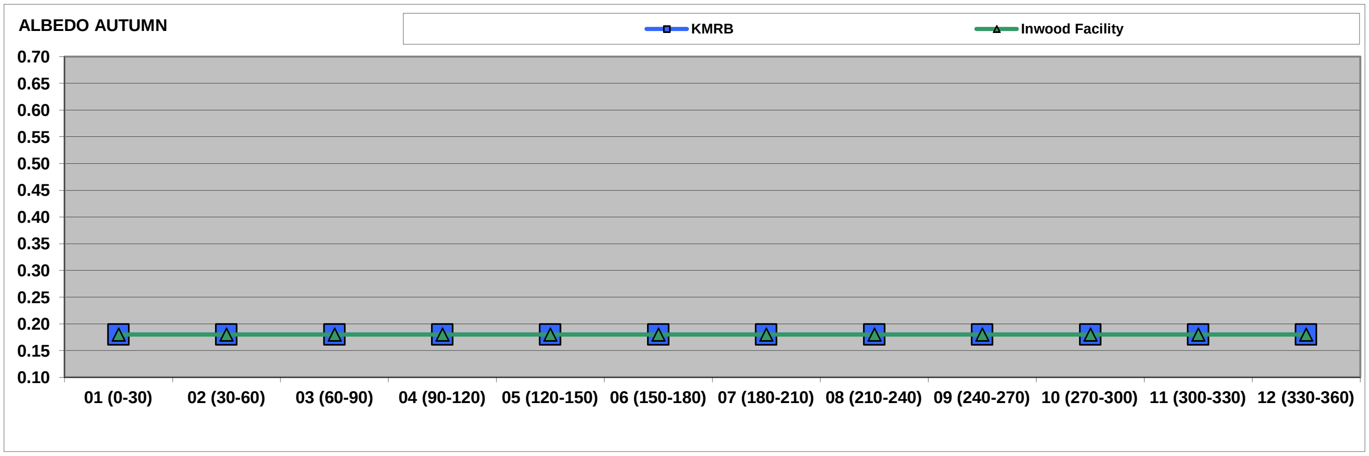
Land Use Comparison Data

COMPARISON OF ALBEDO VALUES

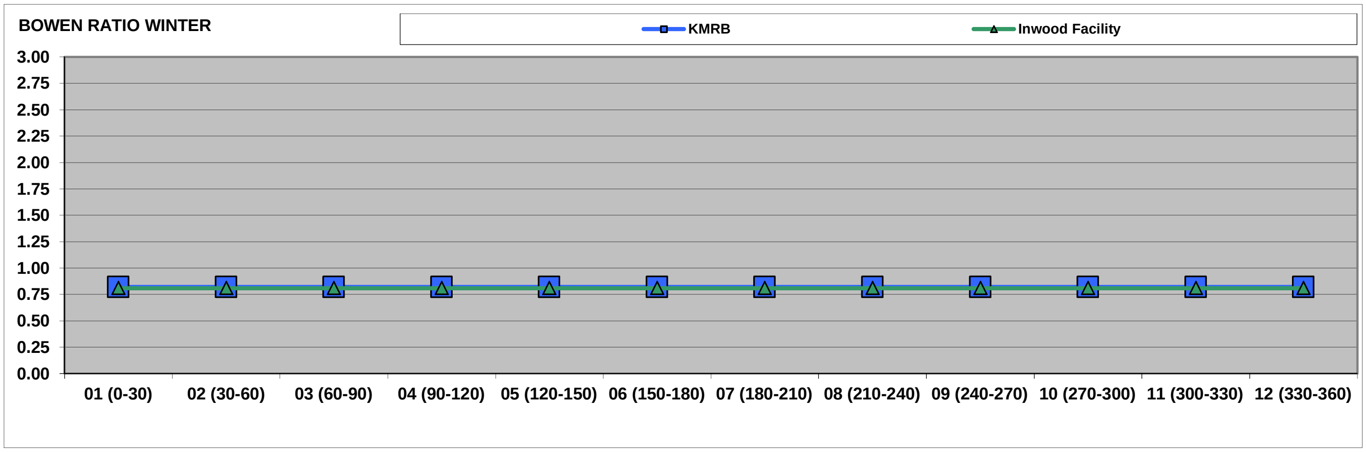


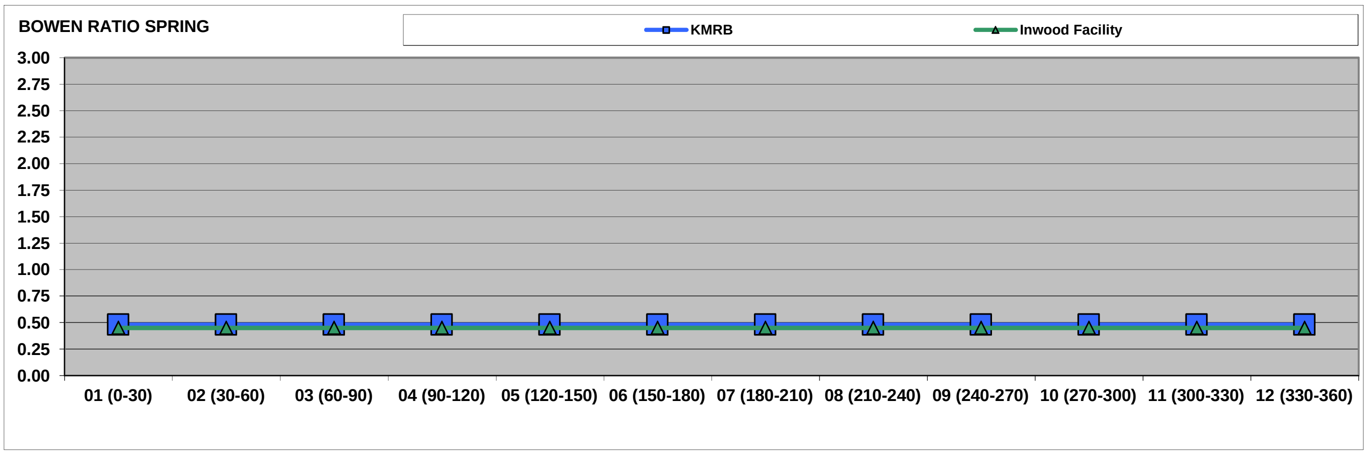


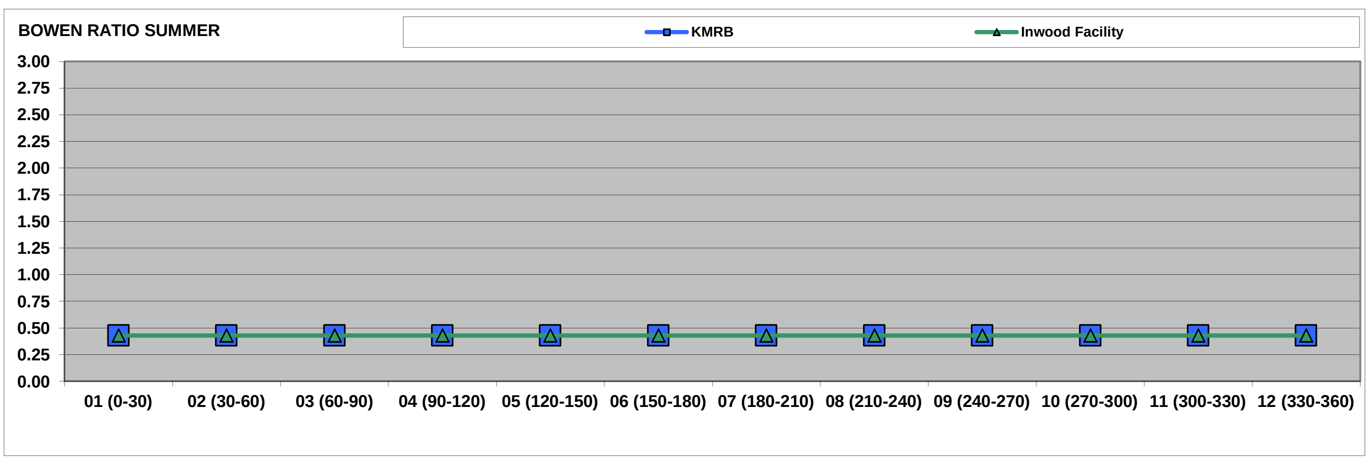


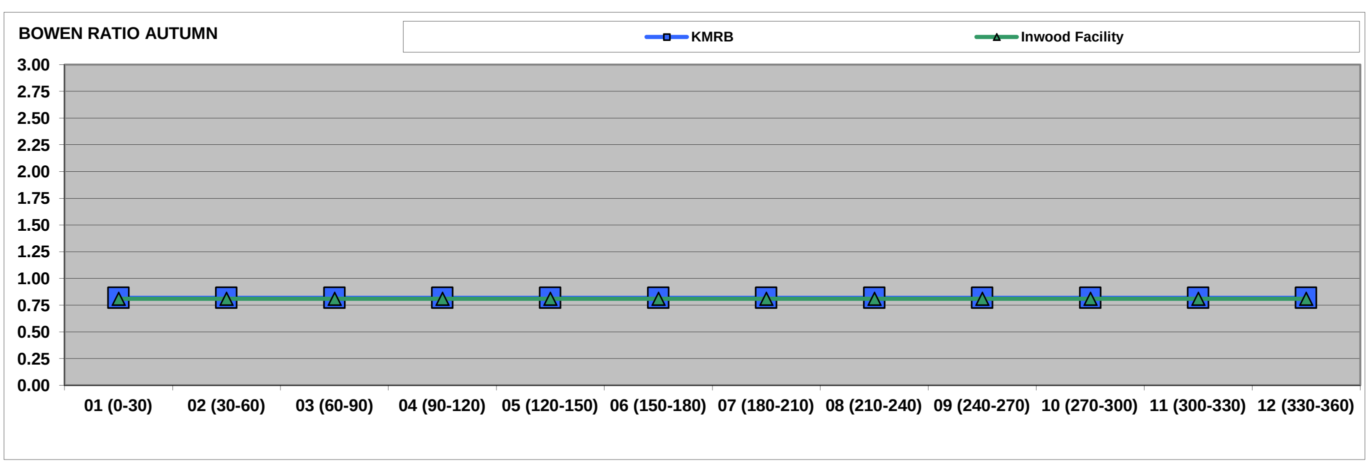


COMPARISON OF BOWEN RATIO VALUES

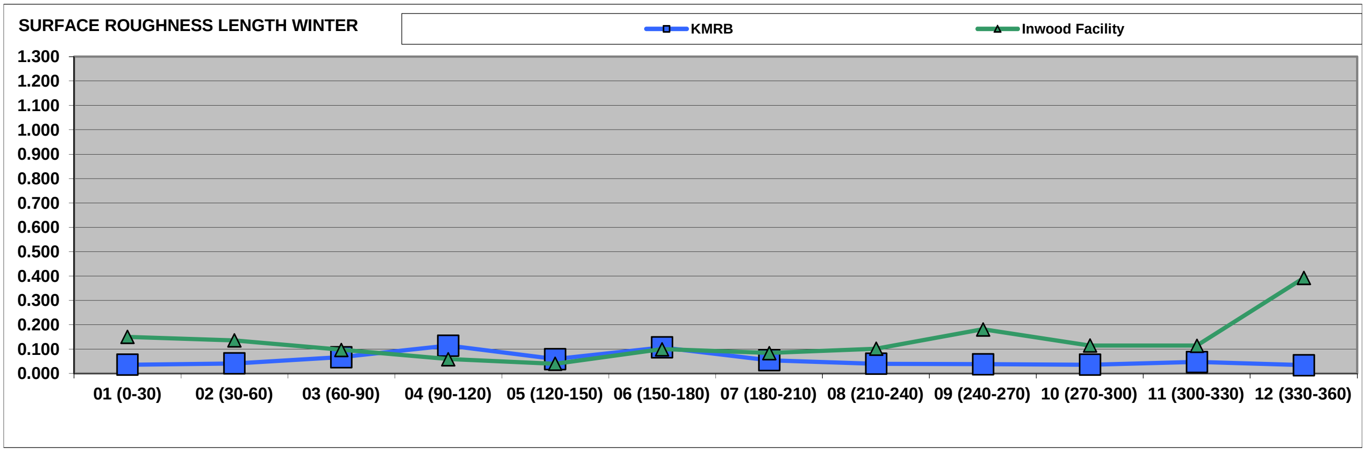


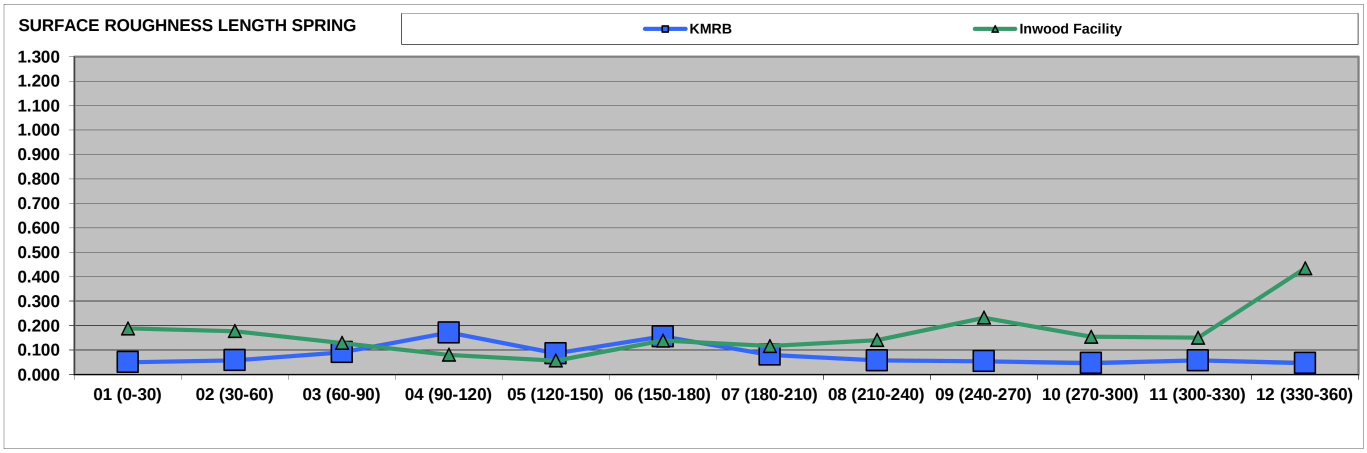


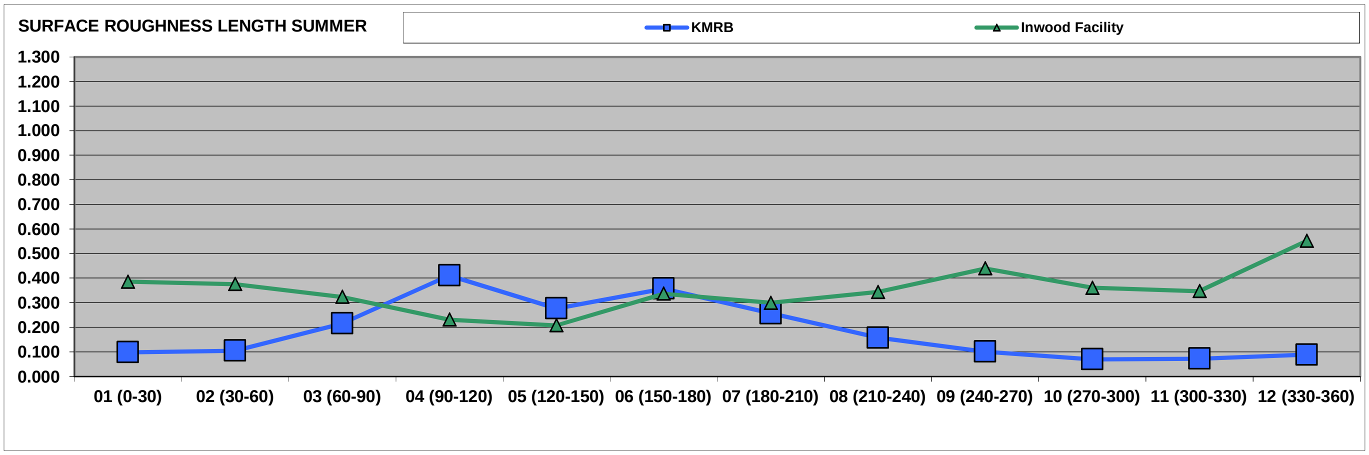


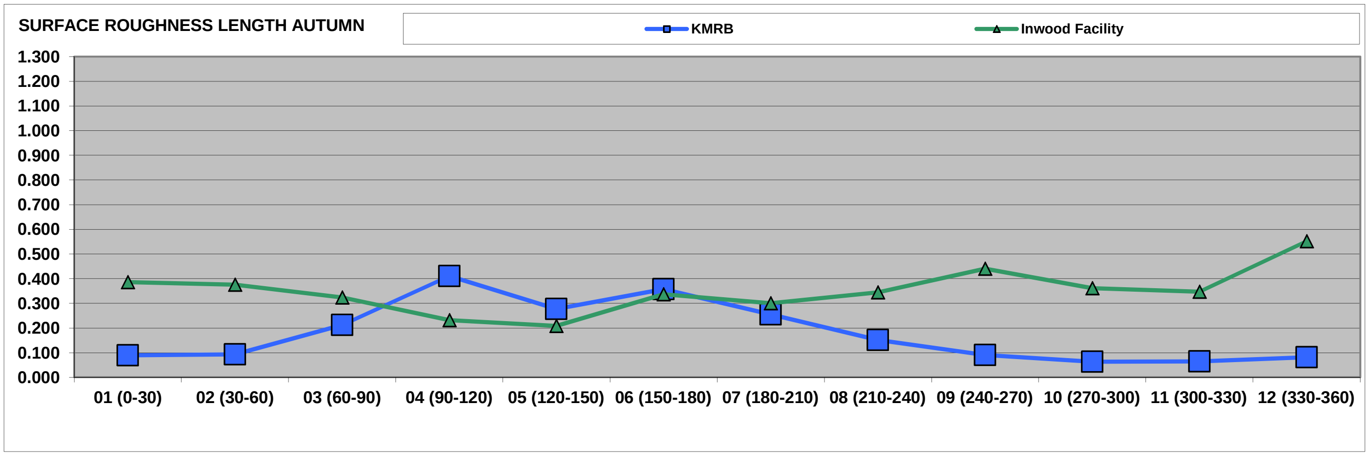


COMPARISON OF SURFACE ROUGHNESS LENGTH VALUES









From: McClung, Jon D <Jon.D.McClung@wv.gov>
Sent: Sunday, November 13, 2016 11:49 AM
To: Ian Donaldson
Cc: Mahin, Christopher; Stephanie Miller; Tom Muscenti; Crowder, Laura M; Andrews, Edward S; Kessler, Joseph R; Pursley, Steven R; Qutaish, Fadi
Subject: RE: Knauf Inwood Class II Air Quality Modeling Protocol for Line 2 Project

Follow Up Flag: Follow up
Flag Status: Completed

Ian,

We have reviewed the Knauf Inwood Class II Air Quality Modeling Protocol for Line 2 Project and offer the following comments:

1. Section 2.1.3. Knauf states that “Prior to completing the analysis, Knauf may request the WVDEP’s acceptance of the regional source inventories.” This should be changed to indicate that Knauf will coordinate with the WVDEP to develop the regional source inventory by considering all sources within the area identified in section 2.1.3 and will include the rationale for excluding any sources in the final modeling report.
2. Section 2.2. Knauf states that “Knauf reserves the right to modify the background concentrations listed in Table 2.2-2 according to EPA-approved procedures.” This should be changed to indicate that any changes to background concentrations proposed in the protocol will be coordinated with WVDEP prior to implementation.
3. Section 2.3. Knauf needs to perform a screening level Class I area increment analysis to determine the need for a more refined analysis. WVDEP recommends using AERMOD as a screening tool by placing a receptor ring at 50 km from the project source at an elevation level representative of the Class I area in that specific direction from the source to the receptor.
4. Section 8. WVDEP requests detailed calculation information for the calculation of “Q”. The maximum 24-hour emission rate changes should be the basis for the calculation.

If Knauf accepts these comments and changes the protocol accordingly then the protocol is approvable and Knauf may proceed with the modeling analysis. Please contact me with any questions or concerns. I will be traveling to New Orleans next week for EPA’s R/S/L Modeling Conference and you can contact me on my cell phone at (304) 546-7399 if needed.

Regards,
Jon.

From: Ian Donaldson [mailto:IDonaldson@trinityconsultants.com]
Sent: Thursday, October 13, 2016 1:34 PM
To: McClung, Jon D <Jon.D.McClung@wv.gov>
Cc: Mahin, Christopher <chris.mahin@knaufinsulation.com>; Stephanie Miller <smiller@trinityconsultants.com>; Tom Muscenti <tmuscenti@trinityconsultants.com>
Subject: Knauf Inwood Class II Air Quality Modeling Protocol for Line 2 Project

Jon,

Per information relayed to Mr. Ed Andrews by Knauf Insulation (Knauf), and my voicemail to your attention during the week of 10/10, please see the attached air quality dispersion modeling protocol for Knauf’s Inwood Facility Line 2 project. As noted in prior meetings with the Department, the project triggers PSD permitting requirements. As such, the modeling protocol provides current project details and outlines the proposed methodology for the air quality modeling demonstrations required under the PSD program. Once you have had a chance to review the document, we would appreciate the opportunity to discuss it with you and walk through any questions or comments you may have.

Feel free to reach out to myself or Chris Mahin with any questions. Also, if you would please confirm receipt of this email and attachment, I would appreciate it.

Regards,

Ian Donaldson
Managing Consultant

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Trinity Consultants

APPENDIX C: KNAUF MODELED SOURCE PARAMETERS AND EMISSION RATES

Table C-1. Knauf Inwood Modeled Stack Parameters

Emission Point ID	Emission Point Description	Release Height		Exit Diameter		Exhaust Gas Temperature		Exhaust Gas Flow Rate	Exhaust Gas Velocity		Exhaust Stack Raincap?	Exhaust Stack Orientation
		(m)	(ft)	(m)	(in)	(°K)	(°F)	(acfm)	(m/s)	(ft/s)		
EP23	LINE 2 Facing & Packaging, Raw Material Handling Forming, Melting & Refining Baghouse Stack	60.66	199	2.90	114	333.15	140	288,100	20.65	67.74	No	Vertical
EP24	LINE 2 Curing & Cooling Stack	36.58	120	1.45	57	449.82	350	70,000	20.07	65.84	No	Vertical
EP12	LINE 1 Melting & Refining Baghouse Stack	18.38	60.3	0.71	28	316.48	110	15,000	17.82	58.47	No	Vertical
EP13	LINE 1 Forming & Collection Stack	60.66	199	2.13	84	344.26	160	158,000	20.86	68.43	No	Vertical
EP13	LINE 1 Forming & Collection Stack - Old Stack	36.58	120	1.98	78	344.26	160	158,000	24.19	79.36	No	Vertical
EP14	LINE 1 Curing & Cooling Stack	36.58	120	1.32	52	385.93	235	61,335	21.13	69.31	No	Vertical
EP16	ESDG12 Emergency Generator	7.32	24	0.30	12	845.93	1063	3,404	22.02	72.24	No	Vertical
EP17	ESDG13 Emergency Generator	7.32	24	0.30	12	739.65	872	3,334	21.56	70.74	No	Vertical
EP18	ESFW11 Emergency Fire Pump	3.05	10	0.30	12	583.15	590	1,425	9.22	30.24	No	Vertical
EP11A	Day Bin 1	25.46	83.54	0.10	4	294.26	70	1,000	0.001	0.003	No	Horizontal
EP11B	Day Bin 2	25.46	83.54	0.10	4	294.26	70	1,000	0.001	0.003	No	Horizontal
NEWGEN	New Emergency Generator	4.27	14.00	0.10	4	807.76	994	4,784	50.00	164.04	No	Vertical
CT1	Cooling Tower 1	8.84	29	1.83	72	302.59	85	110,000	19.76	64.84	No	Vertical
CT2	Cooling Tower 2	8.84	29	1.83	72	302.59	85	110,000	19.76	64.84	No	Vertical
CT3	Cooling Tower 3	8.84	29	1.83	72	302.59	85	110,000	19.76	64.84	No	Vertical
CT4	Cooling Tower 4	7.92	26	2.44	96	302.59	85	150,000	15.16	49.74	No	Vertical
CT5	Cooling Tower 5	7.92	26	2.44	96	302.59	85	150,000	15.16	49.74	No	Vertical

Notes:
1. Exhaust gas velocity for the day bins was modeled at 0.001 m/s to reflect the horizontal exhaust stack orientation. Actual exit velocity will be greater.
2. Exhaust gas velocity for the new generator was modeled at 50 m/s due to model contraints. Actual exit velocity may be greater.

Table C-2. Knauf Inwood Modeled Emission Rates - PSD Increment and NAAQS Analyses

Emission Point ID	Emission Point Description	NO_2 Short-Term		NO_2 Long-Term		PM_{10} Short-Term		PM_{10} Long-Term		$PM_{2.5}$ Short-Term		$PM_{2.5}$ Long-Term	
		(g/s)	(lb/hr)	(g/s)	(lb/hr)	(g/s)	(lb/hr)	(g/s)	(lb/hr)	(g/s)	(lb/hr)	(g/s)	(lb/hr)
EP23	LINE 2 Facing & Packaging, Raw Material Handling Forming, Melting & Refining Baghouse Stack	2.70	21.40	2.70	21.40	3.01	23.89	3.01	23.89	3.01	23.89	3.01	23.89
EP24	LINE 2 Curing & Cooling Stack	4.96E-01	3.93	4.96E-01	3.93	9.24E-01	7.33	9.24E-01	7.33	9.24E-01	7.33	9.24E-01	7.33
EP12	LINE 1 Melting & Refining Baghouse Stack	1.70E-02	0.14	1.70E-02	0.14	7.71E-02	0.61	7.71E-02	0.61	7.71E-02	0.61	7.71E-02	0.61
EP13	LINE 1 Forming & Collection Stack	1.81E-01	1.44	1.81E-01	1.44	1.97	15.62	1.97	15.62	1.97	15.62	1.97	15.62
EP13	LINE 1 Forming & Collection Stack - Old Stack	---	---	---	---	---	---	---	---	-5.66E-01	-4.49	-5.30E-01	-4.21
EP14	LINE 1 Curing & Cooling Stack	2.13	16.88	2.13	16.88	3.06E-01	2.43	3.06E-01	2.43	3.06E-01	2.43	3.06E-01	2.43
EP16	ESDG12 Emergency Generator	---	---	---	---	4.17E-03	0.03	4.17E-03	0.03	4.17E-03	0.03	4.17E-03	0.03
EP17	ESDG13 Emergency Generator	---	---	---	---	6.47E-04	0.01	6.47E-04	0.01	6.47E-04	0.01	6.47E-04	0.01
EP18	ESFW11 Emergency Fire Pump	---	---	---	---	4.28E-03	0.03	4.28E-03	0.03	4.28E-03	0.03	4.28E-03	0.03
EP11A	Day Bin 1	---	---	---	---	1.39E-03	0.01	4.62E-04	0.004	1.39E-03	0.01	4.62E-04	0.004
EP11B	Day Bin 2	---	---	---	---	1.39E-03	0.01	4.62E-04	0.004	1.39E-03	0.01	4.62E-04	0.004
NEWGEN	New Emergency Generator	---	---	8.86E-02	0.70	2.25E-02	0.18	1.28E-03	0.01	2.25E-02	0.18	1.28E-03	0.01
CT1	Cooling Tower 1	---	---	---	---	5.15E-03	0.04	5.15E-03	0.04	2.35E-05	0.0002	2.35E-05	0.0002
CT2	Cooling Tower 2	---	---	---	---	5.15E-03	0.04	5.15E-03	0.04	2.35E-05	0.0002	2.35E-05	0.0002
CT3	Cooling Tower 3	---	---	---	---	4.90E-03	0.04	4.90E-03	0.04	2.24E-05	0.0002	2.24E-05	0.0002
CT4	Cooling Tower 4	---	---	---	---	4.90E-03	0.04	4.90E-03	0.04	2.24E-05	0.0002	2.24E-05	0.0002
CT5	Cooling Tower 5	---	---	---	---	4.90E-03	0.04	4.90E-03	0.04	2.24E-05	0.0002	2.24E-05	0.0002

Notes:
1. Negative emission rate for old EP13 stack configuration is based on actual emissions for 2012 and 2013 emissions inventory.
2. EP12, EP14, EP16, EP17, EP18, CT1, and CT2 are not increment consuming for $PM_{2.5}$ and as such were not included in increment model runs for this pollutant.

Table C-3. Knauf Inwood Modeled Emission Rates - Significant Impact Analysis

Emission Point ID	Emission Point Description	NO_2 Short-Term		NO_2 Long-Term		PM_{10} Short-Term		PM_{10} Long-Term		$PM_{2.5}$ Short-Term		$PM_{2.5}$ Long-Term	
		(g/s)	(lb/hr)	(g/s)	(lb/hr)	(g/s)	(lb/hr)	(g/s)	(lb/hr)	(g/s)	(lb/hr)	(g/s)	(lb/hr)
EP23	LINE 2 Facing & Packaging, Raw Material Handling Forming, Melting & Refining Baghouse Stack	2.68	21.30	2.68	21.30	2.58	20.51	2.58	20.51	2.58	20.51	2.58	20.51
EP24	LINE 2 Curing & Cooling Stack	3.13E-01	2.49	3.13E-01	2.49	8.87E-01	7.04	8.87E-01	7.04	8.87E-01	7.04	8.87E-01	7.04
EP11A	Day Bin 1	---	---	---	---	1.39E-03	0.01	4.62E-04	0.004	1.39E-03	0.01	4.62E-04	0.004
EP11B	Day Bin 2	---	---	---	---	1.39E-03	0.01	4.62E-04	0.004	1.39E-03	0.01	4.62E-04	0.004
NEWGEN	New Emergency Generator	---	---	8.86E-02	0.70	2.25E-02	0.18	1.28E-03	0.01	2.25E-02	0.18	1.28E-03	0.01
CT3	Cooling Tower 3	---	---	---	---	4.90E-03	0.04	4.90E-03	0.04	2.24E-05	0.0002	2.24E-05	0.0002
CT4	Cooling Tower 4	---	---	---	---	4.90E-03	0.04	4.90E-03	0.04	2.24E-05	0.0002	2.24E-05	0.0002
CT5	Cooling Tower 5	---	---	---	---	4.90E-03	0.04	4.90E-03	0.04	2.24E-05	0.0002	2.24E-05	0.0002

Notes:
1. Signifiance analysis emission rates for EP23 and EP24 exclude baseline emissions.

APPENDIX D: REGIONAL SOURCE INVENTORY

Table D-1. Regional Source Inventory

Facility Name	Emission Unit Description	Model Emission Unit ID	UTM Easting (m)	UTM Northing (m)	Elevation (m)	UTM Zone	State	County	Distance from Knauf (km)	Stack Height (m)	Stack Temperature (K)	Exit Velocity (m/s)	Stack Diameter (m)	NO_2 Emission Rate (g/s)		PM_{10} Emission Rate (g/s)		$PM_{2.5}$ Emission Rate (g/s)		Increment Consuming?		
														Short Term	Long Term	Short Term	Long Term	Short Term	Long Term	NO_2	PM_{10}	$PM_{2.5}$
Carmeuse Winchester	Winchester 1	WIN1	751445.00	4348795.70	192.13	17	VA	Frederick	17.46	60.96	393.15	19.8	1.21	5.54	5.54	9.02E-01	9.02E-01	1.05	1.05	Yes	Yes	Yes
Carmeuse Winchester	Winchester 2	WIN2	751461.40	4348812.80	192.80	17	VA	Frederick	17.44	60.96	393.15	19.8	1.21	5.54	5.54	9.02E-01	9.02E-01	1.05	1.05	Yes	Yes	Yes
CONTINENTAL BRICK - MARTINSBURG FACILITY	Tunnel Kiln 1	CB1	761805.90	4369216.00	155	17	WV	Berkeley	6.25	6.10	444.26	49.64	0.61	5.30E-01	5.30E-01	9.50	50.59	9.05E-01	9.04E-01	No	No	No
CONTINENTAL BRICK - MARTINSBURG FACILITY	Tunnel Kiln 2	CB2	761805.90	4369216.00	155	17	WV	Berkeley	6.25	6.10	444.26	49.64	0.61	5.30E-01	5.30E-01	9.50	50.59	9.05E-01	9.04E-01	No	No	No
CONTINENTAL BRICK - MARTINSBURG FACILITY	Periodic Kiln	CB3	761805.90	4369216.00	155	17	WV	Berkeley	6.25	6.10	422.04	0.00	0.01	8.82E-02	2.88E-04	1.00E-01	3.00E-02	1.26E-02	8.63E-04	Yes	Yes	No
CONTINENTAL BRICK - MARTINSBURG FACILITY	Rotary Sand Dryer	CB4	761805.90	4369216.00	155	17	WV	Berkeley	6.25	6.10	422.04	0.00	0.01	1.26E-02	1.27E-02	2.00	1.20	2.52E-01	3.45E-02	Yes	Yes	No
ESSROC CEMENT - MARTINSBURG	PH/PC KILN SYSTEM	ESS1	760294.10	4369359.30	153	17	WV	Berkeley	5.98	133.20	358.15	22.92	5.19	219.87	114.58	58.64	225.16	3.96	3.4698	Yes	No	No
ESSROC CEMENT - MARTINSBURG	FINISH MILL 1&2 AIR HEATR	ESS2	760130.30	4369306.30	153	17	WV	Berkeley	5.98	47.24	368.15	18.81	1.75	3.53E-01	3.57E-01	5.00E-01	2.00	6.30E-02	5.75E-02	Yes	No	No
ESSROC CEMENT - MARTINSBURG	RAIL TRANSLOADER	ESS3	760130.30	4369306.30	153	17	WV	Berkeley	5.98	3.90	293.15	31.38	0.40	NA[1]	1.29E-01	1.80E-01	3.20E-01	2.27E-02	9.21E-03	Yes	No	Yes
ESSROC CEMENT - MARTINSBURG	PRIMARY CRUSHER D/C	ESS4	760130.30	4369306.30	153	17	WV	Berkeley	5.98	13.11	293.15	23.74	0.40	---	---	5.00E-01	1.91	2.27E-02	1.93E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	SECONDARY CRUSHER D/C	ESS5	760130.30	4369306.30	153	17	WV	Berkeley	5.98	3.35	293.15	20.06	1.17	---	---	3.63	13.94	1.61E-01	1.42E-01	---	No	No
ESSROC CEMENT - MARTINSBURG	BUILDING 30 NORBLO	ESS6	760130.30	4369306.30	153	17	WV	Berkeley	5.98	17.37	293.15	19.90	0.57	---	---	3.32	12.76	1.47E-01	1.30E-01	---	No	No
ESSROC CEMENT - MARTINSBURG	FINISH MILL 3 SEPARATOR	ESS7	760130.30	4369306.30	153	17	WV	Berkeley	5.98	25.91	353.15	21.00	1.46	---	---	10.27	39.44	4.57E-01	4.00E-01	---	No	No
ESSROC CEMENT - MARTINSBURG	N.E. PACKER D/C	ESS8	760130.30	4369306.30	153	17	WV	Berkeley	5.98	15.54	310.93	13.93	0.57	---	---	1.21	5.29	1.52E-01	1.52E-01	---	No	No
ESSROC CEMENT - MARTINSBURG	FLYASH TANK D/C	ESS9	760130.30	4369306.30	153	17	WV	Berkeley	5.98	4.27	293.15	35.66	0.20	---	---	2.00E-01	7.70E-01	8.82E-03	7.77E-03	---	No	No
ESSROC CEMENT - MARTINSBURG	BYPASS DUST TANK D/C	ESS10	760130.30	4369306.30	153	17	WV	Berkeley	5.98	28.65	293.15	35.66	0.20	---	---	2.00E-01	7.70E-01	8.82E-03	7.77E-03	---	No	No
ESSROC CEMENT - MARTINSBURG	BYPASS DUST LOADOUT D/C	ESS11	760130.30	4369306.30	153	17	WV	Berkeley	5.98	6.10	293.15	76.14	0.15	---	---	2.40E-01	9.40E-01	1.13E-02	9.49E-03	---	No	No
ESSROC CEMENT - MARTINSBURG	NEW PRIMARY CRUSHER	ESS12	760130.30	4369306.30	153	17	WV	Berkeley	5.98	19.81	293.15	12.86	1.39	---	---	1.63	6.24	7.18E-02	6.33E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	CRUSHING SYSTEM TT	ESS13	760130.30	4369306.30	153	17	WV	Berkeley	5.98	11.28	293.15	31.70	0.30	---	---	8.00E-02	3.20E-01	3.78E-03	3.16E-03	---	No	No
ESSROC CEMENT - MARTINSBURG	PREMIX CONVEYING	ESS14	760130.30	4369306.30	153	17	WV	Berkeley	5.98	23.16	293.15	22.89	0.41	---	---	5.30E-01	2.03	2.39E-02	2.07E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	PREMIX STORAGE FEEDING	ESS15	760130.30	4369306.30	153	17	WV	Berkeley	5.98	7.01	293.15	4.79	0.52	---	---	1.80E-01	6.80E-01	7.56E-03	6.90E-03	---	No	No
ESSROC CEMENT - MARTINSBURG	PREMIX STORAGE DISCHARGE	ESS16	760130.30	4369306.30	153	17	WV	Berkeley	5.98	7.01	293.15	4.79	0.52	---	---	1.80E-01	6.80E-01	7.56E-03	6.90E-03	---	No	No
ESSROC CEMENT - MARTINSBURG	ADDITIVE DELIVERY SYSTEM	ESS17	760130.30	4369306.30	153	17	WV	Berkeley	5.98	14.33	293.15	11.89	1.22	---	---	2.45	9.39	1.08E-01	9.52E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	ADDITIVE FEEDING SYSTEM	ESS18	760130.30	4369306.30	153	17	WV	Berkeley	5.98	49.68	293.15	5.49	0.90	---	---	6.20E-01	2.37	2.77E-02	2.42E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	LIMESTONE BIN	ESS19	760130.30	4369306.30	153	17	WV	Berkeley	5.98	36.58	293.15	4.79	0.52	---	---	1.80E-01	6.80E-01	7.56E-03	6.90E-03	---	No	No
ESSROC CEMENT - MARTINSBURG	RAW MATERIAL BINS	ESS20	760130.30	4369306.30	153	17	WV	Berkeley	5.98	36.27	293.15	4.72	0.73	---	---	3.50E-01	1.35	1.51E-02	1.38E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	SHALE BIN 2	ESS21	760130.30	4369306.30	153	17	WV	Berkeley	5.98	44.81	293.15	4.48	0.65	---	---	2.60E-01	1.01	1.13E-02	1.04E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	RAW MILL FEED BELT	ESS22	760130.30	4369306.30	153	17	WV	Berkeley	5.98	7.92	293.15	1.83	0.83	---	---	1.80E-01	6.80E-01	7.56E-03	6.90E-03	---	No	No
ESSROC CEMENT - MARTINSBURG	RAW MILL HIGH ZONE	ESS23	760130.30	4369306.30	153	17	WV	Berkeley	5.98	15.54	293.15	19.02	0.53	---	---	6.60E-01	2.54	2.90E-02	2.56E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	RAW MILL LOW ZONE	ESS24	760130.30	4369306.30	153	17	WV	Berkeley	5.98	39.32	293.15	21.31	0.46	---	---	6.20E-01	2.37	2.77E-02	2.42E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	RAW MEAL AIR SLIDE	ESS25	760130.30	4369306.30	153	17	WV	Berkeley	5.98	13.72	363.15	9.05	0.63	---	---	5.30E-01	2.03	2.39E-02	2.07E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	HOMO SILO FEEDING	ESS26	760130.30	4369306.30	153	17	WV	Berkeley	5.98	92.96	363.15	15.21	0.51	---	---	4.40E-01	1.69	2.02E-02	1.73E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	HOMO SILO DISCHARGE	ESS27	760130.30	4369306.30	153	17	WV	Berkeley	5.98	18.59	363.15	15.09	0.46	---	---	3.50E-01	1.35	1.51E-02	1.38E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	TOP OF HOMO SILO	ESS28	760130.30	4369306.30	153	17	WV	Berkeley	5.98	78.94	363.15	20.57	0.28	---	---	1.90E-01	8.34E-01	2.40E-02	2.40E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	KILN FEEDING ELEVATOR	ESS29	760130.30	4369306.30	153	17	WV	Berkeley	5.98	115.21	363.15	21.03	0.43	---	---	4.40E-01	1.69	2.02E-02	1.73E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	KILN FEED BELT 1	ESS30	760130.30	4369306.30	153	17	WV	Berkeley	5.98	115.21	363.15	36.52	0.51	---	---	1.06	4.06	4.66E-02	4.11E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	KILN FEED BELT 2	ESS31	760130.30	4369306.30	153	17	WV	Berkeley	5.98	114.91	363.15	16.98	0.30	---	---	1.80E-01	6.80E-01	7.56E-03	6.90E-03	---	No	No
ESSROC CEMENT - MARTINSBURG	CEMENT FRINGE BIN	ESS32	760130.30	4369306.30	153	17	WV	Berkeley	5.98	33.53	352.04	10.97	0.71	---	---	7.40E-01	2.85	3.28E-02	2.91E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	LIME STORAGE	ESS33	760130.30	4369306.30	153	17	WV	Berkeley	5.98	33.22	293.15	25.88	0.15	---	---	1.22	4.70	5.42E-02	4.78E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	BIG CLINKER SILO FEEDING	ESS34	760130.30	4369306.30	153	17	WV	Berkeley	5.98	22.86	403.15	29.08	0.45	---	---	4.40E-01	1.69	2.02E-02	1.73E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	BIG CLINKER SILO	ESS35	760130.30	4369306.30	153	17	WV	Berkeley	5.98	39.32	403.15	27.31	0.28	---	---	2.28E-01	9.97E-01	2.87E-02	2.87E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	SMALL CLINKER SILO FEED	ESS36	760130.30	4369306.30	153	17	WV	Berkeley	5.98	54.56	403.15	13.62	0.44	---	---	2.60E-01	1.01	1.13E-02	1.04E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	SMALL CLINKER SILO DISCH	ESS37	760130.30	4369306.30	153	17	WV	Berkeley	5.98	54.56	293.15	16.92	0.27	---	---	2.00E-02	7.00E-02	1.26E-03	5.75E-04	---	No	No
ESSROC CEMENT - MARTINSBURG	BIG CLINKER SILO DISCHARE	ESS38	760130.30	4369306.30	153	17	WV	Berkeley	5.98	22.86	293.15	17.31	0.27	---	---	2.00E-02	7.00E-02	1.26E-03	5.75E-04	---	No	No
ESSROC CEMENT - MARTINSBURG	UB1 TO FM FEED HOPPERS	ESS39	760130.30	4369306.30	153	17	WV	Berkeley	5.98	3.05	293.15	17.31	0.27	---	---	2.00E-02	7.00E-02	1.26E-03	5.75E-04	---	No	No
ESSROC CEMENT - MARTINSBURG	LB1 TO FM FEED HOPPERS	ESS40	760130.30	4369306.30	153	17	WV	Berkeley	5.98	3.05	293.15	17.31	0.27	---	---	2.00E-02	7.00E-02	1.26E-03	5.75E-04	---	No	No
ESSROC CEMENT - MARTINSBURG	UB2 TO FM FEED HOPPERS	ESS41	760130.30	4369306.30	153	17	WV	Berkeley	5.98	3.05	293.15	17.31	0.27	---	---	2.00E-02	7.00E-02	1.26E-03	5.75E-04	---	No	No
ESSROC CEMENT - MARTINSBURG	FINISH MILL 1 & 2 HOPPERS	ESS42	760130.30	4369306.30	153	17	WV	Berkeley	5.98	38.71	293.15	11.19	0.53	---	---	4.40E-01	1.69	2.02E-02	1.73E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	FINISH MILL 3 HOPPER	ESS43	760130.30	4369306.30	153	17	WV	Berkeley	5.98	30.18	293.15	10.24	0.56	---	---	4.40E-01	1.69	2.02E-02	1.73E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	NORMAL CLINKER BIN	ESS44	760130.30	4369306.30	153	17	WV	Berkeley	5.98	17.68	383.15	27.31	0.28	---	---	8.15E-01	3.57	1.03E-01	1.03E-01	---	No	Yes
ESSROC CEMENT - MARTINSBURG	LA CLINKER BIN TO FM2 BT	ESS45	760130.30	4369306.30	153	17	WV	Berkeley	5.98	20.73	293.15	10.18	0.43	---	---	2.60E-01	1.01	1.13E-02	1.04E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	CLINKER BIN TO FM1 BELT	ESS46	760130.30	4369306.30	153	17	WV	Berkeley	5.98	20.73	293.15	10.18	0.43	---	---	2.60E-01	1.01	1.13E-02	1.04E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	CLINKER BIN TO FM2 BELT	ESS47	760130.30	4369306.30	153	17	WV	Berkeley	5.98	4.57	293.15	2.99	0.65	---	---	1.80E-01	6.80E-01	7.56E-03	6.90E-03	---	No	No
ESSROC CEMENT - MARTINSBURG	FINISH MILL 2 FEEDING	ESS48	760130.30	4369306.30	153	17	WV	Berkeley	5.98	9.14	293.15	10.18	0.43	---	---	2.60E-01	1.01	1.13E-02	1.04E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	FINISH MILL 1 FEEDING	ESS49	760130.30	4369306.30	153	17	WV	Berkeley	5.98	8.84	293.15	10.18	0.43	---	---	2.60E-01	1.01	1.13E-02	1.04E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	FM1 CONVEYOR	ESS50	760130.30	4369306.30	153	17	WV	Berkeley	5.98	37.19	293.15	4.48	0.65	---	---	2.60E-01	1.01	1.13E-02	1.04E-02	---	No	No

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Table D-1. Regional Source Inventory

Facility Name	Emission Unit Description	Model Emission Unit ID	UTM Easting (m)	UTM Northing (m)	Elevation (m)	UTM Zone	State	County	Distance from Knauf (km)	Stack Height (m)	Stack Temperature (K)	Exit Velocity (m/s)	Stack Diameter (m)	NO_2 Emission Rate (g/s)		PM_{10} Emission Rate (g/s)		$PM_{2.5}$ Emission Rate (g/s)		Increment Consuming?		
														Short Term	Long Term	Short Term	Long Term	Short Term	Long Term	NO_2	PM_{10}	$PM_{2.5}$
ESSROC CEMENT - MARTINSBURG	FINISH MILL 1 HIGH ZONE	ESS51	760130.30	4369306.30	153	17	WV	Berkeley	5.98	38.71	293.15	5.49	0.90	---	---	6.20E-01	2.37	2.77E-02	2.42E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	FINISH MILL 1 LOW ZONE	ESS52	760130.30	4369306.30	153	17	WV	Berkeley	5.98	12.19	373.15	5.94	0.74	---	---	3.50E-01	1.35	1.51E-02	1.38E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	FINISH MILL 1	ESS53	760130.30	4369306.30	153	17	WV	Berkeley	5.98	47.24	368.15	18.81	1.75	---	---	6.36	24.42	2.82E-01	2.48E-01	---	No	No
ESSROC CEMENT - MARTINSBURG	FINISH MILL 1 DISCHARGE	ESS54	760130.30	4369306.30	153	17	WV	Berkeley	5.98	21.95	403.15	4.45	0.63	---	---	1.80E-01	6.80E-01	7.56E-03	6.90E-03	---	No	No
ESSROC CEMENT - MARTINSBURG	FM2 CONVEYOR	ESS55	760130.30	4369306.30	153	17	WV	Berkeley	5.98	37.49	293.15	4.48	0.65	---	---	2.60E-01	1.01	1.13E-02	1.04E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	FINISH MILL 2 HIGH ZONE	ESS56	760130.30	4369306.30	153	17	WV	Berkeley	5.98	39.01	293.15	5.49	0.90	---	---	6.20E-01	2.37	2.77E-02	2.42E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	FINISH MILL 2 LOW ZONE	ESS57	760130.30	4369306.30	153	17	WV	Berkeley	5.98	12.19	373.15	5.94	0.74	---	---	3.50E-01	1.35	1.51E-02	1.38E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	FINISH MILL 2	ESS58	760130.30	4369306.30	153	17	WV	Berkeley	5.98	47.55	368.15	18.81	1.75	---	---	6.36	24.42	2.82E-01	2.48E-01	---	No	No
ESSROC CEMENT - MARTINSBURG	FINISH MILL 2 DISCHARGE	ESS59	760130.30	4369306.30	153	17	WV	Berkeley	5.98	22.25	403.15	4.45	0.63	---	---	1.80E-01	6.80E-01	7.56E-03	6.90E-03	---	No	No
ESSROC CEMENT - MARTINSBURG	FINISH MILL 1 AIRSLIDES	ESS60	760130.30	4369306.30	153	17	WV	Berkeley	5.98	7.62	373.15	20.03	0.40	---	---	3.50E-01	1.35	1.51E-02	1.38E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	FINISH MILL 2 AIRSLIDES	ESS61	760130.30	4369306.30	153	17	WV	Berkeley	5.98	7.62	373.15	20.03	0.40	---	---	3.50E-01	1.35	1.51E-02	1.38E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	FM 1 TO CEMENT SILOS	ESS62	760130.30	4369306.30	153	17	WV	Berkeley	5.98	65.23	373.15	15.73	0.39	---	---	2.60E-01	1.01	1.13E-02	1.04E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	FM 2 TO CEMENT SILOS	ESS63	760130.30	4369306.30	153	17	WV	Berkeley	5.98	64.92	373.15	15.73	0.39	---	---	2.60E-01	1.01	1.13E-02	1.04E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	CEMENT SILO A1 & A2	ESS64	760130.30	4369306.30	153	17	WV	Berkeley	5.98	64.92	373.15	16.70	0.48	---	---	4.20E-01	1.62	1.89E-02	1.64E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	CEMENT SILO B1 & B2	ESS65	760130.30	4369306.30	153	17	WV	Berkeley	5.98	64.92	373.15	16.70	0.48	---	---	4.20E-01	1.62	1.89E-02	1.64E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	CEMENT SILO C1 & C2	ESS66	760130.30	4369306.30	153	17	WV	Berkeley	5.98	64.92	373.15	17.47	0.48	---	---	4.40E-01	1.69	2.02E-02	1.73E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	BULK LANE LOADOUT 1	ESS67	760130.30	4369306.30	153	17	WV	Berkeley	5.98	13.11	373.15	26.15	0.30	---	---	2.30E-01	9.00E-01	1.01E-02	9.21E-03	---	No	No
ESSROC CEMENT - MARTINSBURG	BULK LANE LOADOUT 2	ESS68	760130.30	4369306.30	153	17	WV	Berkeley	5.98	13.41	373.15	29.35	0.27	---	---	2.30E-01	9.00E-01	1.01E-02	9.21E-03	---	No	No
ESSROC CEMENT - MARTINSBURG	BULK LANE LOADOUT 3	ESS69	760130.30	4369306.30	153	17	WV	Berkeley	5.98	13.72	373.15	25.79	0.29	---	---	2.30E-01	9.00E-01	1.01E-02	9.21E-03	---	No	No
ESSROC CEMENT - MARTINSBURG	BULK LANE LOADOUT 4	ESS70	760130.30	4369306.30	153	17	WV	Berkeley	5.98	14.02	373.15	26.15	0.30	---	---	2.30E-01	9.00E-01	1.01E-02	9.21E-03	---	No	No
ESSROC CEMENT - MARTINSBURG	CEMENT ANALYZER	ESS71	760130.30	4369306.30	153	17	WV	Berkeley	5.98	9.75	293.15	11.25	0.28	---	---	1.20E-01	4.70E-01	5.04E-03	4.89E-03	---	No	No
ESSROC CEMENT - MARTINSBURG	AIRSLIDE AT MULTICELL SIL	ESS72	760130.30	4369306.30	153	17	WV	Berkeley	5.98	16.46	373.15	40.66	0.21	---	---	2.08E-01	9.09E-01	2.62E-02	2.62E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	MIDDLE BANK SILOS 1	ESS73	760130.30	4369306.30	153	17	WV	Berkeley	5.98	33.22	366.48	14.97	0.48	---	---	5.00E-01	1.92	2.27E-02	1.96E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	MIDDLE BANK SILOS 2	ESS74	760130.30	4369306.30	153	17	WV	Berkeley	5.98	33.22	366.48	14.97	0.48	---	---	5.00E-01	1.92	2.27E-02	1.96E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	MIDDLE BANK SILOS 3	ESS75	760130.30	4369306.30	153	17	WV	Berkeley	5.98	33.22	366.48	14.97	0.48	---	---	5.00E-01	1.92	2.27E-02	1.96E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	MIDDLE BANK SILOS 4	ESS76	760130.30	4369306.30	153	17	WV	Berkeley	5.98	32.61	366.48	14.97	0.48	---	---	5.00E-01	1.92	2.27E-02	1.96E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	MIDDLE BANK SILOS 5	ESS77	760130.30	4369306.30	153	17	WV	Berkeley	5.98	32.92	366.48	14.97	0.48	---	---	5.00E-01	1.92	2.27E-02	1.96E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	MIDDLE BANK BIN VENT 1	ESS78	760130.30	4369306.30	153	17	WV	Berkeley	5.98	3.66	355.37	18.38	0.25	---	---	8.00E-02	3.20E-01	3.78E-03	3.16E-03	---	No	No
ESSROC CEMENT - MARTINSBURG	MIDDLE BANK BIN VENT 2	ESS79	760130.30	4369306.30	153	17	WV	Berkeley	5.98	3.66	355.37	18.38	0.25	---	---	8.00E-02	3.20E-01	3.78E-03	3.16E-03	---	No	No
ESSROC CEMENT - MARTINSBURG	MIDDLE BANK BIN VENT 3	ESS80	760130.30	4369306.30	153	17	WV	Berkeley	5.98	3.66	355.37	22.77	0.25	---	---	8.00E-02	3.20E-01	3.78E-03	3.16E-03	---	No	No
ESSROC CEMENT - MARTINSBURG	MIDDLE BANK BIN VENT 4	ESS81	760130.30	4369306.30	153	17	WV	Berkeley	5.98	3.96	355.37	22.77	0.25	---	---	8.00E-02	3.20E-01	3.78E-03	3.16E-03	---	No	No
ESSROC CEMENT - MARTINSBURG	BULK RAIL LOADOUT 1	ESS82	760130.30	4369306.30	153	17	WV	Berkeley	5.98	15.54	408.15	28.62	0.28	---	---	1.00E-01	3.80E-01	3.78E-03	3.74E-03	---	No	No
ESSROC CEMENT - MARTINSBURG	BULK RAIL LOADOUT 2	ESS83	760130.30	4369306.30	153	17	WV	Berkeley	5.98	15.54	408.15	28.62	0.28	---	---	1.00E-01	3.80E-01	3.78E-03	3.74E-03	---	No	No
ESSROC CEMENT - MARTINSBURG	TRUCK LOADOUT SILO 1	ESS84	760130.30	4369306.30	153	17	WV	Berkeley	5.98	24.38	322.04	20.63	0.33	---	---	2.00E-01	7.50E-01	8.82E-03	7.77E-03	---	No	Yes
ESSROC CEMENT - MARTINSBURG	TRUCK LOADOUT SILO 2	ESS85	760130.30	4369306.30	153	17	WV	Berkeley	5.98	24.38	322.04	9.30	0.72	---	---	2.00E-01	7.50E-01	8.82E-03	7.77E-03	---	No	Yes
ESSROC CEMENT - MARTINSBURG	TRUCK LOADOUT SILO 3	ESS86	760130.30	4369306.30	153	17	WV	Berkeley	5.98	24.38	322.04	15.54	0.33	---	---	2.00E-01	7.50E-01	8.82E-03	7.77E-03	---	No	Yes
ESSROC CEMENT - MARTINSBURG	TRUCK LOADOUT SILO 4	ESS87	760130.30	4369306.30	153	17	WV	Berkeley	5.98	24.38	322.04	15.54	0.33	---	---	2.00E-01	7.50E-01	8.82E-03	7.77E-03	---	No	Yes
ESSROC CEMENT - MARTINSBURG	TRUCK LOADOUT SILO 5	ESS88	760130.30	4369306.30	153	17	WV	Berkeley	5.98	24.38	353.71	16.03	0.33	---	---	2.00E-01	7.50E-01	8.82E-03	7.77E-03	---	No	Yes
ESSROC CEMENT - MARTINSBURG	BULK LOADOUT 5 - TRUCK	ESS89	760130.30	4369306.30	153	17	WV	Berkeley	5.98	12.19	310.93	14.20	0.28	---	---	1.70E-01	6.40E-01	7.56E-03	6.62E-03	---	No	Yes
ESSROC CEMENT - MARTINSBURG	BULK LOADOUT 6 - TRUCK	ESS90	760130.30	4369306.30	153	17	WV	Berkeley	5.98	12.19	310.93	14.20	0.28	---	---	1.70E-01	6.40E-01	7.56E-03	6.62E-03	---	No	Yes
ESSROC CEMENT - MARTINSBURG	EAST BANK SILOS 1	ESS91	760130.30	4369306.30	153	17	WV	Berkeley	5.98	33.53	366.48	18.75	0.39	---	---	4.00E-01	1.53	1.76E-02	1.55E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	EAST BANK SILOS 2	ESS92	760130.30	4369306.30	153	17	WV	Berkeley	5.98	33.53	366.48	18.75	0.39	---	---	4.00E-01	1.53	1.76E-02	1.55E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	EAST BANK SILOS 3	ESS93	760130.30	4369306.30	153	17	WV	Berkeley	5.98	33.22	366.48	18.75	0.39	---	---	4.00E-01	1.53	1.76E-02	1.55E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	PACKHOUSE	ESS94	760130.30	4369306.30	153	17	WV	Berkeley	5.98	13.41	294.26	18.53	0.66	---	---	1.17	4.51	5.17E-02	4.57E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	WEST BANK SILO #71	ESS95	760130.30	4369306.30	153	17	WV	Berkeley	5.98	33.83	293.15	6.46	0.30	---	---	6.31E-01	2.76	7.95E-02	7.95E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	WEST BANK SILO #72	ESS96	760130.30	4369306.30	153	17	WV	Berkeley	5.98	33.83	293.15	6.46	0.30	---	---	6.31E-01	2.76	7.95E-02	7.95E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	WEST BANK SILO #82	ESS97	760130.30	4369306.30	153	17	WV	Berkeley	5.98	33.83	293.15	6.46	0.30	---	---	6.31E-01	2.76	7.95E-02	7.95E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	WEST BANK SILO #83	ESS98	760130.30	4369306.30	153	17	WV	Berkeley	5.98	33.83	293.15	6.46	0.30	---	---	2.75E-01	1.20	3.46E-02	3.46E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	DRY FLYASH BIN	ESS99	760130.30	4369306.30	153	17	WV	Berkeley	5.98	23.77	293.15	20.57	0.28	---	---	6.20E-01	2.39	2.77E-02	2.42E-02	---	No	No
ESSROC CEMENT - MARTINSBURG	FM REJECT BIN	ESS100	760130.30	4369306.30	153	17	WV	Berkeley	5.98	6.71	373.15	12.92	0.15	---	---	2.52E-02	1.10E-01	3.18E-03	3.18E-03	---	No	Yes
QG PRINTING II CORP.	PRESS 3 STACK	QGP1	766610.60	4367417.80	149	17	WV	Berkeley	10.54	12.19	433.71	6.10	0.46	5.80E-02	5.78E-02	2.00E-02	1.00E-01	2.52E-03	2.88E-03	No	No	No
QG PRINTING II CORP.	PRESS 4 STACK	QGP2	766610.60	4367417.80	149	17	WV	Berkeley	10.54	12.19	433.71	6.10	0.46	7.69E-02	7.71E-02	3.00E-02	1.30E-01	3.78E-03	3.74E-03	No	No	No
QG PRINTING II CORP.	Press 5 Stack	QGP3	766610.60	4367417.80	149	17	WV	Berkeley	10.54	12.19	433.71	6.10	0.46	7.69E-02	7.71E-02	3.00E-02	1.30E-01	3.78E-03	3.74E-03	No	No	No
QG PRINTING II CORP.	PRESS 6 STACK	QGP4	766610.60	4367417.80	149	17	WV	Berkeley	10.54	12.19	433.71	6.10	0.46	3.65E-02	3.65E-02	2.00E-02	9.00E-02	2.52E-03	2.59E-03	No	No	No
QG PRINTING II CORP.	PRESS 7 STACK	QGP5	766610.60	4367417.80	149.00	17	WV	Berkeley	10.54	12.19	433.71	6.10	0.46	2.27E-02	2.30E-02	1.00E-02	4.00E-02	1.26E-03	1.15E-03	Yes	Yes	No
LCS Services, Inc. - NORTH MOUNTAIN SANITARY LANDFILL	Flare Stack	LCS1	758388.00	4384717.70	203.61	17	WV	Berkeley	19.95	9.14	1273.00	20.00	0.30	2.05E-01	2.06E-01	6.90E-01	3.04	8.69E-02	8.75E-02	Yes	Yes	No
QUAD/GRAPHICS, INC	BOILER STACK S-1	QGI17	762516.60	4377389.50	148.00	17	WV	Berkeley	13.18	21.34	435.93	2.53	0.91	1.38	2.44E-01	4.70E-01	2.08	5.92E-02	5.98E-02	Yes	Yes	No
QUAD/GRAPHICS, INC	BOILER STACK S-2	QGI18	762516.60	4377389.50	148.00	17	WV	Berkeley	13.18	21.34	435.93	2.53	0.91	1.38	2.44E-01	4.70E-01	2.08	5.92E-02	5.98E-02	Yes	Yes	No
QUAD/GRAPHICS, INC	BOILER STACK S-3	QGI13	762612.40	4377309.50	148.00	17	WV	Berkeley	13.18	21.34	479.40	0.01	1.04	1.44	2.86E-01	5.40E-01	2.38	6.80E-02	6.85E-02	Yes	Yes	No

Table D-1. Regional Source Inventory

Facility Name	Emission Unit Description	Model Emission Unit ID	UTM Easting (m)	UTM Northing (m)	Elevation (m)	UTM Zone	State	County	Distance from Knauf (km)	Stack Height (m)	Stack Temperature (K)	Exit Velocity (m/s)	Stack Diameter (m)	NO_2 Emission Rate (g/s)		PM_{10} Emission Rate (g/s)		$PM_{2.5}$ Emission Rate (g/s)		Increment Consuming?		
														Short Term	Long Term	Short Term	Long Term	Short Term	Long Term	NO_2	PM_{10}	$PM_{2.5}$
QUAD/GRAPHICS, INC	BOILER STACK S-4	QGI14	762602.70	4377321.90	148.00	17	WV	Berkeley	13.18	21.34	449.80	0.01	0.76	1.24	3.27E-01	7.00E-02	2.90E-01	8.82E-03	8.34E-03	Yes	Yes	No
QUAD/GRAPHICS, INC	BOILER STACK S-5	QGI15	762599.60	4377325.70	148.00	17	WV	Berkeley	13.18	21.34	449.80	0.01	0.76	1.24	3.27E-01	7.00E-02	2.90E-01	8.82E-03	8.34E-03	No	No	No
QUAD/GRAPHICS, INC	BOILER STACK S-9	QGI16	762596.70	4377329.50	148.00	17	WV	Berkeley	13.18	21.34	449.80	0.01	0.76	1.24	3.27E-01	7.00E-02	2.90E-01	8.82E-03	8.34E-03	No	No	No
QUAD/GRAPHICS, INC	S-28 OP-01	QGI1	762384.80	4377359.90	148.00	17	WV	Berkeley	13.18	12.19	663.90	14.40	0.83	4.23E-01	1.35E-01	7.65E-02	3.35E-01	9.64E-03	9.64E-03	No	No	No
QUAD/GRAPHICS, INC	S-29 OP-02	QGI2	762375.20	4377372.30	148.00	17	WV	Berkeley	13.18	12.19	422.00	12.70	0.76	4.23E-01	1.35E-01	7.65E-02	3.35E-01	9.64E-03	9.64E-03	No	No	No
QUAD/GRAPHICS, INC	M-83 STACK S-30	QGI3	762365.60	4377384.70	148.00	17	WV	Berkeley	13.18	12.19	422.00	12.70	0.76	2.76E-01	8.05E-02	4.53E-02	1.98E-01	5.70E-03	5.70E-03	Yes	Yes	No
QUAD/GRAPHICS, INC	MR-4 STACK S-31	QGI4	762356.10	4377397.70	148.00	17	WV	Berkeley	13.18	12.19	422.00	12.70	0.76	3.70E-01	1.16E-01	6.53E-02	2.86E-01	8.23E-03	8.23E-03	Yes	Yes	No
QUAD/GRAPHICS, INC	MR-5 STACK S-32	QGI5	762346.50	4377410.10	148.00	17	WV	Berkeley	13.18	12.19	422.00	12.70	0.76	3.70E-01	1.16E-01	6.53E-02	2.86E-01	8.23E-03	8.23E-03	Yes	Yes	No
QUAD/GRAPHICS, INC	S-33 OP-06	QGI6	762336.90	4377422.50	148.00	17	WV	Berkeley	13.18	12.19	422.00	12.70	0.76	3.70E-01	1.16E-01	6.53E-02	2.86E-01	8.23E-03	8.23E-03	No	No	No
QUAD/GRAPHICS, INC	S-34 OP-07	QGI7	762322.60	4377440.50	148.00	17	WV	Berkeley	13.18	12.19	422.00	12.70	0.76	3.70E-01	1.16E-01	6.53E-02	2.86E-01	8.23E-03	8.23E-03	No	No	No
QUAD/GRAPHICS, INC	S-35 OP-08	QGI8	762313.00	4377452.90	148.00	17	WV	Berkeley	13.18	12.19	422.00	12.70	0.76	3.70E-01	1.16E-01	6.53E-02	2.86E-01	8.23E-03	8.23E-03	No	No	No
QUAD/GRAPHICS, INC	S-36 OP-09	QGI9	762303.50	4377465.30	148.00	17	WV	Berkeley	13.18	12.19	422.00	12.70	0.76	4.23E-01	1.35E-01	7.65E-02	3.35E-01	9.64E-03	9.64E-03	No	No	No
QUAD/GRAPHICS, INC	S-37 OP-10	QGI10	762293.90	4377477.70	148.00	17	WV	Berkeley	13.18	12.19	422.00	12.70	0.76	4.23E-01	1.35E-01	7.65E-02	3.35E-01	9.64E-03	9.64E-03	No	No	No
QUAD/GRAPHICS, INC	S-38 OP-11	QGI11	762283.50	4377490.00	148.00	17	WV	Berkeley	13.18	12.19	422.00	12.70	0.76	4.23E-01	1.35E-01	7.65E-02	3.35E-01	9.64E-03	9.64E-03	No	No	No
QUAD/GRAPHICS, INC	S-39 OP-12	QGI12	762274.70	4377502.50	148.00	17	WV	Berkeley	13.18	12.19	422.00	12.70	0.76	4.23E-01	1.35E-01	7.65E-02	3.35E-01	9.64E-03	9.64E-03	No	No	No
IRS MARTINSBURG CENTER CAMPUS	ENG-1 through ENG-10	IRS1	765593.40	4365610.00	146	17	WV	Berkeley	9.28	3.05	422.04	26.52	0.30	NA [1]	1.98	13.40	2.00	1.69	5.75E-02	No	No	No
IRS MARTINSBURG CENTER CAMPUS	Emergency Generators E41-001A through 0005A	IRS2	765593.40	4365610.00	146	17	WV	Berkeley	9.28	3.05	422.04	23.93	0.30	NA [1]	1.65	6.70	1.70	8.44E-01	4.89E-02	No	No	No
IRS MARTINSBURG CENTER CAMPUS	B2-001A and B2-002A	IRS3	765593.40	4365610.00	146	17	WV	Berkeley	9.28	13.56	477.59	3.33	0.41	7.06E-02	7.02E-02	5.32E-02	2.33E-01	4.52E-03	4.52E-03	No	No	No
IRS MARTINSBURG CENTER CAMPUS	B-1.1, B-1.2, B-1.3, B-1.4	IRS4	765593.40	4365610.00	146.00	17	WV	Berkeley	9.28	13.56	477.59	3.33	0.41	3.58E-01	3.58E-01	3.29E-01	1.44	2.79E-02	2.79E-02	Yes	Yes	No
OX PAPERBOARD, LLC - HALLTOWN MILL	STACK FOR COAL BOILER	OX1	776001.80	4356454.80	125	17	WV	Jefferson	21.37	27.43	438.71	16.18	1.22	6.00	4.77	17.80	77.96	2.24	2.24	No	No	No
OX PAPERBOARD, LLC - HALLTOWN MILL	PAPERBOARD MILL	OX2	776001.80	4356454.80	125	17	WV	Jefferson	21.37	27.43	438.71	0.00	1.22	---	---	14.00	61.32	1.76	1.76	---	No	No
MAAX U.S. CORP	RTO STACK	MUC1	762469.00	4376320.20	145	17	WV	Berkeley	12.04	18.29	324.82	11.64	3.05	3.11E-01	3.11E-01	1.50E-01	6.60E-01	1.89E-02	1.90E-02	No	No	No
MAAX U.S. CORP	DUST COLLECTOR	MUC2	762333.60	4376352.70	145	17	WV	Berkeley	12.04	13.72	299.82	38.80	0.15	---	---	1.00E-02	6.00E-02	1.26E-03	1.73E-03	---	No	No
PROCTOR AND GAMBLE	Scrubber Stacks	PG01	757965.10	4367312.60	175.85	17	WV	Berkeley	2.41	22.86	338.71	20.00	0.91	1.34E-01	1.33E-01	1.74	6.81E-01	1.74	6.81E-01	Yes	Yes	No
PROCTOR AND GAMBLE	Rotoclones 3C - 6C	PG02	757965.10	4367312.60	175.85	17	WV	Berkeley	2.41	22.86	293.15	20.00	0.46	---	---	3.21E-01	3.25E-01	3.21E-01	3.25E-01	---	Yes	No
PROCTOR AND GAMBLE	Rotoclones 7C - 8C	PG03	757965.10	4367312.60	175.85	17	WV	Berkeley	2.41	22.86	293.15	20.00	0.46	---	---	4.28E-02	4.37E-02	4.28E-02	4.37E-02	---	Yes	No
PROCTOR AND GAMBLE	Rotoclones 9C - 12C	PG04	757965.10	4367312.60	175.85	17	WV	Berkeley	2.41	22.86	293.15	20.00	0.46	---	---	1.81E-01	1.78E-01	1.81E-01	1.78E-01	---	Yes	No
PROCTOR AND GAMBLE	Rotoclone 13C	PG05	757919.60	4367247.30	175.85	17	WV	Berkeley	2.33	22.86	293.15	20.00	0.46	---	---	3.02E-02	3.02E-02	3.02E-02	3.02E-02	---	Yes	No
PROCTOR AND GAMBLE	14C RTO	PG06	757941.30	4367280.30	175.85	17	WV	Berkeley	2.37	22.86	1088.71	20.00	0.61	3.02E-02	3.16E-02	2.52E-03	2.01E-03	2.52E-03	2.01E-03	Yes	Yes	No
PROCTOR AND GAMBLE	Rotoclone 15C	PG07	757919.60	4367247.30	175.85	17	WV	Berkeley	2.33	22.86	293.15	20.00	0.61	---	---	8.82E-03	8.63E-03	8.82E-03	8.63E-03	---	Yes	No
PROCTOR AND GAMBLE	Rotoclone 16C	PG08	757919.60	4367247.30	175.85	17	WV	Berkeley	2.33	22.86	293.15	20.00	0.61	---	---	6.30E-03	6.04E-03	6.30E-03	6.04E-03	---	Yes	No
PROCTOR AND GAMBLE	Rotoclone 17C	PG09	757919.60	4367247.30	175.85	17	WV	Berkeley	2.33	22.86	293.15	20.00	0.61	---	---	6.30E-03	5.75E-03	6.30E-03	5.75E-03	---	Yes	No
PROCTOR AND GAMBLE	Rotoclones 18C - 19C	PG10	757919.60	4367247.30	175.85	17	WV	Berkeley	2.33	22.86	293.15	20.00	0.91	---	---	3.88E-01	3.91E-01	3.88E-01	3.91E-01	---	Yes	No
PROCTOR AND GAMBLE	Rotoclone 20C	PG11	757919.60	4367247.30	175.85	17	WV	Berkeley	2.33	22.86	293.15	20.00	0.61	---	---	7.06E-02	6.90E-02	7.06E-02	6.90E-02	---	Yes	No
PROCTOR AND GAMBLE	Boiler 1	PG12	757880.80	4367207.80	175.85	17	WV	Berkeley	2.28	30.48	422.04	20.00	0.61	5.67E-01	5.70E-01	5.92E-02	5.75E-02	5.92E-02	5.75E-02	Yes	Yes	No
PROCTOR AND GAMBLE	Boiler 2	PG13	757880.80	4367207.80	175.85	17	WV	Berkeley	2.28	30.48	422.04	20.00	0.61	5.67E-01	5.70E-01	5.92E-02	5.75E-02	5.92E-02	5.75E-02	Yes	Yes	No
PROCTOR AND GAMBLE	Boiler 3	PG14	757880.80	4367207.80	175.85	17	WV	Berkeley	2.28	30.48	422.04	20.00	0.61	2.90E-01	2.85E-01	2.90E-02	2.88E-02	2.90E-02	2.88E-02	Yes	Yes	No
PROCTOR AND GAMBLE	Main Cooling Towers	PG15	757838.60	4367154.30	175.85	17	WV	Berkeley	2.21	12.19	293.15	20.00	0.91	---	---	1.70E-01	1.70E-01	1.70E-01	1.70E-01	---	Yes	No
PROCTOR AND GAMBLE	Fire Pump Engines	PG16	757809.90	4367109.40	175.85	17	WV	Berkeley	2.16	6.10	533.15	20.00	0.30	NA [1]	2.59E-02	1.76E-02	9.72E-04	1.76E-02	9.72E-04	Yes	Yes	No
PROCTOR AND GAMBLE	Backup/Standby Power Generators	PG17	757809.90	4367109.40	175.85	17	WV	Berkeley	2.16	6.10	766.04	20.00	0.30	NA [1]	7.51E-02	1.89E-02	1.04E-03	1.89E-02	1.04E-03	Yes	Yes	No
PROCTOR AND GAMBLE	Heaters	PG18	757809.90	4367109.40	175.85	17	WV	Berkeley	2.16	6.10	310.93	20.00	0.30	1.13E-01	1.12E-01	1.76E-02	1.73E-02	1.76E-02	1.73E-02	Yes	Yes	No
PROCTOR AND GAMBLE	Plastics Area Heat/Engine	PG19	757965.10	4367312.60	175.85	17	WV	Berkeley	2.41	6.10	533.15	20.00	0.30	2.39E-02	1.08E-01	1.76E-02	1.64E-02	1.76E-02	1.64E-02	Yes	Yes	No
PROCTOR AND GAMBLE	Plastics Modeling Area	PG20	757965.10	4367312.60	175.85	17	WV	Berkeley	2.41	22.86	293.15	20.00	0.46	---	---	2.07E-01	1.67E-01	2.07E-01	1.67E-01	---	Yes	No

Notes:
1. Emission units with intermittent or emergency use only were not included in the model for the 1-hour NO_2 standard.

Table D-2. Sources Excluded from Regional Source Inventory

Facility Name	Emission Unit Description	UTM Easting (m)	UTM Northing (m)	UTM Zone	County	State	Distance from Knauf (km)	Reason for Exclusion
QG PRINTING II CORP.	Pseudo Stack - Fugitives	766,610.6	4,367,417.8	17	Berkeley	WV	10.47	Miscellaenous, distant fugitive emission source
OX PAPERBOARD, LLC - HALLTOWN MILL	Plantwide Fugitives	776,001.8	4,356,454.8	17	Jefferson	WV	21.70	Miscellaenous, distant fugitive emission source
LCS Services, Inc. - NORTH MOUNTAIN SANITARY LANDFILL	Sitewide Fugitives	758,470.0	4,384,521.0	17	Berkeley	WV	19.08	Miscellaenous, distant fugitive emission source
CONTINENTAL BRICK - MARTINSBURG FACILITY	Other Sources	761,805.9	4,369,216.0	17	Berkeley	WV	6.60	Miscellaneous fugitive emission source
ESSROC CEMENT - MARTINSBURG	Plantwide Fugitives	760,130.3	4,369,306.3	17	Berkeley	WV	5.35	Miscellaneous fugitive emission source
IRS MARTINSBURG CENTER CAMPUS	PLANTWIDE FUGITIVES	765,593.4	4,365,610.0	17	Berkeley	WV	9.29	Miscellaenous, distant fugitive emission source

APPENDIX E: DETAILED FULL IMPACT NAAQS RESULTS

Table E-1. NO_2 1-hr Average NAAQS Cause and Contribute Analysis (with ARM).
Table E-2. PM_{10} 24-hr Average NAAQS Cause and Contribute Analysis.
Table E-3. $PM_{2.5}$ 24-hr Average NAAQS Cause and Contribute Analysis.
Table E-4. $PM_{2.5}$ Annual Average NAAQS Cause and Contribute Analysis.

Tables included in the model files CD under Appendix A.

APPENDIX F: DETAILED CLASS II PSD INCREMENT RESULTS

Table F-1. $PM_{2.5}$ 24-hr Average Increment Cause and Contribute Analysis.
Table F-2. PM_{10} 24-hr Average Increment Cause and Contribute Analysis.
Table F-3. PM_{10} Annual Average Increment Cause and Contribute Analysis.

Tables included in the model files CD under Appendix A.