4.0 AIR QUALITY IMPACTS

4.1 IMPACT ASSESSMENT BACKGROUND AND METHODOLOGY

4.1.1 Overview

As part of the CPCN application process, the Maryland Power Plant Research Program (PPRP), in conjunction with the Maryland Department of Environment Air and Radiation Management Administration (MDE-ARMA), evaluates potential impacts to air quality resulting from emissions of projects to be licensed in Maryland under COMAR 20.80. This evaluation includes emissions investigations and other studies, including air dispersion modeling assessments, to ensure that impacts to air quality from proposed projects are acceptable. PPRP and MDE-ARMA also conduct a complete air quality regulatory review for two purposes: 1) to assist in the impact assessment, because air quality regulatory standards and emissions limitations define levels to protect against adverse health, welfare, and environmental effects; and 2) to ensure that the proposed project will meet all applicable regulatory requirements.

To conduct the air quality evaluation of the proposed Calvert Cliffs Unit 3 project, PPRP and MDE-ARMA evaluated projected maximum potential air pollutant emissions to ensure that the project will meet applicable regulatory thresholds and limits. The proposed project was also evaluated to determine whether its emissions would have any significant impacts on the existing ambient air quality in the region. This was completed through air dispersion modeling that predicts the ambient air concentrations resulting from source emissions.

Note that Calvert Cliffs Unit 3 and its radionuclide emissions are not regulated by the State. We did not evaluate any impacts from radionuclide emissions from the reactor or any associated fuel or waste handling operations; this Environmental Review addresses only the non-NRC regulated emissions sources that are part of the Calvert Cliffs Unit 3 project.

4.1.2 Regulatory Considerations

The United States Environmental Protection Agency (EPA) has defined concentration-based National Ambient Air Quality Standards (NAAQS) for several pollutants, which are set at levels considered to be protective of the public health and welfare. Specifically, the NAAQS have been defined for six "criteria" pollutants, including particulate matter (PM), sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), ozone, and lead (Pb). Three forms of particulate matter are regulated: total suspended particulate (known as PM or TSP), particulate matter less than 10 microns (PM10), and particulate matter less than 2.5 microns (PM2.5). Air emissions limitations and pollution control requirements are generally more stringent for sources located in areas that do not currently attain a NAAQS for a particular pollutant (known as "nonattainment" areas).

The air quality in Calvert County in the vicinity of the proposed Calvert Cliffs Unit 3 project is in attainment for all pollutants with the exception of ozone. Because of the high levels of ozone historically found in Calvert County during the ozone season (May-October), the County is designated a "moderate" ozone nonattainment area. Emissions of the two pollutants that are the primary precursors to ozone—volatile organic compounds (VOCs) and nitrogen oxides (NO_x)—are regulated more stringently in ozone nonattainment areas such as Calvert County to ensure that air quality is not further degraded (i.e., the ambient air concentrations of ozone does not continue to increase as new sources of emissions are constructed).

Potential emissions from new and modified sources in nonattainment areas are evaluated through the nonattainment New Source Review (NA-NSR) regulatory program (COMAR 26.11.17). The goal of the NA-NSR program is to allow construction of new emission sources and modifications to existing sources, while ensuring that progress is made towards attainment of the NAAQS. Triggering NA-NSR indicates that a project could adversely impact air quality, which means that impacts must be managed. NA-NSR requires that major sources of VOCs or NO_x limit emissions of pollutants through the implementation of the most stringent levels of pollution control, known as Lowest Achievable Emission Rate (LAER). In addition, NA-NSR requires pollutant "offsets" to be obtained for every ton of regulated pollutant emitted.

Potential emissions from new and modified sources in attainment areas are evaluated through the Prevention of Significant Deterioration (PSD) program. The goal of the PSD program is to ensure that emissions from major sources do not degrade air quality. Triggering PSD requires pollution control known as Best Available Control Technology (BACT) and additional impact assessments.

The proposed Calvert Cliffs Unit 3 Project has the potential to emit the criteria pollutants PM, PM10, PM2.5, CO, NO_2, SO_2, and Pb; ozone precursors (NO_x and VOCs); and several hazardous air pollutants (HAPs). Because the area in which Unit 3 will be located is nonattainment for ozone and attainment for the other pollutants, PPRP and MDE-ARMA assessed applicability with both NA-NSR and PSD requirements to ensure no adverse impacts would be caused by the project. The results of these evaluations for the proposed project are discussed in Sections 4.3 (PSD program) and 4.4 (NA-NSR program).

Other federal and State air quality regulations may apply to the proposed Unit 3 project. These regulations apply either as a result of the types of emission sources that are to be constructed, or as a result of the pollutants to be emitted from the project. These regulations, discussed in Section 4.5, specify limits on pollutant emissions, and impose monitoring, recordkeeping, and reporting requirements.

4.2 *PROPOSED PROJECT AIR EMISSIONS*

UniStar's proposed new Unit 3 will produce 1,710 MW (nominal) of electricity for sale to the grid. Regulated air emission sources associated with the installation and operation of Unit 3 include the following:

- One cooling tower for the circulating water system (CWS) with a maximum water circulation rate of 777,560 gallons per minute (gpm),
- Four smaller essential service water system (ESWS) cooling towers with a maximum water circulation rate of 19,075 gpm (two in-service at any one time and two backup),
- Four 10,130-kilowatt (kWe) emergency diesel generators (EDGs),
- Two 5,000-kWe Station Blackout Generators (SBOs); and
- Six diesel fuel storage tanks, one for each emergency engine (UniStar does not have final design specifications at this time).

A more detailed description of the proposed Unit 3 project is found in Section 2.

UniStar presented emissions estimates for proposed new sources in its CPCN application, subsequent amendments, and in responses to DNR data requests. PPRP and MDE-ARMA reviewed UniStar's estimates and independently verified emissions to evaluate impacts from the proposed Unit 3 project. Backup information on emissions calculations is found in Appendix D.

4.2.1 *Criteria Pollutants*

4.2.1.1 *Cooling Towers*

UniStar proposes to install two major cooling systems: one hybrid cooling tower for the CWS and four smaller mechanical draft cooling towers for the

ESWS. Only two of the EWS cooling towers will operate at any given time (the other two are for backup purposes only).

Emissions of particulate matter are generated from the drift that is discharged from the cooling towers. Drift is comprised of water droplets created during the cooling process that are carried out in the exhaust stream. These water droplets have generally the same concentration of total dissolved solids (TDS) as the circulating water used in the cooling system. As the water droplets evaporate, particulate matter is generated in the atmosphere.

To determine PM emissions, EPA's "Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources, Fifth Edition" (AP-42) was used. PM emissions from the CWS cooling tower were based on a water circulation rate of 777,560 gpm, a drift loss of 0.0005 percent, and a total dissolved solids content of 17,500 ppm and two cycles of concentration. PM emissions for the ESWS cooling towers were based on a water circulation rate of 19,075 gpm, a drift loss of 0.005 percent, and a total dissolved solids content of 372 ppm and two cycles of concentration.

PM10 and PM2.5 emissions are a fraction of the total PM emissions. To determine the fractions of particle matter that are considered PM10 and PM2.5, the Reisman and Frisbie (2002) methodology and particle size distribution data provided by SPX (the manufacturer of the proposed cooling towers) were used. Emissions from the cooling towers are presented in Table 4-1. Although there are four ESWS cooling towers proposed for the project, only two will operate at any one time, while the other two serve as backup units. Therefore, annual emissions are based on the operation of two ESWS cooling towers.

Table 4-1 Emissions from the Cooling Towers (tons per year)

Source	PM	PM10	PM2.5
Circulating Water System (CWS) Cooling Tower (1)	306.5	238.4	39.7
Essential Service Water System (ESWS) Cooling Towers (2)	3.1	3.1	1.6

(1) Assumes 777,560 gallons per minutes (gpm), a total dissolved solids (TDS) concentration of 17,500 parts per million by weight (ppmw), two cycles of concentration, and a drift eliminator with 0.0005 percent drift loss.

(2) Assumes 19,075 gpm, a TDS concentration of 372 ppmw, two cycles of concentration, and a drift eliminator with 0.005 percent drift loss.

4.2.1.2 *Diesel Generators*

Potential emissions of criteria pollutants from the emergency generators (EDGs and SBOs) are shown in Table 4-2. The project will consist of the installation of four EDG units and two SBO units.

Emission factors for the EDGs were based on maximum allowable emission rates in federal New Source Performance Standard (NSPS) Subpart IIII (Standards for Stationary Compression Ignition Internal Combustion Engines) for NO_x and PM; EPA's Emission Standards Reference Guide for Heavy-Duty and Nonroad Engines for CO; material balance calculations for SO_2; and U.S. EPA's emission factor guidance manual, AP-42 (Section 3.4) for VOCs. It was assumed that the EDGs will operate for no more than 600 hours per year (total for all four engines), will have a displacement of greater than 30 liters, and will use exclusively low sulfur diesel fuel with a maximum sulfur content of 0.05 percent by weight.

Emission factors for the SBOs were based on material balance calculations for SO_2 and maximum allowable emissions from NSPS Subpart IIII for PM, CO, and NO_x + THC (total hydrocarbons). To determine NO_x and VOC emissions from the NO_x + THC limit (11 grams per kilowatt hour, g/kW-hr), we conservatively assumed that 100% of emissions are NO_x and 10% are VOCs (thus double-counting to ensure emissions are conservative). It was assumed that the SBOs will operate no more than 200 hours per year (total for both units), have a displacement of between 10 and 30 liters, and will exclusively use ultra low sulfur diesel fuel with a maximum sulfur content of 0.0015 percent by weight.

Table 4-2 Emissions from the Emergency Engines (tons per year)

Source	**PM**	**PM10**	**PM2.5**	**NO_x**	**CO**	**VOC**	**SO_2**
Four EDGs(1)	1.0	1.0	1.0	10.7	23.4	2.6	1.3
Two SBOs(2)	0.6	0.6	0.5	12.1	5.5	1.2	0.0
Total Diesel Generators	1.6	1.6	1.5	22.8	28.9	3.8	1.3

(1) Assumes that the EDGs will not operate more than 600 hours per year (total all four engines), a displacement of greater than 30 liters, and the exclusive use of low-sulfur diesel fuel.

(2) Assumes that the SBOs will not operate more than 200 hours per year (total both engines), a displacement of between 10 and 30 liters, and the exclusive use of ultra low-sulfur diesel fuel.

4.2.1.3 *Fuel Oil Tanks*

Each of the six emergency engines (four EDGs and two SBOs) will have a dedicated fuel oil storage tank; however, UniStar does not have final design specifications for the tanks at this time. In its response to DNR Data Request No. 6-1, UniStar indicated the tanks for the EDGs will be sized to store sufficient fuel oil for the EDGs to operate for a period of seven days, or approximately 100,000 gallon capacity, and the tanks will be located within the EDG buildings. The SBOs and their storage tanks will be located in a separate building; the final design specifications and locations have not yet been determined.

4.2.1.4 *Summary of Criteria Pollutant Emissions*

A summary of short-term criteria pollutants emissions associated with the Calvert Cliffs Unit 3 project is provided in Table 4-3 and total (ton per year) emissions in Table 4-4. Emissions as presented by UniStar in the CPCN application are also provided in Table 4-4 for comparison purposes. The criteria pollutant emissions presented by UniStar, with the exception of PM10 emissions, compare favorably to the values calculated by the State. The difference in PM10 emissions estimated by the State and those estimated by UniStar is attributable to differences in the PM10 drift fraction calculated using the Reisman/Frisbie methodology for both the CWS and ESWS cooling towers. The State calculated a PM10 draft fraction of 0.778 based on a TDS concentration of 17,500 ppm and cycles of concentration ratio of 2, while UniStar estimated a PM10 drift fraction of 0.8 using the same parameters. PM10 emissions are a function of the PM emissions and the PM10 drift fraction. The State's calculated value of 238.4 tons of PM10 emissions for the CWS tower in approximately 6.6 tons lower than the value estimated by UniStar due to this difference in the PM10 drift fraction.

Table 4-3 Summary of Short-term Emissions from the Unit 3 Project

Emissions Unit	PM	PM10	PM2.5	NO_x	CO	VOC	SO2	Lead	SAM
Cooling Water System Cooling Tower	0.0005 % drift loss 70.0 lb/hr 0.0001 gr/dscf 8.82 g/s	0.0005 % drift loss 53.0 lb/hr 0.0001 gr/dscf 6.68 g/s	0.0005 % drift loss 8.8 lb/hr 0.00002 gr/dscf 1.11 g/s	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Essential Service Water System Cooling Towers (each)	0.005 % drift loss 0.4 lb/hr 0.00003 gr/dscf 0.04 g/s	0.005 % drift loss 0.4 lb/hr 0.00003 gr/dscf 0.04 g/s	0.005 % drift loss 0.19 lb/hr 0.00002 gr/dscf 0.02 g/s	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Emergency Diesel Generators (each)	0.15 g/kW-hr 3.3 lb/hr 0.037 lb/MMBTU 0.42 g/s	0.15 g/kW-hr 3.3 lb/hr 0.037 lb/MMBTU 0.42 g/s	0.15 g/kW-hr 3.2 lb/hr 0.036 lb/MMBTU 0.41 g/s	1.60 g/kW-hr 35.7 lb/hr 0.4 lb/MMBTU 4.50 g/s	3.5 g/kW-hr 78.1 lb/hr 0.87 lb/MMBTU 9.85 g/s	0.39 g/kW-hr 8.7 lb/hr 0.10 lb/MMBTU 1.10 g/s	0.20 g/kW-hr 4.5 lb/hr 0.05 lb/MMBTU 0.56 g/s	Not reported	Negligible
Station Black Out Generators (each)	0.50 g/kW-hr 5.5 lb/hr 0.12 lb/MMBTU 0.69 g/s	0.50 g/kW-hr 5.5 lb/hr 0.12 lb/MMBTU 0.69 g/s	0.49 g/kW-hr 5.3 lb/hr 0.11 lb/MMBTU 0.67 g/s	[1] 11.0 g/kW-hr 121.1 lb/hr 2.6 lb/MMBTU 15.28 g/s	5.0 g/kW-hr 55.1 lb/hr 1.2 lb/MMBTU 6.94 g/s	[1] 1.10 g/kW-hr 12.1 lb/hr 0.3 lb/MMBTU 1.53 g/s	0.0064 g/kW-hr 0.07 lb/hr 0.0015 lb/MMBTU 0.01 g/s	Not reported	Negligible

[1] NSPS Subpart IIII standard of total hydrocarbon (THC) + NO_X. For emission calculations, it was assumed 100 percent NO_x and 10 percent VOC.

Table 4-4 Summary of Emissions Associated with Calvert Cliffs Unit 3 (tons per year)

	PM	PM10	PM2.5	NOx	CO	VOC	SO2	SAM
Cooling Water System Cooling Tower	306.5	238.4	39.7	--	--	--	--	--
Essential Service Water System Cooling Towers	3.1	3.1	1.6	--	--	--	--	--
Diesel Generators	1.6	1.6	1.5	22.8	28.9	3.8	1.3	negligible
Total	**311.1**	**243.0**	**42.8**	**22.8**	**28.9**	**3.8**	**1.3**	negligible
UniStar Total	311.0	249.5 (1)	NP	22.8	29.0	3.8	1.3	NP

NP – Not provided by the Applicant.

(1) Difference due to the calculation of the PM10 fraction.

4.2.2 *Toxic and Hazardous Air Emissions*

Toxic air pollutants (TAPs) are those pollutants that are known or suspected to cause health problems. TAPs are regulated by Maryland under COMAR 26.11.15 and .16 and are divided into two categories—Class I and Class II. Class I TAPs are known, probable, or potential carcinogens specifically identified in COMAR 26.11.16.06. Class II TAPs include all other chemical compounds that have other potential acute or chronic health effects. Affected sources are subject to Best Available Control Technology for Toxics (T-BACT) requirements (COMAR 26.11.15.05) and an ambient impact demonstration requirement (COMAR 26.11.15.06).

The Maryland TAP regulations include provisions for exempting certain types of sources, including fuel burning equipment (such as the EDGs and SBOs). Therefore, the only sources associated with the proposed Calvert Cliffs Unit 3 project that may be subject to the Maryland TAP regulations are the cooling towers. The cooling towers require the use of chemical additives to prevent biological growth and scale build-up that would reduce heat transfer and cooling tower performance; release of these materials in cooling tower drift represent Class II TAP emissions (none is a Class I TAP).

UniStar's TAPs evaluation presented in the March 2008 application amendment was reviewed and PPRP and MDE-ARMA calculated and verified UniStar's TAP emissions estimates for the CWS cooling tower. Table 4-5 presents these TAPs emissions. The projected TAP emissions from the CWS are significantly lower than the most stringent applicable emission rates in COMAR 26.11.16.02 and thus the TAP ambient impact assessment is satisfactorily demonstrated. Emissions from the ESWS are so significantly smaller than those from the CWS that only the CWS emissions were evaluated here.

The cooling towers will be equipped with high efficiency drift eliminators, which constitutes T-BACT for this source type.

Table 4-5 TAPs Emissions Associated with CWS Cooling Tower

Chemical	**NaOCl**	**NaOH**	**HEDP**	**Petroleum Distillate**
Annual Feed Rate (gal/yr)	547000	547000	182816	18250
Density (lb/gal)	10.17	10.17	10.48	7.23
TAP Content (wt%)	20	5	20	100
TAP Emissions				
Hourly (lb/hr)	0.00064	0.00016	0.00022	0.00008
Annual (tpy)	0.002781	0.000695	0.000958	0.00033
TAP Screening Level | (µg/m^3)	81.2 (8-hr)	20 (1-hr)	82 (8-hr)	170 (8-hr)
TAP Allowable Emission Rate (lb/hr)*	0.21	0.04	0.21	0.04

*Represents most conservative allowable emission rate for the TAP in COMAR 26.11.16.02

Hazardous air pollutants (HAPs) are a list of 187 specific pollutants included in Section 112 of the Clean Air Act (CAA). The source of HAPs from the Unit 3 project is burning fuel oil in the EDGs and SBOs. An estimate of total HAP emissions from the Unit 3 project is presented in Table 4-6. HAP emissions are based on the design rated heat input of each engine and AP-42 (Section 3.4) emission factors. A facility is considered a "major" source of HAPs if it has the potential to emit 10 tons per year (tpy) or more of any individual HAP, or 25 tpy or more of all HAPs combined. As depicted in Table 4-6, total HAPs from the project are estimated to be considerably less than 10 tpy; therefore, the project is not considered a major source of HAPs. Note that radionuclides are one of the listed HAPs; however, emissions of radionuclides from nuclear power plants are regulated by the NRC and were not reviewed here.

Table 4-6 HAPs Emissions Associated with Calvert Cliffs Unit 3

Pollutant	Emission Factor (lb/MMBtu)[1]	Emissions (tpy)
Benzene	7.76E-04	2.45E-02
Toluene	2.81E-04	8.86E-03
Xylenes	1.93E-04	6.09E-03
Formaldehyde	7.89E-05	2.49E-03
Acetaldehyde	2.52E-05	7.95E-04
Acrolein	7.88E-06	2.49E-04
Naphthalene[2]	1.30E-04	4.10E-03
POM[2]	8.15E-05	2.57E-03
Total		**4.96E-02**

[1] AP-42 Chapter 3.4, Tables 3.4-3 and 3.4-4.
[2] Naphthalene is listed as an individual HAP and is classified as a PAH. To avoid double counting, naphthalene has been subtracted from the total PAH value (<2.14E-04 lb/MMBtu) listed in AP-42 Table 3.4-4; POM = Polycyclic Organic Matter (listed as "Total PAH" in AP-42, Table 3.4-4).

4.2.3 *Greenhouse Gases – Carbon Dioxide*

The Regional Greenhouse Gas Initiative (RGGI) is a cooperative effort by Northeastern and Mid-Atlantic states to reduce carbon dioxide (CO_2) emissions – a greenhouse gas (GHG) contributing to global warming. Maryland joined RGGI as a component of the Healthy Air Act of 2006. The Maryland RGGI program will start in 2009 and will address coal-fired, oil-fired, and natural gas-fired electric generating units that have a capacity of at least 25 MW, which means that Calvert Cliffs will not be subject to RGGI. However, for information purposes, PPRP and MDE-ARMA have estimated direct GHG emissions for the EDGs and SBOs. Emission were estimated using the GHG Protocol Initiative's guidance tool developed by the World Business Council for Sustainable Development (WBCSD) and the World Resources Institute (WRI) for "direct emissions from stationary combustion" and are summarized in Table 4-7.

*Table 4-7 GHG Emissions Associated with Calvert Cliffs Unit 3**

Pollutant	Emission Factor (kg/GJ)	Emissions (tpy)
CO_2	68.97	5,057
CH_4	0.002	0.1
N_2O	0.001	0.1

*Emission factors, emission data, density of fuel, higher heating value of fuel and oxidation factor (% conversion of carbon to CO_2) are provided by the GHG Protocol Guidance: Direct Emissions from Stationary Combustion; assumed No. 2 fuel oil parameters were equal to diesel; CO2 emission factor is based on 19 kg C available for emissions/MJ and a 99% oxidation factor.

4.2.4 *Construction Emissions*

Construction activities for the Calvert Cliffs Unit 3 project will generate emissions from essentially two types of activities: site preparation and the use of off-road fossil fuel-fired construction vehicles. According to the UniStar CPCN application, site preparation activities will include:

- Creation of construction access roads from MD 2/4 to Calvert Cliffs Unit 3 construction areas;
- Upgrading and extending heavy haul roads from barge landing to Calvert Cliffs Unit 3 construction areas;
- Establishing general plant area grade;
- Excavating building foundations; and
- Backfilling around foundations.

These site-preparation activities will generate particulate matter (PM, PM10 and PM2.5) emissions.

Off-road construction vehicles will be used for land clearing, road construction and grading, material transfer, and other various activities. These off-road construction vehicles will include: bulldozers; backhoes and loaders; cranes; dump trucks; and other support vehicles, trucks and compressors. The engines associated with these vehicles will generate emissions of criteria pollutants from the combustion of fuel.

Emissions from these sources were estimated using the proposed construction schedule provided by Bechtel (as presented by UniStar in the CPCN application), appropriate sections of AP-42, and EPA's NONROADs model. Construction activities will vary over the anticipated seven-year construction schedule; therefore, the emissions associated with these activities will be temporary and will vary over time. It is anticipated that year two of construction will have the most activity (i.e., the worst-case emissions). Table 4-8 presents the estimated emissions for each criteria pollutant for year two of construction.

According to the CPCN application, the contractor will employ the following practices during construction to mitigate emissions:

- Stabilizing construction roads, parking lots and laydown areas with gravel;
- Daily application of water to unpaved roads and other exposed areas;
- Use of a high efficiency baghouse for the concrete batch plant; and
- Operating EPA compliant diesel engines (Tier 2, Tier 3, and Tier 4).

Table 4-8 Summary of Worst-Case Annual (Year Two) Construction Emissions (in tons per year)

Source	**PM**	**PM10**	**PM2.5**	**NO_x**	**CO**	**VOC**	**SO_2**
Construction Vehicles	4.9	4.9	4.9	165.3	54.9	12.3	6.6
Vehicle Travel – Unpaved and Paved Roads	59.3	14.6	1.5				
Disturbed Earth Movement	10.9	5.2	1.6				
Wind Erosion	6.6	6.6	6.6				
Aggregate Movement	0.3	0.2	0.0				
Concrete Plant	2.3	1.4					
Total	**84.3**	**32.8**	**16.1**	**165.3**	**54.9**	**12.3**	**6.6**

PPRP and ARMA reviewed UniStar's impact assessment modeling presented in Section 5.5.3 of the CPCN application of November 2007 to evaluate construction emissions, and conducted an independent screening modeling assessment of impacts from construction emissions. Modeling of projected emissions during construction, added to monitored ambient background concentrations, did not show exceedances of any NAAQS.

4.3 PREVENTION OF SIGNIFICANT DETERIORATION (PSD)

4.3.1 Applicability

Calvert Cliffs is an existing major stationary source for air permitting purposes, meaning that potential emissions of one or more regulated pollutants from existing Units 1 and 2 are above "major" source thresholds. Therefore, PSD applicability for this modification is based on whether there will be a "significant net emissions increase" of any regulated pollutants with the installation and operation of proposed Unit 3. As indicated in Table 4-9, potential emissions of PM, PM10, and PM2.5 exceed the significance thresholds and are subject to PSD review. Because there are pollutants that exceed the PSD significant thresholds, UniStar must:

- Demonstrate use of Best Available Control Technology (BACT) for pollutants with significant emissions (Section 4.3.2);
- Assess the ambient impact of emissions through the use of dispersion modeling; if the impact is significant, evaluate (through refined dispersion modeling) compliance with the NAAQS and consumption of air quality increments (Section 4.3.3); and
- Conduct additional impact assessments that analyze impairment to visibility, soils, and vegetation as a result of the modification, as well as impacts on Class I areas (Section 4.3.4).

VOCs (nonattainment pollutant) and NO_x emissions (both an attainment and nonattainment pollutant) are discussed further in Section 4.4.

Table 4-9 Potential Emissions from the Proposed Calvert Cliffs Unit 3 Project and PSD Significant Emission Rates

Pollutant	Potential Project Emissions (tpy)	PSD Significance Level (tpy)
NO_x/NO_2	22.8	40
CO	28.9	100
PM	311.1	25
PM10	243.0	15
PM2.5	42.8	10
Ozone	3.8[(1)]	Nonattainment
SO2/SOx	1.3	40
Sulfuric acid mist (SAM)	trace	7

[1]Ozone impacts are represented by VOC emissions.

4.3.2 *Best Available Control Technology (BACT)*

Based on projected potential emissions, BACT is required for PM, PM10 and PM2.5 emissions from all project emissions units (cooling towers and emergency generators). This section summarizes the BACT determination for these pollutants.

4.3.2.1 *BACT Analysis*

BACT for any source is defined in COMAR 26.11.17.01(B)(5) as:

a) …an emissions limitation, including a visible emissions standard, based on the maximum degree of reduction for each regulated NSR pollutant which would be emitted from any proposed major stationary source or major modification which the Department[1], on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for that source or modification through application of production processes or available methods, systems, and

[1] Department here means MDE-ARMA

techniques, including fuel cleaning or treatment or innovative fuel combination techniques for control of the pollutant.

b) Application of best available control technology may not result in emissions of any pollutant which would exceed the emissions allowed by an applicable standard under 40 CFR 60 and 61.

c) If the Department determines that technological or economic limitations on the application of measurement methodology to a particular emissions unit would make the imposition of an emissions standard infeasible, a design, equipment, work practice, operational standard, or combination of these, may be prescribed instead to satisfy the requirement for the application of best available control technology. This standard shall, to the degree possible, set forth the emissions reduction achievable by implementation of the design, equipment, work practice, or operation, and shall provide for compliance by means which achieve equivalent results.

BACT analyses are conducted using EPA's "top-down" BACT approach, as described in EPA's *Draft New Source Review Workshop Manual* (USEPA 1990). The five basic steps of a top-down BACT analysis are listed below:

- Step 1: Identify potential control technologies
- Step 2: Eliminate technically infeasible options
- Step 3: Rank remaining control technologies by control effectiveness
- Step 4: Evaluate the most effective controls and document results
- Step 5: Select BACT

The first step is to identify potentially "available" control options for each emission unit triggering PSD, for each pollutant under review. Available options consist of a comprehensive list of those technologies with a potentially practical application to the emission unit in question. The list includes technologies used to satisfy BACT requirements, innovative technologies, and controls applied to similar source categories.

For this analysis, the following sources were investigated to identify potentially available control technologies:

- EPA's RACT/BACT/LAER Clearinghouse (RBLC) database,
- EPA's New Source Review website,
- Permits for like sources
- In-house experts, and
- New Source Review Workshop Manual.

After identifying potential technologies, the second step is to eliminate technically infeasible options from further consideration. To be considered feasible for BACT, a technology must be both "available" and "applicable."

The third step is to rank the technologies not eliminated in Step 2 in order of descending control effectiveness for each pollutant of concern. If the highest ranked technology is proposed as BACT, it is not necessary to perform any further technical or economic evaluations. Potential adverse impacts, however, must still be identified and evaluated.

The fourth step entails an evaluation of energy, environmental, and economic impacts for determining a final level of control. The evaluation begins with the most stringent control option and continues until a technology under consideration cannot be eliminated based on adverse energy, environmental, or economic impacts. The economic or "cost-effectiveness" analysis is conducted in a manner consistent with EPA's *OAQPS Control Cost Manual, Fifth Edition* (USEPA 1996) and subsequent revisions.

The fifth and final step is to select as BACT the emission limit from application of the most effective of the remaining technologies under consideration for each pollutant of concern.

4.3.2.2 UniStar BACT for the Proposed Units

UniStar is proposing to control PM emissions (PM, PM10 and PM2.5) from the cooling towers by the installation and use of high efficiency drift eliminators (0.0005 percent drift loss for the CWS cooling tower and 0.005 percent drift loss for the ESWS cooling towers).

UniStar is proposing to control PM emissions (collectively PM, PM10 and PM2.5) from the emergency engines by the use of NSPS-compliant engines, exclusive use of low sulfur diesel, and a limitation on hours of operation (600 hours per year for the EDGs and 200 hours per year for the SBOs).

4.3.2.3 *BACT Determination*

PPRP and MDE-ARMA conducted an independent BACT determination for the sources associated with Calvert Cliffs Unit 3. Table 4-10 presents the PM/PM10/PM2.5 BACT emission limits for the emissions units associated with the Calvert Cliffs Unit 3 project.

Table 4-10 Proposed BACT Emission Limits for PM/PM10/PM2.5

Emission Source	Proposed BACT Limit	To be Achieved By
EDGs	0.15 g/hp-hr	Low sulfur diesel with maximum sulfur content of 0.05% by weight ; operations limited to no more than 600 hr/yr total all EDGs combined
SBOs	0.50 g/hp-hr	Low sulfur diesel with maximum sulfur content of 0.0015% by weight ; operations limited to no more than 200 hr/yr total all SBOs combined
CWS Cooling Tower	PM: 26.0 ton/mon PM10: 19.7 ton/mon PM2.5: 3.3 ton/mon	Drift eliminators designed not to exceed 0.0005% drift loss rate
ESWS Cooling Towers	PM/PM10/PM2.5: 3 tpy	Drift eliminators designed not to exceed 0.005% drift loss rate

CWS Cooling Tower

Actual drift loss rates from wet or wet/dry cooling systems, including those proposed by UniStar for this project, are affected by a variety of factors, including the type and design of the cooling system, capacity, velocity of air flow, density of the air in the cooling tower, and the TDS concentration in the circulating water. Commercially available techniques used to limit PM/PM10/PM2.5 drift from wet cooling towers include:

- **Application of drift eliminators** – Drift eliminators are incorporated into cooling tower systems to remove as many water droplets from the air leaving the system as possible. Types of drift eliminators include herringbone (blade-type), wave form, and cellular (or honeycomb) designs; system materials of construction may include ceramics, fiber reinforced cement, fiberglass, metal, plastic, or wood. Designs may include other features, such as corrugations and water removal channels, to enhance the drift removal further. Drift eliminators are considered standard in the utility industry; the rate of drift as a percentage of circulating water flow rates varies with the specific project and can range from about 0.01 to 0.0005 percent of circulating water flow rates. Higher efficiency drift eliminators can achieve drift loss rates of 0.0005 percent of the circulating water flow rates.

- **Limiting TDS concentrations in the circulating water**—In general, water droplets released as drift from wet cooling towers contain TDS concentrations equivalent to the solids concentrations in the circulating water. Reducing the TDS concentrations in the water, including by managing the cycles of concentrations, minimizes drift. In any particular project, TDS concentrations are defined primarily by the water source and the concentration cycles.
- **Maintaining low air velocities**—Particulate entrainment rates are influenced by air velocities in the system, so maintaining low (or optimum design) air velocities can reduce the drift.

All of these options are technically feasible for the Calvert Cliffs Unit 3 CWS cooling tower system and UniStar is proposing to implement each of these features to some degree. UniStar is proposing to use a round, hybrid, evaporative mechanical draft cooling tower equipped with high-efficiency drift eliminators for the CWS cooling tower that will achieve a minimum of a 0.0005 percent drift. They propose to manage cycles of concentration to limit TDS concentrations to a maximum of 35,000 ppm. Air velocities will be restricted to between approximately 14 feet per second (fps) with the wet section only in operation to 21 fps when both wet and dry sections are in operation to minimize entrainment.

A review of the RBLC and several other recently permitted cooling towers throughout the United States indicates that a drift rate of 0.0005 percent, or emissions limits resulting from use of such high efficiency drift eliminators, is consistent with what is being proposed as BACT. PPRP and MDE-ARMA concur that PM BACT for the CWS cooling tower is the operation of drift eliminators with a minimum drift loss of 0.0005 percent, to achieve the emission rates presented in Table 4-10. The PM emissions limits, in ton/month, were determined as the maximum hourly emissions x 24 hours per day x maximum days per month (31).

ESWS Cooling Towers

UniStar is proposing to use rectangular mechanical draft evaporative cooling towers for the ESWS system equipped with drift eliminators that will achieve a minimum 0.005 percent drift rate. The ESWS towers are significantly smaller in capacity than the CWS system (each of the four ESWS towers is rated at about 19,000 gpm water flow rate versus 777,000 gpm flow rate for the CWS cooling tower system). The maximum TDS concentration in the circulating water for the ESWS towers is 744 ppm, based on desalination plant makeup water with TDS concentrations of a maximum of 372 ppm and two cycles of concentration.

The techniques potentially available to limit PM/PM10/PM2.5 drift from the ESWS cooling towers are the same as identified above for the CWS system (drift eliminators, TDS concentration minimization, and air velocity management). All of these options are technically feasible for application to the ESWS, and UniStar is proposing to apply each of these techniques to some degree, including drift eliminators. As designed, UniStar is proposing installation of drift eliminators to achieve a maximum drift loss rate of 0.005 percent of circulating water flow (as opposed to a drift loss rate of 0.0005 percent for the CWS system). Because UniStar is proposing a drift rate less than the most efficient systems that may be feasible, we investigated the proposed ESWS systems further.

In its response to DNR Data Request No. 6-4, UniStar indicated that the drift eliminators for the ESWS towers must be manufactured of stainless steel for fire-proofing purposes to comply with NRC regulations. The system vendor, SPX, indicated that the stainless steel drift eliminators cannot be manufactured into a shape capable of achieving the higher 0.0005 percent efficiency with known manufacturing processes. Therefore, at least for this vendor, high efficiency drift eliminators of the type required by NRC regulation for this application do not appear to be technically feasible. Even if higher efficiency eliminators were technically feasible, an incremental cost effectiveness evaluation would demonstrate that additional reductions would not be cost effective, given that PM from the ESWS is projected to be 3 tpy.

PPRP and MDE-ARMA concur that BACT for the ESWS cooling towers is the installation of drift eliminators with a drift loss of 0.005 percent with use of circulating water with a maximum TDS concentration of 744 ppm, to achieve the emission rates presented in Table 4-10. Because emissions from the smaller ESWS cooling towers are so low (3 tpy) and represent a small proportion of total project PM emissions, no short-term emissions limit (lb/hr or lb/day) are necessary for this emissions unit.

Diesel Engines - EDGs

PM (and NO_x, VOC and CO) emission rates from diesel engines continue to improve as more stringent regulations drive advances in engine design and fuels (e.g., development and distribution of ultra-low sulfur fuels). Emission controls, both combustion controls (such as fuel injection systems, air management system design, and combustion system design) and post-combustion controls (such as diesel oxidation catalysts and catalyzed diesel particulate filters, CDPF) continue to advance. Feasibility and effectiveness of both types of controls are affected by engine size and rating; efficiencies of certain types of controls are greater with larger size engines.

The provisions of NSPS Subpart IIII to which the EDGs are subject are technology-forcing regulations; applicable emission limits decrease over time and later vintage engines will have more stringent emissions limits than earlier (older) units. For diesel engines with a displacement $\geq$30 liters per cylinder like the proposed EDGs, the standards require that PM emissions be reduced by at least 60 percent or PM emissions must be limited to 0.15 g/kWh (under 40 CFR 60.4205(d)). At present, UniStar has not identified the specific engines to be employed for the EDGs; however, the units will be subject to NSPS and will likely need to incorporate a combination of combustion and add-on controls to achieve the NSPS limits.

A review of the RBLC and other recently permitted, similarly sized emergency engines indicates that an emission rate of 0.15 g/kWh to be achieved through use of low sulfur fuels, and a limit on hours of operation, appears to represent BACT for these units.

According to information in the March 2008 application amendment and in UniStar's response to DNR Data Request Nos. 1-3 and 6-5, UniStar must maintain the flexibility to operate the EDGs in the event of "non-normal conditions" associated with a Loss of Offsite Power (LOOP) event. During such an event, the EDGs (and SBOs) must be able to operate unrestricted to provide power to Unit 3 for a safe shutdown and continued operation of the ESWS cooling towers, as needed. As such, the EDGs will be limited to 600 hours of operation per year, with the exception that the units will be able to operate as needed in the unlikely occurrence of a LOOP event.

Based on information available to date, BACT for the EDGs is represented by a limitation on hours of operation (no more than 600 hours per year total for all four EDGs) and a maximum PM emission rate of 0.15 g/kWh to be achieved through use of appropriate vintage engine and use of low sulfur diesel (maximum sulfur content of 0.05 percent by weight).

Diesel Engines - SBOs

PM BACT issues for the SBOs are similar to those for the EDGs. The SBOs (5,000-kWe) are smaller engines than the EDGs (10,130-kWe) and will be licensed to operate much less frequently (a maximum of 200 hr/year combined all units as opposed to 600 hr/year combined for all EDGs). The proposed PM emission rates for the SBOs (at 0.5 g/kWh), which are based on applicable NSPS Subpart IIII limits, are higher than the rates for the EDGs (0.15 g/kWh). Because the rates are higher and it may be technically feasible to apply catalyzed diesel particulate filter (CDPFs) to the SBO engines, we investigated further. UniStar, in response to DNR Data Request No. 6-5, suggests that use of a combination of CDPFs and ultra-low sulfur fuel could reduce PM emissions by up to 90%; however, UniStar also indicates that such filters would not be cost-effective. Because UniStar has not yet selected engines that will serve as the SBOs, system specifications are not yet available; however, UniStar applied information from an EPA analysis (USEPA, 2007) that provided cost-effectiveness evaluations for diesel engines. The report indicates that application of CDPF with ultra-low sulfur fuel would cost on the order of $48,000 per ton of PM removed, assuming a unit operating nearly 400 hours per year (twice the amount of operations of the SBOs, which means that this application would cost even more on a per-ton-removed basis for the SBOs).

UniStar estimated the cost effectiveness of using CDPF on the SBO units on the basis of operating hours. A single SBO unit was limited to operating less than 100 hours per year; therefore, UniStar states that the cost effectiveness of using CDPF to control PM emissions is $163,000 per ton. MDE-ARMA does not agree with the calculated cost effectiveness value presented by UniStar because the cost should also be adjusted for factors other than hours of operations, such as size. The size of the engine evaluated in the EPA analysis was 100 hp versus the planned SBO engines each rated at 5,000 kW (6,705 hp). However, the EPA analysis does report that the cost effectiveness for CDPF for generator sets range between $20,800 and $51,300 per ton of PM removed. In addition, PPRP and MDE-ARMA contacted a vendor, Miratech, for a ballpark estimate of the installation of a CDPF on a emergency generator of this size. Miratech provided a capitol cost of approximately $560,000 (operational costs would be in addition to that value).

On that basis, MDE-ARMA and PPRP determined that this control option is cost-prohibitive since the SBO units collectively will operate less than 200 hours per year and the potential PM emissions are 0.6 ton per year. Any emissions reduction achieved through installation of add-on controls would be provide, at best, a marginal environmental benefit. Therefore, based on information available to date, BACT for the SBOs is represented by a limitation on hours of operation (no more than 200 hours per year total for SBOs combined) and a maximum PM emission rate of 0.5 g/kWh to be achieved through use of appropriate vintage engine and use of ultra-low sulfur diesel (maximum sulfur content of 0.0015 percent by weight).

As is the case for the EDGs, UniStar must maintain the flexibility to operate the SBOs in the event of a LOOP event. During such an event, the SBOs, which serve as backup to the EDGs, must be able to operate unrestricted to provide power to Unit 3 for a safe shutdown and continued operation of the ESWS cooling towers, as needed. As such, the SBOs will be limited to 200 hours of operation per year, with the exception that the units will be able to operate as needed in the unlikely occurrence of a LOOP event.

4.3.3 *NAAQS and PSD Increment Compliance Demonstration*

The NAAQS are concentrations in the ambient air that are established by EPA at levels intended to protect human health and welfare, with an adequate margin of safety. The air quality analysis required for sources subject to PSD includes an evaluation of the impact of the new source's emissions on NAAQS attainment, and also includes an evaluation of the impact of the new source's emissions on applicable PSD "increments." PSD increments are established by EPA as allowable incremental increases in ambient air concentrations due to new sources in attainment areas, set at levels that are substantially less than the NAAQS. PSD increments cannot be exceeded even if the NAAQS evaluation would allow for impacts from new sources that are greater than the PSD increments.

An air quality modeling analysis was conducted to evaluate the air quality impact from the proposed Calvert Cliffs project. UniStar presented the results of its air quality modeling to demonstrate compliance with the NAAQS and PSD increments for each criteria pollutant with significant emissions from the proposed facility as part of the CPCN application. PPRP and MDE-ARMA have conducted an independent verification of the UniStar air quality modeling analysis as part of this ERD. For reference, the NAAQS, PSD increments, Significant Impact Levels (SILs), and significant monitoring concentrations for the criteria pollutants NO_2, SO_2, CO, lead, PM10, PM2.5, and ozone defined by federal regulations (40 CFR 50), are shown in Table 4-11. On September 21, 2007, EPA proposed PSD increments, SILs, and significant monitoring concentration ranges for PM2.5; however, final action has not been taken on this proposal and further analysis of PM2.5 was not conducted.

The SILs have been established by EPA to serve as an initial test of air quality impacts. Predicted impacts less than the SILs are considered low enough that no threat to the NAAQS or PSD increments is present. Additional air quality modeling analyses relative to attainment of the NAAQS and PSD increments are not required or necessary for projects with predicted impacts less than the SILs. Impacts that are greater than the SILs need to be evaluated further to determine whether additional modeling is necessary to demonstrate NAAQS and increment attainment.

PSD regulations require a source impact analysis (NAAQS and PSD increments) and an ambient air quality evaluation. The ambient air quality evaluation requires the analysis of monitored concentrations in the vicinity of the PSD source if the source impacts are greater than the monitoring de minimis values displayed in Table 4-11, and allows the regulatory agency to exempt a source from the analysis if impacts are less than the de minimis values.

Table 4-11 Ambient Air Quality Thresholds

Pollutant	Averaging Time	Primary NAAQS	Secondary NAAQS	PSD Increment	Monitoring *de minimis*	Significant Impact Level
NO_2	Annual	100 (0.053 ppm)	100 (0.053 ppm)	25	14	1.0
SO_2	Annual	80 (0.03 ppm)	—	20	—	1.0
	24-hr	365 (0.14 ppm)	—	19	13	5.0
	3-hr		1300 (0.5 ppm)	512	—	25.0
CO	8-hr	10,000 (9 ppm)	—	—	575	500
	1-hr	40,000 (35 ppm)	—	—	—	2000
PM10	Annual	50	50	17	--	1.0
	24-hr	150	150	30	10	5.0
PM2.5	Annual	15	15	—	—	—
	24-hr	35	35	—	—	—
Lead	Calendar quarter	1.5	1.5	—	0.1	—
Ozone	1-hr	235 (0.12 ppm)	235 (0.12 ppm)	—	100 tpy VOC	—
	8-hr	156 (0.08 ppm)	156 (0.08 ppm)	—	—	—

ppm = parts per million
Source: 40 CFR 50; all values are shown in μg/m³ except as noted.

4.3.3.1 *UniStar Air Quality Modeling Analysis*

To initiate the compliance demonstration for the NAAQS and PSD increments, the applicant modeled project related emissions of all PSD pollutants that are emitted above the PSD major source thresholds. The proposed Calvert Cliffs project PM10 emissions exceed the PSD significance threshold for PM10. The purpose of this initial modeling analysis was to determine maximum project impacts relative to the SILs and monitoring *de minimis* concentrations. As shown in Table 4-11, PM10 has applicable primary and secondary NAAQS, 24-hour annual increments, a 24-hour monitoring de minimis threshold, and 24-hr and annual SILs. By design, the SILs are substantially lower concentrations then the increments and NAAQS.

UniStar submitted an air quality modeling protocol to PPRP and MDE-ARMA for review. The protocol proposed the use of the most recent version of the EPA regulatory refined dispersion model AERMOD (version 07026) in the modeling analysis. After comment, PPRP and MDE-ARMA approved the final protocol in March 2008. The following paragraphs summarize the major elements of the UniStar dispersion modeling analysis.

Meteorological Data

Five years (2001-2005) of site-specific surface meteorological data were used in the modeling analysis. The site-specific meteorological data were collected at a multi-level meteorological tower located on the Calvert Cliffs property. The surface data were supplemented with cloud cover data from Reagan National Airport (DCA), and upper air observations from Sterling, VA. The most recent version of the AERMOD meteorological processor, AERMET (version 06341), was used to process the surface and upper air meteorological data for input into AERMOD.

AERMET also requires that the land use surrounding the meteorological data collection site be characterized and input into the model. Land use is characterized by identifying the surface roughness, Bowen ratio, and albedo of the surrounding land cover. These micrometeorological parameters are used by AERMET, along with the standard surface meteorological data, to determine the stability state of the boundary layer of the atmosphere. UniStar used the EPA approved land use processing program AERSURFACE (version 08009) to develop the land use characteristics surrounding the Calvert Cliffs meteorological tower. UniStar used three separate wind direction sectors and seasonal micrometeorological variables in AERSURFACE. PPRP and MDE-ARMA reviewed UniStar's AERSURFACE methodology and approved its use in the modeling protocol.

Source Characterization

The following project related emissions sources were characterized and included in the air quality modeling analysis: one CWS cooling tower, four ESWS cooling towers, four EDGs, and two SBOs.

UniStar identified five potential short-term operating scenarios to assess the facility emissions impact compared to the 24-hr PM10 SIL. The five short-term operating scenarios are as follows:

- Normal Operations Case I: CWS cooling tower and two ESWS in operation for 24 hours.
- Normal Operations Case II: CWS cooling tower and two ESWS in operation for 24 hours, plus one EDG operating at full load for 24 hours.
- Normal Operations Case III: CWS cooling tower and two ESWS in operation for 24 hours, plus one SBO operating for 12 hours.
- Backup Power Operations Case I: Two ESWS cooling towers and four EDGs operating at 70% load for one hour, and two EDGs operating at 70% load for an additional 23 hours.
- Backup Power Operations Case II: Two ESWS cooling towers and two SBOs operating for 8 hours.

For the scenarios that had limited hours of operation for certain units, UniStar used the "Hour of Day" feature of AERMOD to toggle the emissions on/off for certain hours. UniStar identified hours where worst-case dispersion characteristics would be present, and used these hours as "on" hours in the model. The worst case periods used were:

- Worst Case 12 hour period: Hours 1 through 12
- Worst Case 8 hour period: Hours 1 through 8
- Worst Case Hour: Hour 5

UniStar developed an annual operations scenario for comparison to the annual PM10 SIL. This scenario assumed constant operation of the CWS cooling tower and each ESWS cooling tower. This assumption is conservative (that is, tending to overestimate impacts), since normal operations of the ESWS would only involve running two units at a time. The four EDGs were assumed to operate for a combined 600 hours per year, split evenly among the four units. Similarly, the SBOs were assumed to operate at a combined 200 hours per year, split evenly between the two units.

The physical stack characteristics for each emissions unit are shown in Table 4-12. The annual and short-term emission rates used for each project related emissions unit are shown in Tables 4-13 and 4-14.

Table 4-12 Physical Source Characteristics

Pollutant	Units	EDG 1	EDG 1&2	EDG 3&4	SBO 1	SBO 1&2	CWS	ESWS 1&2	ESWS 3&4
UTM-X (Zone 18)	m	374,491	374,491	374,380	374,422	374,422	374,614	374,557	374,321
UTM-Y (Zone 18)	m	4,254,011	4,254,011	4,254,129	4,254,002	4,254,002	4,253,336	4,254,032	4,254,055
Stack Height	m	23.8	23.8	23.8	23.8	23.8	50	32.3	32.3
Base Elevation	m	25	25	25	25.9	25.9	30	24.4	24.4
Temperature[1]	K	767.6	767.6	767.6	767.6	767.6	-3	-	-
Temperature[2]	K	-	708.6	708.6	-	-	-	-	-
Velocity[1]	m/s	58.7	58.7	58.7	56.8	56.8	4.34 (3.62)*	-	-
Velocity[2]	m/s	-	47.5	47.5	-	-	-	-	-
Diameter	m	0.89	0.89	0.89	0.64	0.64	105	-	-
Area	m2	-	-	-	-	-	-	2800	2800

* 4.34 m/s is the exit velocity from the wet and dry sections. 3.63 m/s is from wet section only.

[1] EDGs at 100% Load

[2] EDGs at 70% Load

Table 4-13 Project Related Long Term Emission Rates

Pollutant	Scenario	EDG 1	EDG 1&2	EDG 3&4	SBO 1	SBO 1&2	CWS	ESWS 1&2	ESWS 3&4
Units		gm/sec	gm/sec	gm/sec	gm/sec	gm/sec	gm/sec	g/s/m2	g/s/m2
NO_x	4 EDGs & 2 SBOs	-	0.15	0.15	-	0.35	-	-	-
SO_2	4 EDGs & 2 SBOs	-	0.02	0.02	-	0.00	-	-	-
PM_{10}	ESWS & CWS & 4 EDGs & 2 SBOs	-	0.01	0.01	-	0.02	7.05	1.4862E-05	1.49E-05
$PM_{2.5}$	ESWS & CWS & 4 EDGs & 2 SBOs	-	0.01	0.01	-	0.01	1.15	2.56E-06	2.56E-06

Table 4-14 Project Related Short Term Emission Rates

Pollutant	Scenario	EDG 1	EDG 1&2	EDG 3&4	SBO 1	SBO 1&2	CWS	ESWS 1&2	ESWS 3&4
Units		gm/sec	gm/sec	gm/sec	gm/sec	gm/sec	gm/sec	g/s/m2	g/s/m2
SO_2	1 EDG at 100% Load for 24 hrs	0.56	-	-	-	-	-	-	-
	1 SBO for 12 hrs (find worst 12 hrs a day)	-	-	-	0.01		-	-	-
	4 EDG at 70% Load for 1 hr (find worst 1 hr) & 2 EDGs at 70% Load for 23 hrs	-	0.78	0.78	-	-	-	-	-
	2 SBOs for 8 hrs (find worst 8 hrs a day)	-	-	-	-	0.02	-	-	-
CO	1 EDG at 100% Load for 24 hrs	9.85	-	-	-	-	-	-	-
	1 SBO for 12 hrs (find worst 12 hrs a day)	-	-	-	6.94	-	-	-	-
	4 EDG at 70% Load for 1 hr (find worst 1 hr) & 2 EDGs at 70% Load for 23 hrs		13.79	13.79	-	-	-	-	-
	2 SBOs for 8 hrs (find worst 8 hrs a day)		-	-	-	13.89	-	-	-
PM_{10}	CWS+ESWS+1 EDG at 100% Load for 24 hrs	0.42	-	-	-	-	7.05	1.49E-05	1.49E-05
	CWS+ESWS+1 SBO for 12 hrs (find worst 12 hrs a day)	-	-	-	0.69	-	7.05	1.49E-05	1.49E-05
	CWS+ESWS+4 EDG at 70% Load for 1 hr (find worst 1 hr) & 2 EDGs at 70% Load for 23 hrs	-	0.59	0.59	-	-	7.05	1.49E-05	1.49E-05
	CWS+ESWS+2 SBOs for 8 hrs (find worst 8 hrs a day)	-	-	-	-	1.39	7.05	1.49E-05	1.49E-05
$PM_{2.5}$	CWS+ESWS+1 EDG at 100% Load for 24 hrs	0.41	-	-	-	-	1.15	2.56E-06	2.56E-06
	CWS+ESWS+1 SBO for 12 hrs (find worst 12 hrs a day)	-	-	-	0.62	-	1.15	2.56E-06	2.56E-06
	CWS+ESWS+4 EDG at 70% Load for 1 hr (find worst 1 hr) & 2 EDGs at 70% Load for 23 hrs	-	0.53	0.53	-	-	1.15	2.56E-06	2.56E-06
	CWS+ESWS+2 SBOs for 8 hrs (find worst 8 hrs a day)	-	-	-	-	1.25	1.15	2.56E-06	2.56E-06

Downwash

Aerodynamic downwash caused by buildings and structures in the vicinity of exhaust stacks can lead to an increase in ground level concentrations. Downwash effects are modeled within AERMOD by using algorithms derived from the ISCPRIME model. AERMOD requires information about buildings and structures to be input in a prescribed format. UniStar used EPA's Building Profile Input Program (BPIP, version 04274) for this purpose. The BPIP program generates information on the location and size of buildings and structures relative to each stack, and AERMOD uses this information to calculate downwash effects.

BPIP also calculates the good engineering practice (GEP) stack height for a given stack location. GEP is the height at which downwash effects are considered to be insignificant. BPIP determined the GEP height for the all project related stacks as well in excess of the actual planned stack heights. Therefore, the direction specific downwash information created by BPIP for each source was used in the air quality modeling analysis.

Receptor Grid Development

A receptor grid was developed by UniStar that extended to approximately 7 kilometers from the Calvert Cliffs project site in each direction. Receptor spacing was set to 100 m along the site boundary; 100-m spacing from the site boundary to 1 km; 300 m from 1 km to 3 km; and 500 m spacing from 3 km to 7 km.

A total of 4,946 receptors were analyzed in the model. Terrain elevations were assigned to each receptor, and a hill scale was calculated with the AERMAP (version 06341) terrain processor. AERMAP is a companion program to AERMOD that utilizes digitized USGS digital elevation model (DEM) data files to assign elevations and hill scales to receptors. The hill scale assigned to each receptor is used by AERMOD to determine the appropriate terrain algorithm to use for the receptor. AERMOD calculates a critical dividing streamline height, based on the hill scale that divides the approach flow towards the hill into two parts: one that rises over the terrain obstacle, and one that passes around the side of the obstacle. Based on the plume height relative to the terrain and relative to the receptor, AERMOD calculates concentration contributions from different parts of the plume following the different flow regimes.

UniStar Air Quality Modeling Results and Discussion

PPRP and MDE-ARMA evaluated UniStar's modeling methodology including the model used, the development and application of the meteorological database, the use and application of BPIP to determine downwash effects, the design of the receptor grid, and the actual model application. PPRP and MDE-ARMA's conclusion based on this evaluation is that the methodology is adequate to determine PSD significance and other subsequent air quality model evaluations for this project.

Table 4-15 summarizes the PSD significance modeling results for the Calvert Cliffs project. The maximum overall concentrations predicted by AERMOD are intended to be compared to the SILs and monitoring de minimis values that are also shown on Table 4-15. The modeling results as presented in the CPCN application, as confirmed by PPRP and MDE-ARMA, are shown. As shown in these tables, maximum impacts for all pollutants of concern and for all relevant averaging periods are less than applicable SILs, with the exception of the 24-hr PM10 SIL; Backup Power Operations Case 2 (ESWS and two SBOs for 8 hours) shows modeled PM10 concentrations in excess of the 24-hr SIL. Because modeled concentrations are greater than the 24-hour PM10 SIL, a cumulative air quality modeling analysis is required to be performed for the 24-hr PM10 NAAQS and PSD increment evaluation.

UniStar identified a "significant impact distance" (SID) of 2.7 kilometers from the proposed site. The significance of the SID is that multi-source modeling must be conducted to determine the total impact on PSD increments and NAAQS within a circle with a radius equal to the SID. The area within this circle is referred to as the significant impact area (SIA). The inventory of sources to be evaluated for possible inclusion in the multi-source modeling should include all sources within a distance of 50 kilometers of the outer edge of the SIA. The development of multi-source inventories for PM10 is described in Section 4.3.3.2, and the multi-source modeling for PM10 is described in Section 4.3.3.3. The issue of preconstruction monitoring is discussed further in Section 4.3.3.4.

Table 4-15 PSD Significance Modeling Results

Pollutant	Averaging Period	Operating Scenario	Modeled Sources	2001-2005 Max Modeled Concentration (μg/m³) 2001	2002	2003	2004	2005	Max	Class II SIL (μg/m³)	PSD Class II Increment (μg/m³)	NAAQS (μg/m³)
CO	1-hr	Normal Operations Case 2	1 EDG at Testing 100% Load	344.6	246.0	285.0	303.3	296.4	344.6	2,000	-	40,000
	1-hr	Normal Operations Case 3	1 SBO	299.7	260.3	314.7	332.5	296.3	332.5	2,000	-	40,000
	1-hr	Backup Power Operations Case 1	4 EDGs at 70% Load for 1 hr & 2 EDGs at 70% Load for rest of period	640.3	478.8	486.3	691.9	487.4	691.9	2,000	-	40,000
	1-hr	Backup Power Operations Case 2	2 SBOs	599.4	520.5	629.3	665.0	592.6	665.0	2,000	-	40,000
	8-hr	Normal Operations Case 2	1 EDG Testing at 100% Load	101.4	94.3	108.1	100.7	97.0	108.1	500	-	10,000
	8-hr	Normal Operations Case 3	1 SBO	90.3	93.4	98.0	114.2	116.1	116.1	500	-	10,000
	8-hr	Backup Power Operations Case 1	4 EDGs at 70% Load for 1 hr & 2 EDGs at 70% Load for rest of period	134.5	103.5	115.9	114.9	140.4	140.4	500	-	10,000
	8-hr	Backup Power Operations Case 2	2 SBOs	180.7	186.8	195.9	228.3	232.3	232.3	500	-	10,000
SO_2	3-hr	Normal Operations Case 2	1 EDG Testing at 100% Load	10.52	7.86	8.85	7.49	9.21	10.52	25	512	1,300
	3-hr	Normal Operations Case 3	1 SBO	0.19	0.16	0.20	0.19	0.18	0.20	25	512	1,300
	3-hr	Backup Power Operations Case 1	4 EDGs at 70% Load for 1 hr & 2 EDGs at 70% Load for rest of period	18.73	10.59	13.59	13.93	12.34	18.73	25	512	1,300
	3-hr	Backup Power Operations Case 2	2 SBOs for 8 hrs	0.37	0.33	0.40	0.38	0.36	0.40	25	512	1,300
	24-hr	Normal Operations Case 2	1 EDG Testing at 100% Load for 24 hrs	3.19	3.34	2.79	2.90	3.20	3.34	5	19	365
	24-hr	Normal Operations Case 3	1 SBO Testing for 12 hrs	0.05	0.05	0.05	0.06	0.05	0.06	5	19	365
	24-hr	Backup Power Operations Case 1	4 EDGs at 70% Load for 1 hr & 2 EDGs at 70% Load for rest of period	3.42	3.44	3.52	3.52	3.64	3.64	5	19	365
	24-hr	Backup Power Operations Case 2	2 SBOs for 8 hrs	0.08	0.08	0.08	0.10	0.10	0.10	5	19	365
	Annual	Annual hours of operation	4 EDGs & 2 SBOs	0.03	0.03	0.03	0.02	0.02	0.03	1	20	80
NO_X	Annual	Annual hours of operation	4 EDGs & 2 SBOs	0.61	0.61	0.60	0.47	0.53	0.61	1	25	100
PM_{10}	24-hr	Normal Operations Case 1	CWS & ESWS	0.91	0.63	1.12	0.75	0.84	1.12	5	30	150
	24-hr	Normal Operations Case 2	CWS & ESWS & 1 EDG Testing at 100% Load	2.78	2.87	2.34	2.58	2.83	2.87	5	30	150
	24-hr	Normal Operations Case 3	CWS & ESWS & 1 SBO Testing for 12 hrs	3.84	3.91	4.11	4.48	4.42	4.48	5	30	150
	24-hr	Backup Power Operations Case 1	ESWS & 4 EDGs at 70% Load for 1 hr & 2 EDGs at 70% Load for rest of period	3.02	3.04	2.96	2.81	3.06	3.06	5	30	150
	24-hr	Backup Power Operations Case 2	ESWS & 2 SBOs for 8 hrs	6.16	6.41	6.64	7.76	7.97	**7.97**	5	30	150
	Annual	Annual hours of operation	CWS & ESWS & 4 EDGs & 2 SBOs	0.14	0.13	0.11	0.13	0.10	0.14	1	17	50

4.3.3.2 *Multi-Source Inventory Development for PM10*

The process of developing an appropriate inventory to conduct multi-source modeling involves several steps, and is aided by developing information from different sources for the sake of intercomparison. This intercomparison of information from different sources allows for choices to be made that help ensure that conservative estimates of background source impacts are made.

UniStar acquired a background modeling inventory, including source specific PM10 emissions and stack parameters from the Virginia Department of Environmental Quality (VDEQ). The file provided by VDEQ contained information on PM10 emissions from the District of Columbia, Maryland and Virginia. UniStar considered all the background sources within the SIA plus 50 kilometers as candidates for the cumulative modeling.

PPRP and MDE-ARMA have reviewed the development of UniStar's multi-source inventories. The results of this review are discussed in two parts: first, for the selection of sources to model, and second, for the development of modeling inputs including stack parameters and emission rates.

Source Selection

For the purpose of the PSD increment evaluation, increment-consuming emissions for facilities in operation should represent "actual" emissions. For the purposes of the NAAQS evaluation, emissions should represent "potential" emissions, defined in EPA's Guideline on Air Quality Models (GAQM) as the product of an allowable emission limit (in lb/MMBtu) and an operating level (in MMBtu/hr), and assumed to occur continuously (i.e., 8,760 hrs/yr).

The first step in developing a multi-source inventory is to identify sources within 50 kilometers of the SIA. UniStar took the step of identifying PM10 sources out to a distance of 50 kilometers from Calvert Cliffs.

The ultimate goal of a NAAQS and PSD increment consumption analysis is to demonstrate compliance with these standards within a source's SIA. The selection of which sources to model in addition to the source requesting a permit is intended to accomplish this goal. The basic selection criterion, according to the EPA GAQM, is to model all sources with a significant concentration gradient within the SIA. A significant concentration gradient would suggest that the source's impacts may not be captured in the ambient monitoring and that modeling is necessary to define whether the source's impacts, in conjunction with impacts from the new source, are within ambient standards.

A source that is within the SIA is almost certain to have a significant concentration gradient in the SIA, and most sources within the SIA should be modeled. For sources outside of the SIA, however, the definition of significant concentration gradient is not well defined, and source selection relies on more qualitative judgments.

UniStar applied a screening technique to select background sources for modeling. The screening technique compares the annual emissions of a source (in tpy) to 0.3 times the distance of the source from the SIA. If the ratio of these values (tpy/0.3D) is greater than 1, UniStar included the source in the cumulative modeling analysis. UniStar applied the conservative factor of 0.3 as opposed to the commonly used factor of 20 used in the "20D" screening technique. The so-called 20D technique is frequently used for screening sources to model, but has not been approved generically either by PPRP, MDE-ARMA or EPA. It does, however, provide a first-cut at limiting the number of sources that can serve as a useful starting point. The information retrieval resulted in data for approximately six sources. The facilities that were selected by UniStar, using this technique, are shown in Table 4-16.

PPRP and MDE-ARMA have reviewed the selections made by UniStar and conclude that the six facilities selected for PM10 modeling as displayed in Table 4-16, in addition to the existing Calvert Cliffs Units 1 and 2, are appropriate for determining attainment of the PM10 NAAQS and PSD increments in the PM10 SIA defined for the UniStar expansion project.

Table 4-16 Off-Site Sources Modeled for the PSD Increment and NAAQS Analysis

StateFIPs+Facility ID	Allowable PM10 Emissions (lbs/day)	Point ID	UTM-X-18 m	UTM-Y-18 m	Base Elevation (m)	Short-term Allowable Emissions (g/sec)	Stack Height (m)	Temperature (K)	Velocity (m/s)	Diameter (m)
24009-009-0021-	56.00	26	376800	4249400	30	0.29	8.23	314.82	30.48	1.22
24009-009-0021-	11.19	38	376800	4249400	30	0.06	13.11	422.04	14.33	2.44
24009-009-0021-	13.58	36	376800	4249400	30	0.07	13.11	422.04	14.33	2.44
24017-017-0014-	42.00	8	327100	4247200	0	0.22	14.63	727.59	24.38	6.78
24017-017-0014-	44.00	7	327100	4247200	0	0.23	14.63	727.59	24.38	6.78
24017-017-0014-	117.00	12	327100	4247200	0	0.61	14.63	727.59	24.38	6.78
24017-017-0014-	118.00	10	327100	4247200	0	0.62	14.63	727.59	24.38	6.78
24017-017-0014-	131.00	9	327100	4247200	0	0.69	14.63	727.59	24.38	6.78
24017-017-0014-	139.00	11	327100	4247200	0	0.73	14.63	727.59	24.38	6.78
24017-017-0014-	7.00	6	327100	4247200	0	0.04	56.69	408.15	20.42	1.52
24017-017-0014-	8.00	5	327100	4247200	0	0.04	56.69	408.15	20.42	1.52
24017-017-0014-	6766.00	15	327100	4247200	0	35.52	213.36	405.37	30.48	5.89
24017-017-0014-	9155.00	14	327100	4247200	0	48.06	213.36	405.37	30.48	5.89
24019-019-0029-	0.70	22	418400	4267700	6	0.00	7.01	505.37	12.19	0.46
24019-019-0029-	3.30	21	418400	4267700	6	0.02	7.01	505.37	12.19	0.46
24019-019-0029-	5.10	19	418400	4267700	6	0.03	7.32	519.26	3.05	1.37
24019-019-0029-	16.20	35	418400	4267700	6	0.09	9.14	422.04	9.14	0.63
24019-019-0029-	80.90	34	418400	4267700	6	0.42	9.14	422.04	9.14	0.63
24033-033-0014-	59.26	6	353100	4267300	0	0.31	9.14	755.37	27.43	3.14
24033-033-0014-	50.00	9	353100	4267300	0	0.26	12.19	755.37	17.37	4.57
24033-033-0014-	25.69	14	353100	4267300	0	0.13	64.92	813.15	32.31	5.64
24033-033-0014-	25.69	15	353100	4267300	0	0.13	64.92	813.15	32.31	5.64
24033-033-0014-	38.81	16	353100	4267300	0	0.20	64.92	814.82	34.44	5.61
24033-033-0014-	41.51	17	353100	4267300	0	0.22	64.92	814.82	34.44	5.61
24033-033-0014-	1.52	13	353100	4267300	0	0.01	67.06	588.71	9.45	2.13
24033-033-0014-	1232.93	8	353100	4267300	0	6.47	213.36	644.26	9.14	5.09
24033-033-0014-	401.72	1	353100	4267300	0	2.11	216.10	415.93	17.07	9.60
24033-033-0014-	417.93	2	353100	4267300	0	2.19	216.10	415.93	17.07	9.60
24033-033-0014-	2330.58	7	353100	4267300	0	12.24	217.02	395.93	19.20	7.62
24037-037-0017-	1.00	48	373200	4237600	17.66	0.01	1.22	294.26	15.24	0.97
24037-037-0017-	4.00	153	373200	4237600	17.66	0.02	3.66	294.26	19.51	0.25
24037-037-0017-	2.00	205	373200	4237600	17.66	0.01	4.57	505.37	19.51	0.25
24037-037-0017-	1.00	194	373200	4237600	17.66	0.01	6.10	477.59	15.24	0.30
24037-037-0017-	1.00	196	373200	4237600	17.66	0.01	6.10	477.59	15.24	0.30
24037-037-0017-	7.00	195	373200	4237600	17.66	0.04	6.10	477.59	15.24	0.30
24037-037-0017-	1.00	88	373200	4237600	17.66	0.01	10.97	463.71	10.97	0.51
24037-037-0017-	1.00	89	373200	4237600	17.66	0.01	10.97	463.71	10.97	0.51
24037-037-0017-	23.00	198	373200	4237600	17.66	0.12	10.97	519.26	15.54	0.56
24037-037-0017-	3.00	199	373200	4237600	17.66	0.02	21.34	533.15	4.27	1.47
24041-041-0069-	17.00	11	407100	4294200	9	0.09	12.19	765.37	30.48	0.41
24041-041-0069-	17.00	12	407100	4294200	9	0.09	12.19	765.37	30.48	0.41
24041-041-0069-	12.00	9	407100	4294200	9	0.06	21.34	705.37	30.48	0.89
24041-041-0069-	73.00	8	407100	4294200	9	0.38	21.34	634.26	24.38	0.99
24041-041-0069-	77.00	7	407100	4294200	9	0.40	21.34	634.26	30.48	0.99
24041-041-0069-	210.00	10	407100	4294200	9	1.10	21.34	705.37	30.48	0.89

4.3.3.3 NAAQS and PSD Increment Modeling Results

To demonstrate compliance with the PSD increments and the NAAQS for PM10, an air quality modeling analysis was conducted using the same methodology as with the project source-only analysis. For the increment and NAAQS analyses, model runs were conducted using five years of meteorology but only at receptors located in the PM10 SIA. The worst-case operating scenario was modeled, along with the appropriate multi-source inventories. The Backup Power Operations Case II scenario corresponded to the scenario that resulted in the highest project source impacts for PM10.

UniStar included a background PM10 concentration for inclusion in the NAAQS analysis. The PM10 monitor site located in Fairfax County, VA (Monitor ID #510590018) is the closest active PM10 monitor to Calvert Cliffs. The average "highest second-highest" 24-hr monitor value from the most recent three year period (2005-2007) was used and added to the cumulative modeling concentration.

The UniStar PSD increment and NAAQS modeling results are shown in Tables 4-17 and 4-18. These multi-source modeling results demonstrate compliance with the PM10 NAAQS and PSD increments.

Table 4-17 Calvert Cliffs Unit 3 PM10 NAAQS Analysis

Pollutant	Averaging Period	Modeled Sources	Highest of 2nd Highest 2001-2005 Modeled Concentration (μg/m³)						Ambient Monitoring Background	Total	NAAQS
			2001	2002	2003	2004	2005	Maximum	(μg/m³)	(μg/m³)	(μg/m³)
PM_{10}	24-hr	Units 1-3 + Major Sources	85.2	75.7	76.2	76.3	76.6	85.2	38	123.2	150

Table 4-18 Calvert Cliffs Unit 3 PM10 PSD Increment Modeling Results

Pollutant	Averaging Period	Modeled Sources	Highest of 2nd Highest 2001-2005 Modeled Concentration (μg/m³)						PSD Class II
			2001	2002	2003	2004	2005	Maximum	(μg/m³)
PM_{10}	24-hr	Units 1-3 + Major Sources	20.1	17.1	24.2	26.4	20.1	26.4	30

4.3.3.4 *Preconstruction Monitoring*

The air quality modeling analyses described in Section 4.3.4.1, which address attainment of the NAAQS and PSD increments, are intended to fulfill the requirements contained in the PSD regulations at 40 CFR Part 52.21(k), "source impact analysis." Additional requirements at 40 CFR Part 52.21(m) require an analysis of air quality in the vicinity of the PSD source, including preconstruction monitoring. If the projected ambient impacts of a new source or modification are less than the monitoring *de minimis* levels specified in Part 52.21(i)(5)(i), an exemption may be granted from the air quality analysis. Since the impacts of the Calvert Cliffs expansion project do not exceed the monitoring *de minimis* levels for PM10 (see Table 4-11), an exemption can be granted for this pollutants. PPRP and MDE-ARMA conclude, therefore, that the air quality analysis requirements of 52.21(m) have been satisfied for the Calvert Cliffs facility and no preconstruction monitoring is required.

4.3.3.5 *Summary and Conclusions*

Based on the information provided in the Calvert Cliffs Unit 3 project CPCN application, supplemented with independent analyses, PPRP and MDE-ARMA conclude that criteria pollutant impacts for the UniStar Calvert Cliffs facility project will not adversely affect the NAAQS or PSD increments for PM10.

4.3.3.6 *PPRP/MDE-ARMA AERMOD Analysis – Adjustments to UniStar Analysis*

PPRP and MDE-ARMA re-ran the air quality modeling analysis provided by UniStar, to uncover any sensitivity to input assumptions assumed by UniStar in the modeling analysis. Since the Calvert Cliffs project used onsite meteorological data, the uncertainties associated with this modeling analysis are somewhat limited. However, some assumptions in the AERMET processing for the on-site meteorological were identified by PPRP and MDE-ARMA as possibly having an effect on modeled concentrations.

Meteorological Processing Changes

PPRP and MDE-ARMA changed the wind speed threshold from 0.5 m/s to 0.1 m/s in AERMET. This threshold change allows for the use of lowest wind speeds recorded by the on-site meteorological monitoring system. The higher threshold may unnecessarily treat lower wind speeds as calms, when the on-site monitoring system is still able to accurately report wind speeds in this range. AERMOD does not predict concentrations for calm hours.

The UniStar modeling used cloud cover data from Reagan National Airport (DCA) to as input into AERMET, to calculate boundary layer parameters for both stable and unstable hours. For unstable hours, AERMET has the ability to use on-site measurements of solar radiation to perform the necessary calculations; however, solar radiation is not a recorded parameter at the Calvert Cliffs meteorological monitoring site. Therefore, DCA cloud cover is required for unstable hours. AERMET also has the ability to use two measurements of temperature, taken at different elevations, to perform the so-called Bulk Richardson Number (Bulk Rn) approximation scheme. The use of the Bulk Rn scheme does not require off-site cloud cover data. The Bulk Rn scheme has not gained wide acceptance for use in AERMOD as the use of standard cloud cover data; however, PPRP and MDE-ARMA reran AERMET using the Bulk Rn scheme to uncover any sensitivity in modeled concentrations.

Receptor Grid Changes

PPRP and MDE-ARMA also developed a separate receptor grid to use in our analyses. The PPRP-MDE-ARMA receptor grid used 150 m spacing along the facility property boundary, 150 m spacing out to 3 km in all directions from the facility, and 400 m spacing from 3 km to 5 km from the facility. The total number of receptors modeled is reduced to 1,302.

Cumulative Modeling Inventory Changes

PPRP and MDE-ARMA conducted a review of the stack parameters and emission rates used in the cumulative modeling analysis. UniStar's methodology and results for developing the inventory were reviewed in conjunction with recent Environmental Reviews coordinated by PPRP for power plant facilities in Morgantown, MD (Facility ID – 24017-0014) and Chalk Point, MD (Facility ID – 24033-0014) and as well as from the 2002 National Emissions Inventory (NEI) from EPA. This review uncovered significant discrepancies in the PM10 emissions and the stack locations for the above mentioned facilities. Subsequently, PPRP and MDE-ARMA conducted a revision of the cumulative modeling analysis including the appropriate stack locations and PM10 emissions for these facilities as shown in Table 4-19.

*Table 4-19 Revised Stack Locations**

StateFIPs+Facility ID	Allowable PM10 Emissions (lbs/day)	Point ID	UTM-X-18-m	UTM-Y-18-m	Base Elevation (m)	Short-term Allowable Emissions (g/sec)	Stack Height (m)	Temperature (K)	Velocity (m/s)	Diameter (m)
24009-009-0021-	56.00	26	376552.45	4250099.84	30	0.29	8.23	314.82	30.48	1.22
24009-009-0021-	11.19	38	376552.45	4250099.84	30	0.06	13.11	422.04	14.33	2.44
24009-009-0021-	13.58	36	376552.45	4250099.84	30	0.07	13.11	422.04	14.33	2.44
24017-017-0014-	42.00	8	327340.77	4247375.9	0	0.22	14.63	727.59	24.38	6.78
24017-017-0014-	44.00	7	327340.77	4247375.9	0	0.23	14.63	727.59	24.38	6.78
24017-017-0014-	117.00	12	327340.77	4247375.9	0	0.61	14.63	727.59	24.38	6.78
24017-017-0014-	118.00	10	327340.77	4247375.9	0	0.62	14.63	727.59	24.38	6.78
24017-017-0014-	131.00	9	327340.77	4247375.9	0	0.69	14.63	727.59	24.38	6.78
24017-017-0014-	139.00	11	327340.77	4247375.9	0	0.73	14.63	727.59	24.38	6.78
24017-017-0014-	7.00	6	327340.77	4247375.9	0	0.04	56.69	408.15	20.42	1.52
24017-017-0014-	8.00	5	327340.77	4247375.9	0	0.04	56.69	408.15	20.42	1.52
24017-017-0014-	9,410.95	15	327340.77	4247375.9	0	49.41	213.36	405.37	30.48	5.89
24017-017-0014-	9,410.95	14	327340.77	4247375.9	0	49.41	213.36	405.37	30.48	5.89
24019-019-0029-	0.70	22	418400	4267700	6	0.00	7.01	505.37	12.19	0.46
24019-019-0029-	3.30	21	418400	4267700	6	0.02	7.01	505.37	12.19	0.46
24019-019-0029-	5.10	19	418400	4267700	6	0.03	7.32	519.26	3.05	1.37
24019-019-0029-	16.20	35	418400	4267700	6	0.09	9.14	422.04	9.14	0.63
24019-019-0029-	80.90	34	418400	4267700	6	0.42	9.14	422.04	9.14	0.63
24033-033-0014-	59.26	6	353061.16	4267369.58	0	0.31	9.14	755.37	27.43	3.14
24033-033-0014-	50.00	9	353061.16	4267369.58	0	0.26	12.19	755.37	17.37	4.57
24033-033-0014-	25.69	14	353061.16	4267369.58	0	0.13	64.92	813.15	32.31	5.64
24033-033-0014-	25.69	15	353061.16	4267369.58	0	0.13	64.92	813.15	32.31	5.64
24033-033-0014-	38.81	16	353061.16	4267369.58	0	0.20	64.92	814.82	34.44	5.61
24033-033-0014-	41.51	17	353061.16	4267369.58	0	0.22	64.92	814.82	34.44	5.61
24033-033-0014-	1.52	13	353061.16	4267369.58	0	0.01	67.06	588.71	9.45	2.13
24033-033-0014-	808.87	8	353061.16	4267369.58	0	4.25	213.36	644.26	9.14	5.09
24033-033-0014-	11,895.78	1	353061.16	4267369.58	0	62.45	216.10	415.93	17.07	9.60
24033-033-0014-	12,677.73	2	353061.16	4267369.58	0	66.56	216.10	415.93	17.07	9.60
24033-033-0014-	955.89	7	353061.16	4267369.58	0	5.02	217.02	395.93	19.20	7.62
24037-037-0017-	1.00	48	373200	4237600	17.66	0.01	1.22	294.26	15.24	0.97
24037-037-0017-	4.00	153	373200	4237600	17.66	0.02	3.66	294.26	19.51	0.25
24037-037-0017-	2.00	205	373200	4237600	17.66	0.01	4.57	505.37	19.51	0.25
24037-037-0017-	1.00	194	373200	4237600	17.66	0.01	6.10	477.59	15.24	0.30
24037-037-0017-	1.00	196	373200	4237600	17.66	0.01	6.10	477.59	15.24	0.30
24037-037-0017-	7.00	195	373200	4237600	17.66	0.04	6.10	477.59	15.24	0.30
24037-037-0017-	1.00	88	373200	4237600	17.66	0.01	10.97	463.71	10.97	0.51
24037-037-0017-	1.00	89	373200	4237600	17.66	0.01	10.97	463.71	10.97	0.51
24037-037-0017-	23.00	198	373200	4237600	17.66	0.12	10.97	519.26	15.54	0.56
24037-037-0017-	3.00	199	373200	4237600	17.66	0.02	21.34	533.15	4.27	1.47
24041-041-0069-	17.00	11	407100	4294200	9	0.09	12.19	765.37	30.48	0.41
24041-041-0069-	17.00	12	407100	4294200	9	0.09	12.19	765.37	30.48	0.41
24041-041-0069-	12.00	9	407100	4294200	9	0.06	21.34	705.37	30.48	0.89
24041-041-0069-	73.00	8	407100	4294200	9	0.38	21.34	634.26	24.38	0.99
24041-041-0069-	77.00	7	407100	4294200	9	0.40	21.34	634.26	30.48	0.99
24041-041-0069-	210.00	10	407100	4294200	9	1.10	21.34	705.37	30.48	0.89

*Shaded values represent PPRP and MDE-ARMA's updated information.

The results of the AERMOD analyses, with the changes made by PPRP and MDE-ARMA described above, are shown in Tables 4-20, 4-21, and 4-22. No significant deviations in the modeled concentrations from the analyses conducted by UniStar were found. PPRP and MDE-ARMA conclude that no uncertainties exist that would significantly alter the findings of the air quality modeling analysis for this project.

Table 4-20 PPRP and MDE-ARMA SILs Analysis

Pollutant	Averaging Period	Operating Scenario	Modeled Sources	2001-2005 Max Modeled Concentration (μg/m^3)						Class II SIL	PSD Class II Increment	NAAQS
				2001	2002	2003	2004	2005	Max	(μg/m^3)	(μg/m^3)	(μg/m^3)
CO	1-hr	Normal Operations Case 2	1 EDG at Testing 100% Load	344.6	246.0	285.0	303.3	296.4	344.6	2,000	-	40,000
	1-hr	Normal Operations Case 3	1 SBO	299.7	260.3	314.7	332.5	296.3	332.5	2,000	-	40,000
	1-hr	Backup Power Operations Case 1	4 EDGs at 70% Load	640.3	478.8	486.3	691.9	487.4	691.9	2,000	-	40,000
	1-hr	Backup Power Operations Case 2	2 SBOs	599.4	520.5	629.3	665.0	592.6	665.0	2,000	-	40,000
	8-hr	Normal Operations Case 2	1 EDG Testing at 100% Load	101.4	94.3	108.1	100.7	97.0	108.1	500	-	10,000
	8-hr	Normal Operations Case 3	1 SBO	90.3	93.4	98.0	114.2	116.1	116.1	500	-	10,000
	8-hr	Backup Power Operations Case 1	4 EDGs at 70% Load for 1 hr & 2 EDGs at 70% Load for rest of period	134.5	103.5	115.9	114.9	140.4	140.4	500	-	10,000
	8-hr	Backup Power Operations Case 2	2 SBOs	180.7	186.8	195.9	228.3	232.3	232.3	500	-	10,000
SO_2	3-hr	Normal Operations Case 2	1 EDG Testing at 100% Load	10.52	7.86	8.85	7.49	9.21	10.52	25	512	1,300
	3-hr	Normal Operations Case 3	1 SBO	0.19	0.16	0.20	0.19	0.18	0.20	25	512	1,300
	3-hr	Backup Power Operations Case 1	4 EDGs at 70% Load for 1 hr & 2 EDGs at 70% Load for rest of period	18.73	10.59	13.59	13.93	12.34	18.73	25	512	1,300
	3-hr	Backup Power Operations Case 2	2 SBOs for 8 hrs	0.37	0.33	0.40	0.38	0.36	0.40	25	512	1,300
	24-hr	Normal Operations Case 2	1 EDG Testing at 100% Load for 24 hrs	3.19	3.34	2.79	2.90	3.20	3.34	5	19	365
	24-hr	Normal Operations Case 3	1 SBO Testing for 12 hrs	0.05	0.05	0.05	0.06	0.05	0.06	5	19	365
	24-hr	Backup Power Operations Case 1	4 EDGs at 70% Load for 1 hr & 2 EDGs at 70% Load for rest of period	3.42	3.44	3.52	3.52	3.64	3.64	5	19	365
	24-hr	Backup Power Operations Case 2	2 SBOs for 8 hrs	0.08	0.08	0.08	0.10	0.10	0.10	5	19	365
	Annual	Annual hours of operation	4 EDGs & 2 SBOs	0.03	0.03	0.03	0.02	0.02	0.03	1	20	80
NO_X	Annual	Annual hours of operation	4 EDGs & 2 SBOs	0.61	0.61	0.60	0.47	0.53	0.61	1	25	100
PM_{10}	24-hr	Normal Operations Case 1	CWS & ESWS	0.91	0.63	1.12	0.75	0.84	1.12	5	30	150
	24-hr	Normal Operations Case 2	CWS & ESWS & 1 EDG Testing at 100% Load	2.78	2.87	2.34	2.58	2.83	2.87	5	30	150
	24-hr	Normal Operations Case 3	CWS & ESWS & 1 SBO Testing for 12 hrs	3.84	3.91	4.11	4.48	4.42	4.48	5	30	150
	24-hr	Backup Power Operations Case 1	ESWS & 4 EDGs at 70% Load for 1 hr & 2 EDGs at 70% Load for rest of period	3.02	3.04	2.96	2.81	3.06	3.06	5	30	150
	24-hr	Backup Power Operations Case 2	ESWS & 2 SBOs for 8 hrs	6.16	6.41	6.64	7.76	7.97	**7.97**	5	30	150
	Annual	Annual hours of operation	CWS & ESWS & 4 EDGs & 2 SBOs	0.14	0.13	0.11	0.13	0.10	0.14	1	17	50

Table 4-21 PPRP and MDE-ARMA PM10 NAAQS Analysis

Pollutant	Averaging Period	Modeled Sources	Highest of 2nd Highest 2001-2005 Modeled Concentration (μg/m³)						Ambient Monitoring Background	Total	NAAQS
			2001	2002	2003	2004	2005	Maximum	(μg/m³)	(μg/m³)	(μg/m³)
PM_{10}	24-hr	Units 1-3 + Major Sources	83.8	76.7	88.3	83.7	91.1	91.1	38	129.1	150

Table 4-22 PPRP and MDE-ARMA PM10 PSD Increment Analysis

Pollutant	Averaging Period	Modeled Sources	Highest of 2nd Highest 2001-2005 Modeled Concentration (μg/m³)						PSD Class II
			2001	2002	2003	2004	2005	Maximum	(μg/m³)
PM_{10}	24-hr	Units 1-3 + Major Sources	20.3	18.6	22.9	23.0	23.0	23.0	30

4.3.4 *Additional Impact Analyses*

The PSD regulations require additional analyses beyond the NAAQS and PSD increment assessment described in the previous section. In particular, the regulations require an assessment of any impairment to visibility, soils, and vegetation that would occur as a result of the new source, and of general commercial, residential, industrial, and other growth associated with the new source. Furthermore, impacts on Class I areas—specific areas of the country identified as having pristine air quality that warrants additional protection—must be analyzed to determine compliance with Class I increments and to assess the impacts of new emissions on air quality related values (AQRVs). A review of UniStar's analyses, and a discussion of further analyses conducted by PPRP and MDE-ARMA, follows.

4.3.4.1 *Impacts on Soils, Vegetation and Wildlife; Impacts of Growth*

UniStar has conducted analyses of the effects of growth (e.g., emissions associated with construction of the facility and new development in the area as a result of the facility) associated with the Calvert Cliffs project, and of the impact of project emissions on soils, vegetation, wildlife, and visibility in the vicinity of the facility. These analyses consist of mostly qualitative assessments of these impacts, due to the temporary nature of the construction activities, the low emission rates from facility sources, and the low ambient impacts of all pollutants. PPRP and MDE-ARMA have reviewed these assessments and agree with the conclusion that emissions from the Calvert Cliffs project during operation will have minimal effects on soils, vegetation, wildlife, and local visibility. To support this conclusion, PPRP and MDE-ARMA conducted a brief analysis of salt deposition on the local environment as described in the following section.

4.3.4.2 *Cooling Tower Salt Deposition*

Deposition is a term that is used to describe the result of the interaction of pollutants with the ground surface, where some of the pollutant mass is deposited on the ground or is absorbed by vegetation. Deposition occurs through physical and biological processes, and is generally thought of as a secondary pollution problem (i.e., pollutants that are directly emitted by combustion sources must undergo chemical transformation in the atmosphere before deposition becomes a significant factor). The new CWS cooling tower system will be a source of particulate matter pollution due to the use of salt water. The salt particulate will be expected to deposit locally in the area surrounding Calvert Cliffs. PPRP and MDE-ARMA conducted a modeling analysis based on information provided by UniStar to quantify the impact of salt deposition from the Calvert Cliffs' CWS cooling system. AERMOD was used to model the proposed facility's salt deposition impacts at the vicinity of the plant. Table 4-23 summarizes the results of the salt deposition on nearby flora and fauna.

According to the Nuclear Regulatory Commission report "Generic Environmental Impact Statement for License Renewal of Nuclear Plant" (NUREG-1437), the effect of salt deposition on nearby flora and fauna can be characterized by the flowering dogwood (Cornus florida). The flowering dogwood is the most sensitive native plant in the vicinity of Calvert Cliffs that could experience acute injury at salt deposition rates exceeding approximately at 4.6 lb/acre (5.2 kg/hectare) per month. This threshold level is based on observational data from forest vegetation affected by salt drift from cooling towers at the Chalk Point power plant. The predicted values due to the cooling tower are lower than threshold deposition rates needed to have an adverse impact on the nearby flora and fauna.

Table 4-23 Maximum Annual Salt Deposition

2001-2005 Maximum Annual Salt Deposition				
Year	**($g/m^2/yr$)**	**($g/m^2/month$)**	**kg/ha/month**	**lb/acre/month**
2001	0.11687	0.010	0.10	0.09
2002	0.18861	0.016	0.16	0.14
2003	**0.25402**	**0.021**	**0.21**	**0.19**
2004	0.15256	0.013	0.13	0.11
2005	0.12039	0.010	0.10	0.09

4.3.4.3 *Impacts on Class I Areas*

PSD Class I areas are those that are designated as requiring special protection from the effects of pollutants emitted by PSD sources due to the pristine quality of their natural resources. The Class I areas located within 300 km of the proposed facility are the Shenandoah National Park and James River Face Wilderness in Virginia; Brigantine National Wildlife Refuge in New Jersey; and the Dolly Sods and Otter Creek Wilderness Areas in West Virginia. The Class I area that is closest to the proposed facility is the Shenandoah National Park located approximately 160 km to the northwest of the site at its closet point. The distances from the Calvert Cliffs facility to Dolly Sods NWA, Otter Creek NWA, James River Face Wilderness and Brigantine National Wildlife Refuge in New Jersey are approximately 253, 284, 277 and 210 km, respectively.

Applicants are required to show that new emissions will not have an adverse impact on the air quality related values (AQRVs) of the Class I areas under consideration. The PSD regulations do not contain a definition of AQRVs, and in fact, the assessment of impacts on AQRVs has historically been less prescriptive than the assessment of impacts on PSD increments. The Federal Land Manager (FLM) of the Class I area under consideration has an affirmative responsibility, under the PSD regulations, to ensure that AQRVs are not adversely affected. A working definition of AQRVs can be found in a report prepared by representatives of the U.S. Forest Service, the NPS, and the U.S. Fish and Wildlife Service – the Federal Land Managers' *Air Quality Related Values Workgroup (FLAG) Phase I Report*, December 2000 (NPS, 2000). The FLAG report's definition of an AQRV is, "A resource, as identified by the FLM for one or more Federal areas, that may be adversely affected by a change in air quality." The resource may include visibility or a specific scenic, cultural, physical, biological, ecological, or recreational resource identified by the FLM for a particular area. The FLAG report identifies three types of AQRV impacts that are common to all Class I areas: visibility, ozone, and deposition. These types of impacts are influenced by the concentrations in the Class I area of PM10, SO_2, NO_x, and VOCs due to PSD sources.

UniStar inquired with FLM representatives to determine if a Class I area analysis was required for this project. Correspondence from the FLMs indicated that no Class I area analyses for AQRVs were required to be submitted as part of the permit application process. However, PPRP and MDE-ARMA conducted an analysis of PM10 emissions from the new CWS cooling tower to determine Class I area visibility impacts due to the project, in order to provide perspective of these impacts to on-going analyses conducted by PPRP and MDE-ARMA to evaluate effects on Class I areas of Maryland power plant emissions. The PM10 emissions from the CWS cooling tower will be largely composed of sea salt, which is hygroscopic (i.e., absorbs humidity from the atmosphere) and can cause visibility degradation. In this analysis, PPRP and MDE-ARMA considered impacts in the Shenandoah National Park and Brigantine National Wildlife Refuge only.

PPRP and MDE-ARMA modeled PM10 from the CWS cooling tower as primary sulfate emissions in CALPUFF. Sulfate is also a hygroscopic particle, and the CALPOST post-processor is set up to apply relative humidity factors to modeled sulfate concentrations in the algorithm to calculate the modeled light extinction. To customize the treatment of sulfate to reflect the properties of sea salt in the model, the extinction coefficient associated with sulfate was changed from 3.0 to 1.7. Also, the emissions of PM10 were scaled down (divided by a factor of 1.38) to account for the scaling of sulfate emissions that is automatically done in CALPOST. CALPOST assumes that a transformation of primary sulfate to ammonium sulfate takes place, and in this customized application of CALPOST, no such mass increase is needed.

PPRP and MDE-ARMA used the meteorological data prepared by the Visibility Improvement State and Tribal Association of the Southeast (VISTAS) for the years 2001-2003. These meteorological data were originally provided by VISTAS for use in visibility analyses as part of the Clean Air Visibility Rule (CAVR) Best Available Retrofit Technology (BART) exemption process. VISTAS used the most recent EPA-approved version of CALMET (Version 5.8) to conduct these simulations. VISTAS developed several different CALMET domains covering the southeastern US. PPRP and MDE-ARMA used the VISTAS "domain 5" which covers all the above mentioned Class I areas for this analysis.

The following sections describe additional analyses conducted by PPRP and MDE-ARMA to examine the visibility impacts on the above mentioned Class I areas.

Class I Impacts: Visibility Modeling Results

CALPUFF/CALPOST visibility impacts were calculated and the results are summarized in Table 4-24. This value represents the maximum daily visibility impact for receptors in the Shenandoah National Park and Brigantine National Wildlife Refuge. Visibility impairment (in terms of the extinction coefficient and the percent change due to the proposed sources) was calculated for each day of the input meteorological data set, based on concentrations predicted at all Class I receptors. Results in Table 4-24 represent the worst case year (2003) of meteorology. The daily maximum daily visibility change was 4.17 percent, less than the FLAG criterion of 5 percent.

Table 4-24 Visibility Impacts in the Class I Area

Pollutant	Modeled Extinction due to Calvert Cliffs Sources (Mm^{-1})	Modeled Extinction – Background (Mm^{-1})	Percent Change
PM10 (Modeled as sulfate)	0.353	-	-
Total	0.353	8.449	4.17

4.3.4.4 *Class I Impacts: Visibility Modeling Results*

PPRP and MDE-ARMA believe that it can be reasonably concluded that the Calvert Cliffs facility's impacts on visibility in the surrounding Class I areas are likely to be minimal. The relatively low impacts are due to the considerable distance between the Calvert Cliffs facility and the surrounding Class I areas, as well as the relatively low emissions of NO_x, SO_2, and PM10 from the proposed project. The visibility analysis conducted by PPRP and MDE-ARMA provides a quantitative evaluation of this small effect.

4.4 NONATTAINMENT NEW SOURCE REVIEW (NA-NSR)

Calvert Cliffs is located in Calvert County, which is designated as moderate nonattainment area for ozone. Because chemicals such as NO_x and VOCs react to form ozone in the atmosphere, if emissions of these pollutants from the project are greater than 25 tpy, the project will trigger the requirements of NA-NSR.

As indicated in Table 4-4, projected maximum potential NO_x emissions (at 22.8 tpy) and VOCs emissions (at 3.8 tpy) from the proposed Unit 3 project do not exceed major source threshold for NA-NSR for these pollutants of 25 tpy each; therefore, no NA-NSR requirements are triggered by this project.

4.5 APPLICABLE REQUIREMENTS REVIEW

Based on source types and projected emissions, this section outlines the Federal, State, and local air quality requirements, beyond the PSD requirements reviewed in Section 4.3, that are applicable to the Calvert Cliffs Unit 3 project. A summary of key regulatory programs that were considered follows.

4.5.1 Federal Regulations

4.5.1.1 National Emissions Standard for Hazardous Air Pollutants (NESHAPs)

NESHAPs are federal HAP requirements in 40 CFR 63 that apply generally to "major" sources of HAPs, defined as facilities with the potential to emit 10 tpy or more of any one HAP, or 25 tpy or more of two or more HAPs. HAP standards, known as Maximum Achievable Control Technology (MACT) standards, for major HAP sources are established for classes or categories of sources. For example, there are NESHAP for Stationary Reciprocating Internal Combustion Engines (40 CFR 63, Part ZZZZ) and Industrial Process Cooling Towers (40 CFR 63, Part Q).

The total potential HAP emissions associated with Calvert Cliffs Unit 3 are projected to be considerably less than 10 tpy (see Table 4-6); therefore the project is not considered a major HAP source and the MACT standards do not apply.

4.5.1.2 *New Source Performance Standards (NSPS)*

Section 111 of the Clean Air Act requires EPA to establish emission standards for source categories that cause or contribute significantly to air pollution, referred to as new source performance standards (NSPS). The proposed Calvert Cliffs Unit 3 emergency generators (EDGs and SBOs) are subject to one of these NSPS—40 CFR 60, Subpart IIII, "Standards of Performance for Stationary Compression Ignition Internal Combustion Engines"—and the associated fuel, monitoring, compliance, testing, notification, reporting, and recordkeeping requirements (40 CFR §60.4200 *et seq*.) and related applicable provisions of 40 CFR §60.7 and §60.8. UniStar is subject to NSPS Subpart IIII and will meet the applicable requirements.

The fuel oil storage tanks, depending on final design specifications, may be subject to 40 CFR 60, Subpart Kb "*Standards of Performance for Volatile Organic Liquid Storage Vessels (Including Petroleum Liquid Storage Vessels) for Which Construction, Reconstruction, or Modification Commenced After July 23, 1984*." Based on UniStar's response to DNR Data Request No. 6-1, the tanks for the EDGs will be greater than 100,000 gallons in capacity; no specific design information is available for the SBO tanks. It appears that the tanks for the EDGs would not be subject to NSPS Subpart Kb (based on size and vapor pressure of material stored). Should any of the tanks be subject to NSPS Subpart Kb, UniStar will need to design the tanks to meet NSPS specifications, keep required records, and make required notifications.

4.5.2 ***State Regulations***

The project will be subject to several State air quality regulations including, but not limited to those summarized in Table 4-25, which lists current Maryland air quality regulations in COMAR 26.11, and indicated whether each regulation will be applicable to the project.

Table 4-25 COMAR Applicability Determination

Chpt	Sub. Sec	Title	CWS Cooling Tower	ESWS Cooling Towers (4)	EDGs (4)	Black Out Diesel Generators (SBOs) (2)	Facility-Wide	Notes
01	-	**General Administrative Provisions**						
	04	A. Compliance Testing, B. Requirements for Monitoring, C. Emissions Test Methods					Yes	
	05	Records and Information					Yes	
	05-1	Emissions Statements (Calvert Co. - Source Exceeding 25 TPY NOx or VOCs)					Yes	
	06	Circumvention					Yes	
	07	Malfunctions & Temporary Increses of Emissions (Reporting Excess Emissions)					Yes	
	08	Determination of Ground Level Concentrations (Acceptable Techniques)					Yes	
	09	Vapor Pressure of Gasoline					No	
	10	Continuous Emissions Monitoring					No	
	11	Additional CEM Installation Requirements					No	
02	-	**Permits, Approvals, and Registration**					Yes/No	Some exemptions for EGUs
03	-	**Permits, Approvals, and Registration -- Title V Permits**					Yes	
04		**Ambient Air Quality Standards**					No	
05		**Air Pollution Episode System**						
06		**General Emission Standards, Prohibitions, and Restrictions**						
	02	Visible Emissions	<20% opacity under (C)(1)	<20% opacity under (C)(1)	No	No	No	
	03	Particulate Matter	<0.05 gr/dscf under (B)(1)(a)	<0.05 gr/dscf under (B)(1)(a)	No	No	No	
	04	Carbon Monoxide In Areas III And IV	No	No	No	No	No	
	05	Sulfur Compounds From Other Than Fuel Burning Equipment	No	No	No	No	No	
	06	Volatile Organic Compounds	No	No	No	No	No	
	07	Control Of Sources Of Fluoride Emissions	No	No	No	No	No	
	08	Nuisance	Yes	Yes	Yes	Yes	Yes	
	09	Odors	Yes	Yes	Yes	Yes	Yes	
	12	Control of NSPS Sources	No	No	Yes	Yes	Yes	
	14	Control of PSD Sources	Yes	Yes	Yes	Yes	Yes	
07		**Open Fires**					No	
08		**Control of Incinerators**					No	
09		**Control of Fuel-Burning Equipment, Stationary Internal Combustion Engines, and Certain Fuel Burning Installations**						
	03	General Conditions for Fuel Burning Equipment	No	No	No	No	No	
	04	Prohibition Of Certain New Fuel-Burning Equipment	No	No	No	No	No	
	05	Visible Emissions	No	No	<20% under (A)(1)	<20% under (A)(1)	No	
	06	Control of Particulate Matter	No	No	No	No	No	No solid or residual oil fuel
	07	Control of Sulfur Oxides From Fuel Burning Equipment	No	No	S <0.3% under (A)(1)(c)	S <0.3% under (A)(1)(c)	No	
	08	Control of NO_x Emissions for Major Stationary Sources	No	No	Yes	Yes	No	
10		**Control of Iron and Steel Production Installations**	No	No	No	No	No	
11		**Control of Petroleum Products Installations, Including Asphalt Paving and Asphalt Concrete Plants**	No	No	No	No	No	
12		**Control of Batch Type Hot-Dip Galvanizing Installations**	No	No	No	No	No	
13		**Control of Gasoline and Volatile Organic Compound Storage and Handling**	No	No	No	No	No	
14		**Control of Emissions from Kraft Pulp Mills**	No	No	No	No	No	
15		**Toxic Air Pollutants**	Yes	Yes	No	No	No	
16		**Procedures Related to Requirements for Toxic Air Pollutants**	No	No	No	No	No	
17		**Requirements for Major New Sources and Modifications**	No	No	No	No	No	
18		**Control of Agriculturally Related Installations**	No	No	No	No	No	
19		**Volatile Organic Compounds from Specific Processes**	No	No	No	No	No	
20		**Mobile Sources**	No	No	No	No	No	
21		**Control of Asbestos**	No	No	No	No	No	
22		**Vehicle Emissions Inspection**	No	No	No	No	No	
23		**Asbestos Accreditation of Individuals, and Approval of Training Courses**	No	No	No	No	No	
24		**Stage II Vapor Recovery at Gasoline Dispensing Facilities**	No	No	No	No	No	
25		**Control of Glass Melting Furnaces**	No	No	No	No	No	
26		**Conformity**	No	No	No	No	No	
27		**Emission Limitations For Power Plants**	No	No	No	No	No	
28		**Clean Air Interstate Rule**	No	No	No	No	No	
29		**NO(x) Reduction and Trading Program**	No	No	No	No	No	
30		**Maryland's NO(x) Reduction and Trading Program**	No	No	No	No	No	
31		**Small Business Pollution Compliance Program**	No	No	No	No	No	
32		**Control of Emissions of VOCs from Consumer Products**	No	No	No	No	No	

4.4.3 *Other Air Requirements*

Calvert County does not have any additional air quality regulations that will be applicable to the Calvert Cliffs Unit 3 Project.

5.0 ANALYSIS OF OTHER ENVIRONMENTAL IMPACTS

5.1 IMPACTS TO SURFACE WATER QUALITY AND AQUATIC BIOTA

This section discusses potential impacts to surface water quality and aquatic biota due to construction and operation of Calvert Cliffs Unit 3, as these activities are described by UniStar. Many of these activities are subject to various federal, State, and local permits and regulations outside of the CPCN process. These permits and regulatory requirements are listed in Table 5-1, along with terrestrial impact related permits and approvals. PPRP's recommended licensing conditions would require that these permits be obtained and the regulatory requirements met prior to the start of construction and/or operation of the facility, as applicable.

5.1.1 Construction Impacts

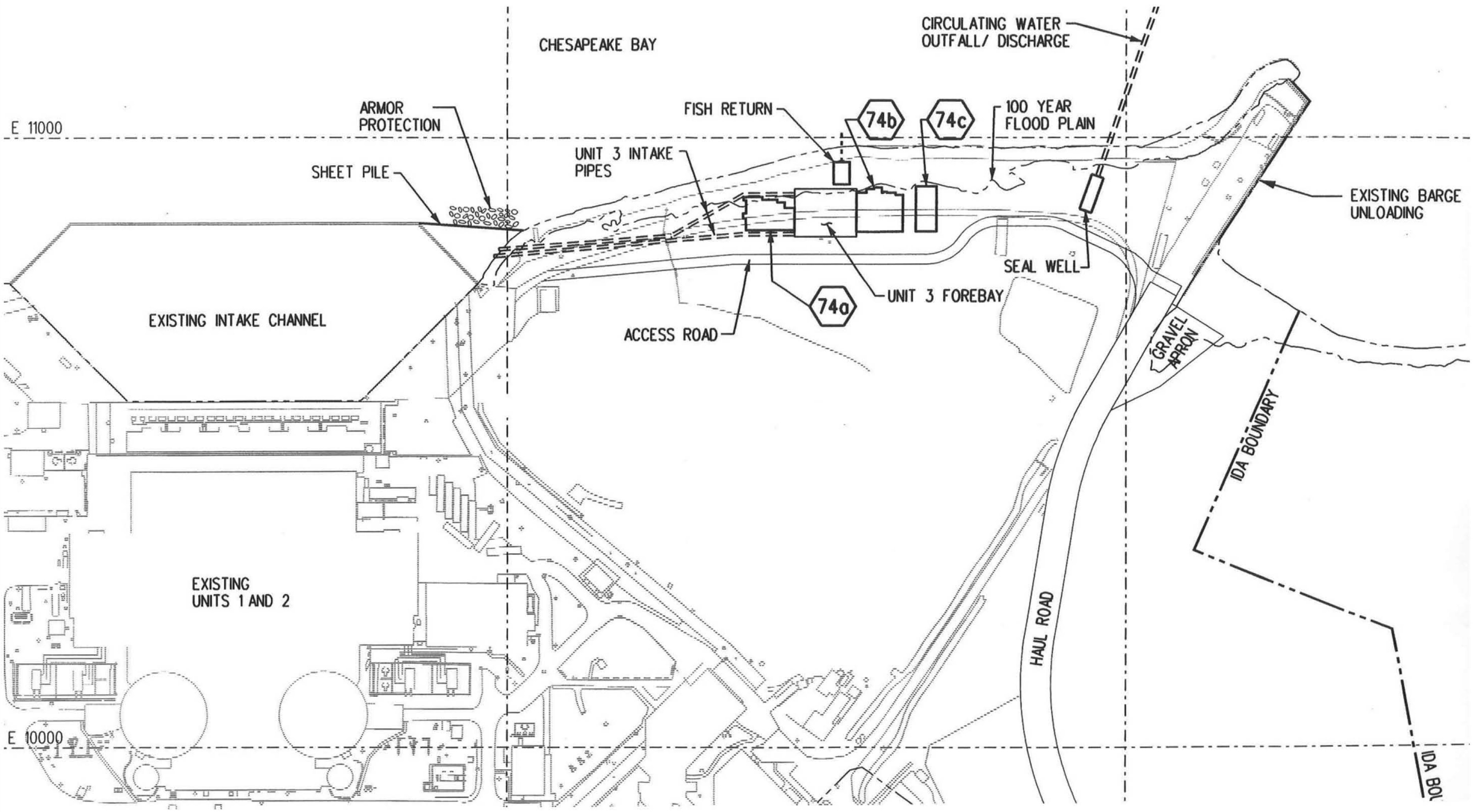
5.1.1.1 Barge Slip and Intake/Discharge Facilities

Dredging will take place at the barge slip area to accommodate delivery of large components for the project. Dredging will also be performed for construction of the discharge line from the circulating water system. Dredged material will be deposited in the previously used disposal area known as Lake Davies. A Clean Water Act Section 404 Joint Permit (Table 5-1) for these activities will be required from the U.S. Army Corps of Engineers (USACE) and the Maryland Department of the Environment (MDE), which will also conduct their own assessment of the impacts of dredging. USACE may prepare an Environmental Assessment or an Environmental Impact Statement, to be determined at a later date.

Construction of the intake structure and discharge pipeline, and enlargement of the barge slip (Figure 5-1) will cause some disturbance in the Bay, including dredging of about 50,000 cubic yards (cy) over a 4.7-acre area for the barge slip. A sheet pile cofferdam and dewatering system will be installed on the south side of Units 1 and 2 intake structure to facilitate the construction of the Unit 3 Circulating Water System (CWS) and Essential Service Water System (ESWS) intake structures and pump houses;

Table 5-1. Calvert Cliffs Unit 3 – Regulatory Requirements Related to Terrestrial and Aquatic Biota			
Regulatory Requirement	Agency(ies)	Status	Needed Prior to Construction in Affected Areas of the Site?
Joint Federal/State Application for the Alteration of Any Floodplain, Waterway, Tidal or Nontidal Wetland in Maryland (covers tidal and non-tidal wetlands and dredging); requires a mitigation plan for impacts to wetlands and streams	U.S. Army Corps of Engineers, Maryland Department of the Environment	Application submitted 16May08; review in progress	Yes
Incidental Take Permit for bald eagle nest as required by State Endangered Species Act and federal Bald and Golden Eagle Protection Act	U.S. Fish and Wildlife Service, Maryland Department of Natural Resources	Consultation with USFWS ongoing; application submitted to DNR 1July08	Yes
Critical Area Compliance requires mitigation plan for Forest Interior Dwelling Species (FIDS) of birds, as well as addressing impacts to sensitive species and wetlands (Habitat Protection Plan)	Critical Area Commission	Application submitted 7May08	Yes
Coastal Zone Consistency	Maryland Department of the Environment	Not yet submitted	Yes
Water Quality Certification	Maryland Department of the Environment	Not yet submitted	Yes
Forest Conservation Plan as required by the Forest Conservation Act	Maryland Department of Natural Resources	Application submitted 30May08	Yes
National Pollutant Discharge Elimination System (NPDES) permit	Maryland Department of the Environment	Not yet submitted	No
Sediment and Erosion Control Plan	Calvert County	Not yet submitted	Yes
Grading Permit	Calvert County	Not yet submitted	Yes

Figure 5-1
Calvert Cliffs Unit 3 Cooling Water Intake and Discharge Structures



Adapted from Unistar's Calvert Cliffs Unit 3 Plot Plan,
Drawing No. 209-C2-0000-00002, Rev. B.

construction of the intake structure will involve dredging about 600 cy over a 0.2-acre area. Pilings may also be driven into the seabed to facilitate construction of new discharge system piping. Construction of the discharge pipe will include dredging of about 7,000 cy and fill of about 6,900 cy over a 1-acre area. Approximately 4,700 cy of riprap and armor stone will be used. The total area impacted by dredging in the Bay would be about 6 acres. UniStar estimates dredging of the barge slip would result in increased suspended sediment in the immediate area for approximately two weeks. Excavation and dredging of the intake and discharge structures would have similar effects in increasing suspended sediment near the site temporarily.

Dredging inevitably causes an increase in suspended sediment in the immediate area, and may result in a plume of suspended sediment some distance from the site. In a study of the effects of hopper dredging in the Bay, near-field concentrations of suspended sediment less than 980 ft (300 m) from the dredge reached 840 to 7,200 mg/L or 50 to 400 times the normal background level. Far-field suspended sediment concentrations (greater than 980 ft [300 m]) were enriched 5 to 8 times background concentrations and persisted 34 percent to 50 percent of the time during a dredging cycle (1.5 to 2.0 hr) (Nichols *et al.*, 1990).

The ecological effect of the suspended sediment depends on a variety of factors, including the type of dredge used, the timing and duration of the dredging, the particle size of the suspended sediment, the presence of toxins in the sediment, the success of environmental controls to contain suspended sediment, and the life stage of the species present. Both short term direct behavioral effects (such as entrainment, turbidity, fish injury, and noise) and long term cumulative effects (such as possible contaminant release and habitat alteration) on marine organisms can result from dredging.

Excavation and dredging of the intake structure, discharge pipe, and barge slip will continue through Unit 3 site preparation into the first two years of plant construction. Excavated and dredged material will be transported to the on-site Lake Davies dredge spoils area (see location on Figure 2-1). Important species in the project area that may be temporarily affected by dredging include eggs, larvae, and adults of invertebrates and fishes. Recreationally or commercially important aquatic species near the Calvert Cliffs site include: blue crab, soft shell clam, eastern oyster, spot, bay anchovy, croaker, white perch, winter flounder, hogchoker, Atlantic menhaden, striped bass, silver perch, alewife, Atlantic herring, and blueback herring. Based on recent monitoring (2006-2007) of the baffle wall and intake screens for Units 1 and 2, bay anchovy, sciaenidae (including spot and croaker), and Atlantic menhaden are the most common early life stages of fish in the immediate area. These species may be temporarily affected by high levels of suspended sediment which can interfere with feeding and respiration, as well as cause dermal abrasion to delicate fishes.

No threatened or endangered species are expected to be affected by the proposed dredging. During the license renewal review process in 1999 for Units 1 and 2, the National Marine Fisheries Service (NMFS) concluded that renewal of the license for Calvert Cliffs Units 1 and 2 would not adversely affect either the shortnose sturgeon or the loggerhead sea turtles because the Units 1 and 2 intake and discharge do not lie within the areas normally used by either species. Neither species has been found impinged on the Unit 1 and 2 intake screens during the 30 years of its operation. Estuarine species that use the Bay as nursery grounds need submerged aquatic vegetation (SAV) and tidal marshes for nutrient-rich forage for the larvae and young-of-the-year, as well as for protective cover from predators. The area near the Calvert Cliffs site has no SAV, and does not provide critical habitat for any species.

The community of aquatic species present near the Calvert Cliffs site varies throughout the year, due to spawning and migration patterns of individual fish and invertebrate species. The season of the year in which dredging and construction occur would determine to a large extent the impact on specific aquatic resources within the Bay. However, because the area to be dredged is only about 6 acres in size and the dredging process is of a relatively short duration, the overall impact on eggs and larvae is expected to be temporary and of minimal consequence; however, these impacts are subject to further evaluation by the USACE and MDE as part of their permitting process.

Mitigation measures appropriate to barge slip dredging and construction activities in the area of the new intake structure and discharge outfall include:

- Restricting dredging during certain times of the year to minimize impacts to aquatic species;

- Restricting dredging to only the areas identified for dredging;
- Installing a silt curtain around each dredge or active dredge area to minimize sediment release, as far as practicable, at the seabed/silt curtain interface and at the surface water level/silt curtain interface;
- Ensuring clam-shell dredges are fully closed and hoisted slowly to limit the amount of spillage;
- Not filling spoils barges to levels that will cause overflowing of materials during loading and moving;
- Not allowing vessel decks to be washed in such a way that allows material to be released overboard;
- Installing a sheet pile cofferdam and dewatering system to facilitate construction of the Unit 3 intake structure; and
- Carrying out water-quality monitoring in accordance with any permit requirements.

PPRP expects that these types of mitigation measures will be included in the Joint USACE/MDE permit required for the project.

To minimize any adverse impacts to nearby oyster beds as a result of dredging associated with facility construction, PPRP is recommending that dredging be prohibited during sensitive times of the year for oyster development (see recommended conditions in Appendix A). With the inclusion of this condition protecting the nearby oyster beds, it is concluded that the impacts to aquatic communities will be minimal, and will not warrant further mitigation.

5.1.1.2 *Stormwater and Erosion/Sediment Control*

Construction of Calvert Cliffs Unit 3 is anticipated to increase runoff from the power block pad, cooling tower pad, switch yard, laydown, and parking areas. Impacts will also include the infilling and elimination of the upper reaches of Branch 2 and Branch 3, an unnamed tributary to Johns Creek, and the isolation of the upper reach of Branch 1 (laydown areas for the power block foundation for Unit 3). Additionally, construction impacts are anticipated to include the disruption and removal of wetlands, as well as the disruption of the drainage in the Lake Davies dredge spoils disposal area. The Lake Davies dredge spoils disposal area has the potential to impact two downstream impoundments. It is also possible that the proposed stormwater impoundments and the downstream reaches will be impacted by increased sediment loads from runoff.

Runoff from the final grade surrounding Unit 3, including runoff from the power block, switchyard, cooling tower, parking areas, and permanent laydown areas, will be directed to bioretention ditches at the periphery of these permanent features. Utilizing sloping, the bioretention ditches will be constructed of materials that promote water quality. Any excess runoff will be directed to the four planned stormwater impoundments.

The four stormwater impoundments will be unlined basins with earth-fill enclosure on the downstream end, and will include a piping system to direct any discharge to the adjacent watercourses. The impoundment located to the northeast of the power block will discharge into the Branch 2 channel, and ultimately to the Chesapeake Bay. The power block and permanent laydown area will have its own impoundment on the east side which will discharge into the Branch 1 channel, the two impoundments downstream of the fishing pond, and then to the Chesapeake Bay. Impoundment runoff from adjacent to the cooling tower, as well as the excess runoff from the switchyard and parking areas, will discharge to Johns Creek.

The Lake Davies dredge spoils pile, when graded for the access road, construction parking areas, and a temporary laydown area, may increase runoff into existing impoundments and new temporary impoundments to the south of the new access road.

The Unit 3 power block is located within the Maryland Western Shore watershed, while the cooling tower and switchyard will be located in the St. Leonard Creek watershed. Post-construction drainage from the Unit 3 power block will be directed to the Chesapeake Bay, while drainage from the cooling tower and switchyard will be directed to Johns Creek.

Mitigation measures to reduce runoff impacts to downstream surface water bodies will be included in the Storm Water Pollution Prevention Plan (SWPPP) for the site. These would likely include the use of dikes, earthen berms, seeded ditches, and impoundments. Additionally, best management practices (BMPs) designed to minimize the potential for accidental discharge of contaminants (e.g., fuel oil spills) will be implemented as applicable. UniStar states in its application that it intends to conduct additional onsite surface water monitoring to compare established water quality benchmarks to current water quality conditions.

5.1.2 *Operational Impacts*

Calvert Cliffs Unit 3 will require water from the Bay for cooling and operational purposes. Approximately half of this water will be lost by evaporation and cooling tower drift. The remainder will be cooling tower blowdown that will be combined with the desalination plant and the wastewater treatment plant effluents and returned to the Bay. Discharges from Unit 3 must comply with National Pollutant Discharge Elimination System (NPDES) discharge permit requirements issued by MDE. UniStar will be required to apply for a NPDES permit that will include an SWPPP to prevent or minimize the discharge of potential pollutants with storm water discharge and will reflect the addition of new paved areas and facilities and changes in drainage patterns. Impacts from increases in volume of pollutants in the storm water discharge will be minimized by implementation of BMPs.

Potential impacts from chemical constituents in the cooling discharges from Unit 3 will be minimized via compliance with NPDES permit requirements. Calvert Cliffs Unit 3 will be required to maintain engineering controls that prevent or minimize the release of chemical constituents to the Bay. Chemical concentrations in the cooling water discharge will be limited by NPDES permit requirements. PPRP concurs with UniStar that impacts from chemical discharges will be minimal or non-detectable in the Bay.

5.1.2.1 *Water Intake Impacts*

During operation of Unit 3, the primary external impact will be the withdrawal of Bay water and the discharge of cooling tower blowdown water to the Bay. Once in operation, there will be little ongoing impact to water bodies other than the Bay. The existing intake system for Units 1 and 2 includes an intake channel, and an embayment established by a curtain wall. The Unit 3 intake for the CWS will be located on the southern edge of the intake embayment (Figure 5-1). The intake for the Ultimate Heat Sink (UHS) cooling tower makeup will be located to the east immediately adjacent to the CWS intake. The Unit 3 intake forebay will be 100 ft by 120 ft by 30 feet deep and will be located between the Units 1 and 2 intake and the barge slip. It will draw water from the extended Units 1 and 2 intake forebay through new intake water piping. Based on operational experience at Units 1 and 2, UniStar expects that no maintenance dredging will be needed to keep the intake area clear.

The desalination plant is the source of the makeup water for the Essential Service Water System (ESWS) during normal and shutdown/cooldown conditions. The desalination plant is supplied by the Bay via the intake structure for the CWS. Design approach velocities for both Unit 3 intake structures will be less than about 0.5 ft/s (0.15 m/s) to minimize impingement and entrainment of aquatic organisms. The actual flow through the Unit 3 intake system is determined by plant operating conditions.

The intake structures will incorporate fish and invertebrate protection measures that maximize impingement survival. The screen wash system consists of two screen wash pumps that provide a pressurized spray to remove debris from the water screens. A fish return system will be provided even though flow velocities through the screens are less than the protective velocity threshold in the worst case scenario (minimum Bay water level with highest makeup demand flow). In the UHS makeup water intake structure, one makeup pump will be located in each pump bay, along with one dedicated traveling band screen and trash rack.

The Unit 3 CWS and UHS makeup intakes will meet the U.S. EPA Phase 1 regulations for Cooling Water Intake Structures (CWIS) design criteria under Section 316(b) of the Clean Water Act (40 CFR Parts 9, 122-125). The amount of Bay water withdrawn will increase only slightly over the amount used for Units 1 and 2, with the maximum additional makeup required to meet the Unit 3 water requirement of 43,480 gpm (164,590 lpm), including the supply for the desalination plant. Some fish impingement and entrainment will occur, even though low velocity approach and screens will be used, but fish loss is expected to be negligible. Calvert Cliffs Unit 3 will employ the same fish return impingement/entrainment mitigation techniques currently used by Units 1 and 2 to minimize the impact on aquatic resources. Unit 3 will be subject to a new NPDES permit under the Phase 1 regulations for CWIS at new facilities and further evaluation of intake impacts will be conducted as part of that permit application and review process.

5.1.2.2 *Cooling Tower Blowdown and Other Wastewater*

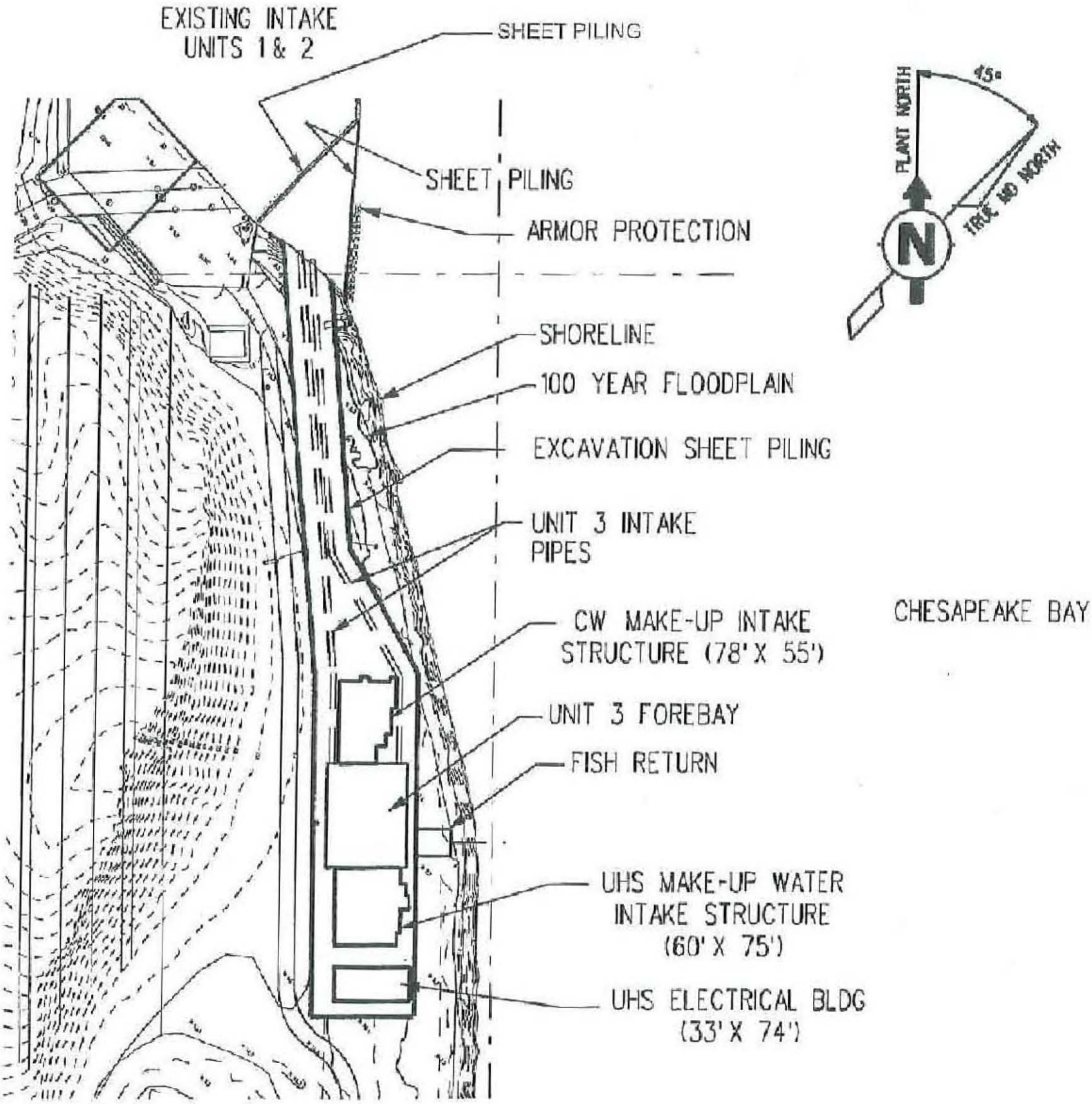
Water Discharge Impacts

U.S. EPA declared the Chesapeake Bay an impaired water body in 1998 under the Federal Water Pollution Control Act because of excess nutrients and sediments. The area of the Chesapeake Bay near the Calvert Cliffs site is included on Maryland's Clean Water Act Section 303(d) list for impaired watersheds. Chesapeake Bay water is required to meet federal regulatory water quality standards by 2010. The potential effects of the discharge from all Calvert Cliffs units will be considered in developing the NPDES permit for Unit 3. Unit 3 must comply with applicable State of Maryland regulations requiring the design of the cooling water intake and discharge structures to incorporate the Best Technology Available (BTA) to minimize adverse environmental impacts (COMAR 26.08.02.03). The discharge outfall for Unit 3 will be located approximately 1,200 ft (366 m) southeast of the Unit 3 intake structures (Figure 5-2). The discharge piping will extend approximately 550 ft (168 m) east from the outfall into the Bay. The discharge structure (Figure 5-3) will utilize a single 30-in (76-cm) diameter pipe having three outlet nozzles. The preliminary centerline elevation of the diffuser nozzles is 3 ft (0.9 m) above the bay bottom. Riprap will be placed around the discharge point to resist potential scour due to the discharge jet from the diffuser nozzles.

UniStar estimates that the Unit 3 CWS cooling tower maximum discharge would be 20,200 gpm (76,500 lpm). A common retention basin will hold cooling tower blowdown and effluents from the proposed desalination plant and wastewater treatment plant before discharging, further reducing thermal impacts to receiving waters. Effluent from the retention basin, which will contain dilute quantities of chemicals and dissolved solids and be slightly elevated in temperature, will be discharged to the Bay within the limits of the facility NPDES permit. When discharged and diluted, this small amount of slightly contaminated water would be expected to have negligible impacts.

Chemical Impacts

The water lost to evaporation during the operation of the cooling tower for Unit 3 must be continuously replaced with makeup water. To prevent build-up of solids, a small portion of the circulating water stream with elevated levels of solids is drained



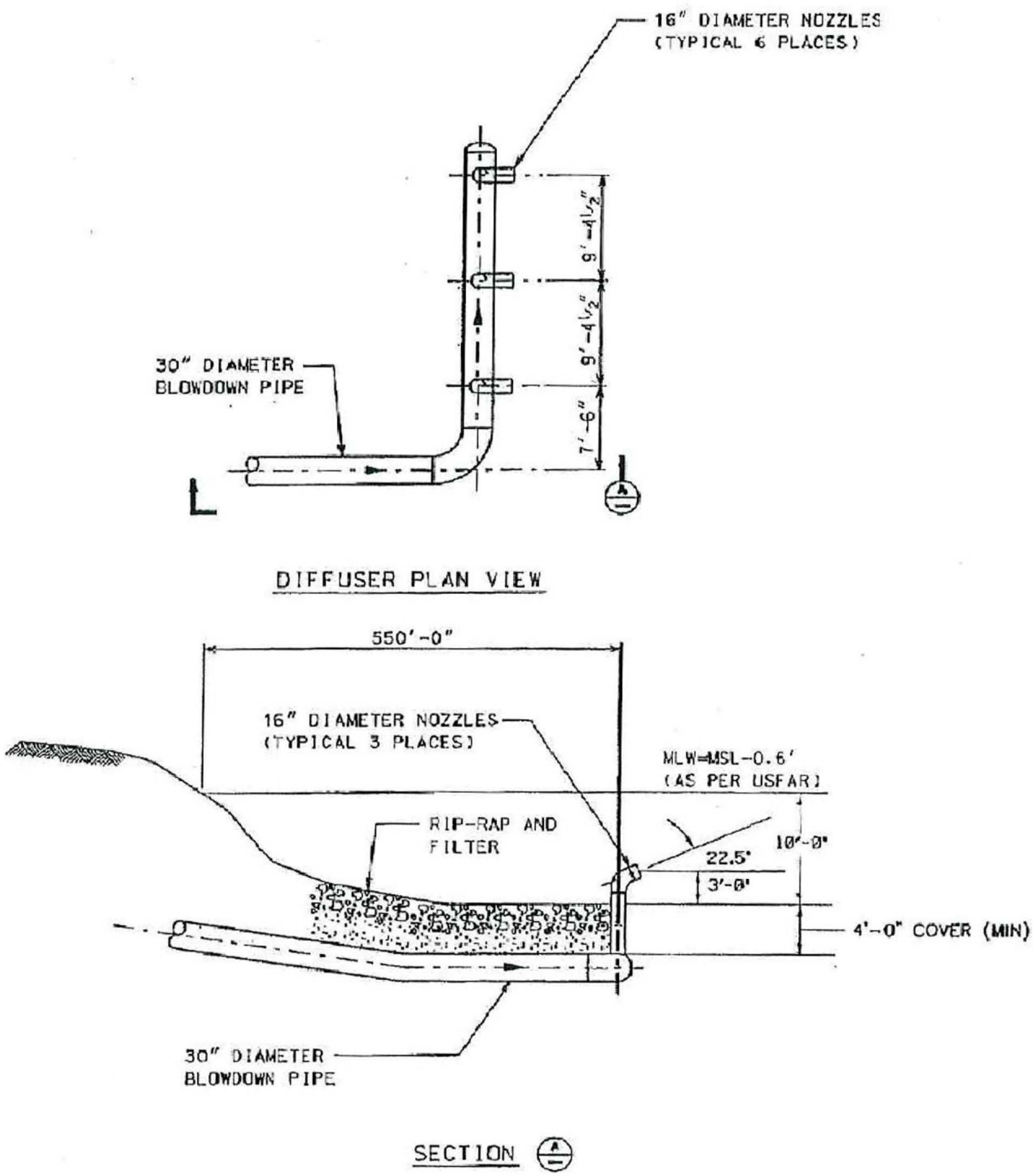
NOTES: 1. - MEAN HIGH WATERLINE: 0.57'
- MEAN LOW WATERLINE: -0.60'
- MAXIMUM SPRING WATERLINE: 1.47'

2. NAVIGATION CHANNEL (MIDDLE OF BAY) APPROX. 3 MILES FROM SHORELINE.

CW = Circulating Water
UHS = Ultimate Heat Sink

PURPOSE: PLANT EXPANSION DATUM: (NAVD 27) PROJECT LATITUDE/LONGITUDE: 38.424133 -76.441598	**Figure 5-2** **Site Plan Intake Structure** 0 150 300FT

Figure 5-3
Calvert Cliffs Unit 3 Discharge Outfall Details



Adapted from Figure 3.8-3 of Unistar's Joint Application for the Alteration of any Floodplain, Waterway, Tidal or Nontidal Wetland in Maryland.

or blown down. Cooling towers concentrate solids (minerals and salts) and organics that enter the system in makeup water. The water chemistry must be maintained with anti-scaling compounds and corrosion inhibitors. In addition, because conditions in cooling towers are conducive to the growth of fouling bacteria and algae, biocides are added to the system. These are normally chlorine or bromine-based compounds, but occasionally hydrogen peroxide or ozone is used.

As opposed to the CWS cooling tower, which uses brackish Chesapeake Bay water as its makeup water source, the ESWS cooling towers will typically be supplied with fresh water makeup from the desalination plant, and will only use Bay water directly as an emergency backup source when freshwater makeup from storage tanks or the desalination plant is not available. The buildup of solids and solid scale formation in the ESWS cooling towers will therefore be substantially less than for the CWS cooling tower. The ESWS cooling towers will use the water treatment chemicals described above, but to a lesser degree than the CWS cooling tower. Limited treatment of raw water to prevent biofouling in the intake structures and makeup water piping may be required. Additional water treatment will take place in the cooling tower basin, and will include the addition of biocides, anti-scaling compounds, and foam dispersants. Sodium hypochlorite and sodium bromide are available to be used to control biological growth in the existing CWS and will likely be used in the new system as well.

The NPDES permit will likely specify threshold concentrations of Free Available Chlorine (when chlorine is used) and Free Available Oxidants (when bromine or a combination of bromine and chlorine is used) in cooling tower blowdown when the dechlorination system is not in use. Dechlorination is a component of the planned Unit 3 project site wastewater treatment plant, which is discussed below. Lower discharge limits would apply to effluent from the dechlorination system (which is released into the Bay) when it is in use. The NPDES permit for Unit 3 is expected to contain limits for discharges from the cooling towers for at least two priority pollutants, chromium and zinc, which are widely used in the U.S. as corrosion inhibitors in cooling towers.

Operation of the Unit 3 cooling tower systems will be based on two cycles of concentration. As a result, levels of solids and organics in cooling tower blowdown will be approximately twice as high as ambient concentrations in the Chesapeake Bay. Blowdown wastewater from the cooling tower and similar waste from the saltwater desalination plant (membrane filtration pretreatment and saltwater reverse osmosis) will discharge to a retention basin to allow time for settling of suspended solids and to allow additional chemical treatment of the wastewater, if required, prior to discharge to the Bay. The final discharge will consist of cooling tower blowdown from the CWS cooling tower, the ESWS cooling towers, the desalination plant, and site waste streams, including the domestic water treatment and circulating water treatment systems. Under normal conditions, 19,425 gpm (73,531 lpm) will be discharged by pipe from the detention basin into the Bay; a maximum discharge of 23,227 gpm (87,923 lpm) is anticipated. Because the discharge stream volume will be extremely small relative to the volume of the Bay, concentrations of solids and chemicals used in cooling tower water treatment will rapidly dilute and approach ambient concentrations in the Chesapeake Bay shortly after exiting the discharge pipe.

The cooling tower blowdown and desalination plant wastewater effluent volume entering the Bay from the common Unit 3 retention basin will be small and any chemicals it contains low in concentration. T he operation of Unit 3 will comply with a NPDES permit, and the applicable state water quality standards. All biocides or chemical additives in the discharge will be among those approved by the U.S. EPA and the State of Maryland as safe for humans and the environment.

The area of the Chesapeake Bay near Calvert Cliffs is included on the Clean Water Act, Section 303(d) List for Maryland because of high nutrient levels and low dissolved oxygen (DO) concentration (i.e., <5 mg/L) (MDE, 2004). Section 303(d) of the federal Water Pollution Control Act requires states to identify waters that are impaired by pollution, even after application of pollution controls. For those waters, states must establish a total maximum daily load (TMDL) of pollutants to ensure that water quality standards can be attained. A State of Maryland regulatory deadline of 2011 exists to establish TMDLs for the Chesapeake Bay. Because of this mandate and the State enforcement of environmental design of discharge structures, the effluent from Unit 3 will be monitored, and any necessary measures will be taken to mitigate impacts from possible pollutants and low DO content in the effluent. No negative effect is expected on the DO concentration in the Bay due to the Unit 3 discharge plume. Impacts of chemicals in the permitted blowdown discharge wastewater to the water quality of the Bay are expected to be negligible.

The Calvert Cliffs Unit 3 Wastewater Treatment Plant (WWTP) will also discharge chemically treated water to the Bay. Wastewater generated onsite during operation of Unit 3 will be treated using standard wastewater treatment plant processes. The treated wastewater will meet all applicable health standards, regulations, and TMDLs as set by MDE and the U.S. EPA. All sludges are tested for radiological contaminants prior to shipping offsite. If any radionuclides are detected, the waste would be classified as radioactive and disposed of as low level radioactive waste. The liquid effluent then flows into a chlorine contact chamber where any remaining microorganisms are dosed with a specified concentration of chlorine. The effluent is allowed to remain in the chlorine contact chamber for a set period which allows time for the chlorine to effectively kill any pathogenic organisms. The effluent flows into a dechlorination chamber. This step removes any residual chlorine which would be toxic to organisms in downstream environments. From the dechlorination chamber, the final effluent is gravity fed to the main discharge pipe and released to the Bay. Based on the above, impacts of chemicals in thoroughly treated, permitted WWTP effluent constituents to the water quality of the Chesapeake Bay are expected to be minimal and not warrant additional mitigation. However, the discharge will be subject to any requirements contained in the facility NPDES permit to be issued by MDE at a later date.

Desalination Impacts

Brackish wastewater from the desalination plant will be treated prior to release to the Bay by mixing with site process waters to reduce the salt and metal concentration to match the ambient Bay water conditions. Brackish process wastewater may contain all or some of the following constituents: high salt concentrations, chemicals used during defouling of plant equipment and pretreatment, and toxic metals (which are most likely to be present if the discharge water was in contact with metallic materials used in fabrication of the plant facilities). Liquid wastes from the desalination plant will be discharged to a retention basin before being returned to the Chesapeake Bay. A Reverse-Osmosis (RO) desalination system will be utilized. In an RO plant, water is pumped at high pressures through membranes to filter out dissolved particles. The desalination plant will be located adjacent to the CWS cooling tower and will withdraw Bay water from the CWS makeup line. The desalination plant feed water will be pretreated to protect the membranes of the RO process. Pretreatment equipment includes holding tanks, strainers, a series of sand filters, coagulation tanks, and an ultraviolet sanitation system. The pretreatment system is periodically backwashed, and the small amount of backwash is combined with a large dilution volume of cooling tower blowdown before it is discharged into the Chesapeake Bay through a series of diffusers.

Under normal operation, the product water requirement for the liquid desalination plant is 3,040 gpm (11,508 lpm). The desalination plant will be able to recover up to 50 percent of the input Bay water as fresh water, and will produce a wastewater stream with a salt concentration that is up to twice the ambient Chesapeake Bay concentration. This is similar to the concentration of the cooling tower blowdown. During plant shutdown conditions, salt concentration will be managed to remain within discharge limits.

Desalination plant effluent will be only a small fraction of the total blowdown flow (see water balance diagram, Figure 6-1, in Section 6 of this report). Approximately 18,295 gpm (69,254 lpm) of blowdown will be returned to the Bay from the CWS and ESWS cooling towers, which is equivalent to 40.8 ft^3/s (1.2 m^3/s). The desalination plant wastewater and waste treatment system effluent produces only a slightly higher total discharge flow of approximately 19,425 gpm (73,531 lpm) or 43.2 ft^3/s (1.2 m^3/s).

Sanitary Sewage Impacts

A sanitary WWTP will collect sanitary wastes. It will be designed for domestic waste only and exclude industrial materials, such as chemical laboratory wastes, and will be sized to accommodate the number of personnel associated with the unit. The WWTP system will be monitored and controlled by trained operators. Unit 3 WWTP's system capacity and unit loading factors are provided in Table 5-2. The Unit 3 WWTP is expected to treat sanitary waste the same as other WWTPs in Maryland and meet similar limitations. The Calvert Cliffs Unit 3 discharge will be combined with other waste streams and discharged to the Bay pursuant to the NPDES permit. Table 5-3 lists anticipated Unit 3 effluent concentrations associated with the WWTP. It includes flow rates, pollutant concentrations, and the biochemical oxygen demand at the point of discharge. The effluent discharge rates from the

Table 5-2 Calvert Cliffs Unit 3 Waste Water Treatment Plant Capacity and Unit Loading

Average Daily Flows	2
Number of people during normal operation	363/day
Flow assumption	30 gpd (132.5 lpd)/person/shift
Shifts per day	3
Peak flow during outages (times daily average flow)	3
Mass BOD and TSS per person	0.055 lb (0.25 kg)/day/person
Minimum number of people using shower facilities during normal operation	250/day/shift
Construction phase staffing	4,000/day/shift
Design flow-normal operation	52,500 gpd (1.98 E+5 lpd)
Design flow-outages (peak)	183,000 gpd (6.93 E+5 lpd)
Design flow-construction CCNPP Unit 3	250,000 gpd (9.46 E+5 lpd)
BOD/TSS (estimated)	
Normal plant operations	125 lbs (56.7 kg)/day
Outages	375 lbs (170 kg)/day
CCNPP Unit 3 construction	400 lbs (181.4 kg)/day

TSS = Total Suspended Solids
BOD = Biochemical Oxygen Demand

Table 5-3 Waste Water Treatment Plant System Effluents

Parameter	Concentrations	
	Daily Maximum	Monthly Average
Biochemical Oxygen Demand (BOD)		10.6 mg/l
Chemical Oxygen Demand	26 mg/l	
Total Organic Carbon	5.6 mg/l	
Total Suspended Solids		3.4 mg/l
pH	6.3-8.6	
Ammonia	<1.0 mg/l	
Flow		19,500 gpd (73,800 lpd)
Arsenic	0.014 mg/l	
Chromium	0.041 mg/l	
Copper	0.022 mg/l	
Nickel	0.028 mg/l	
Zinc	0.060 mg/l	
Total Residual Chlorine	<0.1 mg/l	
Fecal Coliform	12 mg/l	

The indicated parameters and concentrations for Unit's waste water treatment plant (WWTP) are based on effluent for the CCNPP Units 1 and 2 WWTP. Effluent characteristics for the CCNPP Unit 3 WWTP are anticipated to be similar.

Source: Unistar Technical Report, 2007

WWTP are expected to be similar to those achieved by the WWTP for Units 1 and 2.

The combined effluent from all point sources has been tentatively estimated as listed in Table 5-4, in comparison with applicable Maryland effluent limitations. None of the parameters listed exceeds limitations. A final estimate of effluent concentrations will be provided by UniStar as part of its NPDES permit application for this project and additional limitations may also be applicable, including those that may be required as part of a TMDL. The CPCN will require an NPDES permit be obtained as one of its conditions.

Thermal Impacts

Unit 3 would discharge through a multi-port diffuser system (Figure 5-3) designed to minimize the potential impact of the thermal plume as it enters the Bay. The subsurface diffusers would create rapid mixing of the thermal effluent with ambient tidal flows. Strong tidal currents driven by the rise and fall of tides in the Chesapeake Bay largely determine plume size and shape. The NPDES permit will limit the thermal discharges in accordance with State of Maryland requirements (COMAR 26.08.03.03). These regulations limit the spatial extent of thermal plumes, as described in Section 3 of this report.

General temperature requirements for Maryland Class II waters such as the Chesapeake Bay also include a limit on maximum water temperature and zone of passage outside the mixing zone (COMAR 26.08.02.03) or as provided in the NPDES permit for Calvert Cliffs 1 and 2:

- Water temperatures may not exceed 90°F (32°C) or the ambient temperature of surface waters,
- A thermal barrier that adversely affects aquatic life may not be established, and
- Discharge of chlorine from the cooling tower blowdown is limited to 0.0075 mg/l monthly average and 0.013 mg/l daily maximum of free available chlorine as determined using the amperometric titration method; because the minimum level (quantification level) for chlorine is 0.10 mg/l, results below this level are reported as "<0.10 mg/l" and are considered in compliance with permit limits.

Table 5-4 Estimated Effluent Constituent Concentrations for CCNPP Unit 3 Constituent Concentration (mg/l)

Effluent Stream[1]	**Flow (lpm)**[1]	**NaOCl**	**NaOH**	**HEDP**	**Petrol. Distil.**	**Sodium Bisulfite**	**TDS**	**Silica**	**Nitrates**	**NH3**	**BOD**
CWS Blowdown[3]	65,695	1.45	3.61	1.01	1.73	1.01	35,000	6	20	2	
ESWS Blowdown[4]	3,558	0.098	0.244	1.01			743	0.2	4.32	0.74	
Desal Plants[5]	3,994						39,700	5.9	16.07	1.63	
Treated Sanitary[6]	76									1	10.6
Misc Aqueous	208										
Treated Radwaste[7]	4										
Total	73,535	1.30	3.24	0.95	1.55	0.90	33,461	5.7	18.9	1.91	0.011
COMAR limits[8]										2.6[9]	

1 Taken from Technical Report Table 2.3-1.

2 These chemicals are added to effluents other than rad waste in the Liquid Waste Storage System as part of biological and chemical treatment and thus are substantially depleted prior to release of the effluent to the Chesapeake Bay.

3 NaOCl, NaOH, HEDP, Petroleum Distillates, and Sodium Bisulfate based on chemicals added from Technical Report Table 6.4-2 and CWS blowdown; TDS based on value used for air emissions calculations; silica, nitrates, and NH3 based on constituent data in Calvert Cliffs Desalination Study Table 4.4-1 (50% recovery); and other concentrations taken from Environmental Report Table 3.6-1 that provides data on concentrations of total reduced chlorine, total organic carbon, and total suspended solids.

4 NaOCl, NaOH, HEDP, Petroleum Distillates, and Sodium Bisulfate based on chemicals added from Technical Report Table 6.4-2 and ESWS blowdown; TDS, silica, nitrates, and NH3 based on constituent data in Calvert Cliffs Desalination Study Table 4.4-1; and other concentrations taken from Environmental Report Table 3.6-1.

5 TDS, silica, nitrates, and NH3 based on constituent data in Calvert Cliffs Desalination Study Table 4.4-1.

6 Constituent concentrations (except TRC and TSS) are from Technical Report Table 6.4-4 and are based on effluent for Units 1 and 2 wastewater treatment plant and do not reflect tertiary treatment for Unit 3, which will result in improvements in effluent quality. TRC and TDS data from Environmental Report Table 3.6-1.

7 Waste stream contains only very small amounts of radioactive material that would be diluted by a factor of 250 or more when combined with the other effluent streams.

8 Except as noted, COMAR limits are the lesser of acure or chronic, estuarine or saltwater aquatic life criteria, as listed in Table 1, Part 6 of COMAR 26.08.02.03-4

9 Based on Table 1, Part K of COMAR 26.08.02.03-2, at pH=7.6, at 20C and 10 ppt salinity; see table for chronic ammonia criteria values under other ambient conditions

Table 5-4 (cont) ***Estimated Effluent Constituent Concentrations for CCNPP Unit 3 Constituent Concentration (mg/l)***

COD	**TOC**	**TSS**	**Arsenic**	**Chromium**	**Copper**	**Nickel**	**Zinc**	**TRC**	**Fecal Col**	**$H2SO4_2$**	**$NaOH_2$**
	1.4	5.2						0.1			
								0.1			
26	5.6	3.4	0.014	0.041	0.022	0.028	0.06	0.1	12		
0.027	1.26	4.65	1.4E-05	4.2E-05	2.3E-05	2.9E-05	6.2E-05	0.094	0.012		
			3.6E-02	5E-02	3.1E-03	8.2E-03	8.1E-02				

Thermal Plume Model

UniStar simulated the spatial configuration of the proposed Unit 3 thermal plume using the Cornell Mixing Zone Expert System (CORMIX). CORMIX is a U.S. EPA supported mathematical modeling tool for the analysis, prediction, and design of aqueous toxic or conventional pollutant discharges into diverse water bodies. The model can be used for environmental impact assessment of regulatory mixing zones resulting from continuous point source discharges such as Unit 3. The model accounts for the effects of boundary interactions, and predicts steady-state mixing behavior and plume geometry. The CORMIX methodology contains different options used to model single-port, multi-port diffuser discharges, and surface discharge sources.

Input parameters used in the Unit 3 CORMIX thermal plume simulation are given in Tables 5-5 and 5-6. Results are provided in Table 5-7 and Figure 5-4. The 3.6°F (2°C) isotherm would extend approximately 207 ft (63 m) beyond the discharge multi-port diffusers on the ebb and flood tides. The slack tide 3.6°F isotherm is predicted to extend less than 20 ft (6.6 m) beyond the diffusers. The UniStar modeled plume predictions are considered conservative since the CORMIX model requires the depth of the receiving water cross-section be no more than 30 percent greater than the depth at discharge; depth in this case was specified as -13 ft (-4.0 m), although the average depth was actually considerably greater. The smaller model depth resulted in a prediction of less mixing than would actually occur in the Bay. Furthermore, a sensitivity analysis comparing plume size at differential water temperatures below 12°F (6.7°C) demonstrated that plume size decreases as delta-T is reduced.

The area predicted to be occupied by the plume was compared to the State of Maryland water quality criteria in Table 5-8. This comparison demonstrates that the Unit 3 thermal plume would conform to each of the criteria. The radial dimension of the 3.6°F (2°C) isotherm is less than 3 percent of the ebb tide excursion, as compared to the less than one-half (50 percent) ebb tide excursion specified by Maryland regulation. The full capacity of the 3.6°F (2°C) isotherm is less than 0.3 percent of the Chesapeake Bay cross section, and the bottom area affected by the plume is about 0.01 percent of the average ebb tidal excursion multiplied by the width of the Bay. The distance between thermal plumes from Units 1

Table 5-5 ***CORMIX Thermal Plume Simulation Receiving Water Baseline Input Parameters***

Input Quantity/Data	Parameter Value
Bathymetry Surrounding Project Site	NOAA Navigational Chart
Minimum Water Surface Elevation at Discharge Location	-10 ft = MSL – 0.6 ft (MLW -3.05 m)
Tidal Excursion	Mean Range = 1 ft (0.305 m) Spring Range = 1.1 ft (0.335 m)
Maximum Ebb and Flow Tidal Velocities	1 ft/s (0.305 m/s)
Receiving Water Temperature(s)	Average annual Temperature 57.5ºF (14.3ºC)
Average Wind Speed	3.28 ft/s (1.00 m/s)
Average (?) Salinity	13.0%
Receiving Water Density 57.5ºF (14.3ºC), 13.0%	63.004 lb/ft3 (1009.22 kg/m3)

MLW – mean low water
MSL – mean sea level

Source: Unistar Technical Report, 2007

Table 5-6 Baseline Discharge Structure Input Data CORMIX Thermal Plume Prediction

Input Quantity/Data	Parameter Value
Location	1,200 ft (366 m) south of the CCNPP Unit 3 intake structure
Discharge Water Temperature ΔT	12ºF (6.67ºC)
Discharge Water Density (69.5ºF, 13.0%)	62.919 lbm/ft3 (1007.87 kg/m3)
Discharge Flow Rate	17,633 gpm (1.1125 m3/s)
Diffuser Type	Multi-port
Number of Discharge Ports	3
Distance from Shore	550 ft (167.6 m)
Orientation	Parallel to Shoreline
Height of Discharge Ports above Bottom	3 ft (0.91 m)
Angle of Inclination	22.5 degrees
Nozzle Diameters	16 in (0.406 m)
Active Diffuser Length	18.75 ft (5.715 m)

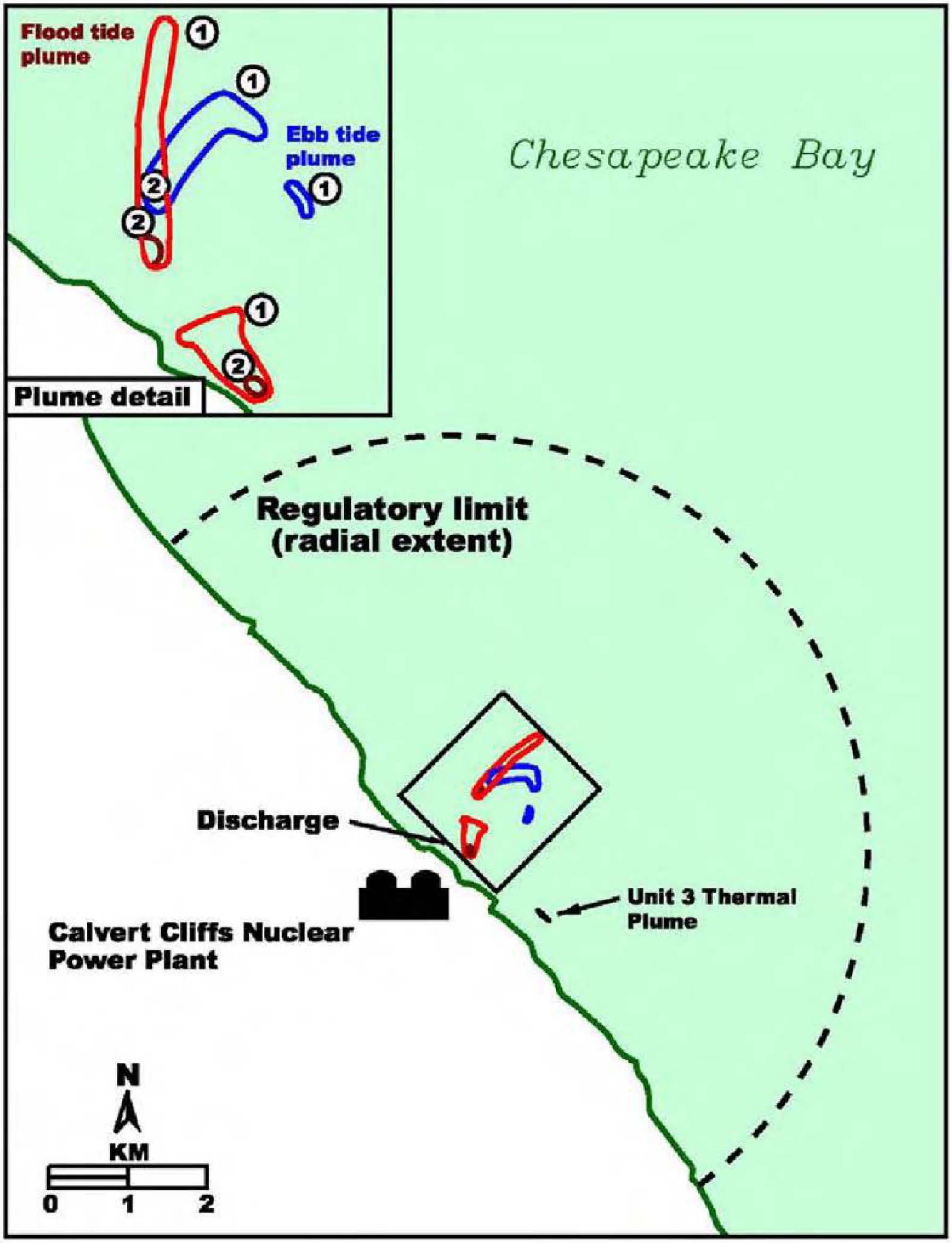
Source: Unistar Technical Report, 2007

Table 5-7 CORMIX Thermal Plume Predictions for the 3.6˚F (2˚C) Isotherm

Plume No.	Description	Length	Width
1	Max. Ebb	207 ft (63 m)	59 ft (18 m)
2	Max. Flood	207 ft (63 m)	59 ft (18 m)
3	Slack	19 ft (6 m)	6 ft (2 m)
4	Mid. Ebb (before and after slack)	105 ft (32 m)	43 ft (13 m)
5	Mid. Flood (before and after slack)	105 ft (32 m)	43 ft (13 m)
Overall	Thermal Plume Envelope	414 ft (126 m)	69 ft (21 m)

Source: Unistar Technical Report, 2007

Figure 5-4
Calvert Cliffs Unit 3 Thermal Plume Predictions



Note:
This figure shows the Unit 3 Thermal Plume Predictions Compared to CCNPP Units 1 and 2 Historical Predictions: The CCNPP Units 1 and 2 plume is shown in the box insert. The CCNPP Unit 3 predicted plume is shown South of the plant.

Table 5-8 Comparison of the Predicted Thermal Plume to the Maryland Power Plant Thermal Plume Compliance Criteria

Water Quality Standard	Permissible Limit	Calculated
The 24-hour average of the maximum radial dimension measured from the point of discharge to the boundary of the full capacity 2ºC[3.6ºF] above ambient isotherm (measured during the critical periods) may not exceed 1/2 of the average ebb tidal excursion.	4,101 ft (1250 m)	< 207 ft (63 m)
The 24-hour average full capacity 2ºC[3.6ºF] above ambient thermal barrier (measured during the critical periods) may not exceed 50 percent of the accessible cross section of the receiving water body. Both cross sections shall be taken in the same plane.	16,000 ft (4,800 m)	69 ft (21 m)
The 24-hour average area of the bottom touched by waters heated 2ºC[3.6ºF] or more above ambient at full capacity (measured during the critical periods) may not exceed 5% of the bottom beneath the average ebb tidal excursion multiplied by the width of the receiving water body.	1.3E07 ft2 (1.2E06 m2)	2.9E04 ft2 (2.7E03 m2)

Source: Unistar Technical Report, 2007

and 2 and that expected from Unit 3 is about 1 mile, so there would be no interaction between them.

Site Surface Water Impacts

Site surface water bodies potentially impacted by site operations are dependent upon operational conditions related to site safety and spill containment training, a spill pollution prevention control and counter-measure plan (SPCC), and a SWPPP as required, reviewed, and approved by MDE. Spills or operational debris potentially occurring on outdoor facilities could mix with site precipitation or washing wastewater and be conveyed to downstream impoundments, creeks, rivers, and eventually the Bay. The majority of polluted runoff can be controlled and prevented from escaping the site. Environmental impacts on water quality during operation of Unit 3 are expected to be minimal. Surface water runoff and sedimentation effects will be minimized by implementation of a site safety and spill prevention plan and an SWPPP. Effluent from the planned wastewater treatment plant will meet all applicable health standards, regulations, and total maximum daily loads (TMDL) as set by MDE and the U.S. EPA.

5.1.3 Cooling Water System Intake Biological Impacts

5.1.3.1 Regulatory Criteria

Aquatic impacts attributable to operation of the Calvert Cliffs Unit 3 cooling water system intake structures are impingement and entrainment. Impingement occurs when larger organisms become trapped on the intake screens and entrainment occurs when small organisms pass through the traveling screens and subsequently through the cooling water system. Factors that influence impingement and entrainment include cooling system and intake structure location, design, construction, and capacity. Clean Water Act Section 316(b) requires that cooling water intakes represent "Best Technology Available" for these criteria. The U.S. EPA promulgated regulations implementing Section 316(b) in 2001 for new facilities (40 CFR Part 124, Subpart I, 125.84(b)). The Unit 3 intake and cooling water systems will conform to these criteria.

The U.S. EPA design criteria (indicated in italics) for Phase I new facilities and how Unit 3 will comply with these requirements is summarized below.

1) Reduce intake flow, at a minimum, to a level commensurate with that which can be attained by a closed-cycle recirculating cooling water system.

The Unit 3 cooling system will be a closed-cycle, recirculating, wet cooling system.

2) Design and construct each cooling water intake structure to achieve a maximum through-screen velocity of 0.5 f/s.

The design of the intake structure is based on achieving an approach velocity of less than 0.5 f/s.

3) The total design intake flow over one tidal cycle of ebb and flow must be no greater than one (1) percent of the water volume of the water column within the area centered about the opening of the intake with a diameter defined by the distance of one tidal excursion at the mean low water level.

The intake flow design rate will not exceed one percent of the calculated water column volume criterion. The maximum design intake flow rate is 43,480 gpm (164,582 lpm). Over an approximate 12-hour tidal cycle, this equates to 31 million gallons (119 million liters or 0.119 million cubic meters). The tidal excursion distance (radius) is estimated to be 5.3 kilometers, with an average depth of 15 meters over this distance. The resultant water column estimate is 1,324 million cubic meters. The one percent limit of 13 million cubic meters far exceeds the estimated maximum intake volume of 0.119 million cubic meters.

4) Select and implement design and construction technologies or operational measures for minimizing impingement mortality of fish and shellfish, if:

- There are threatened, endangered or otherwise protected species potentially impacted; and

- Migratory, sport or commercial species pass through the hydraulic zone of influence.

5) Select and implement design and construction technologies or operational measures for minimizing entrainment of entrainable life stages of fish and shellfish, if:

- There are threatened, endangered or otherwise protected species potentially impacted; and

- There would be undesirable cumulative stressors affecting entrainable life stages of species of concern.

The intake structures for Unit 3 will incorporate fish and invertebrate protection measures that maximize impingement survival including fish return systems similar to those employed at Units 1 and 2. Moreover, because the through-trash rack and through-screen mesh flow velocities will be less than 0.5 ft/sec (0.15 m/sec) in the worst case scenario (minimum Chesapeake Bay water level with highest makeup water demand flow), the proposed Calvert Cliffs Unit 3 represents the BTA.

Maryland also established cooling water system requirements (COMAR 26.08.03.05) that require "[t]he location, design, construction, and capacity of cooling water intake structures shall reflect the best technology available (BTA) for minimizing adverse environmental impact" determined by:

- Installation and operation of functional modifications to mitigate impingement loss based on economic considerations including the value of the resource compared to corrective actions; and
- Determination of the extent to which entrainment loss affects a spawning or nursery area for representative important species, and corrective actions if necessary. Important ecological impact findings for Calvert Cliffs Units 1 and 2 were reported by Martin Marietta (1980) and later supported by the State of Maryland Power Plant Research Program (McLean et al., 2002) as follows:
    - The Calvert Cliffs site area was not a spawning area for species of commercial or recreational value,
    - Field data showed no consistently detectable depletions of ichthyoplankton in the plant vicinity,
    - The magnitude of impingement from Units 1 and 2 intake appeared insufficient to substantially modify the ecosystem in the Calvert Cliffs region, and
    - Ecological and economic projections suggested entrainment impacts would be very limited in magnitude and spatial extent.

The evaluation of compliance with the State of Maryland power plant cooling water intake regulations requires an assessment of the relative value of the resource to be protected compared to the cost of additional measures that may be needed to further reduce impingement and entrainment impacts.

5.1.3.2 *Biological Impact Assessment*

The impact of Units 1 and 2 intake represents less than 0.1 percent of commercial landings. Given the relatively small amount of cooling water flow required for Unit 3, the incremental effects of impingement and entrainment should be an even smaller fraction of recreational and commercial harvest rates. A summary of over 10 years of macrobenthic studies conducted from 1968 through 1978 also provided evidence that potential impacts of entrainment on key commercial and recreational species including the American oyster, soft shell clam and blue crab were minimal. Conclusions were as follows:

- The Calvert Cliffs area was not a major oyster spawning area;
- After Unit 1 and 2 operation began, soft shell clam production was consistently higher at the plant sampling site than at reference locations; and
- Very few planktonic stages of blue crabs occurred as far up the Chesapeake Bay as Calvert Cliffs.

Protected aquatic species potentially found in the vicinity of the intake structures include the shortnose sturgeon (*Acipenser brevirostrum*), Atlantic sturgeon (*Acipenser oxyrhynchus*) and the spotfin killifish (*Fundulus luciae*). Both the shortnose and Atlantic sturgeon spawn in fresh waters and the migration of young downstream does not occur until the late larval stage. As a result, the eggs and young larvae of these two species are unlikely to be affected by entrainment in the cooling water intake of Unit 3. In the many years of sampling at Calvert Cliffs, only one Shortnose Sturgeon was caught in trawls; none were impinged. The spotfin killifish frequents tidal marshes in saline systems and is unlikely to be abundant within the unique habitat found along the Calvert Cliffs shoreline.

The NRC consulted with the U.S. Fish and Wildlife Service and the National Marine Fisheries Services (NMFS) regarding additional protective measures relative to the Unit 1 and 2 license renewal and determined that there is little likelihood for adverse impacts to endangered or threatened aquatic species and that no additional measures beyond those already implemented at the Calvert Cliffs site were necessary. Operation of Unit 3 with closed-cycle cooling systems and fish protection measures incorporated into the intake should limit any incremental effect beyond that already evaluated. Additional regulatory protection has been provided by the NMFS under the Magnuson-Stevens Fishery Conservation Management Act (16 USC Sections 1801-1883) for certain species with unique or otherwise "essential fish habitat" requirements as shown in Table 5-9. Impingement and entrainment data collected at the Calvert Cliffs site indicate that certain of these species occur at some life stage in the vicinity of the site. However, their overall abundance in impingement and entrainment samples has been low, and in most cases represents less than 1 percent of species composition.

Potential impacts from impingement and entrainment of key representative important species have been reviewed by the NRC and DNR. DNR concluded that after many years of study, potential impacts encompassing all of the various power generation facilities in Maryland waters have not resulted in a depletion of populations. The NRC concluded in its Environmental Impact Statement regarding the license renewal for Calvert Cliffs Units 1 and 2 that any impacts were small and that mitigative measures beyond those already implemented at Units 1 and 2 were not warranted. Nevertheless, additional mitigation measures for Units 1 and 2 are being evaluated as part of that facility's NPDES permit renewal under Phase II of Section 316(b) of the CWA, as described in section 3.4.4.

Based on the facts that: 1) the proposed cooling tower-based heat dissipation system will, under normal circumstances, withdraw small amounts of Chesapeake Bay water compared to Units 1 and 2; 2) the design of the intake structures and cooling water system incorporates a number of features that will reduce impingement and entrainment; and 3) experience that suggests that the Chesapeake Bay fish and shellfish populations have not been adversely affected by operation of Units 1 and 2, the impacts of the intakes for the cooling water systems are not expected be significant; however further evaluation of intake impacts will likely be conducted as part of Unit 3's NPDES permit application and review process.

Table 5-9 Species Identified as Having Essential Fish Habitat Requirements in the Chesapeake Bay

Species	Eggs	Larvae	Juveniles	Adults	Spawning Adults
Windowpane Flounder (*Scopthalmus aquosus*)			X	X	
Bluefish (*Pomatomus saltatrix*)			X	X	
Atlantic Butterfish (*Peprilus triacanthus*)	X	X	X	X	
Summer Flounder (*Paralicthys dentatus*)		X	X	X	
Black Sea Bass (*Centropristus striata*)			X	X	
King Mackerel (*Scomberomorus cavalla*)	X	X	X	X	
Spanish Mackerel (*Scomberomorus maculatus*)	X	X	X	X	
Cobia (*Rachycentron canadum*)	X	X	X	X	
Red Drum (*Sciaenops occelatus*)	X	X	X	X	
Red Hake (*Urophycis chuss*)			X	X	
Scup (*Stenotomus chysops*)			X	X	
Atlantic Sea Herring (*Clupea Harengus*)				X	

Source: Unistar Technical Report, 2007

5.1.4 *Biological Impacts from Cooling Water System Discharge*

The thermal discharge from Unit 3 will return blowdown from the cooling towers and site wastewater streams to the Chesapeake Bay. The power plant discharge effects could include attraction of fish to the thermal plume, cold shock, blockage to movement and migration, changes in benthic species composition, growth of nuisance species, alteration of reproductive patterns, and chemical effects of biocides. These effects have been studied extensively at Units 1 and 2 (e.g., MMEC, 1980; and ANSP, 1981), which provides a basis for assessing the potential ecological consequences of the Unit 3 discharge. The absence of harm caused by the Calvert Cliffs Units 1 and 2 discharge to key species of concern, including recreationally and commercially important species, provides evidence that the incremental discharge of cooling tower blowdown and wastewaters from Unit 3 will have minimal impact on the Chesapeake Bay in the Calvert Cliffs area.

Thermal Effects

The Unit 3 plume is predicted to be a very small fraction (3.5 percent of the surface area) of the Units 1 and 2 plume (Figure 5-4). Based on its relative distribution, the Unit 3 plume will have little or no interaction with the Units 1 and 2 plume. Its small cross sectional area is unlikely to provide a barrier to fish migration and its transient nature should limit attraction of fish that could otherwise become acclimated and entrapped there, particularly during winter when fish are susceptible to cold shock from plant shutdown. Because fish are unlikely to become acclimated to the small plume, gas bubble disease should not occur. The potential for fish kills resulting from attraction of fish to the Units 1 and 2 thermal plume was studied in 1987 with no winter fish kills observed during the period of the study. Assuming that the benthic area is potentially exposed to the entire 3.6°F (2°C) isotherm, that area would be less than 0.7 acres (0.3 hectares), well within the State of Maryland regulatory criteria for benthic area affected, which in this case would be approximately 296 acres (120 hectares). In addition, since the plume is largely a surface phenomenon, benthic species are not likely to be affected. It is concluded that the thermal impacts to aquatic communities will be minimal; however, further evaluation of thermal discharge impacts will likely be conducted as part of Unit 3's NPDES permit application and review process .

Chemical Effects

Chemical effects of the discharge include the addition of biocides to limit fouling within the cooling water systems and other chemical agents to limit scaling in the Unit 3 sewage treatment system. Discharge concentrations of these constituents will likely be limited by the NPDES permit for the facility. Bioassay testing required by the NPDES permit would assess the potential toxicity of the discharge and provide for corrective action if necessary. To date, the testing performed for Units 1 and 2 has not indicated any toxicity to test organisms. Similar tests are expected to be required during operation of Unit 3 to confirm that chemical effects from the Unit 3 discharge on aquatic biota will be minimal.

Physical Effects

Physical and related ecological impacts of the Units 1 and 2 thermal discharge have been limited to sediment scour in the vicinity of the high velocity discharge ports. It is expected that the physical impacts associated with Unit 3 will also be limited to sediment scour of a small area which will be minimized by placing riprap around the discharge point. With Calvert Cliffs Units 1 and 2, the sand substrate present prior to station operation was scoured leaving a hard-pan clay substrate. The benthic community changed from one dominated by burrowing organisms to one dominated by fouling organisms. For Calvert Cliffs Unit 3, the same results are anticipated but on a much smaller scale due to the much smaller discharge volume (i.e., recolonization with epibenthic organisms similar to those observed at the Units 1 and 2 discharge). Past studies at Calvert Cliffs concluded that there were no effects of significance to food web interactions between benthic and finfish communities. Food web structure was similar at the reference site, suggesting that measurable changes in the benthic community had no impact on higher trophic levels. Thus, it is anticipated that there will be little or no ecological impact on the food base.

Several fish and invertebrate species that may occur within the Calvert Cliffs area of the Chesapeake Bay have designated essential habitat or Habitat Areas of Particular Concern (HAPC), or are otherwise protected. A review of the species having designated HAPC suggests that the small size of the thermal plume and its limited impact on substrate are unlikely to impact any life history stage of these species. In large measure, their presence in the Calvert Cliffs area is transient. The dominant fish species found in the Calvert Cliffs site area have no designated HAPC. Of the species listed as threatened or endangered, occurrence in the Calvert Cliffs area is rare.

Studies of finfish in the Calvert Cliffs area were conducted from 1969 through 1981 (ANSP, 1981). The studies were designed to examine long-term trends including explanatory environmental variables. The three most abundant fish in trawls were the anchovy, spot, and croaker. Also common were white perch, winter flounder, hogchoker, and menhaden. The anchovy and spot were also common in impingement samples reflecting their local abundance. Annual and long-term changes in recruitment were explained by factors other than power plant operation. The most common fish species fed on a combination of benthic organisms, zooplankton, and detritus. Their relative dominance in trawls increased over the study period, while those fish species that fed primarily on piscivores and mysids decreased. The loss of SAV in the area was given as a possible explanation for the decrease in fish that feed among vegetation. The loss of SAV was common throughout the Chesapeake Bay during the study period. In general, there were no strong positive or negative correlations among ecologically related groups that might indicate response to varying ecological conditions in the study area.

In addition, observations regarding the oyster, soft shell clam, and blue crab populations near the Units 1 and 2 discharge have been documented. Settlement of oyster spat continued to occur in the discharge zone for Units 1 and 2 during power plant operation. Young oysters were equally abundant there compared to other areas of the Calvert Cliffs region. This has occurred despite the relocation of oysters from the discharge area to other areas prior to operation of Units 1 and 2. Abundance and growth rates of the soft shell clam (*Mya arenaria*) were greater in the discharge area during plant operations compared to the pre-operational period. No effect on the blue crab was noted. Similar observations following the operation of Unit 3 are expected.

5.2 *IMPACTS TO TERRESTRIAL AND FRESHWATER AQUATIC RESOURCES*

The Calvert Cliffs site consists of 2,070 acres of land that supports an array of upland, wetland, and freshwater aquatic habitats as well as the facilities for the existing Calvert Cliffs Units 1 and 2.

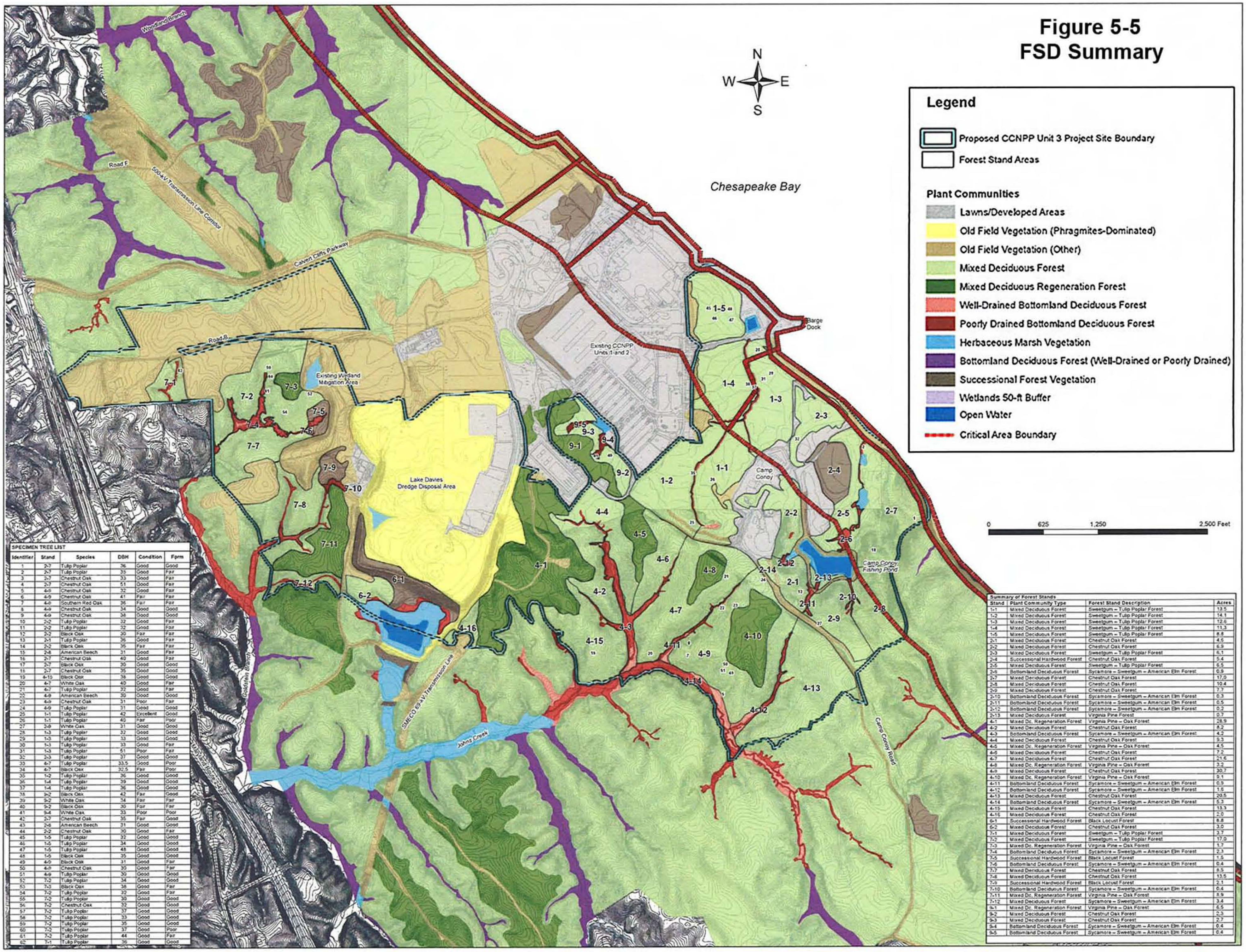
The construction of Unit 3 would require the use of approximately 420 acres of the site, of which 281 acres would be permanently used by Unit 3 and its supporting facilities. Given the extensive area that will be required to construct the project, impacts to terrestrial and freshwater aquatic resources are primarily concerned with those occurring from the construction of the project; operational impacts on these resources are considered minimal by comparison.

5.2.1 *Vegetation and Land Cover*

Much of the area required for the construction of Unit 3 is forested. Approximately 238 acres of forest would be cleared, of which 21 acres are in the Chesapeake Bay Critical Area (CBCA). Most of the impact would be to forest characterized as mixed deciduous forest. Bottomland forests that occur along stream corridors and areas described as regenerative would be affected to a lesser extent. The remaining areas affected by the project are comprised of open areas of old field vegetation including the phragmites dominated Lake Davies dredge disposal area and developed or maintained areas which include the Camp Conoy area.

In compliance with the Forest Conservation Act (FCA), UniStar prepared a Forest Conservation Plan (FCP) that described impacts to forests outside of the CBCA as approximately 217 acres (Table 5-10). The impacts were distributed among several forest community types, some more valuable than others as indicated by their retention priority. Additionally, many of the forest stands that were delineated had Specimen Trees, i.e., trees of 30" diameter at breast height (dbh) or greater and trees with at least 75 percent of the diameter of the State champion tree of that species (Figure 5-5). As a total tract area for the project, the FCP used 657 acres. Of this, 97 acres that are part of the CBCA were deducted from further calculations for a net tract area of approximately 560 acres. Applying the Afforestion Threshold (15 percent) and Conservation Threshold (15 percent) to the amount of existing forest cover within the net tract area, they calculated a Breakeven Point of 143 acres or the amount of forest that must be retained so that no mitigation is required. As the total area to be cleared is 217 acres, the amount of retained forest at 160 acres is greater than the Breakeven Point; therefore, no reforestation or afforestation efforts would be required. It was noted that a 58-acre section of forest in the northeastern portion of the Calvert Cliffs site was added to the FCP and declared as an forest area to

Figure 5-5
FSD Summary



SPECIMEN TREE LIST					
Identifier	Stand	Species	DBH	Condition	Form
1	2-7	Tulip Poplar	36	Good	Good
2	2-7	Tulip Poplar	35	Good	Fair
3	2-7	Chestnut Oak	33	Good	Fair
4	2-7	Chestnut Oak	51	Good	Fair
5	4-9	Chestnut Oak	32	Good	Fair
6	4-9	Chestnut Oak	41	Fair	Fair
7	4-9	Southern Red Oak	36	Fair	Fair
8	4-9	Chestnut Oak	34	Good	Good
9	4-9	Chestnut Oak	38	Good	Good
10	2-2	Tulip Poplar	32	Good	Fair
11	2-2	Tulip Poplar	32	Good	Fair
12	2-2	Black Oak	30	Fair	Fair
13	2-1	Tulip Poplar	36	Good	Fair
14	2-2	Black Oak	35	Fair	Fair
15	2-8	American Beech	31	Good	Fair
16	2-7	Chestnut Oak	40	Good	Fair
17	2-7	Black Oak	30	Good	Good
18	2-7	Chestnut Oak	35	Good	Good
19	4-15	Black Oak	38	Good	Good
20	4-7	White Oak	40	Good	Fair
21	4-7	Tulip Poplar	32	Good	Fair
22	4-9	American Beech	30	Good	Good
23	4-9	Chestnut Oak	31	Poor	Fair
24	4-9	Tulip Poplar	31	Good	Good
25	1-1	Tulip Poplar	42	Excellent	Good
26	1-1	Tulip Poplar	40	Fair	Poor
27	2-9	White Oak	31	Good	Good
28	1-3	Tulip Poplar	32	Good	Good
29	1-3	Tulip Poplar	33	Good	Good
30	1-3	Tulip Poplar	33	Good	Fair
31	1-3	Tulip Poplar	51	Poor	Fair
32	2-3	Tulip Poplar	37	Good	Good
33	4-7	Tulip Poplar	33.5	Good	Poor
34	4-7	Black Oak	32.5	Fair	Poor
35	1-2	Tulip Poplar	36	Good	Good
36	1-4	Tulip Poplar	39	Good	Good
37	1-4	Tulip Poplar	36	Good	Good
38	9-2	Black Oak	42	Fair	Good
39	9-2	White Oak	34	Fair	Fair
40	9-2	Black Oak	30	Fair	Fair
41	9-4	White Oak	33	Poor	Poor
42	2-7	Chestnut Oak	35	Fair	Good
43	2-6	American Beech	31	Good	Good
44	2-2	Chestnut Oak	30	Good	Fair
45	1-5	Tulip Poplar	32	Good	Good
46	1-5	Tulip Poplar	34	Good	Good
47	1-5	Tulip Poplar	48	Good	Good
48	1-5	Black Oak	35	Good	Good
49	4-9	Black Oak	31	Good	Fair
50	4-9	Chestnut Oak	30	Good	Fair
51	4-9	Tulip Poplar	30	Good	Good
52	7-2	Tulip Poplar	34	Good	Good
53	7-3	Black Oak	38	Good	Fair
54	7-2	Tulip Poplar	32	Good	Fair
55	7-2	Tulip Poplar	30	Good	Good
56	7-2	Chestnut Oak	32	Good	Good
57	7-2	Tulip Poplar	37	Good	Good
58	7-2	Tulip Poplar	33	Good	Good
59	7-2	Tulip Poplar	35	Good	Good
60	7-2	Tulip Poplar	37	Good	Poor
61	7-2	Tulip Poplar	44	Good	Fair
62	7-1	Tulip Poplar	36	Good	Good

Summary of Forest Stands			
Stand	Plant Community Type	Forest Stand Description	Acres
1-1	Mixed Deciduous Forest	Sweetgum – Tulip Poplar Forest	13.5
1-2	Mixed Deciduous Forest	Sweetgum – Tulip Poplar Forest	14.1
1-3	Mixed Deciduous Forest	Sweetgum – Tulip Poplar Forest	12.6
1-4	Mixed Deciduous Forest	Sweetgum – Tulip Poplar Forest	11.3
1-5	Mixed Deciduous Forest	Sweetgum – Tulip Poplar Forest	8.8
2-1	Mixed Deciduous Forest	Chestnut Oak Forest	4.6
2-2	Mixed Deciduous Forest	Chestnut Oak Forest	6.9
2-3	Mixed Deciduous Forest	Sweetgum – Tulip Poplar Forest	6.1
2-4	Successional Hardwood Forest	Chestnut Oak Forest	5.4
2-5	Mixed Deciduous Forest	Sweetgum – Tulip Poplar Forest	6.5
2-6	Bottomland Deciduous Forest	Sycamore – Sweetgum – American Elm Forest	0.9
2-7	Mixed Deciduous Forest	Chestnut Oak Forest	17.0
2-8	Mixed Deciduous Forest	Chestnut Oak Forest	10.4
2-9	Mixed Deciduous Forest	Chestnut Oak Forest	7.7
2-10	Bottomland Deciduous Forest	Sycamore – Sweetgum – American Elm Forest	0.3
2-11	Bottomland Deciduous Forest	Sycamore – Sweetgum – American Elm Forest	0.5
2-12	Bottomland Deciduous Forest	Sycamore – Sweetgum – American Elm Forest	0.2
2-13	Mixed Deciduous Forest	Virginia Pine Forest	0.7
4-1	Mixed Dc. Regeneration Forest	Virginia Pine – Oak Forest	28.9
4-2	Mixed Deciduous Forest	Chestnut Oak Forest	8.2
4-3	Bottomland Deciduous Forest	Sycamore – Sweetgum – American Elm Forest	4.2
4-4	Mixed Deciduous Forest	Chestnut Oak Forest	9.3
4-5	Mixed Dc. Regeneration Forest	Virginia Pine – Oak Forest	4.5
4-6	Mixed Deciduous Forest	Chestnut Oak Forest	7.2
4-7	Mixed Deciduous Forest	Chestnut Oak Forest	21.6
4-8	Mixed Dc. Regeneration Forest	Virginia Pine – Oak Forest	3.2
4-9	Mixed Deciduous Forest	Chestnut Oak Forest	30.7
4-10	Mixed Dc. Regeneration Forest	Virginia Pine – Oak Forest	9.1
4-11	Bottomland Deciduous Forest	Sycamore – Sweetgum – American Elm Forest	0.9
4-12	Bottomland Deciduous Forest	Sycamore – Sweetgum – American Elm Forest	1.6
4-13	Mixed Deciduous Forest	Chestnut Oak Forest	20.5
4-14	Bottomland Deciduous Forest	Sycamore – Sweetgum – American Elm Forest	5.3
4-15	Mixed Deciduous Forest	Chestnut Oak Forest	13.3
4-16	Mixed Deciduous Forest	Chestnut Oak Forest	2.0
6-1	Successional Hardwood Forest	Black Locust Forest	8.8
6-2	Mixed Deciduous Forest	Chestnut Oak Forest	3.0
7-1	Mixed Deciduous Forest	Sweetgum – Tulip Poplar Forest	3.7
7-2	Mixed Deciduous Forest	Sweetgum – Tulip Poplar Forest	17.0
7-3	Mixed Dc. Regeneration Forest	Virginia Pine – Oak Forest	1.7
7-4	Bottomland Deciduous Forest	Sycamore – Sweetgum – American Elm Forest	2.3
7-5	Successional Hardwood Forest	Black Locust Forest	1.5
7-6	Bottomland Deciduous Forest	Sycamore – Sweetgum – American Elm Forest	0.4
7-7	Mixed Deciduous Forest	Chestnut Oak Forest	8.5
7-8	Mixed Deciduous Forest	Chestnut Oak Forest	13.5
7-9	Successional Hardwood Forest	Black Locust Forest	2.1
7-10	Bottomland Deciduous Forest	Sycamore – Sweetgum – American Elm Forest	0.4
7-11	Mixed Dc. Regeneration Forest	Virginia Pine – Oak Forest	8.9
7-12	Mixed Deciduous Forest	Sycamore – Sweetgum – American Elm Forest	3.4
9-1	Mixed Dc. Regeneration Forest	Virginia Pine – Oak Forest	6.5
9-2	Mixed Deciduous Forest	Chestnut Oak Forest	2.3
9-3	Mixed Deciduous Forest	Chestnut Oak Forest	2.7
9-4	Bottomland Deciduous Forest	Sycamore – Sweetgum – American Elm Forest	0.4
9-5	Bottomland Deciduous Forest	Sycamore – Sweetgum – American Elm Forest	0.4

be preserved as mitigation (Figure 5-5). This section was not characterized by the FSD but described by the floral composition report as mixed deciduous forest with bottomland deciduous forest along a stream corridor within.

Table 5-10 Impacts to Forests (Outside of the CBCA) from the Construction of Unit 3 as Described by UniStar's Forest Conservation Plan

Forest Community Type	Acreage of Impact	Retention Priority
Chestnut – Oak	125.5	High
Virginia Pine – Oak	39.9	Low
Sweetgum – Tulip Poplar	35.6	Moderate
Sycamore – Sweetgum – American Elm	8.9	Highest
Black Locust	6.1	Low
Virginia Pine	0.7	Low

The existing forests currently provide numerous ecological benefits to this region in southern Maryland, particularly to wildlife (see Section 5.2.3). Most of the forest that would be removed for construction of the power plant project consists of mature, seed and mast-producing (seeds and hard nuts) trees. Some areas of the forest currently possess trees with average dbh of 15 to 18 inches; some of the trees are as large as 30 inches dbh. It is estimated that the largest trees on the site could be at least 100 years old, and likely older. Mature forests of this type take many years to mature, and the substantial ecological benefits they provide are becoming rare throughout the state; they are dwindling in Calvert County and the region.

Although a portion of the Calvert Cliffs site forest would be left intact, impacts to the remaining forest would continue following the construction of the project. The mature forest would be more exposed to invasive and exotic vegetation (e.g., Japanese honeysuckle, Japanese stiltgrass, Asiatic bittersweet, tree of heaven, etc.), lowering diversity, decreasing food resources for wildlife, and increasing the potential for damage to individual trees in inclement weather. Further, impervious surfaces would replace the existing forest, increasing runoff to local streams and the risk of erosion. Wildlife that use the forest would also be affected; given diminished on-site opportunities, resident individuals may perish or move off site to utilize other resources.

Cumulative effects would be substantial to regional forests. At least 330 acres of forested lands were cleared for development of the original Calvert Cliffs Units 1 and 2. Calvert County indicated that in recent years they had lost more forest resources to various kinds of development than that of other counties in the state (Calvert County, 2008). In addition, there is a need to reach and maintain nutrient caps. Currently forests in the Chesapeake Bay watershed are being lost at a rate of about 100 acres per day (DNR, 2008). If water quality conditions in the Chesapeake Bay cannot be improved on a voluntary basis before 2010, more regulatory approaches to reduce loads and maintain a nutrient cap are likely. Effective forest conservation is needed to avoid widening the gap between current pollutant loads and required caps (DNR, 2008).

The construction of Unit 3 would impact the Chesapeake Bay Critical Area (CBCA). Although much of the related construction would impact the Intensely Developed Area (IDA) associated with the existing Units 1 and 2, the Resource Conservation Area (RCA) would also be affected, including areas with steep slopes (greater than 15 percent), forested habitats for birds that are Forest Interior Dwelling Species (FIDS), and tidal and nontidal wetlands. As outlined in Section 3.4.1.3, the impacts to the CBCA are primarily associated with seven impact areas:

- Installing a new water intake structure and pump houses, and constructing a fish return will impact 0.84 acre in the IDA, of which 0.75 acre is within the tree line. The intake itself will create 0.46 acre of new impervious surface within the IDA, and the associated structures will create 1.05 acres of new impervious surfaces within the IDA.
- The steep hill immediately adjacent to the west of the structures described above will be terrace graded and stabilized with vegetation. The grading will impact approximately 7 acres within the IDA of which 6.4 acres is within the treeline.
- A heavy haul road will be constructed from the barge pier to the construction site and will impact 5.93 acres in the IDA, of which 4.93 acres will be pervious, 4.75 acres will be within the treeline, and 0.78 acre will be within the Critical Area Buffer. The upgrades to the heavy haul road will create 1 acre of new impervious surface within the IDA.

- The power block and related construction laydown area will be graded to an average elevation of approximately 85 feet msl over an area of 48 acres. Of this, 7.78 acres of the CBCA would be graded including 1.19 acres in the IDA and 6.59 acres in the RCA; 5.61 acres of the graded area would be within the treeline.
- As mitigation for impacts to the CBCA, a forested wetland would be created in an area of the CBCA originally developed in connection with Camp Conoy. A low area of mostly fields surrounding former recreation facilities would be graded and planted with native species to create a forested wetland mitigation area of 6.28 acres, all of which would be in the Resource Conservation Area (RCA). Additional planting around the wetland would create a nearly contiguous forest of approximately 23.8 acres.
- The reconstruction of the existing barge pier would add 0.26 acre of impervious surface to within the IDA. Dredging necessary to enhance the barge slip would impact 1.04 acres of tidal wetlands; only a 0.16-acre area of the barge slip to be dredged is with the existing tree line.
- Construction of a concrete flood wall running west to east parallel to the property line of Calvert Cliffs Units 1 and 2 would occupy 0.21 acre within the IDA, of which 0.18 acre would be pervious in nature and 0.03 acres would be impervious.

To conform with the Critical Area Program, UniStar addressed the impacts to the resources of concern within the CBCA. A Habitat Protection Plan, presented conceptually, describes measures to avoid or mitigate for impacts to sensitive plant or animal species (see also Section 5.2.4, Threatened and Endangered Species). Nontidal wetlands impacts would be addressed by the Wetlands Mitigation Plan submitted as part of the Joint Application for a permit to impact jurisdictional wetlands. This plan states that UniStar expects to remove impervious surfaces in the RCA, plant native species in the disturbed area, and create a forested wetland in the tennis court area of Camp Conoy to close the canopy and provide habitat for FIDS (see also Section 5.2.2, Wetlands).

A FIDS Protection Plan, also presented conceptually by UniStar, calculated the mitigation required to compensate for the loss of 21 acres of forest in the CBCA (see also Section 5.2.3, Wildlife). Based on the losses of forest interior and FIDS habitat, a total of 67.4

acres of forest mitigation would be required in the CBCA. UniStar proposed four mitigation actions to address impacts to forest cover and FIDS habitat within the CBCA (Figure 5-6):

- Creation of a 6.8-acre forested wetlands in the open fields areas of Camp Conoy in the CBCA (this would also serve as mitigation for wetlands);
- Planting 3.2 acres of upland forest vegetation in the gaps associated with the Eagle's Den;
- Planting 16.4 acres of upland forest vegetation in an open field area north of Units 1 and 2; and
- Preservation of existing forest cover in the CBCA elsewhere on the Calvert Cliffs site such as the extensive tract south of the project construction site (this would also serve as mitigation for bald eagles).

After implementing the above mitigation actions, the CBCA would have more forest cover and FIDS habitat, but the extent of forest interior would still be less than what currently exists on the site (Table 5-11).

Table 5-11 FIDS Summary of Proposed Impacts and Mitigation to Existing Forest Cover and FIDS Habitat in the CBCA for the Construction of Unit 3

Project Phase	Forest Cover (acres)	Forest Interior (acres)	FIDS Habitat (acres)
Pre-development	70.3	30.9	62.5
Post-development; prior to mitigation	49.3	14.6	27.7
Post-mitigation	75.7	14.6	77.8

5.2.2 *Wetlands*

The construction of the proposed Unit 3 would permanently impact 11.7 acres of wetlands distributed throughout the project site. Among the nine Wetland Assessment Areas characterized for the project site, six would incur losses ranging from 0.03 to 4.97 acres (Table 5-12). Of the total wetlands affected, 7.87 acres are palustrine forested, 1.21 are palustrine emergent, and 2.63 are

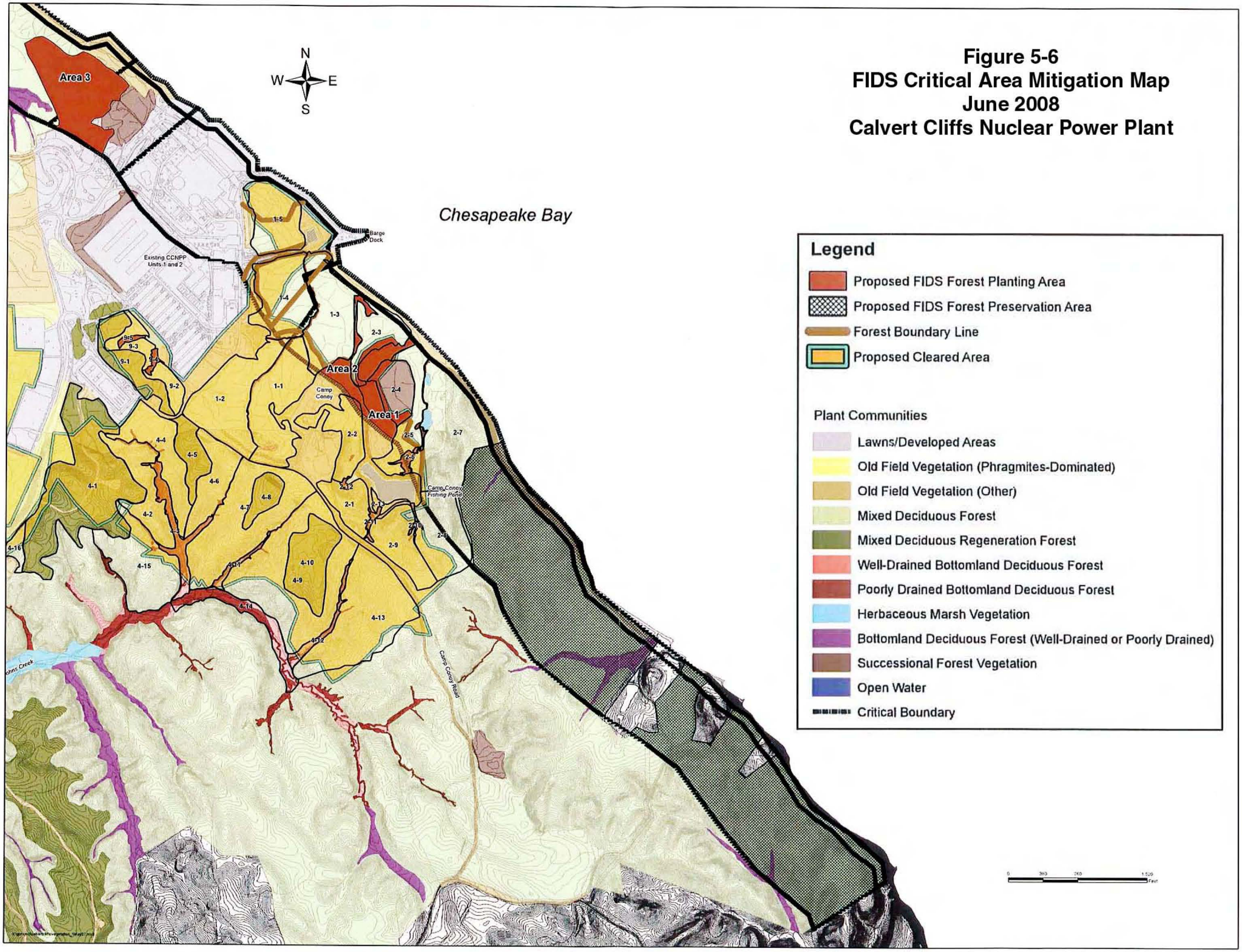


Figure 5-6
FIDS Critical Area Mitigation Map
June 2008
Calvert Cliffs Nuclear Power Plant
N
W
E
S
Chesapeake Bay
Area 3
Area 2
Area 1
Existing CCNPP Units 1 and 2
Barge Dock
Camp Conoy
Camp Conoy Fishing Pond
Camp Conoy Road
Johns Creek
Legend
Proposed FIDS Forest Planting Area
Proposed FIDS Forest Preservation Area
Forest Boundary Line
Proposed Cleared Area
Plant Communities
Lawns/Developed Areas
Old Field Vegetation (Phragmites-Dominated)
Old Field Vegetation (Other)
Mixed Deciduous Forest
Mixed Deciduous Regeneration Forest
Well-Drained Bottomland Deciduous Forest
Poorly Drained Bottomland Deciduous Forest
Herbaceous Marsh Vegetation
Bottomland Deciduous Forest (Well-Drained or Poorly Drained)
Successional Forest Vegetation
Open Water
Critical Boundary

palustrine open water, which is effectively the Camp Conoy fishing pond. Also affected by project construction are two seeps located in Wetland Assessment II that are regarded as wetlands by the State but not by the USACE. Project construction would impact 30.85 acres of wetland buffer area. In Calvert County, lands within 50 feet of the landward edge of non-tidal wetlands are defined as non-tidal wetlands buffers.

Table 5-12 Impacts to Wetlands from the Construction of Proposed Unit 3

Wetland Assessment Area	Existing Wetlands (acres)	Wetland Losses (acres)	Buffer Losses (acres)	Wetland Remaining (acres)
I	2.20	0.03	2.00	2.17
II	6.18*	4.84*	6.79	1.34
III	0.77	No Losses		0.77
IV	12.79	4.97	15.84	7.82
V	9.13	No Losses		9.13
VI	14.01	No Losses		14.01
VII	11.55	0.72	3.41	10.83
VIII	0.45	No Losses		0.45
IX	1.12	1.10	2.81	0.02
Totals	58.20	11.71	30.85	46.54
* Includes 0.05 acre isolated wetland that is Maryland jurisdictional only.				

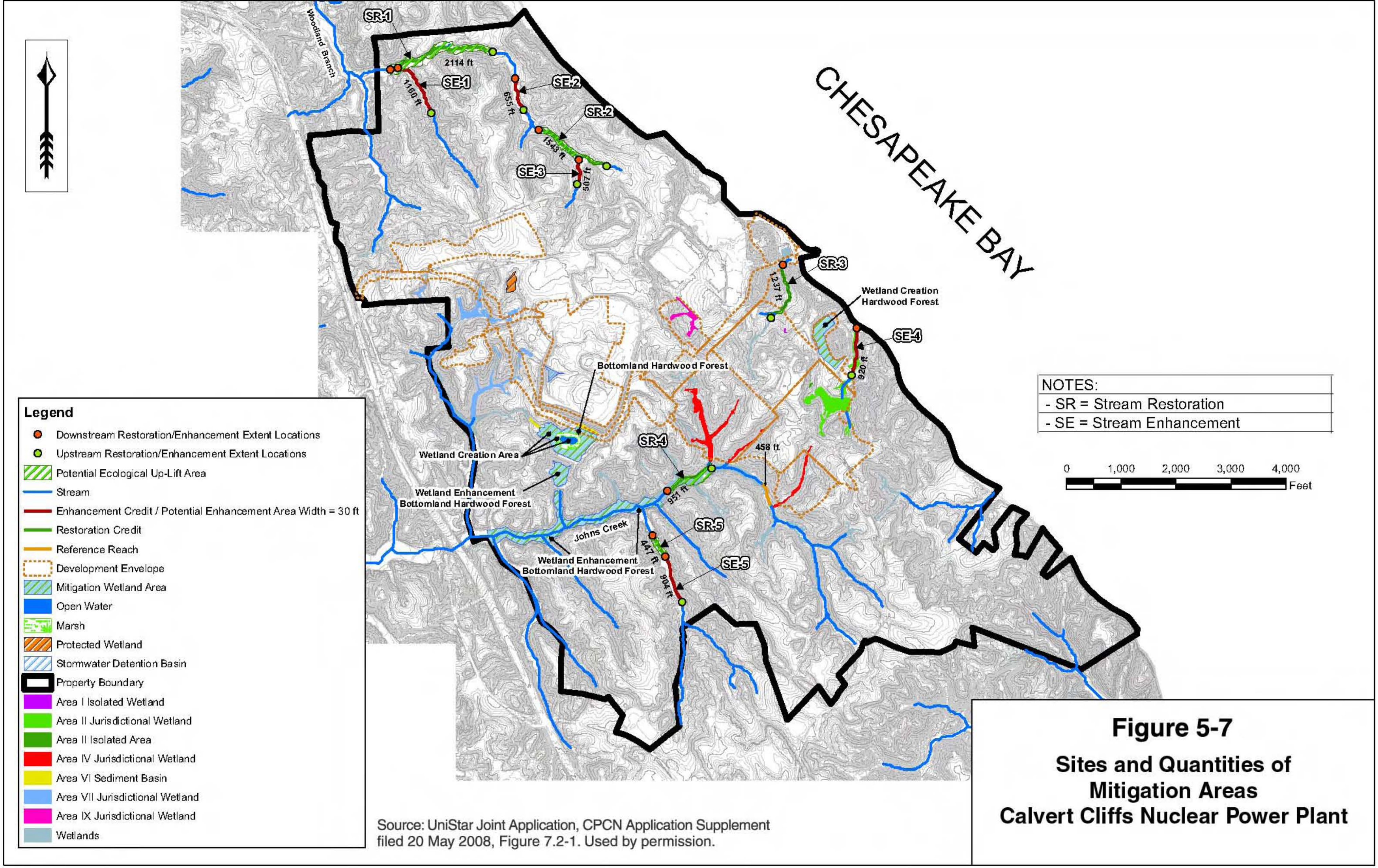
As indicated by the wetlands functional assessment discussed in Section 3 (see Table 3-15), forested wetlands provide numerous valuable physical benefits to the environment such as sediment and toxicant retention, nutrient removal, production export, and sediment stabilization to both the site ecology and the Chesapeake Bay region. They also provide critical habitat for many species of forest-dwelling wildlife.

The loss of forested wetlands on the project site will adversely affect the ecology of the site, and in a cumulative sense, impact the Chesapeake Bay. To address the impacts to wetlands and streams, UniStar prepared a compensatory mitigation plan. The plan calls for "in-kind" mitigation on the project site consisting of wetland creation and enhancement to conditions more suitable for use by wildlife species native to the region. In essence, the mitigation for impacts to 11.71 acres of wetlands is composed of four actions (Figure 5-7):

- The enhancement of one manmade abandoned sediment basin within the Lake Davies Disposal Area – eradication of phragmites in the central basin will provide 2.4 acres of wetland enhancement;
- The enhancement of a portion of Johns Creek – eradication of phragmites and planting of woody bottomland hardwood species will provide 15.7 acres of wetland enhancement;
- The creation of forested and herbaceous wetland habitat within the largest manmade abandoned sediment basin of the Lake Davies Disposal Area – approximately 0.9 acres of open water habitat and 1.3 acres of freshwater marsh habitat will be created; and
- The creation of forested wetland habitat within the Camp Conoy area which lies within the CBCA – an area currently occupied by tennis courts will be graded and planted with hydrophytic tree and shrub species providing 4.6 acres of forested wetlands.

The mitigation plan also included a planting plan for the wetland areas to be created or enhanced. A monitoring program would be instituted for five years following the mitigation actions to evaluate the success of the mitigation plan; remedial/contingency measures would be implemented as necessary. The wetland mitigation areas would be protected in perpetuity through the establishment of a legally-binding deed restriction, or other protection mechanism such as conservation easement or restrictive covenant.

Concomitant with the impacts to wetlands, UniStar proposes to permanently fill approximately 8,350 linear feet of perennial and intermittent stream beds on the Calvert Cliffs site. Removing these streams will directly eliminate habitats for aquatic organisms and other wildlife. Removal of these primarily headwater streams will also likely have additional negative effects in remaining on-site and off-site wetlands and streams, by altering their hydrologic regimes and degrading water quality. To address impacts to streams, UniStar prepared a stream mitigation plan that describes on-site mitigation efforts through stream



Source: UniStar Joint Application, CPCN Application Supplement filed 20 May 2008, Figure 7.2-1. Used by permission.

Figure 5-7

Sites and Quantities of Mitigation Areas Calvert Cliffs Nuclear Power Plant

restoration and stream enhancement. In total, over 10,000 linear feet of streams would be mitigated according to the plan. In all, five stream segments would be restored for a total length of 6,283 feet, and five stream segments would be enhanced for a total length of 4,146 feet (Figure 5-7). Stream restoration would involve reestablishing physical, biological, and riparian function to a stream channel using techniques such as adding instream habitat structures, improving bank stabilization using vegetative and bioengineering treatments, and implementing riparian wetland enhancements. Stream enhancement involves less intensive alterations of the stream channel to increase existing functions. Examples of stream enhancements include making improvements to aquatic habitat, bank stabilization, and native riparian planting.

It is of primary importance that UniStar adequately mitigate for the impacts to wetlands and streams. Given that MDE Nontidal Wetlands and USACE Baltimore District mitigation standards are often 3:1 for forested wetlands (i.e., 3 acres must be created for 1 acre of forested wetland destroyed), the mitigation that UniStar proposes may be insufficient; about 43 acres of created wetlands would be more appropriate as mitigation at this ratio.

Prior to disturbing wetlands on site, UniStar will need to obtain MDE and USACE approval of its Section 404 Joint Permit Application.

5.2.3 *Wildlife*

The principal impact to wildlife from the construction of the proposed Calvert Cliffs Unit 3 project would be the loss of habitat available to resident species. The clearing of forests would displace larger resident animals such as white-tailed deer, red fox, and raccoon, as well as birds and bats in general, which have more extensive ranges and are capable of broader movements. Their displacement, however, would affect adjacent areas of similar habitat that are already occupied by the same species. Smaller animals such as white-footed mouse, eastern worm snake, and marbled salamander that are less mobile would likely perish during site clearing and grading, or be exposed to greater predation. In between, species such as gray squirrel, northern black racer, and the loss of wetlands and aquatic habitats would directly impact species such as northern watersnake, green frog, fish, and dragonflies, and indirectly affect most other species that rely on them as sources of water.

The mature forests at the site provide habitat to birds that are FIDS such as scarlet tanager (*Piranga olivacea*), red-eyed vireo (*Vireo olivaceus*), wood thrush (*Hylocichla mustelina*), and worm-eating warbler (*Helmitheros vermivorus*), which were all observed at the site by UniStar during the supporting field studies. According to MDNR, scarlet tanager and red-eyed vireo require mature forest with trees of at least 10 inches dbh, and, optimally, forest tracts of about 250 acres. Worm-eating warblers require mature forest tracts of at least 750 acres, and optimally 2,500 acres (Bushman and Therres, 1988). Therefore the clearing of forest at Calvert Cliffs will not only have a direct impact on FIDS from the removal of habitat, but adjoining forest habitats will also be less supportive due to fragmentation effects. Additionally, the mature forest that remains after project construction would be more exposed to invasive and exotic vegetation, making it potentially less valuable to wildlife (by lowering diversity, decreasing food resources, and increasing the potential for damage to individual trees in inclement weather).

Cumulative effects regarding both locally breeding and migratory wildlife are likely substantial. Approximately 330 acres of forested lands were de-forested for development of the original Calvert Cliffs Units 1 and 2. Calvert County indicated that the County has recently lost more forest resources to various kinds of development than all other Maryland Counties (Calvert County, 2008). Most of the terrestrial wildlife that currently use the site use forests for at least one of their primary life requisites (food, shelter, breeding). Local loss of forest has been substantial (Calvert County, 2008). Many species of forest interior dwelling birds, in particular, have been declining. While many factors have contributed to the decline of FIDS populations, including the loss of habitat on wintering grounds and loss of migratory stopover areas for neotropical migrants, the loss and fragmentation of forests on the breeding grounds here in North America appear to play a critical role. Forest fragmentation reduces the size of forest patches, reducing the total area of contiguous habitat available to birds and increases the isolation of habitat, reducing the quality of that which remains (Jones et al. 2000).

To compensate for the impacts to wildlife, PPRP recommends a licensing condition requiring UniStar to develop and implement acceptable mitigation plans that address impacts to affected habitats. Impacts to forest resources should be addressed by a Forest Conservation Plan as prescribed by the Maryland FCA. Although the Calvert Cliffs property is zoned for industrial uses, and the Conservation Threshold for such areas is the lowest among land use categories, it should be realized that the forest resources at the site are of the highest quality in Calvert County. Preservation of forests in this area, especially where contiguous with other large forest tracts (such as Flag Ponds Park to the north), would be beneficial to species affected by the proposed project. Mitigation for the loss of wetlands and streams should follow as above.

5.2.4 *Threatened and Endangered Species*

Showy goldenrod (*Solidago speciosa*), a state-listed Threatened species, would be adversely affected by the construction of Unit 3. As indicated by UniStar's floral surveys, suitable habitat is present on the site primarily at the edges of forest habitats in the Camp Conoy area (Figure 5-8). Impacts to showy goldenrod should be avoided or minimized to the extent possible. Mitigation for impacts to this population through transplanting individuals is discouraged. Transplanting of threatened and endangered plants is not considered a substitute for the protection of existing populations and may result in limited or no conservation value. However, since threatened and endangered plants are the property of the landowner, transplanting such species is not illegal provided the plants are not transported off the property. If such an action is pursued, adherence to DNR's guidelines for the reintroduction of rare plants (http://www.dnr.state.md.us/wildlife/rteplantreintro.html) is recommended (see DNR Heritage letter dated 23 June 2008, included in Appendix E to this document). UniStar indicated that it would develop a mitigation and monitoring plan in consultation with DNR. The monitoring plan would include an initial baseline (time-zero) monitoring event, to be conducted immediately following the transplanting to mitigation areas. After the baseline event is completed, a five-year monitoring schedule would be initiated, to include annual sample events during September-October of each monitoring year. A baseline report and five annual monitoring reports should be prepared and submitted to DNR. The reports should include results of transplanting, photo-documentation, site maps, descriptions of problems encountered, and discussion of maintenance actions taken. Following agency review and coordination, remedial and/or contingency measures may be implemented if required.

Shumard's oak (*Quercus shumardii*), a State-listed Threatened species, is present on the Calvert Cliffs site, but in an area outside

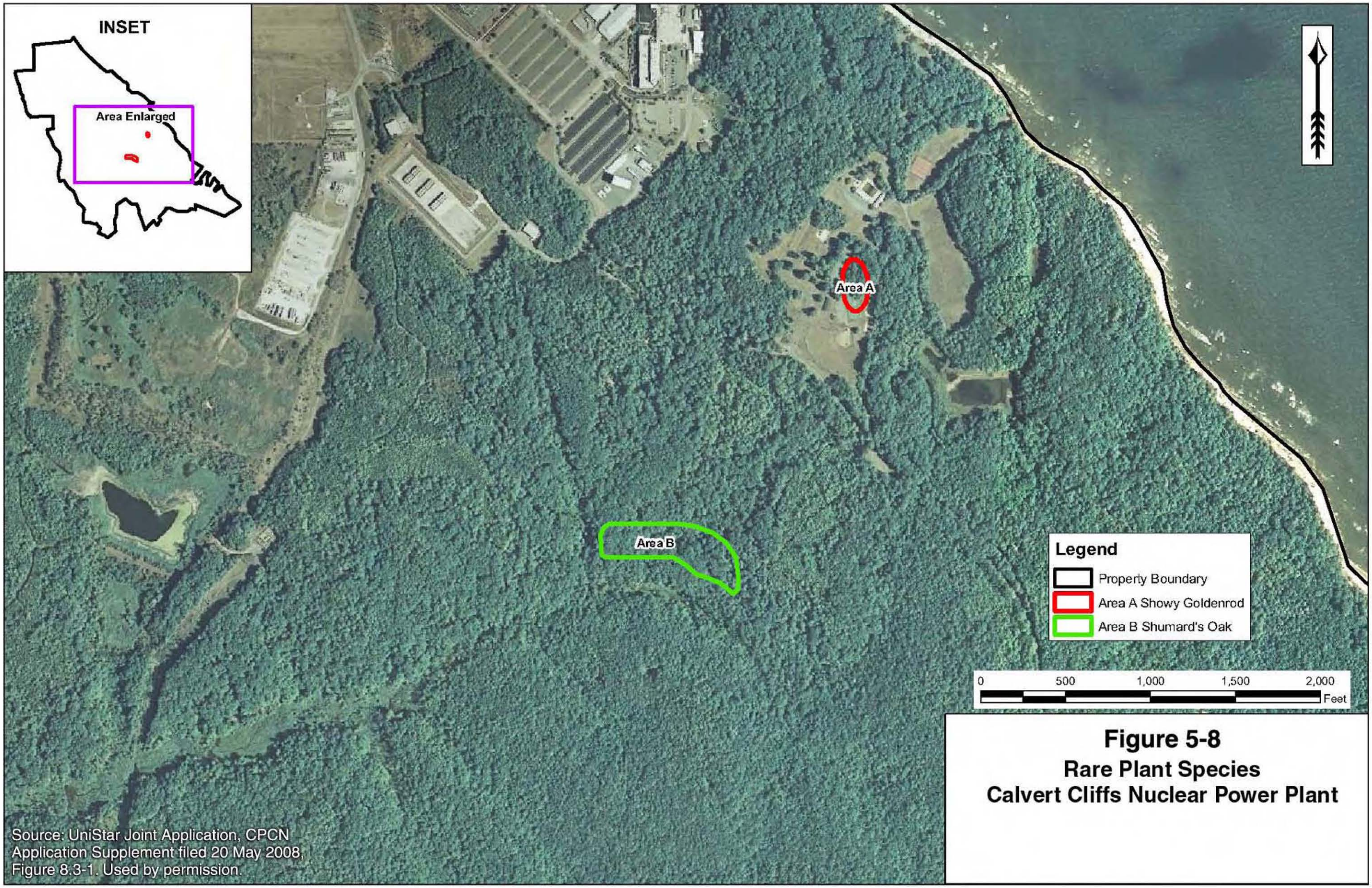


Figure 5-8
Rare Plant Species
Calvert Cliffs Nuclear Power Plant

of the development footprint of the project. Therefore, UniStar concluded that the project was "not likely to adversely affect" this species. Several trees were identified in well-drained bottomland deciduous forest in the floodplain adjoining the southern of the two main headwaters to Johns Creek (Figure 5-8). This area appears to be immediately adjacent to project areas (i.e., switchyard, laydown area 1, cooling tower) that will be cleared, grubbed, and graded. Impacts to Shumard's oak should be avoided or minimized to the extent possible. Project development in this area should retain as much of the existing vegetation as possible to serve as a buffer area. As part of the monitoring reports for the showy goldenrod, the general health of the Shumard's oaks should receive comment. As an initial baseline monitoring event (prior to clearing), the presence of invasive plant species should be documented and reviewed annually for the next five years.

Spurred butterfly pea (*Centrosema virginianum*) is a State-listed Rare species that DNR indicated was as known to occur on the project site (DNR Letter dated 31 July 2006). The plant was not found at the location described by the DNR record, but was possibly identified at another location, although the species was unconfirmed. Regardless, both locations are outside the impact area of the project and therefore would not be affected by the construction of Calvert Cliffs Unit 3. Nonetheless, conservation of this species and its habitat is encouraged.

Bobcat (*Lynx rufus*) is State-listed In Need of Conservation and currently has a ranking of S3 indicating that it is a Watch List species. UniStar reported what appeared to be a bobcat was briefly observed in a forested area north of Camp Conoy during the 2006 faunal studies (Figure 5-8); other Calvert Cliffs employees also indicate they have seen bobcats in the area as well. Impacts to bobcats should be avoided or minimized to the extent possible. Forest resources, that may support bobcats in the vicinity of the project site, should be conserved to the greatest means practical. The Forest Conservation Plan developed for Unit 3, as well as mitigation actions for impacts to the CBCA, should consider this species.

Bald eagle (*Haliaeetus leucocephalus*), a State-listed Threatened species, would be adversely affected by the development of Calvert Cliffs Unit 3. UniStar has submitted a permit application to DNR for Incidental Take of a nest within the footprint of developmental impact. Under the permit, the nest tree would be removed after the young birds have fledged and prior to any new nesting activities (likely between August and December of either 2008 or 2009). The permit would also cover the take of any additional eagle nests built within the bounds of the project area and out to 0.25 miles. As mitigation for impacts to bald eagles, UniStar has committed to protect bald eagle nesting habitat on the south portion of the Calvert Cliffs site (Figure 5-9). As noted in Section 3, this area had an active nest during 2008, and historically, has supported bald eagle nesting territories since at least 2000. UniStar has indicated that an area of approximately 100 acres will be protected for 15 years. Within the bald eagle preservation area, no tree harvesting activities would be permitted and human activity would be limited. Even if an Incidental Take permit is issued by the state, UniStar would still need to obtain any necessary federal permits for actions affecting bald eagles.

Following its federal delisting by the USFWS under the Endangered Species Act (ESA), the bald eagle remains protected under the Bald and Golden Eagle Protection Act (BGEPA) and Migratory Bird Treaty Act (MBTA). Neither of these laws, however, has a provision that authorizes the take of bald eagles as did the ESA. The USFWS has since issued a Proposed Rule authorizing such actions under BGEPA, but until a Final Rule has been published, the Incidental Take of bald eagles is not authorized. The USFWS has also published National Bald Eagle Management Guidelines, which prescribe a buffer area around nest trees out to 660 feet. The Guidelines further recommend minimizing disruptive activities and development in the direct flight path between nests and roost sites and important foraging areas.

The northeastern beach tiger beetle (*Cicindela dorsalis*) and puritan tiger beetle (*Cicindela puritana*), both federally threatened and State endangered species, are known to occur along the Chesapeake Bay shoreline proximal to the project site. Construction of Unit 3 project is not likely to impact either tiger beetle species provided their preferred habitats are undisturbed. UniStar indicates that construction along the shoreline necessary for Unit 3 will make use of existing access routes and structures associated with Units 1 and 2. No construction activities should occur within 500 feet of any cliff or beach habitats that are suitable for either tiger beetle species. Administrative controls that restrict personnel access to beaches should be implemented. In the interest of safeguarding this species, UniStar should allow DNR

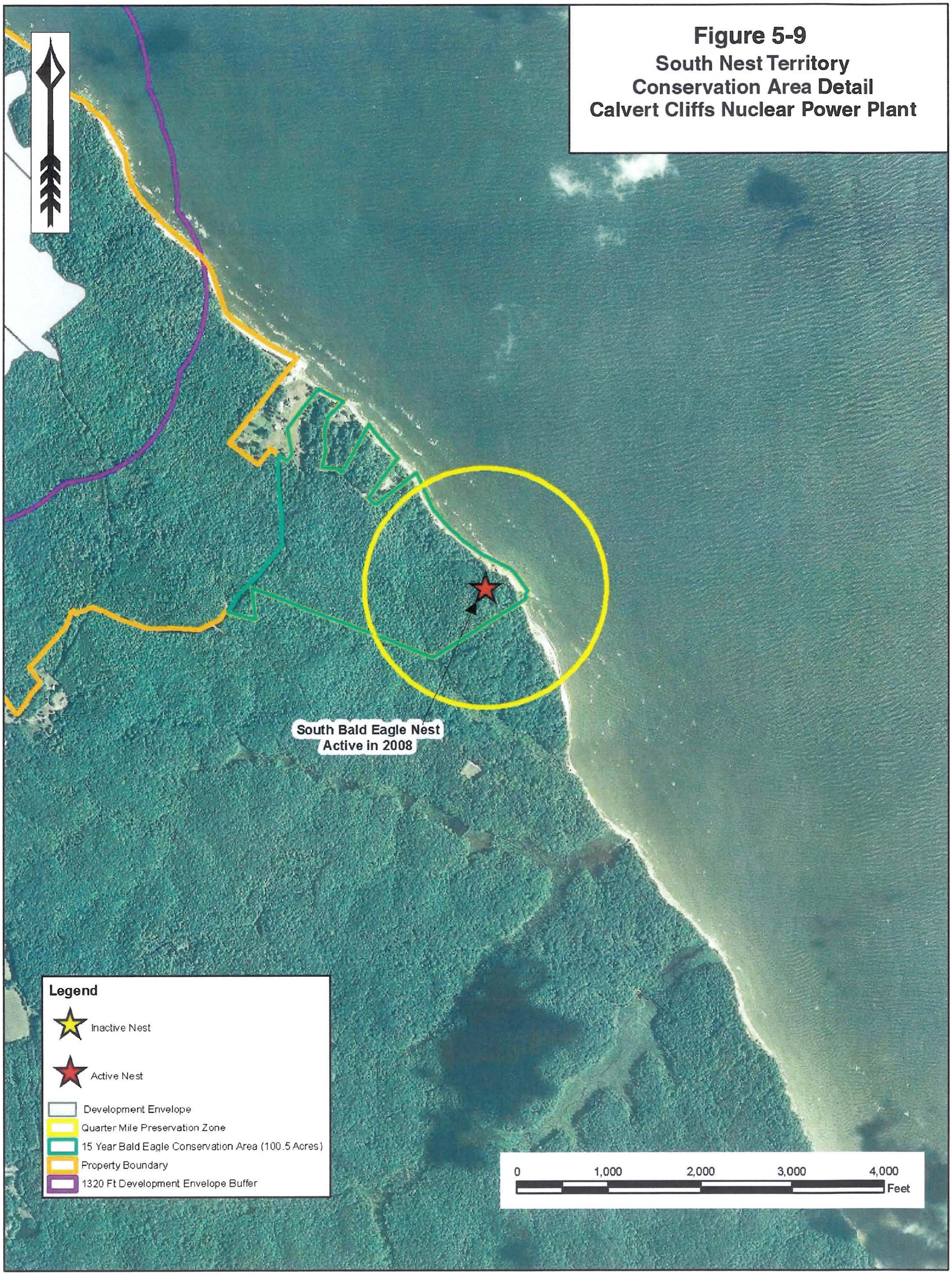


Figure 5-9
South Nest Territory
Conservation Area Detail
Calvert Cliffs Nuclear Power Plant
South Bald Eagle Nest
Active in 2008
Legend
Inactive Nest
Active Nest
Development Envelope
Quarter Mile Preservation Zone
15 Year Bald Eagle Conservation Area (100.5 Acres)
Property Boundary
1320 Ft Development Envelope Buffer
0
1,000
2,000
3,000
4,000
Feet

to access the shoreline as requested to conduct surveys to examine the health of tiger beetle populations. Habitat management or restoration for tiger beetles is encouraged.

Cumulative impacts to rare, threatened, and endangered species are not likely to be significant with respect to the construction of Calvert Cliffs Unit 3. The State-listed plants and animals that occur on the project site are relatively secure throughout their natural ranges (i.e., in other states). However, as protected species Maryland, they should receive due consideration under the law for their preservation within the state. The conservation of federal-listed tiger beetles is at the very least understood. Both species rely on specific habitat types that are globally rare. Wherever they occur, strict protective measures should be implemented to safeguard these species.

5.2.5 *Aquatic Wildlife Resources*

The proposed Calvert Cliffs Unit 3 project would permanently impact around 8,350 linear feet of freshwater streams as well as other habitats. These impacts would occur on several unnamed streams, parts of Johns Creek, Goldstein Branch, Laveel Branch, Camp Conoy Fishing Pond, Lake Davies, and two unnamed impoundments. In addition to the forest clearing, wetland destruction, grading, and other site preparation work required to construct the proposed project, UniStar would construct about 133 acres of impervious surfaces. According to UniStar, approximately 15 to 20 acres of capacity would be added to the east drainage drainage basin.

The proposed changes to site streams, wetlands, and forests, along with the significant amount of new impervious surface, would adversely affect water quality and aquatic wildlife resources in the immediate area of impact as well as downstream areas following project construction. Despite the additional capacity that would be added to the east drainage basin, and stream mitigation (see below), the proposed project would likely result in higher average stream flows, along with greater erosion and silt loads in the remaining streams. Siltation is the primary cause of stream degradation.

When surface waters are heavily disturbed and filled, impacts to aquatic life are likely, with the almost certain loss of fish and invertebrates. Aquatic organisms are typically affected by sediment deposition in streams, including aquatic plants, benthic macroinvertebrates, and fish. The effects of sediment are influenced by particle size. Turbidity reduces photosynthetic activity in periphyton and aquatic plants. Suspended particles may also interfere with respiration in invertebrates and newly-hatched fish or reduce their feeding efficiency. Larger particles fall out of suspension to the stream bed, where they can smother eggs and developing fry, or degrade the quality of spawning grounds. Changes in the benthic community result in a loss of fish forage, with a subsequent loss in fish populations.

Although many of the existing aquatic species at the Calvert Cliffs site are common and relatively ubiquitous, one of them, American eel, is an important commercial species in the Chesapeake Bay region. Given the recent federal recognition that this species has declined in some areas (see Section 3), impacts to American eels are potentially significant. Regionally, fisheries management actions are being implemented to enhance eel populations. For example, eel ladders are to be constructed in the near future on the Holtwood Dam hydropower project on the Susquehanna River in Lancaster County, Pennsylvania. New facilities such as these are likely to positively effect local populations of eels. Construction projects, such as the Unit 3 project, that directly and indirectly affect coastal freshwater streams are among the greatest threats to the American eel in the Chesapeake Bay region. The Atlantic States Marine Fisheries Commission (ASMFC) developed a Fishery Management Plan (FMP) in 2000 for the American eel to protect and restore the species. One of the primary objectives in this plan is to protect and enhance American eel abundance in all watersheds where eel now occur, since habitat losses are listed as one of the primary causes of any possible historic and recent decline in abundance. Thus, it is recommended that UniStar be required to submit a mitigation plan for DNR Fisheries Division approval to compensate for the loss of eels and stream habitat.

Cumulative effects on aquatic freshwater wildlife resources from the proposed Unit 3 project would not likely be significant to most species found at the site and in the region. UniStar has indicated that it would minimize construction impacts to water resources and freshwater aquatic wildlife by use of best management practices and good construction engineering practices such as stormwater retention basins and silt screens. The SWPPP provides specifications to control soil erosion and sedimentation to waterways, streams and wetlands. The Spill Prevention, Control and Countermeasures (SPCC) plan would be used by UniStar to minimize the impact to wetlands and waterways.

In addition, UniStar has indicated that it would provide over 10,000 linear feet of stream restoration on remaining site freshwater streams to mitigate impacts. This work would include adjustment of horizontal and vertical channel alignments and channel cross sections. Additional restoration treatments include in-stream habitat structures, bank stabilization, and riparian wetland enhancements. Although the stream mitigation plan proposed by UniStar appears substantial, it should also contain measures for further minimizing or eliminating stream impacts from the construction and operation of the proposed facility. Such measures should include reduction of new impervious surfaces, and moving new buildings and facilities out of streams, wetlands and forests where possible. Other important measures should include culverting, instead of filling, streams where possible, construction of retaining walls where appropriate above wetlands and streams, and other techniques. Only when all of these measures are included in the proposed Unit 3 stream mitigation will impacts to site aquatic systems and aquatic wildlife likely be minimized and properly mitigated.

5.3 IMPACTS TO GROUND WATER

This section describes the impacts to ground water quantity and quality associated with construction activities. Impacts to ground water due to withdrawal to meet the demand during construction are discussed in Section 6.3.

5.3.1 Ground Water Quantity Impacts

This section evaluates whether potential impacts to ground water quality from dewatering excavations during construction will be realized. Dewatering the Surficial aquifer could lead to the following potential impacts to ground water quantity:

- A reduction in the amount of ground water that discharges to down gradient streams (i.e., Branch 1, Branch 2 and Branch 3);
- Alteration of hydraulic gradients; and
- Impacts to other ground water users.

According to UniStar's response to DNR Data Request No. 1-20, the current design for Unit 3 requires the following major excavations:

- Power Block Area – 750,000 square feet of area to a depth of 45 feet below the final grade of 84.6 feet msl (rounded to 85 feet msl);
- CWS Cooling Tower – 250,000 square feet to a depth of 10 feet below the final grade of 85 feet msl;
- Retention Pond – 50,000 square feet to a depth of 30 feet below a final grade of 85 feet msl; and
- Circulating Water Pipe laydown – 25,000 square feet to a depth of 45 feet below a final grade of 85 feet msl.

UniStar's response to DNR Data Request No. 1-20 estimated that the dewatering of these excavations will generate an annual average flow rate of 44 gallons per minute (gpm), which equates to 63,400 gpd. UniStar adjusted this number to 75,000 gpd to add contingency to the annual average estimate. UniStar estimated the maximum monthly rate of 64 gpm, which equates to 92,200 gpd and was adjusted up to 100,000 gpd. UniStar requested in its Technical Report a ground water appropriation to conduct the dewatering at the 75,000 gpd average daily and 100,000 month of maximum use gpd limits. UniStar's response to DNR Data Request No. 1-20 indicates that dewatering is expected to begin during the first year of construction, with backfilling of excavated sites during the second year, and dewatering activities decreasing by the third year.

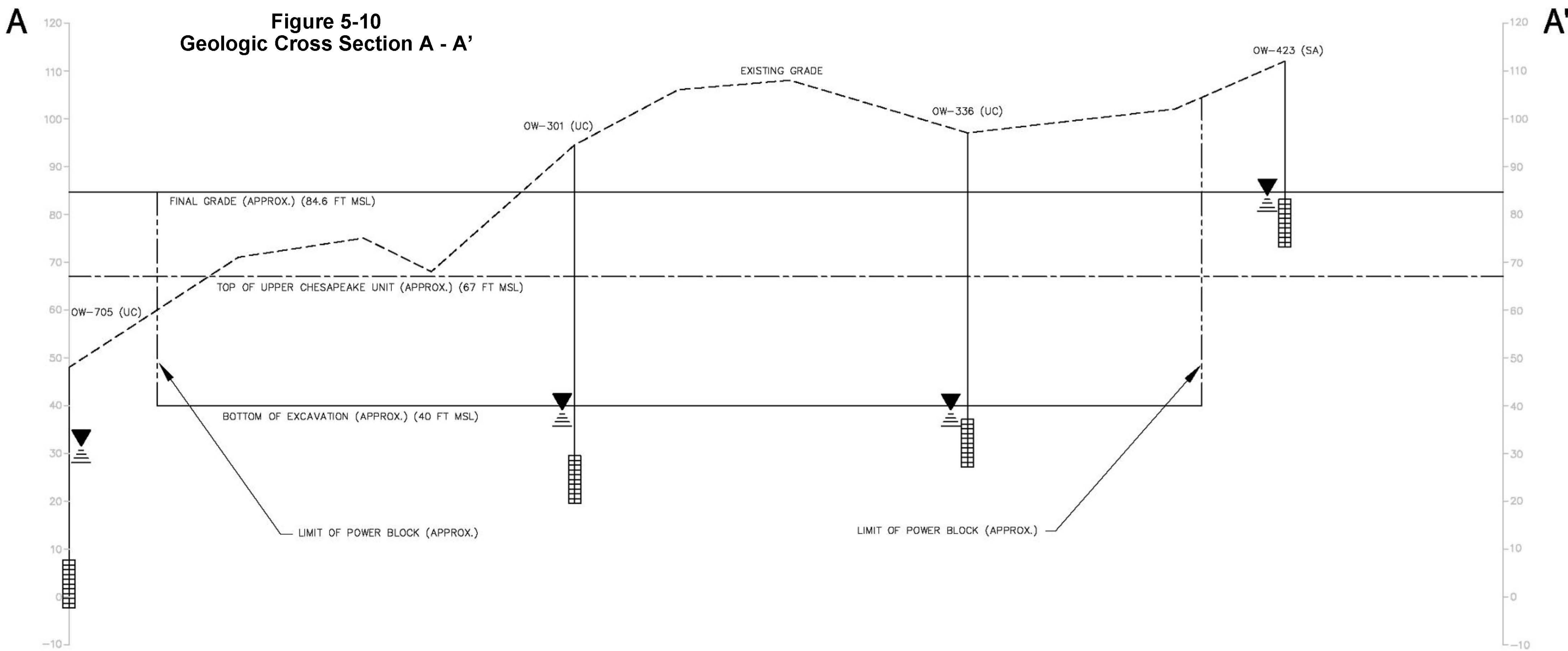
According to UniStar's Final Safety Analysis Report (FSAR) Section 2.5.4.6.2, ground water in excavations will be controlled through site grading (i.e., direct water during grading towards sumps for withdrawal), or a system of drains and ditches. Drainage ditches will be installed below grade as the excavation progresses, and will be connected to sumps to facilitate the withdrawal of water. Deeper ground water will be managed using a series of sumps and pumps located in the excavation. UniStar's response to DNR Data Request No. 1-26 indicated that no long-term dewatering of structures will be required. Impermeable membranes on below-grade surfaces will be used to eliminate any ground water flow into the subsurface structures. UniStar is proposing to collect the water generated during dewatering, store it in tanks or impoundments, and apply the stored water to exposed soils and road surfaces for dust control.

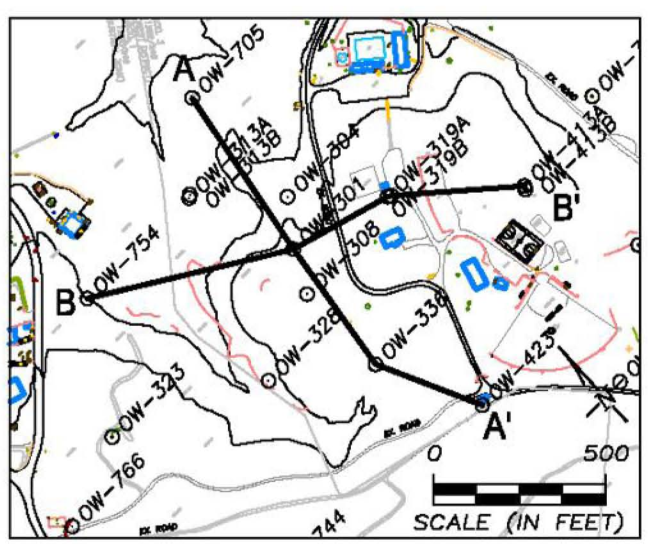
In the short-term, ground water will be released from storage in the aquifer matrix as excavations extend beneath the water table. Cross-sections (Figures 5-10 and 5-11) illustrate the approximate power block excavation relative to the Surficial aquifer and the Chesapeake confining unit. The maximum design depth for the excavation of the power block will be 40 feet msl (85 feet msl – 45 feet depth of excavation). To calculate the amount of ground water stored in the proposed power block excavation area, an estimated effective porosity of 0.34 was used, based on the average measured total porosity for the Surficial aquifer provided by UniStar in their response to DNR Data Request No. 1-14. Using an average Surficial aquifer water table elevation of about 80 feet across the power block area (based on UniStar's water level data), and an average Surficial aquifer bottom elevation of 67.5 feet msl over the proposed 750,000 square feet of proposed power block excavation (based on UniStar's cross sections in Technical Report Figures 5.4-6 and 7), provides an estimated ground water storage volume of 3.19×10^6 cubic feet (2.38×10^7 gallons). This volume spread over 365 days translates to a dewatering rate of about 65,200 gpd to extract all of the ground water in storage. As shown in cross sections A-A′ and B-B′, the Surficial aquifer does not extend over the entire power block excavation at a uniform thickness. Therefore, the volumetric estimate of ground water is considered to be higher than the actual volume that could be extracted from the Surficial aquifer during or prior to excavation.

Smaller excavations have the potential to generate additional ground water from storage from the Surficial aquifer, as described below.

- CWS Cooling Tower – The water table elevation in the Surficial aquifer in this area is approximately 77 feet msl, and the finished grade will be 85 msl. Therefore, the 10-foot deep excavation will penetrate 2 feet into the water table. Two feet of saturated Surficial aquifer over the proposed 250,000 square feet of the excavation provides an estimated ground water storage volume of 170,000 cubic feet (1.30×10^6 gallons), or 3,600 gpd over one year.
- Retention Pond – The excavation will extend from 85 feet msl to 55 feet msl. The water table elevation in the Surficial aquifer in this area is approximately 78 feet msl. The base of the Surficial aquifer is approximately at approximately 67.5 feet msl over the proposed 50,000 square feet of the excavation, which provides an estimated ground water

Figure 5-10
Geologic Cross Section A - A'





CROSS SECTION LINES

LEGEND:

UC	UPPER CHESAPEAKE (A.K.A. CHESAPEAKE CONFINING LAYER)
SA	SURFICIAL AQUIFER
▼	WATER LEVEL IN THE MONITORING WELL
▤	MONITORING WELL SCREEN

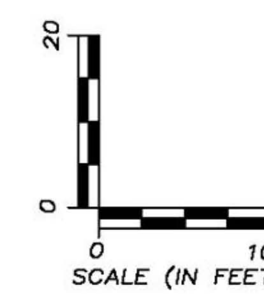


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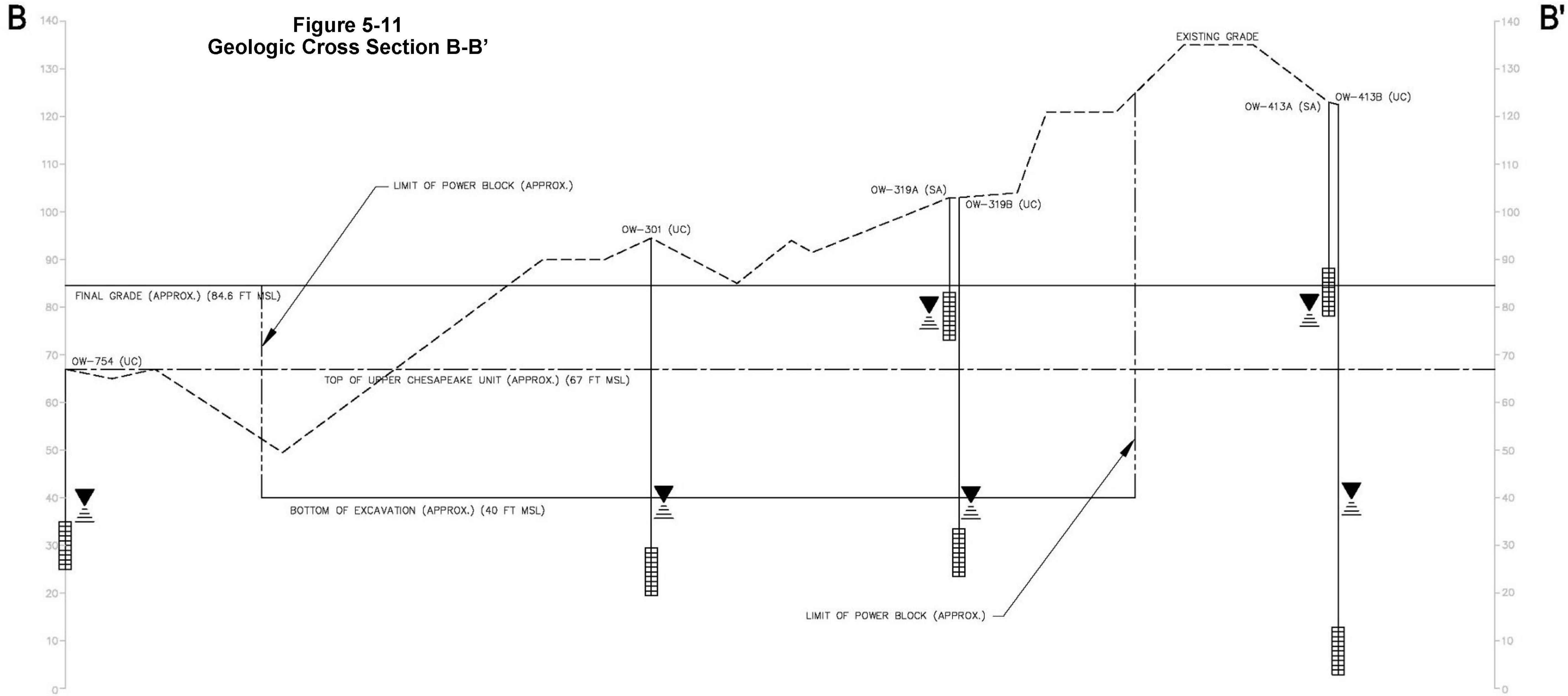
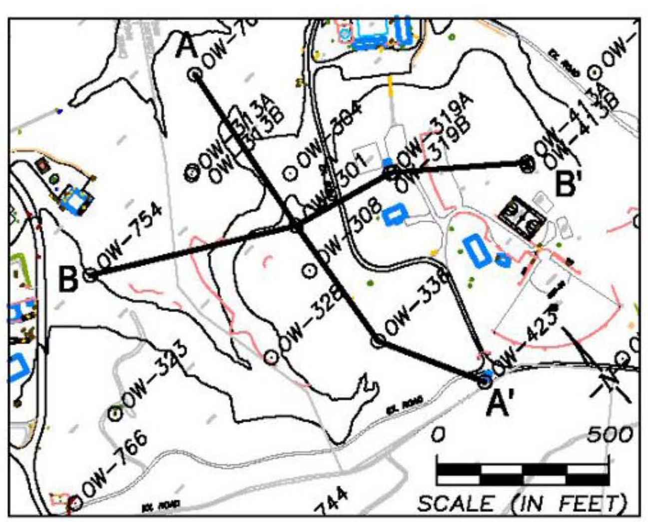
Figure 5-11
Geologic Cross Section B-B'

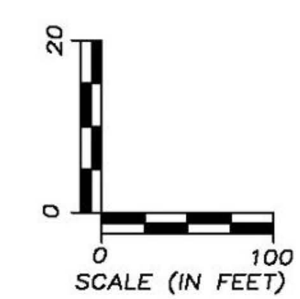




CROSS SECTION LINES

LEGEND:

UC	UPPER CHESAPEAKE (A.K.A. CHESAPEAKE CONFINING LAYER)
SA	SURFICIAL AQUIFER
▼	WATER LEVEL IN THE MONITORING WELL
▤	MONITORING WELL SCREEN



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storage volume of 178,000 cubic feet (1.34×10^6 gallons), or 3,700 gpd over one year.

- Circulating Water Pipe laydown – The excavation will extend from 85 feet msl to 45 feet msl. The water table elevation in the Surficial aquifer in this area is approximately 78 feet msl. The base of the Surficial aquifer is at 67.5 feet msl over the proposed 25,000 square feet of the excavation, which provides an estimated ground water storage volume of 89,300 cubic feet (668,000 gallons), or 1,800 gpd over one year.

In total, an estimated 74,300 gpd of ground water over the first year is estimated to available for release storage from the Surficial aquifer. This estimate is essentially identical to UniStar's estimate and within its average daily use amount of 75,000 gpd. This estimate is considered to be conservative because the Surficial aquifer does not extend over the entire excavation area at a uniform thickness.

The relatively impermeable Chesapeake confining unit underlies the Surficial aquifer in the area of the power block. The Chesapeake confining unit will release little if any water from storage because the bottom of the power block excavation will barely intercept the ground water surface in this unit. As shown in cross section A-A′ (Figure 5-10), the excavation will penetrate 27.5 feet into the top of the Chesapeake confining unit (67.5 feet msl – 40 feet msl). As shown in the A-A′ and B-B′ cross sections, the water level elevation in this unit is about 40 feet msl, which coincides with the targeted bottom of the excavation. Therefore, the penetration of the Chesapeake confining unit will not yield much ground water from storage.

After the ground water is released from storage, the source of ground water into the excavations will either be from the upgradient and cross gradient sides of the excavation, or from the exposed bottom of the excavation. PPRP believes that the sides and bottom of the excavation will not yield a substantive amount of ground water for two reasons:

1. The presence of the power block, which is the largest excavation area, on a hydrologic divide will limit the amount of ground water that flows into the excavation from the sides of the excavation; and
2. There is a limited amount of ground water within the exposed Chesapeake confining unit.

Each reason is described further below.

The area of the proposed power block is located over a topographic high that bisects the drainage between the Maryland Western Shore watershed to the east, and the Lower Patuxent watershed to the west. The water table surface in the Surficial aquifer underlying the proposed power block excavation area follows a subdued reflection of surface topography, with roughly two-thirds of the water directed east toward Branch 1 and Branch 2 to the Chesapeake Bay, and one third west toward Branch 3 to Johns Creek in the Lower Patuxent watershed. In addition, the downward vertical hydraulic gradients measured in nested monitoring wells completed in the Surficial aquifer and Chesapeake confining unit also indicate that ground water flow on the hydraulic divide will be downward and out of the excavation. Therefore, little to no ground water is expected to flow into the proposed power block excavation area from the cross gradient and upgradient sides of the excavation.

The relatively impermeable Chesapeake confining unit consists of predominantly clay and silt with discontinuous sands. Even if the excavation reaches the level of the ground water in the unit, the low permeability unit will yield small amounts of ground water from the exposed sides and bottom of the excavation. In addition, the measured vertical hydraulic gradients between the Surficial aquifer and the Chesapeake confining unit are downward, which indicate that ground water flow will be downward into the Chesapeake confining unit and not upward into the excavation.

One additional source of water to the excavation will be precipitation that falls into the excavations. Annual rainfall in this area is typically about 45 inches per year. There is uncertainty associated with the amount of rainfall that will evaporate versus the amount that will be captured in the excavation. Assuming two-thirds of the rainfall evaporates and one-third is captured by the surface water diversions in the excavated areas, the 15 inches spread over the 750,000 square foot power block excavation will generate about 7,000,000 gallons per year or 19,000 gpd over a 365-day period. Assuming one-third of the rainfall evaporates and two-thirds is captured by the surface water diversions in the excavated areas, rainfall over the 750,000 square foot power block excavation will generate about 38,000 gpd over a 365-day period. Thus rainfall could add another 19,000 to 38,000 gpd of water to the excavation during the second year of construction. During a particularly wet month where 8 inches of rainfall is received, 42,000 gpd would be expected for a 30-day period. It is assumed that the rainfall would be received during year two, and thus the amount of water generated by rainfall would be within the average daily and month of maximum use limits proposed by UniStar for construction dewatering.

Impacts to the Surficial aquifer and downgradient streams from localized dewatering are expected to be minimal for two reasons.

1. Ground water extracted during dewatering will reduce the amount of water that discharges into downgradient streams (i.e., Branch 1, Branch 2, and Branch 3). However, the affected downgradient streams will likely receive baseflow from other parts of the watershed during construction dewatering and will not be completely drained. Additionally, the dewatering impacts will be temporary. After construction dewatering is complete and the excavations are backfilled, the elevation of the water table in the Surficial aquifer and water to the downgradient streams will be restored.

2. Local and temporary alterations to the water table in the cross gradient area adjacent to the power block excavation could occur, redirecting ground water into the excavations and away from streams. Once again, after construction dewatering is complete and the excavations are backfilled, the elevation of the water table in the Surficial aquifer and water to the downgradient streams will be restored.

Ground water users in the vicinity of Calvert Cliffs use ground water withdrawn from the deeper Piney Point, Aquia and Lower Patapsco formations, and thus would not be adversely affected by a lowering of the Surficial aquifer water table during dewatering.

UniStar has proposed to use water collected during dewatering for dust control. As discussed in Section 6.0, MDE WMA supports this use of the water. Typically dewatering water is discharged back into the watershed through a direct discharge to a surface water body or infiltration in a retention basin. Using the water for dust control will cause a minor consumptive loss of water through evaporation and therefore not discharge water back into the watershed. This consumptive loss of water will reduce the amount of water being released to the streams in the water shed. However, this consumptive loss of water to the watershed will be temporary and thus will have a minor impact on downgradient streams.

5.3.2 *Recommendations Relative to Ground Water Dewatering for Construction*

Construction dewatering for foundation excavations requires a permit from MDE WMA to appropriate and use waters of the State when dewatering either exceeds 10,000 gpd or 30 calendar days. UniStar requested in its Technical Report a ground water appropriation to conduct the dewatering at the 75,000 gpd and 100,000 gpd limits. The MD PSC is the actual permitting authority for the facility's water appropriations through the issuance of the CPCN. However, MDE's statutes and regulations in COMAR 26.17.06, as administered by the WMA, are used to guide the State's decision regarding water appropriations.

MDE WMA recommends that UniStar be granted an appropriation to allow the extraction of ground water from the Surficial aquifer for dewatering to support the construction of Unit 3. The appropriation is recommended to be granted with the following amounts:

- **Average Daily Use**. The annual average water requirement is 75,000 gpd from the Aquia Aquifer; and

- **Month of Maximum Use**. The maximum daily water use is 100,000 gpd from the Aquia Aquifer for the month of maximum use.

MDE WMA accepts UniStar's proposed appropriation limits for the average daily and month and maximum use amounts even though the analysis provided above indicates that the annual withdrawals beyond the first year of dewatering will likely be less than the amounts estimated by UniStar. The extraction of ground water during construction is a reasonable use of ground water. Further, the impacts to the Surficial aquifer and downgradient streams are temporary because the water level in the Surficial aquifer will recover once the excavations are backfilled.

MDE WMA recommends that UniStar obtain the appropriate MDE approval if dewatering water requires discharge to a surface water body. Specifically, UniStar needs to file a Notice of Intent form to MDE WMA for a General Permit for Construction

Activities in accordance with COMAR 26.08 to discharge dewatering water in excess of 10,000 gallons per day to a surface water body that is not used for dust control.

5.3.3 *Ground Water Quality Impacts*

Construction activities have the potential to adversely impact ground water quality. The following represent potential sources of ground water quality degradation during construction:

- Fuel spills;
- Construction effluents; and
- Dredge spoils associated with dredging the barge slip.

UniStar has proposed the following control measures to avoid potential impacts to ground water quality during construction:

- Implementation of a Stormwater Pollution Prevention Plan (SWPPP);
- Controlling runoff and potential spills;
- Monitoring for contaminants with construction area impoundments;
- Installation of bioretention ditches for the periphery of the power block, laydown, cooling tower and switchyard areas;
- Implementation of Best Management Practice (BMP) to protect against accidental discharge of fuel, or other fluids or solids that could degrade ground water quality; and
- Performing ground water monitoring to determine whether potential ground water quantity and quality impacts are realized.

PPRP believes that the control measures listed above will be adequate to minimize and mitigate impacts to ground water quality. PPRP recommends that the SWPPP be implemented to prevent runoff of contaminated stormwater from impacting ground water quality. In addition, implementation of UniStar's proposed BMPs during construction will protect ground water quality.