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SUBJECT: Revised Nitrogen Deposition Modeling for Saguaro East National Park

On April 19, 2013, the USFS received the requested near-field deposition modeling utilizing the EPA/AMS AERMOD modeling system (Version 12060). The USFS reviewed the modeling analysis provided and concluded that the modeling performed was not adequate because the procedures employed by JBR for estimating total nitrogen deposition would not be considered conservative for a screening level analysis. JBR utilized the following modeling methodologies to estimate total nitrogen deposition.

1. Tier III Ozone Limiting Method (40 CFR 50, Appendix W, Section 5.2.4(a)) which limits conversion of  $\text{NO}_x$  to  $\text{NO}_2$  by the amount of ambient ozone
2.  $\text{NO}_2$  deposition parameters derived from publication included Appendix A of their original transmittal memorandum of April 19, 2013

While there are no standardized procedures for modeling near-field deposition, such procedures are considered to be simple screening procedures (USFS et al, 2010). The primary purpose of any screening analysis is to produce a preliminary or conservative estimate of potential impacts (USEPA, 2005). Treatment of emissions as inert  $\text{NO}_2$  likely will underestimate near-field deposition of nitrogen because the deposition velocities for  $\text{NO}$  and  $\text{NO}_2$  are relatively low in comparison to other nitrogen species. While most emissions are initially introduced into the atmosphere as  $\text{NO}$  and  $\text{NO}_2$  ( $\text{NO}_x$ ), chemical processes in the atmosphere can rapidly convert to other nitrogen species with higher deposition velocities. Nitric acid ( $\text{HNO}_3$ ) is of greater concern because it has one of the highest deposition velocities of various nitrogen species. Using non-reactive (no chemistry) dispersion models such as AERMOD to complete a deposition analysis further complicates matters because additional simplifying assumptions must be made in order to simulate complex chemical and atmospheric processes.

1. Assume total conversion of all  $\text{NO}_x$  emissions to depositional nitrogen
2. Assign depositional parameters based upon  $\text{HNO}_3$

To produce conservative results consistent with the screening level nature of FLAG depositional analyses, model depositional parameters should have been based upon the two factors delineated above.

In order to rectify the issues identified above, the USFS conducted revised AERMOD modeling using the original input and meteorological files supplied by JBR in their original April 19, 2013 transmittal of results to the USFS. The deposition parameters were revised to reflect deposition parameters of  $\text{HNO}_3$  and are presented in Table 1. AERMOD Version 12345, downloaded from EPA's Support Center for

Regulatory Air Modeling (SCRAM), was used for this analysis. The deposition output units of AERMOD are expressed in g/m<sup>2</sup>/yr. AERMOD output must then be converted from g/m<sup>2</sup>/yr to kg/hectares/yr. The conversion parameters used are presented in Table 2.

**Table 1 – Deposition parameters utilized for revised total N deposition modeling.**

Compound	<i>Deposition Parameters</i>			
	Diffusivity in Air (cm <sup>2</sup> /s)	Diffusivity in Water (cm <sup>2</sup> /s)	Cuticular Resistance Term (s/cm)	Henry's Law Coefficient (Pa m <sup>3</sup> /mol)
HNO <sub>3</sub>	0.1628 <sup>a</sup>	1 <sup>b</sup>	13.33 <sup>a</sup>	1.E-12 <sup>b</sup>

<sup>a</sup>From CALPUFF User's Guide (Scire, et al., 2000)

<sup>b</sup>From Deposition Parameterization for the Industrial Source Complex (ISC3) Model (Wesley, et al. 2002)

**Table 2 – Deposition conversion parameters**

MW Ratio of N in HNO <sub>3</sub>	g to kg	m <sup>2</sup> to hectares
0.22	0.001	10,000

The revised modeling results for all of the alternatives analyzed are presented in Tables 3. The revised results show that the nitrogen deposition results for NOx emissions from Rosemont indicate are well above the deposition analysis thresholds established in the FLAG 2010 guidelines for all alternatives analyzed.

**Table 3 – Revised nitrogen deposition parameters for Saguaro East National Park**

Year	Nitrogen (kg/hectare/yr)	Threshold (kg/hectare/yr)
<i>Barrel Alternative</i>		
1	0.052272	0.005
5	0.049412	0.005
<i>Barrel Trail Alternative</i>		
1	0.055418	0.005
5	0.053988	0.005
<i>Scholefield Alternative</i>		
1	0.062656	0.005
5	0.061050	0.005
<i>Mine Plant Alternative</i>		
1	0.051810	0.005
5	0.050710	0.005

## References

Scire, J.S., D.G. Strimaitis, and R.J. Yamartino, 2000b: A User's Guide for the CALPUFF Dispersion Model (Version 5), Tech. Rep., Earth Tech, Inc., Concord, MA, 521 pp. [Available online at <http://www.src.com/calpuff/download>]

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