United States Department of the Interior

OFFICE OF THE SECRETARY
Washington, DC 20240

NOV 29 2010

Ms. Anita Riggleman
Valley Regional Office
Virginia Department of Environmental Quality
P.O. Box 3000, 4411 Early Road
Harrisonburg, Virginia 22801

Dear Ms. Riggleman:

We have reviewed the preliminary determination and draft Prevention of Significant Deterioration (PSD) permit prepared for the construction and operation of Virginia Electric and Power Company's (Dominion) Warren County Power Station (WCPS). The proposed natural gas-fired combined-cycle combustion turbine electric power generating facility will have an electrical output capacity of approximately 1280 megawatts. The plant would be located near Front Royal, seven kilometers northwest of Shenandoah National Park, a Class I air quality area managed by the National Park Service (NPS).

Under the Clean Air Act, I have an affirmative responsibility to protect the visibility and other air quality related values of Shenandoah National Park from the adverse impacts of air pollution. As discussed in detail in the enclosed Technical Support Document, I have determined that emissions from the proposed facility would adversely impact visibility and aquatic resources (e.g., sensitive streams) at Shenandoah National Park, thereby (1) diminishing the national significance of the park, (2) potentially impairing the structure and function of the park's ecosystem, and (3) diminishing the quality of the visitor experience to this national treasure. I understand that the Virginia Department of Environmental Quality (VA DEQ) helped the NPS and Dominion reach a mutually acceptable emissions reduction plan that will result in a net environmental benefit at the park, thereby adequately mitigating the WCPS adverse impacts on aquatic resources at the park and alleviating our adverse visibility impact concerns. I appreciate the VA DEQ's help in negotiating this emissions reduction plan, and your help in making the plan enforceable in the WCPS permit. Suggested draft permit language is included as Appendix C of the enclosed Technical Support Document. Assuming that the VA DEQ is able to include such an enforceable permit condition, and Dominion meets its obligation to implement the agreed upon emissions reduction plan, I do not oppose the WCPS permit.

The WCPS will be a major source of total filterable and condensable particulate matter (PM) with a diameter less than or equal to 10 microns (PM_{10}) at 216.1 tons per year (tpy), $PM_{2.5}$ (PM with a diameter less than or equal to 2.5 microns) at 215.6 tpy, nitrogen oxides (NO_X) at 330.7 tpy, carbon monoxide at 374.9 tpy, volatile organic compounds at 240.3 tpy, and sulfuric acid mist at 9.5 tpy. We acknowledge that the WCPS would be well-controlled, and we commend Dominion for their efforts in this regard.

In addition to our adverse impact concerns, we would like to bring to your attention an apparent procedural error regarding the VA DEQ's processing of the Dominion permit. Specifically, the VA DEQ did not provide us adequate time to review all relevant information regarding the proposed project, including the visibility modeling results, the preliminary determination, and the draft permit, before publishing the public notice and scheduling the public meeting regarding the WCPS. One purpose of the PSD program is to "assure that any decision to permit increased air pollution ...is made only after careful evaluation of all the consequences of such a decision and after adequate procedural opportunities for informed public participation in the decision-making process." In this case, the VA DEQ published a public hearing notice without providing us adequate time to conduct a thorough review, consistent with the requirements in the federal and VA DEQ PSD regulations. As a result, the public has not been notified of our concerns regarding potential adverse impacts on Shenandoah National Park, and the opportunity for informed public participation has been compromised.

Thank you for the opportunity to review the WCPS PSD permit application and related materials, and the VA DEQ's help and cooperation throughout the WCPS permit review process. If you have any questions regarding this matter, please contact Martha Bogle, Superintendent, Shenandoah National Park, at (540) 999-3500 x3100, or John Bunyak, Acting Chief, NPS Air Resources Division, at (303) 969-2818.

Sincerely,

Thomas L. Strickland
Acting Assistant Secretary for Fish and Wildlife and Parks

Enclosures

cc: w/enclosures:
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Department of the Interior
Comments on the Dominion Warren County Power Station
Prevention of Significant Deterioration Permit Application
November 24, 2010

Introduction

Virginia Electric and Power Company (Dominion) proposes to construct and operate its Warren County Power Station (WCPS) consisting of three natural gas-fired combined-cycle combustion turbines with an electrical output capacity of approximately 1280 megawatts. The plant would be located near Front Royal, Virginia, seven kilometers (km) northwest of Shenandoah National Park (NP), a Class I air quality area administered by the National Park Service (NPS). As proposed, the WCPS will be a major source and emit the following pollutants: nitrogen oxide (NO_X--331 tons per year, or TPY), particulate matter (PM_{10}--216 TPY), fine particulate matter ($PM_{2.5}$--216 TPY), carbon monoxide (375 TPY), volatile organic compounds (240 TPY), and sulfuric acid mist (9.5 TPY).

This proposed permit is being issued under the Prevention of Significant Deterioration of Air Quality Program (PSD). The purposes of the PSD program include to "preserve, protect and enhance the air quality in national parks, wilderness areas and other areas of natural, recreational, scenic or historic value" and "insure economic growth will occur in a manner consistent with the preservation of existing clean air resources." 42 U.S.C. 7470. In other words, the purpose of the PSD program is to manage growth in the context of environmental protection. For this permit application, the environmental protection context includes consideration of impacts on Shenandoah NP. The Clean Air Act gives the Federal Land Manager (FLM) an affirmative responsibility to protect air quality related values of Class I areas, like Shenandoah NP. A recent report recognizes that the park "has among the highest monitored concentrations of airborne sulfate particles, acidic deposition, and ground-level ozone of all national parks." [1] Even though the emission rates from the proposed WCPS project are relatively low, the predicted impacts are significant. As discussed further below, the NPS believes the emissions from the WCPS project will have an adverse impact on air quality related values at Shenandoah NP.

Another purpose of the PSD program is to "assure that any decision to permit increased air pollution …is made only after careful evaluation of all the consequences of such a decision and after adequate procedural opportunities for informed public participation in the decision-making process." In this case, the Virginia Department of Environmental Quality (VA DEQ) published a public hearing notice without providing the NPS with adequate time to conduct a thorough review, which is inconsistent with the requirements in the federal PSD and VA DEQ regulations. As a result, the public has not been notified of the NPS concerns regarding potential adverse impacts on Shenandoah NP and the opportunity for informed public participation has been compromised.

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[1] *Assessment of Air Quality and Related Values in Shenandoah National Park*, U.S. Department of the Interior, Tech. Report NPS/NERCHAL/NRTR-03/090 (2003).

Best Available Control Technology (BACT) Analysis

Based on the review and analysis of the materials received, we believe the proposed emissions from the WCPS would adversely impact resources at Shenandoah NP (see discussion below). Therefore, it is important that impacts at Shenandoah NP be lessened. We agree with the type of control technologies (e.g., Selective Catalytic Reduction) selected by Dominion for a combined cycle combustion turbine; however we believe that the WCPS could achieve lower emission limits by choosing an inherently cleaner combustion turbine (see table below) or reducing the size of the project. Please note that it is generally understood that a source impacting a Class I area is held to a higher emissions control standard and may be required to take additional measures to minimize impacts at that Class I area.

Turbine Manufacturer	Emissions (lb/hr) per turbine	
	NOx	PM10/2.5
Mitsubishi (currently proposed)	25.32	21.16
Siemens	19.90	15.93
GE	19.81	17.93

In summary, we agree with the type of control technologies selected by WCPS for a combined cycle combustion turbine. However, we believe that the WCPS could achieve lower emission limits by choosing an inherently cleaner combustion turbine and/or reducing the size of the project. Therefore, we recommend that Dominion consider these alternatives to reduce its emissions and to help mitigate its adverse impacts at Shenandoah NP.

Air Quality/Air Quality Related Values (AQRV) Modeling Analysis

Increment Analysis

Single Source Analysis: The first step in the air quality impact analysis is to estimate the impact of emissions from the proposed source alone and compare those impacts to the PSD significant impact levels for Class I increments. If the predicted impacts are considered significant, then the permit applicant must examine the cumulative impacts to determine if any PSD increment would be violated. We agree with the modeling methodology used to estimate impacts from the WCPS project alone. The draft permit also includes a one-hour NO_X limit, which is used to model the one-hour National Ambient Air Quality Standards (NAAQS) and is used in the PLUVUE visibility analysis.

Dominion's modeling of project emissions of NO_2 and PM_{10} indicate that the WCPS will have a significant impact within Shenandoah NP for these two pollutants. Therefore, a cumulative modeling analysis was conducted, using a background source inventory provided by Virginia and West Virginia.

Cumulative Analysis: The results of Dominion's cumulative increment analysis show that the WCPS would not cause or contribute to any NO_2 or PM Class I increment violations at Shenandoah NP. However, although we recognize that it is the responsibility of the State and EPA to insure that increments are not exceeded, we continue to question the methods used by

Dominion to determine which sources to exclude from the cumulative analyses—especially sources within 50 km of Shenandoah NP.

Visibility--Coherent Plume Visibility Analysis

The visibility analysis for the WCPS was performed with the EPA's PLUVUE model following the guidance in both the Federal Land Managers' Air Quality Related Values Work Group (FLAG 2000 and FLAG 2010) documents. Dominion conducted the coherent plume analysis because the source is located less than 50 km from Shenandoah NP. The NPS conducted its own haze analysis for impacts beyond 50 km, and the results indicated that the haze impacts were below the NPS's threshold of a 5 percent change in extinction, and therefore insignificant. The plume analysis from Dominion followed the modeling protocol that was originally developed for the Competitive Power Ventures (CPV) 600 megawatt permit in 2003, which we did not oppose due to its lower impacts. The CPV-permitted facility was never built, and Dominion bought the CPV site for its WCPS project. The PLUVUE analysis was performed using five years (1988-1992) of National Weather Service (NWS) meteorological data for Dulles International Airport, which is the most appropriate data set available for this area. Only daylight hours were evaluated. Five observer locations were placed to evaluate whether a coherent plume could be seen within the boundaries of the park. These locations are Shenandoah Valley Overlook, Dickey Ridge, Signal Knob Overlook, Compton Gap Road, and Lands Run Road Gate. The PLUVUE model calculates one-hour impacts at the each of the five observer locations. The plume is transported and dispersed based on wind speed and direction, and atmospheric stability and the final plume rise from the stack.

The thresholds for a visible plume impact in both FLAG 2000 and FLAG 2010 are a plume contrast (|C|) of 0.02 and a change in color (Delta E) of 1.0. The NPS, in accordance with FLAG, evaluated impacts based on frequency, magnitude and duration. The PLUVUE model also calculates it own thresholds based on observer-plume viewing angles, terrain background conditions, and sun angle for the specific hour of the calculation. These internally calculated thresholds can differ from the above-cited FLAG thresholds and can be either greater or less than the FLAG thresholds. Based on the existing CPV analysis for the proposed 600 MW power plant, the five observer locations, and the Dulles NWS meteorological data, the internally-calculated most-stringent value for plume contrast |C| = 0.017 and 0.85 for Delta E. PLUVUE calculates impacts to |C| and Delta E against four types of backgrounds. They are the sky, and three colors of background terrain: white, grey, and black. The short-term emissions of NO_X, SO_2 and PM are modeled in PLUVUE and are assumed to be emitted from a single stack.

The WCPS PLUVUE analysis indicates that there would be 73 hours of visible plume impacts in Shenandoah NP. All 73 hours of impacts exceeded the contrast |C| thresholds and 14 of those hours also exceeded the Delta E thresholds. There are hours when there are impacts at two of the observer locations at the same time. When this is taken into account, there are 65 individual hours when there is either an exceedance of the Delta E and/or contrast threshold. Therefore, the frequency of impacts is between 65 hours to 73 hours depending if individual hours are double-counted with impacts at two observer locations. The duration of the impacts, that is, having consecutive hours of impacts, occurred five times (each was two consecutive hours of impacts above the thresholds). The magnitude of the impacts, however, is large. Six of the impacts (at

Signal Knob) are an order of magnitude over the FLAG thresholds or the internally calculated PLUVUE thresholds.

For example, the most-impacted observer location is Signal Knob Overlook which would experience 26 days with visible plumes for a total of 29 hours in which the contrast threshold would be exceeded, and five of those hours would also exceed the Delta E threshold. Nine of these days were predicted in October, and six in September (months with some of the highest visitation rates in Shenandoah NP). The largest contrast impact is 40 times the threshold and the largest Delta E impact is four times the threshold.

A summary of the impacts predicted for each observer location is presented below.

View Point	Days	Contrast Hours	Delta E Hours
Signal Knob Overlook	26	29	5
Dickey Ridge	14	16	3
Compton Gap Road	14	15	0
Lands Run Road Gate	8	8	5
Shenandoah Valley Overlook	3	3	0
Totals	65	71	13

With this severe magnitude of impacts, we conclude that the visibility impacts adversely affect one of the prime resources of Shenandoah NP, namely the visibility from Skyline Drive.

Unlike some adverse impacts to a park's resources, a visible plume impact cannot be directly mitigated by emission reductions from other sources in other locations. For visible plume impacts to be directly mitigated, the new source in question must reduce its emissions and/or change its location relative to the park. In the initial permit submittal to the VA DEQ, WCPS submitted applications based on three different manufacturers of gas-fired turbines. As discussed above in the BACT section, the proposed turbines are manufactured by Mitsubishi and emit more visibility-impairing pollutants than the other two brands, Siemens and General Electric.

The NPS conducted a limited PLUVUE analysis of the Siemens engines by modeling the hour of the largest contrast impact and the hour of the largest Delta E impact. This analysis indicates that the magnitude of the impacts would be reduced by approximately 30%. A similar PLUVUE analysis of the General Electric engines indicates that the magnitude of the impacts would be reduced by approximately 15%. Also, in addition to reducing the magnitude of impacts by using the Siemens or GE turbines, the frequency of impacts would be reduced because the hours that were marginally over the perception thresholds with the Mitsubishi turbines would drop below the threshold levels with the other turbines.

Acid Deposition

The modeled nitrogen deposition rates resulting from WCPS emissions are predicted by Dominion, VA DEQ, and NPS to exceed the 0.01 kilograms per hectare per year (kg/ha/yr)

Deposition Analysis Thresholds (DAT) used by NPS to determine whether a source's impacts are significant and warrant further analysis. Therefore, WCPS is expected to contribute significantly to acidic deposition in Shenandoah NP. The maximum predicted nitrogen deposition impact at the park from WCPS is 0.022 kg/ha/yr, more than twice the DAT. As discussed in Appendix A, streams in the park are currently impaired because of acidification and WCPS is expected to contribute to that impairment. WCPS's impacts occur in areas where deposition is of concern because of the potential depletion of acid neutralizing capacity (ANC) and subsequent impacts to stream biota. In addition, WCPS's impacts would occur in areas that currently experience acidic deposition loading that are unsustainable over the long-term. For these reasons, the predicted impacts from the WCPS on streams and aquatic biota in Shenandoah NP are determined to be adverse.

Summary of Modeling Results:

- Visibility at Shenandoah NP would be adversely affected by a coherent plume due to the emissions from WCPS.
- Nitrogen deposition from WCPS would adversely affect stream water chemistry at Shenandoah NP.

Procedural Concerns

We are concerned that the VA DEQ did not follow proper procedures regarding publication of its Public Notice and the FLM's review of the WCPS application. According to 40CFR51.307, VA DEQ should have provided us with all information relevant to the permit application within 30 days of receipt and at least 60 days prior to the public hearing, which was held on November 9, 2010. Instead, VA DEQ did not provide the necessary PLUVUE modeling files until September 24, 2010, and its staff analysis and the draft permit until October 7, 2010. In particular, the PLUVUE modeling files were essential in evaluating the magnitude, frequency, and duration of the plume impacts. Furthermore, the VA DEQ should have provided the FLM the opportunity to fully analyze the September 24 modeling data and submit a visibility analysis before announcing the public hearing. This compromises the public's ability to comment on this important issue, as envisioned by procedural requirements in the federal regulations.

VA DEQ has stated that it was following the public notification procedures in its State Implementation Plan (SIP):

> 9VAC5-80-1765. Sources affecting federal class I areas - additional requirements.
>
> B. The board shall provide written notice of any permit application for a proposed major stationary source or major modification, the emissions from which may affect a class I area, to the federal land manager and the federal official charged with direct responsibility for management of any lands within any such area. Such notification shall include a copy of all information relevant to the permit application and shall be given within 30 days of receipt and at least 60 days prior to any public hearing on the application for a permit to construct. Such notification shall include an analysis of the proposed source's anticipated impacts on visibility in the federal class I area. The board shall also provide the federal land manager and such federal officials with a copy of the preliminary determination required under 9VAC5-80-1773 B, and shall make available to them any materials used in making that determination, promptly after the board makes

such determination. Finally, the board shall also notify all affected federal land managers within 30 days of receipt of any advance notification of any such permit application.

Potential Mitigation Measures

In addition to reducing emissions from WCPS as suggested above, it may be possible to mitigate acid deposition impacts by securing emission reductions from other sources in the area which would provide a net environmental benefit to Shenandoah NP. However, as noted above, plume impacts cannot be directly offset with emissions reductions in other locations. Nevertheless, adverse visibility impact concerns may be alleviated if sufficient emission reductions are achieved to demonstrate "a net environmental benefit" at the park.

Acid Deposition Mitigation Modeling Analysis

The NPS conducted an acid deposition mitigation analysis in order to evaluate the effectiveness of potential NO_X emission reductions either through emission reduction credits or purchases of emission allowances from other sources. The acid deposition mitigation analysis was performed using the EPA CALPUFF v 5.8 suite of models. Initially, the standard VISTAS Domain 5 CALMET data set was used for the years of 2001, 2002, and 2003. The offset nitrogen acid deposition mitigation analysis eventually focused on 2001 which was the year the WCPS analysis modeled the highest impact of 0.022 kilograms per hectare per year (kg/ha/yr). WCPS's analysis only evaluated nitrogen deposition for 50 km from the Front Royal site with CALPUFF, which only covered the northern 43 km of Shenandoah NP.

For the modeling analysis, a large synthetic combustion source emitting 1000 TPY of NO_X, 1000 TPY of sulfur dioxide, and 60 TPY of primary sulfate was placed at distances of 50 km, 100 km, and 150 km in the eight cardinal directions from the proposed location of the WCPS site in Front Royal. In addition to the 24 locations in the cardinal directions, the synthetic combustion source was also located at distances of 200 km and 250 km from Front Royal to the west and northwest (270 degrees and 315 degrees) due to the predominate wind flow from those directions toward Front Royal and Shenandoah NP. The impacts of the potential deposition offsets were calculated at 298 receptor locations in Shenandoah NP, covering the entire length of the park. This is the same fixed receptor data set that is used by the NPS in its PSD permitting analyses. The CALPOST model was then run in the wet and dry deposition combination mode to assess the possible environmental benefits of reducing nitrogen and/or sulfur emissions from a potential offset source at different wind directions and distances from the Front Royal location.

Nitrogen deposition offset ratios were then calculated by the ratio of WCPS's modeled impact 0.022 kg/ha/yr to the NPS's modeled deposition impact of the 1000 TPY synthetic source multiplied by a factor of three to adjust WCPS's emissions to the synthetic offset source. Using these output ratios, NPS calculated a spline interpolation (using default ArcGIS inputs) which conceptually bends a rubber sheet exactly thru the sample points while minimizing curvature of the surface. NPS then reclassified the spline interpolation, in effect creating a contour surface at ratios of 1, 2, 3, 5, 10, 20, 30 and 40. Using these classification values, NPS assigned to each county a ratio value based upon inspection of the contour lines crossing each county. The results of this analysis are contained in Appendix B. NPS believes that actual reductions of emissions

according to the manner described above would be a viable option for mitigating acid deposition impacts from WCPS.

Dominion's Proposed Emissions Reduction Plan

The NPS and Dominion have reached a mutually acceptable emissions reduction plan that will result in a net environmental benefit at the park, thereby adequately mitigating the WCPS adverse impacts on aquatic resources at the park. As noted above, adverse plume impacts cannot be directly offset with emissions reductions in other locations. Nevertheless, adverse visibility impact concerns may be alleviated if sufficient emission reductions are achieved to demonstrate a net environmental benefit at the park. The Dominion plan consists of a combination of emission reduction credits and emission allowances under the Acid Rain Program, resulting in a net environmental benefit to park resources. Draft permit language that would make the emissions reduction plan enforceable is included as Appendix C.

Conclusions and Recommendations

- The draft permit proposed by VA DEQ is well-crafted, and we commend VA DEQ for the stringency of the emission limits it has proposed for NO_X--they are equal to the lowest such rates we have seen for a combustion turbine.

- We also commend VA DEQ for insuring that the averaging periods established for each pollutant are protective of the relevant NAAQS and PSD Increments. We also believe that the measures proposed by VA DEQ to insure that compliance with the proposed permit limits is accurately monitored are exemplary.

- We recommend that Dominion consider other turbines as alternatives to the proposed turbines in order to further reduce its emissions and its corresponding impacts at Shenandoah NP.

- The air pollutant dispersion modeling analyses presented to date indicate that even at the relatively low emission rates contained in the proposed permit, the impacts of those emissions in Shenandoah NP constitute an adverse impact upon visibility.

- We are also concerned about the contribution of additional acidifying pollutants into the aquatic ecosystems of Shenandoah NP. These ecosystems are already degraded by acidic deposition, and WCPS will significantly contribute to that degradation. Based on the review and analysis of the information received by us, we believe the WCPS facility, as proposed, would have an adverse impact on aquatic systems at Shenandoah NP.

- We believe that Dominion's proposed emissions reduction plan will adequately mitigate the adverse impacts on the aquatic systems of the park and result in a net environmental benefit to park resources.

Appendix A.
Potential Impacts to Streams and Associated Biota in Shenandoah NP from the Dominion Warren County Power Station (WCPS) Project

Background

Atmospheric deposition of sulfur (S) and nitrogen (N), derived from emissions of sulfur dioxide and nitrogen oxides (NOx), has caused acidification of soils, streams, and lakes across broad areas of the eastern U.S., including Shenandoah National Park (NP) (Sullivan et al. 2003). Sensitivity of terrestrial and aquatic ecosystems to acidification from S and N deposition is primarily governed by bedrock type. Soils derived from bedrock low in base cations (e.g., calcium and magnesium) have little acid-buffering capacity and are very sensitive. Streams associated with this bedrock type are also poorly buffered and sensitive. Acid deposition depletes already low concentrations of base cations in sensitive soils and streams, with eventual reduction in pH. As soils become acidic, base cations necessary for plant and tree growth become less available, and toxic aluminum becomes soluble, affecting roots and general tree health. As streams become acidic, acid-sensitive fish and invertebrate species decline and can be extirpated from areas (EPA 2008).

Many streams in Shenandoah NP are located on sensitive or very sensitive bedrock, with limited acid-neutralizing capacity (ANC). Because of long-term elevated levels of acid deposition to the area, a number of streams in the park experience chronic or episodic acidification, with subsequent effects to stream biota (Bulger et al. 1999, 2000). Even in streams not yet acidified, biodiversity has been reduced as ANC is depleted over time by acid deposition. Relatively unaffected streams with ANC greater than 100 microequivalents per liter (μeq/L) generally support healthy fish and aquatic macroinvertebrates (e.g., insects). Fish species richness is much reduced and macroinvertebrate diversity begins to decline as ANC decreases to 50-100 μeq/L. Streams below an ANC of 50 μeq/L (ANC 50) are considered extremely sensitive to acidification. Below ANC 50, fish and aquatic insect diversity is much reduced and acidic rainfall or snowmelt events may episodically depress ANC to below 0 μeq/L. At or below ANC 0, streams are acidified and no longer support fish and aquatic insect populations (Cosby et al. 2006).

For fish, these ANC effects thresholds are based on brook trout, but brook trout are one of the least sensitive fish species in Shenandoah NP. There are several species that are significantly more sensitive to decreasing ANC including longnose dace, mountain redbelly dace, blacknose dace, rosyside dace, and mottled sculpin (Krawczel 2004). Therefore, if conditions are such that brook trout are affected, other species are likely to be even more negatively affected. On average in the park fish species richness declines by one fish species for every 21 μeq/L decrease in ANC (Cosby et al. 2006). Table 1 summarizes levels of concern for fish and macroinvertebrates associated with varying levels of ANC.

Table 1. Stream ANC levels and associated impacts to fish and invertebrates at Shenandoah NP (from Cosby et al. 2006).

Level of Concern	Effects
Low (ANC >100 μeq/L)	Reproducing brook trout populations expected where habitat is suitable. Fish species richness probably unaffected. Diversity and/or evenness of aquatic macroinvertebrate communities unaffected. Number of families and/or number of individuals of aquatic insects unaffected.
Moderate (ANC = 50 to 100 μeq/L)	Reproducing brook trout populations expected where habitat is suitable. Fish species richness much reduced as species more sensitive than brook trout are impacted. Diversity and/or evenness of aquatic macroinvertebrate communities begin to decline. Number of families and/or number of individuals of aquatic insects begin to decline.
Elevated (ANC = 0 to 50 μeq/L)	Brook trout populations sensitive and variable, lethal and sub-lethal effects possible. Fish species richness much reduced. Diversity and/or evenness of macroinvertebrate communities decline markedly. Number of families of aquatic insects declines markedly. Number of individuals in most aquatic insect families declines markedly. Number of individuals of acidophilic (acid-loving) aquatic insect families increases.
Acute (ANC < 0 μeq/L)	Lethal effects on brook trout populations probable. Complete extirpation of fish populations expected (species richness equal zero). Extremely low diversity and/or evenness of aquatic macroinvertebrate communities. Extremely reduced number of families of aquatic insects. Extremely reduced numbers of individuals of most aquatic insect families. Large numbers of individuals of acidophilic aquatic insect families.

Potential Impacts to Shenandoah NP Streams from WCPS

Virginia Electric and Power Company's (Dominion) analysis predicted that emissions of NOx from the project would increase nitrogen deposition in the northern portion of Shenandoah NP. To determine the significance of their contribution, Dominion compared their predicted impacts to the Deposition Analysis Threshold (DAT) for nitrogen or sulfur deposition. The DAT is a screening tool used by the National Park Service (NPS) to evaluate a new or modified source's predicted contribution to deposition in an NPS area. A DAT is defined as the additional amount of N or S deposition within an area, below which estimated impacts from a proposed new or modified source are considered negligible. In other words, if the new or modified source has a predicted N or S deposition impact below the respective DAT, the NPS will consider that impact to be negligible, and no further analysis would be required for that pollutant. In cases where a

source's impact equals or exceeds the DAT, the NPS will make a project-specific assessment of whether the projected increase in deposition would likely result in an "adverse impact" on resources considering existing AQRV conditions, the magnitude of the expected increase, and other factors (FLAG 2010). The DAT for the eastern U.S. is 0.010 kilograms/hectare/year (kg/ha/yr) for either N or S deposition. At some receptors, WCPS' predicted impact was greater than 0.020 kg N/ha/yr, a value more than twice the DAT (Figure 1).

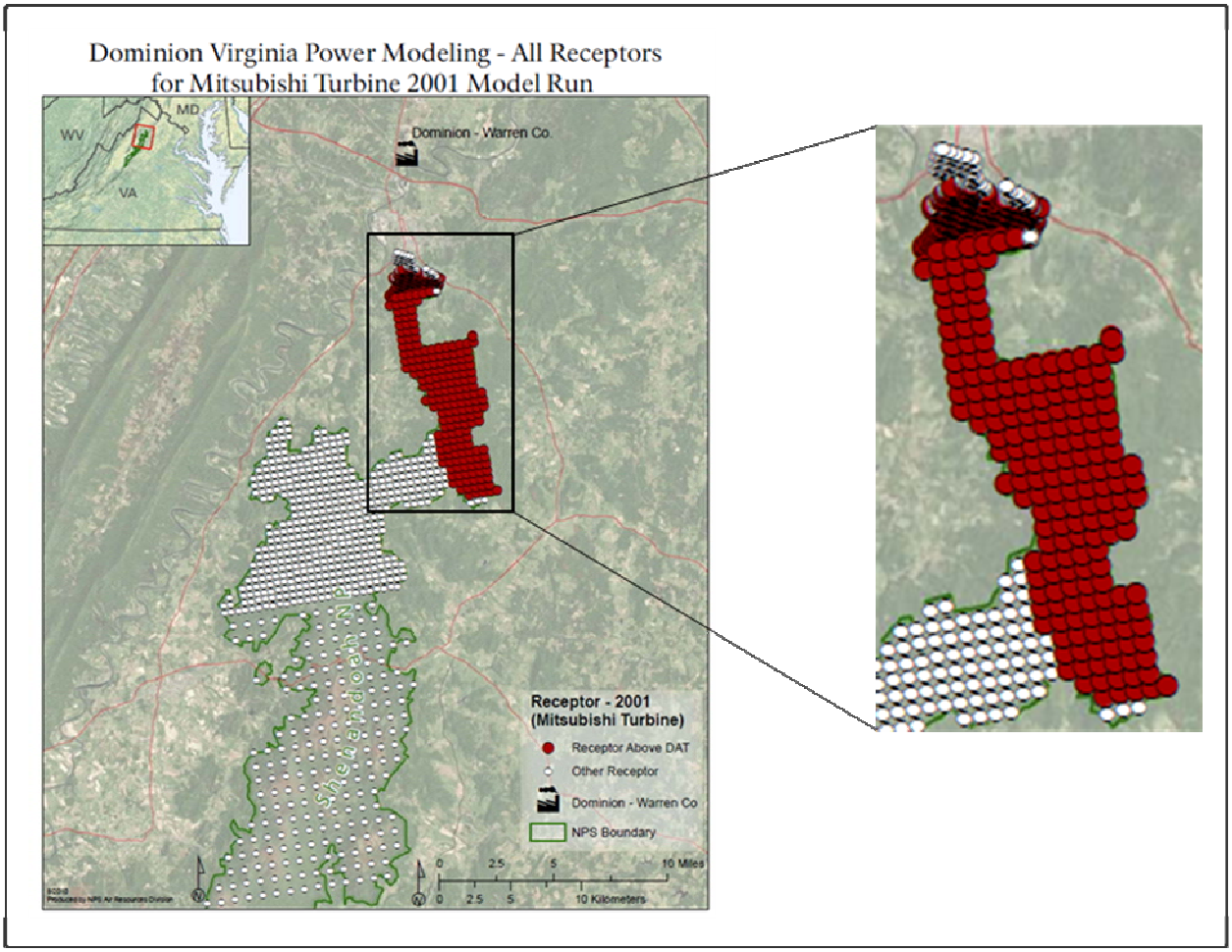

Figure 1. Receptors in northern portion of Shenandoah NP where impacts from the WCPS project are predicted to exceed the Deposition Analysis Threshold (DAT) for nitrogen deposition.

A project-specific assessment was then conducted to evaluate whether the projected increase from WCPS would cause or contribute to an adverse impact on resources in Shenandoah NP. First, we examined the current condition of stream ANC in the park. Streams in the park are currently degraded by acidic deposition. Of the streams on the most sensitive bedrock, almost half are chronically acidic (ANC < 0 μeq/L). Streams in which ANC has been depleted to less than 50 μeq/L by acidic deposition support fewer fish and have lower fish species richness, lower population density, poorer condition, fewer age classes, and smaller sizes (Sullivan et al. 2003). Streams with lower ANC also have fewer numbers and types of aquatic insects, which are indicative of stream health and provide an important source of food for fish. To date, one

watershed in the park, Jeremy's Run, has been designated as "impaired" by the State of Virginia Department of Environmental Quality (VA DEQ) under Section 303(d) of the Clean Water Act because of acidity attributed to atmospheric deposition of N and S compounds (VA DEQ 2006 Water Quality Assessment). VA DEQ is required to develop a Total Maximum Daily Loadings (TMDL) Plan to restore pH in Jeremy's Run to levels capable of sustaining healthy biota by 2016.

The streams located in the northern part of the park affected by the DAT exceedance have not been sampled, so their ANC status can only be inferred by extrapolating data from nearby watersheds that have been studied. An analysis using such an extrapolation method predicted that some of the areas of WCPS' DAT exceedance are expected to be of "moderate" concern (Cosby et al. 2006; Figure 2). That is, ANC is expected to be from 50-100 μeq/L, with fish diversity much reduced and macroinvertebrate communities beginning to decline (Table 1). Additional acid inputs could reduce ANC to the "elevated" concern category, with lethal and sub-lethal effects to brook trout, but even greater effects to more sensitive fish species. Numbers and diversity of aquatic insects would also decline.

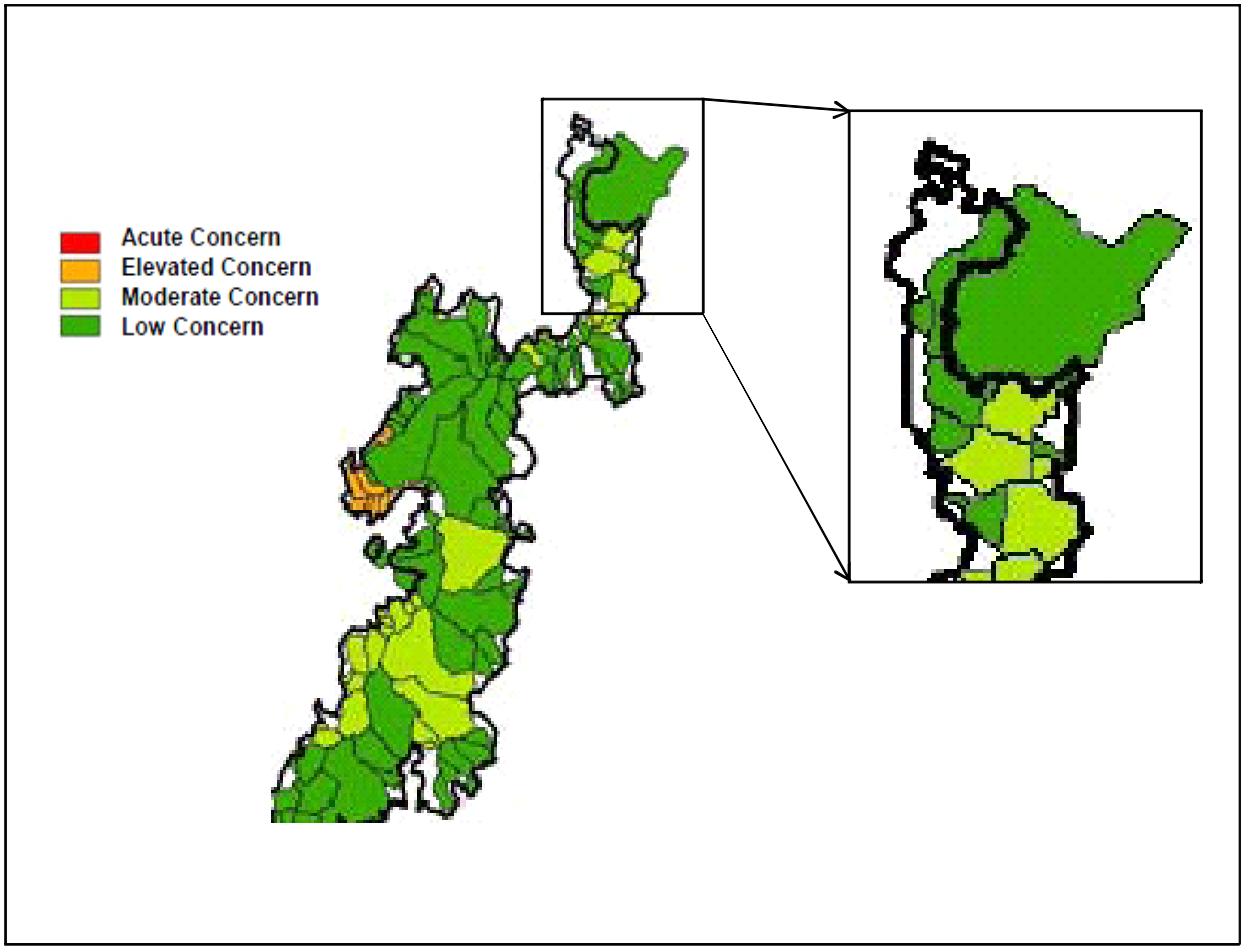

Figure 2. Areas of concern for acidic deposition impacts in the northern portion of Shenandoah NP (from Cosby et al. 2006). Receptors with DAT exceedances (compare to figure 1) occur in areas of moderate

concern. In areas of moderate concern, fish diversity is expected to be much reduced and aquatic insect diversity reduced (see Table 1).

Of particular concern to the NPS is the long-term ecosystem health of parks. The NPS Organic Act of 1916 directs national park managers "to conserve the scenery and the natural and historic objects and wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations" 16 U.S.C. §1(1997). In keeping with this mandate, NPS is interested in determining what amount of deposition loading can be tolerated by park ecosystems over the long-term (i.e., "future generations") without degradation. The loading that a stream can sustain long-term without damage is termed the "steady-state" critical load. Below this loading, significant harm to sensitive ecosystems is not expected to occur according to current scientific understanding. The Steady-State Water Chemistry Model was used to estimate the steady-state critical loads to maintain healthy aquatic biota (i.e., ANC 50) in streams in Shenandoah NP. The analysis indicated that most of the streams in Shenandoah NP are currently receiving unsustainable loadings of N and S deposition (Figure 3). Although currently the areas affected by the DAT exceedance are considered to be of moderate concern (Figure 2), these areas are receiving up to twice the steady-state critical load and under these conditions, the streams would be expected to eventually become acidified (Sullivan et al. 2010).

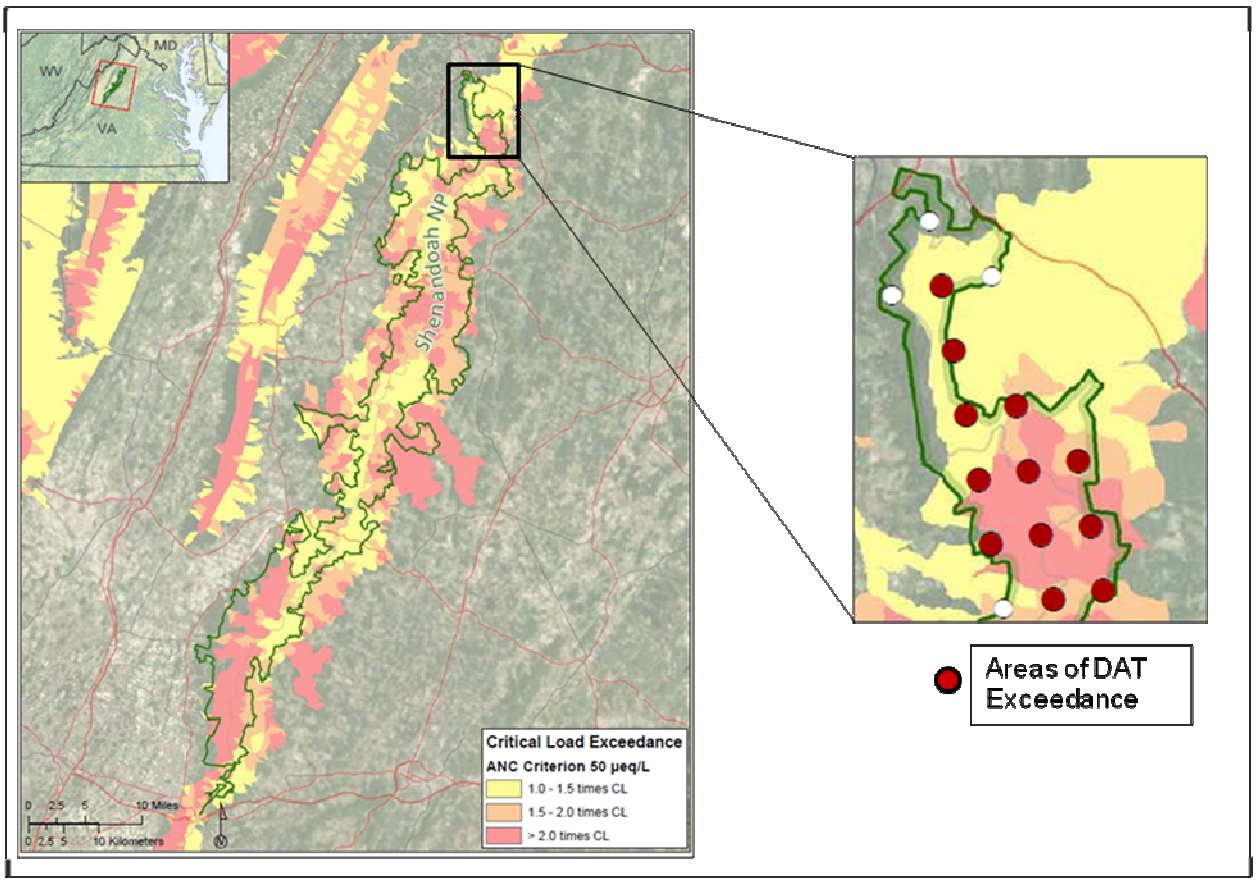

Figure 3. Steady-state critical load exceedances in Shenandoah NP to maintain ANC of 50 µeq/L. Enlargement at right shows DAT exceedances in areas of critical load exceedances. The DAT is

exceeded in areas where current deposition is 1.0 to more than 2.0 times the steady-state critical load (Sullivan et al. 2010).

In summary, the WCPS is predicted to significantly increase acidic deposition in Shenandoah NP. Several streams in the park are currently impaired because of acidification and WCPS is expected to contribute to that impairment. WCPS' significant impacts occur in areas where deposition is of concern because of the potential depletion of ANC and subsequent impacts to stream biota. In addition, the WCPS' impacts occur in areas that currently experience acidic deposition loading that are unsustainable over the long-term. For these reasons, the predicted impacts from the WCPS on streams and aquatic biota in Shenandoah NP are determined to be potentially adverse.

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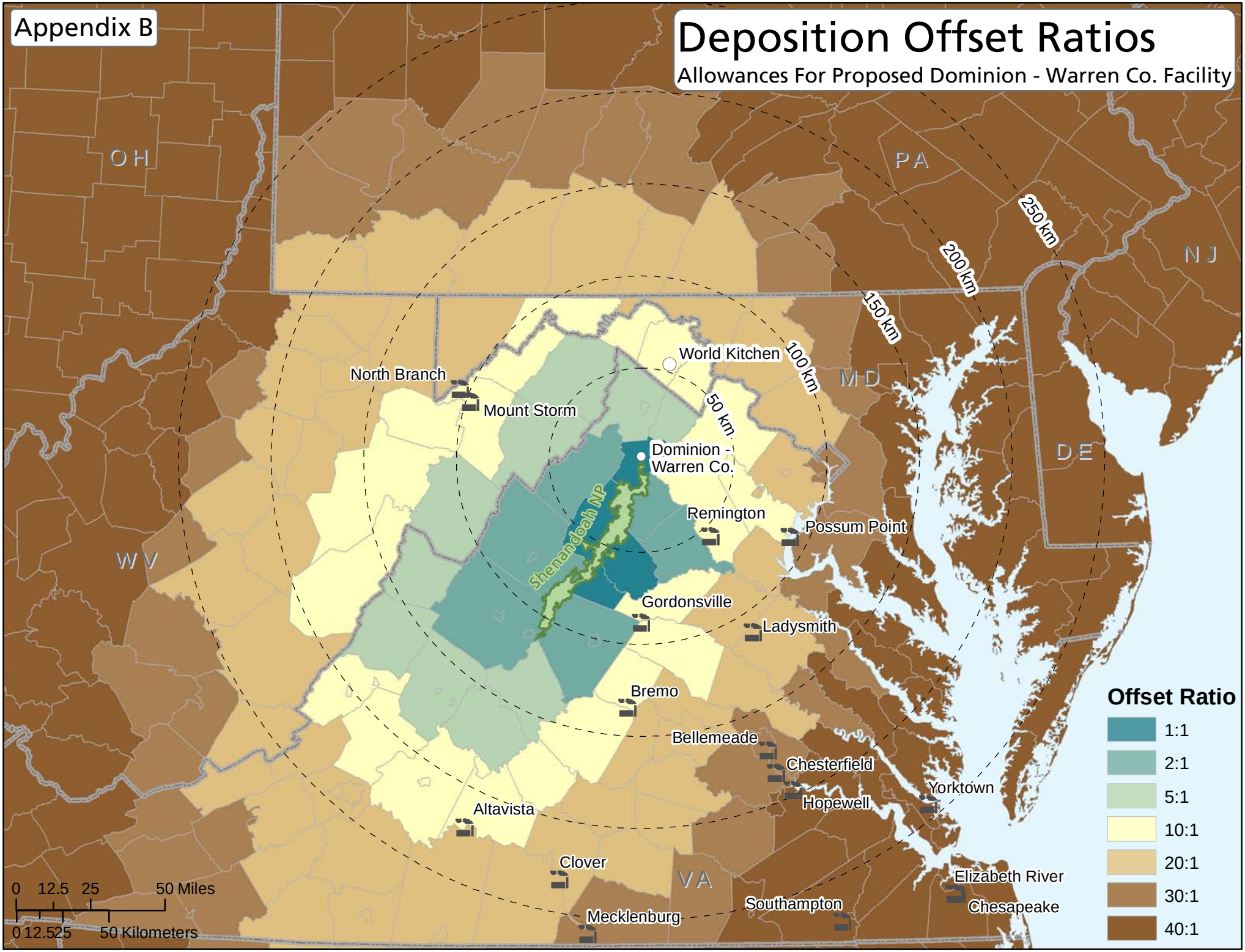
Appendix B

Deposition Offset Ratios

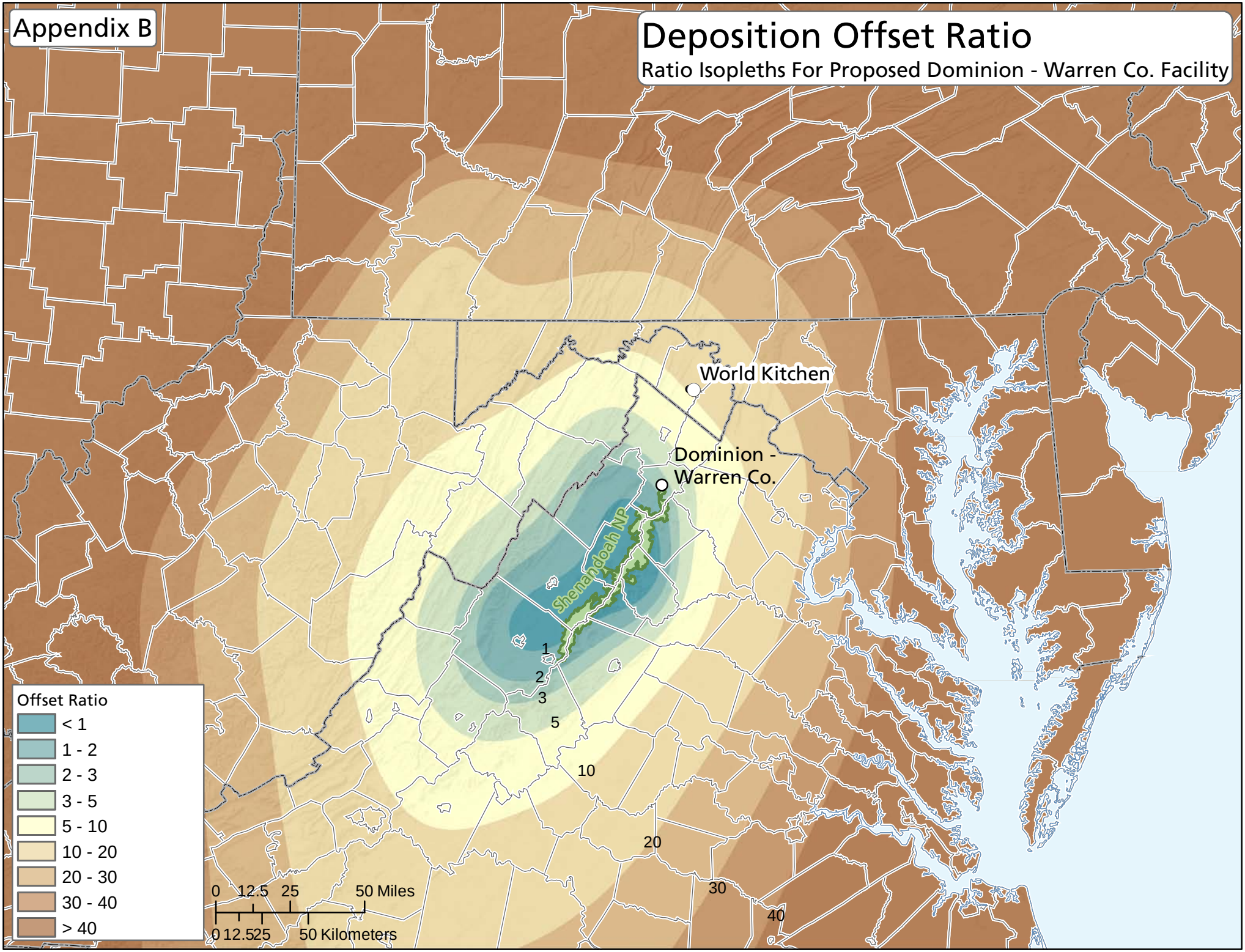
Allowances For Proposed Dominion - Warren Co. Facility



Appendix B

Deposition Offset Ratio

Ratio Isopleths For Proposed Dominion - Warren Co. Facility



Appendix C.
Proposed Dominion – Warren County Power Station Mitigation Plan

The following draft permit language reflects Dominion's mitigation plan for its proposed Warren County Power Station. The plan consists of a combination of emission reduction credits and emission allowances under the Acid Rain Program, resulting in a net environmental benefit to resources at Shenandoah National Park (NP).

Source Reductions and Emission Offsets – The permittee shall implement the following actions to secure a total of emission offsets equal to the Total Annual NO_x Limit, (i.e. the sum of NO_x limits for the combustion turbines, duct burners and emergency engines in the PSD Permit) ("TANL") at the Dominion-Warren County Power Station. The National Park Service has determined that for the Warren County Power Station these actions provide full mitigation or acceptable net environmental benefits for all potential or actual adverse impacts to Air Quality Related Values, including visibility and aquatic resources, at Shenandoah NP.

a. Definitions – Solely for the purposes of this Mitigation Plan, the following definitions shall apply:

   i. "Emissions Offsets" means Emission Reduction Credits, Allowances under the Acid Rain Program or other emissions reductions that are obtained to mitigate potential impacts of the permitted facility on the air quality and related values in Shenandoah NP.

   ii. "Eligible SO_2 Allowances" mean those Allowances (as defined in the Clean Air Act, section 402(3)) that originate from Dominion owned facilities in the region shown on Appendix B ("Originating Account").

   iii. "Eligible NO_x Allowances" mean any NO_x Allowances as that term is defined in a federally-approved NO_x emissions trading program.

   iv. "Facility NO_x Emission Ton" means each ton of NO_x emissions from the permitted facility.

   v. "Allowable Annual NO_x Emissions" means 330.7 tons NO_x per year, which represents the maximum Facility NO_x Emission Tons authorized under the permit.

   vi. "Emissions Reduction Credits" means the number of tons per year of creditable emissions reductions.

   vii. "Offset Ratio" means the ratios shown on the map at Appendix B.

b. <u>Emission Offsets from specific facilities</u> – The permittee shall secure a reduction in emissions from a source or sources in the manner prescribed as follows:

   i. The permittee shall permanently cease all permitted SO_2 and NO_x emissions at North Branch Power Station in Grant County, West Virginia. Based on the actual

emissions in 2007-2008 and the distance and direction of North Branch Power Station from the Park these reductions shall result in an Emission Offset of 243 TPY toward the TANL offset requirement. Neither the permitted nor actual SO_2 and NO_x emission reductions from the North Branch Power Station may be used as Emissions Offsets for any other purpose.

ii. The permittee shall retire permanently the 175 TPY of NO_x offsets procured from World Kitchen in Martinsburg, West Virginia approved by the DEQ by letter of 11/17/07. Based on the distance and direction of World Kitchen from the Park, this retirement of emission reduction credits shall result in 17.5 TPY emission offsets toward the TANL requirement.

c. Allowances or Emission Reduction Credits retirements

The permittee shall secure and retire Eligible SO_2 Allowances, Eligible NO_x Allowances, or Emission Reduction Credits in the amount equivalent to 70.2 TPY of Emission Offsets toward the TANL requirement by a combination of the following.

i. Retire Eligible SO_2 Allowances or Eligible NO_x Allowances by transferring them from the Originating Account each year (by making the appropriate designation(s) in the Allowance Tracking System transfer form) into an account administered by the U.S. EPA for the Acid Rain Program to be identified by the DEQ.

(a) To ensure that Eligible SO_2 Allowance or Eligible NO_x Allowance retirements benefit air quality and related values in Shenandoah NP, any such Allowance that originates from facilities located in an area with an Offset Ratio (from the Appendix B map) higher than 10:1 shall require retirement of an additional ten percent of Eligible SO_2 Allowances or Eligible NO_x Allowances in order to offset one Facility NO_x Emission Ton. For example, Eligible SO_2 Allowances that originate from the 20:1 Offset Ratio area shall be retired at the rate of 22:1; Eligible SO_2 Allowances that originate from the 30:1 Offset Ratio area shall be retired at the rate of 33:1; and Eligible SO_2 Allowances that originate from the 40:1 Offset Ratio area shall be retired at the rate of 44:1 until all of the Allowable Annual NO_x Emissions are offset.

(b) The permittee is prohibited from replenishing or causing to be replenished those retired allowances in the Originating Account of the specific Dominion unit that the allowances originated from, by securing, purchasing or otherwise acquiring allowances from any other accounts and transferring them into that Originating Account. After the date of initial operation, the only allowances that can be placed in that account are those allocated by EPA to that account of a vintage year of and after startup of the equipment listed in the Dominion-Warren County Power Station PSD Permit.

ii. Secure and retire Emission Reduction Credits multiplied by the Offset Ratio of the plant location shown on Appendix B.

iii. The requirements of c.i. and ii. in equation form are:

(Eligible SO_2 or NO_x $\text{Allowance}_{\text{Plant in area of 10:1 Offset Ratio or less}}$ /Offset Ratio) +

(Eligible SO_2 or NO_x $\text{Allowance}_{\text{Plant in area greater than 10:1 Offset Ratio}}$ /(1.1x Offset Ratio))

$\geq 70.2 - \sum (\text{ERC}_{\text{Plant}}/\text{Offset Ratio})$

d. Procedure and timing.

i. The actions in items b. and c. shall be completed and in effect prior to startup of the equipment listed in the Dominion-Warren County Power Station PSD Permit.

ii. Prior to startup of the equipment listed in the Dominion-Warren County Power Station PSD Permit, the permittee shall provide to the DEQ written documentation from the air pollution control agency that regulates each of the sources identified in b. and c.ii. that the requirements of b. and c.ii. (if that option is selected) have been met and that the emission reductions are recognized by the agency as creditable, permanent, and federally enforceable. The document shall state that the emissions reduction has not been and will not be credited toward another reduction requirement. The facility shall not commence operation until the DEQ has approved in writing the documentation submitted by the permittee pursuant to this subsection as satisfying the requirements of b. and c.ii. (if that option is selected).

iii. The permittee shall submit a report to the DEQ prior to the commencement of operation of the permitted facility that demonstrates that the Allowances have been retired in accordance with c.i. Annual reports demonstrating compliance with the retirement obligations and prohibition on replenishment in c.i. must be submitted to the DEQ within 90 days of the end of each calendar year (i.e. 30 days after the compliance deadline under the Acid Rain Program). These reports shall continue to be required for the life of the facility or until all obligations under this permit condition are satisfied with permanent emission reductions. To the extent the permittee accepts federally enforceable limitations on the Total Annual NO_x Emissions in the future, the permittee will only be required to retire Eligible SO_2 Allowances or ERCs such that the sum of the retired allowances at a plant multiplied by that plant's Offset Ratio is equal to the new Total Annual NO_x Emissions minus 260.5. All reports shall be sent to the DEQ, and

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Shenandoah National Park
3655 U.S. Highway 211 East

Luray, VA 22835

e. At any time, but after at least 30 days notice to the public and the Federal Land Manager, the DEQ, in consultation with the Federal Land Manager, may approve an alternative mitigation plan proposed by the permittee in lieu of this condition. At a minimum, such a plan shall result in actual sulfur dioxide or nitrogen oxides reductions from an existing stationary source(s) within one of the areas identified in Appendix B of at least the Allowable Annual NO_x Emissions multiplied by the corresponding Offset Ratio. Such reductions must be practically enforceable, permanent, and quantifiable, and must be created after January 19, 2010. The reductions must result in the same or greater reduction in impacts to aquatic resources and visibility to the Shenandoah NP as the retirements of allowances outlined in paragraphs a through c of this condition.

(9 VAC 5-170-160, 9 VAC 5-80-1180, and 9 VAC 5-80-1985 E)