Rosemont Copper Company

AERMOD Modeling Protocol to Assess Ambient Air Quality Impacts

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1. INTRODUCTION

This document, "*AERMOD 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. 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.

1.1 Project Overview

The proposed Rosemont Copper Company Project (Rosemont) consists of an open-pit copper mine and its associated copper production activities. The proposed mine site is located on the east side of the Santa Rita Mountains, approximately 30 miles south of Tucson, Arizona in Pima County (). The preliminary mine plan of operations (MPO) was submitted to the Coronado in July 2007 (available at www.rosemontcopper.com). As proposed, the operation would directly impact National Forest System land on the Coronado National Forest in addition to private land owned by the Rosemont Copper Company, State Trust land administered by the Arizona State Land Department, and Bureau of Land Management-administered lands. While the Forest Service is the lead agency for the EIS, there are nearly twenty cooperating agencies that have been provided the opportunity to comment on the air modeling protocol and DEIS.

1.2 Purpose of AERMOD Modeling and Submittal of Modeling Protocol

Construction, mining, and reclamation activities at the mine would increase emissions in the affected area. Therefore, air quality modeling is being performed to identify, to the extent feasible, what impact those emissions would have on ambient air quality. The Federal Land Manager (FLM) requested that an air impact analysis be submitted as part of the EIS in order to demonstrate that the National Ambient Air Quality Standards (NAAQS) will be protected.

In October 2009, Rosemont submitted the "*Modeling Protocol to Asses Ambient Air Quality Impacts from the Rosemont Copper Project*." A modeling analysis titled "*Modeling Report to Asses Ambient Air Quality Impacts*" was subsequently submitted on July 28, 2010. Comments to this modeling analysis were provided by the Forest Service on February 25, 2011. Additional comments as well as recommendations for addressing potential concerns were discussed during conference calls on March 14, 25, 29 and 31, 2011. A revised modeling report was submitted to the Forest Service on April 4, 2011, and the Forest Service issued the DEIS in September 2011. In order to respond to questions and comments received by the cooperating agencies regarding the ambient air quality modeling, and to incorporate additional mitigation measures that Rosemont will implement that reduce emissions of pollutants, further ambient air quality modeling will be performed prior to the Forest Service issuing a final EIS. This document presents the protocol that will be followed for the revised modeling as requested by the Forest Service and cooperating agencies.

The modeling protocol presented herein incorporates changes in emissions due to the additional mitigation measures and is also intended to addresses the questions, comments, and recommendations made by the Forest Service and cooperating agencies. The remaining sections of this report present the protocol that will be followed to assess ambient air quality impacts from the proposed project. This protocol has been developed following recommendations of the Forest Service and cooperating agencies and taking into consideration the precedents set forth in the Arizona Department of Environmental Quality (ADEQ) guidance document *Air Dispersion Modeling Guidelines for Air Quality Permits* (ADEQ Guidance, December 2004) and the EPA's *Guideline on Air Quality Models* (*Guidelines*, 40 CFR Part 51, Appendix W, November 2005). Additional references taken into consideration include EPA's *Meteorological Monitoring Guidance for Regulatory Modeling Applications* (February 2000) and guidance documents available through EPA's Technology Transfer Network (TTN) Support Center for Regulatory Atmospheric Modeling (SCRAM) website at http://www.epa.gov/ttn/scram/.

1.3 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. Details of the changes in emissions for each category for different project years are provided in Appendix G. 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.

1.4 Facility Description

The Rosemont project includes an open-pit mine and ore processing operations comprised of milling, copper concentrating, copper leaching, and solvent extraction/electrowinning. No copper smelting is included in the project, nor is any connection to any existing copper smelter under consideration. 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 of approximately 115,000,000 tons per year (tpy) of total material (ore and waste) could be anticipated in Year 1. During this year of operation, however, operations would still be in the development stages. Once full-scale operation has been achieved, maximum mining rates during Years 2-10 are estimated by including a 20% capacity factor above the average mining capacity. For Years 2-10 the maximum mining rate is expected to be approximately 110,000,000 tpy of total material. Mining rates are expected to taper off during the remaining 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.

1.5 Site Description

Rosemont will be located in Pima County, approximately 30 miles southeast of Tucson, Arizona (Arizona Geological Society 2007:11) as shown in . Regionally, the facility location is in the eastern part of the Sonoran Desert sub-province of the Basin and Range physiographic province (Arizona Geological Society 2007:26), near the boundary with the Mexican Highlands. The area is characterized by northerly trending fault block mountains separated by broad, down-faulted valleys (see Figures 1.1, 3.1 and 5.1) on the eastern slope of the Santa Rita Mountains, a range that separates the Cienega Basin to the east from the Santa Cruz Basin to the west. The site is at an elevation of approximately 5,350 feet with elevations in the project area range from 4,600 feet to nearly 6,300 feet above mean sea level. Slope angles vary from less than 3 percent in drainage bottoms to more than 100 percent on the rock faces of some mountain fronts.

Areas where mine activities take place, including the open pit, waste rock storage area, tailings area, heap leach facility, plant site and ancillary facilities, and mine primary and secondary access roads will be excluded from public access by fencing and signage. These areas will not be accessible to the public and the boundaries will be formally and legally established through the EIS process.

Figure 1.1 General location map of Rosemont and surrounding area.

2. AIR QUALITY REGULATORY FRAMEWORK

2.1 Rosemont Area Air Quality Classifications

EPA classifies air quality regions as "nonattainment" for a given pollutant if ambient air concentrations exceed the National Ambient Air Quality Standards (NAAQS). NAAQS are established separately for each of the "criteria" pollutants and these NAAQS have been promulgated under Title 40 of the Code of Federal Regulations (40 CFR) Part 50 (see http://www.epa.gov/air/criteria.html for more information). Areas that are not nonattainment are either "attainment" if the NAAQS have not been exceeded, or the area is deemed unclassifiable/attainment if insufficient data exists to make a determination. Attainment status is based on the results of ambient air quality monitoring, typically performed over a 3-year period.

The Rosemont area is classified as attainment or unclassifiable/attainment for particulate matter, represented as both PM_{10} and PM less than 2.5 microns nominal aerodynamic diameter ($PM_{2.5}$), as well as lead (Pb), carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and ozone (O_3) (see 40 CFR §81.303 for the promulgated attainment status of all areas in Arizona, or http://www.epa.gov/oaqps001/greenbk/ for maps identifying nonattainment areas throughout Arizona and the United States). Each of the criteria pollutants may be directly emitted from a source, with the exception of ozone, which is produced by a complex photochemical reaction of volatile organic compounds (VOCs) and NO_X in the lower atmosphere.

2.2 Source Designation

New stationary sources located in attainment areas are subject to air quality permitting under Prevention of Significant Deterioration (PSD) as promulgated under 40 CFR Part 52 if the potential to emit of PM_{10}, $PM_{2.5}$, NO_x, SO_2, or CO exceed 250 tpy. Rosemont is not a PSD source. (While emissions of other pollutants also trigger PSD, the pollutants listed are of interest for the purposes of this modeling protocol.) PSD permitting involves a number of requirements, one of which is an air quality impact analysis involving dispersion modeling. Rosemont's emissions are well below the PSD thresholds for all pollutants, so PSD does not apply. However, since the PSD program does provide a long-standing, nationally-standardized framework for performing ambient air quality monitoring and dispersion modeling, the PSD methodologies will generally be applied for the modeling at Rosemont and have been applied for the ambient air quality monitoring. Since PSD does not apply to the Rosemont project, strict adherence to the PSD rules is not a regulatory requirement. It is important to note that while the PSD regulations provide a framework for ambient air quality monitoring and for dispersion modeling, PSD only applies to sources with a potential to emit that is much greater than those from the Rosemont project.

Based on the potential to emit (PTE) for all criteria pollutants, Rosemont will be categorized as a synthetic minor stationary source. Emissions of hazardous air pollutants (HAPs) will not exceed the major source thresholds of 10 tpy for a single HAP or 25 tpy for all HAPs combined, therefore Rosemont will also be a minor source of HAP emissions. Since the PTE for all criteria pollutants will be below 100 tpy and the facility will not be a major source of HAPs, Rosemont will not be subject to Title V permitting. Consequently, the facility will operate under a Class II Permit issued by the Arizona Department of Environmental Quality (ADEQ). Ambient air quality monitoring and air dispersion modeling are not routinely required of Class II sources. Since the PSD status of the project was not yet determined early in the project's planning stages, ambient air quality monitoring was initiated as if PSD would apply. At the request of the Forest Service to identify the potential impacts of emissions from Rosemont on air quality, dispersion modeling will be performed.

2.3 Air Quality Regulatory Authority

Rosemont will be located within the Pima Intrastate Air Quality Control Region (AQCR) which encompasses Pima County. The Pima County Department of Environmental Quality (PCDEQ) permits and regulates most stationary sources of emissions located within their jurisdiction although ADEQ retains original jurisdiction over some types of sources as provided in §49-402(B) of the Arizona Revised Statutes (ARS). An application for an air quality permit was initially submitted to PCDEQ. However, the existing Pima County State Implementation Plan is inconsistent with state law in that it further grants jurisdiction of certain other sources (such as Rosemont) to ADEQ. As a result, while state law would indicate that PDEQ is the appropriate air permitting authority for Rosemont, the Pima County SIP requires otherwise. The PCDEQ has denied the issuance of an air quality permit and Rosemont has therefore submitted an application for a Class II air permit to ADEQ.

3. DISPERSION MODELING INPUT DATA AND DEFAULTS

The dispersion modeling will be conducted using the PSD regulatory guideline dispersion model developed by the EPA in conjunction with the American Meteorological Society (however, as previously stated, Rosemont is not subject to PSD requirements). The model is called the AMS/EPA Regulatory Model, or AERMOD. Evaluation of the maximum ambient air quality impacts from the proposed Rosemont Project will be conducted using the latest version of AERMOD (*User's Guide for the AMS/EPA Regulatory Model – AERMOD,* U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Emissions, Monitoring, and Analysis Division, Research Triangle Park, North Carolina, EPA-454/B-03-001, September 2004), version 12060. JBR Environmental Consultants, Inc. (JBR) uses the commercial version of AERMOD from BEE-Line Software (P.O. Box 7348, Asheville, NC 28802, (828) 628-0636). Since the Saguaro East National Forest lies within 50 KM of the proposed Rosemont Project, the Forest Service also recommended using AERMOD to evaluate the ambient air quality impacts at this Class I area based on the FLAG 2010 guidance.

EPA's *Guideline on Air Quality Models* addresses the regulatory application of air quality models for assessing criteria pollutants under the Clean Air Act[1]. Appendix A of the *Guideline* identifies AERMOD as the preferred model for a wide range of regulatory applications. The AERMOD modeling system consists of one main program (AERMOD) and two pre-processors (AERMET and AERMAP). The major purpose of AERMET is to calculate boundary layer parameters for use by AERMOD. The major purpose of AERMAP is to calculate terrain heights and receptor grids for AERMOD. Both AERMET and AERMAP require observational data to parameterize the growth and structure of the atmospheric boundary layer. AERMOD uses terrain, boundary layer and source data to model pollutant transport and dispersion for calculating temporally averaged air pollution concentrations.

AERMOD's three models and required model inputs are as follows:

1) AERMET: calculates boundary layer parameters for input to AERMOD
    a. Model inputs: wind speed; wind direction; cloud cover; ambient temperature; morning sounding; albedo; surface roughness; Bowen ratio
    b. Model outputs for AERMOD: wind speed; wind direction; ambient temperature; lateral turbulence; vertical turbulence; Sensible heat flux; friction velocity; Monin-Obukhov Length
2) AERMAP: calculates terrain heights and receptor grids for input to AERMOD
    a. Model inputs: DEM data [x,y,z]; design of receptor grid (pol., cart., disc.)
    b. Model outputs for AERMOD: [x,y,z] and hill height scale for each receptor
3) AERMOD: calculates temporally-averaged air pollution concentrations at receptor locations for comparison to the NAAQS

1 "Revision to the Guideline on Air Quality Models: Adoption of a Preferred General Purpose (Flat and Complex Terrain) Dispersion Model and Other Revisions: Summary (Final Rule)." Federal Register 70:216 (9 November 2005) p. 68218

a. Model inputs: source parameters (from permit application); boundary layer meteorology (from AERMET); receptor data (from AERMAP)

b. Model outputs: temporally averaged air pollutant concentrations

3.1 Recommended Regulatory Default Options

The following recommended regulatory default options for AERMOD as stated in the *Guideline* will be used for the model runs: stack-tip downwash, incorporation of the effects of elevated terrain, and calms and missing data processing routines.

3.2 Missing Data Processing Routines

The missing data processing routines that are included in AERMOD allow the model to handle missing meteorological data in the processing of short term averages. The model treats missing meteorological data in the same way as the calms processing routine (i.e., it sets the concentration values to zero for that hour and calculates the short term averages according to EPA's calms policy, as set forth in the Guideline). Calms and missing values are tracked separately for the purpose of flagging the short term averages. An average that includes a calm hour is flagged with a 'c', an average that includes a missing hour is flagged with an 'm', and an average that includes both calm and missing hours is flagged with a 'b'. If the number of hours of missing meteorological data exceeds 10 percent of the total number of hours for a given model run, a cautionary message is written to the main output file, and the user is referred to Section 5.3.2 of *On-site Meteorological Program Guidance for Regulatory Modeling Applications* (EPA, 1987).

3.3 Regional Topography

Rosemont will be located in the Santa Rita Mountains which trend northeast to southwest with elevations ranging from 4,500 feet to over 6,000 feet (See Section 1.5). To the west of the mountain range lies the broad Santa Cruz River Valley and to the east of the mountains lies a smaller valley bisected by Cienega Creek.

3.4 Rural/Urban Classification

For modeling purposes, the rural/urban classification of an area is determined by either the dominance of a specific land use or by population data in the study area. Generally, if the sum of heavy industrial, light-moderate industrial, commercial, and compact residential (single and multiple family) land uses within a three kilometer radius from the facility are greater than 50%, the area is classified as urban. Conversely, if the sum of common residential, estate residential, metropolitan natural, agricultural rural, undeveloped (grasses), undeveloped (heavily wooded) and water surfaces land uses within a three kilometer radius from the facility are greater than 50%, the area is classified as rural. Alternatively, if the population is greater than 750 persons per km^2, the area is also classified as urban.

As shown in the aerial photograph in and the topographic map in Figures 1.1 and 5.1, rural land use in the area surrounding the proposed Rosemont Project is much greater than 50%. Thus, the rural classification will be used in the modeling.

3.5 Regional Climatology

The climate of the Rosemont area is semi-arid with precipitation varying with elevation and season. The 30-year normal (1971 to 2000) annual average precipitation for the Santa Rita Experimental Range station is 23.41 inches (Western Regional Climate Center). Over this 30-year period, nearly half of the precipitation occurred in the months associated with the Arizona monsoon season comprised of July, August and September. The least amount of precipitation occurred during the months of April, May and June.

Temperatures regionally are moderate to extreme with maximums and minimums also varying with elevation. The 30-year normal average monthly maximum temperatures at the Santa Rita Experimental Range station ranged from a low of 60.4°F in January to a high of 93.3°F in June. Average monthly minimum temperatures ranged from a low of 37.5°F in December and January to a high of 66.8°F in July.

On-site meteorological monitoring was performed to obtain site-specific temperature and wind data as described in further detail in Section 3.6.

3.6 Meteorological Monitoring for On-Site Data

On-site meteorological monitoring was initiated by Rosemont in April 2006 and is continuing to date. Complete quarterly data summary and semi-annual audit reports have been submitted to the PCDEQ and ADEQ since the monitoring began. Detailed results of the monitoring program can be found in these quarterly reports. On-site monitoring was performed in accordance with EPA's *Meteorological Monitoring Guidance for Regulatory Modeling Applications*.

The modeling will be based upon the on-site weather observations from the Rosemont monitoring site, which is located at the center of the proposed open pit at an elevation of 5,350 feet as shown in Figure 5.1 . Parameters measured at the Rosemont monitoring site include ambient temperature at 2 meters, differential temperature between 2 and 10 meters, and wind speed and wind direction at 10 meters. The monitoring site was chosen following EPA's *Meteorological Monitoring Guidance for Regulatory Modeling Applications* (EPA-454/R-99-005, February 2000). A monitoring protocol entitled *Monitoring Protocol and Quality Assurance Project Plan for Conducting Ambient PM_{10} and Meteorological Monitoring for the Proposed Rosemont Copper Mine Pima County, Arizona* (July 1, 2006) (Monitoring Protocol and QAAP) was submitted to PCDEQ and is available at http://www.rosemonteis.us/documents/013220. Quarterly reports of the meteorological measurements were subsequently submitted to both PCDEQ and to ADEQ.

As stated above, monitoring began in April 2006 and is on-going. The database, however, is not continuous as data between December 2006 and February 2007 were lost due to a data logger malfunction (see quarterly and audit reports submitted to the PCDEQ and ADEQ). The modeling will be conducted based upon 3 full years of on-site data, with missing data periods filled in with data from other years for the same time period. Wind roses for the data collected in 2006-2007, 2007-2008 and 2008-2009 are presented in Figures 3.2 through 3.4, respectively. The year-to-year consistency in the wind data indicates that meteorological data collection was consistent. The missing data for December 2006 to February 2007 was filled in with data for the same period from the next year.

3.7 Meteorological Data Processing for AERMOD

Meteorological data will be combined into AERMOD-ready surface and upper air input files using AERMET. As a regulatory component of the AERMOD modeling system, the AERMET program serves as the meteorological preprocessor for AERMOD. AERMET is designed to combine and quality control on-site and NWS surface and upper air data for use by AERMOD.

3.8 Sky Cover Data

AERMOD requires parameters for determining boundary layer conditions which include opaque sky cover (or total sky cover). The Rosemont on-site surface measurements do not include sky cover data. Per EPA's AERMET guidance, the concurrent sky cover data for the on-site surface meteorological data will be obtained from the nearest NWS site, the Tucson Airport (WBAN 23160).

3.9 Upper Air and Surface Meteorological Data

AERMOD also requires upper air data. Only two upper air sites are available for Arizona, Tucson and Flagstaff. The only other nearby upper air data is at Santa Rita, New Mexico, which is approximately 150 miles away from the Rosemont site. Upper air data concurrent with the on-site surface meteorological data will be obtained from the NWS Tucson Airport station (WBAN 23160), which is the closest NWS station.

3.10 Surface Characteristics

Surface conditions at the measurement site, referred to as the surface characteristics, influence the boundary layer parameter estimates generated by AERMOD. Obstacles to the wind flow, the amount of moisture at the surface, and reflectivity of the surface all affect the boundary layer estimates. These influences are quantified through the surface albedo, Bowen ratio and roughness length, and are introduced into AERMOD through the files generated by AERMET.

The albedo is the fraction of total incident solar radiation reflected by the surface back to space without absorption. Typical values range from 0.1 for thick deciduous forests to 0.90 for fresh snow. The daytime Bowen ratio, an indicator of surface moisture, is the ratio of the sensible heat flux to the latent heat flux and is used for determining planetary boundary layer parameters for convective conditions. While the diurnal variation of the Bowen ratio may be significant, the Bowen ratio usually attains a fairly constant value during the day. Midday values of the Bowen ratio range from 0.1 over water to 10.0 over desert. The surface roughness length is related to the height of obstacles to the wind flow and is, in principle, the height at which the mean horizontal wind speed is zero. Values range from less than 0.001 m over a calm water surface to 1 m or more over a forest or urban area. The values for surface albedo, Bowen ratio and roughness length can be entered into the AERMET preprocessor based on frequency and sector. The frequency defines how often these characteristics change, or alternatively, the period of time over which these characteristics remain constant.

The frequency defines how often these characteristics change, or alternatively, the period of time over which these characteristics remain constant. The frequency can be annual, seasonal (winter [December, January, February], spring [March, April, May], summer [June, July, August], fall

[September, October, November]), or monthly, corresponding to 1, 4, or 12 periods, respectively. Sectors refer to the number of non-overlapping sectors into which the 360° compass is divided.

A minimum of 1 and a maximum of 12 sectors can be specified (i.e., 1 sector of 360°, up to 12 non-overlapping sectors of 30°). Thus, AERMET allows the values for surface albedo, Bowen ratio and roughness length to be entered annually, seasonally or monthly for each sector, the number of which can range between 1 and 12. As shown in the Monitoring Protocol and QAAP, the area surrounding the proposed Rosemont Project is undeveloped, pinyon-juniper mountainous terrain in all directions. Consequently, surface characteristics will be entered for a single sector.

The EPA has developed a computer program called AERSURFACE to aid users in obtaining realistic and reproducible surface characteristic values for the albedo, Bowen ratio, and surface roughness length for input to AERMET. The program uses publicly available national land cover datasets and look-up tables of surface characteristics that vary by land cover type and season. Land cover data (not partitioned) from the USGS NLCD92 will be used for the modeling as recommended by the AERSURFACE user guide (http://www.epa.gov/ttn/scram/7thconf/aermod/aersurface_userguide.pdf).

The surface characteristics that will be used in the modeling will be entered on a seasonal basis and are listed in Table 3.1. The values listed in Table 3.1 were generated by AERSURFACE.

Table 3.1 Surface Characteristics Proposed for Use in the AERMOD Modeling

Surface Characteristic*	Spring	Summer	Autumn	Winter
Albedo	0.25	0.25	0.25	0.25
Bowen Ratio	2.88	3.76	5.70	5.70
Surface Roughness	0.153	0.153	0.153	0.152

* Generated by AERSURFACE, dated 0809

- Center UTM Easting (meters): 522896.0; Center UTM Northing (meters): 3521802.0; UTM Zone: 12, Datum: NAD83
- Study radius (km) for surface roughness: 1.0
- Airport? N, Continuous snow cover? N
- Surface moisture? Average, Arid region? Y, Month/Season assignments? Default
- Late autumn after frost and harvest, or winter with no snow: 12 1 2
- Winter with continuous snow on the ground: 0
- Transitional spring (partial green coverage, short annuals): 3 4 5
- Midsummer with lush vegetation: 6 7 8; Autumn with un-harvested cropland: 9 10 11

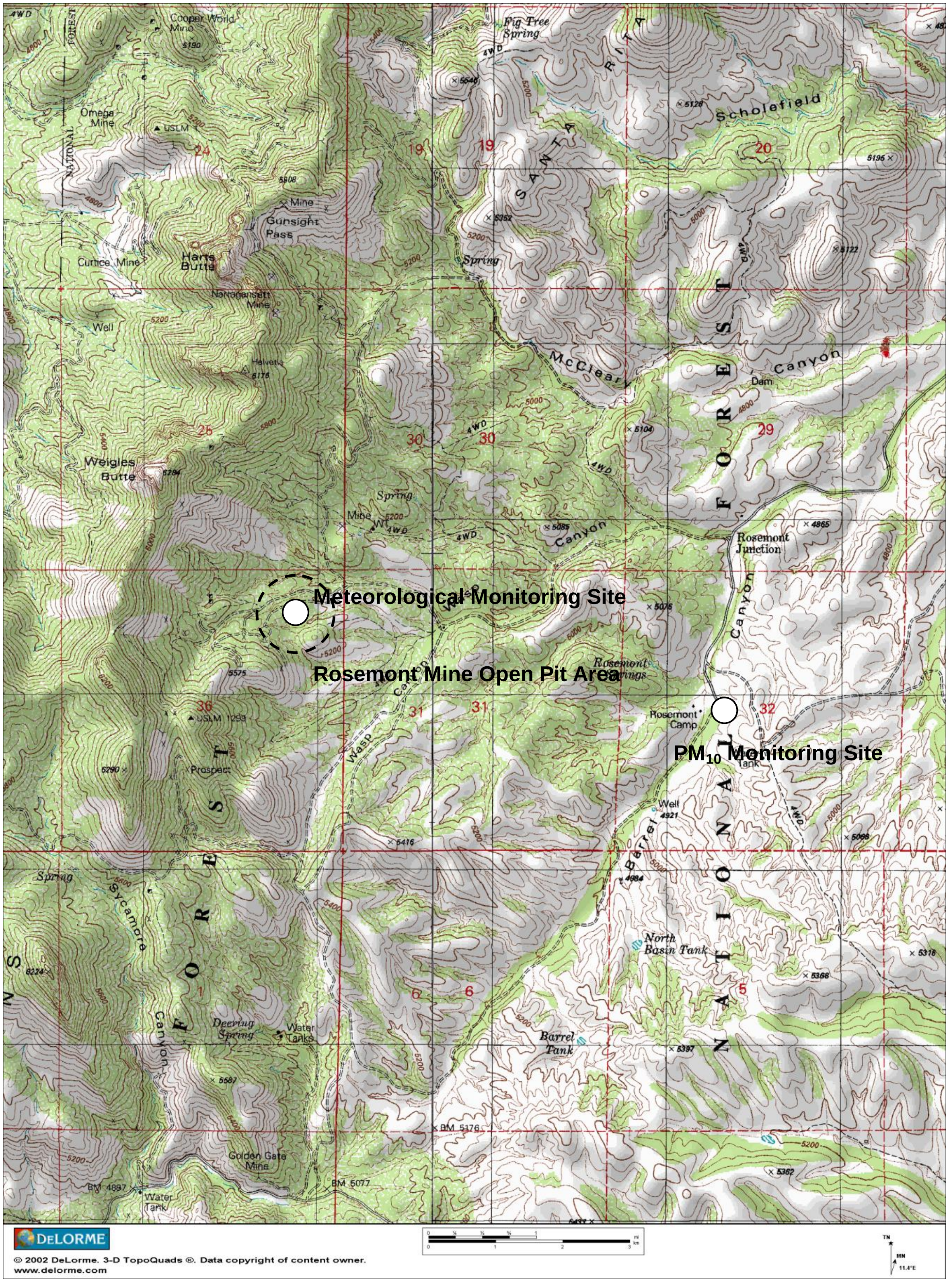


Figure 3.1 Topographic Map Showing Location of the PM_{10} and Meteorological Monitoring Sites.

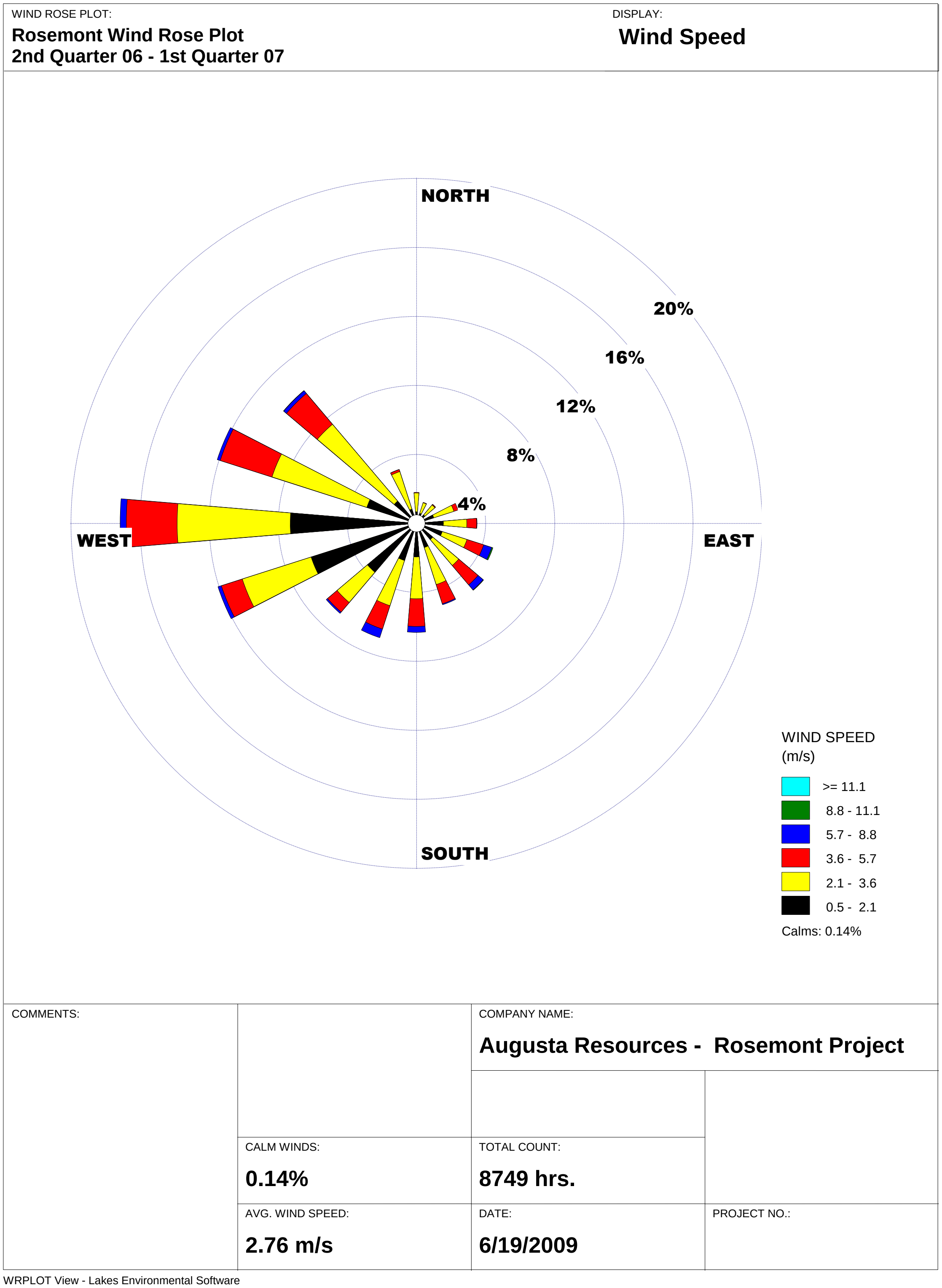


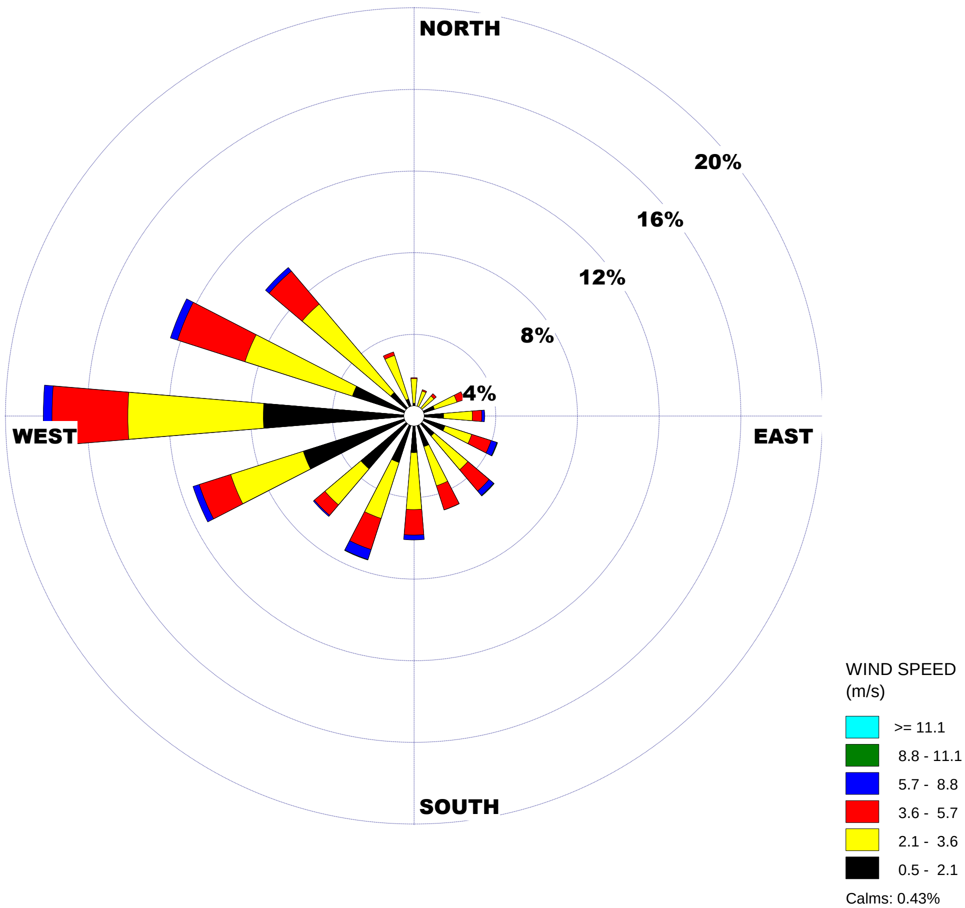
Figure 3.2 Wind Rose for the Rosemont Meteorological Station for the Time Period April 1, 2006 – March 31, 2007.

WIND ROSE PLOT:

Rosemont Wind Rose Plot
2nd Quarter 07 - 1st Quarter 08

DISPLAY:

Wind Speed



COMMENTS:

COMPANY NAME:

Augusta Resources - Rosemont Project

CALM WINDS:

0.43%

TOTAL COUNT:

8766 hrs.

AVG. WIND SPEED:

2.78 m/s

DATE:

6/19/2009

PROJECT NO.:

WRPLOT View - Lakes Environmental Software

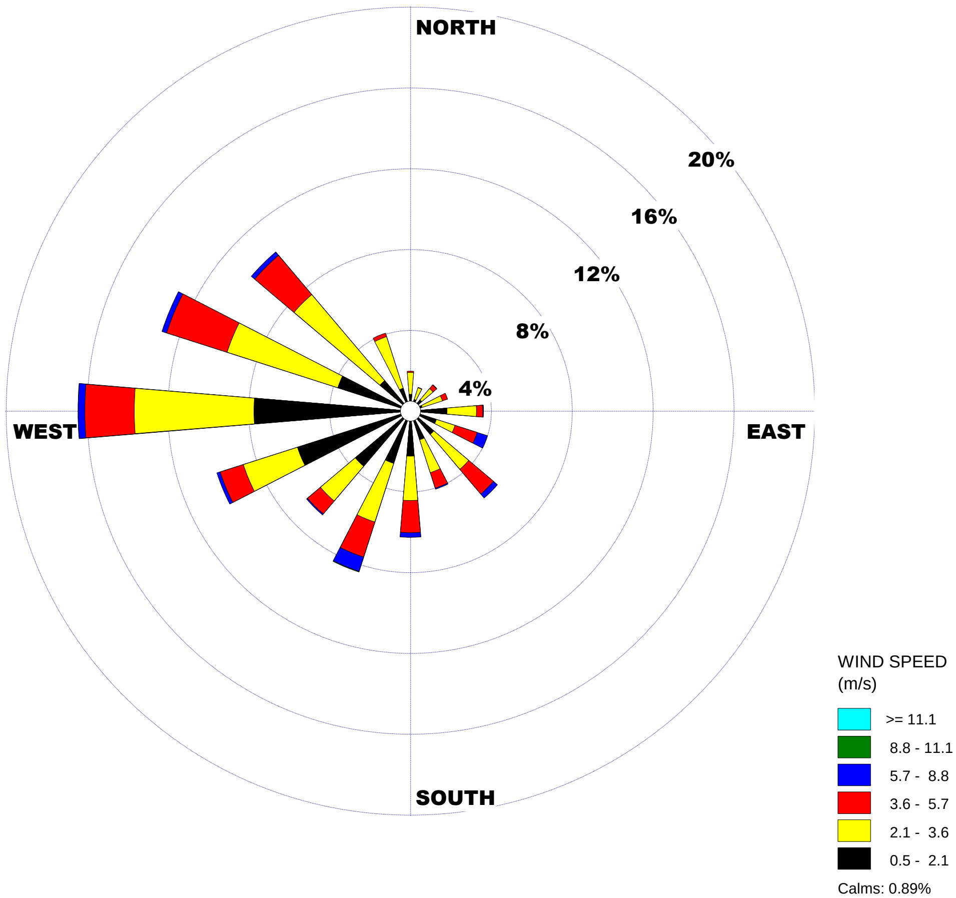
Figure 3.3 Wind Rose for the Rosemont Meteorological Station for the Time Period April 1, 2007 - March 31, 2008.

WIND ROSE PLOT:

Rosemont Wind Rose Plot
2nd Quarter 08 - 1st Quarter 09

DISPLAY:

Wind Speed



COMMENTS:		COMPANY NAME: **Augusta Resources - Rosemont Project**	
	CALM WINDS: **0.89%**	TOTAL COUNT: **8753 hrs.**	
	AVG. WIND SPEED: **2.71 m/s**	DATE: **6/19/2009**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

Figure 3.4 Wind Rose for the Rosemont Meteorological Station for the Time Period April 1, 2008 - March 31, 2009.

4. BACKGROUND CONCENTRATIONS

To evaluate the potential impacts of emissions from Rosemont operations on the public, the dispersion modeling evaluation must consider the existing background concentrations of pollutants in the area where impacts are being evaluated. The background concentration of a given pollutant is added to the modeled impact from Rosemont operations, and the result is compared to the NAAQS for that pollutant.

For the DEIS, potential air quality impacts are being evaluated near the Rosemont location as well as at the Class I areas located within 50 km of the project site. Different background concentrations will be used to represent local conditions for each of the locations where impact is being evaluated. For example, to evaluate the impacts at Saguaro National Park East, the background concentrations at Saguaro National Park East will be used. These background concentrations will be obtained from ambient air quality monitoring that is done at that location. However, to evaluate impacts near the fenceline and within close proximity to the Rosemont site, different pollutant background concentrations will be used. The selected background concentrations for each pollutant at Rosemont will be chosen in order to best represent existing background pollutant concentrations at the site since no on-site data exists for pollutants other than PM_{10}.

Pollutants directly emitted by operations at Rosemont and under evaluation for dispersion modeling purposes are PM_{10}, $PM_{2.5}$, NO_2, CO, and SO_2. Thorough evaluations of available air quality data are required in order to determine what background concentration is most representative of conditions at a particular location. Modeling guidance used for PSD permitting provides a general methodology for choosing background concentrations when on-site or nearby data are not available. However, due to site- and location-specific conditions and the limited representative monitoring data that is available, there is no one approach that is required to be used, even for purposes of modeling for PSD permitting. For purposes of this modeling protocol, available guidance will be followed and proposed variations from guidance documents will be identified.

4.1 PM_{10}

Rosemont initiated pre-application air quality monitoring for PM_{10} in June 2006. At that time it was undetermined whether the project would trigger PSD permitting for PM_{10}, so the on-site monitoring was performed in compliance with the PSD regulations. The monitoring ended in June 2009. The location of the monitoring site is shown in the Monitoring Protocol and QAAP. Complete quarterly data summary and audit reports have been submitted to the PCDEQ and ADEQ since the monitoring began. Detailed results of the monitoring program can be found in these quarterly reports and the quarterly summaries are presented in Appendix B. The on-site PM_{10} data will be used to define background concentrations for locations near Rosemont.

As stated in the November 9, 2005 *Revision to the Air Quality Models* (found at 40 CFR 51 Appendix W) that is applied to PSD permitting and can be followed in this case as a guideline for non-PSD modeling, the 24-hr PM_{10} background concentration will be based on the average of the highest 24-hr concentrations recorded for each year. With respect to determination of this value, ambient PM_{10} monitoring commenced at the start of the 3rd quarter of 2006. Annual time periods are thus defined as the time period from July of one year through June of the following year. A listing of the highest and second highest concentrations for the three year period is tabulated in Table 4.1.

Table 4.1 PM_{10} Monitoring Results

Year	Highest Concentration ($\mu g/m^3$)	2nd Highest Concentration ($\mu g/m^3$)
July 2006 -June 2007	71.3	27.0
July 2007 -June 2008	40.3	28.2
July 2008 - June 2009	31.6	21.2

The high concentration of 71.3 $\mu g/m^3$ was recorded on the second day of the monitoring program and is not representative of the typical background concentration observed at the Rosemont site. Likewise, the measured ambient PM_{10} concentration of 40.3 $\mu g/m^3$ appears to be abnormally high in comparison to other monitored concentrations.

Statistical analyses were performed to quantitatively evaluate whether these data points are legitimate and should be included in the calculation of the PM_{10} background concentration. The statistical analyses provided in Appendix C show that the monitored concentration of 71.3 $\mu g/m^3$ is an extreme outlier and the second highest monitored concentration of 40.3 $\mu g/m^3$ is an outlier.

Additional qualitative analysis has been performed to evaluate whether the high data point generally meets the criteria required of an "exceptional event" under 40 CFR Part 50 §§50.1(j), (k), and (l), and 50.14, *Treatment of air quality monitoring data influenced by exceptional events*. The rule guiding the determination of whether a high monitored value is an exceptional event applies to air quality regulatory agencies that are seeking to determine an area's NAAQS attainment or nonattainment status. It does not apply to individual sources or on-site monitoring. However, since the Rosemont project is also not subject to monitoring or modeling under PSD, the exceptional event evaluation process used by States does generally provide a reasonable framework for evaluating whether the high monitored value at the Rosemont site should be included in determining the PM_{10} background concentration.

Per 40 CFR Part 50 and the Preamble to the Final Rule at 72 FR 13560, an exceptional event:

(i) Affects air quality as established by an air quality impact that:

  1. Falls above the level of the applicable standard; and
  2. Is significantly beyond the normal fluctuating range of air quality, including background air quality concentrations, and
  3. Should be large enough that without it there would have been no exceedances

(ii) Is an event that is not reasonably controllable or preventable;

(iii) Is an event caused by human activity that is unlikely to recur at a particular location or a natural event; and is

(iv) Determined by EPA to be an exceptional event

While the above criteria clearly apply to States that are using monitored data to evaluate attainment status and not to sources, all available information regarding the monitored concentration of 71.3 $\mu g/m^3$ indicates that it should be excluded. Since dispersion modeling is being performed to evaluate the project's anticipated effects on ambient air quality as determined through comparison with the NAAQS, a similar approach for excluding a high data point due to an exceptional event is appropriate in this case.

As described in Appendix K of 40 CFR Part 50—Interpretation of the National Ambient Air Quality Standards for Particulate Matter, a State or other air quality jurisdiction that is evaluating the monitored concentrations of PM_{10} to determine whether the area is or is not in compliance with the NAAQS can exclude high data points under certain circumstances. This is because the Clean Air Act and EPA recognize that including in the computation of exceedances or averages a high value that is due to an exceptional event could result in inappropriate estimates of expected annual values. Including high values that are very unlikely to recur could place an area in nonattainment for reasons over which it has no control and for which regulatory control measures would have essentially no effect.

The Clean Air Act states that air quality data should be carefully screened to ensure that events not likely to recur are represented accurately in all monitoring data and analyses (42 U.S.C. 7619(b)(3)(A)). Based on the above considerations, the monitored concentration of 71.3 $\mu g/m^3$ will not be used. Instead, the next highest monitored concentration that occurred during the monitoring period, 40.3 $\mu g/m^3$, will be used in its place. This is a conservative value, because as shown in Table 4.1, the second highest PM_{10} concentration recorded during the first year of monitoring is 27.0 $\mu g/m^3$.

The background concentration for evaluating predicted impacts with the 24-hour PM_{10} NAAQS will be the mean of the highest values in Table 4.1 with 71.3 $\mu g/m^3$ replaced by 40.3 $\mu g/m^3$.

The annual PM_{10} background concentration for the area near Rosemont will be based on the average of the annual averages for the three-year monitoring period. This is the methodology presented in the November 9, 2005 *Revision to the Air Quality Models* (40 CFR 51, Appendix W) applied to PSD permitting and can be followed in this case as a guideline for Rosemont's non-PSD modeling. The summary of the annual averages and the resulting annual PM_{10} background concentration at Rosemont of 11.7 $\mu g/m^3$ is presented in Table 4.2.

Background concentrations for the impact analysis at the Saguaro East NP will be based on the 2007-2009 aerosol data from the Saguaro East NP IMPROVE monitoring site. The 24-hr and annual average background PM_{10} concentrations at Saguaro East NP are 47.6 $\mu g/m^3$ and 12.6 $\mu g/m^3$, respectively.

Table 4.2 PM_{10} Annual Average Monitored Concentrations	
Year	**Average Monitored PM_{10} Concentration ($\mu g/m^3$)**
July 2006 -June 2007	12.3
July 2007 -June 2008	12.4
July 2008 - June 2009	10.3
Average of Annual Averages	**11.7**

4.2 $PM_{2.5}$

To obtain a representative background concentration for $PM_{2.5}$ in the vicinity of Rosemont, a number of monitoring sites were evaluated to determine which site most closely reflected the conditions near Rosemont. The closest $PM_{2.5}$ monitors—located by straight-line distance from Rosemont—are in the Tucson metropolitan area.

The Rosemont site is located in the Santa Rita Mountains which trend northeast to southwest. Elevations range from 4,500 feet to over 6,000 feet and feature complex terrain. The approximate elevation of the Rosemont site itself is 5350 feet. The nearest sources of emissions are the small community of Green Valley located 15 miles to the west of Rosemont and several industrial facilities located 3 to 8 miles further west. These sources are distant from the Rosemont site and on the other side of the Santa Rita Mountains. Since Rosemont is not located near any existing monitors, nor are the locations of the existing Pima County monitors representative of the Rosemont site due to the significant urban influences that are nonexistent near Rosemont, it is necessary to evaluate other monitors to obtain background data for evaluating the fence-line impacts.

Two EPA IMPROVE monitoring sites, the Saguaro National Monument (NM) site and Chiricahua National Monument (NM) site, were evaluated for background data for the $PM_{2.5}$ modeling analysis. The Saguaro NM monitor is at an elevation of 3080 ft and located in close proximity to the Tucson metropolitan area, and thus influenced by urban and industrial emissions from Tucson. The Chiricahua NM monitor located in Cochise County is at an elevation of 5150 feet, similar to that of Rosemont, and is surrounded by similar complex terrain features like the Rosemont site. The physical characteristics of the terrain near the Chiricahua National Monument monitoring site are significantly more representative of the terrain in the vicinity of the Rosemont site compared to the Saguaro National Park East terrain characteristics. Emission sources impacting the Chiricahua National Monument monitoring site are more closely representative of the sources impacting the Rosemont site than the sources impacting the Saguaro National Park East monitoring site. Thus the Chiricahua NM site was selected for background data, as it is more representative of the Rosemont site on account of its similar terrain features, elevation and remoteness from emission sources.

EPA published a memorandum titled, "Modeling Procedures for Demonstrating Compliance with $PM_{2.5}$ NAAQS" on March 23, 2010 that states the following: "The representative monitored $PM_{2.5}$ design value, rather than the overall maximum monitored background concentration, should be used as a component of the cumulative analysis. The $PM_{2.5}$ design value for the annual averaging period is based on the 3-year average of the annual average $PM_{2.5}$ concentrations; for the 24-hour averaging period, the design value is based on the 3-year average of the 98th percentile 24-hour average $PM_{2.5}$ concentrations for the daily standard. Details regarding the determination of the 98th percentile monitored 24-hour value based on the number of days sampled during the year are provided in the ambient monitoring regulations, Appendix N to 40 CFR Part 50."

As described in the document entitled, *"Revised AERMOD Modeling Report to Assess Ambient Air Quality Impacts*" dated April 4, 2011, the procedure detailed in Appendix N of 40 CFR Part 50 will be applied to arrive at the monitored background $PM_{2.5}$ design values for the Saguaro NM IMPROVE site (based on 2008-2010 monitored data) for evaluating impacts at that location, and Chiricahua NM IMPROVE site (based on 2008-2010 monitored data) will be used to evaluate impacts in the vicinity of Rosemont.

4.3 NO_2

Emissions from Rosemont operations will include tailpipe emissions from mobile equipment conducting mining operations in addition to minor fuel combustion sources used in ore processing operations. Tailpipe emissions from mobile sources are not considered in applications for air quality permits, but those emissions are included in air impact analyses for Environmental Impact Statements. The planned air impact analysis will consider emissions from both process sources and mobile sources. Tail pipe emissions are generally comprised primarily of both NO_x and CO.

Nitrogen dioxide (NO_2) is formed by the oxidation of nitric oxide (NO) which is a byproduct of combustion. Ambient NO_2 concentrations for locations in Arizona are currently monitored only in urban areas and near coal fired power plants. One rural monitoring site where emissions are due to minor vehicle traffic and outboard motorboats on Alamo Lake was in place during 2005–2006. There are no monitoring sites in the vicinity of the proposed Rosemont project. Table 4.3 provides the NO_2 monitoring station locations in Arizona and the maximum one-hour average NO_2 concentrations monitored from 2005 through 2008 as reported by ADEQ in the Air Quality Annual Reports (available at http://www.azdeq.gov/function/forms/reports.html).

Urban areas are very highly influenced by emissions from vehicle traffic that do not exist near Rosemont. As a result, those monitoring locations are not representative of existing NO_2 background concentrations near Rosemont. Coal-fired power plants are significant sources of NO_2 and monitoring data from those locations do not represent existing background NO_2 concentrations near Rosemont. The only remaining monitor in Arizona that could be considered representative of NO_2 background concentrations for Rosemont is located at Alamo Lake.

The Rosemont site is similar to the Alamo Lake site in that the only sources of NO_2 are minor vehicle traffic on a road approximately 2.5 miles from the site. Both locations are rural. The highest background 1-hr NO_2 concentration recorded at the Alamo Lake site measured during a two year monitoring program (2005-2006) was 24.5 $\mu g/m^3$ (note that the ADEQ Air Quality Annual Reports show NO_2 concentrations in ppm, not $\mu g/m^3$). The second-highest monitored 1-hour concentration was 20.7 $\mu g/m^3$. For purposes of providing a background NO_2 concentration at the Rosemont site, the highest of the two years, 24.5 $\mu g/m^3$ will be used as the 1-hr background NO_2 concentration. In the absence of on-site NO_2 data, this value will also be used for the Saguaro East NP. Use of the highest monitored Alamo Lake 1-hour NO_2 value represents a conservative estimate of NO_2 background.

Table 4.3 Maximum Monitored Value of the One-Hour Average NO_2 Concentration (ppm)

Monitoring Station	Location Type	2005	2006	2007	2008
Apache County					
TEP – Springerville – Coyote Hills	Coal-fired power plant	0.014	0.018	0.037	0.025
La Paz County					
Alamo Lake[a]	Rural	0.011	0.013	-	-
Maricopa County					
Buckeye	Urban	0.053	0.047	0.069	0.059
Central Phoenix	Urban	0.095	0.085	0.077	0.076
Greenwood	Urban	0.131	0.111	0.094	0.138
JLG Supersite[b]	Urban	0.077	0.067	0.076	0.073
South Scottsdale	Urban	0.079	0.065	0.068	0.063
West Phoenix	Urban	0.100	0.092	0.082	0.065
Pima County					
22nd St. & Craycroft - Tucson	Urban	0.056	0.051	0.058	0.054
Childrens Park - Tucson	Urban	0.049	0.054	0.049	0.049
Yuma County					
Yuma Game & Fish[c]	Urban	0.051	0.067	0.060	-

[a] Seasonal Monitor – operated May 20 – December 31, 2005 and April – October, 2006.
[b] Seasonal Monitor – operated January 1 – April 30 and October 1 – December 1, 2008.
[c] Seasonal Monitor – operated April 1, 2005 – April 12, 2007.

Rosemont has recently been made aware of a NO_2 background concentration data set from a monitor located at Tonto National Forrest. The duration of this database is from May 2002 to Nov 2006. This data set is available from the EPA Air Quality Systems database and is currently being evaluated. If the Tonto National Forrest monitor data is selected, then the 98th percentile of the annual distribution of daily maximum 1-hour NO_2 concentration values averaged across 3 years of the monitored data will be used as background.

4.4 CO

CO is produced by the incomplete combustion of fuels with anthropogenic activities (automobiles, construction equipment, lawn and garden equipment, commercial and residential heating, etc.) representing the major source of emissions. Consequently, the CO monitoring sites in Arizona are located exclusively in urban areas (Phoenix, Tucson and Casa Grande) and there are no representative monitoring stations to determine background CO concentrations.

The ADEQ recommended CO background concentrations for rural areas with no major sources of CO for both the 1-hour and 8-hour averaging periods are 582 $\mu g/m^3$ (communications with the ADEQ see Appendix E). These values will be used as background CO concentrations for all impact analyses: the fence line, near vicinity and Saguaro East NP impact analysis.

4.5 SO_2

Historically, the principal sources of SO_2 emissions in Arizona have been copper smelters and coal-fired power plants. The non-urban SO_2 monitoring sites in Arizona are located in areas near smelters, including Miami, Globe, and Hayden, and near coal-fired power plants, including Springerville, Page, and Bullhead City. To evaluate whether SO_2 is a pollutant of concern for large populations of people in Arizona, SO_2 monitors are also located in the urban areas of Phoenix and Tucson. Since the Rosemont site is neither near a copper smelter or coal-fired power plant, nor located near an urban area, there are no representative monitoring stations to determine background SO_2 concentrations.

The ADEQ-recommended SO_2 background concentrations for rural areas with no major sources of SO_2 for the 3-hour, 24-hour and annual averaging periods are 43 $\mu g/m^3$, 17 $\mu g/m^3$ and 3 $\mu g/m^3$, respectively (communications with the ADEQ; see Appendix E). These values will be used as background SO_2 concentrations for the fence line and near vicinity impact analyses as well as for the Saguaro East NP impact analysis.

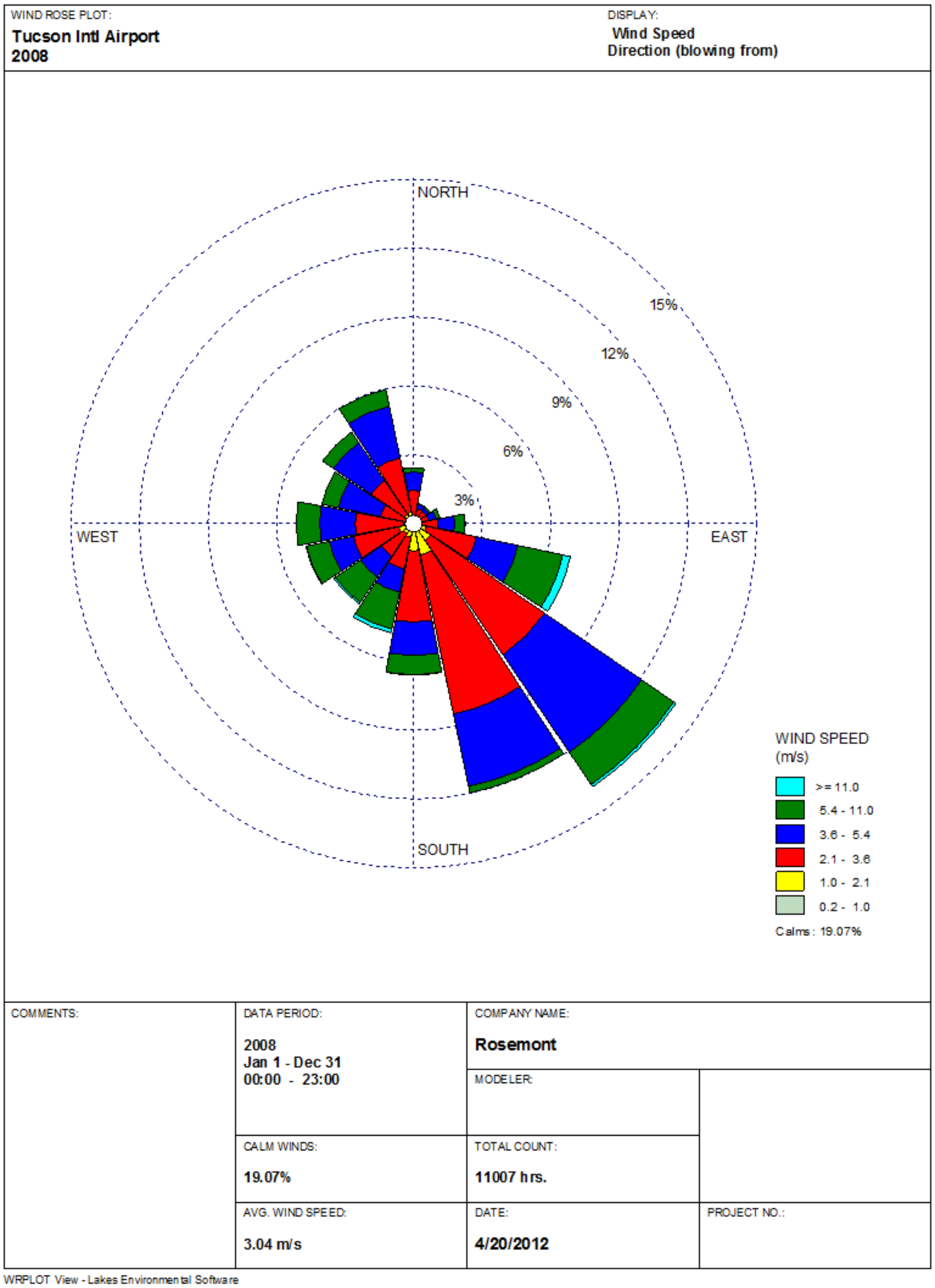
4.6 Pollutant Transport to Rosemont

Transport of emissions to the Rosemont site from Tucson and Interstate 10 (I-10) to effect background concentrations at the site is highly unlikely as illustrated by wind roses for the Rosemont site (Figures 3.2 through 3.4) and for the Tucson airport (Figure 4.1). Rosemont wind patterns have a very strong western component with almost no northerly component. This is primarily due to the site’s location on the eastern slope of the Santa Rita mountains, which extend to the north-northeast and to the south of the site.

Any emissions transported toward Rosemont from the north or northwest, such as from the Tucson metropolitan area, would have to travel over or around the higher elevations in those directions. Any emissions transported toward Rosemont from the east would have to overcome the frequent, relatively strong winds from the west. The wind rose from the Tucson airport as shown in Figure 4.1 exhibits a pronounced southeasterly component directing emissions away from the site. The primary Tucson winds and their accompanying emissions tend to blow away from the Rosemont location, which is at a distance of approximately 30 miles and over elevations greater than those at Rosemont.

The Rosemont location is approximately 15 miles south of Interstate 10 (I-10), which runs primarily from east to west. The interstate changes direction at a point almost due north of Rosemont and begins heading northwest. As indicated in Figures 3.2 through 3.4, the frequency of winds from the direction of I-10 to the Rosemont site is less than 5%. Vehicle emissions could potentially be transported from I-10 to the Rosemont site. However, the winds at Rosemont only rarely blow from the north or northeast. The relative frequency and strength with which the winds at Rosemont blow from the west make it highly unlikely that vehicle emissions originating at I-10 have an impact at

Rosemont that is more significant than what the proposed background concentrations already



consider.

Figure 4.1 Wind Rose for the Tucson Airport

Aside from the very loaw frequency of winds from the Tucson and I-10 areas to Rosemont, it should also be noted that the highest impacts from a stationary source usually occur under stable meteorological conditions. Such conditions generally occur during calm conditions characterized by down slope winds from elevated terrain to lower elevations. Upslope winds from low elevations to higher elevations generally occur during less stable conditions that produce lower impacts. The Rosemont site is in complex terrain at a higher elevation than both Tucson and the I-10. Consequently any emissions that could be transported from these areas to Rosemont would be greatly dispersed and would occur when Rosemont impacts are at reduced levels. Including additional emissions in the background concentrations during meteorological conditions when Rosemont emissions produce peak impacts would inappropriately skew the modeling. Therefore, while it is theoretically possible that transported emissions could reach Rosemont, there is no indication that use of the proposed methods to determine background pollutant concentrations for modeling, which are based on the regulatory methods, are insufficient.

5. MODELING ANALYSIS DESIGN

5.1 Ozone Limiting Method for Evaluating NO_2 Impacts

The Ozone Limiting method (OLM), which is a non-regulatory option in AERMOD, will be used to evaluate the impact of NO_2 in the near vicinity of the Rosemont Project as well as at the Saguaro East National Park. Background ozone data for Chiricahua National Monument will be used for the Rosemont near-vicinity impact evaluation.

OLM involves an initial comparison of the estimated maximum NO_x concentration and the ambient ozone concentration to determine the limiting factor in the formation of NO_2. If the ozone concentration is greater than the maximum NO_x concentration, total conversion is assumed. If the NO_x concentration is greater than the ozone concentration, the formation of NO_2 is limited by the ambient ozone concentration. The method also uses a correction factor to account for in-stack conversion of NO_x to NO_2. While the modeling being performed for Rosemont is not subject to the regulatory requirements therein, the use of OLM for the Rosemont modeling analysis is based on the requirements of 40 CFR Part 51, Appendix W, 3.2.2(e) being met as follows:

3.2.2(e)(i). The model has received scientific peer review;

- The chemistry for the OLM option has received peer review as noted in "Sensitivity Analysis of PVMRM and OLM in AERMOD" document posted in EPA's SCRAM website. The document indicates that the model appears to performs as expected.

3.2.2(e)(ii). The model can be demonstrated to be applicable to the problem on a theoretical basis;

- The model has been reviewed and the chemistry has been widely accepted by the EPA and other government agencies as being appropriate for addressing the formation of NO_2 and the calculation of NO_2 concentration at receptors downwind. For a given concentration of NO_x emission rate and ambient ozone concentration, the NO_2/NO_x conversion ratio for OLM is primarily controlled by the ground level NO_x concentrations.
- The EPA issued a memorandum dated March 1, 2011 entitled "Additional Clarification Regarding Application of Appendix W Modeling Guidance for 1-hr NO_2 NAAQS." This memo indicates that the PVMRM method as currently implemented may have a tendency to overestimate the conversion of NO to NO_2 for low-level plumes by overestimating the amount of ozone available for the conversion due to the manner in which the plume volume is calculated. Furthermore, the EPA's Risk and Exposure Assessment (REA) for the most recent NO_2 NAAQS review (EPA, 2008) for the Atlanta area used the OLM option with OLMGROUP ALL to estimate NO_2 concentration from mobile source emissions. The vast majority of the NO_2 emissions at the Rosemont facility will be from mobile sources.
- Additionally, the "Sensitivity Analysis of PVMRM and OLM in AERMOD" report indicates that PVMRM/OLM provides a better estimation of the NO_2 impacts compared to other screening options.

3.2.2(e)(iii). The data bases which are necessary to perform the analysis are available and adequate;

- Hourly background ozone data for the period April 2006 to March 2009 from the Chiricahua National Monument IMPROVE site will be used. The Chiricahua NM site is the most representative of the terrain and conditions at the Rosemont site.

3.2.2(e)(iv). Appropriate performance evaluations of the model have shown that the model is not biased towards underestimates;

- Although no assessment of bias has been conducted for the OLM model, based on the "Sensitivity Analysis of PVMRM and OLM in AERMOD" report, OLM was estimated to provide similar or more conservative estimates of concentration than PVMRM and therefore would also be judged to be unbiased toward underestimation.

3.2.2(e)(v). A protocol on methods and procedures to be followed has been established;

- The methods and procedures for conducting an assessment for determining compliance with the 1-hr federal NAAQS are contained in other sections of this document.

EPAs guidance “Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard, March 01, 2011” recommends use of an in-stack NO_2/NO_x ratio of 0.5, but allows different ratios to be used provided that available data justifies use. Lower NO_2/NO_x ratios for boilers, blasting and compression ignition internal combustion engines have been recommended by regulatory agencies including the Texas Commission on Environmental Quality (TCEQ) and the San Joaquin Valley Air Pollution Control District (SJVAPCD). The value of 0.1 was the default value in the addendum to the AERMOD user guide “Addendum: User’s Guide for the AMS/EPA Regulatory Model AERMOD, EPA-454/B-03-001, September 2004”. Because the overwhelming majority of NO_x emissions are from mobile sources, an in-stack ratio of 0.05 will be used in this modeling. For analysis of the available data and justification pertaining to the NO_2 to NO_x ratio of 0.05, see Appendix F.

The OLM method requires hourly background ozone values to calculate the conversion of NO_2 to NO_x. Hourly background ozone values from the Chiricahua National Monument IMPROVE site will be used (see previous section for explanation). This data base is complete with only 4% missing data. The missing data will be replaced by the 1-hour average of the entire database. The OLMGROUP option will also be used which essentially models all the plumes as one combined plume.

5.2 Receptor Network

Following the *ADEQ Guidance*, the receptor grid (see Figure 5.1) consisting of the following will be modeled:

- receptors spaced at 25 meters along the Process Area Boundary (PAB);
- receptors spaced at 100 meters from the PAB to 1 kilometer;
- receptors spaced at 500 meters from 1 kilometer to 5 kilometers;
- receptors spaced at 1000 meters from 5 kilometers to 50 kilometers.

Based on the recommendation of the Forest Service, a second receptor grid consisting of receptors at the Saguaro East National Park will also be modeled (see Figure 5.2). These receptors were obtained from the Class I Area Receptor Database developed by the Forest Service.

5.3 Receptor Elevations

Receptor elevations will be determined from the National Elevation Dataset (NED) distributed by the USGS, which are based on North American Datum 1927 (NAD27). This dataset has a resolution of 1/3 arc-second (or approximately 10 meters).

The NED data will be processed with AERMAP. AERMAP, like AERMET, is a preprocessor program which was developed to process terrain data in conjunction with a layout of receptors and sources to be used in AERMOD. For complex terrain situations, AERMOD captures the essential physics of dispersion in complex terrain and therefore, needs elevation data that convey the features of the surrounding terrain. In response to this need, AERMAP first determines the base elevation at each receptor. AERMAP then searches for the terrain height and location that has the greatest influence on dispersion for each individual receptor. This height is referred to as the hill height scale. Both the base elevation and hill height scale data are produced by AERMAP as a file or files which are then inserted into an AERMOD input control file.

5.4 Modeling Domain

The AERMAP terrain preprocessor requires the user to define a modeling domain. The modeling domain is defined as the area that contains all the receptors and sources being modeled with a buffer to accommodate any significant terrain elevations. Significant terrain elevations include all the terrain that is at or above a 10% slope from each and every receptor. BEE-Line's software automatically calculates the modeling domain based on the receptor grid being used and identifies each 7.5-minute DEM quadrangle that must be used in AERMAP to meet the 10% slope requirement.

5.5 Plume Depletion

One other option in the AERMOD model requires particle size data. This option is known as DDEP, which specifies that dry deposition flux values will be calculated. If this option is selected, dry removal (depletion) mechanisms (known as dry plume depletion (DRYDPLT) in the old ISC modeling program and earlier versions of AERMOD) are automatically included in the calculated concentrations. This option will be selected in the proposed modeling for receptors exhibiting high particulate impacts in initial modeling runs.

5.6 Building Downwash

Building downwash effects will be evaluated by incorporating the appropriate building/structure dimensions into the AERMOD input files using BEE-Line's commercial version of EPA's Building Profile Input Program for PRIME (BPIPPRM) software. The BPIPPRM program is EPA approved and includes the latest EPA building downwash algorithms. The downwash files generated by BPIPPRM program will be provided in the final modeling report.

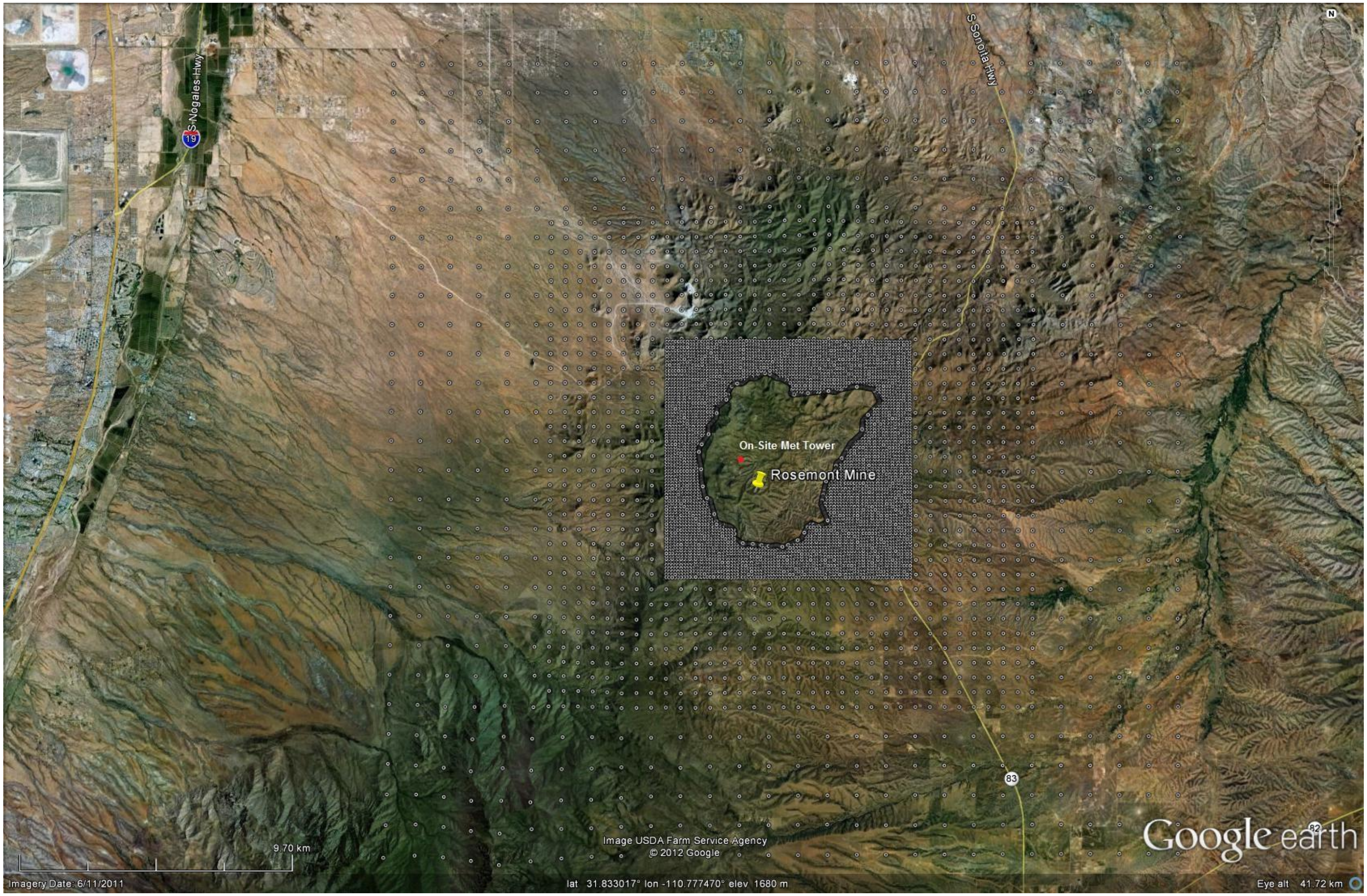


Figure 5.1 Receptor Grid Network Developed for the Rosemont Project Modeling Analysis

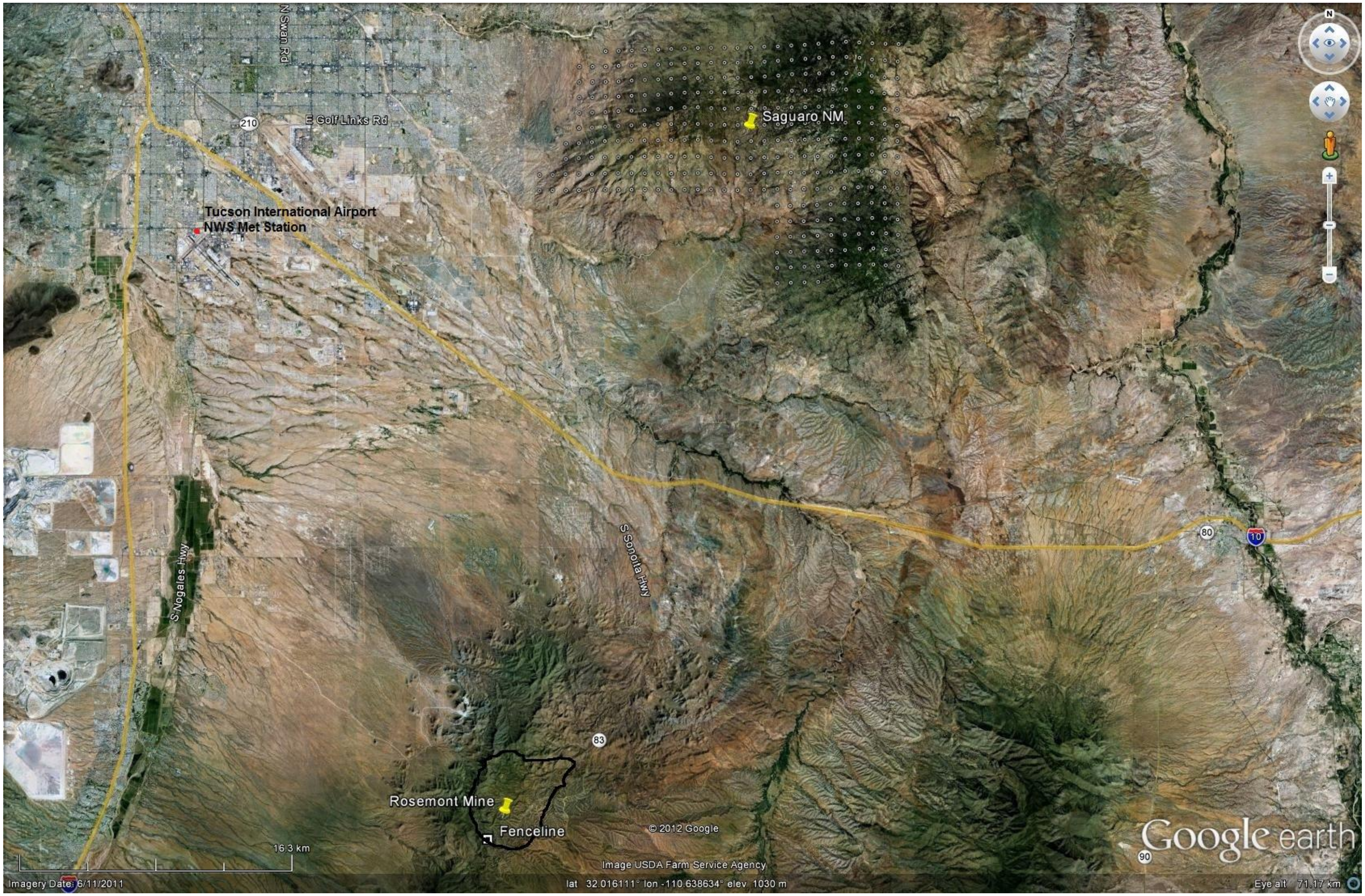


Figure 5.2 Receptor Network for Evaluating Impacts at the Saguaro East National Park

6. EMISSIONS MODELED AND SOURCE CHARACTERIZATION

A preliminary description of the planned equipment and emission generating processes at Rosemont can be found in the previously referenced *Mine Plan of Operations*. A plan view map depicting the facility layout by Year 5 is presented in Figure 6.1. A preliminary plan view of the ancillary operations, to include locations of the primary crusher and flotation operations, is presented in Figure 6.2 .

6.1 Operational Years to Be Modeled

A preliminary summary of average and maximum mining rates and haul truck travel (vehicle miles) is presented in Appendix D. This summary is subject to change depending upon any further refinements to the mine plan. The mining information in Appendix D indicates:

- The highest projected annual mining rate and highest haul truck travel outside the pit will occur in Year 1 (approximately 115,000,000 tons of ore and waste per year; 2,237,113 haul truck VMT).

- The highest projected haul truck travel will occur in Year 5 (2,793,243 VMT per year).

Emissions from Rosemont 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.

Since haul truck travel will be the primary source of emissions (PM_{10} and tail pipe), Year 5 will be modeled. Appendix D also shows that haul truck travel outside the pit will be a maximum during Year 1. 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. Emissions, and therefore impacts, during all other years will be less than during these two years.

6.1.1 Annual Criteria Pollutant Emissions Modeling

Annual impacts of particulate and gaseous emissions will be based upon emissions calculated using the average daily process rates for Years 1 and 5. The average daily process rate is used for determining annual impacts since it represents expected emissions over the course of a year.

6.1.2 Short-Term Criteria Pollutant Emissions Modeling

Short-term impacts (1-hour, 3-hour, 8-hour and 24-hour) will be based upon the emissions calculated using the maximum daily process rates for Years 1 and 5. Short-term impacts are affected by peak emission rates. These are better determined using the expected maximum daily process rates rather than the average daily process rates. For Year 5, the maximum daily process rate is based on the average daily process rate increased by a capacity factor of 20%.

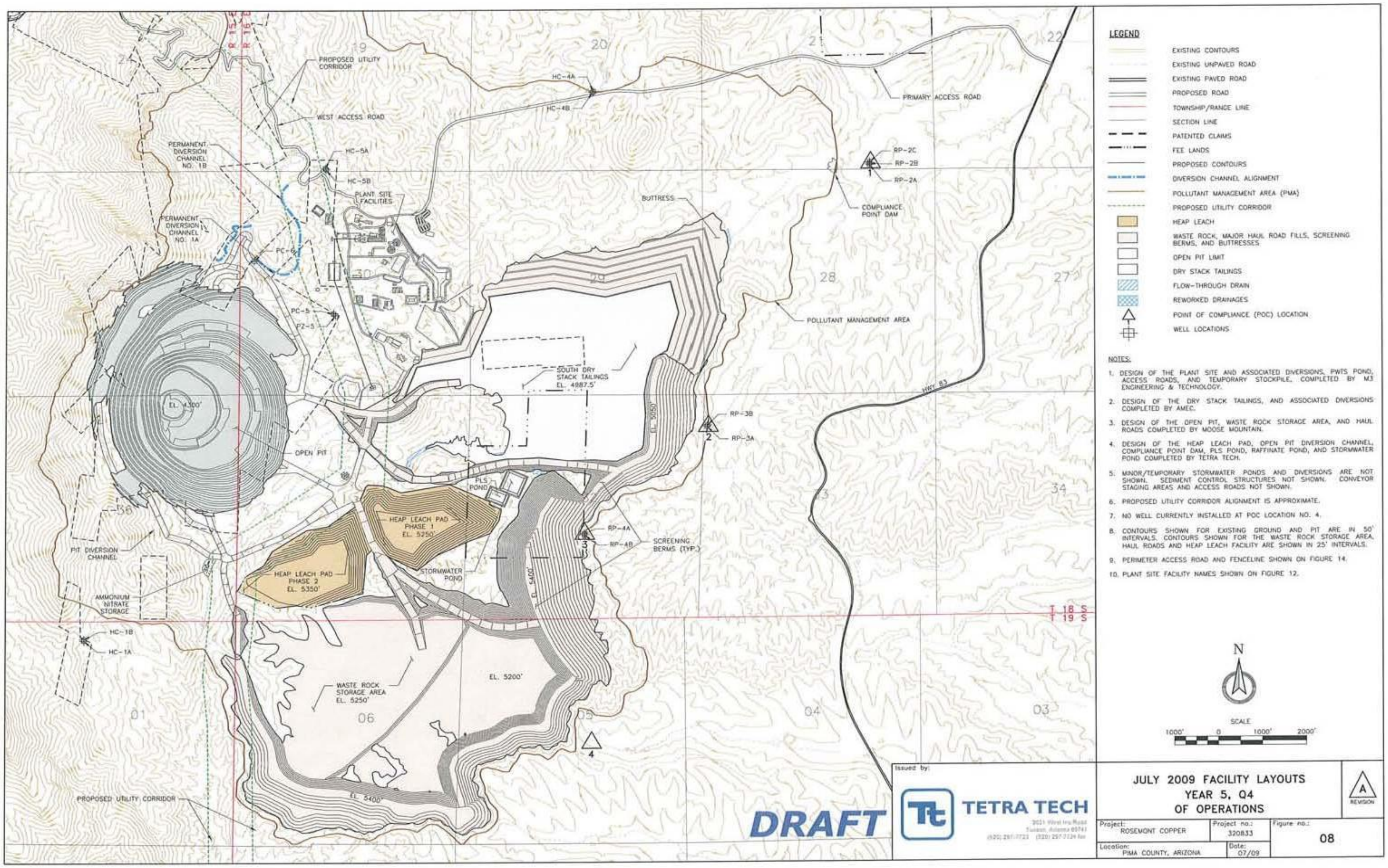


Figure 6.1 Plan View Map of Operations Depicting Facility Layout by Year 5

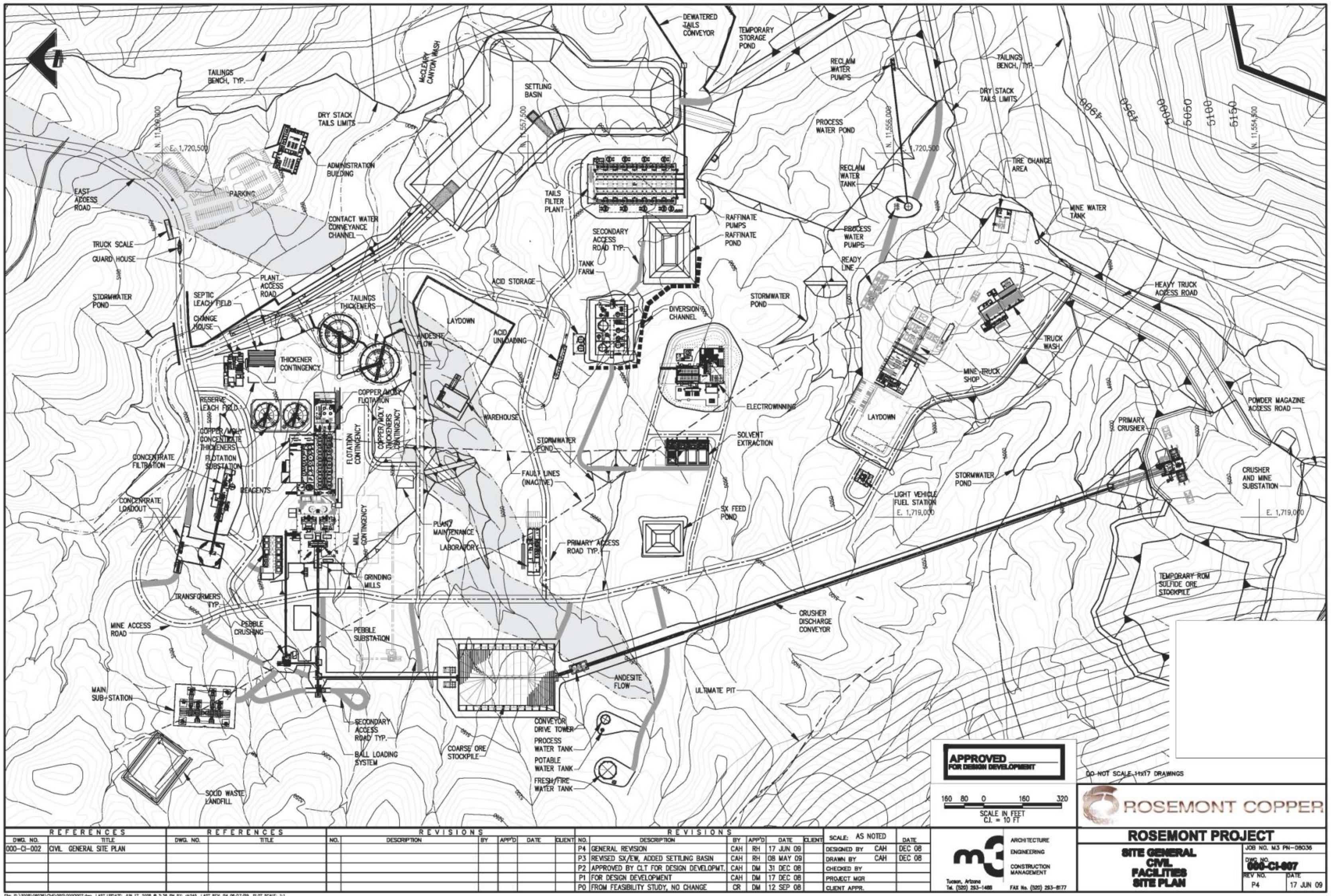


Figure 6.2 Plan View Map of Operations Showing Updated Ancillary Operation Locations for Rosemont

6.2 Point Sources

Point sources at Rosemont will include dust collectors, hot water heaters, and emergency generator(s). Emissions from these sources will be modeled as individual point sources. Dust collectors or baghouses are anticipated to have ambient exit temperatures and will be modeled using a stack temperature of 0°K per ADEQ guidance, thus forcing 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. Particulate emissions from the emergency generators will not be included in the PM_{10} modeling since most other operations would be shut down if the generators are needed. Therefore, the generators would not add to peak emissions being modeled. Gaseous emissions from these sources, however, will be included in the gaseous modeling runs. The point source emissions will be modeled using the particle size distribution shown in Table A.13 of Appendix A.

6.3 Volume Sources

Due to the nature of Rosemont's operations, a majority of sources will be modeled as volume sources. They are described in the sections below.

6.3.1 Roads

A refined road network will be developed to depict the anticipated haul truck routes and dumping locations during the year of the mine plan with the estimated greatest emissions, which will be the basis of the emissions inventory that will be used for all of the modeling. Emissions due to haul road and general plant traffic on the paved and unpaved road network will be modeled as volume sources and the modeling parameters will be based on guidance from ADEQ and the AERMOD User's Guide. The modeling parameters will be set as follows:

- volume height will be set equal to twice the height of the vehicles generating the emissions;
- initial vertical dimension will be set equal to the volume height divided by 2.15;
- release height will be set equal to half of the volume height; and
- initial lateral dimension will be set to the width of the road divided by 2.15. The road will be further divided into two lanes representing 2-way traffic (by request of the Forest Service)

The majority of emissions on the haul road network will be due to large haul trucks. The height of the Haul Trucks obtained from the manufacturers data was 6.6 meters (21.6 feet). Thus, for each road source the volume height will be set to 13 meters (twice the height of the vehicles generating the emissions rounded to the nearest meter), the initial vertical dimension will be set to 6.05 meters (volume height divided by 2.15), and the release height will be set to 6.5 meters (half of the volume height). The road width was estimated to be 35 meters. Thus, the initial lateral dimension for each volume will be set to 16.3 meters (width of 35 meters divided by 2.15).

The road sources will be placed along the road network at approximately 35 meter intervals. According to the mine plan, during Year 1 of operations, 78% of the haul emissions would be generated outside the pit whereas during Year 5, 58% would be generated outside the pit. In-pit traffic versus out-of-pit traffic distributions will be taken into account when evaluating the location of haul road emissions..

The emissions from dumping to the sulfide ore stockpile, waste rock stockpiles and to the leach pad will also be modeled as volume sources. The height of the haul trucks obtained from the manufacturers data was 6.6 meters (21.6 feet). Thus, for each source representing dumping, the volume height will be set to 13 meters (twice the height of the vehicles generating the emissions rounded to the nearest meter), the initial vertical dimension will be set to 6..05 meters (volume height divided by 2.15), and the release height will be set to 6.5 meters (half of the volume height). The width of the trucks (simulating the dump width) obtained from the manufacturers data was 8.7 meters (28.5 feet). Thus the initial horizontal dimension will be set to 4 meters (volume width divided by 2.15). The haul road emissions will be modeled using the particle size distribution shown in Table A.4 of Appendix A.

6.3.2 Truck Unloading

Fugitive emissions from truck unloading at the primary crusher will be represented by a single volume source. The side length will be set to 8.23 meters (approximate width of dump pocket) and therefore, the initial horizontal dimension will be set to 1.91 meters (8.23/4.3). The vertical length will be set to 3 meters (vertical drop of dump pocket). Consequently, the initial vertical dimension will be set to 1.4 meters (3/2.15) and the release height will be set to 0 meters (dump pocket is at grade level).

6.3.3 Sulfide Ore Stockpile

Fugitive emissions due to wind erosion from the sulfide ore stockpile will be represented by a single volume source. The side length obtained from the map was 318 meters (average width of the stockpile) and therefore the initial horizontal dimension will be set to 74 meters (318/4.3). The vertical will be set to 12 meters (average height of stockpile). Consequently, the initial vertical dimension will be set to 5.6 meters (12/2.15) and the release height will be set to 6 meters (half of the volume height of 12 meters).

6.3.4 Tailings Stockpile

Fugitive emissions due to wind erosion from the Tailings stockpile will be represented either by a single volume source or by multiple volume sources. If the stockpile is modeled as a single volume source, then based on the area of tailings stockpile obtained from the map, the side length was estimated to be 2464 meters; and therefore the initial horizontal dimension will be set to 573 meters (2464/4.3). The vertical will be set to 12 meters (average height of stockpile). Consequently, the initial vertical dimension will be set to 5.6 meters (12/2.15) and the release height will be set to 6 meters (half of the volume height of 12 meters). A similar approach will be followed if the Tailing stockpile is modeled as multiple volume sources.

6.3.5 Conveyor Transfer Points

Fugitive emissions from conveyor transfer points will be represented by single volume sources. The side length will be set to 2 meters (approximate width of the conveyors) and therefore, the initial horizontal dimension will be set to 0.5 meters (2/4.3). The vertical length will be set to 3 meters (approximate height of material drops from the conveyors). Consequently, the initial vertical dimension will be set to 0.7 meters (3/4.3). The release height will be set to 3 meters (assumed height of conveyors, except for the conveyors feeding the coarse ore stockpile. The release heights for these sources will be set to the actual height of the conveyor at the top of the stockpile. Transfer emissions will be modeled using the particle size distribution shown in Table A.7 of Appendix A.

6.3.6 Gaseous Emissions Due to Blasting

The gaseous emissions due to blasting in the pit will be modeled as volume sources. The fugitive gaseous emissions due to blasting in the pit were equally spaced at 250 meter intervals (arbitrarily selected) over the pit area. The side length of each volume source was set at 61.0 meters (represents the average width of a blast) and therefore, the initial horizontal dimension was set to 14.2 meters (61.0/4.3).

A typical blast can send emissions 30 meters into the air. Consequently, a conservative vertical dimension of 20 meters was assigned to the volume sources representing the blasting emissions. Thus the initial vertical dimension of each source will be set to 9.3 meters (20/2.15) and the release height will be set to 10 meters (1/2 of the vertical dimension of 20 meters). The base elevation for the volume sources in the pit will be set to the average elevation between the lowest and highest elevation of the terrain defining the bottom and top of the pit, based on the assumption that these emissions must rise above the walls of the pit before being dispersed downwind. Since Rosemont anticipates blasting to occur only between 12 PM and 4 PM, the variable emission rate option HROFDY in AERMOD will be used to model the emissions between the above 4 hour interval every day. The PM_{10} emissions from blasting will also be modeled as volume sources and will use the particle size distribution shown in Table A.10. For evaluating the 1-hr averaged impacts from NO_2, SO_2 and CO, blasting emissions will be set to occur every hour between 12 PM to 4 PM. Test modeling runs indicated that the maximum impact due to blasting emissions occurred at 4 PM every day. Therefore for all impact evaluations greater than the 1-hr averaged impacts, blasting will be set to occur at 4 PM every day. The HROFDY variable emissions rate option in AERMOD will be used for this.

6.3.7 Open Pit

Fugitive particulate emissions from the open pit at Rosemont will be modeled using the open pit source model as defined by the AERMOD model (only particulate emissions are considered with the open pit source model). The open pit source parameters, easterly length, northerly length and volume, will be based on the length and width dimensions of the rectangle drawn to simulate the pit shape in the model and the anticipated depth of the pit in the worst case year. The release height will be set to zero. The Year 5 mine plan shows a berm developed on the east and south side of the process area boundary. This 150 foot berm essentially covers the waste dump and leach pads on the east and south. Therefore the emissions generated at the leach pad and waste dump will be modeled as a second pit with a depth of 150 feet.

The open pit source option in the AERMOD model requires particle size distribution data in the form of the mass-mean particle diameter, mass weighted size distribution, and particle density. Table A.4

shows the particle size distribution developed for haul road emissions. This distribution will be used for the open pit source since a majority of the emissions in the pit are haul road emissions.

A particle density of 2.44 gm/cm^3, the other required input variable, is initially proposed for use in the modeling as a representative value of the average density of the various rock materials (overburden, waste rock, ore) that will be mined. A more specific value will be used if specific density data for the materials to be mined at Rosemont become available.

6.3.8 Tail Pipe Emissions

Tail pipe emissions from mobile sources 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 on an evaluation of the vehicle miles travelled (VMT) along each road segment and inside the pit. Appendix D provides a breakdown of the in-pit versus out-of-pit traffic. All tailpipe particulate emissions will be modeled as $PM_{2.5}$ as recommended by ADEQ. See supporting email correspondence with ADEQ in Appendix E.

7. ALTERNATIVE SCENARIOS

Rosemont is currently developing an alternative scenario called the Barrel Only Alternative. The modeling for the proposed alternative scenario will follow the same procedures as outlined in the previous sections of this document. The Barrel Only Alternative re-routes some of the haul roads and dumping locations, thus the source locations would differ from those in the Proposed Action. However, the modeling methodology for the Barrel Only Alternative will follow the methodology for the Proposed Action.

8. EVALUATION OF DISPERSION MODELING RESULTS

Evaluation of protection of the NAAQS will be performed by comparing the maximum modeled impacts to the applicable standards. The final impact analysis will include all information necessary for this evaluation including: (a) background concentrations; (b) source location map; (c) 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. The methodology for evaluating protection of the NAAQS for each pollutant of interest is described below.

8.1 CO Evaluation

The modeled highest 2nd high 1-hour and 8-hour CO concentrations will be determined. These predicted concentrations will be added to the 1-hour and 8-hour CO background concentrations to determine the maximum ambient CO concentrations for both Year 1 and Year 5. The results will be compared to the applicable 1-hour and 8-hour CO NAAQS of 40,000 $\mu g/m^3$ and 10,000 $\mu g/m^3$ respectively.

8.2 NO_2 Evaluation

Although emissions are estimated in terms of total NO_x, only NO_2 has a NAAQS. NO_x emissions from fuel combustion sources are primarily NO (nitrous oxide) which gradually converts to NO_2 over time. Comparison of the maximum predicted NO_x concentrations with the annual NAAQS for NO_2 thus represents a very conservative method of demonstrating protection of NAAQS. Modeling for the 1-hour NO_2 concentration will be conducted using an in-stock NO_2/NO_x ratio as described in Section 5.1.

The modeled highest annual NO_x concentration will be added to the annual NO_2 background concentration, and the 98th percentile 1-hour NO_x concentration will be added to the 1-hour background NO_2 concentration for Years 1 and 5. The results will be compared to the applicable 1-hr and annual NO_2 NAAQS of 188.6 $\mu g/m^3$ and 100 $\mu g/m^3$, respectively.

8.3 PM_{10} Evaluation

The modeled highest 4th high 24-hour PM_{10} concentration for Year 1 and Year 5 will be added to the 24-hour PM_{10} background concentration. The highest modeled annual PM_{10} concentrations for Years 1 and 5 will be added to the annual PM_{10} background concentration. These concentrations will be compared to the applicable 24-hour and annual PM_{10} NAAQS of 150 $\mu g/m^3$ and 50 $\mu g/m^3$, respectively, to evaluate protection of the PM_{10} NAAQS.

8.4 SO_2 Evaluation

The 99th percentile of the 1-hour daily maximum SO_2 concentration and the highest 2nd high 3-hour SO_2 concentration will be added to their respective background concentrations. The resulting predicted concentrations for Years 1 and 5 will be compared to the 1-hour and 3-hour SO_2 NAAQS of 196 $\mu g/m^3$ and 1,300 $\mu g/m^3$, respectively. The 24-hour and annual SO_2 concentrations will be evaluated for both Years 1 and 5 and compared to the applicable 24-hour and annual SO_2 NAAQS of 365 $\mu g/m^3$ and 80 $\mu g/m^3$, respectively.

8.5 $PM_{2.5}$ Evaluation

The three year average of the 98th percentile 24-hour concentration and highest annual concentration for Year 1 and Year 5 modeling will be added to the 24-hour and annual $PM_{2.5}$ background concentrations. These concentrations will be compared to the applicable 24-hour and annual $PM_{2.5}$ NAAQS of 35 $\mu g/m^3$ and 15 $\mu g/m^3$, respectively.

APPENDIX A

PARTICLE SIZE DISTRIBUTIONS

A. PARTICLE SIZE DISTRIBUTIONS

The Dry Deposition option in AERMOD calculates the fraction of the particulate emissions in the plume that are removed by interaction with the ground surface or vegetation, thus providing a better estimate of the concentration of pollutants downwind from the source. The use of this option in AERMOD requires particle size distribution data in the form of the mass-mean particle diameter, mass weighted particle size distribution, and particle density. EPA modeling guidance does not specify any default values and this type of data is not readily available. The table below shows the particle size categories and the corresponding mass-mean particle diameters that will be used for modeling for the Rosemont project. The following sections describe the methodologies used to estimate the mass-mean particle diameter, particle density and mass weighted particle size distributions for various emission sources based on AP 42 emission factors.

A.1 Mass-Mean Particle Diameters

The expected mass mean particle diameter for particle size ranges between 0 and 10 microns in diameter was calculated using the formula below.

$$d = \left(\frac{{d_1}^3 + {d_1}^2 d_2 + d_1 {d_2}^2 + {d_2}^3}{4}\right)^{\frac{1}{3}}$$

where: d = mass-mean particle diameter
d_1 = low end of particle size category range
d_2 = high end of particle size category range

Table A.1 Mass-Mean Particle Diameters

Particle Size Category Range (microns)	Mass-Mean Particle Diameter (microns)
0 - 3.5	2.20
3.5 - 5	4.29
5 - 7	6.05
7 - 8.5	7.77
8.5 - 10	9.27

A.2 Particle Density

A particle density of 2.44 gm/cm^3 will be used for modeling. This value has previously been approved for use in similar modeling analyses by ADEQ, and is based on a weighted average of the densities of various rock materials (overburden, waste rock, ore) at copper mines.

A.3 Haul Road Sources - Particle Size Distribution

Section 13.2.2 of EPA's AP-42, *Compilation of Air Pollutant Emission Factors,* provides in Equation 1a a method to calculate emission factors for unpaved industrial roads. Based on a mean haul truck weight of 305 tons and a silt content of 5% and using Equation 1a, the estimated emission factors for haul trucks at Rosemont were calculated. The emission factors were used to determine the distribution of emissions for particles with nominal diameters less than 30, 10 and 2.5 μm by calculating the percentage of PM_{30} emissions that can be attributed to PM_{10} and $PM_{2.5}$ emissions. The emission factors and distribution of PM_{30} emissions are presented in Table A.2.

$$E = k\left(\frac{s}{12}\right)^a \left(\frac{W}{3}\right)^b \qquad \text{Equation 1a}$$

where k, a, b, c and d are empirical constants and:

E = size-specific emission factor (lb/VMT)
s = surface material silt content (%)
W = mean vehicle weight (tons)

Table A.2 Haul Road Emission Factors and Distribution of PM_{30} Emissions

Particle Size Diameter (microns)	Emission Factor (lb/VMT)[a]	Percentage of PM_{30} Emissions (%)
30	21.25	100.00
10	5.46	25.69
2.5	0.55	2.59

[a] Based on Equation 1a, AP-42 Section 13.2.2, and AP-42 Table 13.2.2-2

The percentage of PM_{30} emissions was plotted against the particle size diameter for each of the given particle sizes. A 2nd degree polynomial equation was used to fit the particle size diameter and percentage data as shown in Figure A.1.

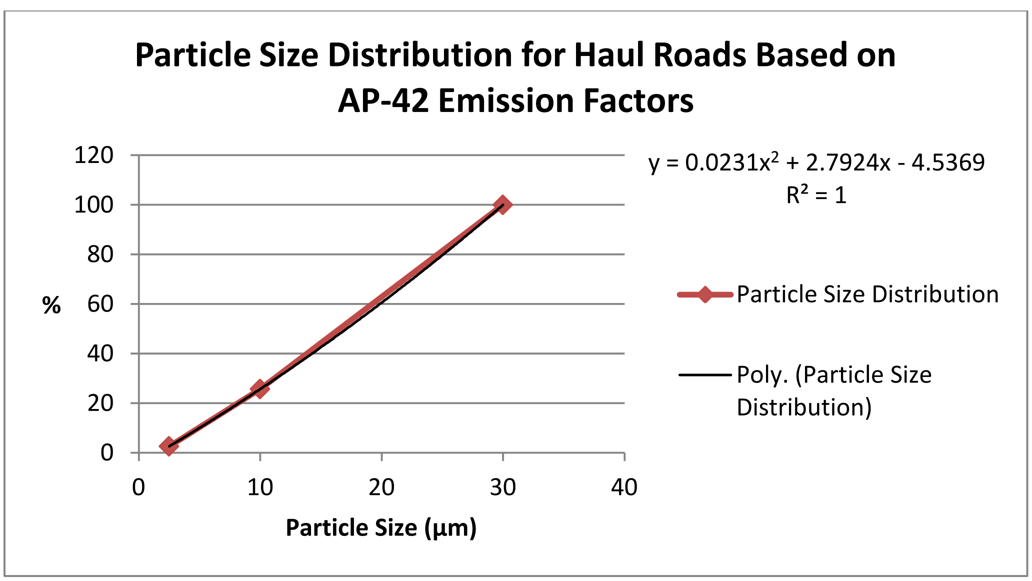


Figure A.1 Particle Size Distributions for Haul Roads Based on AP-42 Emission Factors

The percentage of particulates in each mass-mean particle diameter category described in Table A.1 was calculated based on the polynomial equation shown in Figure A.1. These percentages and the cumulative distribution of emissions between 0-10 microns was determined as shown in Table A.3.

Table A.3 Haul Road Cumulative Particle Size Distribution		
Mass-Mean Particle Diameter (microns)	**Percentage of PM_{30} Emissions (%)**	**Cumulative Distribution of Particle Sizes (%)**
2.20	1.72	7.36
4.29	7.87	33.72
6.05	13.20	56.58
7.77	18.55	79.52
9.27	23.33	100.00

The particle size distribution for each particle size category range was then determined based on the 0 to 10 micron portion of the PM_{30} distribution. These particle size distribution percentages as shown in Table A.4 will be used in the modeling.

Table A.4 Particle Size Distribution - Haul Roads		
Particle Size Category Range (microns)	**Mass-Mean Particle Diameter (microns)**	**Particle Size Distribution (%)**
0 - 3.5	2.20	7.36
3.5 - 5	4.29	26.35
5 - 7	6.05	22.86
7 - 8.5	7.77	22.94
8.5 - 10	9.27	20.48

A.4 Aggregate Handling - Particle Size Distribution

Section 13.2.4 of AP-42 lists equations to estimate emission factors for aggregate handling processes. The emission factors for different particle sizes are determined by the particle size multipliers that are given in Section 12.2.4.3 of AP-42. These particle size multipliers were used to determine the distribution of emissions for particles with nominal diameters less than 30, 10 and 2.5 μm by calculating the percentage of PM_{30} emissions that can be attributed to PM_{10} and $PM_{2.5}$ emissions. The aggregate handling particle size multipliers and the distribution of PM_{30} emissions are presented in Table A.5.

Table A.5 Aggregate Handling Particle Size Multipliers and Distribution of PM_{30} Emissions		
Particle Size Diameter (microns)	**Particle Size Multiplier**	**Percentage of PM_{30} Emissions (%)**
30	0.74	100.00
15	0.48	64.86
10	0.35	47.30
5	0.20	27.03
2.5	0.053	7.16

The percentage of PM_{30} emissions was plotted against the particle size diameter for each of the given particle sizes. A 2nd degree polynomial equation was used to fit the emission factor and percentage data as shown in Figure A.2.

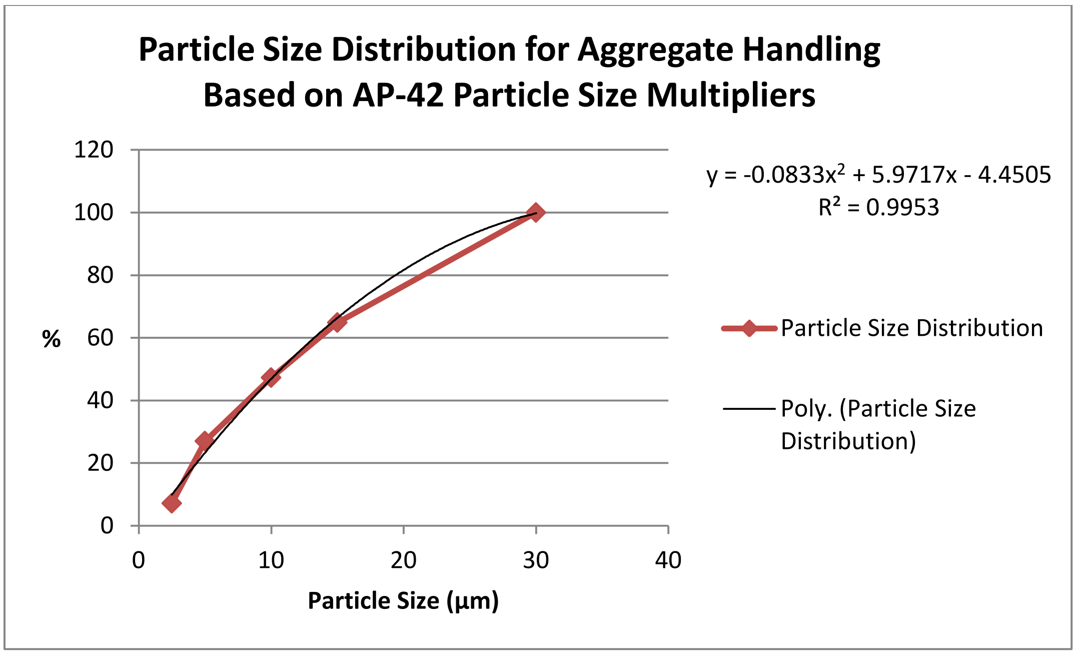


Figure A.2 Particle Size Distribution for Aggregate Handling Based on AP-42 Particle Size Multipliers

The percentage of particulates in each mass-mean particle diameter category described in Table A.1 was calculated based on the polynomial equation shown in Figure A.2. These percentages and the cumulative distribution of emissions between 0-10 microns was determined as shown in Table A.6.

Table A.6 Aggregate Handling Cumulative Particle Size Distribution		
Mass-Mean Particle Diameter (microns)	**Percentage of PM_{30} Emissions (%)**	**Cumulative Distribution of Particle Sizes (%)**
2.20	8.28	18.94
4.29	19.64	44.88
6.05	28.63	65.44
7.77	36.92	84.39
9.27	43.75	100.00

The particle size distribution for each particle size category range was then determined based on the 0 to 10 micron portion of the PM_{30} distribution. These particle size distribution percentages as shown in Table A.7 will be used in the modeling.

Table A.7 Particle Size Distribution – Aggregate Handling		
Particle Size Category Range (microns)	**Mass-Mean Particle Diameter (microns)**	**Particle Size Distribution (%)**
0 - 3.5	2.20	18.94
3.5 - 5	4.29	25.95
5 - 7	6.05	20.56
7 - 8.5	7.77	18.95
8.5 - 10	9.27	15.61

A.5 Blasting - Particle Size Distribution

AP-42 Table 11.9-1 lists a predictive equation for estimating the PM_{30} emission factor for blasting based on the western surface coal mining process. This table also lists scaling factors used to multiply with the predictive equation to estimate emission factors for other particle sizes. The scaling factors for blasting were used to determine the distribution of emissions for particles with nominal diameters less than 30, 10 and 2.5 μm by calculating the percentage of PM_{30} emissions that can be attributed to PM_{10} and $PM_{2.5}$ emissions. The scaling factors and distribution of PM_{30} emissions are presented in Table A.8.

Table A.8 Blasting Scaling Factors and Distribution of PM_{30} Emissions		
Particle Size Diameter (microns)	**Scaling Factor**	**Percentage of PM_{30} Emissions (%)**
30	1	100
10	0.52	52
2.5	0.03	3

[a]Predictive equation = 0.000014(A)^(1.5) ; A = Area of blast

The percentage of PM_{30} emissions was plotted against the particle size diameter for each of the given particle sizes. A 2nd degree polynomial equation was used to fit the emission factor and percentage data as shown in Figure A.3.

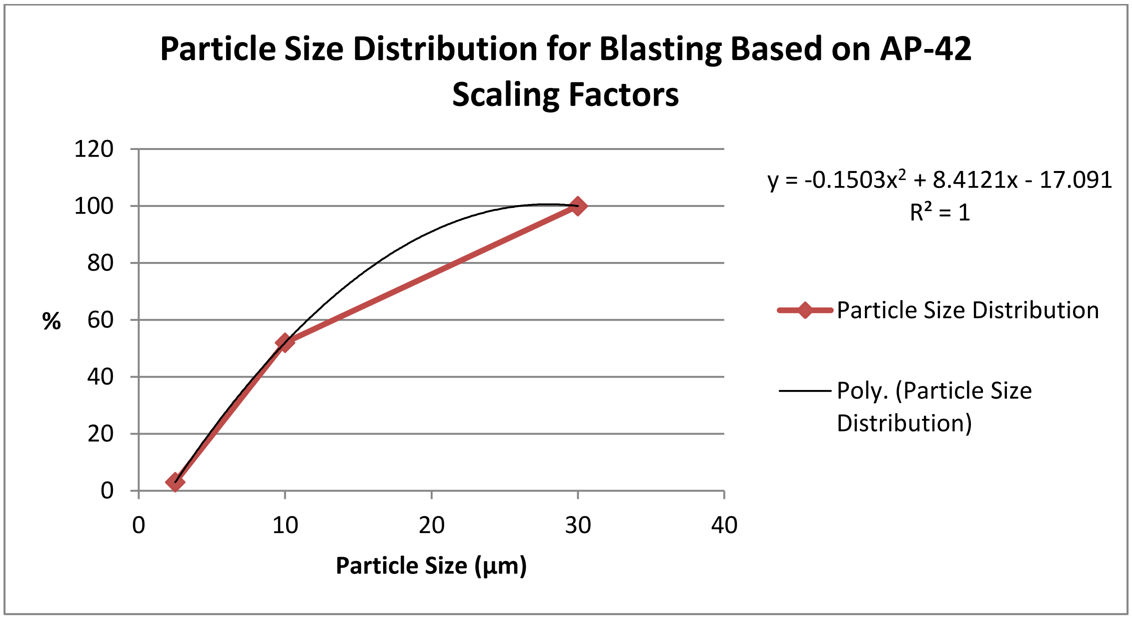


Figure A.3 Particle Size Distribution for Blasting Based on AP-42 Scaling Factors

The percentage of particulates in each mass-mean particle diameter category described in Table A.1 was calculated based on the polynomial equation shown in Figure A.3. These percentages and the cumulative distribution of emissions between 0-10 microns was determined as shown in Table A.9.

Table A.9 Blasting Cumulative Particle Size Distribution

Mass-Mean Particle Diameter (microns)	Percentage of PM_{30} Emissions (%)	Cumulative Distribution of Particle Sizes (%)
2.20	0.69	1.43
4.29	16.23	33.83
6.05	28.30	58.99
7.77	39.20	81.71
9.27	47.97	100.00

The particle size distribution for each particle size category range was then determined based on the 0 to 10 micron portion of the PM_{30} distribution. These particle size distribution percentages as shown in Table A.10 will be used in the modeling.

Table A.10 Particle Size Distribution - Blasting		
Particle Size Category Range (microns)	**Mass-Mean Particle Diameter (microns)**	**Particle Size Distribution (%)**
0 - 3.5	2.20	1.43
3.5 - 5	4.29	32.40
5 - 7	6.05	25.16
7 - 8.5	7.77	22.71
8.5 - 10	9.27	18.29

A.6 Point Sources - Particle Size Distribution

Page B.2-6, Appendix B.2 of AP-42 lists the collection efficiency of fabric filters used in baghouses for various particle sizes. These collection efficiencies were used along with emission factors for aggregate handling processes (Section 13.2.4 of AP-42) to calculate particle size distributions. The aggregate handling process emission factors for various particle sizes depend upon the particle size multiplier. These particle size multipliers were used to determine the distribution of emissions for particles with nominal diameters less than 30, 15, 10, 5 and 2.5 μm by calculating the percentage of PM_{30} emissions that can be attributed to PM_{10} and $PM_{2.5}$ emissions. The scaling factors and distribution of PM_{30} emissions are presented in Table A.11.

Table A.11 Point Source Emission Factors and Distribution of PM_{30} Emissions		
Particle Size Diameter (microns)	**Emission Factor (lb/VMT)[a]**	**Percentage of PM_{30} Emissions (%)**
30	0.74	100.00
15	0.48	64.86
10	0.35	47.30
5	0.20	27.03
2.5	0.053	7.16

The percentage of PM_{30} emissions was plotted against the particle size diameter for each of the given particle sizes. A 2nd degree polynomial equation was used to fit the emission factor and percentage data as shown in Figure A.4.

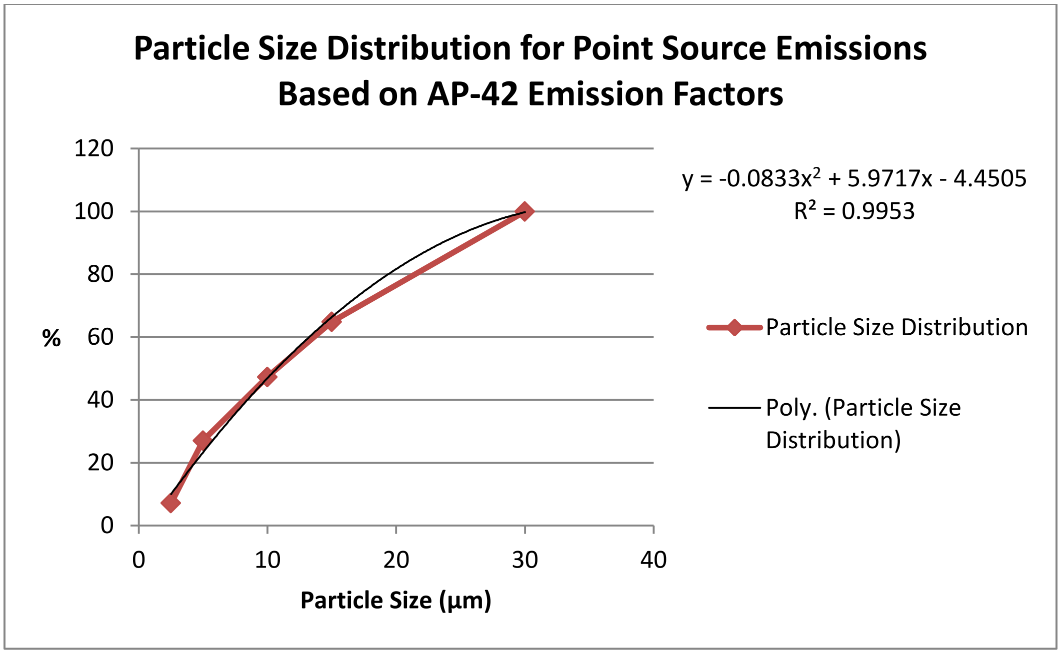


Figure A.4 Particle Size Distribution for Point Source Emissions Based on AP-42 Emission Factors

The percentage of particulates in each mass-mean particle diameter category described in Table A.1 was calculated based on the polynomial equation shown in Figure A.4. These percentages and the cumulative distribution of emissions between 0-10 microns was determined as shown in Table A.12.

Table A.12 Point Source Cumulative Particle Size Distribution

Mass-Mean Particle Diameter (microns)	Percentage of PM_{30} Emissions (%)	Cumulative Distribution of Particle Sizes (%)
2.20	8.28	18.94
4.29	19.64	44.88
6.05	28.63	65.44
7.77	36.92	84.39
9.27	43.75	100.00

The particle size distribution for each particle size category range was then determined based on the 0 to 10 micron portion of the PM_{30} distribution and adjusted based on fabric filter collection efficiencies of 99% for the 2.5 micron fraction and 99.5% for the remaining size fractions. These particle size distribution percentages as shown in Table A.13 will be used in the modeling.

Table A.13 Particle Size Distribution - Point Sources		
Particle Size Category Range (microns)	Mass-Mean Particle Diameter (microns)	Particle Size Distribution (%)
0 - 3.5[a]	2.20	31.84
3.5 - 5[b]	4.29	21.81
5 - 7[b]	6.05	17.29
7 - 8.5[b]	7.77	15.93
8.5 - 10[b]	9.27	13.12

[a] 99% collection efficiency for fabric filter dust collectors used.

[b] 99.5% collection efficiency for fabric filter dust collectors used.

A.7 Paved Road Sources - Particle Size Distribution

Section 13.2.1 of AP 42 lists equations to estimate emission factors for Paved Roads. The emission factors for different particle sizes are determined by the particle size multipliers that are given in Section 13.2.1 of AP42. These particle size multipliers were used to determine the distribution of emissions for particles with nominal diameters less than 30, 15, 10, 5 and 2.5 μm by calculating the percentage of PM_{30} emissions that can be attributed to PM_{10} and $PM_{2.5}$ emissions. The paved road particle size multipliers and the distribution of PM_{30} emissions are presented in Table A.14.

Table A.14 Paved Road Emission Factors		
Particle Size Diameter (microns)	Particle Size Multiplier[a]	Percentage Distribution (%)
30	0.011	100.00
15	0.0027	24.55
10	0.0022	20.00
2.5	0.00054	4.91

[a] AP42 Section 13.2.1 Table 13.2.1-1. Used in equation 1 of AP42 Section 13.2.1.3

The percentage of PM_{30} emissions was plotted against the particle size diameters for each of the given particle sizes. A 2[nd] degree polynomial equation was used to fit the particle size diameter and percentage data as shown in Figure A.5..

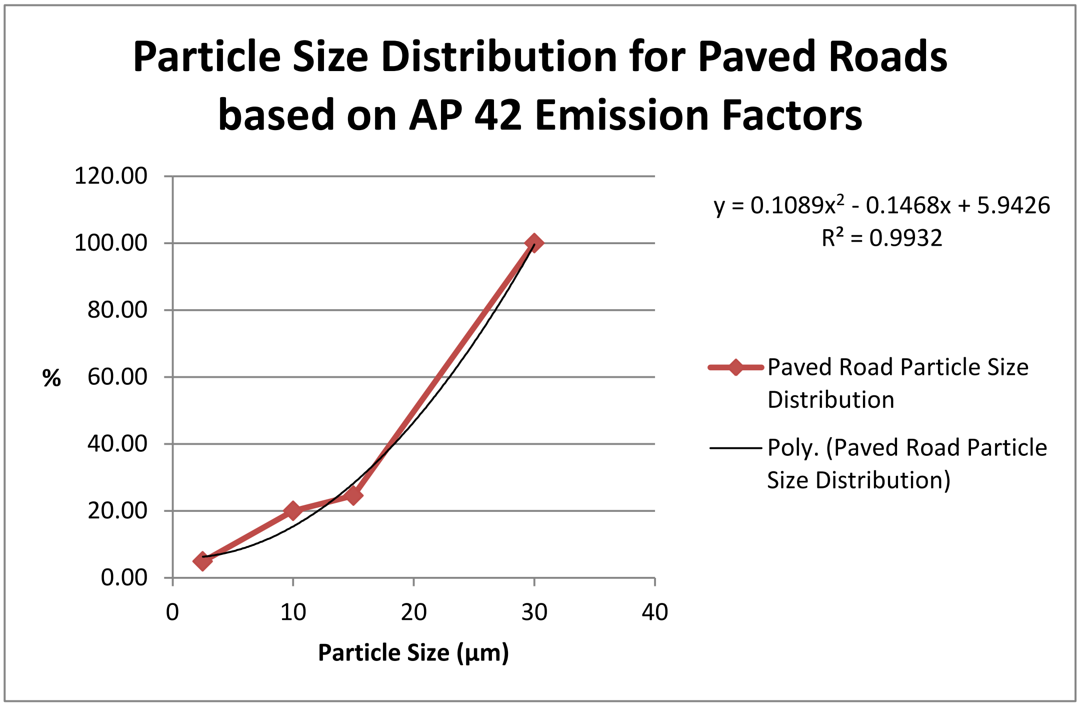


Figure A.5 Particle Size Distribution - Paved Road Source Emissions based on AP 42 Emission Factors

The percentage of particulates in each mass-mean particle diameter category described in Table A.1 was calculated based on the polynomial equation shown in Figure A.5. These percentages and the cumulative distribution of emissions between 0-10 microns was determined as shown in Table A.15.

Table A.15 Paved Roads Cumulative Particle Size Distribution

Mass-Mean Particle Diameter (microns)	Percentage of PM_{30} Emissions (%)	Cumulative Distribution of Particle Sizes (%)
2.20	6.15	44.09
4.29	7.32	52.49
6.05	9.04	64.85
7.77	11.38	81.61
9.27	13.94	100.00

The particle size distribution for each particle size category range was determined based on the 0 to 10 microns portion of the PM_{30} distribution. These particle size distribution percentages as shown in Table A.16 will be used in the modeling.

Table A.16 Particle Size Distribution - Paved Road Sources		
Particle Size Category Range (microns)	**Mass-Mean Particle Diameter (microns)**	**Particle Size Distribution (%)**
0 - 3.5[a]	2.20	44.09
3.5 - 5[b]	4.29	8.40
5 - 7[b]	6.05	12.36
7 - 8.5[b]	7.77	16.76
8.5 - 10[b]	9.27	18.39

APPENDIX B

QUARTERLY PM_{10} MONITORING SUMMARIES

Table B.1 Summary of 24-Hour PM_{10} Concentrations ($\mu g/m^3$) July 2006-June 2007					
Time Period	**Valid Samples**	**Arithmetic Mean**	**Highest**	**2nd Highest**	**3rd Highest**
3rd Quarter 06	13	24.6	71.3	27.0	26.8
4th Quarter 06	14	8.3	18.7	17.7	10.6
1st Quarter 07	15	2.3	7.0	5.5	4.6
2nd Quarter 07	15	17.6	28.7	27.0	25.6
Average	14.25	13.2	N/A	N/A	N/A
Highest Overall	N/A	N/A	71.3	27.0	26.8

Table B.2 Summary of 24-Hour PM_{10} Concentrations ($\mu g/m^3$) July 2007-June 2008					
Time Period	**Valid Samples**	**Arithmetic Mean**	**Highest**	**2nd Highest**	**3rd Highest**
3rd Quarter 07	13	19.2	40.3	21.7	20.8
4th Quarter 07	15	5.3	11.9	11.9	8.0
1st Quarter 08	16	4.1	13.5	9.6	7.7
2nd Quarter 08	15	19.5	32.6	28.2	25.2
Average	14.75	12.02	N/A	N/A	N/A
Highest Overall	N/A	N/A	40.3	28.2	25.2

Table B.3 Summary of 24-Hour PM_{10} Concentrations ($\mu g/m^3$) July 2008-June 2009					
Time Period	**Valid Samples**	**Arithmetic Mean**	**Highest**	**2nd Highest**	**3rd Highest**
3rd Quarter 08	14	15.3	24.5	21.2	20.0
4th Quarter 08	15	8.5	31.6	15.1	12.7
1st Quarter 09	15	8.0	17.9	17.8	17.6
2nd Quarter 09	16	10.0	15.4	12.9	12.9
Average	15	10.45	N/A	N/A	N/A
Highest Overall	N/A	N/A	31.6	21.2	20.0

Table B.4 Summary of Annual PM_{10} Concentrations ($\mu g/m^3$)					
Time Period	**Valid Samples**	**Arithmetic Mean**	**Highest**	**2nd Highest**	**3rd Highest**
July 2006-June 2007	14.25	13.2	71.3	27.0	26.8
July 2007- June 2008	14.8	12.0	40.3	28.2	25.2
July 2008- June 2009	15	10.45	31.6	21.2	20.0
Average	14.7	11.9	N/A	N/A	N/A
Highest Overall	N/A	N/A	71.3	28.2	26.8

APPENDIX C

STATISTICAL EVALUATION OF AMBIENT PM_{10} MEASUREMENTS

C.1 INTRODUCTION AND BACKGROUND INFORMATION

Ambient monitoring at the Rosemont site for PM_{10} concentrations was performed and recorded from June 16, 2006 to June 30, 2009. The PM_{10} concentration measurements, as a function of the date they were recorded (time series plot) are presented in Figure C.1. Within this data, there are two concentration measurements that appear to be outlying data. These data points are indicated in red in Figure C.1.

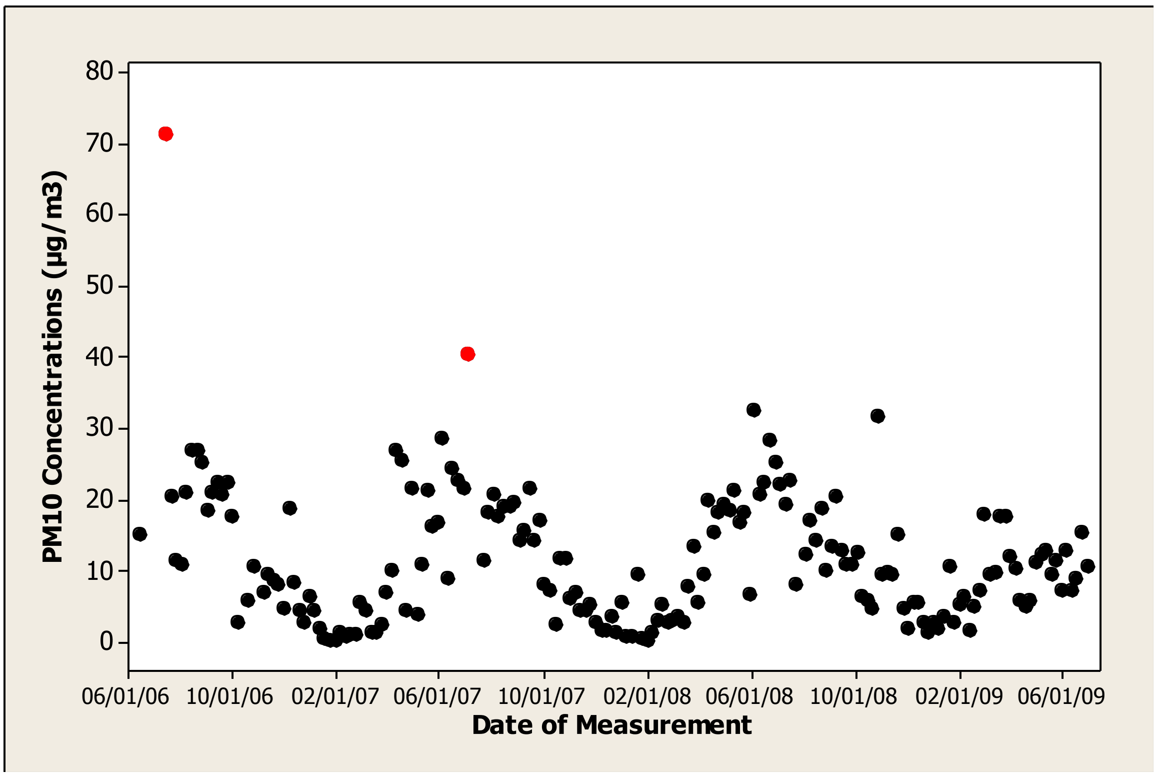


Figure C.1 PM10 Concentration Measurements

The remainder of this appendix will statistically analyze these two data points to determine:

- If each data point can statistically be labeled as an outlier; and
- What the probability is of a future occurrence greater than or equal to each data point.

The results of the above analyses will determine if the data points can statistically be eliminated during further PM_{10} concentration data analysis. All graphs and statistical data presented in this appendix have been generated using Minitab. The Minitab output is presented in Appendix C1.

C.2 OUTLIER ANALYSIS

C.2.1 ANALYSIS

An **outlier** is defined as a data point:

1. Greater than 1.5 interquartile ranges but less than 3 interquartile ranges from the third quartile value; or

2. Less than 1.5 interquartile ranges but more than 3 interquartile ranges from the first quartile value.

Additionally, an **extreme outlier** is defined as a data point:

A. Greater than 3 interquartile ranges from the third quartile value; or
B. Less than 3 interquartile ranges from the first quartile value.

These are widely accepted definitions and can be found in any statistics textbook. For reference, the definitions can be located on page 33 of the Third Edition of *Engineering Statistics* (Montgomery, Runger, Hubele).

As shown in Figure C.1, the data points being analyzed are greater than the remaining PM_{10} concentration measurements. Therefore, only Definition 1 for an outlier and Definition A for extreme outlier will be considered further in this analysis.

The statistical data for the PM_{10} concentration measurements are presented and defined in Table C.1. This information is also graphically shown in the box plot presented in Figure C.2.

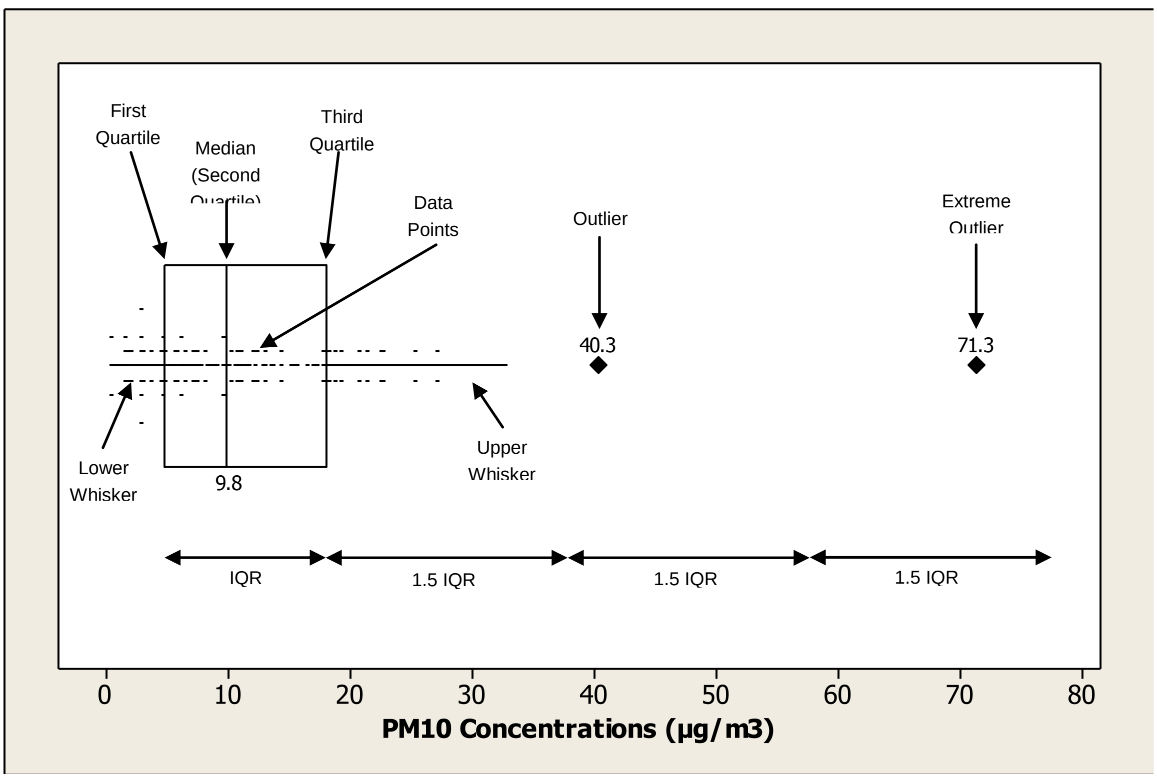


Figure C.2 Box Plot for PM_{10} Concentration Measurements

As shown in Table C.1 and Figure C.2, the 40.3 µg/m^3 data point meets the definition of an outlier while the 71.3 µg/m^3 data point meets the definition of extreme outlier. The 71.3 µg/m^3 data point is within four interquartile ranges from the third quartile value.

Table C.1 Statistical Data for the PM_{10} Concentration Measurements		
Statistical Data	Definition	Value for the PM_{10} Concentration Measurements
Minimum Value	The smallest observation in the data set.	0.30 µg/m^3
First Quartile Value	The value that has 25% of the data points less than it and 75% of the data points greater than it.	4.65 µg/m^3
Median (Second Quartile) Value	The value that has 50% of the data points less than it and 50% of the data points greater than it.	9.80 µg/m^3
Mean	The location or central tendency of the data points.	11.625 µg/m^3
Third Quartile Value	The value that has 75% of the data points less than it and 25% of the data points greater than it.	18.05 µg/m^3
Maximum Value	The largest observation in the data set.	71.30 µg/m^3
Interquartile Range (IQR)	The difference between the third and first quartile values.	13.40 µg/m^3
Lower Whisker Endpoint	The smallest data point within 1.5 interquartile ranges from the first quartile value.	0.30 µg/m^3
Upper Whisker Endpoint	The largest data point within 1.5 interquartile ranges from the third quartile value.	32.60 µg/m^3
3rd Quartile Value + 1.5 IQR	The third quartile value plus 1.5 times the interquartile range.	38.15 µg/m^3
3rd Quartile Value + 3 IQR	The third quartile value plus 3 times the interquartile range.	58.25 µg/m^3
3rd Quartile Value + 4 IQR	The third quartile value plus 4 times the interquartile range.	71.65 µg/m^3

C.2.2 CONCLUSION BASED ON OUTLIER ANALYSIS

The high value of the extreme outlier (71.3 μg/m^3) compared to the other PM_{10} concentration measurements recorded during the monitoring program (median value of 9.80 μg/m^3) indicates that a highly unusual event or some error occurred during the measurement or processing of the data (e.g. recording of an incorrect filter weight). Consequently, it is unrealistic to include this data point in further PM_{10} concentration data analysis.

Instead, the 71.3 μg/m^3 data point will be replaced by a value equivalent to the outlier data point (40.3 μg/m^3). Although the 40.3 μg/m3 data point is a statistical outlier, it is within 2.15 μg/m^3 of being considered a non-outlier data point. Therefore, retaining the 40.3 μg/m^3 data point in future PM_{10} concentration data analysis and replacing the 71.3 μg/m^3 data point with 40.3 μg/m^3 is a conservative method used to approximate realistic high concentration measurements for the Rosemont project.

C.3 PROBABILITY ANALYSIS

C.3.1 DETERMINATION OF DISTRIBUTION

In order to determine the probability of occurrence of future PM_{10} concentration measurements, the statistical distribution of the data set needs to be determined. Probability plots are commonly used to evaluate the fit of a statistical distribution to a data set. They use a scale specific to a certain type of statistical distribution and plot the ordered data points against the percentage of data points in the data set that are less than or equal to the data points. If the plotted points approximately form a straight line, the data set can be assumed to follow the specified distribution.

Probability plots for the PM_{10} concentration measurements were made in Minitab for 14 different types of statistical distributions. These probability plots are presented with the Minitab output in Appendix C1. As shown in Appendix C1, two probability plots were made for each type of distribution including:

1) All PM_{10} concentration measurement data points; and

2) All PM_{10} concentration measurement data points excluding 71.3 μg/m^3, which was replaced by 40.3 μg/m^3 as suggested in Section C.2.2.

For each probability plot, Minitab records the Anderson-Darling (AD) statistic, which is used to measure how well the statistical distribution fits the data set. For a given data set, the better the statistical distribution fits the data, the smaller the AD statistic will be.

The AD statistics for each probability plot associated with the PM_{10} concentration measurements are presented in Table C.2. As shown in Table C.2, the Weibull distribution has the lowest AD statistic when including all PM_{10} concentration measurements (from now on referred to as the CM data set). Although the AD statistic increases slightly when replacing the 71.3 μg/m^3 data point with 40.3 μg/m^3 (from now on referred to as CM* data set), the Weibull distribution still results in the lowest AD statistic. Therefore, it is assumed that the CM and CM* data sets have a Weibull distribution. The following probability analysis will be based on a Weibull distribution.

Table C.2 Anderson-Darling Statistic for Statistical Distributions of the PM_{10} Concentration Measurements		
Type of Distribution	Anderson-Darling Statistic	
	CM - All PM_{10} Concentration Measurements (µg/m3)	CM* - All PM_{10} Concentration Measurements (µg/m3) Except with 71.3 Replaced by 40.3
Normal	3.285	2.989
Lognormal	3.744	3.870
3-Parameter Lognormal	1.471	1.524
Exponential	3.280	3.586
2-Parameter Exponential	2.727	3.014
Smallest Extreme Value	16.867	6.735
Weibull	**0.796**	**0.955**
3-Parameter Weibull	1.012	1.066
Largest Extreme Value	1.643	1.761
Logistic	2.809	2.906
Loglogistic	2.742	2.832
3-Parameter Loglogistic	1.824	1.864
Gamma	1.082	1.224
3-Parameter Gamma	1.144	1.261

C.3.2 PROBABILITY ANALYSIS

Since the CM and CM* data sets have been determined to have a Weibull distribution, the following Weibull probability density and cumulative distribution functions can be utilized:

$$f(x) = \left(\frac{\beta}{\delta}\right)\left(\frac{x}{\delta}\right)^{\beta-1} \exp\left[-\left(\frac{x}{\delta}\right)^{\beta}\right], \text{ for } x > 0,\ \beta > 0,\ \delta > 0$$ Weibull Probability Density Function

$$F(x) = 1 - \exp\left[-\left(\frac{x}{\delta}\right)^{\beta}\right]$$ Weibull Cumulative Distribution Function

where:

x	=	Weibull random variable;
β	=	shape parameter
δ	=	scale parameter

The probability density function, f(x), produces the probability of a data point, x, occurring in a future sample. The cumulative distribution function, F(x), produces the probability of a future sample being equal to or less than the specified data point, x. The probability of a future sample being greater than a specified data point, x, can be determined by subtracting the value found using the cumulative distribution function from 100% probability (1-F(x)). Furthermore, the number of samples expected to occur before obtaining a sample greater than a specified data point, x, can be determined by taking the multiplicative inverse (reciprocal) of 1-F(x).

The output of the Weibull probability density function for the CM and CM* data sets are presented in Figure C.3. The output of the Weibull cumulative distribution function for the CM and CM* data sets are presented in Figure C.4. The CM data set has a shape parameter of 1.258 and a scale parameter of 12.48 while the CM* data set has a shape parameter of 1.311 and a scale parameter of 12.38. The shape and scale parameters were determined by Minitab and are shown in the Minitab output in Appendix C1.

The specific numerical output of the probability density function and the cumulative distribution function for PM_{10} concentrations 40.3 µg/m^3 and 71.3 µg/m^3 are presented in Table C.3. The probabilities of a future sample being greater than 40.3 µg/m^3 and 71.3 µg/m^3 are also presented in Table C.3. Additionally, Table C.3 presents the number of samples expected to occur before obtaining a sample greater than 40.3 µg/m^3 and 71.3 µg/m^3.

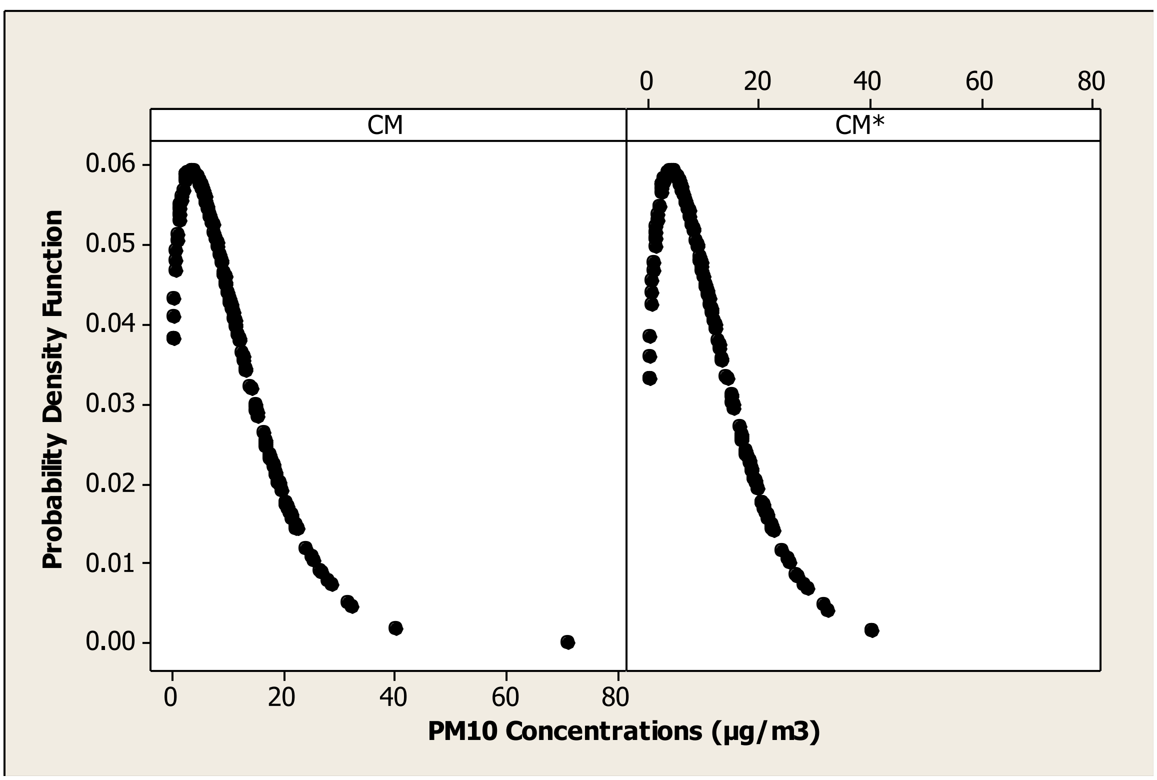


Figure C.3 Weibull Probability Density for PM_{10} Concentration Measurements

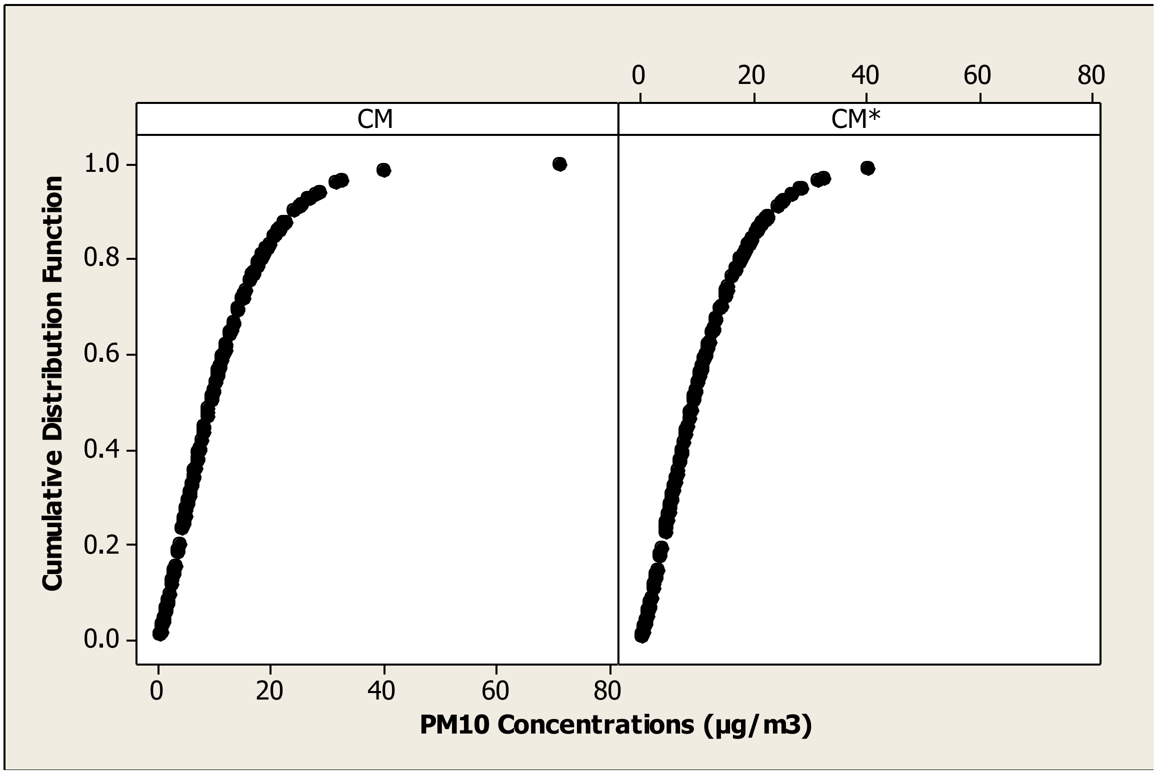


Figure C.4 Weibull Cumulative Distribution for PM_{10} Concentration Measurements

Table C.3 Probability Data for the PM_{10} Concentration Measurements				
Probability/Expected Value	CM Data Set		CM* Data Set	
	40.3 µg/m^3	71.3 µg/m^3	40.3 µg/m^3	71.3 µg/m^3
Probability of a Data Point Occurring in a Future Sample (Weibull Probability Density Function, f(x))	0.002	0.00002	0.001	0.000009
Probability of a Future Sample Being Equal to or Less than the Data Point (Weibull Cumulative Distribution Function, F(x))	0.987	0.9999	0.991	0.99995
Probability of a Future Sample Being Greater than the Data Point (1-F(x))	0.013	0.0001	0.009	0.00005
Number of Samples Expected to Occur Before Obtaining a Sample Greater than the Data Point (1/(1-F(x)))	79	7,760	110	20,488

C.3.3 CONCLUSION BASED ON PROBABILITY ANALYSIS

As shown in Table C.3, the probability of a future PM_{10} concentration measurement being greater than 71.3 µg/m^3 is extremely low, regardless of if the 71.3 µg/m^3 data point is included or replaced by 40.3 µg/m^3 in the data set being analyzed (0.01% and 0.005% probability, respectively). Furthermore, for a sampling plan that obtains a PM_{10} concentration measurement once every six days (identical to the sampling plan used to obtain the data analyzed in this appendix), it would be expected to see a PM_{10} concentration measurement greater than 71.3 µg/m^3 approximately once every 127 or 336 years, using the CM or CM* data sets, respectively. Therefore, combining the extreme outlier determination with the low probability of reoccurrence, it is determined to be unrealistic to use the 71.3 µg/m^3 data point in future PM_{10} concentration data analysis.

Since the probability of a future PM_{10} concentration measurement being greater than the 40.3 µg/m^3 is approximately 1% and this future measurement is expected to occur during the life of the RCP (using a once every six day sampling plan), the 40.3 µg/m^3 data point should be included in future PM_{10} concentration data analysis.

APPENDIX C.1

MINITAB OUTPUT

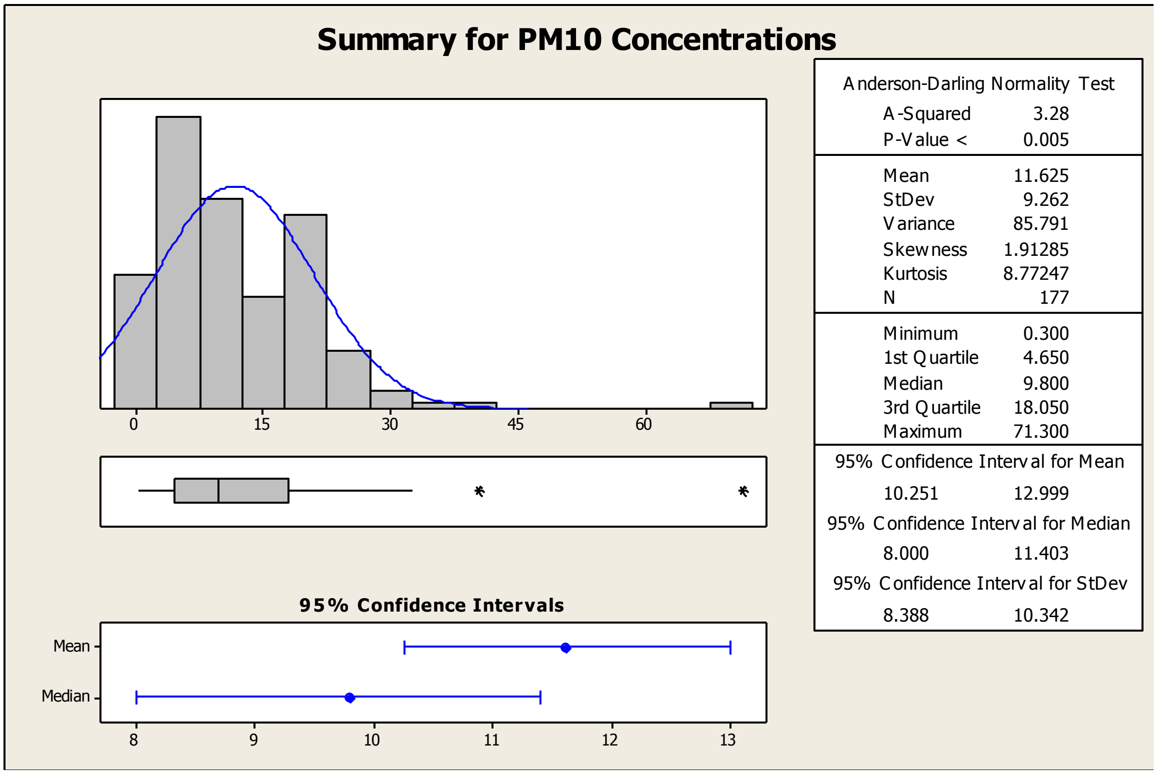
Data Display

Row	Date	PM10 Concentrations
1	06/16/06	15.0
2	07/16/06	71.3
3	07/22/06	20.6
4	07/28/06	11.5
5	08/03/06	10.8
6	08/09/06	21.0
7	08/15/06	27.0
8	08/21/06	26.8
9	08/27/06	25.2
10	09/02/06	18.6
11	09/08/06	20.9
12	09/14/06	22.4
13	09/20/06	20.7
14	09/26/06	22.4
15	10/02/06	17.7
16	10/08/06	2.7
17	10/20/06	6.0
18	10/26/06	10.6
19	11/07/06	7.0
20	11/13/06	9.5
21	11/19/06	8.7
22	11/25/06	8.2
23	12/01/06	4.7
24	12/07/06	18.7
25	12/13/06	8.3
26	12/19/06	4.6
27	12/25/06	2.8
28	12/31/06	6.3
29	01/06/07	4.4
30	01/12/07	2.0
31	01/18/07	0.5
32	01/24/07	0.3
33	01/30/07	0.3
34	02/05/07	1.5
35	02/11/07	0.9
36	02/17/07	1.1
37	02/23/07	1.0
38	03/01/07	5.5
39	03/07/07	4.6
40	03/13/07	1.4
41	03/19/07	1.5
42	03/25/07	2.5
43	03/31/07	7.0
44	04/06/07	10.2
45	04/12/07	27.0
46	04/18/07	25.6

47	04/24/07	4.4
48	04/30/07	21.6
49	05/06/07	3.8
50	05/12/07	10.9
51	05/18/07	21.3
52	05/24/07	16.4
53	05/30/07	16.9
54	06/05/07	28.7
55	06/11/07	9.0
56	06/17/07	24.3
57	06/23/07	22.6
58	06/29/07	21.5
59	07/05/07	40.3
60	07/23/07	11.6
61	07/29/07	18.3
62	08/04/07	20.8
63	08/10/07	17.7
64	08/16/07	19.2
65	08/22/07	19.2
66	08/28/07	19.7
67	09/03/07	14.3
68	09/09/07	15.6
69	09/15/07	21.7
70	09/21/07	14.2
71	09/27/07	17.1
72	10/03/07	8.0
73	10/09/07	7.4
74	10/15/07	2.4
75	10/21/07	11.9
76	10/27/07	11.9
77	11/02/07	6.2
78	11/08/07	6.9
79	11/14/07	4.5
80	11/20/07	4.6
81	11/26/07	5.4
82	12/02/07	2.7
83	12/08/07	1.7
84	12/14/07	1.7
85	12/20/07	3.5
86	12/26/07	1.4
87	01/01/08	5.6
88	01/07/08	0.7
89	01/13/08	0.8
90	01/19/08	9.6
91	01/25/08	0.4
92	01/31/08	0.3
93	02/06/08	1.3
94	02/12/08	3.0
95	02/18/08	5.3
96	02/24/08	2.8
97	03/01/08	3.0

98	03/07/08	3.6
99	03/13/08	2.7
100	03/19/08	7.7
101	03/25/08	13.5
102	03/31/08	5.5
103	04/06/08	9.5
104	04/12/08	19.8
105	04/18/08	15.3
106	04/24/08	18.2
107	04/30/08	19.4
108	05/06/08	18.6
109	05/12/08	21.3
110	05/18/08	16.8
111	05/24/08	18.2
112	05/30/08	6.6
113	06/05/08	32.6
114	06/11/08	20.7
115	06/17/08	22.5
116	06/23/08	28.2
117	06/29/08	25.2
118	07/05/08	22.2
119	07/11/08	19.3
120	07/17/08	22.6
121	07/23/08	8.0
122	08/04/08	12.2
123	08/10/08	17.0
124	08/16/08	14.3
125	08/22/08	18.7
126	08/28/08	10.2
127	09/03/08	13.4
128	09/09/08	20.6
129	09/15/08	13.0
130	09/21/08	11.0
131	09/27/08	11.0
132	10/03/08	12.7
133	10/09/08	6.3
134	10/15/08	5.9
135	10/21/08	4.8
136	10/27/08	31.6
137	11/02/08	9.6
138	11/08/08	9.9
139	11/14/08	9.4
140	11/20/08	15.1
141	11/26/08	4.8
142	12/02/08	2.0
143	12/08/08	5.7
144	12/14/08	5.7
145	12/20/08	2.7
146	12/26/08	1.4
147	01/01/09	2.7
148	01/07/09	1.8

149	01/13/09	3.6
150	01/19/09	10.7
151	01/25/09	2.9
152	01/31/09	5.2
153	02/06/09	6.5
154	02/12/09	1.6
155	02/18/09	5.0
156	02/24/09	7.3
157	03/02/09	17.9
158	03/08/09	9.5
159	03/14/09	9.8
160	03/20/09	17.6
161	03/26/09	17.8
162	04/01/09	12.1
163	04/07/09	10.5
164	04/13/09	6.0
165	04/19/09	5.1
166	04/25/09	6.0
167	05/01/09	11.3
168	05/07/09	12.2
169	05/13/09	12.9
170	05/19/09	9.6
171	05/25/09	11.4
172	05/31/09	7.2
173	06/06/09	12.9
174	06/12/09	7.3
175	06/18/09	8.9
176	06/24/09	15.4
177	06/30/09	10.6



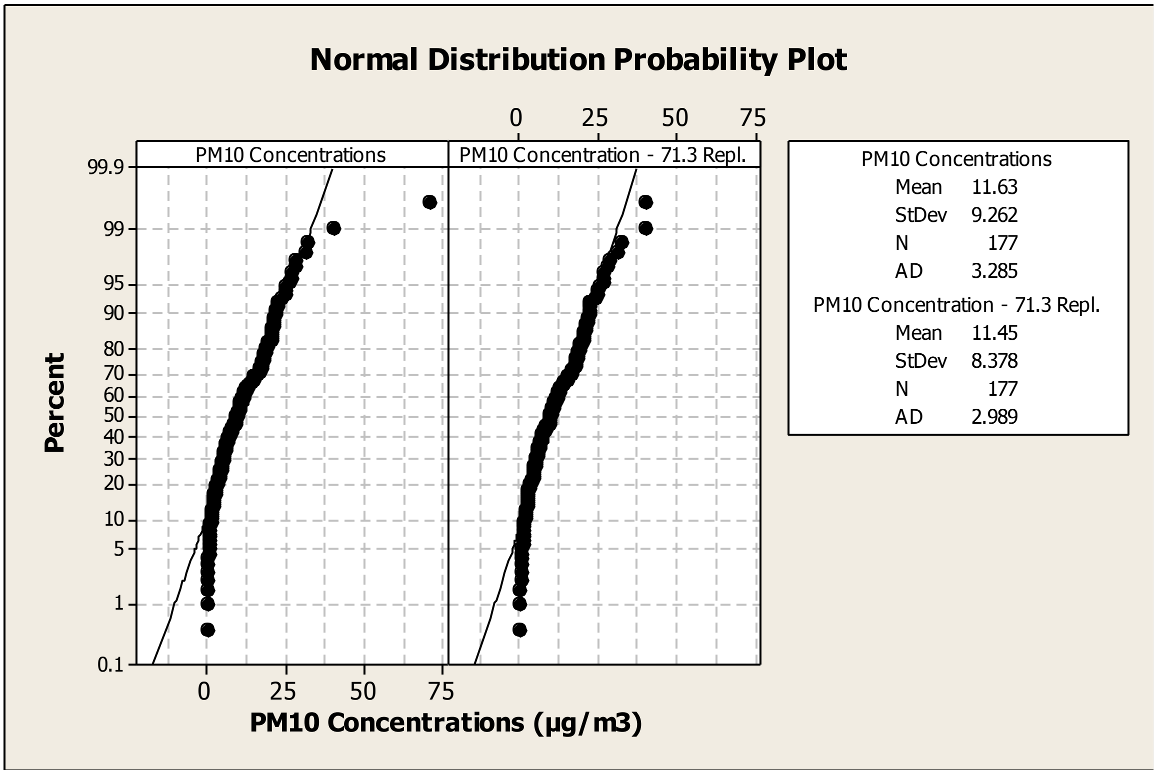
Descriptive Statistics: PM10 Concentrations

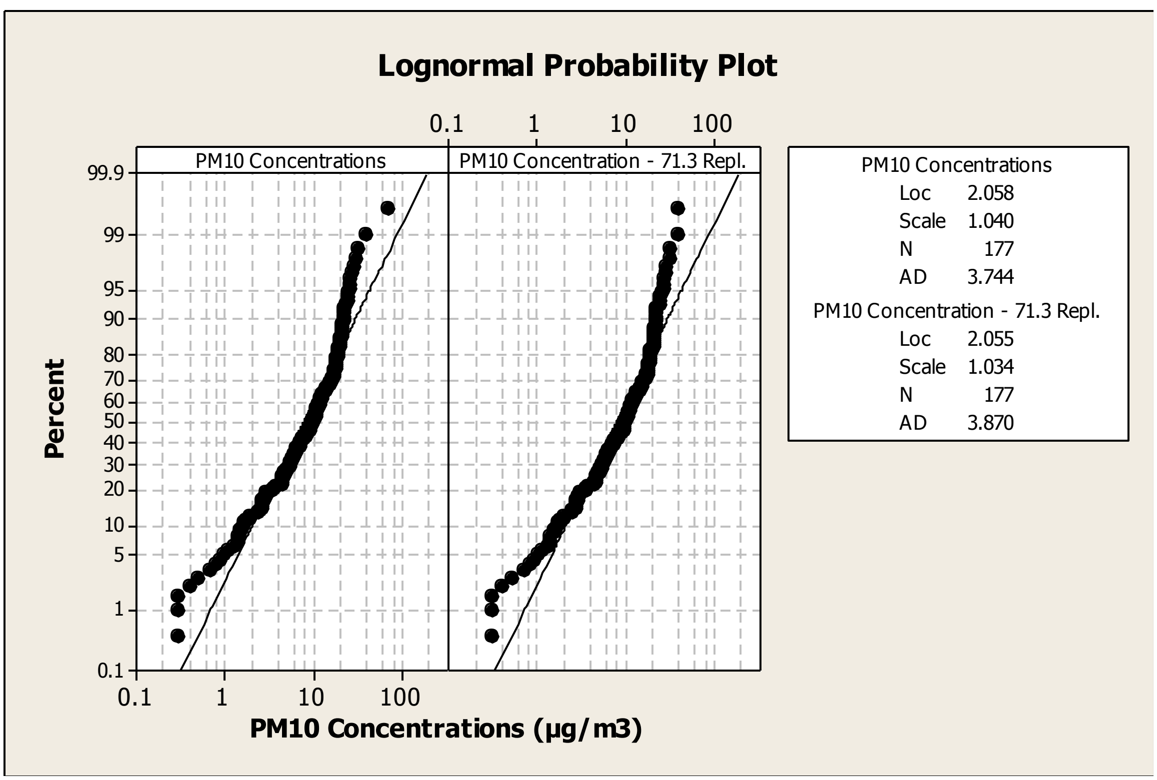
Variable	Total Count	N	N*	CumN	Percent	CumPct	Mean	SE Mean
PM10 Concentrations	177	177	0	177	100	100	11.625	0.696

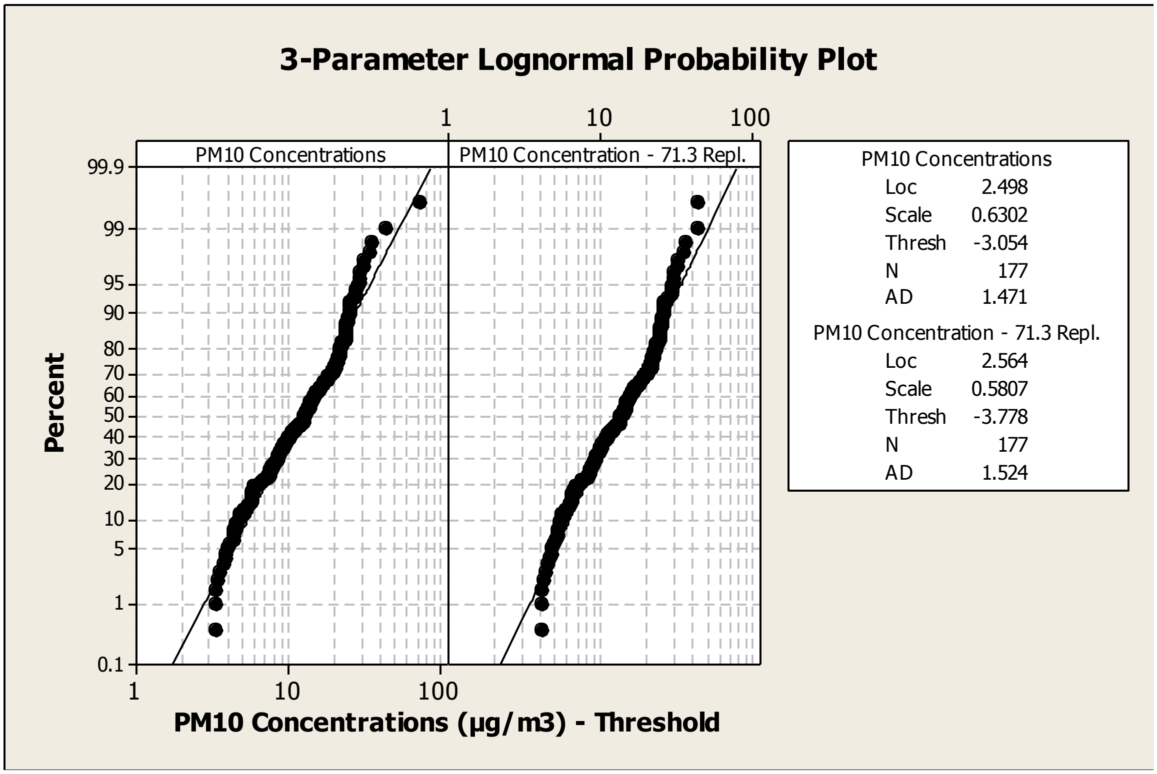
Variable	TrMean	StDev	Variance	CoefVar	Sum	Sum of Squares
PM10 Concentrations	10.937	9.262	85.791	79.67	2057.700	39020.810

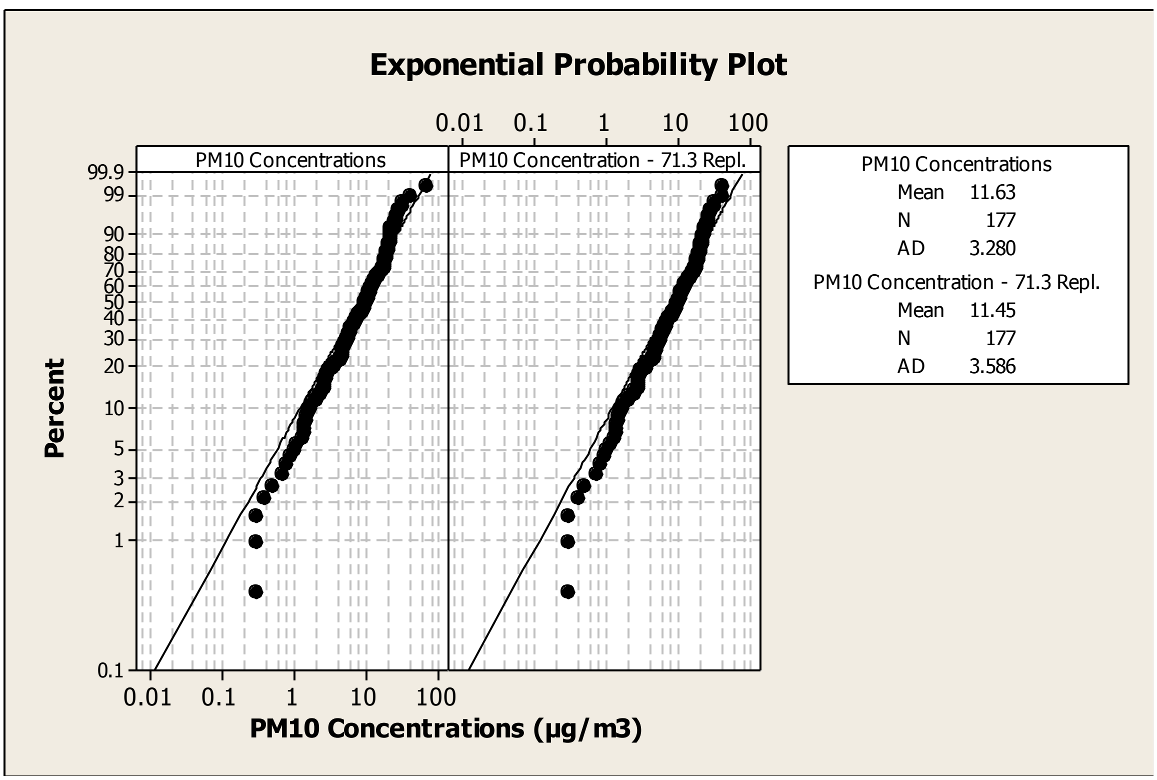
Variable	Minimum	Q1	Median	Q3	Maximum	Range	IQR
PM10 Concentrations	0.300	4.650	9.800	18.050	71.300	71.000	13.400

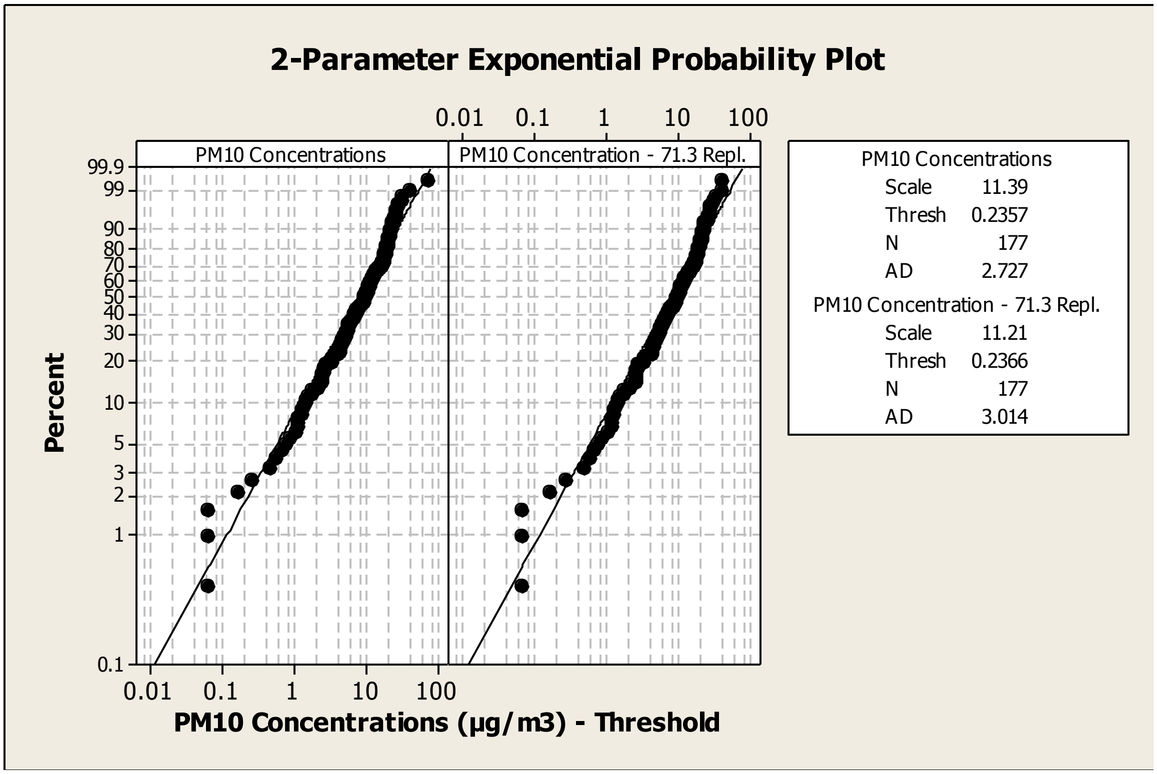
Variable	Mode	N for Mode	Skewness	Kurtosis	MSSD
PM10 Concentrations	2.7	5	1.91	8.77	41.960

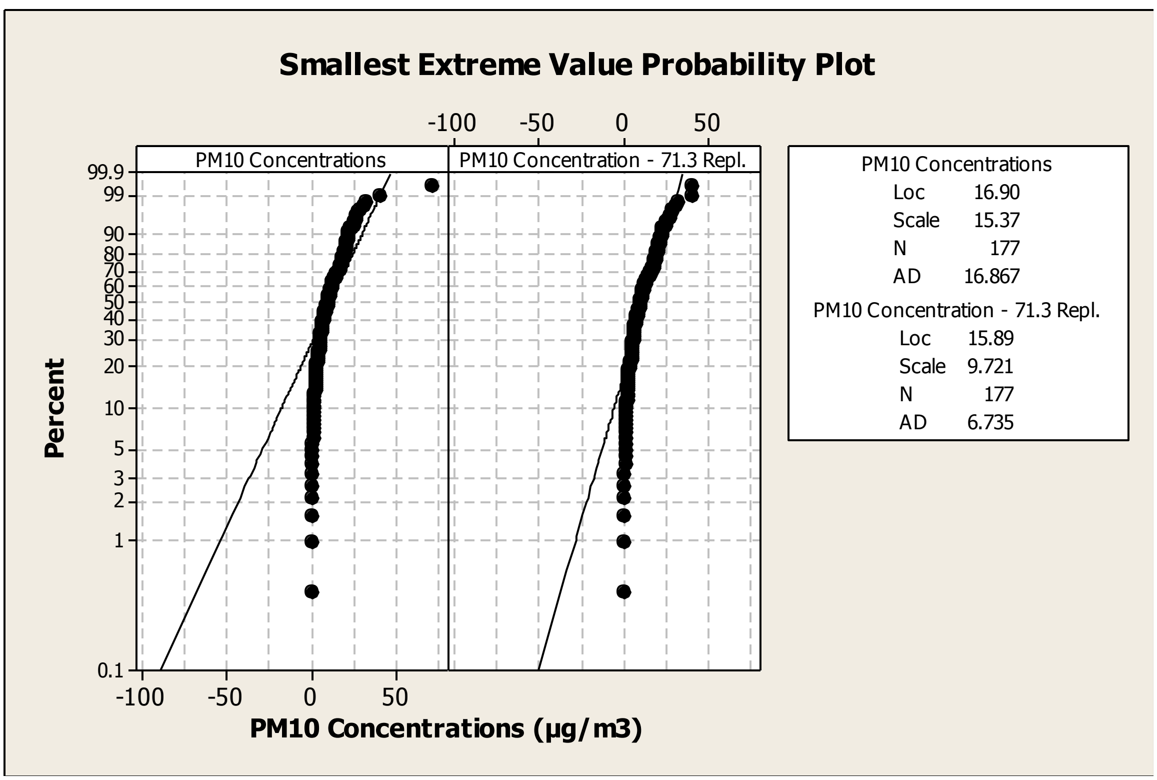

Normal Distribution Probability Plot
PM10 Concentrations
PM10 Concentration - 71.3 Repl.
Percent
PM10 Concentrations (µg/m3)
PM10 Concentrations
Mean 11.63
StDev 9.262
N 177
AD 3.285
PM10 Concentration - 71.3 Repl.
Mean 11.45
StDev 8.378
N 177
AD 2.989

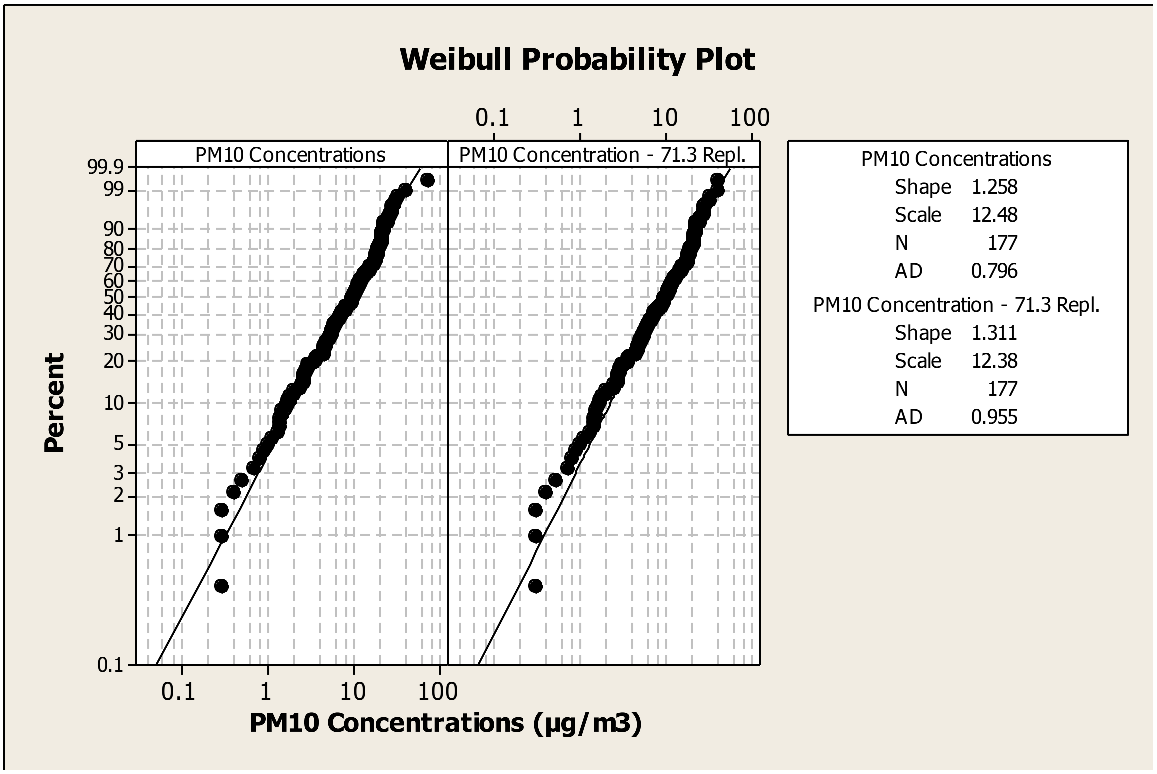

Lognormal Probability Plot
PM10 Concentrations
PM10 Concentration - 71.3 Repl.
Percent
PM10 Concentrations (µg/m3)
PM10 Concentrations
Loc 2.058
Scale 1.040
N 177
AD 3.744
PM10 Concentration - 71.3 Repl.
Loc 2.055
Scale 1.034
N 177
AD 3.870


3-Parameter Lognormal Probability Plot
PM10 Concentrations
PM10 Concentration - 71.3 Repl.
Percent
PM10 Concentrations (µg/m3) - Threshold
PM10 Concentrations
Loc 2.498
Scale 0.6302
Thresh -3.054
N 177
AD 1.471
PM10 Concentration - 71.3 Repl.
Loc 2.564
Scale 0.5807
Thresh -3.778
N 177
AD 1.524

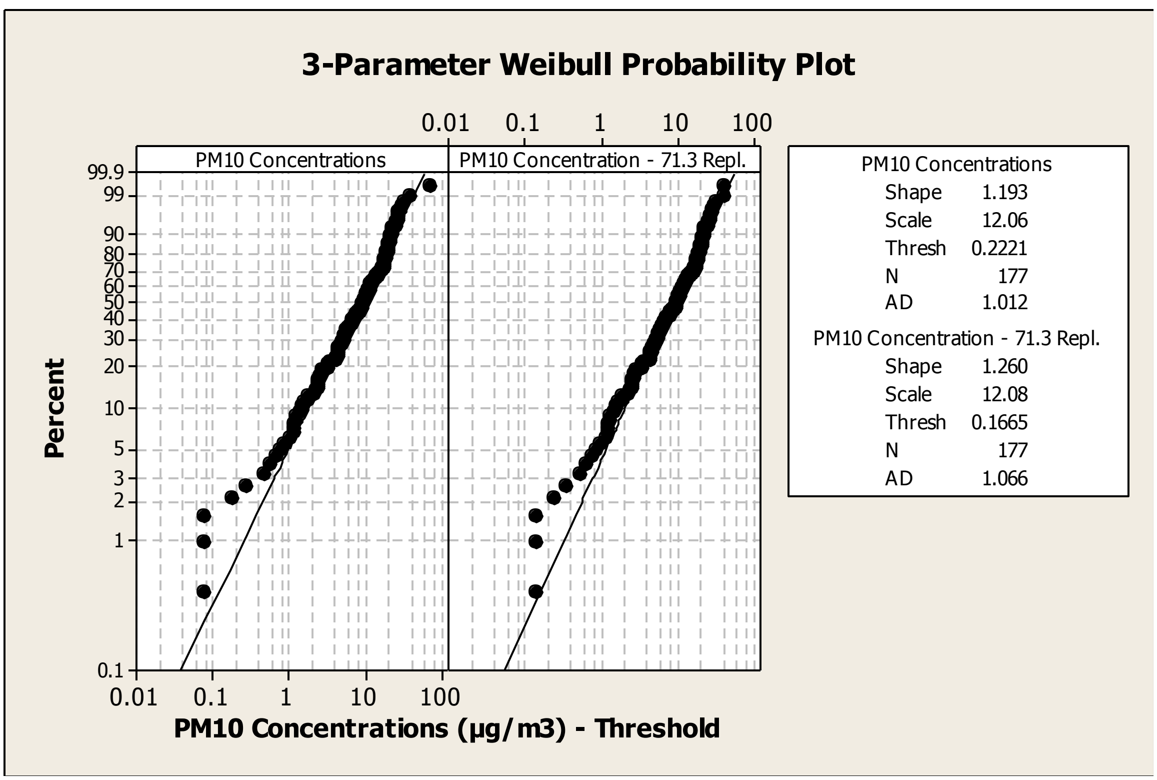

Exponential Probability Plot
PM10 Concentrations
PM10 Concentration - 71.3 Repl.
Percent
PM10 Concentrations (µg/m3)
PM10 Concentrations
Mean 11.63
N 177
AD 3.280
PM10 Concentration - 71.3 Repl.
Mean 11.45
N 177
AD 3.586


2-Parameter Exponential Probability Plot
PM10 Concentrations
PM10 Concentration - 71.3 Repl.
Percent
PM10 Concentrations (µg/m3) - Threshold
PM10 Concentrations
Scale 11.39
Thresh 0.2357
N 177
AD 2.727
PM10 Concentration - 71.3 Repl.
Scale 11.21
Thresh 0.2366
N 177
AD 3.014

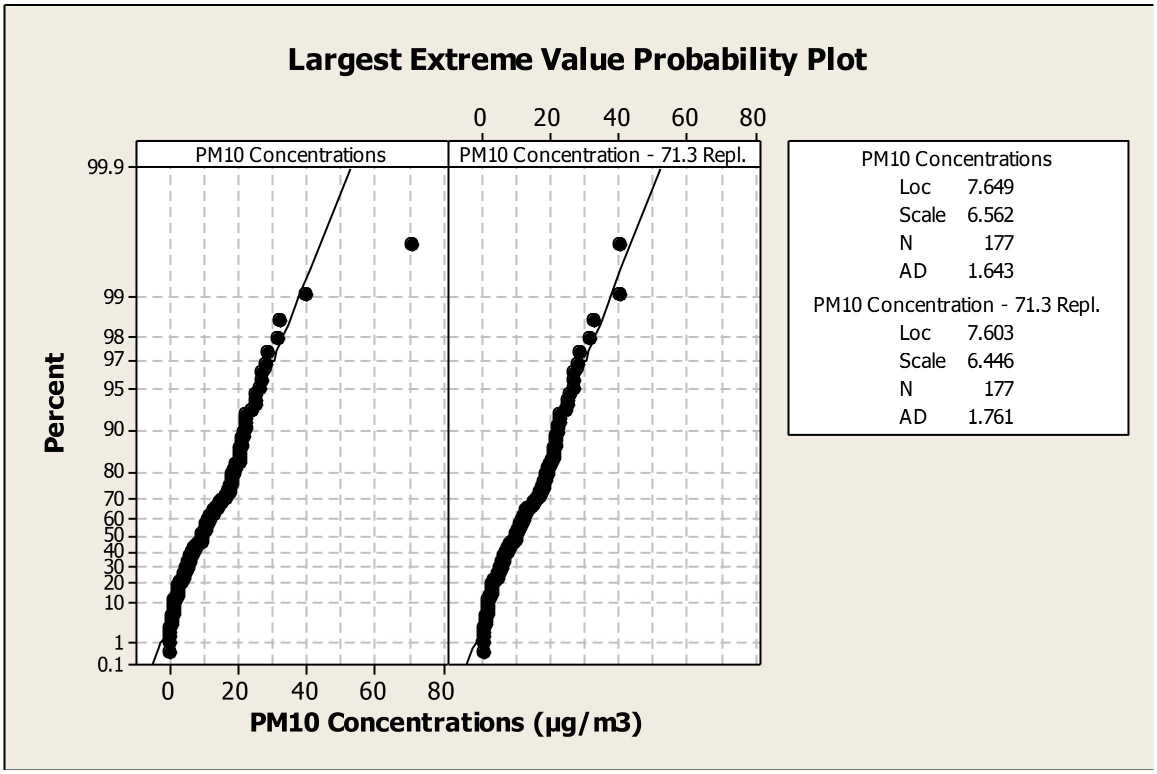

Smallest Extreme Value Probability Plot
PM10 Concentrations
PM10 Concentration - 71.3 Repl.
Percent
PM10 Concentrations (µg/m3)
PM10 Concentrations
Loc 16.90
Scale 15.37
N 177
AD 16.867
PM10 Concentration - 71.3 Repl.
Loc 15.89
Scale 9.721
N 177
AD 6.735



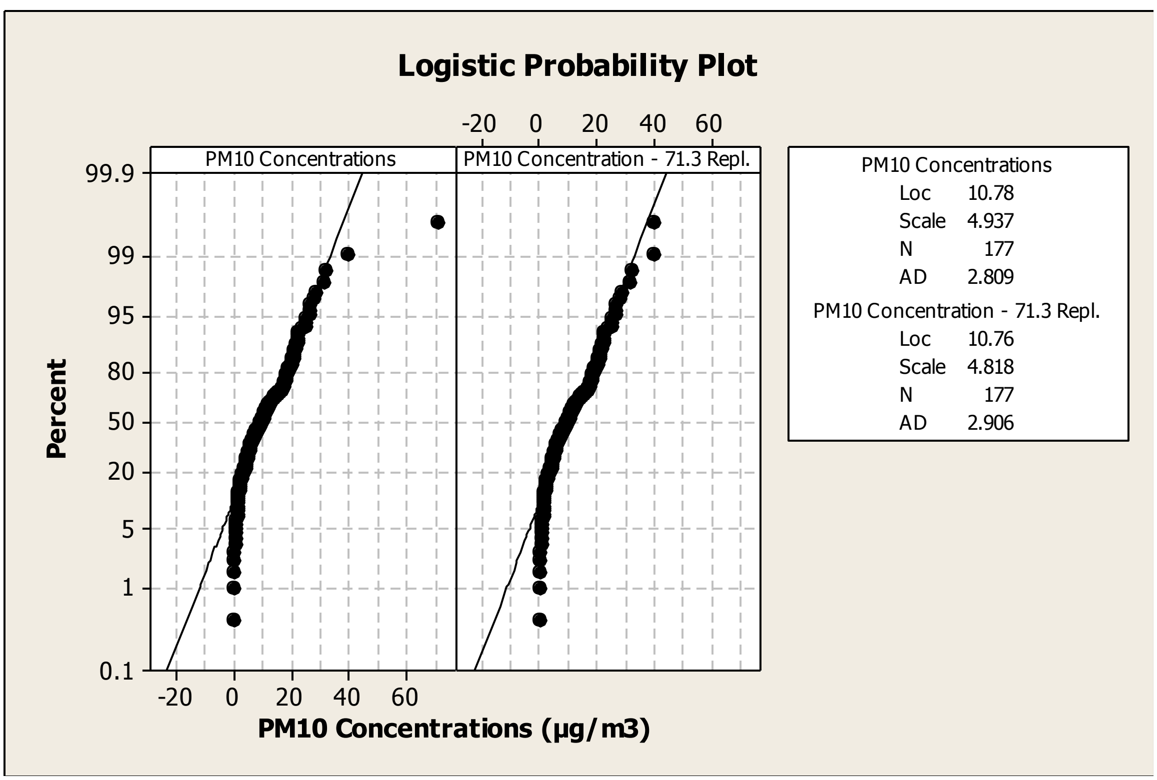
Weibull Probability Plot
PM10 Concentrations
PM10 Concentration - 71.3 Repl.
Percent
PM10 Concentrations (µg/m3)
PM10 Concentrations
Shape 1.258
Scale 12.48
N 177
AD 0.796
PM10 Concentration - 71.3 Repl.
Shape 1.311
Scale 12.38
N 177
AD 0.955



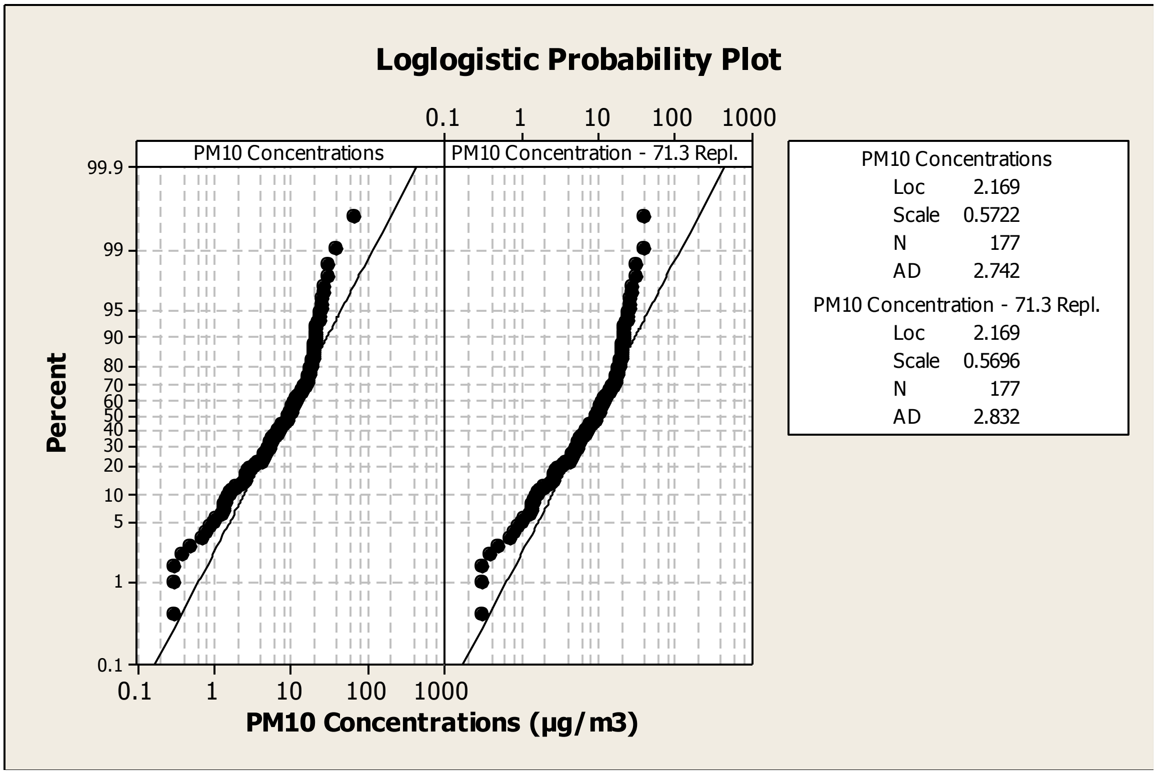
3-Parameter Weibull Probability Plot
PM10 Concentrations
PM10 Concentration - 71.3 Repl.
Percent
PM10 Concentrations (µg/m3) - Threshold
PM10 Concentrations
Shape 1.193
Scale 12.06
Thresh 0.2221
N 177
AD 1.012
PM10 Concentration - 71.3 Repl.
Shape 1.260
Scale 12.08
Thresh 0.1665
N 177
AD 1.066

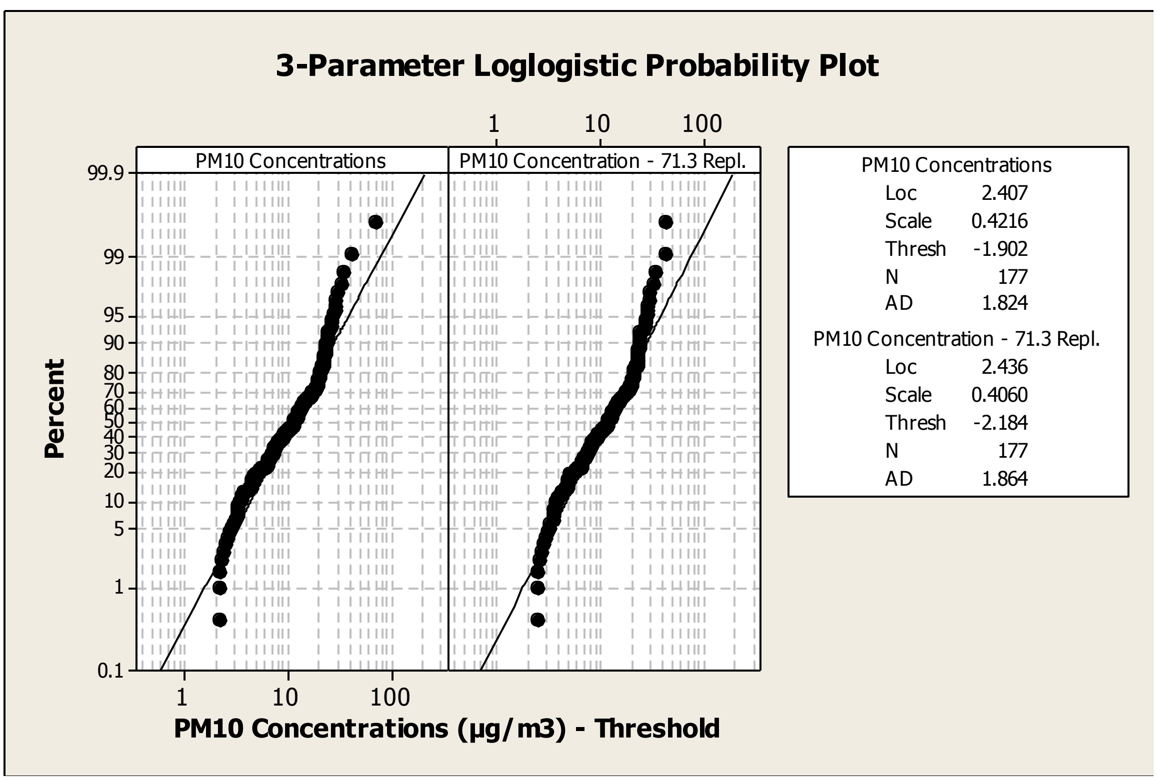


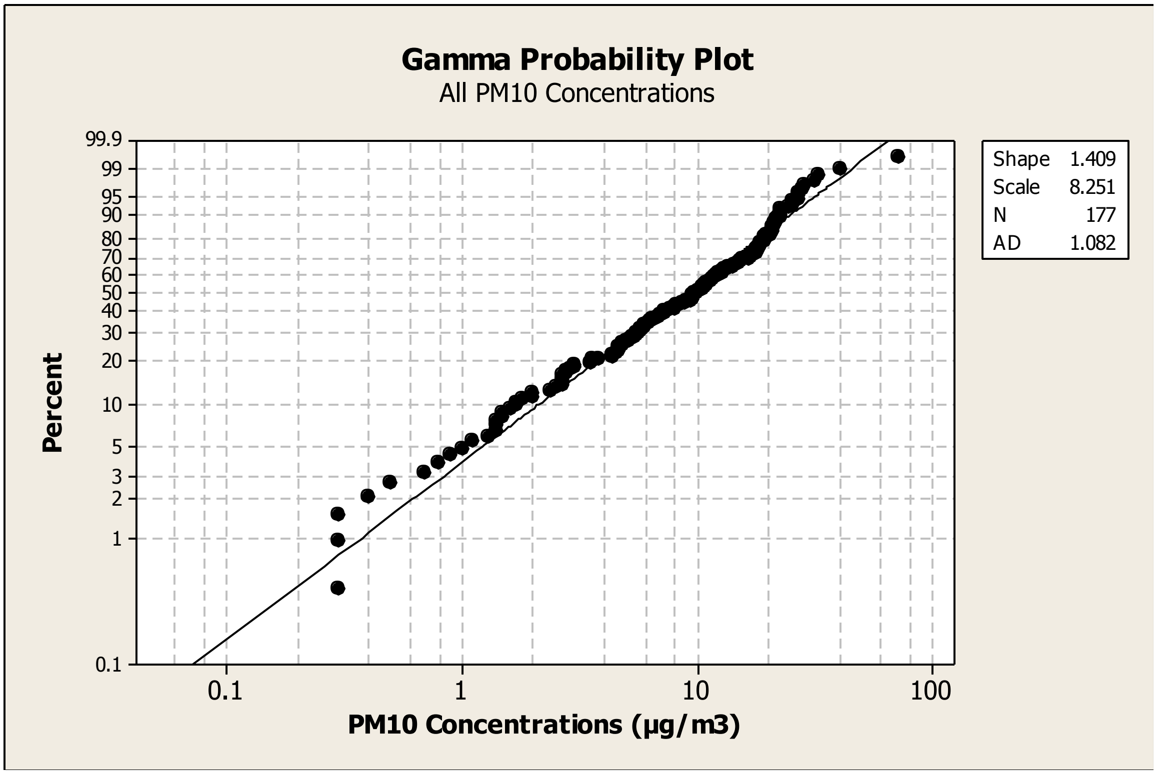
Largest Extreme Value Probability Plot
PM10 Concentrations
PM10 Concentration - 71.3 Repl.
Percent
PM10 Concentrations (µg/m3)
PM10 Concentrations
Loc 7.649
Scale 6.562
N 177
AD 1.643
PM10 Concentration - 71.3 Repl.
Loc 7.603
Scale 6.446
N 177
AD 1.761

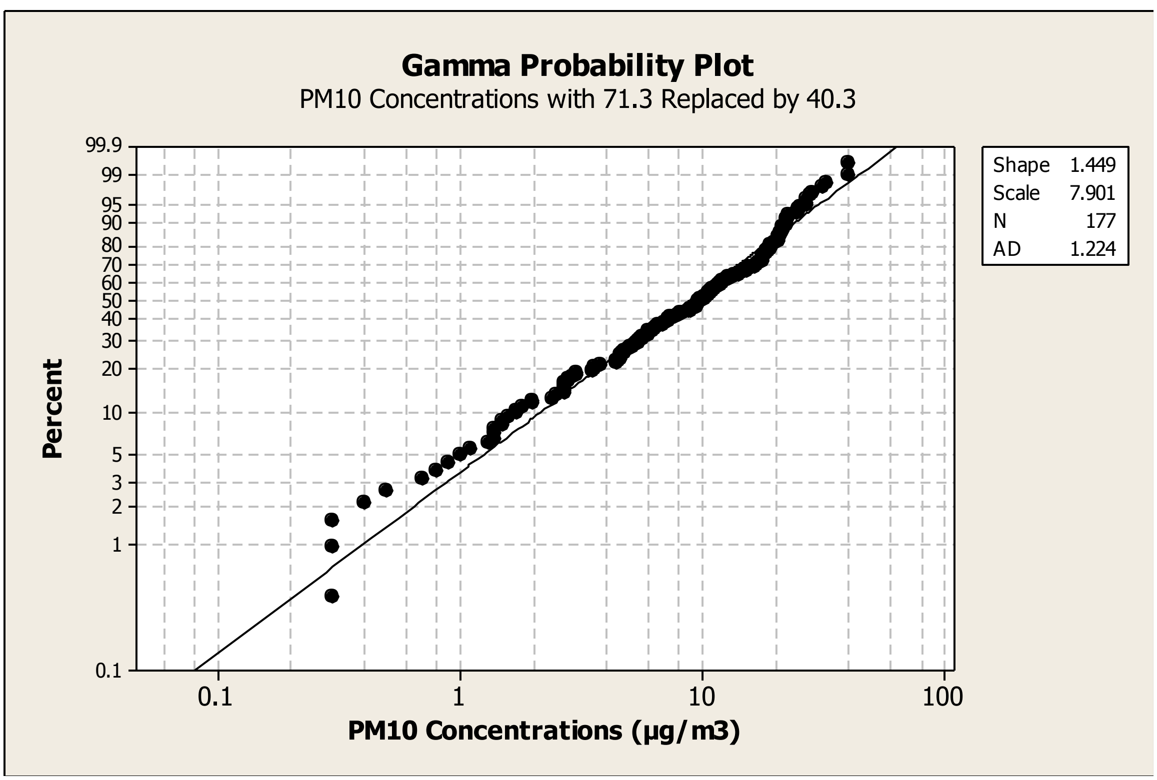


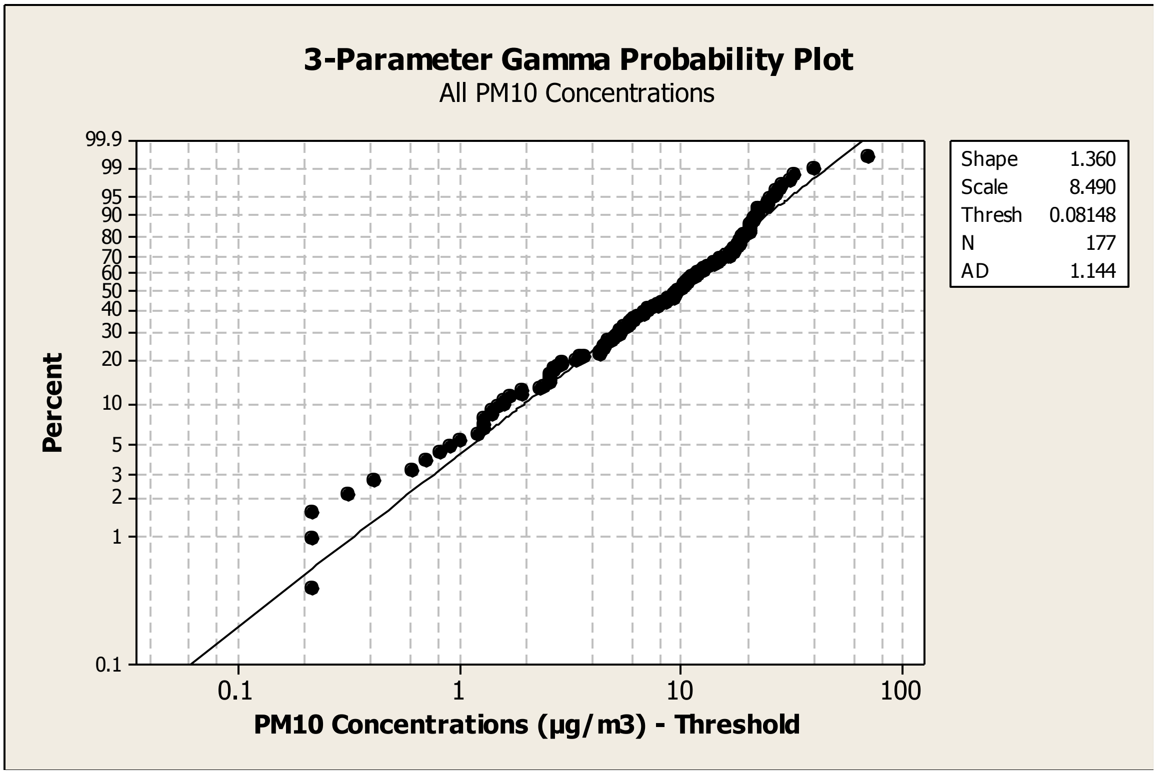
Logistic Probability Plot
PM10 Concentrations
PM10 Concentration - 71.3 Repl.
Percent
PM10 Concentrations (µg/m3)
PM10 Concentrations
Loc 10.78
Scale 4.937
N 177
AD 2.809
PM10 Concentration - 71.3 Repl.
Loc 10.76
Scale 4.818
N 177
AD 2.906

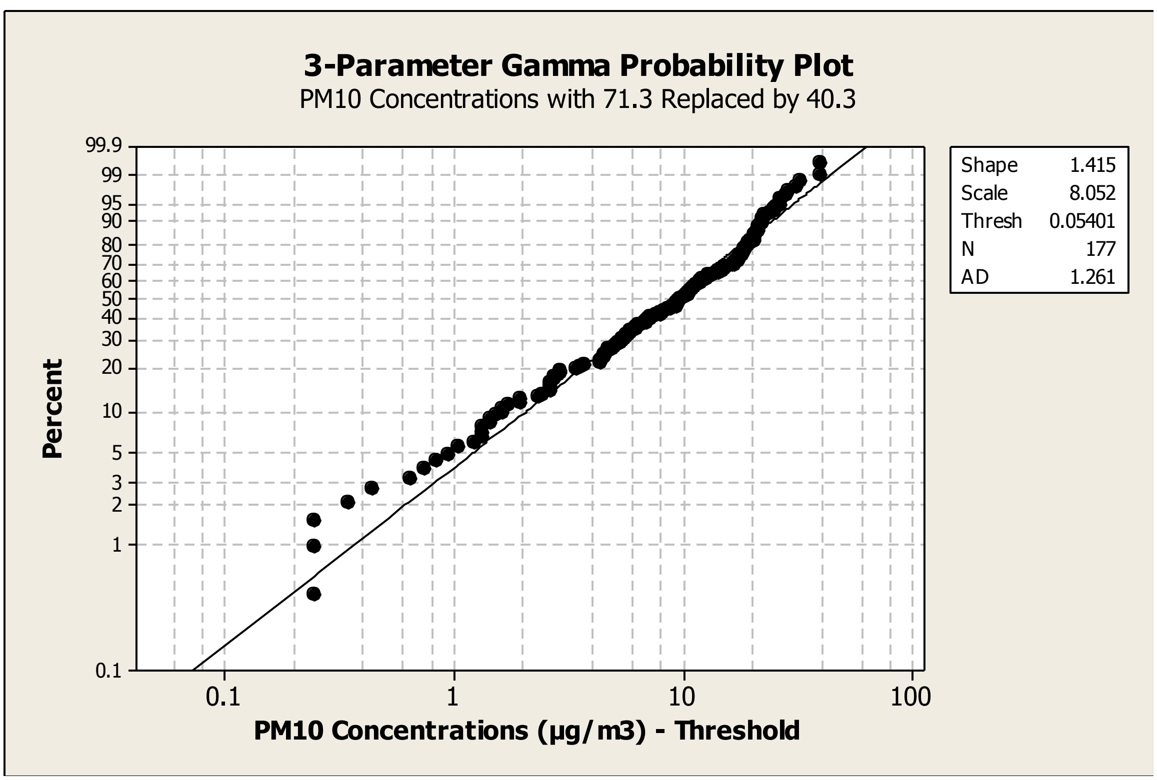

Loglogistic Probability Plot
PM10 Concentrations
PM10 Concentration - 71.3 Repl.
Percent
PM10 Concentrations (µg/m3)
PM10 Concentrations
Loc 2.169
Scale 0.5722
N 177
AD 2.742
PM10 Concentration - 71.3 Repl.
Loc 2.169
Scale 0.5696
N 177
AD 2.832


3-Parameter Loglogistic Probability Plot
PM10 Concentrations
PM10 Concentration - 71.3 Repl.
Percent
PM10 Concentrations (µg/m3) - Threshold
PM10 Concentrations
Loc 2.407
Scale 0.4216
Thresh -1.902
N 177
AD 1.824
PM10 Concentration - 71.3 Repl.
Loc 2.436
Scale 0.4060
Thresh -2.184
N 177
AD 1.864


Gamma Probability Plot
All PM10 Concentrations
Percent
PM10 Concentrations (µg/m3)
99.9
99
95
90
80
70
60
50
40
30
20
10
5
3
2
1
0.1
0.1
1
10
100
Shape 1.409
Scale 8.251
N 177
AD 1.082


Gamma Probability Plot
PM10 Concentrations with 71.3 Replaced by 40.3
Percent
PM10 Concentrations (µg/m3)
99.9
99
95
90
80
70
60
50
40
30
20
10
5
3
2
1
0.1
0.1
1
10
100
Shape 1.449
Scale 7.901
N 177
AD 1.224


3-Parameter Gamma Probability Plot
All PM10 Concentrations
Percent
PM10 Concentrations (µg/m3) - Threshold
Shape 1.360
Scale 8.490
Thresh 0.08148
N 177
AD 1.144


3-Parameter Gamma Probability Plot
PM10 Concentrations with 71.3 Replaced by 40.3
Percent
PM10 Concentrations (µg/m3) - Threshold
Shape 1.415
Scale 8.052
Thresh 0.05401
N 177
AD 1.261

Probability Density Function

```
Weibull with shape = 1.258 and scale = 12.48
   x     f( x )
40.3  0.0017264
```

Cumulative Distribution Function

```
Weibull with shape = 1.258 and scale = 12.48
   x  P( X <= x )
40.3     0.987343
```

Probability Density Function

```
Weibull with shape = 1.258 and scale = 12.48
   x     f( x )
71.3  0.0000204
```

Cumulative Distribution Function

```
Weibull with shape = 1.258 and scale = 12.48
   x  P( X <= x )
71.3     0.999871
```

Probability Density Function

```
Weibull with shape = 1.311 and scale = 12.38
   x     f( x )
40.3  0.0013918
```

Cumulative Distribution Function

```
Weibull with shape = 1.311 and scale = 12.38
   x  P( X <= x )
40.3     0.990895
```

Probability Density Function

```
Weibull with shape = 1.311 and scale = 12.38
   x     f( x )
71.3  0.0000089
```

Cumulative Distribution Function

```
Weibull with shape = 1.311 and scale = 12.38
   x  P( X <= x )
71.3     0.999951
```

APPENDIX D

AVERAGE AND MAXIMUM MINING RATES

Table D.1 Annual Mining and Haul Truck Process Rates						
Year	**Mining Process Rates (tons/year)**			**Haul Truck Process Rates (VMT/year)**		
	Ore	**Waste**	**Total**	**Inside the Pit**	**Outside the Pit**	**Total**
PP-2	0	1,688,000	1,688,000	1,279	21,489	22,768
PP-1	10,665,000	62,231,000	72,896,000	151,724	1,329,627	1,481,351
1	42,172,000	72,821,000	114,993,000	495,174	1,741,939	2,237,113
2	42,127,000	72,242,000	114,369,000	573,472	1,571,449	2,144,921
3	37,005,000	72,370,000	109,375,000	681,809	1,234,790	1,916,599
4	31,277,000	78,094,000	109,371,000	793,148	1,390,710	2,183,858
5	29,197,000	80,177,000	109,374,000	1,169,202	1,624,041	2,793,243
6	37,134,000	71,241,000	108,375,000	783,422	1,214,853	1,998,276
7	27,376,000	81,998,000	109,374,000	924,290	1,311,106	2,235,396
8	27,376,000	81,996,000	109,372,000	723,846	908,705	1,632,551
9	27,376,000	81,994,000	109,370,000	864,579	1,114,705	1,979,284
10	27,376,000	81,500,000	108,876,000	1,085,986	1,129,025	2,215,011
11	27,376,000	77,000,000	104,376,000	1,180,062	1,267,800	2,447,862
12	27,376,000	68,000,000	95,376,000	1,367,410	1,334,886	2,702,296
13	27,376,000	77,999,000	105,375,000	1,044,548	1,234,969	2,279,518
14	27,376,000	64,999,000	92,375,000	1,149,575	1,104,718	2,254,294
15	27,376,000	51,998,000	79,374,000	1,210,908	984,951	2,195,859
16	27,376,000	40,513,000	67,889,000	1,289,484	841,752	2,131,237
17	27,376,000	4,927,000	32,303,000	643,804	241,285	885,089
18	27,376,000	1,434,000	28,810,000	600,867	171,088	771,955
19	27,376,000	144,000	27,520,000	630,667	164,425	795,092
20	27,376,000	4,368,000	31,744,000	815,388	297,982	1,113,370
21	2,870,000	15,431,000	18,301,000	534,813	201,104	735,917

Table D.2 Maximum Daily Mining and Haul Truck Process Rates												
Year	**Mining Process Rates (tons/day)**						**Haul Truck Process Rates (VMT/day)**					
	Average			**Maximum [a]**			**Average**			**Maximum [a]**		
	Ore	**Waste**	**Total**	**Ore**	**Waste**	**Total**	**Inside the Pit**	**Outside the Pit**	**Total**	**Inside the Pit**	**Outside the Pit**	**Total**
PP-2	0	4,625	4,625	0	4,625	4,625	14	235	250	14	235	250
PP-1	29,219	170,496	199,715	29,219	170,496	199,715	416	3,643	4,058	416	3,643	4,058
1	115,540	199,510	315,049	115,540	199,510	315,049	1,357	4,772	6,129	1,357	4,772	6,129
2	115,416	197,923	313,340	138,500	237,508	376,008	1,571	4,305	5,876	1,885	5,166	7,052
3	101,384	198,274	299,658	121,660	237,929	359,589	1,868	3,383	5,251	2,242	4,060	6,301
4	85,690	213,956	299,647	102,828	256,747	359,576	2,173	3,810	5,983	2,608	4,572	7,180
5	79,992	219,663	299,655	95,990	263,596	359,586	3,203	4,449	7,653	3,844	5,339	9,183
6	101,737	195,181	296,918	122,084	234,217	356,301	2,146	3,328	5,475	2,576	3,994	6,570
7	75,003	224,652	299,655	90,003	269,582	359,586	2,532	3,592	6,124	3,039	4,310	7,349
8	75,003	224,647	299,649	90,003	269,576	359,579	1,983	2,490	4,473	2,380	2,988	5,367
9	75,003	224,641	299,644	90,003	269,569	359,573	2,369	3,054	5,423	2,842	3,665	6,507
10	75,003	223,288	298,290	90,003	267,945	357,948	2,975	3,093	6,069	3,570	3,712	7,282
11	75,003	210,959	285,962	90,003	253,151	343,154	3,233	3,473	6,706	3,880	4,168	8,048
12	75,003	186,301	261,304	90,003	223,562	313,565	3,746	3,657	7,404	4,496	4,389	8,884
13	75,003	213,696	288,699	90,003	256,435	346,438	2,862	3,383	6,245	3,434	4,060	7,494
14	75,003	178,079	253,082	90,003	213,695	303,699	3,150	3,027	6,176	3,779	3,632	7,411
15	75,003	142,460	217,463	90,003	170,952	260,956	3,318	2,698	6,016	3,981	3,238	7,219
16	75,003	110,995	185,997	90,003	133,193	223,197	3,533	2,306	5,839	4,239	2,767	7,007
17	75,003	13,499	88,501	90,003	16,198	106,202	1,764	661	2,425	2,117	793	2,910
18	75,003	3,929	78,932	90,003	4,715	94,718	1,646	469	2,115	1,975	562	2,538
19	75,003	395	75,397	90,003	473	90,477	1,728	450	2,178	2,073	541	2,614
20	75,003	11,967	86,970	90,003	14,361	104,364	2,234	816	3,050	2,681	980	3,660
21	7,863	42,277	50,140	9,436	50,732	60,168	5,861	2,204	8,065	7,033	2,645	9,678

[a] 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).

APPENDIX E

CORRESPONDENCE WITH ADEQ

From:	Herbert J. Verville
To:	Shantanu Kongara
Subject:	FW: Rural Background Concentrations
Date:	Tuesday, September 16, 2008 11:13:47 AM
Attachments:	Rural Background.xls

-----Original Message-----
From: Tim Martin [mailto:Martin.Tim@ev.state.az.us]
Sent: Monday, March 29, 2004 7:31 AM
To: hverville@aecinc.org
Cc: Peter Hyde
Subject: Rural Background Concentrations

March 29, 2004

Herb:

I have attached an example of rural background concentrations for NO2, SO2, and CO in Arizona. The footnotes for the table explain the basis of the values. These values are typically used by ADEQ when modeling Class II (minor) sources. As always, try your best to utilize representative background data that was actually measured. When all else fails, utilize the NO2 and CO data in the table. Please contact me with questions.

-Tim

Timothy S. Martin
Arizona Dept. of Environmental Quality
Air Quality Division
Phone: (602) 771-2357
Fax: (602) 771-2366
E-mail: tsm@ev.state.az.us

Rural Arizona

Example Background Concentrations

Pollutant	Averaging Time	Ambient Data			Background Value (μg/m3)	Standard (μg/m^3)
		1999	2000	2001		
NO_2[a]	annual	---	---	---	4	100
CO[b]	1-hour	---	---	---	582	40,000
	8-hour	---	---	---	582	10,000
SO_2	3-hour	43	14	15	43	1,300
	24-hour	17	7	8	17	365
	annual	2	1	3	3	80

[a] Long-term average value (0.002 ppm) of several monitors located near power plants in rural areas of Arizona

[b] Typical continental ambient CO background value (0.5 ppm) used in most regional models

[c] Max. values over 3-year period from Page monitoring station (Coconino County)

From:	Leonard H. Montenegro
To:	skongara@aecinc.org
Cc:	Feng Mao
Subject:	RE: Tail Pipe Emissions
Date:	Friday, August 14, 2009 10:53:48 AM

Shantanu,
Please see below and in the future, feel free to direct your questions to Feng Mao or myself.
Cordially,
Leonard

-----Original Message-----
From: Feng Mao
Sent: Wed 8/12/2009 4:32 PM
To: Leonard H. Montenegro
Subject: RE: Tail Pipe Emissions

Leonard,

Table 3.3-1 in AP-42 provides the emission factors for PM10 with an assumption of "all particulate is assumed to be <1um in size". This assumption indicates that all particulate emissions are PM2.5 (the emission rate of PM10 is identical to that of PM2.5).

Based on Appendix B.2 of AP-42, the emission rate for PM2.5 is around 94% of the emission rate for PM10.

I did not see much difference between the two methods. To be conservative for modeling PM2.5, it is recommended to assume that all of the particulate emissions from tail pipes are PM2.5.

Feng

From: Leonard H. Montenegro
Sent: Wednesday, August 12, 2009 3:12 PM
To: Feng Mao
Subject: FW: Tail Pipe Emissions

Can you look this up?

Thanks

APPENDIX F

IN-STACK NO_2/NO_X RATIO JUSTIFICATION

APPENDIX G

CHANGES IN EMISSIONS FROM PRIOR SUBMITTALS

Table G.1 Comparison of Non-Fugitive Emissions from the RCP - Proposed Action												
Emission Category	Non-Fugitive Emissions (tpy)											
	PM/TSP	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC	H_2SO_4	CO_2	CH_4	N_2O	HAPs
Year 1												
Prior to Mitigation and Refinement [a]	72.44	66.81	53.68	9.00	16.76	0.06	1.51	0.02	6,040.20	0.25	0.05	0.05
After Mitigation and Refinement [b]	78.46	39.03	10.23	9.00	16.76	0.06	1.51	0.02	6,040.20	0.25	0.05	0.05
Change in Emissions	6.02	-27.78	-43.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Year 5												
Prior to Mitigation and Refinement	72.44	66.81	53.68	9.00	16.76	0.06	1.51	0.02	6,040.20	0.25	0.05	0.05
After Mitigation and Refinement	78.46	39.03	10.23	9.00	16.76	0.06	1.51	0.02	6,040.20	0.25	0.05	0.05
Change in Emissions	6.02	-27.78	-43.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Year 10												
Prior to Mitigation and Refinement	72.44	66.81	53.68	9.00	16.76	0.06	1.51	0.02	6,040.20	0.25	0.05	0.05
After Mitigation and Refinement	78.46	39.03	10.23	9.00	16.76	0.06	1.51	0.02	6,040.20	0.25	0.05	0.05
Change in Emissions	6.02	-27.78	-43.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Year 15												
Prior to Mitigation and Refinement	72.44	66.81	53.68	9.00	16.76	0.06	1.51	0.02	6,040.20	0.25	0.05	0.05
After Mitigation and Refinement	78.46	39.03	10.23	9.00	16.76	0.06	1.51	0.02	6,040.20	0.25	0.05	0.05
Change in Emissions	6.02	-27.78	-43.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Year 20												
Prior to Mitigation and Refinement	72.44	66.81	53.68	9.00	16.76	0.06	1.51	0.02	6,040.20	0.25	0.05	0.05
After Mitigation and Refinement	78.46	39.03	10.23	9.00	16.76	0.06	1.51	0.02	6,040.20	0.25	0.05	0.05
Change in Emissions	6.02	-27.78	-43.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[a] Emission totals are from *"Rosemont Copper Company, Application for a Class II Permit and Emission Inventory Information, Rosemont Copper Project, Southeastern Arizona"* submitted to ADEQ on November 15, 2011.

[b] Emission totals are from *"Rosemont Copper Company, Amendment to: Application for a Class II Permit and Emission Inventory Information, Rosemont Copper Project, Southeastern Arizona"* submitted to ADEQ on March 19, 2012.

Table G.2 Comparison of Fugitive Emissions from the RCP - Proposed Action

Emission Category	Fugitive Emissions (tpy)											
	PM/TSP	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC	H_2SO_4	CO_2	CH_4	N_2O	HAPs
Year 1												
Prior to Mitigation and Refinement [a]	2,851.09	785.29	87.92	635.83	161.33	18.98	3.77	0.00	5,375.60	0.22	0.04	3.32
After Mitigation and Refinement [b]	2,791.22	765.20	88.32	635.83	161.33	18.98	3.77	0.00	5,375.60	0.22	0.04	3.32
Change in Emissions	-59.87	-20.10	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Year 5												
Prior to Mitigation and Refinement	3,297.90	894.91	98.84	606.22	153.82	18.10	3.77	0.00	5,125.23	0.21	0.04	3.32
After Mitigation and Refinement	3,238.04	874.81	99.24	606.22	153.82	18.10	3.77	0.00	5,125.23	0.21	0.04	3.32
Change in Emissions	-59.87	-20.10	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Year 10												
Prior to Mitigation and Refinement	2,786.66	763.36	85.71	602.73	152.93	17.99	3.77	0.00	5,095.78	0.21	0.04	3.32
After Mitigation and Refinement	2,726.80	743.27	86.11	602.73	152.93	17.99	3.77	0.00	5,095.78	0.21	0.04	3.32
Change in Emissions	-59.87	-20.10	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Year 15												
Prior to Mitigation and Refinement	2,715.41	735.13	81.96	438.98	111.38	13.10	3.77	0.00	3,711.38	0.15	0.03	3.32
After Mitigation and Refinement	2,655.49	715.01	82.35	438.98	111.38	13.10	3.77	0.00	3,711.38	0.15	0.03	3.32
Change in Emissions	-59.92	-20.11	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Year 20												
Prior to Mitigation and Refinement	1,586.52	428.87	48.00	175.94	44.64	5.25	3.77	0.00	1,487.50	0.06	0.01	3.32
After Mitigation and Refinement	1,526.67	408.78	48.40	175.94	44.64	5.25	3.77	0.00	1,487.50	0.06	0.01	3.32
Change in Emissions	-59.84	-20.09	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[a] Emission totals are from *"Rosemont Copper Company, Application for a Class II Permit and Emission Inventory Information, Rosemont Copper Project, Southeastern Arizona"* submitted to ADEQ on November 15, 2011.

[b] Emission totals are from *"Rosemont Copper Company, Amendment to: Application for a Class II Permit and Emission Inventory Information, Rosemont Copper Project, Southeastern Arizona"* submitted to ADEQ on March 19, 2012.

Table G.3 Comparison of Tailpipe Emissions from the RCP - Proposed Action

Emission Category	Tailpipe Emissions (tpy)											
	PM/TSP	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC	H_2SO_4	CO_2	CH_4	N_2O	HAPs
Year 1												
Prior to Mitigation and Refinement [a]	33.85	33.85	33.85	831.98	1,086.65	1.54	78.70	--	163,786.04	--	--	--
After Mitigation and Refinement [b]	29.40	29.40	29.40	831.98	1,016.69	1.54	72.84	--	163,786.04	--	--	--
Change in Emissions	-4.45	-4.45	-4.45	0.00	-69.96	0.00	-5.86	--	0.00	--	--	--
Year 5												
Prior to Mitigation and Refinement	33.84	33.84	33.84	829.16	1,086.32	1.54	78.55	--	163,247.91	--	--	--
After Mitigation and Refinement	29.39	29.39	29.39	829.16	1,016.36	1.54	72.69	--	163,247.91	--	--	--
Change in Emissions	-4.45	-4.45	-4.45	0.00	-69.96	0.00	-5.86	--	0.00	--	--	--
Year 10												
Prior to Mitigation and Refinement	33.84	33.84	33.84	829.36	1,086.35	1.54	78.56	--	163,285.50	--	--	--
After Mitigation and Refinement	29.39	29.39	29.39	829.36	1,016.38	1.54	72.70	--	163,285.50	--	--	--
Change in Emissions	-4.45	-4.45	-4.45	0.00	-69.96	0.00	-5.86	--	0.00	--	--	--
Year 15												
Prior to Mitigation and Refinement	33.83	33.83	33.83	826.39	1,086.00	1.54	78.40	--	162,718.15	--	--	--
After Mitigation and Refinement	29.38	29.38	29.38	826.39	1,016.04	1.54	72.54	--	162,718.15	--	--	--
Change in Emissions	-4.45	-4.45	-4.45	0.00	-69.96	0.00	-5.86	--	0.00	--	--	--
Year 20												
Prior to Mitigation and Refinement	33.59	33.59	33.59	795.06	1,068.97	1.54	76.71	--	156,725.16	--	--	--
After Mitigation and Refinement	29.14	29.14	29.14	795.06	999.01	1.54	70.85	--	156,725.16	--	--	--
Change in Emissions	-4.45	-4.45	-4.45	0.00	-69.96	0.00	-5.86	--	0.00	--	--	--

[a] Emission totals are from *"Rosemont Copper Company, Application for a Class II Permit and Emission Inventory Information, Rosemont Copper Project, Southeastern Arizona"* submitted to ADEQ on November 15, 2011.

[b] Emission totals are from *"Rosemont Copper Company, Amendment to: Application for a Class II Permit and Emission Inventory Information, Rosemont Copper Project, Southeastern Arizona"* submitted to ADEQ on March 19, 2012.