NO. 3 BIOMASS BOILER PSD PERMIT APPLICATION
VOLUME II - MODELING
GRAPHIC PACKAGING INTERNATIONAL, INC. ▪ MACON, GEORGIA

Prepared by:

TRINITY CONSULTANTS
53 Perimeter Center East
Suite 230
Atlanta, Georgia 30346
(678) 441-9977

Project 101101.0032

and

GRAPHIC PACKAGING INTERNATIONAL, INC.
100 GPI Way
Macon, Georgia 31206
(478) 784-4411

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GRAPHIC PACKAGING CORPORATION
We Package Results

Trinity Consultants

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1. EXECUTIVE SUMMARY

Graphic Packaging International, Inc. (GPI) owns and operates an integrated pulp and paper mill (Macon Mill) in Macon, Bibb County, Georgia. GPI is proposing to install a new bubbling fluidized bed (BFB) boiler (No. 3 Biomass Boiler) at the Macon Mill. The scope of the project will require an air quality permit issued under the nonattainment new source review (NNSR) and/or Prevention of Significant Deterioration (PSD) permitting rules as facility emissions exceed NSR applicability major modification thresholds, as shown in Table 1-1.

TABLE 1-1. PROPOSED PROJECT NET EMISSION INCREASES

Pollutant	Emissions (tpy)	NSR Major Modification Threshold (tpy)	Exceed NSR Threshold? (Yes/No)
Project Potential Emissions Increases			
VOC	30.5	40	No
Pb	0.1	0.6	No
H_2S	-	10	No
Fluoride[1]	-	3	No
Net Emissions Increase			
CO	421.7	100	Yes
NO_X	38.3	40	No
SO_2	-459.9	40	No
Total PM	-13.9	25	No
Total PM_{10}	14.5	15	No
Total $PM_{2.5}$	9.6	10	No
H_2SO_4	6.9	7	No
CO_2e[2]	68,649.5	75,000	No

1. Excluding hydrogen fluoride, which is regulated per Clean Air Act Section 112.

2. NSR permitting for greenhouse gases (i.e., CO_2e) is required if NSR permitting is triggered for any other pollutant and the permit application is submitted after January 2, 2011 but before July 1, 2011.

Volume I of the PSD permit application contained the project description, emission calculation methodologies, regulatory applicability analysis, Best Available Control Technology (BACT) review, proposed permit conditions, and permit application forms. This report (Volume II) provides details of the air quality dispersion modeling conducted in support of the Volume I submittal.

The following sections detail the methods and models used to demonstrate that the proposed facility will not cause or contribute to a violation of either the National Ambient Air Quality Standards (NAAQS) or PSD Increment. The modeling methods used are consistent with the U.S. EPA's *Guideline on Air Quality Models,* 40 CFR Part 51, Appendix W (Revised, November 9, 2005), and

the U.S. EPA's *AERMOD Implementation Guide*.[1] Additionally, the ambient impact assessment of toxic air pollutant (TAP) emissions is conducted in accordance with the Georgia's *Guideline for Ambient Impact Assessment of Toxic Air Pollutant Emissions* (June 21, 1998).

The proposed project only exceeds the NSR Major Modification threshold for CO emissions. Accordingly, this report (Volume II) only addresses PSD related modeling requirements for CO emissions.

The results of the air quality dispersion modeling analyses presented in this report are summarized below.

1. The proposed project does not cause any ambient impacts of carbon monoxide (CO) above Class II Significant Impact Levels (SILs) for all applicable averaging periods in steady state modeling.

2. The proposed project does not cause any ambient impacts of CO above Class II SILs for all applicable averaging periods for startup operations.
3. The ambient impacts of TAP emissions are less than the acceptable ambient concentrations (AACs) as defined by Georgia EPD based on ISCST3 modeling.
4. A comparison of ambient lead impacts to the lead NAAQS indicates the proposed project will not lead to an exceedance of the lead NAAQS.

The PSD air quality analyses described in this report demonstrates that the proposed project will neither cause nor contribute to a violation of any NAAQS or any Georgia EPD toxic air pollutant standards.

The remainder of this modeling report is organized as follows.

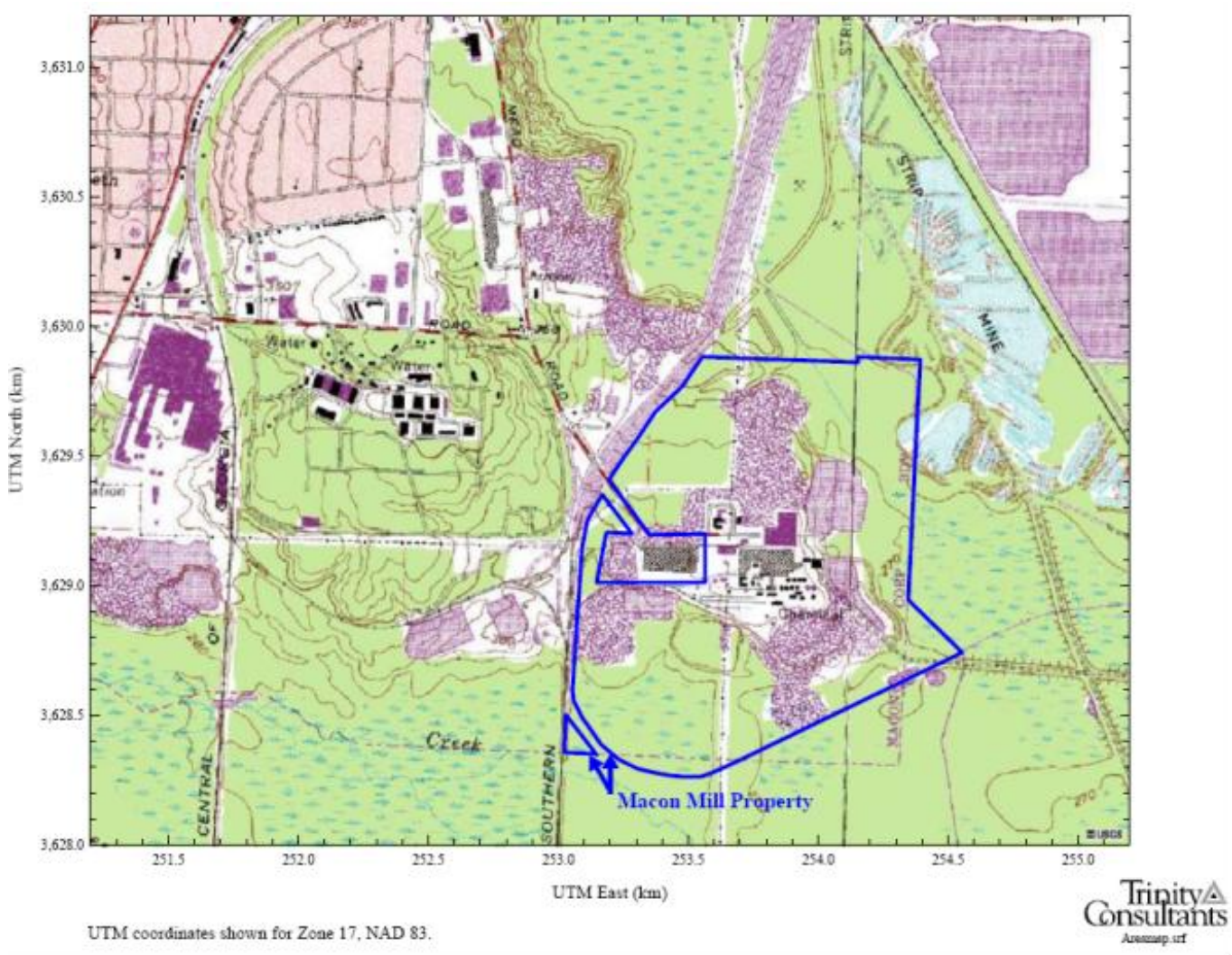
- Section 2 – description of the proposed project;
- Section 3 – required dispersion modeling analyses;
- Section 4 – technical approach employed in the modeling analyses;
- Section 5 – results of the PSD dispersion analysis;
- Section 6 – startup modeling analyses;
- Section 7 – ambient impact assessment of TAP emissions;
- Section 8 – lead NAAQS analysis;
- Appendix A – area map, site layout map, and other supporting figures;
- Appendix B – flowchart of PSD modeling requirements;
- Appendix C – electronic modeling files and figures from all analyses;

[1] http://www.epa.gov/scram001/7thconf/aermod/aermod_implmtn_guide_19March2009.pdf

- Appendix D – documentation of the Georgia EPD TAP analysis;
- Appendix E – dispersion modeling protocol and related correspondence;
- Appendix F – Class I notification letters;
- Appendix G – supporting documentation

Figure 1 provides a map of the area surrounding the Macon Mill property. The approximate central UTM coordinates of the Macon Mill are 253.68 kilometers east and 3,629.076 kilometers north in Zone 17 (NAD 83).

FIGURE 2-1. FACILITY LOCATION



GPI is proposing to install a new BFB boiler (No. 3 Biomass Boiler) at the Macon Mill. The proposed biomass boiler is currently anticipated to be equipped with flue gas recirculation, a baghouse, a selective non-catalytic reduction (SNCR) system, and will potentially include a duct sorbent injection for emissions control. The boiler, to be rated at approximately 620 MMBtu/hr heat input, will be designed to combust a variety of fuels. The boiler will be designed to combust primarily biomass. Mill wastewater treatment plant (WWTP) sludge will also be combusted. Natural gas will be utilized for startups and during some limited normal operating scenarios.

Installation of a new boiler allows the Macon Mill to shutdown the existing No. 1 Power Boiler, which combusts coal, fuel oil, and natural gas. Additionally, the ability to combust coal and fuel oil on the No. 2 Power Boiler will be removed and only natural gas combustion capability will be retained.

A detailed discussion of emission estimates, including control technology limitations, was presented in Volume I of the PSD permit application submitted in January 2011, with an update in August 2011. Figures in Appendix A present the layout of property, receptors, buildings, and modeled emission sources at the Mill. The emissions rates included in this modeling analysis are discussed in Section 3, Section 4, Section 6, and Section 7 and provided (for toxic air pollutants) in appendix D.

3. PSD MODELING REQUIREMENTS

Bibb County, home of the Macon Mill, is currently designated as a fine particulate matter ($PM_{2.5}$) nonattainment area. For all other criteria pollutants (i.e., carbon monoxide [CO], oxides of nitrogen [NO_X], sulfur dioxides [SO_2], particulate matter with an aerodynamic particle size of 10 microns or less [PM_{10}], ozone, and lead [Pb]), Bibb County has been designated as an "attainment" area or "unclassifiable". As such, the proposed project potentially requires NNSR and/or PSD permitting. Therefore, net emission increases from the proposed project and modified emission units were evaluated and compared to the major modification thresholds for regulated pollutants for NSR permitting applicability as shown in Table 1-1. It is evident, due to the emissions of the proposed project, that PSD dispersion modeling requirements are triggered for CO. As there are currently no modeling requirements regarding GHG emissions, GHG emissions have not been addressed within this modeling report.

This section of this report addresses requirements for evaluating NAAQS and additional impacts. There are no established PSD increment standards for CO. Therefore, no PSD increment analysis was necessary for this project. The PSD air dispersion modeling analyses were conducted in accordance with the following guidance documents:

- EPA's *Guideline on Air Quality Models* 40 CFR Part 51, Appendix W (Revised, November 9, 2005)
- EPA's *AERMOD Implementation Guide* http://www.epa.gov/scram001/7thconf/aermod/aermod_implmtn_guide_19March2009.pdf
- EPD's *Georgia Air Dispersion Modeling Guidance* http://www.georgiaair.org/airpermit/downloads/sspp/modeling/AirDispModelingGuid_v2.pdf

A summary of the tasks that are performed in a standard PSD air quality modeling analysis is presented in the flow chart provided as Appendix B to this report.

3.1 LOAD MODELING ANALYSIS

The *Guideline on Air Quality Models* 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. For some types of sources, operating at a reduced load translates into reduced stack gas exit velocities and/or temperatures, leading to different and potentially higher modeled impact characteristics.

In order to evaluate the worst case load condition for the No. 3 Biomass Boiler, boiler operating conditions were obtained for several different load conditions, including 40%, 60%, 80%, and 100% load. The boiler is not anticipated to be operated at normal circumstances below 40% load. Table 3-1 provides the No. 3 Biomass Boiler stack conditions for each of the specified loads.

TABLE 3-1. LOAD ANALYSIS STACK PARAMETERS

Stack Description	Load	Potential Emissions (lb/hr)	Potential Emissions (g/s)	Stack Height[1] (feet)	Stack Height[1] (meters)	Stack Temperature[1] (F)	Stack Temperature[1] (K)	Velocity[1] (ft/s)	Velocity[1] (m/s)	Diameter[1] (ft)	Diameter[1] (m)
No. 3 Biomass Boiler	40%	37.20	4.69	316	96.32	300	422.04	42.65	13.00	8.50	2.59
No. 3 Biomass Boiler	60%	55.80	7.03	316	96.32	300	422.04	56.39	17.19	8.50	2.59
No. 3 Biomass Boiler	80%	74.40	9.37	316	96.32	320	433.15	75.19	22.92	8.50	2.59
No. 3 Biomass Boiler	100%	93.00	11.72	316	96.32	320	433.15	93.99	28.65	8.50	2.59

[1] Parameters per RFI response from Larson Engineering sent by Paul Douglas via email on November 23, 2010. The temperature at 60% load was updated per email from Paul Douglas on February 22, 2011.

The load modeling analysis was conducted using the latest version (09292) of the AERMOD modeling system. Other pertinent modeling information (meteorological data used, receptor information, etc.) is as described within Section 4 of this report.

The load modeling analysis was conducted to determine the operating condition which results in the highest modeled ambient impacts. Table 3-2 presents the results for each of the modeled load analysis stack conditions. As shown in Table 3-2, the 100% load condition results indicated the worst case modeled result of all load conditions evaluated. Therefore, the 100% load condition parameters were evaluated for the No. 3 Biomass Boiler in the steady state significance modeling conducted for CO emissions in comparison to the CO SILs.

TABLE 3-2. LOAD ANALYSIS RESULTS

Stack Description	Load	Potential Emissions (lb/hr)	Potential Emissions (g/s)	Macon Met Data 1-hour Impact ($\mu g/m^3$)	Macon Met Data 8-hour Impact ($\mu g/m^3$)	GPI Met Data 1-hour Impact ($\mu g/m^3$)	GPI Met Data 8-hour Impact ($\mu g/m^3$)	Modeling Significance 1-hour ($\mu g/m^3$)	Modeling Significance 8-hour ($\mu g/m^3$)	Impacts Below Modeling Significance Level? 1-hour	Impacts Below Modeling Significance Level? 8-hour
No. 3 Biomass Boiler	40%	37.20	4.69	7.29	3.04	5.68	3.30	2,000	500	Yes	Yes
No. 3 Biomass Boiler	60%	55.80	7.03	9.80	4.02	6.94	4.41				
No. 3 Biomass Boiler	80%	74.40	9.37	11.30	4.57	7.08	5.10				
No. 3 Biomass Boiler	100%	93.00	11.72	12.65	5.11	7.76	5.70				

[1] Parameters per RFI response from Larson Engineering sent by Paul Douglas via email on November 23, 2010. The temperature at 60% load was updated per email from Paul Douglas on February 22, 2011.

3.2 SIGNIFICANCE ANALYSIS (CLASS II)

The Class II Significance Analysis is conducted to determine whether the emissions increases associated with the project would cause a significant impact upon the area surrounding the facility. The Significance Analysis is limited to CO as this is the only pollutant for which PSD modeling requirements are triggered. "Significant" impacts are defined by ambient concentration thresholds commonly referred to as the SILs, shown in Table 3-3.

TABLE 3-3. SIGNIFICANT IMPACT LEVELS, NAAQS, PSD CLASS II INCREMENTS, AND MONITORING DE MINIMIS LEVELS FOR CO

Pollutant	Averaging Period	PSD SIL ($\mu g/m^3$)	Primary and Secondary NAAQS ($\mu g/m^3$)	Class II PSD Increment ($\mu g/m^3$)	Monitoring *de minimis* Level ($\mu g/m^3$)
CO	1-hour	2,000	40,000	--[1]	--
	8-hour	500	10,000	--[1]	575

1. No PSD Increments have been established for CO.

If the highest off-property concentration is less than the SIL for all averaging periods, then further analyses are not required. This is because the emissions increases resulting in impacts less than the SIL, by definition, are unable to either cause or contribute to any exceedance of a NAAQS or PSD Increment. If concentrations exceed the SIL, NAAQS and PSD Increment analyses are required to demonstrate that the project neither causes nor contributes to any exceedances.

3.3 AMBIENT MONITORING REQUIREMENTS

Under current U.S. EPA policies, the maximum impacts due to the emissions increases from a project are also assessed against monitoring *de Minimis* levels to determine whether pre-construction monitoring should be considered. The monitoring *de Minimis* concentration for CO is listed in Table 3-3. If either the predicted modeled impact from the 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. CO modeling results as presented in this report are below the monitoring *de Minimis* concentration, and thus no pre-construction monitoring should be required.

3.4 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 which the U.S. EPA judges are necessary, with an adequate margin of safety, to protect the public health."[2] Secondary NAAQS define the levels that "protect the public welfare from any known or anticipated adverse effects of a pollutant." The objective of the NAAQS analysis is to demonstrate through air quality modeling that emissions from a proposed project do not contribute to or cause an exceedance of the NAAQS at any ambient location. Table 3-3 lists the NAAQS for CO; however, a NAAQS analysis is not required since the Significance Analysis impacts were below the SILs as demonstrated within this report.

[2] 40 CFR 50.2(b)

3.5 CLASS II PSD INCREMENT ANALYSIS

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. To achieve this goal, U.S. EPA established PSD Increments for certain pollutants. 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. The only pollutant for which the project exceeded the major NSR modification threshold for which modeling is required was CO. As CO has no established Class II increment, no Class II increment analysis was required as part of this report.

3.6 CLASS I REQUIREMENTS

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. Two principal air quality impacts are considered for Class I areas: PSD Increments for NO_2, SO_2, and PM_{10}, and air quality related values (AQRV).

In general, all PSD permit applications are required to demonstrate through air quality modeling that the emissions increases from the proposed project will not cause or contribute to any violations of allowable increments within potentially affected Class I areas, which are protected to a greater degree (i.e., the allowable increments are lower) than Class II areas. However, the only modeled pollutant for which the project exceeded the major NSR modification threshold was CO. As CO has no established Class I increment, no Class I increment analysis was conducted as part of this project.

In addition to the Class I Increment, the proposed project may be evaluated for its potential impact on AQRV at potentially-affected Class I areas. The FLM for Class I areas have the responsibility to protect AQRV and to consider, in consultation with the permitting authority, whether a proposed major emitting facility will have an adverse impact on such values. AQRV typically considered include visibility and deposition of sulfur and nitrogen.

GPI has qualitatively evaluated its impacts on federally-protected Class I areas by performing a Q/D screening analysis consistent with the recently revised Federal Land Managers Air Quality Related Values Work Group (FLAG) Phase I Report.[3] The analysis suggests that the proposed project will have no presumptive adverse impacts to any AQRVs at near-by Class I areas; therefore, GPI plans no AQRV analyses for the proposed project.

GPI submitted a request for concurrence to the appropriate FLMS on the findings of this analysis for the nearby Class I areas.[4,5,6] Copies of the letters to the FLMs presenting the Q/D screening analysis are included in Appendix F.

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[3] Federal Land Managers Air Quality Related Values Work Group (FLAG) Phase I Report, Revised 2010 located at http://www.nature.nps.gov/air/Permits/flag/index.cfm

[4] Letter from Mr. Justin Fickas (Trinity) to Mr. Bill Jackson (USDA Forest Service), dated February 28, 2011.

[5] Letter from Mr. Justin Fickas (Trinity) to Ms. Catherine Collins (US Fish and Wildlife Service), dated February 28, 2011.

3.7 ADDITIONAL IMPACTS ANALYSIS

PSD regulations require that three additional impacts be considered as part of a PSD permit action. These are a growth analysis, a soil and vegetation analysis, and a visibility analysis. The effect of the proposed project's CO emissions on local soils and vegetation is addressed through comparison of modeled impacts to secondary NAAQS and other relevant screening criteria that have been developed by U.S. EPA to provide protection for public welfare, including protection against decreased visibility, damage to animals, crops, vegetation and buildings.[7]

There will be minimal growth associated with the project. Long-term, it is not anticipated that a significant number of new jobs at the facility will be generated by this project. There is significant existing capacity in the city and county to absorb any project related growth without requiring an infrastructure or housing expansion, and any general population growth impacts would be considered *de Minimis*.

The project did not exceed the NSR major modification threshold for any visibility impairing pollutants (e.g. PM). Also, modeled impacts did not result in an exceedance of the SIL for CO. Therefore, no visibility analyses for Class II areas were necessary for this project.

[6] Letter from Mr. Justin Fickas (Trinity) to Mr. John Notar (US National Park Service), dated February 28, 2011.

[7] EPA, *A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils and Animals* (EPA 450/2-81-078). 1980.

This section includes a summary of the modeling methodology originally presented in a dispersion modeling protocol previously submitted to Mr. Peter Courtney of the Georgia EPD,[8] and approved by Georgia EPD.[9] A copy of the protocol letter and approval is included in Appendix E.

4.1 MODELED EMISSION SOURCES

As discussed in Section 3 of this report, a Significance Analysis evaluates the emission increases associated with the project. This section discusses the emission sources and rates included in each of these analyses.

4.1.1 MACON MILL MODELED SOURCES

Table 4-1 presents a summary of the Macon Mill modeled sources included in the steady state Significance Analysis. For the short-term averaging periods, the emission rates reflect normal operations (short-term emissions for startup and/or shutdown operations are addressed in Section 6). Sources were modeled assuming continuous operation at the potential-to-emit rates. The modeled emission rate for the No. 3 Biomass Boiler corresponds to the proposed BACT emission limit for the source of 0.15 lb/MMBtu on a 30-day rolling average.[10] The No. 2 Power Boiler emissions are conservatively represented using the new potential-to-emit of the unit when combusting solely natural gas.[11] The modeled emission rate has not been reduced to reflect baseline actual emissions.

TABLE 4-1. MODELED MACON MILL SOURCE LIST

				Stack Parameters									Emissions		
Emission Unit ID	Stack ID	Emission Release Point Type	Point Description	Height (ft)	Height (m)	Temperature (F)	Temperature (K)	Flow Rate (acfm)	Velocity (ft/sec)	Velocity (m/sec)	Diameter (ft)	Diameter (m)	Potential Emissions (tpy)	Potential Emissions (lb/hr)	Potential Emissions (g/s)
B002[1]	ST15 (new stub)	02 - Vert	No. 2 Power Boiler	65.00	19.81	370.00	460.93	76,000	179.20	54.62	3.00	0.91	20.33	4.64	0.58
B005[2]	ST14 (new)	02 - Vert	No. 3 Biomass Boiler	316.00	96.32	320.00	433.15	320,000	93.99	28.65	8.50	2.59	407.34	93.00	11.72

1. Stack diameter per email from Jim McGahee (GPI) on October 20, 2011. Temperature and flow rate per email from Kathleen Wheeler (GPI) on January 11 and stack height on January 12, 2011.
2. Parameters per RFI response from Larson Engineering sent by Paul Douglas via email on November 23, 2010.

[8] Letter from Mr. Justin Fickas (Trinity) to Mr. Peter Courtney (Georgia EPD) dated January 14, 2011.

[9] Letter from Mr. Peter Courtney (EPD) to Mr. Justin Fickas (Trinity) dated February 1, 2011.

[10] 0.15 lb/MMBtu * 620 MMBtu/hr = 93 lb/hr

[11] 198 MMBtu/hr * 1 scf/1,024 Btu * 24 lb CO / MMscf = 4.64 lb/hr

4.2 SELECTION OF MODEL

The latest version (09292) of the AERMOD modeling system was used to estimate maximum ground-level concentrations in the Significance Analysis 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 for this type of air quality analysis.[12] 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 (BPIP PRIME), version 04274.[13] 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.[14]

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 Database (NED) data available from the USGS are utilized to interpolate surveyed elevations onto user-specified receptor grids and buildings and sources in the absence of more accurate site-specific 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 particular facility and/or meteorological site. By feeding raw surface and upper air station NWS observation data to AERMET, a complete set of model-ready meteorological data specific to the project can be created. The details of the AERMET processing are provided in Section 4.3 below.

The *BREEZE*®-AERMOD Pro software, developed by Trinity Consultants, was used to assist in developing the model input files for AERMOD and AERMET, respectively. These software programs incorporate and utilize the most recent U.S. EPA versions of AERMOD (dated 09292), AERMET (dated 06341), and AERMAP (dated 09040) to estimate ambient impacts from the modeled sources. Following procedures outlined in the *Guideline*, the AERMOD modeling was performed using all regulatory default options.

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[12] 40 CFR Part 51, Appendix W–*Guideline on Air Quality Models*, Appendix A.1– AMS/EPA Regulatory Model (AERMOD).

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

[14] 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.

4.3 METEOROLOGICAL DATA AND LAND USE REPRESENTATIVENESS

The U.S. EPA's federal *Guideline on Air Quality Models*, codified at 40 CFR Part 51, Appendix W, states in Section 9.3.1.2, "Meteorological Input Data – Recommendations" that:

> *… five years of representative meteorological data should be used when estimating concentrations with an air quality model. Consecutive years from the most recent, readily available 5-year period are preferred. The meteorological data may be collected either onsite or at the nearest National Weather Service (NWS) station.*

The meteorological data that are "representative" for a particular facility are typically determined subjectively, and the *Guideline* offers the following guidance in Section 9.3(a).

> *The meteorological data … should be selected on the basis of spatial and climatological (temporal) representativeness as well as the ability of the individual parameters selected to characterize the transport and dispersion conditions in the area of concern. The representativeness of the data is dependent on: (1) the proximity of the meteorological monitoring site to the area under consideration; (2) the complexity of the terrain; (3) the exposure of the meteorological monitoring site; and (4) the period of time during which data are collected. The spatial representativeness of the data can be adversely affected by large distances between the source and receptors of interest and the complex topographic characteristics of the area.*

GPI conducted a land use representativeness analysis for the Macon Mill and two nearby NWS stations (Atlanta and Macon) that was submitted in the modeling protocol to identify the meteorological data set most appropriate for use with the Macon Mill.[15] It was found that the surface characteristics of the Macon Mill were dissimilar to both the Macon and Atlanta NWS stations; however, GPI proposed that the Macon (MCN) NWS station is slightly more representative of the expected land use conditions at the Macon Mill and provides a suitable match. It was also acknowledged that an additional preprocessed weather data set using the surface characteristics of the Macon Mill might be more representative.

Therefore, the Georgia EPD provided GPI with AERMET processed meteorological data files for using the surface characteristics of the Macon weather station, as well as the surface characteristics of the GPI Macon Mill.[16] These files had already been processed using the latest version of AERMET (06341). As such, no AERMET processing was required to be performed by GPI. All AERMOD modeling analyses were conducted for both meteorological data sets for the 1987-1991 time periods. A 5 year concatenated meteorological dataset was used in the refined modeling analysis for both meteorological datasets to reduce the number of model runs in the analyses. The height of the Macon (Centerville) meteorological profile base (met station elevation above sea-level, used in computation

[15] Letter from Mr. Justin Fickas (Trinity) to Mr. Peter Courtney (EPD) dated January 14, 2011.

[16] AERMET files provided via email to Mr. Justin Fickas (Trinity) by Mr. Pete Courtney (EPD) on February 3, 2011.

of the potential temperature) is listed on the National Climatic Data Center (NCDC) website as 354 ft (107.9 meters).[17,18]

4.4 RECEPTOR GRID COORDINATE SYSTEM

For this air dispersion modeling analysis, ground level concentrations were calculated at receptors placed along the fence line and on a Cartesian receptor grid. Fence line receptors were spaced 100 meters apart, as specified in the Georgia Air Dispersion Modeling Guidance.[19] Beyond the fence line, receptors are spaced 100 meters apart in a Cartesian grid extending to a radius of 2 km in all directions, then spaced 250 meters apart extending to a radius of 5 km from the fence line, and spaced 500 meters apart extending to a radius of 10 km from the fence line.

Receptor elevations required by AERMOD were determined using the AERMAP terrain preprocessor (version 09040). AERMAP also calculates hill height parameters required by AERMOD. Terrain elevations from the USGS 1/3 arc second NED were used for AERMAP processing.[20] NED data are freely available from the USGS via its National Map Viewer.[21] The map allows a user to interactively view and download geographic data from the USGS and other government agencies. AERMAP uses elevation data files to determine the terrain profiles around the receptors (where impacts are calculated).

The NED data utilized in the modeling analyses was downloaded by selecting the region covering the Class II receptor grid and was based on approximate geographic coordinates. Then the 1/3 arc second NED CONUS (Continental US) data format was selected.

The downloaded files were in ZIP file format and included the GeoTIFF NED data file (.TIF extension), the TIF world file enabling the file to be mapped in GIS (.TFW extension), and additional metadata for the file. The TIF is the only file used in AERMAP to obtain the receptors elevations. Copies of the NED files are included on the CD in Appendix C. Plots of the receptor locations and elevations are included in Appendix A.

4.5 BUILDING DOWNWASH

The emission units at the Macon Mill were evaluated in terms of their proximity to nearby structures. The purpose of this 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. The current

[17] Per email from Mr. Pete Courtney (Georgia EPD) and Ms. Lori Price (Trinity Consultants), dated April 16, 2010. https://mi3.ncdc.noaa.gov/mi3qry/locationGrid.cfm?fid=5123&stnId=5123&PleaseWait=OK

[18] As provided in the Stage 3 AERMET input files provided by Mr. Pete Courtney (EPD) on February 3, 2011.

[19] Georgia EPD's *Georgia Air Dispersion Modeling Guidance*, December 1, 2006.

[20] NED obtained from USGS: http://nmviewogc.cr.usgs.gov/viewer.htm

[21] http://nmviewogc.cr.usgs.gov/viewer.htm

version of the AERMOD dispersion model treats building wake effects following the algorithms developed by Schulman and Scire.[22] This approach requires the modeler to input wind direction-specific building dimensions for structures located within 5*L* of a stack, where *L* is the lesser of the height or projected width of a nearby structure. Stacks taller than the structure height plus 1.5*L* are not subject to the effects of downwash in the AERMOD model.

For these modeling analyses, the direction-specific building dimensions used as input to the AERMOD model were calculated using the U.S. EPA sanctioned Building Profile Input Program, PRIME version (BPIP PRIME), version 04274, as incorporated in the *BREEZE®AERMOD Pro* software, developed by Trinity. 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.[23]

Output from the BPIP PRIME downwash analysis is provided in the electronic files included in Appendix C. The output contains a summary of the dominant structure for each emissions unit and the actual building height and projected widths for all wind directions. A plot of the Macon Mill buildings used in the analysis is included in Appendix A.

4.6 REPRESENTATION OF EMISSION SOURCES

4.6.1 COORDINATE SYSTEM

In all modeling analysis input and output files, the location of emission sources, structures, and receptors will be represented in the UTM coordinate system (NAD 83). The Macon Mill is located at approximately 253.68 kilometers east and 3,629.076 kilometers north in Zone 17 (NAD 83).

4.6.2 SOURCE TYPES

The AERMOD dispersion model allows for emissions units to be represented as point, area, or volume sources. For point sources with unobstructed vertical releases, it is appropriate to use actual stack parameters (i.e., height, diameter, exhaust gas temperature, and gas exit velocity) in the modeling analyses. Table 4-1 above provides details on the source parameters for point sources used in the AERMOD modeling analyses.

4.6.3 GEP STACK HEIGHT ANALYSIS

The U.S. 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. The

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

[23] 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.

GEP height of a stack is the greater of (1) 65 meters (measured from the base elevation of the stack) and (2) the value returned from the following equation: [24]

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

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

Under the regulations, that portion of a stack that is in excess of the GEP stack height is generally not creditable when modeling to determine source impacts, preventing the use of excessively tall stacks to reduce ground-level pollutant concentrations. Stacks that have a release height lower than their GEP value were modeled at their actual release height.

A GEP analysis was conducted for each stack included in these modeling analyses using BPIP. All point source stacks were either below 65 meters in height or less than their GEP values. Therefore, the stacks were modeled at the actual release heights.

[24] 40 CFR 51.100(ii).

This section summarizes the results of the Class II dispersion modeling analyses and demonstrates that the proposed changes at the Macon Mill do not cause or contribute to an exceedance of the NAAQS during normal operations. The results of the startup modeling analysis are presented in Section 6. Electronic copies of modeling files are included on a CD-ROM in Appendix C.

5.1 SIGNIFICANCE ANALYSIS

5.1.1 CLASS II SIGNIFICANCE ANALYSIS

As discussed in Section 3, a Significance Analysis was conducted to determine the need for further pollutant modeling. The results of the Significance Analysis for CO are provided in Tables 5-1 and 5-2. A comparison of the significance modeling results and the monitoring *de Minimis* levels is shown in Table 5-3.

TABLE 5-1. CO SIGNIFICANCE RESULTS (MCN MET DATA)

Averaging Period	Year[1]	UTM East (km)	UTM North (km)	Max Conc. (µg/m^3)	SIL (µg/m^3)	Exceeds SIL?	SIA (km)
1-Hour	1989	253,527.6	3,629,021.5	29.68	2,000	No	N/A
8-Hour	1990	253,528.1	3,629,041.3	15.33	500	No	N/A

1. The maximum concentration is based on a single model run using a 5-year concatenated meteorolgical dataset.

TABLE 5-2. CO SIGNIFICANCE RESULTS (GPI MET DATA)

Averaging Period	Year[1]	UTM East (km)	UTM North (km)	Max Conc. (µg/m^3)	SIL (µg/m^3)	Exceeds SIL?	SIA (km)
1-Hour	1990	253,528.1	3,629,041.3	23.23	2,000	No	N/A
8-Hour	1988	253,528.7	3,629,066.3	12.42	500	No	N/A

1. The maximum concentration is based on a single model run using a 5-year concatenated meteorolgical dataset.

As shown in the tables above, both averaging periods for CO are below the SILs for both meteorological datasets, and no further modeling is required to demonstrate compliance with the air quality standards.

TABLE 5-3. COMPARISON AGAINST MONITORING DE MINIMIS LEVELS

Pollutant	Averaging Period	Year	UTM East (km)	UTM North (km)	Max Conc. (µg/m^3)	Monitoring *De Minimis* (µg/m^3)	Exceeds *De Minimis?*
CO	8-Hour	1990	253,528.1	3,629,041.3	15.33	575	No

The modeled impacts of CO do not exceed the monitoring *de Minimis* levels and no pre-construction monitoring requirements are expected.

5.2 ADDITIONAL IMPACTS

Significance Analysis impacts were compared against conservative screening levels provided by U.S. EPA specifically to address potential soil and vegetation impacts.[25] Table 5-4 shows that no impacts exceed the U.S. EPA screening levels. Thus, there are no adverse impacts expected on soils or vegetation. All other pollutants documented within Table 3.1 of the U.S. EPA screening document either had no facility net emissions increase as part of this project (i.e. lead), or are not exceeding the NSR major modification thresholds for this project (e.g. NO_X).

TABLE 5-4. SOIL AND VEGETATION IMPACTS

Pollutant	Averaging Period	Total Concentration[1] (µg/m^3)	Vegetation Sensitivity[2]			Minimum Threshold (µg/m^3)	Threshold Exceeded?
			Sensitive (µg/m^3)	Intermediate (µg/m^3)	Resistant (µg/m^3)		
CO[3]	1 -wk	29.68	1,800,000	-	18,000,000	1,800,000	No

1. Impact associated with the emission rates as included in the Significance Analysis.

2. Screening concentrations based on Table 3.1 in *A Screening Procedure for Impact of Air Pollution Sources on Plants, Soil and Animals* , EPA, December 12, 1980. Minimum values noted if range listed.

3. Maximum impact is for 1-hour averaging period since AERMOD does not calculate a weekly averaging period.

[25] EPA, *A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals* (EPA 450/2-81-078), 1981.

6. STARTUP MODELING ANALYSES

This section addresses the analysis of hour-by-hour emissions during startup for CO emissions, then demonstrates that these modeled emission rates do not cause an exceedance of any ambient air quality standard.

Specific stack parameters and emissions were estimated for each hour of startup. Dispersion modeling was then conducted with these estimates for two scenarios: one with startup beginning at 12 AM for the No. 3 Biomass Boiler and the other with startup beginning at 12 PM. These times were picked as the most likely potential start times for the units, though the units could commence operation at other times. These startup times are also believed to be representative of the span of potential meteorological conditions that would be encountered during the hours of startup.

6.1 STARTUP PARAMETER AND EMISSION ESTIMATES

Table 6-1 provides the hour by-hour data modeled for each startup scenario (12 AM and 12 PM) for the No. 3 Biomass Boiler. The table also provides the stack parameters for the No. 2 Power Boiler, which was conservatively modeled during the startup assessment for the new boiler. Table 6-2 provides the startup parameters for a cold start of the No. 3 Biomass Boiler. For the first three hours of the startup cycle, the unit will utilize only natural gas for combustion. During hour four of the startup cycle, biomass will begin to be introduced into the boiler. It will take approximately eight hours for the boiler to reach 100% load from a cold start.

The emission rates indicated in the startup cycle are based on vendor provided data for CO emissions during startup. Volume I of the PSD permit application proposed a BACT emission limit for CO for the No. 3 Biomass Boiler of 0.15 lb/MMBtu on a 30-day rolling average, excluding startup and shutdown. GPI has also proposed a secondary CO BACT limit of 407.3 tpy, equivalent to the maximum mass hourly emission rate allowed by the primary BACT limit, presuming 8,760 hours per year of operation, that would apply at all times including periods of startup and shutdown.

Therefore, the modeled emission rates for CO during the startup cycle are not in contradiction with the proposed BACT emission limits in Volume I of the report. The emission rate used for the last three hours of the startup cycle, and once steady state operation was achieved, was equivalent to the same numeric limit of 0.15 lb/MMBtu proposed as BACT. Therefore, the modeled emission rate once startup was achieved is consistent with the numeric BACT emission limit of 0.15 lb/MMBtu proposed in Volume I of the PSD permit application.

TABLE 6-1. EMISSIONS DATA FOR HOUR-BY-HOUR CO STARTUP MODELING

Startup Hour[1]	Phase Description[1]	Estimated Heat Input	Estimated Steam Load[1]	Biomass Fired?[1]	Heat Input (MMBtu/hr)[1]			CO Emissions[1] (lb/MMbtu)	CO Emissions (lb/hr)	Height[1] (ft)	Temperature[1] (F)	Flow Rate[1] (acfm)	Diameter[1] (ft)	Velocity (ft/s)
					Natural Gas	Biomass	Total							
1	Natural Gas	12%	0.06%	No	71.8	0.0	71.8	0.6276	45.1	316	250	124,103	8.5	36.45
2	Natural Gas	21%	4%	No	133.3	0.0	133.3	0.3922	52.3	316	250	172,788	8.5	50.75
3	Natural Gas	21%	23%	No	133.3	0.0	133.3	0.3922	52.3	316	300	172,788	8.5	50.75
4	Natural Gas	29%	27%	Yes	114.2	63.6	177.7	0.1961	34.9	316	300	195,184	8.5	57.33
5	Biomass	46%	44%	Yes	0.0	286.2	286.2	0.1500	42.9	316	300	162,462	8.5	47.72
6	Biomass	64%	63%	Yes	0.0	397.4	397.4	0.1500	59.6	316	300	215,385	8.5	63.26
7	Biomass	95%	95%	Yes	0.0	588.2	588.2	0.1500	88.2	316	320	303,590	8.5	89.17
8-24	Normal Operation	100%	100%	Yes	0.0	620.0	620.0	0.1500	93.0	316	320	320,000	8.5	93.99

1. Per RFI response from Larson Engineering sent by Paul Douglas via email on November 23, 2010, February 18 and February 22, 2011.

TABLE 6-2. EMISSIONS DATA FOR HOUR-BY-HOUR CO STARTUP MODELING

Startup Hour	Model ID	Source Description	CO (g/s)	Height (m)	Temperature (K)	Diameter (m)	Velocity (m/s)
1	ST14_1	No. 3 Biomass Boiler	5.677E+00	96.32	394.26	2.59	11.11
2	ST14_2	No. 3 Biomass Boiler	6.587E+00	96.32	394.26	2.59	15.47
3	ST14_3	No. 3 Biomass Boiler	6.587E+00	96.32	422.04	2.59	15.47
4	ST14_4	No. 3 Biomass Boiler	4.392E+00	96.32	422.04	2.59	17.47
5	ST14_5	No. 3 Biomass Boiler	5.408E+00	96.32	422.04	2.59	14.54
6	ST14_6	No. 3 Biomass Boiler	7.511E+00	96.32	422.04	2.59	19.28
7	ST14_7	No. 3 Biomass Boiler	1.112E+01	96.32	433.15	2.59	27.18
8-24	ST14_824	No. 3 Biomass Boiler	1.172E+01	96.32	433.15	2.59	28.65
N/A	ST15	No. 2 Power Boiler	5.847E-01	19.81	460.93	0.91	54.62

6.2 STARTUP DISPERSION MODELING METHODOLOGY

The Significance Analyses for CO, as discussed in Section 5.1, demonstrated that the project did not exceed the SILs for the CO 1-hr and 8-hr averaging periods. Therefore, the startup modeling assessment was conducted as a significance analysis to determine if the appropriate SILs for CO would be exceeded. Please refer to Table 3-3 for a discussion of the appropriate SILs. The modified and associated emission units with this project, the new No. 3 Biomass Boiler, and the No. 2 Power Boiler, were included within the startup modeling assessment to compare impacts to the established SILs. Power Boiler 2 was conservatively modeled at its potential to emit CO combusting natural gas, with the No. 3 Biomass Boiler modeled with the emission rates provided in Table 6-1 and Table 6-2. This assessment was conservative as it did not account for project decreases of CO detailed in Volume I.

Each of the startup hours for the No. 3 Biomass Boiler was assigned an individual source ID with specific stack parameters as described in Tables 6-1 and 6-2. Hours 8 to 24, which encompass normal operation at 100% load, were modeled as one source since the stack parameters and emission rates do not change over this time interval. Next, the EMISFACT and HOUREMIS keywords within AERMOD were enabled for each stack ID. This keyword combination provides the option of specifying hourly emission rates for modeled sources. Thus, each source ID was assigned a non-zero

emission rate only for the hour(s) that it represents and zero emissions from that source ID for all other hours of the day. This hour-by-hour cycle is repeated in AERMOD every day for the entire year.

The results of each modeled startup scenario are discussed in the following section 6.3. Electronic modeling files are provided on the CD included in Appendix C.

6.3 CLASS II STARTUP MODELING

6.3.1 CLASS II STARTUP SIGNIFICANCE RESULTS

The results of the Significance Analysis for CO for both startup scenarios are provided in Table 6-3 through Table 6-6.

TABLE 6-3. 12AM STARTUP, CO SIGNIFICANCE ANALYSIS RESULTS (MCN MET DATA)

Averaging Period	Year[1]	UTM East (km)	UTM North (km)	Max Conc. (µg/m^3)	SIL (µg/m^3)	Exceeds SIL?	SIA (km)
1-Hour	1989	253,527.6	3,629,021.5	29.68	2,000	No	N/A
8-Hour	1990	253,528.1	3,629,041.3	15.33	500	No	N/A

1. The maximum concentration is based on a single model run using a 5-year concatenated meteorolgical dataset.

TABLE 6-4. 12PM STARTUP, CO SIGNIFICANCE ANALYSIS RESULTS (MCN MET DATA)

Averaging Period	Year[1]	UTM East (km)	UTM North (km)	Max Conc. (µg/m^3)	SIL (µg/m^3)	Exceeds SIL?	SIA (km)
1-Hour	1989	253,527.6	3,629,021.5	29.68	2,000	No	N/A
8-Hour	1990	253,528.1	3,629,041.3	15.33	500	No	N/A

1. The maximum concentration is based on a single model run using a 5-year concatenated meteorolgical dataset.

TABLE 6-5. 12AM STARTUP, CO SIGNIFICANCE ANALYSIS RESULTS (GPI MET DATA)

Averaging Period	Year[1]	UTM East (km)	UTM North (km)	Max Conc. (µg/m^3)	SIL (µg/m^3)	Exceeds SIL?	SIA (km)
1-Hour	1990	253,528.1	3,629,041.3	23.23	2,000	No	N/A
8-Hour	1988	253,528.7	3,629,066.3	12.42	500	No	N/A

1. The maximum concentration is based on a single model run using a 5-year concatenated meteorolgical dataset.

TABLE 6-6. 12PM STARTUP, CO SIGNIFICANCE ANALYSIS RESULTS (GPI MET DATA)

Averaging Period	Year[1]	UTM East (km)	UTM North (km)	Max Conc. ($\mu g/m^3$)	SIL ($\mu g/m^3$)	Exceeds SIL?	SIA (km)
1-Hour	1990	253,528.1	3,629,041.3	23.23	2,000	No	N/A
8-Hour	1988	253,528.7	3,629,066.3	12.42	500	No	N/A

1. The maximum concentration is based on a single model run using a 5-year concatenated meteorolgical dataset.

As shown in the preceding tables, CO does not have a significant impact during startup, and further a NAAQS analysis is not required since CO shows impacts below the SIL.

7. TOXIC AIR POLLUTANTS IMPACT ASSESSMENT

This section details the assumptions used for completing the toxic air pollutant (TAP) modeling analysis (i.e., model setup) and the results of modeling analysis.

Georgia EPD regulates the emissions of TAP emissions through a program approved under the provisions of *Georgia Rules for Air Quality Control*, 391-3-1-.02(2)(a)3(ii). A TAP is defined as any substance that may have an adverse effect on public health, excluding any specific substance that is covered by a State or Federal ambient air quality standard. Procedures governing the Georgia EPD's review of toxic air pollutant emissions as part of air permit reviews are contained in the agency's *Guideline for Ambient Impact Assessment of Toxic Air Pollutant Emissions (Guideline)*.[26]

7.1 DERIVATION OF ACCEPTABLE AMBIENT CONCENTRATION

According to the *Guideline*, dispersion modeling should be completed for each potentially toxic pollutant having quantifiable emission increases. The *Guideline* infers that a pollutant is identified as a toxic pollutant if any of the following toxicity-determined values have been established for that pollutant:

- U.S. EPA Integrated Risk Information System (IRIS) reference concentration (RfC) or unit risk;
- Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PEL);
- American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV);
- National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limits (REL); and,
- Lethal Dose – 50% (LD50) Standards.

The *Guideline* specifies that the resources should be referenced in the priority schedule listed above to determine long-term and short-term acceptable ambient concentrations (AACs) based on the exposure limits that are provided.

The AAC for each toxic pollutant is calculated from the toxicity data presented in the resources listed above. For any pollutant, both a long-term and short-term AAC might be calculated. If a pollutant has an RfC and/or unit risk, an annual average (long-term) AAC can be calculated as follows. The RfC is an estimate of daily inhalation exposure that is likely to be without an appreciable risk of deleterious effects during a lifetime. The unit risk is a quantitative assessment of cancer-causing potential per concentration of air inhaled. An annual average AAC is obtained by dividing the unit risk by a cancer risk factor based on the weight-of-evidence classification, i.e., 1:1,000,000 for known carcinogens (class A), 1:100,000 for probable carcinogens (class B), and 1:10,000 for suspected carcinogens (class C). The resultant is an annual average AAC in units of micrograms per cubic

[26] *Guideline for Ambient Impact Assessment of Toxic Air Pollutant Emissions*. Georgia Department of Natural Resources, Environmental Protection Division, Air Protection Branch, Revised, June 21, 1998.

meter ($\mu g/m^3$). RfC values are given in units of milligrams per cubic meter (mg/m^3) and require no conversion.

If RfC and unit risk data are not available in the IRIS database, then an annual standard cannot be calculated and a 24-hour AAC must be derived. The bases for the 24-hour standards are the OSHA PEL given at 29 CFR Part 1910 Subpart Z, followed in priority by the ACGIH TLV, NIOSH REL, and LD50 databases. These resources provide exposure limits as time-weighted averages (TWA) in terms of occupational exposure duration (i.e., typically an 8-hour average). If a TWA value is provided for a given pollutant, the 24-hour average AAC is derived as follows. First, an adjustment factor (i.e., 40 divided by the total weekly emitting hours) is applied to the TWA to account for exposure in excess of occupational duration. This adjustment factor is assumed to be 168 hours per week for continuous operation. Second, the adjusted TWA is divided by a safety factor to account for human carcinogenicity: 100 for pollutants that are not known human carcinogens, 300 for pollutants that are known human carcinogens. The resultant value is adopted as a 24-hour AAC. Per the *Guideline*, if a toxic air pollutant has an annual AAC, then the derivation of and comparison to a 24-hour standard is not required.

An additional standard must be met if a given pollutant has listed a Short Term Exposure Limit (STEL) or Ceiling (C) in any one of the above-named resources. A STEL is a 15-minute weighted average concentration that should not be exceeded at any time during the workday. A C value is a concentration that should not be exceeded at any time during occupational exposure. These values have been established for pollutants that are acute sensory irritants and apply as a 15-minute standard, also adjusted by a safety factor of 10 as recommended by the *Guideline*. No other adjustment factor is applied to STEL or C values. A 15-minute average standard, if applicable, must be met in addition to an annual average and/or 24-hour average standard. The *Guideline* clearly states that each of annual, 24-hour, and 15-minute AAC should be derived if the appropriate toxicity information is provided in any of the listed resources.

With respect to the long term acrolein AAC development, Trinity is proposing reliance on an alternative from EPD's standard approach. Documentation and research which supports a higher annual AAC of 0.15 $\mu g/m^3$ was found under the final Development Support Documents (DSDs) on the Texas Commission on Environmental Quality (TCEQ) website.[27] The TCEQ Toxicology Division reviews inhalation reference values (ReVs), inhalation unit risk factors (URF's) and effects screening levels for a subset of toxic pollutants and provides a detailed derivation on the development of values used in toxic impact evaluations.

Specifically, the TCEQ conducted a comprehensive literature search through December of 2009 for the purpose of reviewing the toxicity of acrolein on a long term basis. In short, a key study was found, Dorman et al. (2008), and is what the final long-term screening level value, or annual AAC, is based on. The TCEQ DSD distinguishes that the U.S. EPA's 2003 Reference Concentration (RfC) of 0.02 $\mu g/m^3$ is based on the study Feron et al. from 1978 whereas the TCEQ, as well as the California EPA, screening levels are based on the more recent 2008 study by Dorman et al.

[27] http://tceq.com/assets/public/implementation/tox/dsd/final/nov10/acrolein.pdf

Trinity proposes the use of 0.15 µg/m^3 for the annual AAC of acrolein as an acceptable limit to assess ambient impacts against. This value is consistent with values established by both the TCEQ and California EPA. Supporting TCEQ documentation for the annual AAC for acrolein of 0.15 µg/m^3 is provided in Appendix G.

Details on the development of the toxic emissions AACs for the proposed project are provided in Appendix D. GPI has evaluated the available reference material to determine the applicable AAC standards for all TAP for which an emission increase is occurring as a result of the proposed project, as detailed in Section 7.2.

Tables D-10 through D-12 summarize the annual, 24-hour and 15-minute AACs for these pollutants.

7.2 DETERMINATION OF TAPS

The TAP analysis would generally be an assessment of off-property impacts due to mill-wide emissions of any TAP that experiences an emissions increase due to the proposed project. However, to conduct a mill-wide TAP impact evaluation for any pollutant that could conceivably be emitted at an increased level as a result of the proposed project is impractical. A literature review would suggest that at least one molecule of hundreds of organic and inorganic chemical compounds could be emitted from the proposed boiler, which is understandable given the nature of biomass and natural gas combustion. The vast majority of compounds with emissions increases however are emitted in only trace amounts that are not reasonably quantifiable. Therefore, GPI refined the list of TAP assessed to those pollutants that are otherwise regulated at the Macon Mill, i.e., regulated by emissions standards.[28] The subset of compounds which was evaluated is detailed in the following paragraphs.

Subpart MM identified eleven particulate matter HAP as being warranted for regulation.[29]

- Antimony
- Arsenic
- Beryllium
- Cadmium
- Chromium
- Cobalt
- Lead
- Manganese
- Mercury
- Nickel
- Selenium

NESHAP Subpart S targets the reduction of specific pollutants generally emitted in the highest quantities from pulp and paper mill operations.[30] The primary pollutants of concern include the following:[31]

[28] The proposed short list of air toxics was approved in the letter from Mr. Peter Courtney (EPD) to Mr. Justin Fickas (Trinity) dated February 1, 2011.

[29] 40 CFR 63.861

[30] 63 FR 18507, April 15, 1998.

[31] Two other additional pollutants are listed in Subpart S for which there is no published biomass or natural gas emission factor data, and thus are not expected to have increased emissions: cumene and o-cresol.

- Acrolein
- Acetaldehyde
- Carbon Tetrachloride
- Chloroform
- Formaldehyde
- Methanol
- Methylene Chloride
- Methyl Ethyl Ketone
- Phenol
- Propionaldehyde
- 1,2,4-Trichlorobenzene
- o-Xylene

The major pollutants included in the March 2011 Boiler MACT include the following:

- Dioxins/furans
- Hydrochloric Acid
- Hydrogen fluoride
- Mercury

This list captures all TAP that are reasonably anticipated to be emitted in quantities that would warrant an evaluation in a dispersion model.[32] These TAP were then evaluated to determine if a net emissions increase for these pollutants would occur as a result of this project at the mill. The future potential emissions increase of the TAP of interest for the No. 2 Power Boiler and No. 3 Biomass Boiler were compared to the past actual emissions decrease associated with shutdown of the No. 1 Power Boiler and the removal of coal and fuel oil from the No. 2 Power Boiler. Average past actual emissions for those sources was based on the maximum 2-year average past actual emissions for the TAP of interest from the source within the last ten years, the same methodology employed for establishing baseline past actual for NSR applicability evaluations. Calculations demonstrating this netting evaluation can be found in Appendix D.

Following the determination of which of the TAP of interest would have a project net emissions increase, the emission sources at the facility which emitted those TAP were identified. All sources were then modeled at their PTE for the remaining TAP of interest. Only those TAP for which sufficient documentation was available to develop the necessary AAC values were modeled. Multiple dioxin and furan compounds for which emissions were estimated did not have sufficient information available to develop an AAC value. All sources at the Macon Mill considered in the toxics analysis demonstrate that there are no adverse impacts resulting from the cumulative effects of multiple point sources of TAP emissions.

7.3 DETERMINATION OF TOXIC AIR POLLUTION IMPACT

The Georgia EPD Guideline recommends a tiered approach to model TAP impacts, beginning with screening analyses using SCREEN3, followed by refined modeling, if necessary. The following sections present the modeling methodology and the model results.

7.3.1 SELECTION OF THE MODEL

Two levels of air quality dispersion model sophistication exist: screening and refined dispersion modeling. Normally, screening modeling is performed to determine the need for

[32] Note that this approach for identifying TAP for modeling purposes is consistent with the approach approved by Georgia EPD in the 2005 PSD application submitted by the Weyerhauser NR Company Flint River Operations that was approved by Georgia EPD's dispersion modeling group per the modeling protocol response letter from Mr. Jim Stogner (Georgia EPD) to Ms. Lori Price (Trinity), dated December 15, 2004.

refined modeling. When results from a screening model indicate potentially adverse impacts, a refined modeling analysis is performed. A refined modeling analysis can provide a more accurate estimate of a source's impact and requires more detailed and precise input data than a screening model. Screening modeling was not performed due to the larger number of sources and toxics being evaluated; therefore, refined modeling was carried out for the toxic pollutants being assessed. The U.S. EPA ISCST3 model (02035) was used to assess emissions from the non-emergency and significant units at the Macon Mill, as allowed per the Georgia guideline.

7.3.2 REFINED MODELING ANALYSIS

ISCST3 requires that the land surrounding the facility be classified as either urban or rural, in order to select the proper dispersion coefficients. As the location for the Macon Mill is largely surrounded by commercial/industrial/transportation and woody wetland, a land classification of rural was selected for the analysis. Similar to the Significance Analysis, a 5 year concatenated Macon/Centreville (1974-1978) meteorological dataset, as produced from meteorological data available on the Georgia EPD website, was used in the refined modeling analysis.

Similar to the Significance Analysis, ground level concentrations were calculated at receptors placed along the fence line and on a Cartesian receptor grid. Fence line receptors were spaced 100 meters apart, as specified in the Georgia Air Dispersion Modeling Guidance. Beyond the fence line, receptors are spaced 100 meters apart in a Cartesian grid extending to a radius of 2 km in all directions, then spaced 250 meters apart extending to a radius of 5km from the fence line, and spaced 500 meters apart extending to a radius of 10km from the fence line. Buildings, emission sources, and receptor elevations were determined using the AERMAP terrain preprocessor (version 09040).

In the refined modeling analysis, for point sources with unobstructed vertical releases, it is appropriate to use actual stack parameters (i.e., height, diameter, exhaust gas temperature, and gas exit velocity) in the modeling analyses. Per the Model Clearinghouse Record 93-II-09, the velocity of pseudo-point sources (tank emissions or sources with raincaps or horizontal discharges) was adjusted to 0.003 feet/second (0.001 meters/seconds). Consistent with the Georgia EPD *Guideline*, building downwash was not included in the toxic impact assessment. Table 7-1 presents the stack parameters used for the ISCST3 analyses; emission rates for toxic pollutants are provided in Appendix D. Pollutant specific refinements are reviewed in the following sections.

7.3.2.1 ACROLEIN EMISSION FACTOR FROM WOOD-FIRED BOILERS

Appendix B of the Volume I application provided a detailed description regarding the refinement of the acrolein emission factor for the No. 3 Biomass Boiler. In the support of the refinement, a full description was given regarding the concern of the Maine Department of Environmental Protection (Maine DEP) to U.S. EPA on the appropriateness of the AP-42 Section 1.6 acrolein

factor for biomass boilers,[33] in addition to a detailed review of other available sources of acrolein data specific to BFB boilers. However, reliance on the same emission factor for the No. 3 Biomass Boiler and the No. 2 Biomass Boiler would not be appropriate as the No. 2 Biomass Boiler is a stoker grate boiler.

Accordingly, the potential emissions of acrolein from the No. 2 Biomass Boiler utilized a publicly available National Council for Air and Stream Improvements (NCASI) emission factor of 7.8E-05 lb/MMBtu.[34] This NCASI factor was identified in a publicly available reference regarding the submittal of a memo to the Maine Air Toxics Initiative (MATI) which expressed concerns of the over-estimating of acrolein emissions from wood-fired boilers, particularly when relying on the conservative AP-42 acrolein factor. The referenced NCASI factor has been incorporated into the emissions estimate for acrolein for the No. 2 Biomass Boiler. The new No. 3 Biomass Boiler relies on a customized emission factor for acrolein derived from the 2010 Boiler MACT database for fluidized bed combustion units, as discussed in Appendix B of the Volume I Report (Page B-6). The memo referencing the NCASI emission factor of 7.8E-05 lb/MMBtu can be found in Appendix G.

7.3.2.2 ACROLEIN EMISSION FACTOR FROM PAPER MACHINES

It should be noted that the current acrolein emission estimates for the No. 1 and No. 2 Paper Machines are based on an NCASI emission factor based on limited data. Based on a recent review of facility MSDS information (completed as part of GPI's response to a U.S. EPA Section 114 information sector information request), no acrolein was identified as being present in materials used on the paper machines above de minimus concentrations. Therefore, use of the NCASI factor is conservative and is likely overestimating emissions of acrolein from the Paper Machines.

7.3.2.3 MODELED SOURCE PARAMETERS

For the majority of pollutants evaluated, the No. 1 and 2 Paper Machines were conservatively modeled as pseudo-point sources with the following stack parameters: 0.001 m/s exit stream velocity, 1 meter exit diameter, and ambient exit temperature. These parameters were consistent with those used in the Riverwood International Macon Mill Expansion PSD Permit Application (1996) for the facility for NAAQS and Increment modeling and reported within inventory information. In actuality, there are over twenty exhaust points per paper machine, but those stacks were conservatively grouped into a single pseudo-point source for initial impacts assessments. However, due to the

[33] Letter from Mr. David P. Littell (Maine DEP) to Mr. Steve Page (U.S. EPA OAQPS), dated April 19, 2006. Available on-line at: http://maine.gov/dep/air/toxics/SAS_Ltr_to_S_Page.doc

[34] GPI is not presently a member of NCASI; hence Trinity may only rely on NCASI data which is either publicly available or were obtained by the Macon Mill when they were previously members of NCASI.

stringency of the acceptable ambient concentrations for acrolein and formaldehyde, it was decided that the specific available stack information for the paper machine stacks should be used.

In the acrolein and formaldehyde modeling assessments, similar detail was applied to the Paper Machine sources as was used in the February 1996 Air Toxics Modeling Analysis submitted to EPD in support of the Riverwood International Macon Mill Expansion PSD Permit Application (1996 Analysis). Specifically, actual stack parameters were used for each paper machine and the No. 1 and No. 2 Paper Machines were split into 22 and 25 sources, respectively. Furthermore, No. 1 Paper Machine was assigned 6 dry end and 16 wet end sources. No. 2 Paper Machine was assigned 6 dry end and 19 wet end sources. The height and diameter were the same for each of the 47 stacks; however, the temperature and velocity varied among the dry and wet end sources. The potential emission rate of acrolein and formaldehyde from both paper machines, combined, was split evenly among all 47 sources. Source locations correspond with the longitude (UTM North) of the No. 1 and 2 Paper Machines and were dispersed latitudinally along the Paper Machine building (Model ID BLDG108) using the same coordinates that were used in the 1996 Analysis. Detailed modeled source parameters for the No. 1 and 2 Paper Machines are provided in Appendix D and in the following Table 7-2.

The maximum modeled impact of each TAP was compared to the 15-minute, 24-hour, and/or the annual AAC. Per the *Guidelines*, the 1-hour predicted impact is multiplied by 1.32 to establish the 15-minute average impact for comparison to the AAC. Table 7-3 presents the refined modeling analyses results. As seen in Table 7-3, all predicted impacts are below the AAC.

TABLE 7-1. MODELED MACON MILL TOXIC EMISSION SOURCE LIST AND PARAMETERS

Emission Unit ID	Stack ID	Emission Release Point Type	Point Description	UTM East X Coordinate[4] (meters)	UTM North Y Coordinate[4] (meters)	Stack Parameters[1]								
						Height		Temperature		Flow Rate	Velocity[2]		Diameter	
						(ft)	(m)	(F)	(K)	(acfm)	(ft/sec)	(m/sec)	(ft)	(m)
A904	ST07	02 - Vert	Hardwood High Density Storage Chests	253,939.9	3,629,094.8	71.5	21.79	68	293.15	1.52	0.003	0.001	3.28	1.00
A903	ST08	05 - Vert w/cap	Pine High Density Storage Chest	253,914.0	3,629,102.3	90	27.43	68	293.15	1.52	0.003	0.001	3.28	1.00
A905	ST09	04 - Goose Neck	Transition Tank	253,936.3	3,629,043.7	24	7.32	68	293.15	1.52	0.003	0.001	3.28	1.00
B005	ST14	02 - Vert	No. 3 Biomass Boiler	253,782.7	3,629,074.5	316	96.32	320	433.15	320,000	93.99	28.65	8.50	2.59
B002	ST15	02 - Vert	No. 2 Power Boiler	253,794.7	3,629,078.5	65	19.81	370	460.93	76,000	179.20	54.62	3.00	0.91
B003	ST16	02 - Vert	No. 2 Biomass Boiler	253,749.7	3,629,077.5	300	91.44	147	337.04	240,402	51.01	15.549	10.00	3.05
D902	ST17	04 - Goose Neck	No. 1 Horizontal Seal Tank	253,920.3	3,629,039.7	24	7.32	68	293.15	1.52	0.003	0.001	3.28	1.00
D901	ST18	04 - Goose Neck	North Weak Black Liquor Million Gallon Tank	253,849.2	3,628,933.4	48	14.63	68	293.15	1.52	0.003	0.001	3.28	1.00
D905	ST19	05 - Vert w/cap	Intermediate Liquor Tank	253,785.5	3,629,042.9	24	7.32	68	293.15	1.52	0.003	0.001	3.28	1.00
D001	ST20	02 - Vert	No. 3 Recovery Boiler	253,751.6	3,629,032.1	300	91.44	351	450.37	349,081	61.22	18.66	11.00	3.35
D002/D907	ST21	02 - Vert	No. 3 Smelt Dissolving Tank/Salt Cake Mix Tank	253,750.7	3,629,046.5	220	67.06	177.3	353.87	23,535	19.98	6.09	5.00	1.52
D003	ST25	02 - Vert	Tall Oil Reaction Tank	253,989.9	3,629,006.4	22.5	6.86	68	293.15	1.52	0.003	0.001	3.28	1.00
L901	ST28	04 - Goose Neck	Green Liquor Clarifier & Storage	253,855.7	3,628,989.3	24	7.32	68	293.15	1.52	0.003	0.001	3.28	1.00
L903	ST31	02 - Vert	Mud Precoat Filters	253,896.7	3,628,989.5	50	15.24	68	293.15	1.52	0.003	0.001	3.28	1.00
L001	ST32	02 - Vert	No. 1 Lime Kiln	253,884.7	3,628,992.5	51	15.54	165	347.04	18,115	34.60	10.55	3.33	1.02
L002	ST33	02 - Vert	No. 2 Lime Kiln	253,884.7	3,628,984.5	51	15.54	158	343.15	18,175	34.71	10.58	3.33	1.02
L003	ST34	02 - Vert	Lime Slaker	253,950.0	3,628,998.2	50	15.24	68	293.15	1.52	0.003	0.001	3.28	1.00
P001[5]	ST39	02 - Vert	Nos. 1 Paper Machine	253,691.7	3,629,132.5	59.5	18.14	68	293.15	1.52	0.003	0.001	3.28	1.00
P002[5]	ST41	02 - Vert	Nos. 2 Paper Machine	253,691.7	3,629,155.5	59.5	18.14	68	293.15	1.52	0.003	0.001	3.28	1.00
W901	ST46	01 - Fug	Wastewater Treatment	254,061.0	3,629,169.0	35	10.67	68	293.15	1.52	0.003	0.001	3.28	1.00
L904	ST48	02 - Vert	Lime Mud Precoat Filter Vacuum Pumps	253,896.0	3,628,982.0	51	15.54	68	293.15	1.52	0.003	0.001	3.28	1.00
D904	ST51	04 - Goose Neck	Boilout Black Liquor Million Gallon Tank	253,760.9	3,628,961.0	40	12.19	68	293.15	1.52	0.003	0.001	3.28	1.00
D903	ST52	04 - Goose Neck	South Weak Black Liquor Million Gallon Tank	253,828.6	3,628,920.8	40	12.19	68	293.15	1.52	0.003	0.001	3.28	1.00
L902	ST59	04 - Goose Neck	Causticizers	253,898.7	3,629,002.5	50	15.24	68	293.15	1.52	0.003	0.001	3.28	1.00
A901/A902	ST75	02 - Vert	Chemi Washers	253,921.7	3,629,069.5	30	9.14	68	293.15	1.52	0.003	0.001	3.28	1.00
R901[3]	ST81	01 - Fug	Recycle Mill	253,849.7	3,629,212.5	35.37	10.78	68	293.15	1.52	0.003	0.001	3.28	1.00
C004	ST88	02 - Vert	PVOH Silo	253,640.7	3,629,191.5	115	35.05	68	293.15	706	59.93	18.27	0.50	0.15

1. Stack Parameters per the CERR tool, unless otherwise noted.
2. The velocity of rain capped or pseudo-point sources is updated and estimated at 0.001 meters/second per Model Clearinghouse Record 93-II-09.
3. The height of the recycle mill stack has been raised 0.3 meters above the height of the Recycle Mill building.
4. UTM Coordinates have been adjusted based on Google Earth imaging in NAD83.
5. The Paper Machine building sources were conservatively grouped into 2 sources and assigned psuedo-point source parameters for the modeling of toxic emissions except for acrolein and formaldehyde.

TABLE 7-2. MODELED MACON MILL PARAMETERS FOR INDIVIDUAL PAPER MACHINE STACKS

Emission Unit ID	Stack ID[1]	Emission Release Point Type	Point Description[1]	UTM East X Coordinate (meters)	UTM North Y Coordinate[2] (meters)	Stack Parameters[1]								
						Height[3]		Temperature		Flow Rate	Velocity		Diameter	
						(ft)	(m)	(F)	(K)	(acfm)	(ft/sec)	(m/sec)	(ft)	(m)
P001	DA1	02 - Vert	Paper Machine 1 - Dry End (Point-01)	253,743.5	3,629,132.5	59.50	18.14	149.99	338.7	82,049.86	70.01	21.34	4.99	1.52
P001	DA2	02 - Vert	Paper Machine 1 - Dry End (Point-02)	253,731.1	3,629,132.5	59.50	18.14	149.99	338.7	82,049.86	70.01	21.34	4.99	1.52
P001	DA3	02 - Vert	Paper Machine 1 - Dry End (Point-03)	253,725.1	3,629,132.5	59.50	18.14	149.99	338.7	82,049.86	70.01	21.34	4.99	1.52
P001	DA4	02 - Vert	Paper Machine 1 - Dry End (Point-04)	253,718.9	3,629,132.5	59.50	18.14	149.99	338.7	82,049.86	70.01	21.34	4.99	1.52
P001	DA5	02 - Vert	Paper Machine 1 - Dry End (Point-05)	253,697.5	3,629,132.5	59.50	18.14	149.99	338.7	82,049.86	70.01	21.34	4.99	1.52
P001	DA6	02 - Vert	Paper Machine 1 - Dry End (Point-06)	253,685.2	3,629,132.5	59.50	18.14	149.99	338.7	82,049.86	70.01	21.34	4.99	1.52
P002	DB1	02 - Vert	Paper Machine 2 - Dry End (Point-01)	253,744.0	3,629,155.5	59.50	18.14	149.99	338.7	82,049.86	70.01	21.34	4.99	1.52
P002	DB2	02 - Vert	Paper Machine 2 - Dry End (Point-02)	253,731.6	3,629,155.5	59.50	18.14	149.99	338.7	82,049.86	70.01	21.34	4.99	1.52
P002	DB3	02 - Vert	Paper Machine 2 - Dry End (Point-03)	253,725.2	3,629,155.5	59.50	18.14	149.99	338.7	82,049.86	70.01	21.34	4.99	1.52
P002	DB4	02 - Vert	Paper Machine 2 - Dry End (Point-04)	253,719.5	3,629,155.5	59.50	18.14	149.99	338.7	82,049.86	70.01	21.34	4.99	1.52
P002	DB5	02 - Vert	Paper Machine 2 - Dry End (Point-05)	253,702.1	3,629,155.5	59.50	18.14	149.99	338.7	82,049.86	70.01	21.34	4.99	1.52
P002	DB6	02 - Vert	Paper Machine 2 - Dry End (Point-06)	253,696.5	3,629,155.5	59.50	18.14	149.99	338.7	82,049.86	70.01	21.34	4.99	1.52
P001	WA01	02 - Vert	Paper Machine 1 - Wet End (Point-01)	253,845.6	3,629,132.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P001	WA02	02 - Vert	Paper Machine 1 - Wet End (Point-02)	253,845.6	3,629,132.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P001	WA03	02 - Vert	Paper Machine 1 - Wet End (Point-03)	253,845.7	3,629,132.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P001	WA04	02 - Vert	Paper Machine 1 - Wet End (Point-04)	253,819.1	3,629,132.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P001	WA05	02 - Vert	Paper Machine 1 - Wet End (Point-05)	253,814.0	3,629,132.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P001	WA06	02 - Vert	Paper Machine 1 - Wet End (Point-06)	253,811.4	3,629,132.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P001	WA07	02 - Vert	Paper Machine 1 - Wet End (Point-07)	253,806.1	3,629,132.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P001	WA08	02 - Vert	Paper Machine 1 - Wet End (Point-08)	253,799.2	3,629,132.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P001	WA09	02 - Vert	Paper Machine 1 - Wet End (Point-09)	253,793.8	3,629,132.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P001	WA10	02 - Vert	Paper Machine 1 - Wet End (Point-10)	253,787.5	3,629,132.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P001	WA11	02 - Vert	Paper Machine 1 - Wet End (Point-11)	253,782.2	3,629,132.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P001	WA12	02 - Vert	Paper Machine 1 - Wet End (Point-12)	253,776.4	3,629,132.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P001	WA13	02 - Vert	Paper Machine 1 - Wet End (Point-13)	253,771.5	3,629,132.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P001	WA14	02 - Vert	Paper Machine 1 - Wet End (Point-14)	253,766.4	3,629,132.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P001	WA15	02 - Vert	Paper Machine 1 - Wet End (Point-15)	253,761.4	3,629,132.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P001	WA16	02 - Vert	Paper Machine 1 - Wet End (Point-16)	253,755.1	3,629,132.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB01	02 - Vert	Paper Machine 2 - Wet End (Point-01)	253,839.9	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB02	02 - Vert	Paper Machine 2 - Wet End (Point-02)	253,842.1	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB03	02 - Vert	Paper Machine 2 - Wet End (Point-03)	253,839.8	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB04	02 - Vert	Paper Machine 2 - Wet End (Point-04)	253,836.6	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB05	02 - Vert	Paper Machine 2 - Wet End (Point-05)	253,826.8	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB06	02 - Vert	Paper Machine 2 - Wet End (Point-06)	253,824.4	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB07	02 - Vert	Paper Machine 2 - Wet End (Point-07)	253,818.6	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB08	02 - Vert	Paper Machine 2 - Wet End (Point-08)	253,818.6	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB09	02 - Vert	Paper Machine 2 - Wet End (Point-09)	253,813.4	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB10	02 - Vert	Paper Machine 2 - Wet End (Point-10)	253,807.0	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB11	02 - Vert	Paper Machine 2 - Wet End (Point-11)	253,799.4	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB12	02 - Vert	Paper Machine 2 - Wet End (Point-12)	253,793.6	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB13	02 - Vert	Paper Machine 2 - Wet End (Point-13)	253,786.8	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB14	02 - Vert	Paper Machine 2 - Wet End (Point-14)	253,782.5	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB15	02 - Vert	Paper Machine 2 - Wet End (Point-15)	253,777.2	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB16	02 - Vert	Paper Machine 2 - Wet End (Point-16)	253,772.4	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB17	02 - Vert	Paper Machine 2 - Wet End (Point-17)	253,767.0	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB18	02 - Vert	Paper Machine 2 - Wet End (Point-18)	253,761.6	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB19	02 - Vert	Paper Machine 2 - Wet End (Point-19)	253,754.6	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52

1. Stack description and parameters per February 1996 Air Toxics Modeling Analysis submitted to the EPD in support of the Macon Mill Expansion PSD Permit Application
2. UTM North Y Coordinate was updated from the 1996 Analysis to match current adjustments of the model per Google Earth. Y Coordinates match what was submitted in Volume II for the No. 1 and 2 Paper Machines.
3. Stack height remains the same as what was presented in table 7-1.

TABLE 7-3. ISC REFINED MODELING ANALYSIS RESULTS

Pollutant[1]	ISC 1-hr Impact (µg/m³)	Maximum 15-minute Average Impact (µg/m³)	15-minute Average AAC (µg/m³)	Maximum 15-minute Average Impact (% of AAC)	ISC Maximum 24-hour Average Impact (µg/m³)	24-hour Average AAC (µg/m³)	Maximum 24-hour Average Impact (% of AAC)	ISC Maximum Annual Impact (µg/m³)	Annual Average AAC (µg/m³)	Maximum Annual Impact (% of AAC)
Acetaldehyde	2.48E+02	3.27E+02	4.50E+03	7.26%	2.67E+01	Not Needed	-	2.90E+00	4.55E+00	63.70%
Acrolein	4.68E+00	6.18E+00	2.50E+01	24.70%	6.65E-01	Not Needed	-	5.36E-02	0.15	35.73%
Antimony	8.90E-03	1.17E-02	None	-	1.31E-03	3.97E-01	0.33%	7.00E-05	None	-
Arsenic	6.38E-03	8.42E-03	2.00E-01	4.21%	9.50E-04	Not Needed	-	6.00E-05	2.33E-04	25.80%
Beryllium	3.92E-03	5.17E-03	5.00E-01	1.03%	5.20E-04	Not Needed	-	3.00E-05	2.00E-02	0.15%
Cadmium	1.57E-03	2.07E-03	3.00E+01	<0.01%	3.30E-04	Not Needed	-	3.00E-05	5.56E-03	0.54%
Carbon Tetrachloride	1.75E+01	2.30E+01	1.57E+04	0.15%	1.48E+00	Not Needed	-	7.21E-02	6.67E-01	10.81%
Chloroform	2.09E+01	2.75E+01	2.40E+04	0.11%	1.98E+00	Not Needed	-	8.69E-02	9.80E+01	0.09%
Chromium	1.08E-02	1.42E-02	None	-	2.22E-03	Not Needed	-	1.90E-04	8.00E-03	2.38%
Cobalt	9.99E-03	1.32E-02	None	-	1.41E-03	Not Needed	-	8.00E-05	1.00E-01	0.08%
Formaldehyde	1.90E+01	2.51E+01	2.45E+02	10.21%	2.67E+00	Not Needed	-	2.29E-01	1.10E+00	20.82%
Hexachlorodibenzo-p-dioxins[2]	4.56E-04	6.02E-04	None	-	6.59E-05	Not Needed	-	3.89E-06	7.69E-06	50.57%
Lead	5.58E-02	7.37E-02	None	-	1.15E-02	Not Needed	-	8.20E-04	1.50E+00	0.05%
Manganese	3.71E-01	4.89E-01	5.00E+02	0.10%	5.25E-02	Not Needed	-	2.86E-03	5.00E-02	5.72%
Mercury	2.09E-03	2.76E-03	4.00E+00	0.07%	3.60E-04	Not Needed	-	2.00E-05	3.00E-01	<0.01%
Methylene chloride [dichloromethane]	2.60E+01	3.44E+01	4.34E+04	0.08%	3.03E+00	Not Needed	-	2.45E-01	2.13E+01	1.15%
Nickel	1.39E-01	1.83E-01	None	-	1.86E-02	Not Needed	-	9.80E-04	9.00E-02	1.09%
Phenol	4.04E+01	5.33E+01	6.00E+03	0.89%	3.41E+00	Not Needed	-	1.47E-01	2.00E+02	0.07%
Propionaldehyde [propanal]	1.61E+00	2.13E+00	None	-	1.35E-01	Not Needed	-	8.32E-03	8.00E+00	0.10%
2,3,7,8-Tetrachlorodibenzo-p-dioxins[3]	2.45E-09	3.23E-09	None	-	3.54E-10	Not Needed	-	2.09E-11	3.03E-07	<0.01%
Tetrachlorodibenzo-p-dioxins[4]	1.34E-07	1.77E-07	None	-	1.94E-08	Not Needed	-	1.14E-09	3.03E-07	0.38%
o-Xylene	3.42E+00	4.52E+00	6.55E+04	<0.01%	4.12E-01	Not Needed	-	4.40E-02	1.00E+02	0.04%
Methanol	2.78E+03	3.67E+03	3.25E+04	11.30%	3.88E+02	Not Needed	-	3.78E+01	4.00E+03	0.95%

1. AAC values listed above for those TAP for which sufficient documentation was available to develop the necessary AAC values
2. Resultant modeled concentrations are divided by a factor of 1E03 to correct for adjustment factor to emission rate in model to produce a quantifiable result.
3. Resultant modeled concentrations are divided by a factor of 1E09 to correct for adjustment factor introduced upon initialization.
4. Resultant modeled concentrations are divided by a factor of 1E06 to correct for adjustment factor introduced upon initialization.

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."[35] Secondary NAAQS define the levels that "protect the public welfare from any known or anticipated adverse effects of a pollutant." The objective of the NAAQS analysis is to demonstrate through air quality modeling that emissions from a proposed project do not contribute to or cause an exceedance of the NAAQS at any ambient location. Table 8-1 lists the NAAQS for Pb, only. Please note that the monitoring de minimis level provided below was established with use of the calendar quarter averaging period NAAQS standard, but has been provided here for reference.

TABLE 8-1. SIGNIFICANT IMPACT LEVELS, NAAQS, PSD CLASS II INCREMENTS, AND MONITORING DE MINIMIS LEVELS FOR PB

Pollutant	Averaging Period	PSD SIL ($\mu g/m^3$)	Primary and Secondary NAAQS ($\mu g/m^3$)	Class II PSD Increment ($\mu g/m^3$)	Monitoring *de minimis* Level ($\mu g/m^3$)
Pb	Rolling 3-month	--[1]	0.15	--[1]	0.1

1. No PSD Increments or SIL have been established for Lead.

Per the request of Pete Courtney in the Review of Air Dispersion Modeling Protocol, dated February 1, 2011, a NAAQS Analysis using the AERMOD model (version 09292) was conducted for Pb, only, to determine whether or not the potential emissions at the Macon Mill will contribute to or cause an exceedance of the NAAQS. Similar to the toxic impact assessment, lead sources were modeled at their potential to emit, and all sources were modeled using the same parameters as were used and documented in this report. There were, otherwise, no changes to the fundamental AERMOD model setup (e.g. meteorology, land use, elevations, buildings, receptors, etc) from what was submitted for CO modeling analyses in this report.

The monthly averaging period was evaluated in the modeling analysis; however, as evident in Table 8-1, the NAAQS is defined as a maximum concentration averaged over any three rolling months in the evaluated time period (e.g. 1987 – 1991). U.S. EPA provides an executable program called LEADPOST (version 11096) to be used with an AERMOD postfile output as a way to evaluate the 3-month rolling average.[36] Table 8-2 illustrates the results from the Pb NAAQS analyses and LEADPOST post-processing, indicating that, with the ambient background concentration, potential exceedances of the rolling 3-month NAAQS will not occur.

[35] 40 CFR 50.2(b)

[36] http://epa.gov/ttn/scram/

TABLE 8-2. PB NAAQS RESULTS

Averaging Period	Month-Year[1]	UTM East (km)	UTM North (km)	Modeled Conc.[3] (µg/m^3)	Bkg. Conc.[2] (µg/m^3)	Total Ambient Conc. (µg/m^3)	NAAQS (µg/m^3)	Exceeds NAAQS?
Rolling 3-month	Feb-89	254,389.4	3,628,745.8	0.004	0.04	0.044	0.15	No

1. The maximum concentration is based on a single model run using a 5-year concatenated meteorolgical dataset.
2. Provided by Pete Courtney, Review of Air Dispersion Modeling Protocol, February 1, 2001.
3. Modeled concentrations correspond to an AERMOD analysis performed with Macon (MCNCNT) meteorological data.

Additionally, under current U.S. EPA policies, the maximum impacts due to the emissions increases from a project are also assessed against monitoring *de Minimis* levels to determine whether pre-construction monitoring should be considered. While this may not necessarily be required in this case, since the project did not undergo PSD review for lead emissions, such comparison has been provided here for conservatism. The monitoring *de Minimis* concentration for Pb, only, is listed in Table 8-1. If either the predicted modeled impact from the 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. Pb modeling results as presented in Table 8-3 are below the monitoring *de Minimis* concentration, and thus no pre-construction monitoring should be required.

TABLE 8-3. COMPARISON AGAINST MONITORING DE MINIMIS LEVELS

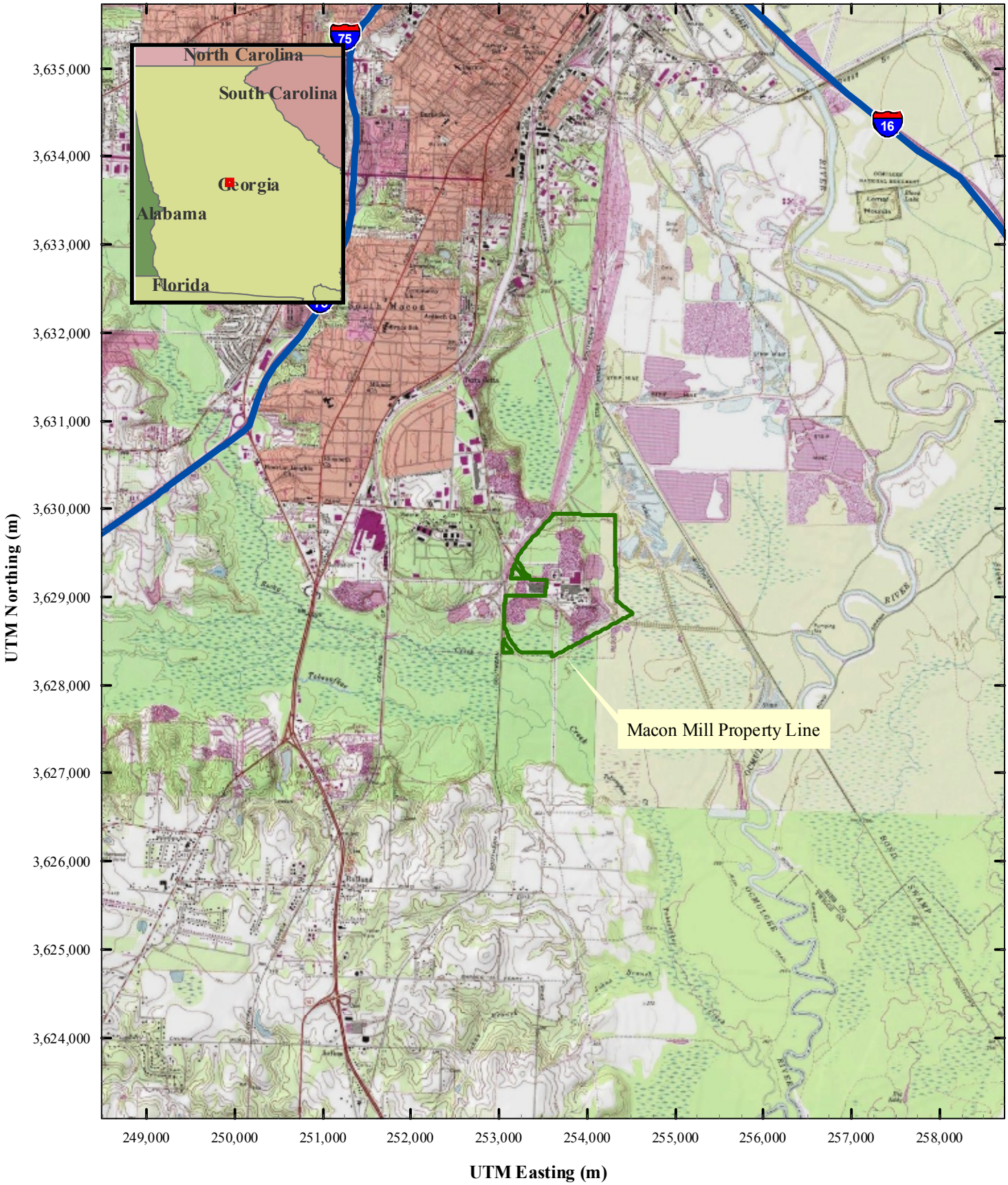
Pollutant	Averaging Period	Month-Year	UTM East (km)	UTM North (km)	Max Conc. (µg/m^3)	Monitoring *De Minimis* (µg/m^3)	Exceeds *De Minimis?*
Pb	Rolling 3-month	Feb-89	254,389.4	3,628,745.8	0.004	0.1	No

APPENDIX A

SUPPORTING FIGURES

Figure A-1. Area Map

Graphic Packaging International, Inc - Macon Mill
Macon, Bibb County, Georgia



Coordinates reflect UTM projection Zone 17, NAD83.

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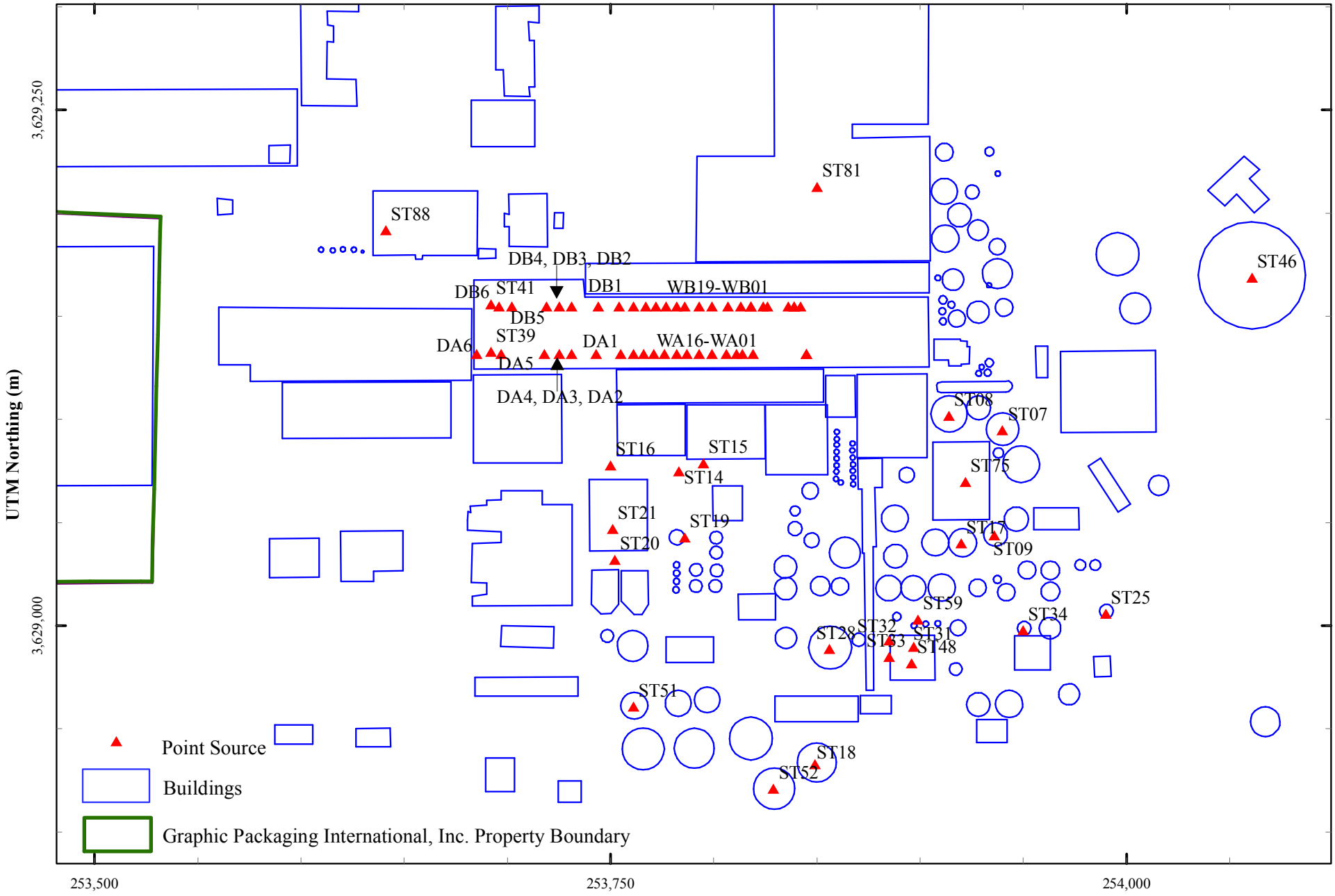
Figure A-2. Modeled Site Layout

Graphic Packaging International, Inc - Macon Mill
Macon, Bibb County, Georgia



Coordinates reflect UTM projection Zone 17, NAD83.

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Figure A-2. (Continued)

Emission Unit ID	Stack ID	Emission Release Point Type	Point Description	UTM East X Coordinate[4] (meters)	UTM North Y Coordinate[4] (meters)
A904	ST07	02 - Vert	Hardwood High Density Storage Chests	253,939.9	3,629,094.8
A903	ST08	05 - Vert w/cap	Pine High Density Storage Chest	253,914.0	3,629,102.3
A905	ST09	04 - Goose Neck	Transition Tank	253,936.3	3,629,043.7
B005	ST14	02 - Vert	No. 3 Biomass Boiler	253,782.7	3,629,074.5
B002	ST15	02 - Vert	No. 2 Power Boiler	253,794.7	3,629,078.5
B003	ST16	02 - Vert	No. 2 Biomass Boiler	253,749.7	3,629,077.5
D902	ST17	04 - Goose Neck	No. 1 Horizontal Seal Tank	253,920.3	3,629,039.7
D901	ST18	04 - Goose Neck	North Weak Black Liquor Million Gallon Tank	253,849.2	3,628,933.4
D905	ST19	05 - Vert w/cap	Intermediate Liquor Tank	253,785.5	3,629,042.9
D001	ST20	02 - Vert	No. 3 Recovery Boiler	253,751.6	3,629,032.1
D002/D907	ST21	02 - Vert	No. 3 Smelt Dissolving Tank/Salt Cake Mix Tank	253,750.7	3,629,046.5
D003	ST25	02 - Vert	Tall Oil Reaction Tank	253,989.9	3,629,006.4
L901	ST28	04 - Goose Neck	Green Liquor Clarifier & Storage	253,855.7	3,628,989.3
L903	ST31	02 - Vert	Mud Precoat Filters	253,896.7	3,628,989.5
L001	ST32	02 - Vert	No. 1 Lime Kiln	253,884.7	3,628,992.5
L002	ST33	02 - Vert	No. 2 Lime Kiln	253,884.7	3,628,984.5
L003	ST34	02 - Vert	Lime Slaker	253,950.0	3,628,998.2
P001	ST39	02 - Vert	Nos. 1 Paper Machine	253,691.7	3,629,132.5
P002	ST41	02 - Vert	Nos. 2 Paper Machine	253,691.7	3,629,155.5
W901	ST46	01 - Fug	Wastewater Treatment	254,061.0	3,629,169.0
L904	ST48	02 - Vert	Lime Mud Precoat Filter Vacuum Pumps	253,896.0	3,628,982.0
D904	ST51	04 - Goose Neck	Boilout Black Liquor Million Gallon Tank	253,760.9	3,628,961.0
D903	ST52	04 - Goose Neck	South Weak Black Liquor Million Gallon Tank	253,828.6	3,628,920.8
L902	ST59	04 - Goose Neck	Causticizers	253,898.7	3,629,002.5
A901/A902	ST75	02 - Vert	Chemi Washers	253,921.7	3,629,069.5
R901[3]	ST81	01 - Fug	Recycle Mill	253,849.7	3,629,212.5
C004	ST88	02 - Vert	PVOH Silo	253,640.7	3,629,191.5

1. Stack Parameters per the CERR tool, unless otherwise noted.
2. The velocity of rain capped or pseudo-point sources is updated and estimated at 0.001 meters/second per Model Clearinghouse Record 93-II-09.
3. The height of the recycle mill stack has been raised 0.3 meters above the height of the Recycle Mill building.
4. UTM Coordinates have been adjusted based on Google Earth imaging in NAD83.

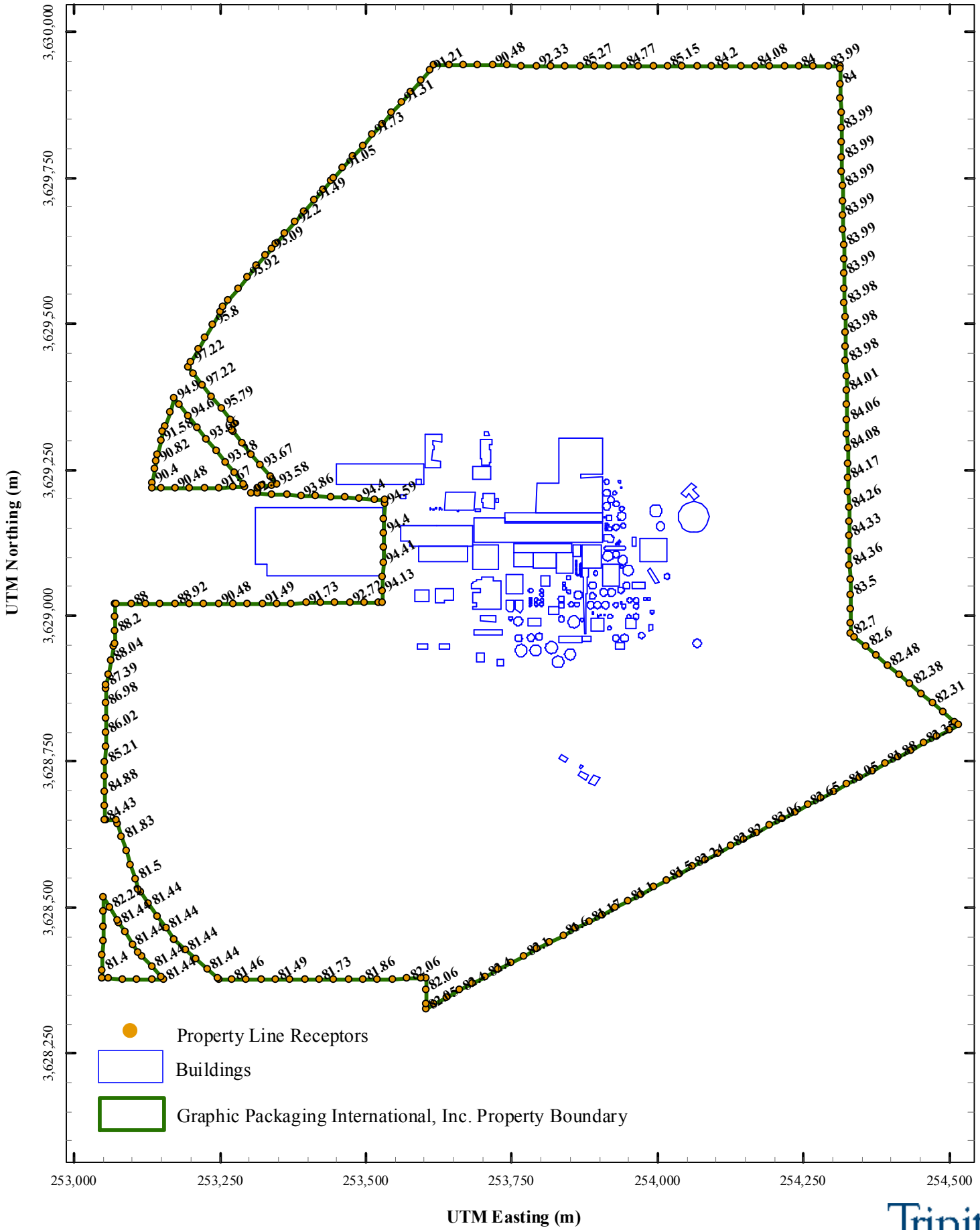
Emission Unit ID	Stack ID[1]	Emission Release Point Type	Point Description[1]	UTM East X Coordinate (meters)	UTM North Y Coordinate[2] (meters)
P001	DA1	02 - Vert	Paper Machine 1 - Dry End (Point-01)	253,743.5	3,629,132.5
P001	DA2	02 - Vert	Paper Machine 1 - Dry End (Point-02)	253,731.1	3,629,132.5
P001	DA3	02 - Vert	Paper Machine 1 - Dry End (Point-03)	253,725.1	3,629,132.5
P001	DA4	02 - Vert	Paper Machine 1 - Dry End (Point-04)	253,718.9	3,629,132.5
P001	DA5	02 - Vert	Paper Machine 1 - Dry End (Point-05)	253,697.5	3,629,132.5
P001	DA6	02 - Vert	Paper Machine 1 - Dry End (Point-06)	253,685.2	3,629,132.5
P002	DB1	02 - Vert	Paper Machine 2 - Dry End (Point-01)	253,744.0	3,629,155.5
P002	DB2	02 - Vert	Paper Machine 2 - Dry End (Point-02)	253,731.6	3,629,155.5
P002	DB3	02 - Vert	Paper Machine 2 - Dry End (Point-03)	253,725.2	3,629,155.5
P002	DB4	02 - Vert	Paper Machine 2 - Dry End (Point-04)	253,719.5	3,629,155.5
P002	DB5	02 - Vert	Paper Machine 2 - Dry End (Point-05)	253,702.1	3,629,155.5
P002	DB6	02 - Vert	Paper Machine 2 - Dry End (Point-06)	253,696.5	3,629,155.5
P001	WA01	02 - Vert	Paper Machine 1 - Wet End (Point-01)	253,845.6	3,629,132.5
P001	WA02	02 - Vert	Paper Machine 1 - Wet End (Point-02)	253,845.6	3,629,132.5
P001	WA03	02 - Vert	Paper Machine 1 - Wet End (Point-03)	253,845.7	3,629,132.5
P001	WA04	02 - Vert	Paper Machine 1 - Wet End (Point-04)	253,819.1	3,629,132.5
P001	WA05	02 - Vert	Paper Machine 1 - Wet End (Point-05)	253,814.0	3,629,132.5
P001	WA06	02 - Vert	Paper Machine 1 - Wet End (Point-06)	253,811.4	3,629,132.5
P001	WA07	02 - Vert	Paper Machine 1 - Wet End (Point-07)	253,806.1	3,629,132.5
P001	WA08	02 - Vert	Paper Machine 1 - Wet End (Point-08)	253,799.2	3,629,132.5
P001	WA09	02 - Vert	Paper Machine 1 - Wet End (Point-09)	253,793.8	3,629,132.5
P001	WA10	02 - Vert	Paper Machine 1 - Wet End (Point-10)	253,787.5	3,629,132.5
P001	WA11	02 - Vert	Paper Machine 1 - Wet End (Point-11)	253,782.2	3,629,132.5
P001	WA12	02 - Vert	Paper Machine 1 - Wet End (Point-12)	253,776.4	3,629,132.5
P001	WA13	02 - Vert	Paper Machine 1 - Wet End (Point-13)	253,771.5	3,629,132.5
P001	WA14	02 - Vert	Paper Machine 1 - Wet End (Point-14)	253,766.4	3,629,132.5
P001	WA15	02 - Vert	Paper Machine 1 - Wet End (Point-15)	253,761.4	3,629,132.5
P001	WA16	02 - Vert	Paper Machine 1 - Wet End (Point-16)	253,755.1	3,629,132.5
P002	WB01	02 - Vert	Paper Machine 2 - Wet End (Point-01)	253,839.9	3,629,155.5
P002	WB02	02 - Vert	Paper Machine 2 - Wet End (Point-02)	253,842.1	3,629,155.5
P002	WB03	02 - Vert	Paper Machine 2 - Wet End (Point-03)	253,839.8	3,629,155.5
P002	WB04	02 - Vert	Paper Machine 2 - Wet End (Point-04)	253,836.6	3,629,155.5
P002	WB05	02 - Vert	Paper Machine 2 - Wet End (Point-05)	253,826.8	3,629,155.5
P002	WB06	02 - Vert	Paper Machine 2 - Wet End (Point-06)	253,824.4	3,629,155.5
P002	WB07	02 - Vert	Paper Machine 2 - Wet End (Point-07)	253,818.6	3,629,155.5
P002	WB08	02 - Vert	Paper Machine 2 - Wet End (Point-08)	253,818.6	3,629,155.5
P002	WB09	02 - Vert	Paper Machine 2 - Wet End (Point-09)	253,813.4	3,629,155.5
P002	WB10	02 - Vert	Paper Machine 2 - Wet End (Point-10)	253,807.0	3,629,155.5
P002	WB11	02 - Vert	Paper Machine 2 - Wet End (Point-11)	253,799.4	3,629,155.5
P002	WB12	02 - Vert	Paper Machine 2 - Wet End (Point-12)	253,793.6	3,629,155.5
P002	WB13	02 - Vert	Paper Machine 2 - Wet End (Point-13)	253,786.8	3,629,155.5
P002	WB14	02 - Vert	Paper Machine 2 - Wet End (Point-14)	253,782.5	3,629,155.5
P002	WB15	02 - Vert	Paper Machine 2 - Wet End (Point-15)	253,777.2	3,629,155.5
P002	WB16	02 - Vert	Paper Machine 2 - Wet End (Point-16)	253,772.4	3,629,155.5
P002	WB17	02 - Vert	Paper Machine 2 - Wet End (Point-17)	253,767.0	3,629,155.5
P002	WB18	02 - Vert	Paper Machine 2 - Wet End (Point-18)	253,761.6	3,629,155.5
P002	WB19	02 - Vert	Paper Machine 2 - Wet End (Point-19)	253,754.6	3,629,155.5

1. Stack description and parameters per February 1996 Air Toxics Modeling Analysis submitted to the EPD in support of the Macon Mill Expansion PSD Permit Application

2. UTM North Y Coordinate was updated from the 1996 Analysis to match current adjustments of the model per Google Earth. Y Coordinates match what was submitted in Volume II for the No. 1 and 2 Paper Machines.

Figure A-3. Modeled Property Line Receptors and Elevations (meters)

Graphic Packaging International, Inc - Macon Mill
Macon, Bibb County, Georgia



Coordinates reflect UTM projection Zone 17, NAD83.

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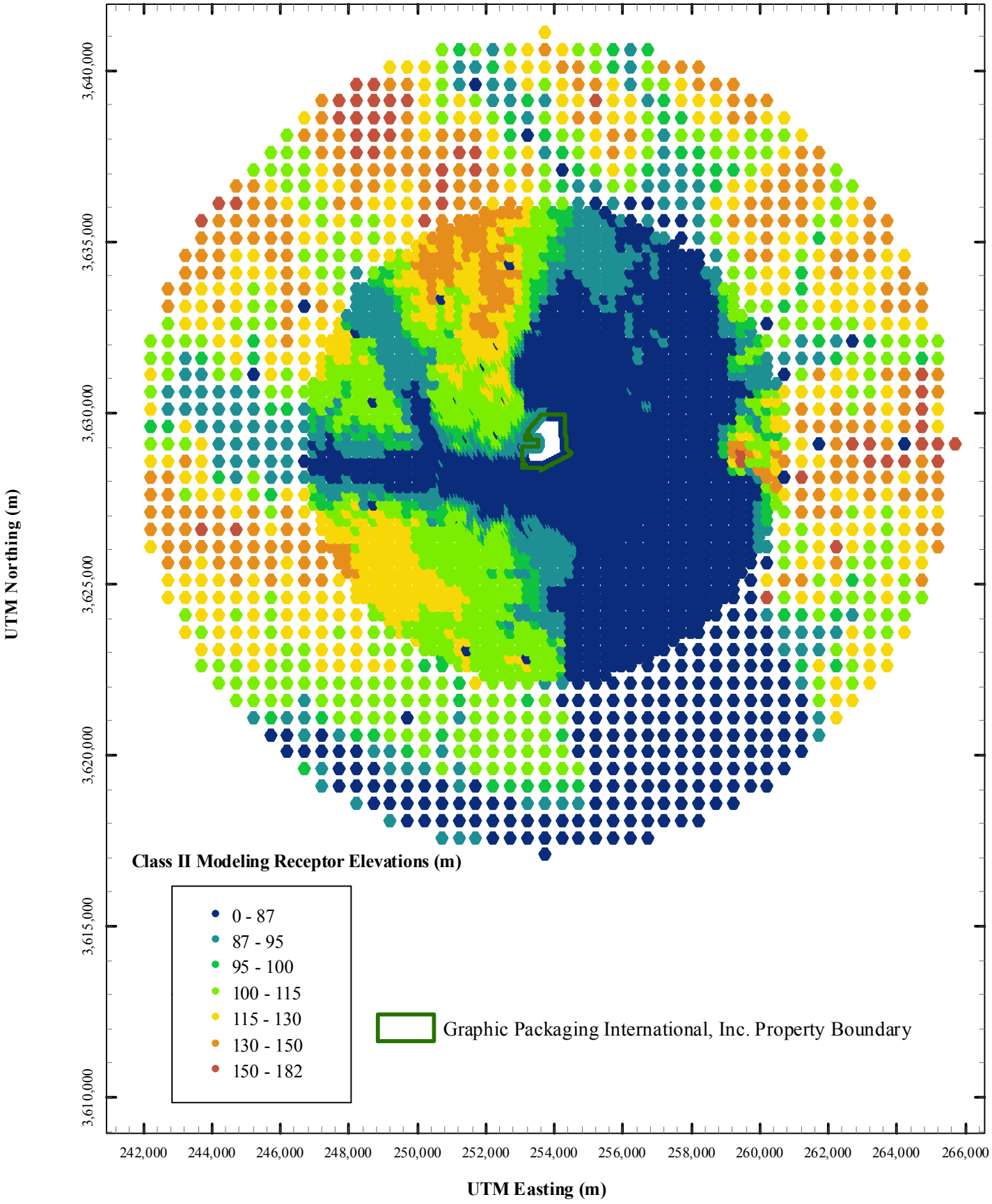
Figure A-4. Class II Significance Modeling Grid and Elevations

Graphic Packaging International, Inc - Macon Mill
Macon, Bibb County, Georgia



Coordinates reflect UTM projection Zone 17, NAD83.

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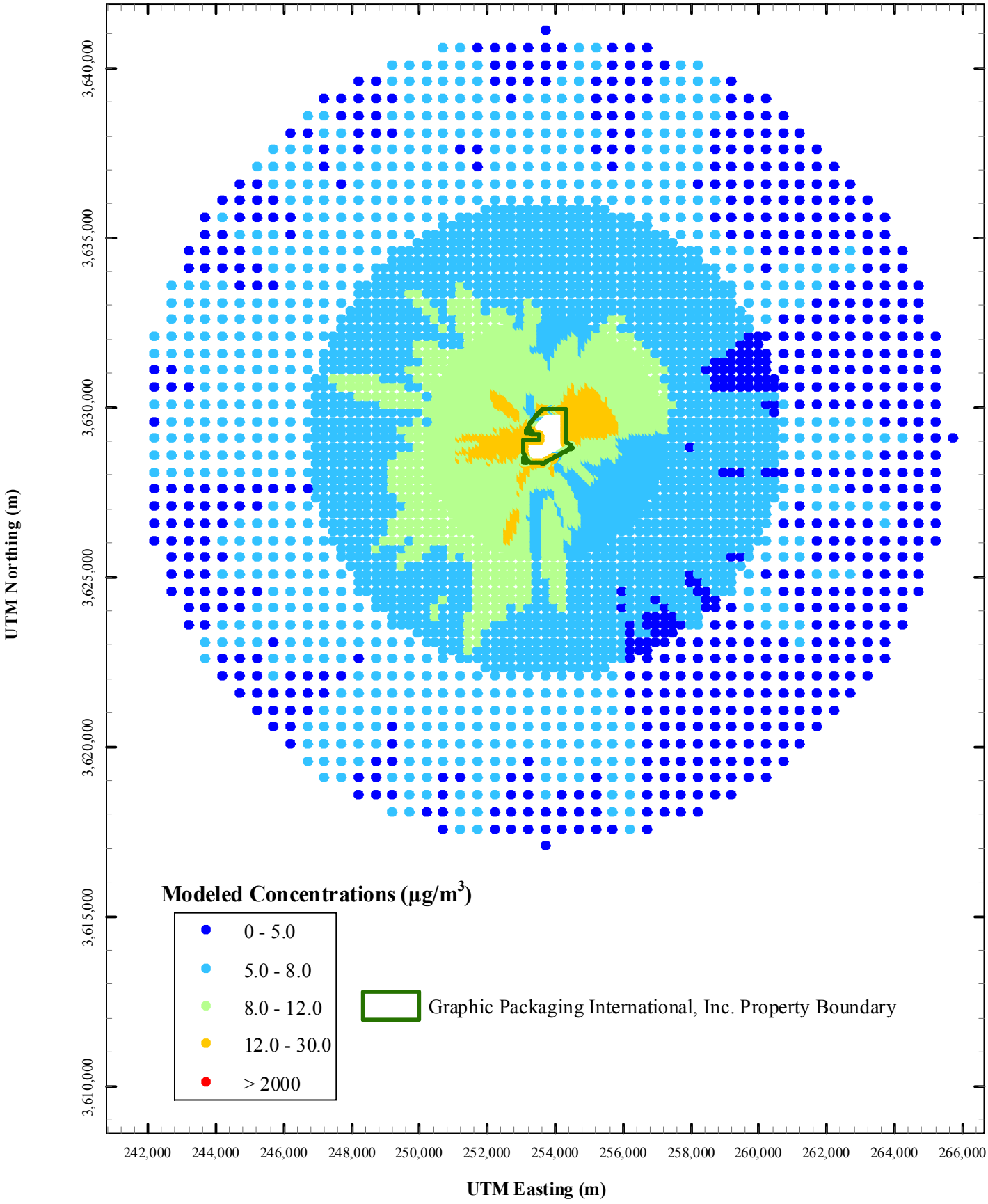
Figure A-5. Class II Significance Modeling - Steady State
1-Hr CO Maximum 1st High Concentrations, Macon Met Data

Graphic Packaging International, Inc - Macon Mill
Macon, Bibb County, Georgia



1-Hour CO PSD SIL: 2,000 µg/m^3
Coordinates reflect UTM projection Zone 17, NAD83.

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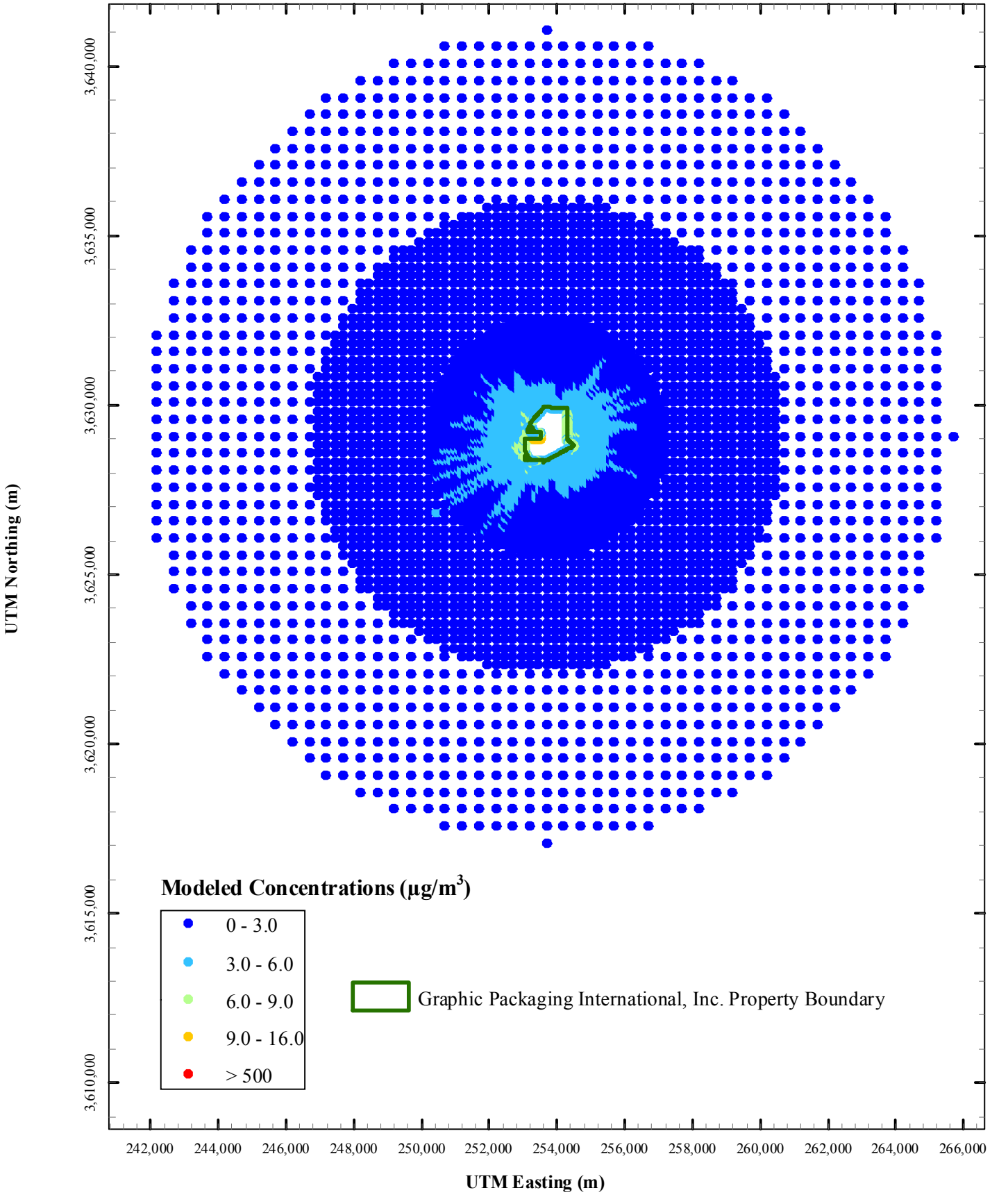
Figure A-6. Class II Significance Modeling - Steady State
8-Hr CO Maximum 1st High Concentrations, Macon Met Data

Graphic Packaging International, Inc - Macon Mill
Macon, Bibb County, Georgia



8-Hour CO PSD SIL: 500 µg/m^3
Coordinates reflect UTM projection Zone 17, NAD83.

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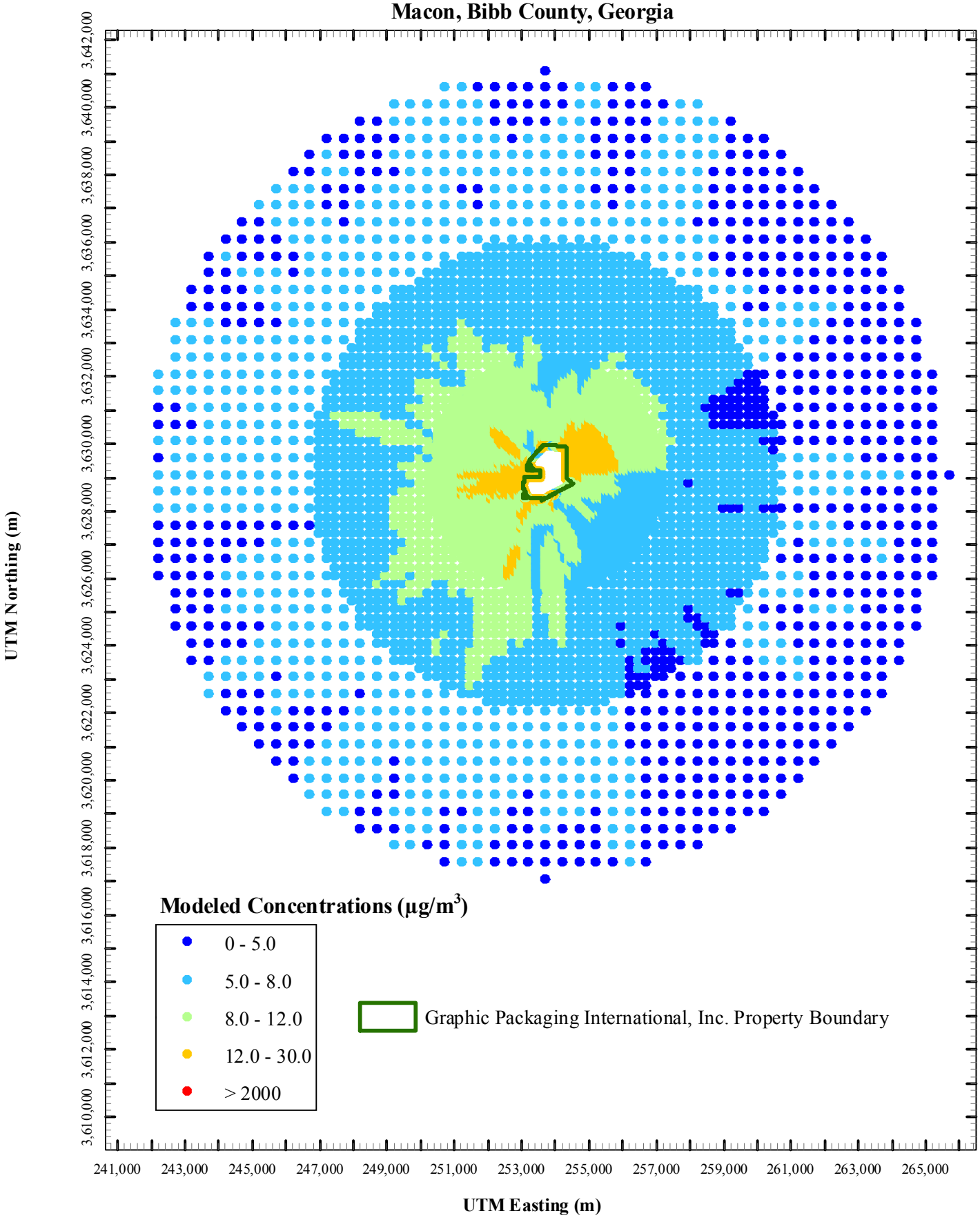
Figure A-7. Class II Significance Modeling - 12AM Startup
1-Hr CO Maximum 1st High Concentrations, Macon Met Data

Graphic Packaging International, Inc - Macon Mill
Macon, Bibb County, Georgia



1-Hour CO PSD SIL: 2,000 µg/m^3
Coordinates reflect UTM projection Zone 17, NAD83.

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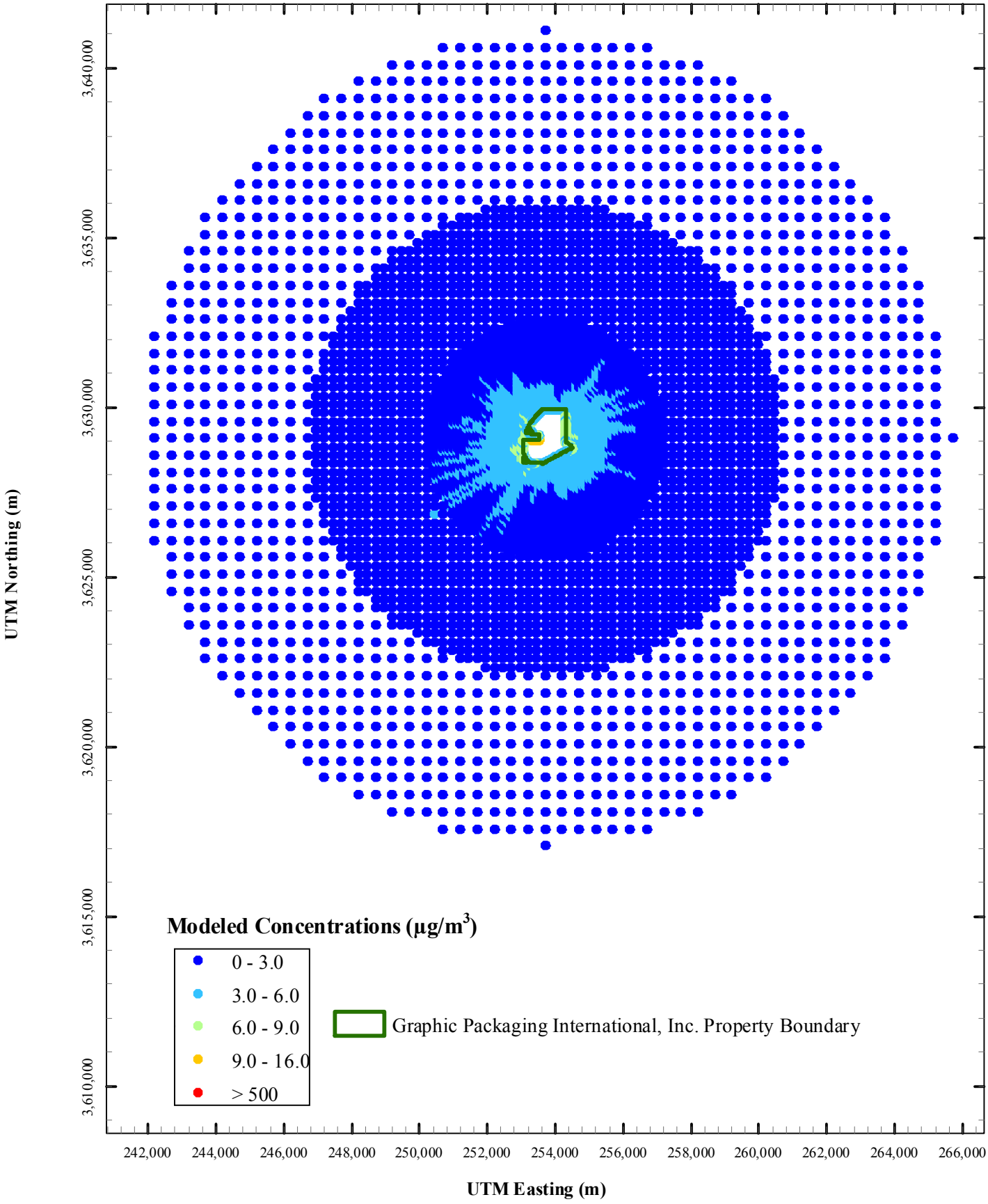
Figure A-8. Class II Significance Modeling - 12AM Startup
8-Hr CO Maximum 1st High Concentrations, Macon Met Data

Graphic Packaging International, Inc - Macon Mill
Macon, Bibb County, Georgia



8-Hour CO PSD SIL: 500 µg/m^3
Coordinates reflect UTM projection Zone 17, NAD83.

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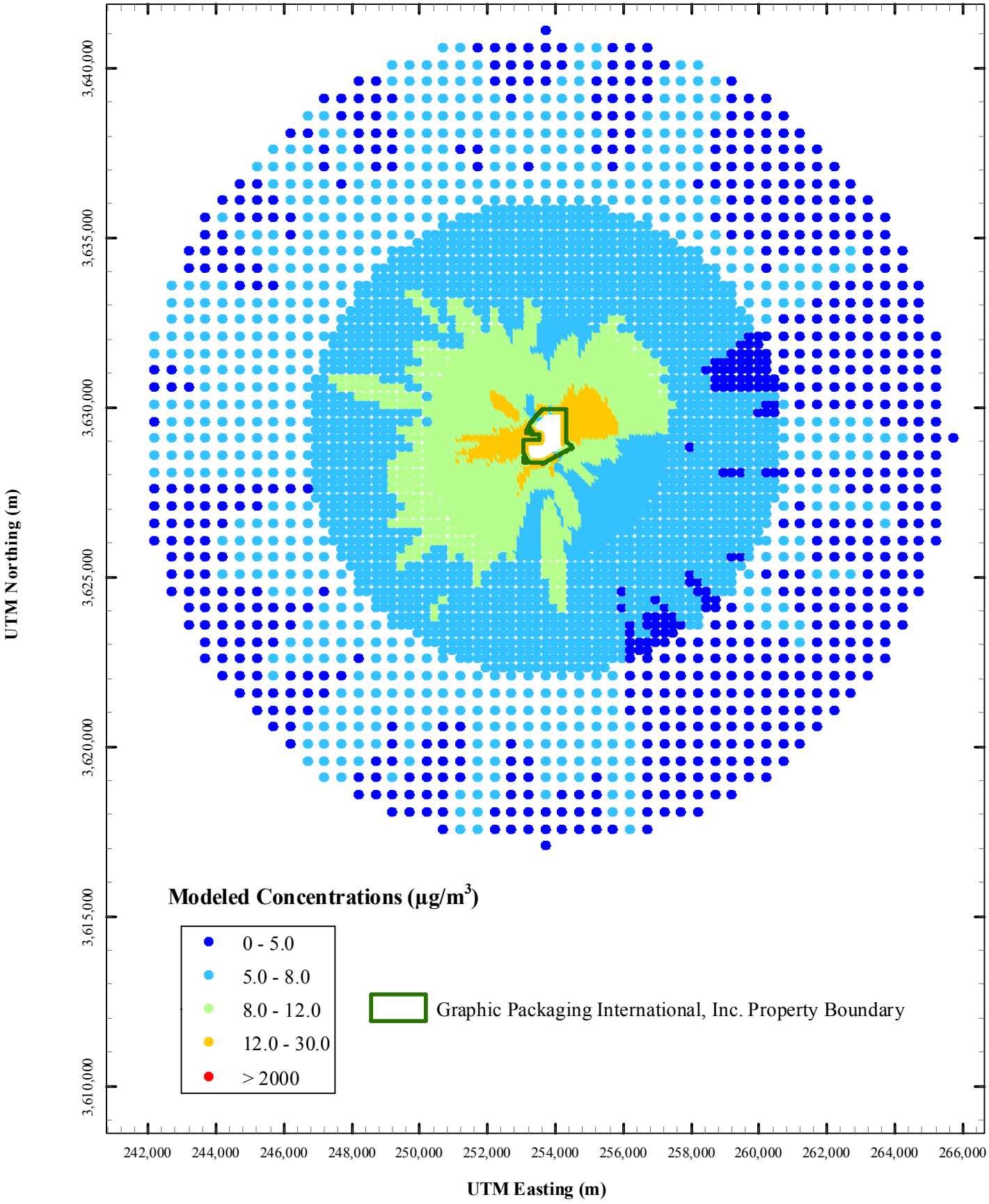
Figure A-9. Class II Significance Modeling - 12PM Startup
1-Hr CO Maximum 1st High Concentrations, Macon Met Data

Graphic Packaging International, Inc - Macon Mill
Macon, Bibb County, Georgia



1-Hour CO PSD SIL: 2,000 µg/m^3
Coordinates reflect UTM projection Zone 17, NAD83.

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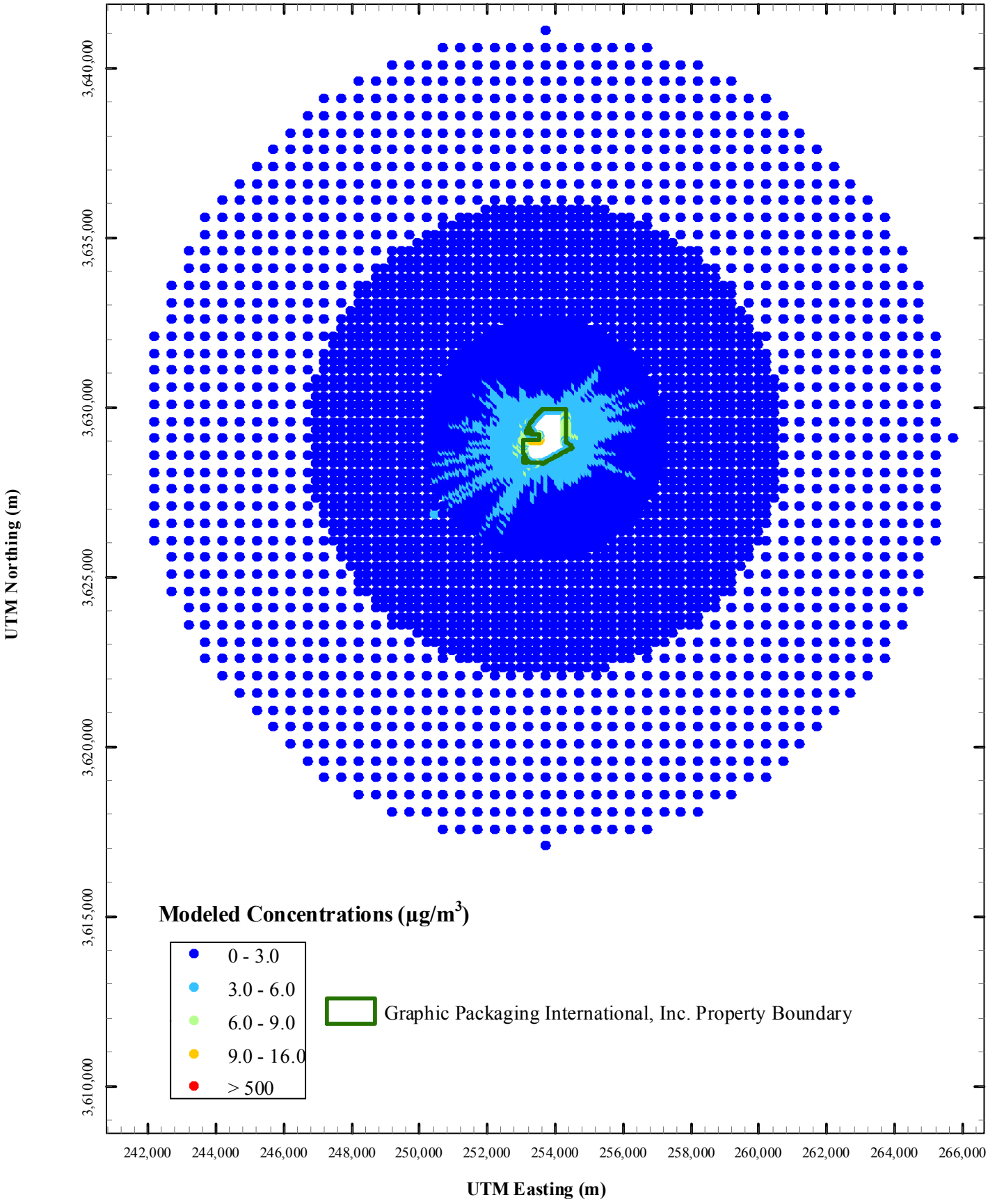
Figure A-10. Class II Significance Modeling - 12PM Startup
8-Hr CO Maximum 1st High Concentrations, Macon Met Data

Graphic Packaging International, Inc - Macon Mill
Macon, Bibb County, Georgia



8-Hour CO PSD SIL: 500 µg/m^3
Coordinates reflect UTM projection Zone 17, NAD83.

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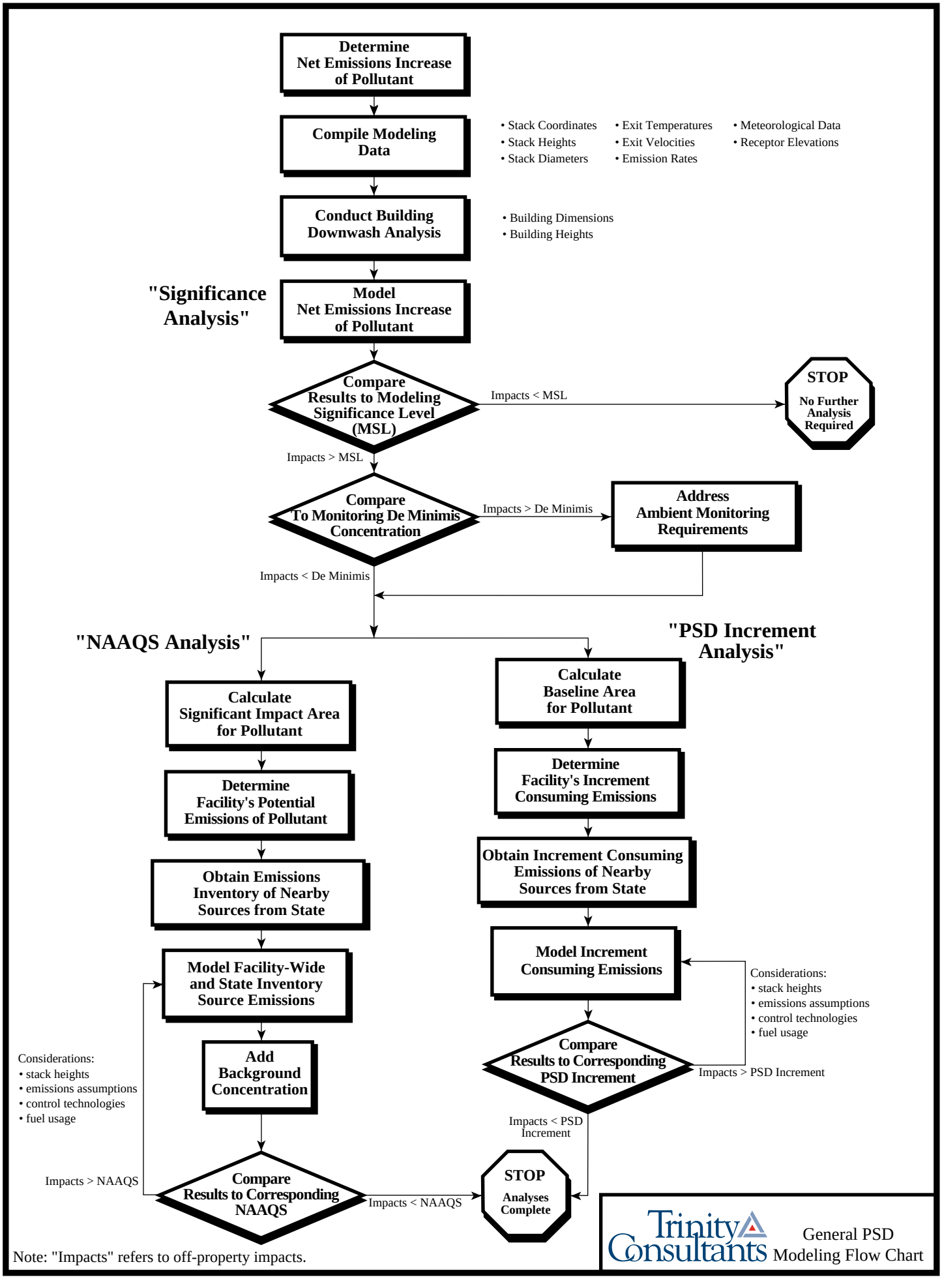
APPENDIX B

PSD FLOW CHART


Determine Net Emissions Increase of Pollutant
Compile Modeling Data
• Stack Coordinates
• Stack Heights
• Stack Diameters
• Exit Temperatures
• Exit Velocities
• Emission Rates
• Meteorological Data
• Receptor Elevations
Conduct Building Downwash Analysis
• Building Dimensions
• Building Heights
"Significance Analysis"
Model Net Emissions Increase of Pollutant
Compare Results to Modeling Significance Level (MSL)
Impacts < MSL
STOP
No Further Analysis Required
Impacts > MSL
Compare To Monitoring De Minimis Concentration
Impacts > De Minimis
Address Ambient Monitoring Requirements
Impacts < De Minimis
"NAAQS Analysis"
"PSD Increment Analysis"
Calculate Significant Impact Area for Pollutant
Determine Facility's Potential Emissions of Pollutant
Obtain Emissions Inventory of Nearby Sources from State
Model Facility-Wide and State Inventory Source Emissions
Add Background Concentration
Considerations:
• stack heights
• emissions assumptions
• control technologies
• fuel usage
Impacts > NAAQS
Compare Results to Corresponding NAAQS
Impacts < NAAQS
STOP
Analyses Complete
Calculate Baseline Area for Pollutant
Determine Facility's Increment Consuming Emissions
Obtain Increment Consuming Emissions of Nearby Sources from State
Model Increment Consuming Emissions
Considerations:
• stack heights
• emissions assumptions
• control technologies
• fuel usage
Compare Results to Corresponding PSD Increment
Impacts > PSD Increment
Impacts < PSD Increment
Note: "Impacts" refers to off-property impacts.
Trinity Consultants
General PSD Modeling Flow Chart

APPENDIX C

ELECTRONIC MODEL FILES

The CD included with this application contains all of the input and output data files used to generate the results from the air quality analyses presented in Sections 3, 5, 6 and 7. The following section provides a description of the contents of each folder included in the attached CD.

FOLDER 1 - MET

- For the meteorological data files, the nomenclature is as follows:
  MCNCNTYY.xxx where:
  MCN = meteorological surface station (Macon)
  GPI = GPI derived meteorological data set
  CNT = meteorological upper air station (Centreville)
  87_91 = met year (1987-1991)
  xxx = profile, surface file, ASCII (.pfl = profile, .sfc = output, asc = ISC met data)

FOLDER 2 – NORMAL OPERATION

01 DOWNWASH

- Contains the input, output, and summary files from the building downwash analysis. This analysis includes all modeled sources and buildings at the Mill for the AERMOD analyses.

02 LOAD ANALYSIS

- Contains the input (.dat) and output (.out) files from the load analysis
  For the load analysis files, the nomenclature is as follows:
  CSDz87_91.xxx where:
  z = M for Macon derived meteorological data set, and G for GPI derived meteorological data set
  xxx = input or output file (.ami = input, .aml = output)

03 SIGNIFICANCE

- CO – contains the input (.ami), output (.aml) and plot (.plt) files from the 1-hr and 8-hr significance analysis

For all of the Class II significance files, the nomenclature is as follows:

CSA87_91.xxx where:

C = pollutant ID (C = CO)

S = type of analysis (S = significance)

A= model run

xxx = input, output or plot file (.ami = input, .aml = output, .plt=plot)

FOLDER 3 – STARTUP ANALYSES

01 SIGNIFICANCE

Contains the AERMOD input (.ami), output (.ami) and plot (.plt) files from the startup modeling for the 12AM and 12PM startup scenarios.

▲ For all of the files, the nomenclature is as follows:
CSyz87_91.xxx where:
y = B for 12AM startup, C for 12PM startup
z = M for Macon derived meteorological data set, and G for GPI derived meteorological data set
xxx = input or output file (.ami = input, .aml = output)

02 DOWNWASH

Contains the input, output, and summary files from the building downwash analysis. This analysis includes all modeled sources and buildings at the Mill for the AERMOD analyses.

FOLDER 4 – TOXICS MODELING

▲ Contains the input and output parameters used for TAP analyses

▲ For all of the files, the nomenclature is as follows:
wwy74_78.xxx where:
ww = Pollutant ID code as follows;

AT = Antimony
CT = Carbon Tetrachloride
CL = Chloroform
FR = Formaldehyde
HXD = Hexachloro dibenzo-p-dioxins
MN = Manganese
MC = Methylene Chloride
PH = Phenol
2TD = 2,3,7,8-Tetrachloro dibenzo-p-dioxins
TD = Tetrachloro dibenzo-p-dioxins
OX = O-Xylene
ML = Methanol
AH = Acetaldehyde
AC = Acrolein
AS = Arsenic
BE = Beryllium
CD = Cadmium
CR = Chromium
CO = Cobalt
PB = Lead
HG = Mercury
NI = Nickel
PR = Propanal

y = model run
zzz = input or output file (.inp = input, .lst = output)

FOLDER 05 – NED

- Contains the NED file (.tif) used in AERMAP to import receptor elevations.

FOLDER 06 – NAAQS Modeling

- Contains the files pertaining to the lead NAAQS analysis.

FOLDER 07 – AERMAP Files

- Contains the AERMAP input files used in the AERMAP evaluation.

APPENDIX D

GEORGIA TAP ANALYSIS DOCUMENTATION

Table D-1a. Maximum Heat Input for Each Type of Fuel Fired at Each Firing Rate

New Biomass Boiler Max Heat Input	620 MMBtu/hr
Hours of Operation	8,760 hrs/yr

Fuel Combusted	% of Maximum Heat Input	Fuel Heat Input Value	Fuel Heat Input Units
Biomass	100%	620.00	MMBtu/hr
Natural Gas (short term)	40%	249.00	MMBtu/hr
Natural Gas (long term)	10%	62.00	MMBtu/hr

Table D-1b. Heat Input and Steaming Rates for Biomass Combustion

Fuel Combusted	Anticipated Wood+Sludge Combination[1]	Maximum Wood+Sludge Combustion[2]
Biomass Heat Input (MMBtu/hr)	571.10	620.00
Associated Steam Production (lb/hr)	350,000	379,968

1. Information provided via email from Aku Raino (Andritz) to GPI on January 6, 2011.
2. Based on maximum heat input capacity of the boiler. Calculated associated steam production as maximum heat input capacity of boiler multiplied by the ratio of the anticipated steam production to anticipated heat input.

Table D-2. New Biomass Boiler Maximum Potential Hazardous Air Pollutant and Toxic Air Pollutant Emissions

Pollutant	Pollutant Classifications: Georgia TAP (Yes/No)	Pollutant Classifications: HAP (Yes/No)	Emission Factors: Biomass[1] (lb/MMBtu)	Emission Factors: Biomass[1] (lb/lb steam)	Emission Factors: Natural Gas[2] (lb/MMscf)	Potential Emissions[3]: Biomass (lb/hr)	Biomass (tpy)	Natural Gas (lb/hr)	Natural Gas (tpy)	Maximum (lb/hr)	Maximum (tpy)
1,1,1-Trichloroethane [methyl chloroform]	Yes	Yes	3.10E-05	5.06E-08	-	1.92E-02	8.42E-02	-	-	1.92E-02	8.42E-02
1,2-Dibromoethene	No	Yes	5.50E-05	8.97E-08	-	3.41E-02	1.49E-01	-	-	3.41E-02	1.49E-01
1,2-Dichloroethane [ethylene dichloride]	Yes	Yes	2.90E-05	4.73E-08	-	1.80E-02	7.88E-02	-	-	1.80E-02	7.88E-02
1,2-Dichloropropane	Yes	Yes	3.30E-05	5.38E-08	-	2.05E-02	8.96E-02	-	-	2.05E-02	8.96E-02
2,3,7,8-Tetrachlorodibenzo-p-dioxins	Yes	Yes	8.60E-12	1.40E-14	-	5.33E-09	2.34E-08	-	-	5.33E-09	2.34E-08
2,3,7,8-Tetrachlorodibenzo-p-furans	No	Yes	9.00E-11	1.47E-13	-	5.58E-08	2.44E-07	-	-	5.58E-08	2.44E-07
2,4,6-Trichlorophenol	Yes	Yes	2.20E-08	3.59E-11	-	1.36E-05	5.97E-05	-	-	1.36E-05	5.97E-05
2,4-Dinitrophenol	Yes	Yes	1.80E-07	2.94E-10	-	1.12E-04	4.89E-04	-	-	1.12E-04	4.89E-04
Methyl ethyl ketone [2-butanone]	Yes	No	-	-	-	-	-	-	-	0.00E+00	0.00E+00
2-Chloronaphthalene	No	Yes	2.40E-09	3.92E-12	-	1.49E-06	6.52E-06	-	-	1.49E-06	6.52E-06
2-Chlorophenol	Yes	No	2.40E-08	3.92E-11	-	1.49E-05	6.52E-05	-	-	1.49E-05	6.52E-05
2-Methyl naphthalene (POM)	Yes	Yes	1.60E-07	2.61E-10	2.40E-05	9.92E-05	4.34E-04	5.84E-06	6.36E-06	9.92E-05	4.34E-04
2-Nitrophenol	Yes	No	2.40E-07	3.92E-10	-	1.49E-04	6.52E-04	-	-	1.49E-04	6.52E-04
3-Methylchloranthrene (POM)	Yes	Yes	-	-	1.80E-06	-	-	4.38E-07	4.77E-07	4.38E-07	4.77E-07
4-Nitrophenol	Yes	Yes	1.10E-07	1.79E-10	-	6.82E-05	2.99E-04	-	-	6.82E-05	2.99E-04
7,12-Dimethylbenz(a)anthracene (POM)	Yes	Yes	-	-	1.60E-05	-	-	3.89E-06	4.24E-06	3.89E-06	4.24E-06
Acenaphthene (POM)	No	Yes	9.10E-07	1.48E-09	1.80E-06	5.64E-04	2.47E-03	4.38E-07	4.77E-07	5.64E-04	2.47E-03
Acenaphthylene (POM)	No	Yes	5.00E-06	8.16E-09	1.80E-06	3.10E-03	1.36E-02	4.38E-07	4.77E-07	3.10E-03	1.36E-02
Acetaldehyde	Yes	Yes	4.66E-05	7.60E-08	-	2.89E-02	1.26E-01	-	-	2.89E-02	1.26E-01
Acetone	Yes	No	1.90E-04	3.10E-07	-	1.18E-01	5.16E-01	-	-	1.18E-01	5.16E-01
Acetophenone	Yes	Yes	3.20E-09	5.22E-12	-	1.98E-06	8.69E-06	-	-	1.98E-06	8.69E-06
Acrolein	Yes	Yes	9.17E-06	1.50E-08	-	5.69E-03	2.49E-02	-	-	5.69E-03	2.49E-02
Anthracene (POM)	Yes	Yes	3.00E-06	4.90E-09	2.40E-06	1.86E-03	8.15E-03	5.84E-07	6.36E-07	1.86E-03	8.15E-03
Antimony	Yes	Yes	7.90E-06	1.29E-08	-	4.90E-03	2.15E-02	-	-	4.90E-03	2.15E-02
Arsenic	Yes	Yes	2.20E-05	3.59E-08	2.00E-04	1.36E-02	5.97E-02	4.86E-05	5.30E-05	1.36E-02	5.97E-02
Barium	Yes	No	1.70E-04	2.77E-07	4.40E-03	1.05E-01	4.62E-01	1.07E-03	1.17E-03	1.05E-01	4.62E-01
Benzaldehyde	Yes	No	8.50E-07	1.39E-09	-	5.27E-04	2.31E-03	-	-	5.27E-04	2.31E-03
Benzene	Yes	Yes	2.53E-05	4.13E-08	2.10E-03	1.57E-02	6.87E-02	5.11E-04	5.57E-04	1.57E-02	6.87E-02
Benzo(a)anthracene (POM)	Yes	Yes	6.50E-08	1.06E-10	1.80E-06	4.03E-05	1.77E-04	4.38E-07	4.77E-07	4.03E-05	1.77E-04
Benzo(a)pyrene (POM)	Yes	Yes	2.60E-06	4.24E-09	1.20E-06	1.61E-03	7.06E-03	2.92E-07	3.18E-07	1.61E-03	7.06E-03
Benzo(k)fluoranthene (POM)	Yes	Yes	3.60E-08	5.87E-11	1.80E-06	2.23E-05	9.78E-05	4.38E-07	4.77E-07	2.23E-05	9.78E-05
Benzo(b)fluoranthene (POM)	Yes	Yes	-	-	1.80E-06	-	-	4.38E-07	4.77E-07	4.38E-07	4.77E-07
Benzo(e)pyrene	No	Yes	2.60E-09	4.24E-12	-	1.61E-06	7.06E-06	-	-	1.61E-06	7.06E-06
Benzo(g,h,i)perylene (POM)	No	Yes	9.30E-08	1.52E-10	1.20E-06	5.77E-05	2.53E-04	2.92E-07	3.18E-07	5.77E-05	2.53E-04
Benzo(j,k)fluoranthene	Yes	Yes	1.60E-07	2.61E-10	-	9.92E-05	4.34E-04	-	-	9.92E-05	4.34E-04
Benzo(k)fluoranthene (POM)	Yes	Yes	3.60E-08	5.87E-11	1.80E-06	2.23E-05	9.78E-05	4.38E-07	4.77E-07	2.23E-05	9.78E-05
Benzoic acid	Yes	No	4.70E-08	7.67E-11	-	2.91E-05	1.28E-04	-	-	2.91E-05	1.28E-04
Beryllium	Yes	Yes	1.10E-06	1.79E-09	1.20E-05	6.82E-04	2.99E-03	2.92E-06	3.18E-06	6.82E-04	2.99E-03
Bis (2-ethylhexyl) phthalate	Yes	Yes	4.70E-08	7.67E-11	-	2.91E-05	1.28E-04	-	-	2.91E-05	1.28E-04
Bromomethane [methyl bromide]	Yes	Yes	1.50E-05	2.45E-08	-	9.30E-03	4.07E-02	-	-	9.30E-03	4.07E-02
Butane	Yes	No	-	-	2.10E+00	-	-	5.11E-01	5.57E-01	5.11E-01	5.57E-01
Cadmium	Yes	Yes	4.10E-06	6.69E-09	1.10E-03	2.54E-03	1.11E-02	2.67E-04	2.92E-04	2.54E-03	1.11E-02
Carbazole	Yes	Yes	1.80E-06	2.94E-09	-	1.12E-03	4.89E-03	-	-	1.12E-03	4.89E-03
Carbon tetrachloride	Yes	Yes	4.50E-05	7.34E-08	-	2.79E-02	1.22E-01	-	-	2.79E-02	1.22E-01
Chlorine	Yes	Yes	7.90E-04	1.29E-06	-	4.90E-01	2.15E+00	-	-	4.90E-01	2.15E+00
Chlorobenzene	Yes	Yes	3.30E-05	5.38E-08	-	2.05E-02	8.96E-02	-	-	2.05E-02	8.96E-02
Chloroform	Yes	Yes	2.80E-05	4.57E-08	-	1.74E-02	7.60E-02	-	-	1.74E-02	7.60E-02
Chloromethane [methyl chloride]	Yes	Yes	2.30E-05	3.75E-08	-	1.43E-02	6.25E-02	-	-	1.43E-02	6.25E-02
Chromium	Yes	Yes	2.10E-05	3.43E-08	1.40E-03	1.30E-02	5.70E-02	3.40E-04	3.71E-04	1.30E-02	5.70E-02
Chromium VI	Yes	Yes	3.50E-06	5.71E-09	-	2.17E-03	9.50E-03	-	-	2.17E-03	9.50E-03
Chrysene (POM)	Yes	Yes	3.80E-08	6.20E-11	-	2.36E-05	1.03E-04	-	-	2.36E-05	1.03E-04
Cobalt	Yes	Yes	6.50E-06	1.06E-08	8.40E-05	4.03E-03	1.77E-02	2.04E-05	2.23E-05	4.03E-03	1.77E-02
Copper	Yes	No	4.90E-05	8.00E-08	8.50E-04	3.04E-02	1.33E-01	2.07E-04	2.25E-04	3.04E-02	1.33E-01
Crotonaldehyde	Yes	No	9.90E-06	1.62E-08	-	6.14E-03	2.69E-02	-	-	6.14E-03	2.69E-02
Decachlorobiphenyl	Yes	Yes	2.70E-10	4.41E-13	-	1.67E-07	7.33E-07	-	-	1.67E-07	7.33E-07
Dibenzo(a,h)anthracene (POM)	Yes	Yes	9.10E-09	1.48E-11	1.20E-06	5.64E-06	2.47E-05	2.92E-07	3.18E-07	5.64E-06	2.47E-05
Dichlorobenzene	Yes	Yes	-	-	1.20E-03	-	-	2.92E-04	3.18E-04	2.92E-04	3.18E-04
Dichlorobiphenyl	Yes	Yes	7.40E-10	1.21E-12	-	4.59E-07	2.01E-06	-	-	4.59E-07	2.01E-06
Methylene chloride [dichloromethane]	Yes	Yes	2.90E-04	4.73E-07	-	1.80E-01	7.88E-01	-	-	1.80E-01	7.88E-01
Ethane	Yes	No	-	-	3.10E+00	-	-	7.54E-01	8.22E-01	7.54E-01	8.22E-01
Ethylbenzene	Yes	Yes	3.10E-05	5.06E-08	-	1.92E-02	8.42E-02	-	-	1.92E-02	8.42E-02
Fluoranthene (POM)	No	Yes	1.60E-06	2.61E-09	3.00E-06	9.92E-04	4.34E-03	7.29E-07	7.96E-07	9.92E-04	4.34E-03
Fluorene (POM)	No	Yes	3.40E-06	5.55E-09	2.80E-06	2.11E-03	9.23E-03	6.81E-07	7.43E-07	2.11E-03	9.23E-03
Formaldehyde	Yes	Yes	2.29E-04	3.73E-07	7.50E-02	1.42E-01	6.21E-01	1.82E-02	1.99E-02	1.42E-01	6.21E-01
Heptachlorobiphenyl	Yes	Yes	6.60E-11	1.08E-13	-	4.09E-08	1.79E-07	-	-	4.09E-08	1.79E-07
Heptachlorodibenzo-p-dioxins	No	Yes	2.00E-09	3.26E-12	-	1.24E-06	5.43E-06	-	-	1.24E-06	5.43E-06
Heptachlorodibenzo-p-furans	No	Yes	2.40E-10	3.92E-13	-	1.49E-07	6.52E-07	-	-	1.49E-07	6.52E-07
Hexachlorobiphenyl	Yes	Yes	5.50E-10	8.97E-13	-	3.41E-07	1.49E-06	-	-	3.41E-07	1.49E-06
Hexachlorodibenzo-p-dioxins	Yes	Yes	1.60E-06	2.61E-09	-	9.92E-04	4.34E-03	-	-	9.92E-04	4.34E-03
Hexachlorodibenzo-p-furans	No	Yes	2.80E-10	4.57E-13	-	1.74E-07	7.60E-07	-	-	1.74E-07	7.60E-07
Hexanal	Yes	No	7.00E-06	1.14E-08	-	4.34E-03	1.90E-02	-	-	4.34E-03	1.90E-02
Hydrogen chloride*	Yes	Yes	N/A	N/A	-	2.26E+00	9.90E+00	-	-	2.26E+00	9.90E+00
Hydrogen fluoride [hydrofluoric acid]	Yes	Yes	2.22E-04	3.62E-07	-	1.38E-01	6.02E-01	-	-	1.38E-01	6.02E-01
Indeno(1,2,3-c,d)pyrene (POM)	Yes	Yes	8.70E-08	1.42E-10	1.80E-06	5.39E-05	2.36E-04	4.38E-07	4.77E-07	5.39E-05	2.36E-04
Iron	No	No	9.90E-04	1.62E-06	-	6.14E-01	2.69E+00	-	-	6.14E-01	2.69E+00
Isobutyraldehyde	Yes	No	1.20E-05	1.96E-08	-	7.44E-03	3.26E-02	-	-	7.44E-03	3.26E-02
Lead	Yes	Yes	4.80E-05	7.83E-08	5.00E-05	2.98E-02	1.30E-01	1.22E-05	1.33E-05	2.98E-02	1.30E-01
Manganese	Yes	Yes	3.61E-04	5.89E-07	3.80E-04	2.24E-01	9.81E-01	9.24E-05	1.01E-04	2.24E-01	9.81E-01
Mercury	Yes	Yes	3.50E-06	5.71E-09	2.60E-04	2.17E-03	9.50E-03	6.32E-05	6.90E-05	2.17E-03	9.50E-03
Methane	Yes	No	2.10E-02	3.43E-05	-	1.30E+01	5.70E+01	-	-	1.30E+01	5.70E+01
Methanol	Yes	Yes	1.62E-03	2.64E-06	-	1.00E+00	4.39E+00	-	-	1.00E+00	4.39E+00
Molybdenum	Yes	No	2.10E-06	3.43E-09	1.10E-03	1.30E-03	5.70E-03	2.67E-04	2.92E-04	1.30E-03	5.70E-03
Monochlorobiphenyl	No	Yes	2.20E-10	3.59E-13	-	1.36E-07	5.97E-07	-	-	1.36E-07	5.97E-07
Naphthalene	Yes	Yes	9.70E-05	1.58E-07	6.10E-04	6.01E-02	2.63E-01	1.48E-04	1.62E-04	6.01E-02	2.63E-01
n-Hexane	Yes	Yes	-	-	1.80E+00	-	-	4.38E-01	4.77E-01	4.38E-01	4.77E-01
Nickel	Yes	Yes	3.30E-05	5.38E-08	2.10E-03	2.05E-02	8.96E-02	5.11E-04	5.57E-04	2.05E-02	8.96E-02
Octachlorodibenzo-p-dioxins	No	Yes	6.60E-08	1.08E-10	-	4.09E-05	1.79E-04	-	-	4.09E-05	1.79E-04
Octachlorodibenzo-p-furans	No	Yes	8.80E-11	1.44E-13	-	5.46E-08	2.39E-07	-	-	5.46E-08	2.39E-07
o-Tolualdehyde	No	No	7.20E-06	1.17E-08	-	4.46E-03	1.96E-02	-	-	4.46E-03	1.96E-02
o-Xylene	Yes	Yes	2.50E-05	4.08E-08	-	1.55E-02	6.79E-02	-	-	1.55E-02	6.79E-02
Pentachlorobiphenyl	No	Yes	1.20E-09	1.96E-12	-	7.44E-07	3.26E-06	-	-	7.44E-07	3.26E-06
Pentachlorodibenzo-p-dioxins	No	Yes	1.50E-09	2.45E-12	-	9.30E-07	4.07E-06	-	-	9.30E-07	4.07E-06
Pentachlorodibenzo-p-furans	No	Yes	4.20E-10	6.85E-13	-	2.60E-07	1.14E-06	-	-	2.60E-07	1.14E-06
Pentachlorophenol	Yes	Yes	5.10E-08	8.32E-11	-	3.16E-05	1.38E-04	-	-	3.16E-05	1.38E-04
Pentane	Yes	No	-	-	2.60E+00	-	-	6.32E-01	6.90E-01	6.32E-01	6.90E-01
Perylene	No	Yes	5.20E-10	8.48E-13	-	3.22E-07	1.41E-06	-	-	3.22E-07	1.41E-06
Phenanthrene (POM)	Yes	Yes	7.00E-06	1.14E-08	1.70E-05	4.34E-03	1.90E-02	4.13E-06	4.51E-06	4.34E-03	1.90E-02
Phenol	Yes	Yes	5.10E-05	8.32E-08	-	3.16E-02	1.38E-01	-	-	3.16E-02	1.38E-01
Phosphorus	Yes	Yes	2.70E-05	4.41E-08	-	1.67E-02	7.33E-02	-	-	1.67E-02	7.33E-02
Potassium	No	No	3.90E-02	6.36E-05	-	2.42E+01	1.06E+02	-	-	2.42E+01	1.06E+02
Propane	Yes	No	-	-	1.60E+00	-	-	3.89E-01	4.24E-01	3.89E-01	4.24E-01
Propionaldehyde [propanal]	Yes	Yes	6.10E-05	9.95E-08	-	3.78E-02	1.66E-01	-	-	3.78E-02	1.66E-01
p-Tolualdehyde	No	No	1.10E-05	1.79E-08	-	6.82E-03	2.99E-02	-	-	6.82E-03	2.99E-02
Pyrene (POM)	Yes	Yes	3.70E-06	6.04E-09	5.00E-06	2.29E-03	1.00E-02	1.22E-06	1.33E-06	2.29E-03	1.00E-02
Selenium	Yes	Yes	2.80E-06	4.57E-09	2.40E-05	1.74E-03	7.60E-03	5.84E-06	6.36E-06	1.74E-03	7.60E-03
Silver	Yes	No	1.70E-03	2.77E-06	-	1.05E+00	4.62E+00	-	-	1.05E+00	4.62E+00
Sodium	No	No	3.60E-04	5.87E-07	-	2.23E-01	9.78E-01	-	-	2.23E-01	9.78E-01
Strontium	No	No	1.00E-05	1.63E-08	-	6.20E-03	2.72E-02	-	-	6.20E-03	2.72E-02
Styrene	Yes	Yes	5.60E-07	9.14E-10	-	3.47E-04	1.52E-03	-	-	3.47E-04	1.52E-03
Tetrachlorobiphenyl	Yes	Yes	2.50E-09	4.08E-12	-	1.55E-06	6.79E-06	-	-	1.55E-06	6.79E-06
Tetrachlorodibenzo-p-dioxins	Yes	Yes	4.70E-10	7.67E-13	-	2.91E-07	1.28E-06	-	-	2.91E-07	1.28E-06
Tetrachlorodibenzo-p-furans	No	Yes	7.50E-10	1.22E-12	-	4.65E-07	2.04E-06	-	-	4.65E-07	2.04E-06
Tetrachloroethylene [perchloroethylene]	Yes	Yes	3.80E-05	6.20E-08	-	2.36E-02	1.03E-01	-	-	2.36E-02	1.03E-01
Tin	Yes	No	2.30E-05	3.75E-08	-	1.43E-02	6.25E-02	-	-	1.43E-02	6.25E-02
Titanium	Yes	No	2.00E-05	3.26E-08	-	1.24E-02	5.43E-02	-	-	1.24E-02	5.43E-02
Toluene	Yes	Yes	5.72E-06	9.33E-09	3.40E-03	3.55E-03	1.55E-02	8.27E-04	9.02E-04	3.55E-03	1.55E-02
Trichlorobiphenyl	Yes	Yes	2.60E-09	4.24E-12	-	1.61E-06	7.06E-06	-	-	1.61E-06	7.06E-06
Trichloroethylene	Yes	Yes	3.00E-05	4.90E-08	-	1.86E-02	8.15E-02	-	-	1.86E-02	8.15E-02
Trichlorofluoromethane	Yes	No	4.10E-05	6.69E-08	-	2.54E-02	1.11E-01	-	-	2.54E-02	1.11E-01
Vanadium	Yes	No	9.80E-07	1.60E-09	2.30E-03	6.08E-04	2.66E-03	5.59E-04	6.10E-04	6.08E-04	2.66E-03
Vinyl chloride	Yes	Yes	1.80E-05	2.94E-08	-	1.12E-02	4.89E-02	-	-	1.12E-02	4.89E-02
Yttrium	Yes	No	3.00E-07	4.90E-10	-	1.86E-04	8.15E-04	-	-	1.86E-04	8.15E-04
Zinc	No	No	4.20E-04	6.85E-07	2.90E-02	2.60E-01	1.14E+00	7.05E-03	7.69E-03	2.60E-01	1.14E+00
Toxic Air Pollutant Total						**44.37**	**194.35**	**2.35**	**2.56**	**46.71**	**196.90**
Hazardous Air Pollutant Total						**5.02**	**21.99**	**0.46**	**0.50**	**5.46**	**22.46**
Maximum Hazardous Air Pollutant						**2.26**	**9.90**	**0.44**	**0.48**	**2.26**	**9.90**

1. Emission factors (lb/MMBtu) for biomass taken from AP-42 Chapter 1.6. Lb/Lb steam factors estimated based on design steaming capabilities of the boiler. Intended to facilitate future actual emission calculations.
2. Emission factors for natural gas firing taken from AP-42 Chapter 1.4, "Natural Gas Combustion," Tables 1.4-3 and 1.4-4 (July 1998).
3. Biomass short and long term emissions based on 100% biomass fuel. Natural gas short term emissions based on the maximum natural gas burner capacity. Natural gas long term emissions are based on a maximum of 10% of the boiler heat input capacity on an annual basis. Annual emissions are based on the 8,760 hours of operation.

*GPI is proposing to limit HCl emissions from the No. 3 Biomass Boiler to < 10 tpy.

Table D-3. Maximum Hourly Fuel Consumption for Fuel Fired[1]

Emission Unit	Heat Input (MMBtu/hr)	Natural Gas (MMscf/hr)	Hours of Operation (hrs/yr)
No. 2 Power Boiler	198.00	1.93E-01	8,760

1. Maximum hourly fuel consumption of natural gas, fuel oil, and propane is listed if unit fires particular fuel. Maximum fuel consumption is based on the heating value of each fuel.

Table D-4. No. 2 Power Boiler (B002) Maximum Potential Hazardous Air Pollutant and Toxic Air Pollutant Emissions - After Project

Pollutant	Pollutant Classifications		Emission Factors	Potential Emissions	
	Georgia TAP (Yes/No)	HAP (Yes/No)	Natural Gas[1] (lb/MMscf)	Natural Gas (lb/hr)	(tpy)
1,1,1-Trichloroethane [methyl chloroform]	Yes	Yes	-	-	-
1,2,3,4,6,7,8,9-Octachlorodibenzodioxin [OCDD]	Yes	Yes	-	-	-
1,2-Dibromoethane [ethylene dibromide]	No	Yes	-	-	-
1,2-Dichloroethane [ethylene dichloride]	Yes	Yes	-	-	-
2,4-Dinitrotoluene	Yes	Yes	-	-	-
2-Chloroacetophenone	Yes	Yes	-	-	-
2-Methyl naphthalene (POM)	Yes	Yes	2.40E-05	4.64E-06	2.03E-05
3-Methylchloranthrene (POM)	Yes	Yes	1.80E-06	3.48E-07	1.52E-06
5-Methyl chrysene (POM)	No	Yes	-	-	-
7,12-Dimethylbenz(a)anthracene (POM)	Yes	Yes	1.60E-05	3.09E-06	1.36E-05
Acenaphthene (POM)	No	Yes	1.80E-06	3.48E-07	1.52E-06
Acenaphthylene (POM)	No	Yes	1.80E-06	3.48E-07	1.52E-06
Acetaldehyde	Yes	Yes	-	-	-
Acetophenone	Yes	Yes	-	-	-
Acrolein	Yes	Yes	-	-	-
Anthracene (POM)	Yes	Yes	2.40E-06	4.64E-07	2.03E-06
Antimony	Yes	Yes	-	-	-
Arsenic	Yes	Yes	2.00E-04	3.87E-05	1.69E-04
Barium	Yes	No	4.40E-03	8.51E-04	3.73E-03
Benzene	Yes	Yes	2.10E-03	4.06E-04	1.78E-03
Benzo(a)anthracene (POM)	Yes	Yes	1.80E-06	3.48E-07	1.52E-06
Benzo(a)pyrene (POM)	Yes	Yes	1.20E-06	2.32E-07	1.02E-06
Benzo(b)fluoranthene (POM)	Yes	Yes	1.80E-06	3.48E-07	1.52E-06
Benzo(b,k)fluoranthene (POM)	Yes	Yes	-	-	-
Benzo(g,h,i)perylene (POM)	No	Yes	1.20E-06	2.32E-07	1.02E-06
Benzo(k)fluoranthene (POM)	Yes	Yes	1.80E-06	3.48E-07	1.52E-06
Benzyl chloride	Yes	Yes	-	-	-
Beryllium	Yes	Yes	1.20E-05	2.32E-06	1.02E-05
Biphenyl	Yes	Yes	-	-	-
Bis (2-ethylhexyl) phthalate	Yes	Yes	-	-	-
Bromoform	Yes	Yes	-	-	-
Bromomethane [methyl bromide]	Yes	Yes	-	-	-
Butane	Yes	No	2.10E+00	4.06E-01	1.78E+00
Cadmium	Yes	Yes	1.10E-03	2.13E-04	9.32E-04
Carbon disulfide	Yes	Yes	-	-	-
Chloride	Yes	Yes	-	-	-
Chlorobenzene	Yes	Yes	-	-	-
Chloroform	Yes	Yes	-	-	-
Chloromethane [methyl chloride]	Yes	Yes	-	-	-
Chromium	Yes	Yes	1.40E-03	2.71E-04	1.19E-03
Chromium VI	Yes	Yes	-	-	-
Cobalt	Yes	Yes	8.40E-05	1.62E-05	7.11E-05
Copper	Yes	No	8.50E-04	1.64E-04	7.20E-04
Cumene	Yes	Yes	-	-	-
Cyanide	Yes	Yes	-	-	-
Dibenzo(a,h)anthracene (POM)	Yes	Yes	1.20E-06	2.32E-07	1.02E-06
Dichlorobenzene	Yes	Yes	1.20E-03	2.32E-04	1.02E-03
Methylene chloride [dichloromethane]	Yes	Yes	-	-	-
Dimethyl sulfate	Yes	Yes	-	-	-
Ethane	Yes	No	3.10E+00	5.99E-01	2.63E+00
Ethyl chloride [chloroethane]	Yes	Yes	-	-	-
Ethylbenzene	Yes	Yes	-	-	-
Fluoranthene (POM)	No	Yes	3.00E-06	5.80E-07	2.54E-06
Fluorene (POM)	No	Yes	2.80E-06	5.41E-07	2.37E-06
Fluoride	Yes	No	-	-	-
Formaldehyde	Yes	Yes	7.50E-02	1.45E-02	6.35E-02
Hydrogen chloride	Yes	Yes	-	-	-
Hydrogen fluoride [hydrofluoric acid]	Yes	Yes	-	-	-
Indeno(1,2,3-c,d)pyrene (POM)	Yes	Yes	1.80E-06	3.48E-07	1.52E-06
Isophorone	Yes	Yes	-	-	-
Lead	Yes	Yes	5.00E-05	9.67E-06	4.23E-05
Magnesium	No	No	-	-	-
Manganese	Yes	Yes	3.80E-04	7.35E-05	3.22E-04
Mercury	Yes	Yes	2.60E-04	5.03E-05	2.20E-04
Methyl ethyl ketone [2-butanone]	Yes	No	-	-	-
Methyl hydrazine	Yes	Yes	-	-	-
Methyl methacrylate	Yes	Yes	-	-	-
Methyl tert butyl ether [MTBE]	Yes	Yes	-	-	-
Molybdenum	Yes	No	1.10E-03	2.13E-04	9.32E-04
Naphthalene	Yes	Yes	6.10E-04	1.18E-04	5.17E-04
n-Hexane	Yes	Yes	1.80E+00	3.48E-01	1.52E+00
Nickel	Yes	Yes	2.10E-03	4.06E-04	1.78E-03
o-Xylene	Yes	Yes	-	-	-
Pentane	Yes	No	2.60E+00	5.03E-01	2.20E+00
Phenanthrene (POM)	Yes	Yes	1.70E-05	3.29E-06	1.44E-05
Phenol	Yes	Yes	-	-	-
Phosphorus	Yes	Yes	-	-	-
Propane	Yes	No	1.60E+00	3.09E-01	1.36E+00
Propionaldehyde [propanal]	Yes	Yes	-	-	-
Pyrene (POM)	Yes	Yes	5.00E-06	9.67E-07	4.23E-06
Selenium	Yes	Yes	2.40E-05	4.64E-06	2.03E-05
Styrene	Yes	Yes	-	-	-
Tetrachloroethylene [perchloroethylene]	Yes	Yes	-	-	-
Toluene	Yes	Yes	3.40E-03	6.57E-04	2.88E-03
Vanadium	Yes	No	2.30E-03	4.45E-04	1.95E-03
Vinyl acetate	Yes	Yes	-	-	-
Zinc	No	No	2.90E-02	5.61E-03	2.46E-02
Toxic Air Pollutant Total				**2.18**	**9.57**
Hazardous Air Pollutant Total				**0.37**	**1.60**
Maximum Hazardous Air Pollutant				**0.35**	**1.52**

1. Emission factors for natural gas firing taken from AP-42 Chapter 1.4, "Natural Gas Combustion," Tables 1.4-3 and 1.4-4 (July 1998).

Table D-5. No. 1 Power Boiler Past Actual Production Data[1]

Parameter	Year 2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Coal Combusted (MMBtu)	894,563	856,005	618,363	554,761	422,351	585,597	403,174	672,059	330,251	574,700
Fuel Oil Combusted (Mgal)	241.70	0.00	2.00	0.00	2.20	0.00	0.00	0.00	36.04	4.91
Natural Gas Combusted (MMscf)	28.30	11.10	16.40	17.90	13.50	9.10	9.64	8.03	185.21	50.02
Annual Hours of Operation	6,439	7,479	6,144	5,657	4,012	5,478	3,786	5,848	5,289	5,442

1. Past actual production data from the netting tool.

Table D-6. No. 2 Power Boiler Past Actual Production Data[1]

Parameter	Year 2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Coal Combusted (MMBtu)	730,936	452,095	632,028	700,151	1,071,423	507,162	855,193	873,582	356,362	651,408
Fuel Oil Combusted (Mgal)	164.60	12.10	137.60	2.73	22.40	0.00	7.43	0.38	71.48	44.73
Natural Gas Combusted (MMscf)	23.00	10.20	11.20	8.50	8.80	8.40	6.09	6.97	406.99	70.15
Annual Hours of Operation	7,082	4,951	7,061	6,478	7,968	4,496	7,440	7,089	7,768	6,075

1. Past actual production data from the netting tool.

Table D-7. No. 1 Power Boiler Past Actual Hazardous Air Pollutant and Toxic Air Pollutant Emissions

	Pollutant Classifications		Emission Factors			2001 Actual Emissions								2002 Actual Emissions								2003 Actual Emissions							
	Georgia TAP	HAP				Coal		Natural Gas		Fuel Oil		Total		Coal		Natural Gas		Fuel Oil		Total		Coal		Natural Gas		Fuel Oil		Total	
Pollutant	**(Yes/No)**	**(Yes/No)**	**Coal[1] (lb/ton)**	**Natural Gas[2] (lb/MMscf)**	**Fuel Oil[3] (lb/Mgal)**	**(lb/hr)[4]**	**(tpy)[5]**	**(lb/hr)[4]**	**(tpy)[5]**	**(lb/hr)[4]**	**(tpy)[5]**	**(lb/hr)**	**(tpy)**	**(lb/hr)[4]**	**(tpy)[5]**	**(lb/hr)[4]**	**(tpy)[5]**	**(lb/hr)[4]**	**(tpy)[5]**	**(lb/hr)**	**(tpy)**	**(lb/hr)[4]**	**(tpy)[5]**	**(lb/hr)[4]**	**(tpy)[5]**	**(lb/hr)[4]**	**(tpy)[5]**	**(lb/hr)**	**(tpy)**
Acetaldehyde	Yes	Yes	5.70E-04	-	-	3.12E-03	1.00E-02	-	-	-	-	3.12E-03	1.00E-02	2.57E-03	9.60E-03	-	-	-	-	2.57E-03	9.60E-03	2.26E-03	6.94E-03	-	-	-	-	2.26E-03	6.94E-03
Acrolein	Yes	Yes	2.90E-04	-	-	1.59E-03	5.11E-03	-	-	-	-	1.59E-03	5.11E-03	1.31E-03	4.89E-03	-	-	-	-	1.31E-03	4.89E-03	1.15E-03	3.53E-03	-	-	-	-	1.15E-03	3.53E-03
Antimony	Yes	Yes	1.80E-05	-	5.25E-04	9.85E-05	3.17E-04	-	-	1.97E-05	6.34E-05	1.18E-04	3.80E-04	8.11E-05	3.03E-04	-	-	0.00E+00	0.00E+00	8.11E-05	3.03E-04	7.13E-05	2.19E-04	-	-	1.71E-07	5.25E-07	7.15E-05	2.20E-04
Arsenic	Yes	Yes	4.10E-04	2.00E-04	1.32E-04	2.24E-03	7.22E-03	8.79E-07	2.83E-06	4.95E-06	1.60E-05	2.25E-03	7.24E-03	1.85E-03	6.91E-03	2.97E-07	1.11E-06	0.00E+00	0.00E+00	1.85E-03	6.91E-03	1.62E-03	4.99E-03	5.34E-07	1.64E-06	4.30E-08	1.32E-07	1.63E-03	4.99E-03
Beryllium	Yes	Yes	2.10E-05	1.20E-05	2.78E-06	1.15E-04	3.70E-04	5.27E-08	1.70E-07	1.04E-07	3.36E-07	1.15E-04	3.70E-04	9.46E-05	3.54E-04	1.78E-08	6.66E-08	0.00E+00	0.00E+00	9.46E-05	3.54E-04	8.32E-05	2.56E-04	3.20E-08	9.84E-08	9.05E-10	2.78E-09	8.32E-05	2.56E-04
Cadmium	Yes	Yes	5.10E-05	1.10E-03	3.98E-05	2.79E-04	8.98E-04	4.83E-06	1.56E-05	1.49E-06	4.81E-06	2.85E-04	9.18E-04	2.30E-04	8.59E-04	1.63E-06	6.11E-06	0.00E+00	0.00E+00	2.31E-04	8.65E-04	2.02E-04	6.21E-04	2.94E-06	9.02E-06	1.30E-08	3.98E-08	2.05E-04	6.30E-04
Chloroform	Yes	Yes	5.90E-05	-	-	3.23E-04	1.04E-03	-	-	-	-	3.23E-04	1.04E-03	2.66E-04	9.94E-04	-	-	-	-	2.66E-04	9.94E-04	2.34E-04	7.18E-04	-	-	-	-	2.34E-04	7.18E-04
Chromium	Yes	Yes	2.60E-04	1.40E-03	8.45E-05	1.42E-03	4.58E-03	6.15E-06	1.98E-05	3.17E-06	1.02E-05	1.43E-03	4.61E-03	1.17E-03	4.38E-03	2.08E-06	7.77E-06	0.00E+00	0.00E+00	1.17E-03	4.39E-03	1.03E-03	3.16E-03	3.74E-06	1.15E-05	2.75E-08	8.45E-08	1.03E-03	3.18E-03
Cobalt	Yes	Yes	1.00E-04	8.40E-05	6.02E-04	5.47E-04	1.76E-03	3.69E-07	1.19E-06	2.26E-05	7.28E-05	5.70E-04	1.83E-03	4.51E-04	1.69E-03	1.25E-07	4.66E-07	0.00E+00	0.00E+00	4.51E-04	1.69E-03	3.96E-04	1.22E-03	2.24E-07	6.89E-07	1.96E-07	6.02E-07	3.97E-04	1.22E-03
Methylene chloride [dichloromethane]	Yes	Yes	2.90E-04	-	-	1.59E-03	5.11E-03	-	-	-	-	1.59E-03	5.11E-03	1.31E-03	4.89E-03	-	-	-	-	1.31E-03	4.89E-03	1.15E-03	3.53E-03	-	-	-	-	1.15E-03	3.53E-03
Formaldehyde	Yes	Yes	2.40E-04	7.50E-02	4.25E-02	1.31E-03	4.23E-03	3.30E-04	1.06E-03	1.60E-03	5.14E-03	3.24E-03	1.04E-02	1.08E-03	4.04E-03	1.11E-04	4.16E-04	0.00E+00	0.00E+00	1.19E-03	4.46E-03	9.51E-04	2.92E-03	2.00E-04	6.15E-04	1.38E-05	4.25E-05	1.17E-03	3.58E-03
Hydrogen chloride	Yes	Yes	1.20E+00	-	-	6.56E+00	2.11E+01	-	-	-	-	6.56E+00	2.11E+01	5.41E+00	2.02E+01	-	-	-	-	5.41E+00	2.02E+01	4.75E+00	1.46E+01	-	-	-	-	4.75E+00	1.46E+01
Hydrogen fluoride [hydrofluoric acid]	Yes	Yes	1.50E-01	-	-	8.20E-01	2.64E+00	-	-	-	-	8.20E-01	2.64E+00	6.76E-01	2.53E+00	-	-	-	-	6.76E-01	2.53E+00	5.94E-01	1.83E+00	-	-	-	-	5.94E-01	1.83E+00
Lead	Yes	Yes	4.20E-04	5.00E-05	1.51E-04	2.30E-03	7.40E-03	2.20E-07	7.08E-07	5.67E-06	1.82E-05	2.30E-03	7.41E-03	1.89E-03	7.08E-03	7.42E-08	2.78E-07	0.00E+00	0.00E+00	1.89E-03	7.08E-03	1.66E-03	5.11E-03	1.33E-07	4.10E-07	4.92E-08	1.51E-07	1.66E-03	5.11E-03
Manganese	Yes	Yes	4.90E-04	3.80E-04	3.00E-04	2.68E-03	8.63E-03	1.67E-06	5.38E-06	1.13E-05	3.63E-05	2.69E-03	8.67E-03	2.21E-03	8.26E-03	5.64E-07	2.11E-06	0.00E+00	0.00E+00	2.21E-03	8.26E-03	1.94E-03	5.96E-03	1.01E-06	3.12E-06	9.77E-08	3.00E-07	1.94E-03	5.97E-03
Mercury	Yes	Yes	8.30E-05	2.60E-04	1.13E-04	4.54E-04	1.46E-03	1.14E-06	3.68E-06	4.24E-06	1.37E-05	4.59E-04	1.48E-03	3.74E-04	1.40E-03	3.86E-07	1.44E-06	0.00E+00	0.00E+00	3.74E-04	1.40E-03	3.29E-04	1.01E-03	6.94E-07	2.13E-06	3.68E-08	1.13E-07	3.30E-04	1.01E-03
Methyl ethyl ketone [2-butanone]	Yes	No	3.90E-04	-	-	2.13E-03	6.87E-03	-	-	-	-	2.13E-03	6.87E-03	1.76E-03	6.57E-03	-	-	-	-	1.76E-03	6.57E-03	1.55E-03	4.75E-03	-	-	-	-	1.55E-03	4.75E-03
Nickel	Yes	Yes	2.80E-04	2.10E-03	8.45E-03	1.53E-03	4.93E-03	9.23E-06	2.97E-05	3.17E-04	1.02E-03	1.86E-03	5.98E-03	1.26E-03	4.72E-03	3.12E-06	1.17E-05	0.00E+00	0.00E+00	1.26E-03	4.73E-03	1.11E-03	3.41E-03	5.61E-06	1.72E-05	2.75E-06	8.45E-06	1.12E-03	3.43E-03
o-Xylene	Yes	Yes	3.70E-05	-	1.09E-04	2.02E-04	6.52E-04	-	-	4.09E-06	1.32E-05	2.06E-04	6.65E-04	1.67E-04	6.23E-04	-	-	0.00E+00	0.00E+00	1.67E-04	6.23E-04	1.47E-04	4.50E-04	-	-	3.55E-08	1.09E-07	1.47E-04	4.50E-04
Phenol	Yes	Yes	1.60E-05	-	-	8.75E-05	2.82E-04	-	-	-	-	8.75E-05	2.82E-04	7.21E-05	2.70E-04	-	-	-	-	7.21E-05	2.70E-04	6.34E-05	1.95E-04	-	-	-	-	6.34E-05	1.95E-04
Propionaldehyde [propanal]	Yes	Yes	3.80E-04	-	-	2.08E-03	6.69E-03	-	-	-	-	2.08E-03	6.69E-03	1.71E-03	6.40E-03	-	-	-	-	1.71E-03	6.40E-03	1.51E-03	4.63E-03	-	-	-	-	1.51E-03	4.63E-03
Selenium	Yes	Yes	1.30E-03	2.40E-05	6.83E-05	7.11E-03	2.29E-02	1.05E-07	3.40E-07	2.56E-06	8.25E-06	7.11E-03	2.29E-02	5.86E-03	2.19E-02	3.56E-08	1.33E-07	0.00E+00	0.00E+00	5.86E-03	2.19E-02	5.15E-03	1.58E-02	6.41E-08	1.97E-07	2.22E-08	6.83E-08	5.15E-03	1.58E-02
Toxic Air Pollutant Total						**7.45**	**24.00**	**0.05**	**0.16**	**0.00**	**0.01**	**7.51**	**24.17**	**6.14**	**22.96**	**0.02**	**0.06**	**0.00**	**0.00**	**6.16**	**23.03**	**5.40**	**16.59**	**0.03**	**0.09**	**0.00**	**0.00**	**5.43**	**16.68**
Hazardous Air Pollutant Total						**7.45**	**23.99**	**0.01**	**0.03**	**0.00**	**0.01**	**7.46**	**24.03**	**6.14**	**22.96**	**0.00**	**0.01**	**0.00**	**0.00**	**6.14**	**22.97**	**5.40**	**16.58**	**0.01**	**0.02**	**0.00**	**0.00**	**5.40**	**16.60**
Maximum Hazardous Air Pollutant						**6.56**	**21.13**	**0.01**	**0.03**	**0.00**	**0.01**	**6.56**	**21.13**	**5.41**	**20.22**	**0.00**	**0.01**	**0.00**	**0.00**	**5.41**	**20.22**	**4.75**	**14.61**	**0.00**	**0.01**	**0.00**	**0.00**	**4.75**	**14.61**

1. Emission factors for Coal taken from AP-42 Section 1.1 for a PC fired, dry bottom, tangentially fired, bituminous, pre-NSPS boiler.
2. Emission factors for natural gas firing taken from AP-42 Chapter 1.4, "Natural Gas Combustion," Tables 1.4-3 and 1.4-4 (July 1998).
3. Emission factors for No. 2 fuel oil firing taken from AP-42 Chapter 1.3, "Fuel Oil Combustion," Tables 1.3.8 (HCHO), 1.3-9 (organic) and 1.3-10 (metals) (May 2010).
4. Hourly emissions equal the pollutant specific emission factor for the fuel multiplied by the annual amount of fuel combusted divided by the annual hours of operation per year. Note that the hourly emission rates assume the fuel was burned during each operating hour throughout the entire year.
5. Annual emissions equal the pollutant specific emission factor for the fuel multiplied by the annual amount of fuel combusted.

2004 Actual Emissions								2005 Actual Emissions								2006 Actual Emissions							
Coal		Natural Gas		Fuel Oil		Total		Coal		Natural Gas		Fuel Oil		Total		Coal		Natural Gas		Fuel Oil		Total	
(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)	(tpy)	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)	(tpy)	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)	(tpy)
2.20E-03	6.22E-03	-	-	-	-	2.20E-03	6.22E-03	2.36E-03	4.74E-03	-	-	-	-	2.36E-03	4.74E-03	2.40E-03	6.57E-03	-	-	-	-	2.40E-03	6.57E-03
1.12E-03	3.17E-03	-	-	-	-	1.12E-03	3.17E-03	1.20E-03	2.41E-03	-	-	-	-	1.20E-03	2.41E-03	1.22E-03	3.34E-03	-	-	-	-	1.22E-03	3.34E-03
6.95E-05	1.97E-04	-	-	0.00E+00	0.00E+00	6.95E-05	1.97E-04	7.46E-05	1.50E-04	-	-	2.88E-07	5.78E-07	7.49E-05	1.50E-04	7.58E-05	2.07E-04	-	-	0.00E+00	0.00E+00	7.58E-05	2.07E-04
1.58E-03	4.48E-03	6.33E-07	1.79E-06	0.00E+00	0.00E+00	1.58E-03	4.48E-03	1.70E-03	3.41E-03	6.73E-07	1.35E-06	7.24E-08	1.45E-07	1.70E-03	3.41E-03	1.73E-03	4.73E-03	3.32E-07	9.10E-07	0.00E+00	0.00E+00	1.73E-03	4.73E-03
8.11E-05	2.29E-04	3.80E-08	1.07E-07	0.00E+00	0.00E+00	8.11E-05	2.29E-04	8.70E-05	1.75E-04	4.04E-08	8.10E-08	1.52E-09	3.06E-09	8.71E-05	1.75E-04	8.84E-05	2.42E-04	1.99E-08	5.46E-08	0.00E+00	0.00E+00	8.84E-05	2.42E-04
1.97E-04	5.57E-04	3.48E-06	9.85E-06	0.00E+00	0.00E+00	2.00E-04	5.67E-04	2.11E-04	4.24E-04	3.70E-06	7.43E-06	2.18E-08	4.38E-08	2.15E-04	4.31E-04	2.15E-04	5.88E-04	1.83E-06	5.01E-06	0.00E+00	0.00E+00	2.16E-04	5.93E-04
2.28E-04	6.44E-04	-	-	-	-	2.28E-04	6.44E-04	2.45E-04	4.91E-04	-	-	-	-	2.45E-04	4.91E-04	2.48E-04	6.80E-04	-	-	-	-	2.48E-04	6.80E-04
1.00E-03	2.84E-03	4.43E-06	1.25E-05	0.00E+00	0.00E+00	1.01E-03	2.85E-03	1.08E-03	2.16E-03	4.71E-06	9.45E-06	4.63E-08	9.30E-08	1.08E-03	2.17E-03	1.09E-03	3.00E-03	2.33E-06	6.37E-06	0.00E+00	0.00E+00	1.10E-03	3.00E-03
3.86E-04	1.09E-03	2.66E-07	7.52E-07	0.00E+00	0.00E+00	3.86E-04	1.09E-03	4.14E-04	8.31E-04	2.83E-07	5.67E-07	3.30E-07	6.62E-07	4.15E-04	8.33E-04	4.21E-04	1.15E-03	1.40E-07	3.82E-07	0.00E+00	0.00E+00	4.21E-04	1.15E-03
1.12E-03	3.17E-03	-	-	-	-	1.12E-03	3.17E-03	1.20E-03	2.41E-03	-	-	-	-	1.20E-03	2.41E-03	1.22E-03	3.34E-03	-	-	-	-	1.22E-03	3.34E-03
9.27E-04	2.62E-03	2.37E-04	6.71E-04	0.00E+00	0.00E+00	1.16E-03	3.29E-03	9.95E-04	2.00E-03	2.52E-04	5.06E-04	2.33E-05	4.68E-05	1.27E-03	2.55E-03	1.01E-03	2.77E-03	1.25E-04	3.41E-04	0.00E+00	0.00E+00	1.13E-03	3.11E-03
4.63E+00	1.31E+01	-	-	-	-	4.63E+00	1.31E+01	4.97E+00	9.98E+00	-	-	-	-	4.97E+00	9.98E+00	5.05E+00	1.38E+01	-	-	-	-	5.05E+00	1.38E+01
5.79E-01	1.64E+00	-	-	-	-	5.79E-01	1.64E+00	6.22E-01	1.25E+00	-	-	-	-	6.22E-01	1.25E+00	6.31E-01	1.73E+00	-	-	-	-	6.31E-01	1.73E+00
1.62E-03	4.59E-03	1.58E-07	4.48E-07	0.00E+00	0.00E+00	1.62E-03	4.59E-03	1.74E-03	3.49E-03	1.68E-07	3.38E-07	8.28E-08	1.66E-07	1.74E-03	3.49E-03	1.77E-03	4.84E-03	8.31E-08	2.28E-07	0.00E+00	0.00E+00	1.77E-03	4.84E-03
1.89E-03	5.35E-03	1.20E-06	3.40E-06	0.00E+00	0.00E+00	1.89E-03	5.35E-03	2.03E-03	4.07E-03	1.28E-06	2.57E-06	1.65E-07	3.30E-07	2.03E-03	4.08E-03	2.06E-03	5.65E-03	6.31E-07	1.73E-06	0.00E+00	0.00E+00	2.06E-03	5.65E-03
3.20E-04	9.06E-04	8.23E-07	2.33E-06	0.00E+00	0.00E+00	3.21E-04	9.09E-04	3.44E-04	6.90E-04	8.75E-07	1.76E-06	6.20E-08	1.24E-07	3.45E-04	6.92E-04	3.49E-04	9.57E-04	4.32E-07	1.18E-06	0.00E+00	0.00E+00	3.50E-04	9.58E-04
1.51E-03	4.26E-03	-	-	-	-	1.51E-03	4.26E-03	1.62E-03	3.24E-03	-	-	-	-	1.62E-03	3.24E-03	1.64E-03	4.50E-03	-	-	-	-	1.64E-03	4.50E-03
1.08E-03	3.06E-03	6.64E-06	1.88E-05	0.00E+00	0.00E+00	1.09E-03	3.08E-03	1.16E-03	2.33E-03	7.07E-06	1.42E-05	4.63E-06	9.30E-06	1.17E-03	2.35E-03	1.18E-03	3.23E-03	3.49E-06	9.56E-06	0.00E+00	0.00E+00	1.18E-03	3.24E-03
1.43E-04	4.04E-04	-	-	0.00E+00	0.00E+00	1.43E-04	4.04E-04	1.53E-04	3.08E-04	-	-	5.98E-08	1.20E-07	1.53E-04	3.08E-04	1.56E-04	4.27E-04	-	-	0.00E+00	0.00E+00	1.56E-04	4.27E-04
6.18E-05	1.75E-04	-	-	-	-	6.18E-05	1.75E-04	6.63E-05	1.33E-04	-	-	-	-	6.63E-05	1.33E-04	6.73E-05	1.84E-04	-	-	-	-	6.73E-05	1.84E-04
1.47E-03	4.15E-03	-	-	-	-	1.47E-03	4.15E-03	1.57E-03	3.16E-03	-	-	-	-	1.57E-03	3.16E-03	1.60E-03	4.38E-03	-	-	-	-	1.60E-03	4.38E-03
5.02E-03	1.42E-02	7.59E-08	2.15E-07	0.00E+00	0.00E+00	5.02E-03	1.42E-02	5.39E-03	1.08E-02	8.08E-08	1.62E-07	3.75E-08	7.51E-08	5.39E-03	1.08E-02	5.47E-03	1.50E-02	3.99E-08	1.09E-07	0.00E+00	0.00E+00	5.47E-03	1.50E-02
5.26	**14.88**	**0.05**	**0.13**	**0.00**	**0.00**	**5.31**	**15.01**	**5.65**	**11.33**	**0.05**	**0.10**	**0.00**	**0.00**	**5.70**	**11.43**	**5.73**	**15.71**	**0.02**	**0.07**	**0.00**	**0.00**	**5.76**	**15.77**
5.26	**14.88**	**0.02**	**0.04**	**0.00**	**0.00**	**5.28**	**14.92**	**5.65**	**11.33**	**0.02**	**0.03**	**0.00**	**0.00**	**5.66**	**11.36**	**5.73**	**15.70**	**0.01**	**0.02**	**0.00**	**0.00**	**5.74**	**15.73**
4.63	**13.10**	**0.01**	**0.03**	**0.00**	**0.00**	**4.63**	**13.10**	**4.97**	**9.98**	**0.01**	**0.02**	**0.00**	**0.00**	**4.97**	**9.98**	**5.05**	**13.83**	**0.01**	**0.01**	**0.00**	**0.00**	**5.05**	**13.83**

2007 Actual Emissions								2008 Actual Emissions								2009 Actual Emissions								2010 Actual Emissions							
Coal		Natural Gas		Fuel Oil		Total		Coal		Natural Gas		Fuel Oil		Total		Coal		Natural Gas		Fuel Oil		Total		Coal		Natural Gas		Fuel Oil		Total	
(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)	(tpy)	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)	(tpy)	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)	(tpy)	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)	(tpy)
2.39E-03	4.52E-03	-	-	-	-	2.39E-03	4.52E-03	2.58E-03	7.54E-03	-	-	-	-	2.58E-03	7.54E-03	1.40E-03	3.71E-03	-	-	-	-	1.40E-03	3.71E-03	2.37E-03	6.45E-03	-	-	-	-	2.37E-03	6.45E-03
1.22E-03	2.30E-03	-	-	-	-	1.22E-03	2.30E-03	1.31E-03	3.84E-03	-	-	-	-	1.31E-03	3.84E-03	7.13E-04	1.89E-03	-	-	-	-	7.13E-04	1.89E-03	1.21E-03	3.28E-03	-	-	-	-	1.21E-03	3.28E-03
7.55E-05	1.43E-04	-	-	0.00E+00	0.00E+00	7.55E-05	1.43E-04	8.14E-05	2.38E-04	-	-	0.00E+00	0.00E+00	8.14E-05	2.38E-04	4.42E-05	1.17E-04	-	-	3.58E-06	9.46E-06	4.78E-05	1.26E-04	7.48E-05	2.04E-04	-	-	4.74E-07	1.29E-06	7.53E-05	2.05E-04
1.72E-03	3.25E-03	5.09E-07	9.64E-07	0.00E+00	0.00E+00	1.72E-03	3.25E-03	1.86E-03	5.42E-03	2.75E-07	8.03E-07	0.00E+00	0.00E+00	1.86E-03	5.42E-03	1.01E-03	2.67E-03	7.00E-06	1.85E-05	8.99E-07	2.38E-06	1.02E-03	2.69E-03	1.70E-03	4.64E-03	1.84E-06	5.00E-06	1.19E-07	3.24E-07	1.71E-03	4.64E-03
8.80E-05	1.67E-04	3.05E-08	5.78E-08	0.00E+00	0.00E+00	8.81E-05	1.67E-04	9.50E-05	2.78E-04	1.65E-08	4.82E-08	0.00E+00	0.00E+00	9.50E-05	2.78E-04	5.16E-05	1.37E-04	4.20E-07	1.11E-06	1.89E-08	5.01E-08	5.21E-05	1.38E-04	8.73E-05	2.38E-04	1.10E-07	3.00E-07	2.51E-09	6.83E-09	8.74E-05	2.38E-04
2.14E-04	4.05E-04	2.80E-06	5.30E-06	0.00E+00	0.00E+00	2.17E-04	4.10E-04	2.31E-04	6.75E-04	1.51E-06	4.42E-06	0.00E+00	0.00E+00	2.32E-04	6.79E-04	1.25E-04	3.32E-04	3.85E-05	1.02E-04	2.71E-07	7.17E-07	1.64E-04	4.34E-04	2.12E-04	5.77E-04	1.01E-05	2.75E-05	3.59E-08	9.78E-08	2.22E-04	6.05E-04
2.47E-04	4.68E-04	-	-	-	-	2.47E-04	4.68E-04	2.67E-04	7.81E-04	-	-	-	-	2.67E-04	7.81E-04	1.45E-04	3.84E-04	-	-	-	-	1.45E-04	3.84E-04	2.45E-04	6.67E-04	-	-	-	-	2.45E-04	6.67E-04
1.09E-03	2.06E-03	3.56E-06	6.74E-06	0.00E+00	0.00E+00	1.09E-03	2.07E-03	1.18E-03	3.44E-03	1.92E-06	5.62E-06	0.00E+00	0.00E+00	1.18E-03	3.45E-03	6.39E-04	1.69E-03	4.90E-05	1.30E-04	5.76E-07	1.52E-06	6.89E-04	1.82E-03	1.08E-03	2.94E-03	1.29E-05	3.50E-05	7.63E-08	2.08E-07	1.09E-03	2.98E-03
4.19E-04	7.94E-04	2.14E-07	4.05E-07	0.00E+00	0.00E+00	4.19E-04	7.94E-04	4.52E-04	1.32E-03	1.15E-07	3.37E-07	0.00E+00	0.00E+00	4.53E-04	1.32E-03	2.46E-04	6.50E-04	2.94E-06	7.78E-06	4.10E-06	1.08E-05	2.53E-04	6.69E-04	4.16E-04	1.13E-03	7.72E-07	2.10E-06	5.44E-07	1.48E-06	4.17E-04	1.13E-03
1.22E-03	2.30E-03	-	-	-	-	1.22E-03	2.30E-03	1.31E-03	3.84E-03	-	-	-	-	1.31E-03	3.84E-03	7.13E-04	1.89E-03	-	-	-	-	7.13E-04	1.89E-03	1.21E-03	3.28E-03	-	-	-	-	1.21E-03	3.28E-03
1.01E-03	1.90E-03	1.91E-04	3.61E-04	0.00E+00	0.00E+00	1.20E-03	2.27E-03	1.09E-03	3.18E-03	1.03E-04	3.01E-04	0.00E+00	0.00E+00	1.19E-03	3.48E-03	5.90E-04	1.56E-03	2.63E-03	6.95E-03	2.90E-04	7.66E-04	3.51E-03	9.27E-03	9.98E-04	2.72E-03	6.89E-04	1.88E-03	3.84E-05	1.04E-04	1.73E-03	4.70E-03
5.03E+00	9.52E+00	-	-	-	-	5.03E+00	9.52E+00	5.43E+00	1.59E+01	-	-	-	-	5.43E+00	1.59E+01	2.95E+00	7.80E+00	-	-	-	-	2.95E+00	7.80E+00	4.99E+00	1.36E+01	-	-	-	-	4.99E+00	1.36E+01
6.29E-01	1.19E+00	-	-	-	-	6.29E-01	1.19E+00	6.79E-01	1.98E+00	-	-	-	-	6.79E-01	1.98E+00	3.69E-01	9.75E-01	-	-	-	-	3.69E-01	9.75E-01	6.24E-01	1.70E+00	-	-	-	-	6.24E-01	1.70E+00
1.76E-03	3.33E-03	1.27E-07	2.41E-07	0.00E+00	0.00E+00	1.76E-03	3.33E-03	1.90E-03	5.56E-03	6.86E-08	2.01E-07	0.00E+00	0.00E+00	1.90E-03	5.56E-03	1.03E-03	2.73E-03	1.75E-06	4.63E-06	1.03E-06	2.72E-06	1.04E-03	2.74E-03	1.75E-03	4.75E-03	4.60E-07	1.25E-06	1.36E-07	3.71E-07	1.75E-03	4.75E-03
2.05E-03	3.89E-03	9.67E-07	1.83E-06	0.00E+00	0.00E+00	2.06E-03	3.89E-03	2.22E-03	6.48E-03	5.22E-07	1.53E-06	0.00E+00	0.00E+00	2.22E-03	6.48E-03	1.20E-03	3.19E-03	1.33E-05	3.52E-05	2.04E-06	5.41E-06	1.22E-03	3.23E-03	2.04E-03	5.54E-03	3.49E-06	9.50E-06	2.71E-07	7.37E-07	2.04E-03	5.55E-03
3.48E-04	6.59E-04	6.62E-07	1.25E-06	0.00E+00	0.00E+00	3.49E-04	6.60E-04	3.76E-04	1.10E-03	3.57E-07	1.04E-06	0.00E+00	0.00E+00	3.76E-04	1.10E-03	2.04E-04	5.40E-04	9.10E-06	2.41E-05	7.70E-07	2.04E-06	2.14E-04	5.66E-04	3.45E-04	9.39E-04	2.39E-06	6.50E-06	1.02E-07	2.78E-07	3.48E-04	9.46E-04
1.64E-03	3.10E-03	-	-	-	-	1.64E-03	3.10E-03	1.76E-03	5.16E-03	-	-	-	-	1.76E-03	5.16E-03	9.59E-04	2.54E-03	-	-	-	-	9.59E-04	2.54E-03	1.62E-03	4.41E-03	-	-	-	-	1.62E-03	4.41E-03
1.17E-03	2.22E-03	5.34E-06	1.01E-05	0.00E+00	0.00E+00	1.18E-03	2.23E-03	1.27E-03	3.70E-03	2.88E-06	8.43E-06	0.00E+00	0.00E+00	1.27E-03	3.71E-03	6.88E-04	1.82E-03	7.35E-05	1.94E-04	5.76E-05	1.52E-04	8.19E-04	2.17E-03	1.16E-03	3.17E-03	1.93E-05	5.25E-05	7.63E-06	2.08E-05	1.19E-03	3.24E-03
1.55E-04	2.94E-04	-	-	0.00E+00	0.00E+00	1.55E-04	2.94E-04	1.67E-04	4.89E-04	-	-	0.00E+00	0.00E+00	1.67E-04	4.89E-04	9.10E-05	2.41E-04	-	-	7.43E-07	1.96E-06	9.17E-05	2.43E-04	1.54E-04	4.19E-04	-	-	9.84E-08	2.68E-07	1.54E-04	4.19E-04
6.71E-05	1.27E-04	-	-	-	-	6.71E-05	1.27E-04	7.24E-05	2.12E-04	-	-	-	-	7.24E-05	2.12E-04	3.93E-05	1.04E-04	-	-	-	-	3.93E-05	1.04E-04	6.65E-05	1.81E-04	-	-	-	-	6.65E-05	1.81E-04
1.59E-03	3.02E-03	-	-	-	-	1.59E-03	3.02E-03	1.72E-03	5.03E-03	-	-	-	-	1.72E-03	5.03E-03	9.34E-04	2.47E-03	-	-	-	-	9.34E-04	2.47E-03	1.58E-03	4.30E-03	-	-	-	-	1.58E-03	4.30E-03
5.45E-03	1.03E-02	6.11E-08	1.16E-07	0.00E+00	0.00E+00	5.45E-03	1.03E-02	5.88E-03	1.72E-02	3.29E-08	9.63E-08	0.00E+00	0.00E+00	5.88E-03	1.72E-02	3.20E-03	8.45E-03	8.40E-07	2.22E-06	4.65E-07	1.23E-06	3.20E-03	8.45E-03	5.40E-03	1.47E-02	2.21E-07	6.00E-07	6.17E-08	1.68E-07	5.41E-03	1.47E-02
5.71	**10.81**	**0.04**	**0.07**	**0.00**	**0.00**	**5.75**	**10.88**	**6.17**	**18.03**	**0.02**	**0.06**	**0.00**	**0.00**	**6.18**	**18.08**	**3.35**	**8.86**	**0.50**	**1.33**	**0.00**	**0.00**	**3.85**	**10.19**	**5.67**	**15.42**	**0.10**	**0.28**	**9.39E-05**	**2.56E-04**	**5.77**	**15.70**
5.71	**10.81**	**0.01**	**0.02**	**0.00**	**0.00**	**5.72**	**10.84**	**6.16**	**18.02**	**0.01**	**0.02**	**0.00**	**0.00**	**6.17**	**18.04**	**3.35**	**8.86**	**0.17**	**0.46**	**0.00**	**0.00**	**3.52**	**9.32**	**5.66**	**15.41**	**0.02**	**0.05**	**8.73E-05**	**2.37E-04**	**5.68**	**15.46**
5.03	**9.52**	**0.01**	**0.01**	**0.00**	**0.00**	**5.03**	**9.52**	**5.43**	**15.88**	**0.00**	**0.01**	**0.00**	**0.00**	**5.43**	**15.88**	**2.95**	**7.80**	**0.11**	**0.29**	**0.00**	**0.00**	**2.95**	**7.80**	**4.99**	**13.58**	**0.02**	**0.05**	**3.84E-05**	**1.04E-04**	**4.99**	**13.58**

Table D-8. No. 2 Power Boiler Past Actual Hazardous Air Pollutant and Toxic Air Pollutant Emissions

	Pollutant Classifications		Emission Factors			2001 Actual Emissions								2002 Actual Emissions								2003 Actual Emissions							
						Coal		Natural Gas		Fuel Oil		Total		Coal		Natural Gas		Fuel Oil		Total		Coal		Natural Gas		Fuel Oil		Total	
Pollutant	Georgia TAP (Yes/No)	HAP (Yes/No)	Coal[1] (lb/ton)	Natural Gas[2] (lb/MMscf)	Fuel Oil[3] (lb/Mgal)	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]
Acetaldehyde	Yes	Yes	5.70E-04	-	-	2.32E-03	8.20E-03	-	-	-	-	2.32E-03	8.20E-03	2.05E-03	5.07E-03	-	-	-	-	2.05E-03	5.07E-03	2.01E-03	7.09E-03	-	-	-	-	2.01E-03	7.09E-03
Acrolein	Yes	Yes	2.90E-04	-	-	1.18E-03	4.17E-03	-	-	-	-	1.18E-03	4.17E-03	1.04E-03	2.58E-03	-	-	-	-	1.04E-03	2.58E-03	1.02E-03	3.61E-03	-	-	-	-	1.02E-03	3.61E-03
Antimony	Yes	Yes	1.80E-05	-	5.25E-04	7.31E-05	2.59E-04	-	-	1.22E-05	4.32E-05	8.53E-05	3.02E-04	6.47E-05	1.60E-04	-	-	1.28E-06	3.18E-06	6.60E-05	1.63E-04	6.34E-05	2.24E-04	-	-	1.02E-05	3.61E-05	7.37E-05	2.60E-04
Arsenic	Yes	Yes	4.10E-04	2.00E-04	1.32E-04	1.67E-03	5.90E-03	6.50E-07	2.30E-06	3.07E-06	1.09E-05	1.67E-03	5.91E-03	1.47E-03	3.65E-03	4.12E-07	1.02E-06	3.23E-07	7.99E-07	1.47E-03	3.65E-03	1.44E-03	5.10E-03	3.17E-07	1.12E-06	2.57E-06	9.08E-06	1.45E-03	5.11E-03
Beryllium	Yes	Yes	2.10E-05	1.20E-05	2.78E-06	8.53E-05	3.02E-04	3.90E-08	1.38E-07	6.46E-08	2.29E-07	8.54E-05	3.03E-04	7.55E-05	1.87E-04	2.47E-08	6.12E-08	6.79E-09	1.68E-08	7.55E-05	1.87E-04	7.40E-05	2.61E-04	1.90E-08	6.72E-08	5.42E-08	1.91E-07	7.41E-05	2.62E-04
Cadmium	Yes	Yes	5.10E-05	1.10E-03	3.98E-05	2.07E-04	7.34E-04	3.57E-06	1.27E-05	9.25E-07	3.28E-06	2.12E-04	7.50E-04	1.83E-04	4.54E-04	2.27E-06	5.61E-06	9.73E-08	2.41E-07	1.86E-04	4.60E-04	1.80E-04	6.35E-04	1.74E-06	6.16E-06	7.76E-07	2.74E-06	1.82E-04	6.43E-04
Chloroform	Yes	Yes	5.90E-05	-	-	2.40E-04	8.49E-04	-	-	-	-	2.40E-04	8.49E-04	2.12E-04	5.25E-04	-	-	-	-	2.12E-04	5.25E-04	2.08E-04	7.34E-04	-	-	-	-	2.08E-04	7.34E-04
Chromium	Yes	Yes	2.60E-04	1.40E-03	8.45E-05	1.06E-03	3.74E-03	4.55E-06	1.61E-05	1.96E-06	6.95E-06	1.06E-03	3.76E-03	9.35E-04	2.31E-03	2.88E-06	7.14E-06	2.07E-07	5.11E-07	9.38E-04	2.32E-03	9.16E-04	3.23E-03	2.22E-06	7.84E-06	1.65E-06	5.81E-06	9.20E-04	3.25E-03
Cobalt	Yes	Yes	1.00E-04	8.40E-05	6.02E-04	4.06E-04	1.44E-03	2.73E-07	9.66E-07	1.40E-05	4.95E-05	4.21E-04	1.49E-03	3.60E-04	8.90E-04	1.73E-07	4.28E-07	1.47E-06	3.64E-06	3.61E-04	8.94E-04	3.52E-04	1.24E-03	1.33E-07	4.70E-07	1.17E-05	4.14E-05	3.64E-04	1.29E-03
Methylene chloride [dichloromethane]	Yes	Yes	2.90E-04	-	-	1.18E-03	4.17E-03	-	-	-	-	1.18E-03	4.17E-03	1.04E-03	2.58E-03	-	-	-	-	1.04E-03	2.58E-03	1.02E-03	3.61E-03	-	-	-	-	1.02E-03	3.61E-03
Formaldehyde	Yes	Yes	2.40E-04	7.50E-02	4.25E-02	9.75E-04	3.45E-03	2.44E-04	8.63E-04	9.88E-04	3.50E-03	2.21E-03	7.81E-03	8.63E-04	2.14E-03	1.55E-04	3.83E-04	1.04E-04	2.57E-04	1.12E-03	2.78E-03	8.46E-04	2.99E-03	1.19E-04	4.20E-04	8.28E-04	2.92E-03	1.79E-03	6.33E-03
Hydrogen chloride	Yes	Yes	1.20E+00	-	-	4.88E+00	1.73E+01	-	-	-	-	4.88E+00	1.73E+01	4.31E+00	1.07E+01	-	-	-	-	4.31E+00	1.07E+01	4.23E+00	1.49E+01	-	-	-	-	4.23E+00	1.49E+01
Hydrogen fluoride [hydrofluoric acid]	Yes	Yes	1.50E-01	-	-	6.10E-01	2.16E+00	-	-	-	-	6.10E-01	2.16E+00	5.39E-01	1.33E+00	-	-	-	-	5.39E-01	1.33E+00	5.29E-01	1.87E+00	-	-	-	-	5.29E-01	1.87E+00
Lead	Yes	Yes	4.20E-04	5.00E-05	1.51E-04	1.71E-03	6.04E-03	1.62E-07	5.75E-07	3.51E-06	1.24E-05	1.71E-03	6.06E-03	1.51E-03	3.74E-03	1.03E-07	2.55E-07	3.69E-07	9.14E-07	1.51E-03	3.74E-03	1.48E-03	5.23E-03	7.93E-08	2.80E-07	2.94E-06	1.04E-05	1.48E-03	5.24E-03
Manganese	Yes	Yes	4.90E-04	3.80E-04	3.00E-04	1.99E-03	7.05E-03	1.23E-06	4.37E-06	6.97E-06	2.47E-05	2.00E-03	7.08E-03	1.76E-03	4.36E-03	7.83E-07	1.94E-06	7.33E-07	1.82E-06	1.76E-03	4.36E-03	1.73E-03	6.10E-03	6.03E-07	2.13E-06	5.85E-06	2.06E-05	1.73E-03	6.12E-03
Mercury	Yes	Yes	8.30E-05	2.60E-04	1.13E-04	3.37E-04	1.19E-03	8.44E-07	2.99E-06	2.63E-06	9.30E-06	3.41E-04	1.21E-03	2.98E-04	7.39E-04	5.36E-07	1.33E-06	2.76E-07	6.84E-07	2.99E-04	7.41E-04	2.92E-04	1.03E-03	4.12E-07	1.46E-06	2.20E-06	7.77E-06	2.95E-04	1.04E-03
Methyl ethyl ketone [2-butanone]	Yes	No	3.90E-04	-	-	1.58E-03	5.61E-03	-	-	-	-	1.58E-03	5.61E-03	1.40E-03	3.47E-03	-	-	-	-	1.40E-03	3.47E-03	1.37E-03	4.85E-03	-	-	-	-	1.37E-03	4.85E-03
Nickel	Yes	Yes	2.80E-04	2.10E-03	8.45E-03	1.14E-03	4.03E-03	6.82E-06	2.42E-05	1.96E-04	6.95E-04	1.34E-03	4.75E-03	1.01E-03	2.49E-03	4.33E-06	1.07E-05	2.07E-05	5.11E-05	1.03E-03	2.55E-03	9.87E-04	3.48E-03	3.33E-06	1.18E-05	1.65E-04	5.81E-04	1.15E-03	4.08E-03
o-Xylene	Yes	Yes	3.70E-05	-	1.09E-04	1.50E-04	5.32E-04	-	-	2.53E-06	8.97E-06	1.53E-04	5.41E-04	1.33E-04	3.29E-04	-	-	2.66E-07	6.59E-07	1.33E-04	3.30E-04	1.30E-04	4.60E-04	-	-	2.12E-06	7.50E-06	1.33E-04	4.68E-04
Phenol	Yes	Yes	1.60E-05	-	-	6.50E-05	2.30E-04	-	-	-	-	6.50E-05	2.30E-04	5.75E-05	1.42E-04	-	-	-	-	5.75E-05	1.42E-04	5.64E-05	1.99E-04	-	-	-	-	5.64E-05	1.99E-04
Propionaldehyde [propanal]	Yes	Yes	3.80E-04	-	-	1.54E-03	5.47E-03	-	-	-	-	1.54E-03	5.47E-03	1.37E-03	3.38E-03	-	-	-	-	1.37E-03	3.38E-03	1.34E-03	4.73E-03	-	-	-	-	1.34E-03	4.73E-03
Selenium	Yes	Yes	1.30E-03	2.40E-05	6.83E-05	5.28E-03	1.87E-02	7.79E-08	2.76E-07	1.59E-06	5.62E-06	5.28E-03	1.87E-02	4.67E-03	1.16E-02	4.94E-08	1.22E-07	1.67E-07	4.13E-07	4.67E-03	1.16E-02	4.58E-03	1.62E-02	3.81E-08	1.34E-07	1.33E-06	4.70E-06	4.58E-03	1.62E-02
Toxic Air Pollutant Total						**5.54**	**19.61**	**0.04**	**0.13**	**2.42E-03**	**8.56E-03**	**5.58**	**19.74**	**4.90**	**12.13**	**0.02**	**0.06**	**2.54E-04**	**6.29E-04**	**4.92**	**12.19**	**4.80**	**16.95**	**0.02**	**0.06**	**2.03E-03**	**7.16E-03**	**4.82**	**17.02**
Hazardous Air Pollutant Total						**5.54**	**19.60**	**0.01**	**0.02**	**2.25E-03**	**7.95E-03**	**5.54**	**19.63**	**4.90**	**12.12**	**3.89E-03**	**0.01**	**2.36E-04**	**5.85E-04**	**4.90**	**12.13**	**4.80**	**16.95**	**2.99E-03**	**0.01**	**1.88E-03**	**6.65E-03**	**4.81**	**16.97**
Maximum Hazardous Air Pollutant						**4.88**	**17.27**	**0.01**	**0.02**	**9.88E-04**	**3.50E-03**	**4.88**	**17.27**	**4.31**	**10.68**	**3.71E-03**	**0.01**	**1.04E-04**	**2.57E-04**	**4.31**	**10.68**	**4.23**	**14.93**	**2.86E-03**	**0.01**	**8.28E-04**	**2.92E-03**	**4.23**	**14.93**

1. Emission factors for Coal taken from AP-42 Section 1.1 for a PC fired, dry bottom, tangentially fired, bituminous, pre-NSPS boiler.
2. Emission factors for natural gas firing taken from AP-42 Chapter 1.4, "Natural Gas Combustion," Tables 1.4-3 and 1.4-4 (July 1998).
3. Emission factors for No. 2 fuel oil firing taken from AP-42 Chapter 1.3, "Fuel Oil Combustion," Tables 1.3.8 (HCHO), 1.3-9 (organic) and 1.3-10 (metals) (May 2010).
4. Hourly emissions equal the pollutant specific emission factor for the fuel multiplied by the annual amount of fuel combusted divided by the annual hours of operation per year. Note that the hourly emission rates assume the fuel was burned during each operating hour throughout the entire year.
5. Annual emissions equal the pollutant specific emission factor for the fuel multiplied by the annual amount of fuel combusted.

2004 Actual Emissions								2005 Actual Emissions								2006 Actual Emissions								2007 Actual Emissions							
Coal		Natural Gas		Fuel Oil		Total		Coal		Natural Gas		Fuel Oil		Total		Coal		Natural Gas		Fuel Oil		Total		Coal		Natural Gas		Fuel Oil		Total	
(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]
2.43E-03	7.86E-03	-	-	-	-	2.43E-03	7.86E-03	3.02E-03	1.20E-02	-	-	-	-	3.02E-03	1.20E-02	2.53E-03	5.69E-03	-	-	-	-	2.53E-03	5.69E-03	2.58E-03	9.60E-03	-	-	-	-	2.58E-03	9.60E-03
1.23E-03	4.00E-03	-	-	-	-	1.23E-03	4.00E-03	1.54E-03	6.12E-03	-	-	-	-	1.54E-03	6.12E-03	1.29E-03	2.90E-03	-	-	-	-	1.29E-03	2.90E-03	1.31E-03	4.88E-03	-	-	-	-	1.31E-03	4.88E-03
7.66E-05	2.48E-04	-	-	2.21E-07	7.17E-07	7.68E-05	2.49E-04	9.53E-05	3.80E-04	-	-	1.48E-06	5.88E-06	9.68E-05	3.86E-04	7.99E-05	1.80E-04	-	-	0.00E+00	0.00E+00	7.99E-05	1.80E-04	8.15E-05	3.03E-04	-	-	5.25E-07	1.95E-06	8.20E-05	3.05E-04
1.74E-03	5.65E-03	2.62E-07	8.50E-07	5.56E-08	1.80E-07	1.74E-03	5.65E-03	2.17E-03	8.65E-03	2.21E-07	8.80E-07	3.71E-07	1.48E-06	2.17E-03	8.65E-03	1.74E-03	5.65E-03	3.74E-07	8.40E-07	5.56E-08	1.80E-07	1.75E-03	5.65E-03	1.86E-03	6.90E-03	1.64E-07	6.09E-07	1.32E-07	4.91E-07	1.86E-03	6.90E-03
8.94E-05	2.89E-04	1.57E-08	5.10E-08	1.17E-09	3.79E-09	8.94E-05	2.89E-04	1.11E-04	4.43E-04	1.33E-08	5.28E-08	7.82E-09	3.11E-08	1.11E-04	4.43E-04	9.33E-05	2.10E-04	2.24E-08	5.04E-08	0.00E+00	0.00E+00	9.33E-05	2.10E-04	9.50E-05	3.54E-04	9.82E-09	3.65E-08	2.78E-09	1.03E-08	9.50E-05	3.54E-04
2.17E-04	7.03E-04	1.44E-06	4.68E-06	1.68E-08	5.43E-08	2.18E-04	7.08E-04	2.70E-04	1.08E-03	1.21E-06	4.84E-06	1.12E-07	4.46E-07	2.71E-04	1.08E-03	2.26E-04	5.09E-04	2.06E-06	4.62E-06	0.00E+00	0.00E+00	2.29E-04	5.14E-04	2.31E-04	8.59E-04	9.00E-07	3.35E-06	3.98E-08	1.48E-07	2.32E-04	8.62E-04
2.51E-04	8.13E-04	-	-	-	-	2.51E-04	8.13E-04	3.12E-04	1.24E-03	-	-	-	-	3.12E-04	1.24E-03	2.62E-04	5.89E-04	-	-	-	-	2.62E-04	5.89E-04	2.67E-04	9.93E-04	-	-	-	-	2.67E-04	9.93E-04
1.11E-03	3.58E-03	1.84E-06	5.95E-06	3.56E-08	1.15E-07	1.11E-03	3.59E-03	1.38E-03	5.48E-03	1.55E-06	6.16E-06	2.38E-07	9.46E-07	1.38E-03	5.49E-03	1.15E-03	2.60E-03	2.62E-06	5.88E-06	0.00E+00	0.00E+00	1.16E-03	2.60E-03	1.18E-03	4.38E-03	1.15E-06	4.26E-06	8.44E-08	3.14E-07	1.18E-03	4.38E-03
4.26E-04	1.38E-03	1.10E-07	3.57E-07	2.54E-07	8.22E-07	4.26E-04	1.38E-03	5.29E-04	2.11E-03	9.28E-08	3.70E-07	1.69E-06	6.74E-06	5.31E-04	2.12E-03	4.44E-04	9.98E-04	1.57E-07	3.53E-07	0.00E+00	0.00E+00	4.44E-04	9.99E-04	4.53E-04	1.68E-03	6.87E-08	2.56E-07	6.02E-07	2.24E-06	4.53E-04	1.69E-03
1.23E-03	4.00E-03	-	-	-	-	1.23E-03	4.00E-03	1.54E-03	6.12E-03	-	-	-	-	1.54E-03	6.12E-03	1.29E-03	2.90E-03	-	-	-	-	1.29E-03	2.90E-03	1.31E-03	4.88E-03	-	-	-	-	1.31E-03	4.88E-03
1.02E-03	3.31E-03	9.84E-05	3.19E-04	1.79E-05	5.80E-05	1.14E-03	3.68E-03	1.27E-03	5.06E-03	8.28E-05	3.30E-04	1.19E-04	4.76E-04	1.47E-03	5.87E-03	1.02E-03	3.31E-03	1.40E-04	3.15E-04	1.79E-05	5.80E-05	1.18E-03	3.68E-03	1.09E-03	4.04E-03	6.14E-05	2.28E-04	4.25E-05	1.58E-04	1.19E-03	4.43E-03
5.11E+00	1.65E+01	-	-	-	-	5.11E+00	1.65E+01	6.35E+00	2.53E+01	-	-	-	-	6.35E+00	2.53E+01	5.33E+00	1.20E+01	-	-	-	-	5.33E+00	1.20E+01	5.43E+00	2.02E+01	-	-	-	-	5.43E+00	2.02E+01
6.38E-01	2.07E+00	-	-	-	-	6.38E-01	2.07E+00	7.94E-01	3.16E+00	-	-	-	-	7.94E-01	3.16E+00	6.38E-01	2.07E+00	-	-	-	-	6.38E-01	2.07E+00	6.79E-01	2.53E+00	-	-	-	-	6.79E-01	2.53E+00
1.79E-03	5.79E-03	6.56E-08	2.13E-07	6.36E-08	2.06E-07	1.79E-03	5.79E-03	2.22E-03	8.86E-03	5.52E-08	2.20E-07	4.24E-07	1.69E-06	2.22E-03	8.86E-03	1.87E-03	4.19E-03	9.34E-08	2.10E-07	0.00E+00	0.00E+00	1.87E-03	4.19E-03	1.90E-03	7.07E-03	4.09E-08	1.52E-07	1.51E-07	5.61E-07	1.90E-03	7.07E-03
2.09E-03	6.75E-03	4.99E-07	1.62E-06	1.26E-07	4.10E-07	2.09E-03	6.76E-03	2.59E-03	1.03E-02	4.20E-07	1.67E-06	8.43E-07	3.36E-06	2.60E-03	1.03E-02	2.18E-03	4.89E-03	7.10E-07	1.60E-06	0.00E+00	0.00E+00	2.18E-03	4.89E-03	2.22E-03	8.25E-03	3.11E-07	1.16E-06	3.00E-07	1.12E-06	2.22E-03	8.25E-03
3.53E-04	1.14E-03	3.41E-07	1.11E-06	4.76E-08	1.54E-07	3.54E-04	1.15E-03	4.39E-04	1.75E-03	2.87E-07	1.14E-06	3.18E-07	1.27E-06	4.40E-04	1.75E-03	3.53E-04	1.14E-03	4.86E-07	1.09E-06	4.76E-08	1.54E-07	3.54E-04	1.15E-03	3.76E-04	1.40E-03	2.13E-07	7.91E-07	1.13E-07	4.20E-07	3.76E-04	1.40E-03
1.66E-03	5.38E-03	-	-	-	-	1.66E-03	5.38E-03	2.06E-03	8.23E-03	-	-	-	-	2.06E-03	8.23E-03	1.73E-03	3.89E-03	-	-	-	-	1.73E-03	3.89E-03	1.76E-03	6.57E-03	-	-	-	-	1.76E-03	6.57E-03
1.19E-03	3.86E-03	2.76E-06	8.93E-06	3.56E-06	1.15E-05	1.20E-03	3.88E-03	1.48E-03	5.91E-03	2.32E-06	9.24E-06	2.38E-05	9.46E-05	1.51E-03	6.01E-03	1.24E-03	2.80E-03	3.92E-06	8.82E-06	0.00E+00	0.00E+00	1.25E-03	2.80E-03	1.27E-03	4.71E-03	1.72E-06	6.39E-06	8.44E-06	3.14E-05	1.28E-03	4.75E-03
1.57E-04	5.10E-04	-	-	4.59E-08	1.49E-07	1.57E-04	5.10E-04	1.96E-04	7.80E-04	-	-	3.06E-07	1.22E-06	1.96E-04	7.82E-04	1.57E-04	5.10E-04	-	-	4.59E-08	1.49E-07	1.57E-04	5.10E-04	1.67E-04	6.23E-04	-	-	1.09E-07	4.05E-07	1.68E-04	6.23E-04
6.81E-05	2.21E-04	-	-	-	-	6.81E-05	2.21E-04	8.47E-05	3.37E-04	-	-	-	-	8.47E-05	3.37E-04	7.11E-05	1.60E-04	-	-	-	-	7.11E-05	1.60E-04	7.24E-05	2.69E-04	-	-	-	-	7.24E-05	2.69E-04
1.62E-03	5.24E-03	-	-	-	-	1.62E-03	5.24E-03	2.01E-03	8.01E-03	-	-	-	-	2.01E-03	8.01E-03	1.62E-03	5.24E-03	-	-	-	-	1.62E-03	5.24E-03	1.72E-03	6.40E-03	-	-	-	-	1.72E-03	6.40E-03
5.53E-03	1.79E-02	3.15E-08	1.02E-07	2.88E-08	9.32E-08	5.53E-03	1.79E-02	6.88E-03	2.74E-02	2.65E-08	1.06E-07	1.92E-07	7.65E-07	6.88E-03	2.74E-02	5.53E-03	1.79E-02	4.48E-08	1.01E-07	2.88E-08	9.32E-08	5.53E-03	1.79E-02	5.88E-03	2.19E-02	1.96E-08	7.30E-08	6.82E-08	2.54E-07	5.88E-03	2.19E-02
5.80	**18.78**	**0.01**	**0.05**	**4.38E-05**	**1.42E-04**	**5.81**	**18.83**	**7.21**	**28.74**	**0.01**	**0.05**	**2.92E-04**	**1.17E-03**	**7.23**	**28.79**	**6.02**	**14.21**	**0.02**	**0.05**	**2.01E-05**	**6.50E-05**	**6.04**	**14.25**	**6.17**	**22.94**	**0.01**	**0.03**	**1.04E-04**	**3.87E-04**	**6.18**	**22.97**
5.80	**18.78**	**2.48E-03**	**0.01**	**4.07E-05**	**1.32E-04**	**5.80**	**18.78**	**7.21**	**28.73**	**2.09E-03**	**0.01**	**2.72E-04**	**1.08E-03**	**7.21**	**28.74**	**6.02**	**14.20**	**3.53E-03**	**0.01**	**1.86E-05**	**6.03E-05**	**6.02**	**14.21**	**6.16**	**22.93**	**1.54E-03**	**0.01**	**9.66E-05**	**3.59E-04**	**6.17**	**22.94**
5.11	**16.54**	**2.36E-03**	**0.01**	**1.79E-05**	**5.80E-05**	**5.11**	**16.54**	**6.35**	**25.31**	**1.99E-03**	**0.01**	**1.19E-04**	**4.76E-04**	**6.35**	**25.31**	**5.33**	**11.98**	**3.36E-03**	**0.01**	**1.79E-05**	**5.80E-05**	**5.33**	**11.98**	**5.43**	**20.20**	**1.47E-03**	**0.01**	**4.25E-05**	**1.58E-04**	**5.43**	**20.20**

2008 Actual Emissions							
Coal		Natural Gas		Fuel Oil		Total	
(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]
2.43E-03	7.86E-03	-	-	-	-	2.43E-03	7.86E-03
1.23E-03	4.00E-03	-	-	-	-	1.23E-03	4.00E-03
7.66E-05	2.48E-04	-	-	2.80E-08	9.92E-08	7.66E-05	2.48E-04
1.74E-03	5.65E-03	1.97E-07	6.97E-07	7.04E-09	2.49E-08	1.74E-03	5.65E-03
8.94E-05	2.89E-04	1.18E-08	4.18E-08	1.48E-10	5.25E-10	8.94E-05	2.89E-04
2.17E-04	7.03E-04	1.08E-06	3.83E-06	2.12E-09	7.52E-09	2.18E-04	7.07E-04
2.51E-04	8.13E-04	-	-	-	-	2.51E-04	8.13E-04
1.11E-03	3.58E-03	1.38E-06	4.88E-06	4.51E-09	1.60E-08	1.11E-03	3.59E-03
4.26E-04	1.38E-03	8.25E-08	2.93E-07	3.21E-08	1.14E-07	4.26E-04	1.38E-03
1.23E-03	4.00E-03	-	-	-	-	1.23E-03	4.00E-03
1.02E-03	3.31E-03	7.37E-05	2.61E-04	2.27E-06	8.03E-06	1.10E-03	3.58E-03
5.11E+00	1.65E+01	-	-	-	-	5.11E+00	1.65E+01
6.38E-01	2.07E+00	-	-	-	-	6.38E-01	2.07E+00
1.79E-03	5.79E-03	4.91E-08	1.74E-07	8.05E-09	2.85E-08	1.79E-03	5.79E-03
2.09E-03	6.75E-03	3.73E-07	1.32E-06	1.60E-08	5.67E-08	2.09E-03	6.75E-03
3.53E-04	1.14E-03	2.55E-07	9.05E-07	6.03E-09	2.14E-08	3.53E-04	1.14E-03
1.66E-03	5.38E-03	-	-	-	-	1.66E-03	5.38E-03
1.19E-03	3.86E-03	2.06E-06	7.31E-06	4.51E-07	1.60E-06	1.19E-03	3.87E-03
1.57E-04	5.10E-04	-	-	5.81E-09	2.06E-08	1.57E-04	5.10E-04
6.81E-05	2.21E-04	-	-	-	-	6.81E-05	2.21E-04
1.62E-03	5.24E-03	-	-	-	-	1.62E-03	5.24E-03
5.53E-03	1.79E-02	2.36E-08	8.36E-08	3.64E-09	1.29E-08	5.53E-03	1.79E-02
5.80	**18.78**	**0.01**	**0.04**	**5.55E-06**	**1.97E-05**	**5.81**	**18.82**
5.80	**18.78**	**1.85E-03**	**0.01**	**5.15E-06**	**1.83E-05**	**5.80**	**18.78**
5.11	**16.54**	**1.77E-03**	**0.01**	**2.27E-06**	**8.03E-06**	**5.11**	**16.54**

2009 Actual Emissions							
Coal		Natural Gas		Fuel Oil		Total	
(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]
1.03E-03	4.00E-03	-	-	-	-	1.03E-03	4.00E-03
5.24E-04	2.03E-03	-	-	-	-	5.24E-04	2.03E-03
3.25E-05	1.26E-04	-	-	4.83E-06	1.88E-05	3.73E-05	1.45E-04
7.41E-04	2.88E-03	1.05E-05	4.07E-05	1.21E-06	4.72E-06	7.52E-04	2.92E-03
3.79E-05	1.47E-04	6.29E-07	2.44E-06	2.56E-08	9.94E-08	3.86E-05	1.50E-04
9.21E-05	3.58E-04	5.76E-05	2.24E-04	3.66E-07	1.42E-06	1.50E-04	5.83E-04
1.07E-04	4.14E-04	-	-	-	-	1.07E-04	4.14E-04
4.70E-04	1.82E-03	7.34E-05	2.85E-04	7.78E-07	3.02E-06	5.44E-04	2.11E-03
1.81E-04	7.02E-04	4.40E-06	1.71E-05	5.54E-06	2.15E-05	1.91E-04	7.40E-04
5.24E-04	2.03E-03	-	-	-	-	5.24E-04	2.03E-03
4.33E-04	1.68E-03	3.93E-03	1.53E-02	3.91E-04	1.52E-03	4.75E-03	1.85E-02
2.17E+00	8.42E+00	-	-	-	-	2.17E+00	8.42E+00
2.71E-01	1.05E+00	-	-	-	-	2.71E-01	1.05E+00
7.59E-04	2.95E-03	2.62E-06	1.02E-05	1.39E-06	5.40E-06	7.63E-04	2.96E-03
8.85E-04	3.44E-03	1.99E-05	7.73E-05	2.76E-06	1.07E-05	9.08E-04	3.53E-03
1.50E-04	5.82E-04	1.36E-05	5.29E-05	1.04E-06	4.04E-06	1.65E-04	6.39E-04
7.04E-04	2.74E-03	-	-	-	-	7.04E-04	2.74E-03
5.06E-04	1.96E-03	1.10E-04	4.27E-04	7.78E-05	3.02E-04	6.94E-04	2.69E-03
6.68E-05	2.60E-04	-	-	1.00E-06	3.90E-06	6.78E-05	2.63E-04
2.89E-05	1.12E-04	-	-	-	-	2.89E-05	1.12E-04
6.86E-04	2.67E-03	-	-	-	-	6.86E-04	2.67E-03
2.35E-03	9.12E-03	1.26E-06	4.88E-06	6.29E-07	2.44E-06	2.35E-03	9.13E-03
2.46	**9.56**	**0.59**	**2.30**	**9.57E-04**	**3.72E-03**	**3.05**	**11.86**
2.46	**9.56**	**0.10**	**0.38**	**8.89E-04**	**3.45E-03**	**2.56**	**9.94**
2.17	**8.42**	**0.09**	**0.37**	**3.91E-04**	**1.52E-03**	**2.17**	**8.42**

2010 Actual Emissions							
Coal		Natural Gas		Fuel Oil		Total	
(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]	(lb/hr)[4]	(tpy)[5]
2.41E-03	7.31E-03	-	-	-	-	2.41E-03	7.31E-03
1.22E-03	3.72E-03	-	-	-	-	1.22E-03	3.72E-03
7.60E-05	2.31E-04	-	-	3.87E-06	1.17E-05	7.99E-05	2.43E-04
1.73E-03	5.26E-03	2.31E-06	7.01E-06	9.72E-07	2.95E-06	1.73E-03	5.27E-03
8.87E-05	2.69E-04	1.39E-07	4.21E-07	2.05E-08	6.22E-08	8.88E-05	2.70E-04
2.15E-04	6.54E-04	1.27E-05	3.86E-05	2.93E-07	8.90E-07	2.28E-04	6.93E-04
2.49E-04	7.57E-04	-	-	-	-	2.49E-04	7.57E-04
1.10E-03	3.33E-03	1.62E-05	4.91E-05	6.22E-07	1.89E-06	1.11E-03	3.38E-03
4.22E-04	1.28E-03	9.70E-07	2.95E-06	4.43E-06	1.35E-05	4.28E-04	1.30E-03
1.22E-03	3.72E-03	-	-	-	-	1.22E-03	3.72E-03
1.01E-03	3.08E-03	8.66E-04	2.63E-03	3.13E-04	9.51E-04	2.19E-03	6.66E-03
5.07E+00	1.54E+01	-	-	-	-	5.07E+00	1.54E+01
6.33E-01	1.92E+00	-	-	-	-	6.33E-01	1.92E+00
1.77E-03	5.39E-03	5.77E-07	1.75E-06	1.11E-06	3.38E-06	1.77E-03	5.39E-03
2.07E-03	6.28E-03	4.39E-06	1.33E-05	2.21E-06	6.71E-06	2.08E-03	6.30E-03
3.50E-04	1.06E-03	3.00E-06	9.12E-06	8.32E-07	2.53E-06	3.54E-04	1.08E-03
1.65E-03	5.00E-03	-	-	-	-	1.65E-03	5.00E-03
1.18E-03	3.59E-03	2.42E-05	7.37E-05	6.22E-05	1.89E-04	1.27E-03	3.85E-03
1.56E-04	4.74E-04	-	-	8.03E-07	2.44E-06	1.57E-04	4.77E-04
6.75E-05	2.05E-04	-	-	-	-	6.75E-05	2.05E-04
1.60E-03	4.87E-03	-	-	-	-	1.60E-03	4.87E-03
5.49E-03	1.67E-02	2.77E-07	8.42E-07	5.03E-07	1.53E-06	5.49E-03	1.67E-02
5.75	**17.47**	**0.13**	**0.40**	**7.66E-04**	**2.33E-03**	**5.88**	**17.87**
5.75	**17.47**	**0.02**	**0.07**	**7.12E-04**	**2.16E-03**	**5.77**	**17.54**
5.07	**15.39**	**0.02**	**0.06**	**3.13E-04**	**9.51E-04**	**5.07**	**15.39**

Table D-9. Hazardous Air Pollutant and Toxic Air Pollutant Emissions Netting Analyses

Pollutant	Pollutant Classifications		Past Actual Emissions Decrease[1]				Potential Future Emissions Increase[2]				Net Emissions Increase[3]			Emissions Increase?
	Georgia TAP (Yes/No)	HAP (Yes/No)	No. 1 Power Boiler (lb/hr)	No. 1 Power Boiler (tpy)	No. 2 Power Boiler (lb/hr)	No. 2 Power Boiler (tpy)	No. 2 Power Boiler (lb/hr)	No. 2 Power Boiler (tpy)	New Biomass Boiler (lb/hr)	New Biomass Boiler (tpy)	(lb/hr)	(g/s)	(tpy)	TAP Modeling? (Yes/No)
1,2,3,4,6,7,8,9-Octachlorodibenzodioxin [OCDD]	Yes	Yes	5.82E-11	1.87E-10	3.98E-11	1.37E-10	-	-	-	-	-9.80E-11	-1.23E-11	-3.24E-10	No
2,3,7,8-Tetrachlorodibenzo-p-dioxins	Yes	Yes	-	-	-	-	-	-	5.33E-09	2.34E-08	5.33E-09	6.72E-10	2.34E-08	**Yes**
2,3,7,8-Tetrachlorodibenzo-p-furans	No	Yes	-	-	-	-	-	-	5.58E-08	2.44E-07	5.58E-08	7.03E-09	2.44E-07	**Yes**
Acetaldehyde	Yes	Yes	2.84E-03	9.82E-03	2.77E-03	9.94E-03	-	-	2.89E-02	1.26E-01	2.32E-02	2.93E-03	1.07E-01	**Yes**
Acrolein	Yes	Yes	1.45E-03	5.00E-03	1.41E-03	5.06E-03	-	-	5.69E-03	2.49E-02	2.83E-03	3.57E-04	1.49E-02	**Yes**
Antimony	Yes	Yes	9.96E-05	3.42E-04	8.84E-05	3.17E-04	-	-	4.90E-03	2.15E-02	4.71E-03	5.93E-04	2.08E-02	**Yes**
Arsenic	Yes	Yes	2.05E-03	7.07E-03	1.96E-03	7.15E-03	3.87E-05	1.69E-04	1.36E-02	5.97E-02	9.67E-03	1.22E-03	4.57E-02	**Yes**
Beryllium	Yes	Yes	1.05E-04	3.62E-04	1.02E-04	3.66E-04	2.32E-06	1.02E-05	6.82E-04	2.99E-03	4.77E-04	6.01E-05	2.27E-03	**Yes**
Cadmium	Yes	Yes	2.58E-04	8.92E-04	2.50E-04	8.94E-04	2.13E-04	9.32E-04	2.54E-03	1.11E-02	2.25E-03	2.83E-04	1.03E-02	**Yes**
Carbon tetrachloride	Yes	Yes	-	-	-	-	-	-	2.79E-02	1.22E-01	2.79E-02	3.52E-03	1.22E-01	**Yes**
Chloroform	Yes	Yes	2.94E-04	1.02E-03	2.87E-04	1.03E-03	-	-	1.74E-02	7.60E-02	1.68E-02	2.11E-03	7.40E-02	**Yes**
Chromium	Yes	Yes	1.30E-03	4.50E-03	1.27E-03	4.54E-03	2.71E-04	1.19E-03	1.30E-02	5.70E-02	1.07E-02	1.35E-03	4.92E-02	**Yes**
Cobalt	Yes	Yes	5.10E-04	1.76E-03	4.88E-04	1.75E-03	1.62E-05	7.11E-05	4.03E-03	1.77E-02	3.05E-03	3.84E-04	1.42E-02	**Yes**
Methylene chloride [dichloromethane]	Yes	Yes	1.45E-03	5.00E-03	1.41E-03	5.06E-03	-	-	1.80E-01	7.88E-01	1.77E-01	2.23E-02	7.77E-01	**Yes**
Formaldehyde	Yes	Yes	2.62E-03	7.44E-03	3.47E-03	1.26E-02	1.45E-02	6.35E-02	1.42E-01	6.21E-01	1.50E-01	1.89E-02	6.65E-01	**Yes**
Heptachlorodibenzo-p-dioxins	No	Yes	-	-	-	-	-	-	1.24E-06	5.43E-06	1.24E-06	1.56E-07	5.43E-06	**Yes**
Heptachlorodibenzo-p-furans	No	Yes	-	-	-	-	-	-	1.49E-07	6.52E-07	1.49E-07	1.87E-08	6.52E-07	**Yes**
Hexachlorodibenzo-p-dioxins	Yes	Yes	-	-	-	-	-	-	9.92E-04	4.34E-03	9.92E-04	1.25E-04	4.34E-03	**Yes**
Hexachlorodibenzo-p-furans	No	Yes	-	-	-	-	-	-	1.74E-07	7.60E-07	1.74E-07	2.19E-08	7.60E-07	**Yes**
Hydrogen chloride	Yes	Yes	5.99E+00	2.07E+01	5.84E+00	2.09E+01	-	-	2.26E+00	9.90E+00	-9.57E+00	-1.21E+00	-3.17E+01	No
Hydrogen fluoride [hydrofluoric acid]	Yes	Yes	7.48E-01	2.58E+00	7.16E-01	2.62E+00	-	-	1.38E-01	6.02E-01	-1.33E+00	-1.67E-01	-4.60E+00	No
Lead	Yes	Yes	2.10E-03	7.25E-03	2.04E-03	7.32E-03	9.67E-06	4.23E-05	2.98E-02	1.30E-01	2.56E-02	3.23E-03	1.16E-01	**Yes**
Manganese	Yes	Yes	2.45E-03	8.46E-03	2.39E-03	8.55E-03	7.35E-05	3.22E-04	2.24E-01	9.81E-01	2.19E-01	2.76E-02	9.64E-01	**Yes**
Mercury	Yes	Yes	4.17E-04	1.44E-03	3.97E-04	1.45E-03	5.03E-05	2.20E-04	2.17E-03	9.50E-03	1.41E-03	1.77E-04	6.84E-03	**Yes**
Methanol	Yes	Yes	-	-	-	-	-	-	1.00E+00	4.39E+00	1.00E+00	1.26E-01	4.39E+00	**Yes**
Methyl ethyl ketone [2-butanone]	Yes	No	1.95E-03	6.72E-03	1.90E-03	6.80E-03	-	-	-	-	-3.84E-03	-4.84E-04	-1.35E-02	No
Nickel	Yes	Yes	1.56E-03	5.36E-03	1.38E-03	4.94E-03	4.06E-04	1.78E-03	2.05E-02	8.96E-02	1.79E-02	2.26E-03	8.11E-02	**Yes**
Octachlorodibenzo-p-dioxins	No	Yes	-	-	-	-	-	-	4.09E-05	1.79E-04	4.09E-05	5.16E-06	1.79E-04	**Yes**
Octachlorodibenzo-p-furans	No	Yes	-	-	-	-	-	-	5.46E-08	2.39E-07	5.46E-08	6.87E-09	2.39E-07	**Yes**
o-Xylene	Yes	Yes	1.87E-04	6.44E-04	1.77E-04	6.46E-04	-	-	1.55E-02	6.79E-02	1.51E-02	1.91E-03	6.66E-02	**Yes**
Pentachlorodibenzo-p-dioxins	No	Yes	-	-	-	-	-	-	9.30E-07	4.07E-06	9.30E-07	1.17E-07	4.07E-06	**Yes**
Pentachlorodibenzo-p-furans	No	Yes	-	-	-	-	-	-	2.60E-07	1.14E-06	2.60E-07	3.28E-08	1.14E-06	**Yes**
Phenol	Yes	Yes	7.98E-05	2.76E-04	7.79E-05	2.79E-04	-	-	3.16E-02	1.38E-01	3.15E-02	3.96E-03	1.38E-01	**Yes**
Propionaldehyde [propanal]	Yes	Yes	1.90E-03	6.55E-03	1.81E-03	6.63E-03	-	-	3.78E-02	1.66E-01	3.41E-02	4.30E-03	1.52E-01	**Yes**
Selenium	Yes	Yes	6.49E-03	2.24E-02	6.21E-03	2.27E-02	4.64E-06	2.03E-05	1.74E-03	7.60E-03	-1.10E-02	-1.38E-03	-3.74E-02	No
Tetrachlorodibenzo-p-dioxins	Yes	Yes	-	-	-	-	-	-	2.91E-07	1.28E-06	2.91E-07	3.67E-08	1.28E-06	**Yes**
Tetrachlorodibenzo-p-furans	No	Yes	-	-	-	-	-	-	4.65E-07	2.04E-06	4.65E-07	5.86E-08	2.04E-06	**Yes**

1. Past actual emissions decreases are from the shutdown of Power Boiler No. 1 and the removal of coal and fuel oil from Power Boiler No. 2. Maximum average annual emissions from a 2-year calendar period in the past 10 years.
2. Future potential emissions increases are from the combustion of natural gas only in Power Boiler No. 2 and the installation of the new No. 3 Biomass Boiler.
3. The net emissions increase is equal to the future potential emissions minus the past actual emissions decreases.

Table D-10. Derivation of Long-term Acceptable Ambient Concentrations (AAC) for Georgia EPD

Pollutant[1,2]	CAS No.	Formula	Mol. Wt. (g/mol)	Unit Risk ($\mu g/m^3)^{-1}$	Weight of Evidence	Inhalation RfC (mg/m^3)	Annual AAC ($\mu g/m^3$)	24-hour AAC Required?
Acetaldehyde	75-07-0	CH3CHO	44.05	2.20E-06	B2	4.55E-03	**4.55E+00**	Not Required
Acrolein	107-02-8	CH2CHCHO	56.07			Not Used	**1.50E-01**	Not Required
Antimony	7440-36-0	Sb	121.76			None	**None**	Need 24-hr TWA
Arsenic	7440-38-2	As	74.92	4.30E-03	A	2.33E-07	**2.33E-04**	Not Required
Beryllium	7440-41-7	Be	9.01		B1	2.00E-05	**2.00E-02**	Not Required
Cadmium	7440-43-9	Cd	112.41	1.80E-03	B1	5.56E-06	**5.56E-03**	Not Required
Carbon Tetrachloride	56-23-5	CCl4	153.82	1.50E-05	B2	6.67E-04	**6.67E-01**	Not Required
Chloroform	67-66-3	CHCl3	119.38		B2	9.80E-02	**9.80E+01**	Not Required
Chromium	7440-47-3	Cr	52.00		A	8.00E-06	**8.00E-03**	Not Required
Cobalt	7440-48-4	Co	58.93			1.00E-04	**1.00E-01**	Not Required
Formaldehyde	50-00-0	HCHO	30.00		B1	N/A	**1.10E+00**	Not Required
Heptachlorodibenzo-p-dioxins	35822-46-9	C12HCl7O2	425.31			None	**None**	Need 24-hr TWA
Heptachlorodibenzo-p-furans	67562-39-4	C12HCl7O	409.31		D	None	**None**	Need 24-hr TWA
Hexachlorodibenzo-p-dioxins	19408-74-3	C12H2Cl6O2	390.86	1.30E+00	B2	7.69E-09	**7.69E-06**	Not Required
Hexachlorodibenzo-p-furans	57117-44-9	C12H2Cl6O	374.87		D	None	**None**	Need 24-hr TWA
Lead	7439-92-1	Pb	207.20		B2	1.50E-03	**1.50E+00**	Not Required
Manganese	7439-96-5	Mn	54.94		D	5.00E-05	**5.00E-02**	Not Required
Mercury	7439-97-6	Hg	200.59		D	3.0E-04	**3.00E-01**	Not Required
Methylene chloride (dichloromethane)	75-09-2	CH2Cl2	84.93	4.70E-07	B2	2.13E-02	**2.13E+01**	Not Required
Nickel	7440-02-0	Ni	58.69		A	9.00E-05	**9.00E-02**	Not Required
Octachlorodibenzo-p-dioxins	3268-87-9	C12Cl8O2	459.75			None	**None**	Need 24-hr TWA
Octachlorodibenzo-p-furans	39001-02-0	C12Cl8O	443.76		D	None	**None**	Need 24-hr TWA
Pentachlorodibenzo-p-dioxins	36088-22-9	C12H3Cl5O2	356.42			None	**None**	Need 24-hr TWA
Pentachlorodibenzo-p-furans	57117-41-6	C12H3Cl5O	340.42		D	None	**None**	Need 24-hr TWA
Phenol	108-95-2	C6H5OH	94.11		D	2.00E-01	**2.00E+02**	Not Required
Propionaldehyde [propanal]	123-38-6	C3H6O	58.08			8.00E-03	**8.00E+00**	Not Required
2,3,7,8-Tetrachlorodibenzo-p-dioxins	9014-42-0	C12H4Cl4O2	321.97	3.30E+01	B2	3.03E-10	**3.03E-07**	Not Required
Tetrachlorodibenzo-p-dioxins	1746-01-6	C12H4Cl4O2	321.97	3.30E+01	B2	3.03E-10	**3.03E-07**	Not Required
2,3,7,8-Tetrachlorodibenzo-p-furans	51207-31-9	C12H4Cl4O	305.98		D	None	**None**	Need 24-hr TWA
Tetrachlorodibenzo-p-furans	51207-31-9	C12H4Cl4O	305.98		D	None	**None**	Need 24-hr TWA
o-Xylene	95-47-6	C8H10	106.16		D	1.00E-01	**1.00E+02**	Not Required
Methanol	67-56-1	CH3OH	32.04			4.00E+00	**4.00E+03**	Not Required

1. AAC values listed above provided for those TAP for which sufficient documentation was available to develop the necessary AAC values.
2. Acrolein AAC is updated to be based on TCEQ Reference Value (ReV) located in the final development support document (http://tceq.com/assets/public/implementation/tox/dsd/final/nov10/acrolein.pdf).

Table D-11. Derivation of 24-hr Acceptable Ambient Concentrations (AAC) for Georgia EPD

Pollutant[1]	24-hr AAC Required?	CAS No.	Formula	Mol. Wt. (g/mol)	24-hr Rating 1. OSHA TWA (ppm)	24-hr Rating 1. OSHA TWA (mg/m^3)	24-hr Rating 2. ACGIH TWA (ppm)	24-hr Rating 2. ACGIH TWA (mg/m^3)	24-hr Rating 3. NIOSH TWA (ppm)	24-hr Rating 3. NIOSH TWA (mg/m^3)	Rating Available 24-hour TWA (mg/m^3)	24-hour AAC ($\mu g/m^3$)
Antimony	Need 24-hr TWA	7440-36-0	Sb	121.76		0.5		0.5		0.5	5.00E-01	0.40
Heptachlorodibenzo-p-dioxins	Need 24-hr TWA	35822-46-9	C12HCl7O2	425.31	None		None		None		None	None
Heptachlorodibenzo-p-furans	Need 24-hr TWA	67562-39-4	C12HCl7O	409.31	None		None		None		None	None
Hexachlorodibenzo-p-furans	Need 24-hr TWA	57117-44-9	C12H2Cl6O	374.87	None		None		None		None	None
Octachlorodibenzo-p-dioxins	Need 24-hr TWA	3268-87-9	C12Cl8O2	459.75	None		None		None		None	None
Octachlorodibenzo-p-furans	Need 24-hr TWA	39001-02-0	C12Cl8O	443.76	None		None		None		None	None
Pentachlorodibenzo-p-dioxins	Need 24-hr TWA	36088-22-9	C12H3Cl5O2	356.42	None		None		None		None	None
Pentachlorodibenzo-p-furans	Need 24-hr TWA	57117-41-6	C12H3Cl5O	340.42	None		None		None		None	None
2,3,7,8-Tetrachlorodibenzo-p-furans	Need 24-hr TWA	51207-31-9	C12H4Cl4O	305.98	None		None		None		None	None
Tetrachlorodibenzo-p-furans	Need 24-hr TWA	51207-31-9	C12H4Cl4O	305.98	None		None		None		None	None

Note: for conservatism, the safety factor of 300 for known carcinogens is applied to all pollutants unless otherwise noted.

Note: LD50 values are reported in datasheets from http://cameochemicals.noaa.gov/

1. AAC values listed above for those TAP for which sufficient documentation was available to develop the necessary AAC values Multiple dioxin and furan compounds for which emission were estimated did not have sufficient information available to develop an AAC value.

Table D-12. Derivation of 15-minute Acceptable Ambient Concentrations (AAC) for Georgia EPD

Pollutant[1]	CAS No.	Formula	Mol. Wt. (g/mol)	OSHA Ceiling (ppm)	OSHA Ceiling (mg/m^3)	ACGIH STEL (ppm)	ACGIH STEL (mg/m^3)	NIOSH STEL (ppm)	NIOSH STEL (mg/m^3)	Ceiling or STEL (mg/m^3)	15-minute AAC ($\mu g/m^3$)
Acetaldehyde	75-07-0	CH3CHO	44.05	None		25	45	None		45.0	4,504.1
Acrolein	107-02-8	CH2CHCHO	56.07	None		0.1	0.25	0.3	0.8	0.3	25.0
Antimony	7440-36-0	Sb	121.76	None		None		None		None	None
Arsenic	7440-38-2	As	74.92	None		None			0.002	0.0	0.2
Beryllium	7440-41-7	Be	9.01		0.005	None		None		0.0	0.5
Cadmium	7440-43-9	Cd	112.41		0.3	None		None		0.3	30.0
Carbon Tetrachloride	56-23-5	CCl4	153.82	25	157	10	63	None		157.3	15,728.0
Chloroform	67-66-3	CHCl3	119.38	50	240	None		None		240.0	24,000.0
Chromium	7440-47-3	Cr	52.00	None		None		None		None	None
Cobalt	7440-48-4	Co	58.93	None		None		None		None	None
Formaldehyde	50-00-0	HCHO	30.00	2	2.5	0.3	0.4	0.1	0.1	2.5	245.4
Heptachlorodibenzo-p-dioxins	35822-46-9	C12HCl7O2	425.31	None		None		None		None	None
Heptachlorodibenzo-p-furans	67562-39-4	C12HCl7O	409.31	None		None		None		None	None
Hexachlorodibenzo-p-dioxins	19408-74-3	C12H2Cl6O2	390.86	None		None		None		None	None
Hexachlorodibenzo-p-furans	57117-44-9	C12H2Cl6O	374.87	None		None		None		None	None
Lead	7439-92-1	Pb	207.20	None		None		None		None	None
Manganese	7439-96-5	Mn	54.94		5	None			3	5.0	500.0
Mercury	7439-97-6	Hg	200.59		0.04	None			0.1	0.04	4.0
Methylene chloride (dichloromethane)	75-09-2	CH2Cl2	84.93	125	434.2	None		None		434.2	43,420.2
Nickel	7440-02-0	Ni	58.69	None		None		None		None	None
Octachlorodibenzo-p-dioxins	3268-87-9	C12Cl8O2	459.75	None		None		None		None	None
Octachlorodibenzo-p-furans	39001-02-0	C12Cl8O	443.76	None		None		None		None	None
Pentachlorodibenzo-p-dioxins	36088-22-9	C12H3Cl5O2	356.42	None		None		None		None	None
Pentachlorodibenzo-p-furans	57117-41-6	C12H3Cl5O	340.42	None		None		None		None	None
Phenol	108-95-2	C6H5OH	94.11	None		None		15.6	60	60.0	6,000.0
Propionaldehyde [propanal]	123-38-6	C3H6O	58.08	None		None		None		None	None
2,3,7,8-Tetrachlorodibenzo-p-dioxins	9014-42-0	C12H4Cl4O2	321.97	None		None		None		None	None
Tetrachlorodibenzo-p-dioxins	1746-01-6	C12H4Cl4O2	321.97	None		None		None		None	None
2,3,7,8-Tetrachlorodibenzo-p-furans	51207-31-9	C12H4Cl4O	305.98	None		None		None		None	None
Tetrachlorodibenzo-p-furans	51207-31-9	C12H4Cl4O	305.98	None		None		None		None	None
o-Xylene	95-47-6	C8H10	106.16	None		150	655	150	655	655.0	65,500.0
Methanol	67-56-1	CH3OH	32.04	None		250	325	250	325	325	32,500

1. AAC values listed above for those TAP for which sufficient documentation was available to develop the necessary AAC values.

Table D-13. ISCST3 Modeled Impacts Assessment

Pollutant[1]	ISC 1-hr Impact (µg/m³)	Maximum 15-minute Average Impact (µg/m³)	15-minute Average AAC (µg/m³)	Maximum 15-minute Average Impact (% of AAC)	ISC Maximum 24-hour Average Impact (µg/m³)	24-hour Average AAC (µg/m³)	Maximum 24-hour Average Impact (% of AAC)	ISC Maximum Annual Impact (µg/m³)	Annual Average AAC (µg/m³)	Maximum Annual Impact (% of AAC)
Acetaldehyde	2.48E+02	3.27E+02	4.50E+03	7.26%	2.67E+01	Not Needed	-	2.90E+00	4.55E+00	63.70%
Acrolein	4.68E+00	6.18E+00	2.50E+01	24.70%	6.65E-01	Not Needed	-	5.36E-02	0.15	35.73%
Antimony	8.90E-03	1.17E-02	None	-	1.31E-03	3.97E-01	0.33%	7.00E-05	None	-
Arsenic	6.38E-03	8.42E-03	2.00E-01	4.21%	9.50E-04	Not Needed	-	6.00E-05	2.33E-04	25.80%
Beryllium	3.92E-03	5.17E-03	5.00E-01	1.03%	5.20E-04	Not Needed	-	3.00E-05	2.00E-02	0.15%
Cadmium	1.57E-03	2.07E-03	3.00E+01	<0.01%	3.30E-04	Not Needed	-	3.00E-05	5.56E-03	0.54%
Carbon Tetrachloride	1.75E+01	2.30E+01	1.57E+04	0.15%	1.48E+00	Not Needed	-	7.21E-02	6.67E-01	10.81%
Chloroform	2.09E+01	2.75E+01	2.40E+04	0.11%	1.98E+00	Not Needed	-	8.69E-02	9.80E+01	0.09%
Chromium	1.08E-02	1.42E-02	None	-	2.22E-03	Not Needed	-	1.90E-04	8.00E-03	2.38%
Cobalt	9.99E-03	1.32E-02	None	-	1.41E-03	Not Needed	-	8.00E-05	1.00E-01	0.08%
Formaldehyde	1.90E+01	2.51E+01	2.45E+02	10.21%	2.67E+00	Not Needed	-	2.29E-01	1.10E+00	20.82%
Hexachlorodibenzo-p-dioxins[2]	4.56E-04	6.02E-04	None	-	6.59E-05	Not Needed	-	3.89E-06	7.69E-06	50.57%
Lead	5.58E-02	7.37E-02	None	-	1.15E-02	Not Needed	-	8.20E-04	1.50E+00	0.05%
Manganese	3.71E-01	4.89E-01	5.00E+02	0.10%	5.25E-02	Not Needed	-	2.86E-03	5.00E-02	5.72%
Mercury	2.09E-03	2.76E-03	4.00E+00	0.07%	3.60E-04	Not Needed	-	2.00E-05	3.00E-01	<0.01%
Methylene chloride [dichloromethane]	2.60E+01	3.44E+01	4.34E+04	0.08%	3.03E+00	Not Needed	-	2.45E-01	2.13E+01	1.15%
Nickel	1.39E-01	1.83E-01	None	-	1.86E-02	Not Needed	-	9.80E-04	9.00E-02	1.09%
Phenol	4.04E+01	5.33E+01	6.00E+03	0.89%	3.41E+00	Not Needed	-	1.47E-01	2.00E+02	0.07%
Propionaldehyde [propanal]	1.61E+00	2.13E+00	None	-	1.35E-01	Not Needed	-	8.32E-03	8.00E+00	0.10%
2,3,7,8-Tetrachlorodibenzo-p-dioxins[3]	2.45E-09	3.23E-09	None	-	3.54E-10	Not Needed	-	2.09E-11	3.03E-07	<0.01%
Tetrachlorodibenzo-p-dioxins[4]	1.34E-07	1.77E-07	None	-	1.94E-08	Not Needed	-	1.14E-09	3.03E-07	0.38%
o-Xylene	3.42E+00	4.52E+00	6.55E+04	<0.01%	4.12E-01	Not Needed	-	4.40E-02	1.00E+02	0.04%
Methanol	2.78E+03	3.67E+03	3.25E+04	11.30%	3.88E+02	Not Needed	-	3.78E+01	4.00E+03	0.95%

1. AAC values listed above for those TAP for which sufficient documentation was available to develop the necessary AAC values

Table D-14a. Modeled Macon Mill Stack Parameters

Emission Unit ID	Stack ID	Emission Release Point Type	Point Description	UTM East X Coordinate[4] (meters)	UTM North Y Coordinate[4] (meters)	Stack Parameters[1]							
						Height		Temperature		Flow Rate	Velocity[2]		Diameter
						(ft)	(m)	(F)	(K)	(acfm)	(ft/sec)	(m/sec)	(ft)	(m)
A904	ST07	02 - Vert	Hardwood High Density Storage Chests	253,939.9	3,629,094.8	71.5	21.79	68	293.15	1.52	0.003	0.001	3.28	1.00
A903	ST08	05 - Vert w/cap	Pine High Density Storage Chest	253,914.0	3,629,102.3	90	27.43	68	293.15	1.52	0.003	0.001	3.28	1.00
A905	ST09	04 - Goose Neck	Transition Tank	253,936.3	3,629,043.7	24	7.32	68	293.15	1.52	0.003	0.001	3.28	1.00
B005	ST14	02 - Vert	No. 3 Biomass Boiler	253,782.7	3,629,074.5	316	96.32	320	433.15	320,000	93.99	28.65	8.50	2.59
B002	ST15	02 - Vert	No. 2 Power Boiler	253,794.7	3,629,078.5	65	19.81	370	460.93	76,000	179.20	54.62	3.00	0.91
B003	ST16	02 - Vert	No. 2 Biomass Boiler	253,749.7	3,629,077.5	300	91.44	147	337.04	240,402	51.01	15.549	10.00	3.05
D902	ST17	04 - Goose Neck	No. 1 Horizontal Seal Tank	253,920.3	3,629,039.7	24	7.32	68	293.15	1.52	0.003	0.001	3.28	1.00
D901	ST18	04 - Goose Neck	North Weak Black Liquor Million Gallon Tank	253,849.2	3,628,933.4	48	14.63	68	293.15	1.52	0.003	0.001	3.28	1.00
D905	ST19	05 - Vert w/cap	Intermediate Liquor Tank	253,785.5	3,629,042.9	24	7.32	68	293.15	1.52	0.003	0.001	3.28	1.00
D001	ST20	02 - Vert	No. 3 Recovery Boiler	253,751.6	3,629,032.1	300	91.44	351	450.37	349,081	61.22	18.66	11.00	3.35
D002/D903	ST21	02 - Vert	No. 3 Smelt Dissolving Tank/Salt Cake Mix Tank	253,750.7	3,629,046.5	220	67.06	177.3	353.87	23,535	19.98	6.09	5.00	1.52
D003	ST25	02 - Vert	Tall Oil Reaction Tank	253,989.9	3,629,006.4	22.5	6.86	68	293.15	1.52	0.003	0.001	3.28	1.00
L901	ST28	04 - Goose Neck	Green Liquor Clarifier & Storage	253,855.7	3,628,989.3	24	7.32	68	293.15	1.52	0.003	0.001	3.28	1.00
L903	ST31	02 - Vert	Mud Precoat Filters	253,896.7	3,628,989.5	50	15.24	68	293.15	1.52	0.003	0.001	3.28	1.00
L001	ST32	02 - Vert	No. 1 Lime Kiln	253,884.7	3,628,992.5	51	15.54	165	347.04	18,115	34.60	10.55	3.33	1.02
L002	ST33	02 - Vert	No. 2 Lime Kiln	253,884.7	3,628,984.5	51	15.54	158	343.15	18,175	34.71	10.58	3.33	1.02
L003	ST34	02 - Vert	Lime Slaker	253,950.0	3,628,998.2	50	15.24	68	293.15	1.52	0.003	0.001	3.28	1.00
P001[5]	ST39	02 - Vert	Nos. 1 Paper Machine	253,691.7	3,629,132.5	59.5	18.14	68	293.15	1.52	0.003	0.001	3.28	1.00
P002[5]	ST41	02 - Vert	Nos. 2 Paper Machine	253,691.7	3,629,155.5	59.5	18.14	68	293.15	1.52	0.003	0.001	3.28	1.00
W901	ST46	01 - Fug	Wastewater Treatment	254,061.0	3,629,169.0	35	10.67	68	293.15	1.52	0.003	0.001	3.28	1.00
L904	ST48	02 - Vert	Lime Mud Precoat Filter Vacuum Pumps	253,896.0	3,628,982.0	51	15.54	68	293.15	1.52	0.003	0.001	3.28	1.00
D904	ST51	04 - Goose Neck	Boilout Black Liquor Million Gallon Tank	253,760.9	3,628,961.0	40	12.19	68	293.15	1.52	0.003	0.001	3.28	1.00
D903	ST52	04 - Goose Neck	South Weak Black Liquor Million Gallon Tank	253,828.6	3,628,920.8	40	12.19	68	293.15	1.52	0.003	0.001	3.28	1.00
L902	ST59	04 - Goose Neck	Causticizers	253,898.7	3,629,002.5	50	15.24	68	293.15	1.52	0.003	0.001	3.28	1.00
A901/A902	ST75	02 - Vert	Chemi Washers	253,921.7	3,629,069.5	30	9.14	68	293.15	1.52	0.003	0.001	3.28	1.00
R901[3]	ST81	01 - Fug	Recycle Mill	253,849.7	3,629,212.5	35.37	10.78	68	293.15	1.52	0.003	0.001	3.28	1.00
C004	ST88	02 - Vert	PVOH Silo	253,640.7	3,629,191.5	115	35.05	68	293.15	706	59.93	18.27	0.50	0.15

1. Stack Parameters per the CERR tool, unless otherwise noted.
2. The velocity of rain capped or pseudo-point sources is updated and estimated at 0.001 meters/second per Model Clearinghouse Record 93-II-09.
3. The height of the recycle mill stack has been raised 0.3 meters above the height of the Recycle Mill building.
4. UTM Coordinates have been adjusted based on Google Earth imaging in NAD83.
5. The Paper Machine building sources were conservatively grouped into 2 sources and assigned psuedo-point source parameters for the modeling of toxic emissions except for acrolein and formaldehyde.

Table D-14b. Refined Modeled Macon Mill Stack Parameters - Paper Machines

Emission Unit ID	Stack ID[1]	Emission Release Point Type	Point Description[1]	UTM East X Coordinate (meters)	UTM North Y Coordinate[2] (meters)	Stack Parameters[1]							
						Height[3]		Temperature		Flow Rate	Velocity		Diameter
						(ft)	(m)	(F)	(K)	(acfm)	(ft/sec)	(m/sec)	(ft)	(m)
P001	DA1	02 - Vert	Paper Machine 1 - Dry End (Point-01)	253,743.5	3,629,132.5	59.50	18.14	149.99	338.7	82,049.86	70.01	21.34	4.99	1.52
P001	DA2	02 - Vert	Paper Machine 1 - Dry End (Point-02)	253,731.1	3,629,132.5	59.50	18.14	149.99	338.7	82,049.86	70.01	21.34	4.99	1.52
P001	DA3	02 - Vert	Paper Machine 1 - Dry End (Point-03)	253,725.1	3,629,132.5	59.50	18.14	149.99	338.7	82,049.86	70.01	21.34	4.99	1.52
P001	DA4	02 - Vert	Paper Machine 1 - Dry End (Point-04)	253,718.9	3,629,132.5	59.50	18.14	149.99	338.7	82,049.86	70.01	21.34	4.99	1.52
P001	DA5	02 - Vert	Paper Machine 1 - Dry End (Point-05)	253,697.5	3,629,132.5	59.50	18.14	149.99	338.7	82,049.86	70.01	21.34	4.99	1.52
P001	DA6	02 - Vert	Paper Machine 1 - Dry End (Point-06)	253,685.2	3,629,132.5	59.50	18.14	149.99	338.7	82,049.86	70.01	21.34	4.99	1.52
P002	DB1	02 - Vert	Paper Machine 2 - Dry End (Point-01)	253,744.0	3,629,155.5	59.50	18.14	149.99	338.7	82,049.86	70.01	21.34	4.99	1.52
P002	DB2	02 - Vert	Paper Machine 2 - Dry End (Point-02)	253,731.6	3,629,155.5	59.50	18.14	149.99	338.7	82,049.86	70.01	21.34	4.99	1.52
P002	DB3	02 - Vert	Paper Machine 2 - Dry End (Point-03)	253,725.2	3,629,155.5	59.50	18.14	149.99	338.7	82,049.86	70.01	21.34	4.99	1.52
P002	DB4	02 - Vert	Paper Machine 2 - Dry End (Point-04)	253,719.5	3,629,155.5	59.50	18.14	149.99	338.7	82,049.86	70.01	21.34	4.99	1.52
P002	DB5	02 - Vert	Paper Machine 2 - Dry End (Point-05)	253,702.1	3,629,155.5	59.50	18.14	149.99	338.7	82,049.86	70.01	21.34	4.99	1.52
P002	DB6	02 - Vert	Paper Machine 2 - Dry End (Point-06)	253,696.5	3,629,155.5	59.50	18.14	149.99	338.7	82,049.86	70.01	21.34	4.99	1.52
P001	WA01	02 - Vert	Paper Machine 1 - Wet End (Point-01)	253,845.6	3,629,132.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P001	WA02	02 - Vert	Paper Machine 1 - Wet End (Point-02)	253,845.6	3,629,132.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P001	WA03	02 - Vert	Paper Machine 1 - Wet End (Point-03)	253,845.7	3,629,132.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P001	WA04	02 - Vert	Paper Machine 1 - Wet End (Point-04)	253,819.1	3,629,132.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P001	WA05	02 - Vert	Paper Machine 1 - Wet End (Point-05)	253,814.0	3,629,132.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P001	WA06	02 - Vert	Paper Machine 1 - Wet End (Point-06)	253,811.4	3,629,132.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P001	WA07	02 - Vert	Paper Machine 1 - Wet End (Point-07)	253,806.1	3,629,132.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P001	WA08	02 - Vert	Paper Machine 1 - Wet End (Point-08)	253,799.2	3,629,132.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P001	WA09	02 - Vert	Paper Machine 1 - Wet End (Point-09)	253,793.8	3,629,132.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P001	WA10	02 - Vert	Paper Machine 1 - Wet End (Point-10)	253,787.5	3,629,132.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P001	WA11	02 - Vert	Paper Machine 1 - Wet End (Point-11)	253,782.2	3,629,132.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P001	WA12	02 - Vert	Paper Machine 1 - Wet End (Point-12)	253,776.4	3,629,132.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P001	WA13	02 - Vert	Paper Machine 1 - Wet End (Point-13)	253,771.5	3,629,132.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P001	WA14	02 - Vert	Paper Machine 1 - Wet End (Point-14)	253,766.4	3,629,132.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P001	WA15	02 - Vert	Paper Machine 1 - Wet End (Point-15)	253,761.4	3,629,132.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P001	WA16	02 - Vert	Paper Machine 1 - Wet End (Point-16)	253,755.1	3,629,132.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB01	02 - Vert	Paper Machine 2 - Wet End (Point-01)	253,839.9	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB02	02 - Vert	Paper Machine 2 - Wet End (Point-02)	253,842.1	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB03	02 - Vert	Paper Machine 2 - Wet End (Point-03)	253,839.8	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB04	02 - Vert	Paper Machine 2 - Wet End (Point-04)	253,836.6	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB05	02 - Vert	Paper Machine 2 - Wet End (Point-05)	253,826.8	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB06	02 - Vert	Paper Machine 2 - Wet End (Point-06)	253,824.4	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB07	02 - Vert	Paper Machine 2 - Wet End (Point-07)	253,818.6	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB08	02 - Vert	Paper Machine 2 - Wet End (Point-08)	253,818.6	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB09	02 - Vert	Paper Machine 2 - Wet End (Point-09)	253,813.4	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB10	02 - Vert	Paper Machine 2 - Wet End (Point-10)	253,807.0	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB11	02 - Vert	Paper Machine 2 - Wet End (Point-11)	253,799.4	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB12	02 - Vert	Paper Machine 2 - Wet End (Point-12)	253,793.6	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB13	02 - Vert	Paper Machine 2 - Wet End (Point-13)	253,786.8	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB14	02 - Vert	Paper Machine 2 - Wet End (Point-14)	253,782.5	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB15	02 - Vert	Paper Machine 2 - Wet End (Point-15)	253,777.2	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB16	02 - Vert	Paper Machine 2 - Wet End (Point-16)	253,772.4	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB17	02 - Vert	Paper Machine 2 - Wet End (Point-17)	253,767.0	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB18	02 - Vert	Paper Machine 2 - Wet End (Point-18)	253,761.6	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52
P002	WB19	02 - Vert	Paper Machine 2 - Wet End (Point-19)	253,754.6	3,629,155.5	59.50	18.14	99.95	310.9	35,142.25	29.99	9.14	4.99	1.52

1. Stack description and parameters per February 1996 Air Toxics Modeling Analysis submitted to the EPD in support of the Macon Mill Expansion PSD Permit Application
2. UTM North Y Coordinate was updated from the 1996 Analysis to match current adjustments of the model per Google Earth. Y Coordinates match what was submitted in Volume II for the No. 1 and 2 Paper Machines.
3. Stack height remains the same as what is presented in table D14a.

Table D-15a. Modeled Macon Mill Toxic Emission Rates

Emission Unit ID	Stack ID	Emission Release Point Type	Point Description	Potential Emissions[9]																					
				Antimony		Manganese		Carbon Tetrachloride		Chloroform		Formaldehyde		Methanol		Methylene Chloride		Phenol		o-Xylene		2,3,7,8-Tetrachlorodibenzo-p-		Hexachlorodibenzo-p-dioxins[8]		Tetrachlorodibenzo-p-	
				(lb/hr)	(g/s)	(lb/hr)	(g/s)	(lb/hr)	(g/s)	(lb/hr)	(g/s)	(lb/hr)	(g/s)	(lb/hr)	(g/s)	(lb/hr)	(g/s)	(lb/hr)	(g/s)	(lb/hr)	(g/s)	(lb/hr)	(g/s)	(lb/hr)	(g/s)	(lb/hr)	(g/s)
A904	ST07	02 - Vert	Hardwood High Density Storage Chests	-	-	-	-	-	-	1.100E-02	1.386E-03	1.200E-04	1.512E-05	1.200E-01	1.512E-02	-	-	4.300E-03	5.418E-04	2.100E-04	2.646E-05	-	-	-	-	-	-
A903	ST08	05 - Vert w/cap	Pine High Density Storage Chest	-	-	-	-	-	-	1.100E-02	1.386E-03	1.200E-04	1.512E-05	1.200E-01	1.512E-02	-	-	4.300E-03	5.418E-04	2.100E-04	2.646E-05	-	-	-	-	-	-
A905	ST09	04 - Goose Neck	Transition Tank	-	-	-	-	-	-	1.100E-02	1.386E-03	1.200E-04	1.512E-05	1.200E-01	1.512E-02	-	-	4.300E-03	5.418E-04	2.100E-04	2.646E-05	-	-	-	-	-	-
B005	ST14	02 - Vert	No. 3 Biomass Boiler	4.898E-03	6.171E-04	2.239E-01	2.821E-02	2.790E-02	3.515E-03	1.736E-02	2.187E-03	1.419E-01	1.788E-02	1.002E+00	1.263E-01	1.798E-01	2.265E-02	3.162E-02	3.984E-03	1.550E-02	1.953E-03	5.332E-09	6.718E-10	9.920E-04	1.250E-04	2.914E-07	3.672E-08
B002	ST15	02 - Vert	No. 2 Power Boiler	-	-	7.348E-05	9.258E-06	-	-	-	-	1.450E-02	1.827E-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B003[8]	ST16	02 - Vert	No. 2 Biomass Boiler	1.936E-02	2.440E-03	8.321E-01	1.048E-01	2.340E-02	2.949E-03	1.456E-02	1.835E-03	2.288E+00	2.883E-01	7.281E-01	9.173E-02	4.836E-01	6.094E-02	2.652E-02	3.342E-03	1.300E-02	1.638E-03	4.472E-09	5.635E-10	2.652E-02	3.341E-03	2.444E-07	3.079E-08
D902	ST17	04 - Goose Neck	No. 1 Horizontal Seal Tank	-	-	-	-	3.200E-04	4.032E-05	-	-	-	-	7.100E-01	8.946E-02	-	-	-	-	4.500E-04	5.670E-05	-	-	-	-	-	-
D901	ST18	04 - Goose Neck	North Weak Black Liquor Million Gallon Tank	-	-	-	-	3.200E-04	4.032E-05	-	-	-	-	7.100E-01	8.946E-02	-	-	-	-	4.500E-04	5.670E-05	-	-	-	-	-	-
D905	ST19	05 - Vert w/cap	Intermediate Liquor Tank	-	-	-	-	-	-	1.400E-04	1.764E-05	5.000E-04	6.300E-05	1.300E-01	1.638E-02	-	-	4.600E-03	5.796E-04	7.100E-05	8.946E-06	-	-	-	-	-	-
D001	ST20	02 - Vert	No. 3 Recovery Boiler	2.450E-03	3.087E-04	4.462E-03	5.623E-04	-	-	3.412E-03	4.300E-04	6.825E-01	8.599E-02	4.375E+00	5.512E-01	6.737E-02	8.489E-03	-	-	2.888E-02	3.638E-03	-	-	-	-	-	-
D002/D90	ST21	02 - Vert	No. 3 Smelt Dissolving Tank/Salt Cake Mix Tank	7.612E-04	9.592E-05	3.325E-03	4.189E-04	-	-	2.013E-04	2.536E-05	4.574E-01	5.763E-02	1.444E+00	1.819E-01	1.313E-04	1.654E-05	-	-	2.187E-05	2.756E-06	-	-	-	-	-	-
D003	ST25	02 - Vert	Tall Oil Reaction Tank	-	-	-	-	-	-	7.462E-02	9.402E-03	-	-	9.580E-01	1.207E-01	5.600E-04	7.056E-05	1.440E-01	1.814E-02	6.400E-03	8.064E-04	-	-	-	-	-	-
L901	ST28	04 - Goose Neck	Green Liquor Clarifier & Storage	-	-	-	-	-	-	3.360E-05	4.234E-06	-	-	1.848E-02	2.328E-03	-	-	-	-	5.712E-06	7.197E-07	-	-	-	-	-	-
L903	ST31	02 - Vert	Mud Precoat Filters	-	-	-	-	-	-	-	-	3.528E-03	4.445E-04	2.016E-01	2.540E-02	-	-	-	-	7.560E-04	9.525E-05	-	-	-	-	-	-
L001	ST32	02 - Vert	No. 1 Lime Kiln	1.680E-05	2.117E-06	3.192E-03	4.022E-04	-	-	4.116E-05	5.186E-06	1.428E-02	1.799E-03	6.132E-02	7.726E-03	4.956E-05	6.244E-06	3.444E-03	4.339E-04	1.344E-03	1.693E-04	-	-	-	-	-	-
L002	ST33	02 - Vert	No. 2 Lime Kiln	1.680E-05	2.117E-06	3.192E-03	4.022E-04	-	-	4.116E-05	5.186E-06	1.428E-02	1.799E-03	6.132E-02	7.726E-03	4.956E-05	6.244E-06	3.444E-03	4.339E-04	1.344E-03	1.693E-04	-	-	-	-	-	-
L003	ST34	02 - Vert	Lime Slaker	-	-	-	-	-	-	-	-	-	-	4.536E-01	5.715E-02	-	-	-	-	2.856E-04	3.598E-05	-	-	-	-	-	-
P001	ST39	02 - Vert	Nos. 1 Paper Machine	-	-	-	-	-	-	-	-	1.320E+00	1.663E-01	2.712E+01	3.417E+00	2.820E-01	3.553E-02	-	-	3.120E-02	3.931E-03	-	-	-	-	-	-
P002	ST41	02 - Vert	Nos. 2 Paper Machine	-	-	-	-	-	-	-	-	1.320E+00	1.663E-01	2.712E+01	3.417E+00	2.820E-01	3.553E-02	-	-	3.120E-02	3.931E-03	-	-	-	-	-	-
W901	ST46	01 - Fug	Wastewater Treatment	-	-	-	-	-	-	-	-	-	-	6.358E-01	8.010E-02	-	-	-	-	-	-	-	-	-	-	-	-
L904	ST48	02 - Vert	Lime Mud Precoat Filter Vacuum Pumps	-	-	-	-	-	-	1.193E-03	1.503E-04	-	-	3.024E-01	3.810E-02	-	-	-	-	3.864E-04	4.869E-05	-	-	-	-	-	-
D904	ST51	04 - Goose Neck	Boilout Black Liquor Million Gallon Tank	-	-	-	-	3.200E-04	4.032E-05	-	-	-	-	7.100E-01	8.946E-02	-	-	-	-	4.500E-04	5.670E-05	-	-	-	-	-	-
D903	ST52	04 - Goose Neck	South Weak Black Liquor Million Gallon Tank	-	-	-	-	3.200E-04	4.032E-05	-	-	-	-	7.100E-01	8.946E-02	-	-	-	-	4.500E-04	5.670E-05	-	-	-	-	-	-
L902	ST59	04 - Goose Neck	Causticizers	-	-	-	-	-	-	-	-	-	-	4.536E-01	5.715E-02	-	-	-	-	2.856E-04	3.598E-05	-	-	-	-	-	-
A901/A90	ST75	02 - Vert	Chemi Washers	-	-	-	-	6.120E-02	7.711E-03	1.020E-03	1.285E-04	3.480E-03	4.385E-04	9.000E+00	1.134E+00	-	-	-	-	8.280E-03	1.043E-03	-	-	-	-	-	-
R901[3]	ST81	01 - Fug	Recycle Mill	-	-	-	-	-	-	-	-	-	-	2.180E-01	2.747E-02	-	-	-	-	-	-	-	-	-	-	-	-
C004	ST88	02 - Vert	PVOH Silo	-	-	-	-	-	-	-	-	-	-	1.750E+01	2.205E+00	-	-	-	-	-	-	-	-	-	-	-	-

1. Stack Parameters per the CERR tool, unless otherwise noted.
2. The velocity of rain capped or pseudo-point sources is updated and estimated at 0.001 meters/second per Model Clearinghouse Record 93-II-09.
3. The height of the recycle mill stack has been raised 0.3 meters above the height of the Recycle Mill building.
4. UTM Coordinates have been adjusted based on Google Earth imaging in NAD83.
5. Due to the non-scientific number format that the model produces, the model was initialized with a factor of 1E09 multiplied to the emission rate to obtain non-zero resultant concentrations. The adjustment was accounted for later upon evaluation against the AACs.
6. Due to the non-scientific number format that the model produces, the model was initialized with a factor of 1E03 multiplied to the emission rate to obtain non-zero resultant concentrations. The adjustment was accounted for later upon evaluation against the AACs.
7. Due to the non-scientific number format that the model produces, the model was initialized with a factor of 1E06 multiplied to the emission rate to obtain non-zero resultant concentrations. The adjustment was accounted for later upon evaluation against the AACs.
8. Calculated potential dioxins and furans potential emissions based on boiler's maximum heat input capacity of: 520 MMBtu/hr
9. Except for the No. 2 Power Boiler and No. 3 Biomass Boiler, emission rates can be found in the Title V Renewal Application submitted September 2006 in support of Permit No. 2631-021-0001-V-03-0 dated March 10, 2008.

Table D-15b. Modeled Macon Mill Toxic Emission Rates

Emission Unit ID	Stack ID	Emission Release Point Type	Point Description	Potential Emissions[1]																			
				Arsenic		Beryllium		Cadmium		Chromium		Cobalt		Lead		Mercury		Nickel		Acrolein[2]		Acetaldehyde		Propionaldehyde [propanal]	
				(lb/hr)	(g/s)	(lb/hr)	(g/s)	(lb/hr)	(g/s)	(lb/hr)	(g/s)	(lb/hr)	(g/s)	(lb/hr)	(g/s)	(lb/hr)	(g/s)	(lb/hr)	(g/s)	(lb/hr)	(g/s)	(lb/hr)	(g/s)	(lb/hr)	(g/s)
A904	ST07	02 - Vert	Hardwood High Density Storage Chests	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.000E-02	-	2.300E-03	2.898E-04
A903	ST08	05 - Vert w/cap	Pine High Density Storage Chest	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.000E-02	-	2.300E-03	2.898E-04
A905	ST09	04 - Goose Neck	Transition Tank	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.000E-02	-	2.300E-03	2.898E-04
B005	ST14	02 - Vert	No. 3 Biomass Boiler	1.364E-02	1.719E-03	6.820E-04	8.593E-05	2.542E-03	3.203E-04	1.302E-02	1.640E-03	4.030E-03	5.078E-04	2.976E-02	3.750E-03	2.170E-03	2.734E-04	2.046E-02	2.578E-03	5.687E-03	7.166E-04	2.886E-02	3.637E-03	3.782E-02	4.765E-03
B002	ST15	02 - Vert	No. 2 Power Boiler	3.867E-05	4.873E-06	2.320E-06	2.924E-07	2.127E-04	2.680E-05	2.707E-04	3.411E-05	1.624E-05	2.046E-06	9.668E-06	1.218E-06	5.027E-05	6.334E-06	4.061E-04	5.116E-05	-	-	-	-	-	-
B003	ST16	02 - Vert	No. 2 Biomass Boiler	1.144E-02	1.442E-03	8.841E-03	1.114E-03	2.132E-03	2.686E-04	1.092E-02	1.376E-03	2.220E-02	2.797E-03	2.496E-02	3.145E-03	4.682E-03	5.899E-04	3.116E-01	3.927E-02	4.056E-02	5.110E-03	4.316E-01	5.439E-02	3.172E-02	3.997E-03
D902	ST17	04 - Goose Neck	No. 1 Horizontal Seal Tank	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.500E-05	6.930E-06	3.200E-03	4.032E-04	-	-
D901	ST18	04 - Goose Neck	North Weak Black Liquor Million Gallon Tank	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.500E-05	6.930E-06	3.200E-03	4.032E-04	-	-
D905	ST19	05 - Vert w/cap	Intermediate Liquor Tank	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.800E-05	2.268E-06	2.000E-02	2.520E-03	2.300E-03	2.898E-04
D001	ST20	02 - Vert	No. 3 Recovery Boiler	4.200E-04	5.292E-05	3.675E-05	4.630E-06	7.350E-04	9.261E-05	4.725E-04	5.953E-05	-	-	2.712E-03	3.418E-04	2.450E-03	3.087E-04	3.587E-03	4.520E-04	-	-	4.375E-02	5.512E-03	-	-
D002/D90	ST21	02 - Vert	No. 3 Smelt Dissolving Tank/Salt Cake Mix Tank	2.625E-04	3.307E-05	8.400E-05	1.058E-05	2.625E-04	3.307E-05	1.312E-03	1.654E-04	-	-	7.175E-04	9.040E-05	1.575E-05	1.984E-06	5.250E-04	6.615E-05	1.190E-03	1.499E-04	7.087E-02	8.930E-03	-	-
D003	ST25	02 - Vert	Tall Oil Reaction Tank	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.200E-04	6.552E-05	1.978E-01	2.492E-02	-	-
L901	ST28	04 - Goose Neck	Green Liquor Clarifier & Storage	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9.744E-04	1.228E-04	-	-
L903	ST31	02 - Vert	Mud Precoat Filters	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.904E-04	1.122E-04	1.848E-02	2.328E-03	-	-
L001	ST32	02 - Vert	No. 1 Lime Kiln	5.040E-06	6.350E-07	4.368E-06	5.504E-07	1.092E-04	1.376E-05	7.728E-04	9.737E-05	1.848E-04	2.328E-05	4.032E-03	5.080E-04	3.864E-06	4.869E-07	1.344E-03	1.693E-04	2.016E-04	2.540E-05	8.064E-03	1.016E-03	-	-
L002	ST33	02 - Vert	No. 2 Lime Kiln	5.040E-06	6.350E-07	4.368E-06	5.504E-07	1.092E-04	1.376E-05	7.728E-04	9.737E-05	1.848E-04	2.328E-05	4.032E-03	5.080E-04	3.864E-06	4.869E-07	1.344E-03	1.693E-04	2.016E-04	2.540E-05	8.064E-03	1.016E-03	-	-
L003	ST34	02 - Vert	Lime Slaker	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.948E-04	4.974E-05	5.712E-02	7.197E-03	-	-
P001	ST39	02 - Vert	No. 1 Paper Machine	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.240E-01	4.082E-02	2.460E+00	3.100E-01	-	-
P002	ST41	02 - Vert	No. 2 Paper Machine	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.240E-01	4.082E-02	2.460E+00	3.100E-01	-	-
W901	ST46	01 - Fug	Wastewater Treatment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.037E-01	5.086E-02	-	-
L904	ST48	02 - Vert	Lime Mud Precoat Filter Vacuum Pumps	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.360E-03	4.234E-04	-	-
D904	ST51	04 - Goose Neck	Boilout Black Liquor Million Gallon Tank	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.500E-05	6.930E-06	3.200E-03	4.032E-04	-	-
D903	ST52	04 - Goose Neck	South Weak Black Liquor Million Gallon Tank	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.500E-05	6.930E-06	3.200E-03	4.032E-04	-	-
L902	ST59	04 - Goose Neck	Causticizers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.948E-04	4.974E-05	5.712E-02	7.197E-03	-	-
A901/A90	ST75	02 - Vert	Chemi Washers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.400E-03	6.804E-04	2.400E-01	3.024E-02	-	-
R901	ST81	01 - Fug	Recycle Mill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.420E-02	3.049E-03	-	-
C004	ST88	02 - Vert	PVOH Silo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1. Except for the No. 2 Power Boiler and No. 3 Biomass Boiler, emission rates can be found in the Title V Renewal Application submitted September 2006 in support of Permit No. 2631-021-0001-V-03-0 dated March 10, 2008.
2. The emission rate from the No. 2 Biomass Boiler is equal to the heat input capacity (520 MMBtu/hr) multiplied by an updated emission factor (7.8E-05 lb/MMBtu). The emission factor is based on an NCASI factor for pulp and paper mill boilers as found in a letter from Mr. David P. Littell (Maine DEP) to Mr. Steve Page (U.S. EPA OAQPS), dated April 19, 2006. Available on-line at: http://maine.gov/dep/air/toxics/SAS_Ltr_to_S_Page.doc

APPENDIX E

DISPERSION MODELING PROTOCOL

Trinity Consultants

Offices nationwide ■ trinityconsultants.com

53 Perimeter Center East, Suite 230, Atlanta, GA 30346 U.S.A. ■ 678-441-9977 ■ Fax 678-441-9978

January 14, 2011

Mr. Peter Courtney
Georgia Environmental Protection Division
Air Protection Branch
4244 International Parkway, Suite 120
Atlanta, GA 30354

RE: Graphic Packaging International, Inc. – Macon Mill
Air Dispersion Modeling Protocol

Dear Mr. Courtney:

Graphic Packaging International, Inc. (GPI) owns and operates an integrated pulp and paper mill (Macon Mill) in Macon, Bibb County, Georgia. GPI is proposing to install a new bubbling fluidized bed (BFB) boiler (No. 3 Biomass Boiler) at the Macon Mill.

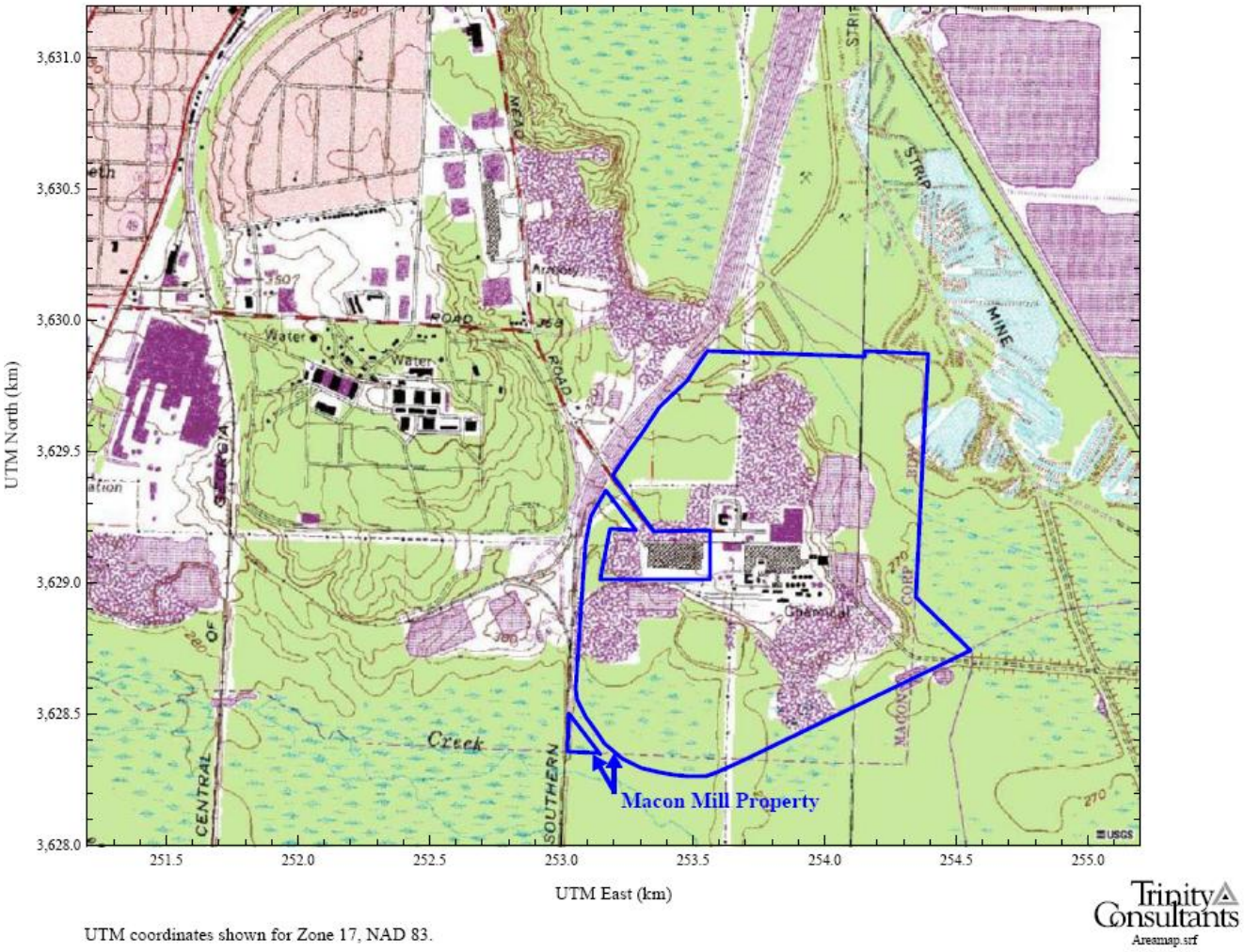
The proposed biomass boiler project will require a Prevention of Significant Deterioration (PSD) permit. Emission increases from the proposed project will exceed PSD thresholds for carbon monoxide (CO), a modeled pollutant. GPI is planning on submittal of a PSD construction permit application (Volume I) to the Georgia Environmental Protection Division (EPD) in late January 2011. A Volume II report, including a dispersion modeling analysis, will follow soon thereafter, pending receipt of comments on this modeling protocol.

Following EPD policy, a dispersion modeling protocol has been prepared. On behalf of our client, GPI, this document presents a dispersion modeling protocol describing proposed modeling methodologies for the project reviewed during the pre-application meeting at EPD on January 5, 2011. This protocol includes a brief description of the Macon Mill, an overview of the required PSD and State modeling analyses, and a description of the methodology proposed to be used in the modeling analyses. The analyses discussed below include evaluations of National Ambient Air Quality Standards (NAAQS), 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 Macon Mill property. The approximate central UTM coordinates of the Macon Mill are 253.68 kilometers east and 3,629.076 kilometers north in Zone 17 (NAD 83).

FIGURE 1. FACILITY LOCATION



UTM coordinates shown for Zone 17, NAD 83.

GPI is proposing to install a new bubbling fluidized bed (BFB) boiler (No. 3 Biomass Boiler) at the Macon Mill. The proposed biomass boiler is currently anticipated to be equipped with flue gas recirculation, a dry electrostatic precipitator (ESP), a selective non-catalytic reduction (SNCR) system, and will potentially include a duct sorbent injection for emissions control. The boiler, to be rated at approximately 620 MMBtu/hr heat input, will be designed to combust a variety of fuels. The primary fuels will be biomass and mill wastewater treatment plant (WWTP) sludge; natural gas will be utilized for startups and during some limited normal operating scenarios.

Installation of a new boiler allows the Macon Mill to shutdown the existing No. 1 Power Boiler, which combusts coal, fuel oil, and natural gas. Additionally, the ability to combust coal and fuel oil on the No. 2 Power Boiler will be removed and only natural gas combustion capability will be retained.

Bibb County, home of the Macon Mill, is currently designated as a fine particulate matter ($PM_{2.5}$) nonattainment area. For all other criteria pollutants (i.e., carbon monoxide [CO], oxides of nitrogen [NO_X], sulfur dioxides [SO_2], particulate matter with an aerodynamic particle size of 10 microns or less [PM_{10}], ozone, and lead [Pb]), Bibb County has been designated as an attainment area or unclassifiable. As such, the proposed project potentially requires nonattainment new source review (NNSR) and/or Prevention of Significant Deterioration (PSD) permitting. Therefore, net emission increases from the proposed project and modified emission units must be evaluated and compared to the major modification thresholds for regulated pollutants for NSR permitting applicability as shown in Table 1.

TABLE 1. PRELIMINARY PROJECT EMISSIONS

Pollutant	Emissions (tpy)	NSR Major Modification Threshold (tpy)	Exceed NSR Threshold? (Yes/No)
Project Potential Emissions Increases			
VOC	30.5	40	No
Pb	0.1	0.6	No
H_2S	-	10	No
Fluoride[1]	-	3	No
Net Emissions Increase			
CO	421.7	100	Yes
NO_X	38.3	40	No
SO_2	-459.9	40	No
Total PM	-16.0	25	No
Total PM_{10}	13.9	15	No
Total $PM_{2.5}$	9.4	10	No
H_2SO_4	6.9	7	No
CO_2e[2]	603,774.5	75,000	Yes

1. Excluding hydrogen fluoride, which is regulated per Clean Air Act Section 112.
2. NSR permitting for greenhouse gases (i.e., CO_2e) is required if NSR permitting is triggered for any other pollutant and the permit application is submitted after January 2, 2011 but before July 1, 2011.

PSD MODELING ANALYSES

PSD regulations require an evaluation of impacts against NAAQS and Increment at Class I and Class II areas, as well as an evaluation of additional impacts (e.g., visibility degradation, impact on soil and vegetation). The dispersion modeling analyses will be conducted in accordance with the EPA's *Guideline on Air Quality Models* 40 CFR 51, Appendix W (Revised, November 9,

2005), and in accordance with the EPA's *AERMOD Implementation Guide*.[1] A summary of the tasks to be performed is discussed in this section. As shown in Table 1, CO is the only modeling pollutant identified for which there is a significant emission increase as part of this project. Therefore, since there is no established PSD increment for CO, no increment evaluations are anticipated to be necessary for this project.

The EPA is also currently under a court ordered deadline for issuance of a new proposed CO NAAQS by January 28, 2011, with issuance of a final standard potentially becoming effective in late 2011. At this time, it is unknown if the proposed rule will be issued in January 2011, and how any newly issued standard would impact this project. GPI will evaluate the potential impacts of any new CO NAAQS if those standards become effective prior to issuance of the final permit for this project.

SIGNIFICANCE ANALYSIS

Initially, a significance analysis will be conducted for CO to determine if the emissions increases associated with the project will significantly impact the area surrounding the facility. Modeled concentrations will be compared to the EPA established significant impact levels (SIL) shown in Table 2.

TABLE 2. PSD MODELING SIGNIFICANCE LEVELS

Pollutant	Averaging Period	Significant Impact Level ($\mu g/m^3$)
CO*	8-hour	500
	1-hour	2,000

* No PSD Increments have been established for CO.

It is proposed that the significance analysis be conducted using the EPA SCREEN3 (96043) model. The SCREEN3 model is well suited for this purpose as there is only one new source that is part of this project, the new No. 3 Biomass Boiler, which is anticipated to have an actual emissions increase of CO emissions. Another unit at the facility, the No. 2 Power Boiler, is anticipated to have a small associated emissions increase in CO emissions (approximately 12 tpy) when conservatively evaluated on a baseline actual to potential emissions basis. The No. 2 Power Boiler is not anticipated to operate at its full potential capacity in the future following the changes made as part of this project, and is an associated emission unit in relation to the overall project as it will cease combusting coal or oil but retain the ability to combust natural gas. The No. 3 Biomass Boiler will be re-using the existing stack servicing the No. 1 and No. 2 Power Boilers. The No. 2 Power Boiler will now utilize a smaller stack dedicated to that emission unit.

The SCREEN3 model is preferred for this project due to the simplicity of the analysis. Use of a screening model for a significance analysis can be found in modeling guidance documents for

[1] http://www.epa.gov/scram001/7thconf/aermod/aermod_implmtn_guide_19March2009.pdf.

various State agencies.[2] Use of a screening model for evaluation of CO emissions from point sources is referenced in the EPA's *Guideline on Air Quality Models* 40 CFR 51, Appendix W (Revised, November 9, 2005), Section 5.2.3(d). A conservative approach will be conducted to evaluate emissions by combining the peak impact from each individual screen run as if the peak impact from each emission point (No. 3 Biomass Boiler and No. 2 Power Boiler) occurred at the same point in space.

To further justify use of the SCREEN3 model, an evaluation of terrain conditions was conducted around the Macon Mill. The area around the Macon Mill does not have any significant terrain features. The AERMAP terrain preprocessor (version 09040) was used to evaluate a 5 kilometer radius around the Macon Mill, with receptors at a spacing of 50 meters. This evaluation indicated that the maximum elevation difference within a 5 kilometer radius of the facility was approximately 50 meters. This difference is less than the height of the No. 3 Biomass Boiler (approximately 96 meters) and greater than the height of the No. 2 Power Boiler stack (approximately 20 meters). The closest distance at which complex terrain is encountered in relation to the No. 2 Power Boiler stack (> 20 meters) is over 1.5 kilometers away. However, in the following tables, it is evident that the maximum ground impacts due to the No. 2 Power Boiler occur near the property line of the Mill (approximately 150 meters) and, thus, within the vicinity of the simple terrain surrounding the Mill. Therefore, no complex terrain (terrain higher than the stack height) was found in the immediate vicinity of the Macon Mill, and complex terrain influences are not anticipated to have a significant impact on the results.

The following tables provide a summary of a preliminary CO screening analysis for the No. 3 Biomass Boiler and the No. 2 Power Boiler. In order to account for possible downwash influences, building dimensions of the potential controlling structures were input into the SCREEN3 model. The emissions estimated from the No. 3 Biomass Boiler correspond to GPI's potential proposed BACT emission limit for this unit, and the corresponding boiler heat input at the corresponding load condition.

[2] Maine Burea of Air Quality Department of Environmental Protection, Texas Commission on Environmetnal Quality (TCEQ), Oklahoma Department of Environmental Quality (DEQ), Engineering Division of the Bay Area Air Quality Management District (BAAQMD), etc.

TABLE 3. PRELIMINARY STACK PARAMETERS AND RESULTANT SCREEN3 IMPACTS

Stack Description	Load	Stack Height[1] (feet)	(meters)	Stack Temperature[1] (F)	(K)	Velocity[1] (ft/s)	(m/s)	Diameter[1] (ft)	(m)	Modeled Emissions (g/s)	Max. 1-hr Impact[2] (µg/m³)	Distance at Max. Impact (m)	Downwash Structure[3]
No. 3 Biomass Boiler	40%	316	96.32	300	422.04	42.65	13.00	8.50	2.59	1.0	2.764	975	Recovery Boiler Building
No. 3 Biomass Boiler	60%	316	96.32	320	433.15	56.39	17.19	8.50	2.59	1.0	2.100	1,100	Recovery Boiler Building
No. 3 Biomass Boiler	80%	316	96.32	320	433.15	75.19	22.92	8.50	2.59	1.0	1.918	963	Recovery Boiler Building
No. 3 Biomass Boiler	100%	316	96.32	320	433.15	93.99	28.65	8.50	2.59	1.0	1.609	1,016	Recovery Boiler Building
No. 2 Power Boiler	100%	65	19.81	370	460.93	179.20	54.62	3.00	0.91	1.0	505.5	150	Recovery Boiler Building

[1] Parameters per RFI response from Larson Engineering sent by Paul Douglas via email on November 23, 2010.

[2] Modeled impact resultant of rural land-use conditions and full meteorology.

[3] Recovery Boiler Building: 62 meters in height, 30 meters min. horizontal distance, 40 meters max horizontal distance.

TABLE 4. PRELIMINARY CARBON MONOXIDE IMPACTS ANALYSIS

Description	Emission Increase (lb/hr)	(g/s)	1-hour Impact (µg/m³)	8-hour Impact (µg/m³)	Modeling Significance Level 1-hour (µg/m³)	8-hour (µg/m³)	Impacts Below Modeling Significance Level? 1-hour	8-hour
CO - 40% load, No. 3 Biomass Boiler	37.20	4.69	12.96	9.07				
CO - 60% load, No. 3 Biomass Boiler	55.80	7.03	14.76	10.34				
CO - 80% load, No. 3 Biomass Boiler	74.40	9.37	17.98	12.59	2,000	500	N/A	N/A
CO - 100% load, No. 3 Biomass Boiler	93.00	11.72	18.85	13.20				
CO - 100% load, No. 2 Power Boiler	2.62	0.33	166.83	116.78				
Boilers - Combined[1]	**95.62**	**12.05**	**185.68**	**129.98**	**2,000**	**500**	**Yes**	**Yes**

[1] Summation of the worst case No. 3 Biomass Boiler impacts based on load and No. 2 Power Boiler.

As can be seen from the model results listed above, preliminary results indicate that modeling using the SCREEN3 model would demonstrate results below the 1-hr and 8-hr significance levels. If the highest ambient concentration resulting from the modeled project emissions is less than the SIL, then further analyses are not required because the emissions will neither cause nor contribute to any exceedance of the NAAQS. Electronic copies of the screen modeling runs providing these results can be provided to the Georgia EPD upon request.

If concentrations exceed the SIL, a NAAQS analysis is required in a "Full Impacts Analysis." The geographic extent to which significant impacts occur is used to define the significant impact area (SIA) within which compliance with the NAAQS must be demonstrated. The SIA encompasses a circle centered on the Macon Mill with a radius extending out to either (1) the farthest location where the predicted ambient impact of CO from the project exceeds the Class II SIL, or (2) a distance of 50 km, whichever is less. The "Screening Area" encompasses all sources within a distance of 50 km of the radius of the SIA, which are assumed to potentially contribute to ground-level concentrations within the SIA and will be evaluated for possible inclusion in the NAAQS analysis. If CO is exceeding the SIL, a regional source inventory will be compiled for the NAAQS analysis.

OFFSITE SOURCE INVENTORY

GPI is not expecting that proposed project emissions of CO will result in modeled impacts that are above the SIL. Should offsite impacts exceed the SIL, air dispersion modeling analyses inclusive of regional inventory source data are expected to be required to demonstrate compliance with the NAAQS. If such data is required, EPD guidance on development of regional inventory data will be followed.

AMBIENT MONITORING REQUIREMENTS

Under current EPA policies, the maximum impacts due to the projected emissions from a project are also assessed against monitoring *de minimis* concentrations to determine whether pre-construction monitoring should be considered. The monitoring *de minimis* concentrations for CO are listed in Table 5. It is not anticipated that the CO monitoring *de minimis* concentration will be exceeded as part of this project.

TABLE 5. PSD *DE MINIMIS* MONITORING CONCENTRATION

Pollutant	Averaging Period	Monitoring *De Minimis* Concentration ($\mu g/m^3$)
CO	8-hour	575
	1-hour	-

NAAQS ANALYSIS

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 EPA judges are necessary, with an adequate margin of safety, to protect the public health."[3] Secondary NAAQS define the levels that "protect the public welfare from any known or anticipated adverse effects of a pollutant." The objective of the NAAQS analysis is to demonstrate through air quality modeling that emissions from the proposed project do not contribute to or cause an exceedance of the NAAQS at any ambient location. The primary and secondary NAAQS for CO are detailed in Table 6.

[3] 40 CFR §50.2(b).

TABLE 6. NAAQS

Pollutant	Averaging Period	Primary NAAQS ($\mu g/m^3$)	Secondary NAAQS ($\mu g/m^3$)
CO	8-hour	10,000	-
	1-hour	40,000	-

If a SIL is exceeded, the NAAQS analysis is completed for that pollutant. In the NAAQS analysis the potential emissions from all emission units at the Macon Mill (i.e, those included in the significance analysis for the proposed project as well as the those other sources of the corresponding pollutant at the facility), combined with the emissions of regional sources included in a source inventory for the screening area, will be modeled together to compute the cumulative impact.

The NAAQS regional source inventory will be comprised of all sources (major and minor) within the SIA that are not excluded based on the "20D" procedure.[4] 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 Macon Mill (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.

The resulting modeled concentration (project plus offsite inventory), added to the representative background level for each pollutant, will be assessed against the applicable NAAQS to demonstrate that the proposed project neither causes nor contributes to any modeled excess of an applicable air quality standard.

Each NAAQS includes a specific statistical form for demonstrating compliance with that NAAQS; that statistical form is relevant both in assigning background monitoring concentrations and modeled impact concentrations. For the CO short-term average NAAQS, the highest, second-high concentration for each of five years of meteorological data will be assessed against the NAAQS to demonstrate compliance with the form of the standard, not to be exceeded more than once per year.GPI will work with the Georgia EPD in development of an appropriate background concentration for CO, for summing with modeled impacts to provide a total impact for comparison to the NAAQS.

ADDITIONAL IMPACTS ANALYSIS

PSD regulations require that three additional impact analyses be performed as part of a PSD permit action. These evaluations include a growth analysis, a soil and vegetation analysis, and a

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

visibility analysis. No adverse impacts from growth are anticipated from the proposed project since all construction activities will occur for a finite time period and the project is created as a reaction to growth rather than a prelude to growth. More details on potential growth aspects of the project will be provided in the alternatives analysis required by GRAQC §391-3-1-.03(8)(c)(15).

To address potential soil and vegetation impacts, two comparisons are used. First, the NAAQS results (or significance results if SILs are not reached) are assessed against the secondary NAAQS standards, which provide protection for public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings. The NAAQS analysis includes emissions from all existing sources and significant regional sources, not only those associated with the proposed project. However, for CO there are no secondary NAAQS. Therefore, this comparison will not be made. NAAQS impacts for CO will be compared against conservative screening levels provided by EPA specifically to address potential soil and vegetation impacts.[5]

The remainder of the additional impacts analysis addresses impacts on visibility resulting from coherent plumes emanating from the proposed facility on nearby receptors that are potentially sensitive to plume visibility impacts. As shown in Table 1, since this project is not anticipated to exceed the PSD significance thresholds for any visibility impairing pollutants, and the SIL for CO is not anticipated to be exceeded, then no visibility analysis for airports, state parks, or historic sites is anticipated as part of this project.

CLASS I AREA ANALYSIS

Since there will be no significant increase of any visibility impairing pollutants, or for any pollutants which have an established increment, no Class I analysis is anticipated for this project. A letter summarizing the project, including an estimate of the emissions associated with this project, will be sent to the appropriate Federal Land Managers (FLMs) for their concurrence that no Class I visibility analysis is necessary. The Georgia EPD will be copied on this correspondence.

CLASS II MODELING METHODOLOGY

This section of the modeling protocol describes the specific modeling procedures and data resources to be utilized in the Class II Area PSD air quality modeling analyses if a screening analysis is insufficient. The techniques proposed for the air quality analysis are consistent with the current *Georgia EPD Guidelines.*

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[5] EPA, *A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals* (EPA 450/2-81-078), 1981.

SELECTION OF MODEL

If a NAAQS analysis is required, the air quality modeling analyses will be conducted using the **A**MS/**E**PA **R**egulatory **Mod**el (AERMOD version 09292).[6] AERMOD is a refined, steady-state, multiple source, Gaussian dispersion model.

RECEPTOR GRID AND COORDINATE SYSTEM

If required, the NAAQS analysis ground level concentrations will be calculated at receptors placed along the fenceline and on a Cartesian receptor grid. Fenceline receptors will be spaced no further than 100 meters apart as specified in the Georgia Air Dispersion Modeling Guidance.[7] Beyond the fenceline, receptors will be spaced 100 meters apart in a Cartesian grid extending to a distance sufficient to resolve the SIA.

Receptor elevations required by AERMOD will be determined using the AERMAP terrain preprocessor (version 09040). AERMAP also calculates hill height parameters required by AERMOD. Terrain elevations from the USGS 1 arc second National Elevation Dataset (NED) will be used for AERMAP processing.

In all modeling analysis data files, the location of emission sources, structure, and receptors will be represented in the Universal Transverse Mercator (UTM) coordinate system. The Macon Mill is located at approximately 253.68 kilometers east and 3,629.076 kilometers north in Zone 17 (NAD 83).

METEOROLOGICAL DATA

Site-specific dispersion models require a sequential hourly record of dispersion meteorology representative of the region within which the source is located. In the absence of site-specific measurements, the EPA guidelines recommend the use of readily available data from the closest and most representative National Weather Service (NWS) stations. Regulatory air quality modeling using AERMOD requires five years of quality-assured meteorological data that includes hourly records of the following parameters:

- ▲ Wind speed
- ▲ Wind direction
- ▲ Air temperature
- ▲ Micrometeorological Parameters (e.g., friction velocity, Monin-Obukhov length)
- ▲ Mechanical mixing height

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[6] EPA, Office of Air Quality Planning and Standards, *Federal Register* Vol. 70 / No. 216, pp. 68,218-68,261, 40 CFR 51, Appendix W, *Revision to Guideline on Air Quality Models*, November 9, 2005.

[7] http://www.georgiaair.org/airpermit/downloads/sspp/modeling/AirDispModelingGuid_v2.pdf.

- Convective mixing height

The first three of these parameters are directly measured by monitoring equipment located at typical surface observation stations. The friction velocity, Monin-Obukhov length, and mixing heights are derived from characteristic micrometeorological parameters and from observed and correlated values of cloud cover, solar insulation, time of day and year, and latitude of the surface observation station. Surface observation stations form a relatively dense network, are almost always found at airports, and are typically operated by the NWS. Upper air stations are fewer in number than surface observing points since the upper atmosphere is less vulnerable to local effects caused by terrain or other land influences and is therefore less variable. The NWS operates virtually all available upper air measurement stations in the United States.

The Macon Mill is located approximately 8 km northeast of the Macon (MCN) NWS station, and 120 km southeast of the next nearest NWS station in Atlanta (ATL), Georgia, and each of these stations was considered in the land use analysis discussed in the following section. For the Atlanta (ATL) NWS, EPD provided NWS coordinates for usage in AERSURFACE for Atlanta (station 13874).[8] For the Macon (MCN) NWS, EPD provided preprocessed meteorological data based on surface observations from Macon (station 03813) and upper air measurements from Centreville (station 3881) for the 1987-1991 time period.[9]

LAND USE REPRESENTATIVENESS ANALYSIS

AERMOD utilizes planetary boundary layer (PBL) turbulence calculations to characterize the stability of the atmosphere, which is affected by the prevailing meteorological conditions and the land use and cover of the surrounding area. Because site-specific parameters are utilized in the meteorological data files, EPA made the following recommendation in the March 19, 2009 *AERMOD Implementation Guide*:[10]

> *When applying the AERMET meteorological processor (EPA, 2004a) to prepare the meteorological data for the AERMOD model (EPA, 2004b), the user must determine appropriate values for three surface characteristics: surface roughness length {zo}, albedo {r}, and Bowen ratio {Bo}*
>
> …
>
> *When using National Weather Service (NWS) data for AERMOD, data representativeness can be thought of in terms of constructing realistic planetary*

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[8] Conversation between Mr. Pete Courtney (EPD) and Ms. Lori Price (Trinity), April 13, 2010. Coordinates provided as: 33.63 N and 84.442 W, equivalent to approximately 180.7 and 3,726.5 km, NAD83 (Zone 17).

[9] AERMET files provided via email to Ms. Deanna Duram (Trinity Consultants) by Mr. Pete Courtney (EPD) on January 29, 2009. Files were confirmed to be the most recent available from EPD during a conservation between Mr. Pete Courtney (EPD) and Ms. Lori Price (Trinity Consultants), April 13, 2010.

[10] http://www.epa.gov/scram001/7thconf/aermod/aermod_implmtn_guide_19March2009.pdf, Sections 3.1 and 3.1.1, pages 3-4.

> *boundary layer (PBL) similarity profiles and adequately characterizing the dispersive capacity of the atmosphere. As such, the determination of representativeness should include a comparison of the surface characteristics (i.e., zo, Bo and r) between the NWS measurement site and the source location, coupled with a determination of the importance of those differences relative to predicted concentrations.*
> *…*
> *If the proposed meteorological measurement site's surface characteristics are determined to NOT be representative of the application site, it may be possible that another nearby meteorological measurement site may be representative of both meteorological parameters and surface characteristics. Failing that, it is likely that site-specific meteorological data will be required.*

The surface characteristics of interest for AERMET – surface roughness, albedo, and Bowen ratio – are based on the land use cover (e.g., urban, agriculture, wetlands, forest, water) in the area upwind of the Macon Mill (1 km for surface roughness, 10 km for albedo and Bowen ratio). If two locations have similar land use and cover, then the locations are expected to have similar surface characteristics. Thus, a land use analysis must be performed for the area immediately surrounding the source (the Macon Mill) and for the area immediately surrounding the NWS site. In its March 19, 2009 *AERMOD Implementation Guide*, the EPA states:[11]

> *Based on model formulations and model sensitivities, the relationship between the surface roughness upwind of the measurement site and the measured wind speeds is generally the most important consideration.*
>
> *The dependence of meteorological measurements and plume dispersion on Bowen ratio and albedo is very different than the dependence on surface roughness. Effective values for Bowen ratio and albedo are used to estimate the strength of convective turbulence during unstable conditions by determining how much of the incoming radiation is converted to sensible heat flux. These estimates of convective turbulence are not linked as directly with tower measurements as the linkage between the measured wind speed and the estimation of mechanical turbulence intensities driven by surface roughness elements.*

An analysis of the surface characteristics for the Macon Mill and two nearby NWS stations, Atlanta and Macon, Georgia was performed to assess which of the two meteorological datasets better characterize land use conditions at the facility and whether or not the better station is a reasonable match. The tables and figures associated with several comparisons are included in Attachment A. These tables demonstrate that the Macon Mill's surface characteristics for albedo and Bowen ratio are similar to both the Macon and Atlanta NWS stations.

The Macon Mill's surface roughness parameter assignments are slightly more similar to the Macon NWS station than the Atlanta NWS station (on a sector-by-sector basis). The surface

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[11] http://www.epa.gov/scram001/7thconf/aermod/aermod_implmtn_guide_19March2009.pdf, Section 3.1.2, pages 4-5.

roughness is evaluated on a sector by sector (30°) basis and over a much smaller area (1 km vs. 10 km). Therefore, there is greater variability between the calculated surface roughness values at the three sites. Given the differing locations (airport vs. site location for a utility), it is unlikely that any other NWS station within Georgia would have significantly better surface characteristics correlation; further, a more distant NWS station would likely have meteorological conditions that are more dissimilar to the Macon Mill than either of the Macon or Atlanta NWS stations. The land use assignment surrounding the Macon Mill is more similar to the Macon NWS station. Further, the Macon NWS station is significantly closer to the Macon Mill than the Atlanta NWS station, and its meteorological data (i.e., temperature, precipitation, wind speed/direction) would be expected to be more similar to the Macon Mill than the Atlanta NWS station meteorological data.

Therefore, the Macon NWS meteorological dataset provides a better representation of the land use conditions and meteorology at the Macon Mill. In addition, the Macon NWS provides a reasonable match to the Macon Mill characteristics; the only area with significant difference is surface roughness, which is higher at the site than at Macon NWS. In addition, higher surface roughness tends to result in lower calculated concentrations, and thus using the lower surface roughness from Macon would be conservative.

Based on those results, GPI proposes to use the Macon NWS station for surface observational meteorological data. GPI will use AERMOD-ready surface and profile meteorological files provided by EPD for Macon for the modeling analyses.[12] GPI will use the preprocessed AERMET output files from EPD in completing the AERMOD analyses.

However, due to the dissimilarity in the surface characteristics of the Macon Mill and the Macon NWS station, there is the potential the EPD would request conducting a modeling evaluation using both a weather data set prepared based on the surface characteristics of the Macon NWS station, and a weather data set prepared using the surface characteristics of the Macon Mill. If it is anticipated that this request would occur, GPI requests that Georgia EPD work with GPI to prepare a preprocessed weather data set for the Macon/Centreville AERMOD data using the surface characteristics of the Macon Mill.

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).

[12] AERMET files were provided via email to Ms. Deanna Duram (Trinity Consultants) by Mr. Pete Courtney (EPD) on January 29, 2009. Files were confirmed to be the most recent available from EPD during a conservation between Mr. Pete Courtney (EPD) and Ms. Lori Price (Trinity Consultants), April 13, 2010.

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. For point sources with unobstructed vertical releases, it is appropriate to use actual stack parameters (i.e., height, diameter, exhaust gas temperature, and gas exit velocity) in the modeling analyses.

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.[13] The No. 3 Biomass Boiler will be re-using the existing stack servicing the No. 1 and No. 2 Power Boilers. The No. 2 Power Boiler will now utilize a smaller stack dedicated to that emission unit. A preliminary evaluation has indicated that these emission units will not exceed GEP height.

Load Modeling Analysis

The *Guideline on Air Quality Models* 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. For some types of sources, operating at a reduced load translates into reduced stack gas exit velocities and lower temperatures leading to different and potentially higher impact characteristics.

[13] 40 CFR §51.100(ii)

A design engineering firm has provided stack parameters for the No. 3 biomass boiler based on varying load conditions. The single scenario resulting in the highest modeled impact will be used for subsequent steady-state modeling in AERMOD if necessary.

ADDITIONAL IMPACTS MODELING METHODOLOGY

The required additional impacts evaluations include a growth analysis, a soil and vegetation analysis, and a plume visibility analysis. As mentioned above, since this project is not anticipated to exceed the PSD significance thresholds for any visibility impairing pollutants, and the SIL for CO is not anticipated to be exceeded, then no visibility analysis for airports, state parks, or historic sites is anticipated as part of this project. 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.

TOXIC AIR POLLUTANT MODELING

The evaluation of ambient impacts of toxic pollutant emissions will be submitted in accordance to the Georgia's *Guideline for Ambient Impact Assessment of Toxic Air Pollutant Emissions* (June 21, 1998), which was issued by the EPD Air Protection Branch pursuant to the provisions of GRAQC §391-3-1-.02(2)(a)3(ii).

According to the *Guideline*, dispersion modeling should be completed for potentially toxic pollutants having quantifiable emission increases. The *Guideline* infers that a pollutant is identified as a toxic pollutant if any of the following toxicity-determined values have been established for that pollutant. The *Guideline* specifies that the resources used to develop the long-term and short-term acceptable ambient concentrations (AAC) of toxic air pollutants should be referenced in the priority schedule shown following.

- EPA Integrated Risk Information System (IRIS) reference concentration (RfC) or unit risk;
- Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PEL);
- American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV);
- National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limits (REL); and
- Lethal Dose – 50% (LD50) Standards.

The TAP analysis would generally be an assessment of off-property impacts due to mill-wide emissions of any TAP that experiences an emissions increase due to the proposed project. However, to conduct a mill-wide TAP impact evaluation for any pollutant that could

conceivably be emitted at an increased level as a result of the proposed project is impractical. A literature review would suggest that at least one molecule of hundreds of organic and inorganic chemical compounds could be emitted from the proposed boiler, which is understandable given the nature of biomass and natural gas combustion. The vast majority of compounds with emissions increases however are emitted in only trace amounts that are not reasonably quantifiable. Therefore, GPI is proposing to refine the list of TAP assessed to those pollutants that are otherwise regulated at the Macon Mill, i.e., regulated by emissions standards.

The Macon Mill operates sources subject to National Emission Standards for Hazardous Air Pollutants (NESHAP), which establish emissions levels for hazardous air pollutants (HAP) equivalent to the best performing sources in operation. Specifically, the Macon Mill is subject to NESHAP Subpart MM, *Chemical Recovery Combustion Sources at Kraft, Soda, Sulfite, and Stand-Alone Semichemical Pulp Mills*, and NESHAP Subpart S, *Pulp and Paper Industry*. These NESHAP were carefully developed by U.S. EPA to target pollutants of particular concern that may be emitted from Kraft pulp mill emission units. Careful research and review of toxicity data led to the decision to target specific pollutants. Thus, GPI intends to conduct TAP analyses for the proposed project for those compounds identified by U.S. EPA in the development of NESHAP Subparts MM and S, for which there is also published emissions data available.

Promulgation of the proposed NESHAP Subpart DDDDD, *Industrial-Institutional-Commercial Boilers and Process Heaters*, (AKA Boiler MACT) has been potentially delayed due to a U.S. EPA filed motion on December 7, 2010, requesting that the current court ordered deadline to issue the final rule by January 16, 2011, be extended to April 2012. The Boiler MACT will likely apply to the proposed boiler at the Macon Mill when finalized. Therefore, GPI has considered those TAP compounds that were included in the proposed Boiler MACT in the TAP analysis for the proposed project. Also, as several units at the Macon Mill are combustion points for non-condensable gases (NCG), TRS compounds were considered in the TAP analysis; however, GPI has not identified emissions increases of any TRS compounds from the proposed project. Therefore, TRS has not been included in the following compounds to be evaluated.

The subset of compounds to be evaluated is detailed in the following paragraphs.

Subpart MM identified eleven particulate matter HAP as being warranted for regulation.[14]

- Antimony
- Arsenic
- Beryllium
- Cadmium
- Chromium
- Cobalt
- Lead
- Manganese
- Mercury
- Nickel
- Selenium

[14] 40 CFR §63.861

NESHAP Subpart S targets the reduction of specific pollutants generally emitted in the highest quantities from pulp and paper mill operations.[15] The primary pollutants of concern include the following:[16]

- Acrolein
- Acetaldehyde
- Carbon Tetrachloride
- Chloroform
- Formaldehyde
- Methanol
- Methylene Chloride
- Methyl Ethyl Ketone
- Phenol
- Propionaldehyde
- 1,2,4-Trichlorobenzene
- o-Xylene

The major pollutants included in the June 2010 proposed Boiler MACT include the following:

- Dioxins/furans
- Hydrochloric Acid
- Hydrogen fluoride
- Mercury

This list captures all TAP that are reasonably anticipated to be emitted in quantities that would warrant an evaluation in a dispersion model.[17] Aside from taking this approach regarding selection of compounds to be reviewed, the TAP analysis will be completed consistent with Georgia EPD's *Guideline*. All sources at the Macon Mill (with the exception of emergency and insignificant units) will be considered in the toxics analysis to demonstrate that there are no adverse impacts resulting from the cumulative effects of multiple point sources of TAP emissions.

A preliminary assessment of the air toxic impacts from the project will be conducted using the SCREEN3 model. If preliminary screening results show that refined modeling is required, either the AERMOD or ISCST3 (02035) models will be used to complete the air dispersion analysis.

If AERMOD will be used (if needed for a NAAQS analysis) all applicable elements of the modeling methodology outlined for the PSD air dispersion modeling analysis will be utilized as developed for that analysis, including the effects of building downwash. If ISCST3 will be used, the refined modeling procedures outlined in the *Guideline* will be utilized. Meteorological data for use with the ISCST3 model for Macon/Centreville (1974-1978), as available on the Georgia EPD website, will be used unless otherwise specified.[18]

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[15] 63 FR 18507, April 15, 1998.

[16] Two other additional pollutants are listed in Subpart S for which there is no published biomass or natural gas emission factor data, and thus are not expected to have increased emissions: cumene and o-cresol.

[17] Note that this approach for identifying TAP for modeling purposes is consistent with the approach approved by Georgia EPD in the 2005 PSD application submitted by the Weyerhauser NR Company Flint River Operations that was approved by Georgia EPD's dispersion modeling group per the modeling protocol response letter from Mr. Jim Stogner (Georgia EPD) to Ms. Lori Price (Trinity), dated December 15, 2004.

[18] http://www.georgiaair.org/airpermit/html/sspp/modeling.htm

SUMMARY AND APPROVAL OF MODELING PROTOCOL

GPI is supplying this written preliminary protocol so that EPD can formally comment on and approve the methodologies to be used for this analysis. I would like to meet with EPD at your earliest convenience to discuss this protocol and would appreciate a written response to this protocol after the meeting.

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 678-441-9977.

Sincerely,

TRINITY CONSULTANTS

Justin Fickas
Managing Consultant

Attachment

cc: Ms. Wendy Troemel (Georgia EPD)
Ms. Kathleen Wheeler (Graphic Packaging International Inc.)
Ms. Deanna Duram (Trinity Consultants)

Attachment A

Land Use Representativeness Comparison Information

To define the land use characteristics and micrometeorological parameters in the areas of interest, Trinity Consultants (Trinity) utilized the EPA program AERSURFACE (version 08009) to analyze a digital mapping of land use and cover; specifically the 30-meter resolution USGS digital National Land Cover Data (NLCD) from 1992, as is recommended for usage with AERSURFACE.[1]

AERSURFACE resolves predominant land cover types into a grid comprising 30 meter-by-30 meter cells extending out to a specified distance from the center of the Mill or NWS site; the recommended distance is 1 km for surface roughness and 10 km for albedo and Bowen ratio. The data, which contain the land use category code and coordinates for each cell, are used by AERSURFACE to calculate the wind sectors and determine the weighted percentage of each land use type contained within each of the twelve 30-degree sectors; note that albedo and Bowen ratio are constant for each of the sectors, varying only seasonally. The weighted percentages of each land use type are then utilized to calculate the weighted average surface parameters (Bowen ratio, albedo, and surface roughness) for each of the sectors.

Figure A-1 illustrates the land use and cover for the Macon Mill based on the grid cell assignments contained in the AERSURFACE roughness domain output file. The circle in the figure denotes a 1 km radius around the center of the Macon Mill; individual sectors are also shown in black. Two similar figures for the Atlanta and Macon NWS stations were created by Trinity using the AERSURFACE grid cell assignments (from AERSURFACE runs prepared using the NWS coordinates provided by EPD) and are included as Figures A-2 and A-3.[2]

[1] http://seamless.usgs.gov/website/seamless/viewer.htm

[2] http://mi3.ncdc.noaa.gov/mi3qry/login.cfm

FIGURE A-1. LAND USE CATEGORIES FOR THE 1-KM AREA SURROUNDING THE MACON MILL

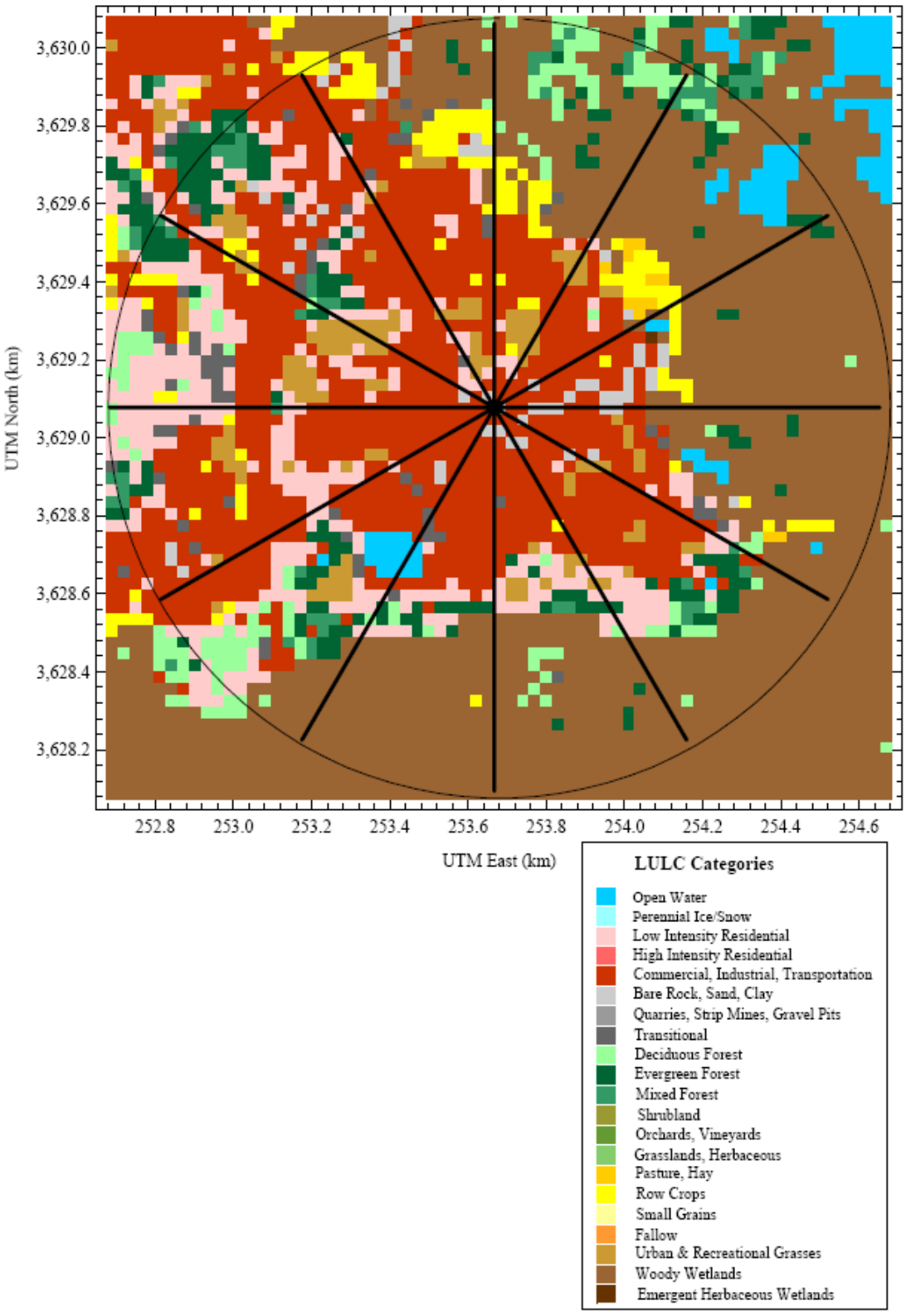


FIGURE A-2. LAND USE CATEGORIES FOR THE 1-KM AREA SURROUNDING THE ATLANTA NWS

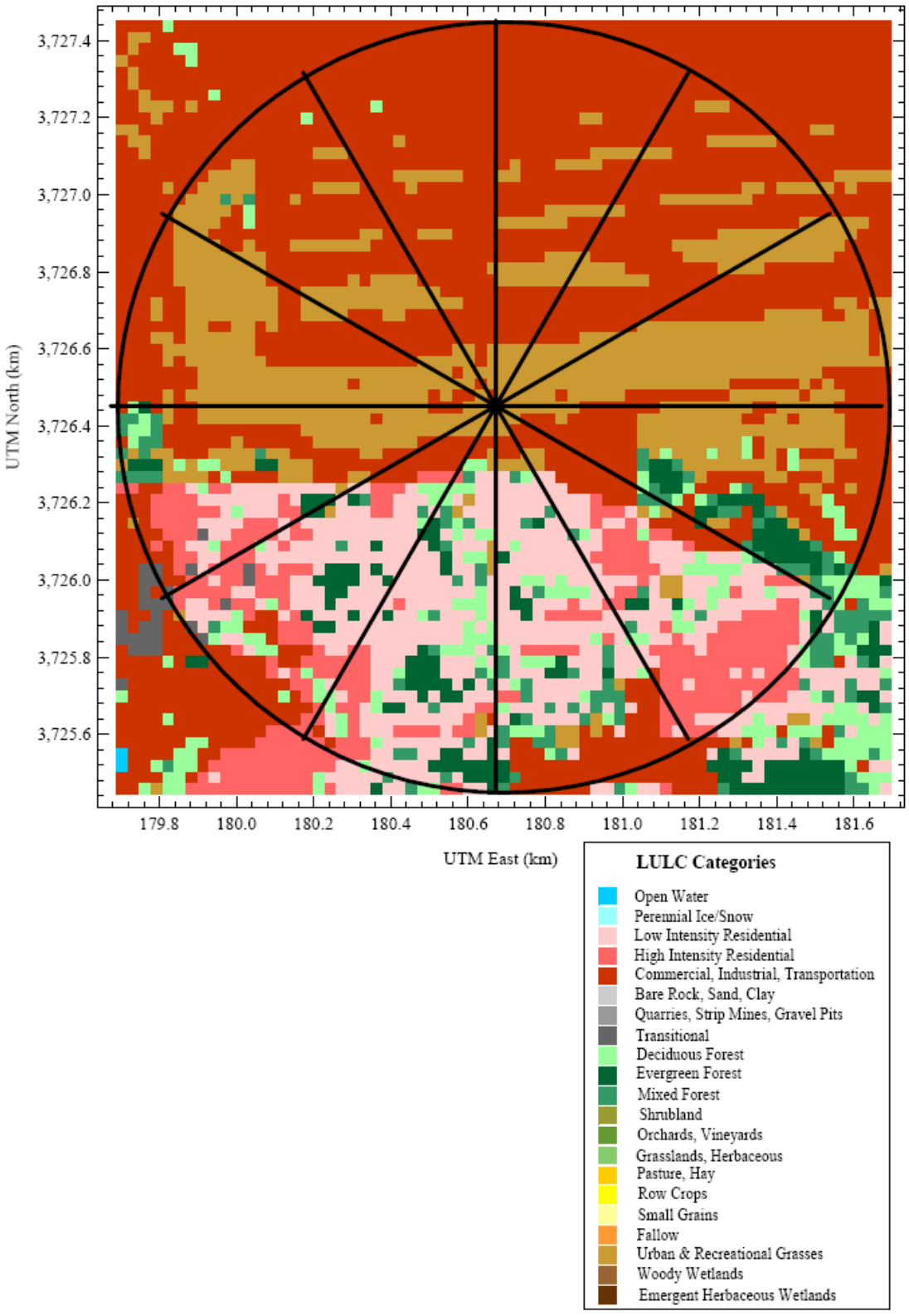
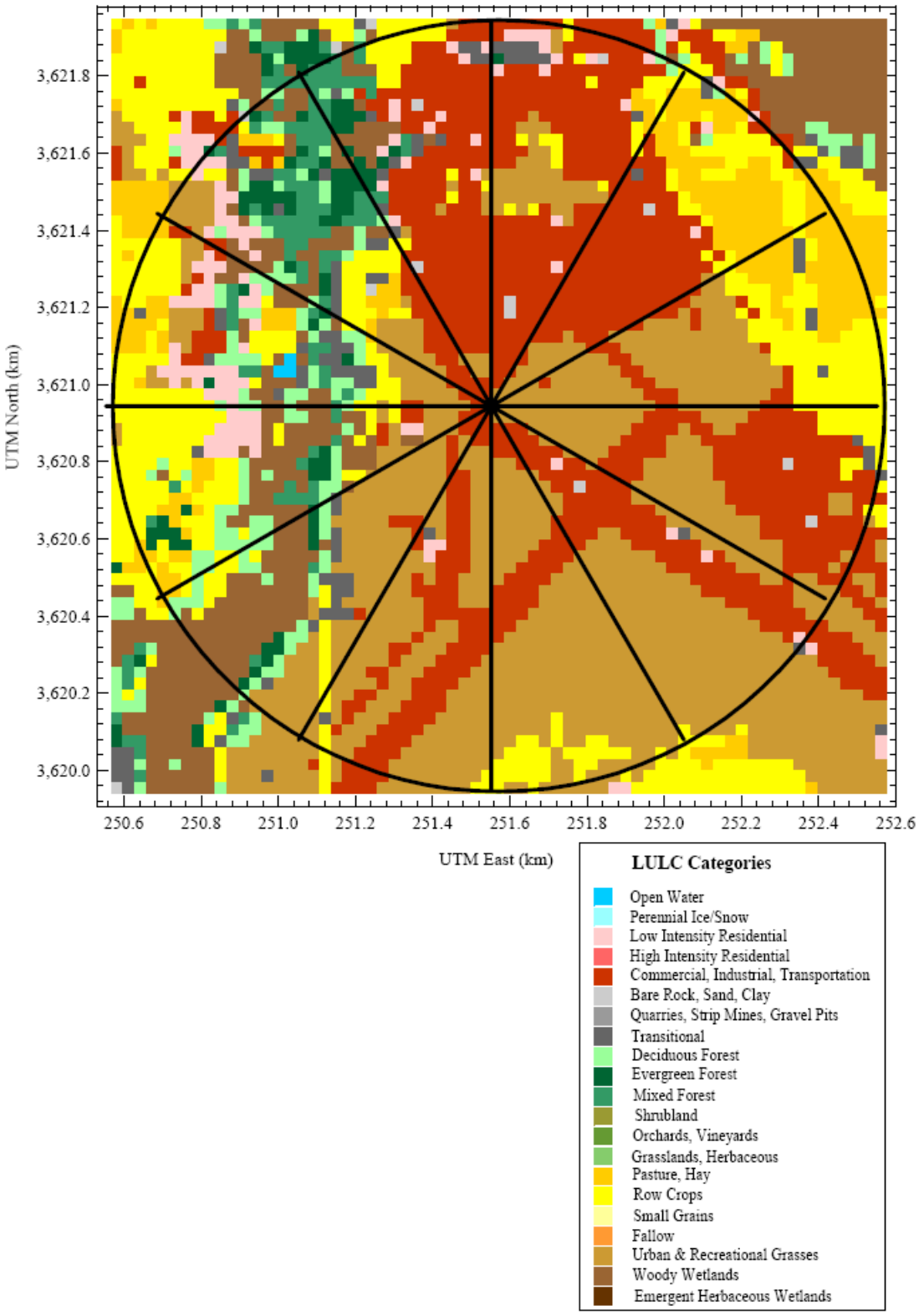


FIGURE A-3. LAND USE CATEGORIES FOR THE 1-KM AREA SURROUNDING THE MACON NWS



Inspection of the land use figures shows that the land use surrounding the Macon Mill appears to be predominantly commercial/industrial/transportation and woody wetland. The Macon NWS station has large areas of urban and recreation grasses as well as low and high intensity residential, and commercial/industrial/transportation and some forested areas and agricultural characteristics. The Atlanta NWS station has large areas of urban and recreational grasses, low and high intensity residential, and commercial/industrial/transportation assignments with very little forested areas and no agricultural usages. Although neither NWS station is very similar to the Macon Mill, the Macon NWS station is more similar than the Atlanta NWS station.

To facilitate a quantitative comparison of surface characteristics, Trinity utilized AERSURFACE to determine the weighted average parameters for the Macon Mill and the NWS sites based on the 1992 NLCD data. The geographic coordinates for the two NWS sites extracted from the NOAA website were used for the center of the study area for the NWS sites while an approximate central location was used as the center of the Macon Mill study area. Because the Macon Mill and NWS sites are located in a temperate region that experiences weather conditions typical of varying seasons, seasonal average parameters were computed for each season; the seasonal assignment "Winter" values were assigned by AERSURFACE based on no "continuous snow cover for most of winter". The analysis was completed for dry, wet, and average moisture conditions (moisture conditions impact the Bowen ratio parameters assigned).

Table A-1 presents a summary of the parameter values utilized to compute the weighted average parameters, while Table A-2 presents the surface characteristics determined by AERSURFACE for the Macon Mill. All parameter values are based on the values recommended in EPA's *AERMET User's Guide*.[3]

Tables A-3 through A-5 present various comparisons of the parameter assignments, considering annual averages, seasonal averages, and overall differences.[4] Figure A-4 includes a quantitative review of the land use assignments. These comparisons illustrate there is no significant difference between the two NWS stations on albedo or Bowen ratio (when considering all moisture conditions). The Macon Mill's surface roughness parameter assignments are slightly more similar to the Macon NWS station than the Atlanta NWS station when considered on a sector-by-sector basis. Figure A-4 illustrates that the Macon Mill's actual land use assignments are slightly more similar to the Macon NWS site.

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[3] EPA, *User's Guide for the AERMOD Meteorological Preprocessor (AERME*T), EPA-454/B-03-002, November 2004.

[4] Analyses presented based on methodology recommended by the Alabama Department of Environmental Management (ADEM).

TABLE A-1. AERMET PARAMETER VALUES

Landuse	Albedo				Surface Roughness				Bowen Ratio (Average Moisture)				Bowen Ratio (Dry Conditions)				Bowen Ratio (Wet Conditions)			
	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
Water	0.12	0.10	0.14	0.20	0.0001	0.0001	0.0001	0.0001	0.1	0.1	0.1	1.5	0.1	0.1	0.1	2.0	0.1	0.1	0.1	0.3
Deciduous Forest	0.12	0.12	0.12	0.50	1.00	1.30	0.80	0.50	0.7	0.3	1.0	1.5	1.5	0.6	2.0	2.0	0.3	0.2	0.4	0.5
Coniferous Forest	0.12	0.12	0.12	0.35	1.30	1.30	1.30	1.30	0.7	0.3	0.8	1.5	1.5	0.6	1.5	2.0	0.3	0.2	0.3	0.3
Swamp/Wetlands	0.12	0.14	0.16	0.30	0.20	0.20	0.20	0.05	0.1	0.1	0.1	1.5	0.2	0.2	0.2	2.0	0.1	0.1	0.1	0.5
Cultivated Land	0.14	0.20	0.18	0.60	0.03	0.20	0.05	0.01	0.3	0.5	0.7	1.5	1.0	1.5	2.0	2.0	0.2	0.3	0.4	0.5
Grassland	0.18	0.18	0.20	0.60	0.50	0.10	0.01	0.001	0.4	0.8	1.0	1.5	1.0	2.0	2.0	2.0	0.3	0.4	0.5	0.5
Urban	0.14	0.16	0.18	0.35	1.00	1.00	1.00	1.00	1.0	2.0	2.0	1.5	2.0	4.0	4.0	2.0	0.5	1.0	1.0	0.5
Desert Shrubland	0.30	0.28	0.28	0.45	0.30	0.30	0.30	0.15	3.0	4.0	6.0	6.0	5.0	6.0	10.0	10.0	1.0	1.5	2.0	2.0

TABLE A-2. AERSURFACE ASSIGNMENTS FOR THE MACON MILL

Sector	Albedo				Surface Roughness				Bowen Ratio (Average Moisture)				Bowen Ratio (Dry Conditions)				Bowen Ratio (Wet Conditions)			
	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
1 (0-30 deg)	0.15	0.15	0.15	0.16	0.306	0.381	0.374	0.266	0.39	0.37	0.46	0.55	0.63	0.58	0.71	0.71	0.22	0.22	0.25	0.25
2 (30-60 deg)	0.15	0.15	0.15	0.16	0.315	0.374	0.367	0.275	0.39	0.37	0.46	0.55	0.63	0.58	0.71	0.71	0.22	0.22	0.25	0.25
3 (60-90 deg)	0.15	0.15	0.15	0.16	0.438	0.485	0.485	0.397	0.39	0.37	0.46	0.55	0.63	0.58	0.71	0.71	0.22	0.22	0.25	0.25
4 (90-120 deg)	0.15	0.15	0.15	0.16	0.450	0.470	0.467	0.405	0.39	0.37	0.46	0.55	0.63	0.58	0.71	0.71	0.22	0.22	0.25	0.25
5 (120-150 deg)	0.15	0.15	0.15	0.16	0.539	0.559	0.551	0.498	0.39	0.37	0.46	0.55	0.63	0.58	0.71	0.71	0.22	0.22	0.25	0.25
6 (150-180 deg)	0.15	0.15	0.15	0.16	0.600	0.620	0.614	0.544	0.39	0.37	0.46	0.55	0.63	0.58	0.71	0.71	0.22	0.22	0.25	0.25
7 (180-210 deg)	0.15	0.15	0.15	0.16	0.645	0.652	0.650	0.599	0.39	0.37	0.46	0.55	0.63	0.58	0.71	0.71	0.22	0.22	0.25	0.25
8 (210-240 deg)	0.15	0.15	0.15	0.16	0.351	0.362	0.359	0.324	0.39	0.37	0.46	0.55	0.63	0.58	0.71	0.71	0.22	0.22	0.25	0.25
9 (240-270 deg)	0.15	0.15	0.15	0.16	0.600	0.632	0.625	0.583	0.39	0.37	0.46	0.55	0.63	0.58	0.71	0.71	0.22	0.22	0.25	0.25
10 (270-300 deg)	0.15	0.15	0.15	0.16	0.476	0.514	0.503	0.445	0.39	0.37	0.46	0.55	0.63	0.58	0.71	0.71	0.22	0.22	0.25	0.25
11 (300-330 deg)	0.15	0.15	0.15	0.16	0.454	0.482	0.469	0.428	0.39	0.37	0.46	0.55	0.63	0.58	0.71	0.71	0.22	0.22	0.25	0.25
12 (330-360 deg)	0.15	0.15	0.15	0.16	0.328	0.386	0.373	0.300	0.39	0.37	0.46	0.55	0.63	0.58	0.71	0.71	0.22	0.22	0.25	0.25

TABLE A-3. COMPARISON OF AERSURFACE ASSIGNMENTS, ANNUAL AVERAGES

Albedo Assignments

Sector	**Atlanta NWS (ATL)** Average	**Macon NWS (MCN)** Average	**GPI Mill** Average	**GPI Mill** % of ATL[1]	**GPI Mill** % of MCN[1]
All	0.163	0.160	0.153	6.2%	**4.7%**

1. Calculated as the absolute value of (NWS average - facility average)/NWS average.

Bowen Ratio Assignments - Average Moisture

Sector	**Atlanta NWS (ATL)** Average	**Macon NWS (MCN)** Average	**GPI Mill** Average	**GPI Mill** % of ATL[1]	**GPI Mill** % of MCN[1]
All	0.94	0.48	0.44	53%	**7%**

1. Calculated as the absolute value of (NWS average - facility average)/NWS average.

Bowen Ratio Assignments - Dry Conditions

Sector	**Atlanta NWS (ATL)** Average	**Macon NWS (MCN)** Average	**GPI Mill** Average	**GPI Mill** % of ATL[1]	**GPI Mill** % of MCN[1]
All	2.02	0.90	0.66	67%	**27%**

1. Calculated as the absolute value of (NWS average - facility average)/NWS average.

Bowen Ratio Assignments - Wet Conditions

Sector	**Atlanta NWS (ATL)** Average	**Macon NWS (MCN)** Average	**GPI Mill** Average	**GPI Mill** % of ATL[1]	**GPI Mill** % of MCN[1]
All	0.54	0.25	0.24	56.7%	**6.0%**

1. Calculated as the absolute value of (NWS average - facility average)/NWS average.

Surface Roughness Assignments

Sector	**Atlanta NWS (ATL)** Average	**Macon NWS (MCN)** Average	**GPI Mill** Average	**GPI Mill** % of ATL[1]	**GPI Mill** % of MCN[1]
1	0.058	0.070	0.332	474%	**374%**
2	0.051	0.076	0.333	556%	**341%**
3	0.023	0.036	0.451	1,884%	**1,162%**
4	0.052	0.037	0.448	**762%**	1,103%
5	0.295	0.035	0.537	**82%**	1,445%
6	0.296	0.025	0.595	**101%**	2,254%
7	0.414	0.030	0.637	**54%**	2,058%
8	0.379	0.051	0.349	**8%**	588%
9	0.115	0.163	0.610	430%	**274%**
10	0.032	0.130	0.485	1,414%	**272%**
11	0.045	0.158	0.458	924%	**191%**
12	0.069	0.152	0.347	404%	**129%**
All	0.152	0.080	0.465	**205%**	480%

1. Calculated as the absolute value of (NWS average - facility average)/NWS average.

TABLE A-4. COMPARISON OF AERSURFACE ASSIGNMENTS, SEASONAL AVERAGES

Albedo Assignments

	Atlanta NWS (ATL)				Macon NWS (MCN)				GPI Mill (as % of ATL)[1]				GPI Mill (as % of MCN)[1]			
	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
Seasonal Average	0.16	0.16	0.16	0.17	0.14	0.17	0.17	0.16	0.15	0.15	0.15	0.16	0.15	0.15	0.15	0.16
% of NWS[1]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**6%**	**6%**	**6%**	6%	7%	12%	12%	**0%**

1. Calculated as the absolute value of (NWS average - facility average)/NWS average.

Bowen Ratio Assignments - Average Moisture

	Atlanta NWS (ATL)				Macon NWS (MCN)				GPI Mill (as % of ATL)[1]				GPI Mill (as % of MCN)[1]			
	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
Seasonal Average	0.90	0.70	1.08	1.08	0.37	0.38	0.55	0.61	0.39	0.37	0.46	0.55	0.39	0.37	0.46	0.55
% of NWS[1]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	57%	47%	57%	49%	**5%**	**3%**	**16%**	**10%**

1. Calculated as the absolute value of (NWS average - facility average)/NWS average.

Bowen Ratio Assignments - Dry Conditions

	Atlanta NWS (ATL)				Macon NWS (MCN)				GPI Mill (as % of ATL)[1]				GPI Mill (as % of MCN)[1]			
	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
Seasonal Average	1.99	1.50	2.30	2.30	0.76	0.74	1.04	1.04	0.63	0.58	0.71	0.71	0.63	0.58	0.71	0.71
% of NWS[1]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	68%	61%	69%	69%	**17%**	**22%**	**32%**	**32%**

1. Calculated as the absolute value of (NWS average - facility average)/NWS average.

Bowen Ratio Assignments - Wet Conditions

	Atlanta NWS (ATL)				Macon NWS (MCN)				GPI Mill (as % of ATL)[1]				GPI Mill (as % of MCN)[1]			
	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
Seasonal Average	0.53	0.48	0.58	0.58	0.21	0.23	0.28	0.28	0.22	0.22	0.25	0.25	0.22	0.22	0.25	0.25
% of NWS[1]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	58%	54%	57%	57%	**5%**	**4%**	**11%**	**11%**

1. Calculated as the absolute value of (NWS average - facility average)/NWS average.

Surface Roughness Assignments

	Atlanta NWS (ATL)				Macon NWS (MCN)				GPI Mill (as % of ATL)[1]				GPI Mill (as % of MCN)[1]			
	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
Seasonal Average	0.152	0.165	0.157	0.135	0.070	0.100	0.093	0.057	0.459	0.493	0.486	0.422	0.459	0.493	0.486	0.422
% of NWS[1]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**202%**	**199%**	**209%**	**214%**	553%	393%	423%	638%

1. Calculated as the absolute value of (NWS average - facility average)/NWS average.

TABLE A-5. COMPARISON OF AERSURFACE ASSIGNMENTS, DIFFERENCES

Albedo Assignments

Sector	Atlanta NWS (ATL)				Macon NWS (MCN)				GPI Mill				Difference Between ATL & GPI Mill				Difference Between MCN & GPI Mill				GPI Mill (as % of ATL)1				GPI Mill (as % of MCN)1			
	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
All	0.16	0.16	0.16	0.17	0.14	0.17	0.17	0.16	0.15	0.15	0.15	0.16	0.01	0.01	0.01	0.01	(0.01)	0.02	0.02	-	**6%**	**6%**	**6%**	6%	7%	12%	12%	**0%**

1. Calculated as the absolute value of (NWS average - facility average)/NWS average.

Bowen Ratio Assignments - Average Moisture

Sector	Atlanta NWS (ATL)				Macon NWS (MCN)				GPI Mill				Difference Between ATL & GPI Mill				Difference Between MCN & GPI Mill				GPI Mill (as % of ATL)1				GPI Mill (as % of MCN)1			
	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
All	0.90	0.70	1.08	1.08	0.37	0.38	0.55	0.61	0.39	0.37	0.46	0.55	0.51	0.33	0.62	0.53	(0.02)	0.01	0.09	0.06	57%	47%	57%	49%	**5%**	**3%**	**16%**	**10%**

1. Calculated as the absolute value of (NWS average - facility average)/NWS average.

Bowen Ratio Assignments - Dry Conditions

Sector	Atlanta NWS (ATL)				Macon NWS (MCN)				GPI Mill				Difference Between ATL & GPI Mill				Difference Between MCN & GPI Mill				GPI Mill (as % of ATL)1				GPI Mill (as % of MCN)1			
	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
All	1.99	1.50	2.30	2.30	0.76	0.74	1.04	1.04	0.63	0.58	0.71	0.71	1.36	0.92	1.59	1.59	0.13	0.16	0.33	0.33	68%	61%	69%	69%	**17%**	**22%**	**32%**	**32%**

1. Calculated as the absolute value of (NWS average - facility average)/NWS average.

Bowen Ratio Assignments - Wet Conditions

Sector	Atlanta NWS (ATL)				Macon NWS (MCN)				GPI Mill				Difference Between ATL & GPI Mill				Difference Between MCN & GPI Mill				GPI Mill (as % of ATL)1				GPI Mill (as % of MCN)1			
	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
All	0.53	0.48	0.58	0.58	0.21	0.23	0.28	0.28	0.22	0.22	0.25	0.25	0.31	0.26	0.33	0.33	(0.01)	0.01	0.03	0.03	58%	54%	57%	57%	**5%**	**4%**	**11%**	**11%**

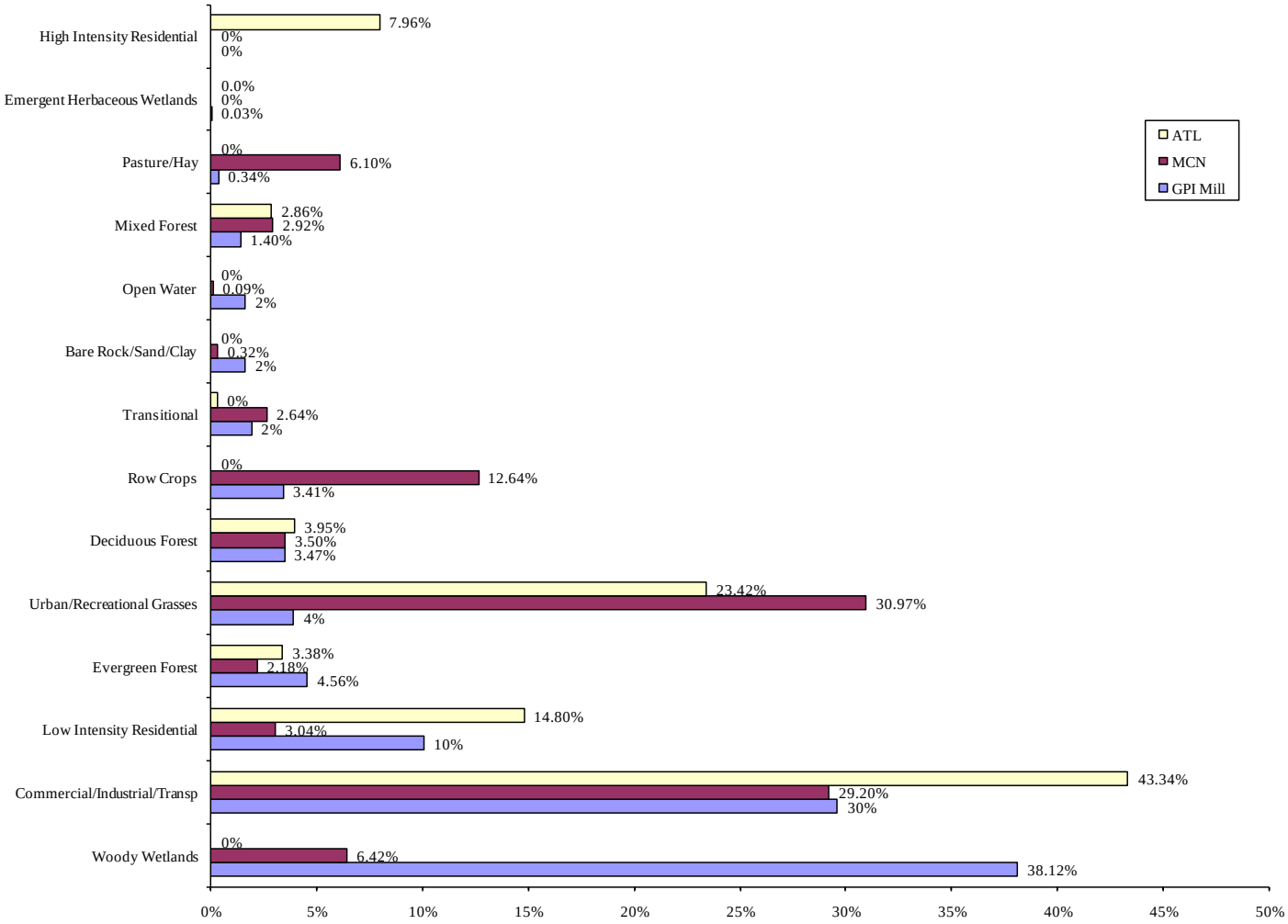
1. Calculated as the absolute value of (NWS average - facility average)/NWS average.

Surface Roughness Assignments

Sector	Atlanta NWS (ATL)				Macon NWS (MCN)				GPI Mill				Difference Between ATL & GPI Mill				Difference Between MCN & GPI Mill				GPI Mill (as % of ATL)1				GPI Mill (as % of MCN)1			
	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
1	0.058	0.063	0.058	0.052	0.069	0.077	0.072	0.062	0.306	0.381	0.374	0.266	-0.248	-0.318	-0.316	-0.214	-0.237	-0.304	-0.302	-0.204	428%	505%	545%	412%	**343%**	**395%**	**419%**	**329%**
2	0.051	0.057	0.051	0.044	0.061	0.096	0.093	0.052	0.315	0.374	0.367	0.275	-0.264	-0.317	-0.316	-0.231	-0.254	-0.278	-0.274	-0.223	518%	556%	620%	525%	**416%**	**290%**	**295%**	**429%**
3	0.023	0.028	0.023	0.017	0.027	0.052	0.045	0.019	0.438	0.485	0.485	0.397	-0.415	-0.457	-0.462	-0.380	-0.411	-0.433	-0.440	-0.378	1,804%	1,632%	2,009%	2,235%	**1,522%**	**833%**	**978%**	**1,989%**
4	0.052	0.060	0.053	0.043	0.034	0.048	0.041	0.026	0.450	0.470	0.467	0.405	-0.398	-0.410	-0.414	-0.362	-0.416	-0.422	-0.426	-0.379	**765%**	**683%**	**781%**	**842%**	1,224%	879%	1,039%	1,458%
5	0.294	0.311	0.304	0.270	0.035	0.041	0.035	0.028	0.539	0.559	0.551	0.498	-0.245	-0.248	-0.247	-0.228	-0.504	-0.518	-0.516	-0.470	**83%**	**80%**	**81%**	**84%**	1,440%	1,263%	1,474%	1,679%
6	0.295	0.320	0.307	0.262	0.025	0.032	0.026	0.018	0.600	0.620	0.614	0.544	-0.305	-0.300	-0.307	-0.282	-0.575	-0.588	-0.588	-0.526	**103%**	**94%**	**100%**	**108%**	2,300%	1,838%	2,262%	2,922%
7	0.411	0.449	0.437	0.358	0.029	0.037	0.030	0.022	0.645	0.652	0.650	0.599	-0.234	-0.203	-0.213	-0.241	-0.616	-0.615	-0.620	-0.577	**57%**	**45%**	**49%**	**67%**	2,124%	1,662%	2,067%	2,623%
8	0.377	0.401	0.393	0.343	0.050	0.062	0.053	0.038	0.351	0.362	0.359	0.324	0.026	0.039	0.034	0.019	-0.301	-0.300	-0.306	-0.286	**7%**	**10%**	**9%**	**6%**	602%	484%	577%	753%
9	0.115	0.130	0.117	0.098	0.135	0.213	0.201	0.104	0.600	0.632	0.625	0.583	-0.485	-0.502	-0.508	-0.485	-0.465	-0.419	-0.424	-0.479	422%	386%	434%	495%	**344%**	**197%**	**211%**	**461%**
10	0.032	0.039	0.032	0.025	0.097	0.180	0.170	0.074	0.476	0.514	0.503	0.445	-0.444	-0.475	-0.471	-0.420	-0.379	-0.334	-0.333	-0.371	1,388%	1,218%	1,472%	1,680%	**391%**	**186%**	**196%**	**501%**
11	0.045	0.051	0.045	0.038	0.136	0.197	0.187	0.110	0.454	0.482	0.469	0.428	-0.409	-0.431	-0.424	-0.390	-0.318	-0.285	-0.282	-0.318	909%	845%	942%	1,026%	**234%**	**145%**	**151%**	**289%**
12	0.069	0.073	0.069	0.064	0.144	0.166	0.163	0.133	0.328	0.386	0.373	0.300	-0.259	-0.313	-0.304	-0.236	-0.184	-0.220	-0.210	-0.167	375%	429%	441%	369%	**128%**	**133%**	**129%**	**126%**

1. Calculated as the absolute value of (NWS average - facility average)/NWS average.

FIGURE A-4. COMPARISON OF LAND USE CATEGORIES



Georgia Department of Natural Resources

Environmental Protection Division • Air Protection Branch
4244 International Parkway • Suite 120 • Atlanta • Georgia 30354
404/363-7000 • Fax: 404/363-7100
Mark Williams, Commissioner
F. Allen Barnes, Director
James A. Capp, Branch Chief

February 1, 2011

Forwarded to: jfickas@TrinityConsultants.com

Mr. Justin Fickas, P.E.
Managing Consultant
Trinity Consultants, Inc.
53 Perimeter Center East,
Suite 230
Atlanta, GA 30346

Subject: **Review of Air Dispersion Modeling Protocol**
Graphics Packaging International, Inc., Bibb Co., Georgia

Dear Mr. Fickas:

We have reviewed your air quality dispersion modeling protocol dated January 14, 2011, which addresses the dispersion modeling of Graphics Packaging International (GPI), Inc. emission sources at the Macon Mill to assess conformance with applicable air quality standards. We find that it generally conforms to the procedures and guidelines we use to assess Prevention of Significant Deterioration (PSD) modeling projects. However, we do have the following comments:

1. We note you propose you will be modeling carbon monoxide (CO) emissions. Please include in the air quality assessment a discussion of various emissions scenarios, including alternate capacities of operation, periods of start-up/shut-down/malfunction, and emergency operating scenarios. Derive a modeled worst-case scenario from these alternatives, as may be applicable, providing the emission rates and source characteristics for each. We suggest a separate source group be entered into AERMOD representing each scenario. A single run of the model using the concatenated Middle Georgia Regional National Weather Service (NWS) station meteorological data (MCN/CTV) file, and seeking maximum 1- and 8-hour CO impacts by applicable source group should comprise half of the CO modeling requirement. The other half would be conducted by re-modeling with the same data, changing only the surface characteristics to those of the Macon Mill (GPI/CTV) site. This assumes the project impacts are lower than the applicable SILs. If this should not be the modeled result, please proceed with refined CO NAAQS modeling in accordance with the 1990 New Source Review Workshop Manual, and 40 CFR 51, Appendix W.

2. Based on the background information you provided during the pre-PSD meeting and in the Project Modeling Protocol, no modeling of PM10/2.5, SO2, or NO2 is expected to be required of the project. If this changes, please let me know as it will affect the modeling protocol. The proposed increases of VOC and NOx do not exceed the threshold which would require an ozone impacts analysis.

   Ambient average high-2nd-high background concentrations of CO are 1031 and 870 $\mu g/m^3$, as measured over the past 5 years at the GA EPD monitor in Paulding Co.

3. General Modeling considerations: Please use BPIPPRM (version 04274) to assess building downwash dimensions and GEP stack heights. Stacks of heights equal to, or in excess of GEP height should be modeled using the GEP height. Stacks below GEP height must be modeled to

assess building downwash influences on their plumes. Please use AERMAP (version 09040) to assess all model receptor elevations above sea level with the USGS NED database (all model coordinates, including building corners, should be in the Universal Transverse Mercator projection, and referenced using the NAD83 datum). For modeling, please use AERMOD (version 09292, or a more recent version which may be released by EPA) for all criteria pollutant modeling. For modeling air toxics, please use the ISCST3 model (version 02035) with receptors assigned terrain elevations, use the Macon/Centerville meteorological data set downloadable from the georgiaair.org website for ISCST3 modeling. It is assumed the facility sources are located on a common plant grade elevation. If this is not the case, please assess source elevations using AERMAP. Ambient air for criteria pollutants is defined by a fenceline surrounding the project facility. Ambient air for air toxics is defined by the facility's property boundary.

4. The surface characteristics of the meteorological monitoring site for AERMOD modeling are found to be sufficiently dissimilar in surface roughness to warrant duplicative modeling of the CO impacts using the surface roughness characteristics of the site to process the Macon meteorological data. GA EPD will provide the requisite meteorological data sets as soon as possible.

5. Model receptors should be spaced at least as close together as 100 meters. Please extend the proposed receptor grid using 100-m spaced receptors out to approximately 2 km from the facility in each direction. Use a 250-m grid spacing beyond that distance to 5 km from the facility. Use a 500-m receptor spacing beyond that distance to 10 km from the facility. All design concentrations should be resolved to the nearest 100 meters.

6. Air toxics modeling should be conducted in accordance with the GA EPD Guideline for Ambient Impact Assessment of Toxic Air Pollutant Emissions, 1998. There may be short-term (STEL or Ceiling-based 15-minute averaged limits) and long-term (RfC, RBAC, PEL, TLV, or REL-based 24-hour or annual based limits) Acceptable Ambient Concentration (AAC) limits. The short-term limits are modeled using the maximum fifteen-minute emission rate, entered into the model as an equivalent hourly rate. The short-term modeled output is corrected from a 1-hr average concentration to a fifteen-minute concentration by multiplying by the factor of 1.32 for comparison to the applicable short-term AAC(s). The time-averaging period of the long-term assessments is either annual (for IRIS values of RfC or RBAC) or 24-hr (for all other bases of AAC limits, such as PEL, TLV, and REL), but not both. GA EPD no longer requires calculation of an AAC value using NIOSH LD_{50} data. If air toxics are modeled with ISCST3, no downwash influences should be considered. If AERMOD is used to assess air toxics conformance, building downwash effects must be considered. If lead is required to be modeled, it must be modeled using allowable emission rates with AERMOD and the 2009 lead post-processor to derive the maximum 3-month rolling average concentration. Please use 0.04 $\mu g/m^3$ as an initial estimate of the lead ambient background concentration, and compare the modeled result to the lead NAAQS, not a lead-based AAC. Air toxics modeling should use the same receptors and receptor elevations as derived for the AERMOD modeling of CO impacts, regardless of the use of ISCST3 or AERMOD. Please consider using a concatenated meteorological data set (ISCST3- or AERMOD-compatible) to assess all non-lead air toxics impacts. This is possible using 1-hr, 24-hr, and period time-averaging to assess the 15-minute, 24-hr, and annual time-averaged AACs. This alleviates the need to run five individual annual models to get one or two results. I have discussed the air toxics which you proposed to evaluate with the project permit engineer. She agrees with your proposal.

7. Please copy GA EPD modeling staff on all correspondence with any FLM related to the review of this project. We concur with your postulate that no Class I assessment is necessary. However, this could change if the emission rates change, or contaminants for which an Increment has been promulgated are required to be modeled.

8. Please address growth associated with the project in a section of the air quality assessment entitled Additional Impacts. Please re-iterate that the project will result in no increase in a pollutant which contributes to Class II Visible Plume impacts, so no assessment was conducted. The monthly averaged CO impact threshold of potential harm should be acceptably and conservatively addressed using the maximum 1-hr CO concentration predicted by the Significance model. Increases of non-Hazardous Air Pollutant (non-HAP) trace metals are to be assessed using EPA's 1980 publication, "A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals".

9. Remember this project application is likely the best time and place to capture the Increment expansion associated with the project. It is our experience that, if Increment expansion is not captured at the time the source is shut down, the actual emissions on the applicable major source baseline date may be difficult to re-construct, and perhaps more difficult to document. Include PM2.5 Increment expansion, since the major source baseline date for that pollutant was 10/22/10.

Please contact me at 404-363-7095 if you have any questions. This protocol does not recommend the use of either the SCREEN3 model or the AERSCREEN model for any analysis. Based on the project timeframe, the protocol is valid for 10 months from the date of this approval letter.

Sincerely,

Peter S. Courtney, P.E.
Environmental Specialist
GA EPD

APPENDIX F

CLASS I NOTIFICATION LETTERS

Trinity Consultants

Offices nationwide ■ trinityconsultants.com

53 Perimeter Center East, Suite 230, Atlanta, GA 30346 U.S.A. ■ (678) 441-9977 ■ Fax (678) 441-9978

February 28, 2011

Mr. Bill Jackson
Air Program Staff
USDA Forest Service (FS)
National Forests in North Carolina
P.O. Box 2750
Ashville, NC 28802
bjackson02@fs.fed.us

RE: Graphic Packaging International, Inc. – Macon Mill
Notification of PSD Project in Reference to FS Class I Areas

Dear Mr. Jackson,

Trinity Consultants (Trinity) is submitting this letter to your attention on behalf of our client Graphic Packaging International, Inc. (GPI) for a proposed project at the Macon Mill, located in Bibb County, Georgia. (GPI) is proposing to install a new bubbling fluidized bed (BFB) boiler (No. 3 Biomass Boiler) at the Macon Mill. The proposed biomass boiler will be equipped with flue gas recirculation, a dry electrostatic precipitator (ESP), and a selective non-catalytic reduction (SNCR) system for emissions control. In addition, GPI is potentially considering utilizing duct sorbent injection for acid gas emissions control. The boiler, to be rated at approximately 620 MMBtu/hr heat input, will be designed to combust primarily biomass. Mill wastewater treatment plant (WWTP) sludge will also be combusted. Natural gas will be utilized for startups and during some normal operating scenarios if there is an interruption in biomass fuel supply.

The overall project will also include shutdown of an existing facility emission unit (No. 1 Power Boiler) and removal of the use of coal and fuel oil from the facility No. 2 Power Boiler, and now only using natural gas within that unit. The unit being shut down, the No. 1 Power Boiler, is an existing combustion source of coal, fuel oil, and natural gas. These changes will lead to significant decreases in facility wide pollutant emissions.

The proposed project presently requires Prevention of Significant Deterioration (PSD) permitting for projected emission increases of carbon monoxide (CO) and greenhouse gases (GHG). A PSD construction permit application was submitted to the Georgia Environmental Protection Division (EPD) in January 2011.

As part of the PSD application process, GPI has qualitatively evaluated its impacts on federally-protected Class I areas. The purpose of this letter is to provide the Federal Land Managers (FLM) with preliminary information on the proposed project and to request concurrence from the FLM on the findings presented.

Q/D Screening Analysis

A Q/D screening analysis was performed in a manner consistent with the approach discussed in the most recent Federal Land Managers' Air Quality Related Values Work Group (FLAG) guidance document (FLAG 2010), which compares the ratio of visibility affecting pollutant emissions to the distance from the Class I area (i.e., referenced herein as the FLAG 2010

Approach).[1] "Q" is the sum of the annual NO_X, PM_{10}, SO_2, and H_2SO_4 emissions, in tons per year (tpy) [2] and "D" is the distance, in kilometers (km), from the proposed facility to the corresponding Class I area.

A summary of the visibility-affecting pollutant (VAP) emissions resulting from the proposed project are shown in Table 1 using the FLAG 2010 Approach. Please note that both the project related emissions related to the emissions increases at the facility due solely to the new No. 3 Biomass Boiler, and the overall project annual emissions increase (accounting for site wide emissions decreases) is provided. It is also important to again note that the project does not exceed the major NSR modification thresholds for any VAP, and no Best Available Control Technology (BACT) or modeling requirements were triggered for any VAP.

TABLE 1. SUMMARY OF VISIBILITY-AFFECTING POLLUTANT EMISSIONS

Pollutant	Facility Project Annual Emissions[1] (tpy)	Facility Project Net Emissions Increase[2] (tpy)
NO_X	404.6	38.3
PM_{10}	133.1	14.4
SO_2	869.0	-459.9
H_2SO_4	13.2	6.9
Sum of Emissions	**1,419.9**	**59.6**

[1] Pollutant tpy projected related emissions for the No. 3 Biomass Boiler as reported in the Volume I PSD permit application submitted for GPI in January 2011. Emission estimates are conservative as they do not account for emission reductions likely under the recently issued Boiler MACT standard, nor do they account for project related emission decreases, leading to the project only exceeding the major NSR modification threshold for CO and GHGs.

[2] Pollutant net emissions increase information as reported in the Volume I PSD permit application submitted for GPI in January 2011. Emissions total reported does not include the large decrease in facility wide SO_2 emissions.

As shown in Table 2, eight (8) Class I areas are located within 300 km of the proposed project in Bibb County, Georgia. The only Class I areas within 300 km of the proposed facility managed by the FS are Shining Rock, Cohutta, Joyce Kilmer/Slickrock, and Bradwell Bay, which are between 246 and 295 kilometers away.

---

[1] Federal Land Managers' Air Quality Related Values Work Group (FLAG) Phase I Report – Revised 2010, *October 7, 2010.*

[2] It is specified within the Flag 2010 Report that "Q" be calculated as the sum of the worst-case 24-hour emissions converted to an annual basis.

TABLE 2. SUMMARY OF CLASS I AREAS WITHIN 300 KM OF THE PROPOSED PROJECT

Class I Area Within 300km of Facility - Responsible FLM	Distance from Facility, D (km)	Sum of Annualized VAP Emissions, Q (tpy)[1]	FLAG 2010 Approach Q/D	Sum of Annualized VAP Emissions, Q (tpy)[2]	FLAG 2010 Approach Q/D
Cohutta (GA) - FS	246	1,419.9	**5.8**	59.6	**0.2**
Okefenokee (GA) - FWS	227		**6.3**		**0.3**
Joyce Kilmer/Slickrock (NC/TN) - FS	288		**4.9**		**0.2**
Great Smoky Mountains (NC/TN) - NPS	294		**4.8**		**0.2**
Shining Rock (NC) - FS	293		**4.8**		**0.2**
Saint Marks (FL) - FWS	293		**4.8**		**0.2**
Bradwell Bay (FL) - FS	295		**4.8**		**0.2**
Wolf Island (GA) - FWS	267		**5.3**		**0.2**

[1] Pollutant tpy projected related emissions for the No. 3 Biomass Boiler as reported in the Volume I PSD permit application submitted for GPI in January 2011.

[2] Based on pollutant net emissions increase information as reported in the Volume I PSD permit application submitted for GPI in January 2011.

Table 2 shows the results of the Q/D screening analysis for the FLAG 2010 Approach. As shown in Table 2, all of the eight Class I areas within 300 km of the project have a Q/D well below ten. This suggests that the proposed project will have no adverse impacts to any AQRVs at near-by Class I areas; therefore, GPI plans no AQRV analyses for the proposed project. It is important to emphasize that when accounting for the other project associated emissions decreases at the facility, the net emissions increase of VAP, and corresponding Q/D value, is far less than that determined when based solely on the project emissions increase of VAP associated with the No. 3 Biomass Boiler. Based on Table 2, GPI requests that the FS provide written concurrence of this finding of no impact.

~~~~~~

GPI greatly appreciates your feedback on this conclusion regarding no presumptive impacts to AQRVs at Class I areas under management of the FS. Please feel free to contact me at 678-441-9977 with any questions that you have.

Sincerely,

TRINITY CONSULTANTS

Managing Consultant

cc: Mr. Eric Cornwell (Georgia EPD)
Mr. Pete Courtney (Georgia EPD)
Mr. John Notar (National Park Service)
Ms. Catherine Collins (Fish and Wildlife Service)
Ms. Kathleen Wheeler (GPI)
Ms. Deanna Duram (Trinity Consultants)
~~~~~~

Trinity Consultants

Offices nationwide ■ trinityconsultants.com

53 Perimeter Center East, Suite 230, Atlanta, GA 30346 U.S.A. ■ (678) 441-9977 ■ Fax (678) 441-9978

February 28, 2011

Ms. Catherine Collins
Environmental Engineer
United States Fish and Wildlife Service (FWS)
Branch of Air Quality
7333 West Jefferson Avenue, Suite 375
Lakewood, CO 80235-2017
Catherine_Collins@fws.gov

RE: Graphic Packaging International, Inc. – Macon Mill
Notification of PSD Project in Reference to FS Class I Areas

Dear Ms. Collins,

Trinity Consultants (Trinity) is submitting this letter to your attention on behalf of our client Graphic Packaging International, Inc. (GPI) for a proposed project at the Macon Mill, located in Bibb County, Georgia. (GPI) is proposing to install a new bubbling fluidized bed (BFB) boiler (No. 3 Biomass Boiler) at the Macon Mill. The proposed biomass boiler will be equipped with flue gas recirculation, a dry electrostatic precipitator (ESP), and a selective non-catalytic reduction (SNCR) system for emissions control. In addition, GPI is potentially considering utilizing duct sorbent injection for acid gas emissions control. The boiler, to be rated at approximately 620 MMBtu/hr heat input, will be designed to combust primarily biomass. Mill wastewater treatment plant (WWTP) sludge will also be combusted. Natural gas will be utilized for startups and during some normal operating scenarios if there is an interruption in biomass fuel supply.

The overall project will also include shutdown of an existing facility emission unit (No. 1 Power Boiler) and removal of the use of coal and fuel oil from the facility No. 2 Power Boiler, and now only using natural gas within that unit. The unit being shut down, the No. 1 Power Boiler, is an existing combustion source of coal, fuel oil, and natural gas. These changes will lead to significant decreases in facility wide pollutant emissions.

The proposed project presently requires Prevention of Significant Deterioration (PSD) permitting for projected emission increases of carbon monoxide (CO) and greenhouse gases (GHG). A PSD construction permit application was submitted to the Georgia Environmental Protection Division (EPD) in January 2011.

As part of the PSD application process, GPI has qualitatively evaluated its impacts on federally-protected Class I areas. The purpose of this letter is to provide the Federal Land Managers (FLM) with preliminary information on the proposed project and to request concurrence from the FLM on the findings presented.

Q/D Screening Analysis

A Q/D screening analysis was performed in a manner consistent with the approach discussed in the most recent Federal Land Managers' Air Quality Related Values Work Group (FLAG) guidance document (FLAG 2010), which compares the ratio of visibility affecting pollutant emissions to the distance from the Class I area (i.e., referenced herein as the FLAG 2010

Approach).[1] "Q" is the sum of the annual NO_X, PM_{10}, SO_2, and H_2SO_4 emissions, in tons per year (tpy) [2] and "D" is the distance, in kilometers (km), from the proposed facility to the corresponding Class I area.

A summary of the visibility-affecting pollutant (VAP) emissions resulting from the proposed project are shown in Table 1 using the FLAG 2010 Approach. Please note that both the project related emissions related to the emissions increases at the facility due solely to the new No. 3 Biomass Boiler, and the overall project annual emissions increase (accounting for site wide emissions decreases) is provided. It is also important to again note that the project does not exceed the major NSR modification thresholds for any VAP, and no Best Available Control Technology (BACT) or modeling requirements were triggered for any VAP.

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[2] Pollutant net emissions increase information as reported in the Volume I PSD permit application submitted for GPI in January 2011. Emissions total reported does not include the large decrease in facility wide SO_2 emissions.

As shown in Table 2, eight (8) Class I areas are located within 300 km of the proposed project in Bibb County, Georgia. The only Class I areas within 300 km of the proposed facility managed by the FWS are Okefenokee, Saint Marks, and Wolf Island, which are between 227 and 293 kilometers away.

---

[1] Federal Land Managers' Air Quality Related Values Work Group (FLAG) Phase I Report – Revised 2010, *October 7, 2010*.

[2] It is specified within the Flag 2010 Report that "Q" be calculated as the sum of the worst-case 24-hour emissions converted to an annual basis.

TABLE 2. SUMMARY OF CLASS I AREAS WITHIN 300 KM OF THE PROPOSED PROJECT

Class I Area Within 300km of Facility - Responsible FLM	Distance from Facility, D (km)	Sum of Annualized VAP Emissions, Q (tpy)[1]	FLAG 2010 Approach Q/D	Sum of Annualized VAP Emissions, Q (tpy)[2]	FLAG 2010 Approach Q/D
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[1] Pollutant tpy projected related emissions for the No. 3 Biomass Boiler as reported in the Volume I PSD permit application submitted for GPI in January 2011.

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Table 2 shows the results of the Q/D screening analysis for the FLAG 2010 Approach. As shown in Table 2, all of the eight Class I areas within 300 km of the project have a Q/D well below ten. This suggests that the proposed project will have no adverse impacts to any AQRVs at near-by Class I areas; therefore, GPI plans no AQRV analyses for the proposed project. It is important to emphasize that when accounting for the other project associated emissions decreases at the facility, the net emissions increase of VAP, and corresponding Q/D value, is far less than that determined when based solely on the project emissions increase of VAP associated with the No. 3 Biomass Boiler. Based on Table 2, GPI requests that the FWS provide written concurrence of this finding of no impact.

~~~~~~

GPI greatly appreciates your feedback on this conclusion regarding no presumptive impacts to AQRVs at Class I areas under management of the FWS. Please feel free to contact me at 678-441-9977 with any questions that you have.

Sincerely,

TRINITY CONSULTANTS

Justin Fickas
Managing Consultant

cc: Mr. Eric Cornwell (Georgia EPD)
Mr. Pete Courtney (Georgia EPD)
Mr. John Notar (National Park Service)
Mr. Bill Jackson (Forest Service)
Ms. Kathleen Wheeler (GPI)
Ms. Deanna Duram (Trinity Consultants)
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Trinity Consultants

Offices nationwide ■ trinityconsultants.com

53 Perimeter Center East, Suite 230, Atlanta, GA 30346 U.S.A. ■ (678) 441-9977 ■ Fax (678) 441-9978

February 28, 2011

Mr. John Notar
National Park Service (NPS)
Air Resource Division
12795 W. Alameda Pkwy.
Lakewood, CO 80228
john_notar@nps.gov

RE: Graphic Packaging International, Inc. – Macon Mill
Notification of PSD Project in Reference to FS Class I Areas

Dear Mr. Notar,

Trinity Consultants (Trinity) is submitting this letter to your attention on behalf of our client Graphic Packaging International, Inc. (GPI) for a proposed project at the Macon Mill, located in Bibb County, Georgia. (GPI) is proposing to install a new bubbling fluidized bed (BFB) boiler (No. 3 Biomass Boiler) at the Macon Mill. The proposed biomass boiler will be equipped with flue gas recirculation, a dry electrostatic precipitator (ESP), and a selective non-catalytic reduction (SNCR) system for emissions control. In addition, GPI is potentially considering utilizing duct sorbent injection for acid gas emissions control. The boiler, to be rated at approximately 620 MMBtu/hr heat input, will be designed to combust primarily biomass. Mill wastewater treatment plant (WWTP) sludge will also be combusted. Natural gas will be utilized for startups and during some normal operating scenarios if there is an interruption in biomass fuel supply.

The overall project will also include shutdown of an existing facility emission unit (No. 1 Power Boiler) and removal of the use of coal and fuel oil from the facility No. 2 Power Boiler, and now only using natural gas within that unit. The unit being shut down, the No. 1 Power Boiler, is an existing combustion source of coal, fuel oil, and natural gas. These changes will lead to significant decreases in facility wide pollutant emissions.

The proposed project presently requires Prevention of Significant Deterioration (PSD) permitting for projected emission increases of carbon monoxide (CO) and greenhouse gases (GHG). A PSD construction permit application was submitted to the Georgia Environmental Protection Division (EPD) in January 2011.

As part of the PSD application process, GPI has qualitatively evaluated its impacts on federally-protected Class I areas. The purpose of this letter is to provide the Federal Land Managers (FLM) with preliminary information on the proposed project and to request concurrence from the FLM on the findings presented.

Q/D Screening Analysis

A Q/D screening analysis was performed in a manner consistent with the approach discussed in the most recent Federal Land Managers' Air Quality Related Values Work Group (FLAG) guidance document (FLAG 2010), which compares the ratio of visibility affecting pollutant emissions to the distance from the Class I area (i.e., referenced herein as the FLAG 2010

Approach).[1] "Q" is the sum of the annual NO_X, PM_{10}, SO_2, and H_2SO_4 emissions, in tons per year (tpy) [2] and "D" is the distance, in kilometers (km), from the proposed facility to the corresponding Class I area.

A summary of the visibility-affecting pollutant (VAP) emissions resulting from the proposed project are shown in Table 1 using the FLAG 2010 Approach. Please note that both the project related emissions related to the emissions increases at the facility due solely to the new No. 3 Biomass Boiler, and the overall project annual emissions increase (accounting for site wide emissions decreases) is provided. It is also important to again note that the project does not exceed the major NSR modification thresholds for any VAP, and no Best Available Control Technology (BACT) or modeling requirements were triggered for any VAP.

TABLE 1. SUMMARY OF VISIBILITY-AFFECTING POLLUTANT EMISSIONS

Pollutant	Facility Project Annual Emissions[1] (tpy)	Facility Project Net Emissions Increase[2] (tpy)
NO_X	404.6	38.3
PM_{10}	133.1	14.4
SO_2	869.0	-459.9
H_2SO_4	13.2	6.9
Sum of Emissions	**1,419.9**	**59.6**

[1] Pollutant tpy projected related emissions for the No. 3 Biomass Boiler as reported in the Volume I PSD permit application submitted for GPI in January 2011. Emission estimates are conservative as they do not account for emission reductions likely under the recently issued Boiler MACT standard, nor do they account for project related emission decreases, leading to the project only exceeding the major NSR modification threshold for CO and GHGs.

[2] Pollutant net emissions increase information as reported in the Volume I PSD permit application submitted for GPI in January 2011. Emissions total reported does not include the large decrease in facility wide SO_2 emissions.

As shown in Table 2, eight (8) Class I areas are located within 300 km of the proposed project in Bibb County, Georgia. The only Class I area within 300 km of the proposed facility managed by the NPS is the Great Smoky Mountains that are approximately 294 kilometers away.

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[1] Federal Land Managers' Air Quality Related Values Work Group (FLAG) Phase I Report – Revised 2010, *October 7, 2010.*

[2] It is specified within the Flag 2010 Report that "Q" be calculated as the sum of the worst-case 24-hour emissions converted to an annual basis.

TABLE 2. SUMMARY OF CLASS I AREAS WITHIN 300 KM OF THE PROPOSED PROJECT

Class I Area Within 300km of Facility - Responsible FLM	Distance from Facility, D (km)	Sum of Annualized VAP Emissions, Q (tpy)[1]	FLAG 2010 Approach Q/D	Sum of Annualized VAP Emissions, Q (tpy)[2]	FLAG 2010 Approach Q/D
Cohutta (GA) - FS	246	1,419.9	**5.8**	59.6	**0.2**
Okefenokee (GA) - FWS	227		**6.3**		**0.3**
Joyce Kilmer/Slickrock (NC/TN) - FS	288		**4.9**		**0.2**
Great Smoky Mountains (NC/TN) - NPS	294		**4.8**		**0.2**
Shining Rock (NC) - FS	293		**4.8**		**0.2**
Saint Marks (FL) - FWS	293		**4.8**		**0.2**
Bradwell Bay (FL) - FS	295		**4.8**		**0.2**
Wolf Island (GA) - FWS	267		**5.3**		**0.2**

[1] Pollutant tpy projected related emissions for the No. 3 Biomass Boiler as reported in the Volume I PSD permit application submitted for GPI in January 2011.

[2] Based on pollutant net emissions increase information as reported in the Volume I PSD permit application submitted for GPI in January 2011.

Table 2 shows the results of the Q/D screening analysis for the FLAG 2010 Approach. As shown in Table 2, all of the eight Class I areas within 300 km of the project have a Q/D well below ten. This suggests that the proposed project will have no adverse impacts to any AQRVs at near-by Class I areas; therefore, GPI plans no AQRV analyses for the proposed project. It is important to emphasize that when accounting for the other project associated emissions decreases at the facility, the net emissions increase of VAP, and corresponding Q/D value, is far less than that determined when based solely on the project emissions increase of VAP associated with the No. 3 Biomass Boiler. Based on Table 2, GPI requests that the NPS provide written concurrence of this finding of no impact.

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GPI greatly appreciates your feedback on this conclusion regarding no presumptive impacts to AQRVs at Class I areas under management of the NPS. Please feel free to contact me at 678-441-9977 with any questions that you have.

Sincerely,

TRINITY CONSULTANTS

Managing Consultant

cc: Mr. Eric Cornwell (Georgia EPD)
Mr. Pete Courtney (Georgia EPD)
Ms. Catherine Collins (Fish and Wildlife Service)
Mr. Bill Jackson (Forest Service)
Ms. Kathleen Wheeler (GPI)
Ms. Deanna Duram (Trinity Consultants)
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APPENDIX G

SUPPORTING DOCUMENTATION

Development Support Document
Final, November 19, 2010

Acrolein

CAS Registry Number: 107-02-8

Prepared by

Allison Jenkins, M.P.H.
Toxicology Division

Chief Engineer's Office

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

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List of Acronyms and Abbreviations

AEGL	Acute Exposure Guideline Level
AMCV	Air monitoring comparison values
ATSDR	Agency for Toxic Substances and Disease Registry
BMC	benchmark concentration
BMCL	benchmark concentration 95% lower confidence limit
C	Concentration or Celsius
Cal EPA	California Environmental Protection Agency
CFD	computational fluid dynamics
CO_2	carbon dioxide
d	day or days
D	exposure duration, hours per day
DF	deposition fraction in the target region of the respiratory tract
DAF	dosimetric adjustment factor
DSD	development support document
E	exposure level or concentration
EC	effective concentration
ET	extrathoracic
ESL	Effects Screening Level
$^{acute}ESL$	acute health-based Effects Screening Level for chemicals meeting minimum database requirements
$^{acute}ESL_{odor}$	acute odor-based Effects Screening Level
$^{acute}ESL_{veg}$	acute vegetation-based Effects Screening Level
$^{chronic}ESL_{linear(c)}$	chronic health-based Effects Screening Level for linear dose response cancer effect
$^{chronic}ESL_{linear(nc)}$	chronic health-based Effects Screening Level for linear dose response noncancer effects
$^{chronic}ESL_{nonlinear(c)}$	chronic health-based Effects Screening Level for nonlinear dose response cancer effects
$^{chronic}ESL_{nonlinear(nc)}$	chronic health-based Effects Screening Level for nonlinear dose response noncancer effects
$^{chronic}ESL_{veg}$	chronic vegetation-based Effects Screening Level
F	exposure frequency, days per week
GSH-S	glutathione *S*
h	hour
HEC	human equivalent concentration
HQ	hazard quotient
Hg	mercury

List of Acronyms and Abbreviations

HSDB	Hazardous Substances Data Bank
IL-1β	Interleukin 1, beta
IL-12	Interleukin 12
IRIS	Integrated Risk Information System
g/m^3	gram per cubic meter
K	constant level or severity of response
Kow	octanol water partition coefficient
LC_{50}	concentration producing lethality in 50% of experimental animals
LOAEL	lowest-observed-adverse-effect-level
LOEL	Lowest-observed-effect level
m	meter
µg	microgram
$µg/m^3$	microgram per cubic meter
mg/m^3	milligram per cubic meter
mg/L	milligram per liter
mm	millimeter
MW	molecular weight
min	minute
MOA	mode of action
MRL	Minimal Risk Level
NAC	National Advisory Committee
NAD+	nicotinamide adenine dinucleotide
NADP+	nicotinamide adenine dinucleotide phosphate
NADPH	nicotinamide adenine dinucleotide phosphate
NIOSH	National Institute for Occupational Safety and Health
NOAEL	no-observed-adverse-effect-level
NOEL	no-observed-effect-level
NRC	National Research Council
OEHHA	Office of Environmental Health Hazard Assessment
OSHA	Occupational Safety and Health Administration
POD	point of departure
POD_{ADJ}	point of departure adjusted for exposure duration
POD_{HEC}	point of departure adjusted for human equivalent concentration
ppb	parts per billion
ppm	parts per million
REL	Reference Exposure Level
ReV	Reference Value
RD_{50}	exposure concentration producing a 50% respiratory rate decrease

List of Acronyms and Abbreviations

RfC	Reference Concentration
RGDR	regional gas dose ratio
$(SA_{ET})_A$	extrathoracic surface area in rats
$(SA_{ET})_H$	extrathoracic surface area in humans
SPF OFA	SPF Sprague-Dawley OFA strain
T	time or exposure duration
TCEQ	Texas Commission on Environmental Quality
TD	Toxicology Division
TNF-α	Tumor necrosis factor-alpha
TWA	Time-Weighted Average
TWA-TLV	Time-Weighted Average Threshold Limit Value
UF	uncertainty factor
UF_H	interindividual or intraspecies human uncertainty factor
UF_A	animal to human uncertainty factor
UF_{Sub}	subchronic to chronic exposure uncertainty factor
UF_L	LOAEL to NOAEL uncertainty factor
UF_D	incomplete database uncertainty factor
UN	United Nations
USEPA	United States Environmental Protection Agency
$(VE)_A$	ventilation rate in animals
$(VE)_H$	ventilation rate in humans
wk	week

Chapter 1 Summary Tables and Figure

Table 1 for air monitoring and Table 2 for air permitting provide a summary of health- and welfare-based values from an acute and chronic evaluation of acrolein. Please refer to the Air Monitoring Comparison Values Document (AMCV Document) available at http://www.tceq.state.tx.us/implementation/tox/AirToxics.html for an explanation of values used for review of ambient air monitoring data and air permitting. Table 3 provides summary information on acrolein's physical/chemical data. Figure 1 compares the values in Tables 1 and 2 to values developed by other federal/occupational organizations.

Table 1. Air Monitoring Comparison Values (AMCVs) for Ambient Air

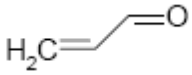
Short-Term Values	**Concentration**	**Notes**
acute ReV	11 µg/m^3 (4.8 ppb) **Short-Term Health**	**Critical Effect(s):** eye, nose, and throat irritation and decreased respiratory rate in human volunteers
$^{acute}ESL_{odor}$	8.2 µg/m^3 (3.6 ppb) **Odor**	50% odor detection threshold; piercing, disagreeable odor
$^{acute}ESL_{veg}$	230 µg/m^3 (100 ppb) **Short-Term Vegetation**	Lowest-observed adverse effect level after 9 h (alfalfa leaf damage)
Long-Term Values	**Concentration**	**Notes**
chronic ReV (noncarcinogenic)	0.50 µg/m^3 (0.22 ppb) **Long-Term Health** *	**Critical Effect(s):** Mild hyperplasia and lack of recovery of the respiratory epithelium in Fisher 344 rats
$^{chronic}ESL_{linear(c)}$ $^{chronic}ESL_{nonlinear(c)}$	- - -	Data are inadequate for an assessment of human carcinogenic potential
$^{chronic}ESL_{veg}$	- - - **Long-Term Vegetation**	No data found

Abbreviations for Tables 1 and 2: **HQ**, hazard quotient; **ppb**, parts per billion; **µg/m^3**, micrograms per cubic meter; **h**, hour; **AMCV**, air monitoring comparison value; **ESL**, Effects Screening Level; **ReV**, Reference Value; **^{acute}ESL**, acute health-based ESL; **$^{acute}ESL_{odor}$**, acute odor-based ESL; **$^{acute}ESL_{veg}$**, acute vegetation-based ESL; **$^{chronic}ESL_{linear(c)}$**, chronic health-based ESL for linear dose-response cancer effect; **$^{chronic}ESL_{nonlinear(nc)}$**, chronic health-based ESL for nonlinear dose-response noncancer effects; **$^{chronic}ESL_{veg}$**, chronic vegetation-based ESL

Table 2. Air Permitting Effects Screening Levels (ESLs)		
Short-Term Values	**Concentration**	**Notes**
$^{acute}ESL$ [1 h] (HQ = 0.3)	3.2 µg/m^3 (1.6 ppb) [a] **Short-Term ESL for Air Permit Reviews**	**Critical Effect(s):** eye, nose, and throat irritation and decreased respiratory rate in humans
$^{acute}ESL_{odor}$	8.2 µg/m^3 (3.6 ppb)	50% odor detection threshold; piercing, disagreeable odor
$^{acute}ESL_{veg}$	230 µg/m^3 (100 ppb)	Lowest-observed-adverse effect level after 9 h (alfalfa leaf damage)
Long-Term Values	**Concentration**	**Notes**
$^{chronic}ESL_{nonlinear(nc)}$ (HQ = 0.3)	0.15 µg/m^3 (0.066 ppb) [b] **Long-Term ESL for Air Permit Reviews**	**Critical Effect:** elevated rates of symptoms such as eye, nasal, and lower airway discomfort in humans
$^{chronic}ESL_{linear(c)}$ $^{chronic}ESL_{nonlinear(c)}$	---	Data are inadequate for an assessment of human carcinogenic potential
$^{chronic}ESL_{veg}$	---	No data found

[a] Based on the acute ReV of 11 µg/m^3 (4.8 ppb) multiplied by 0.3 (i.e., HQ = 0.3) to account for cumulative and aggregate risk during the air permit review.

[b] Based on the chronic ReV of 0.50 µg/m^3 (0.22 ppb) multiplied by 0.3 (i.e., HQ = 0.3) to account for cumulative and aggregate risk during the air permit review.

Table 3. Chemical and Physical Data		
Parameter	Value	Reference
Molecular Formula	C_3H_4O	ATSDR 2007
Molecular Weight	56.1	TCEQ 2009
Chemical Structure		ATSDR 2007
Physical State	Liquid	ATSDR 2007
Color	Colorless or yellowish	ATSDR 2007
Odor	Disagreeable, choking odor, pungent	ATSDR 2007
CAS Registry Number	107-02-8	TCEQ 2009
Synonyms/Trade Names	Acraldehyde, Acrylaldehyde, Acrylic aldehyde, Allyl aldehyde, Propenal, 2-Propenal, Magnicide, Magnicide H	ATSDR 2007
Solubility in water	2.12E+5 mg/L	ATSDR 2007
Log K_{ow}	-0.1	TCEQ 2009
Vapor Pressure	274 mm Hg	ATSDR 2007
Vapor Density (air = 1)	1.94	ATSDR 2007
Density (water = 1)	0.84 g/m^3	ATSDR 2007
Melting Point	-87.7°C	ATSDR 2007
Boiling Point	52.6°C	ATSDR 2007
Conversion Factors	1 ppm = 2.29 mg/m^3 1 mg/m^3 = 0.44 ppm	Toxicology Staff

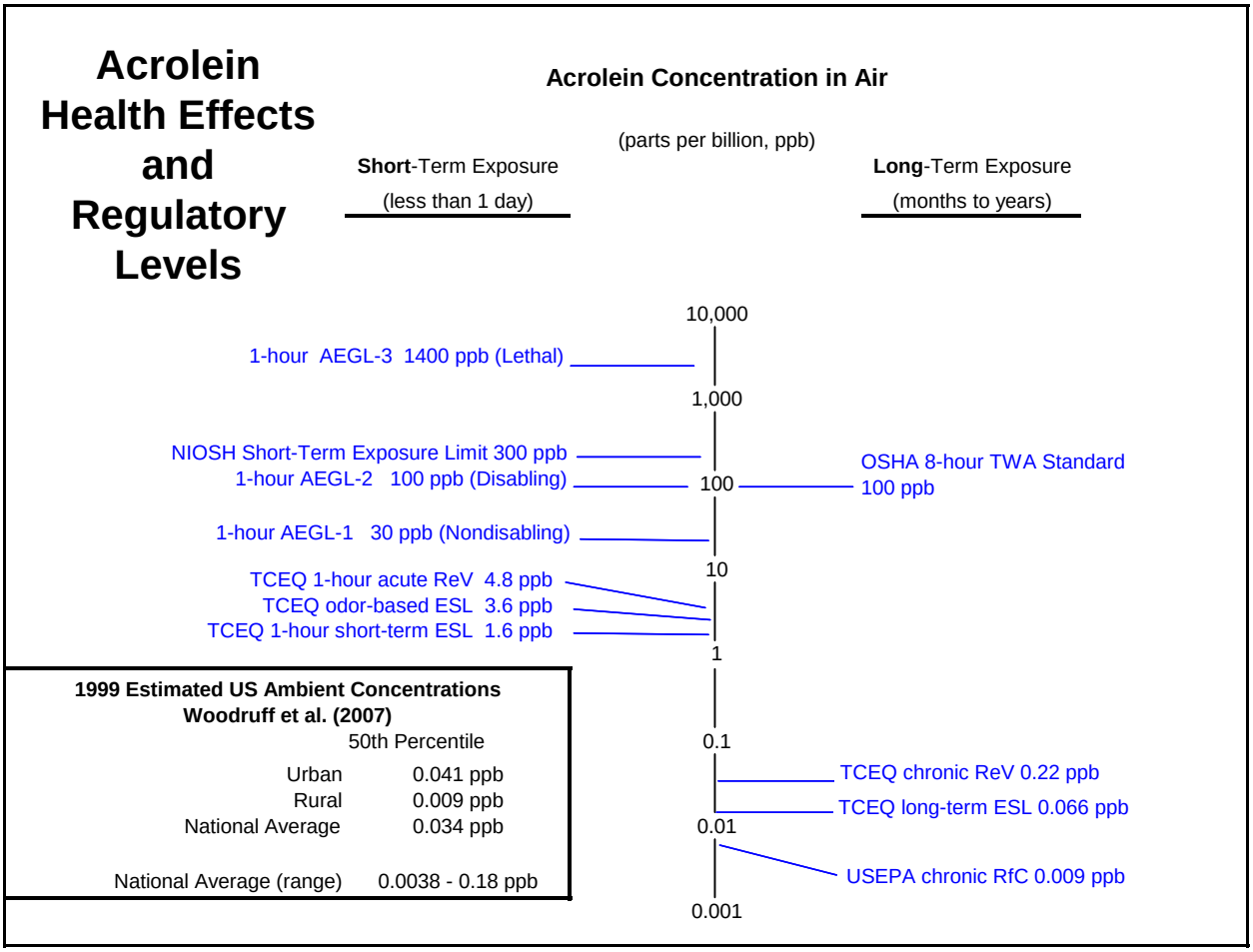


Figure 1. Acrolein Health Effects and Regulatory Levels.
This figure compares acrolein's acute toxicity values (acute ReV, odor-based ESL, and health-based short-term ESL) and chronic toxicity values (chronic ReV and long-term ESL) found in Tables 1 and 2 to Acute Exposure Guideline Level (AEGL) values (NRC 2009); Occupational Safety and Health Administration (OSHA) and National Institute Occupational Safety and Health (NIOSH) occupational values from NRC (2009); and to the United States Environmental Protection Agency (USEPA) Reference Concentration (RfC) (USEPA 2003).

Chapter 2 Major Sources or Uses

According to the Hazardous Substances Data Bank (HSDB), acrolein is used as an intermediate in the production of acrylic acid, glycerine, methionine, glutaraldehyde and other organic chemicals (HSDB 2005). Acrolein is also an herbicide used for control of vegetation in irrigation canals and as a biocide in water pumped into injection wells associated with petroleum production (USEPA 2008). Humans are exposed to acrolein primarily through tobacco smoke, gasoline and diesel exhaust, structural and forest fires, and partially combusted animal fats and

vegetable oils (Beauchamp et al. 1985). Seaman et al. (2007) reported that human exposure to acrolein is dominated by indoor air (3-40 times higher than concentrations measured in outdoor air) due to a combination of fixed sources (e.g., off-gassing from wood) combined with activities such as cooking.

Chapter 3 Acute Evaluation

3.1 Health-Based Acute ReV and ESL

3.1.1 Physical/Chemical Properties and Key Studies

3.1.1.1 Physical/Chemical Properties

Acrolein is a clear or yellow liquid with a piercing, disagreeable “acrid” odor (ATSDR 2007). It is water soluble, volatile, and highly reactive. The main chemical and physical properties of acrolein are summarized in Table 3.

3.1.1.2 Essential Data and Key Studies

A comprehensive literature search through December 2009 was conducted and key studies were reviewed regarding the acute toxicity of acrlein. In addition, information from both human and animal studies regarding the acute toxicity of acrolein was reviewed in detail from ATSDR (2007) and USEPA (2003), and NRC (2009). Well-conducted human studies demonstrate mild sensory irritation and respiratory effects at low concentrations and are preferentially used to develop the acute ReV and ESL. Since acrolein is reactive and very water soluble, it mainly produces sensory irritation and point-of-entry respiratory effects. Minor systemic effects are observed, but only at higher acrolein concentrations producing serious respiratory effects.

3.1.1.2.1 Human Studies

Two human experimental studies with acrolein conducted by Weber-Tschopp et al. (1977) and Darley et al. (1960) were located and identified as potential key studies for the acute evaluation of acrolein.

3.1.1.2.1.1 Weber-Tschopp et al. (1977)

The key study for derivation of the ReV and ESL was conducted by Weber-Tschopp et al. (1977) which includes three separate studies and was published in German. An English translation of the article was requested and received from the ATSDR. The study authors reported the average irritation threshold for acrolein ranged from 0.09 to 0.30 ppm. Although the Weber-Tschopp et al. (1977) study was well conducted, it was somewhat difficult to ascertain the exact concentrations at which adverse effects occurred from the study’s figures.

In the first sub-study, 46 healthy college students (21 males and 25 females) were exposed in groups of three for 60 minutes (min) to a constant concentration of 0.3 ppm acrolein (analytical

concentration). No control exposure was discussed for this sub-study. The authors measured blink rate, respiratory rate, and subjective irritation via a question form completed by study subjects. Annoyance increased during the first 20-30 min and then remained constant throughout the remainder of the 1-hour (h) exposure period. Eye, nose, and throat irritation and blink rate increased with increased exposure time to acrolein, with eye irritation recorded as being the most sensitive. Eye irritation was described by subjects as between "a little" and "medium" irritation. The highest level of irritation occurred after about 40 min. The authors reported a significant decrease in respiratory rate after 40 min of exposure ($p<0.01$). They also reported 47 percent of subjects experienced a 10 percent decrease in respiratory rate after 10 min and 60 percent of subjects experienced a 10 percent decrease in respiratory rate after 20 min. According to the American Society for Testing and Materials (ASTM 1991 as cited in NRC 2009), a 12-20 percent decrease in respiratory rate corresponds to slight irritation and respiratory rate decreases in the range of 20 to 50 percent correspond to moderate irritation. A minimal lowest-observed-adverse-effect level (LOAEL) (i.e., an exposure level close to the expected no-observed-adverse-effect level (NOAEL)) of 0.3 ppm acrolein was identified from this sub-study based on eye, nose, and throat irritation and decreased respiratory rate.

The other sub-studies within Weber-Tschopp et al. (1977) used varying exposure concentrations and shorter exposure times. In the second sub-study, 31 male and 22 female college students were exposed for 40 min to increasing acrolein concentrations. The acrolein concentration increased in the first 35 min from 0 to 0.60 ppm and remained constant for the last 5 min. This same group of subjects served as the control group exposed under identical conditions but without acrolein exposure. Subjects filled out a question form every 5 min and blink rate was measured from two of the three subjects in each group and respiratory rate was measured continuously from the third group member. The blink rate was significantly different from control exposure at approximately 0.26 ppm ($p<0.01$). The authors reported throat irritation was found to be a less sensitive criterion than eye irritation measured via blink rate; throat irritation increased significantly at 0.43 ppm acrolein. Annoyance (measured by participant questionnaire) increased with increasing exposure; however, the answer, "wish to leave room," occurred at approximately 0.40 ppm. An approximate 25 percent decrease in respiratory rate was significantly different from that of controls at 0.6 ppm. A LOAEL of 0.26 ppm was selected from the second sub-study based on eye irritation. The third sub-study involved discontinuous exposure to increasing concentrations of acrolein. Subjects were exposed five times for 1.5 min to either 0, 0.15, 0.30, 0.45, and 0.60 ppm. A period of recovery for 8 min occurred between each exposure. Authors stated the difference between continuous and discontinuous exposure was striking as both eye and nose irritation were stronger with continuous exposure.

3.1.1.2.1.2 Darley et al. (1960)

A study to examine eye irritation in humans resulting from exposure to ozone-hydrocarbon mixtures was conducted by Darley et al. (1960). The study's purpose was to evaluate the effects of a number of ozone-hydrocarbon mixtures; acrolein was used as the comparison chemical, as it was a known eye irritant. Approximately 31 college students (both male and female) were exposed to acrolein via only eye exposure. Each student wore an activated carbon respirator

covering the mouth and nose to enable only eye exposure. Subjects were exposed to concentrations of acrolein of 0, 0.06, 1.3-1.6 ppm, or 2.0-2.3 ppm for 5 min (analytical concentrations). The subjects recorded their level of eye irritation as none (score 0), medium (score 1), or severe (score 2) every 30 seconds during the 5-min exposure.

The maximum level of eye irritation recorded by the test subjects was used as the response of that subject. The average scores of the maximum irritation scores were as follows:

Average of Maximum Irritation Scores	Concentration of Acrolein
0.361	0 ppm
0.471	0.06 ppm
1.182	1.3-1.6 ppm
1.476	2.0-2.3 ppm

At a concentration of 0.06 ppm acrolein, less than medium irritation was reported (0.471) and was similar to the irritation score resulting from exposure to filtered air alone (0.361) (i.e., slight irritation was reported during exposure to both filtered air and 0.06 ppm acrolein). Study details (including the exact number of participants, whether exposure to the ozone-hydrocarbon mixtures affected subject responses, significance of irritation scores, and whether irritation increased with exposure time) were lacking, nonetheless, the Toxicology Division (TD) identified 0.06 ppm as the NOAEL and 1.3 ppm as the LOAEL.

The Darley et al. (1960) study was not selected as the key study because the LOAEL of 1.3 ppm for eye irritation was greater than the LOAEL of 0.3 ppm for eye, nose, and throat irritation from the first substudy (Weber-Tschopp et al. 1977). The Darley et al. (1960) study also involved 5-min exposures and several study details were lacking.

The Weber-Tschopp et al. (1977) 1-h study with a LOAEL of 0.3 ppm is selected as the key study because:

- The exposure duration of 60 min corresponds to that desired for derivation of an acute ReV/ESL;
- The experimental procedures and study discussion were more robust than those of the Darley et al. (1960) study and resulted in a LOAEL similar to that from the 40-minute Weber-Tschopp et al. (1970) study; and
- Darley et al. (1960) only evaluated eye irritation for a 5-min exposure whereas the Weber-Tschopp study evaluated eye irritation (sensory effects) and effects on the respiratory tract using both qualitative and quantitative measures.

3.1.1.2.2 Animal Studies

Numerous acute animal studies were located involving inhalation exposure to acrolein and are discussed in ATSDR (2007) and NRC (2009). It should be noted that ATSDR (2007), noted, “Acrolein exposure levels were very comparable for the appearance of cellular changes in nasal epithelium of animals (Cassee et al. 1996b) and onset of nasal irritation in humans (Weber-

Tschopp et al. 1977). Therefore, it is reasonable to extrapolate animal health effects to human health risk resulting from acrolein exposure." Studies that investigated effects in animals after exposure to acrolein at low concentrations where less serious adverse effects were noted are summarized in Table 4.

Table 4. Summary of Acute Animal Inhalation Studies Noting Adverse Effects

Study (Animal Strain)	Exposure Duration	NOAEL (ppm)	LOAEL (ppm)	Response at LOAEL
Dorman et al. 2008 (Male F344 rat)	0. 0.02, 0.06, 0.2, 0.6, 1.8 ppm 6 h/day (d), 5 d/week (wk) for up to 65 d (observations at 4, 14, 30, 65, and +60 d)	0.2	0.6	Nasal respiratory epithelial hyperplasia (4 d exposure)
Cassee et al. 1996b (Wistar rat)	0, 0.25, 0.67, 1.4 ppm, 6 h/d, 1-3 d	0.25 (6 h for 1 d)	0.25 (6 h for 3 d)	No effects after 6 h Slight effects (disarrangement of respiratory/transitional epithelium) at 0.25 ppm after 3 d.
Morris et al. 2003 (C57B1/6J mouse)	0, 0.3, 1.6, 3.9 ppm 1 time/d, 10 min	--	0.3	Decreased breathing rate, relative to mice without allergic airway disease
Morris et al. 2003 (C57B1/6J mouse)	0, 1.1 ppm 1 time/d, 10 min	--	1.1	Increased airflow resistance
Costa et al. 1986 (Sprague-Dawley rat)	15, 20, 25, 30, and 80 ppm for 1 h, 5, 7, 9, 12 ppm for 4 h	--	15 for 1 h 5 for 4 h	Peripheral sensory irritation and toxicity at all concentrations.
Ballentyne et al. 1989 (Sprague-Dawley rat)	14, 22, 24, 31, or 81 ppm for 1 h or 4.8, 7.0, 9.1, or 12.1 ppm for 4 h			Combined male/female LC_{50} values of 26 ppm (1 h) and 8.3 ppm (4 h) (5 males/5 females/group)

Table 4. Summary of Acute Animal Inhalation Studies Noting Adverse Effects (continued)				
Study (Animal Strain)	Exposure Duration	NOAEL (ppm)	LOAEL (ppm)	Response at LOAEL
Cassee et al. 1996a (Wistar rat)	1.73, 11.18, or 31.90 ppm for 30 min		1.73 9.2 (6.5 to 13.7)	Decreased breathing frequency RD_{50} (statistically derived concentration which reduces the respiratory rate by 50 percent)
Reproductive/Developmental				
Bouley et al. 1976 (as cited in NRC 2009) SPF OFA rat	0 or 0.55 ppm, 4 d, then for additional 22 d after mating	0.55	-	No treatment-related effects were observed on the number of pregnant rats or on the number and mean weight of fetuses.
Kutzman et al. 1981 Fischer 344 male rat	0, 0.14, 1.4, or 4.0 ppm for 6 h/d, 5 d/wk for 62 wk	4.0	-	No effects on number of viable embryos, resorptions, late deaths, corpora lutea, or sperm morphology.

3.1.1.2.2.1 Dorman et al. (2008)

One animal study (Dorman et al. 2008) was identified as a supporting study. Dorman et al. exposed adult male F344 rats whole body (n=12 rats/exposure concentration/time point) to 0, 0.02 0.06, 0.2, 0.6, or 1.8 ppm acrolein (measured concentrations were 0, 0.018, 0.052, 0.200, 0.586, and 1.733 ppm) for 6 h/d, 5 d/wk for up to 65 d. This study is appropriate to discuss in the acute section because clinical signs and histopathology were evaluated (12 rats/exposure concentration/time point) after 4 d of exposure, in addition to longer exposure periods. A NOAEL of 0.2 ppm (0/12) and a LOAEL of 0.6 ppm were identified based on the incidence of nasal respiratory epithelial hyperplasia. At 0.6 ppm, minimal nasal epithelial hyperplasia was identified in the dorsal meatus of 7/12 rats and slight/mild epithelial hyperplasia was identified in the lateral wall of 12/12 rats.

3.1.1.2.2.2 Other Select Animal Studies

Cassee et al. (1996b) exposed groups of five male rats nose-only to acrolein for 6 h/d for 1 or 3 consecutive d to 0.25, 0.67, and 1.40 ppm acrolein and reported slight nasal effects at 0.25 ppm. No treatment-related histopathological nasal lesions or cell proliferation were found after exposure to acrolein for 6 h to concentrations as high as 1.40 ppm. After 3 d exposure at 0.25 ppm, the nasal effects were mainly slight, consisting of disarrangement of the respiratory/transitional epithelium in four of five rats. One of five rats had moderate

disarrangement, necrosis, thickening, and desquamation of respiratory/transitional epithelium. At the next higher exposure concentration of 0.67 ppm, three of six rats had slight, mainly disarrangement of the respiratory/transitional epithelium and three of six rats had moderate disarrangement, necrosis, thickening, and desquamation of respiratory-transitional epithelium. USEPA (2003) stated, "the nose-only exposure chamber may have delivered more dose or had a different dosimetric distribution to the nasal epithelium as compared to exposure in the whole-body chambers. In a whole body chamber, rats may bury their noses in their fur during daytime sleeping postures resulting in the animals receiving less exposure than assumed." Because of uncertainty regarding the nose-only exposures, the 6-h NOAEL of 1.25 ppm and the 3-d LOAEL of 0.25 ppm are used only for information purposes and not used quantitatively in the calculation of an acute ReV or ESL.

Exposure to higher concentrations of acrolein (> 2 ppm) has resulted in the following observed effects in animals (ATSDR 2007):

- Lacrimation
- Decreased breathing frequency
- Severe respiratory tract irritation
- Emphysema
- Decreased body weight
- Death

More serious adverse effects (e.g., lacrimation, weakness, gasping for breath) were reported in rats and mice following exposure via inhalation to concentrations of acrolein higher than 2 ppm. Rats exposed to 12 ppm acrolein for 4 h exhibited severe eye and respiratory tract irritation, gasping, anorexia, and weakness (Murphy et al. 1964). Rats exposed to 15, 20, 25, 30, and 80 ppm acrolein for 1-h and 5, 7, 9, and 12 ppm for 4 h exhibited lacrimation, perinasal and periocular wetness, mouth breathing, decreased breathing rate, and hypoactivity (Ballantyne et al. 1989). An RD_{50} (statistically derived concentration which reduces the respiratory rate by 50 percent) of 9.2 ppm was derived by Cassee et al. (1996a). The authors exposed Wistar rats for 30 min to concentrations of 1.73, 11.18, or 31.90 ppm followed by a 10 min recovery period. They reported that the rats responded with an "initial fast decreased breathing frequency" (Cassee et al. 1996a).

Two studies investigating the immunological effects of acrolein were located; USEPA (2003) states the studies suggest that acrolein exposure can inhibit pulmonary antibacterial defenses. Aranyi et al. (1986) exposed mice to a single 3-h inhalation exposure to 0.1 ppm acrolein and for 3 h/d for 5 d to 0.1 ppm acrolein to measure pulmonary bactericidal activity to inhaled *Klebsiella pneumoniae*. The single exposure caused no significant effects on streptococcal-induced mortality or bactericidal activity, but 5 d of exposure reduced bactericidal activity. Astry and Jakab (1983) found 8-h exposures to 3 and 6 ppm acrolein in mice showed a concentration-related reduction in clearance of *Staphylococcus aureus* from an 8-h pulmonary infection.

Exposures to 8 to 10 ppm acrolein did not significantly add to the impairment of bactericidal activity (Astry and Jakab 1983).

3.1.1.2.2.3 Developmental/Reproductive Toxicity

Acrolein produces point-of-entry effects in the respiratory tract after inhalation exposure and significant systemic absorption does not occur (ATSDR 2007). There are no reports of reproductive or developmental toxicity following inhalation exposure to acrolein in humans (Cal EPA 2008). The World Health Organization (1992) summarized that inhalation of acrolein is unlikely to affect the developing embryo.

Two animal studies evaluating developmental/reproductive toxicity were located as shown in Table 4 and summarized by NRC (2009) below:

> SPF Sprague-Dawley, OFA strain (SPF OFA) rats were exposed to 0 or 0.55 ppm acrolein continuously for four days (Bouley et al. 1976). Three exposed males were then mated with 21 exposed females and the exposures continued for an additional 22 d, at which time the females were sacrificed. No treatment-related effects were observed on the number of pregnant rats or on the number and mean weight of the fetuses.
>
> In another study, Fischer 344 male rats were exposed to 0, 0.14, 1.4 or 4.0 ppm acrolein for 6 h/d, 5 d/wk for 62 wk (Kutzman et al. 1981).The males were then mated with untreated females. No effects on number of viable embryos, resorptions, late deaths, corpora lutea, or sperm morphology were observed.

3.1.2 Mode-of-Action (MOA) Analysis

Acrolein is a highly reactive aldehyde that is strongly irritating to mucous membranes, especially the eyes and upper respiratory tract (ATSDR 2007; Beauchamp et al. 1985). As reported in USEPA (2003), “Sensory irritation and depressed breathing frequency are regarded as defense mechanisms for penetration to the lower respiratory tract.” The irritant effects of acrolein may result from its reactivity toward sulfhydryl groups on receptor proteins in the nasal mucosa (Beauchamp et al. 1985). Cellular glutathione depletion has also been observed (Beauchamp et al. 1985). These adverse point-of-entry effects are assumed to have a threshold MOA. The following information was obtained from NRC (2009):

> Data regarding the metabolism of acrolein following inhalation exposure were not available; however, Patel et al. (1980) investigated the *in vitro* metabolism of acrolein in rat liver and lung preparations. Oxidation of acrolein to acrylic acid in liver 9000 g supernatant and cytosol required either NAD+ or NADP+ and was inhibited by disulfiram, suggesting the involvement of aldehyde dehydrogenase. Acrolein was also metabolized to acrylic acid when incubated with liver microsomes. In the presence of NADPH [nicotinamide adenine dinucleotide phosphate] and liver or lung microsomes, acrolein was metabolized to glycidaldehyde, a potent mutagen and carcinogen. Hydration of glycidaldehyde to

glyceraldehyde was catalyzed by liver and lung epoxide hydrolase. The glycidaldehyde was also a substrate for liver and lung GSH-S transferases. Although glycidaldehyde is formed *in vitro*, there is no experimental evidence for its formation *in vivo*. Acrylic acid and glyceraldehyde can be oxidized to CO_2. The glyceraldehyde is metabolized to CO_2 by glycolytic enzymes and although the pathway of acrylic acid conversion has not been determined, it is possible that it is metabolized as a short chain fatty acid.

Egle (1972) exposed anesthetized, male and female mongrel dogs to acrolein concentrations ranging from 172 to 262 ppm for 1 to 3 min. Acrolein retention by the entire respiratory tract averaged 80-85 percent of the inhaled dose and was independent of respiratory rate. Approximately 20 percent of the inhaled dose reached the lower respiratory tract. Exposure of only the lower respiratory tract resulted in retention of 65-70 percent concentration-independent retention; in this case uptake varied inversely with ventilatory rate.

Many of the effects of acrolein are caused by reaction with sulfhydryl groups. Acrolein is the most toxic of the 2-alkenals (including crotonaldehyde, pentenal, and hexenal) and is also the most reactive toward sulfhydryl groups. Deactivation of the cellular protein sulfhydryl groups could result in disruption of intermediary metabolism, inhibition of cell growth or division, and cell death. The respiratory irritancy of acrolein may be due to reactivity toward sulfhydryl groups in receptor proteins in the nasal mucosa (Beauchamp et al., 1985). Li et al. (1997) investigated the effects of acrolein on isolated human alveolar macrophage function and response *in vitro*. Acrolein induced dose-dependent cytotoxicity as evidenced by the induction of apoptosis and necrosis. At lower doses, the heme oxygenase protein was induced; however, stress protein was not induced. These data suggest that acrolein caused a dose-dependent selective induction of a stress response, apoptosis, and necrosis. Macrophage function was examined by cytokine release in response to acrolein exposure. Acrolein caused a dose-dependent inhibition of IL-1β, TNF-α, and IL-12 release.

3.1.3 Dose Metric

In the key and supporting studies, data on exposure concentration of the parent chemical are available. Concentration of the parent chemical is the most appropriate dose metric for the acute irritation effects of acrolein since it produces sensory irritation and point-of-entry respiratory effects.

3.1.4 Point of Departure (POD) for the Key Study

In the key study by Weber-Tschopp et al. (1977), humans exposed to 0.3 ppm acrolein experienced a slight, but significant decrease in respiratory rate ($p<0.01$) after 40 min of exposure. In addition, eye, nose, and throat irritation increased during exposure, with eye irritation recorded as the most sensitive parameter of irritation (eye medium irritation index),

compared to irritation of the nose and throat. The relevant POD is 0.3 ppm and is considered a LOAEL.

3.1.5 Dosimetric Adjustments

No exposure duration adjustments were needed for the key study as human subjects were exposed for 1 h to 0.3 ppm acrolein. The appropriate human equivalent concentration POD (POD_{HEC}) is 0.3 ppm (LOAEL) for the critical effect.

3.1.6 Critical Effect and Adjustments to the POD_{HEC}

3.1.6.1 Critical Effect

As indicated in Section 3.1.1.2.2, data suggest that eye, nose, and respiratory tract irritation is the most sensitive endpoint for short-term exposure to acrolein. The specific critical effect of acrolein exposure in the key study (Weber-Tschopp et al. 1977) is decreased respiratory rate, eye, nose, and throat irritation in humans exposed to 0.3 ppm acrolein in a one-time exposure of 60 min.

3.1.6.2 Uncertainty Factors (UFs)

The MOA by which acrolein may produce toxicity is assumed to have a threshold/nonlinear MOA, as discussed in Section 3.1.2. Therefore, the POD_{HEC} was divided by relevant UFs. The UF for extrapolation from animals to humans (UF_A) is not applicable to the key study.

The following UFs were applied to the POD_{HEC} of 0.3 ppm: 10 for intrahuman variability (UF_H), 6.3 for extrapolation from a LOAEL to a NOAEL (UF_L), and 1 for database uncertainty (UF_D) for a total UF = 63:

- A UF_H of 10 was used for intrahuman variability since the irritant effects were observed in studies involving healthy male and female college students;
- The UF_L of 6.3 is consistent with the study by Alexeeff et al. (2002) and the ESL Guidelines (TCEQ 2006) that state the TD uses a UF_L of 6.3 if the acute inhalation health effect is judged to be mild. The LOAEL is considered minimal due to the decreased respiratory rate of 10% which is considered slight irritation at best (i.e., 12-20 percent decrease in respiratory rate corresponds to slight irritation (ASTM 1991 as cited in NRC 2009); and
- A UF_D of 1 was used because the overall database of acute toxicological studies with acrolein is large (ATSDR 2007, NRC 2009). The acute studies consist of both human and animal studies as well as short-term reproductive/developmental studies.

Key Study (Weber-Tschopp et al. 1977):

acute ReV = POD_{HEC} / (UF_H x UF_L x UF_D)
= 0.3 ppm/ (10 x 6.3 x 1)
= 0.00476 ppm
= 4.76 ppb

3.1.7 Health-Based Acute ReV and ^{acute}ESL

The acute ReV of 4.76 ppb was rounded to two significant figures at the end of all calculations resulting in a value of 4.8 ppb. The acute ReV of 4.8 ppb (11 µg/m^3) was multiplied by 0.3 to calculate the ^{acute}ESL. At the target hazard quotient of 0.3, the ^{acute}ESL is 1.4 ppb (3.2 µg/m^3) (Table 5).

Table 5. Derivation of the Acute ReV and ^{acute}ESL	
Study	Weber-Tschopp et al. 1977
Study population	College students; male and female
Study quality	High (human subjects of both genders, three sub-studies)
Exposure Methods	1 h via inhalation
LOAEL	0.3 ppm
NOAEL	None
Critical Effects	Eye, nose and throat irritation and decreased respiratory rate
PODanimal	NA
Exposure Duration	1 h
Extrapolation to 1 h	NA
POD_{ADJ} (extrapolated 1 h concentration)	NA
POD_{HEC}	0.3 ppm
Total Uncertainty Factors (UFs)	63
Interspecies UF	*NA*
Intraspecies UF	*10*
LOAEL UF	*6.3*
Incomplete Database UF	*1*
Database Quality	*High*
acute ReV [1 h] (HQ = 1)	**11 µg/m^3 (4.8 ppb)**
^{acute}ESL [1 h] (HQ = 0.3)	**3.2 µg/m^3 (1.4 ppb)**

3.1.8 Comparison of Acute ReV to other Acute Values

The acute ReV of 4.8 ppb is slightly higher than the acute inhalation ATSDR Minimum Risk level (MRL) for acrolein of 3 ppb. Both the TD and ATSDR used the Weber-Tschopp et al. 1977 study and a POD_{HEC} of 0.3 ppm. The difference is the TD used a UF_L of 6.3 whereas ATSDR

used a UF_L of 10. The acute ReV is also higher than the acute California Environmental Protection (Cal EPA) Reference Exposure Level (REL) of 1.1 ppb (2.5 µg/m^3) (Cal EPA 2008) which is based on a geometric mean of the REL values from the Darley et al. (1960) and Weber-Tschopp studies**.** In addition, as part of Cal EPA's acute evaluation, a 95% upper confidence limit on the benchmark concentration at the 5% response level ($BMCL_{05}$) of 56 µg/m^3 was calculated using data from the Cassee et al. (1996b) study. The resulting acute REL after time and dosimetric adjustment and applying UFs was 2.1 µg/m^3 (similar to their final acute REL of 2.5 µg/m^3.

3.2. Welfare-Based Acute ESLs

3.2.1 Odor Perception

The Japanese Ministry of the Environment (Nagata 2003) and Katz and Talbert (1930) are approved sources of information for odor thresholds according to the ESL Guidelines (TCEQ 2006). In Nagata (2003), the 50% odor detection threshold for acrolein determined by the triangular odor bag method was 0.0036 ppm. Katz and Talbert (1930) reported an acrolein odor threshold of 1.8 ppm.

According to the Interim Guidelines for Setting Odor-Based Effects Screening Levels (TCEQ 2010), odor detection values defined as the highest quality level of odor thresholds (Level 1) will be considered first in setting the $^{acute}ESL_{odor}$ values. The odor detection thresholds reported by Nagata (2003) was determined by the standardized methods of measuring odor and is defined as Level 1 quality data. The odor threshold reported by Katz and Talbert (1930) is defined as Level 3 quality data. Therefore, only the standardized odor detection threshold determined by Nagata (2003) was used to set the $^{acute}ESL_{odor}$. Accordingly, the $^{acute}ESL_{odor}$ for acrolein is 3.6 ppb (8.2 µg/m^3).

3.2.2 Vegetation Effects

Acrolein is used as an herbicide for control of submerged and floating aquatic weeds and algae in irrigation canals as well as irrigation reservoirs in some states (USEPA 2008). It is also used as a biocide to kill bacteria that accumulate in pipes associated with petroleum production (USEPA 2008). Acrolein is a restricted use pesticide subject to strict use limitations (e.g., sold and applied only to trained and certified applicators or persons under their direct supervision) and is not available for residential uses (USEPA 2008).

Three acute studies on the vegetative effects of acrolein in air were located and are arranged from the most serious vegetative effects to less serious or NOAEL:

- Masaru et al. (1976) exposed pollen grains of lily plants to various concentrations of gases, including acrolein, for 1, 2, or 5 h. Pollen tube lengths were measured after exposure to determine plant damage. A complete inhibition of lily pollen germination or

tube elongation occurred after a 5-h exposure to 0.40 ppm acrolein in the lily seed (*Lilium longiflorum*) (Masaru et al. 1976). The serious effect level was 0.40 ppm.

- Spinach, sugar beets, endive, oats, and alfalfa plants were exposed to concentrations of acrolein of 0.1 (9 h), 0.6 (3 h), or 1.2 ppm (4.5 h) and leaves were assessed following exposure. Effects were classified as either no injury, injury typical of smog damage (production of a metallic glaze or silvering on the lower surface of leaves), and injury not typical of smog damage (Haagen-Smith et al. 1952). Alfalfa was the most sensitive plant to acrolein with leaves exhibiting marginal bleaching with numerous small necrotic spots after exposure to all three exposure levels. The lowest concentration of acrolein producing alfalfa leaf damage was 0.1 ppm; the lowest observed effect level (LOEL). No other plants were damaged after exposure to 0.1 ppm acrolein after 9 h.
- Darley et al. (1960) exposed 14-day old pinto bean plants to concentrations of 0, 0.06 ppm (calculated), 1.3-1.6 ppm, or 2.0-2.3 ppm acrolein for 70 min. Injury to the leaves was estimated the second day after exposure as percent of damage to the leaf surface. Damage was assessed on an injury scale of 0 to 10 (100 percent injury). Approximately 10 percent of the pinto bean leaf surface area damage was observed after exposure to 1.3-1.6 ppm acrolein for 70 min. The NOAEL was 0.06 ppm.

A NOAEL was noted at 0.06 ppm (pinto bean leaf damage after exposure for 70 min), whereas the LOEL of 0.1 ppm or 100 ppb (230 µg/m^3) (alfalfa leaf damage after exposure for 9 h) observed in the Haagen-Smith et al. (1952) study, was used to set the $^{acute}ESL_{veg}$.

3.3. Short-Term ESL and Values for Air Monitoring Data Evaluations

The acute evaluation resulted in the derivation of the following values:

- $^{acute}ReV$ = 11 µg/m^3 (4.8 ppb)
- $^{acute}ESL$ = 3.2 µg/m^3 (1.4 ppb)
- $^{acute}ESL_{odor}$ = 8.2 µg/m^3 (3.6 ppb)
- $^{acute}ESL_{veg}$ = 230 µg/m^3 (100 ppb)

For the evaluation of ambient air monitoring data, the $^{acute}ESL_{odor}$ of 8.2 µg/m^3 (3.6 ppb) is lower than the acute ReV of 11 µg/m^3 (4.8 ppb) and the $^{acute}ESL_{veg}$ of 230 µg/m^3 (100 ppb) although all values may be used for the evaluation of ambient air monitoring data (Table 1).

The short-term ESL for air permit reviews is the health-based $^{acute}ESL$ of 3.2 µg/m^3 (1.4 ppb) as it is lower than the $^{acute}ESL_{odor}$ and the $^{acute}ESL_{veg}$ (Table 2). The $^{acute}ESL$ (HQ = 0.3) is not used to evaluate ambient air monitoring data.

Chapter 4 Chronic Evaluation

4.1 Noncarcinogenic Potential

A comprehensive literature search through December 2009 was conducted and key studies were reviewed regarding the chronic toxicity of acrolein. In addition, information presented in the

ATSDR Toxicological Profile for Acrolein (2007), California's Acrolein Reference Exposure Levels Document (Cal EPA 2008), Acute Exposure Guideline Levels (NRC 2009), and USEPA's Toxicological Review of Acrolein in support of summary information on the IRIS (2003) was evaluated. As stated previously, since acrolein is reactive and very water soluble, it mainly produces sensory irritation and point-of-entry respiratory effects.

4.1.1 Physical/Chemical Properties and Key Studies

For physical/chemical properties, refer to Section 3.1.1.1 and Table 3.

4.1.2 Key and Supporting Studies

4.1.2.1 Key Study

The key study, Dorman et al. (2008), exposed male F344 rats (whole-body exposure) to concentrations of 0, 0.02, 0.06, 0.2, 0.6, or 1.8 ppm acrolein (analytical concentrations) for 6 h/d, five d/wk for up to 65 exposure days (13 wk). Neither mortality nor a significant increase in incidence of observable clinical signs occurred following exposure to acrolein at any concentration. After 5-8 wk of exposure, the authors reported rats exposed to 0.06, 0.2, or 0.6 ppm developed significantly depressed (~3-5%) body weight gains compared to air-exposed controls after 5-8 wk of exposure. At 1.8 ppm, body weight gains were reduced by ~ 20 percent compared to air-exposed controls. Histopathology of the respiratory tract was evaluated after 4, 14, 30, and 65 exposure days and a 60-day recovery period after the 13-wk exposure period.

Nasal respiratory epithelial hyperplasia and squamous metaplasia were more sensitive endpoints, both with a NOAEL of 0.2 ppm and a minimal LOAEL of 0.6 ppm (minimal to slight/mild hyperplasia in the dorsal meatus and the lateral wall and squamous metaplasia in the septum and the larynx). In rats exposed to $\geq$ 0.6 ppm acrolein, mild/moderate respiratory epithelial hyperplasia was observed following 4 or more days of exposure. As the concentration of acrolein increased, more severe effects were observed. A higher NOAEL of 0.6 ppm and a LOAEL of 1.8 ppm were identified for olfactory epithelial inflammation and atrophy. Because hyperplasia and squamous metaplasia of the respiratory epithelium were associated with exposure to acrolein at lower concentrations than olfactory epithelium atrophy, they were considered the critical effects.

- Dorman et al. (2008) examined animals 60 days following cessation of acrolein exposure: At the LOAEL of 0.6 ppm for nasal respiratory epithelial hyperplasia(Table 2 of Dorman et al. 2008), hyperplasia of the lateral wall (level II) and septum (level I) did not show recovery compared to air controls as shown below in Table 6.

Table 6. Lack of Recovery for Nasal Respiratory Epithelial Hyperplasia at the LOAEL of 0.6 ppm (number of affected/number examined)					
Exposure Day	4	14	30	65	+60 recovery
Lateral wall (level II)	12/12[a] (2.0)[b]	12/12[a] (1.0)[b]	12/12[a] (2.0)[b]	12/12[a] (1.0)[b]	11/12[a] (1.0)[b]
Septum (level I)	0/12	0/12	0/12	0/12	10/12[a] (2)[b]

[a] statistically significant increase in the incidence of the lesion was seen (versus air-exposed controls, $p < 0.05$, Pearson's).

[b] number in parentheses indicates average severity of the lesion seen in animals with a statistically significant lesion incidence. Unaffected animals were excluded from this calculation. 1= minimal, 2 = light/mild, 3 = moderate, 4= moderately severe.

- At the LOAEL of 1.8 ppm for olfactory epithelial atrophy (Table 4 of Dorman et al. 2008), they found partial recovery of the olfactory epithelium and stated, "Areas where recovery occurred were generally the more caudal regions of the nose where lesions developed more slowly." They further state, "…subchronic exposure to relatively high levels (1.8 ppm) of acrolein inhibited regeneration of the olfactory epithelium. It remains unknown whether the remainder of the olfactory epithelium would recover over time."

The Dorman et al. (2008) study was selected as the key study because it investigated both duration and concentration effects including several exposure groups, evaluated recovery, evaluated histopathology of the respiratory tract, and identified both a LOAEL and NOAEL. The critical effects are minimal to light/mild nasal respiratory epithelial hyperplasia in areas that did not show signs of recovery (i.e., lateral wall (level II) and septum (level I)).

4.1.2.2 Supporting Studies

Supporting studies include those by Feron et al. (1978), Kutzman et al. (1981, 1985), Costa et al. (1986), and Lyon et al. (1970). Feron et al. (1978) was determined by USEPA to be the most suitable study for the development of a reference concentration or RfC during their assessment in 2003. The Dorman et al. (2008) study was not available to USEPA for their 2003 assessment. The studies are discussed in more detail below.

Lyon et al. (1970) conducted two studies for the purposes of collecting data to derive Confined Space Guidelines for submarines. One study exposed 15 Sprague-Dawley rats, 15 guinea pigs, 9 male squirrel monkeys, and 4 male beagle dogs to acrolein concentrations of 0, 0.22, 1.0, and 1.8 ppm for 24 h/d for 90 d. All animals exposed at 0.22 ppm appeared normal. Two of four dogs exposed to 0.22 ppm had histopathological inflammatory changes in the lungs (including moderate emphysema, acute congestion, focal vacuolization of the bronchiolar epithelial cells). A LOAEL of 0.22 ppm was determined for the 90-d study (inflammatory changes in the lungs of two of four dogs). Signs of irritation (ocular and nasal discharge) in dogs and monkeys were

visible from the beginning of exposure to a concentration of 1.0 ppm; although, the authors stated the signs appeared to diminish in severity as exposure continued. The authors also exposed 15 Sprague-Dawley rats, 15 guinea pigs, 2 male beagle dogs, and 9 male squirrel monkeys to 0.7 ppm or 3.7 ppm acrolein for 8 h/d, 5 d/wk for 6 wk. The lungs of animals exposed to 0.7 ppm showed chronic inflammation and occasional emphysema more prominent in dogs and monkeys. No definite alteration of the respiratory epithelium was noted. A LOAEL of 0.7 (lung inflammation) was determined for the 6-wk study. The authors stated that based on their studies, dogs and monkeys were the most susceptible of the species tested, although they stated that changes were minor in all animals continuously exposed to 0.22 ppm for 90 d.

Feron et al. (1978) conducted a 13-wk sub-chronic inhalation study (6 h/day, 5 d/wk) using groups of equal numbers of both sexes of 20 hamsters, 12 rats, and 4 rabbits per concentration using whole body exposure. Acrolein concentrations were 0, 0.4, 1.4, and 4.9 ppm. Hematological data, body weights, organ weights, and limited macroscopic and microscopic pathology were evaluated. Significantly ($p < 0.05$) decreased body weights were found after exposure to 1.4 ppm acrolein in male and female rats. Histopathological changes observed in the respiratory tract were the only effects attributed by the authors to acrolein. Rats were slightly more sensitive than the other two species to the effects of acrolein; treatment-related effects in one rat (1/12) in the 0.4 ppm group consisting of metaplastic and inflammatory changes in the nasal cavity (reported as “slightly affected”). Conversely, hamsters and rabbits in the 0.4 ppm exposure group did not show treatment-related effects. Exposure to 4.9 ppm induced marked changes including death, severe growth retardation, increased adrenal weights, and pathological changes in the respiratory tract in all species tested. The authors stated that acrolein produces destruction and hyperplasia and metaplasia of the lining epithelium of the respiratory tract accompanied by acute and subacute inflammatory effects. A minimal LOAEL for metaplastic and inflammatory changes in the nasal cavity was 0.4 ppm; no NOAEL was identified (Feron et al. 1978). In support of the RfC for acrolein, USEPA (2003) summarized:

> “given the apparent concentration-related increase in severity of nasal lesions (i.e., slightly to severely affected), it is reasonable to consider 0.4 ppm as a minimal LOAEL (i.e., an exposure level close to the expected NOAEL). Even though only 1/12 rats at this concentration demonstrated minimal metaplastic and inflammatory changes, these effects were consistent with the pathology demonstrated at the higher concentrations in which severity was increased.”

A NOAEL of 0.4 ppm and a LOAEL of 1.4 ppm based on pulmonary lesions were identified from the studies by Kutzman et al. (1981, 1985) and Costa et al. (1986). These studies involved exposure of male Fischer 344 rats (whole-body exposure) of both sexes to 0, 0.4, 1.4, or 4.0 ppm acrolein for 62 d (6 h/day, 5 d/wk). Of the approximately fifty animals in each group, 24 were assessed for pulmonary function, 8 for pathology only, 10 for cytology, and 8 for reproductive function. All examinations were done 6 d after final exposure to reduce the effect of acute exposure on results. Mortality in male rats (32 of 57) was observed in the 4.0 ppm dose group with many displaying severe acute bronchopneumonia. No female rats in the 4.0 ppm dose group

died. Rats in the 0.4 ppm group did not exhibit pulmonary lesions related to acrolein exposure. Three rats in the 1.4 ppm dose group appeared to have pulmonary lesions (bronchiolar epithelial necrosis and sloughed cells lying free in the lumen) related to exposure. Nasal pathology was not examined in the Kutzman et al. (1981, 1985) studies.

Costa et al. (1986) presented the results on the lung mechanics and diffusion and associated structural correlates from the studies conducted by Kutzman et al. (1981, 1985). The authors conducted pulmonary function testing on rats 6 d after exposure ended. Rats exposed to 4.0 ppm had significant changes in tidal volume, breathing frequency, and pulmonary resistance when compared to controls and other exposure groups. Measurements of lung volume were also significantly affected in rats exposed to 4.0 ppm. Animals in the 1.4 ppm dose group did not differ functionally from controls nor show significant morphologic changes, however, there was a slight increase in collagen content. Some evidence of parenchymal restriction in the lungs was evident at 0.4 ppm, however, the authors stated, "…there were no light microscopic features that could be related to exposure."

Feron and Kruysse (1977) exposed hamsters to 0 or 4 ppm (9.2 mg/m^3) acrolein for 7 hr/d, 5 d/wk, for 52 wk. The authors reported neither respiratory tract tumors nor changes in other parts of the respiratory tract following exposure. They did report inflammation, hyper-, and metaplastic changes in the nasal cavity that were reversible after a withdrawal period of about 6 mos. The chronic LOAEL for hamsters is 4 ppm; although, hamsters appear to be a less sensitive species than rats based on the study by Feron et al. (1978). The authors concluded that acrolein is irritating to the mucous membranes of the upper respiratory tract but does not possess carcinogenic activity. LeBouffant et al. (1980) exposedgroups of 20 female Sprague-Dawley rats to 0 or 8 ppm acrolein for 1 hr/d, 7 d/wk for 10 or 18 months. The study's purpose was to evaluate the effects of high doses of cigarette smoke alone or in combination with coal dust or acrolein. Occasional emphysematous areas were the only changes noted by the authors in rats exposed to acrolein for 10 or 18 months. The authors also noted, "…that the irritant effects of acrolein proved transient, as shown by the fast disappearance of the initial functional disorders."

4.1.2.3 Chronic Studies with Structurally-Similar Chemicals, Acrylate Esters

Because there are few chronic studies with acrolein, a comparison with acrylate esters is presented. Acrylate esters are structurally-similar chemicals that also induce similar responses in the respiratory tract of rodents as acrolein, albeit at much higher concentrations than acrolein. Schroeter et al. (2008) and Ontario Ministry of the Environment (2009) both cite several chronic studies with acrylate esters as supporting studies for acrolein as they found no evidence of oncogenic responses after chronic exposures (Lomax et al. 1997; Reininghaus et al. 1991; Miller et al. 1985). Lomax et al. (1997) exposed rats for 24 months by inhalation to methyl methacrylate at concentrations of 0, 25, 100, or 400 ppm. No tumors were observed following chronic exposure to methyl methacrylate. Reininghaus et al. (1991) exposed rats to methyl acrylate or n-butyl acrylate at 0, 15, 45, or 135 ppm for 24 months. No oncogenic responses were observed. Miller et al (1985) also observed no tumors following a 27-month exposure to ethyl

acrylate at 1, 25, or 75 ppm. Chronic studies with acrylate esters, structurally-similar chemicals to acrolein that also induce similar responses in the olfactory epithelium, show little progression in lesions

4.1.2.4 Reversibility and Persistence of Effects

USEPA briefly discussed reversibility and persistence of the irritant effects of acrolein in their 2003 Toxicological Review of Acrolein. USEPA states, "Cassee et al. (1996b) does not discuss the persistence or reversibility of the observed histopathological changes in the low-dose group with exposures greater than 3 days (e.g., adaptive response). An adaptive response in nonprotein sulfhydryl levels after 3 days of exposure was observed and is discussed. It is possible that an adaptative response to the irritant effects of acrolein occurs over time. Conversely, cessation of exposure for 2 days each week in the Feron et al. (1978) study might have provided a period during which partial recovery from nasal effects could occur. Because the Feron et al. (1978) study was much longer in duration, it is possible that some adaptation to the irritant effects of acrolein occurs with increasing duration, or that cessation of exposure for 2 days each week provides a period during which partial recovery from nasal effects might have occurred."

4.1.2.5 Summary of Key and Supporting Studies

The observed effects and LOAEL/NOAELs that were noted in these subchronic studies were very similar to each other:

- Lyon et al. (1970): a LOAEL 0.22 ppm (histopathological inflammatory changes in dogs and monkeys);
- Feron et al. (1978): a LOAEL of 0.4 ppm (metaplastic and inflammatory changes in the nasal cavity of 1/12 rats)
- Kutzman et al. (1985): a NOAEL of 0.4 ppm and LOAEL of 1.4 ppm (exposure related lesions in rats)
- Dorman et al. (2008): a NOAEL of 0.2 ppm and LOAEL of 0.4 ppm (respiratory epithelial hyperplasia in rats).

Acute effects observed in animals exposed to acrolein occur at similar concentrations (Table 4) as effects that are observed after subchronic exposure. The findings from Dorman et al. (2008) in Appendix A and comparison of concentrations producing acute and chronic effects indicate that concentration plays more of a role in the nasal and respiratory irritant effects of acrolein than duration of exposure.

4.1.3 Mode-of-Action (MOA) and Dose Metric

Refer to Section 3.1.2 for a discussion of the MOA for acrolein. As stated in USEPA (2003), "acrolein is highly reactive and can induce toxicity in a variety of ways. An increase in reactive oxygen species resulting from reaction with and depletion of glutathione is considered to be the primary mechanism of toxicity (Zitting and Heinonen, 1980; Arumugam et al., 1999a). Reactions with cell membrane proteins and inhibition of regulatory proteins may also play a role." As a result of acrolein's high degree of reactivity during inhalation, deposition occurs primarily in the

nasal mucosa with the accompanying pathological effects. As concentrations increase, penetration and toxicity occur deeper within the respiratory system. Effects in other organs such as the liver were occasionally reported (Lyon et al., 1970), but only at concentrations higher than those affecting the respiratory system and the mechanism(s) for the effects are uncertain given acrolein's high reactivity.

For the critical effects that were not reversible for nasal respiratory epithelial hyperplasia (Dorman et al. 2008), exposure concentration of the parent chemical are available. Since data on other more specific dose metrics are not available, the exposure concentration of the parent chemical was used as the default dose metric. Schroeter et al. (2008) used the data from Dorman et al. (2008) to develop a tissue dose-based NOAEL for acrolein. In Shroeter et al. (2008), a human nasal computational fluid dynamics (CFD) model was used to extrapolate adverse effects in rats from Dorman et al. (2008) to humans using tissue dose and responses. However, the modeling was done using a NOAEL of 0.6 ppm based on olfactory epithelial atrophy, instead of the more relevant NOAEL of 0.2 ppm based on respiratory hyperplasia. Therefore, the Schroeter et al. (2008) study and tissue dose-based dose-metric were not used in determining dosimetric adjustments for acrolein.

4.1.4 POD for Key Study

The POD identified from the key study was the NOAEL of 0.2 ppm for nonreversible hyperplasia of nasal respiratory epithelial (Dorman et al. 2008). These effects were not amenable to benchmark dose modeling because incidences were either 0% at lower concentrations or 100% at the LOAEL and above.

4.1.5 Dosimetric Adjustments

4.1.5.1 Exposure Duration Adjustments

Rats were exposed for 6 h/day, 5 d/wk, thus the following calculation will be applied to adjust the discontinuous exposure to a continuous exposure to obtain an adjusted NOAEL:

POD_{ADJ} = POD x D/24 h x F/7 d

Where:
POD_{ADJ} = POD from animal studies, adjusted to continuous exposure scenario
POD = POD from animal studies, based on discontinuous exposure scenario
D = exposure duration, h per day
F = exposure frequency, days per wk

POD_{ADJ} = 0.2 ppm x 6 h/24 h x 5d/7d
POD_{ADJ} = 0.03571 ppm

4.1.5.2 Default Dosimetry Adjustments from Animal-to-Human Exposure

Acrolein is soluble in water and highly reactive. The health effects produced by acrolein at lower concentrations are respiratory tract effects in the extrathoracic region of the respiratory tract, so dosimetric adjustments were performed as a Category 1 vapor based on guidance in USEPA (1994) in order to calculate a POD_{HEC}.

A Regional Gas Dose Ratio (RGDR) for a Category 1 gas with extrathoracic respiratory effects was derived using study-specific body weight data for rats shown in Appendix B from the Dorman et al. (2008) study provided by the study author in a separate communication (Dorman 2009). A calculated ventilation rate of 193 ml/min based on study-specific time-weighted average Fischer 344 rat body weight of 0.273 kg for male rats from Dorman et al. (2008), and a default value of 13,800 ml/min for humans along with default extrathoracic region surface area values of 15.0 cm^2 for the rat, and 200 cm^2 for humans (USEPA 1994). The resulting equation is as follows:

$$RGDR_{ET} = [(VE)_A/(SA_{ET})_A] / [(VE)_H/(SA_{ET})_H]$$

Where:

$RGDR_{ET}$	=	regional gas dose ratio in the extrathoracic region
VE (ml/min)	=	ventilation rate in humans $(VE)_H$ from page 4-27 in USEPA (1994), and in rats $(VE)_A$ calculated from Equation 4-4 in USEPA (1994);
SA_{ET} (cm^2)	=	extrathoracic surface area in rats $(SA_{ET})_A$ and humans $(SA_{ET})_H$ from Table 4-4 in USEPA (1994)
$RGDR_{ET}$	=	0.187

For Category 1 gases, the default dosimetric adjustment from animal-to-human exposure is conducted using the following equation:

$$POD_{HEC} = POD_{ADJ} \times RGDR_{ET}$$

Dorman et al. (2008):

POD_{HEC} = POD_{ADJ} x $RGDR_{ET}$
= 0.03571 ppm x 0.187
= 0.006678 ppm or 6.678 ppb

4.1.6 Adjustments of the POD_{HEC}

Acrolein acts as a sensory and upper respiratory tract irritant and both of these effects are assumed to have a threshold. Therefore, UFs were applied to the POD_{HEC} to derive a ReV (i.e., assume a nonlinear MOA).

- The UF_H of 10 was applied to account for human variability and sensitive subpopulations to the effects of acrolein. Some evidences exists to suggest that acrolein exacerbates asthma in adults and children (Cal EPA 2008).
- The UF_A of 3 was used for animal-to-human extrapolation. The RGDR for a Category 1 gas was calculated using study-specific body weight data (Dorman et al. 2008) and applied to the POD_{ADJ} to account for toxicokinetic differences between the rat and humans. Only the pharmacodynamic area of uncertainty remains as a partial factor for interspecies uncertainty. The UF_A is conservative because the rat is an obligatory nose-breather, in contrast to humans (Nemec et al. 2008). According to Nemec et al. (2008), "studies have found clear species-specific differences, particularly between rats and humans, suggesting that rats are often much more sensitive to localized nasal insult from inhaled toxicants (Morgan and Monicello 1990; Kimbell et al. 1997; Frederick et al. 2002)."
- A UF_{Sub} of 1 rather than 10 was applied for adjustment from sub-chronic to chronic duration because:
    - there is a very close agreement of both NOAELs and LOAELs from acute and subchronic animal and human studies;
    - effects observed after 4 d of exposure were similar to effects occurring after 14, 30, and 65 d of exposure in the Dorman et al. 2008 study (Appendix A) indicating concentration was generally more important in producing adverse effects than duration of exposure; and
    - chronic studies with acrylate esters, structurally-similar chemicals that induce similar responses in the olfactory epithelium, show little progression in lesions (Schroeter et al. 2008, Ontario Ministry of the Environment 2009).
- The UF_D of 1 was used because the database for acrolein was considered complete and of high quality.
- The UF_L was not applicable as the POD was a NOAEL

A total UF of 100 was applied to the POD_{HEC} of 6.678 ppb.

$$\text{Chronic ReV} = POD_{HEC}/(UF_H \times UF_A \times UF_{Sub})$$
$$= 6.678 \text{ ppb } /(10 \times 3 \times 1)$$
$$= 6.678 \text{ ppb}/(30)$$
$$= 0.2226 \text{ ppb}$$

4.1.7 Health-Based Chronic ReV and $^{chronic}ESL_{nonlinear(nc)}$

The chronic ReV of 0.2226 ppb was rounded to two significant figures at the end of all calculations resulting in a value of 0.22 ppb (0.50 µg/m^3). The rounded chronic ReV was then multiplied by 0.3 to calculate the $^{chronic}ESL_{nonlinear(nc)}$. At the target hazard quotient of 0.3, the $^{chronic}ESL_{nonlinear(nc)}$ is 0.066 ppb (0.15 µg/m^3) (Table 7).

Table 7. Derivation of the Chronic ReV and $^{chronic}ESL_{nonlinear(nc)}$	
Study	Dorman et al. 2008
Study Population	360 adult Fischer-344 rats (12 rats/exposure concentration/time point)
Study Quality	High
Exposure Method	Discontinuous whole body at 0, 0.018, 0.052, 0.20, 0.586, or 1.733 ppm
Critical Effects	Mild hyperplasia and lack of recovery of the respiratory epithelium
Exposure Duration	6 h/day, 5 d/wk for 13 wk (65 d)
LOAEL	0.6 ppm
NOAEL	0.2 ppm
POD_{ADJ}	0.03571 ppm
POD_{HEC}	0.006678 ppm
Total UFs	30
Interspecies UF	3
Intraspecies UF	10
LOAEL UF	NA
Subchronic to chronic UF	1
Incomplete Database UF	1
Database Quality	High
chronic ReV (HQ = 1)	**0.50 µg/m^3 (0.22 ppb)**
$^{chronic}ESL_{nonlinear(nc)}$ (HQ = 0.3)	**0.015 µg/m^3 (0.066 ppb)**

4.1.8 Comparison of the Chronic ReV to other Chronic Values

Table 8 presents a comparison of the chronic ReV to the RfC developed by USEPA (2003) and the REL developed by Cal EPA (2008).

Table 8. Comparison of the Chronic ReV to Other Chronic Values					
Agency (Study)	POD	POD_{ADJ}	POD_{HEC}	Total UFs	Values
TCEQ ReV (Dorman et al. 2008)	0.2 ppm (NOAEL)	0.03571 ppm	0.006678 ppm [a]	30	0.22 ppb
USEPA RfC (Feron et al. 1978)	0.4 ppm (LOAEL)	0.0070 ppm	0.008723 ppm [b]	1000	0.0087 ppb
Cal EPA REL (Dorman et al. 2008)	0.2 ppm (NOAEL)	0.036 ppm	0.03 ppm [c]	200	0.15 ppb

[a] dosimetric adjustments using the RGDR (USEPA 1994) with study-specific body weight
[b] dosimetric adjustments using the RGDR (USEPA 1994) with default body weight
[c] dosimetric adjustment factor of 0.85 based on modeling done by Kimbell et al. (2001) with formaldehyde.

4.1.8.1 USEPA

USEPA's 2003 RfC of 0.02 µg/m3 (0.0087 ppb) is based on the study by Feron et al. (1978) with a LOAEL of 0.4 ppm, dosimetric adjustments using the RGDR (USEPA 1994) with default body weight, and a cumulative UF of 1000.

4.1.8.2 Cal EPA

The REL developed by Cal EPA is 0.35 µg/m³ (0.15 ppb) (Cal EPA 2008). Their chronic REL is based on the Dorman et al. (2008) study with a NOAEL of 0.2 ppm (lesions in respiratory epithelium) and a cumulative UF of 200. Cal EPA also applied a dosimetric adjustment factor (DAF) of 0.85 based on comparative modeling of gas flux in human and rat nasal passages with formaldehyde to calculate a POD_{HEC} of 0.03 ppm. The TD did not find that method preferable in deriving the ReV for acrolein.

In deriving their REL for acrolein, Cal EPA (2008) derived a dosimetric adjustment factor or DAF based on modeling done by Kimbell et al. (2001) with formaldehyde. Kimbell et al. (2001) used a computational fluid dynamics (CFD) model to estimate mass flux of formaldehyde across 20 consecutive bins that represented the nasal passages. In applying the DAF to acrolein, it was assumed that acrolein and formaldehyde deposit similarly in the nasal passages (Cal EPA 2008). In an email communication with Dr. Schroeter (2009), he stated that the nasal dosimetry patterns for acrolein and formaldehyde are quite different. Cal EPA also applied a UF of 2 to account for the toxicokinetic uncertainty, as they used modeling with formaldehyde and applied it to acrolein. Because of the additional uncertainty in applying data from formaldehyde to acrolein, the Kimbell et al. (2001) model results were not used in the TD's derivation of the POD_{HEC} for acrolein. Instead,the TD used the USEPA's recommended dosimetric adjustments using the RGDR (USEPA 1994) with study-specific body weight data in the calculation of the POD_{HEC} for acrolein, although there were other studies and approaches reviewed by the TD as discussed below.

4.1.8.3 Schroeter et al. (2008)

As mentioned previously, Schroeter et al. (2008) used the data from Dorman et al. (2008) to develop a tissue dose-based NOAEL for acrolein. In Shroeter et al. (2008), a human nasal CFD model was used to extrapolate adverse effects in rats from Dorman et al. (2008) to humans using tissue dose and responses. However, the modeling was done using a NOAEL of 0.6 ppm and a LOAEL of 1.8 ppm for olfactory neuronal loss instead of the more relevant NOAEL of 0.2 ppm based on respiratory hyperplasia. Therefore, the Schroeter et al. (2008) study was not used specifically in determining dosimetric adjustments for acrolein. In an email communication with Dr. Schroeter (2009), he stated that although he did not report a dosimetric adjustment factor in his paper for the extrathoracic region, it nonetheless would be very similar to the $RGDR_{ET}$ of 0.14. This may be entirely coincidental as his estimate was based on interspecies differences in olfactory dosimetry. The RfC developed by Schroeter was 0.27 ppb (POD_{HEC} = 8 ppb divided by total UFs of 30).

4.1.8.4 ATSDR

ATSDR did not derive a chronic-duration MRL for inhalation of acrolein in 2007 due to an inadequate database.

4.2 Carcinogenic Potential

Chronic human or animal inhalation or oral studies indicating that acrolein has carcinogenic potential are not available, so a chronic carcinogenic value was not developed. As stated in the summary of acrolein data in IRIS (USEPA 2003),

> "Under the Draft Revised Guidelines for Carcinogen Risk Assessment (EPA 1999), the potential carcinogenicity of acrolein cannot be determined because the existing 'data are inadequate for an assessment of human carcinogenic potential for either the oral or inhalation route of exposure.'
>
> There are no adequate human studies of the carcinogenic potential of acrolein. Collectively, experimental studies provide inadequate evidence that acrolein causes cancer in laboratory animals. Specifically, two inhalation bioassays in laboratory animals are inadequate to make a determination because of protocol limitations. Two gavage bioassays failed to show an acrolein-induced tumor response in two species of laboratory animals. Suggestive evidence of an extra-thoracic tumorigenic response in a drinking water study in female rats was not supported in the reanalysis of data by an independently-convened pathology working group. Questions were also raised about the accuracy of the reported levels of acrolein in the drinking water from this study. A skin tumor initiation-promotion study was negative, and the findings from an intraperitoneal injection study were of uncertain significance. Although acrolein has been shown to be capable of inducing sister chromatid exchange, DNA cross-linking and mutations under certain conditions, its highly reactive nature and the lack of tumor induction at portals of entry make it unlikely that acrolein reaches systemic sites at biologically-significant

exposure levels. The observations of positive mutagenic results in bacterial systems occurred at high concentrations near the lethal dose."

4.2.1 *In vitro* Mutagenicity

The ATSDR summarized the *in vitro* mutagenicity of acrolein in their 2007 Toxicological Profile for Acrolein. In it, the ATSDR stated,

> "The overall evidence indicates that acrolein is weakly mutagenic without activating systems and non-mutagenic in the presence of activating systems in *Salmonella typhimurium* (Andersen et al. 1972; Bartsch et al. 1980; Basu and Marnett 1984; Bignami et al. 1977; Eder et al. 1982; Florin et al. 1980; Foiles et al. 1989; Khudoley et al. 1987; Lijinsky and Andrews 1980; Loquet et al. 1981; Lutz et al. 1982; Marnett et al. 1985; Parent et al. 1996b; Waegemaekers and Bensink 1984) and *Escherichia coli* (Bilimoria 1975; Ellenberger and Mohn 1977; Hemminki et al. 1980; Parent et al. 1996b; VanderVeen et al. 2001; Von der Hude et al. 1988). In the yeast, *Saccharomyces cerevisiae*, acrolein was not mutagenic without activating systems (Izard 1973). In mammalian cells, acrolein gave positive results without activating systems (Au et al. 1980; Moule et al. 1971; Munsch et al. 1973, 1974). Acrolein inhibited the activity of DNA polymerase as well as DNA and RNA synthesis in rat liver cell nuclei (Crook et al. 1986a; Curren et al. 1988; Grafstrom et al. 1988; Krokan et al. 1985). The inconsistencies in the *in vitro* assay results may be due, in part, to the high cytotoxicity of acrolein to these systems."

4.2.2 In vivo Mutagenicity

No data were found regarding *in vivo* mutagenicity of acrolein.

4.3 Welfare-Based Chronic ESL

No data were found regarding long-term vegetative effects.

4.4 Long-Term ESL and Values for Air Monitoring Data Evaluations

The chronic evaluation resulted in the derivation of the following values:

- Chronic ReV = 0.50 µg/m3 (0.22 ppb)
- $^{chronic}ESL_{nonlinear(nc)}$ = 0.15 µg/m3 (0.066 ppb)

The chronic ReV of 0.50 $\mu g/m^3$ (0.22 ppb) is used for the evaluation of ambient air monitoring data (Table 1). The long-term ESL for air permit reviews is the health-based $^{chronic}ESL_{nonlinear(nc)}$ of 0.15 $\mu g/m^3$ (0.066 ppb) (Table 2). The $^{chronic}ESL_{nonlinear(nc)}$ (HQ = 0.3) is not used to evaluate ambient air monitoring data.

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Appendix A Incidence Data from Dorman et al. (2008)

Table A-1 Incidence (number affected/number examined) of Epithelial Squamous Metaplasia (Dorman et al. 2008)

Acrolein Concentration (ppm)		Air					0.2					0.6					1.8				
Exposure Day		**4**	**14**	**30**	**65**	**+60**	**4**	**14**	**30**	**65**	**+60**	**4**	**14**	**30**	**65**	**+60**	**4**	**14**	**30**	**65**	**+60**
Nasal respiratory	**Level**																				
Dorsal meatus	**I**	0/12	0/12	0/12	0/12	0/12	1/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	**11/11** (1.5)	**12/12** (1.3)	**11/12** (1.0)	**12/12** (1.3)	**6/12** (1.0)
Lateral wall	**II**	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	1/12	0/12	0/12	0/12	0/12	**11/11** (2.9)	**12/12** (3.0)	**12/12** (2.6)	**12/12** (2.8)	0/12
	III	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	**10/11** (1.2)	**12/12** (1.1)	**12/12** (1.9)	**12/12** (1.5)	0/12
Septum	**I**	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	**7/12** (1.0)	**9/12** (1.0)	**6/12** (1.0)	**10/12** (1.0)	2/12	**11/11** (1.8)	**11/12** (1.0)	**11/12** (1.0)	**12/12** (1.0)	**8/12** (1.8)
	II	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	**7/11** (1.0)	**12/12** (1.0)	**12/12** (1.0)	**11/12** (1.0)	0/12
	III	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	**10/11** (1.1)	**12/12** (1.0)	**12/12** (1.8)	**9/12** (1.1)	0/12
Maxillo-turbinate	**I**	0/12	0/12	0/12	0/12	0/12	2/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	**9/11** (1.1)	**6/12** (1.0)	**10/12** (1.0)	**10/12** (1.1)	**6/12** (1.0)
	II	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	**9/11** (1.0)	**11/12** (1.0)	**10/12** (1.6)	**12/12** (2.5)	0/12
Nasopharyn-geal duct	**V**	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	**12/12** (1.1)	**10/12** (1.0)	**4/12** (1.0)	0/12	0/12

Acrolein Concentration (ppm)		**Air**					**0.2**					**0.6**					**1.8**				
Exposure Day		**4**	**14**	**30**	**65**	**+60**	**4**	**14**	**30**	**65**	**+60**	**4**	**14**	**30**	**65**	**+60**	**4**	**14**	**30**	**65**	**+60**
Nasal olfactory	**Level**																				
Dorsal meatus	**II**	0/12	0/12	0/12	1/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	**11/11** (2.0)	**11/12** (1.0)	**12/12** (1.1)	**12/12** (1.1)	0/12
	III	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	**12/12** (1.0)	**12/12** (1.0)	**8/12** (1.1)
Ethmoid turbinate	**III**	0/12	0/12	0/12	0/12	0/12	2/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	1/11	**7/12** (1.0)	**12/12** (1.5)	**12/12** (1.5)	0/12
Larynx		0/12	0/12	1/12	5/12[c]	7/12	0/12	1/12[b]	1/12	6/12[c]	6/12	2/12	**5/12** (1.0)	**6/12** (1.5)	7/12[c]	7/12	**12/12** (2.0)	**9/12** (1.9)	**12/12** (1.7)	**12/12**[c] (1.7)	**10/12** (1.4)
Trachea		0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	**12/12** (1.0)	**11/12** (1.0)	0/12	0/12	0/12

Bold numbers denote that a statistically significant increase in the incidence of the lesion was seen (vs. air-exposed controls, $p < .05$, Pearson's).

[a] Number in parentheses indicates average severity of the lesion seen in animals with a statistically significant lesion incidence. Unaffected animals were excluded from this calculation. 1= minimal, 2 = light/mild, 3 = moderate, 4= moderately severe.

[b] Lesion incidence at 0.02 ppm = 1/12 (mild) and at 0.06 ppm = 4/12 ($p < 0.05$, average severity score of affected animals = 1.0).

[c] Larynx squamous epithelial metaplasia data at 65 d exposure used in BMD modeling.

Appendix B Study Specific Body Weight Data from Dorman et al. (2008) *

Concen-tration	Weight (mg)	Weeks														
		-2	**-1**	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
0 ppm**	Mean	121.5	154.2	177.5	200.4	224.0	239.7	258.4	271.5	281.2	295.6	305.9	314.0	323. 2	327.5	334.8
	S.D.	12.4	14.8	15.1	15.0	13.6	13.0	11.4	12.0	14.0	15.5	16.1	16.9	16.0	18.0	17.9
0.02 ppm	Mean	122.8	156.8	180.6	202.4	226.1	240.0	254.4	268.4	276.3	287.4	297.0	304.8	311.4	318.4	322.9
	S.D.	12.7	14.8	14.7	13.1	13.8	15.8	12.8	12.9	13.1	15.9	16.0	16.9	18.4	18.4	18.5
0.06 ppm	Mean	122.6	155.5	180.1	202.2	223.1	234.9	252.0	263.0	272.4	284.2	292.1	301.2	307.1	311.7	318.4
	S.D.	13.0	15.2	16.9	14.8	14.6	15.9	15.4	15.8	17.4	21.1	22.8	23.5	24.6	25.3	27.1
0.2 ppm	Mean	118.4	151.4	179.0	202.2	221.2	232.9	254.2	265.0	274.2	287.1	293.8	298.6	304.8	309.8	318.8
	S.D.	11.4	13.7	15.1	13.5	16.0	20.7	16.7	16.6	17.8	17.4	18.2	18.3	18.4	19.8	20.4
0.6 ppm	Mean	121.8	154.3	182.9	207.0	223.1	235.3	252.7	265.9	275.0	288.0	293.3	299.3	306.3	312.8	318.9
	S.D.	11.8	14.23	15.8	15.7	14.0	15.1	14.0	12.3	12.1	13.0	13.9	14.1	14.8	15.9	16.9
1.8 ppm	Mean	120.9	154.5	157.9	172.	194.2	204.7	212.5	221.4	227.6	237.6	242.7	254.9	250.4	259.2	267.5
	S.D.	13.6	15.6	12.1	11.5	13.1	13.2	13.6	14.4	13.4	11.4	13.4	14.3	12.7	15.1	14.1

* September 2009 email communication from Dorman, all data were rounded to the nearest tenth.

** Time-weighted average body weight of control group Fischer 344 rats of 0.273 kg.

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NEWS

Key Environmental Issues in U.S. EPA Region 1 (from home page)

Staying ahead of the curve is important in assisting clients to anticipate future regulations and requirements that affect decisions today. David attended the May 8, 2007 conference on "*Key Environmental Issues in U.S. EPA Region 1*" sponsored by the American Bar Association's Section of Environment, Energy and Resources where the EPA Regional Administrator, Regional Counsel, EPA General Counsel and each of the New England Commissioners of Environmental Protection discussed priorities and directions of each of their programs. At this conference, David was the moderator for the panel on "Air and Climate", where several timely issues were presented: coordination of energy and environmental programs, regional greenhouse gas initiative (RGGI), proposed changes to EPA rules for "once in always in" affecting both the PSD and MACT regulations, and the Maine Air Toxics Initiative as a demonstration project. David is also an active member of the New England section of the Air and Waste Management Association (A&WMA) where he has been elected for several terms as a member of its Board of directors. He has coordinated several local dinner meetings for the Association in Maine.

Outdoor Wood Boilers (from news on home page)

David Dixon testified before the Maine Legislature's Committee on Natural Resources on April 26, 2007, concerning a number of bills aimed at regulating outdoor wood boilers (OWB) in Maine. He noted that regulation of these sources is important as the number of OWB has grown dramatically in the last couple of years. The Maine Air Toxics Initiative (MATI) toxicity weighted emissions inventory indicates that OWB are a developing concern. He pointed out that regulation is difficult in order to deal with existing installations that are creating nuisance conditions and urged the Committee to recognize the improvements in air quality in Maine achieved through reliance of a philosophy of requiring new or modified sources to use the "best available control technology" (BACT).A copy of this testimony is available here.

Archieved News and Views

VIEWS

MEMO

To: MATI Emissions Inventory Subcommittee

From: David Dixon

Date: November 1, 2005

Subject: Dealing with the Uncertainty of Acrolein Emissions in MATI Inventory

This memo summarizes the case I have made repeatedly that I believe the current proposed version of the MATI Inventory greatly over-estimates the amount of acrolein emitted in Maine. The case illustrates the importance of accounting for the confidence interval surrounding estimates of both emissions and toxicity in the MATI process. In an attempt to be conservative in applying values to represent the possible worst case for acrolein, where there is clearly a high degree of uncertainty, its risk is so high that it trivializes the importance of all other compounds where, for some, we have much greater confidence in both emissions and toxicity factors. This results in uncertainty becoming more important than quantifiable

toxicity-weighed emissions or even risk.

Reasonableness of the Inventory

The decision to use the AP-42 emission factor for acrolein results in a skewed inventory as shown ion Table 1. The revised MATI Inventory leads to the conclusion that point sources contribute more to total toxicity weighted emissions than any other category, in fact almost half of the total. The June 2005 version of the MATI Inventory yielded a much more reasonable distribution of emissions between source categories based on comparisons to the 1996 NATA emissions and 1990 VOC Inventory for the Maine SIP. There is considerable variability in the estimates for point source due in part to different definitions for point sources. NATA used the definition of major HAP source, and MATI has included in the point source category many that would otherwise be grouped in the area source category. .

Table 1: Percent of Emissions by Source Category

	Point	Area	On-road	Off-road
MATI – 10/7/05	47	21	20	12
MATI – 6/2/05	27	38	21	14
NATA – 1996*	4	36	23	37
Me VOC 1990*	14.5	34	45	6.5

* Emissions only – not toxicity weighted emissions; definition for point source (major) is different from what has been used in MATI

The October 7 draft MATI Inventory indicates that 65% of Maine's air toxicity weighted emissions are attributed to acrolein, 10 times greater than the number 2 ranked compound. The October 7 draft MATI Inventory uses two different emission factors for acrolein, the AP-42 factor for industrial combustion at non-pulp and paper facilities and the National Council for Air and Stream Improvement (NCASI) factor for wood fired boilers located at pulp and paper mills. If the AP-42 emission factor were used consistently for all large wood burning boilers, acrolein would then account for 91% of Maine's total toxicity-weighted emissions. This distribution leads to the inevitable conclusion that the source from which to seek reductions is the large wood-fired boiler group, when in reality, gasoline and diesel engines are traditionally significant source categories to consider.

Competing Emission Factors

Note: This memo uses the scientific notation convention x.xx E -0y to represent small numbers. The value following the E represents the number of decimal places to the left of the indicated decimal point, i.e. 9.47 E-06 = 0.00000947. This could also be presented as 9.47×10^{-6}. A value of 1 E-03 is therefore 100 times greater than a value of 1 E-05.

The June 2005 MATI Inventory estimate for acrolein was based on the Memorandum from Eastern Research Group, Inc. (ERG Memo) to EPA, dated October, 2002. That emission factor was 9.47 E-06 lbs/MMBtu for uncontrolled emissions from all boiler types burning wood/other biomass. Subsequently it was found that the ERG Memo also included an emission factor of 1.71 E-03 lbs/MMBtu for uncontrolled emissions from "other" boiler types burning "wood". The ERG data suggested that emissions from wood and other biomass is expected to be 180 times less than from a boiler burning only wood, which did not seem reasonable. This triggered a search for other emission factors and evaluation of the data to support the various emission factors. Two other emission factors were identified: the AP-42 factor = 4.04 E -03 lbs/MMBtu, and the NCASI emission factor = 7.8 E-05 lbs/MMBtu. The October 7 MATI uses the AP-42 emission factor for large wood boilers (non-pulp and paper) which is 426 times greater than the factor that was used for the June draft of the MATI Inventory.

The magnitude of the differences in emission factors and the significant impact the selection of the emission factor would have on the overall MATI Inventory triggered an evaluation of the emission test data that was used to develop each of the factors.

Table 1. Emission Test Data to Support AP-42 Emission Factor

T	ID	FUEL TYPE	FIRING CONFIGURATION	CONTROL DEVICE	NUMBER OF RUNS	RUN AVERAGE
	B12	Dry Wood	Stoker	Mechanical Collector	1	4.26E-05
	B23	Wet Wood	Stoker	ESP	1	3.15E-05
	B33	Dry Wood	Not Reported	Mechanical Collector	1	3.80E-06
	B42	Dry Wood	Stoker	Mechanical Collector	1	1.43E-05
	B50	Wet Wood	FBC	Mechanical Collector, Uncontrolled	2	2.30E-02
	B78	Wet Wood	Stoker	Wet Scrubber	1	1.10E-03
					AVG	4.04E-03
					MIN	3.80E-06
					MAX	2.30E-02
					STD DEV	9.31E-03
					COUNT	6

Table 1 shows the stack test results used to develop the AP-42 emission factor (4.04 E-03 lbs/MMBtu). As shown the high emission test is 6,052 times greater than the lowest emission test, which led me to conclude the data was not normally distributed so that the arithmetic mean was not a valid statistic to represent the full data set; i.e. the high number is so large that it totally dominates the average to the extent that the average emission rate is 4 times higher than the second highest emission rate in the dataset. NCASI submitted additional documentation as to why the arithmetic mean was inappropriate (see Attachment 1). However, USEPA responded that the arithmetic average is appropriate and typically used in developing AP-42 emission factors, which assures a degree of conservatism in applying the factor to other sources.

The two high emission tests in the AP-42 dataset could also have been rejected on the basis that the control technology does not match the controls in place at Maine's large wood-fired boilers. The large wood-fired co-generation boilers typically have a mechanical collector in combination with ESP or fabric filter (baghouse). If these non-representative test results were eliminated from the dataset, the resulting data would be closely grouped with a range of 11.2 from low to high with an arithmetic average value of 2.31 E-05 lbs/MMBtu.

EPA provided a detailed spreadsheet entitled "tblAcrolein for Susan Lancy3" which is now rolled into the spreadsheet entitled "Acrolein EF Analysis3" which has been provided to the ATAC. This spreadsheet provides the backup data used to support the ERG emission factor for acrolein. I have reviewed the emission factors and other data presented in the spreadsheet and sorted the data into tests that I believe are representative of the wood-fired power plants as part of the MATI inventory process and those that I propose to reject. Table 2 lists those that I believe are representative.

Table 2. Acrolein Test Results Representative for Wood-Fired Boilers

Facility	*Capacity*	*Emission Factor (lbs/MMBtu)*	*Fuel*
Delano Energy Corp	31 MW	8.52E-06	Biomass
Inland Paperboard	270000 lbs steam	6.35E-05	gas/wood
BVTBC Genesee	38 MW	1.05E-04	wood + C&D + waste
BVTBC Genesee	38 MW	4.08E-07	wood + C&D + waste
BVTBC Genesee	38 MW	3.19E-06	wood + C&D + waste
Bernhardt Furniture		6.81E-05	wood + <15% adhesives
BVTBC Genesee	38 MW	4.05E-07	wood + C&D + waste
BVTBC Genesee	38 MW	1.04E-04	wood + C&D + waste
BVTBC Genesee	38 MW	3.18E-06	wood + C&D + waste
BVTBC Genesee	38 MW	4.64E-06	wood + C&D + waste
Craven County Wood	45MW	1.27E-04	Wood
Average		4.44E-05	

It is noteworthy that test results for several facilities that appear to be representative were eliminated on the basis of non-detects in the samples (i.e. Inland Paperboard, Yorktowne, Northern States Power, and Wood-Mode). Had 0 or ½ of the detection limit been reported for these 8 tests, the average would have been considerably lower.

Table 3 lists those test results that I propose to reject and the reason that I believe they are not representative of the wood-fired boilers for which the MATI Inventory Subcommittee is seeking an appropriate factor.

Table 3. Non-representative Acrolein Emissions and Basis

Facility	***Capacity***	***Reason for Rejection***
Minnesota Power	69 MW	Fuel was coal
Minnesota Power	69 MW	Fuel was coal
Baldwin Power	568 MW	Fuel was coal
Baldwin Power	568 MW	Fuel was coal
Ohio Edison - Niles	108 MW	Fuel was coal
Ohio Edison - Niles	108 MW	Fuel was coal
Ohio Edison - Niles	108 MW	Fuel was coal
EPRI Site 16	500 MW	Fuel was coal
Blandin Paper	195000 lbs	Fuel was coal/wood
Champion International	250000 lbs	Fuel was coal/wood
Kern Oil & Refining		Fuel was oil
Inland Paperboard	300000 lbs	Fuel was oil/industrial sludge/gas
BP Chemical		Fuel was process gas
BP Chemical		Fuel was process gas
BP Chemical		Fuel was process gas
BP Chemical		Fuel was process gas
Mead		No fuel information, Unit has cyclone, ESP, Venturi; Stack temp only 145ºF
Craven County Wood	45 MW	Fuel included 20% railroad ties
Georgia Pacific Corp		Testing was done on CFB "dump" stack
Georgia Pacific Corp		Testing was done on CFB "dump" stack

Tab 3 “Only Wood etc.” of the “Acrolein EF analysis 3” spreadsheet shows that the average emission factor from wood only in the data set was 8.52 E-06 lbs/MMBtu.

Conclusion:

Table 4 provides a summary of the possible emission factors that could be applied to large wood burning boilers in the MATI Inventory.

Table 4. Comparison of Alternative Acrolein emission Factors

Factor	Value	Units	Notes
AP-42	4.04 E-03	Lbs/MMBtu	Used in MATI for large wood combustors other than at pulp and paper mills – 10/7/05
ERG -2002 - wood	1.71 E-03	Lbs/MMBtu	Combustor type = other
NCASI	7.8 E-05	Lbs/MMBtu	Used in MATI for pulp and paper mills -10/7/05
ERG – 2002 -biomass	9.47 E-06	Lbs/MMBtu	Used in earlier versions of MATI – represents all boiler types - uncontrolled
AP-42 adjusted	2.31 E-05	Lbs/MMBtu	AP-42 data set eliminating tests from uncontrolled and wet scrubber controlled boilers; or because they are statistical outliers
AP-42 median	3.7 E-05	Lbs/MMBtu	Statistic for distribution that is not normal or log-normal
EF Analysis tab 3	8.52 E-06	Lbs/MMBtu	Wood combustion only
ERG adjusted	4.44 E-05	Lbs/MMBtu	Representative test data as shown in Table 2

I recommend the use of the NCASI emission factor (7.8 E-05 lbs/MMBtu) for all wood-fired boilers, not just those at pulp and paper mills. That factor is conservative from the perspective that it is somewhat greater than emission factors predicted by correcting either the AP-42 or ERG supporting test results to representative boiler types, fuel and control technology. Use of the NCASI factor for all wood burning boilers would not only make the MATI Inventory internally consistent, it would result in a more reasonable distribution of toxicity-weighted emissions between point, area and mobile source categories and a priority ranking list where the uncertainty of the acrolein data does not unreasonably elevate its importance relative to all other air toxic compounds on the list.

Attachment 1

NCASI Memo on Acrolein

NORTHERN REGIONAL CENTER

Western Michigan University

A-114 Parkview Campus, Mail Stop 5436

Kalamazoo, MI 49008

(269) 276-3550

FAX: (269) 276-3551

NATIONAL COUNCIL FOR AIR AND STREAM IMPROVEMENT, INC.

To: Mike Barden

From: Jay Unwin

Date: September 2, 2005

Subj: Statistics on Acrolein emission factors

You had asked about DEP's calculation of the arithmetic mean of emission rates to derive an emission factor for acrolein from wood-fired boilers. You indicated that the database DEP is using is as follows:

4.260E-05, 3.150E-05, 3.800E-06, 1.430E-05, 2.300E-02, 1.100E-03

The arithmetic mean of these values is 4.03E-3.

The arithmetic mean is generally used to represent the central tendency of a normally distributed population. I performed a standard (Kolmogorov-Smirnov) goodness-of-fit test on these data and found that the null hypothesis that the data come from a normal distribution can be rejected ($p<0.01$). The null hypothesis that the sample is from a lognormal population (i.e. logarithms of data normally distributed), often associated with environmental data, could not be rejected ($p=0.133$). The figures below illustrate. The closer the data fall to a straight line, the more likely the underlying population is normally distributed.

If the data are considered lognormally distributed, the appropriate central tendency statistic is the geometric mean, 1.1E-4.

If no particular distribution is assumed (other than it being monomodal) then the appropriate central tendency statistic is the median, 3.7E-5.

I am unfamiliar with the basis for the ERG and NCASI emission factors you cited (7.8E-6 and 7.8E-5, respectively, so I cannot comment on their validity. However, it would seem that further consideration of these factors is warranted, especially given that they are closer in value to the geometric mean and median cited above than they are to arithmetic mean DEP proposes to use.

Memo

Date: February 27, 2006

To: David Wright, Director Air Toxics and Emissions Inventory Program

Cc: Tammy Gould

MATI Stationary Source Committee

From: David Dixon

Subject: 2006 HAP Reporting Guidance

I offer the following comments in response to your inventory guidance memo dated February 1, 2006, FIRE emission factors used for estimating emissions from fuel burning and the three spreadsheets posted by the Department indicating default values that will be used in the absence of appropriate factors listed in the EPA FIRE database. I offer them now in hopes that revisions to the guidance can be incorporated prior to the Department's training program for facilities relevant to preparation of the HAP inventories for calendar year 2005.

Distillate Oil

I was disappointed that the DEP spreadsheet "HAP_EF_Distillate_v3" relies on the AP-42 emission factor for mercury. We spent considerable time and energy in the MATI process and introduced updated distillate oil analysis to demonstrate that the mercury content of distillate oil today is less than 5 ppb and reached agreement on a compromise emission factor of 0.036 lbs/million gallons (AP-42 factor is 4.2E-04 lbs/1000 gallons, i.e. 0.42 lbs/million gallons). The MATI value should be loaded into the i-STEPS calculation.

Acrolein is the HAP that triggers the need for a source combusting distillate oil to report. Neither the FIRE database nor AP-42 for external combustion boilers contains an emission factor for acrolein. The factor the Department has proposed to use for this source category is based on the emission factor for stationary internal combustion engines. The emissions profile from internal combustion engines is very different from boilers; therefore this substitution is not appropriate. The same is true for the next greatest factor, acetaldehyde. That is, there is no EPA emission factor for external combustion boilers burning distillate oil so the proposed Guidance substitutes a value appropriate for an internal combustion engine.

The next factor that would trigger the reporting threshold is ammonia. While there is no emission factor reported in AP-42, there is a factor for uncontrolled distillate oil combustion listed in the FIRE database; the same value used on your spreadsheet. Therefore the amount of distillate oil that would have to be burned to trigger the reporting threshold is

2,500,000 gallons. Based on the fuel use sheet from your spreadsheet "Copy of HAPS from Fuel Combust 2003(4b)", no source combusted 2,500,000 gallons of distillate oil although two sources were close. Only 5 sources combusted over 1,000,000 gallons and only 6 exceeded the 772,000 gallon threshold identified in the Guidance memo.

I think it is important to eliminate the factors substituted for internal combustion engines because using them will significantly exaggerate the amount of HAPS contributed from distillate oil and it leads to the impression that distillate oil is somehow more hazardous than residual oil, i.e. a facility triggers reporting at 772,000 gallons of distillate but does not trigger reporting until it reaches 1,600,000 gallons of residual oil (according to the Guidance Memo).

Residual Oil

I have reviewed the FIRE data base and the DEP proposed substitutions and can not identify a HAP factor for residual oil combustion that would trigger reporting at 1,600,000 gallons as stated in the Guidance Memo. The lowest threshold that I could find is for ammonia with an emission factor of 0.8 lbs/1000 gallons which results in a minimum consumption to trigger reporting at 2,500,000 gallons. Note that other entries for ammonia all involve selective catalytic reduction (SCR) or selective non-catalytic reduction (SNCR), both of which are NOX control technologies which inject ammonia into the exhaust gas and therefore are not representative of residual oil-fired boilers. To the best of my knowledge, there are no residual oil fired boilers in Maine using either SCR or SNCR.

I would also suggest removing methane from the spreadsheet "HAP_EF_Residual_v3" because methane is not a HAP. It is appropriate to use the methane emission factors for calculation of greenhouse gas emissions. Including it on this spreadsheet and also the greenhouse gas emissions calculator could result in double counting of methane emissions and because it is on a HAP spreadsheet will lead people to believe that it is a HAP.

Based on the fuel use sheet from your spreadsheet "Copy of HAPS from Fuel Combust 2003(4b)", only 14 sources combusted more than 2,500,000 gallons of residual oil.

Wood

The reporting threshold for wood stated in the Guidance Memo is 250 tons/year which seems to be based on the calculated value of 278 tons/year based on acrolein. It bears repeating that the FIRE database includes an emission factor of 4.0 E-06 lbs/ton of wood for boilers identified as having "miscellaneous control". The AP-42 factor is 4.0 E-03 lbs/MMBtu which translates to 3.6E-02 lbs/ton.

The DEP proposed substitution factors include ammonia at 0.31 lbs/ton of wood burned. Ammonia is not listed in AP-42 as being emitted from wood boilers and ammonia from wood burning sources listed in the FIRE database is associated with source categories using SCR or SNCR for control of NOx emissions. Since I believe that no wood burning boilers are using SCR or SNCR, the use of the proposed substitution factor for all wood burning boilers is not appropriate.

The minimum reporting threshold for wood boilers is so low that many sources that are below the air emission licensing threshold should report. It is unfair for the Department to threaten enforcement action on small wood burning sources such as lumber mills where the facility has not historically reported. This is especially troubling since the problem arises from the use of an acrolein emission factor that we believe greatly overstates actual emissions.

General

The MATI consensus document clearly identified a role for the Science Advisory Subcommittee to review and assist the Department in providing guidance for the 2005 HAPS emission statements so I believe it is appropriate for these issues to be addressed in the MATI process.

Since the majority of oil burning sources (both residual and distillate) will not trigger the reporting threshold, the enforcement threat for failure to sign and return emission factor sheets or to create i-STEP emissions at the process level is not appropriate for all but a handful of very large oil combustion sources. It seems like it should be easy for sources to report even though they are below the threshold based on the work the Department has done in preparation for the filing of the 2005 HAP updates; however, they should be encouraged to do so voluntarily. There should be no penalty for going beyond what Chapter 137 requires for reporting.

Finally, I think is important to initiate discussions with the Toxics Use Reduction program and the Toxics Release Inventory program to discuss ramification for calculating HAP emissions from fuel combustion that have not been previously reported to those programs. It is important not to release a report that shows significant increases in emissions or that HAPs are emitted from processes not previously identified.

I look forward to discussing these comments on the next Stationary Source Committee conference call.

Dirigo Environmental Consultants initiated efforts to revise DEP guidance on reporting of HAPs as shown in the following sequence of messages. HAP Corrrespondence

Dirigo Requests Guidance on 2004 Annual Emissions Statements.

March 27, 2005

David Wright
Director, Air Toxics and Inventory Section
Bureau of Air Quality
State House Station #17
Augusta, Maine 04333

Subject: Guidance on Filing Annual Emission Statements for 2005

Dear David:

As we have discussed on several occasions, I have been very defensive when the Bureau's quality control review of annual inventory statements have indicated errors in submittals that I have prepared for clients when in fact the "error" is attributed to using the emission factor built into the software package (i-STEPS) that the Bureau has selected as the standard format for reporting. In order to avoid disputes over the correct factor and approach, the Bureau should issue specific guidance through its listserver and notifications to sources concerning the submittal for calendar year 2004. Listed below are issues identified on emission statements that I prepared. I am sure there are others which should also be included.

1. **NOx emission factor for boilers**: I consistently used the i-STEPS NOx emission factor of 47 lbs/1000 gallons for several #6 oil fired boilers. The i-STEPS factor is also the AP-42 factor which is an A-rated emission factor. The QA review by licensing engineers suggested a change in every case with proposed values of 55 lbs/1000 gallons, 67 lbs/1000 gallons and 90 lbs/1000 gallons for different sources. The staff explained that they believed the AP-42 number was too low but in all cases failed to provide any documentation for the proposed higher alternative emission factors. The responsible party is then required to sign a certification statement "The data presented herein represents the best available information and is true and accurate to the best of my ability". Absent any continuous emissions monitoring data, stack test information, or technical supporting information from the Department supporting its alternative recommended emission factor, I have to say that the A-weighted emission factor (and i-STEPS factor) represents the "best available information". If the Bureau wants facilities to use a factor other than the one built into the required software, it should provide guidance prior to filing and a technical basis for it or amend the certification statement to say the estimates are based on the best available information "or emission factors provided by the Bureau of Air Quality".
2. **VOC emission factors for boilers**: In some cases alternative emission factors were also proposed for VOC. Same comments as per item 1.
3. **Use of allowable emission limit for particulate matter**: Multiple reviewers used the Chapter 103 allowable particulate emission rate instead of the i-STEPS and AP-42 emission factor for particulate matter. The allowable emission limit results in emission estimates much greater than using the fuel-specific emission factor. Since the purpose of the annual emission statement is to provide an estimate of actual emissions, use of the best estimate for actual emissions is appropriate.
4. **Use of allowable fuel sulfur content**: In one case the QA review proposed using the Chapter 106 allowable fuel sulfur content in lieu of the actual average sulfur content as calculated from records of fuel deliveries. Since the purpose of the annual emission statement is to provide an estimate of actual annual emissions, fuel sulfur content provides the best estimate for actual emissions.
5. **Annual fuel use**: During last years' training, participants were instructed to not use the 12 months of the previous year for the annual fuel use but rather use December from the previous year so that the winter season would be more accurately characterized. That instruction has not been widely distributed so that most reports are likely based on calendar year fuel use. The Bureau should clarify which method should be used.
6. **Greenhouse gas emission factor for wood**: The spreadsheet provided by the Bureau for estimating emissions of greenhouse gases provides a value of 3,814 lbs/CO_2 per ton of wood. The proposed factor was based on work by the National Council for Air and Stream Improvement (NCASI) and is based on wood on a dry-weight basis. The factor is therefore appropriate for dry wood with a heat content of 8500 to 9000 Btu/lb. Most wood burned in facilities required to report emissions under Chapter 137 are not burning dry wood but rather wood whose heat content is more typically 4500 Btu/lb. This results in two consequences: (1) the amount of CO_2 estimated to be emitted is likely over-estimated by a factor of close to 2, and (2) the amount of wood burned in reported facilities is similarly over-estimated. The latter has become an issue with respect to mercury emission estimates where there is a substantial difference in the amount of wood burned between the Chapter 137 reports and the DOE, Energy Information Administration reports that serve as the basis for state-wide energy use. Guidance should be provided to facilities that the factor is appropriate for dry wood or the Bureau should provide a factor for 50% moisture wood as is provided in the referenced NCASI documentation.

Thank you for the opportunity to provide some input prior to the scheduled training in advance of the filing deadline for the 2004 emission statements. I believe that if you supplement the scheduled training with guidance on each of these issues and inform sources in advance of reporting, consistency will be greatly enhanced. I remain available to work with you or your staff to improve the technical credibility of the emissions inventory.

Sincerely yours,

Dirigo Environmental Consultants

David W. Dixon, P.E.

Proposed Climate Change Action Plan Is Not the Best Public Policy for Maine

A copy of the Maine Climate Change Action Plan is available at: http://maineghg.raabassociates.org/finalplan.asp

The Plan now proposed will impose higher costs on Maine consumers and businesses alike with no corresponding measurable benefit to the dynamics of global climate change. With a Company name of Dirigo, I clearly agree that Maine should lead with good public policy. Good public policy, however, must weigh the public benefits against the investment of public and private resources to combat global warming and proceed only when such investment is shown to be more important than investment in health, education, and all other services. In fact, the Department's Plan prioritizes the reduction of greenhouse gas emissions above air quality strategies to reduce VOC and NOx emissions which are known to contribute to unhealthful concentrations of ozone along southern coastal sections of Maine. Similarly, the proposed Plan ignores important findings and recommendations being developed by the Maine Air Toxics Initiative (MATI) stakeholder process.

The Department's Plan purports CO_2 reductions to achieve the legislated targets but fails to acknowledge the cost of implementation. Even those options which will result in net long-term energy savings come with a price tag. It is not sufficient to report a positive rate of return over the next ten or twenty years. The plan must delineate the initial investment in each option, who will be required to make the investment, who will be the beneficiary and how many years of investment will be required before the option achieves revenue neutrality. To demonstrate that the Plan is good public policy, the Department should show total annual costs (and CO_2 reductions) for each of the 54 proposed options starting in 2005 through 2020 and beyond.

Strategies are made to sound cost effective by presenting them in terms of dollars per ton of reduction of greenhouse gas emissions as has been done for demonstrating the cost effectiveness of strategies to control emissions of criteria air pollutants for years. This is akin to comparing apples and oranges. For example, CO_2 emissions from burning 1000 gallons of oil amounts to 25,000 lbs while NOx emissions, one of the contributors to our ozone nonattainment problem, are on the order of 40 lbs from the same 1000 gallons.

The Plan proposes costs associated with reducing emissions from existing oil fired units with a cost-effectiveness in terms of $1,325/1000 gal. Implementation of the proposed recommendations therefore equates to a cost of more than $1.00/gallon for every gallon of oil replaced. The Department should consider this cost in context with other programs. For example compare the proposed costs to the NOx RACT or VOC RACT programs which mandate reductions that are cost-effective to reduce ozone pollution for which the coastal areas continue to be in nonattainment. The same 1000 gallons of residual oil would result in 47 lbs of NOx emissions. RACT controls have been found to be unwarranted at costs over something in the range of $5,000 - $10,000/ton. Using $8,000/Mton means that the RACT level of control for NOx is approximately equal to $171/1000 gallons. Thus, in terms of air quality management, implementation of the greenhouse gas consensus measures for the electricity sector have the effect of setting the greenhouse gas emission reduction program at 10 times greater priority than the coastal Maine ozone nonattainment program.

Recommendations to re-start non-operating and to subsidize existing biomass electrical generation facilities is in direct opposition to the goals advocated by the DEP's own Air Toxics Advisory Committee. The MATI process has evaluated the relative "toxicity" of emissions for various source categories. Wood burning sources are high on the list of point sources and dominate the area source category. For example, on a Btu basis the amount of manganese emitted from a wood burning boiler is 80 times what it would be from a residual oil-fired boiler. Also high on the area source list are emissions from chain saws and other 2-cycle gasoline engines, whose emissions would increase with any strategy increasing the amount of wood harvested.

Any increase in wood burning will be associated with a significant increase in air toxic emissions compared with generating the same electricity with conventional oil burning. The GHG ranking system should take such negative environmental impacts into account when comparing one option against another or individually before the option is selected in the same way that a best available control technology (BACT) analysis requires consideration of other environmental impacts in addition to the cost-effectiveness of a candidate air pollution control technology.

The Plan goes beyond all other state efforts by seeking to reduce black carbon emissions from diesel engines but advocates options that will increase particulate emissions from biomass burning facilities without even considering the potential deleterious effect that the black carbon content of the particulate emissions may have.

One danger of the local approach to a global issue is the tendency to fail to account for all impacts regardless of where in the world they occur. Strategies advancing the use of natural gas and liquefied natural gas (LNG) should account for pipeline losses in the exporting nations as well as the energy required to liquefy and transport such fuels. Full "life-cycle" accounting is critical for good public policy.

The Department should consider an alternative approach of initially implementing only those strategies which have a negative cost-effectiveness value meaning that if funded the option will provide GHG reductions beyond the direct costs. While such a strategy does not achieve the legislative targets, neither does full implementation of all consensus recommendations. Many other states have taken this approach, calling it the "no regrets" strategy. That is there will be no regret that the strategy was implemented because of the positive impact it will have on energy efficiency or conservation. Meaningful Climate Change Action Plans must be International in scope and be based on good science.

Low Sulfur Oil Limits Imposed Through Air Emission Licenses

The Bureau of Air Quality has been ratcheting down the sulfur content for #2 oil on new or renewed air emission licenses to 0.3% sulfur (S). Distillate (#2) oil has a nominal sulfur specification of 0.5% sulfur (S) and much of it does meet the 0.3% requirement. The net effect of this policy is much paper work to document compliance with no reduction in total sulfur dioxide emissions. The reason is simple. All #2 oil entering Maine is less than 0.5% S and much is below 0.3% S. The license requires that a specific licensed source must get its fuel from a tank storing the compliant low S oil forcing the source and suppliers to keep records to document that its fuel came from a low sulfur cargo. Other sources consequently burn higher average sulfur oil. It is possible that there could be a period of tight supplies when 0.3% S is not readily available and it could then be sold at a premium. For the most part; however, this policy amounts to no more than reducing the sulfur from one stack while increasing it from another for no net environmental benefit. In fact, this policy results in an environmental dis-benefit; burning the best quality oil for licensed sources such as remote asphalt batching plants means that the higher sulfur loads are burned by the smaller, unlicensed, sources such as commercial and residential buildings in built up areas where there is more public exposure. Both the Bureau of Air Quality and licensed sources commit significant resources to assure compliance. Many sources end up in the position of possible violation if conforming fuel is unavailable.

Correspondence with DEP concerning Greenhouse Gas emission factors for biomass burning in boilers