Appendix 9N

Smurfit-Stone Container Company BART Technical Analysis

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1.0 Introduction to The Regional Haze Rule

On July 1, 1999, the Environmental Protection Agency (EPA) finalized a rules package known as the "Regional Haze Regulations. The purpose of the regulation is to limit visibility-impairing emissions of particulate matter, sulfur and nitrogen compounds that impact federal Class I areas. These Class I areas include national parks, wilderness areas, and select areas of the country for which scenic views are considered an important attribute. As required by Section 169B of the Clean Air Act, the Regional Haze Regulations include Best Available Retrofit Technology (BART) provisions for certain sources that may reasonably be anticipated to cause or contribute to any impairment of visibility in a Class I area. More specifically, BART applied to sources within 26 specific source categories that were constructed between 1962 and 1977 and that have the potential to emit 250 tons per year of visibility impairing pollutants. The rule requires states to submit implementation plans for visibility improvement to EPA no later than December 31, 2007. The state must revise the implementation plan and submit the revision by July 31, 2018 and every ten years thereafter.

On July 6, 2005, EPA issued another final rule, titled "Regional Haze Regulations and Guidelines for Best Available Retrofit Technology." This rule lays out the procedural requirements for determination of Best Available Retrofit Technology (BART) for control of visibility-impairing pollutants for sources that may reasonably be anticipated to cause or contribute to any impairment of visibility in a Class I area. The EPA defines BART as follows:

> *"Best Available Retrofit Technology (BART) means an emission limitation based on the degree of reduction achievable through the application of the best system of continuous emission reduction for each pollutant which is emitted by a BART-eligible source. The emission limitation must be established, on a case-by-case basis, taking into consideration the technology available, the costs of compliance, the energy and non-air quality environmental impacts of compliance, any pollution control equipment in use or in existence at the source, and the degree of improvement in visibility which may reasonably be anticipated to result from the use of such technology."*
>
> *The BART analysis identifies the best system of continuous emission reduction taking into account:*
>
> 1. *The available retrofit control options*
> 2. *Any pollution control equipment in use at the source (which affects the availability of options and their impacts).*
> 3. *The costs of compliance with control options*

4. *The remaining useful life of the facility*
5. *The energy and non-air quality environmental impacts of control options*
6. *The visibility impacts analysis*

Only one source at the Smurfit-Stone facility in Ontonagon, Michigan, the Riley Boiler #1, meets the BART eligibility requirements. This report documents the BART applicability determination process for that boiler. The report includes a review of the state/regional planning organization efforts at determining BART eligibility, updating the baseline conditions to 2005-2006 emission averages so as to reflect emission reductions already implemented at the source. Based on the information presented in the following sections, Smurfit Stone does not believe that BART requirements apply to the Ontonagon facility.

2.0 Existing Equipment

2.1 Riley Boiler

The Riley Boiler #1, installed in 1966, was designed to burn pulverized coal, wood waste, natural gas, and oil. When the mill installed emission control equipment for the Pulp and Paper MACT, the boiler was modified to also burn non-condensable gases (NCG). Wood waste is no longer fired and natural gas and oil are seldom fired.

Rated heat input is 375 MMBtu/hr. Flue gas emissions are controlled with multiclones and a Belco electrostatic precipitator which was installed in 1983. The design flue gas flow at the boiler outlet is 160,000 ACFM at a temperature of 475ºF.

2.2 Electrostatic Precipitator

A weighted-wire electrostatic precipitator (ESP) has been in place at the facility since 1983. The ESP removes particulates in the flue gas via electric forces. The particulates are given an electrical charge as they pass through the ESP and an electrical field forces the particulates to the collector plates. The collector plates are rapped to remove particulates from the collector which are then collected in a hopper at the bottom of the ESP. The ESP was designed for a gas flow rate of 160,000 ACFM at a temperature of 475ºF. Recent stack test reports have shown the ESP to be in excellent working condition with particulate removal efficiencies exceeding 99.9%.

2.3 Low NOx Burners

Riley Boiler #1 was retrofitted in 1995 with four low-NOx burners designed to burn pulverized coal. Low-NOx burners (LNBs) are designed to "stage" combustion. In this technology, a fuel-rich combustion zone is created by forcing additional air to the outside of the firing zone and by delaying the combustion of coal.

The burners are DB Riley model 3A Controlled Combustion Venturi (CCV). The design of these burners incorporates a venturi coal nozzle and spreader to reduce NOx emissions. The venturi nozzle concentrates the pulverized coal and primary air into a fuel-rich mixture. The fuel/air mixture passes over spreader blades that divide the mixture into distinct streams. Devolatilization of the coal in the fuel-rich mixture occurs at the burner exit in an oxygen-lean primary combustion zone, resulting in lower fuel NOx conversion. The streams enter the furnace in a helical pattern, resulting in gradual mixing of the coal and secondary air. Secondary air is introduced outside the primary combustion zone to further burn the fuel. Peak flame temperature is thus reduced and thermal NOx formation is suppressed.

Following installation of the LNBs, the NOx emission from Boiler #1 was approximately 0.75 lbs/MMBtu (2004).

2.4 Flame Stabilization Rings

To improve combustion and lower the NOx emissions after installation of the LNBs, flame stabilizer rings were installed during the fall of 2004. The most recent stack test resulted in a NOx emission rate of 0.403 pounds NOx per MMBtu.

2.5 Boiler MACT Compliance

SSCC has been required to address emissions of mercury and hydrogen chloride from the Riley Boiler under the NESHAP for Industrial/Commercial/Institutional Boilers and Process Heaters, commonly referred to as the Boiler MACT. To meet these requirements SSCC has begun installation of a multi-pollutant control system from Mobotec USA.

Mobotec System

The design and construction of a pollution control system from MobotecUSA is currently underway in an effort to ensure compliance with Boiler MACT. The Mobotec system was chosen to meet Boiler MACT requirements in large part due to their system's inherent reduction in NOx and because the system provides the potential for incorporating pollutant control upgrades for other pollutants.

The Mobotec control package is based on a Rotating Opposed Fired Air (ROFA) fan system. The ROFA fan system will supply high velocity air to multiple ROFA boxes installed at key locations inside the furnace of the boiler. This allows the boiler to achieve higher combustion efficiencies and lower pollutant emissions. The design and locations of the ROFA boxes are determined through computational fluid dynamics (CFD).

Below is Mobotec's description of their ROFA system taken from their website:

> *The volume of the furnace is set in rotation via special asymmetrically placed air nozzles. The combustion gases mix well with the added air, making a combustion gas swirl. This generates turbulence and rotation in the entire furnace. Rotation prevents laminated flow and the whole volume of the furnace can be used more effectively for the combustion process. The ROFA® swirl reduces the maximum temperature of the flames and increases heat absorption, which in turn improves the boilers overall efficiency. With the ROFA® technique surplus air can be reduced without increasing CO or other unwanted substances. The combustion*

air is mixed more effectively. The result is less cooling of the furnace due to unused combustion air, thereby increasing efficiency.

Some of the documented advantages of the ROFA techniques are:

- *Less temperature variation in the cross section of the furnace.*
- *A more even distribution of combustion products in the cross-section of the furnace (e.g., CO, NOx, SOx etc.)*
- *Rotary mixing dramatically reduces fly ash (i.e. unburnt content in the flue gas).*
- *Lower CO levels mean less surplus air. Less surplus air (O2) means less NOx and higher overall efficiency.*
- *Increased heat absorption from the furnace itself results in lower outgoing furnace temperature and potential increased energy output.*
- *Less temperature variation of superheated steam.*

To meet Boiler MACT requirements, Smurfit Stone is installing the ROFA system and a sorbent injection system (MinPlus) for control of mercury emissions. Smurfit-Stone expects that this system will also provide further NOx reductions from the Riley Boiler.

3.0 BART Applicability Determination

The regional haze rules established a multi-step process for determining which existing sources must apply BART.

3.1 BART 'Eligible' Sources

In the first step of the process, the state, on its own or through its Regional Planning Organization (RPO) develops a list of sources that; were installed between August 1962 and August 1977, belong to one of the 26 named source categories listed in Table 1., and have aggregated potential emissions within a single category exceeding 250 tons per year for any one of the BART pollutants; sulfur dioxide, nitrogen oxides, particulate matter, VOC.

Table 1. 26 Named Source Categories Where BART-Eligible Source May be Found

(1) Fossil-fuel fired steam electric plants of more than 250 million British thermal units per hour heat input
(2) Coal cleaning plants (thermal dryers)
(3) Kraft pulp mills
(4) Portland cement plants
(5) Primary zinc smelters
(6) Iron and steel mill plants
(7) Primary aluminum ore reduction plants
(8) Primary copper smelters
(9) Municipal incinerators capable of charging more than 250 tons of refuse per day
(10) Hydrofluoric, sulfuric, and nitric acid plants
(11) Petroleum refineries
(12) Lime plants
(13) Phosphate rock processing plants
(14) Coke oven batteries
(15) Sulfur recovery plants
(16) Carbon black plants (furnace process)
(17) Primary lead smelters
(18) Fuel conversion plants
(19) Sintering plants
(20) Secondary metal production facilities
(21) Chemical process plants
(22) Fossil-fuel boilers of more than 250 million British thermal units per hour heat input
(23) Petroleum storage and transfer facilities with a capacity exceeding 300,000 barrels
(24) Taconite ore processing facilities
(25) Glass fiber processing plants
(26) Charcoal production facilities.

The Riley Boiler at the Ontonagon facility is subject to BART under source category 22, Fossil-fuel boilers of more than 250 million British thermal units per hour heat input.

3.2 Determine 'Reasonable Cause or Contribution to Visibility Impairment'

Following identification of BART-eligible sources, the states were to determine whether the sources collectively impaired visibility at a Class I area, and whether a specific source could cause or contribute to impairment. In general terms, this involved determining whether the amount of pollutant emitted and the distance of the source from the Class I area allowed emissions from the source to impact visibility in the Class I area. In the *Guidelines for BART Determinations Under the Regional Haze Rules* (Appendix Y to 40 CFR Part 51), EPA defined 'causing impairment' as demonstrating a modeled impact on visibility exceeding 1.0 deciviews. A source was said to 'contribute to impairment' if its modeled visibility impact exceeded 0.5 deciviews. Further, EPA specified that those thresholds be evaluated based on the 98th percentile modeled impact, which means that the impacts must be indicated for more than seven days per year.

What is a deciview? A deciview is defined as an atmospheric haze metric that expresses uniform changes in visibility regardless of the background. A one deciview change in visibility is thought to be the level of perceptible change that can be noted with the human eye. The measure is related mathematically to the common visibility parameters of light extinction coefficients and visual range; however, it remains a somewhat subjective measure.

The states were given a variety of options for determining whether the BART-eligible source could reasonably cause or contribute to impairment.

- Decide that all BART-eligible sources in the state do cause or contribute to visibility impairment.
- Demonstrate that all of the BART-eligible sources do NOT cause or contribute to visibility impairment.
- Evaluate BART-eligible sources individually to determine whether they contribute to visibility impairment. This could be accomplished by using an emission rate-to-distance (Q/D) from the Class I area metric, or via regional modeling.
- Use a conservative 'model facility' approach that establishes very conservative parameters for a facility, then modeling the impacts of that facility to estimate which BART eligible sources may cause or contribute to visibility impairment.

Michigan has chosen to use the individual source evaluation method.

3.3 State/RPO BART Applicability Determinations

The Michigan Department of Environmental Quality (MDEQ), through the regional planning organization, Lake Michigan Air Directors Consortium (LADCO), conducted modeling of all sources to determine impacts to visibility in Class I areas. The model was developed by LADCO using 2004 MAERS inventory data for the Riley Boiler at the Smurfit-Stone facility (although PM emissions were omitted). The model evaluated visibility impacts from the Riley Boiler upon four Class I areas that fall within the 500 kilometer radius of the facility. Of the four Class I areas evaluated, Voyageur's National Park and Boundary Water Canoe Area in Minnesota, and Seney Wilderness and Isle Royale in Michigan, impacts were indicated only at Isle Royale.

The LADCO model indicated visibility impacts exceeding 0.5 deciviews for more than seven days for the years 2002, 2003 and 2004 meteorological data sets. We have rerun the original LADCO model using their selected model settings and background concentration assumptions, but with two exceptions: LADCO had originally modeled using background values for ammonium sulfate and organic carbon that were established for the Western U.S. – we have changed those background values to reflect the more appropriate Eastern U.S. values. Secondly, we have included the PM emissions that were mistakenly omitted from the original LADCO analysis.

Table 2. LADCO Model Results Using 2004 MAERS Data

Met Year	Days > 0.5 dv
2002	22
2003	21
2004	11

The results of the LADCO model run using the 2004 MAERS emission data, predicts that the Riley Boiler contributes to visibility impairment at Isle Royale.

3.4 Updating the Baseline

Since the baseline emissions were established in 2004, SSCC has implemented additional controls that have reduced the emission of visibility impairing pollutants. As a result, the visibility impact of the Riley Boiler has also been reduced from that indicated by the LADCO baseline model results. In the preamble to the July 20, 2001 Proposed BART Determination Guidelines, EPA says "For purposes of estimating actual emissions, these guidelines take a similar approach to the current definition of actual emissions in NSR programs. That is, the baseline emissions are the average annual emissions from the two most recent years…" This approach was unchanged in the July 6, 2005 final rule. Table 3 presents the MAERS emission inventory information for years 2005 and 2006 and the average of emissions during those two years.

Table 3. 2005, 2006 and Average MAERS Data for Smurfit Stone

Pollutant	2005 (TPY)	2006 (TPY)	Two-Year Average
SO2	2914	2846	2880
NOx	715	628	671.5
PM10	37	38	37.5

Modeling of visibility impacts at Isle Royale was then completed using the updated baseline condition. Table 4 lists the number of days each modeled year with visibility impacts exceeding the 0.5 dv change threshold. Use of the updated baseline period shows that reductions already made by SSCC have significantly reduced the predicted impacts.

Table 4. Model-Predicted Visibility Impacts Using the Updated 2005-2006 Emissions Data

Met Year	Days > 0.5 dv
2002	17
2003	15
2004	7

3.5 Impacting Isle Royale?

As stated on the official Isle Royale Park Service website, Isle Royale "*is one of the few national parks to close during the winter.*" The Park is closed from November 1 through April 16 and operates under reduced hours during May, June and September. Due to harsh conditions, even park management leaves the island during the winter months, relocating to Houghton, Michigan. Not only is the park 'closed' during the winter months, the Park Services states on their website that it is not possible to reach the park during these months:

> *"A National Atmospheric Deposition Program/National Trends Network (NADP/NTN) wet deposition monitor has been operating at Wallace Lake in Isle Royale NP (site #MI97) since 1985. Because the site can't be accessed for winter sampling, data don't meet the completeness criteria required by NADP/NTN for a trend analysis."*
>
> (From http://www2.nature.nps.gov/air/Permits/ARIS/isro/ (accessed March 21, 2007))

Isle Royale differs from the majority of Class I areas because there is no physical way for the park to be observed by visitors, day or night, for nearly half of the year. This brings into question whether it is appropriate to calculate visibility impact values in the same manner for Isle Royale as for other Class I areas which are staffed and open to visitors on a year-round basis. Considering that the park is closed for 5.5 months, or 46 percent of the year, SSCC proposes that the updated baseline case could be represented as shown in Table 5 below, where the number of days with predicted impact exceeding 0.5 dv is multiplied by the 54 percent of the year that the park is operating. It should also be noted that no

additional adjustment was made for the significant amount of time that the park is open, but operating under reduced hours.

Table 5. Updated Baseline Model Results Scaled for Park Closure Period

Met Year	Days > 0.5 dv
2002	9.18
2003	8.10
2004	3.78

Taking the average of the values shown in Table 5 leads to an average of 7.02 days with predicted visibility impact greater than 0.5 dv. This is less than the 98th percentile value for number of days per year : (365 * (1-0.98) = 7.3 days with deciview changes greater than 0.5 dv) , which indicates that the Riley Boiler does not contribute to visibility impairment at Isle Royale. Per the Regional Haze Regulations, BART requirements apply only to sources that may reasonably be anticipated to cause or contribute to impairment of visibility in a Class I area.

SSCC urges that MDEQ determine that the Riley Boiler can not be found to reasonably cause or contribute to appreciable visibility degradation at Isle Royale, and therefore BART does not apply to the Riley Boiler.

4.0 Summary

Smurfit Stone Container Corporation (SSCC) believes that the Riley Boiler at the Ontonagon, Michigan facility does not sufficiently impact visibility at Isle Royale to require installation of BART controls. The continuous improvement in boiler operation and control over recent years, and the current installation of controls to meet requirements of the Boiler MACT have or will reduce potential visibility impacts from the boiler. This claim is further strengthened by the fact that Isle Royale is unique among Class I areas in that there is virtually no access to the park for nearly half of the year. By discounting the modeled visibility impacts to reflect this lack of access, it appears that the Riley Boiler may produce visibility impacts of greater than 0.5 deciviews on an average of only 7.02 days per year, which is below the 7.3 day threshold that is the 98th percentile value as specified in the BART regulations. SSCC therefore concludes that the Riley Boiler does not cause or contribute to visibility impairment in a Class I areas and therefore, is not subject to the requirement to install BART controls.

Appendix A

CALPUFF Protocol

CALPUFF Protocol

The following model settings were employed in all modeling described in this report. In an effort to facilitate the MDEQ review process, SSCC chose to use the regional modeling approach conducted by LADCO with only minor modifications or corrections. Model output files from CALPUFF and the CALPOST utility are included in the appendices to this report.

CALPUFF Modeling Protocol for SSCC BART Impacts Analysis

Model Selection

Regional visibility modeling was performed for the Smurfit Stone Container Corporation (SSCC) in Ontonagon, Michigan, using Bee-Line Software's Professional CALPUFF Version 2.34.0, a Graphical User Interface (GUI) which interfaces with the EPA CALPUFF 2004 Version. This program implements CALPUFF version 5.756 and CALPOST version 5.6393.

Modeling Protocol

The modeling protocols supplied by the Midwest Regional Planning Organization (MRPO) and LADCO were consulted during the development of the SSCC facility model. Recommended default model values were taken from the LADCO protocol. The Interagency Workgroup on Air Quality Modeling (IWAQM) Phase 2 Report and Recommendations for Modeling Long Range Transport Impacts was also consulted during the development of the model and served as the starting point for the SSCC modeling effort.

Modeling Domain

The CALPUFF modeling domain is the RPO grid used by LADCO, a Lambert conformal grid projection centered at 97W, 40N with true latitudes at 33N and 45N and origin at -900 km, -1620 km. There are 97 36-km grid cells in the east-west direction and 90 36-km grid cells in the north –south direction to make up the horizontal domain. The vertical domain contains 16 layers up to 15 km in the atmosphere with higher resolution in the boundary layer.

Meteorological Data

Meteorological data were supplied by LADCO. The CALMET data files were created using MM5 output files. All meteorological data are in 36 km resolution. Each met file contains the data for one day. To retain consistency with the LADCO model, no observation data were added to the MM5-generated CALMET files. The LADCO data set includes calendar years 2002, 2003 and 2004.

Terrain

Terrain effects were incorporated by LADCO in the development of the MM5 data and 36-km grid development.

Receptors

Pre-defined receptors established by the Federal Land Managers were added to the Federal Class I Area of Isle Royale. A total of 966 receptors at ground level are included in the Class I area.

Species Modeled

Sulfur dioxide, sulfate, nitrogen oxides, nitric acid, nitrates and particulate matter less than 10 micrometers in diameter (PM_{10}) are the species modeled for the SSCC facility. Sulfur dioxide, nitrogen oxides and PM_{10} are modeled as emitted and all species are modeled as deposited. The CALPUFF chemical transformation algorithms general sulfate and nitrate concentrations.

Model Settings

The model was set to output for concentrations and visibility in 24-hour averages. Visibility settings identified sulfate, nitrate, and coarse particles (PM_{10}) to be included in computing total light extinction. Rayleigh scattering was set equal to 10. The particle growth curve for hygroscopic species was set to the FLAG (2000) f(RH) tabulation. The method used for background light extinction is Method 6; FLAG RH adjustment factor applied to observed and modeled sulfates and nitrates computed using monthly relative humidity factors. The relative humidity factors used for each month are listed in Table 6 below. Table 7 shows the monthly background concentrations used. In both cases, values are taken directly from LADCO.

Table 6. Assumed Background Relative Humidity Values

Month	Relative Humidity	Month	Relative Humidity
January	3.1	July	3.0
February	2.5	August	3.2
March	2.7	September	3.8
April	2.4	October	2.7
May	2.2	November	3.3
June	2.6	December	3.3

Table 7. Assumed Monthly Background Concentrations

Component	Background Concentration ($\mu g/m^3$)
Ammonium sulfate	0.2
Ammonium nitrate	0.1

Component	Background Concentration (μg/m^3)
Coarse particles	3.0
Organic carbon	1.5
Soil	0.5
Elemental carbon	0.02

Model Settings Compared to Default Values

Both IWAQM and LADCO recommend default model settings in their modeling protocols. These default settings have been used for most variables in the model. The CALPUFF variables, the IWAQM default value, the LADCO default value and the value used in the SSCC model are shown in Table 8 below. Any differences are highlighted in gray and are explained below. Where IWAQM and LADCO guidance differed, the SSCC model generally follows the LADCO methodology. CALPOST defaults are shown in Table 9.

Table 8. CALPUFF Settings and Default Values

Input Group	Variable	Description	IWAQM Default	LADCO Default	SSCC Model Value
1	AVET	Minutes	60	60	60
1	PGTIME	Minutes		60	60
2	MGAUSS	1=Gaussian	1	1	1
2	MCTADJ	3=partial plume path adjustment	3	3	3
2	MCTSG	Subgrid-scale complex terrain flag modeled?	No	No	No
2	MSLUG	Near-field puffs modeled as elongated?	No	No	No
2	MTRANS	Transitional plume rise modeled?	Yes	Yes	Yes
2	MTIP	Stack Tip Downwash Used?	Yes	Yes	Yes
2	MSHEAR	Vertical wind shear modeled?	No	No	No
2	MSPLIT	Puff splitting allowed?	No	No	No
2	MAQCHEM	Aqueous phase transformation modeled?		No	No
2	MWET	Wet removal modeled?	Yes	Yes	Yes
2	MDRY	Dry deposition modeled?	Yes	Yes	Yes
2	MDISP	Dispersion Coefficients used	3 PG dispersion coefficients for RURAL areas (computed using ISCST multi-segment approximation) and MP coefficients in	3 PG dispersion coefficients for RURAL areas (computed using ISCST multi-segment approximation) and MP coefficients in	3 PG dispersion coefficients for RURAL areas (computed using ISCST multi-segment approximation)

Input Group	Variable	Description	IWAQM Default	LADCO Default	SSCC Model Value
			urban areas	urban areas	and MP coefficients in urban areas
2	MROUGH	PG sigma-y,z adjusted for roughness?	No	No	No
2	MPARTL	Model partial plume penetration?	Yes	Yes	Yes
2	MPDF	Use PDF for convective dispersion	No	No	No
2	MSGTIBL	Use TIBL module?	No	No	No
4	MESHDN	Nesting factor for sampling grid?	Yes	Yes	Yes
9	RCUTR	Reference cuticle resistance (s/cm)	30	30	30
9	RGR	Reference ground resistance (s/cm)	10	10	10
9	REACTR	Reference reactivity	8	8	8
9	NINT	Number of particle-size intervals	9	9	9
9	IVEG	Vegetation state in unirrigated areas active and unstressed?	Yes	Yes	Yes
11	BCKO3	Background Ozone concentrations (ppb per month)	80, 80, 80, 80, 80, 80, 80, 80, 80, 80, 80, 80	31, 31, 31, 37, 37, 37, 33, 33, 33, 27, 27, 27	31, 31, 31, 37, 37, 37, 33, 33, 33, 27, 27, 27
11	BCKNH3	Background ammonia concentrations (ppb per month)	10, 10, 10, 10, 10, 10, 10, 10, 10, 10, 10, 10	0.3, 0.3, 0.3, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5	0.3, 0.3, 0.3, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5
11	RNITE1	Nighttime SO2 loss rate (%/hr)	0.2	0.2	0.2
11	RNITE2	Nighttime NOx loss rate (%/hr)	2.0	2.0	2.0
11	RNITE3	Nighttime HNO3 loss rate (%/hr)	2.0	2.0	2.0
12	SYTDEP	Horizontal size (m) to switch to time dependence	550	550	550
12	MHFTSZ	Use Heffter for vertical dispersion?	No	No	No
12	JSUP	PG Stability class above mixed layer	5	5	5
12	CONK1	Stable dispersion constant	0.01	0.01	0.01
12	CONK2	Neutral dispersion constant	0.1	0.1	0.1
12	TBD	Transition for downwash algorithms	0.5 ISC Transition-point	0.5 ISC Transition-point	0.5 ISC Transition-point
12	IURB1	Beginning urban landuse type	10	10	10
12	IURB2	Ending urban landuse type	19	19	19
12	XMXLEN	Maximum slug length in units of DGRIDKM	1.0	1.0	1.0

Input Group	Variable	Description	IWAQM Default	LADCO Default	SSCC Model Value
12	XSAMLEN	Maximum puff travel distance per sampling step (units of DGRIDKM)	1.0	1.0	1.0
12	MXNEW	Maximum number of puffs per hour	99	99	99
12	MXSAM	Maximum sampling steps per hour	99	99	99
12	NCOUNT	Number of iterations used when computing the transport wind for a sampling step that includes gradual rise		2	2
12	SYMIN	Minimum lateral dispersion of new purr (m)	1.0	1.0	1.0
12	SZMIN	Minimum vertical dispersion of new puff (m)	1.0	1.0	1.0
12	SVMIN	Array of minimum lateral turbulence (m/s)	0.5, 0.5, 0.5, 0.5, 0.5, 0.5 for land 0.37, 0.37, 0.37, 0.37, 0.37, 0.37 for water	0.5, 0.5, 0.5, 0.5, 0.5, 0.5 for land 0.37, 0.37, 0.37, 0.37, 0.37, 0.37 for water	0.5, 0.5, 0.5, 0.5, 0.5, 0.5 for land 0.37, 0.37, 0.37, 0.37, 0.37, 0.37 for water
12	SWMIN	Array of minimum vertical turbulence (m/s)	0.20, 0.12, 0.08, 0.06, 0.03, 0.016	0.20, 0.12, 0.08, 0.06, 0.03, 0.016	0.20, 0.12, 0.08, 0.06, 0.03, 0.016
12	CDIV	Divergence criterion for dw/dz across puff used to initiate adjustment for horizontal convergence (1/s)	0.01	0.00, 0.00	0.00, 0.00
12	WSCALM	Minimum wind speed (m/s) allowed for non-calm conditions	0.5	0.5	0.5
12	XMAXZI	Maximum mixing height (m)	3000	3000	3000
12	XMINZI	Minimum mixing height (m)	50	50	50
12	WSCAT	Default wind speed classes		1.54, 3.09, 5.14, 8.23, 10.8	1.54, 3.09, 5.14, 8.23, 10.8
12	PLX0	Default wind speed profile power-law exponents for stabilities 1-6		0.07, 0.07, 0.10, 0.15, 0.35, 0.55	0.07, 0.07, 0.10, 0.15, 0.35, 0.55
12	PTG0	Default potential temperature gradient for stable classes E, F (deg K/m)	0.020, 0.035	0.020, 0.035	0.020, 0.035
12	PPC	Default plume path coefficients for each stability class	0.50, 0.50, 0.50, 0.50, 0.35, 0.35	0.50, 0.50, 0.50, 0.50, 0.35, 0.35	0.50, 0.50, 0.50, 0.50, 0.35, 0.35
12	SL2PF	Slug-to-puff transition criterion factor equal to sigma-y/length of slug		10	10

Input Group	Variable	Description	IWAQM Default	LADCO Default	SSCC Model Value
12	NSPLIT	Number of puffs that result every time a puff is split vertically	3	3	3
12	IRESPLIT	Time of day when split puffs are eligible to be split once again; typically set once per day around sunset before nocturnal shear develops	User Defined	17	17
12	ZISPLIT	Previous hour's mixing height (minimum) (m)	100	100	100
12	ROLDMAX	Previous maximum mixing height / current mixing height ratio, must be less than this value to allow puff split	0.25	0.25	0.25
12	NSPLITH	Number of puffs that result every time a puff is split horizontally		5	5
12	SYSPLITH	Minimum sigma-y (grid cell units) of puff before it may be split		1.0	1.0
12	SHSPLITH	Minimum puff elongation rate (SYSPLIT/hr) due to wind shear before it may be split		2.0	2.0
12	CNSPLITH	Minimum concentration (g/m3) of each species in puff before it may be split		1.0E-07	1.0E-07
12	EPSSLUG	Fractional convergence criterion for numerical SLUG sampling integration	1.0E-04	1.0E-04	1.0E-04
12	EPSAREA	Fractional convergence criterion for numerical AREA source integration	1.0E-06	1.0E-06	1.0E-06
12	DSRISE	Trajectory step-length (m) used for numerical rise integration		1.0	1.0

The SSCC model uses the same defaults as employed by LADCO for CALPOST. IWAQM did not provide default CALPOST values in the Phase 2 report.

Table 9. CALPOST Settings and Default Values for Extinction Efficiency

Variable	LADCO Default	SSCC Model Value
EEPMC	0.6 Modeled PM Coarse	0.6 Modeled PM Coarse
EEPMF	1.0 Modeled PM Fine	1.0 Modeled PM Fine
EEPMCBK	0.6 Background PM Coarse	0.6 Background PM Coarse
EESO4	3.0 Ammonium Sulfate	3.0 Ammonium Sulfate

Variable	LADCO Default	SSCC Model Value
EENO3	3.0 Ammonium Nitrate	3.0 Ammonium Nitrate
EEOC	4.0 Organic Carbon	4.0 Organic Carbon
EESOIL	1.0 Soil	1.0 Soil
EEEC	10.0 Elemental Carbon	10.0 Elemental Carbon

Variables Adjusted from IWAQM and/or LADCO Defaults

CDIV

The LADCO default and the value used for the SSCC model for CDIV, the divergence criterion for dw/dz across the puff used to initiate adjustment for horizontal convergence (1/s) was set at 0.0, 0.0. This differs from the IWAQM recommended setting value equal to 0.01.

BCK03

The IWAQM recommended default for background ozone concentrations is 80 ppb for all months. This value should only be used for missing data. SSCC employed the LADCO defaults for background ozone concentration of 31 ppb for January, February and March; 37 ppb for April, May and June; 33 ppb for July, August, September, and 27 ppb for October, November and December.

BCKNH3

The background ammonia concentration recommended by IWAQM is 10 ppb for all months. The LADCO background concentrations for ammonia are 0.3 ppb in January, February and March and 0.5 ppb for the rest of the year. The LADCO default values were used in the SSCC model.

Source Parameters

The source parameters for the Riley Boiler as entered into the CALPUFF model in Input Group 13 are shown in Table 10 below.

Table 10. Source Parameters Modeled for the Riley Boiler

Variable	Parameter
Source ID	1
UTM X (km)	780.0257
UTM Y (km)	5197.3649
Zone	15
Stack Height (m)	61.1400
Base Elevation (m)	198.0000
Stack Diameter (m)	2.2900
Exit Velocity (m/s)	17.6200
Exit Temperature (K)	445.3700

Appendix B

2005-2006
Baseline Model Output Files