[redacted]

Envira Pellets - Hamlet (Richmond Co)

Dec 17, 2013

ANALYSIS REVIEW LOG

Date	Activity	Facility ID	Region	Reviewer
12/17/13	PSD Modeling Protocol Recd			
	Enviva - Hamlet (Richmond Co.)	TBD	FRO	
12/20/13	1-Hr NO_2 NAAQS Inventory			
	Evaluation Justification			
	recd			
***	PSD Pre-application Meeting			
	held July 18, 2013			
1/2/14	Inv			TA
1/7	Protocol review complete			TA

North Carolina Department of Environment and Natural Resources
Division of Air Quality

Pat McCrory
Governor

Sheila C. Holman
Director

John E. Skvarla, III
Secretary

January 6, 2014

Jonathan Hill, Managing Consultant
Trinity Consultants
1 Copley Parkway
Suite 300
Morrisville, NC 27560

Subject: PSD Dispersion Modeling Protocol – Enviva Pellets Hamlet, LLC
Hamlet, NC Richmond County

Dear Mr. Hill:

The Air Quality Analysis Branch has reviewed the dispersion modeling protocol, received December 7 and updated on December 20, 2013, for the proposed Enviva Pellets facility that will be located in Richmond County near Hamlet, NC. The company plans to construct and operate a wood pellets manufacturing plant and preliminary emissions estimates indicate that the facility will exceed the significant emission rates for carbon monoxide, nitrogen oxides, particulates, and volatile organic compounds, thus requiring a PSD analysis.

The following comments are offered for your consideration and action:

1) The Federal Land Managers (FLMs) for each of the Class 1 areas within 300 km of the facility have been notified but have not yet provided a response; however, an AQRV analysis is not expected for any areas under their jurisdiction. NCDAQ will pass along their responses for your action, if any, when they become available.

2) While NCDAQ generally agrees with your proposed approach for the evaluation of secondary $PM_{2.5}$ formation, we reserve the right to require a more quantitative analysis should the modeling, as proposed, indicate values close to the NAAQS for $PM_{2.5}$.

With these clarifications, the modeling protocol is approved; the approval is valid for **90 days**. This letter approves only the modeling plan and not the specific data submitted, which we will review upon receipt of the complete application. If you have any questions or comments, please contact me at (919) 715-6263 or e-mail at: tom.anderson@ncdenr.gov.

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Sincerely,

Tom Anderson , Meteorologist II
Air Quality Analysis Branch

c: John Evans, Supervisor, PSD permitting Section
Permit Coordinator, FRO
Mark Cuilla, Supervisor, AQAB

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December 17, 2013

Mr. Mark Cuilla
North Carolina Division of Air Quality
1641 Mail Service Center
Raleigh, NC 27699-1641

RE: Enviva Pellets Hamlet, LLC Hamlet, NC Facility
PSD Modeling Protocol

Dear Mr. Cuilla:

Enviva Pellets Hamlet, LLC (Enviva) plans to construct and operate a wood pellets manufacturing plant in Richmond County, near Hamlet, NC (Hamlet Plant). The project was originally discussed with the North Carolina Division of Air Quality (NCDAQ) during a PSD pre-application meeting held on July 18, 2013. The plant will consist of a wood drying system along with various material handling and emergency equipment.

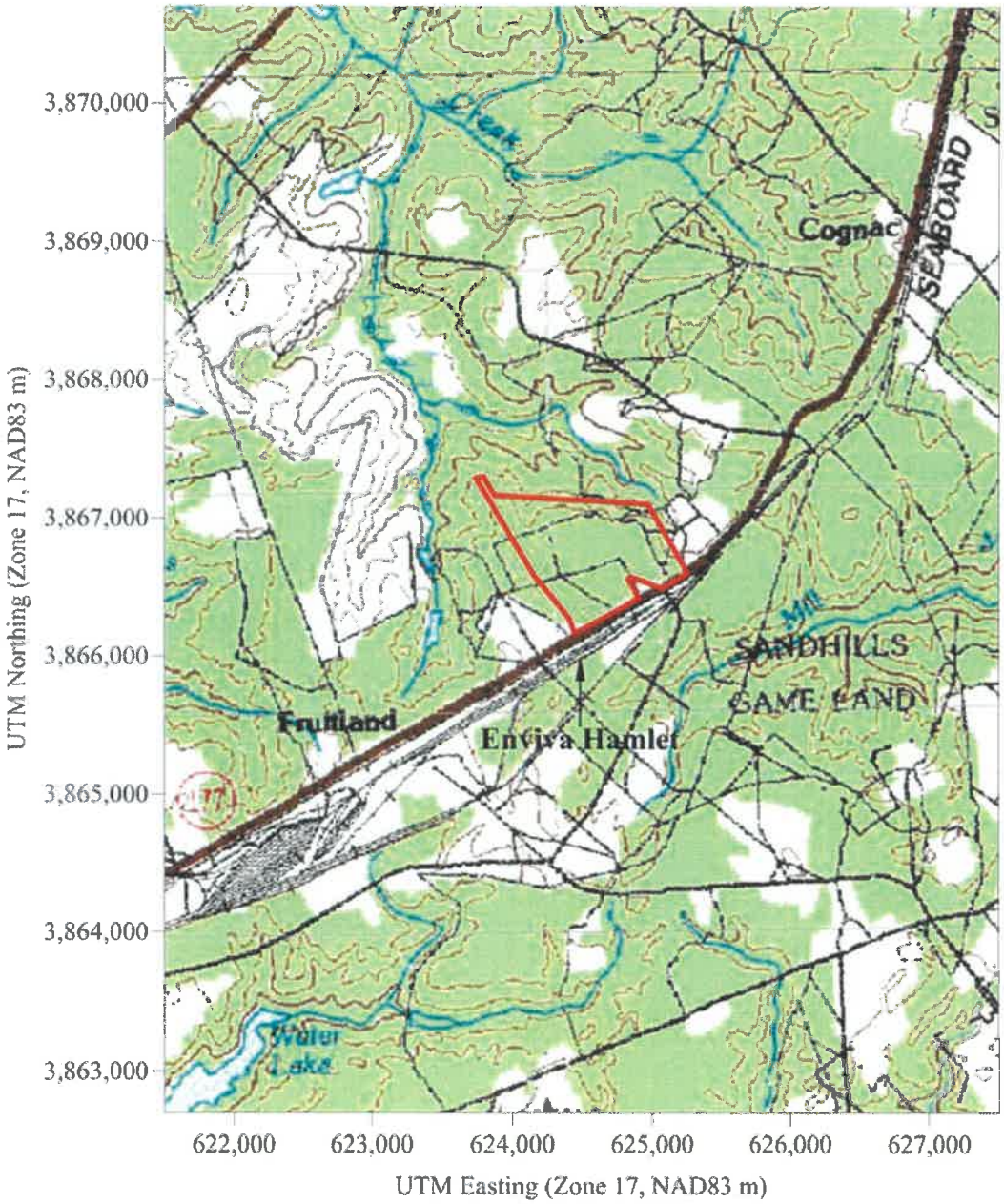
Based on preliminary estimates, it is anticipated that the proposed project will require a Prevention of Significant Deterioration (PSD) permit due to volatile organic carbon (VOC) emissions in excess of 250 tons per year (tpy). Emissions from the proposed facility are also projected to exceed PSD significant emission rate (SER) thresholds for carbon monoxide (CO), oxides of nitrogen (NO_X), total suspended particulate (TSP), particulate matter with an aerodynamic diameter of 10 microns or less (PM_{10}), and PM with an aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$). As such, modeling will need to be performed for those pollutants. Enviva is planning to submit a PSD construction permit application to NCDAQ in December 2013.

Following NCDAQ policy, Trinity Consultants (Trinity), on behalf of Enviva, has prepared this dispersion modeling protocol describing the proposed methodologies and data resources for the project. This protocol includes a brief description of the proposed facility, an overview of the required PSD and State-only modeling analyses, and a description of the methodology proposed to be used in those modeling analyses. The analyses discussed below include evaluations of National Ambient Air Quality Standards (NAAQS), PSD Increment, additional impacts analyses for visibility and non-air quality impacts, as well as the ambient impact assessment of toxic air pollutant (TAP) emissions.

PROJECT DESCRIPTION

Figure 1 provides a map of the area surrounding the Hamlet property. The approximate central Universal Transverse Mercator (UTM) coordinates of the facility are 624.5 kilometers (km) east and 3,866.7 km north in Zone 17 (NAD 83).

FIGURE 1. TOPOGRAPHIC MAP OF PROPOSED HAMLET PLANT



For modeling purposes, the appropriate urban/rural land use classification for the area was determined using the Auer technique, which is recommended in the *Guideline on Air Quality Models.*[1] In accordance with this technique, the area within a 3-km radius of the facility was identified on US Geological Survey (USGS) topographic maps (and was delineated by land use type. More than 50 percent of the surrounding land use can be classified as undeveloped rural (i.e., Auer's A4 classification), therefore the area is classified as rural.

Enviva plans to construct and operate a greenfield wood pellets manufacturing plant in Richmond County, near Hamlet, NC. The Hamlet plant will consist of a wood drying system along with various material handling and emergency equipment. The preliminary emission sources of regulated pollutants at the Hamlet plant are summarized in Table 1.

TABLE 1. PRELIMINARY EMISSION SOURCES

Model ID	Description
EP1	Dryer WESP Stack
EP2	Hammermill Area Common Stack
EP3	Pellet Press Silo
EP4	Emergency Generator
EP5	Fire Pump
EP6	Rechipper Air Assist
EP7	Fines Bin Vent
EP8	Loadout Filter
EP9	Portable Greenwood Chipper
EP10	Pellet Cooler #1 Cyclone
EP11	Pellet Cooler #2 Cyclone
EP12	Pellet Cooler #3 Cyclone
EP13	Pellet Cooler #4 Cyclone
EP14	Pellet Cooler #5 Cyclone
EP15	Pellet Cooler #6 Cyclone
PAVEDRDS	Paved Roadway Areas
UNPVDRDS	Unpaved Roadway Areas

PSD APPLICABILITY

Part C of Title I of the Clean Air Act, 42 U.S.C. §§7470-7492, is the statutory basis for the PSD program. U.S. EPA has codified PSD definitions, applicability, and requirements in 40 CFR Part 51.166. PSD is one component of the federal New Source Review (NSR) permitting program applicable in areas that

[1] U.S. EPA's Guideline on Air Quality Models 40 CFR 51, Appendix W (Revised, November 9, 2005)

are designated in attainment of the NAAQS. Richmond County, in which the proposed facility will be located, is currently designated as unclassifiable or in attainment for all criteria pollutants.[2]

PSD requires *major* stationary sources of air pollution to obtain an air pollution permit prior to commencing construction. The threshold defining the status of a facility as a major source under the PSD regulations is 250 tpy, unless the source belongs to one of 28 specifically defined industrial source categories, in which case the major source threshold is 100 tpy. Wood pellet manufacturing is not on the "List of 28" source categories. Thus, the major source threshold under the PSD program for the facility is 250 tpy of a regulated air pollutant.

The potential emissions associated with the facility require permitting as a new major source under the PSD regulations. Enviva's preliminary emission calculations have shown that the facility may qualify as a PSD major source due to potential emissions of VOC in excess of 250 tpy and would, therefore, trigger PSD review for that pollutant. As a PSD major source due to its VOC emissions, the Hamlet plant will likely trigger PSD modeling requirements for NO_x, PM_{10} and $PM_{2.5}$ as preliminary emissions estimates exceed the respective SER for those pollutants. There are no single-source modeling requirements associated with VOC emissions.

Secondary $PM_{2.5}$ Formation

The AERMOD model, the preferred dispersion model for near-field analyses, does not currently include chemical transformation algorithms required in order to address the formation of secondary $PM_{2.5}$. The Draft Guidance for $PM_{2.5}$ Permit Modeling provides guidance on how applicants should address secondary $PM_{2.5}$ in the context of a PSD modeling analysis.[3] The PSD SERs for NO_X and SO_2 ($PM_{2.5}$ precursors) are utilized to determine whether a proposed source or modification will contribute sufficient quantities of precursor emissions requiring consideration. In this draft guidance document, EPA proposes four "assessment" cases outlining what air quality analysis, if any, is required to demonstrate compliance with the $PM_{2.5}$ NAAQS.

The proposed project falls under Assessment Case 3, with direct $PM_{2.5}$ emissions and NO_X emissions greater than the respective SERs. This case requires that both primary and secondary $PM_{2.5}$ impacts be addressed. Per the Guidance, an applicant can account for the impact of precursor emissions on secondary $PM_{2.5}$ formation in a completely qualitative manner, through the use a hybrid of qualitative and quantitative assessment using existing technical work, or through a full quantitative photochemical grid modeling approach.

The only continuous source of precursor emissions at the facility will be the wood dryer. At facilities such as wood pellet mills, $PM_{2.5}$ impacts are very localized in nature (along or very near the fenceline) and are generally dominated by the ambient/near-ambient release sources (e.g. hammermills, pellet coolers) which do not emit precursor pollutants. Further, the maximum impacts resulting from the dryer and other particulate emission sources are not typically collocated in time or space. As such, Enviva is proposing that secondary $PM_{2.5}$ formation does not need to be included in this modeling evaluation.

O.K.?

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[2] 40 CFR §81.334

[3] U.S. EPA, Office of Air Quality Planning and Standards, *Draft Guidance for PM2.5 Permit Modeling* (March 4, 2013).

→ reserve the right to require qualitative analysis if close to the NAAQS.

PSD MODELING ANALYSES

Trinity has prepared this modeling protocol to describe the modeling methodologies and data resources that will be used to demonstrate that the Hamlet plant does not cause or contribute to exceedances of the NAAQS or PSD Increment, as applicable, for CO, NO_X, PM_{10}, and $PM_{2.5}$ and that no other adverse impacts at Class II areas are attributable to the proposed facility. The dispersion modeling analyses will be conducted in accordance with the following guidance documents:

- U.S. EPA's *Guideline on Air Quality Models* 40 CFR 51, Appendix W (Revised, November 9, 2005)
- 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 NO2 National Ambient Air Quality Standard* (March 1, 2011)
- North Carolina's *PSD Modeling Guidance* (January 6, 2012)
- North Carolina's *Guidelines for Evaluating the Air Quality Impacts of Toxic Air Pollutants in North Carolina* (December 2009)

A standard PSD air quality modeling analysis is conducted in three (3) principal steps. Each of the steps for completing the Class II Area modeling analysis; the Significance Analysis, the NAAQS Analysis, and the PSD Increment Analysis, are described below.

Significance Analysis

The Significance Analysis is conducted to determine whether the emissions associated with the proposed new construction project could cause a significant impact upon the area surrounding the facility. "Significant" impacts are defined by ambient concentration thresholds commonly referred to as the Significant Impact Levels (SIL). Table 2 lists the SIL, NAAQS, and PSD Increments for all relevant NSR regulated pollutants for this project.

If the highest modeled ambient concentrations for a pollutant for all averaging periods are less than the applicable SIL when emissions from only the project are modeled, then further analyses (NAAQS and PSD Increment) are not required for that pollutant. If, however, modeled impacts are greater than the SIL for any averaging period, a full NAAQS and PSD Increment analysis is required for that pollutant and averaging period to demonstrate that the project neither causes nor contributes to any exceedances. The geographic extent to which significant impacts occur is used to define the significantly impacted receptors within which compliance with the NAAQS and PSD Increments must be demonstrated.

Ambient Monitoring Requirements

In addition to determining whether the applicant can forego further modeling analyses, the PSD Significance Analysis is also used to determine whether the applicant is exempt from ambient monitoring requirements. To determine whether pre-construction monitoring should be considered, the maximum impacts attributable to the proposed project are assessed against significant monitoring concentrations (SMC). The SMC for the applicable averaging periods for CO, NO_X, PM_{10} are provided in 40 CFR §52.21(i)(5)(i) and are listed in Table 2. A pre-construction air quality analysis using continuous monitoring data may be required for pollutants subject to PSD review per 40 CFR

§52.21(m). If either the predicted modeled impact from an emissions increase or the existing ambient concentration is less than the SMC, an applicant may be exempt from pre-construction ambient monitoring. If the Significance Analysis shows ambient impacts exceeding the SMC, Enviva proposes to use existing ambient monitor data in lieu of pre-construction monitoring requirements.

TABLE 2. SIGNIFICANT IMPACT LEVELS, NAAQS, CLASS II PSD INCREMENTS, AND SIGNIFICANT MONITORING CONCENTRATIONS FOR RELEVANT NSR REGULATED POLLUTANTS

Pollutant	Averaging Period	PSD SIL (µg/m³)	Primary and Secondary NAAQS (µg/m³)	Class II PSD Increment (µg/m³)	Significant Monitoring Concentration (µg/m³)
CO	1-hour	2,000	40,000 (35 ppm)[1]	--	--
	8-hour	500	10,000 (9 ppm)[1]	--	575
NO_2	1-hour	10[2]	188 (100 ppb)[3]	--	--
	Annual	1	100 (0.053 ppm)[4]	25	14
PM_{10}	24-hour	5	150[5]	30	10
	Annual	1	N/A	17	--
$PM_{2.5}$	24-hour	1.2[6]	35	9[6]	--[7]
	Annual	0.3[6]	12	4[6]	--

[1] Not to be exceeded more than once per year.

[2] Until EPA develops and promulgates a 1-hr NO_2 SIL for the recently promulgated NO_2 1-hr NAAQS, NCDAQ has adopted an interim 1-hr NO_2 SIL of 10 µg/m³. The 10 µg/m³ SIL was developed by the Northeast States for Coordinated Air Use Management (NESCAUM) and is based on the ratio of the existing 1-hr CO SIL to the 1-hr CO NAAQS.

[3] The 3-year average of the 98th percentile of the daily maximum 1-hr average.

[4] Annual arithmetic average.

[5] Not to be exceeded more than three times in 3 consecutive years.

[6] On January 22, 2013, the U.S. Court of Appeals for the District of Columbia Circuit vacated two provisions in EPA's PSD regulations containing SILs for $PM_{2.5}$. (*Sierra Club v. EPA*, No. 10-1413 (D.C. Circuit), 2013 WL 216018). The court decision does not preclude the use of SILs for $PM_{2.5}$, but requires that EPA correct the error in the SIL regulations for $PM_{2.5}$ at 51.166(k)(2) and 52.21(k)(2). In the interim, the EPA states that permitting authorities may continue to apply SILs for $PM_{2.5}$ to support a PSD permitting decision, but permitting authorities should take care to ensure that SILs are not used in a manner that is inconsistent with the requirements of Section 165(a)(3) of the CAA.

[7] The $PM_{2.5}$ SMC was vacated on January 22, 2013 (*Sierra Club v. EPA*, No. 10-1413 (D.C. Circuit), 2013 WL 216018).

The $PM_{2.5}$ SMC was vacated on January 22, 2013 by the U.S. Court of Appeals for the District of Columbia Circuit.[4] Per the *Draft Guidance for $PM_{2.5}$ Permit Modeling*, as a result of the court decision, EPA will not rely on, and advises states with SIP-approved PSD programs not to rely on, the SMC for $PM_{2.5}$ to exempt projects from preconstruction monitoring requirements.[5] However, EPA states that PSD permit applicants can continue to meet pre-construction monitoring requirements by using data from existing monitors that are determined by the permitting authority to be representative of the area surrounding the proposed project. Given the availability of representative monitoring data in the area surrounding the proposed project, Enviva again proposes to use existing ambient monitor data in lieu of pre-construction monitoring requirements.

Background Concentrations

If the maximum modeled impacts for a PSD triggering pollutant are greater than the SIL in the Significance Analysis, a NAAQS analysis is required for that pollutant. In the NAAQS analysis, modeled impacts from the facility will be combined with background concentrations, which represent the air quality concentrations due to sources that are not explicitly modeled (e.g., mobile sources, small but local stationary sources, non-regulated fugitive sources, and large but distant sources). Selection of the existing monitoring station data that is "representative" of the ambient air quality in the area surrounding the proposed facility is determined based on the following three criteria: 1) monitor location, 2) data quality, and 3) data currentness. Key considerations based on the monitor location criteria include proximity to the significant impact area of the proposed facility, similarity of emission sources impacting the monitor to the emission sources impacting the airshed surrounding the proposed facility, and the similarity of the land use and land cover (LULC) surrounding the monitor and proposed facility. The data quality criteria refers to the monitor being an approved SLAM or similar monitor type subject to the quality assurance requirements in 40 CFR Part 58 Appendix A. Data currentness refers to the fact that the most recent three complete years of quality assured data are generally preferred.

Enviva requests that NCDAQ provides the appropriate monitoring site and background value for each pollutant to incorporate in the analysis.

Significant Impact Area and NAAQS/PSD Increment Inventories

For any off-site impact calculated in the PSD Significance Analysis that is greater than the SIL for a given pollutant, the radius of the significant impact area (SIA) is determined. The SIA encompasses a circle centered on the facility 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 (i.e., modeled impact above the SIL on a high first high basis) , or (2) a distance of 50 km, whichever is less. All sources of the affected pollutant(s) within 50 km of the SIA are assumed to potentially contribute to ground-level concentrations within the SIA and are evaluated for possible inclusion in the NAAQS and PSD Increment analyses.

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[4] *Sierra Club v. EPA*, No. 10-1413 (D.C. Circuit), 2013 WL 216018.

[5] U.S. EPA, Office of Air Quality Planning and Standards, *Draft Guidance for PM2.5 Permit Modeling* (March 4, 2013).

The NAAQS regional source inventory will be comprised of all sources (major and minor) within the SIA, as well as any other regional sources that are not excluded based on the "20D" procedure.[6] Using this procedure, sources outside the area of significant impact are excluded from the inventory if the entire facility's emissions (tpy) are less than 20 times the distance (km) from the facility to the nearest edge of the SIA (long-term averaging period), and are excluded if the entire facility's emissions (tpy) are less than 20 times the distance (km) from the facility to the Hamlet plant (short term averaging period). To be conservative, emissions from sources within close proximity to each other (2 km) will be combined prior to applying the "20D" procedure. Enviva will request source inventory data from NCDAQ based from the SIA identified in the SIL modeling analysis.

Sources in the inventories provided by NCDAQ will be evaluated for inclusion in the NAAQS and PSD Increment analyses, if necessary. If Enviva discovers that refinements to these inventories are necessary after conducting a detailed review of the modeled source parameters provided and evaluating impacts from the inventory sources in preliminary NAAQS and PSD Increment modeling scenarios, Enviva will work with NCDAQ to obtain refined inventories. The complete list of modeled inventory sources and the associated model input parameters will be provided in the final modeling report submitted with the PSD permit application for the facility.

NAAQS Analysis

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 that the EPA judges are necessary, with an adequate margin of safety, to protect the public health."[7] Secondary NAAQS define the levels that "protect the public welfare from any known or anticipated adverse effects of a pollutant." The primary NAAQS are shown in Table 2 for CO, NO_X, PM_{10}, and $PM_{2.5}$. Since CO does not have a secondary NAAQS, Table 2 only shows secondary NAAQS for NO_X, PM_{10}, and $PM_{2.5}$. In the NAAQS analysis, the potential emissions from all emission units at the facility combined with the maximum allowable emissions of sources included in the NAAQS inventory will be modeled together to compute the cumulative impact.

The objective of the NAAQS Analysis is to demonstrate through air quality modeling that emissions from the facility do not cause or contribute to an exceedance of the NAAQS at any ambient location at which the impact from the proposed project is greater than the SIL. The modeled cumulative impacts are added to appropriate background concentrations and assessed against the applicable NAAQS as listed in Table 2 to demonstrate compliance.

The following modeling results for each PSD triggering pollutant and averaging period will be used to determine the design concentration in the NAAQS Analysis:

- Maximum five-year average of the 98th percentile (H8H) modeled 1-hr concentration, on a receptor-by-receptor basis, to demonstrate compliance with the 1-hr NO_2 standard.
- The maximum-modeled annual arithmetic mean impact from the full five years of meteorological data to demonstrate compliance with the annual NO_X standard.

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[6] *Federal Register* 8079, March 6, 1992.

[7] 40 CFR §50.2(b).

- The 24-hr $PM_{2.5}$ standard is the 98th percentile (approximated by the high-eighth-high, H8H modeled concentration) of 24-hr concentrations in a given year averaged over the five modeled years.
- The modeled annual arithmetic mean impact averaged over the full five years to demonstrate compliance with the annual $PM_{2.5}$ standard.
- The highest-second-high (H2H) modeled concentration over the five year meteorological period is compared to the NAAQS to demonstrate compliance with the 1-hr and 8-hr CO standards.
- The 24-hr PM_{10} standard is not to be exceeded more than 3 times in any consecutive 3 year period, meaning that generally the highest sixth-high (H6H) modeled concentration over the full five years of meteorological data is compared against the NAAQS. However, the highest second-high concentrations may be used as a more conservative approach to avoid the long model run times associated with running all five meteorological years within one model run and to simplify the year-by-year EVENT analysis required in the case of any modeled NAAQS violations.[8]

When a violation of the NAAQS is predicted at receptor(s) in the significant impact area, a source is not considered to have caused or contributed to the violation if its own impact is not significant (i.e., the source's contribution to the modeled violations is less than the SIL) at the violating receptor at the time of the predicted violation.[9] If a culpability analysis is required for modeled violations, Enviva will first identify all violations using the plot file output feature in AERMOD which will identify the receptor locations and events (i.e., month, day, year, and end hour) for the violations. Based on this information, Enviva will evaluate the facility's contribution to the violation using either the EVENT processing utility or the MAXDCONT/MAXDAILY output options inherent to AERMOD.

As an example, the EVENT run may be set up to predict the individual source contribution for any impacts exceeding the NAAQS by using the MAXIFILE output option with the threshold set to the relevant NAAQS minus the background concentration.[10] Analyzing the EVENT file output during the violations will allow Enviva to demonstrate the facility impacts are below the relevant SIL at the time and location of any modeled exceedance. In cases where violations due to inventory sources are identified, Enviva must determine (for inclusion in the modeling report and project summary issued in conjunction with the draft permit) the maximum NAAQS impact during which the contribution from facility's emissions sources causes a significant impact. To determine the maximum NAAQS impact for the Hamlet plant if violations due to inventory sources are identified, Enviva will first setup an EVENT analysis with the threshold set to the project only NAAQS impacts and then will iteratively evaluate the highest cumulative impacts between the identified NAAQS violations and project only impacts until an event is identified during which the facility's impacts are significant.

PSD Increment Analysis

The PSD regulations were enacted primarily to "prevent significant deterioration" of air quality in areas of the country where the air quality was better than the NAAQS. To achieve this goal, the EPA established PSD Increments for NO_2, SO_2, PM_{10}, and $PM_{2.5}$. The PSD Increments are divided into Class I, II, and III Increments. This modeling protocol is not intended to specifically address any Class I

[8] EVENT analysis refers to the control block keyword EVENTFIL in the AERMOD input file.

[9] U.S. EPA New Source Review Workshop Manual Chapter D Section IV.E and 40 CFR Part 51 Appendix W Section 10.2.3.2 and 10.2.3.3.

[10] MAXIFILE refers to the output block keyword in the AERMOD input file.

modeling procedures other than the increment screening procedure described later in the document. The Class II PSD Increments for NO_2 and PM_{10} are listed in Table 2. No Class III air quality areas have been established and no 1-hr NO_2 or $PM_{2.5}$ Increments have been promulgated; therefore, no PSD Increment Analysis is required for these pollutants and averaging periods. Since all short-term PSD Increments are not to be exceeded more than once per year, the highest-second-high modeled impacts for PM_{10} from among the five meteorological years modeled will be compared against the short-term increment. The highest annual average PM_{10} and NO_2 impacts will be compared against the annual increments.

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 a designated attainment area. Significant deterioration is said to have occurred if the *change* in emissions occurring since a baseline date results in an off-property impact greater than the PSD Increment (i.e., the increased emissions "consume" more than the available PSD Increment).

The determination of whether an emissions change at a given source consumes or expands increment is based on the source definition (major or minor for PSD) and the time the change occurs in relation to baseline dates. The major source baseline date for both PM_{10} and $PM_{2.5}$ is January 6, 1975 and the major source baseline date for NO_X is February 8, 1988. Increases or decreases in actual emissions at major sources after the major source baseline date as a result of construction of a new source, a physical or operational change (i.e., modification) to an existing source, or shutdown of an existing source affect the available increment, and therefore, must be included in an increment analysis. Actual emission changes at minor sources only affect increment after the minor source baseline date (MSBD), which is set at the date the first complete PSD permit application is submitted in a county. The MSBDs for PM_{10} and NO_x were established on February 26, 1999 for Richmond County, and as such, emissions increases or decreases since that date at minor sources must be incorporated in the increment inventory.[11]

To demonstrate compliance with the Class II Increments, potential emissions from the facility along with a conservative estimate of the "increment-affecting emissions" from PSD inventory sources will be modeled and assessed cumulatively against the PSD Increments. NCDAQ guidance on development of regional inventory data will be followed. The previous discussion regarding potential NAAQS violations and the approach for assessing culpability applies to the PSD Increment Analysis as well.

Ozone Ambient Impact Analysis

Elevated ground-level ozone concentrations are the result of photochemical reactions among various chemical species. These reactions are more likely to occur under certain ambient conditions (e.g., high ground-level temperatures, light winds, and sunny conditions). The chemical species that contribute to ozone formation, referred to as ozone precursors, include NO_X and VOC emissions from both anthropogenic (e.g., mobile and stationary sources) and natural sources (e.g., vegetation). While the facility will not directly emit ozone, the facility will emit both NO_X and VOC at levels that are greater than the PSD SER for ozone precursors. While the project triggers PSD review for ozone via exceeding the SER for both NO_X and VOC, Enviva proposes that no modeling be required for ozone since the use of reactive plume models is rarely conducted on an individual source basis. In addition, NCDAQ and other Region 4 states have only very rarely assessed single source impacts on ozone in PSD air quality

[11] http://daq.state.nc.us/permits/psd/docs/mbd1.pdf

analyses. As an alternative to modeling, Enviva will complete a qualitative assessment of the impact of the proposed Hamlet plant on ambient ozone concentrations and the attainment status of the surrounding area.

Class I Area Analysis

Class I areas are federally protected areas for which more stringent air quality standards apply to protect unique natural, cultural, recreational, and/or historic values. There are five (5) Class I areas within 300 km of the Hamlet facility as follow:

- Cape Romain National Wildlife Refuge located 205 km to the south-southeast;
- Linville Gorge Wilderness Area located 225 km to the west-northwest;
- Shining Rock Wilderness Area located 291 km to the west;
- James River Face Wilderness Area located 291 km to the north; and
- Swanquarter National Wildlife Refuge located 295 km to the east.

The Federal Land Managers (FLM) have the authority to protect air quality related values (AQRVs), and to consider in consultation with the permitting authority whether a proposed major emitting facility will have an adverse impact on such values. AQRVs for which PSD modeling is typically conducted include visibility and deposition of sulfur and nitrogen.

When considering the ratio of emissions to Class I distance (e.g., Q/D) for this project, it is unlikely that any FLM will require a full AQRV analysis. Table 3 shows the projected maximum 24-hour emission rates for each of the visibility-affecting pollutants (VAP) emitted from the new facility. Table 4 presents the Q/D for all Class I areas within 300 km from the proposed facility. The FLM's AQRV Work Group (FLAG) 2010 guidance states that a Q/D value of ten or less indicates that AQRV analyses should not be required.[12] The preliminary Q/D values are all less than 1.5 and as such, it is not anticipated that any AQRV analysis will be required. Enviva presumes that NCDAQ will contact the FLMs to seek formal concurrence that a Class I area modeling analysis is not warranted for the proposed Hamlet plant.

[12] U.S. Forest Service, National Park Service, and U.S. Fish and Wildlife Service. 2010. Federal land managers' air quality related values work group (FLAG): phase I report—revised (2010). Natural Resource Report NPS/NRPC/NRR—2010/232. National Park Service, Denver, Colorado.

TABLE 3. MAXIMUM 24-HOUR EMISSION RATES FOR VISIBILITY-AFFECTING POLLUTANTS

Pollutant	Facility-Wide Maximum 24-Hour Emission Increases (lb/hr)	Annualized Maximum Emissions (tpy)
NO_2	40.00	175.20
SO_2	4.38	19.18
PM_{10}	8.24	36.09
H_2SO_4	-	0.00
Total	**52.62**	**230.48**

TABLE 4. CLASS I AREA Q/D ANALYSIS

Class I Area	Distance (D in km)	Sum of Annualized Emissions (Q in tpy)	FLAG 2010 Q/D
Cape Romain (SC)	205	230	1.13
Linville Gorge (NC)	225		1.02
Shining Rock (NC)	291		0.79
James River Face (VA)	291		0.79
Swanquarter (NC)	295		0.78

In addition to the AQRV analysis, Enviva is also required to assess, Class I PSD Increment consumption, at the affected Class I areas. Enviva anticipates this evaluation will be done by placing an arc of receptors in AERMOD at a distance of 50 km in the direction of each affected area, to demonstrate impacts below the Class I SIL. This Class I increment "screening" procedure was originally proposed by EPA Region 4 and has been used in several recent PSD applications to fulfill the Class I increment modeling requirement.

CLASS II MODELING METHODOLOGY

This section of the modeling protocol describes the modeling procedures and data resources utilized in the Class II Area air quality modeling analyses. The techniques proposed for the air quality analysis are consistent with current U.S. EPA guidance as well as the *NCDAQ Guidelines.*

Model Selection

The latest version (12345) of the AERMOD modeling system will be used to estimate maximum ground-level concentrations in all Class II Area analyses conducted for this application. AERMOD is a refined, steady-state, multiple source, Gaussian dispersion model and was promulgated in December

2005 as the preferred model for use by industrial sources in this type of air quality analysis.[13] The AERMOD model has the Plume Rise Modeling Enhancements (PRIME) incorporated in the regulatory version, so the direction-specific building downwash dimensions used as inputs are determined by the Building Profile Input Program, PRIME version (BPIP PRIME), version 04274.[14] BPIP PRIME is designed to incorporate the concepts and procedures expressed in the GEP Technical Support document, the Building Downwash Guidance document, and other related documents, while incorporating the PRIME enhancements to improve prediction of ambient impacts in building cavities and wake regions.[15]

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. AERMAP is the terrain pre-processor that is used to import terrain elevations for selected model objects and to generate the receptor hill height scale data that are used by AERMOD to drive advanced terrain processing algorithms. National Elevation Dataset (NED) data available from the United States Geological Survey (USGS) are utilized to interpolate surveyed elevations onto user specified receptor grids and buildings and sources in the absence of more accurate site-specific (i.e., site surveys, GPS analyses, etc.) elevation data.

AERMET generates a separate surface file and vertical profile file to pass meteorological observations and turbulence parameters to AERMOD. AERMET meteorological data are refined for a particular analysis based on the choice of micrometeorological parameters that are linked to the land use and land cover (LULC) around the meteorological site shown to be representative of the application site.

Enviva will use the most recent versions of AERMOD and AERMAP (version 11103) to estimate ambient impacts from the modeled sources in the Class II area. Per NCDAQ guidelines, AERMOD will be run using all regulatory default options.

Receptor Grid and Coordinate System

Modeled concentrations will be calculated at receptors beginning at the ambient air boundary, which consists of those areas on facility property to with clear deterrents to public access (e.g. fencing, regular security patrols). Receptors will be placed along that "fenceline" and also on a Cartesian receptor grid. Fenceline receptors will be spaced no further than 100 meters apart as specified in NCDAQ's PSD Guidance.[16] Beyond the fenceline, receptors will be spaced 100 meters apart in a Cartesian grid extending out to a distance sufficient to resolve the maximum concentration. For pollutants exceeding the SIL, the grid will be sufficiently large to ensure that the full SIA is captured.

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[13] 40 CFR Part 51, Appendix W–*Guideline on Air Quality Models*, Appendix A.1– AMS/EPA Regulatory Model (AERMOD).

[14] Earth Tech, Inc., *Addendum to the ISC3 User's Guide, The PRIME Plume Rise and Building Downwash Model,* Concord, MA.

[15] U.S. Environmental Protection Agency, 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, North Carolina, EPA 450/4-80-023R, June 1985.

[16] http://www.ncair.org/permits/mets/psd_guidance.pdf

Subsequent NAAQS and PSD increment analyses may be performed for only those receptors within the SIA for which the Hamlet plant is significant.[17]

Receptor elevations required by AERMOD will be determined using the AERMAP terrain preprocessor. AERMAP also calculates hill height parameters required by AERMOD. Terrain elevations from the USGS 1 arc second NED will be used for the AERMAP processing.

In all modeling analysis data files, the location of emission sources, structure, and receptors will be represented in the UTM coordinate system. The Hamlet plant will be located at approximately 624.5 km east and 3,866.7 km north in Zone 17 (NAD 83).

Meteorological Data

The AERMOD modeling results will be based on sequential hourly surface observations from Maxton, NC and upper air data from Greensboro, NC. These stations are recommended by NCDAQ for modeling facilities located in Richmond County and will be downloaded from the website.[18] The base elevation for the surface station is 66 m.[19]

Building Downwash Analysis

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

Representation of Emission Sources

Source Types and Parameters

The AERMOD dispersion model allows for emission units to be represented as point, area, or volume sources. All of the point sources planned for the facility have clearly discernable emission points with vertical orientations and no rain caps. As such those sources will be characterized as point sources and were modeled with actual stack parameters (i.e., height, diameter, exhaust gas temperature, and gas exit velocity). In addition to the modeled point sources, two area sources will be included in the model to represent emissions from the paved and unpaved roadway areas at the site. These release height and initial vertical dimensions for the roadways will be based on the NC Quarry Modeling Guidance document.[20]

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[17] This approach is consistent with the recent memorandum from Tyler Fox (EPA), *Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO2 National Ambient Air Quality Standard, to Regional Air Division Directors.* March 1, 2011.

[18] http://www.ncair.org/permits/mets/metdata.shtml

[19] http://www.ncair.org/permits/mets/ProfileBaseElevations.pdf

[20] http://www.ncair.org/permits/mets/quarry1.pdf

GEP Stack Height Analysis

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

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

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

This equation is limited to stacks located within 5L of a structure. Stacks located at a distance greater than 5L are not subject to the wake effects of the structure. The wind direction-specific downwash dimensions and the dominant downwash structures used in this analysis are determined using BPIP. In general, the lowest GEP stack height for any source is 65 meters by default.[21] A preliminary evaluation has indicated that none of the proposed emission units at the Hamlet facility will exceed GEP height, and thus stacks will be modeled at their actual heights.

NO_2 Modeling Approach

EPA's *Guideline on Air Quality Models (Guideline)*, in 40 CFR Part 51, Appendix W, recommends a tiered approach for modeling annual average NO_2 from point sources. The *Guideline* provides that:

a. A tiered screening approach is recommended to obtain annual average estimates of NO_2 from point sources for New Source Review analysis, including PSD... For Tier 1 ... use an appropriate Gaussian model to estimate the maximum annual average concentration and assume a total conversion of NO to NO_2. If the concentration exceeds the NAAQS and/or PSD Increments for NO_2, proceed to the 2nd level screen.

b. For Tier 2 (2nd level) screening analysis, multiply the Tier 1 estimate(s) by an empirically derived NO_2/NO_X value of 0.75 (annual national default).

c. For Tier 3 (3rd level) analyses, a detailed screening method may be selected on a case-by-case basis. For point source modeling, detailed screening techniques such as the Ozone Limiting Method may also be considered.

Enviva will begin by utilizing the Ambient Ratio Method (ARM), or Tier 2 approach, which has evolved from previous representations of the oxidation of nitric oxide (NO) by ambient ozone and other photochemical oxidants to form nitrogen dioxide (NO_2 – the regulated ambient pollutant). The ARM is an approach contained in Section 6.2.3 of EPA's the *Guideline*.

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[21] 40 CFR §51.100(ii)

EPA issued a memo on March 1, 2011 providing additional clarifications regarding application of Appendix W modeling guidance for the 1-hr NO_2 NAAQS.[22] Per the memo, EPA recommends the use of 0.80 as a default ambient ratio for the 1-hour NO_2 standard under the Tier 2 approach. Based on this updated EPA guidance, Enviva will utilize 0.80 as the ambient NO_2:NO_X ratio. Should further refinement be needed, such as the Ozone Limiting Method (OLM) or Plume Volume Molar Ratio Method (PVMRM), Enviva will submit a separate NO_2 modeling protocol to NCDAQ detailing the alternative approach.

ADDITIONAL IMPACTS MODELING METHODOLOGY

The required additional impacts evaluations include a growth analysis, a soil and vegetation analysis, and a plume visibility analysis. Enviva will use the VISCREEN model to determine the impacts on ambient visibility at any airports or state parks within the SIA to meet the requirements of the additional impacts analysis. To assess soil and vegetation impacts, the modeling results from the PSD NAAQS are assessed against the secondary NAAQS standards and EPA's soils/vegetation screening guidelines. If the screening analysis indicates that values will not exceed the SIL, then the results of the screening analysis will be compared to values from the EPA document, *A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals* (EPA 450/2-81-078), 1981. For those pollutants triggering NAAQS modeling requirements, the full modeled impact from the facility and inventory will be assessed against those documented values.

STATE-ONLY MODELING REQUIREMENTS

In addition to the federal NAAQS and PSD increment standards that are required to be analyzed under PSD review, North Carolina has two additional, state-only modeling requirements that pertain to this project.

Toxic Air Pollutant Modeling

Based on preliminary emissions estimates, Enviva anticipates that several toxic air pollutants (TAP) will exceed their facility-wide toxics permitting emission rates (TPER) and thus the project is likely to trigger TAP modeling requirements. Those modeling analyses will be performed in accordance with the North Carolina's *Guidelines for Evaluating the Air Quality Impacts of Toxic Air Pollutants in North Carolina* (December 2009). The modeling will generally be conducted using the same methodology and data resources in AERMOD as described in the previous sections of this modeling protocol. There are no public right-of-ways traversing the Enviva Hamlet property, and thus, all modeled TAP will be modeled using the PSD modeling grid described earlier in this protocol.

Total Suspended Particulate Modeling

15A NCAC 2D .0403 establishes the ambient air quality standards for total suspended particulate matter (TSP). The standards are the following:

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[22] U.S. EPA, Region 4, Memorandum from Mr. Tyler Fox to Regional Air Division Directors. Research Triangle Park, North Carolina. March 1, 2011.

(1) 75 micrograms per cubic meter annual geometric mean,
(2) 150 micrograms per cubic meter maximum 24-hour concentration not to be exceeded more than once per year.

An additional modeling analysis will be conducted to demonstrate that the TSP emission sources at the proposed Enviva Hamlet plant will not cause an exceedance of that state standard.

SUMMARY AND APPROVAL OF MODELING PROTOCOL

Enviva is supplying this written protocol so that NCDAQ can formally comment on and approve the methodologies to be used for this analysis. Enviva requests a written response to this protocol at your earliest convenience.

If you have any questions about the material presented in this letter, require additional information, or would like to talk about any of the proposed methods, please do not hesitate to call me at 919-462-9693.

Sincerely,

TRINITY CONSULTANTS

Jonathan Hill
Managing Consultant

cc: Mr. Mike Doniger (Enviva Pellets, LLC)
Mr. Joe Harrell (Enviva Pellets, LLC)
Mr. Dale Overcash (Trinity Consultants)

Cuilla, Mark

From: Jonathan Hill [JHill@trinityconsultants.com]
Sent: Tuesday, December 17, 2013 4:55 PM
To: Cuilla, Mark
Cc: Michael Doniger; Joe Harrell; Dale Overcash
Subject: Enviva Hamlet PSD Modeling Protocol
Attachments: Enviva Hamlet PSD Modeling Protocol (2013-12-17, submittal).pdf

Mark,

Trinity, on behalf of Enviva, is submitting the attached PSD modeling protocol for their proposed greenfield wood pellet mill near Hamlet, NC. This project was discussed as part of a larger PSD pre-application meeting with NCDAQ on July 18, 2013. As you aware, we are currently working through some 1-hour NO2 inventory issues with your group but wanted to proceed with this submittal to give you an opportunity to review the other aspects of our approach while they are resolved. Please feel free to contact me with any questions on this document. Enviva looks forward to receiving comments on the document at your earliest convenience.

Thanks and Happy Holidays!

Jon

Jon Hill
Managing Consultant/Meteorologist
Trinity Consultants
919-462-9693 phone
919-462-9694 fax

Cuilla, Mark

From: Jonathan Hill [JHill@trinityconsultants.com]
Sent: Friday, December 20, 2013 10:44 AM
To: Cuilla, Mark
Cc: Vandervaart, Donald; Michael Doniger; Dale Overcash
Subject: Enviva Hamlet 1-hour NO2 NAAQS Inventory Evaluation
Attachments: Enviva Hamlet 1-Hour NO2 NAAQS Modeling Inventory Review (2013-12-20, submittal).pdf

Mark,

Per our phone conversation yesterday, Trinity (on behalf on Enviva) has prepared the attached letter detailing the proposed inventory approach for the 1-hour NO2 NAAQS modeling demonstration required as part of the forthcoming Hamlet PSD permit application. We look forward to your comments on this at your earliest convenience.

Best Regards,

Jon

Jon Hill
Managing Consultant/Meteorologist
Trinity Consultants
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Trinity Consultants

December 20, 2013

Mr. Mark Cuilla
North Carolina Division of Air Quality
1641 Mail Service Center
Raleigh, NC 27699-1641

RE: Enviva Pellets Hamlet, LLC Hamlet, NC Facility
1-Hour NO_2 NAAQS Regional Modeling Inventory

Dear Mr. Cuilla:

As you are aware, Enviva Pellets Hamlet, LLC (Enviva) will soon be submitting a PSD permit application for their proposed greenfield wood pellet mill near Hamlet, NC. As part of that application, a complete PSD modeling analysis is being performed in order to demonstrate that the proposed project will not cause or contribute to any violations of the National Ambient Air Quality Standards (NAAQS), PSD increment thresholds, or any North Carolina State-only standards (e.g. TSP and Toxics). The modeling will include an evaluation of impacts in relation to the 1-hour nitrogen dioxide (NO_2) NAAQS. Since the 1-hour NAAQS are much more stringent than the older standards, and the regulatory models show significant sensitivity in predicting short-term impacts, the U.S. Environmental Protection Agency (U.S. EPA) prepared a new guidance document, *Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO2 National Ambient Air Quality Standard (herein referred to as 1-hour NO2 Guidance),*[1] which specifically addressed many aspects of the 1-hour NAAQS modeling that deviate from the previous air dispersion modeling guidance documents which were developed prior to promulgation of the new, short-term standards.[2,3] One of those deviations is with respect to the development of an appropriate set of regional inventory sources.

Per our phone conversation on December 19, 2013, Trinity Consultants (Trinity) on behalf of Enviva, has performed an evaluation of the 1-hour NO_2 modeled impacts from the proposed Hamlet facility in order to determine the most appropriate radius over which regional inventory sources should be included in the model. By appropriate radius, Trinity is proposing to include those sources which could reasonably be expected to have an impact on the cumulative distribution of 1-hour NO_2 NAAQS impacts in the vicinity of the Hamlet facility.

In their *1-hour NO_2 Guidance*, U.S. EPA provides a general "rule-of-thumb" for estimating the area over which regional inventory sources should be included. That section of the guidance goes on to suggest that for most applications, the inclusion of nearby sources within about 10 kilometers (km) would be

[1] 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 NO2 National Ambient Air Quality Standard (March 1, 2011).

[2] U.S. EPA's Guideline on Air Quality Models 40 CFR 51, Appendix W (Revised, November 9, 2005).

[3] U.S. EPA's *New Source Review Workshop Manual* (Draft, October, 1990).

sufficient. This guidance is based on the concept of "significant concentration gradient" in which modeled impacts from a given facility are reviewed to determine how quickly concentrations diminish out from the site. Trinity reviewed the 1-hour NO_2 significance results for the Hamlet facility to determine if the U.S. EPA's guidance value of 10 km would be appropriate for this application. Figure 1 below presents concentration contours (every 5 micrograms per cubic meter, $\mu g/m^3$) over a 30 km by 30 km modeling domain and shows how localized the highest impacts are. The figure includes are circles with radii of 5 km and 10km to further illustrate the significant concentration gradient present around the facility.

FIGURE 1. 1-HOUR NO_2 MODELED IMPACTS FOR ENVIVA HAMLET FACILITY

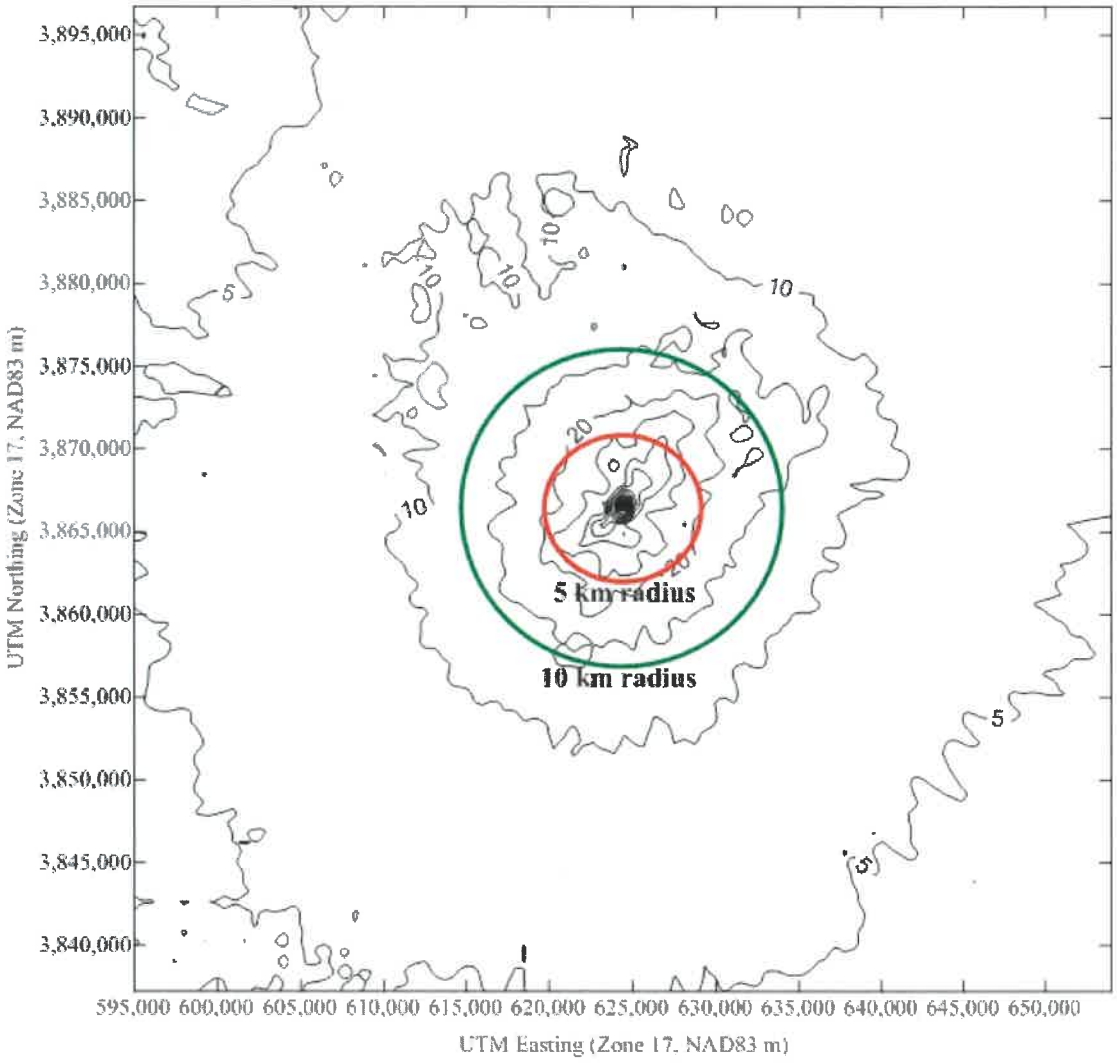
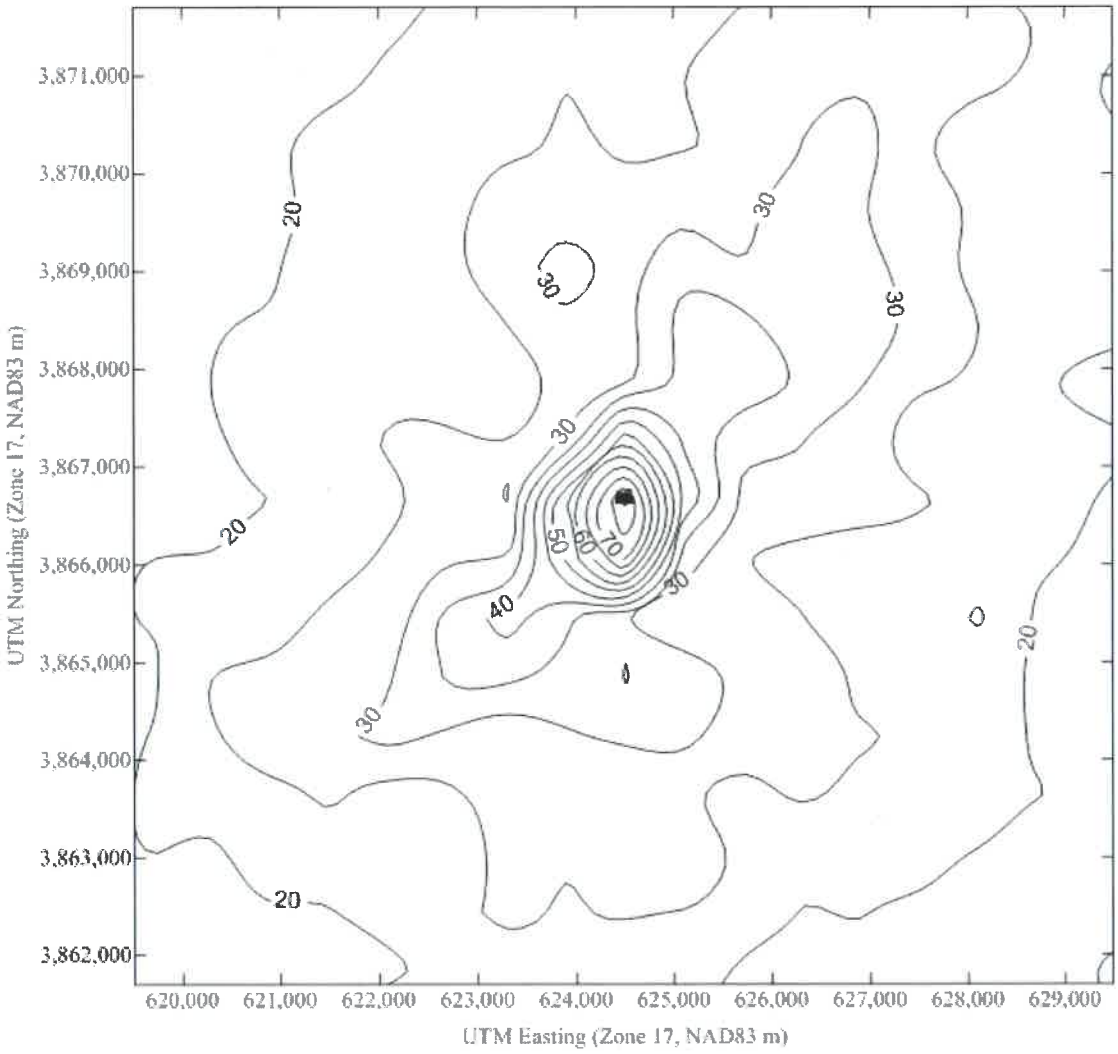


Figure 2 presents the same data, but zoomed to the 10km area around the proposed facility and indicates the sharp concentration gradient just within a few km of the site. Within 5 km of the facility, concentrations have fallen off by 75% to 30 μg/m³ or roughly 15% of the NAAQS (188 μg/m³).

FIGURE 2. 1-HOUR NO_2 MODELED IMPACTS IN IMMEDIATE VICINITY OF THE ENVIVA HAMLET FACILITY



The 1-hour modeled concentrations presented in both figures are the high-first-high (H1H) daily maximum values which are consistent with current significant impact analysis modeling procedures. Actual 1-hour NO_2 NAAQS impacts would be the high-eighth-high (H8H) daily max concentration, which would be less, perhaps substantially, than what is shown here. Given the highly localized nature of the modeled impacts shown in Figures 1 and 2, the U.S. EPA's suggested source radius of 10 km appears appropriate, even conservative for this application.

agree

SUMMARY

Given the modeling results presented in the above sections and the 1-hour NO2 NAAQS-specific modeling guidance provided by U.S. EPA, Enviva proposes to include those regional inventory sources within 10 km of the Enviva Hamlet facility. This radius clearly includes the areas of maximum concentration from the facility and allows a significant buffer for modeling variability introduced by other release characteristics and configurations from nearby sources.

If you have any questions about the material presented in this letter, require additional information, or would like to talk about this proposed approach, please do not hesitate to call me at 919-462-9693.

Sincerely,

TRINITY CONSULTANTS

Jonathan Hill
Managing Consultant

cc: Dr. Don Van der Vaart (NC DAQ)
Mr. Mike Doniger (Enviva Pellets, LLC)
Mr. Dale Overcash (Trinity Consultants)