Rosemont Copper Company
CALPUFF Modeling Protocol to Assess
Ambient Air Quality Impacts

Prepared for:
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December 2012
December 10, 2012

Mr. Jim Upchurch  
Forest Supervisor  
Coronado National Forest  
300 West Congress  
Tucson, Arizona 85701  

Re: Response to August 20, 2012 Forest Service Letter  

Dear Mr. Upchurch:

Along with this are copies of JBR Environmental Consultants, Inc. modeling reports for AERMOD and VISCREEN as well the CALPUFF modeling protocols. These reports have been developed in response to the issues raised in your letter dated August 20, 2012. Your offices are receiving three copies of the reports (including disks) and three copies of the protocol (hardcopy only).

The reports are:

- AERMOD Modeling Report to Assess Ambient Air Quality Impacts, illustrating compliance with the NAAQS at the fence line for three of the alternatives;
- VISCREEN: Revised Visibility Impact Analysis at Saguaro East national Park, illustrating that under the worst-case Level 2 VISCREEN modeling assumptions the plume contrast did not exceed the screening criteria for any alternative; and
- CALPUFF Modeling Protocol to Assess Ambient Air Quality Impacts.

To complete the CALPUFF modeling under the conditions stipulated by the Forest Service, Rosemont has been put into a difficult position. The regulatory default version of CALPUFF cannot model the Rosemont Project as the Forest Service has requested. On the other hand, not complying with the Forest Service’s requests was not an option Rosemont considered. Instead of proposing that the Forest Service modify its requests, Rosemont has invested a great deal of consulting time and effort into meeting those requests.

Despite the significant time, effort, and cost associated with complying with the CALPUFF modeling requests from the Forest Service, Rosemont has done so. We hope it is clear that every effort has been, and is being made; however, because of the irregularity of the model file size, the number of post-processing runs (~2800), individual executable files (96), individual runs (700+) as well as the number of individual input and output files (1500+), we are still two weeks away from having reports. Our consultants are currently running the program on 16 processors and will add 8 more next week so that may speed up the exercise a bit. The letter from JBR explains some other modeling issues associated with the current model runs.
It is important for you to understand that the modifications requested by the Forest Service are not standard and the protocol no longer represents the standard regulatory version of the model. That said, other than the changes to accommodate the number of sources specified, all other aspects of the model remain identical to the regulatory default version.

If you have questions or concerns please let me know.

Regards,

[Signature]

Katherine Ann Arnold
Vice President, Environmental and Regulatory Affairs

Attachment: *JBR referenced reports*

Cc: Chris Garrett, SWCA, 2 copies each

Doc. No. 071/12-15.3.1
December 7, 2012

Mr. Jim Upchurch
Forest Supervisor
United States Department of Agriculture
Forest Service, Coronado National Forest
300 W. Congress
Tucson, AZ 85701

Dear Mr. Upchurch:

On behalf of Rosemont Copper Company (Rosemont), JBR Environmental Consultants (JBR) is providing the revised *CALPUFF Modeling Protocol to Assess Ambient Air Quality Impacts* (CALPUFF Protocol) for the Rosemont Project. Comments provided by JBR to the Forest Service via letter dated October 8, 2012 stated that the Forest Service would be provided a two-week review period for the modeling protocol and input files prior to JBR commencing CALPUFF modeling (response to CALPUFF Comment #3). However, because all Forest Service requests have been incorporated into the attached CALPUFF Protocol, and the corresponding CALPUFF input files reflect those changes, at this time further review would be redundant. Consequently, CALPUFF modeling has already commenced per the Forest Service’s requirements. Input and output files for CALPUFF, POSTUTIL, and CALPOST will be provided to the Forest Service upon completion.

Please note that changes to the CALPUFF modeling since the previous modeling effort have resulted in a number of complications. These have been due, in part, to the need to adequately address the comments referenced above as well as to incorporate the emission-reducing facility changes since the prior modeling.

For example, the regulatory version of CALPUFF is equipped to model up to 276 volume sources of emissions. Previous modeling of the Proposed Action included 262 volume sources in Year 1 and 185 volume sources in Year 5. However, the current modeling includes substantially more volume sources due to the addition of paved roads, the method for representing two-way traffic on roadways, and other similar changes. For the Proposed Action, there are now 367 volume sources in Year 1 and 290 in Year 5. The Alternative scenarios now required to be modeled have even more volume sources, with the Barrel Alternative producing the highest number at 735 volume sources in Year 1 and 627 in Year 12.

In order to represent all volume sources for all scenarios for all years in the manner requested by the Forest Service, it has been necessary to work with the CALPUFF model distributor, TRC Solutions (contact person: Joe Scire, jscire@trcsolutions.com), to re-compile the FORTRAN code of the model itself. This has been completed and all volume sources are represented in the model in the manner
Mr. Jim Upchurch  
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requested. Despite being a revision to the model’s regulatory default version, this revision enables the overarching goal to be met: modeling the air quality impacts of the Project on Class I areas per the Forest Service’s requirements. All other aspects of the model remain identical to the regulatory default version and it provides equally meaningful results, however, as a result of the larger number of sources, longer processing times are required. Modeling is currently being conducted with the re-compiled version of CALPUFF.

Another model limitation encountered in part as a result of the comments is the number of tracked “puffs” that can be modeled. CALPUFF in its regulatory form is coded to accommodate up to 100,000 “puffs”. The huge number of volume sources coupled with this limitation result in exceedances of the model’s capabilities for every scenario for every year modeled. In order to run the model in light of this limitation, each year must be broken down into quarters for each modeled scenario. Each quarter must then be re-combined into annual periods which can be post-processed for visibility, deposition, and pollutant concentration for each Class I area at both the average emission rate as well as the short-term maximum emission rate for 1-hour, 3-hour, and annual periods. In total, this has resulted in over 1500 input files. As stated above, these will be provided for review upon completion of the modeling. Due to the number of files, they will be provided electronically.

We apologize for the delay in completion of the CALPUFF modeling. In light of the challenges described above and the extensive additional computing power required, additional time has been necessary to prepare a thorough and robust analysis. When modeling is complete, all modeling files and results will be provided electronically along with the final report.

Technical questions are best directed to Dave Strohm, who is available at (208) 853-0883 or dstrohm@jbrenv.com. Please feel free to contact me with any other questions.

Sincerely,

Jaime Wilson, P.E.  
JBR Environmental Consultants, Inc.

cc: Kathy Arnold, Rosemont Copper Company
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1. INTRODUCTION

This document, "CALPUFF Modeling Protocol to Assess Ambient Air Quality Impacts," is being submitted to the U.S. Department of Agriculture Forest Service (USFS or Forest Service), Coronado National Forest (the Coronado), on behalf of Rosemont Copper Company. It presents an air dispersion modeling protocol that will be followed to assess impacts of emissions from the proposed new Rosemont Copper Project (Rosemont Project) on Air Quality Related Values (AQRV) including Visibility in Class I areas for the final environmental impact statement (FEIS) document. Pursuant to the National Environmental Quality Act (NEPA), the Forest Service is the lead agency for preparing the Environmental Impact Statement (EIS) for the proposed Rosemont project, and land manager for the Forest Service at the Coronado National Forest that prepared the draft EIS (DEIS) issued in September 2011. Based on comments received in response to the DEIS, changes have been made to the air quality modeling protocol that will be used to model and assess the ambient air quality impacts of the Rosemont project for presentation in the final EIS.

The Rosemont Project is a proposed new open-pit copper mine that will be located in the Santa Rita Mountains approximately 30 miles southeast of Tucson, Arizona in Pima County (Figure 1.1). The Rosemont Project, Mine Plan of Operations was submitted to the Coronado National Forest in July 2007 (complete document available at www.rosemontcopper.com). The Coronado National Forest represents the Federal Land Manager for purposes of the EIS that will be prepared for the Rosemont Project.

Based on the expected emission levels from the facility, the Rosemont Project will be required to demonstrate protection of the National Ambient Air Quality Standards (NAAQS) and will be reviewed against the Class I Prevention of Significant Deterioration (PSD) Increments. Additionally the U.S. Forest Service evaluation requires an AQRV impact analysis to ensure that Class I area resources (i.e., visibility, flora, fauna, etc.) are not adversely affected by the projected emissions.

Evaluation of the ambient air quality impacts from the proposed Rosemont Project in Class I areas will be conducted using CALPUFF, which is the recommended model for long range transport applications (Environmental Protection Agency 40 CFR Part 51 Revision to the Guidelines on Air Quality Models, November 2005. JBR Environmental Consultants, Inc. (JBR) uses the commercial version of CALPUFF from Oris-Solutions (P.O. Box 7348, Asheville, NC 28802, (828) 628-0636).

The ensuing sections of this document describe the methodology that will be used to conduct the modeling. This protocol has been developed following applicable portions of the U.S. Environmental Protection Agency (EPA) guidance document: Interagency Workgroup on Air Quality Modeling (IWAQM) Phase 2 Summary Report And Recommendations for Modeling Long Range Transport Impacts, December 1998; Federal Land Managers’ Air Quality Related Values Workgroup (FLAG) Phase I Report, Revised 2010 and the Western Regional Air Partnership BART protocol, August 2006.

1.1 Facility Description

The Rosemont Project will include an open-pit mine; and ore processing operations comprised of milling, a concentrator, leaching and solvent extraction/electrowinning. The production schedule
developed from mining sequence plans indicates a project operating life of approximately 20-25 years using only proven and probable mineral reserves. Peak mining rates were initially estimated at approximately 378,000 tpd of total material (ore and waste) to be realized in Year 1. These mining rates included a 20% capacity factor above the average capacity. During this year of operation, however, operations would still be in the development stages more typical of 316,000 tpd mining rate. Mining rates during Year 2 are estimated at 376,000 tpd and for Years 3-12 at approximately 360,000 tpd of total material. These rates include the additional 20% capacity factor. These rates will taper off toward the final years of the project.

Mining of the ore will be through conventional open-pit mining techniques including drilling, blasting, loading, hauling and unloading. Waste rock will be transported by haul truck to the waste rock storage areas. Ore will be either transported by haul truck to the leach pad (oxide ore), or crushed and loaded onto a conveyor for transport to the mill (sulfide ore). The copper and molybdenum concentrates from the milling and flotation operations will be shipped off site for further processing. Oxide ore will be placed on the lined leach pad. Pregnant leach solution (PLS) from the pad will be collected in a solution pond and then processed through the SX/EW plant. Copper cathodes generated from the SX/EW plant will be transported off site for further processing.

1.2 Site Description and Relevant Class I Areas

The Rosemont Project will be located in Pima County, approximately 30 miles southeast of Tucson, Arizona as shown in Figure 1.1. Regionally, the facility location is in the Sonoran Desert Section of the Basin and Range Physiographic Province which is characterized by northerly trending fault block mountains separated by broad, down-faulted valleys (see Figure 4.1). The site is at an elevation of approximately 5,350 feet.

Figure 1.2 shows the proposed Rosemont Mine site and all the Class I areas present in Arizona. The distance from the Rosemont Project to the center of the Saguaro National Monument East and Saguaro National Monument West are approximately 44 KM and 66 KM respectively. The Galiuro Wilderness, Chiricahua National Monument and Wilderness Area and Superstition Wilderness are approximately 95 KM, 140 KM and 195 KM respectively from the Rosemont Project site. The Saguaro East National Park will be modeled utilizing AERMOD as a near-field impact location. The other sites will be analyzed utilizing CALPUFF.
Figure 1.1  General location map of the Rosemont Project and surrounding area.
ARIZONA CLASS I AREAS

Class I Federal Lands

Sources:
1990 Bureau of Census TIGER Files
40 CFR Part 81
1993 USGS DLG Files
December 1994

Figure 1.2 Proposed Rosemont Project and All Arizona Class I Areas.
2. REGULATORY STATUS

2.1 Source Designation

The Rosemont Project will be a non-categorical stationary source. Criteria pollutant emissions from the facility will be below the New Source Review major source threshold of 250 tons/year. Therefore, the facility will not be subject to PSD regulations. Additionally, the potential to emit hazardous air pollutants (HAPs) will be less than 10 tons/year for any individual (HAP), and less than 25 tons/year for all HAPs combined and therefore, the facility will not be a major HAP source. Point source emissions of criteria pollutants from the facility will be less than the Title V source threshold of 100 tons per year. Consequently, the facility will operate under a Class II Permit issued by the Arizona Department of Environmental Quality (ADEQ).

2.2 Area Classifications

The Rosemont Project area is classified as “attainment” (better than national standards) or non-classifiable/attainment for total suspended particulates (TSP), particulate matter less than 10 microns nominal aerodynamic diameter (PM_{10}), carbon monoxide (CO), sulfur dioxide (SO_{2}), nitrogen dioxide (NO_{2}), and ozone (O_{3}) (see 40 CFR Part 81.303).

2.3 Baseline Area

The Rosemont Project will be located within the Pima Intrastate Air Quality Control Region (AQCR) which encompasses Pima County. This AQCR represents the “baseline area” for PSD purposes. The Rosemont Project, however, will not be subject to PSD regulations.
3. CALPUFF MODELING SYSTEM

The CALPUFF Modeling System includes three main components: CALMET, CALPUFF, and CALPOST and a large set of preprocessing programs designed to interface the model with standard, routinely available meteorological and geophysical datasets. In the simplest terms, CALMET is a meteorological model that develops hourly wind and temperature fields on a three-dimensional gridded modeling domain. Associated two-dimensional fields such as mixing heights, surface characteristics, and dispersion properties are also included in the file produced by CALMET.

CALPUFF is a transport and dispersion model that advects “puffs” of material emitted from modeled sources, simulating dispersion and transformation processes along the way. In doing so it typically uses the fields generated by CALMET, or as an option, it may use simpler non-gridded meteorological fields explicitly incorporated in the resulting distribution of puffs throughout a simulation period. The primary output files from CALPUFF contain either hourly concentrations or hourly deposition fluxes evaluated at selected receptor locations.

CALPOST is used to process these files, producing tabulations that summarize the results of the simulation, identifying the highest and second highest 3-hour average concentrations at each receptor, for example. When performing visibility related modeling, CALPOST uses concentration from CALPUFF to compute extinction coefficients and related measures of visibility, reporting these for selected averaging times and locations.
4. MODELING METEOROLOGICAL DATA

According to 40 CFR Part 51 Appendix W, the length of the modeled meteorological period should be long enough to ensure that the worst-case meteorological conditions are adequately represented in the model results. The number of years of data needed to obtain a stable distribution of conditions depends on the variable of interest. U.S. EPA recommends that consecutive years from the most recent, readily available 5-year period are preferred. However, "less than five, but at least three, years of meteorological data (need not be consecutive) may be used if mesoscale meteorological fields are available. These mesoscale meteorological fields should be used in conjunction with available standard NWS or comparable meteorological observations within and near the modeling domain. Therefore this modeling analysis will be conducted using 3 years of mesoscale meteorological model output data coupled with observational data from nearby surface, upper air and precipitation stations.

4.1 Prognostic Data

Prognostic meteorological data for the years 2001 (36 km EPA), 2002 (12 km WRAP) and 2003 (36 km MRPO) will be used for developing the Initial Guess Wind Fields in the CALMET model. This data was developed utilizing the PSU/NCAR mesoscale model (MM5) run in prognostic mode. The CALMM5 preprocessing program was utilized to convert the MM5 model data into a format compatible with the CALMET processing framework. The CalMM5 extractions from the prognostic data were supplied by BEE-Line Software (now Oris-Solutions). The 2001 and 2003 data cover the conterminous United States at a spacing of 36 km. The 2002 data cover the western portion of the conterminous United States at a spacing of 12 km.

4.2 Surface Stations

Surface data for the years 2001, 2002 and 2003 will be used as observations in developing the Step 2 Wind Fields in the CALMET model. The processed surface data, obtained from the National Climatic Data Center (NCDC) in Asheville, North Carolina, will be provided by BEE-Line Software. Data from the following four surface stations will be used:

1. Nogales Airport (WBAN – 92728)
2. Douglas Bisbee Airport (WBAN – 93026)
3. Tucson Airport (WBAN – 23160)
4. Davis Monthan Air Force Base (WBAN – 23109)

4.3 Upper Air Stations

Upper air data for the years 2001, 2002 and 2003 from the NWS Tucson Airport Station (WBAN – 23160) will be used as observations in developing the Step 2 Wind Fields in the CALMET model. The processed upper air data, obtained from the National Oceanic and Atmospheric Administration (NOAA) Forecast Systems Laboratory web site, will be provided by BEE-Line Software. Missing data periods will be filled using the UAMAKE program and the prognostic data described in section 4.1.
4.4 Precipitation Stations

Precipitation data for the years 2001, 2002 and 2003 will be used as observations in developing the Step 2 Wind Fields in the CALMET model. The precipitation data, obtained from the NCDC, will be provided by BEE-Line Software. Data from the following seven precipitation stations will be used.

1. Bisbee 2 WNW (WBAN – 20775)
2. Cochise 4 SSE (WBAN – 21870)
3. Nogales 6 N (WBAN – 25924)
4. Oracle 2 SE (WBAN – 26119)
5. Santa Rita Experimental Range (WBAN – 27593)
6. Tucson International Airport (WBAN – 28820)
7. Vail (WBAN – 28995)

4.5 CALMET: Meteorological Data Processing

CALMET is based on the Diagnostic Wind Model (Douglass, S. and R. Kessler, 1988). It has been significantly enhanced by Earth Tech, Inc (Scire, 2000). CALMET uses a two step approach to calculate wind fields. In the first step, an initial guess field is adjusted for slope flows and terrain blocking effects, for example, to produce a step 1 wind field. In the second step, an objective analysis is performed to introduce observational data into the Step 1 wind field. The meteorological fields developed by CALMET depend on the following parameter settings:

1. R1MAX – Maximum radius of influence of the observation over land in the surface layer.
2. R2MAX – Maximum radius of influence of the observation over land in the layers aloft.
3. R3MAX – Maximum radius influence of the observation over water.
4. R1 – Controls weighting of the surface layer. For example, it is the distance from the observational station at which the observation and first guess field are equally weighted.
5. R2 - Controls weighting of the layers aloft.
6. ZIMAX – Maximum mixing height.
7. TERRAD – Radius of influence of Terrain Features.

In defining the above parameters as well as all additional CALMET input variables in the CALMET input file, the August 31, 2009 EPA Memorandum Clarification on EPA-FLM Recommended Settings for CALMET will be followed. Table 4.1 presents the settings that will be used for the revised modeling analysis.
4.6 Analysis Domain

The proposed modeling domain is shown in Figure 4.1. It is based on UTM coordinates and includes five Class I areas: the Saguaro National Monument, Galiuro Wilderness Area, Chiricahua National Monument Area and Wilderness Area and the Superstition Wilderness Area. The domain is about 320KM x 350KM in the Easterly and Northerly directions respectively, with 5 KM grid cells.

<table>
<thead>
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<th>Parameter</th>
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</tr>
<tr>
<td>ZIMAX</td>
<td>3000 m AGL</td>
<td>3000 m AGL</td>
</tr>
<tr>
<td>TERRAD</td>
<td>15 KM</td>
<td>15 KM</td>
</tr>
</tbody>
</table>

4.7 Terrain

Gridded terrain elevations for the modeling domain were derived from 3 arc-second digital elevation models (DEMs) produced by the United States Geological Survey (USGS). The files cover 1-degree by 1-degree blocks of latitude and longitude. USGS 1:250,000 scale DEMs were used.

4.8 Land Use

The land use data will be obtained from USGS in the form of NA Global Azimuthal land data files. Data for missing quads will be substituted using National Land Cover Data (NLCD).

4.9 Receptors

The receptors that will be used for the Class I areas are based on the National Park Service database of Class I receptors. The receptors will be downloaded from the National Park Service database and processed into local domain coordinates for use in this analysis. Based on discussions with the FLM it was decided that although additional Class I areas existed within 300km of the project location, impacts for farther afield Class I's would be minimal. As a result, receptors and associated impacts will be calculated for five Class I areas including Saguaro West National Park, the Galiuro Wilderness Area, the Chiricahua National Monument and Wilderness Area and the Superstition Wilderness Area. See Figure 4.1.
Figure 4.1  Modeling Domain Size and Class I Area Receptors
5. CALPUFF MODELING

This section provides a summary of the modeling procedures that will be used for the CALPUFF analysis to be conducted for the Rosemont Mine. CALPUFF modeling will be completed for PM\textsubscript{10}, PM\textsubscript{2.5}, NO\textsubscript{2}, SO\textsubscript{2}, CO and AQRV’s including visibility and deposition impacts for total Nitrogen and Sulfur compounds.

5.1 Model Version

Based on discussion with the FLM after the conclusion of DEIS initial modeling simulations, CALPUFF Version 5.8 will be used to conduct the modeling analysis. Version 5.8 represents the EPA recommended version of CALPUFF, a conclusion supported by the FLM in the FLAG 2010 guidance. The CALPOST processing will utilize CALPOST 6.221 (level 080724), the EPA approved version.

5.2 Technical Options Used in Modeling

For CALPUFF model technical options, inputs and processing steps, the WRAP common BART protocol, EPA and FLAG guidance will be followed. Due to the large distance to the nearest Class I area, building downwash effects will not be included in the CALPUFF modeling. Example model input files will be provided for CALPUFF, POSTUTIL and CALPOST to verify technical modeling options. PM size speciation data assumptions mirror those completed for the AERMOD processing and emissions inventory development.

5.2.1 Ozone Assumption

Available hourly ozone data collected at the Clean Air Status and Trends Network (CASTNET) station at Chiricahua National Monument will be used for CALPUFF ozone assumption processing. When hourly data is missing, one of two approaches will be used to replace the missing data. For missing data periods that last one day or longer in a particular month, the missing data will be replaced by the maximum ozone concentration recorded for each diurnal hour of the calendar month as observed throughout the three-year period of meteorological data. For other missing hours that last less than a day, linear interpolation will be used to fill the missing concentrations.

5.2.2 Ammonia Assumption

Ammonia is not simulated by CALPUFF, but rather a background value is specified. Ammonia is important because the level of particulate nitrate (NO\textsubscript{3}) can depend on the amount of ammonia present. The partitioning of total nitrate between gaseous HNO\textsubscript{3} and particulate NO\textsubscript{3} depends on the amount of ammonia present and other parameters (e.g., SO\textsubscript{4}, temperature and RH). In the CALPUFF simulation, one value of background is assumed across the region and each puff uses the full background value in its equilibrium calculation. The IWAQM Phase II report contains the following recommendations for background ammonia: "typical (within a factor of 2) background values of ammonia are: 10 ppb for grasslands, 0.5 ppb for forest, and 1 ppb for arid lands at 20°C" (IWAQM, 1998). Based on the fact that all of the reviewed Class I areas lie in an arid region, a background ammonia value of 1 ppb will be used.
5.2.3 Natural Conditions and Monthly Relative Humidity Factors \( f(RH) \) at Class I Areas

For these Class I areas, natural background conditions must be established in order to determine a change in natural conditions related to a source's emissions. The EPA lists three types of Natural Conditions (natural background conditions) in their guidance document, Annual Average, Best 20% Days and Worst 20% Days (EPA, 2003a). Based on the FLAG 2010 guidance as well as ongoing FLM discussion, Annual Average Natural Visibility Conditions will be used for this analysis. These EPA estimates were taken from the Federal Land Managers Air Quality Related Values Workgroup (FLAG) Phase 1 Report Revised Table 6 (2010).

The EPA, in its BART Guidelines (2005), concluded that by using monthly average Relative Humidity Adjustment Factors \( f(RH) \) the likelihood that the highest modeled visibility impacts that were caused by short-term and geographically different meteorological phenomena (e.g., weather events) would be minimized. The FLAG (2010) report agrees with the EPA, therefore the visibility analysis will be conducted using monthly average \( f(RH) \) values for large hygroscopic particles, small hygroscopic particles and sea salt, rather than hourly values.

5.2.4 Light Extinction and Haze Impact Calculations

In keeping with FLM guidance, the CALPOST version 6.221 postprocessor will be used for the calculation of the impact from the modeled source's primary and secondary particulate matter concentrations on light extinction. The formula that is used is the existing IMPROVE/EPA formula, which is applied to determine a change in light extinction due to increases in the particulate matter component concentrations. Using the notation of CALPOST, the formula is the following:

\[
B_{\text{ext}} = 2.2 \times f_s(RH) \times [\text{Small Sulfates}] + 4.8 \times f_s(RH) \times [\text{Large Sulfate}] + 2.4 \times f_s(RH) \times [\text{Small Nitrates}] + 5.1 \times f_s(RH) \times [\text{Large Nitrates}] + 2.8 \times [\text{Small Organic Mass}] + 6.1 \times [\text{Large Organic Mass}] + 10 \times [\text{Elemental Carbon}] + 1 \times [\text{Fine Soil}] + 0.6 \times [\text{Coarse Mass}] + 1.7 \times f_{ss}(RH) \times [\text{Sea Salt}] + [\text{Rayleigh Scattering}] + 0.33 \times [\text{NO}_2 \text{ (ppb)}]
\]

The concentrations, in square brackets, are in \( \mu g/m^3 \) and \( B_{\text{ext}} \) is in units of \( Mm^{-1} \).

For each Class I area that will be analyzed, values for \( f_s(RH) \), \( f_l(RH) \), \( f_{ss}(RH) \) and the Rayleigh scattering term will be acquired from the Federal Land Managers Air Quality Related Values Workgroup (FLAG) Phase 1 Report Revised Tables 6, 7, 8 and 9. (2010)

The assessment of visibility impacts at the Class I areas will use CALPOST Method 8 sub-mode 5. In Method 8_5, each hour's source-caused extinction is calculated by first using the hygroscopic components of the source-caused concentrations, due to ammonium sulfate and nitrate, and monthly.
Class I area-specific f(RH) values. The contribution to the total source-caused extinction from ammonium sulfate and nitrate is then added to the other, non-hygroscopic components of the particulate concentration (from coarse and fine soil, secondary organic aerosols, and from elemental carbon) to yield the total hourly source-caused extinction.

During the review of the DEIS modeling results, USEPA Region 8 commented that "Arizona Portland Cement in Rillito and the H. Wilson Sundt Generation Station in Tucson" represent potential sources of cumulative impacts on visibility for regional Class I areas. These sources will be reviewed for inclusion in the FEIS modeling. The determination will be based on regional wind flow and facility emissions parameter. If the sources are determined to be valid for inclusion, the release parameters and emissions will be based on the most recently available permitting documents for the facilities.

### 5.2.5 Deposition Calculations

In addition to visibility, modeled deposition values for the project were requested by the FLM. As a result, total deposition fluxes will be calculated as part of the revised CALPUFF modeling. Once primary CALPUFF simulations are complete, POSTUTIL will be utilized to summarize total dry and wet deposition fluxes for Sulfur and Nitrogen species. Specifically, total Nitrogen and Sulfur deposition will be assumed to be comprised of the following composition of modeled species:

<table>
<thead>
<tr>
<th>Total Nitrogen Flux</th>
<th>Total Sulfur Flux</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO4 * 0.291667</td>
<td>SO2 * 0.500000</td>
</tr>
<tr>
<td>NOX * 0.304348</td>
<td>SO4 * 0.333333</td>
</tr>
<tr>
<td>HNO3 * 0.222222</td>
<td></td>
</tr>
<tr>
<td>NO3 * 0.451613</td>
<td></td>
</tr>
</tbody>
</table>

After the total Nitrogen and Sulfur deposition is calculated in POSTUTIL, CALPOST will be utilized to determine the average annual deposition, averaged over each receptor in each Class I area.
6. SOURCE CHARACTERIZATION

A general description of how each source type will be treated in the CALPUFF model is presented below. The release parameters and source characteristics used in the CALPUFF modeling will be identical to those used in the revised AERMOD protocol (April 2012). Additionally, separate CALPUFF simulations will be completed for the Proposed Action Alternative as well as for the Barrel, Barrel-Trail, Phased Tailings and Scholefield-McCleary Alternatives.

6.1 Point Sources

Point sources at the Rosemont Project include dust collectors, hot water heaters, and emergency generator(s). Emissions from these sources will be modeled as individual point sources. The baghouses are likely to have ambient exit temperatures and therefore, were modeled using a stack temperature of 0°C per ADEQ guidance, which forces the model to use the ambient temperature as the exit temperature. Stack parameters for the point sources will be based on design parameters and/or conservative estimated values. Emissions from emergency generators will not be included as all other operations would likely be shut down if the generators are needed.

6.2 Volume Sources

6.2.1 Road Sources

A refined road network was developed to depict the anticipated haul truck routes and truck discharge locations during the year 1 of the mine operations, since the Year 1 emissions are estimated to have the greatest impact on ambient air. Emissions due to haul road and general plant traffic on the unpaved road network will be modeled as volume sources. The model volume source parameter for the haul roads initially utilized Arizona Department of Environmental Quality Guidance. However, based on further discussions with the FLM, the haul road source parameters have been revised. The revised haul road sources will utilize a source to source spacing of 35 meters along the simulated haul roads. The roads will be further divided into two lanes representing two-way traffic. The initial lateral dimension of the sources will be set to 16.3m based on guidance and FLM concurrence. The final simulations will utilize 221 haul road sources to simulate the haul truck travel.

6.2.2 Other Fugitive Particulate Sources

Other fugitive particulate emission sources that will be modeled as volume sources include the following:

- Fugitive emissions from trucks unloading at the primary crusher will be represented by a single volume source. The release height will be set to 0 meters (dump pocket is at grade level).

- Fugitive emissions due to wind erosion from the sulfide ore stockpile will be represented by a single volume source. The release height will be set to 6 meters (half the height of the stockpile).
Fugitive emissions from conveyor transfer points will be represented by single volume sources. The release heights for these sources will be set to the actual height of the conveyor transfer process.

6.2.3 Particulate and Gaseous Emissions Due to Blasting

The emissions due to blasting in the pit will be modeled as volume sources. Based on the Rosemont Project limit on normal operational blasting to between the hours of 12 and 4 pm local time, the variable emission rate option will be utilized and blasting emissions will be averaged over the four hours likely to experience blasting. Additionally, when simulating modeling runs which calculated 1-hr impacts, blasting emissions will be concentrated into a total emission rate and emitted at the maximum rate on an hourly basis rather than being average over the proposed 4 hour blasting window.

6.2.4 Open Pit Source

Fugitive particulate emissions from the open pit at the Rosemont Project will be modeled as an area source. The majority of the emission inside the pit will be from Haul Truck travel on the unpaved roads.

6.2.5 Tail Pipe Emissions

Tail pipe emissions from Haul Trucks and support vehicles will be distributed among road emission sources and the open pit source. The amount of emissions assigned to each individual road segment and to the pit will be based upon an evaluation of the vehicle miles travelled (VMT) estimates for each vehicle type along each road segment and inside the pit.
7. EMISSIONS INVENTORY

Emissions from Rosemont operations will result from process equipment and mining operations. Process equipment will be modeled at maximum capacity. Emissions from mining will depend upon the mining rate and haul truck travel necessary to transport the ore and waste from the pit to the primary crusher and the waste rock storage area. A preliminary summary of average and maximum mining rates and haul truck travel (vehicle miles) is presented in Appendix A. This summary is subject to change depending upon any further refinements to the mine plan. The mining information in Appendix A indicates:

- The highest projected mining rate and second highest haul truck travel will occur in year 1
- The highest projected haul truck travel will occur in year 5

Since haul truck travel will be the primary source of emissions (PM$_{10}$ and tail pipe), year 5 will be modeled. Appendix A also shows that haul truck travel outside the pit will be a maximum during year 1 (1,404,736 VMT). Since emissions outside the pit are expected to have a greater impact on ambient concentrations than emissions in the pit, this year will also be modeled. Ambient impacts from operations during all other years will have lower impacts than during these two years.

Emissions associated with the Barrel, Barrel-Trail, Phased Tailings and Scholefield-McCleary Alternatives will also be calculated and used for their appropriate CALPUFF impact assessments. Detailed emissions for each of the alternatives will be used for impact assessment.

7.1 Operational Changes Planned Since Prior Submittals

Since submittal of the previous modeling analyses, Rosemont has re-evaluated its proposed operations and will be making the following changes that affect particulate matter (PM) and gaseous emissions and the resulting predicted impacts:

- Six of the haul trucks will have Tier 4 engines rather than Tier 2 engines
- The entry road will be paved (a distance of 3.1 miles) as will access and main roads that are not traveled by haul trucks
- Changes to the lime systems, including slaking all lime in two lime slakers (controlled by a scrubber) prior to distribution to various processes
- Seven cartridge filter dust collectors will be installed in lieu of the six less-efficient wet scrubbers, and a cartridge filter dust collector will be installed for the molybdenum dust collector

The resulting change in the potential to emit (PTE) for PM less than 10 microns in diameter (PM$_{10}$) for fugitive, non-fugitive, and tailpipe emissions combined is a reduction of 52 tons per year (tpy) in Year 5. For PM less than 2.5 microns in diameter (PM$_{2.5}$), the combined reduction in fugitive, non-fugitive, and tailpipe emissions is 47 tpy. These numbers represent a 5% reduction of PM$_{10}$ and a 25% reduction of PM$_{2.5}$ emissions for fugitive, non-fugitive, and tailpipe emissions combined (based
on Year 5). Non-fugitive emissions of PM$_{10}$ and PM$_{2.5}$ will be reduced by 42% and 81%, respectively in Year 5. Facility-wide emissions of oxides of nitrogen (NO$_x$) will be reduced by 70 tpy and volatile organic compound (VOC) emissions will be reduced by 6 tpy in Year 5 with the planned operational changes.
8. DISPERSION MODELING IMPACT ANALYSIS

The purpose of the dispersion modeling outlined in this protocol is to demonstrate that emissions from the Rosemont Project will not cause exceedances of the applicable NAAQS and to evaluate potential effects on Class I Increment and Air Quality Related Values (AQRV). The FEIS impact analysis will include all the information necessary for this demonstration including: (a) 24-hr visibility impacts; (b) a source location map; (c) a complete list of source parameters; (d) complete modeling input and output files; and (e) graphic presentations of the modeling results for each pollutant showing the magnitude and location of the maximum ambient impacts.
APPENDIX A

AVERAGE AND MAXIMUM MINING RATES
<table>
<thead>
<tr>
<th>Year</th>
<th>Mining Process Rates (tons/year)</th>
<th>Haul Truck Process Rates (VMT/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ore</td>
<td>Waste</td>
</tr>
<tr>
<td>PP-2</td>
<td></td>
<td></td>
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<td>10,665,000</td>
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</tr>
<tr>
<td>2</td>
<td>42,127,000</td>
<td>72,242,000</td>
</tr>
<tr>
<td>3</td>
<td>37,005,000</td>
<td>72,370,000</td>
</tr>
<tr>
<td>4</td>
<td>31,277,000</td>
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<td>29,197,000</td>
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<tr>
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</tr>
<tr>
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<td>27,376,000</td>
<td>81,996,000</td>
</tr>
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<td>81,994,000</td>
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<td>15,431,000</td>
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### Table A.2  Maximum Daily Mining and Haul Truck Process Rates

<table>
<thead>
<tr>
<th>Year</th>
<th>Ore Average (tons/day)</th>
<th>Waste Average (tons/day)</th>
<th>Total Average (tons/day)</th>
<th>Ore Maximum* (tons/day)</th>
<th>Waste Maximum* (tons/day)</th>
<th>Total Maximum* (tons/day)</th>
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<tbody>
<tr>
<td>PP-2</td>
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<td>4,625</td>
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<td>4,625</td>
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<td>29,219</td>
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<td>115,540</td>
<td>199,510</td>
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<td>95,990</td>
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<td>9,436</td>
<td>50,732</td>
<td>60,168</td>
</tr>
</tbody>
</table>

*Maximum mining process rates are calculated by adding a 20% maximum capacity factor to the average process rates (except for Years PP-2, PP-2, and 1 when maximum process rates are not expected to exceed average process rates).