Mirant Potomac River, LLC
Alexandria, Virginia

Protocol for Modeling the Effects of Downwash from Mirant's Potomac River Power Plant

ENSR Corporation
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1.0 INTRODUCTION

1.1 Project Overview

Mirant Potomac River, LLC (Mirant) submitted a modeling protocol on October 13, 2004 pursuant to an Order By Consent issued by the Commonwealth of Virginia, State Air Pollution Control Board. The Protocol described MIrant's proposed refined modeling analysis to assess the effect of aerodynamic downwash from the facility on ambient concentrations of sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO) and particulate matter with an aerodynamic diameter less than or equal to 10 micrometers (PM_{10}). The Protocol described the methods to be used to assess compliance with the National Ambient Air Quality Standards for these pollutants. In addition, the Protocol described the methods to be used to assess the effect of downwash from the facility on ambient concentrations of mercury for comparison to the applicable Standards of Performance for Toxic Pollutants set forth in VAC 5-60-200, et. Seq., in the area immediately surrounding the facility. The Order is included in Appendix A of this protocol.

Mirant received written comments, dated February 10, 2005, from Mr. Ken McBee, Modeling Coordinator for the Virginia Department of Environmental Quality, Office of Air Permit Programs. The letter required Mirant to submit a revised protocol within 30 days (March 15, 2005). On March 8, 2005 Mr. McBee granted Mirant a 10-day extension to March 25, 2005 in order to incorporate recently received GIS data from the City of Alexandria. The GIS data contains building height data for high rise apartments for use as flagpole receptors in the modeling. This revised protocol is being submitted in response to Mr. McBee's written comments.

1.2 Protocol Outline

This document is a modeling protocol for the use of EPA's proposed Guideline model, AERMOD with PRIME (hereafter called AERMOD), to assess downwash from Mirant's Potomac River Generating Station. AERMOD is technically superior to the downwash algorithm in EPA's current Guideline model, ISCST3.

Section 2 of this protocol describes the facility and lists the permitted or maximum emission rates. Section 3 discusses the proposed approach for conducting the air quality dispersion modeling analysis including the dispersion model selection criteria, the Good Engineering Practice (GEP) stack height and downwash modeling inputs, model receptor locations and proposed meteorological database. Section 4 describes representative ambient background data. Section 5 describes how results will be documented. References are listed in Section 6.

1.3 Basis For Ambient Compliance

Modeled concentrations of criteria pollutants will be added to a monitored background concentration and the total will be compared to the NAAQS shown in Table 1-1. The monitored background concentration represents the contribution to total air quality from all other sources in the area. Modeled concentrations of mercury will be compared to the mercury limits contained in the Standards of Performance for Toxic Pollutants.

Table 1-1 National Ambient Air Quality Standards and Standards of Performance for Toxic Pollutants

Pollutant	Averaging Period	Primary NAAQS (µg/m^3)	Secondary NAAQS (µg/m^3)
NO_2	Annual(1)	100	100
SO_2	Annual(1)	80	None
	24-hour(2)	365	None
	3-hour(2)	None	1,300
PM_{10}	Annual(4)	50	50
	24-hour(3,5)	150	150
CO	8-hour(2)	10,305	10,305
	1-hour(2)	40,075	40,075

(1) Not to be exceeded
(2) Not to be exceeded more than once per year
(3) Not to be exceeded more than an average of one day per year over three years
(4) Not to be exceeded by the arithmetic average of the annual arithmetic averages from 3 successive years
(5) Compliance with the 24-hour standard is demonstrated when the 6th highest 24-hour concentration at each receptor, based on 5 years of modeling, is predicted below the standard Source 40 CFR 50

The NAAQS have been developed for various durations of exposure. The short-term (24-hours or less) NAAQS for SO_2 and CO refer to exposure levels not to be exceeded more than once per year. Long-term NAAQS for SO_2 and NO_2 refer to limits that cannot be exceeded for annual exposure. Compliance with the PM_{10} 24-hour and annual standards are statistical, not deterministic. The standards are attained when the expected number of exceedances each year is less than or equal to one. When modeling with a five-year meteorological data set, compliance with the 24-hour standard is demonstrated when the 6th highest 24-hour concentrations at each receptor, based on the 5 year data set, is predicted to be below the standard. Compliance with the annual standard is demonstrated when the arithmetic average of the annual arithmetic average from 3 successive years is predicted to be below the standard at each receptor.

The limits for mercury in the Standards of Performance for Toxic Pollutants are not to be exceeded and have been established for the annual and 1-hour averaging periods for mercury vapor. The TLV-TWA 8-hour limit for mercury vapor is equal to 0.025 mg/m^3 (25 µg/m^3). The Virginia Air Code 9VAC5-60-230 states that the annual ambient concentration (from the facility) should not exceed 1/500 of the TLV-TWA (or 0.05 µg/m^3) and the 1-hour concentration from the facility should not exceed 1/20 of the TLV-TWA (1.25 µg/m^3)

1.4 Modeling Limitations

The purpose of this analysis is to assess compliance with ambient standards. The analysis will incorporate several conservative assumptions to ensure that the absolute maximum pollutant concentrations will be predicted. For example, the modeling will use the highest permitted emissions or highest measured emissions for pollutants having no permit limits. The modeling will assume that all combustion sources at the power plant are operating at maximum load for the entire year. The model itself was developed and verified to overpredict actual maximum expected pollutant concentrations. Thus, highest model predicted pollutant concentrations presented in the final report will be higher than actual maximum concentrations.

2.0 PROJECT DESCRIPTION

The Potomac River Generating Station consists of five bituminous coal-fired electric utility steam generating units. Units #1 and #2 each generate 88 megawatts of electricity. Units #3, #4 and #5 each generate 102 megawatts. The facility is located in Alexandria, VA, approximately 1 mile south of Reagan National Airport. Figure 2-1 depicts the site location.

There are five boiler stacks at the power plant. Flue gases from each boiler exit into the atmosphere through its own stack. Each boiler unit is equipped with hot and cold side electrostatic precipitators for particulate control.

Table 2-1 presents stack parameters and permitted emissions rates for SO_2, NOx and TSP/PM_{10} that will be used in the dispersion modeling. The facility does not have limits on CO and mercury emissions. Maximum CO emissions were determined from the facility's continuous emission monitoring (CEMs) system. The maximum 1- and 8-hour CO emission rates for modeling are based on 10% above maximum measured values during calendar year 2004. The maximum short-term and annual average mercury emission rate is calculated using an emission factor of 2.53E-06 lb/MMBtu. This is the emission factor reported by Mirant Potomac in their annual Toxic Release Inventory (TRI) reporting. Maximum short term mercury emissions from each unit were calculated by multiplying this emission factor by the maximum capacity in MMBtu/hr of each unit. The result is a lb/hr emission rate for modeling. The annual mercury emissions will be calculated by multiplying the 2.53E-06 lb/MMBtu emission factor by the most recent two year average of the power plant's total annual heat input in MMBtu/yr. The result is a lb/yr emission rate. This emission rate will be divided by 8,760 hours in a year to arrive at a lb/hr emission rate for modeling. Annualized lb/hr mercury emissions will be apportioned equally to each unit.

Coal is transported to the site by rail. Coal is unloaded to an underground conveyor system, transported to the breaker house, and from there to the boiler building. Coal that is not fed directly to the boiler building is distributed onto a coal pile in the coal storage yard. Coal reclaimed from the yard is dumped onto the same underground conveyor system and routed to the boiler building. Bottom ash from the boilers and fly ash from the precipitators are stored in silos located on the south side of the boiler house. The ash is then loaded into covered trucks and removed from the facility. Tables 2-1 and 2-2 present point source release parameters from the ash silos and release geometry from the fugitive sources on site. Figure 2-2 shows the locations of point and fugutive sources.

Figure 2-1 Mirant Potomac River Generating Station Location

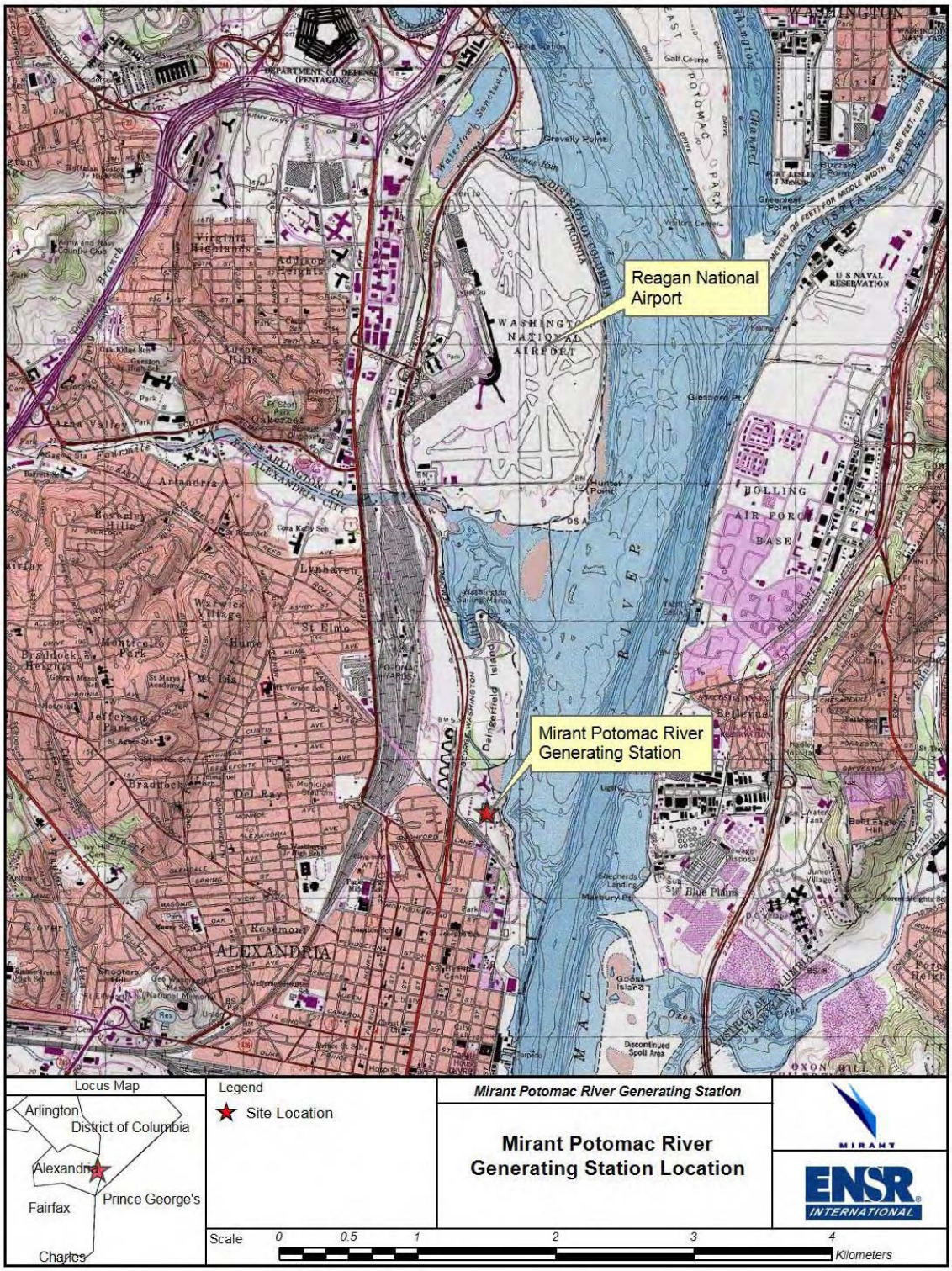


Table 2-1 Point Sources Stacks Parameters and Emissions

Point Source	Heat Input	SO_2		NOx		TSP/PM_{10}		CO			Hg	
	MMBtu/hr	lb/hr[1]	g/sec	lb/hr[2]	g/sec	lb/hr[3]	g/sec	ppmv[4]	lb/hr	g/sec	lb/hr[5]	g/sec
Boiler 1/ Stack 1	970.1	1474.6	185.8	436.5	55.0	116.4	14.7	680.9	860.7	108.4	2.45E-03	3.092E-04
Boiler 2/ Stack 2	970.1	1474.6	185.8	436.5	55.0	116.4	14.7	688.6	870.4	109.7	2.45E-03	3.092E-04
Boiler 3/ Stack 3	960.7	1460.3	184.0	432.3	54.5	115.3	14.5	631.2	790.1	99.6	2.43E-03	3.062E-04
Boiler 4/ Stack 4	960.7	1460.3	184.0	432.3	54.5	115.3	14.5	677.5	848.1	106.9	2.43E-03	3.062E-04
Boiler 5/ Stack 5	960.7	1460.3	184.0	432.3	54.5	115.3	14.5	645.9	808.6	101.9	2.43E-03	3.062E-04
Fly Ash Silo	-	-	--	-	--	3.3	0.4	-	-	-	-	-
Fly Ash Silo	-	-	--	-	--	3.3	0.4	-	-	-	-	-
Bottom Ash Silo	-	-	--	-	--	0.7	0.1	-	-	-	-	-

Notes:

Stack diameter = diameter of venturi nozzle in stack.

Modeled stack height = height of top of venturi nozzle (48.2 meters). Actual stack height = 49.1 m.
Original stack design (1947) included these venturi nozzles to increase exit velocity due to FAA height restrictions.

(1) SO_2 emissions calculations: SO_2 (lb/hr) = 1.52K, where K = total heat input (MMBtu/hr) (9 VAC 5-40-930).
(2) NOx emissions calculations: 0.45 lb/MMBtu (annual average) based on Nox RACT limits.
(3) TSP/PM_{10} emissions calculations: 0.12 lb/MMBtu based on 9 VAC 5-40-900. All TSP assumed to be PM_{10}.
(4) CO emissions based on 10% above highest 1-hour CEM measurement during period 1/1/04 - 12/31/04
CO conversion from ppmv to lb/MMBtu: 1 ppmv =0.001303 lb/MMBtu (assumes flue gas dry @ 3% oxygen).
(5) Mercury emissions based on 2.53 lb/trillion Btu from TRI reporting.

Table 2-1 Point Sources Stacks Parameters and Emissions (cont.)

Point Source	Height m	Diameter m	Temp Deg K	Velocity m/sec	Base Elevation m	UTM-X[6] m	UTM-Y[6] m
Boiler 1/Stack 1	48.2	2.6	444.3	35.7	10.4	322803.6	4298573.9
Boiler 2/Stack 2	48.2	2.6	455.4	30.2	10.4	322807.3	4298597.6
Boiler 3/Stack 3	48.2	2.4	405.4	30.8	10.4	322811.1	4298621.0
Boiler 4/Stack 4	48.2	2.4	405.4	33.2	10.4	322814.7	4298644.3
Boiler 5/Stack 5	48.2	2.4	405.4	33.8	10.4	322819.0	4298668.0
Fly Ash Silo	33.6	1.0	293.0	0.1	10.4	322796.5	4298489.3
Fly Ash Silo	33.6	1.0	293.0	0.1	10.4	322810.7	4298494.2
Bottom Ash Silo	31.0	1.0	293.0	0.1	10.4	322785.1	4298523.9

[6] Datum: NAD27, UTM Zone 18

Table 2-2 Area Sources Parameters and Emissions

Area Sources	Size m^2	Height m	PM_{10} Existing Emissions			
			lb/hr	tpy	g/sec	g/sec-m^2
Ash Loader Upgrade	546	2.0	0.102	0.07	0.013	2.36E-05
Ash Loading System Dust Suppression						
Coal Pile Wind Erosion and Dust Suppression	17,679	4.6	3.260	1.98	0.411	2.32E-05
Coal Stackout Conveyor Dust Suppression	263	9.1	0.046	0.20	0.006	2.19E-05
Coal Railcar Unloading Dust Suppression	288	1.0	0.123	0.06	0.016	5.39E-05
Ash trucks on Paved Roads	5,886	1.0	0.124	0.24	0.016	2.66E-06

Notes:

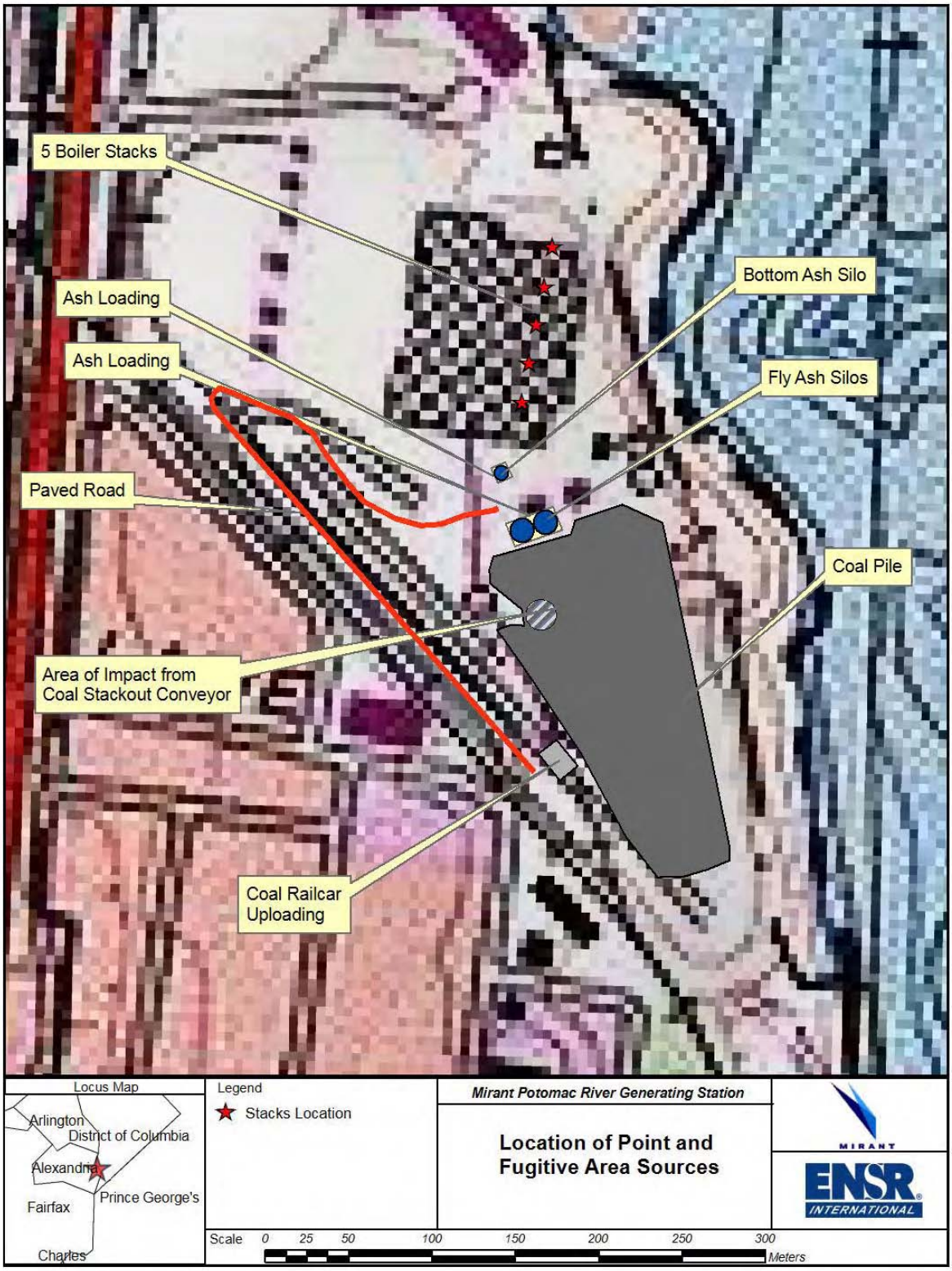
Coal Pile = 4 acres = 17,679 m^2.

Modeled height of coal pile = one half of average pile height = 30 feet x 0.5 = 15 feet (4.6 m).

Modeled height of stackout conveyor dust suppression = average height of coal pile (9.1 m).

Resuspended roadway dust from paved roads: area = 2 x 0.3 miles x 20 feet wide = 5,886 m^2.

Figure 2-2 Point and Fugitive Sources



3.0 DISPERSION MODELING ANALYSIS

3.1 Model Selection

In 1991, the USEPA, in conjunction with the American Meteorological Society (AMS), formed the AMS/USEPA Regulatory Model Improvement Committee (AERMIC). AERMIC's charter was to build upon earlier modeling developments to provide a state-of-the-art dispersion model. The resulting model was AERMOD with PRIME algorithm (hereafter called AERMOD). The PRIME downwash algorithm is technically superior to the downwash algorithm in ISCST3 because the former was developed based on extensive wind tunnel testing that was not available to the developers of ISCST3. The PRIME algorithm allows the model to calculate impacts in the cavity region immediately downwind of a downwashing stack.

Based upon the scientific formulation of AERMOD and its evaluation performance, USEPA is proposing that AERMOD replaces ISCST3 and CTDMPLUS as refined dispersion modeling techniques for simple and complex terrain for receptors within 50 km of a modeled source. Since AERMOD does not have limitations in modeling either simple or complex terrain, USEPA is proposing it as a refined technique for all terrain types.

For this project, given that USEPA has proposed AERMOD as a guideline model to replace ISCST3 and CTDMPLUS, MIRANT proposes to use AERMOD (Version 02222). This model and version is expected to be promulgated as a Guideline model in the near future.

AERMOD represents an advance in the formulation of a steady-state, Gaussian plume model. It is apparent that AERMOD has an advantage over the guideline model ISCST3 when the various scientific components are compared (Paine et al., 1998). Therefore, AERMOD would be expected to perform at least as well as or better than the existing modeling techniques, such as ISCST3. The VADEQ has requested approval from EPA Region 3 to use AERMOD for this study.

3.2 Good Engineering Practice Stack Height Analysis

A Good Engineering Practice (GEP) stack height analysis was performed based on the current facility design to determine the potential for building-induced aerodynamic downwash for all five boiler stacks. The analysis procedures described in EPA's Guidelines for Determination of Good Engineering Practice Stack Height (EPA, 1985), Stack Height Regulations (40 CFR 51), and current Model Clearinghouse guidance were used. A GEP stack height is defined as the greater of 65 meters (213 feet), measured from the ground elevation of the stack, or the formula height (H_g), as determined from the following equation:

$H_g = H + 1.5\ L$

where

H is the height of the nearby structure which maximizes H_g, and

L is the lesser dimension (height or projected width) of the building.

The GEP analysis was conducted using Lakes Environmental's BPIP View (v 4.8.5) software. The controlling structure for determining the GEP formula height for boiler stacks 2 – 5 is Marina Towers. Boiler stack 1, the southernmost stack, is just outside of the influence of Marina Towers. The controlling structure for boiler stack 1 is the boiler building. Figure 3-1 shows the structures that could affect stack downwash. Figure 3-2 shows these structures in three dimensions. Table 3-1 presents the dimensions of these structures from the BPIP output. The GEP height for the boiler stack 1 is 88.2 meters and 97.1 meters for the boiler stacks 2-5. Since the GEP height exceeds the 48.2 meter stack heights, BPIP generated wind direction-specific structure dimensions will be input to AERMOD to simulate downwash from each stack. These dimensions are included in Appendix B.

Table 3-1 Summary of GEP Analysis (Units in Meters)

Structure	Height	Length	Width	MPW[(1)]	GEP Formula Height	5L[(2)]	Base Elevation
Boiler Building	35.3	158.0	64.0	170.5	88.2	176.5	10.4
Turbine Building	23.0	156.0	26.0	158.2	57.5	115.0	10.4
ESP 1-4	35.3	94.5	25.0	97.8	88.2	176.5	10.4
ESP 5	35.3	26.0	24.0	35.4	88.2	176.5	10.4
Silo 1	33.6	N/A	13.7	13.7	54.2	68.5	10.4
Silo 2	33.6	N/A	13.7	13.7	54.2	68.5	10.4
Silo 3	31.0	N/A	9.4	9.4	45.1	47.0	10.4
Marina Towers	39.6	N/A	16.3	90.4	97.1	198.0	8.5

(1) Maximum projected width.
(2) 5 times the lesser of the MPW or height is the maximum influence region.

Table 3-2 Summary of GEP Analysis (Units in Meters) (cont.)

Structure	Distance to the Main Boilers					Stacks Potentially Affected By Downwash				
	1	2	3	4	5	1	2	3	4	5
Boiler Building	0.0	0.0	0.0	0.0	0.0	yes	yes	yes	yes	yes
Turbine Building	55.0	55.0	55.0	55.0	55.0	yes	yes	yes	yes	yes
ESP 1-4	9.6	9.6	9.6	9.6	15.0	yes	yes	yes	yes	yes
ESP 5	111.0	87.3	63.0	40.0	15.7	yes	yes	yes	yes	yes
Silo 1	72.0	96.0	119.0	143.0	167.0	no	no	no	no	no
Silo 2	69.0	92.0	114.0	158.0	161.5	no	no	no	no	no
Silo 3	37.8	62.0	86.0	110.0	134.0	yes	no	no	no	no
Marina Towers	215.0	192.0	170.0	148.0	127.0	no	yes	yes	yes	yes

Figure 3-1 Mirant Potomac River Generating Station Configuration Used for GEP Analysis

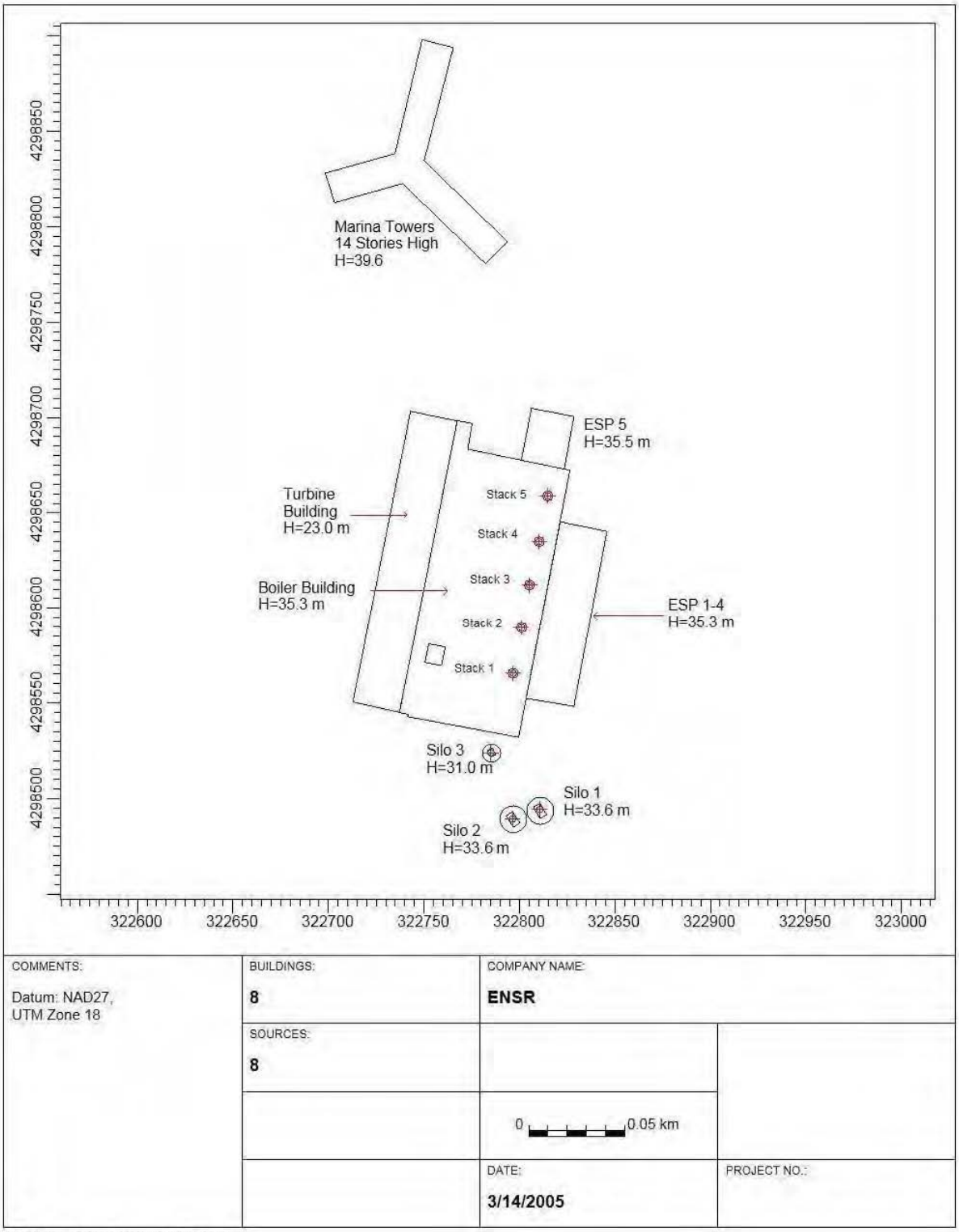
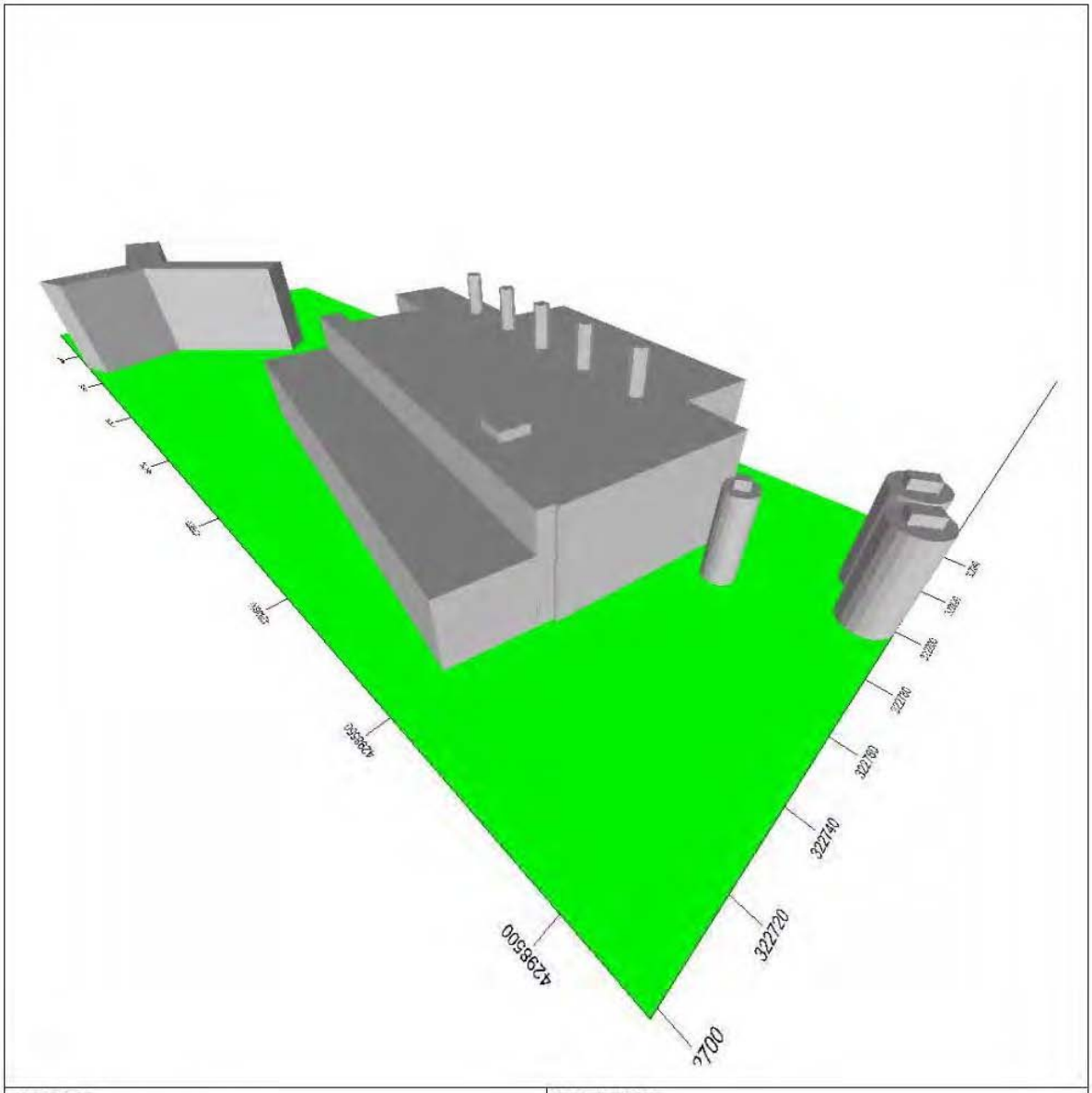


Figure 3-2 Mirant Potomac River Generating Station Configuration Used for GEP Analysis in 3D



COMMENTS:	COMPANY NAME:	
3-D View of the Mirant GEP Structures	MODELER:	
	DATE: **3/14/2005**	PROJECT NO.:

3D View - Lakes Environmental Software J:\AQES\Projects\Mirant 10350\Potomac\Lakes\Mirant.bpv

3.3 Building Cavity Analysis

The PRIME downwash algorithm within AERMOD calculates pollutant concentrations within the cavity region. Therefore, no additional analysis (e.g., SCREEN3) is necessary.

3.4 Terrain and Receptor Data

The downwash analysis will be conducted out to 5 km. Beyond a distance of approximately 1-2 km effects of downwash cannot be distinguished from ambient impacts of the released effluent that are caused by atmospheric turbulence alone. The receptor grid extends out to 5 km at the request of VADEQ. The receptor grid to be used in AERMOD will be chosen from the USGS maps in accordance with standard EPA procedures. Fenceline receptors will be established at 50 m spacing along the property boundary, surrounded by discrete Cartesian receptors placed out to:

0 - 1 km with 100 m spacing.
1 - 3 km with 250 m spacing
3 - 5 km with 500 m spacing

Figures 3-3 and Figure 3-4 show the receptor grid.

Multi-story residential buildings located within approximately 1-2 km from the facility will be modeled with flagpole receptors. Table 3-3 presents these buildings.

AERMOD requires each receptor to identify a “height scale” which is defined as the height of a nearby controlling hill. The controlling hill heights and receptor elevations will be generated from USGS digital elevation model (DEM) files. Receptor coordinates and elevations are listed in Appendix C.

Table 3-3 Multi-Story Buildings Parameters (Used for Flagpole Receptors)

Multi-Story Building	UTM-X (m) (1)	UTM-Y (m) (1)	# of Stories (2)	Building Height (m) (3)	Story Height (m) (5)
Alexandria House	322630.38	4297725.55	22	64.9	3.0
Carlyle Towers	320703.66	4296828.68	20	46.0	2.3
Carydale East	319579.69	4297276.05	18	48.3	2.7
Port Royal Condo	322652.21	4297815.58	17	46.1	2.7
Braddok Place (5)	321792.71	4298023.30	10	29.9	3.0
The Calvert Apartment	321128.13	4300123.85	15	42.7	2.8
Portals of Alexandria	320730.05	4301226.85	14	44.8	3.2
Marina Towers	322741.09	4298831.15	14	39.6	2.8

(1) Datum: NAD27, UTM Zone 18
(2) The data was obtained from Attachment III of 12/30/04 letter to Ken McBee from City of Alexandria, Department of Transportation and Environmental Services.
(3) Building heights were obtained from the City of Alexandria Department of Planning and Zoning GIS Data.
(4) Flagpole receptors will be placed at every story, 3.0 meters apart. Flagpole receptors at the Marina Towers will be placed on each balcony facing the Mirant facility, 2.83 meters apart.
(5) Attachment III lists Meridian Building as 16 stories. The height of this building was not available from the GIS data, therefore we placed flagpole receptors at the neighboring Braddock Place building. Based on the height of the Braddock Place building we assumed that it consists of ten stories.

Figure 3-3 AERMOD Receptor Grid

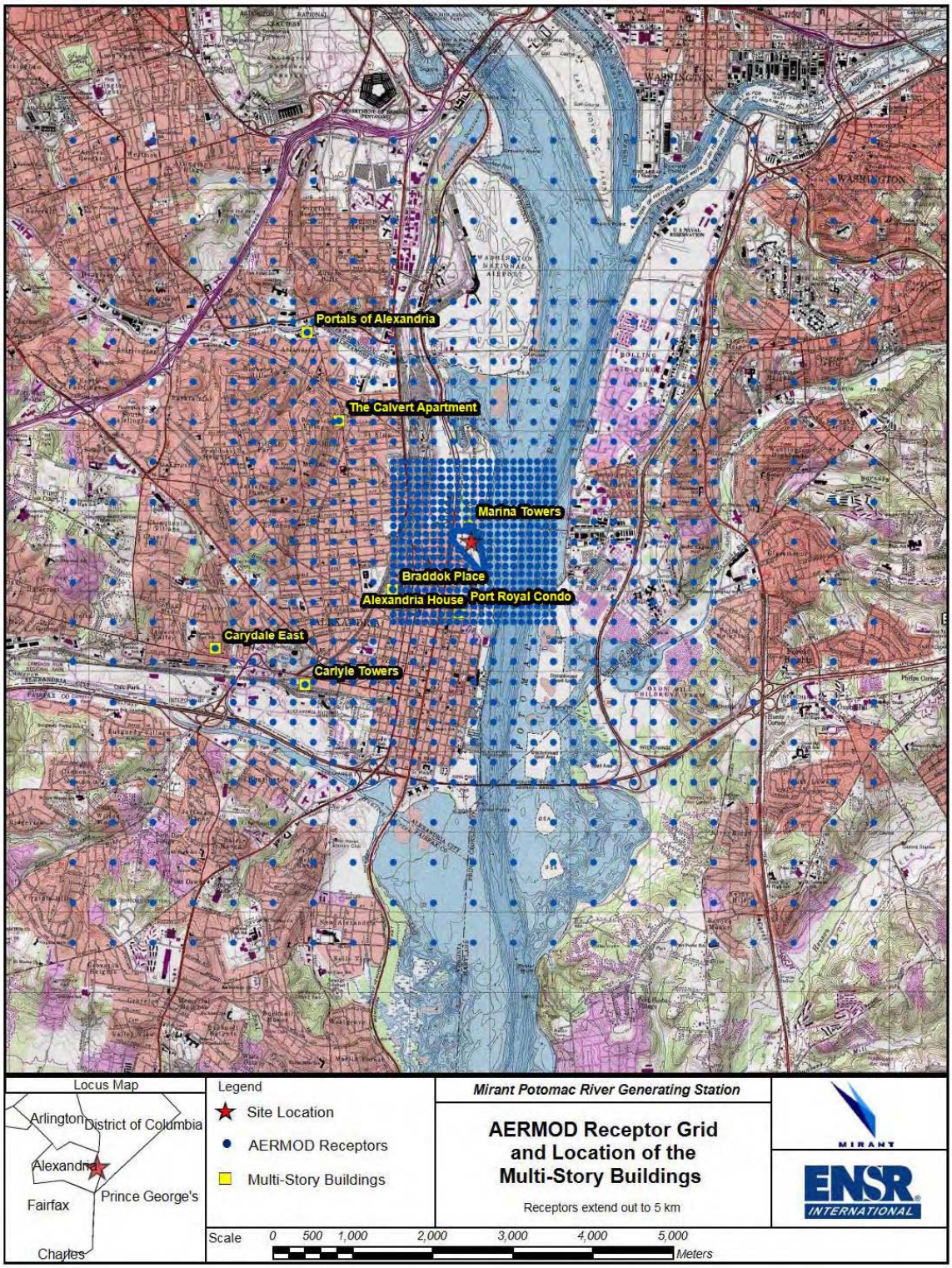
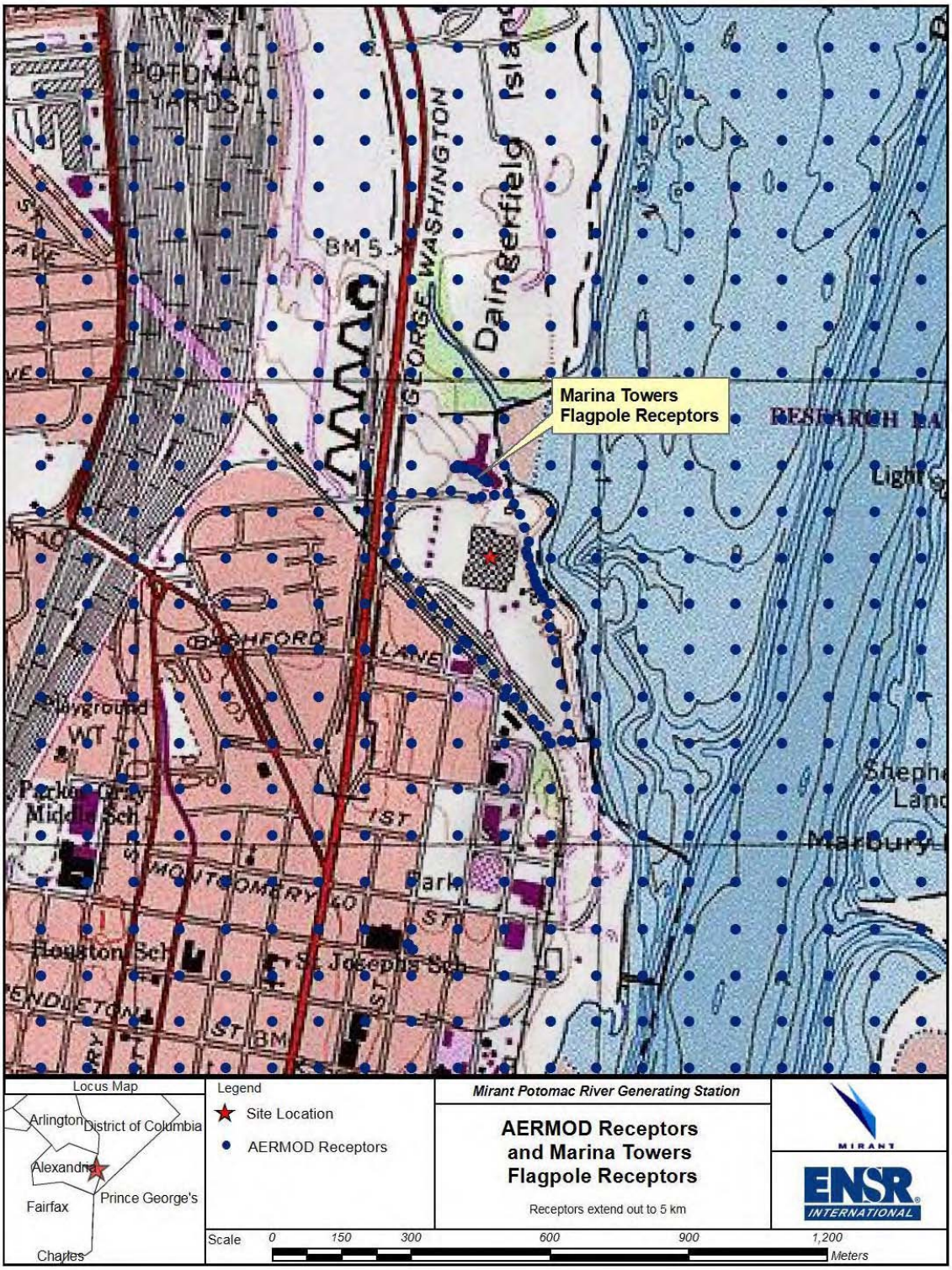


Figure 3-4 AERMOD Receptor Grid and Flagpole Receptors



3.5 Meteorological Data

For refined dispersion modeling, one year of on-site or five years of off-site representative meteorological data are required. For this application, five years of meteorological data will be used for input to AERMET, the meteorological preprocessor for AERMOD. Hourly surface meteorological data from the NWS Station at Reagan National Airport, Virginia will be used in addition to the upper air meteorological data from the NWS Met Station at Sterling, Virginia to develop the 5-year (1998-2002) AERMET data files (see Figure 3-5).

Meteorological data required for the AERMOD model partly consist of hourly values of wind speed, wind direction, and ambient temperature. Since the AERMOD dispersion algorithms are based on atmospheric boundary layer dispersion theory, additional boundary layer parameters are required. These parameters include sensible heat flux, surface friction velocity, convective velocity scale, vertical potential temperature gradient, convective and mechanical mixing heights, Monin-Obukhov length, surface roughness length, Bowen ratio, and albedo. A portion of these boundary layer parameters, as well as hourly wind and temperature profiles of the atmosphere, are estimated using surface parameters and upper air soundings. The base elevation of the primary surface station also is required by AERMOD. The base elevation of the Reagan National Airport will be used in AERMOD.

The AERMET meteorological pre-processor (version 02222) will be used to process data required for AERMOD. Site characteristics of the power plant site such as surface roughness, albedo, and Bowen ratio will be included in the input control file to AERMET.

3.5.1 Site Characteristics

Table 3-4 shows the land use site characteristics surrounding the Mirant facility. These characteristics were determined by examining a 3-kilometer radius area surrounding the site (centered at the boiler building). The area was then divided into 4 directional sectors for specifying site characteristics (see Figure 3-6 and Figure 3-7).

Table 3-4 Land Use Characteristics Surrounding the Mirant Site

Land-Use Type	Fractional Land-Use			
	Sector 1 (60°-120°)	Sector 2 (120°-180°)	Sector 3 (180°-350°)	Sector 4 (350°-60°)
Water	0.25	0.8	0	0.6
Deciduous	0.1	0.05	0.1	0.1
Grassland	0.2	0.05	0.1	0.15
Urban	0.45	0.1	0.8	0.15
Total % Land Use	1	1	1	1

Figure 3-5 Meteorological and Air Pollution Monitoring Stations

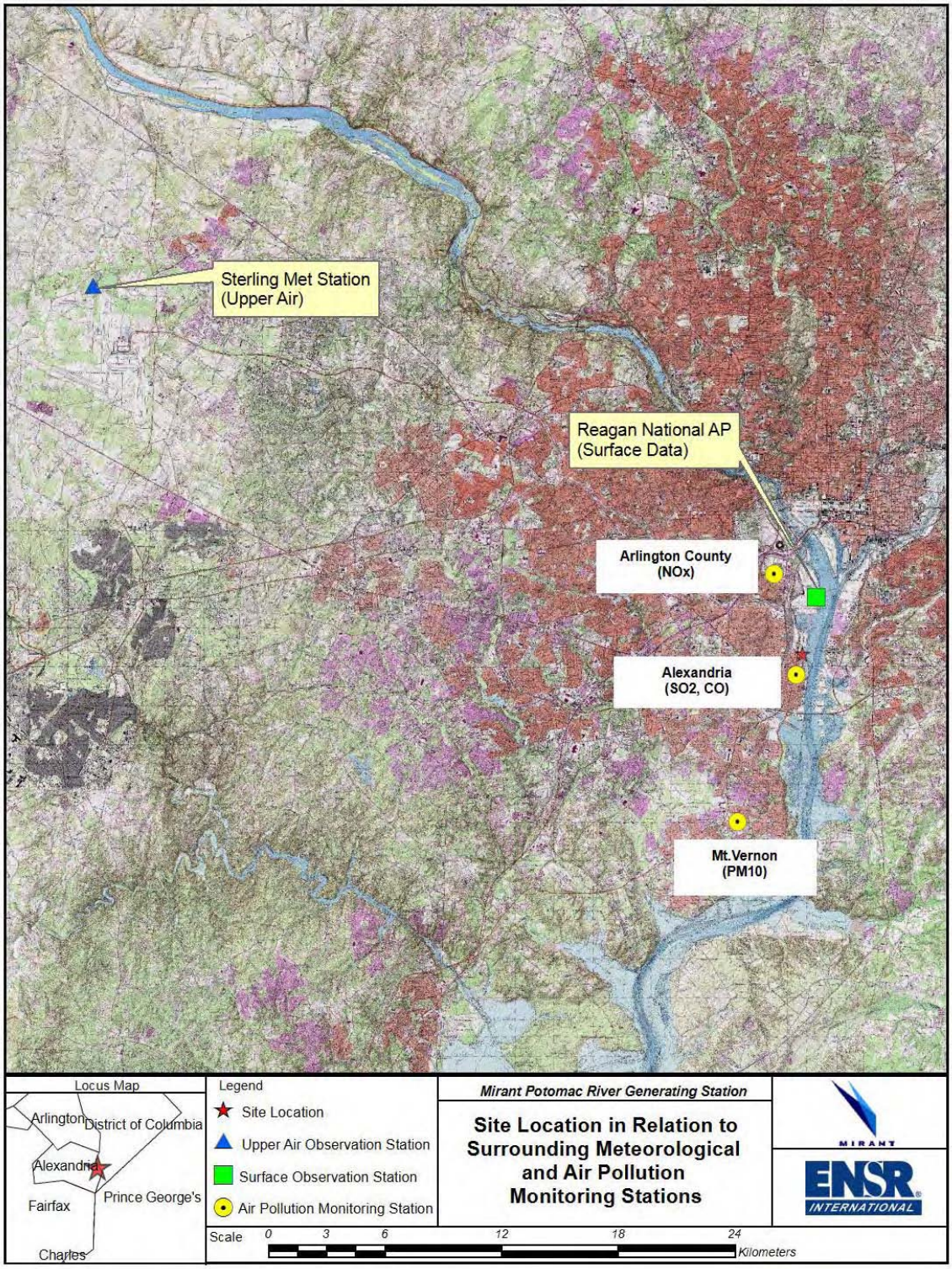


Figure 3-6 Sectors Indicating Land Use at the Mirant Site

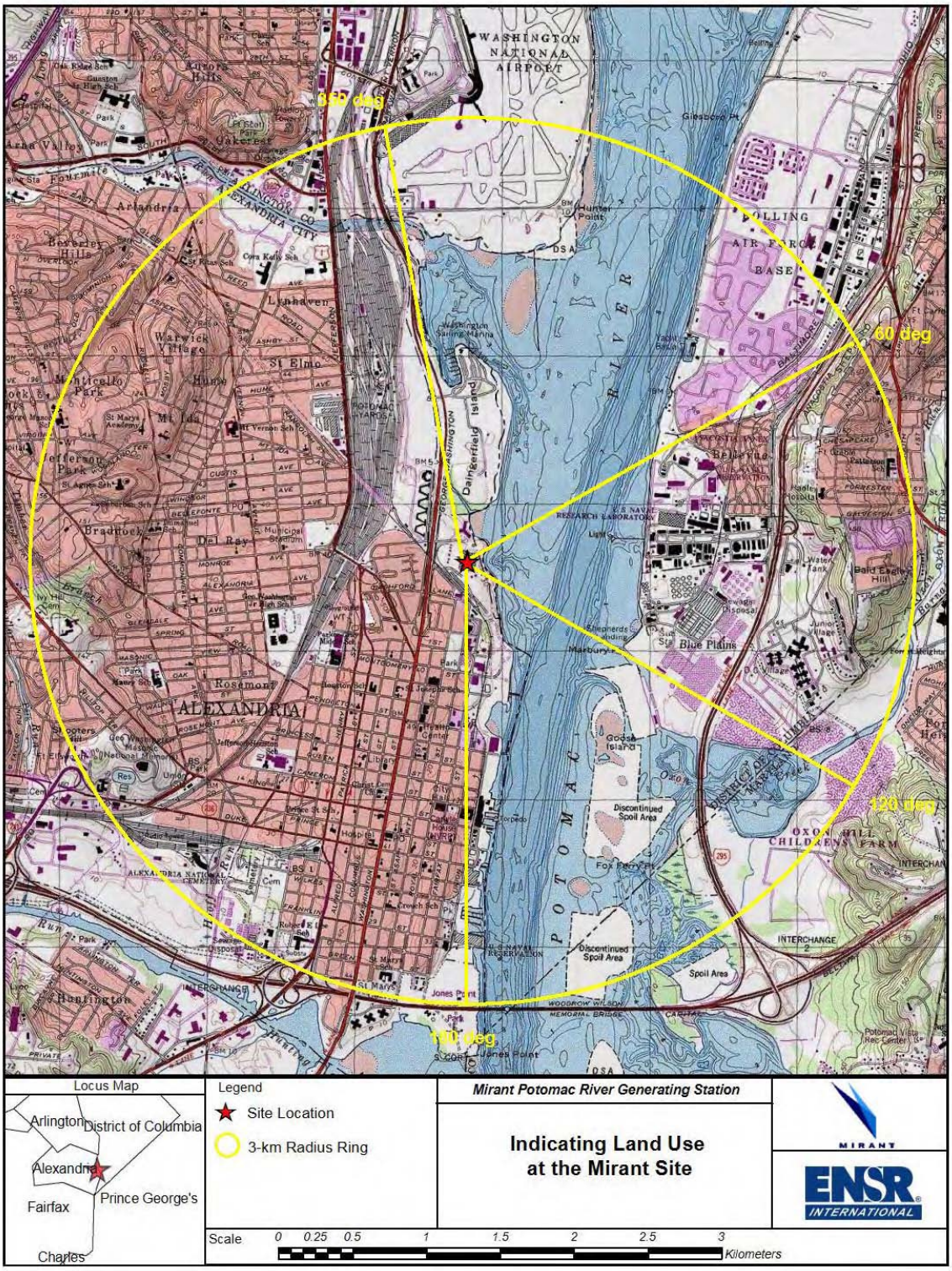
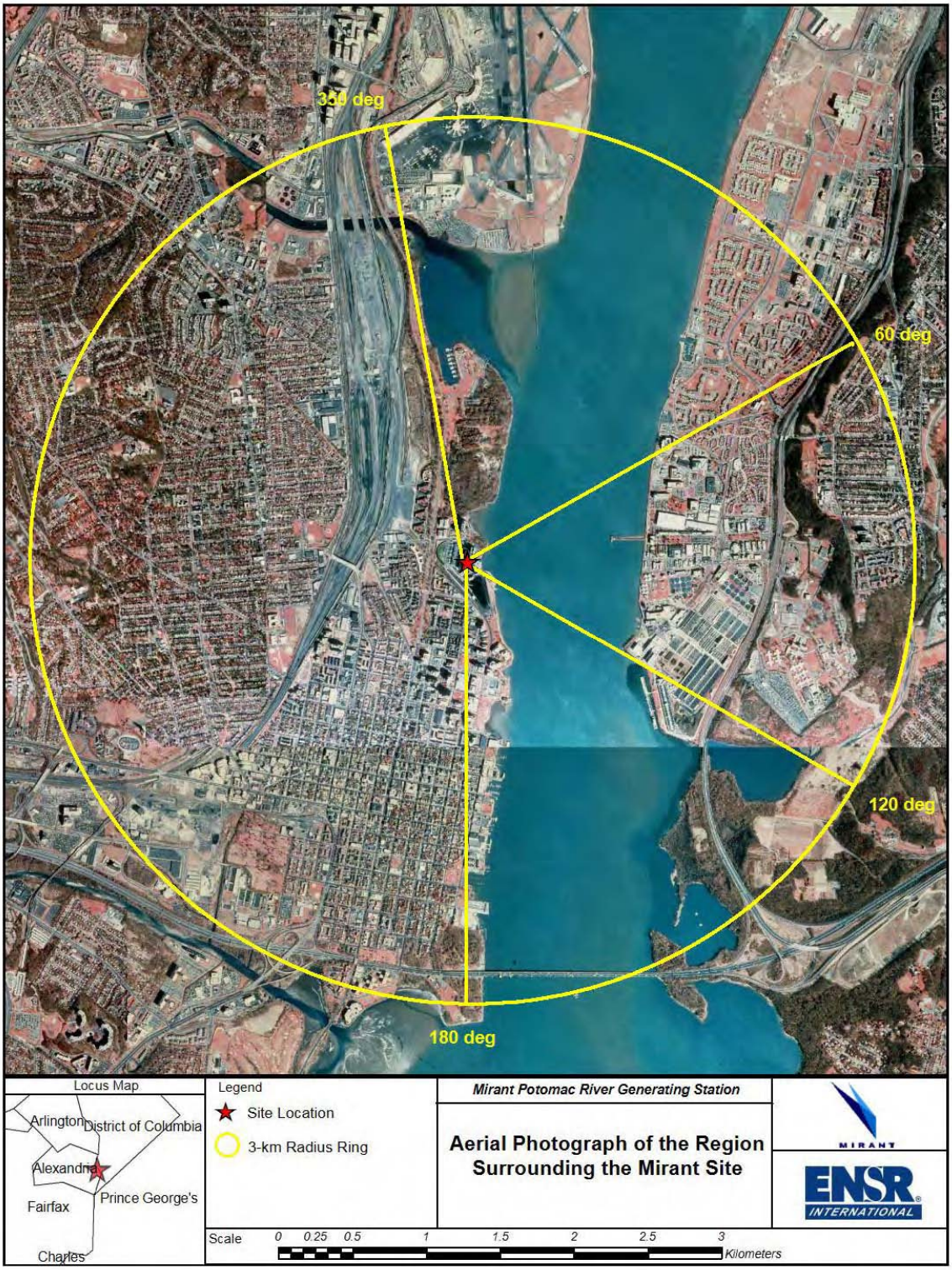


Figure 3-7 Aerial Photo of the Region Surrounding the Mirant Site



The seasonal values for each land classification that are needed based on the above sectors are provided in the AERMET user's guide (USEPA 1998) and summarized in Tables 3-5 through 3-7. Monthly weighted averages of albedo, surface roughness, and Bowen ratio based on the land classification for the above sectors will be calculated for five meteorological years. The Bowen ratio will have different annual values because of its dependency on moisture conditions. Each month will be classified as average, dry, or wet, based on monthly average precipitation data from Reagan National Airport compared to a 30 year average for each month. The calculated values then will be used for that month in determining the weighted average for the sector.

Table 3-5 Seasonal Albedo Values found in the AERMET User's Guide

Land-Use Type	Spring	Summer	Autumn	Winter
Water	0.12	0.10	0.14	0.20
Deciduous	0.12	0.12	0.12	0.50
Coniferous	0.12	0.12	0.12	0.35
Swamp	0.12	0.14	0.16	0.30
Cultivated Land	0.14	0.20	0.18	0.60
Grassland	0.18	0.18	0.20	0.60
Urban	0.14	0.16	0.18	0.35
Desert Shrubland	0.30	0.28	0.28	0.45

Table 3-6 Seasonal Surface Roughness Values found in the AERMET User's Guide

Land-Use Type	Spring	Summer	Autumn	Winter
Water	0.0001	0.0001	0.0001	0.0001
Deciduous	1.00	1.30	0.80	0.50
Coniferous	1.30	1.30	1.30	1.30
Swamp	0.20	0.20	0.20	0.05
Cultivated Land	0.03	0.20	0.05	0.01
Grassland	0.05	0.10	0.01	0.001
Urban	1.00	1.00	1.00	1.00
Desert Shrubland	0.30	0.30	0.30	0.15

Table 3-7 Seasonal Bowen Ratio Values found in the AERMET User's Guide

Land-Use Type	Average				Dry				Wet			
	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter
Water	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	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	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	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	0.3	0.5	0.7	1.5	1.0	1.5	2.0	2.0	0.2	0.3	0.4	0.5
Grassland	0.4	0.8	1.0	1.5	1.0	2.0	2.0	2.0	0.3	0.4	0.5	0.5
Urban	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	3.0	4.0	6.0	6.0	5.0	6.0	10.0	10.0	1.0	5.0	2.0	2.0

4.0 BACKGROUND AIR QUALITY

Ambient air quality data are used to represent the contribution to total ambient air pollutant concentrations from non-modeled sources. Table 4-1 shows locations and the measured concentrations over the past three years (2001-2003) of the closest air pollution monitors to the Mirant power plant. Background concentrations of SO_2 and CO were based on the Alexandria City, VA air quality monitoring station data located 1 km to the SW of the power plant. The Alexandria site is classified as residential land use and is in an urban area.

Background air quality concentrations of NO_2 were based on the Arlington County monitoring data. The monitoring station is located 4.4 km to the NW of the Mirant Potomac facility. The Arlington site is classified as commercial land use and located in an urban area.

Ambient background air quality concentrations of PM_{10} were based on the Mount Vernon, VA monitoring data. The monitoring station is located 9 km to the SSW of the Mirant Potomac facility. The Mount Vernon site is classified as residential land use and located in a suburban area.

Table 4-1 Summary of the Background Air Quality Data

Pollutant	Monitor Site	Averaging Period	Measured Concentrations ($\mu g/m^3$)*			NAAQS ($\mu g/m^3$)
			2001	2002	2003	
SO_2	517 N Saint Asaph St, Alexandria City, VA	3-hour	207.0	238.4*	186.0	1300
		24-hour	57.6	55.0	60.3*	365
		Annual	15.7*	15.7*	15.7*	80
PM_{10}	2675 Sherwood Hall Lane, Mt.Vernon, VA	24-hour	35	40	42*	150
		Annual	18	19	21*	50
NO_2	S 18th And Hayes St, Arlington County, VA	Annual	41.4	41.4	48.9*	100
CO	517 N Saint Asaph St, Alexandria City, VA	1-hour	4945.0*	4600.0	4025.0	40,075
		8-Hour	2760.0	2760.0	3220.0*	10,305

* Short-term and annual values are highest in each year.
Short-term concentrations reported as highest of the second highest and annual concentrations reported as mean.

5.0 DOCUMENTATION OF RESULTS

The report that documents the air quality impact analysis will describe the input data, the modeling procedures, and the results in tabular and graphical form. Much of the information regarding locations, plot plans, etc., associated with the Project that is included in this modeling protocol will be included in the air quality impact analysis report.

The document will be presented in loose-leaf format in a 3-ring binder so that additions or revisions can easily be made. Any process information deemed to be confidential by Mirant Corporation will be so noted.

Three copies of the final air quality modeling report will be submitted to the Virginia DEQ Central Office. Additional copies for distribution to USEPA Region III will be provided, if necessary.

The computer files associated with the air quality analysis will be submitted on a single CD-ROM. All meteorological and monitoring data will be presented so that a reviewer can completely reconstruct the entire modeling demonstration on an IBM-compatible PC. Descriptions of files on the CD will be included in the computer documentation, and the use of binary files will be avoided to promote portability of the files to other computer systems.

6.0 REFERENCES

EPA 1985. *Guideline for the Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations) - Revised*. EPA-450/4-80-023R, U.S. Environmental Protection Agency, Research Triangle Park, NC 27711.

EPA 1990. *New Source Review Workshop Manual*. Draft October 1990. U.S. Environmental Protection Agency, Research Triangle Park, NC 27711.

EPA 1997. *Guideline on Air Quality Models (Revised)*. EPA-450/2-78-027R, U. S. Environmental Protection Agency, Research Triangle Park, NC 27711.

EPA 1998*. Revised Draft User's Guide for the AERMOD Meteorological Preprocessor (AERMET).* U. S. Environmental Protection Agency, Research Triangle Park, NC 27711.

EPA, 2004. Control of Mercury Emissions from Coal-Fired Electric Utility Boilers. Air Office of Research and Development, February 27. EPA's Technology Transfer Network Air Toxics Website/Electric Utility Steam Generating Units NESHAPS

Paine, R.J., R.F. Lee, R. Brode, R.B. Wilson, A.J. Cimorelli, S.G. Perry, J.C. Weil, A. Venkatram and W. Peters, 1998. Model Evaluation results for AERMOD. EPA website www.epa.gov/scram001

Standards of Performance for Toxic Pollutants 9VAC5-60-230
http://leg1.state.va.us/cgi-bin/legp504.exe?000+reg+9VAC5-60-230

APPENDIX A

CONSENT ORDER REGARDING A DOWNWASH STUDY

&

VA DEQ COMMENT LETTER ON THE MODELING PROTOCOL

MIRANT POTOMAC RIVER GENERATING STATION

COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY

W. Tayloe Murphy, Jr.
Secretary of Natural Resources

Street address: 629 East Main Street, Richmond, Virginia 23219
Mailing address: P.O. Box 10009, Richmond, Virginia 23240
Fax (804) 698-4500 TDD (804) 698-4021
www.deq.state.va.us

Robert G. Burnley
Director

(804) 698-4000
1-800-592-5482

February 10, 2005

Dave Shea
Sr. Program Manager
ENSR Corporation
2 Technology Park Drive
Westford, MA 01886

Dear Mr. Shea:

I am writing this letter in response to your Protocol for Modeling the Effects of Downwash from the Mirant's Potomac River Power Plant dated October 2004. As part of Department of Environmental Quality (DEQ)'s review of this document, I have reviewed and considered comments on this protocol from a local neighborhood association and the city of Alexandria.

First of all, I would like to state that the specific Potomac River Power Plant emissions data used in the proposed Downwash Study will be agreed to by the Northern Virginia Regional Office staff. PM2.5 emissions will not be considered due to the lack of an EPA-approved analysis model or procedure. However, PM10 (analyzed as a surrogate for PM2.5), as well as the other specified criteria pollutants will be considered for the total plant operation to include coal and ash yards in the study. You should work closely with the regional staff to develop the worst case emissions and stack parameters for this facility.

As to the proposed model, AERMOD, DEQ has requested approval to use this model since it is still not promulgated and has received it from the USEPA, Region III, Regional Director. Although there are technical disagreements among professional modelers about the location to be examined for land use characteristics, the center of this study should be the placed at the power plant.

Upon reviewing topographic maps and aerial photographs of the area, the Marina Towers as well as some other high rise buildings that are close by should be addressed in the analysis to determine downwash characteristics to be included in the AERMOD model runs. I realize that this will take some time to gather additional dimensions of these buildings.

Also, several discrete receptors have been suggested by the local citizens. In order to determine the worst case concentrations in the area, prepare a refined modeling area receptor grid out to 5 km with receptors placed every 100 m. This grid of receptors should be representative of the air quality for all the specific discrete receptors requested by the populace in the area. If the concentration gradient is decreasing at the 5 km distance and the concentrations are less than the air quality standards promulgated by EPA and this agency, then the modeling area is limited at that point. This receptor grid should also include flag pole receptors for all nearby raised structures. The flagpole receptors should be placed at access points on each level or floor of the nearby raised structures.

After responding to this letter with your amended protocol by March 15, I will supply you with the appropriate monitored background values for the modeled criteria pollutants.

Sincerely yours,

Kenneth L. McBee
Air Quality Modeler

Cc: Larry Labrie, Mirant Corp
John McKie, Air Permitting Engineer, NVRO
Terry Darton, Air Permitting Manager, NVRO

COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY

W. Tayloe Murphy, Jr.
Secretary of Natural Resources

Northern Virginia Regional Office
13901 Crown Court
Woodbridge, VA 22193-1453
(703) 583-3800 *fax* (703) 583-3801
www.deq.state.va.us

Robert G. Burnley
Director

Jeffery A. Steers
Regional Director

COMMONWEALTH OF VIRGINIA
STATE AIR POLLUTION CONTROL BOARD

ORDER BY CONSENT

ISSUED TO

MIRANT POTOMAC RIVER, LLC
Registration No. 70228

SECTION A: Purpose

This is a Consent Order issued under the authority of Va. Code § § 10.1-1307D and 10.1-1307.1, between the Board and Mirant Potomac River, LLC for the purpose of ensuring compliance with ambient air quality standards incorporated at 9 VAC Chapter 30 and Va. Code § 10.1-1307.3(3) requiring certain emissions modeling and analysis related to the Potomac River Power Station located in Alexandria, Virginia.

SECTION B: Definitions

Unless the context clearly indicates otherwise, the following words and terms have the meanings assigned to them below:

1. "Va. Code" means the Code of Virginia (1950), as amended.

2. "Board" means the State Air Pollution Control Board, a permanent collegial body of the Commonwealth of Virginia as described in Va. Code §§ 10.1-1301 and 10.1-1184.

3. "Department" or "DEQ" means the Department of Environmental Quality, an agency of the Commonwealth of Virginia as described in Va. Code § 10.1-1183.

4. "Director" means the Director of the Department of Environmental Quality.

5. "Order" means this document, also known as a Consent Order.

6. "Mirant," means Mirant Potomac River, LLC, a limited liability company qualified to do business in Virginia. Mirant Potomac River, LLC is owned Mirant Corporation and operated by Mirant Mid-Atlantic, LLC.

7. "Facility" means the Potomac River Generating Station owned and operated by Mirant located at 1400 North Royal Street, Alexandria, Virginia, 22314. The facility is a five unit, 488 MW coal-fired electric generating plant.

8. "NVRO" means the Northern Virginia Regional Office of DEQ, located in Woodbridge, Virginia.

9. "The Permit" means the Stationary Source Permit to Operate issued by DEQ to the facility on September 18, 2000, pursuant to 9 VAC 5-80-800, *et seq.*

10. "Marina Towers" means a multiple unit residential condominium building located at 501 Slaters Lane, Alexandria, Virginia, in close proximity to the facility.

11. "Downwash" means the effect that occurs when aerodynamic turbulence induced by nearby structures causes pollutants from an elevated source (such a smokestack) to be mixed rapidly toward the ground resulting in higher ground-level concentrations of pollutants.

12. "NAAQS" means the primary national ambient air quality standards established by the U.S. Environmental Protection Agency for certain pollutants, including sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone, and particulate matter (PM), pursuant to § 109 of the federal Clean Air Act, 42 USC § 7409, set forth at 40 CFR Part 50 and incorporated at 9 VAC Chapter 30. NAAQS are established at concentrations necessary to protect public health with an adequate margin of safety.

13. "NOx" means oxides of nitrogen, which is a pollutant resulting from the combustion of fossil fuels and a precursor to the formation of ozone.

14. "PM_{10}" means particulate matter with an aerodynamic diameter less than or equal to 10 micrometers and is a pollutant resulting from, among other things, the combustion of fossil fuels.

SECTION C: Findings of Fact and Conclusions of Law

1. In order to ensure compliance with the Northern Virginia area's National Ambient Air Quality Standard (NAAQS) for ozone, the Department is in the process of revising the facility's Stationary Source Permit to Operate for the purpose of clarifying the facility's ozone season

(May 1 through September 30) emission requirements for NOx. A public hearing on the proposed permit revision was held in Alexandria, Virginia, on the evening of April 12, 2004.

2. Among the comments offered at the public hearing by Alexandria residents was that DEQ should require Mirant to perform comprehensive modeling to assess the impact of emissions from the facility on the area in the immediate vicinity of the facility.

3. At or about the time of the public hearing, certain residents of Alexandria, Virginia, provided the Department with a document entitled "Screening-Level Modeling Analysis of the Potomac River Power Plant Located in Alexandria, Virginia" prepared by Sullivan Environmental Consulting, Inc., dated March 29, 2004 (the Sullivan Screening). The Sullivan Screening was commissioned by, among others, certain residents of Marina Towers for the purpose of assessing whether emissions from the facility may cause exceedances of certain NAAQS at Marina Towers as a result of "downwash." The Sullivan Screening concluded that, "on average, meteorological conditions associated with plume impaction conditions on the Marina Towers condominium were screened to occur as often as 1,200 hours per year."

4. Although the Sullivan Screening does not establish conclusively that emissions from the facility result in exceedances of the NAAQS at Marina Towers, the Department believes that the results of the Sullivan Study warrant that further comprehensive analysis be conducted in accordance with DEQ and EPA approved modeling procedures in order to more fully determine the effect of emissions from the facility on the ambient air quality at Marina Towers and in the area in the immediate vicinity of the facility.

SECTION D: Agreement and Order

Accordingly, the Board, by virtue of the authority granted it in Va. Code §§ 10.1-1307 D and 10.1-1307.1 orders Mirant, and Mirant agrees, to perform the actions described in this section of the Order:

1. Mirant shall perform a refined modeling analysis to assess the effect of "downwash" from the facility on ambient concentrations of SO_2, NO_2, CO, and PM_{10} for comparison to the applicable NAAQS in the area immediately surrounding the facility. In addition, Mirant shall perform a refined modeling analysis to assess the effect of "downwash" from the facility on ambient concentrations of mercury for comparison to the applicable Standards of Performance for Toxic Pollutants set forth in 9 VAC 5-60-200, *et seq.*, in the area immediately surrounding the facility.

2. The protocol and methodology for the modeling analysis shall be in accordance with EPA and DEQ methods and shall be approved by DEQ prior to commencement of the modeling. Mirant shall submit a proposed modeling protocol and methodology to Kenneth L. McBee, DEQ Air Modeling Program Coordinator, 629 E. Main St., Richmond VA 23219, within twenty-one (21) days of the effective date of this Order.

3. Mirant shall perform the modeling analysis immediately upon receiving written approval of the modeling protocol and methodology from DEQ. Mirant shall submit the results of the modeling analysis to Mr. McBee and the Director of the Department's Northern Virginia Regional Office no later than sixty (60) days after Mirant receives written approval of the modeling protocol and methodology.

4. In the event the modeling analysis indicates that emissions from the facility may cause exceedances of the NAAQS for SO_2, NO_2, CO, or PM_{10}, or exceedances of the Standards of Performance for Toxic Pollutants for mercury in the area immediately surrounding the facility, DEQ shall require Mirant to submit to DEQ, within ninety (90) days of submitting the modeling analysis, a plan and schedule to eliminate and prevent such exceedances on a timely basis. Upon review and approval of that plan and schedule by DEQ, the approved plan and schedule shall be incorporated by reference into this Order.

5. Mirant agrees to waive any objections it may otherwise be entitled to assert under law should DEQ seek to incorporate the approved plan and schedule into the facility's permit.

Section E: Administrative Provisions

1. The Board may modify, rewrite, or amend this Order with the consent of Mirant for good cause shown by Mirant, or after a proceeding as required by the Administrative Process Act for a case decision.

2. This Order addresses only those issues specifically identified herein. This Order shall not preclude the Board or the Director from taking any action authorized by law, including, but not limited to seeking subsequent remediation of the facility as may be authorized by law and/or taking subsequent action to enforce the terms of this Order. This order shall not preclude appropriate enforcement actions by other federal, state or local regulatory agencies for matters not addressed herein.

3. Solely for the purposes of the execution of this Order, for compliance with this Order, and for subsequent actions with respect to this Order, Mirant consents to the jurisdictional allegations and conclusions of law contained herein.

4. Mirant declares it has received fair and due process under the Administrative Process Act, Va. Code §§ 2.2-4000 *et seq.*, and the Air Pollution Control Law and it waives the right to any hearing or other administrative proceeding authorized or required by law or regulation, and to any judicial review of any issue of fact or law contained herein. Nothing herein shall be construed as a waiver of the right to any administrative proceeding for, or to judicial review of, any action taken by the Board to modify, rewrite, amend, or enforce this Order, or any subsequent deliverables required to be submitted by Mirant and approved by the Department, without the consent of Mirant.

5. Failure by Mirant to comply with any of the terms of this Order shall constitute a violation of an order of the Board. Nothing herein shall waive the initiation of appropriate enforcement actions or the issuance of additional orders as appropriate by the Board or Director as a result of such violations.

6. If any provision of this Order is found to be unenforceable for any reason, the remainder of the Order shall remain in full force and effect.

7. Mirant shall be responsible for failure to comply with any of the terms and conditions of this Order unless compliance is made impossible by earthquake, flood, other acts of God, war, strike, or other such circumstance. Mirant must show that such circumstances resulting in noncompliance were beyond its control and not due to a lack of good faith or diligence on its part. Mirant shall notify the Director, NVRO, in writing when circumstances are anticipated to occur, are occurring, or have occurred that may delay compliance or cause noncompliance with any requirement of this Order. Such notice shall set forth:

a. The reasons for the delay or noncompliance;

b. The projected duration of any such delay or noncompliance;

c. The measures taken and to be taken to prevent or minimize such delay or noncompliance; and

The timetable by which such measures will be implemented and the date full compliance will be achieved.

Failure to so notify the Director, NVRO, in writing within 24 hours of learning of any condition above, which Mirant intends to assert will result in the impossibility of compliance, shall constitute a waiver of any claim of inability to comply with a requirement of this Order.

8. This Order is binding on the parties hereto, parent corporations, or their successors in interest, designees, assigns.

9. This Order shall become effective upon execution by both the Director of the Department of Environmental Quality or his designee and Mirant.

10. This Order shall continue in effect until:

a. Mirant petitions the Director or his designee to terminate the order after it has completed all of the requirements of the Order and the Director or his designee approves the termination of the Order; or

b. The Director or Board terminates the Order in his or its sole discretion upon 30 days written notice to Mirant.

Termination of this Order, or of any obligation imposed in this Order, shall not operate to relieve Mirant from its obligation to comply with any statute, regulation, permit condition, other order, certificate, certification, standard, or requirement otherwise applicable.

AND IT IS ORDERED this 23rd day of SEPTEMBER 2004.

By: Jeffery A. Steers per
Robert G. Burnley, Director
Department of Environmental Quality

Mirant Potomac River, LLC, voluntarily agrees to the issuance of this Order.

MIRANT POTOMAC RIVER, LLC

by: Lisa D. Johnson
Lisa D. Johnson, President

The foregoing instrument was signed and acknowledged before me on this 17th day of Sept. 2004 by Lisa D. Johnson of Mirant Potomac River, LLC, in the City of Prince George County, Commonwealth of Virginia.

Janice G. Harrison
Notary Public

My Commission expires: 06/07/05

APPENDIX B

PARTICULATE EMISSION CALCULATIONS

MIRANT POTOMAC RIVER GENERATING STATION

Mirant Potomac River, LLC
Ash Silo Vent Secondary Filtration - Fugitive Dust Emission Calculations

FLY ASH EMISSION CALCULATIONS

Fly Ash Assumptions

Total Ash Shipped in trucks =	631	tpd (according to Mirant)			164,060	ton ash/yr
Est. Fly ash shipped in trucks =	593					
Est. Bottom ash shipped in trucks=	38					
Target moisture for fly ash	20	%				
Worse case moisture for fly ash=	10	%				
Daily Ash generated by Boilers	480	tpd				
Estimated % that is bottom ash	6%					
Estimated % that is fly ash	94%					
Estimated Avg wt of ash in trucks	22	tons @	20%	moisture		
Truck Loading in Silo:	8	min				
Truck Washing	15 - 30	min				
Ash hauling	8	hr/day				
	5	days/wk				
	52	wk/yr	260	days/yr		
Trucks onsite	4	hr/day				
Avg number of trucks hauling ash	7	trucks/day	7,280	truck trips/yr	160,160	ton ash/yr
Avg number of truck trips	4	trips/day				
Peak number of trucks hauling ash	10	trucks/day	40	truck trips/day		
Peak number of truck trips	4	trips/day				

Fly Ash Emissions from Baghouse on top of loading silos

2 - Silo's	Flow of pneumatic air with fly ash into silo	7800	cfm (Mirant - 2 x (2,700 + 1,200)
	Ash Loading into silo	480	tpd (from daily ash generated by boilers)
	Baghouse collection efficiency	99.0%	(based on outlet grain loading)
	Outlet Baghouse emissions (assumed)	0.1	grains/acf
	Estimated PM/PM-10 emissions	780	grains/min
	Estimated PM/PM-10 hourly emissions	6.69	lb/hr
	Estimated PM/PM-10 yearly emissions	29.28	tpy

Bottom Ash Emissions from Baghouse on top of loading silo

1 - Silo	Flow of pneumatic air with fly ash into silo	5400	cfm (from Mirant)
	Outlet Baghouse emissions (assumed)	0.015	grains/acf (assumed based on visual comparison to fly ash silo baghouses)
	Estimated PM/PM-10 emissions	81	grains/min
	Estimated PM/PM-10 hourly emissions	0.69	lb/hr
	Estimated PM/PM-10 yearly emissions	3.04	tpy

Total Ash Emissions (All three silos)

		---PM-10 Emissions---		---PM Emissions---	
		lb/hr	tpy	lb/hr	tpy
Ash Silo Secondary Filtration	Existing	7.4	32.3	7.4	32.3

Represents existing emissions

Mirant Potomac River, LLC
Ash Loader Upgrade - Fugitive Dust Emission Calculations

FLY ASH EMISSION CALCULATIONS

Fly Ash Emissions from Truck Loading in Silos

	PM10		PM	
Existing Peak Estimate	2.17E-04	EF lb/ton	4.58E-04	EF lb/ton
	880	tpd fly ash loaded	880	tpd fly ash loaded
	236	tph fly ash loaded	236	tph fly ash loaded
	0.051	lbs/hr fly ash emissions	0.108	lbs/hr fly ash emissions
	0.035	tpy fly ash emissions	0.075	tpy fly ash emissions

Emission Factor Calculations (1)

UEF PM (lb/ton) = k x 0.0032 x ((U/5)^1.3)/((M/2)^1.4)

Assume:

k (particle size multiplier) =	0.35 for PM-10 &	0.74 for PM
U (mean wind speed) =	8	miles/hour average wind speed within the silo enclosures (assumed)
M (moisture content) =	20	% (target moisture content of fly ash after pug mill)
M (moisture content) =	10	% (worse case moisture content of fly ash after pug mill)

NOTES:

(1) AP-42 Section 13.2.4 Aggregate Handling and Storage Piles

Fly Ash Assumptions

Total Ash Shipped in trucks =	631	tpd (according to Mirant)	
Est. Fly ash shipped in trucks =	593		
Est. Bottom ash shipped in trucks=	38		
Target moisture for fly ash	20	%	
Worse case moisture for fly ash=	10	%	
Daily Ash generated by Boilers	480	tpd	
Estimated % that is bottom ash	6%		
Estimated % that is fly ash	94%		
Estimated Avg wt of ash in trucks	22	tons @	20% moisture
Truck Loading in Silo:	8	min	
Truck Washing	15 - 30	min	
Ash hauling	8	hr/day	
	5	days/wk	
	52	wk/yr	
Trucks onsite	4	hr/day	
Avg number of trucks hauling ash	7	trucks/day	
Avg number of truck trips	4	trips/day	
Peak number of trucks hauling ash	10	trucks/day	
Peak number of truck trips	4	trips/day	

Total Ash Emissions

		---PM-10 Emissions---		---PM Emissions---	
		lb/hr	tpy	lb/hr	tpy
Ash Loader Upgrade	Existing	0.05	0.04	0.11	0.07

Mirant Potomac River, LLC
Ash Loading System Dust Suppression - Fugitive Dust Emission Calculations

FLY ASH EMISSION CALCULATIONS

Fly Ash Emissions from Truck Loading in Silos

	PM10		PM	
Existing Peak Estimate	2.17E-04	EF lb/ton	4.58E-04	EF lb/ton
	880	tpd fly ash loaded	880	tpd fly ash loaded
	236	tph fly ash loaded	236	tph fly ash loaded
	0.051	lbs/hr fly ash emissions	0.108	lbs/hr fly ash emissions
	0.035	tpy fly ash emissions	0.075	tpy fly ash emissions

Emission Factor Calculations (1)

	PM10	PM

UEF PM (lb/ton) = k x 0.0032 x ((U/5)^1.3)/((M/2)^1.4)
CEF PM (lb/ton) = UEF (lb/ton) x ((100 - removal efficiency (%))/100)

Assume:

k (particle size multiplier) =	0.35	for PM-10 &	0.74 for PM
U (mean wind speed) =	8	miles/hour average wind speed within the silo enclosures (assumed)	
M (moisture content) =	20	% (target moisture content of fly ash after pug mill)	
M (moisture content) =	10	% (worse case moisture content of fly ash after pug mill)	
Emission control removal efficiency =	65	%	Water spray system (estimate from Bob Coburn at Benetech)

NOTES:
'(1) AP-42 Section 13.2.4 Aggregate Handling and Storage Piles

Fly Ash Assumptions

Total Ash Shipped in trucks =	631	tpd (according to Mirant)	
Est. Fly ash shipped in trucks =	593		
Est. Bottom ash shipped in trucks=	38		
Target moisture for fly ash	20	%	
Worse case moisture for fly ash=	10	%	
Daily Ash generated by Boilers	480	tpd	
Estimated % that is bottom ash	6%		
Estimated % that is fly ash	94%		
Estimated Avg wt of ash in trucks	22	tons @	20% moisture
Truck Loading in Silo:	8	min	
Truck Washing	15 - 30	min	
Ash hauling	8	hr/day	
	5	days/wk	
	52	wk/yr	
Trucks onsite	4	hr/day	
Avg number of trucks hauling ash	7	trucks/day	
Avg number of truck trips	4	trips/day	
Peak number of trucks hauling ash	10	trucks/day	
Peak number of truck trips	4	trips/day	

Total Ash Emissions

		---PM-10 Emissions---		---PM Emissions---	
		lb/hr	tpy	lb/hr	tpy
Ash Loading Dust Suppression	Existing	0.05	0.04	0.11	0.07

Mirant Potomac River, LLC
Fence - Fugitive Dust Emission Calculations

COAL EMISSIONS CALCULATIONS

Wind Erosion Actual Emissions (for coal emissions)

		---PM-10 Emissions---		---PM Emissions---	
Golder coal pile wind erosion calculations OK		lb/hr	tpy	lb/hr	tpy
6 acre active coal pile (worst case)	Existing (6 acres)	4.9	3.0	9.8	5.9
	Existing (4 acres)	3.3	2.0	6.5	4.0
After Installation of Wind Screen (see calculations below)					
6 acre active coal pile (worst case)	Projected	0.9	1.0	1.7	2.1

Wind Erosion

Reference: Control of Open Fugitive Dust Sources, Section 4.1.3, EPA-450/3-98-008
[Wind Emissions From Continuously Active Piles]

E (lb PM per day per acre) = 1.7 (s/1.5) (365-p/235) (f/15)

where:

	s =	4.8	silt content % [from AP-42 Table 13.2.4-1 (coal as received at coal-fired power plant)
	p =	120	number of days with >0.01 inches precip. per year [from AP-42 Figure 13.2.2-1]
Prior to Installation of Windscreen	f=	28.4	percentage of time that wind speed exceeds 5.4 m/s at mean pile height [from Washington, DC National Airport wind data 1988-1992]
After Installation of Windscreen	f =	27.4	Estimate for percentage of time wind speed exceeds 5.4 m/s after installation of wind screen
	E =	10.4	lb PM per day per acre
	E =	5.2	lb PM-10 per day per acre [using PM-10 to PM ratio of 0.5 from EPA-450/3-98-008]

Source Name	Coal pile size (acres)	Projected Emissions (lb PM_{10}/hr)	Projected Emissions (lb PM/hr)	Projected PM_{10} Emissions (tpy)	Projected PM Emissions (tpy)
Active Coal Storage Pile (Worst Case)	4.0	0.9	1.7	1.0	2.1

Mirant Potomac River, LLC
Coal Stack-Out Conveyor System - Fugitive Dust Emission Calculations

COAL EMISSIONS CALCULATIONS

Total Coal Emissions (Peak)

	---PM-10 Emissions---		---PM Emissions---	
	lb/hr	tpy	lb/hr	tpy
Breaker conveyor dump to coal pile Existing	0.05	0.20	0.10	0.42

Emission Factor Calculations for Coal (1)

UEF PM (lb/ton) = k x 0.0032 x ((U/5)^1.3)/((M/2)^1.4)
CEF PM (lb/ton) = UEF (lb/ton) x ((100 - removal efficiency (%))/100)

Assume:

k (particle size multiplier) =	0.35	for PM-10 &	0.74	for PM
U (mean wind speed) =	12	miles/hour for short term	4.38	miles/hr for annual average
M (moisture content) =	4.5	% (from AP-42 Table 13.2.4-1 for coal as-received at coal fired power plant)		
M (moisture content) =	18	% (based on dust reduction estimate provided by Bob Coburn/ Benetech)		

AVERAGE		***WORSE CASE (PEAK)***	
UEF PM-10 Emission Factor =	3.03E-04	UEF PM-10 Emission Factor =	1.12E-03
CEF PM-10 Emission Factor =	4.35E-05	CEF PM-10 Emission Factor =	1.61E-04
UEF PM Emission Factor =	6.41E-04	UEF PM Emission Factor =	2.37E-03
CEF PM Emission Factor =	9.20E-05	CEF PM Emission Factor =	3.41E-04

NOTES:
'(1) AP-42 Section 13.2.4 Aggregate Handling and Storage Piles

Coal Assumptions

Annual Coal Throughput	711,836	tpy
Hourly Coal Throughput	81	tph (assume coal processed 8760 hr/yr)
Percent of coal throughput to pile	50	% (assume rest goes into storage bunkers in boiler building)

Existing Coal Emissions from Dump to Coal Pile from Breaker (drop from enclosed conveyor onto pile)

	PM10		PM	
Annual	3.03E-04	EF lb/ton	6.41E-04	EF lb/ton
	975	tpd coal dumped on pile	975	tpd coal dumped on pile
	41	tph coal dumped on pile	41	tph coal dumped on pile
	0.012	lbs/hr coal emissions	0.026	lbs/hr coal emissions
	0.054	tpy coal emissions	0.114	tpy coal emissions
	PM10		PM	
Peak Estimate	1.12E-03	EF lb/ton	2.37E-03	EF lb/ton
	975	tpd coal dumped on pile	975	tpd coal dumped on pile
	41	tph coal dumped on pile	41	tph coal dumped on pile
	0.046	lbs/hr coal emissions	0.096	lbs/hr coal emissions
	0.200	tpy coal emissions	0.423	tpy coal emissions

Mirant Potomac River, LLC
Railcar dumper - Fugitive Dust Emission Calculations

COAL EMISSIONS CALCULATIONS

SUMMARY OF FUGITIVE AND EXISTING PARTICULATE MATTER EMISSIONS FROM COAL

Total Coal Emissions (Peak)

		---PM-10 Emissions---		---PM Emissions---	
		lb/hr	tpy	lb/hr	tpy
Rail Car dump in partial enclosure	Existing	0.12	0.06	0.26	0.14

Rail Car Dump in Partial Enclosure - wind speed assumed to be 5 miles/hr

Annual Coal Throughput	711,836	tpy
Hourly Coal Throughput	684	tph (assume coal dumped 4 hr/day)
Partial Enclosure Control Efficiency	50	%
Daily Coal Unloading	4	hr/day
Weekly Coal Unloading	5	day/week
Annual Coal Unloading	52	wk/yr

Emission Factor Calculations for Coal in Partial Enclosure for Rail Car Dumping (1)

UEF PM (lb/ton) = k x 0.0032 x ((U/5)^1.3)/((M/2)^1.4)
CEF PM (lb/ton) = UEF (lb/ton) x ((100 - removal efficiency (%))/100)

Assume:

k (particle size multiplier) =	0.35	for PM-10 &	0.74	for PM
U (mean wind speed) =	5	miles/hour for short term	5	miles/hr for annual average
M (moisture content) =	4.5	% (from AP-42 Table 13.2.4-1 for coal as-received at coal fired power plant)		
Emission Reduction	75%	% (based on dust reduction estimate provided by Bob Coburn/ Benetech)		

AVERAGE		***WORSE CASE (PEAK)***	
Existing PM-10 Emission Factor =	1.80E-04	Existing PM-10 Emission Factor =	1.80E-04
CEF PM-10 Emission Factor =	4.50E-05	CEF PM-10 Emission Factor =	4.50E-05
Existing PM Emission Factor =	3.80E-04	Existing PM Emission Factor =	3.80E-04
CEF PM Emission Factor =	9.51E-05	CEF PM Emission Factor =	9.51E-05

NOTES:
'(1) AP-42 Section 13.2.4 Aggregate Handling and Storage Piles

Existing Emissions from Railcar dumper

	PM10		PM	
Annual	1.80E-04	EF lb/ton	3.80E-04	EF lb/ton
	684	tph coal dumped in enclosure	684	tph coal dumped in enclosure
	0.123	lbs/hr coal emissions	0.260	lbs/hr coal emissions
	0.064	tpy coal emissions	0.135	tpy coal emissions
	PM10		PM	
Peak Estimate	1.80E-04	EF lb/ton	3.80E-04	EF lb/ton
	684	tph coal dumped in enclosure	684	tph coal dumped in enclosure
	0.123	lbs/hr coal emissions	0.260	lbs/hr coal emissions
	0.064	tpy coal emissions	0.135	tpy coal emissions

Road Section	Distance	Max. VMT/day	VMT/yr	PM_{10} Emissions			PM_{10} Emissions	
		Round Trip		24 hour	Annual	Annual	24 hour	Annual
	miles			lb/hr	lb/hr	ton/yr	g/s	g/s
From the edge of First Street to the Gate								
Gate to curve	0.177	14.167	2578.33	0.0739	0.0330	0.1447	0.009305	0.004163
Curve	0.005	0.379	68.94	0.0020	0.0009	0.0039	0.000249	0.000111
Curve to truck scale	0.022	1.742	317.12	0.0091	0.0041	0.0178	0.001145	0.000512
Truck scale to curve	0.028	2.273	413.64	0.0118	0.0053	0.0232	0.001493	0.000668
Curve	0.019	1.515	275.76	0.0079	0.0035	0.0155	0.000995	0.000445
Curve to flyash storage	0.047	3.788	689.39	0.0197	0.0088	0.0387	0.002488	0.001113
Total	0.30	23.864	4343.18	0.1244	0.0557	0.2438	0.015675	0.007013

	Empty truck wieght	10	ton	Input
	Ash per truck	22	ton	From Mirant
W	Average truck weight	16	ton	Calculated
	Maximum number of truck trips per day	40	trucks/day	From Mirant
	Total truck trips per year	7,280	trucks/yr	Calculated from Mirant data
sL	Silt loading	1.00	g/m^2	Input
C	Emission factor for exhaust brake wear and ti	0.00047	lb/VMT	AP-42
k	Particle size multiplier	0.016	lb/VMT	AP-42
P	Annual days with >0.01 inches rain	150	days	AP-42
N	Number of days in the averaging period	365	days	one year

Short term emissions:

$E = k \times (sL/2)^{0.65} \times (W/3)^{1.5} - C$

E = lb/VMT

Short term emissions:

$E = (k \times (sL/2)^{0.65} \times (W/3)^{1.5} - C) \times (1-P/4N)$ lb/VMT

Copy of Final Draft Mirant Fug Dust with Paved Roads
Paved Roads

APPENDIX C

GEP BUILDING DIMENSIONS PRODUCED BY LAKES ENVIRONMENTAL BPIP SOFTWARE

MIRANT POTOMAC RIVER GENERATING STATION

BPIP Output (meters)

SO	BUILDHGT	STACK1	35.29	35.29	35.29	35.29	35.29	35.29
SO	BUILDHGT	STACK1	35.29	35.29	35.29	35.29	35.29	35.29
SO	BUILDHGT	STACK1	35.29	35.29	35.29	35.29	35.29	35.29
SO	BUILDHGT	STACK1	35.29	35.29	35.29	35.29	35.29	35.29
SO	BUILDHGT	STACK1	35.29	35.29	35.29	35.29	35.29	35.29
SO	BUILDHGT	STACK1	35.29	35.29	35.29	35.29	35.29	35.29
SO	BUILDWID	STACK1	36.38	39.88	54.75	68.00	79.00	87.75
SO	BUILDWID	STACK1	93.75	96.75	97.50	94.50	97.00	97.25
SO	BUILDWID	STACK1	94.25	88.75	80.75	69.75	56.88	42.34
SO	BUILDWID	STACK1	36.38	40.00	54.75	68.00	79.00	87.75
SO	BUILDWID	STACK1	93.75	97.00	97.00	94.50	97.00	97.00
SO	BUILDWID	STACK1	94.50	88.75	80.75	69.88	56.88	42.31
SO	BUILDLEN	STACK1	109.50	97.00	97.25	94.50	88.75	80.50
SO	BUILDLEN	STACK1	69.88	57.00	42.31	26.44	39.88	54.75
SO	BUILDLEN	STACK1	67.75	79.00	87.75	93.75	97.00	97.00
SO	BUILDLEN	STACK1	109.00	97.00	97.25	94.50	88.75	80.50
SO	BUILDLEN	STACK1	69.88	57.00	42.31	26.44	39.88	54.75
SO	BUILDLEN	STACK1	67.75	78.75	87.75	93.50	96.75	97.00
SO	XBADJ	STACK1	-11.50	-10.00	-8.00	-5.75	-3.00	-0.75
SO	XBADJ	STACK1	1.88	4.50	6.84	9.00	-4.12	-18.62
SO	XBADJ	STACK1	-32.25	-45.25	-56.75	-66.50	-74.50	-80.00
SO	XBADJ	STACK1	-97.50	-87.00	-89.50	-88.75	-85.75	-80.00
SO	XBADJ	STACK1	-71.75	-61.50	-49.16	-35.47	-35.88	-36.38
SO	XBADJ	STACK1	-35.50	-33.75	-31.00	-27.00	-22.50	-17.00
SO	YBADJ	STACK1	-17.31	-15.81	-8.88	-1.75	5.75	12.88
SO	YBADJ	STACK1	19.62	25.88	31.25	35.75	38.50	40.62
SO	YBADJ	STACK1	41.62	41.12	39.62	36.88	32.94	28.02
SO	YBADJ	STACK1	17.25	15.88	9.00	1.50	-5.75	-12.88
SO	YBADJ	STACK1	-19.62	-25.75	-31.50	-35.75	-38.50	-40.75
SO	YBADJ	STACK1	-41.75	-41.38	-39.62	-36.81	-32.94	-28.03
SO	BUILDHGT	STACK2	35.29	35.29	35.29	35.29	35.29	35.29
SO	BUILDHGT	STACK2	35.29	35.29	35.29	35.29	35.29	35.29
SO	BUILDHGT	STACK2	35.29	35.29	35.29	39.60	39.60	39.60
SO	BUILDHGT	STACK2	35.29	35.29	35.29	35.29	35.29	35.29
SO	BUILDHGT	STACK2	35.29	35.29	35.29	35.29	35.29	35.29
SO	BUILDHGT	STACK2	35.29	35.29	35.29	35.29	35.29	35.29
SO	BUILDWID	STACK2	36.38	39.88	54.75	68.00	79.00	87.75
SO	BUILDWID	STACK2	93.75	96.75	97.50	94.50	97.00	97.25
SO	BUILDWID	STACK2	94.25	88.75	80.75	86.12	87.75	95.56
SO	BUILDWID	STACK2	36.38	40.00	54.75	68.00	79.00	87.75
SO	BUILDWID	STACK2	93.75	97.00	97.00	94.50	97.00	97.00
SO	BUILDWID	STACK2	94.50	88.75	80.75	69.88	56.88	42.31
SO	BUILDLEN	STACK2	109.50	97.00	97.25	94.50	88.75	80.50
SO	BUILDLEN	STACK2	69.88	57.00	42.31	26.44	39.88	54.75
SO	BUILDLEN	STACK2	67.75	79.00	87.75	121.75	121.50	117.50
SO	BUILDLEN	STACK2	109.00	97.00	97.25	94.50	88.75	80.50
SO	BUILDLEN	STACK2	69.88	57.00	42.31	26.44	39.88	54.75
SO	BUILDLEN	STACK2	67.75	78.75	87.75	93.50	96.75	97.00
SO	XBADJ	STACK2	-36.00	-34.00	-31.00	-27.00	-22.00	-16.50
SO	XBADJ	STACK2	-10.50	-4.12	2.34	8.75	-0.12	-10.50
SO	XBADJ	STACK2	-20.25	-29.75	-38.25	-307.75	-313.00	-308.50
SO	XBADJ	STACK2	-73.00	-62.75	-66.50	-67.50	-67.00	-64.00
SO	XBADJ	STACK2	-59.38	-52.88	-44.66	-35.19	-39.75	-44.50
SO	XBADJ	STACK2	-47.50	-49.25	-49.50	-48.00	-45.25	-41.00
SO	YBADJ	STACK2	-17.03	-19.81	-17.00	-13.75	-9.75	-5.62
SO	YBADJ	STACK2	-1.38	2.88	7.25	11.25	14.25	17.62
SO	YBADJ	STACK2	20.38	22.38	23.88	27.44	-16.00	-55.09
SO	YBADJ	STACK2	16.97	19.88	17.12	13.50	9.75	5.62
SO	YBADJ	STACK2	1.38	-3.00	-7.50	-11.25	-14.25	-17.75
SO	YBADJ	STACK2	-20.50	-22.62	-23.88	-24.44	-24.31	-23.53

SO	BUILDHGT	STACK3	35.29	35.29	35.29	35.29	35.29	35.29
SO	BUILDHGT	STACK3	35.29	35.29	35.29	35.29	35.29	35.29
SO	BUILDHGT	STACK3	35.29	35.29	39.60	39.60	39.60	39.60
SO	BUILDHGT	STACK3	35.29	35.29	35.29	35.29	35.29	35.29
SO	BUILDHGT	STACK3	35.29	35.29	35.29	35.29	35.29	35.29
SO	BUILDHGT	STACK3	35.29	35.29	35.29	35.29	35.29	35.29
SO	BUILDWID	STACK3	36.38	39.88	54.75	68.00	79.00	87.75
SO	BUILDWID	STACK3	93.75	96.75	97.50	94.50	97.00	97.25
SO	BUILDWID	STACK3	94.25	88.75	94.50	86.12	87.75	95.56
SO	BUILDWID	STACK3	36.38	40.00	54.75	68.00	79.00	87.75
SO	BUILDWID	STACK3	93.75	97.00	97.00	94.50	97.00	97.00
SO	BUILDWID	STACK3	94.50	88.75	80.75	69.88	56.88	42.31
SO	BUILDLEN	STACK3	109.50	97.00	97.25	94.50	88.75	80.50
SO	BUILDLEN	STACK3	69.88	57.00	42.31	26.44	39.88	54.75
SO	BUILDLEN	STACK3	67.75	79.00	118.50	121.75	121.50	117.50
SO	BUILDLEN	STACK3	109.00	97.00	97.25	94.50	88.75	80.50
SO	BUILDLEN	STACK3	69.88	57.00	42.31	26.44	39.88	54.75
SO	BUILDLEN	STACK3	67.75	78.75	87.75	93.50	96.75	97.00
SO	XBADJ	STACK3	-59.00	-56.50	-52.50	-46.75	-39.50	-31.25
SO	XBADJ	STACK3	-22.00	-12.00	-1.72	8.66	3.75	-2.75
SO	XBADJ	STACK3	-9.00	-15.00	-276.00	-288.00	-291.50	-286.00
SO	XBADJ	STACK3	-50.00	-40.25	-45.00	-47.75	-49.25	-49.25
SO	XBADJ	STACK3	-47.88	-45.00	-40.59	-35.09	-43.62	-52.12
SO	XBADJ	STACK3	-58.75	-63.75	-67.00	-67.75	-66.75	-63.50
SO	YBADJ	STACK3	-16.94	-23.69	-24.75	-25.00	-24.25	-23.12
SO	YBADJ	STACK3	-21.12	-18.38	-15.25	-11.75	-8.25	-3.88
SO	YBADJ	STACK3	0.62	4.88	59.25	15.94	-23.88	-59.16
SO	YBADJ	STACK3	16.88	23.75	24.88	24.75	24.25	23.12
SO	YBADJ	STACK3	21.12	18.50	15.00	11.75	8.25	3.75
SO	YBADJ	STACK3	-0.75	-4.88	-9.12	-12.94	-16.44	-19.47
SO	BUILDHGT	STACK4	35.29	35.29	35.29	35.29	35.29	35.29
SO	BUILDHGT	STACK4	35.29	35.29	35.29	35.29	35.29	35.29
SO	BUILDHGT	STACK4	35.29	35.29	39.60	39.60	39.60	39.60
SO	BUILDHGT	STACK4	35.29	35.29	35.29	35.29	35.29	35.29
SO	BUILDHGT	STACK4	35.29	35.29	35.29	35.29	35.29	35.29
SO	BUILDHGT	STACK4	35.29	35.29	35.29	35.29	35.29	35.29
SO	BUILDWID	STACK4	36.38	39.88	54.75	68.00	79.00	87.75
SO	BUILDWID	STACK4	93.75	96.75	97.50	94.50	97.00	97.25
SO	BUILDWID	STACK4	94.25	88.75	94.50	86.12	87.75	95.56
SO	BUILDWID	STACK4	36.38	40.00	54.75	68.00	79.00	87.75
SO	BUILDWID	STACK4	93.75	97.00	97.00	94.50	97.00	97.00
SO	BUILDWID	STACK4	94.50	88.75	80.75	69.88	56.88	42.31
SO	BUILDLEN	STACK4	109.50	97.00	97.25	94.50	88.75	80.50
SO	BUILDLEN	STACK4	69.88	57.00	42.31	26.44	39.88	54.75
SO	BUILDLEN	STACK4	67.75	79.00	118.50	121.75	121.50	117.50
SO	BUILDLEN	STACK4	109.00	97.00	97.25	94.50	88.75	80.50
SO	BUILDLEN	STACK4	69.88	57.00	42.31	26.44	39.88	54.75
SO	BUILDLEN	STACK4	67.75	78.75	87.75	93.50	96.75	97.00
SO	XBADJ	STACK4	-82.50	-80.00	-75.00	-67.75	-58.25	-47.25
SO	XBADJ	STACK4	-34.75	-21.12	-6.84	7.59	6.88	4.38
SO	XBADJ	STACK4	2.00	-0.75	-258.50	-268.25	-269.75	-263.00
SO	XBADJ	STACK4	-26.50	-17.00	-22.50	-26.75	-30.75	-33.25
SO	XBADJ	STACK4	-35.12	-35.88	-35.47	-34.06	-46.75	-59.25
SO	XBADJ	STACK4	-69.75	-78.25	-84.25	-87.75	-88.50	-86.50
SO	YBADJ	STACK4	-15.91	-26.69	-31.75	-35.75	-38.75	-40.62
SO	YBADJ	STACK4	-41.12	-40.12	-38.25	-35.25	-31.50	-26.38
SO	YBADJ	STACK4	-20.38	-13.88	43.25	3.19	-32.88	-64.28
SO	YBADJ	STACK4	15.81	26.88	31.88	35.75	38.75	40.38
SO	YBADJ	STACK4	40.88	40.25	38.00	35.25	31.50	26.25
SO	YBADJ	STACK4	20.25	13.62	6.88	-0.19	-7.31	-14.34
SO	BUILDHGT	STACK5	35.29	35.29	35.29	35.29	35.29	35.29
SO	BUILDHGT	STACK5	35.29	35.29	35.29	35.29	35.29	35.29
SO	BUILDHGT	STACK5	35.29	39.60	39.60	39.60	39.60	35.29
SO	BUILDHGT	STACK5	35.29	35.29	35.29	35.29	35.29	35.29

SO	BUILDHGT	STACK5	35.29	35.29	35.29	35.29	35.29	35.29
SO	BUILDHGT	STACK5	35.29	35.29	35.29	35.29	35.29	35.29
SO	BUILDWID	STACK5	36.38	39.88	54.75	68.00	79.00	87.75
SO	BUILDWID	STACK5	93.75	96.75	97.50	94.50	97.00	97.25
SO	BUILDWID	STACK5	94.25	99.75	94.50	86.12	87.75	42.34
SO	BUILDWID	STACK5	36.38	40.00	54.75	68.00	79.00	87.75
SO	BUILDWID	STACK5	93.75	97.00	97.00	94.50	97.00	97.00
SO	BUILDWID	STACK5	94.50	88.75	80.75	69.88	56.88	42.31
SO	BUILDLEN	STACK5	109.50	97.00	97.25	94.50	88.75	80.50
SO	BUILDLEN	STACK5	69.88	57.00	42.31	26.44	39.88	54.75
SO	BUILDLEN	STACK5	67.75	111.50	118.50	121.75	121.50	97.00
SO	BUILDLEN	STACK5	109.00	97.00	97.25	94.50	88.75	80.50
SO	BUILDLEN	STACK5	69.88	57.00	42.31	26.44	39.88	54.75
SO	BUILDLEN	STACK5	67.75	78.75	87.75	93.50	96.75	97.00
SO	XBADJ	STACK5	-107.00	-104.00	-98.00	-89.00	-77.25	-63.25
SO	XBADJ	STACK5	-47.12	-29.75	-11.34	7.31	10.75	12.38
SO	XBADJ	STACK5	14.00	-225.25	-240.00	-247.25	-247.00	13.50
SO	XBADJ	STACK5	-2.00	7.25	0.75	-5.50	-11.75	-17.50
SO	XBADJ	STACK5	-22.75	-27.38	-30.97	-33.78	-50.75	-67.38
SO	XBADJ	STACK5	-81.75	-93.75	-103.00	-108.75	-111.25	-110.50
SO	YBADJ	STACK5	-15.62	-30.69	-39.88	-47.75	-54.25	-59.12
SO	YBADJ	STACK5	-62.12	-63.12	-62.25	-59.75	-55.50	-49.38
SO	YBADJ	STACK5	-41.62	62.88	27.25	-9.19	-41.50	9.83
SO	YBADJ	STACK5	15.56	30.75	40.00	47.75	54.00	58.88
SO	YBADJ	STACK5	61.88	63.00	62.00	59.25	55.75	49.25
SO	YBADJ	STACK5	41.50	32.62	22.88	12.19	1.19	-9.84
SO	BUILDHGT	SILO1	35.29	35.29	35.29	35.29	30.71	30.71
SO	BUILDHGT	SILO1	30.71	30.71	30.71	30.71	30.71	30.71
SO	BUILDHGT	SILO1	35.29	35.29	35.29	35.29	35.29	35.29
SO	BUILDHGT	SILO1	35.29	35.29	35.29	35.29	30.71	30.71
SO	BUILDHGT	SILO1	30.71	30.71	30.71	30.71	30.71	30.71
SO	BUILDHGT	SILO1	35.29	35.29	35.29	35.29	35.29	35.29
SO	BUILDWID	SILO1	36.38	39.88	54.75	68.00	19.75	17.25
SO	BUILDWID	SILO1	14.75	16.00	18.50	20.50	23.00	24.75
SO	BUILDWID	SILO1	155.00	150.25	140.75	127.50	64.00	42.34
SO	BUILDWID	SILO1	36.38	40.00	54.75	68.00	19.75	17.25
SO	BUILDWID	SILO1	14.75	15.75	18.50	20.50	23.00	25.00
SO	BUILDWID	SILO1	155.00	150.25	140.75	127.38	64.00	42.31
SO	BUILDLEN	SILO1	109.50	97.00	97.25	94.50	27.75	28.50
SO	BUILDLEN	SILO1	28.88	28.75	28.22	27.16	25.88	24.00
SO	BUILDLEN	SILO1	131.75	148.25	160.25	167.25	97.00	97.00
SO	BUILDLEN	SILO1	109.00	97.00	97.25	94.50	27.75	28.50
SO	BUILDLEN	SILO1	28.88	28.75	28.22	27.12	25.88	24.12
SO	BUILDLEN	SILO1	131.50	148.25	160.25	167.50	96.75	97.00
SO	XBADJ	SILO1	63.50	61.50	58.00	52.75	-7.00	-7.00
SO	XBADJ	SILO1	-6.88	-6.75	-6.72	-6.62	-6.62	-6.62
SO	XBADJ	SILO1	-156.50	-178.50	-195.50	-206.25	-149.25	-156.00
SO	XBADJ	SILO1	-172.00	-158.50	-155.25	-147.25	-20.75	-21.75
SO	XBADJ	SILO1	-22.00	-22.00	-21.50	-20.53	-19.25	-17.62
SO	XBADJ	SILO1	25.00	30.25	35.00	38.75	52.25	59.00
SO	YBADJ	SILO1	-4.31	9.94	28.88	47.00	-3.38	-2.12
SO	YBADJ	SILO1	-0.88	0.50	1.75	3.25	4.25	5.38
SO	YBADJ	SILO1	82.00	65.12	46.88	27.00	42.88	28.23
SO	YBADJ	SILO1	4.25	-9.88	-28.88	-47.25	3.38	2.12
SO	YBADJ	SILO1	0.88	-0.62	-2.25	-3.25	-4.25	-5.50
SO	YBADJ	SILO1	-82.00	-65.38	-46.88	-26.94	-42.75	-28.25
SO	BUILDHGT	SILO2	35.29	35.29	35.29	30.71	30.71	30.71
SO	BUILDHGT	SILO2	30.71	30.71	30.71	30.71	30.71	35.29
SO	BUILDHGT	SILO2	35.29	35.29	35.29	35.29	35.29	35.29
SO	BUILDHGT	SILO2	35.29	35.29	35.29	30.71	30.71	30.71
SO	BUILDHGT	SILO2	30.71	30.71	30.71	30.71	30.71	35.29
SO	BUILDHGT	SILO2	35.29	35.29	35.29	35.29	35.29	35.29
SO	BUILDWID	SILO2	36.38	39.88	54.75	22.00	19.75	17.25
SO	BUILDWID	SILO2	14.75	16.00	18.50	20.50	23.00	154.75

SO	BUILDWID	SILO2	155.00	150.25	140.75	69.75	56.88	42.34
SO	BUILDWID	SILO2	36.38	40.00	54.75	22.25	19.75	17.25
SO	BUILDWID	SILO2	14.75	15.75	18.50	20.50	23.00	155.00
SO	BUILDWID	SILO2	155.00	150.25	140.75	69.88	56.88	42.31
SO	BUILDLEN	SILO2	109.50	97.00	97.25	26.50	27.75	28.50
SO	BUILDLEN	SILO2	28.88	28.75	28.22	27.16	25.88	111.12
SO	BUILDLEN	SILO2	131.75	148.25	160.25	93.75	97.00	97.00
SO	BUILDLEN	SILO2	109.00	97.00	97.25	26.50	27.75	28.50
SO	BUILDLEN	SILO2	28.88	28.75	28.22	27.12	25.88	111.12
SO	BUILDLEN	SILO2	131.50	148.25	160.25	93.50	96.75	97.00
SO	XBADJ	SILO2	56.50	52.50	47.00	-19.75	-21.00	-21.50
SO	XBADJ	SILO2	-21.75	-21.50	-20.94	-19.84	-18.50	-139.75
SO	XBADJ	SILO2	-164.50	-184.25	-198.50	-138.50	-147.25	-151.50
SO	XBADJ	SILO2	-165.50	-149.25	-144.25	-6.75	-7.00	-7.00
SO	XBADJ	SILO2	-7.12	-7.25	-7.28	-7.31	-7.50	28.38
SO	XBADJ	SILO2	33.00	36.00	38.25	45.00	50.50	54.50
SO	YBADJ	SILO2	8.91	21.81	39.00	3.50	2.38	0.88
SO	YBADJ	SILO2	-0.12	-1.50	-2.75	-3.75	-5.00	84.88
SO	YBADJ	SILO2	69.25	51.38	32.38	48.25	31.56	14.02
SO	YBADJ	SILO2	-8.97	-21.75	-38.88	-3.62	-2.12	-1.12
SO	YBADJ	SILO2	0.12	1.38	2.25	3.75	5.00	-84.75
SO	YBADJ	SILO2	-69.25	-51.62	-32.38	-48.19	-31.56	-14.03
SO	BUILDHGT	SILO3	35.29	35.29	35.29	35.29	35.29	35.29
SO	BUILDHGT	SILO3	35.29	35.29	35.29	35.29	35.29	35.29
SO	BUILDHGT	SILO3	35.29	35.29	35.29	35.29	35.29	35.29
SO	BUILDHGT	SILO3	35.29	35.29	35.29	35.29	35.29	35.29
SO	BUILDHGT	SILO3	35.29	35.29	35.29	35.29	35.29	35.29
SO	BUILDHGT	SILO3	35.29	35.29	35.29	35.29	35.29	35.29
SO	BUILDWID	SILO3	36.38	39.88	54.75	68.00	79.00	87.75
SO	BUILDWID	SILO3	93.75	96.75	166.50	158.50	156.25	154.75
SO	BUILDWID	SILO3	155.00	150.25	140.75	127.50	64.00	43.31
SO	BUILDWID	SILO3	36.38	40.00	54.75	68.00	79.00	87.75
SO	BUILDWID	SILO3	93.75	97.00	166.50	158.00	156.50	155.00
SO	BUILDWID	SILO3	155.00	150.25	140.75	127.38	64.00	43.31
SO	BUILDLEN	SILO3	109.50	97.00	97.25	94.50	88.75	80.50
SO	BUILDLEN	SILO3	69.88	57.00	89.22	65.75	87.25	111.12
SO	BUILDLEN	SILO3	131.75	148.25	160.25	167.25	97.00	97.00
SO	BUILDLEN	SILO3	109.00	97.00	97.25	94.50	88.75	80.50
SO	BUILDLEN	SILO3	69.88	57.00	89.22	65.72	87.25	111.12
SO	BUILDLEN	SILO3	131.50	148.25	160.25	167.50	96.75	97.00
SO	XBADJ	SILO3	31.50	33.00	33.75	33.50	32.50	30.00
SO	XBADJ	SILO3	27.00	23.00	-47.94	-50.88	-76.25	-102.50
SO	XBADJ	SILO3	-125.50	-144.75	-159.75	-169.75	-113.25	-121.50
SO	XBADJ	SILO3	-140.00	-130.00	-131.25	-128.00	-121.25	-110.75
SO	XBADJ	SILO3	-96.88	-80.00	-41.28	-14.91	-11.00	-8.75
SO	XBADJ	SILO3	-6.00	-3.50	-0.50	2.50	16.50	24.50
SO	YBADJ	SILO3	-21.50	-12.44	1.88	16.25	30.00	42.88
SO	YBADJ	SILO3	54.62	64.62	91.25	89.75	80.88	71.62
SO	YBADJ	SILO3	62.75	51.88	39.38	25.88	48.00	39.09
SO	YBADJ	SILO3	21.41	12.62	-1.75	-16.25	-30.25	-43.12
SO	YBADJ	SILO3	-54.62	-64.75	-91.25	-89.50	-80.75	-71.75
SO	YBADJ	SILO3	-62.75	-51.88	-39.38	-25.81	-48.00	-39.09