BART Exemption Modeling Report:

Georgia Power Company
Plant Kraft

Prepared by:

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for Georgia Power Company

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1.0 Introduction

1.1 Objectives

The Regional Haze Rule requires Best Available Retrofit Technology (BART) for any BART-eligible source that "emits any air pollutant which may reasonably be anticipated to cause or contribute to any impairment of visibility" in any mandatory Class I federal area. Pursuant to federal regulations, states have the option of exempting a BART-eligible source from the BART requirements based on dispersion modeling demonstrating that the source cannot reasonably be anticipated to cause or contribute to visibility impairment in a Class I area. In addition, the Environmental Protection Agency (EPA) has promulgated a rule allowing states subject to the Clean Air Interstate Rule (CAIR) to determine that CAIR satisfies the BART requirements for SO_2 and NO_x for electric generating units (EGUs). Feedback from the Georgia Environmental Protection Division indicates that CAIR satisfies BART for SO_2 and NO_x for EGUs. Therefore, this modeling report focuses on performing the BART modeling analysis for particulate matter (PM) only.

Units 3 and 4 at Plant Kraft, located near Savannah, which is owned and operated by Georgia Power Company*, has been identified as a BART-eligible source. The modeling procedures outlined in the source-specific BART modeling protocol for Plant Kraft were used to determine whether the source is subject to BART requirements (exemption modeling). The modeling procedures are consistent with those outlined in the updated final VISTAS common BART modeling protocol (dated December 22, 2005, revision 3 – July 18, 2006), available at http://www.vistas-sesarm.org/BART/BARTModelingProtocol_rev3_18Jul2006.pdf. This source-specific BART modeling protocol references relevant portions of the common VISTAS modeling protocol.

1.2 Location of source vs. relevant Class I Areas

The Georgia Environmental Protection Division, which is in charge of the state's BART program, has determined that Units 3 and 4 at Plant Kraft are BART-eligible for PM. Figure 1-1 shows a plot of Plant Kraft relative to nearby Class I Areas. There are three Class I areas within 300 km of the plant: Cape Romain (161.7 km), Okefenokee (159.0 km), and Wolf Island (87.0 km). The BART exemption modeling was conducted for these Class I areas in accordance with the referenced VISTAS common BART modeling protocol and the procedures described in the source-specific BART modeling protocol.

* The merger of Georgia Power and Savannah Electric has been completed. Therefore, these units are now owned and operated by Georgia Power Company.

Figure 1-1 Location of Class I Areas in Relation to Plant Kraft

2.0 Source description and emissions data

2.1 Unit-specific source data

The emissions data used to assess the visibility impacts at the Class I areas within 300 km of Plant Kraft are discussed in this section. The Georgia Environmental Protection Division has indicated that CAIR will satisfy BART for EGUs for SO_2 and NO_x. Therefore, this BART exemption modeling analysis focuses only on PM_{10}. Since various components of PM_{10} emissions have different visibility extinction efficiencies, the PM_{10} emissions are divided, or "speciated," into several components (VISTAS common protocol Sections 4.3.3 and 4.4.2). The VISTAS protocol (Section 5) allows for the use of source-specific emissions and speciation factors and/or default values from AP-42. For the Kraft 3 coal-fired unit, where default speciation values are used, the data represents a unit where current (baseline) emission controls include electrostatic precipitators (ESPs), but no post-combustion NO_x or SO_2 control equipment exists. The PM_{10} emissions and speciation approach used for the Kraft 3 modeling is indicated in the bullets below.

- Total PM_{10} is comprised of filterable and condensable emissions.
- Baseline filterable PM_{10} emissions are based on the highest stack test for the most recent 3-year period (2003-2005). This stack test is combined with the highest 24 hour heat input value for this period from CEMS data to calculate the "maximum 24 hour average emission rate" as required by the VISTAS protocol.
- Filterable PM_{10} has been subdivided by size category consistent with the default approach from AP-42 Table 1-1.6, and as noted on pages 43 and 44 of the VISTAS common BART modeling protocol. The AP-42 Table 1-1.6 specifies for the emission controls indicated above that 55.6% of filterable PM_{10} emissions is coarse (greater than 2.5 microns in size) and 44.4% is fine. Of the fine portion, 3.7% is elemental carbon and the remainder is inorganic fine particulates (soil).
- Condensable PM_{10} consists of inorganic and organic compounds. The inorganic portion is by default assumed to be H_2SO_4, although other non-sulfate inorganic condensables could be present. The organic portion is modeled as organic aerosols.
- Baseline H_2SO_4 emissions are calculated consistent with the method used by Georgia Power to derive these emissions for TRI purposes. This approach assumes that the H_2SO_4 emissions released from the stack are proportional to SO_2 emissions from combustion and are dependent on the fuel type and the removal of H_2SO_4 by downstream equipment (i.e., ESP and air heater). For eastern bituminous coal the baseline H_2SO_4 release rate is in the range of 0.3 to 0.8% of the SO_2 emissions. Appendix A of the site-specific modeling protocol provides the basis for the site-specific values used.
- Baseline emissions of condensable organics (the remaining portion of condensable PM_{10}) are derived based on the supporting field observational information in Appendix B of the site-specific modeling protocol and is estimated as 0.32% of SO_2 emitted.
- Coarse filterable particles (between 2.5 and 10 microns in size) will be modeled with a geometric mass mean diameter of 5 microns, while fine filterable and all condensable particles will be modeled with a geometric mass mean diameter of 0.48 microns, consistent with the CALPUFF default value for fine particles. The geometric standard deviation for both fine and coarse particles will be set to 2 microns, consistent with the CALPUFF default value. The 0.48 micron diameter value for fine particles comes from the default values in sample input files presented on the TRC web site. There is no default value presented for the coarse particles on the TRC web site. However, since 5 is the geometric mass mean diameter of 2.5 and 10 (the bounds of coarse particle sizes), it is a reasonable estimate for the geometric mass mean diameter for that class of particles.

Kraft 4 has can fire either natural gas or #6 oil. Since the highest emission rates for Kraft 4 occur when #6 oil is fired, where default speciation values are used they are based on this fuel. The PM_{10} emissions and speciation approach used for Kraft 4 is indicated in the bullets below.

- Total PM_{10} is comprised of filterable and condensable emissions.
- Since stack tests are not performed for Kraft 4, baseline filterable PM_{10} emissions are based on AP-42 emissions factors and the highest 24 hour heat input for the most recent 3-year period (2003-2005). This results in the "maximum 24 hour average emission rate" as required by the VISTAS protocol.
- Filterable PM_{10} has been subdivided by size category consistent with the default approach from AP-42 Table 1-3.4, and as noted on pages 43 and 44 of the VISTAS common BART modeling protocol. The AP-42 Table 1-3.4 specifies for an uncontrolled boiler that 26.8% of filterable PM_{10} emissions is coarse (greater than 2.5 microns in size) and 73.2% is fine. Of the fine portion, 7.4% is elemental carbon and the remainder is inorganic fine particulates (soil).
- Condensable PM_{10} consists of inorganic and organic compounds. The inorganic portion is by default assumed to be H_2SO_4, although other non-sulfate inorganic condensables could be present. The organic portion is modeled as organic aerosols.
- Baseline H_2SO_4 emissions are calculated consistent with the method used by Georgia Power to derive these emissions for TRI purposes. This approach assumes that the H_2SO_4 emissions released from the stack are proportional to SO_2 emissions from combustion and are dependent on the fuel type and the removal of H_2SO_4 by downstream equipment (i.e., Kraft 4 includes air heater). Appendix A of the site-specific modeling protocol provides the basis for the site-specific value used.
- Baseline emissions of secondary organic aerosols (the remaining portion of condensable PM_{10}) are derived consistent with the default approach based on AP-42 Table 1.3-2 (i.e., 0.225 lb/1000 gal).

In practice, CALPUFF allows for the user to input certain components of PM_{10} as separate species and separate sizes, which will result in more accurate wet and dry deposition velocity results and also more accurate effects on light scattering. As noted above, the particle size distribution information is provided in AP-42 Tables 1-1.6 and 1-3.4, and will be used for the BART exemption modeling.

Table 2-1 provides a summary of the modeling emission parameters used in the BART CALPUFF modeling, consistent with the source emissions data presented in Appendices A and B of the site-specific modeling protocol for the baseline. All of the emissions for Kraft 3 in Table 2-1 were derived from CEMS data for the 2003 to 2005 period and represent the maximum 24-hour average lb/hr rates (excluding days where startup, shutdown, or malfunctions occurred). For NO_x and SO_2 the values are directly from CEMS. Filterable PM_{10} emissions were calculated using the highest stack test over the 2003 to 2005 period and multiplying these values times the maximum 24-hour average heat input derived from CEMS. These values were then adjusted using AP-42 factors from Table 1.1-6 that indicate that PM_{10} is 67% of total PM for a pulverized coal unit with an ESP. PM_{10} speciation was then performed as indicated above such that total Filterable PM_{10} is made up of Coarse Soil plus total Fine PM and total Fine PM is made up of Fine Soil plus Elemental Carbon (EC).

For Kraft 4, baseline emission values for NOx, SO2, and PM_{10} are based on AP-42 factors for a #6 oil-fired boiler considering the highest 24 hour heat input for the most recent 3-year period (2003-2005). PM_{10} speciation was then performed as indicated above such that total Filterable PM_{10} is made up of Coarse Soil plus total Fine PM and total Fine PM is made up of Fine Soil plus Elemental Carbon (EC).

Table 2-1 Plant Kraft modeling emission parameters

Case	Source / Unit	Location UTM (Zone 16 NAD-83)		Actual Stack Ht	Base Elev.	Flue Dia-meter	Gas Exit Vel.	Stack Gas Exit Temp.	Emissions[1]			Particle Speciation[2]							
		UTM East	UTM North						SO_2	NO_X	PM_{10}	Filt. PM_{10}	Coarse Soil	Fine PM	Fine Soil	EC	Cond. PM_{10}	H_2SO_4	Organic
		m	m	m	m	m	m/s	deg K	lbs/hr	lbs/hr	lbs/hr	lbs/hr	lbs/hr	lbs/hr	lbs/hr	lbs/hr	lbs/hr	lbs/hr	lbs/hr
Baseline Data - Current Configuration (Unit Basis)																			
Baseline	Unit 3	486,248	3,556,917	83.8	1.5	6.7	13.4	413.6	1828.50	754.42	51.65	40.42	22.47	17.95	17.28	0.66	11.23	5.38	5.85
Baseline	Unit 4	486,248	3,556,917	83.8	1.5	6.7	13.4	413.6	2815.72	212.56	187.33	133.01	35.65	97.36	90.16	7.20	54.32	52.83	1.49
Baseline Data - Current Configuration (Stack Basis)																			
				Modeled Stk Ht[3]															
		m	m	m	m	m	m/s	deg K	lbs/hr	lbs/hr	lbs/hr	lbs/hr	lbs/hr	lbs/hr	lbs/hr	lbs/hr	lbs/hr	lbs/hr	lbs/hr
Stack 1	3&4	486,248	3,556,917	83.8	1.5	6.7	13.4	413.6	4644.22	966.98	238.98	173.43	58.12	115.31	107.44	7.87	65.55	58.20	7.35
Stack Basis Emissions Converted to g/sec									g/sec	g/sec	g/sec	g/sec	g/sec	g/sec	g/sec	g/sec	g/sec	g/sec	g/sec
Stack 1	3&4	486,248	3,556,917	83.8	1.5	6.7	13.4	413.6	585.17	121.84	30.11	21.85	7.32	14.53	13.54	0.99	8.26	7.33	0.93

[1] SO_2 and NO_x emissions are not BART-applicable for EGU sources in CAIR states, if the state agency agrees with EPA's interpretation of the BART final rule. The emissions for SO_2 and NO_x are provided for information purposes, and for reference in the computation of certain particle species such as H_2SO_4.

[2] Elemental carbon (EC) and Fine PM are a part of Filterable PM_{10} and H_2SO_4 and Organics are a part of Condensable PM_{10}. Note that H_2SO_4 is input to CALPUFF as SO_4. The molecular weights of H_2SO_4 and SO_4 are 98 and 96 respectively, therefore the conversion factor from H_2SO_4 to SO_4 is 96/98.

[3] Stack credit is equal to actual height. GEP of 327 ft (99.7 m) is greater than actual height therefore actual height is used for modeling.

3.0 Modeling results

The exemption modeling results are provided in Table 3-1, and Appendix A lists delta-deciview results for the top 20 days for each year modeled and the top 25 days for the overall three years at each Class I area. The table indicates that both the 8th highest day's impacts for each year and the 22nd highest day's impacts over all three years are below 0.5 delta-dv. These results demonstrate that Plant Kraft's PM_{10} emissions do not cause or contribute to visibility impairment. Therefore, the source is not subject to BART for PM_{10}, and no further BART analysis is required.

Electronic data related to this application are provided on the attached disk. They include all input (INP) and list (LST) files.

Table 3-1 Summary of Results – Plant Kraft Refined BART Exemption Modeling

		2001			2002			2003			Highest of 8th Highest delta-dv for the 3-years	22nd Highest delta-dv over 3-year period
Class I area	**Distance from source to Class I area boundary**	**# of days and receptors beyond 98th percentile with impact > 0.5 delta-dv**		**8th Highest delta-dv**	**# of days and receptors beyond 98th percentile with impact > 0.5 delta-dv**		**8th Highest delta-dv**	**# of days and receptors beyond 98th percentile with impact > 0.5 delta-dv**		**8th Highest delta-dv**		
	km	**Days**	**Rec**	**delta-dv**	**Days**	**Rec**	**delta-dv**	**Days**	**Rec**	**delta-dv**	**delta-dv**	**delta-dv**
Cape Romain	**161.7**	0	0	0.15	0	0	0.14	0	0	0.18	0.18	0.16
Okefenokee	**159.0**	0	0	0.17	0	0	0.18	0	0	0.16	0.18	0.17
Wolf Island	**87.0**	0	0	0.19	0	0	0.20	0	0	0.21	0.21	0.21

Appendix A

Delta-Deciview Values for the Top 20 Days – for Each Year/Each Class I Area and for the Top 25 Days – Over Three Years

Ranked Daily Visibility Change for Cape Romain (Top 20 Days for Each Year)

								% of Modeled Extinction by Species					
YEAR	DAY	HR	REC	DV(Total)	DV(BKG)	DELTA DV	F(RH)	% SO4	% NO3	% OC	% EC	% PMC	% PMF	Ranking
2001	313	0	531	7.746	7.519	0.227	3.4	76.91	0	2.84	7.56	2.35	10.34	1
2001	241	0	578	7.728	7.519	0.209	4.1	80.58	0	2.47	6.57	1.39	8.99	2
2001	240	0	534	7.711	7.519	0.192	4.1	79.96	0	2.45	6.52	2.15	8.92	3
2001	224	0	532	7.711	7.519	0.192	4.1	80.2	0	2.46	6.54	1.86	8.94	4
2001	8	0	532	7.693	7.519	0.174	3.3	76.47	0	2.91	7.75	2.28	10.59	5
2001	220	0	531	7.666	7.519	0.147	4.1	80.16	0	2.46	6.53	1.91	8.94	6
2001	242	0	532	7.664	7.519	0.146	4.1	80.35	0	2.46	6.55	1.68	8.96	7
2001	225	0	532	7.664	7.519	0.145	4.1	79.82	0	2.45	6.51	2.33	8.9	8
2001	222	0	562	7.657	7.519	0.138	4.1	80.33	0	2.46	6.55	1.7	8.96	9
2001	63	0	562	7.657	7.519	0.138	2.9	74.37	0	3.22	8.57	2.12	11.72	10
2001	158	0	532	7.651	7.519	0.132	3.7	78.39	0	2.66	7.08	2.18	9.69	11
2001	277	0	532	7.65	7.519	0.131	3.7	78.15	0	2.65	7.06	2.48	9.66	12
2001	233	0	562	7.648	7.519	0.129	4.1	80.46	0	2.46	6.56	1.55	8.97	13
2001	201	0	531	7.648	7.519	0.129	3.6	77.78	0	2.71	7.22	2.4	9.88	14
2001	53	0	531	7.646	7.519	0.127	3	74.18	0	3.11	8.26	3.15	11.3	15
2001	223	0	547	7.636	7.519	0.117	4.1	80.27	0	2.46	6.54	1.78	8.95	16
2001	139	0	531	7.634	7.519	0.116	3.2	76.07	0	2.99	7.95	2.13	10.87	17
2001	221	0	531	7.631	7.519	0.112	4.1	80.49	0	2.47	6.56	1.5	8.98	18
2001	48	0	532	7.63	7.519	0.111	3	74.33	0	3.11	8.28	2.95	11.33	19
2001	192	0	578	7.624	7.519	0.105	3.6	78.24	0	2.73	7.26	1.83	9.94	20
2002	198	0	532	7.687	7.519	0.169	3.6	77.8	0	2.71	7.22	2.39	9.88	1
2002	232	0	532	7.687	7.519	0.168	4.1	79.97	0	2.45	6.52	2.14	8.92	2
2002	231	0	531	7.683	7.519	0.164	4.1	80.27	0	2.46	6.54	1.77	8.95	3
2002	146	0	562	7.683	7.519	0.164	3.2	76.09	0	2.99	7.95	2.1	10.87	4
2002	6	0	532	7.683	7.519	0.164	3.3	76.16	0	2.9	7.71	2.68	10.55	5
2002	233	0	578	7.681	7.519	0.163	4.1	79.98	0	2.45	6.52	2.14	8.92	6
2002	236	0	550	7.679	7.519	0.16	4.1	80.16	0	2.46	6.54	1.9	8.94	7
2002	202	0	692	7.657	7.519	0.138	3.6	78.07	0	2.72	7.25	2.04	9.91	8
2002	260	0	532	7.656	7.519	0.137	4	79.69	0	2.5	6.66	2.04	9.11	9
2002	214	0	531	7.654	7.519	0.135	4.1	80.42	0	2.46	6.56	1.6	8.97	10
2002	187	0	578	7.652	7.519	0.133	3.6	77.94	0	2.72	7.24	2.21	9.9	11
2002	272	0	531	7.649	7.519	0.13	4	79.71	0	2.5	6.66	2.01	9.11	12
2002	199	0	681	7.648	7.519	0.129	3.6	78.35	0	2.73	7.27	1.7	9.95	13
2002	153	0	562	7.646	7.519	0.127	3.7	78.45	0	2.66	7.09	2.11	9.69	14
2002	179	0	562	7.644	7.519	0.125	3.7	78.75	0	2.67	7.11	1.73	9.73	15
2002	123	0	572	7.644	7.519	0.125	3.2	76.01	0	2.98	7.94	2.21	10.86	16
2002	209	0	626	7.64	7.519	0.121	3.6	78.16	0	2.73	7.26	1.93	9.93	17
2002	169	0	537	7.637	7.519	0.119	3.7	78.12	0	2.65	7.06	2.51	9.65	18
2002	237	0	531	7.637	7.519	0.118	4.1	79.97	0	2.45	6.52	2.14	8.92	19
2002	18	0	532	7.633	7.519	0.114	3.3	76.72	0	2.92	7.77	1.96	10.63	20
2003	172	0	580	7.739	7.519	0.22	3.7	78.62	0	2.67	7.1	1.89	9.71	1
2003	317	0	532	7.72	7.519	0.202	3.4	77.06	0	2.85	7.58	2.16	10.36	2
2003	211	0	571	7.708	7.519	0.189	3.6	77.77	0	2.71	7.22	2.42	9.88	3
2003	263	0	578	7.707	7.519	0.188	4	80.43	0	2.53	6.72	1.13	9.19	4
2003	128	0	532	7.702	7.519	0.183	3.2	75.75	0	2.97	7.91	2.54	10.82	5
2003	35	0	532	7.697	7.519	0.178	3	74.63	0	3.12	8.31	2.56	11.37	6
2003	236	0	579	7.695	7.519	0.176	4.1	80.25	0	2.46	6.54	1.79	8.95	7
2003	230	0	537	7.694	7.519	0.175	4.1	80.1	0	2.45	6.53	1.98	8.93	8
2003	3	0	532	7.688	7.519	0.169	3.3	76.56	0	2.91	7.75	2.16	10.61	9
2003	178	0	540	7.679	7.519	0.16	3.7	78.56	0	2.67	7.1	1.96	9.71	10
2003	202	0	531	7.674	7.519	0.155	3.6	77.61	0	2.71	7.21	2.62	9.86	11
2003	198	0	550	7.674	7.519	0.155	3.6	78.28	0	2.73	7.27	1.77	9.94	12
2003	190	0	558	7.672	7.519	0.154	3.6	77.69	0	2.71	7.21	2.52	9.87	13
2003	186	0	595	7.671	7.519	0.152	3.6	78.01	0	2.72	7.24	2.11	9.91	14
2003	185	0	531	7.664	7.519	0.145	3.6	78.04	0	2.72	7.25	2.08	9.91	15
2003	218	0	531	7.66	7.519	0.141	4.1	79.84	0	2.45	6.51	2.3	8.9	16
2003	192	0	533	7.66	7.519	0.141	3.6	77.63	0	2.71	7.21	2.6	9.86	17
2003	6	0	562	7.658	7.519	0.139	3.3	77.17	0	2.94	7.82	1.39	10.69	18
2003	147	0	577	7.656	7.519	0.137	3.2	75.82	0	2.98	7.92	2.45	10.83	19
2003	322	0	693	7.642	7.519	0.123	3.4	77.02	0	2.85	7.57	2.2	10.36	20

Ranked Daily Visibility Change for Cape Romain (Top 25 Days Over Three Years)

							% of Modeled Extinction by Species					
YEAR	DAY	REC	DV(Total)	DV(BKG)	DELTA DV	F(RH)	% SO4	% NO3	% OC	% EC	% PMC	% PMF	Ranking
2001	313	531	7.746	7.519	0.227	3.4	76.91	0.00	2.84	7.56	2.35	10.34	1
2003	172	580	7.739	7.519	0.220	3.7	78.62	0.00	2.67	7.10	1.89	9.71	2
2001	241	578	7.728	7.519	0.209	4.1	80.58	0.00	2.47	6.57	1.39	8.99	3
2003	317	532	7.720	7.519	0.202	3.4	77.06	0.00	2.85	7.58	2.16	10.36	4
2001	240	534	7.711	7.519	0.192	4.1	79.96	0.00	2.45	6.52	2.15	8.92	5
2001	224	532	7.711	7.519	0.192	4.1	80.20	0.00	2.46	6.54	1.86	8.94	6
2003	211	571	7.708	7.519	0.189	3.6	77.77	0.00	2.71	7.22	2.42	9.88	7
2003	263	578	7.707	7.519	0.188	4.0	80.43	0.00	2.53	6.72	1.13	9.19	8
2003	128	532	7.702	7.519	0.183	3.2	75.75	0.00	2.97	7.91	2.54	10.82	9
2003	35	532	7.697	7.519	0.178	3.0	74.63	0.00	3.12	8.31	2.56	11.37	10
2003	236	579	7.695	7.519	0.176	4.1	80.25	0.00	2.46	6.54	1.79	8.95	11
2003	230	537	7.694	7.519	0.175	4.1	80.10	0.00	2.45	6.53	1.98	8.93	12
2001	8	532	7.693	7.519	0.174	3.3	76.47	0.00	2.91	7.75	2.28	10.59	13
2002	198	532	7.687	7.519	0.169	3.6	77.80	0.00	2.71	7.22	2.39	9.88	14
2003	3	532	7.688	7.519	0.169	3.3	76.56	0.00	2.91	7.75	2.16	10.61	15
2002	232	532	7.687	7.519	0.168	4.1	79.97	0.00	2.45	6.52	2.14	8.92	16
2002	231	531	7.683	7.519	0.164	4.1	80.27	0.00	2.46	6.54	1.77	8.95	17
2002	146	562	7.683	7.519	0.164	3.2	76.09	0.00	2.99	7.95	2.10	10.87	18
2002	6	532	7.683	7.519	0.164	3.3	76.16	0.00	2.90	7.71	2.68	10.55	19
2002	233	578	7.681	7.519	0.163	4.1	79.98	0.00	2.45	6.52	2.14	8.92	20
2002	236	550	7.679	7.519	0.160	4.1	80.16	0.00	2.46	6.54	1.90	8.94	21
2003	178	540	7.679	7.519	0.160	3.7	78.56	0.00	2.67	7.10	1.96	9.71	22
2003	202	531	7.674	7.519	0.155	3.6	77.61	0.00	2.71	7.21	2.62	9.86	23
2003	198	550	7.674	7.519	0.155	3.6	78.28	0.00	2.73	7.27	1.77	9.94	24
2003	190	558	7.672	7.519	0.154	3.6	77.69	0.00	2.71	7.21	2.52	9.87	25

Ranked Daily Visibility Change for Okefenokee (Top 20 Days for Each Year)

								% of Modeled Extinction by Species						
YEAR	DAY	HR	REC	DV(Total)	DV(BKG)	DELTA DV	F(RH)	% SO4	% NO3	% OC	% EC	% PMC	% PMF	Ranking
2001	303	0	500	7.905	7.608	0.297	3.8	79.76	0	2.64	7.02	0.99	9.6	1
2001	322	0	499	7.884	7.608	0.276	3.5	77.56	0	2.78	7.41	2.11	10.13	2
2001	23	0	494	7.866	7.608	0.258	3.5	77.99	0	2.8	7.45	1.58	10.19	3
2001	271	0	214	7.829	7.608	0.221	4	80.47	0	2.53	6.72	1.08	9.2	4
2001	338	0	499	7.798	7.608	0.19	3.6	78.73	0	2.75	7.31	1.21	10	5
2001	295	0	493	7.787	7.608	0.179	3.8	79.47	0	2.63	6.99	1.35	9.56	6
2001	273	0	499	7.775	7.608	0.167	4	80.62	0	2.53	6.74	0.89	9.21	7
2001	292	0	499	7.773	7.608	0.165	3.8	78.7	0	2.6	6.92	2.3	9.47	8
2001	310	0	477	7.758	7.608	0.15	3.5	78.23	0	2.81	7.47	1.28	10.22	9
2001	203	0	494	7.757	7.608	0.149	3.7	78.71	0	2.67	7.11	1.78	9.73	10
2001	272	0	122	7.755	7.608	0.146	4	80.16	0	2.52	6.7	1.46	9.16	11
2001	238	0	499	7.753	7.608	0.145	4.1	80.53	0	2.47	6.57	1.46	8.98	12
2001	294	0	494	7.752	7.608	0.144	3.8	78.84	0	2.61	6.93	2.13	9.48	13
2001	274	0	253	7.744	7.608	0.136	4	80.71	0	2.53	6.74	0.79	9.22	14
2001	50	0	498	7.741	7.608	0.133	3.2	76.9	0	3.02	8.03	1.06	10.99	15
2001	320	0	477	7.734	7.608	0.126	3.5	78.45	0	2.82	7.49	0.99	10.25	16
2001	281	0	222	7.733	7.608	0.125	3.8	80.01	0	2.64	7.04	0.69	9.63	17
2001	170	0	477	7.73	7.608	0.122	3.7	78.51	0	2.67	7.09	2.03	9.7	18
2001	59	0	479	7.721	7.608	0.113	3.2	75.91	0	2.98	7.93	2.34	10.84	19
2001	196	0	499	7.714	7.608	0.106	3.7	78.76	0	2.67	7.12	1.72	9.73	20
2002	343	0	499	7.895	7.608	0.287	3.6	78.5	0	2.74	7.29	1.51	9.97	1
2002	246	0	487	7.853	7.608	0.245	4	80.44	0	2.53	6.72	1.11	9.19	2
2002	325	0	498	7.834	7.608	0.226	3.5	77.85	0	2.79	7.44	1.75	10.17	3
2002	344	0	500	7.827	7.608	0.219	3.6	77.95	0	2.72	7.24	2.19	9.9	4
2002	247	0	499	7.806	7.608	0.198	4	80	0	2.51	6.69	1.66	9.14	5
2002	342	0	33	7.802	7.608	0.194	3.6	78.28	0	2.73	7.27	1.78	9.94	6
2002	217	0	499	7.788	7.608	0.18	4.1	80.11	0	2.45	6.53	1.97	8.93	7
2002	296	0	499	7.783	7.608	0.175	3.8	79.82	0	2.64	7.02	0.91	9.6	8
2002	283	0	494	7.768	7.608	0.16	3.8	79.52	0	2.63	6.99	1.29	9.57	9
2002	221	0	499	7.766	7.608	0.158	4.1	80.33	0	2.46	6.55	1.71	8.96	10
2002	46	0	479	7.763	7.608	0.155	3.2	76.22	0	2.99	7.96	1.94	10.89	11
2002	253	0	493	7.748	7.608	0.14	4	79.58	0	2.5	6.65	2.17	9.1	12
2002	96	0	500	7.747	7.608	0.139	3	75.41	0	3.16	8.4	1.54	11.49	13
2002	141	0	122	7.743	7.608	0.134	3.6	78.42	0	2.74	7.28	1.61	9.96	14
2002	333	0	33	7.734	7.608	0.126	3.5	78.07	0	2.8	7.46	1.47	10.2	15
2002	306	0	494	7.733	7.608	0.125	3.5	78.15	0	2.8	7.46	1.37	10.21	16
2002	140	0	189	7.73	7.608	0.122	3.6	78.79	0	2.75	7.32	1.13	10.01	17
2002	331	0	323	7.72	7.608	0.112	3.5	78.18	0	2.81	7.47	1.33	10.21	18
2002	27	0	499	7.719	7.608	0.111	3.5	77.86	0	2.79	7.44	1.74	10.17	19
2002	143	0	498	7.712	7.608	0.104	3.6	79.03	0	2.76	7.34	0.84	10.04	20
2003	256	0	464	7.893	7.608	0.285	4	80.12	0	2.52	6.69	1.52	9.16	1
2003	255	0	486	7.846	7.608	0.238	4	79.96	0	2.51	6.68	1.71	9.14	2
2003	274	0	499	7.819	7.608	0.211	4	80.42	0	2.53	6.72	1.15	9.19	3
2003	254	0	499	7.818	7.608	0.21	4	79.82	0	2.51	6.67	1.88	9.12	4
2003	32	0	464	7.812	7.608	0.204	3.5	78.26	0	2.81	7.47	1.23	10.22	5
2003	307	0	493	7.784	7.608	0.176	3.5	77.34	0	2.78	7.39	2.4	10.1	6
2003	314	0	189	7.772	7.608	0.164	3.5	78.88	0	2.83	7.53	0.45	10.3	7
2003	273	0	222	7.769	7.608	0.161	4	80.69	0	2.53	6.74	0.81	9.22	8
2003	362	0	499	7.767	7.608	0.159	3.6	78.74	0	2.75	7.31	1.2	10	9
2003	284	0	499	7.76	7.608	0.152	3.8	78.87	0	2.61	6.94	2.09	9.49	10
2003	315	0	500	7.754	7.608	0.146	3.5	78.76	0	2.83	7.52	0.6	10.29	11
2003	293	0	237	7.746	7.608	0.138	3.8	79.53	0	2.63	7	1.28	9.57	12
2003	259	0	464	7.746	7.608	0.138	4	80.5	0	2.53	6.73	1.04	9.2	13
2003	319	0	487	7.738	7.608	0.13	3.5	78.28	0	2.81	7.48	1.21	10.23	14
2003	326	0	499	7.733	7.608	0.125	3.5	77.12	0	2.77	7.37	2.67	10.07	15
2003	337	0	499	7.728	7.608	0.12	3.6	78.84	0	2.75	7.32	1.07	10.01	16
2003	361	0	464	7.723	7.608	0.115	3.6	78.89	0	2.75	7.33	1.01	10.02	17
2003	276	0	33	7.718	7.608	0.11	3.8	79.88	0	2.64	7.03	0.84	9.61	18
2003	261	0	494	7.718	7.608	0.11	4	80.51	0	2.53	6.73	1.03	9.2	19
2003	257	0	499	7.707	7.608	0.099	4	80.3	0	2.52	6.71	1.29	9.18	20

Ranked Daily Visibility Change for Okefenokee (Top 25 Days Over Three Years)

							% of Modeled Extinction by Species					
YEAR	DAY	REC	DV(Total)	DV(BKG)	DELTA DV	F(RH)	% SO4	% NO3	% OC	% EC	% PMC	% PMF	Ranking
2001	303	500	7.905	7.608	0.297	3.8	79.76	0.00	2.64	7.02	0.99	9.60	1
2002	343	499	7.895	7.608	0.287	3.6	78.50	0.00	2.74	7.29	1.51	9.97	2
2003	256	464	7.893	7.608	0.285	4.0	80.12	0.00	2.52	6.69	1.52	9.16	3
2001	322	499	7.884	7.608	0.276	3.5	77.56	0.00	2.78	7.41	2.11	10.13	4
2001	23	494	7.866	7.608	0.258	3.5	77.99	0.00	2.80	7.45	1.58	10.19	5
2002	246	487	7.853	7.608	0.245	4.0	80.44	0.00	2.53	6.72	1.11	9.19	6
2003	255	486	7.846	7.608	0.238	4.0	79.96	0.00	2.51	6.68	1.71	9.14	7
2002	325	498	7.834	7.608	0.226	3.5	77.85	0.00	2.79	7.44	1.75	10.17	8
2001	271	214	7.829	7.608	0.221	4.0	80.47	0.00	2.53	6.72	1.08	9.20	9
2002	344	500	7.827	7.608	0.219	3.6	77.95	0.00	2.72	7.24	2.19	9.90	10
2003	274	499	7.819	7.608	0.211	4.0	80.42	0.00	2.53	6.72	1.15	9.19	11
2003	254	499	7.818	7.608	0.210	4.0	79.82	0.00	2.51	6.67	1.88	9.12	12
2003	32	464	7.812	7.608	0.204	3.5	78.26	0.00	2.81	7.47	1.23	10.22	13
2002	247	499	7.806	7.608	0.198	4.0	80.00	0.00	2.51	6.69	1.66	9.14	14
2002	342	33	7.802	7.608	0.194	3.6	78.28	0.00	2.73	7.27	1.78	9.94	15
2001	338	499	7.798	7.608	0.190	3.6	78.73	0.00	2.75	7.31	1.21	10.00	16
2002	217	499	7.788	7.608	0.180	4.1	80.11	0.00	2.45	6.53	1.97	8.93	17
2001	295	493	7.787	7.608	0.179	3.8	79.47	0.00	2.63	6.99	1.35	9.56	18
2003	307	493	7.784	7.608	0.176	3.5	77.34	0.00	2.78	7.39	2.40	10.10	19
2002	296	499	7.783	7.608	0.175	3.8	79.82	0.00	2.64	7.02	0.91	9.60	20
2001	273	499	7.775	7.608	0.167	4.0	80.62	0.00	2.53	6.74	0.89	9.21	21
2001	292	499	7.773	7.608	0.165	3.8	78.70	0.00	2.60	6.92	2.30	9.47	22
2003	314	189	7.772	7.608	0.164	3.5	78.88	0.00	2.83	7.53	0.45	10.30	23
2003	273	222	7.769	7.608	0.161	4.0	80.69	0.00	2.53	6.74	0.81	9.22	24
2002	283	494	7.768	7.608	0.160	3.8	79.52	0.00	2.63	6.99	1.29	9.57	25

Ranked Daily Visibility Change for Wolf Island (Top 20 Days for Each Year)

								% of Modeled Extinction by Species						
YEAR	**DAY**	**HR**	**REC**	**DV(Total)**	**DV(BKG)**	**DELTA DV**	**F(RH)**	**% SO4**	**% NO3**	**% OC**	**% EC**	**% PMC**	**% PMF**	**Ranking**
2001	260	0	524	8.011	7.58	0.431	4	79.68	0	2.5	6.66	2.05	9.11	1
2002	1	0	524	7.909	7.58	0.329	3.5	77.41	0	2.78	7.39	2.3	10.11	2
2001	261	0	508	7.865	7.58	0.285	4	79.57	0	2.5	6.65	2.19	9.09	3
2001	275	0	530	7.857	7.58	0.277	3.7	78.13	0	2.65	7.06	2.5	9.65	4
2001	272	0	527	7.84	7.58	0.26	4	79.49	0	2.5	6.64	2.29	9.08	5
2001	365	0	530	7.828	7.58	0.248	3.5	77.76	0	2.79	7.43	1.87	10.16	6
2001	291	0	530	7.789	7.58	0.209	3.7	78.76	0	2.67	7.12	1.72	9.73	7
2001	172	0	524	7.77	7.58	0.19	3.7	78.43	0	2.66	7.09	2.13	9.69	8
2001	44	0	530	7.758	7.58	0.178	3.1	75.64	0	3.06	8.16	1.98	11.15	9
2001	36	0	524	7.753	7.58	0.173	3.1	75.46	0	3.06	8.14	2.22	11.13	10
2001	45	0	502	7.747	7.58	0.167	3.1	75.84	0	3.07	8.18	1.72	11.18	11
2001	55	0	530	7.745	7.58	0.165	3.1	75.53	0	3.06	8.14	2.13	11.14	12
2001	11	0	529	7.742	7.58	0.162	3.4	76.65	0	2.83	7.54	2.67	10.31	13
2001	3	0	529	7.74	7.58	0.16	3.4	77.09	0	2.85	7.58	2.11	10.37	14
2001	4	0	524	7.729	7.58	0.149	3.4	76.73	0	2.83	7.54	2.58	10.32	15
2001	274	0	524	7.715	7.58	0.135	4	79.63	0	2.5	6.65	2.11	9.1	16
2001	228	0	530	7.715	7.58	0.135	4.1	79.78	0	2.44	6.5	2.38	8.9	17
2001	356	0	529	7.707	7.58	0.127	3.5	77.48	0	2.78	7.4	2.22	10.12	18
2001	24	0	529	7.695	7.58	0.115	3.4	76.73	0	2.83	7.54	2.58	10.32	19
2001	68	0	529	7.692	7.58	0.112	3.1	74.87	0	3.03	8.07	2.98	11.04	20
2002	308	0	529	8.107	7.58	0.527	3.5	77.12	0	2.77	7.37	2.67	10.07	1
2002	56	0	528	7.963	7.58	0.383	3.1	75.01	0	3.04	8.09	2.8	11.06	2
2002	126	0	530	7.938	7.58	0.358	3.3	76.78	0	2.92	7.78	1.88	10.64	3
2002	337	0	524	7.912	7.58	0.332	3.5	77.49	0	2.78	7.4	2.21	10.12	4
2002	307	0	529	7.82	7.58	0.24	3.5	77.31	0	2.77	7.38	2.44	10.1	5
2002	155	0	529	7.807	7.58	0.227	3.7	78.12	0	2.65	7.06	2.52	9.65	6
2002	324	0	524	7.804	7.58	0.224	3.5	77.6	0	2.78	7.41	2.07	10.14	7
2002	331	0	524	7.78	7.58	0.2	3.5	77.36	0	2.78	7.39	2.36	10.11	8
2002	341	0	524	7.772	7.58	0.192	3.5	77.88	0	2.79	7.44	1.71	10.17	9
2002	312	0	530	7.767	7.58	0.187	3.5	77.8	0	2.79	7.43	1.82	10.16	10
2002	261	0	528	7.763	7.58	0.183	4	79.37	0	2.49	6.63	2.43	9.07	11
2002	17	0	530	7.733	7.58	0.153	3.4	76.72	0	2.83	7.54	2.59	10.32	12
2002	305	0	524	7.727	7.58	0.147	3.7	78.87	0	2.68	7.12	1.59	9.74	13
2002	352	0	527	7.723	7.58	0.143	3.5	77.43	0	2.78	7.4	2.28	10.11	14
2002	281	0	529	7.721	7.58	0.141	3.7	78.35	0	2.66	7.08	2.23	9.68	15
2002	135	0	530	7.713	7.58	0.133	3.3	76.46	0	2.91	7.75	2.29	10.59	16
2002	286	0	530	7.709	7.58	0.129	3.7	77.93	0	2.65	7.04	2.76	9.63	17
2002	319	0	524	7.706	7.58	0.126	3.5	77.13	0	2.77	7.37	2.67	10.07	18
2002	54	0	530	7.702	7.58	0.122	3.1	75.12	0	3.04	8.1	2.66	11.08	19
2002	301	0	530	7.7	7.58	0.12	3.7	77.92	0	2.65	7.04	2.76	9.63	20
2003	335	0	530	7.914	7.58	0.334	3.5	77.27	0	2.77	7.38	2.48	10.09	1
2003	253	0	524	7.893	7.58	0.313	4	79.7	0	2.5	6.66	2.02	9.11	2
2003	252	0	517	7.888	7.58	0.308	4	79.38	0	2.49	6.63	2.42	9.07	3
2003	356	0	529	7.82	7.58	0.24	3.5	77.42	0	2.78	7.39	2.3	10.11	4
2003	259	0	524	7.813	7.58	0.233	4	79.48	0	2.5	6.64	2.29	9.08	5
2003	83	0	524	7.803	7.58	0.223	3.1	74.9	0	3.03	8.08	2.95	11.05	6
2003	251	0	518	7.802	7.58	0.222	4	79.85	0	2.51	6.67	1.84	9.13	7
2003	292	0	524	7.789	7.58	0.209	3.7	78.26	0	2.66	7.07	2.34	9.67	8
2003	284	0	524	7.774	7.58	0.194	3.7	79.04	0	2.68	7.14	1.37	9.77	9
2003	279	0	530	7.769	7.58	0.189	3.7	78.26	0	2.66	7.07	2.35	9.67	10
2003	347	0	530	7.76	7.58	0.18	3.5	77.58	0	2.78	7.41	2.09	10.13	11
2003	256	0	530	7.757	7.58	0.177	4	79.97	0	2.51	6.68	1.69	9.14	12
2003	361	0	524	7.732	7.58	0.152	3.5	77.15	0	2.77	7.37	2.64	10.08	13
2003	331	0	529	7.732	7.58	0.152	3.5	77.84	0	2.79	7.43	1.77	10.17	14
2003	261	0	530	7.727	7.58	0.147	4	79.38	0	2.49	6.63	2.42	9.07	15
2003	135	0	529	7.702	7.58	0.122	3.3	76.37	0	2.91	7.74	2.4	10.58	16
2003	144	0	530	7.701	7.58	0.121	3.3	77.06	0	2.93	7.81	1.53	10.68	17
2003	32	0	524	7.695	7.58	0.115	3.4	76.98	0	2.84	7.57	2.26	10.35	18
2003	114	0	529	7.687	7.58	0.107	3	74.58	0	3.12	8.31	2.62	11.36	19
2003	342	0	524	7.685	7.58	0.105	3.5	77.49	0	2.78	7.4	2.21	10.12	20

Ranked Daily Visibility Change for Wolf Island (Top 25 Days Over Three Years)

							% of Modeled Extinction by Species					
YEAR	**DAY**	**REC**	**DV(Total)**	**DV(BKG)**	**DELTA DV**	**F(RH)**	**% SO4**	**% NO3**	**% OC**	**% EC**	**% PMC**	**% PMF**	**Ranking**
2002	308	529	8.107	7.580	0.527	3.5	77.12	0.00	2.77	7.37	2.67	10.07	1
2001	260	524	8.011	7.580	0.431	4.0	79.68	0.00	2.50	6.66	2.05	9.11	2
2002	56	528	7.963	7.580	0.383	3.1	75.01	0.00	3.04	8.09	2.80	11.06	3
2002	126	530	7.938	7.580	0.358	3.3	76.78	0.00	2.92	7.78	1.88	10.64	4
2003	335	530	7.914	7.580	0.334	3.5	77.27	0.00	2.77	7.38	2.48	10.09	5
2002	337	524	7.912	7.580	0.332	3.5	77.49	0.00	2.78	7.40	2.21	10.12	6
2002	1	524	7.909	7.580	0.329	3.5	77.41	0.00	2.78	7.39	2.30	10.11	7
2003	253	524	7.893	7.580	0.313	4.0	79.70	0.00	2.50	6.66	2.02	9.11	8
2003	252	517	7.888	7.580	0.308	4.0	79.38	0.00	2.49	6.63	2.42	9.07	9
2001	261	508	7.865	7.580	0.285	4.0	79.57	0.00	2.50	6.65	2.19	9.09	10
2001	275	530	7.857	7.580	0.277	3.7	78.13	0.00	2.65	7.06	2.50	9.65	11
2001	272	527	7.840	7.580	0.260	4.0	79.49	0.00	2.50	6.64	2.29	9.08	12
2001	365	530	7.828	7.580	0.248	3.5	77.76	0.00	2.79	7.43	1.87	10.16	13
2002	307	529	7.820	7.580	0.240	3.5	77.31	0.00	2.77	7.38	2.44	10.10	14
2003	356	529	7.820	7.580	0.240	3.5	77.42	0.00	2.78	7.39	2.30	10.11	15
2003	259	524	7.813	7.580	0.233	4.0	79.48	0.00	2.50	6.64	2.29	9.08	16
2002	155	529	7.807	7.580	0.227	3.7	78.12	0.00	2.65	7.06	2.52	9.65	17
2002	324	524	7.804	7.580	0.224	3.5	77.60	0.00	2.78	7.41	2.07	10.14	18
2003	83	524	7.803	7.580	0.223	3.1	74.90	0.00	3.03	8.08	2.95	11.05	19
2003	251	518	7.802	7.580	0.222	4.0	79.85	0.00	2.51	6.67	1.84	9.13	20
2001	291	530	7.789	7.580	0.209	3.7	78.76	0.00	2.67	7.12	1.72	9.73	21
2003	292	524	7.789	7.580	0.209	3.7	78.26	0.00	2.66	7.07	2.34	9.67	22
2002	331	524	7.780	7.580	0.200	3.5	77.36	0.00	2.78	7.39	2.36	10.11	23
2003	284	524	7.774	7.580	0.194	3.7	79.04	0.00	2.68	7.14	1.37	9.77	24
2002	341	524	7.772	7.580	0.192	3.5	77.88	0.00	2.79	7.44	1.71	10.17	25