PROJECT REPORT
EMPS, Inc. > Burning Man Event EIS

AERMOD Modeling Report to Assess Direct and Cumulative Ambient Air Quality Impacts

Prepared By:

Shannon Manoulian, P.E. – Senior Consultant
David E.B. Strohm II – Managing Consultant

TRINITY CONSULTANTS
702 W. Idaho Street
Suite 1100
Boise, ID 83702
208.472.8837

January 2019

Project 171301.0026

Environmental solutions delivered uncommonly well

TABLE OF CONTENTS

ACRONYMS

AMS	American Meteorological Society
AMSL	Above Mean Sea Level
BAPC	Bureau of Air Pollution Control
BRC	Black Rock City, LLC
BLM	Bureau of Land Management
EPA	Environmental Protection Agency
HAPs	Hazardous Air Pollutants
ISR	In-stack ratio
km	kilometers
m	meters
MDBM	Mount Diablo Base and Meridian
NAAQS	National Ambient Air Quality Standards
NBAPC	NDEP, Bureau of Air Pollution Control
NDEP	Nevada Division of Environmental Protection
NED	National Elevation Dataset
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NRS	Nevada Revised Statutes
NWS	National Weather Service
OLM	Ozone Limiting Method
PAB	Project Area Boundary
PCAB	Permit Closure Area Boundary
PSD	Prevention of Significant Deterioration
SRP	Special Recreation Permit
TPY	Tons per Year
TSD	Technical Support Document
VMT	Vehicle Miles Traveled
WRAP	Western Regional Air Partnership

1. EXECUTIVE SUMMARY

This document, "AERMOD Modeling Report to Assess Direct and Cumulative Ambient Air Quality Impacts" is being submitted to the U.S. Bureau of Land Management, Winnemucca District Office, Black Rock Field Office (BLM), on behalf of Black Rock City, LLC (BRC). Pursuant to the National Environmental Policy Act (NEPA), the BLM is the lead agency preparing the NEPA analysis for the proposed revision to BRC's Special Recreation Permit (SRP) for the Burning Man Event.

In October 2018, Trinity submitted an air quality modeling report outlining the modeling procedures that were used to appropriately and thoroughly assess ambient air quality impacts from the implementation of the proposed components of BRC's revised SRP and its alternatives and to present the results of that modeling. The report served as the air quality modeling Technical Support Document (TSD) for inclusion in the NEPA analysis.

After review of the TSD, the BLM requested that quantitative AERMOD modeling be produced that incorporates detailed model sources for the Hycroft Mining Corporation's Hycroft Mine (based on their current EIS) and that total cumulative modeling impacts be disclosed as part of the Burning Man EIS. As such, this document presents a revised and final TSD including an addendum to the previously submitted air dispersion modeling report. This addendum details the methodology used for the cumulative modeling analysis and describes the use of onsite data for the Hycroft Mine as well as presents the results of the cumulative analysis.

A. FACILITY DESCRIPTION AND PROJECT OVERVIEW

Burning Man is an annual event held in the western United States at Black Rock City – a temporary city erected on a dry lake bed known as the Black Rock Playa within the Black Rock Desert of northwest Nevada. The event site is located approximately 100 miles (160 km) north-northeast of Reno in the northwest corner of Pershing County.

The event is attended by approximately 70,000 ticketed attendees as well as support and logistical staff. The event includes dispersed art installations, interactive artistic performances and the infrastructure for event attendees.

The event site is located on public lands managed by the Winnemucca District Office of the BLM. The event is permitted through use of a BLM SRP. The event site has an approximate center point of 40.786432°/ -119.206695° (WGS84 Datum) and occurs at a median elevation of 3,900 feet above mean sea level. Primary site access occurs off County Road 34 located to the west of the Black Rock Playa.

BRC is proposing to modify their SRP to allow for an extended permit term and revisions to total bodies on the playa within the event closure area. BRC is proposing to increase the total number of people allowed on the playa to 100,000. Depending on the number of participants and volunteers for recent events, this is an approximately 20% increase in the total bodies on playa. As a result, this Air Quality Modeling Report has been designed to present both current event air quality dispersion and the impact of the proposed SRP revisions and its alternatives.

Additionally, after initial review of the project modeling and TSD, the BLM requested that quantitative AERMOD modeling be produced that incorporates detailed model sources for the Hycroft Mine (based on their current EIS) and that total cumulative modeling impacts be disclosed as part of the Burning Man EIS.

As such, this document presents a revised and final TSD including an addendum to the previously submitted air dispersion modeling report. This addendum details the methodology used for the cumulative modeling analysis and describes the use of onsite data for the Hycroft Mine as well as presents the results of the cumulative analysis.

B. PURPOSE OF AERMOD MODELING AND SUBMITTAL OF MODELING REPORT

Both installation of the Burning Man Event site infrastructure and the onsite activities of the Event participants will increase fugitive air emissions in the area surrounding the Black Rock Desert. Therefore, air quality modeling was performed to identify, to the extent feasible, what impact those emissions would have on ambient air quality. The BLM requested that an air impact analysis be submitted as part of the NEPA process to demonstrate that the National Ambient Air Quality Standards (NAAQS) will be protected during the expansion of the SRP.

This document presents the methodologies that were followed for the AERMOD modeling as requested by the BLM and cooperating agencies, as well as the results of that modeling.

The modeling methodologies presented herein were followed to assess ambient air quality impacts from the proposed project and its alternatives as well as the cumulative impacts of the project in combination with the emissions sources of the Hycroft Mine. This report has been developed following recommendations of the BLM and cooperating agencies and taking into consideration the precedents set forth in the Nevada Division of Environmental Protection (NDEP) guidance document "General Air Dispersion Modeling Guidelines" (NDEP, Bureau of Air Pollution Control (BAPC) Guidance, September 2008) and the Environmental Protection Agency (EPA) Guideline on Air Quality Models (Guidelines, 40 CFR Part 51, Appendix W, January 2017). 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/.

The objective of this modeling effort is to provide an assessment of pollutant concentrations in ambient air and the resulting potential impacts on the public. These impacts were assessed at the SRP public closure boundary for direct BRC source impacts, which corresponds with the limit of short term public access during the event activities.

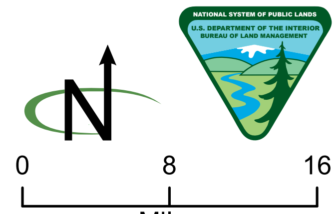
C. SITE DESCRIPTION

The event site has an approximate center point of 40.786432°/ -119.206695° (WGS84 Datum) and occurs at a median elevation of 3,900 feet above mean sea level. Primary site access occurs off County Road 34 located to the west of the Black Rock Playa. The region surrounding the event is currently designated as attainment/unclassifiable for all pollutants in accordance with 40 CFR 81.329. The event is located within a high desert environment, characterized by arid and semiarid conditions, minimal annual precipitation and large temperature ranges. **Figure 1-1** provides a regional view of the event location.

Event activities and infrastructure are located primarily on a central portion of the Black Rock Playa. Onsite activities include operational vehicle activity for BLM and BRC personnel; foot, bicycle and vehicle traffic of event participants; combustion for artistic and event purposes; and enhanced fugitive dust emissions associated with the erosion of playa surface material during wind events. The event site and permit closure area are closed to the general public (not inclusive of ticket event attendees or event employees/invitees). During the event infrastructure installation and the event, these areas will not be accessible to the general public. The boundary for model impacts assessment begins at the outside of the pink area identified on **Figure 1-1.**

Figure 1-1
Air Quality Assessment Area, Aerial

Air quality assesment area



3. AIR QUALITY REGULATORY FRAMEWORK

A. PROJECT AREA AIR QUALITY CLASSIFICATIONS

EPA classifies air quality regions as "nonattainment" for a given pollutant if ambient air concentrations exceed the 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 sufficient data does not exist to make a determination. Attainment status is based on the results of ambient air quality monitoring, typically performed over a three-year period.

According to EPA's green book of non-attainment areas and the NDEP, Bureau of Air Pollution Control (BAPC or NBAPC) (see 40 CFR §81.303 for the promulgated attainment status of all areas in Nevada, or http://www.epa.gov/oaqps001/greenbk/ for maps identifying nonattainment areas throughout Nevada and the United States), Pershing County has been designated as in attainment for all criteria air pollutants that have a NAAQS/Nevada Ambient Air Quality Standard (NVAAQS).

B. FACILITY DESIGNATION AND FEDERAL PERMITTING FRAMEWORK

New point 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_2, SO_2, or CO exceed 250 tons per year (tpy). PSD permitting involves a number of requirements, one of which is an air quality impact analysis involving dispersion modeling. PSD and other air quality permitting components under the Clean Air Act (CAA) do not apply to the Burning Man Event as it does not fulfill the definition of a Stationary Source under those regulations. However, the PSD program does provide a long-standing, nationally-standardized framework for performing ambient air quality monitoring and dispersion modeling. As a result, the PSD dispersion modeling methodologies were applied for BRC project modeling.

Dispersion modeling was performed, at the request of the BLM, to identify the potential impacts of emissions under the proposed EIS alternatives on air quality.

C. STATE AIR QUALITY REGULATORY AUTHORITY

The NBAPC permits and regulates stationary sources of emissions located within the state, as provided in §445(B) of the Nevada Revised Statutes (NRS).

The BRC event is not required to obtain a State of Nevada air quality permit as it does not represent a stationary source of emissions. However, the NDEP also regulates both open burns (Nevada Administrative Code, NAC, 445B.22067) and emission of fugitive dust (NAC 445B.22037), which may require permitting. On April 28, 2017 and in response to a public complaint, the NDEP determined that BRC was not required to obtain an open burn permit. However, a decision was made by NDEP that a Surface Area Disturbance permit was required to control the emission of fugitive dust (NAC 445B.22037(3)). BRC has complied with this requirement.

4. DISPERSION MODELING INPUT DATA AND DEFAULTS

The model used for this application was developed by the EPA in conjunction with the American Meteorological Society (AMS) and is called the AMS/EPA Regulatory Model, or AERMOD. AERMOD is the USEPA–approved model for near-field new source review. The modeling was conducted using the most recent version of AERMOD, version 18081-64bit. Trinity Consultants, Inc. (Trinity) uses the commercial version of AERMOD from BREEZE (a division of Trinity).

Federal Class I areas, such as national parks, some national wilderness areas and national monuments, are granted special air quality protections under Section 162(a) of the federal Clean Air Act. No Federal Class I areas are located within 100 kilometers (km) of the Project Area. As a result, a Class I "Far-Field" analysis was not completed.

EPA's *Guideline on Air Quality Models* (herein after referred to as *Guideline*) 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 near-field (within 50 km) 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 described as follows:

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

---

[1] "Revision to the Guideline on Air Quality Models: Enhancements to the AERMOD Dispersion Modeling System and Incorporation of Approaches to Address Ozone and Fine Particulate Matter (Final Rule)." Federal Register 82:10 (17 January 2017) p. 5182

- Model outputs: temporally averaged air pollutant concentrations

A. RECOMMENDED REGULATORY DEFAULT OPTIONS

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

B. 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 ten 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 *Meteorological Program Guidance for Regulatory Modeling Applications* (EPA, 2000).

C. REGIONAL TOPOGRAPHY

The regional topography of Pershing County generally consists of alternating, linear mountains between broad flat valleys characteristic of the Basin and Range Province. The Project Area is located on the Black Rock Playa, a large dry lake bed located within the Black Rock Desert and is surrounded by elevated topography. The region consists of groups of mostly topographically closed valleys with internal drainage.

D. 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 km radius from the facility are greater than 50 percent, 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 km radius from the facility are greater than 50 percent, 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.

Rural land use in the area surrounding the Project Area is much greater than 50 percent. Thus, the rural classification was used in the modeling.

E. REGIONAL CLIMATOLOGY

The Burning Man event site is located within Pershing County, Nevada. The county receives only 7 inches of rain annually, 8 inches of snow and approximately 38 days with measurable precipitation. Generally mountainous terrain with a major north-south axis surrounds the flat Playa that makes up the Black Rock Desert and event site. The region is comprised of a mix of high alpine forest and sagebrush vegetation at higher elevations and barren Playas at low elevations.

Nevada lies on the eastern, lee side of the Sierra Nevada Range, a massive mountain barrier that markedly influences the climate of the State. One of the greatest contrasts in precipitation found within a short distance in the United States occurs between the western slopes of the Sierra Nevada Range in California and the valleys just to the east of this range. The prevailing winds are from the west. As the warm moist air from the Pacific Ocean ascends the western slopes of the Sierra Nevada Range, the air cools and condensation takes place and most of the moisture falls as precipitation. As the air descends the eastern slope, it is warmed by compression and very little precipitation occurs. The effects of this mountain barrier are felt not only in the west but throughout the State, with the result that the lowlands of Nevada are largely desert or steppes.

Long-term climatological data was obtained from the National Oceanic and Atmospheric Administration (NOAA) for the division of northwestern Nevada. While regionally representative, the climatology data can be assumed to differ slightly from that at the Project Area. This is due to the NOAA data being an average of several weather stations that encompass six counties, one of which is Pershing. **Table 4-1** below depicts the average climatological variables for the region calculated over a period of 36 years from 1980 through 2017.

Table 4-1. Average Northwestern Nevada Climate Data, 1980 through 2017

Title	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Monthly Average
Average Max. Temperature (F)	41.5	46.4	53.5	60.0	69.0	79.4	89.0	87.4	78.3	65.1	50.3	41.0	63.4
Average Min. Temperature (F)	21.4	24.8	29.2	33.2	41.0	48.4	56.0	53.9	46.1	36.1	26.9	20.6	36.5
Average Total Precipitation (in)	1.24	1.06	1.11	0.97	1.13	0.68	0.29	0.25	0.46	0.79	1.12	1.34	0.87

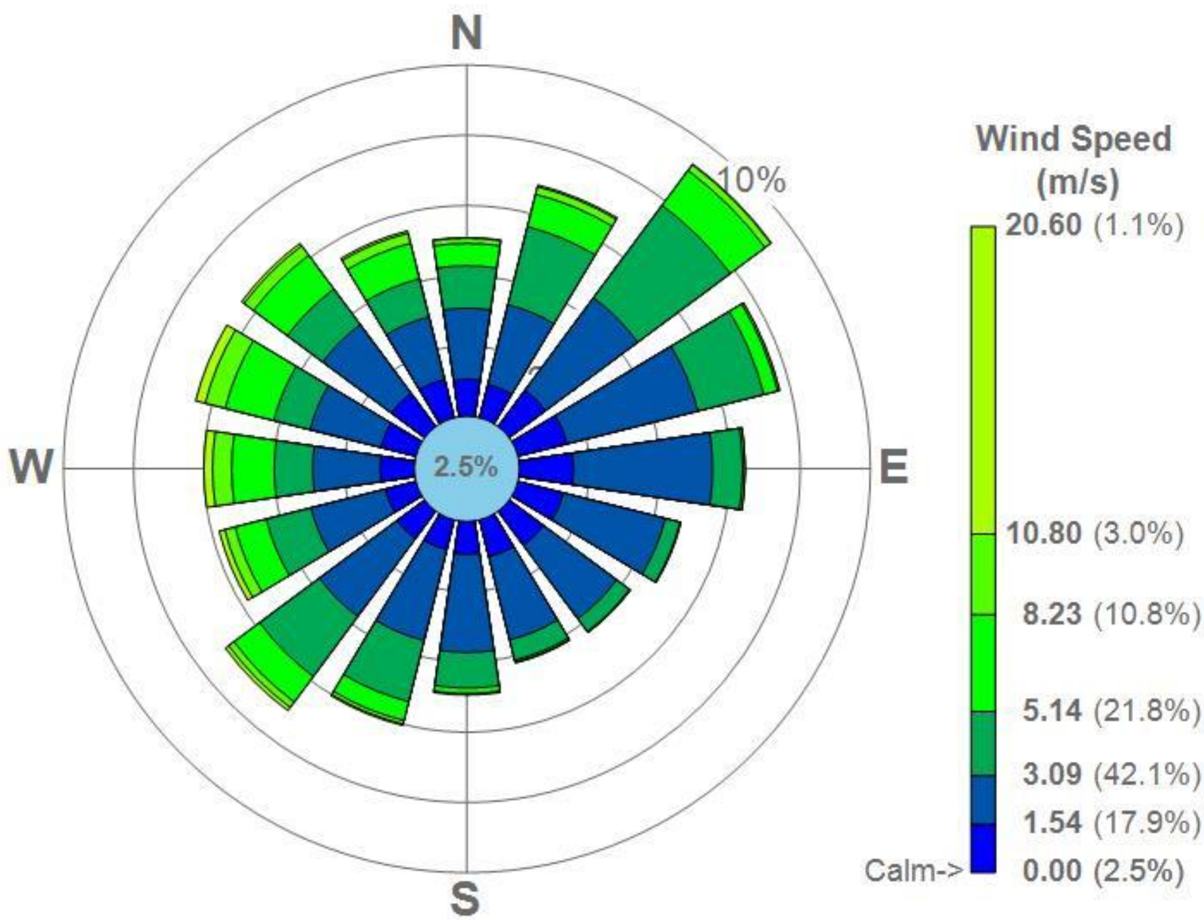
Source: NOAA Divisional Northwestern Nevada data.
http://www7.ncdc.noaa.gov/CDO/CDODivisionalSelect.jsp#

F. METEOROLOGICAL DATA AND PROCESSING FOR AERMOD

The NDEP Air Program processes (using both AERMET and AERSURFACE modules) on-site and National Weather Service (NWS) meteorological data using the most current EPA standards and NDEP policies in order to provide the modeling/consultant/industry community with a set of pre-processed AERMOD input files that have been pre-vetted and are ready to use with the AERMOD model. The pre-processing includes choices on the most representative meteorological data for the modeled location, processing parameters and determination of climatological and surface characteristics. BRC requested, and NDEP provided, five complete calendar years (2010-2014) of NWS meteorological monitoring data (this pre-processed data from NDEP) used for this modeling analysis.

A wind rose of the data collected at Lovelock, NV from January 1, 2010 through December 31, 2014 is presented in **Figure 4-1** as this represents the most representative NDEP data available. A year-to-year data comparison shows consistency in the average wind speeds and directions and also indicates that meteorological data was consistently collected. Winds had no strong tendency toward directionality with only slight preference for the south/southwest. Wind speeds varied somewhat and tended to be strongest from the southwest and west. The representativeness of the Lovelock data for use in modeling the on-playa emissions sources is discussed in more detail in Section 4H below.

Figure 4-1. Wind Rose for the Lovelock AERMET Data for the Time Period January 1, 2010 – December 31, 2014



G. SKY COVER DATA

AERMOD requires parameters for determining boundary layer conditions, which include opaque sky cover (or total sky cover). Per EPA's AERMET guidance, the concurrent sky cover data for surface meteorological data is to be obtained from the nearest NWS site. The Lovelock, Nevada NWS site surface measurement data includes sky cover data, which was used for the analysis.

H. UPPER AIR AND SURFACE METEOROLOGICAL DATA

AERMOD requires upper air and surface characteristic data. Twice-daily upper air sounding data were obtained from the upper air monitoring station most geographically proximate to the surface station site. The nearest upper air data collection site, relative to the Project Area, is the Reno, NV station (REV, WMO 72489). Archived upper air radiosonde data was acquired from the NOAA/ESRL radiosonde database and used in AERMET processing. A map of the NWS station locations can be found at https://www.weather.gov/upperair/nws_upper.

Hourly surface meteorological data were utilized for AERMET processing. Data from the Lovelock, Nevada NWS station was used for surface meteorological data; this station is the nearest and most representative surface station to the project site. The use of 5 years of meteorological data allows for an assessment of conditions that occur at both the Event location as well as at the surface meteorological data collection location, even if they occur at differing times. As a result, the maximum impacts modeled using the Lovelock dataset is likely consistent with data that would be collected on the playa. Additionally, because onsite meteorological data is not available to support the dispersion modeling, the use of Lovelock data was selected as the most representative dataset available.

I. SURFACE CHARACTERISTICS

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 variables 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 can be annual (one period), seasonal (four periods), or monthly (12 periods). Seasonal frequency includes winter (December, January, February), spring (March, April, May), summer (June, July, August) and fall (September, October, November). Monthly frequency includes each month of the calendar year. Sectors refer to the number of non-overlapping sectors into which the 360-degree compass is divided.

A minimum of one and a maximum of 12 sectors can be specified (i.e., one sector of 360 degrees, up to 12 non-overlapping sectors of 30 degrees). 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 one and 12. The area surrounding the Project Area is undeveloped, desert scrub terrain in all directions. Consequently, surface characteristics were 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 was used for the modeling as recommended by the AERSURFACE user guide. This processing was completed by NDEP and inherent in the pre-processed meteorological data provided by NDEP for use in the model.

J. ADJUST U-STAR PROCESSING

EPA has introduced options into AERMET to allow adjustment of friction velocity for low wind stable conditions. The option, known as "Adjust U*" allows for more accurate assessment of concentrations during low wind and stable atmospheric conditions. The NDEP provided meteorological data included the use of the Adjust U* option in AERMET.

5. BACKGROUND CONCENTRATIONS

To evaluate the potential impacts of emissions from the BRC SRP expansion 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 the BRC SRP expansion, and the result is compared to the NAAQs. The NAAQS are allowable concentration limits applied at the public access boundary.

Only criteria air pollutant impacts were assessed as part of the modeling analysis. The criteria air pollutants which are regulated under Nevada law are carbon monoxide (CO), lead (Pb), sulfur dioxide (SO_2), particulate matter less than or equal in diameter to ten microns (PM_{10}), particulate matter less than or equal in diameter to 2.5 microns ($PM_{2.5}$), ozone (O_3) and nitrogen dioxide (NO_2). Pollutants directly emitted by operations from BRC SRP activities, and evaluated as part of this dispersion modeling analysis, are PM_{10}, $PM_{2.5}$, NO_2, CO and SO_2. O_3 was not analyzed as part of this modeling effort due to the photochemical formation of O_3; atmospheric chemistry and photochemical formation are not able to be modeled in a steady state Gaussian plume model such as AERMOD. Lead emissions from the project are negligible and therefore lead was not included in the dispersion model analysis.

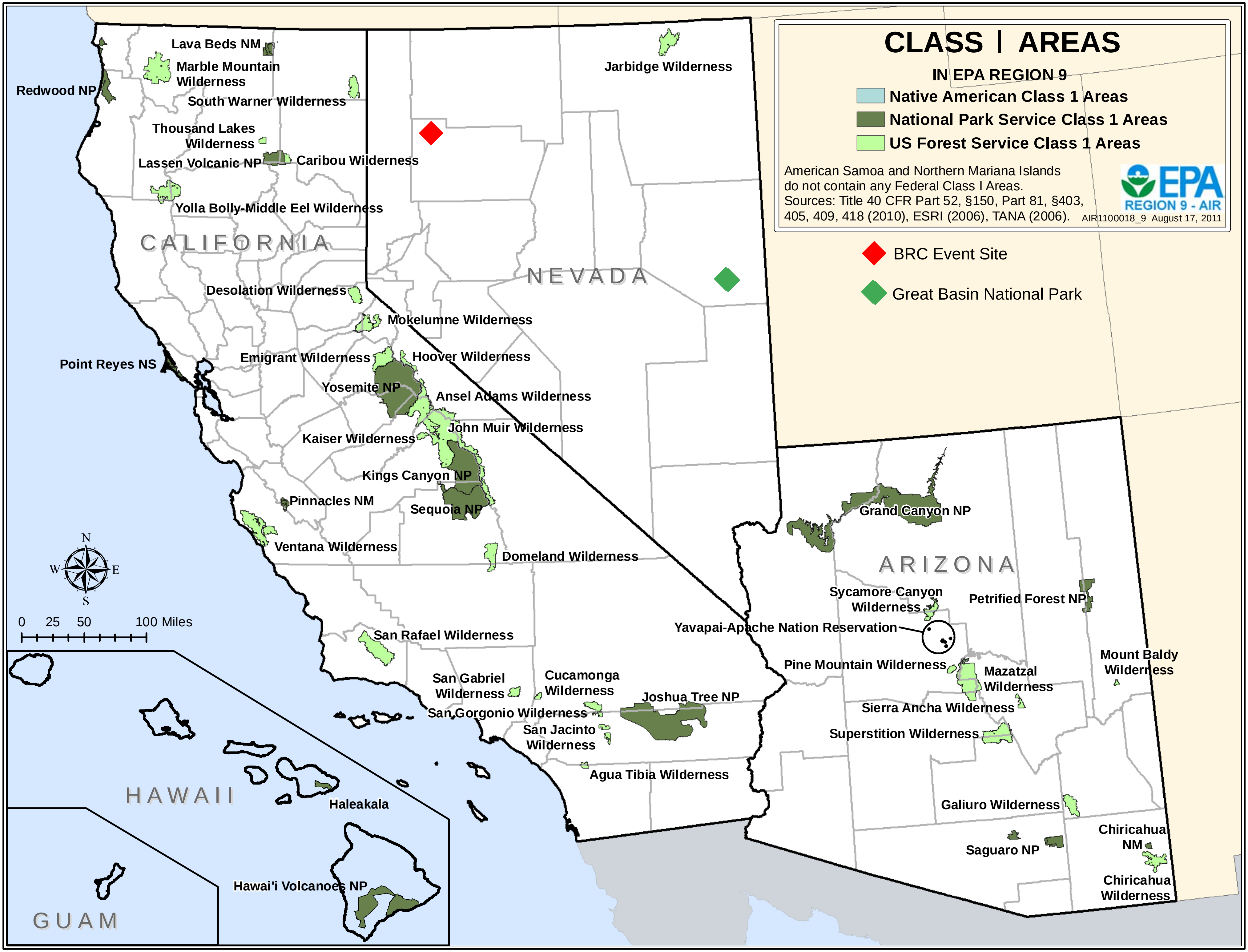
The NBAPC recommended the use of statewide "pristine" background concentrations for state permitting analyses. The background values used for this analysis are tabulated below in **Table 5-1**. The values included in the table were provided by Chung Je, Supervisor, Technical Services Branch at NBAPC. They are further justified for use by an April 17th, 2017 letter from NDEP to the BLM regarding background concentration justification.

Table 5-1. Background Concentration Values to Be Used for the Modeling Analysis

Pollutant	Averaging Period	Background Concentration ($\mu g/m^3$)
$PM_{2.5}$	24-hr	8.0
	Annual	2.3
PM_{10}	24-hr	10.2
	Annual	N/A
SO_2	1-hr	0
	3-hr	0
	24-hr	0
	Annual	0
NO_2	1-hr	0
	Annual	0
CO	1-hr	0
	8-hr	0

Source: Background values provided by NBAPC. PM10 background from monitor in Great Basin National Park; PM2.5 backgrounds from monitor in Jarbidge Wilderness Area.

The background concentrations selected were collected at two Class I areas within Nevada. These areas are considered representative of pristine rural regions throughout the State of Nevada. **Figure 5-1** depicts the location of all Class I areas within EPA Region 9, including the Jarbidge Wilderness Area. Great Basin National Park is not included on EPA's Class I mapping products. As a result, a green diamond has been added at its center on **Figure 5-1**. A red diamond was also added to designate the location of the Burning Man Event. Additional background information on Class I areas within EPA Region 9 can be reviewed using the following link: https://www3.epa.gov/region9/air/maps/r9_clss1.html



CLASS I AREAS
IN EPA REGION 9
Native American Class 1 Areas
National Park Service Class 1 Areas
US Forest Service Class 1 Areas
American Samoa and Northern Mariana Islands do not contain any Federal Class I Areas.
Sources: Title 40 CFR Part 52, §150, Part 81, §403, 405, 409, 418 (2010), ESRI (2006), TANA (2006).
EPA
REGION 9 - AIR
AIR1100018_9 August 17, 2011
BRC Event Site
Great Basin National Park
CALIFORNIA
NEVADA
ARIZONA
HAWAII
GUAM
Lava Beds NM
Marble Mountain Wilderness
Redwood NP
South Warner Wilderness
Thousand Lakes Wilderness
Lassen Volcanic NP
Caribou Wilderness
Yolla Bolly-Middle Eel Wilderness
Jarbidge Wilderness
Desolation Wilderness
Mokelumne Wilderness
Emigrant Wilderness
Hoover Wilderness
Point Reyes NS
Yosemite NP
Ansel Adams Wilderness
John Muir Wilderness
Kaiser Wilderness
Kings Canyon NP
Pinnacles NM
Sequoia NP
Ventana Wilderness
Domeland Wilderness
San Rafael Wilderness
San Gabriel Wilderness
Cucamonga Wilderness
San Gorgonio Wilderness
San Jacinto Wilderness
Joshua Tree NP
Agua Tibia Wilderness
Grand Canyon NP
Sycamore Canyon Wilderness
Petrified Forest NP
Yavapai-Apache Nation Reservation
Pine Mountain Wilderness
Mazatzal Wilderness
Mount Baldy Wilderness
Sierra Ancha Wilderness
Superstition Wilderness
Galiuro Wilderness
Saguaro NP
Chiricahua NM
Chiricahua Wilderness
Haleakala
Hawai'i Volcanoes NP
N
S
E
W
0 25 50 100 Miles

A. OZONE LIMITING METHOD (OLM) FOR EVALUATING NO_2 IMPACTS

The Ozone Limiting method (OLM) was incorporated as a regulatory default in AERMOD in the December 2016 Appendix W updates. 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

Currently, background ozone and NO_2 data does not exist near the Project Area therefore OLM cannot be run with local data. As a result, the initial direct modeling analysis was completed using the default ambient ratio for the one-hour NO_2 impacts.

B. RECEPTOR NETWORK

The full receptor grid for the modeling analysis consists of the following:

- Receptors spaced at 25 meters along the Permit Closure Area Boundary (PCAB)[2] - large pink region in **Figure 1-1**;
- Receptors spaced at 100* meters from the PCAB to one kilometer;
- Receptors spaced at 500* meters from one kilometer to five kilometers; and
- Receptor spaced at 1000 meter from five kilometers to ten kilometers.

* Should maximum impacts occur at the 100 or 500 m grid, and concentrations are close to the NAAQS, an additional modeling run will be conducted using tighter spacing around that concentration in order to ensure that the maximum modeled location is captured.

Due to the significant emissions rates for particulate, initial modeling simulations documented in this report utilized only boundaries at the PCAB at 25-meter spacing. This utilization will allow for impacts testing without significant additional computing time. Model impacts of fugitive sources are strongest at the PCAB therefore modeling impacts are predicted to be consistent with the full receptor modeling.

C. RECEPTOR ELEVATIONS

Receptor elevations were 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 ten meters).

---

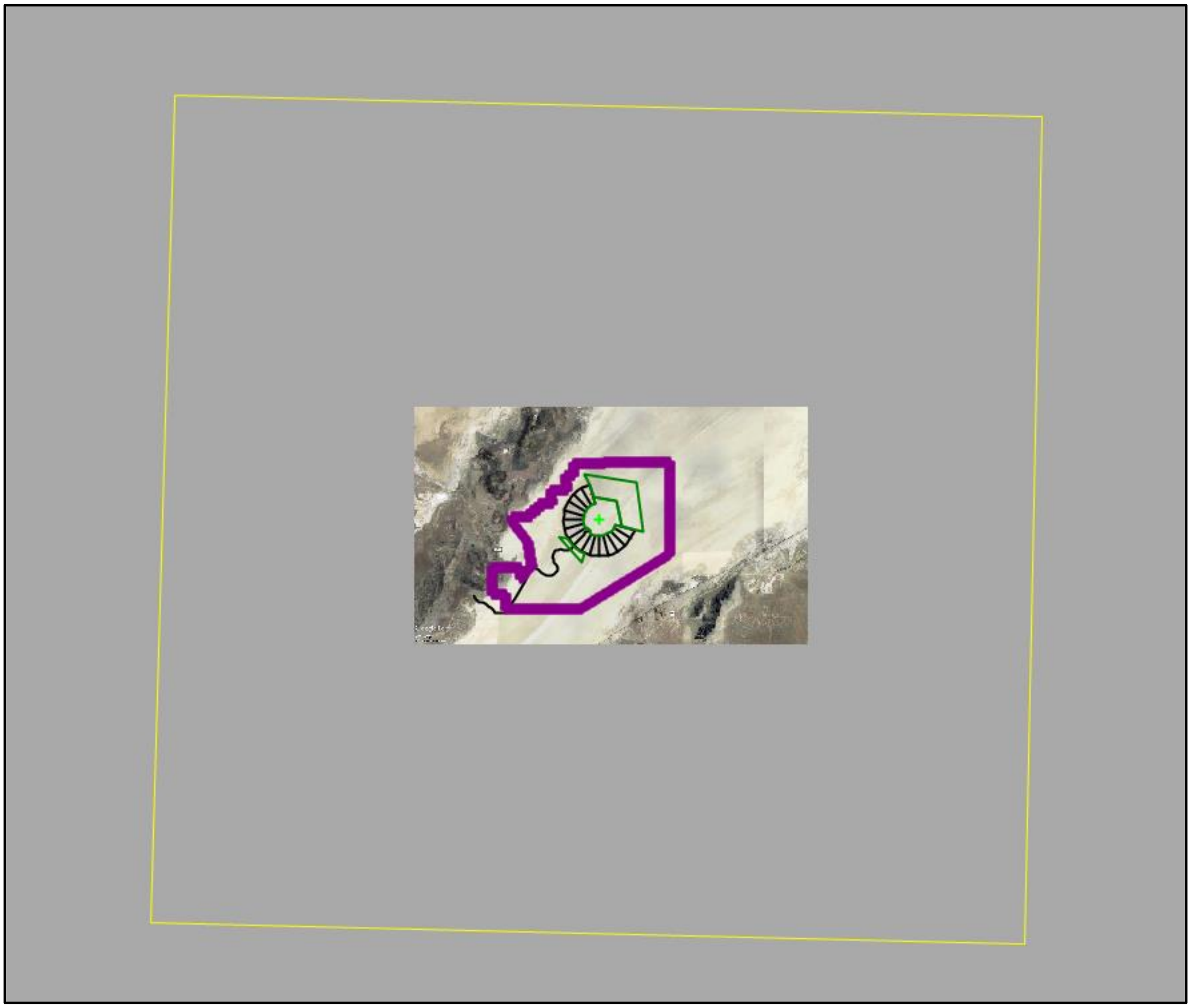
[2] Although the PCAB region changes over time during the closure period and differs by alternative, a constant PCAB was selected for use throughout the modeling. The PCAB selected represents the largest closure area for Alternative A. This is the closure area that would exist at the same time as the maximum event activities and therefore ambient emissions.

The NED data was 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.

D. 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 ten percent slope from each and every receptor. The modeling domain extends a minimum of five kilometers in all directions from the PCAB. The calculated modeling domain was then used to develop a NED file that sufficiently incorporates the geographic area. **Graph 6-1** shows the model source layout; the model domain is shown in yellow, the public closure area is shown in purple outline, the road network is shown in black and disturbed areas are outlined in green. A satellite image overlay in the event region was included for additional reference. This graph represents a direct model output and as such does not include additional formatting.

Graph 6-1 Direct Impacts Modeling Domain and Source Layout



E. PLUME DEPLETION

The Dry Depletion option in AERMOD specifies that dry deposition flux values will be calculated. If this option is selected in AERMOD, 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. Dry plume depletion was utilized in this modeling analysis. Particle size distribution values used are provided in Appendix A; detailed background information on the selected particle size values is included in this report.

F. BUILDING DOWNWASH

Although onsite structures and associated downwash would have some real-world impact, the AERMOD dispersion model does not treat the effects of downwash on surface-based fugitive sources of emissions well. This is particularly true for sources with slow plume rise, due to momentum or buoyancy. Building downwash effects are not likely to influence the total impacts associated with event emissions. As such, building downwash was not evaluated as part of the direct project modeling for BRC onsite structures.

7. BRC DIRECT EMISSIONS MODELED AND SOURCE CHARACTERIZATION

A detailed emissions inventory was generated in keeping with the new and modified sources of ambient emissions associated with the Event expansion and the associated alternatives. All emissions calculations were developed following standard NEPA quantification methodologies and are based on proposed reasonably foreseeable maximum activity rates. An electronic version of the emissions inventory will be provided to BLM for review. All emissions calculations follow EPA and NDEP guidance, where available and utilize the best available information for all calculation inputs. Emissions for criteria pollutants, hazardous air pollutants (HAPs) and greenhouse gasses were calculated (however, only criteria pollutants were modeled). Fugitive dust and tailpipe emissions were approximated for existing event activities as well as each Event expansion alternative. HAPs emissions were quantified; however, a detailed HAPs health risk modeling analysis is not included as part of this assessment. The emissions inventory is based on best estimates of activity rates and locations available throughout the analysis. Additionally, control strategies being implemented were accounted for in the emissions inventory for each modeled alternative. The primary means of emissions control is the watering of roads used by event staff and participants.

Where appropriate, model emissions input data directly match the proposed SRP. For all averaging periods, maximum hourly emission rates from the emission inventory were used to ensure conservatism. This procedure was used for all pollutants modeled and therefore ensures that the maximum and most conservative impact was modeled.

Each source was assumed to emit continuously at the emissions rates and proposed operating hours developed as part of the SRP alternatives analysis. Emission sources were modeled as either point, volume or surface area sources, depending on source characteristics.

A preliminary plan view map depicting the event area layout is presented in **Figure 7-1**.

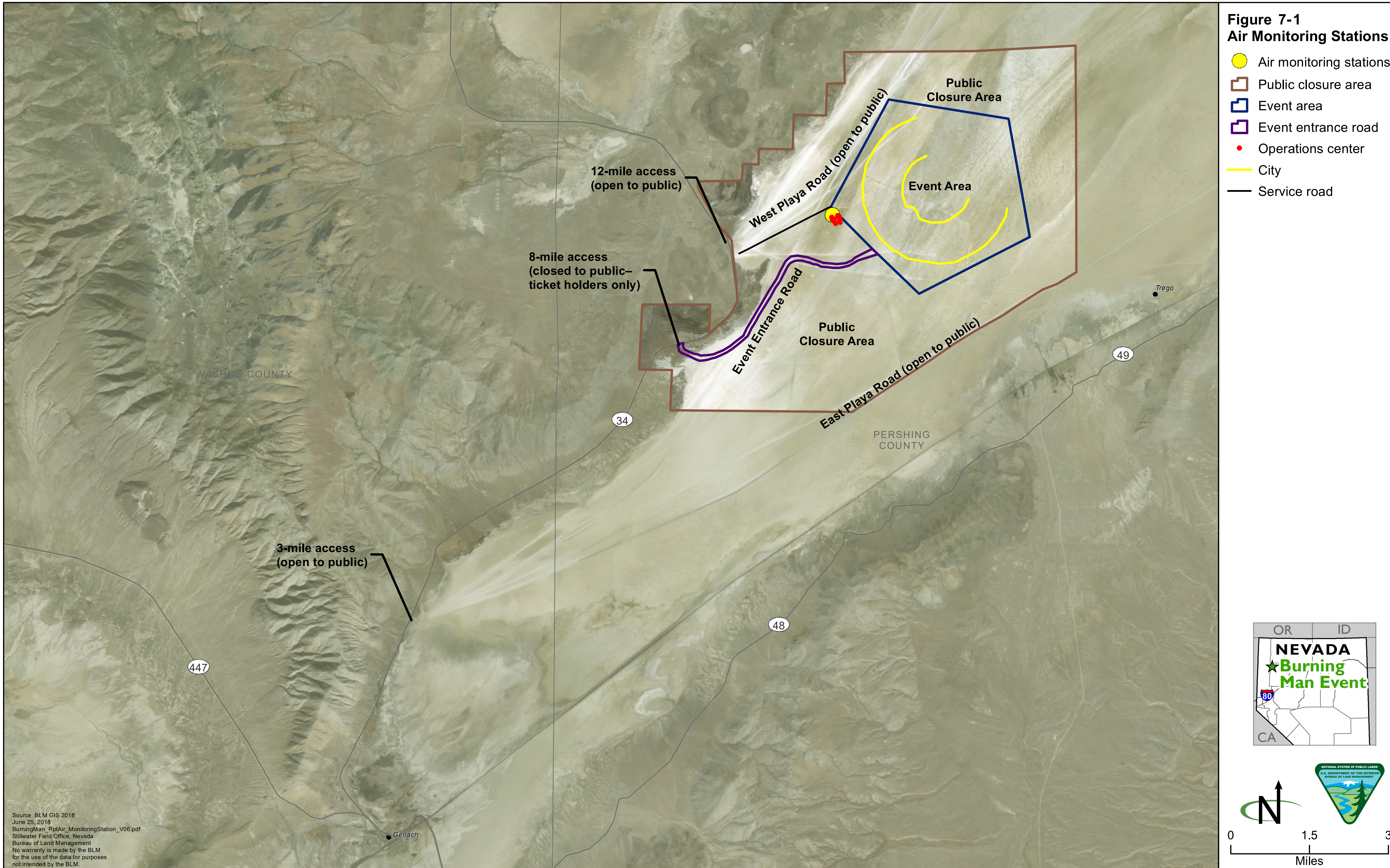


Figure 7-1
Air Monitoring Stations

A. DIRECT IMPACT ALTERNATIVES MODELED

A single modeling simulation was used for each SRP action alternative and separate model runs were performed for each pollutant modeled. Each model run consists of a single pollutant and single operating scenario, however, within each model run, emissions groups were used to assess impacts from each type of source represented in the model run.

Emissions from the BRC SRP expansion will result in expanded event logistical construction emissions and event activity emissions. All sources of emissions were modeled in this analysis.

7.A.1. Annual Criteria Pollutant Emissions Modeling

Annual impacts of particulate and gaseous emissions are based upon emissions calculated using the total event long throughput/process rates during the event closure period for each alternative. Specifically, emissions were based on total event participation rates including approved event participation, disturbance acreage and vehicle passes and mileage. The total usage rates were used to calculate total emissions for the Event in annual tonnage per pollutant. These annual ton per year values were then used to model annual pollutant emissions impacts for those criteria pollutants that have a defined annual NAAQS.

The annual emissions were modeled based on an average hourly concentration for all hours of the year. This is equivalent to total tons per year divided by 8760 hours per year. This likely under predicts the impacts on a daily basis but allows the annual average concentration impacts to take into account the variability of conditions included in the five-year meteorological dataset.

7.A.2. Short-Term Criteria Pollutant Emissions Modeling

Short-term impacts (one hour and 24-hour) are based upon the emissions calculated using the average daily event rates for the period of both the event closure and the active event. Specifically, the following methodologies for assessing the total short-term event impacts were used in the analysis.

For the impacts associated with disturbed playa wind erosion, total windblown dust emissions calculated for the active disturbance acreage of the Event were converted to an average pound per hour emission rate by dividing the total event long windblown dust emissions by the number of hours that occur during the event closure period. This is also the period used to determine the average number of hours when wind speeds may result in windblown dust (further described in Section B below). For the modeling, a total event closure period of 1,536 hours was utilized; this represents the total number of hours from July 29, 12:01am to October 1, 12:01am. The total potential windblown dust emission in tons per year was divided by this number to determine the short-term model emission rates. Short term emissions rates for other event sources, including stationary combustion (generators) and motor vehicle emissions (both tailpipe emissions and fugitive dust from travel on unpaved roads) were calculated using the active event period, as this represents the most likely period that the maximum impacts from these activities will occur. Total event long emissions for combustion and vehicle use were calculated based on activities rates for each alternative (vehicle passes and road lengths are the main determinants). The total event long emissions were then divided by 210 hours to calculate the short-term pound per hour emissions rates. The period used to calculate the 210-hour value is the active event time frame from 12:01am on Sunday the weekend before Labor Day until 6pm on Labor Day.

A general description of each source type used in the model is presented below.

B. AREA POLYGON SOURCES

Windblown dust emissions represent one of the most significant emission impacts associated with the Burning Man Event. In order to assess windblown dust emissions, Trinity followed a methodology of emissions calculation used by the NDEP in assessing windblown dust emissions over large regions in Southern NV.

The NDEP released a report in June of 2015, (NDEP 2015) that detailed the successes of controlling regional scale PM_{10} emissions in Pahrump, NV. Within that report, NDEP provided details on the calculation methodologies used by the agency to determine PM_{10} emissions for parcels of vacant disturbed land. The methodology relied on calculating the number of hours when winds exceed defined thresholds and defined emissions factors based on wind speed brackets above each threshold. Trinity utilized this emissions calculation methodology for the Burning Man Event. Specifically, Trinity used the following:

- Emissions of windblown dust were calculated utilizing the acreage of actively disturbed yet vacant land within the event closure area. This represents the area where vehicles enter and leave the event site (but not the area where vehicles park or camps are erected), the area of active participant travel (inside the semicircle of the city) and the region of the playa between the city and the man and temple structures.
- Wind data from the Lovelock NWS site (the same dataset used for the modeling) was used to determine the average annual occurrence of wind speeds above four critical thresholds, 20mph, 25mph, 30mph and 35mph. The percent occurrence was then multiplied by the number of hours in the event closure period (1536 hours) to determine the average number of hours during the event closure that winds would occur in each wind speed bracket.
- The number of hours in each wind speed bracket, the disturbed-vacant acreage and the NDEP provided emissions factors for each wind speed bracket (NDEP 2015) were then used to calculate the total windblown particulate emissions for the event period. The PM_{10} emissions rates were further size speciated utilizing a ratio found in EPA's AP-42 emission factor guidance document to generate $PM_{2.5}$ and TSP emission rates.

Fugitive emissions due to wind erosion from the disturbed event region are represented by area polygon sources within AERMOD. Release height and initial vertical dimensions for the area poly sources were developed utilizing onsite photos of the 2017 Burning Man Event. During periods of active participant movement, the surface turbulent mixed layer (as observed by active dust/visual obscuration) was approximated at 5 meters. As a result, the initial vertical dimension for the surface-based wind erosion emissions was set equal to this observed value. Additional onsite observation noted that initial active windblown dust emissions occurred at or below the average height of participants when walking or riding bicycles. As a result, a release height that is approximately the same as the average height of participants (1.5m) was used in the modeling. These values are consistent with onsite observation while remaining conservative relative to AERMOD's treatment of surface fugitive sources.

C. VOLUME SOURCES

Emissions associated with vehicle travel on native playa soil generate significant emissions from both fuel combustion and fugitive dust from the unpaved surfaces. These emissions are directly related to the number of vehicles approved for entry into the event. The number of vehicle passes that will be issued was used in determining the number of vehicles and resultant emissions for each action alternative (34,000 passes for the 2020 Alternative A Proposed Action, 17,000 passes for Alternative B Reduced Population and 33,000 passes for Alternative D No Population Change). Based on the total number of vehicle passes, the average number of gasoline and diesel vehicles was approximated utilizing a ratio of two thirds gasoline vehicles and one third diesel vehicles. This approximation was developed using onsite observations of participant vehicles during the 2017 Burning Man Event. Vehicle emissions were calculated based on the average travel distance of both gasoline and diesel vehicles once they enter the Black Rock Playa. Emissions were calculated separately for the access road, also known as Gate Road (from County Road 34 to the entrance to Black Rock City), and the road network internal to the Black Rock City. Average travel distances were based on satellite images of the 2017 city/access layout. The access road distance was based on direct measurement of the 2017 access road and the internal road travel distance was based on the average distance from the city entrance to the closest and farthest camp locations based on the 2017 city layout (average of 1.57 miles).

Total vehicle emissions were based on a single round trip along both the access and internal road distance for each gasoline and diesel-powered vehicle. Total vehicle emissions include both the tailpipe combustions emissions and the unpaved road dust emissions. Emissions for tailpipe combustion utilize emissions factors from the EPA's MOVES/Mobile 6 emissions model while the emissions associated with the unpaved roads utilize the methodology detailed in EPA's AP-42 13.2.2 Equation 1a and Table 13.2.2-2.

The unpaved road portion of the emissions requires assumptions associated with vehicle weight and road silt content. For gasoline vehicles, an average vehicle weight of 2.5 tons was used based on a mid-sized Sport Utility Vehicle. For diesel vehicles, an average weight of 10 tons was used based on an average of large diesel passenger trucks (1-ton class), Class A and Class C recreational vehicles. For both vehicle types a road silt content of 8.5% was used. This is based on a listed silt content from AP-42 13.2.2-1 for "Scraper Travel on Construction Site". This activity represents a similar mechanical disturbance to the travel of vehicles on disturbed crustal playa material.

Volume sources were utilized to model event road and fugitive particulate emissions sources. Volume source parameters were developed by Trinity, in consultation with BRC regarding the types and size of vehicles observed at the Event. Trinity calculated volume source parameters in accordance with EPA's Haul Road Workgroup Final Report Submission to EPA-OAQPS (EPA, 2012) guidance and the AERMOD user's guide as follows:

- Top of Plume Height – 2 x Vehicle Height (VH)
- Volume Source Release Height – 0.5 x Top of Plume Height
- Width of Plume – Vehicle Width (VW) + 6m for single lane roadways
- Initial Sigma Z – Top of Plume/2.15
- Initial Sigma Y – Width of Plume/2.15

A description of the various volume sources and modeling methodologies used are described below.

7.C.1. Access Road Sources

A refined access road network was developed which follows the unpaved access road route from County Road 34 to the entrance to Black Rock City. The emissions were modeled as volume sources in the model, using the release parameters as described above. A single vehicle type, a typical Class C RV, was used to determine dimensions on which the volume source parameters were based. This vehicle type was chosen to represent the average between mid-size passenger vehicles and larger Class A type motorhomes. The dimensions of a typical Class C RV are as follows: 299 inches long x 99 inches wide by 133 inches tall.

Emissions allocated to each volume source include both unpaved road fugitive dust emissions as well as gasoline and diesel combustion emissions. The fugitive dust emissions are based on the access road length, number of vehicle passes issued, average vehicle weight and road silt content. Fuel combustion emissions are based on the vehicle miles travelled (VMT) and emission factors from the Mobile 6 program. Total emissions for all vehicles were divided by the total number of volume sources representing the access road length and allocated to each individual volume source.

Access road particulate emissions utilize dry plume depletion, as outlined in Section 6; all road emissions were modeled using the particle size distribution shown in Table A.1 of Appendix A.

7.C.2. Internal Road Sources

A refined internal road network was developed which is based on the routes from the entrance of Black Rock City to each road segment that traverses the distance from the outer section of the camping area to the inner section of the camping area. The emissions were modeled as volume sources in the model, using the release parameters as described above. As with the access road sources, a single vehicle type, a typical Class C RV, was used to determine dimensions on which the volume source parameters were based.

Emissions allocated to each volume source include both unpaved road fugitive dust emissions as well as gasoline and diesel combustion emissions. The fugitive dust emissions were based on the average of the distance from the entrance to Black Rock City to the farthest camping area and the distance from the entrance to Black Rock City to the closest camping area to the entrance, number of vehicle passes issued, average vehicle weight and road silt content. Fuel combustion emissions were based on the VMT and emission factors from the Mobile 6 program. Total emissions for all vehicles were divided by the total number of volume sources representing the internal road network and allocated to each individual volume source.

Internal road network particulate emissions utilize dry plume depletion, as outlined in Section 6; all road emissions were modeled using the particle size distribution shown in Table A.1 of Appendix A.

D. POINT SOURCE - COMBUSTION

It is anticipated that small gasoline portable generators (3kW) and larger diesel-powered generators (10kW) associated with RV/camper vehicles will be used during the event. These generators were represented in the model as point sources and were placed at various locations within the camping area, with two gasoline generators and two diesel generators in each 'segment' bounded by an internal road. Emissions associated with the generators were calculated using emission factors from Table 3.3-1 of AP-42 for gasoline engines and diesel emission factors from EPA Tier 1-3 Nonroad Diesel Engine Emission Standards (SO2 and TOC EF from AP-42 Table 3.3-1). Exhaust parameters for all generators were based on information presented in NIST Technical Note 1666 (Wang et al, 2010) as follows: exhaust diameter – 2 inches; exhaust temperature 288^{0}C; exhaust velocity – 7 m/s; and release height – 0.5 meters above ground level.

8. EVALUATION OF BRC DIRECT IMPACT DISPERSION MODELING RESULTS

The maximum modeled concentration at the PCAB and the ambient background concentration (provided by NDEP) are presented in **Table 8-1** below. As previously described, explicit modeled impacts were calculated for Alternative A – Proposed Action, Alternative B – Reduced Population and Alternative D – No Population Change Alternative. Emissions impacts for Alternative C – Alternate Site Alternative would be consistent with the Proposed Action as the activity rates are maintained and the setbacks to the PCAB are consistent. The assessment of dispersion for Alternative E **-** No Permit Alternative could not be assessed as the location and activity rates cannot be explicitly identified. The impacts associated with Alternative D would represent a likely worst case for the first year of the No Permit Alternative.

Modeled emissions impacts track in a roughly linear manner with event population and approved vehicle passes. The modeled impacts for each action alternative indicate that the NAAQS could be exceeded for atmospheric particulates (PM_{10} and $PM_{2.5}$) for the short term (24-hr) standards. The NAAQS for NO_x, SO_2 and CO as well as the annual NAAQS standards for PM_{10} and $PM_{2.5}$ are unlikely to be exceeded as a result of the BRC event emissions although these impacts also rise and fall with population and vehicle passes.

Maximum emissions occur along the event closure boundary; as a result, the impacts listed in the EIS represent the impacts along that boundary. Impacts decrease in a roughly linear fashion as distance from the event closure boundary increases.

For the atmospheric particulate emissions (PM_{10} and $PM_{2.5}$), the modeled emissions impacts considerably exceed the NAAQS standards (over 10x for PM_{10}) and represent a potentially significant negative health impact on the general public at the PCAB. Additionally, the modeled results at the closure boundary are theoretically consistent with the magnitude of the ambient particulates monitored during the 2017 event inside of the PCAB. Modeled NAAQS compliance and non-compliance are color coded as green for compliance and red for non-compliance in **Table 8-1** below.

Final modeled emissions inventories, model source parameters and model input and output files are included electronically in Appendix B for review.

Table 8-1 AERMOD Maximum Model Impacts at Closure Boundary – Direct BRC Impacts

Maximum Design Value Modeled Impacts at Closure Boundary							
	Proposed Action		Alternative 1 - Reduced Population		Alternative 3 - No Action		
Pollutant	Modeled Impact[a]	Total Impacts (Including Background) [a]	Modeled Impact[a]	Total Impacts (Including Background) [a]	Modeled Impact[a]	Total Impacts (Including Background) [a]	NAAQS[a]
PM10 24Hr[c,i]	1581.91	1592.11	790.79	800.99	1532.18	1542.38	150
PM2.5 24Hr[b,g]	126.95	134.95	63.61	71.61	122.82	130.82	35
PM2.5 Annual[b,h]	6.32	8.62	3.16	5.46	5.07	7.37	12
NO2 1Hr[d,g]	76.27	76.27	39.22	39.22	74.22	74.22	188
NO2 Annual[d]	0.13	0.13	0.07	0.07	0.13	0.13	100
SO2 1Hr[e,j]	1.31	1.31	0.66	0.66	1.27	1.27	196
SO2 3 Hr[e,k]	0.72	0.72	0.36	0.36	0.70	0.70	1,300
CO 8Hr[f,k]	178.87	178.87	89.44	89.44	173.12	173.12	10,000
CO 1Hr[f,k]	540.67	540.67	270.34	270.34	523.29	523.29	40,000

a. Micrograms/cubic meter

b. Particulate matter with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers.

c. Particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers.

d. Nitrogen dioxide.

e. Sulfur dioxide.

f. Carbon Monoxide.

g. Maximum of 5-year means (or a lesser averaging period if less than 5 years of meteorological data were used in the analyses) of 8th highest modeled concentrations for each year modeled.

h. Maximum of 5-year means (or a lesser averaging period if less than 5 years of meteorological data were used in the analyses) of maximum modeled concentrations for each year modeled.

i. Maximum of 6th highest modeled concentrations for a 5-year period (or the maximum of the 2nd highest modeled concentrations if only 1 year of meteorological data are modeled).

j. Maximum of 5-year means (or a lesser averaging period if less than 5 years of meteorological data were used in the analyses) of 4th highest modeled concentrations for each year modeled.

k. Maximum of 2nd highest modeled concentrations for each year modeled.

A. HYCROFT MODEL SOURCES

In May 2018, Hycroft performed cumulative impacts modeling (cumulative modeling) for the Hycroft Phase II Expansion EIS (Project), per a request from the BLM. The cumulative modeling included all permitted sources within 50 kilometers (km) of the Hycroft Mine. All Hycroft sources described in the 2017 Air Quality Impact Analysis (AQIA) modeling report for the Project were included in the cumulative effects evaluation.

The cumulative modeling files referenced above were provided to Trinity by BLM. Trinity directly incorporated the Hycroft dispersion model sources and relevant model components into the Burning Man cumulative modeling files. The items incorporated included all Hycroft, point, volume, and areas sources of emissions, emissions source parameters and all Hycroft onsite buildings. These items were added to the existing Burning Man model files to generate the Burning Man cumulative modeling files. The AERMOD model was then re-executed to assess the cumulative impacts from the Hycroft Mine and the Burning Man ambient impacts. Only direct Hycroft model sources were included in the cumulative impact analysis. All other "cumulative" model sources from the Hycroft modeling analysis exist outside of the BRC air resource study area and were therefore not included in the BRC cumulative modeling analysis.

B. IMPACT ALTERNATIVES MODELED

Just as with the direct project impact assessment, a single modeling simulation was used for each SRP action alternative, and separate model runs were performed for each pollutant modeled. Each model run consists of a single pollutant and single operating scenario, however, within each model run, emissions groups were used to assess impacts from each type of source represented in the model run. All sources of emissions from the SRP expansion and the Hycroft Mine were modeled concurrently in this analysis.

C. EVALUATING NO_2 IMPACTS

The initial Burning Man modeling analysis was completed using the default ambient ratio for the one-hour NO_2 impacts.

For the Hycroft model, modeling of the NO_2 1-hour averaging period was completed using EPA's Tier 3 method with the Plume Volume Molar Ratio Method (PVMRM). In order to ensure consistency with the Hycroft modeling, the cumulative impacts assessment was executed utilizing the PVMRM option. In order to utilize PVMRM, values for background ozone concentrations and in-stack and atmospheric equilibrium ratios of NO_2 to NO_x must be defined. For the cumulative modeling assessment, the methods for defining these values were designed to be consistent with the Hycroft modeling and are described below.

A single background concentration for ozone was entered using the value found on the EPA Airtrends website using monitoring data from Fallon, Nevada. Data was collected from the monitoring station in Fallon, Nevada from 2005 through 2013. The average concentration of ozone over this time was used in the modeling analysis.

The EPA default ambient NO_2/NO_x equilibrium ratio was utilized. Realistic NO_2/Nitrogen Oxide in-stack ratios (ISRs) were adjusted from the default 0.5 for all generators and/or engines. Numerous EPA and other state air quality permitting agencies allow for a ratio lower for engines/boilers etc. As an example, the EPA's ISR Database provides test results from uncontrolled natural gas engines with values of 0.1 to 0.2. Diesel test data is even lower in some cases. An average representative in-stack value for natural gas, propane and diesel fuel were applied for all applicable units modeled per the USEPA ISR Database. ISR values were not revised for Hycroft emissions sources.

D. RECEPTOR NETWORK

The previous modeling analyses conducted for the Burning Man project showed that maximum impacts occurred along the PCAB. As such, consistent with the previous analysis, receptors were spaced at 25 meters along the Burning Man PCAB. The following represents the receptors that surround the Burning Man Event Site.

- Receptors spaced at 25 meters along the PCAB;
- Receptors spaced at 1000 meters from the Burning Man Event Site center to approximately five kilometers; and;
- Receptors spaced at 2000 meters extending from approximately five kilometers from the Burning Man Event Site center to approximately 20 kilometers from the Burning Man Event Site center.

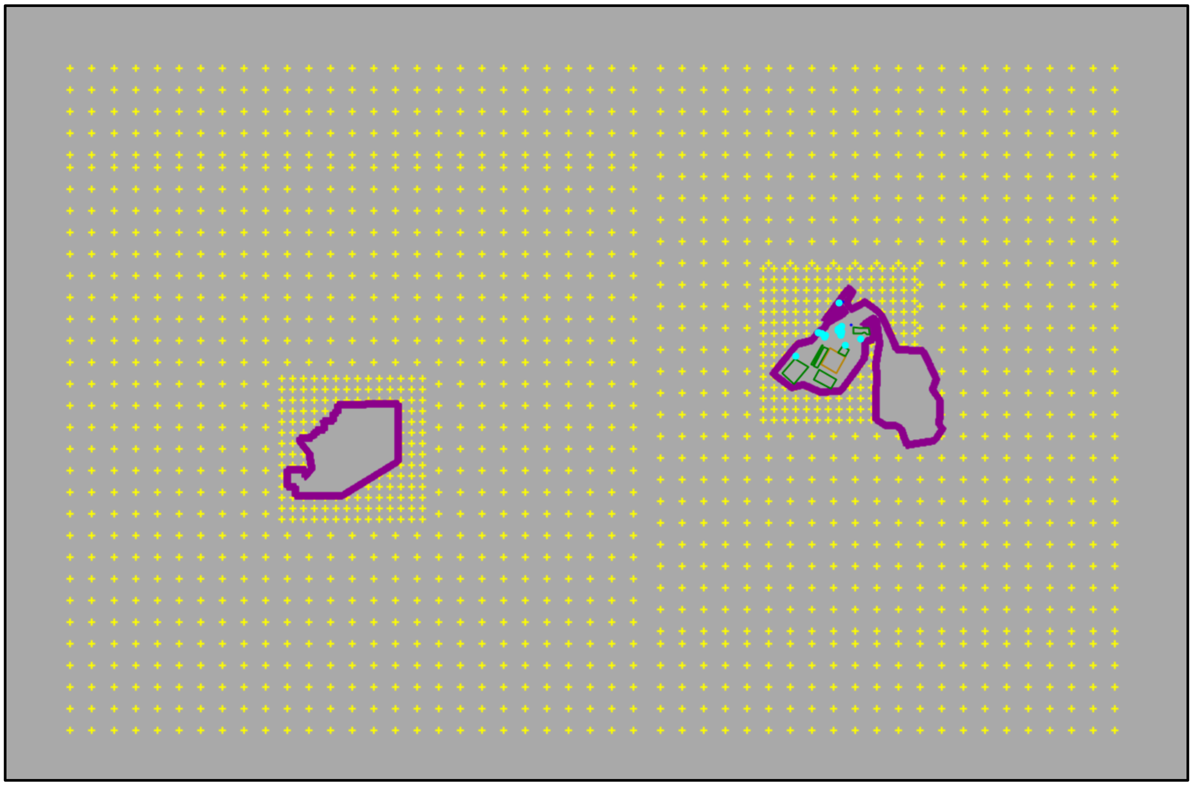
A similar receptor grid was used surrounding the Hycroft ambient air boundary. The Hycroft receptor grid consists of the following:

- Receptors spaced at 25 meters along the Hycroft ambient air boundary;
- Receptors spaced at 1000 meters from the Hycroft facility process area center to approximately five kilometers; and
- Receptors spaced at 2000 meters extending from approximately five kilometers from the Hycroft facility process area center to approximately 20 kilometers from the Hycroft facility center.

This receptor spacing results in an 'overlap' of the 2000-meter grid between the Burning Man Event Site and the Hycroft facility. In order to prevent interfering impact contours, these overlapping receptors were deleted from the grid that extends from the Hycroft facility.

In addition, to provide a complete rectangular grid layout for the 2000-meter grid, additional receptors were added to the north and west of the Burning Man and Hycroft grids, respectively and to the south and east of the Hycroft and Burning Man grids, respectively. The final combined cumulative modeling receptor layout is shown in **Graph 9-1** below. The purple boundary receptors indicate the limitation to public access for both the Hycroft facility and the Burning Man PCAB. This graph represents a direct model output and as such does not include additional figure formatting.

Graph 9-1. Cumulative Modeling Receptor Grid



E. RECEPTOR ELEVATIONS

For the original Burning Man modeling analysis, receptor elevations were 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 ten meters). The NED data were obtained from the Multi-Resolution Land Characteristics Consortium (MRLC). However, since the time that the original modeling was conducted the MRLC website has been reconfigured and the download tool has not yet been made available on the new website (website indicates "Download tool coming soon"). However, the United States Geological Survey (USGS) Landfire Data Distribution website provides 30 m (1-arc second) data available for download. For the Burning Man cumulative modeling analysis, receptor elevations were determined utilizing this 1 arc second dataset.

The 1 arc second NED data were 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.

F. 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 ten percent slope from each and every receptor. The modeling domain extends five kilometers in all directions from the farthest cumulative impact model receptor. The calculated modeling domain was then used to develop a NED file that sufficiently incorporates the geographic area.

G. PLUME DEPLETION

The Dry Depletion option in AERMOD specifies that dry deposition flux values will be calculated. If this option is selected in AERMOD, 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. Dry plume depletion was utilized in the Burning Man direct impacts modeling analysis.

The Hycroft modeling did not include the dry depletion option; however, to be consistent with the original Burning Man modeling methodology, Dry Depletion was employed for all sources in the Burning Man cumulative modeling analysis. A single particle size distribution was used for all sources in the original Burning Man modeling analysis; the same methodology was used for the cumulative modeling, and the same single particle size distribution was applied to the Hycroft sources. The particle size distribution is shown in Table A.1 of Appendix A.

H. BUILDING DOWNWASH

As described in Section 6, building downwash effects are not likely to influence the impacts associated with the Burning Man Event emissions. As such, consistent with the previous modeling, buildings located within the Burning Man PAB were not included as part of the project modeling.

The Hycroft model setup described in the 2017 Air Quality Impact Analysis (AQIA) modeling report includes on-site buildings, and therefore, the Prime building downwash algorithm was applied for the Hycroft facility to account for downwash effects from on-site structures. This was designed for consistency with the Hycroft AQIA.

10. EVALUATION OF CUMULATIVE IMPACT DISPERSION MODELING RESULTS

The maximum modeled concentration and the total combined impact including the ambient background concentrations (provided by NDEP) are presented in **Table 10-1** below. As previously described, cumulative modeled impacts were calculated for Alternative A – the Proposed Action, Alternative B – Reduced Population Alternative, and Alternative D – No Population Change Alternative. Consistent with the direct modeling analysis, impacts for Alternative C – Alternative Site Alternative were not modeled. The assessment of dispersion for Alternative E - No Permit/Action Alternative could not be assessed as the location and activity rates cannot be explicitly identified. The impacts associated with Alternative E would represent a likely worst case for the first year of the No Permit/Action Alternative.

Direct BRC impacts continue to track in a roughly linear manner with event population and approved vehicle passes. The cumulative modeled impacts for each action alternative indicate that the NAAQS could be exceeded for atmospheric particulates (PM_{10} and $PM_{2.5}$) for the short term (24-hr) standards. The NAAQS for NO_x, SO_2 and CO as well as the annual NAAQS standards for PM_{10} and $PM_{2.5}$ are unlikely to be exceeded as a result of the BRC event emissions although these impacts also rise and fall with population and vehicle passes. The Hycroft cumulative impacts modeling report indicate some very limited additional emissions impacts in the eastern half of the Black Rock Desert and in the region immediately surrounding the Hycroft mine. However, the direct emissions impact from Burning Man event continue to dominate the NAAQS compliance in the analysis and Maximum impacts in the cumulative modeling continue to occur at the SRP PCAB.

As with the direct impacts modeling, the cumulative modeling continues to indicate modeled emissions impacts that considerably exceed the NAAQS standards for the atmospheric particulate species (PM_{10} and $PM_{2.5}$). The influence of the Hycroft sources do not significantly influence the maximum concentrations but they do increase the modeled impacts, particularly in the region immediately surrounding their facility.

Cumulative modeled NAAQS compliance and non-compliance are color coded as green for compliance and red for non-compliance in **Table 10-1** below. All impacts listed were assessed at modeling receptors along the SRP PCAB and the inclusion of the Hycroft sources increased impacts less than 2.5 Micrograms/cubic meter for all pollutants with most averaging standards being impacted less than 0.1 Micrograms/cubic meter. Ambient concentration impacts for the NO_x NAAQS decreased as part of the cumulative analysis because of the introduction of PVMRM modeling methods that were not included in the direct impact modeling. The cumulative modeling did not change the compliance or non-compliance with the NAAQS for any pollutant or averaging period.

Final direct and cumulative modeled emissions inventories, model source parameters and model input and output files are included electronically in Appendix B for review.

Table 10-1 AERMOD Maximum Model Impacts – Cumulative Modeling

	Maximum Design Value Modeled Impacts						
	Alternative A- Proposed Action		Alternative B - Reduced Population		Alternative D - No Population Change		
Pollutant	**Modeled Impact[a]**	**Total Impacts (Including Background) [a]**	**Modeled Impact[a]**	**Total Impacts (Including Background) [a]**	**Modeled Impact[a]**	**Total Impacts (Including Background) [a]**	**NAAQS[a]**
PM10 24Hr[c,i]	1581.97	1592.17	790.99	801.19	1532.24	1542.44	150
PM2.5 24Hr[b,g]	126.97	134.97	63.62	71.62	122.93	130.93	35
PM2.5 Annual[b,h]	8.45	10.8	4.23	6.53	7.37	9.67	12
NO2 1Hr[d,g]	58.84	58.84	29.42	29.42	57.26	57.26	188
NO2 Annual[d]	0.14	0.14	0.07	0.07	0.14	0.14	100
SO2 1Hr[e,j]	1.31	1.31	0.66	0.66	1.27	1.27	196
SO2 3 Hr[e,k]	0.72	0.72	0.36	0.36	0.70	0.70	1,300
CO 8Hr[f,k]	178.87	178.87	89.44	89.44	173.12	173.12	10,000
CO 1Hr[f,k]	540.68	540.68	270.34	270.34	523.30	523.30	40,000

a. Micrograms/cubic meter

b. Particulate matter with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers.

c. Particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers.

d. Nitrogen dioxide.

e. Sulfur dioxide.

f. Carbon Monoxide.

g. Maximum of 5-year means (or a lesser averaging period if less than 5 years of meteorological data were used in the analyses) of 8th highest modeled concentrations for each year modeled.

h. Maximum of 5-year means (or a lesser averaging period if less than 5 years of meteorological data were used in the analyses) of maximum modeled concentrations for each year modeled.

i. Maximum of 6th highest modeled concentrations for a 5-year period (or the maximum of the 2nd highest modeled concentrations if only 1 year of meteorological data are modeled).

j. Maximum of 5-year means (or a lesser averaging period if less than 5 years of meteorological data were used in the analyses) of 4th highest modeled concentrations for each year modeled.

k. Maximum of 2nd highest modeled concentrations for each year modeled.

11. REFERENCES

Environmental Protection Agency (EPA). (January 2017). *Guideline on Air Quality Models (Guidelines, 40 CFR Part 51, Appendix W)*. Retrieved from https://www3.epa.gov/ttn/scram/guidance/guide/appw_17.pdf.

EPA. (February 2000) *Meteorological Monitoring Guidance for Regulatory Modeling Applications EPA-454/R-99-005.* Retrieved from https://www3.epa.gov/scram001/guidance/met/mmgrma.pdf.

EPA. (September 2017). Nonattainment Areas for Criteria Pollutants (Green Book). Retrieved from https://www.epa.gov/green-book.

EPA. Technology Transfer Network (TTN) Support Center for Regulatory Atmospheric Modeling (SCRAM) Website. Retrieved from http://www.epa.gov/ttn/scram/.

National Oceanic and Atmospheric Administration (NOAA), National Climatic Data Center (NCDC). *Divisional Northwestern Nevada Climate Data.* Retrieved from http://www7.ncdc.noaa.gov/CDO/CDODivisionalSelect.jsp#.

Nevada Division of Environmental Protection (NDEP) Bureau of Air Pollution Control (BAPC). (September 2008). *General Air Dispersion Modeling Guidelines.* Retrieved from https://ndep.nv.gov/uploads/air-permitting-docs/general-air-modeling-guidelines.pdf.

NDEP BAPC. (September 2017). *PM_{10} background from monitor in Great Basin National Park and PM2.5 background from monitor in Jarbidge Wilderness Area.* Provided via email from Andrew Tucker, NDEP BAPC to Trinity Consultants.

United States Government Publishing Office, Electronic Code of Federal Regulations. T*itle 40, Chapter I, Subpart C, Part 50 – National Primary and Secondary Ambient Air Quality Standards.* Retrieved from https://www.ecfr.gov/cgi-bin/text-idx?tpl=/ecfrbrowse/Title40/40cfr50_main_02.tpl.

NIST Technical Note 1666 (July 2010) - Modeling the Effects of Outdoor Gasoline Powered Generator Use on Indoor Carbon Monoxide Exposures – Phase II, Liangzhu (Leon) Wang, Steven J Emmerich, Ryan Powell

Nevada Division of Environmental Protection (NDEP) Bureau of Air Pollution Control (BAPC) (June 2015) Pahrump Valley, Nevada PM10 Ten Year of Success – Ten Year Update Toward Attaining the 24-hour Federal Standard for Particulate Matter 10 Microns and Smaller.

https://ndep.nv.gov/uploads/air-aqm-docs/2015-pahrump-success-report.pdf

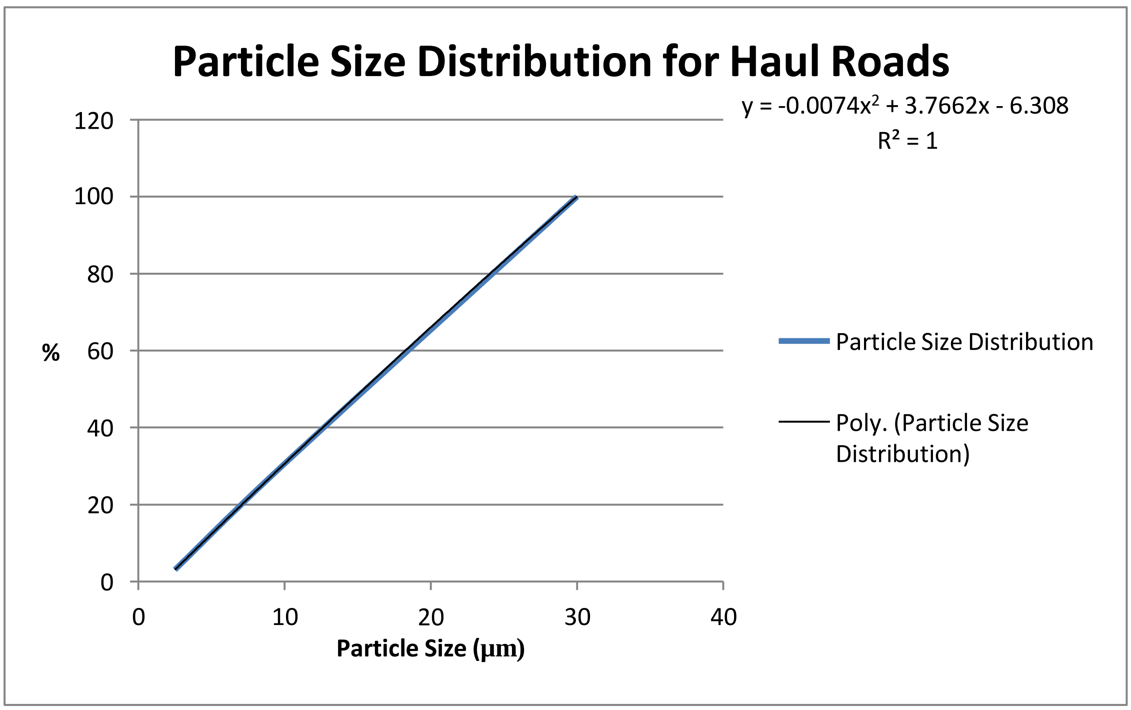
A.1 Particle Size Distributions

The following section describe the methodology used to estimate the particle size distributions for various emission sources. These values will be utilized only if dry plume depletion is determined to be necessary for the modeling of particulate emissions.

A.1.1 Fugitive Dust and Vehicle Emissions

Table 13.2.2-2 from Section 13.2.2 of AP 42 lists particle size multipliers (k-factors) for emissions from unpaved roads. These k-factors were used to determine the distribution of emissions for particles with nominal diameters less than 30, 10 and 2.5 µm. **Graph A-1** shows the distribution of the ratio of each k-factor ($PM_{2.5}$, PM_{10} and PM_{30}) to the PM_{30} k-factor

Appendix Graph A-1. Average size distribution for airborne dust generated by haul trucks for entire study period.



A second-degree polynomial equation was used to fit the data and determine particle size distributions for use with fugitive dust and road emissions for BRC's SRP expansion. **Table A-1** shows the calculated particle size distribution that will be used for haul road emissions.

Appendix Table A-1. Particle Size Distribution – Haul Road Emissions

Diameter (microns)	Mass Fraction	Density (g/cm^3)
2.2	0.069	2.44
3.17	0.128	2.44
6.1	0.385	2.44
7.82	0.224	2.44
9.32	0.194	2.44

APPENDIX B: DIRECT AND CUMULATIVE ELECTRONIC ALTERNATIVES EMISSIONS INVENTORIES AND MODELING FILES

Data files are available upon request from the BLM Winnemucca District Office due to the large file size of the emission inventory and modeling files for the Burning Man Event SRP EIS-AERMOD Modeling Report to Assess Direct and Cumulative Ambient Air Quality Impacts.