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**Resolution Copper
Project
NEPA Air Quality
Impacts Analyses**

PREPARED FOR:
TONTO NATIONAL
FOREST

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LIST OF ABBREVIATIONS

°F	Degrees Fahrenheit
µg/m ³	Micrograms Per Cubic Meter
µm	Micrometer
µm ³	Cubic Micrometer
AAQS	Ambient Air Quality Standards
ADEQ	Arizona Department of Environmental Quality
ADJ_U*	Adjusted Friction Velocity
AERMET	AERMOD Meteorological Preprocessor
AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model
AERSURFACE	AERMOD Land Cover Preprocessor
AMSL	Above Mean Sea Level
AP-42	AP-42 Compilation of Air Pollutant Emission Factors
AQCR	Air Quality Control Region
AQRV	Air Quality-Related Value
B _o	Midday Bowen Ratio
BP-PRIME	Building Profile Input Program with the Plume Rise Model Enhancement
CAI	Central Arizona Intrastate
CFR	Code of Federal Regulations
CO	Carbon Monoxide
CR	Code of Regulations
DEIS	Draft Environmental Impact Statement
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
EPS	East Plant Site
ET	Evapotranspiration
FLM	Federal Land Manager
FP&LF	Filtration Plant and Concentrate Loadout Facility
ft	Foot
g/cm ³	Grams per Cubic Centimeter
GPA	General Project Area
GWA	Galiuro Wilderness Area

HAPs	Hazardous Air Pollutants
in	Inch
ISR	NO ₂ /NO _x In-Stack Ratios
km	Kilometer
LHD	Load-Haul-Dump
LOM	Life-of-Mine
m	Meter
MACT	Maximum Achievable Control Technology
Magma	Magma Junction
MARRCO	Magma Arizona Railroad Company
Modeling Plan	Resolution Copper Project Air Quality Impacts Analysis Modeling Plan for the National Environmental Policy Act
Modeling Report	Resolution Copper Project – NEPA Air Quality Impacts Analyses Modeling Report
MWA	Mazatzal Wilderness Area
NAAQS	National Ambient Air Quality Standards
NAD83	North American Datum of 1983
NED	National Elevation Dataset
NLCD92	1992 National Land Cover Data
NO	Nitric Oxide
NO ₂	Nitrogen Dioxide
NOAA	National Oceanic and Atmospheric Administration
NO _x	Oxides of Nitrogen
NSPS	New Source Performance Standards
NSR	New Source Review
NWS	National Weather Service
O ₃	Ozone
OLM	Ozone Limiting Method
Pb	Lead
PCAQCD	Pinal County Air Quality Control District
PM	Total Particulate Matter
PM ₁₀	Particulate Matter Less than 10 Micrometers in Aerodynamic Diameter
PM _{2.5}	Particulate Matter Less than 2.5 Micrometers in Aerodynamic Diameter
ppb	Parts per Billion

ppm	Parts per Million
Project	Resolution Copper Project
PSD	Prevention of Significant Deterioration
r	Midday Albedo
Resolution Copper	Resolution Copper Mining, LLC
Resolution Project	Resolution Copper Project
ROM	Run-of-Mine
SAG	Semi-Autogenous Grinding
SAWA	Sierra Ancha Wilderness Area
SO ₂	Sulfur Dioxide
SoDAR	Sonic Detection and Ranging
SR	State Route
SWA	Superstition Wilderness Area
TNF	Tonto National Forest
TSF	Tailings Storage Facility
u*	Surface Friction Velocity
USFS	United States Forest Service
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
VOC	Volatile Organic Compounds
WC ACEC	White Canyon Area of Critical Environmental Concern
WPS	West Plant Site
WRCC	Western Regional Climate Center
yr	Year
z _o	Surface Roughness Length

1.0 INTRODUCTION

Resolution Copper Mining, LLC (Resolution Copper) is the operating company and the proponent of the Resolution Copper Project (Resolution Project or Project) in Pinal County in central Arizona, approximately 65 miles east of Phoenix. The proposed project includes underground mining, ore processing operations, and the associated facilities and infrastructure described herein.

This Air Quality Impacts Analysis Modeling Report for the National Environmental Policy Act (Modeling Report) was for submittal to Tonto National Forest (TNF) as part of an Environmental Impact Statement (EIS) to evaluate and disclose the potential environmental effects from the proposed Project. This report is consistent with the Resolution Copper Project General Plan of Operations (GPO), final range of alternatives for detailed analysis¹ and pertinent local, state,² and federal³ requirements.

This Modeling Report includes a description of the methods and datasets used in the air quality modeling analyses to estimate the Resolution Project's air quality impacts relative to the applicable Ambient Air Quality Standards (AAQS) for criteria pollutants and to Air Quality Related Values (AQRV) in the near-field domain (Class I Superstition Wilderness Areas [SWA] and the White Canyon Area of Critical Environmental Concern [WC ACEC]) and in several Class I Wilderness Areas in the far-field domain (Sierra Ancha Wilderness Area [SAWA], Mazatzal Wilderness Area [MWA], and Galiuro Wilderness Area [GWA]). These analyses for the EIS are technically consistent with and in addition to the analyses prepared to demonstrate compliance with the applicable Pinal County Air Quality Control District (PDAQCD) and National Ambient Air Quality Standards (NAAQS), as required by the permit application requirements in applicable PDAQCD rules.⁴

The analyses described in this Modeling Report are consistent with the Air Quality Impacts Analysis Modeling Plan for the National Environmental Policy Act (Modeling Plan). The Modeling Plan was developed in consultation with the TNF, Arizona Department of Environmental Quality – Air Quality Division (ADEQ), PDAQCD, and the TNF's third-party contractor, SWCA Environmental Consultants.

¹<http://www.resolutionmineeis.us/public-involvement/snapshots>

² Arizona Department of Environmental Quality (ADEQ) "Air Dispersion Modeling Guidelines for Arizona Air Quality Permits" (ADEQ 2015a)

³ "Guideline on Air Quality Models" specified in Appendix W to Part 51 of the Code of Federal Regulations (CFR), Title 40 (Protection of Environment) and Federal Land Managers' Air Quality Related Values Work Group (FLAG), Phase I Report (FLAG 2010)

⁴ The "Air Quality Impacts Analysis Modeling Plan for Permitting" has been approved by PDAQCD and submitted to the TNF for review and comment, and the document, its appendices, and associated review, comments, responses, and approvals are hereby incorporated by reference.

This Modeling Report includes the following information:

- Detailed descriptions of the Project area and the Project, including estimated emissions expected from the Project during operations, estimated emissions due to construction of the project, and estimated emissions for several alternatives that were evaluated in the EIS
- Detailed descriptions of the methodologies used and results from several air quality analyses for the project, including the following:
 - Near-field assessment of impacts to applicable AAQS
 - Near-field assessment of impacts to AQRVs in the Class I SWA and the WC ACEC
 - Far-field assessment of impacts to AQRVs in the Class I SAWA, MWA, and GWA

This Modeling Report includes specific technical details about the Project and the air quality analyses performed to support the TNF and SWCA in their preparation of the EIS. Resolution Copper and its air quality consultant have provided these details to document the modeling methods and inputs used for the air quality analyses and to present the results of the analyses.

2.0 PROJECT DESCRIPTION

The proposed Resolution Project facilities and attendant infrastructure components will be located in north-central Pinal County. A location map showing proposed Project facility locations, hereafter referred to as the General Project Area (GPA), is presented in Figure 2-1. A full description of the project is contained in the latest version of the Mine's GPO (available at <http://www.resolutionmineeis.us/documents/resolution-copper-gpo>).

The East Plant Site (EPS) encompasses the proposed underground mine, associated shafts, and surface support facilities. The support facilities are located in the previously disturbed footprint of the Magma Copper mine and include Shaft 9 which was constructed in the early 1970s. The EPS is accessed from Highway US 60 by turning south on Magma Mine Road (also known as Forest Road 469), which terminates at the EPS guard gate. The existing mine site and related surface support facilities are currently located on private lands. Expansion associated with the Project will occur on United States Forest Service (USFS) lands as well as state and private lands, although this area would become private upon completion of the land exchange.⁵

The ore processing operations will be located at the West Plant Site (WPS), approximately 6 miles west of the EPS. These facilities are also located in a previously disturbed footprint of the Magma Copper mine and processing facilities. A new copper concentrate Filtration Plant and Concentrate Loadout Facility (FP&LF) will be constructed on private land near Magma Junction (Magma), proximate to the existing disturbed Magma Arizona Railroad Company (MARRCO) right-of-way. An alternative location for the FP&LF within the footprint of the WPS is also being considered. The air quality analysis assesses the air quality impacts associated with both alternative locations.

The project will require a Tailings Storage Facility (TSF), and several alternative locations and designs of the TSF are being considered. In general, tailings will be delivered to the TSF from the WPS via a pipeline that traverses the intervening area (along with other infrastructure) along the Tailings Corridor. The air quality analysis assesses air quality impacts associated with the alternative locations being considered for the TSF.

Linear infrastructure elements of the Project will include ore conveyors, roads, power lines, copper concentrate pipelines, tailings pipelines, the MARRCO Railroad, and water supply pipelines; these will be primarily located within the Tailings Corridor, within the MARRCO Corridor alongside existing disturbed land or underground.

Resolution Copper will use an underground mining method known as panel caving, which is a variation of caving. Panel caving allows for the mining of large, underground ore bodies by

⁵ In 2014, Congress passed legislation that approved the land exchange. Per the USDA Agreement to Initiate the land exchange, the land exchange is scheduled to become final in 2020.

dividing the deposit into smaller strips, or panels, so that the ore can be removed in a safe and efficient manner.

The benefits of a panel cave mine at the Resolution Project include limited development rock piles at the surface and no large open pits with terraced pit walls. One result of panel cave mines is surface subsidence or settling above the ore deposit. Surface subsidence occurs as the material above the ore body gradually moves downward to replace the ore that has been mined. The settling amount is less than the amount of ore removed due to the “bulking” of the rock underground; that is, the volume of the caved rock fragments will be larger relative to the rock’s in-place volume, which is a major factor controlling subsidence (Holzer 1984).

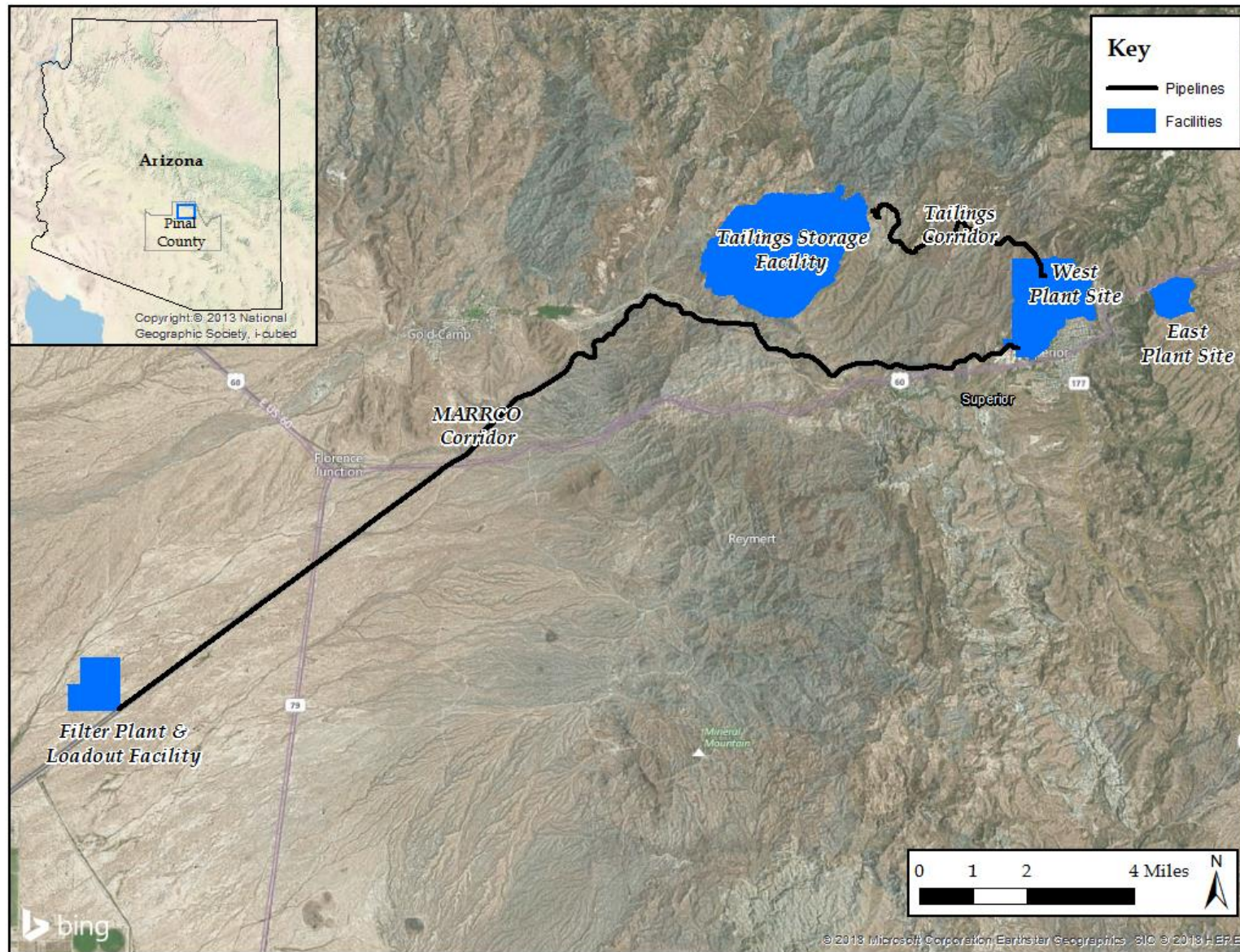
Nominal ore production from the underground operations is expected to be a 120,000 tonnes per day⁶ after an extensive construction and ramp-up period.

Ore material will be crushed underground and then transported by underground haul trucks to two production shafts and hoisted to an underground midway offloading station within the two production shafts at the EPS. The crushed ore will be transferred via underground conveyors to an overland stacker and stockpiled at the WPS. The stockpiled ore will be transferred to a concentrator facility via apron feeders and a reclaim tunnel located underneath the stockpile, where it will be processed using traditional copper sulfide recovery techniques. The concentrator facility will consist of conventional grinding and flotation circuits and will produce copper and molybdenum concentrates. Tailings material, the non-economic excess ground rock with a sand-like consistency that remains after concentrates have been removed during ore processing, will be piped as a slurry to the TSF located west of the WPS. The TSF will be located on land administered by the TNF. Molybdenum concentrates will be bagged at the concentrator facility and shipped to market via trucks. Copper concentrates will be transported as slurry via pipeline to FP&LF near Magma for final filtration and train loadout for shipment to domestic and/or global markets for additional processing.

Resolution Copper anticipates that the project will have a total operational life of approximately 40 years, not including initial site construction, which will span approximately 10 years, and not including final reclamation work (demolition, regrading, and revegetation), which could take up to an additional 10 years. In total, the Project will have a lifespan of approximately 60 years.

⁶ A process rate of 143,750 tonnes per day was used for modeling based on the nominal ore process rate multiplied by a 15% design factor and approximately 4% for moisture.

Figure 2-1. Resolution Project Location (Proposed Action)



2.1 Regional Topographical Characteristics

The GPA lies within the Basin and Range physiographic province, generally characterized by a series of smooth-floored basins separated by mountain ranges (Chronic 1983). The northeastern edge of the province is a mountainous region that is transitional to the Central Highlands bordering the Colorado Plateau province. This mountainous region consists of belts of generally linear ridges and valleys, where the rugged ranges predominate over the valleys. This is in contrast to much of the Basin and Range province and the western portion of the GPA, where broad valleys predominate over relatively narrow mountain ranges. As such, the GPA includes a combination of nearly flat terrain of the broad basin to the west and rugged mountainous terrain (Superstition, Dripping Spring, and Pinal Mountains) to the north and east.

The elevations within the GPA range from 1,520 ft above mean sea level (AMSL) at the western terminus of the MARRCO Corridor to 4,648 ft AMSL at Apache Leap.

2.2 Local Topographical Characteristics

The Project features, which include the FP&LF, MARRCO Corridor, TSF and Tailings Corridor, WPS, and EPS, span approximately 31.8 miles from the southwestern corner of the GPA near Magma to the northeastern corner of the GPA at the EPS, east of Superior. The vast majority of Project activity will take place at the EPS, WPS, and TSF. The following discussion describes the Project features as they occur in geographic order across the GPA from northeast to southwest.

2.2.1 EPS

The EPS will be located in the mountains immediately east of the town of Superior in a transition zone on the northeastern edge of the Basin and Range physiographic province, bordering the Central Highlands. The elevation ranges from 3,100 ft AMSL near Queen Creek to 4,648 ft AMSL at a high point on the Apache Leap escarpment, overlooking Superior. The western edge of this area is generally very steep, with the cliffs of the Apache Leap escarpment rising abruptly above Superior. East of Apache Leap, there is an area of parallel ridges and valleys trending northeast. The northeastern portion of the EPS is relatively flat.

2.2.2 WPS

The WPS will be located at the transition from the basin (in which the town of Superior is situated) to the mountains that border the Central Highlands north of Superior. The southwestern part of the site, adjacent to the town of Superior, is moderately sloped with a base elevation of approximately 2,680 ft AMSL. The site ascends into deeply incised canyons in the rocky slopes along the northern portion of the WPS up to an elevation of approximately 3,400 ft AMSL.

2.2.3 TSF Alternatives and Tailings Corridor(s)

The proposed action is the Near West TSF and Tailings Corridor to be located in a transition zone on the northeastern edge of the Basin and Range physiographic province. The topography in the vicinity is characterized by a series of parallel ridges formed from differential erosion of a tilted fault block dipping to the southeast (Spencer and Richard 1995). The ridges are separated by valleys with thin alluvial deposits in the valley bottoms. The valleys are relatively narrow at higher elevations and widen as elevation decreases toward Queen Creek. The design of the proposed action TSF includes modified centerline construction and two tailings streams⁷ (non-potentially acid generating (NPAG) and potentially acid generating (PAG)).

The TSF footprint is bounded by Roblas Canyon to the west and Potts Canyon to the east. Elevations of the TSF footprint range from approximately 2,240 ft AMSL in the southwest portion to 2,920 ft AMSL in the northern extents.

The Tailings Corridor for the proposed action extends from the northeast corner of the TSF to the WPS, traversing multiple ridges and valleys. The main valleys from west to east are Potts Canyon, Happy Camp Canyon, and Silver King Wash. Elevations along the Tailings Corridor range from approximately 2,690 ft AMSL at the tie-in location on the northeast side of the TSF to 3,050 ft AMSL at the WPS.

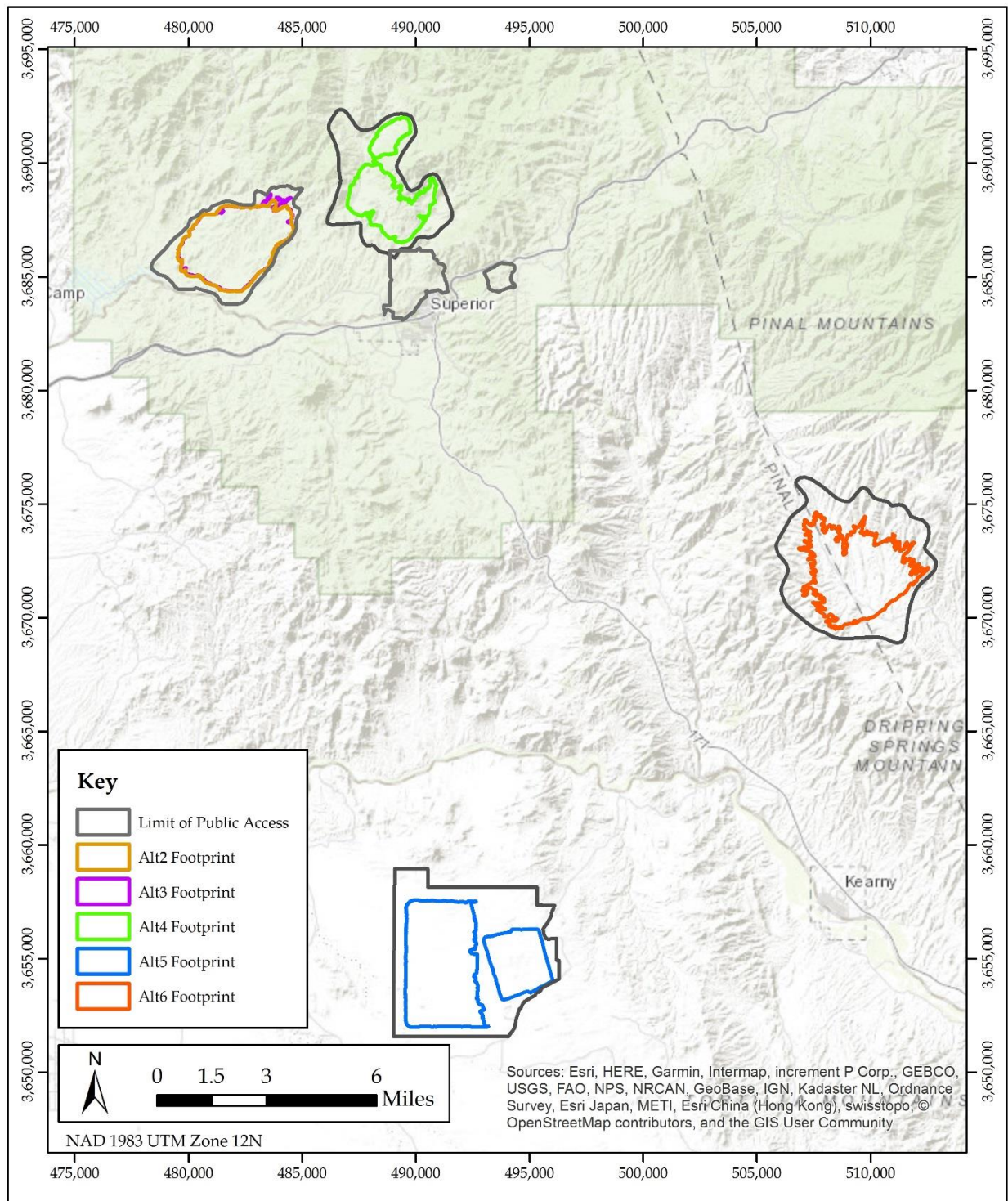
A final range of TSF alternatives for detailed analysis in the Draft Environmental Impact Statement (DEIS) has been determined by the USFS as well as some additional alternatives that have been presented for consideration. Each alternative was evaluated for potential impacts to air quality resources. The alternatives are:

- 1 – No Action
- 2 – Modified Proposed Action – Near West “wet” (slurry tailings; unlined; subaqueous PAG; modified centerline dam embankment). Location: west of the WPS and north of Queen Station within the TNF.
- 3 – Near West “dry” (modified centerline dam; thickened; separate PAG cell). Location: west of the WPS and north of Queen Station within the TNF.
- 4 – Silver King Filtered (filtered tailings, two separate areas for PAG and NPAG). Location: North of WPS.
- 5 – Peg Leg (centerline dam for NPAG thickened tailings; separate downstream dam for PAG cells incorporating a water cover). Location: Approximately 29 km south of the WPS and 25 km east of Florence, AZ.
- 6 – Skunk Camp (centerline dam for NPAG with thickened tailings; separate downstream dam for PAG cells incorporating a water cover). Location: Approximately 15 miles south east of Superior, AZ.

⁷ “Scavenger” (85%, non-potentially acid generating [NPAG]) and “cleaner” (15% potentially acid generating [PAG]).

Figure 2-2 shows the locations of the proposed action and alternative TSFs.

Figure 2-2. Tailings Storage Facility (TSF) Locations



2.2.4 MARRCO Corridor

The existing MARRCO Corridor extends northeast from Magma past the highway crossing at US highway 60 east of Florence Junction to the WPS, a distance of approximately 27 miles. The elevations in this corridor range from a minimum of approximately 1,520 ft AMSL at Magma to a maximum of 3,000 ft AMSL at the WPS. The general trend of the corridor is a gradual increase in elevation from west to east, with minor rises and drops over channels. The western terminus of the corridor in the GPA is at Magma.

2.2.5 FP&LF

The FP&LF will be located approximately 7 miles northeast of Magma and adjacent to the MARRCO Corridor. The site is in a relatively flat area. The elevation of the site is approximately 1,670 ft AMSL. An alternative location for the FP&LF within the footprint of the WPS is also being considered.

2.3 Regional Climatology

The regional climate is characterized as semiarid; long periods often occur with little or no precipitation (WRCC 2012). Precipitation falls in a bimodal pattern: most of the annual rainfall within the region occurs during the winter and summer months, with dry periods characterizing spring and fall. The total average annual precipitation varies between 15.7 inches (in) and 18.8 in, with 52 percent of the precipitation occurring between November and April. Although snow may occur at higher elevations, it does not typically accumulate in the region. Precipitation usually occurs with steady, longer-duration frontal storm events during the winter months (December through March). Rain events during the summer months (July to early September) are typically of shorter duration with more intensity due to the convective nature of thunderstorms.

2.4 Local Climatology

The National Oceanic and Atmospheric Administration's (NOAA) Climate Data Online (NOAA 2013) and the Western Regional Climate Center (WRCC 2013) maintain data records for several weather stations that surround the GPA. A summary of weather stations in the Project vicinity is provided in Table 2-1.

Table 2-1. Weather Stations in Project Area

Station Name	Elevation (ft)	Latitude	Longitude	Data Period
Miami	3,560	33.40°	110.87°	Feb. 1914 to Mar. 2013
Superior	2,859	33.30°	111.10°	Jul. 1920 to Aug. 2006
Roosevelt	2,205	33.67°	111.15°	Jul. 1905 to Mar. 2013

Source: NOAA 2013

Table 2-2 presents a summary of climatic conditions at each of the Project areas based on the three nearby weather stations. Weather conditions in this region are strongly influenced by elevation; therefore, these data are primarily based on the weather station closest in elevation rather than closest by distance. The data, unless otherwise noted, were derived from WRCC 2013.

Table 2-2. Project Area 30-yr Historical Climatological Summary

Project Area	Elevation (ft)	Weather Station	Ann Mean Daily Avg Temp (°F)	Ann Mean Daily Max Temp (°F)	Ann Mean Daily Min Temp (°F)	Ann Mean Total Snow (in)	Ann Mean Total Precip (in)	Ann ET Rate⁽¹⁾ (in)
FP&LF	1,670	Roosevelt	68	81	55	0.2	15.7	67
MARRCO Corridor (west of SR 79)	1,520	Roosevelt	68	81	55	0.2	15.7	67
MARRCO Corridor (east of SR 79)	3,000	Superior	69	79	59	1.4	18.3	63
TSF and Tailings Corridor (Preferred Alt.)	2,240 - 3,050	Superior	69	79	59	1.4	18.3	63
WPS	2,680 - 3,400	Superior	69	79	59	1.4	18.3	63
EPS	3,100 - 4,648	Miami	64	77	51	2.6	18.8	55

⁽¹⁾ Yitayew 1990

Ann = Annual, Avg = Average, Temp = Temperature, Max = Maximum, Min = Minimum, Precip = Precipitation, ET = Evapotranspiration, SR = State Route, °F = Degrees Fahrenheit

As shown in Table 2-2, for the three weather stations selected as representative of the GPA, the annual average maximum temperature ranged from 77 degrees Fahrenheit (°F) to 81°F, and the average minimum temperature ranged from 51°F to 59°F. The total rainfall per year ranged from 15.7 in to 18.8 in across the three weather stations (WRCC 2013).

2.5 Process Description and Emission Sources

The Resolution deposit is located between 5,000 and 7,000 ft below the surface and will be mined using a variation of block caving called panel caving. The mine and process operations will operate on a continuous, 24-hours-per-day basis. A process flow diagram showing the underground operations at the EPS is provided in Figure 2-3, and the subsequent ore processing and transport operations are presented in Figure 2-4.

Figure 2-3. Process Flow Diagram - EPS

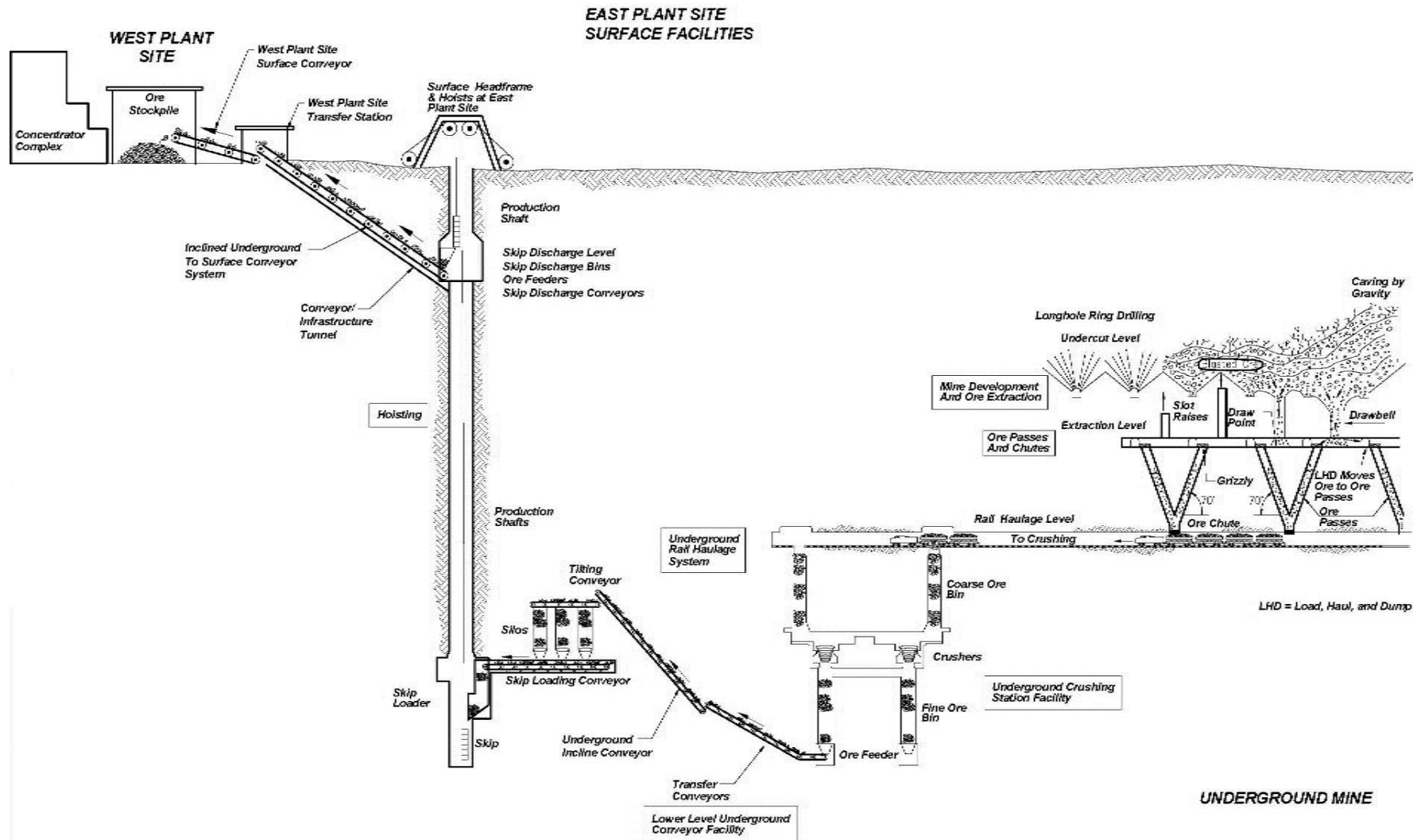
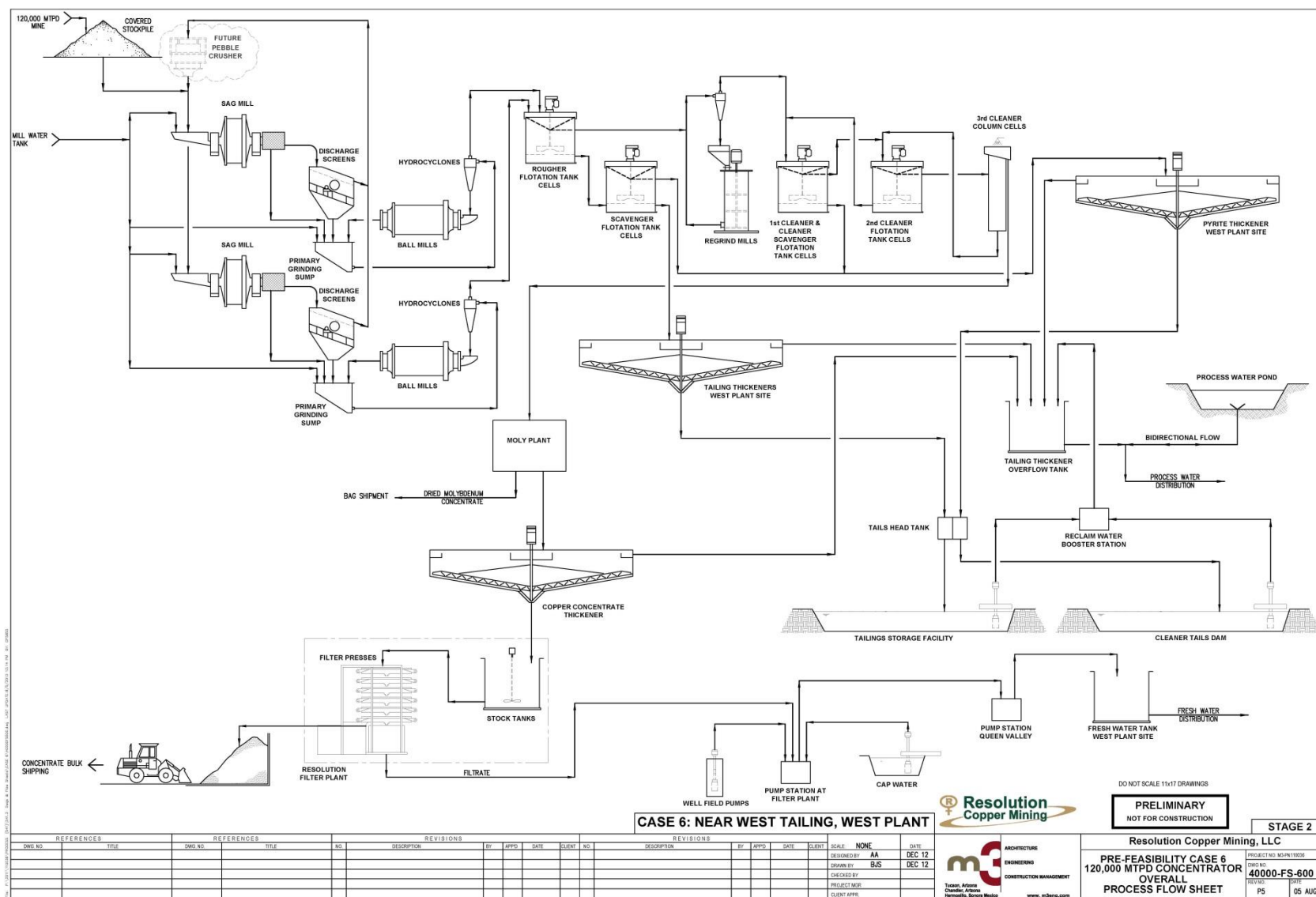


Figure 2-4. Process Flow Diagram - Ore Processing and Transport Operations



2.5.1 EPS Underground Operations – Panel Caving and Ore Preparation

The initial step of the mining process includes preparing the area to be mined. In panel caving, the ore body is mined from the bottom by first breaking up the copper-bearing ore. Once the ore is initially broken up, funnel-shaped cavities are created to direct the broken ore down to be removed and transported. Blasting is used to initially break up the ore body and to create the funnel-shaped openings. Each blast hole is drilled and loaded with an ammonium nitrate and fuel oil-based explosive. Gravity pulls the ore from the ore body down to the draw points where it is loaded into load-haul-dump (LHD) loaders.

The run-of-mine (ROM) ore is transported from the draw points underneath the ore body by LHD loaders to haul trucks. Haul trucks transport the ROM ore underground to one of three gyratory crushers that can process a total of up to 6,889 tons of ore per hour. After a series of underground feeders, conveyors, and bins, the ore is loaded into skips that hoist the ore to an underground midway offloading station, and it is discharged onto an underground conveyor system that transports coarse (crushed) ore to the WPS.

Pollutant emissions from panel cave mining will consist of fugitive emissions from drilling and blasting, ore hauling, loading, and unloading activities; process dust emissions from ore transfers and crushing; and non-road engine tailpipe emissions. Fugitive dust will be controlled by employing dust control measures and best practical methods. Process emissions will be controlled using baghouses and water sprays at process points where feasible. Tailpipe (non-road engine) emissions will be compliant with applicable EPA emission standards.

Three additional mine features act as controls that reduce particulate emissions from underground sources: water droplets in mine shafts, heat rejection sprays, and gravitational settlement. These features' individual scrubbing efficiencies, as well as total effective scrubbing efficiencies, are summarized in Table 2-3.

Table 2-3. Effective Control for Underground Sources

	PM	PM ₁₀	PM _{2.5}
Water Droplets in Shafts ⁽¹⁾	30.9%	30.9%	4.2%
Heat Rejection Sprays ⁽¹⁾	30.0%	30.0%	2.5%
Gravitational Settlement ⁽²⁾	60.4%	6.7%	0.4%
Effective Control	80.9%	54.9%	7.0%

(1) These control efficiencies were derived using Moreby 2008.

(2) These control efficiencies were derived using particulate matter terminal settling velocity (Perry's Chemical Handbook, 1997) and Stokes Law (reference: Subsurface Ventilation and Environmental Engineering, McPherson, M.J., 1993.).

PM = Total Particulate Matter, PM₁₀ = Particulate Matter Less than 10 Micrometers (µm) in Aerodynamic Diameter, PM_{2.5} = Particulate Matter Less than 2.5 µm in Aerodynamic Diameter

Water Droplets in Shafts Removal Mechanism. Due to the saturated nature of the exhaust air, water droplets will form inside the mine shafts and will scrub a fraction of PM from the exhaust air. This, in combination with an approximate shaft depth of 7,000 ft (and the resulting long time for

exhaust air to come in contact with these droplets), results in the scrubbing efficiencies summarized in Table 2-3. Moreby's (2008) analysis demonstrates that exhaust air from the ventilation shafts will be saturated, that water droplets will coagulate particulate matter, and that all water droplets in the air stream will be discharged through surface fans. Through these mechanisms, a significant portion of particulate matter will be removed from the ventilation exhaust. No scrubbing effect for gaseous pollutants is assumed from these droplets.

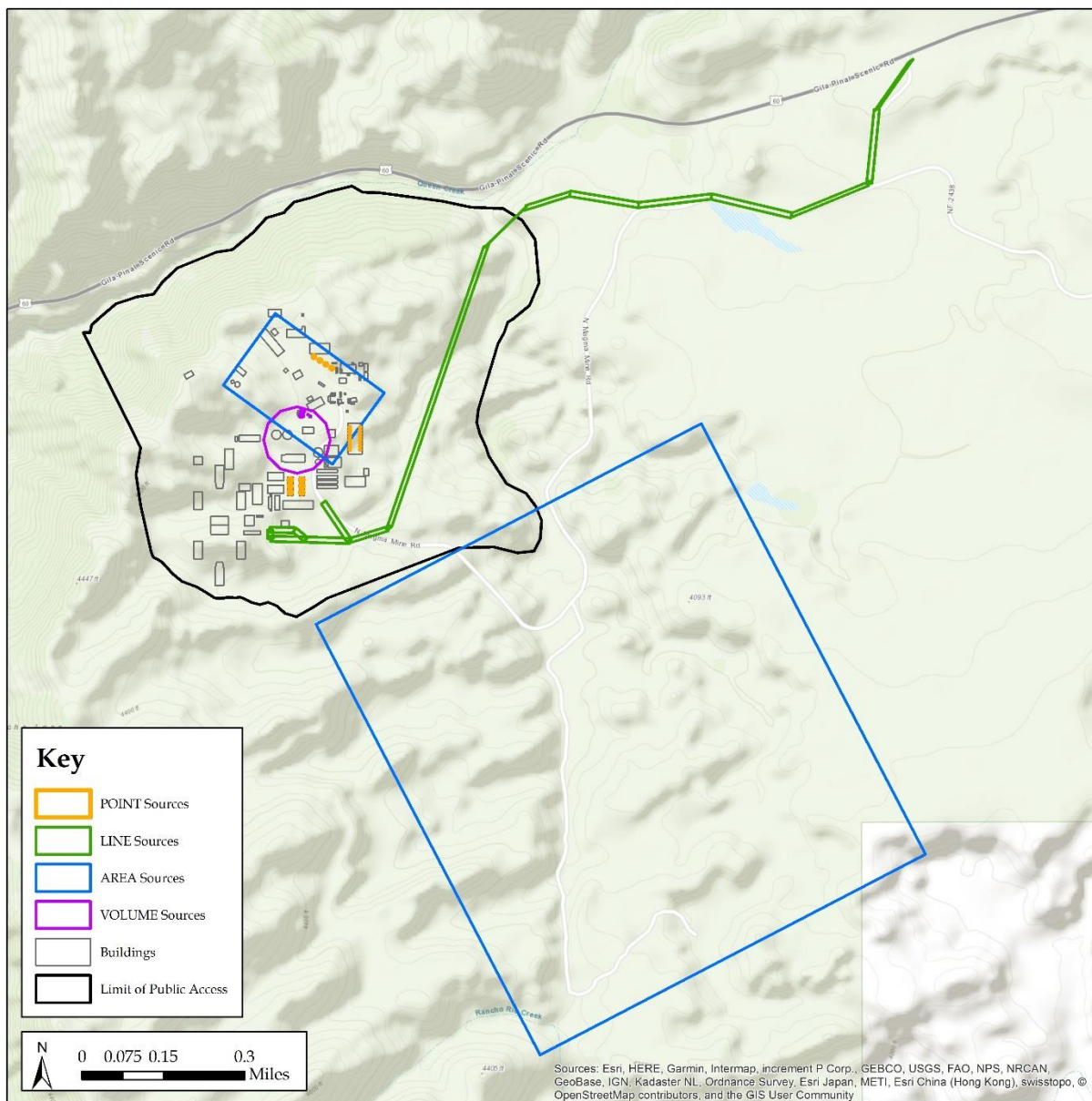
Heat Rejection Spray Removal Mechanism. The underground heat rejection sprays serve as another control for underground emissions. The heat rejection sprays are employed underground to reject heat from the underground refrigeration plant. As designed, a large fraction (at least 50 percent) of the exhaust air will pass through these chambers where heat rejection will occur. No scrubbing effect for gaseous pollutants is assumed from these sprays. The scrubbing efficiencies for particulates are presented in Table 2-3.

Gravitational Settlement Removal Mechanism. The final particulate control measure assumed for underground sources is gravitational settlement. The exhaust chambers are very long; therefore, gravitational settlement for PM will occur. Using the terminal settling velocity in Perry's Chemical Engineering Handbook (Perry and Green 1997), an efficiency due to gravitational settlement was determined. These efficiencies for PM, PM₁₀, and PM_{2.5} are presented in Table 2-3.

2.5.2 EPS Surface Operations

The surface operations at the EPS will consist of support for underground operations above the ore body. Such activities include cooling towers; miscellaneous non-road equipment; and wind erosion of exposed areas, including the subsidence zone. Particulate matter from roads will be controlled with periodic water and/or chemical dust suppressant application. Figure 2-5 shows the locations of the modeled sources at the EPS surface operations.

Figure 2-5. EPS Modeled Source Locations



2.5.3 WPS – Ore Processing

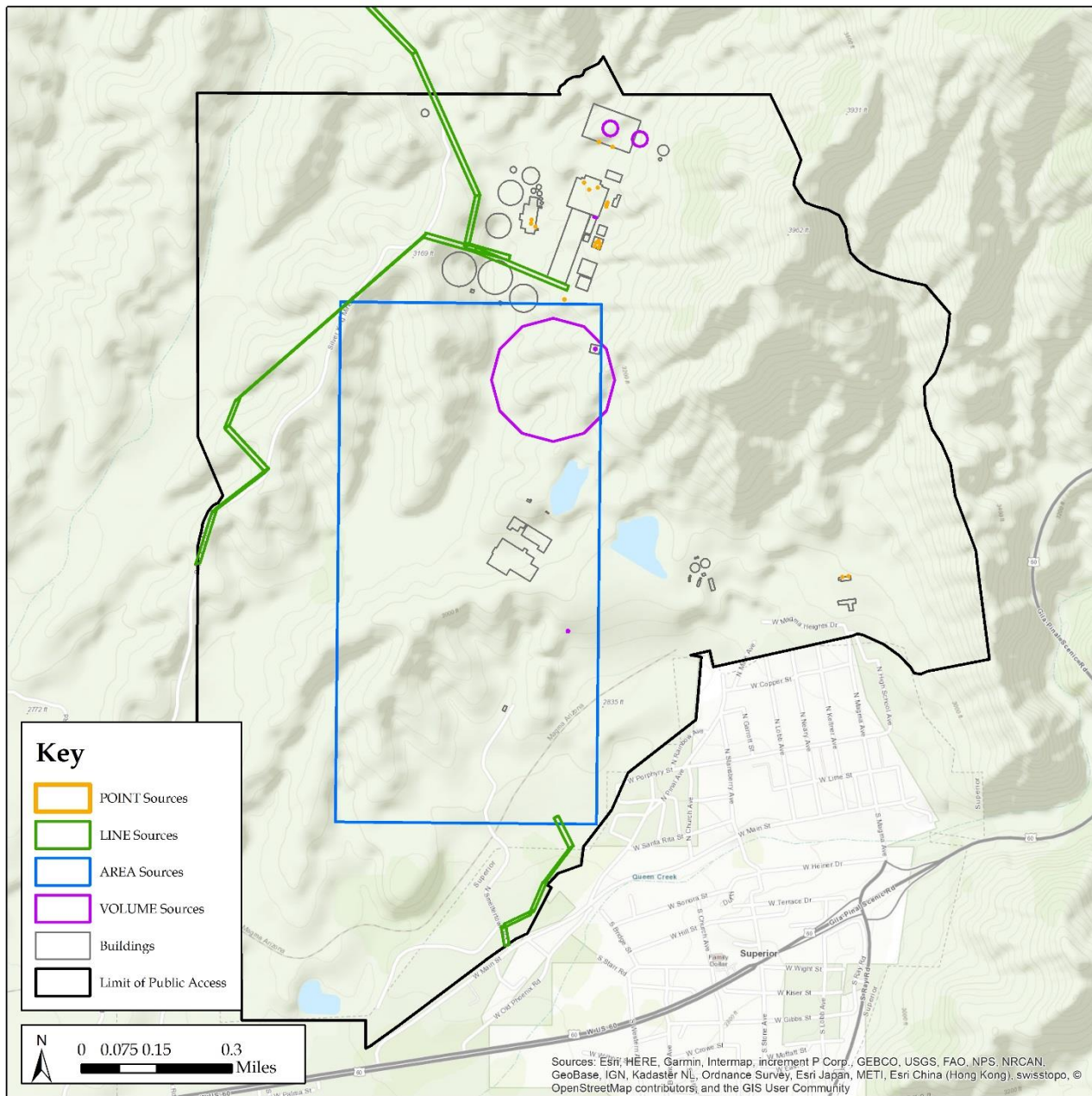
The coarse ore transported from the EPS via an underground conveyor system drops onto an overland feed conveyor at WPS, which transfers the ore to a covered stockpile. The stockpiled coarse ore is drawn through a series of apron feeders and a reclaim tunnel located underneath the stockpile for further processing in the concentrator building. The ore reclaim and transfer operations will be equipped with dust collectors to control particulate emissions.

The overall grinding configuration at the concentrator building will consist of two semi-autogenous grinding (SAG) mills, in parallel, followed by a chemical flotation circuit. Each SAG mill will be designed to operate at a maximum rate of 5,512 tons per hour. Process water will be added to the SAG mill feed to provide the correct slurry density for grinding. Chemical additives will also be added to the SAG mill feed. Several reagents will be added during different processing stages to condition the concentrate slurry. Particulate emissions from dry reagent handling and mixing will be enclosed in the concentrator building to control dust emissions. The SAG mill discharge will be screened and oversized pebbles will be conveyed to one of two pebble crushers. Crushed pebbles will be returned to the SAG mill feed conveyors. All conveyor transfer points will be enclosed in the concentrator building which will control dust emissions. The flotation circuit following the SAG mill will consist of a primary ball mill and flotation circuits followed by thickeners. Figure 2-4 shows the locations of the modeled sources at the WPS.

A small filter plant will be located at the WPS for the purpose of filtering and drying molybdenum concentrate. The molybdenum concentrate will be pumped to additional processing to remove the majority of the liquid before entering a dryer. The dried molybdenum concentrate will be packaged and shipped offsite. Particulate emissions from concentrate handling will be controlled by an enclosure of the concentrator building. SO₂ emissions from the processing of molybdenum concentrate will be controlled by a gas quencher and packed bed scrubber.

Once the molybdenum concentrate is filtered out, the copper concentrate will be removed and the remaining material will be tailings. The copper concentrate, in a slurry form, will be pumped via an approximately 20-mile-long pipeline along the MARRCO Corridor to the FP&LF near Magma. Sandy slurry containing tailings material will be transferred through an approximately 6-mile-long pipeline along the Tailings Corridor to the TSF.

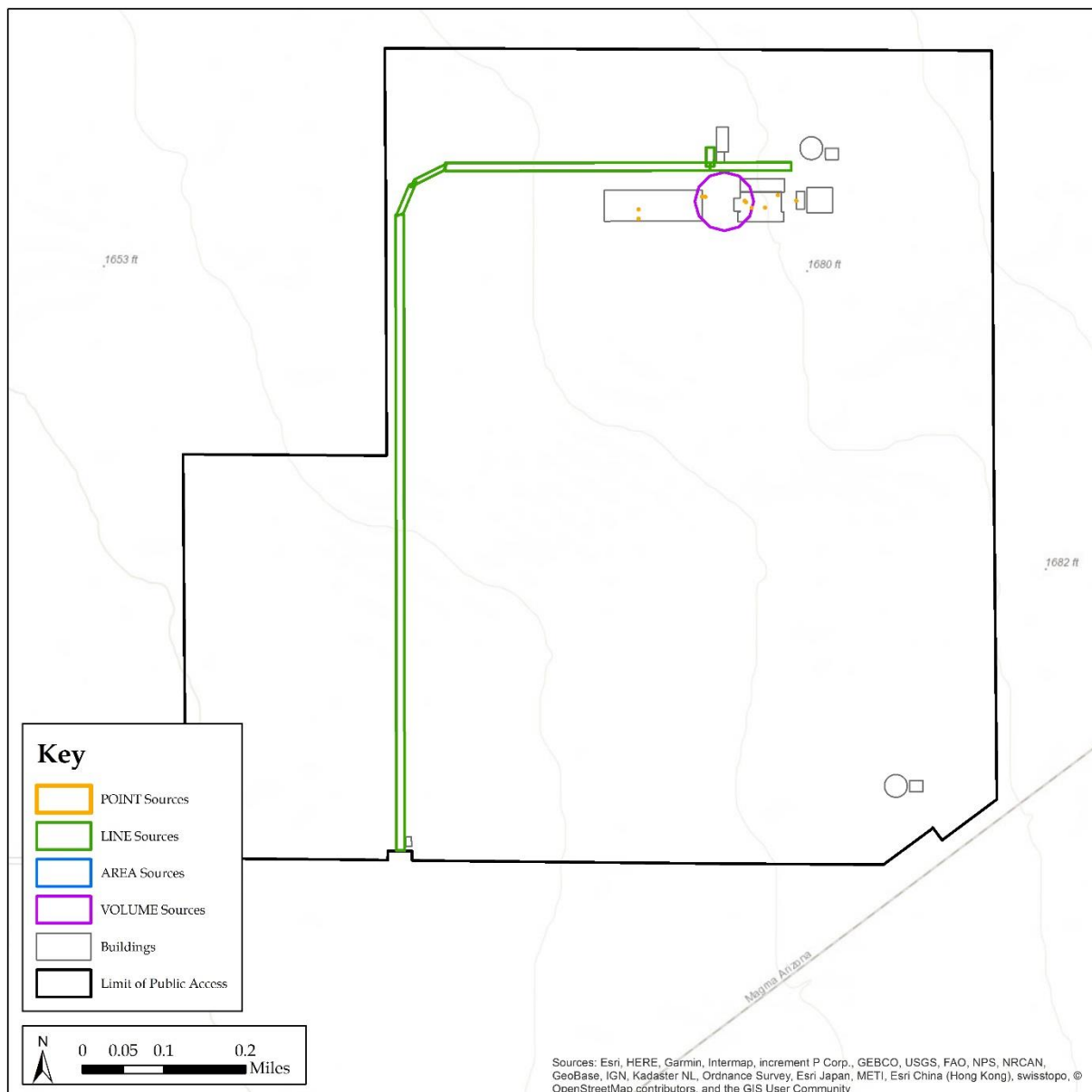
Figure 2-6. WPS Modeled Source Locations



2.5.4 FP&LF

The liquid concentrate slurry arriving at the FP&LF will be pumped to a series of filters to remove the majority of the liquid. Following filtering, the copper concentrate will be loaded onto a series of conveyors to the dry copper concentrate storage and loadout shed. A front-end loader will transfer the copper concentrate from the storage shed into hoppers that feed rail cars to ship the dried copper concentrate offsite. Particulate emissions from concentrate handling will be enclosed in the loadout building and storage shed to minimize emissions. Figure 2-7 shows the locations of the modeled sources at the FP&LF. This configuration (or very similar) of modeled sources will be used to model the FP&LF sources to assess the alternative of locating the FP&LF facility within the footprint of the West Plant.

Figure 2-7. Filter Plant & Load-out Facility (FP&LF) Modeled Source Locations



2.5.5 Tailings Storage Facility (TSF)

The TSF will receive tailings slurry from the concentrator at the WPS. A series of piping and valves will control the location of tailings placement. Over time, the TSF will form a beach area, mainly at the perimeter. Wind erosion emissions from the beach area and other un-reclaimed areas on the surface of the TSF dam will be controlled by deposition as a slurry and with sprinklers. The tailings dam will be constructed as needed. Figure 2-8 through Figure 2-12 show the locations of modeled sources at the preferred (Figure 2-8) and alternative sites being considered for the TSF.

2.5.6 Emergency Equipment

Fourteen diesel-fired emergency generators, rated at 3,263 kilowatts each, will be installed to provide power to the EPS in the event of emergency situations. These generators will power critical systems (ventilation, personnel transport, etc.). Additional diesel-fired emergency generators rated at 500 kilowatts each will be located at other process areas. Three generators located at the WPS, one generator at the TSF, and one generator located at the FP&LF will be used to provide power to critical operations in emergency situations.

Figure 2-8. Alternative 2 (Modified Proposed Action) Near West TSF Modeled Source Locations

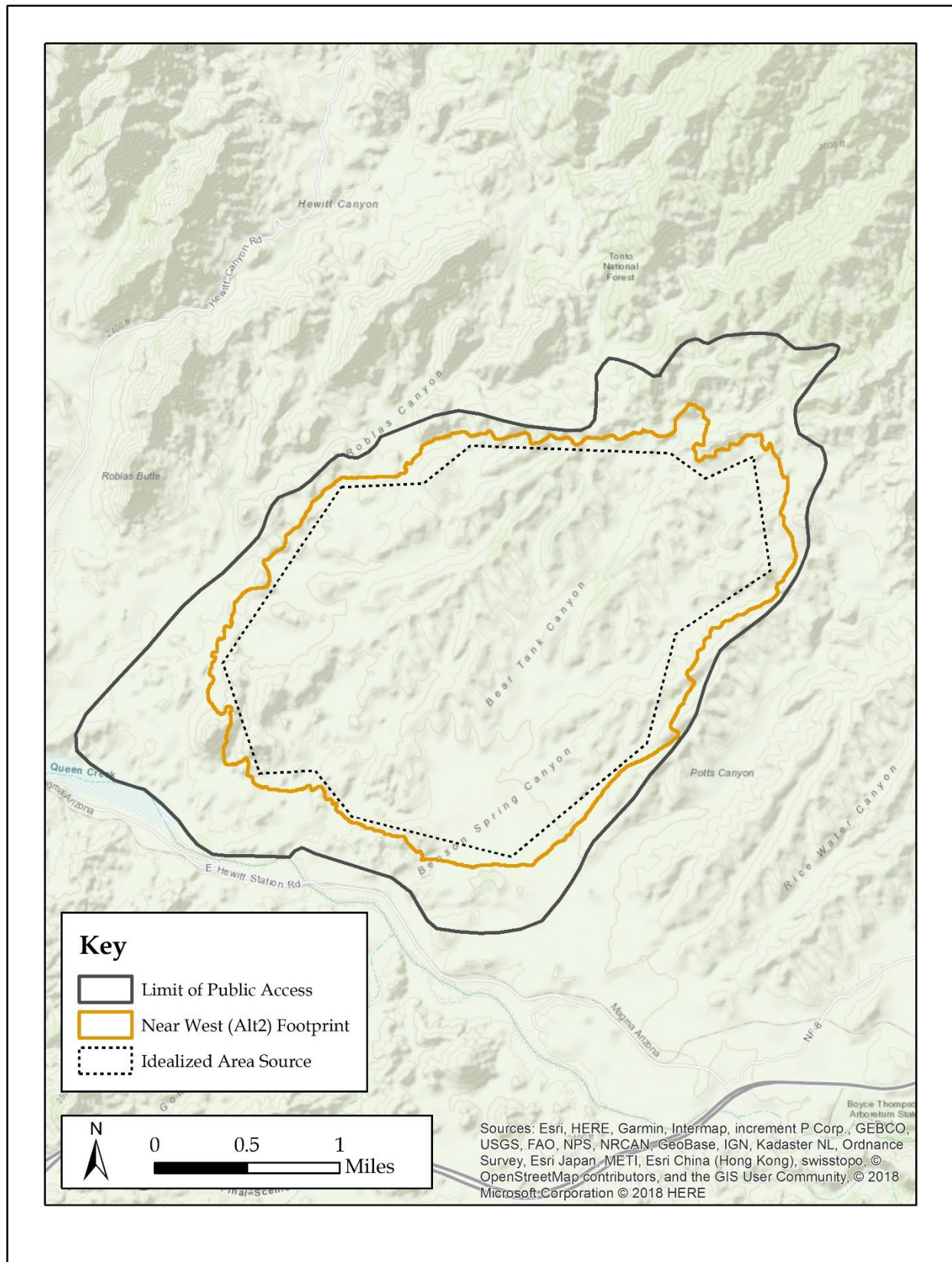


Figure 2-9. Alternative 3 Near West TSF Modeled Source Locations

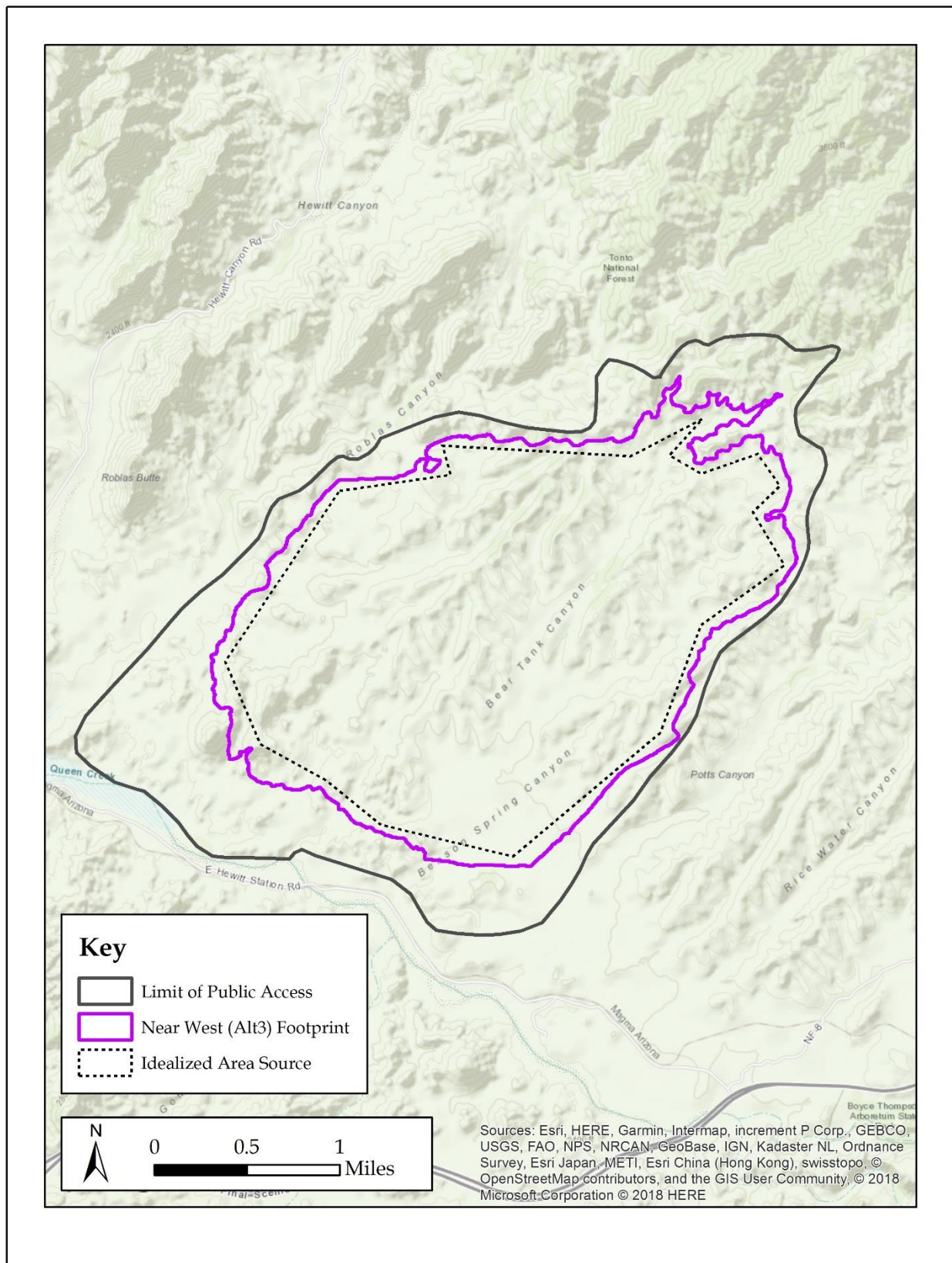


Figure 2-10. Alternative 4 Silver King Filtered TSF Modeled Source Locations

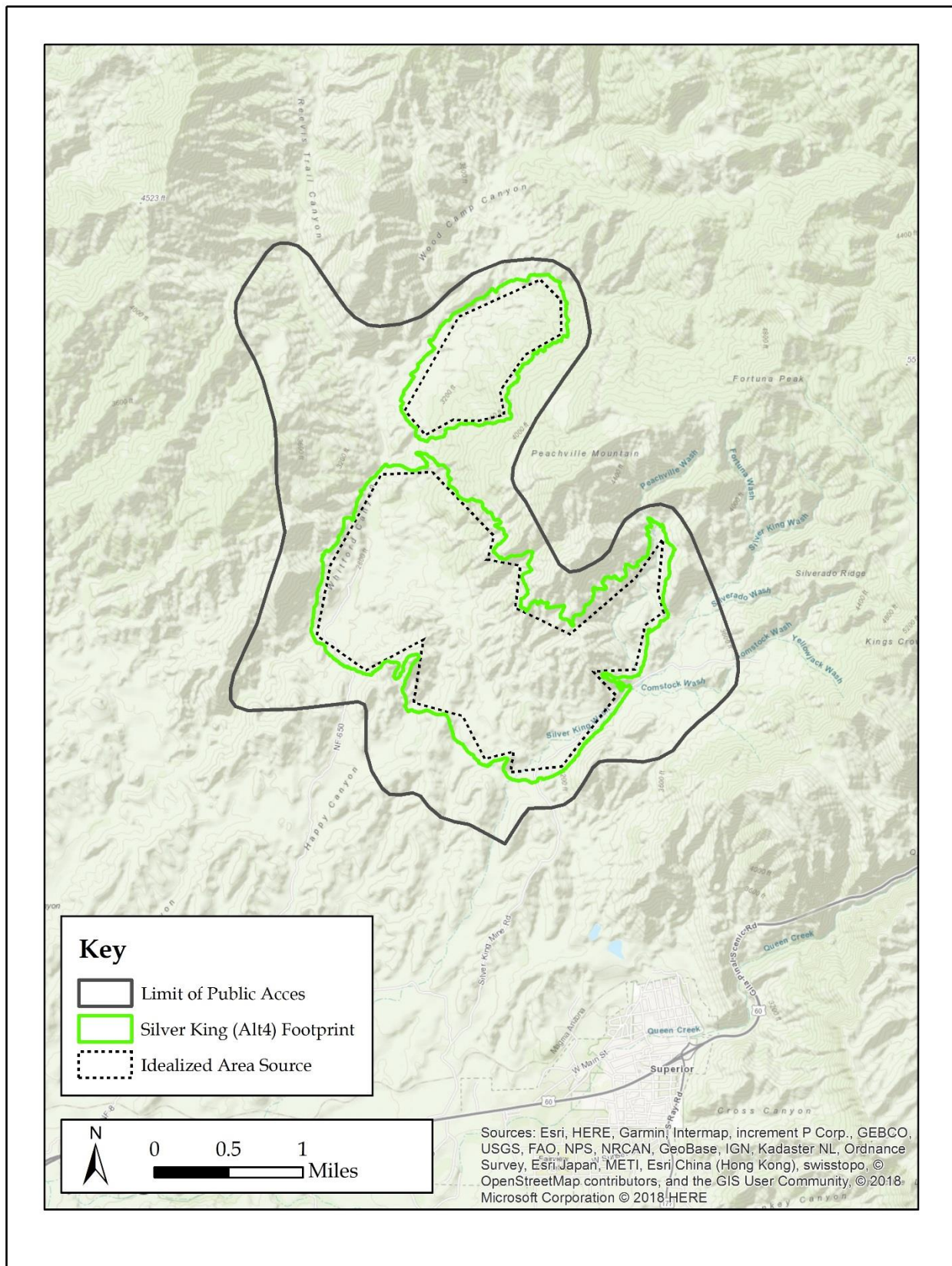


Figure 2-11. Alternative 5 Peg Leg TSF Modeled Source Locations

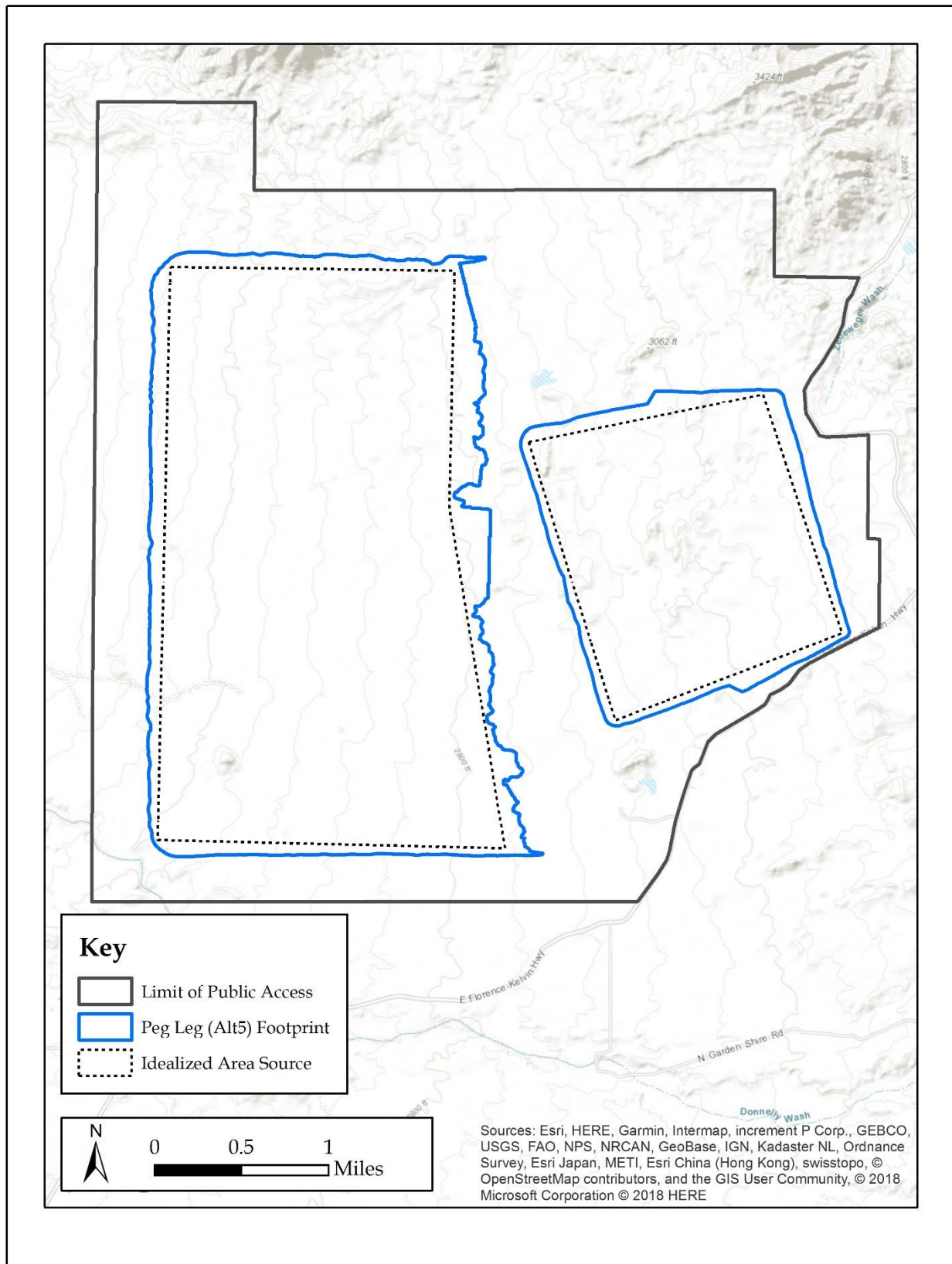
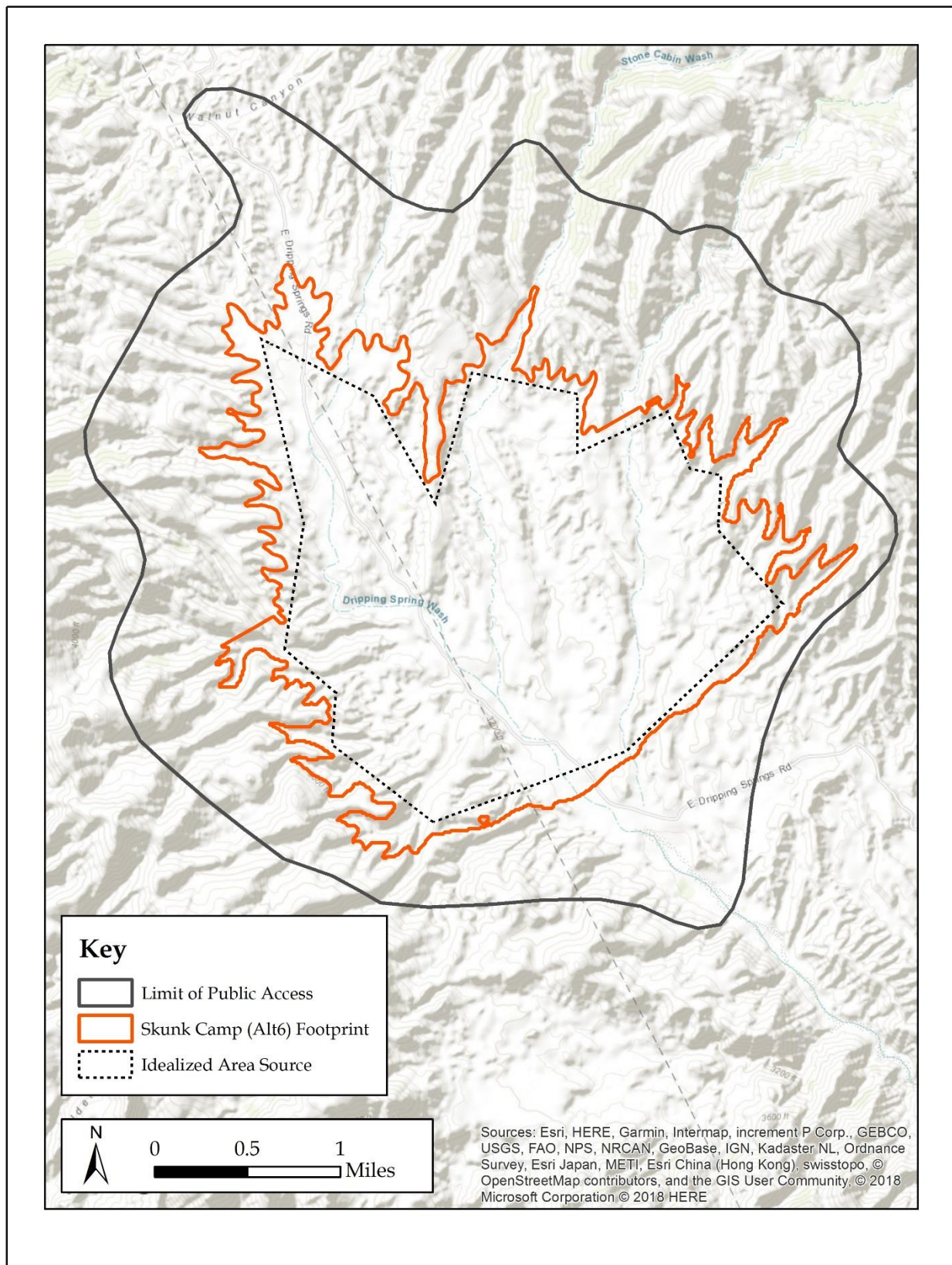


Figure 2-12. Alternative 6 Skunk Camp TSF Modeled Source Locations



2.6 Annual Emission Estimates

Emissions due to underground sources at the EPS will include: dust emissions⁸ from underground mining activities (drilling, blasting, material handling and transfers, and crushing) and combustion emissions⁹ from blasting, operation of underground mining, and transport equipment. Emissions from underground sources will exit the underground workings via the mine ventilation system near the surface activities at the EPS. Emissions from surface activities at the EPS include light vehicle travel, backup power generation, and wind-blown dust from disturbed surfaces. Sources of particulate emissions from ore preparation activities at the WPS will include ore and reagent handling. Sources of combustion emissions will be limited to fuel and freight transportation and light vehicle travel. The maximum potential Project total annual emissions in short tons per year (ton/yr) are provided in Table 2-4.

Table 2-4. Resolution Project Maximum Potential Emissions Summary (ton/yr)

Project Facility	Emissions Type	CO	NO _x	PM _{2.5}	PM ₁₀	SO ₂	VOC
EPS	Process	8.1	33.5	22.9	62.3	0.2	3.3
	Fugitive	26.7	5.1	10.3	100.3	1.6	0.02
	Mobile	170.0	17.7	0.9	1.0	0.2	8.3
	Subtotal	204.8	56.2	34.1	163.6	2.0	11.7
WPS	Process	10.6	10.8	7.6	17.1	14.83	66.0
	Fugitive	2.1	0.4	3.1	19.2	0.1	0.0
	Mobile	30.6	4.6	0.2	0.2	0.06	2.9
	Subtotal	43.3	15.8	10.9	36.4	15.0	68.9
Loadout	Process	1.0	0.1	0.2	1.4	0.0	0.0
	Fugitive	--	--	0.120	0.97	--	0.01
	Mobile	24.4	5.6	0.2	0.2	0.06	1.5
	Subtotal	25.3	5.7	0.5	2.5	0.06	1.5
TSF	Process	1.0	0.1	0.0	0.0	0.0	0.0
	Fugitive	--	--	32.3	208.8	--	0.1
	Mobile	341.6	40.6	2.0	2.0	0.7	20.5
	Subtotal	342.5	40.7	34.3	210.8	0.7	20.6
Facility Wide	Process	20.6	44.4	30.7	80.8	15.0	69.3
	Fugitive	28.8	5.5	45.8	329.3	1.8	0.2
	Mobile	566.5	68.5	3.3	3.4	1.0	33.2
	Total	615.9	118.4	79.8	413.4	17.8	102.7

The emissions provided in Table 2-4 are the maximum expected potential emissions from the Resolution Project. The emissions shown in this table represent the maximum mining activity (fugitive and mobile machinery) expected to occur during the life-of-mine (LOM) year 14 and process sources operating at maximum design capacity. However, the blasting activity will

⁸ PM, PM_{2.5}, and PM₁₀

⁹ PM_{2.5}, PM₁₀, Carbon Monoxide (CO), Oxides of Nitrogen (NO_x), Sulfur Dioxide (SO₂), Volatile Organic Compounds (VOC), and greenhouse gases

wane by LOM year 14. Further, the maximum area susceptible to wind erosion at the TSF is expected to occur during LOM year 41. Therefore, to be comprehensive and conservative, the peak blasting activity that will occur during development and the maximum estimated wind erosion emissions anticipated for the TSF have been combined with LOM year 14 and used in this analysis as a conservative approach. A detailed emissions inventory for the Resolution Project is provided in Appendix A.

In addition to the criteria pollutant emissions discussed in this section, there will be small amounts of Hazardous Air Pollutants (HAPs) emitted from the proposed Resolution Project sources. The estimated potential HAP emissions from the Project are less than the Maximum Achievable Control Technology (MACT) thresholds of 10 ton/yr of a single HAP or 25 ton/yr of combined HAPs. Therefore, the Resolution Project will be classified as an area (or minor) source and will not be subject to MACT review required by 40 CFR 63. The HAP emissions inventory and calculations are also provided in Appendix A.

2.7 Regulatory Basis

The Resolution Project is located in the Central Arizona Intrastate (CAI) Air Quality Control Region (AQCR). The current attainment status of the CAI AQCR and location of Resolution Project facilities are presented in Figure 2-13. This figure shows that the EPS will be partially located in the Hayden PM₁₀ Nonattainment area. The FP&LF will be located in the West Pinal PM₁₀ Nonattainment area. All remaining facilities will be located in areas that are unclassifiable or in attainment for all criteria pollutants. All facilities are located outside of EPA's recently determined nonattainment area (also shown in Figure 2-13) for the 2015 8-hour ozone NAAQS. Table 2-5 compares the facility-wide¹⁰ process emissions¹¹ to the major source thresholds. Since some of the sources will be located in moderate PM₁₀ nonattainment areas, a 100 ton/yr major source threshold is used for PM₁₀. For all other air pollutants, the Prevention of Significant Deterioration (PSD) major source threshold of 250 ton/yr is used.

Table 2-5. Resolution Project Major Source Status Determination

Parameter	CO	NO _x	PM _{2.5}	PM ₁₀	SO ₂	VOC
Process Source Emissions (ton/yr)	20.6	44.4	30.7	80.8	15.0	69.3
PSD/NSR Major Source Threshold (ton/yr)	250	250	250	100	250	250
PSD/NSR Review Triggered	No	No	No	No	No	No

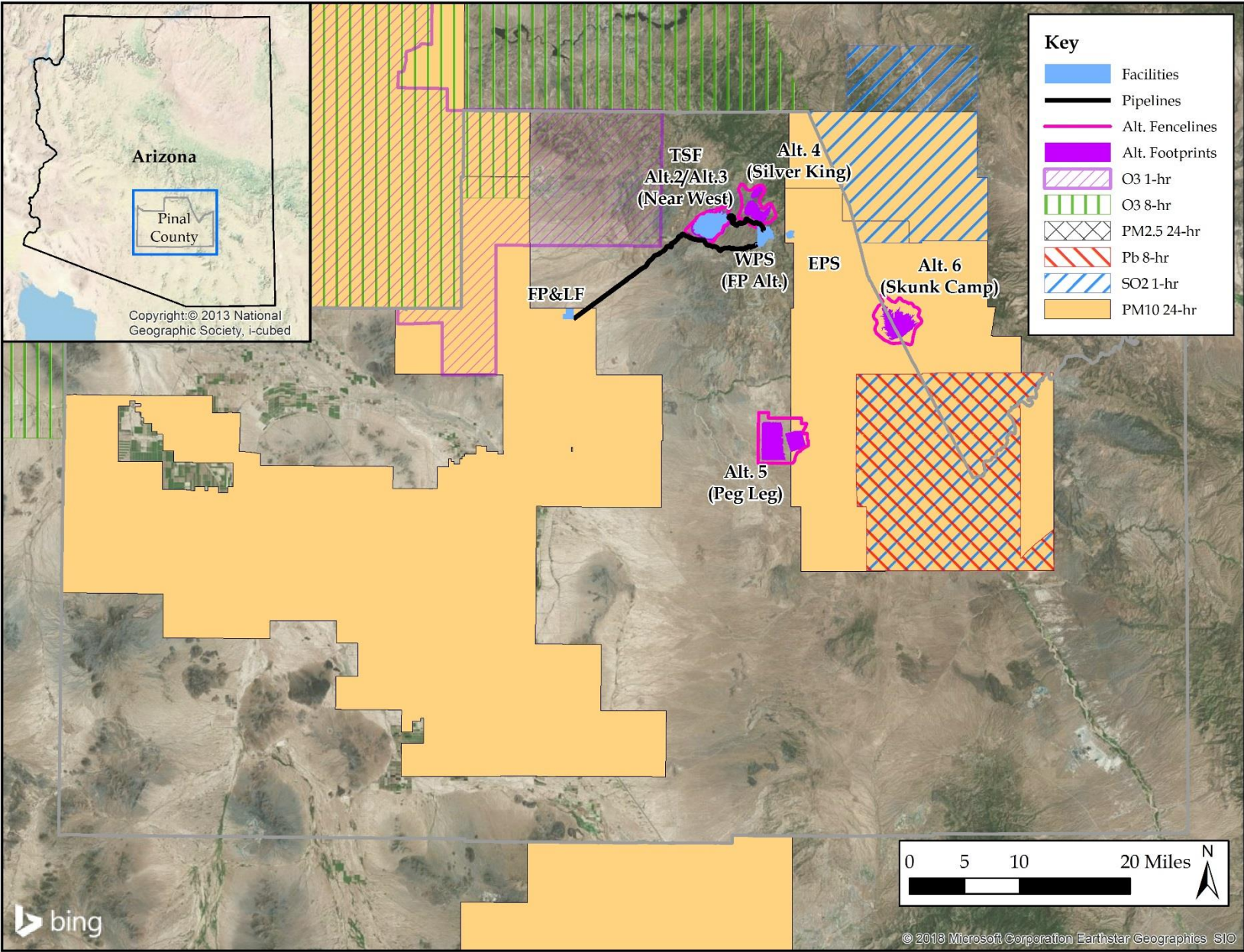
PSD = Prevention of Significant Deterioration; NSR = New Source Review

This table shows that the Resolution Project's potential process source emissions are less than the applicable major source thresholds; therefore, it is not a major source, and the air quality analysis follows the guidelines for non-major (minor) sources set forth in ADEQ 2015a.

¹⁰ While the various operational areas (EPS, WPS, TSF, and FP&LF) constitute separate sources, for purposes of this comparison, their emissions are combined.

¹¹ For purposes of this comparison, all process emissions are assumed to be "point" source emissions. Fugitive and tailpipe/non-road emissions are not included for major source determination per 40 CFR 52.21(b)(1)(iii) (PSD) and 40 CFR 21.165(a)(1)(iv)(C) (major nonattainment NSR).

Figure 2-13. CAI AQCR Attainment Status and GPA Location



Based on the permit application requirements provided in Chapter 3 of PCAQCD Code of Regulations (CR) and ADEQ 2015a, a separate air quality modeling analysis, consistent with the analysis described in this Modeling Report, will be prepared and submitted to PCAQCD to support the air permitting for the project by demonstrating compliance with the applicable PCAQCD (Chapter 2 of PCAQCD CR) and national (40 CFR 50) AAQS provided in Table 2-6, in units of micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) and/or parts per million (ppm). If a PCAQCD standard differs from the corresponding national standard, only the more stringent standard is provided in this table and used for compliance demonstration.

Table 2-6. AAQS for Compliance Demonstration

Pollutant	Averaging Period	AAQS		AAQS Form
		(ppm)	($\mu\text{g}/\text{m}^3$)	
CO	8-Hour	9	10,000	Not to be exceeded more than once per year
	1-Hour	35	40,000	
Nitrogen Dioxide (NO_2)	Annual	0.053	100	Annual mean
	1-Hour	0.1	188	98 th percentile, averaged over 3 years
Ozone	8-hour ⁽¹⁾	0.070	--	Fourth-highest daily maximum, averaged across 3 consecutive years
PM _{2.5}	Annual ⁽²⁾	--	12	Annual mean, averaged over 3 years
	24-Hour ⁽³⁾	--	35	98 th percentile, averaged over 3 years/second-high ⁽²⁾
PM ₁₀	Annual ⁽⁴⁾	--	50	Annual mean
	24-Hour	--	150	Not to be exceeded more than once per year on average over 3 years
SO ₂	Annual ⁽⁴⁾	0.03	80	Annual mean
	24-Hour ⁽⁴⁾	0.14	365	Not to be exceeded more than once per year
	3-Hour ⁽⁵⁾	0.5	1,300	Not to be exceeded more than once per year
	1-Hour	0.075	196	99 th percentile of 1-hour daily maximum concentrations, averaged over 3 years
Lead	Rolling 3-Month ⁽¹⁾	--	0.15	Not to be exceeded

⁽¹⁾ PCAQCD standard is 0.080 ppm.

⁽²⁾ PCAQCD standard is 15 $\mu\text{g}/\text{m}^3$.

⁽³⁾ PCAQCD standard is 65 $\mu\text{g}/\text{m}^3$.

⁽⁴⁾ PCAQCD standard only, no national standard.

⁽⁵⁾ Secondary standard only, no primary standard.

Lead emissions at the Resolution Project are well below the significant increase thresholds defined in 40 CFR 52.21. Therefore, lead is not addressed further.

The Project will emit precursor emissions that can cause secondary formation of ozone (O₃) and PM_{2.5}. Unlike the other criteria pollutants that are directly emitted from sources, O₃ and secondary PM_{2.5} are not directly emitted from emission sources. Rather, they are formed through a series of physical and/or photochemical reactions involving SO₂ and NO_x (precursor emissions for secondary PM_{2.5}) and VOC and NO_x (precursor emissions for O₃) in the atmosphere on a regional scale. Because of this, ADEQ modeling guidelines assert that, *“Modeling involving pollutant transformations (i.e. ozone, sulfates, etc.) is not generally required for new or modified sources and is not addressed in this guidance document”* (ADEQ 2015a). Section 3.1.13 Secondary PM_{2.5} and O₃ Formation describes the non-modeling approach, consistent with federal guidance, that was used to characterize the Project’s expected contribution to ambient ozone concentrations and secondary PM_{2.5} formation in the Project area.

2.8 Baseline Conditions

Resolution Copper has been monitoring and collecting ambient meteorological and air quality data since April 2012 at the EPS and WPS to establish baseline conditions for the air quality analysis. Table 2-7 lists the parameters and locations of the meteorological, upper air wind, and ambient air data that are collected in the GPA.

Table 2-7. Meteorological and Ambient Air Data Collected in the GPA

		Height (m)	East Plant	West Plant	Hewitt
AERMOD Meteorological Data	Horizontal wind speed (meters per second [m/s])	20			✓
	Horizontal wind direction (degrees [°])	20			✓
	Horizontal wind direction standard deviation (sigma theta)	20			✓
	Horizontal wind speed (meters per second [m/s])	10	✓	✓	✓
	Horizontal wind direction (degrees [°])	10	✓	✓	✓
	Horizontal wind direction standard deviation (sigma theta)	10	✓	✓	✓
	Air temperature (degrees Celsius [°C])	2	✓	✓	✓
	Vertical temperature difference (ΔT , Delta T, [°C])	2,10	✓	✓	✓
	Relative humidity (percent [%])	2	✓	✓	✓
	Solar radiation (watts per square meter [W/m ²])	2	✓	✓	✓
	Barometric pressure (millimeters of mercury [mmHg])	1	✓	✓	✓
	Precipitation (inches [in])	Ground	✓	✓	
Upper -Air	Wind speed by vector component (u,v,w; [m/s])	1			✓
	Wind direction by sub-hourly scalar mean (degrees [°])	1			✓
	Standard deviation of vector component (u, v, w)	1			✓
Ambient Air Data	FEM* Particulate matter less than 10 microns (PM ₁₀)	2,3	✓	✓	
	FEM* Particulate matter less than 2.5 microns (PM _{2.5})	2,3	✓	✓	
	Sulfur dioxide (SO ₂)	3	✓		
	Ozone (O ₃)	3	✓		
	Nitrogen dioxide (NO ₂)	3	✓		

*Federal Equivalent Method

Resolution Copper's meteorological and air quality data program is described in detail in the Resolution Copper Meteorological and Air Quality Monitoring Plan ("Monitoring Plan") prepared in consultation with PCAQCD and approved by PCAQCD on November 15, 2011 and July 20, 2016. The monitoring methods and procedures described in the Monitoring Plan were designed to meet the quality system requirements in 40 CR Part 58, Appendix A. Quarterly summaries and data files of these monitoring data are submitted to PCAQCD.

In 2015, Resolution Copper began meteorological monitoring, including surface and boundary layer (Sonic Detection and Ranging [SoDAR]) observations at the Hewitt station, located near the base of the site of the Near West TSF. Data from the Hewitt station have been used for

modeling of particulate emissions from the TSF. Quarterly data summaries and data files for the Hewitt station data have been provided to PCAQCD.

The quality control procedures for metrological ambient air data include weekly site checks, as well as quarterly sampler audits and calibrations. Multi-point calibrations of the NO_x, SO₂, and O₃ analyzers occurred upon installation and are now conducted biannually and in the event of malfunction, equipment relocation, or audit failures. Multi-point calibrations are used to assess the linearity of the analyzers. Multi-point audits of the NO_x, SO₂, and O₃ analyzers are conducted quarterly or as needed. Multi-point audits are used to assess the data accuracy and analyzer performance using certified, traceable standards different than those used for quality control calibration operations. Flow audits are performed on the PM₁₀ and PM_{2.5} samplers on a monthly basis.

The ambient air monitoring sites were primarily selected due to the representativeness of the locations and areas of potential emission sources at the Project as well as the distance from large terrain features. Criterion of secondary importance included the availability of line power and cellular communications. The site selection followed the EPA siting requirements outlined in 40 CFR Part 58, Appendix E and were approved by PCAQCD.

Data summaries for the EPS and WPS meteorological data are provided in Section 3.1.6, and pollutant- and averaging-period-specific baseline air quality data are discussed in Section 3.1.7.

3.0 AIR QUALITY ANALYSES

This section describes the modeling methods, procedures, and datasets that were used for the Resolution Copper air quality analyses to support TNF in its preparation of the EIS. The methods, procedures, and datasets described herein were utilized to prepare air quality impact analyses for the following scenarios:

- Proposed Action – Operations (TSF Alternative 2 – Near West; FP&LF near Magma Junction)
- Alternatives - Operations
 - FP&LF located within the footprint of West Plant (with TSF Alternative 4)
 - TSF Alternatives:
 - Alternative 3 – Modified Proposed Action – Near West
 - Alternative 4 – Silver King Filtered
 - Alternative 5 – Peg Leg
 - Alternative 6 – Skunk Camp
- Proposed Action – Construction (TSF Alternative 2 – Near West; FP&LF near Magma Junction).

3.1 Ambient Air Quality Analysis

3.1.1 Model Selection

The 18081 version of the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) modeling system was used for this air quality analysis. AERMOD is an enhanced steady-state, Gaussian plume model that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources and both simple and complex terrain (EPA 2004). The AERMOD modeling system is listed as the recommended model for short-range (near-field) analyses (up to 50 km) in 40 CFR 51, Appendix W.

3.1.2 Pollutants and Averaging Periods

The air quality analysis includes dispersion modeling for the pollutants and averaging periods presented in Table 3-1. This table also shows the short-term (up to 24-hour) modeled design values that were used for compliance demonstration.

Table 3-1. Pollutants and Averaging Periods

Pollutant	Averaging Period	Compliance Design Value
CO	8-Hour	2 nd High
	1-Hour	
NO ₂	Annual	8 th High (98 th percentile, averaged over 3 years)
	1-Hour	
PM _{2.5}	Annual	8 th High (98 th percentile, averaged over 3 years)
	24-Hour	
PM ₁₀	Annual	Not to be exceeded more than once per year on average over 3 years
	24-Hour	
SO ₂	Annual	2 nd High
	24-Hour	
	3-Hour	
	1-Hour	
		4 th High (99 th percentile, averaged over 3 years)

3.1.3 Building Downwash

The effects of the building-induced downwash were incorporated into this analysis. The building downwash parameters were calculated using version 04274 of the Building Profile Input Program with the Plume Rise Model Enhancement (BPIP-PRIME). Planned building locations and dimensions were acquired from Resolution Copper.

3.1.4 Ambient Air Boundary

To demonstrate compliance with federal and state ambient air standards, air dispersion models are used to simulate the atmospheric dispersion of an air pollutant to determine air pollution concentrations that result from a source's emissions. As part of the modeling setup process, Resolution Copper, in consultation with PCAQCD¹² has determined ambient air boundaries (AAB) that delineate where public access is effectively precluded. The air quality modeling includes receptors along Resolution's AAB and receptor grids outside the AAB.

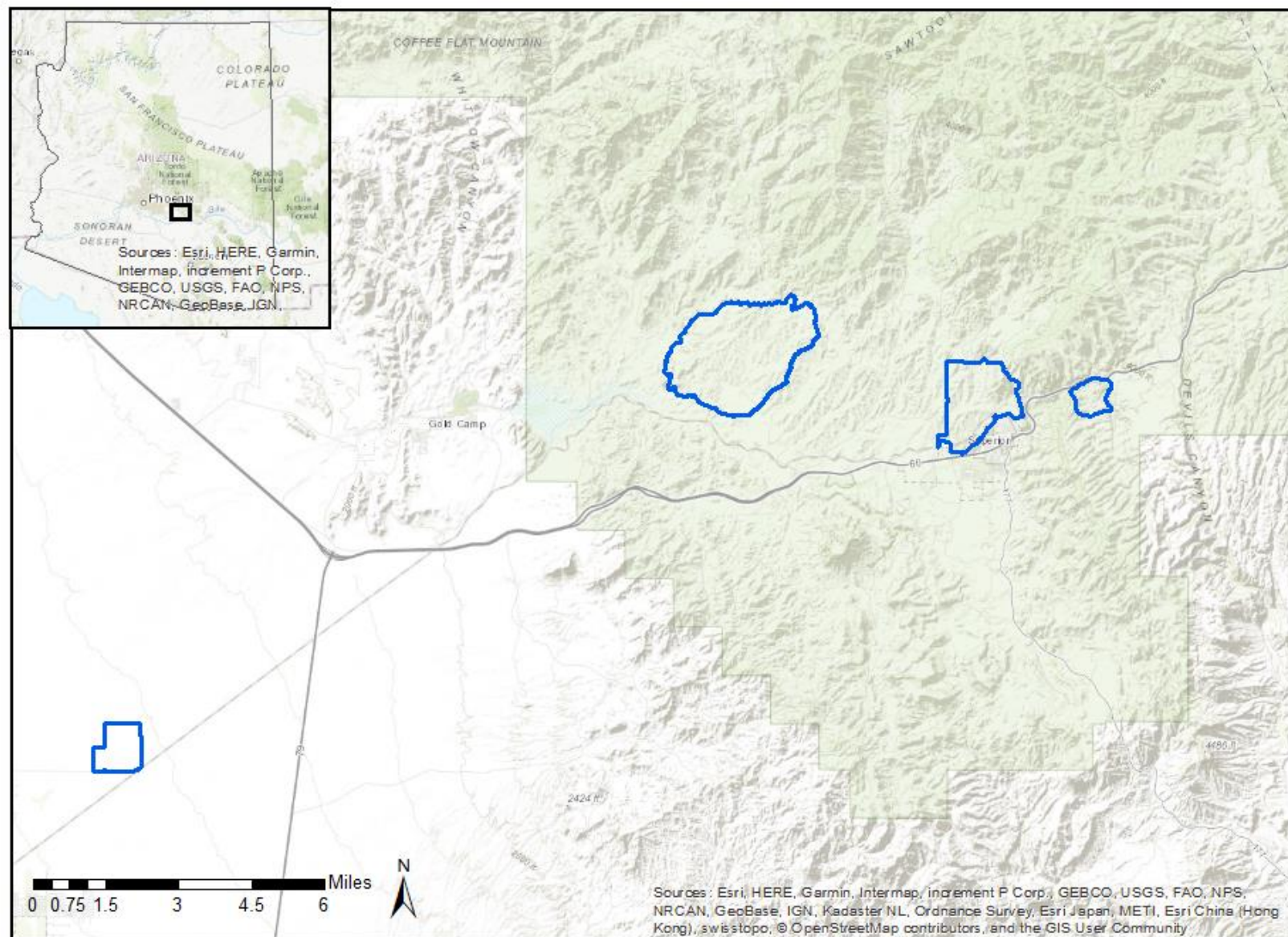
Pursuant to EPA guidance, and consistent with ADEQ 2015a, Section 3.4, the effective AAB can consist of a combination of fences and gates, physical barriers (including natural barriers), warning signage, manned guard shacks, and periodic security patrols. Each project area may use a combination of the following measures to preclude public access:

¹² The "Air Quality Impacts Analysis Modeling Plan for Permitting," approved by PCAQCD, includes the determination of ambient air boundaries for the Project.

- Fencing, berms, and locking gates – Fencing and locking gates will be used along public access roads and other locations near areas of heavy recreational use.
- Signage – Warning and/or no-trespassing signage will be posted on fences and near areas of natural barriers, trails, and recreation.
- Natural barrier/steep terrain – Steep slopes around the project areas will serve as natural barriers or impediments to site access. In general, steep terrain is considered to be terrain with a grade of 25 to 30 percent or greater.
- Periodic patrols – Mine security will routinely patrol the mine facilities and roads for unauthorized individuals. In addition, all onsite personnel will be briefed on the necessity of restricting public access to areas within the AAB. Any suspected trespassing will be immediately reported to security.
- Site security – Authorized access will be controlled by guard shack, where a check-in/check-out system will be implemented. All mine personnel and visitors must gain access to the site through one of these points.

The AAB for the Proposed Action are shown in Figure 3-1. The ambient air boundaries for the alternative TSF locations will be the limit of public access shown in Figure 2-2.

Figure 3-1. Ambient Air Boundaries and Preclusion of Public Access (Proposed Action)



3.1.5 Modeling Receptors

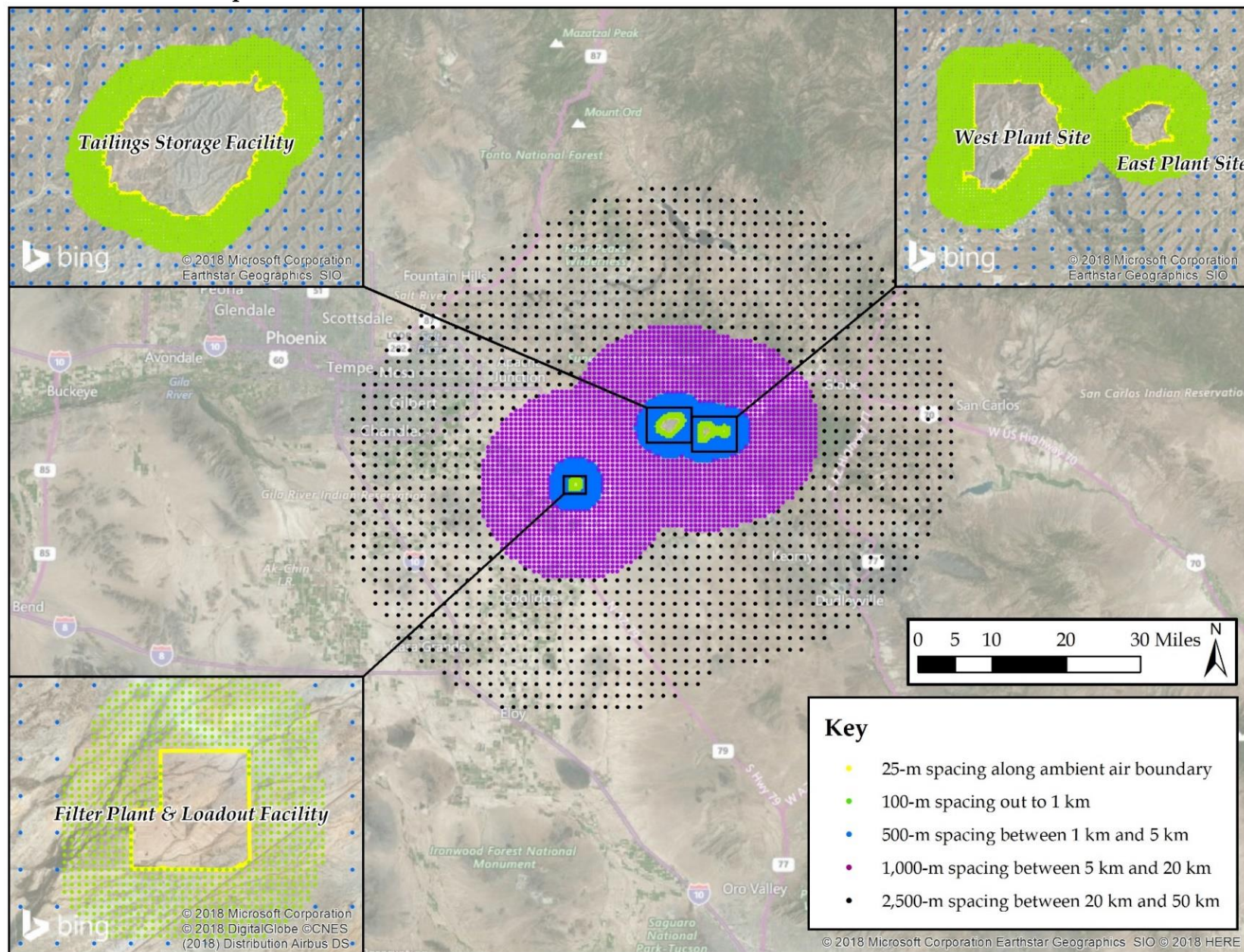
A series of nested receptor grids were used for this analysis to estimate ambient pollutant concentrations resulting from the potential emissions. The following receptor spacing and extents around each facility, in accordance with ADEQ 2015a, Section 3.6, were used for this analysis:

- 25-meter (m) spacing along the AAB
- 100-m spacing out to 1 km from the AAB
- 500-m spacing between 1 km and 5 km from the AAB
- 1,000-m spacing between 5 km and 20 km from the AAB
- 2,500-m spacing between 20 km and 50 km from the AAB
- Additional receptors of interest, as appropriate, on the boundaries or within the Class I Superstition Wilderness Area and the White Canyon Area of Critical Environmental Concern (ACEC) (for near-field evaluation of impacts to AQRVs only)

The 18081 version of the AERMOD terrain preprocessor, AERMAP, was used to develop the receptor elevations and hill heights. A 1/3 arc-sec (10-m) resolution United States Geological Survey (USGS) National Elevation Dataset (NED) file was used for this processing.

The AERMOD receptor network is presented in Figure 3-2. Receptor networks surrounding the alternative TSF facilities were developed per the receptor spacing and extents listed above. The alternative receptor grids started with the preferred alternative grid and were modified as follows. A 25-meter spacing along the tailings footprint was added, any grid receptors that fell within this boundary were removed, and for alternatives not located at the Near West site, a 100-m spacing fill grid covering the Near West footprint was added. For the filter plant alternative location at West Plant (Alternative 4), a 100-m spacing fill grid for the far west site was also added.

Figure 3-2. AERMOD Receptor Network



3.1.6 Meteorological Data

AERMOD requires an input of hourly meteorological data to estimate pollutant concentrations in ambient air resulting from modeled source emissions. The EPA's Guideline on Air Quality Models states that *"5 years of NWS meteorological data or at least 1 year of site specific data is required"* for an air quality modeling analysis (40 CFR 51, Appendix W, 8.3.1.2 b.).

The 16216 version of the AERMOD meteorological preprocessor (AERMET) was used to generate AERMOD-input-ready hourly meteorological files for this analysis. Each of the site-specific datasets (detailed below) was supplemented with cloud cover data from a representative National Weather Service (NWS) station (e.g., Phoenix-Mesa located approximately 35 miles west of the GPA) and twice-daily upper-air data from the Tucson NWS station, located approximately 75 miles south of the GPA.

3.1.6.1 Surface Meteorological Datasets

For this analysis, Resolution Copper used two years of site-specific hourly surface meteorological data collected at the EPS, WPS, and Hewitt monitoring stations from January 1, 2015, through December 31, 2016. These monitoring stations were sited and have been operated per the Resolution Copper Mining Monitoring Plan that has been prepared according to applicable ADEQ and U.S. Environmental Protection Agency (EPA) guidance and submitted to, reviewed, and approved by PCAQCD. The EPS sources were modeled using the EPS meteorological data (tower sensors mounted at 10-meter height), the tailings facilities (the Proposed Action and alternatives) were modeled using the Hewitt meteorological data (SoDAR data collected at 10-meter increments from 20 meters to 190 meters),¹³ and West Plant, the FP&LF, and MARRCO Corridor were modeled using the WPS meteorological data (tower sensors mounted at 10-meter height).

The Hewitt meteorological dataset was used to model the tailings activity impacts for the proposed action and each of the alternatives. By modeling the Hewitt meteorological dataset for all alternatives with the tailings site emissions, direct comparisons can be made between the alternatives' impacts and wind erosion emissions. Further, the vertical wind profile data from the SoDAR was processed with AERMET into a profile file used by AERMOD to determine the wind speed and direction for a variety of altitudes.

The locations of the onsite monitoring and associated NWS stations in relation to the Resolution Project facilities are provided in Figure 3-3. The wind frequency distribution diagrams for the onsite monitoring stations are presented in Figure 3-4.

¹³ In the absence of valid SoDAR data for any given hour(s) in the 2-year meteorological dataset, the 20-meter Hewitt tower wind speed and direction data was substituted.

Figure 3-3. Location of Monitoring Stations

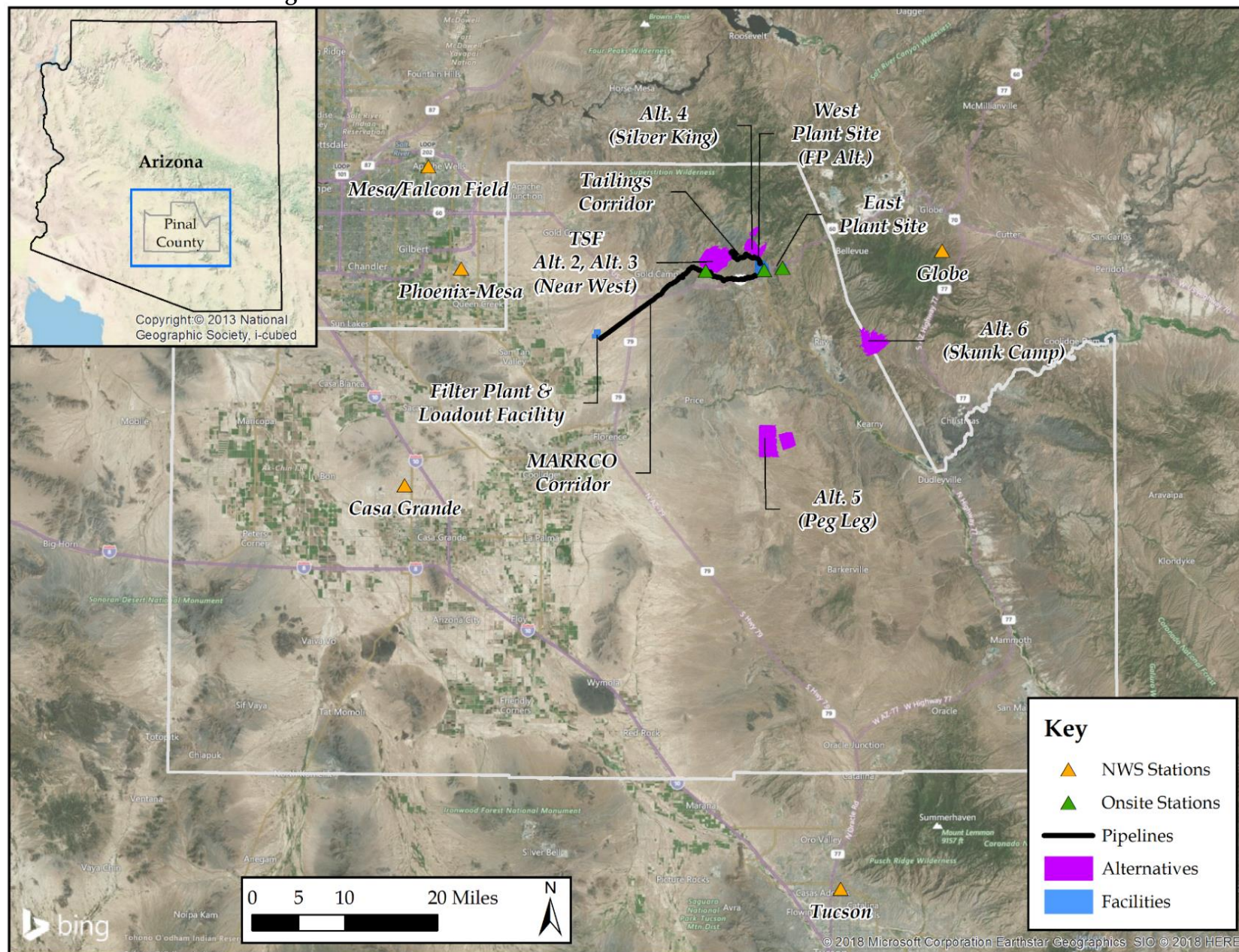
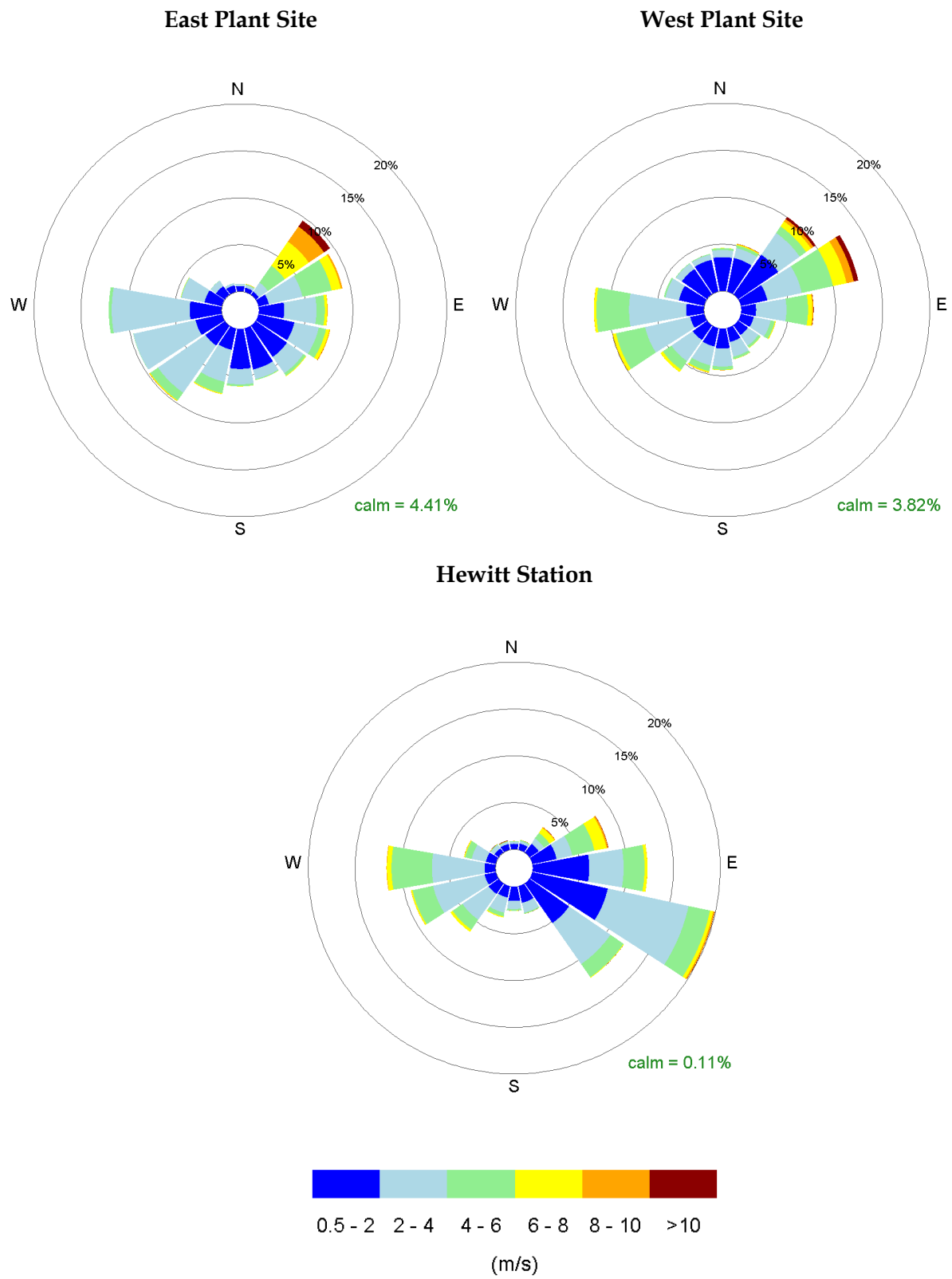


Figure 3-4. Wind Frequency Distribution for Resolution Monitoring Stations, 2015-2016



3.1.6.2 Adjusted Friction Velocity Calculation Method

EPA integrated ADJ_U* as a regulatory default option in the AERMET (beginning in version 16216) meteorological processor for AERMOD to address issues with model overprediction of ambient concentrations associated with the underprediction of the surface friction velocity (u^*) during light wind and stable wind conditions. ADJ_U* is a processing option that affects the meteorology for low wind speeds during stable (nighttime) conditions (EPA 2014a). Based on a series of model evaluation studies, the ADJ_U* option improves model performance for low release height sources whose impacts occur under low wind speed conditions (EPA 2017).

PCAQCD has approved the application of the ADJ_U* method for the Resolution Project AERMOD modeling analysis as the terrain, meteorological, and emission characteristics meet the criteria under which the default option in AERMOD (i.e., no low wind speed correction) is known to overpredict ambient concentrations. The ADJ_U* method is intended to significantly improve AERMOD's performance for sites and sources similar to the Resolution Project, where emissions are released at low heights (typical of mining sources), low wind speeds are present for significant periods (as indicated in the wind roses presented in Figure 3-4, and the project is located in a region with complex terrain.

In the 2017 Revisions to Appendix W to CFR 40 Part 51 and AERMOD version 16216r, the EPA adopted the ADJ_U* method as a regulatory default option. The EPA has stated that AERMOD may possibly underpredict impacts when the ADJ_U* option is combined with site-specific turbulence data. Therefore, the EPA adopted ADJ_U* as a default option only when used without turbulence data (EPA 2017).

Considering the poor performance of the non-ADJ_U* method for low release height sources and the significant improvement by the ADJ_U* method, Resolution Copper processed the modeling met data with the ADJ_U* option. Additionally, when processing the meteorological data with AERMET and ADJ_U*, Resolution Copper removed site-specific turbulence parameters so that AERMOD could be run in the default mode. This adjustment to the processed meteorological data addressed two important matters to improve the model:

1. AERMOD may be run in the default mode.
2. AERMOD is less likely to underpredict impacts

3.1.6.3 Surface Characteristics for AERMET Processing

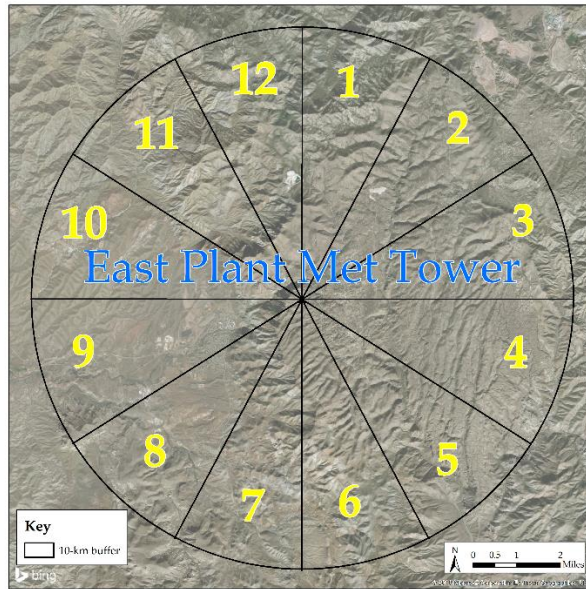
AERMET requires the input of three surface boundary layer parameters: midday Bowen ratio (B_0), midday albedo (r), and surface roughness length (z_0). These parameters are dependent on the land use and vegetative cover of the area being evaluated. The EPA has provided the recommended methods for determining these surface parameters based on 1992 National Land Cover Data (NLCD92) and released an AERMOD land cover preprocessor (AERSURFACE) for this purpose.

The 13016 version of AERSURFACE was used to estimate the surface characteristic parameters for meteorological data processing. AERSURFACE requires the input of land cover data from the USGS NLCD92 archives, which it uses to determine the land cover types for the user-specified location. Each of the land cover categories in the NLCD92 archive is linked within AERSURFACE to a set of seasonal surface characteristics.

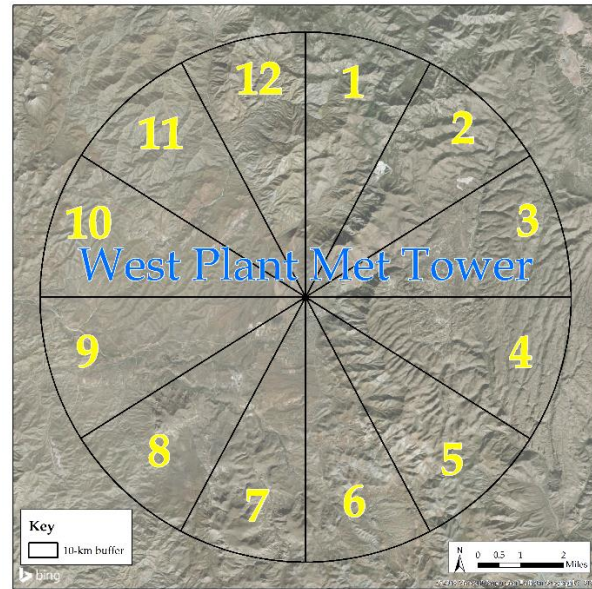
AERSURFACE was run for each onsite meteorological tower location with 12 sectors (in 30-degree increments starting from north). High-resolution aerial photographs showing a 10-km radius and the surface roughness length segments around the three onsite meteorological towers are provided in Figure 3-5 for the three Resolution monitoring stations.

Figure 3-5. Surface Roughness Length Segments - Resolution Monitoring Stations

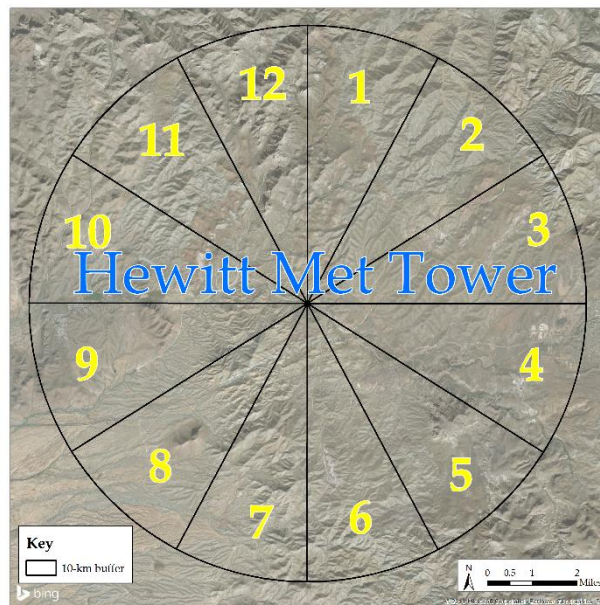
East Plant Site



West Plant Site



Hewitt Station



The determination of B_o is dependent on ambient moisture conditions (i.e., wet, average, or dry). For this purpose, historic 30-year precipitation data from the representative nearby NWS station shown in Table 2-2 will be used. The 70th and 30th percentile values estimated from the 30-year precipitation data were used to assign a moisture class to each calendar month per the following scheme: monthly precipitation greater than 70th percentile as wet, between 70th and 30th percentile as average, and less than 30th percentile as dry (EPA 2008, revised 2013). The monthly estimated B_o and the seasonal estimated z_o for the EPS ($r = 0.23$), WPS ($r = 0.24$), and Hewitt ($r = 0.25$) are presented in Table 3-2 to Table 3-7.

Table 3-2. Bowen Ratio (B_o) by Month – EPS

Year	Month	Moisture Class	Bowen Ratio
2015	January	Wet	1.51
2015	February	Dry	7.42
2015	March	Average	4.34
2015	April	Wet	0.84
2015	May	Wet	0.84
2015	June	Wet	0.84
2015	July	Average	2.76
2015	August	Average	2.76
2015	September	Wet	1.13
2015	October	Wet	1.51
2015	November	Wet	1.51
2015	December	Average	4.34
2016	January	Wet	1.51
2016	February	Average	4.34
2016	March	Dry	7.42
2016	April	Average	2.33
2016	May	Wet	0.84
2016	June	Wet	0.84
2016	July	Wet	1.13
2016	August	Dry	4.39
2016	September	Dry	4.39
2016	October	Average	4.34
2016	November	Wet	1.51
2016	December	Wet	1.51

Table 3-3. Surface Roughness Length (z_0) by Sector and Season - EPS

Sector	Winter	Spring	Summer	Fall
1	0.196	0.205	0.209	0.209
2	0.177	0.187	0.191	0.191
3	0.187	0.187	0.188	0.188
4	0.187	0.187	0.187	0.187
5	0.166	0.166	0.166	0.166
6	0.163	0.163	0.163	0.163
7	0.162	0.162	0.162	0.162
8	0.156	0.156	0.156	0.156
9	0.154	0.154	0.154	0.154
10	0.161	0.161	0.161	0.161
11	0.160	0.162	0.163	0.163
12	0.187	0.194	0.197	0.197

Source: USGS NLCD92; AERSURFACE

Table 3-4. Bowen Ratio (B_o) by Month - WPS

Year	Month	Moisture Class	Bowen Ratio
2015	January	Wet	1.68
2015	February	Dry	8.23
2015	March	Average	4.87
2015	April	Wet	0.90
2015	May	Wet	0.90
2015	June	Wet	0.90
2015	July	Average	3.16
2015	August	Average	3.16
2015	September	Wet	1.26
2015	October	Wet	1.68
2015	November	Wet	1.68
2015	December	Average	4.87
2016	January	Wet	1.68
2016	February	Average	4.87
2016	March	Dry	8.23
2016	April	Average	2.56
2016	May	Wet	0.90
2016	June	Wet	0.90
2016	July	Wet	1.26
2016	August	Dry	4.91
2016	September	Dry	4.91
2016	October	Average	4.87
2016	November	Wet	1.68
2016	December	Wet	1.68

Table 3-5. Surface Roughness Length (z_0) by Sector and Season – WPS

Sector	Winter	Spring	Summer	Fall
1	0.186	0.188	0.188	0.188
2	0.21	0.218	0.218	0.218
3	0.197	0.210	0.210	0.210
4	0.214	0.245	0.247	0.247
5	0.274	0.334	0.338	0.338
6	0.289	0.354	0.357	0.356
7	0.299	0.344	0.347	0.347
8	0.24	0.248	0.249	0.249
9	0.218	0.222	0.222	0.222
10	0.082	0.082	0.082	0.082
11	0.107	0.108	0.108	0.108
12	0.203	0.209	0.209	0.209

Source: USGS NLCD92; AERSURFACE

Table 3-6. Bowen Ratio (B_o) by Month – Hewitt

Year	Month	Moisture Class	Bowen Ratio
2015	January	Wet	1.97
2015	February	Dry	9.78
2015	March	Average	5.90
2015	April	Wet	0.99
2015	May	Wet	0.99
2015	June	Wet	0.99
2015	July	Average	3.92
2015	August	Average	3.92
2015	September	Wet	1.48
2015	October	Wet	1.97
2015	November	Wet	1.97
2015	December	Average	5.90
2016	January	Wet	1.97
2016	February	Average	5.90
2016	March	Dry	9.78
2016	April	Average	2.96
2016	May	Wet	0.99
2016	June	Wet	0.99
2016	July	Wet	1.48
2016	August	Dry	5.89
2016	September	Dry	5.89
2016	October	Average	5.90
2016	November	Wet	1.97
2016	December	Wet	1.97

Table 3-7. Surface Roughness Length (z_0) by Sector and Season – Hewitt

Sector	Winter	Spring	Summer	Fall
1	0.150	0.150	0.150	0.150
2	0.150	0.150	0.150	0.150
3	0.150	0.150	0.150	0.150
4	0.154	0.154	0.154	0.154
5	0.157	0.158	0.158	0.158
6	0.150	0.150	0.150	0.150
7	0.150	0.150	0.150	0.150
8	0.150	0.150	0.150	0.150
9	0.152	0.152	0.152	0.152
10	0.154	0.155	0.156	0.156
11	0.150	0.150	0.150	0.150
12	0.150	0.150	0.150	0.150

Source: USGS NLCD92; AERSURFACE

3.1.7 Background Concentrations

Resolution Copper has collected ambient particulate ($PM_{2.5}$ and PM_{10}) concentrations at both the EPS and the WPS monitoring stations, and gaseous (NO_2 , O_3 , and SO_2) concentrations at the EPS monitoring station, for the period of April 2012 through December 2017 to establish pre-construction baseline concentrations. The monitored pollutant concentrations are considered to be representative of background air quality that is influenced by air pollution from several sources:

- Emissions from nearby existing sources
- Air pollution transported to the project area from more distant urban areas and industrial sources
- Natural sources of pollution

In the modeling analysis, the monitored background concentrations were added to the modeled concentrations given project emissions. The total concentration (background plus modeled impact) accounts for air pollution sources that influence air quality in the project area but were not expressly modeled. The Air Quality Impacts Analysis Modeling Plan for Permitting (as approved by PCAQCD) includes detailed documentation and analysis of the development of representative background concentrations to be used for the permitting and NEPA analyses.

Datasets of monitored and representative background pollutant data were selected based on availability and completeness. The data years used for representative background pollutant concentrations are noted in Table 3-8. The background value for CO was extracted from the 2014, 2015, and 2016 ADEQ Annual Ambient Air Assessment Reports (ADEQ 2015b, ADEQ 2016, ADEQ 2017). All data through 2017 have been reviewed and approved by PCAQCD. For

NO₂ (1-hour), a temporally varying background profile developed from the EPS monitoring station hourly data was used.

A paired-sums approach for PM₁₀ and PM_{2.5} was used. In this method, for total ambient 24-hour PM₁₀/PM_{2.5} concentrations to be compared to the 24-hour NAAQS, the modeled impact for each calendar day is added to the measured onsite PM₁₀/PM_{2.5} concentration for that day in accordance with ADEQ 2015a, Section 7.4.1. This method more accurately characterizes predicted total PM₁₀/PM_{2.5} concentrations because of the correlations between meteorological conditions, monitored PM₁₀/PM_{2.5} concentrations, and modeled concentrations. The availability of contemporaneously monitored PM₁₀/PM_{2.5} concentrations and meteorological data allows for the monitored PM concentration to be compared in time with the modeled concentration.

Within the monitored particulate dataset for use in the paired-sums approach, there are days of elevated PM₁₀ and/or PM_{2.5} concentrations at the EPS and WPS stations. This project is located in a region that occasionally experiences elevated ambient particulate concentrations influenced by natural events such as wind-generated dust storms and wildfires. In addition, elevated particulate concentrations have been influenced by particulate pollution from nearby anthropogenic activities that are temporary and unlikely to reoccur (e.g., major highway construction on the portion of Highway 60 that runs through Superior). Given the purpose of the monitoring data, which is to establish background concentrations for modeling considered representative of the project area during mining operations, and consistent with applicable state and federal guidance, rules, and policy, an analysis was undertaken in order to identify monitored data that was influenced by natural events or unusual anthropogenic activity. Only monitored concentrations that were four times the standard deviation above the median were considered in this analysis. (Statistically, this provides an indication of a potential outlier, or non-representative data point.) If available information supported the occurrence of natural events or unusual anthropogenic activity, such data were excluded from the background concentration dataset.

In accordance with this methodology, a total of ten days were identified that suggested concentrations potentially influenced by natural events or unusual anthropogenic activity. Several sources of data and information were used for the analyses, including: pollution roses, onsite meteorological data and particulate concentrations, surface weather maps, wind fields, images from regional cameras, Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) forward and reverse trajectory models, particulate monitors from the PCAQCD monitoring network, satellite imagery, radar, regional air quality indexes, and BlueSky smoke models. The analyses were summarized in “dashboards” (Appendix B of the Model Plan for Permitting) that were reviewed by PCAQCD. Based on PCAQCD’s review (summarized in a December 7, 2017 letter), particulate data from three days (out of the possible ten days) were removed from the background dataset.

For the paired-sums approach to add monitored background PM₁₀/PM_{2.5} concentrations to modeled impacts, a background concentration is required for every day of the modeling period (January 1, 2015 – December 31, 2016). Particulate data that are missing, invalid, or removed from the background dataset were replaced using the following two-tier gap-filling procedure specified by PCAQCD (K. Walch email, August 28, 2017):

- Tier 1 - Any missing PM₁₀ or PM_{2.5} data should be filled using the measured PM₁₀ and/or PM_{2.5} collected data at the closest monitoring site if available. For the town of Superior sites, this would be East Plant and West Plant or vice-versa.
- Tier 2 - When the monitoring data are missing at the closest monitoring location, a monthly gap-fill value shall be determined for each monitoring site. For PM₁₀, the highest monitored concentration for the month averaged over the monitoring program period shall be used. For PM_{2.5}, the second-highest monitored concentration for the month averaged over the duration of monitoring program period shall be used.

The design background concentrations developed from the EPS and WPS monitoring data, presented in Table 3-8, will be used for this analysis to account for the prevailing ambient pollutant concentrations. These design concentrations were developed following the guidance provided in ADEQ 2015a.

Table 3-8. Modeled Background Concentrations

Pollutant	Averaging Period	Background Concentration		Unit	Form of Background Concentration
		($\mu\text{g}/\text{m}^3$)	Value		
CO	8-Hour	2,519	2.2	ppm	Highest Concentration from 3 years (2014 - 2016)
	1-Hour	3,550	3.1	ppm	
Nitrogen Dioxide (NO ₂)	Annual	3.01	1.6	ppb*	Highest Concentration from 3 years (Q2 2012 - Q1 2015)
	1-Hour	Profile	--	--	3-Year Average Highest Monthly Hour-of-Day Concentrations (Q2 2012 - Q1 2015)
East Plant PM _{2.5}	Annual	Profile	--	--	24-hour Monitored Concentration Paired with Modeled Impact Concentration for Same Day
	24-Hour				
East Plant PM ₁₀	Annual	Profile	--	--	24-hour Monitored Concentration Paired with Modeled Impact Concentration for Same Day
	24-Hour				
West Plant PM _{2.5}	Annual	Profile	--	--	24-hour Monitored Concentration Paired with Modeled Impact Concentration for Same Day
	24-Hour				
West Plant PM ₁₀	Annual	Profile	--	--	24-hour Monitored Concentration Paired with Modeled Impact Concentration for Same Day
	24-Hour				
SO ₂	Annual	2.1	0.8	ppb	Highest Annual Concentration from 3 years (2013, 2015, 2016)
	24-Hour	11.0	4.2	ppb	Highest 24-hour Concentration from 3 years (2013, 2015, 2016)
	3-Hour	30.7	11.7	ppb	Highest 3-hour Concentration from 3 years (2013, 2015, 2016)
	1-Hour	24.4	9.3	ppb	99 th Percentile of the Annual Distribution of Daily Maximum 1-Hour Values Averaged Over 3 Years (2013, 2015, 2016)

*ppb = parts per billion

3.1.8 Emissions and Characterization

3.1.8.1 Source Emissions - Proposed Action

A comprehensive emissions inventory for the Resolution Project has been developed and is provided in Appendix A. A variety of sources, including AP-42 emission factors, performance data from similar sources, manufacturer specifications, New Source Performance Standards (NSPS), best operating practices, engineering design of the facility, and technical literature has been utilized to develop the Resolution Project emissions inventory.

A summary of the Resolution Project maximum potential emissions for model input, by source category, is provided in Table 3-9.

Table 3-9. Maximum Potential Emissions Summary by Source Category (ton/yr)

Source Category	CO	NO _x	PM _{2.5}	PM ₁₀	SO ₂
Process	7.7	10.5	29.6	79.6	14.8
Fugitive	28.8	5.5	45.8	329.3	1.8
Mobile	566.5	68.5	3.3	3.4	1.0
Emergency	12.96	33.89	1.14	1.14	0.21
Total	615.9	118.4	79.8	413.4	17.8

The emissions provided in Table 3-9 are based on the maximum design rates for the process (including process fugitive) sources, and the fugitive and mobile machinery emissions represent the maximum annual emissions over the project life (Section 2.6). The emergency equipment emissions are based on 500 hours per year in accordance with PCAQCD guidance.¹⁴

Table 3-10. Emission Calculation Techniques per Averaging Period

Source Type	Emission Rate Averaging Period		
	1-hour	24-hour	Annual
Process	Intermittent sources' emissions based on annual average activity rates (See Section 3.1.11); all other sources' emissions based on maximum hourly activity rates.	All sources' emissions based on maximum hourly activity rates.	All sources emissions' based on maximum annual process rates.
Fugitive & Mobile	All sources' emissions based on annual average hourly activity rates.	All sources' emissions based on annual average hourly rates.	Unpaved road emissions' estimate incorporate precipitation correction factor; all other sources' based on annual average activity rates.

The process sources with exhaust stacks, such as generators, heaters, and baghouse/dust-collector-equipped sources (crushers, silos, transfer points, apron feeders, etc.), were modeled as POINT sources with design release characteristics. The fugitive process sources, such as ore transfers at the WPS, were characterized as VOLUME sources in the model.

¹⁴ Based on up to 100 hours of non-emergency use (per New Source Performance Standard (NSPS) 40 CFR 60.4211.f.2) and total annual use of 500 hours (emergency and non-emergency use). Email correspondence with K. Walch (PCAQCD), April 14, 2014.

Emissions from underground operations at the EPS will exit through a mine ventilation system (mine vents). The mine vents were modeled as POINT sources.

Emissions from surface activities at the EPS and TSF (fugitive dust and tailpipe emissions) were aggregated and assigned to appropriate modeled fugitive activity locations. Each model input fugitive location was characterized as a VOLUME or an AREA source. The applicable model input physical parameters for VOLUME and AREA sources were developed based on appropriate polygons within the actual footprint of each fugitive activity location.

Source-specific model input emission rates in grams per second (or grams per second per meter squared) and release parameters are provided in Appendix B.

Hourly emissions profiles for wind erosion from exposed surfaces (tailings dry beach, tailings dam, and subsidence area) were developed using the fastest-mile method specified in AP-42, Section 13.2.5. Using this method, each hourly wind speed was converted to a fastest mile by multiplying it by a factor of 1.2.¹⁵ The estimated hourly fastest-mile values were used to calculate the friction velocity using AP-42, Section 13.2.5, Equation 4. When a friction velocity exceeded the material-specific threshold friction velocity, a wind erosion potential (in grams of particulate per square meter of erodible surface) was calculated using AP-42, Section 13.2.5, Equation 3. Hourly wind erosion potentials were multiplied by the applicable erodible surface areas to calculate the particulate emissions for every hour.

The new erodible area (A_{New}) for surface that is not re-disturbed (tailings beach and dam, subsidence) between wind erosion events is calculated, as:

$$A_{New} = A_{Hourly} \times Hr_{Elapsed}$$

Where:

A_{Hourly} is the annual average hourly newly created surface area; and

$Hr_{Elapsed}$ is the number of hours elapsed since the previous wind erosion event.

The hourly emissions profile was input into AERMOD using an external file and the HOUREMIS keyword in the input file. Sample wind erosion emission calculations are provided in Appendix C.

3.1.8.2 Source Emissions - Alternatives

A comprehensive emissions inventory for the Resolution Project Alternatives has been developed. A variety of information sources, including AP-42 emission factors, manufacturer specifications, NSPS, best operating practices, engineering design of the facility, and technical literature has been utilized to develop the Resolution Project Alternatives emissions inventory.

¹⁵ Adopted from EPA's guidance document for modeling fugitive dust impacts from coal mines (EPA 1994).

The emissions are based on the maximum design rates for the process (including process fugitive) sources, and the fugitive and mobile machinery emissions represent the maximum annual emissions over the project life. Emissions from emergency equipment were based on 500 hours per year in accordance with PCAQCD guidance.

Stationary process sources with exhaust stacks, such as generators, were modeled as POINT sources with representative (i.e., “as designed” or per data on technical specification sheets from equipment manufactures) release characteristics. The fugitive process sources, such as uncontrolled ore transfers, were characterized as VOLUME sources in the model.

Emissions from fugitive activities at each alternative (fugitive dust and tailpipe emissions) were aggregated and assigned to appropriate modeled fugitive activity locations. Each model input fugitive location was characterized as a VOLUME or an AREA source. The applicable model input physical parameters for VOLUME and AREA sources were developed based on appropriate polygons within the actual footprint of each fugitive activity location for each alternative.

Source-specific model input emission rates were converted to grams per second (or grams per second per meter squared) for input to AERMOD.

Hourly emissions profiles for wind erosion from exposed surfaces (from areas susceptible to wind erosion) were developed using the fastest-mile method specified in AP-42, Section 13.2.5. Using this method, each hourly wind speed was converted to a fastest mile by multiplying it by a factor of 1.2. The estimated hourly fastest-mile values were used to calculate the friction velocity using AP-42, Section 13.2.5, Equation 4. When a friction velocity exceeds the material-specific threshold friction velocity, a wind erosion potential (in grams of particulate per square meter of erodible surface) was calculated using AP-42, Section 13.2.5, Equation 3. Hourly wind erosion potentials were multiplied by the applicable erodible surface areas to calculate the particulate emissions for every hour.

A summary of estimated annual emissions from the alternative TSFs being considered for the Project is presented in Table 3-11.

Table 3-11. Maximum Potential Annual Emissions Summary by Alternative (ton/yr)

Alternative	Description	PM ₁₀	PM _{2.5}	CO	NO _x	SO ₂	VOC
Alt. 2	Near West, “wet”, modified centerline, subaqueous PAG	413.4	79.8	615.9	118.4	17.8	102.7
Alt. 3	Near West, thickened NPAG (“dry”), modified centerline, PAG under water cover and segregated	408.4	79.3	610.8	117.8	17.8	102.4
Alt. 4	Silver King, filtered tailings, two separate areas for NPAG and PAG	409.4	92.6	667.8	128.5	17.9	104.5
Alt. 5	Peg Leg centerline dam, thickened NPAG, separate PAG (downstream dam and water cover)	508.5	81.7	716.1	130.0	18.0	108.1
Alt. 6	Skunk Camp centerline dam, thickened NPAG, separate PAG (downstream dam and water cover)	413.6	79.8	612.4	117.9	17.8	102.4

3.1.8.3 Construction Emissions – Proposed Action

An emissions inventory for the construction of each of the four facilities (EPS, WPS, TSF, FP&LF), as well as the tailings corridor, has been developed. A variety of information sources, including AP-42 emission factors, contractor estimates, NSPS, best operating practices, engineering design of the facility, and technical literature has been utilized to develop the construction emissions inventory.

The emission estimates are based on the operating capacities for the process (including process fugitive) sources, and the fugitive and mobile machinery emissions are based on the expected maximum annual emissions over the construction period.¹⁶

Stationary process sources with exhaust stacks, such as generators, were modeled as POINT sources with representative (i.e., “as designed” or per data on technical specification sheets from equipment manufactures) release characteristics. The fugitive process sources, such as uncontrolled ore transfers, were characterized as VOLUME sources in the model.

Emissions from fugitive activities at each construction area (fugitive dust and tailpipe emissions) were aggregated and assigned to appropriate modeled fugitive activity locations. Each model input fugitive location was appropriately characterized as a VOLUME or an AREA source. The applicable model input physical parameters for VOLUME and AREA sources were developed based on appropriate polygons within the actual footprint of each fugitive activity location.

¹⁶ Estimated durations for the construction periods: 12 months for EPS, 18 months for WPS, 18 months for TSF Corridor, 36 months for TSF, and 18 months for FP&LF.

Source-specific model input emission rates were converted to grams per second (or grams per second per meter squared) for input to AERMOD.

Hourly emissions profiles for wind erosion from exposed surfaces (from areas susceptible to wind erosion) were developed using the fastest-mile method specified in AP-42, Section 13.2.5. Using this method, each hourly wind speed was converted to a fastest mile by multiplying it by a factor of 1.2. The estimated hourly fastest-mile values were used to calculate the friction velocity using AP-42, Section 13.2.5, Equation 4. When a friction velocity exceeds the material-specific threshold friction velocity, a wind erosion potential (in grams of particulate per square meter of erodible surface) was calculated using AP-42, Section 13.2.5, Equation 3. Hourly wind erosion potentials were multiplied by the applicable erodible surface areas to calculate the particulate emissions for every hour.

A summary of estimated annual emissions from the construction activities for the Project is presented in Table 3-12. A detailed emissions inventory for the Resolution Project construction phase is provided in 4.0Appendix D.

Table 3-12. Maximum Potential Annual Emissions Summary for Construction Activities (Proposed Action) (ton/yr)

Location	PM₁₀	PM_{2.5}	CO	NO_x	SO₂	VOC
West Plant	136	14	135	73	3	51
East Plant	108	11	129	62	4	38
TSF Corridor	74	7	20	17	0	16
TSF (Alt. 2)	126	20	222	140	4	106
Filter Plant	25	3	14	15	1	15
Total	468	54	520	309	12	226

3.1.8.4 Construction Emissions – Alternatives

Construction emissions estimates for each of the Alternative TSFs have been estimated and assessed using the information sources utilized for the construction emissions inventory of the Proposed Action (Alternative 2 – Near West).

The emission estimates are based on the maximum design rates for the process (including process fugitive) sources, and the fugitive and mobile machinery emissions represent the maximum annual emissions over the construction period. Resolution has estimated the type and number of pieces of equipment needed for buildout of each of the TSF alternatives. The duration (anticipated to be three years), construction activities, and scale of the construction effort for the Alternative TSF sites will be similar. Equipment engine technologies, dust control procedures, and best management practices during construction will be identical. Emissions due to construction of Alternatives 3, 4, 5, or 6 were estimated to be the same or less than the

estimated emissions to construct the Proposed Action (Alternative 2 – Near West) (see Table 3-12).

Construction emissions for the alternative of placing the FP&LF Plant within the footprint of the West Plant Site are also expected to be equal to or less than the construction emissions estimated for the FP&LF (Table 3-12). Resolution has estimated the type and number of pieces of equipment needed for buildout of the FP&LF. The duration (eighteen months), construction activities, and scale of the construction effort for the alternative FP&LF will be similar. Equipment engine technologies, dust control procedures, and best management practices during construction will be identical.

3.1.9 Coordinate System

The Universal Transverse Mercator (UTM) coordinate system projected in North American Datum of 1983 (NAD83), Zone 12, was used in this analysis to define all locations in the modeling domain (sources, buildings, and receptors).

3.1.10 NO₂ Modeling

The NO_x emissions from the combustion sources are principally composed of nitric oxide (NO) and NO₂. Once in the atmosphere, the NO can convert to NO₂ through chemical reactions with ambient O₃. To address this atmospheric conversion process, the Guideline on Air Quality Models (40 CFR 51, Appendix W) recommends the following three-tiered screening approach for evaluating the NO₂ impacts:

- Tier 1: Assume total conversion of NO to NO₂.
- Tier 2: Assume representative equilibrium NO₂/NO_x ratio (0.75 for annual and 0.80 for 1-hour).
- Tier 3: Use a detailed screening method on a case-by-case basis.

The default option of the Ozone Limiting Method (OLM), a Tier 3 method from 40 CFR 51, Appendix W, was used to estimate the NO₂ 1-hour and annual impacts for this analysis. This method was chosen because the necessary information is available, and the method is expected to produce more representative model results. The OLM determines the limiting factor for NO₂ formation by comparing the estimated maximum NO_x concentration and the ambient O₃ concentration. The model assumes a total NO-to-NO₂ conversion when the ambient O₃ concentration is greater than the estimated maximum NO_x concentration; otherwise, it is limited by the ambient O₃ concentration (Cole and Summerhays 1979).

The combined plume option (keywords OLMGROUP ALL) of the OLM in AERMOD was used for this analysis.

The use of the OLM requires the following additional input parameters:

- Background O₃ Concentrations – The use of the OLM option in AERMOD requires the input of O₃ concentrations. The O₃ concentration values may be input as a single value, as hourly values to correspond with the meteorological data, or as temporally varying profiles. This analysis used the onsite (EPS) monitored hourly O₃ data.
- Ambient Equilibrium NO₂/NO_x Ratio – The AERMOD default NO₂/NO_x ambient equilibrium ratio of 0.9 was used for this analysis. The equilibrium ratio of 0.9 is the AERMOD default (i.e., AERMOD will automatically use this value if it is not provided in an input file), documented in EPA’s Addendum to the AERMOD User’s Guide.¹⁷
- In-Stack NO₂/NO_x Ratio – The majority of NO_x emissions at Resolution Copper are associated with diesel combustion. A literature search and a review of available stack tests, including the EPA database (http://www.epa.gov/scram001/no2_isr_database.htm), was conducted to identify representative NO₂/NO_x ratios for different combustion source categories. Based on this research, 0.11 is an appropriate NO₂/NO_x ratio for diesel combustion engines and used in this analysis.

The main stationary emergency diesel generators at the Project are expected to be CAT175-16. EPA’s ISR database contains source test ISR values for the CAT175-16 at three engine loads. Resolution Copper used the maximum plus one standard deviation of these ISR values (0.04) for these generators. In addition, there are several smaller emergency diesel engines anticipated for the Project for which Resolution Copper used an ISR of 0.11.

Due to the timeline of the Project, the majority of the diesel-burning equipment has not yet been purchased. Resolution Copper anticipates that much of the equipment to be purchased will be new and comply with current emission standards. In general, ISRs are getting smaller as engine technology progresses. Therefore, Resolution Copper anticipates proposing additionally refined (e.g., manufacturer-specified) ISRs representative of each engine on a case-by-case basis.

A temporally varying NO₂ background concentration profile will be integrated into AERMOD using the BACKGRND keyword. For this purpose, a monthly hour-of-day NO₂ concentration profile was used (developed from the onsite (EPS) monitored hourly NO₂ data) and is provided in Table 3-13 in ppb. This profile consists of the highest value for each monthly hour-of-day per ADEQ 2015a.

¹⁷ EPA. 2015. *Addendum: User’s Guide for the AMS/EPA Regulatory Model – AERMOD* (EPA-454/B-03-001, September 2004). Office of Air Quality Planning and Standards, Air Quality Assessment Division. June 2015. Accessed October 6, 2016. http://www.epa.gov/ttn/scram/models/aermod/aermod_userguide.zip.

Table 3-13. Monthly Hour-of-Day NO₂ Profile (ppb)

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	4.4	3.4	2.4	7.8	6.8	4.1	4.1	6.9	6.0	7.4	8.4	10.3
2	2.5	3.0	3.2	6.3	6.3	4.8	4.0	6.2	6.6	8.7	8.8	9.3
3	2.9	4.2	2.3	9.1	9.9	5.7	4.4	7.0	7.9	12.0	7.1	12.0
4	3.6	4.4	2.2	7.1	10.6	5.3	3.7	5.2	8.0	7.7	8.6	12.3
5	3.0	4.2	2.1	5.9	5.5	6.6	7.2	4.6	6.3	7.8	7.4	7.1
6	3.0	3.9	3.2	9.1	6.2	8.7	5.8	5.8	12.6	10.7	8.4	8.5
7	4.4	4.0	2.6	6.6	8.8	6.9	4.4	11.8	7.0	6.6	10.3	7.9
8	8.1	7.7	3.3	9.3	12.2	5.0	3.7	6.0	5.2	7.6	11.4	8.2
9	8.6	7.1	5.8	4.5	4.5	3.0	2.3	4.4	6.1	10.1	8.5	8.4
10	5.4	8.4	2.5	3.3	4.3	2.7	3.8	6.4	1.5	4.0	6.1	5.7
11	4.5	4.7	5.6	2.4	3.6	2.5	0.8	2.8	1.8	4.0	8.4	5.1
12	5.1	4.0	1.7	1.3	2.0	2.0	1.2	2.5	0.6	3.6	5.8	4.6
13	5.0	4.4	1.5	2.1	1.2	1.0	0.9	1.6	0.8	3.7	4.4	3.4
14	3.7	3.9	1.2	1.6	1.3	1.3	0.8	2.6	1.3	3.3	4.1	3.3
15	3.5	2.4	1.1	2.2	1.1	0.9	0.9	1.6	1.7	2.8	4.9	3.0
16	4.2	2.3	2.0	1.5	0.8	1.0	0.6	3.3	1.0	2.8	4.7	3.9
17	3.9	2.5	1.2	2.1	0.8	0.5	0.6	0.5	0.6	3.0	4.5	3.7
18	5.3	3.0	1.0	2.0	1.7	0.4	1.9	0.4	1.3	2.2	6.8	5.3
19	10.5	4.7	1.3	1.7	2.4	0.3	3.3	1.3	9.5	3.8	6.2	6.2
20	8.0	4.4	1.5	3.0	1.3	0.4	2.5	3.7	2.3	4.9	5.8	5.0
21	4.0	4.7	1.6	5.2	1.8	1.4	2.6	2.7	3.9	5.6	6.7	6.0
22	4.0	3.7	2.5	5.8	2.7	3.3	3.7	2.5	5.3	7.9	6.6	8.5
23	3.6	3.7	3.7	10.5	3.5	7.6	3.0	6.6	6.6	6.7	7.0	7.2
24	4.8	4.3	3.2	7.9	5.9	5.1	4.9	9.0	9.3	8.0	9.1	13.1

3.1.11 Treatment of Intermittent Sources for NO₂ and SO₂ 1-Hour Analyses

In its most recent guidance on NO₂ and SO₂ 1-hour modeling (EPA 2011), the EPA has recognized that intermittent sources that do not operate continuously or frequently enough (e.g., emergency generators) are less likely to contribute significantly to the annual distribution of daily maximum 1-hour values. The EPA recommends *“that compliance demonstrations for the 1-hour NO₂ NAAQS be based on emission scenarios that can logically be assumed to be relatively continuous or which occur frequently enough to contribute significantly to the annual distribution of daily maximum 1-hour concentrations”* (EPA 2011).

The emergency equipment proposed at the Resolution Project includes backup power generators. This equipment is essential to ensure safety and will power critical systems (ventilation, personnel transport, etc.) in case of unforeseen power failure and/or other emergency situations. It is anticipated that this equipment will operate for only limited, periodic maintenance purposes (approximately 50 hours per year); however, potential to emit has been based on 500 hours per year of operation. Thus, the operation of the emergency equipment will not be frequent enough, and inclusion of its emissions does not represent a logical emission

scenario to contribute significantly to the annual distribution of daily maximum 1-hour concentrations. Therefore, emissions from the proposed emergency equipment was based on continuous operation at the average hourly rate, that is, the maximum hourly rate times 500 hours per year divided by 8,760 hours per year for the NO₂ and SO₂ 1-hour analyses.

3.1.12 Particulate Modeling

Default particulate modeling methods, including deposition (AERMOD Method 1, to account for depletion due to particulate settling), will be used for estimating PM₁₀ and PM_{2.5} impacts for this analysis. To account for particulate settling, AERMOD requires the following source-specific variables:

1. Mass-mean aerodynamic particle diameter for each particle size bin
2. Mass fraction for each particle size bin
3. Particle density for each particle size bin

A list of references used to develop broad source-category-based particle size bins and associated mass fractions is provided in Table 3-14. This table also provides the particle densities in grams per cubic centimeter (g/cm³) for each broad source category and associated reference.

Table 3-14. References Used to Develop Deposition Parameters

Source Category	Reference	Density	Density Reference
Underground Fugitive Dust	AP-42, Pg. 13.2.4-4, 11/06, Resolution Exhaust Shaft Emissions Report, 05/08	2.775	Resolution Copper's 2016 geologic model
Ore Handling	AP-42, Pg. 13.2.4-4, 11/06	2.775	Resolution Copper's 2016 geologic model
Road Traffic and Maintenance	AP-42, Sec. 13.2.2, Eqs. 1a and 2, & Tab. 13.2.2-2, 11/06	2.775	Resolution Copper's 2016 geologic model
Baghouses	AP-42, App. B-1, Pg. B.1-77, Sec. 11.21 (Phosphate Rock Processing: Roller Mill and Bowl Mill Grinding), 10/86	2.775	Resolution Copper's 2016 geologic model
Gasoline and Diesel Engines	AP-42, App. B-2, Tab. B.2-2, Pg. B.2-11 (Category 1, Stationary Internal Combustion Engines, Gasoline and Diesel Fuel), 01/95	2.25	Assumption; density of carbon
Boilers	AP-42, App. B-2, Tab. B.2.2, Pg. B.2-12 (Category 2, Combustion, Mixed Fuels, Boilers), 01/95	2.25	Assumption; density of carbon
Wind Erosion	AP-42, Pg. 13.2.5-3, 11/06	2.775	Resolution Copper's 2016 geologic model
Tailings Wind Erosion	AP-42, Pg. 13.2.5-3, 11/06	2.67	Scavenger specific gravity, KCB's Near West Tailings Management, Order of Magnitude Study.
Cooling Towers	Resolution Water Drop Size Distribution for Low Efficiency Drift Eliminators (Resolution_Surface_Cooling.xlsx, 2018-02-21)	2.7	Density of TDS constituents
Aggregate, Cement, and Sand Handling	AP-42, Pg. 13.2.4-4, 11/06	1.435	Average of cement, sand, lime, gravel from AP-42, App A

An example calculation of deposition parameters for ore handling emissions is provided in Table 3-15. In addition to the proposed deposition parameters, this table also shows the step-by-step calculations to determine mass mean diameter for each bin.

Table 3-15. Proposed Deposition Parameters for Ore Handling Emissions

Step	Parameter	PM ₁₀				PM _{2.5}	
		Bin 0 ⁽¹⁾	Bin 1	Bin 2	Bin 3	Bin 0 ⁽¹⁾	Bin 1
	Bin Upper Diameter (μm)	1.60	2.50	5.00	10.00	1.60	2.50
	Particle Size Multiplier	--	0.05	0.20	0.35	--	0.05
1	Cumulative Mass Fraction	--	0.15	0.57	1.00	--	1.00
2	Mass Fraction	--	0.15	0.42	0.43	--	1.00
3	Spherical Volume (μm ³)	2.14	8.18	65.45	523.60	2.14	8.18
4	Mean Spherical Volume (μm ³)	--	5.16	36.82	294.52	--	5.16
5	Mass Mean Diameter (μm)	--	2.14	4.13	8.25	--	2.14
	Particle Density (g/cm ³)	--	2.78	2.78	--	--	2.78

⁽¹⁾ Bin 0 is not input to the model. It is only used to estimate the mass mean diameter of Bin 1. The upper diameter for Bin 0 is estimated by linear interpolation of Bins 1 and 2 and by setting the particle size multiplier for Bin 0 to zero.

The calculation steps listed in Table 3-15 are described below. All example calculations provided in these steps are for PM₁₀ deposition parameters.

- Step 1: The cumulative mass fraction for each bin is calculated by dividing the particle size multiplier by that of the highest bin: Bin 3 in this case. Examples:
- Bin 3 cumulative mass fraction (1.0) = Bin 3 particle size multiplier (0.35) divided by Bin 3 particle size multiplier (0.35)
 - Bin 2 cumulative mass fraction (0.57) = Bin 2 particle size multiplier (0.2) divided by Bin 3 particle size multiplier (0.35)
- Step 2: The mass fraction for each bin is calculated by subtracting the cumulative mass fraction of the next lower bin from the cumulative mass fraction for that bin. Examples:
- Bin 3 mass fraction (0.43) = Bin 3 cumulative mass fraction (1.0) minus Bin 2 cumulative mass fraction (0.57)
 - Bin 2 mass fraction (0.42) = Bin 2 cumulative mass fraction (0.57) minus Bin 1 cumulative mass fraction (0.15)
- Step 3: The spherical volume for each bin is calculated as: $\frac{4}{3} \times \pi \times (\text{Bin Upper Diameter} \div 2)^3$.
- Step 4: The mean spherical volume for each bin is calculated as the average of spherical volumes of that bin and the next lower bin. Examples:
- Bin 3 mean spherical volume (294.52) = The average of Bin 3 (523.6) and Bin 2 (65.45) spherical volumes
 - Bin 2 mean spherical volume (36.82) = The average of Bin 2 (65.45) and Bin 1 (8.18) spherical volumes
- Step 5: The mass mean diameter for each bin is calculated from the mean spherical volume as: $[\text{Mean Spherical Volume} \times 3 \div (4 \times \pi)]^{1/3} \times 2$

The proposed deposition parameters for the source categories are provided in Table 3-16.

Table 3-16. Proposed Deposition Parameters by Source Category

Source Category	Parameter	PM ₁₀					PM _{2.5}		
		Bin 0 ⁽¹⁾	Bin 1	Bin 2	Bin 3	Bin 4	Bin 0 ⁽¹⁾	Bin 1	Bin 2
Underground Fugitive Dust	Bin Upper Diameter (µm)	1.32	2.50	5.00	10.00	--	1.32	2.50	--
	Mass Fraction	--	0.31	0.67	0.02	--	--	1.00	--
	Mass Mean Diameter (µm)	--	2.08	4.13	8.26	--	--	2.08	--
	Particle Density (g/cm ³)	--	2.78	2.78	2.78	--	--	2.78	--
Ore Handling	Bin Upper Diameter (µm)	1.60	2.50	5.00	10.00	--	1.60	2.50	--
	Mass Fraction	--	0.15	0.42	0.43	--	--	1.00	--
	Mass Mean Diameter (µm)	--	2.14	4.13	8.26	--	--	2.14	--
	Particle Density (g/cm ³)	--	2.78	2.78	2.78	--	--	2.78	--
Road Traffic and Maintenance	Bin Upper Diameter (µm)	1.67	2.50	10.00	--	--	1.67	2.50	--
	Mass Fraction	--	0.10	0.90	--	--	--	1.00	--
	Mass Mean Diameter (µm)	--	2.16	7.98	--	--	--	2.16	--
	Particle Density (g/cm ³)	--	2.78	2.78	--	--	--	2.78	--
Baghouses	Bin Upper Diameter (µm)	0.56	2.50	6.00	10.00	--	0.56	2.50	--
	Mass Fraction	--	0.28	0.50	0.22	--	--	1.00	--
	Mass Mean Diameter	--	1.99	4.87	8.47	--	--	1.99	--
	Particle Density (g/cm ³)	--	2.78	2.78	2.78	--	--	2.78	--
Gasoline and Diesel Engines	Bin Upper Diameter (µm)	--	1.00	2.50	6.00	10.00	--	1.00	2.50
	Mass Fraction	--	0.85	0.08	0.03	0.03	--	0.91	0.09
	Mass Mean Diameter (µm)	--	0.79	2.03	4.87	8.47	--	0.79	2.03
	Particle Density (g/cm ³)	--	2.25	2.25	2.25	2.25	--	2.25	2.25
Boilers	Bin Upper Diameter (µm)	--	1.00	2.50	6.00	10.00	--	1.00	2.50
	Mass Fraction	--	0.29	0.28	0.32	0.11	--	0.51	0.49
	Mass Mean Diameter (µm)	--	0.79	2.03	4.87	8.47	--	0.79	2.03
	Particle Density (g/cm ³)	--	2.25	2.25	2.25	2.25	--	2.25	2.25
Wind Erosion	Bin Upper Diameter (µm)	1.18	2.50	10.00	--	--	1.18	2.50	--
	Mass Fraction	--	0.15	0.85	--	--	--	1.00	--
	Mass Mean Diameter (µm)	--	2.05	7.98	--	--	--	2.05	--
	Particle Density (g/cm ³)	--	2.78	2.78	--	--	--	2.78	--
Tailings Wind Erosion	Bin Upper Diameter (µm)	1.18	2.50	10.00	--	--	1.18	2.50	--
	Mass Fraction	--	0.15	0.85	--	--	--	1.00	--
	Mass Mean Diameter (µm)	--	2.05	7.98	--	--	--	2.05	--
	Particle Density (g/cm ³)	--	2.67	2.67	--	--	--	2.67	--
Cooling Towers	Bin Upper Diameter (µm)	--	2.28	2.50	6.00	10.00	--	2.28	2.50
	Mass Fraction	--	0.04	0.10	0.53	0.33	--	0.27	0.73
	Mass Mean Diameter (µm)	--	1.81	2.39	4.87	8.47	--	1.81	2.39
	Particle Density (g/cm ³)	--	2.70	2.70	2.70	2.70	--	2.70	2.70
Aggregate, Cement, and Sand Handling	Bin Upper Diameter (µm)	1.60	2.50	5.00	10.00	--	1.60	2.50	--
	Mass Fraction	--	0.15	0.42	0.43	--	--	1.00	--
	Mass Mean Diameter (µm)	--	2.14	4.13	8.26	--	--	2.14	--
	Particle Density (g/cm ³)	--	1.44	1.44	1.44	--	--	1.44	--

⁽¹⁾ Bin 0 is not input to the model. It is only used to estimate the mass mean diameter of Bin 1. The upper diameter for Bin 0 is estimated by linear interpolation of Bins 1 and 2 and by setting the particle size multiplier for Bin 0 to zero.

3.1.13 Secondary PM_{2.5} and O₃ Formation

3.1.13.1 Regulatory Background

On January 17, 2017, the EPA promulgated an update to its Guideline on Air Quality Models (GAQM) (EPA 2017b) in 40 CFR 51, Appendix W, to incorporate a tiered demonstration approach to address the secondary chemical formation of PM_{2.5} and ozone associated with precursor emissions from single sources (such as the Resolution Copper Project).

The 2017 GAQM outlines a two-tiered approach for addressing single-source PM_{2.5} and ozone impacts:

- **Tier 1:** The first tier of assessment involves those situations where existing technical information is available (e.g., results from existing photochemical grid modeling [PGM], published empirical estimates of source-specific impacts, or reduced-form models) in combination with other supportive information and analysis for the purposes of estimating secondary impacts from a particular source. According to the EPA, the existing technical information should provide a credible and representative estimate of the secondary impacts from the project source.
- **Tier 2:** If the first-tier analysis is not suitable, then a second-tier analysis would be accomplished, which involves the application of more sophisticated, case-specific air quality modeling analyses using chemical transport models.

The EPA's expectation is that the first-tier analysis should be appropriate for most permit applicants; the second-tier analysis may only be necessary in special situations (EPA 2016c).

In addition to the 2017 GAQM updates, the EPA issued single-source ozone and secondary PM_{2.5} guidance on December 2, 2016 (EPA 2016b). This guidance provides information for the development of modeled emission rates for precursors (MERPs) as a Tier 1 demonstration tool for ozone. MERPs are maximum emission rates of precursors (NO_x and SO₂ for PM_{2.5} and NO_x and VOC for ozone) that would not be expected to exceed critical air quality thresholds (assumed to be equal to significant impact levels (SILs) [PM_{2.5} daily = 1.2 µg/m³, PM_{2.5} annual = 0.2 g/µm³; 8-hour ozone 1 part per billion (ppb)]), and thus would not cause or contribute to air quality violations for these pollutants. To derive a MERP value, the model predicted the relationship between precursor emissions from hypothetical sources, and their downwind maximum impacts can be combined with a critical air quality threshold using the following equation:

$$\text{MERP} = \text{Critical Air Quality Threshold} * (\text{Modeled emission rate from hypothetical source} / \text{Modeled air quality impact (ppb) from hypothetical source})$$

3.1.13.2 PM_{2.5} Analysis

The estimated annual NO_x and SO₂ emissions from the Project are well below the lowest (most conservative) illustrative PM_{2.5} MERP value for these pollutants shown in the EPA's guidance (Table 7.1) of any source modeled by the EPA in the Western U.S. Using this methodology, air quality impacts of PM_{2.5} from the Project would be expected to be below the annual PM_{2.5} critical air quality thresholds (0.2 µg/m³) and the daily PM_{2.5} critical air quality threshold (1.2 µg/m³).

The NO₂ and SO₂ precursor contributions to secondary PM_{2.5} formation need to be considered together to determine if the source's air quality impact would be expected to exceed the critical air quality threshold. The proposed emissions increase can be expressed as a percentage of the lowest MERP for each precursor and then summed. A value less than 100% indicates that the critical air quality threshold is not expected to be exceeded when considering the combined impacts of NO_x and SO₂ precursors on annual or daily PM_{2.5}.

Using the lowest illustrative MERP value for the Western U.S., the summed precursor method calculations are as follows:

$$\begin{aligned}\text{Daily PM}_{2.5} &= 118 \text{ tpy NO}_{x\text{source}}/1,115 \text{ tpy NO}_{x\text{MERP}} + \\ &17.8 \text{ tpy SO}_{2\text{source}}/225 \text{ tpy SO}_{2\text{MERP}} = 19\% \\ \text{Annual PM}_{2.5} &= 118 \text{ tpy NO}_{x\text{source}}/3,184 \text{ tpy NO}_{x\text{MERP}} + \\ &17.8 \text{ tpy SO}_{2\text{source}}/2,289 \text{ tpy SO}_{2\text{MERP}} = 4\%\end{aligned}$$

The Tier-1, summed precursor method indicates that the Project's emissions will not cause increases to secondary PM_{2.5} concentrations in the project area that exceed the critical air quality thresholds.

3.1.13.3 Ozone Analysis

The estimated annual NO_x and VOC emissions from the Project are well below the lowest (most conservative) illustrative O₃ MERP value shown in the EPA's guidance (Table 7.1) of any source modeled by the EPA in the Western U.S. Using this methodology, air quality impacts of O₃ from the Project would be expected to be below the critical air quality threshold (1 ppb).

The NO_x and VOC precursor contributions to 8-hour daily O₃ formation need to be considered together to determine if the source's air quality impact would be expected to exceed the critical air quality threshold. The proposed emissions increase can be expressed as a percentage of the lowest MERP for each precursor and then summed. A value less than 100% indicates that the critical air quality threshold will not be exceeded when considering the combined impacts of NO_x and VOC precursors on 8-hour daily O₃.

Using the lowest illustrative MERP value for the Western U.S., the summed precursor method calculations are as follows:

$$\begin{aligned} \text{8-hour O}_3 &= 118.4 \text{ tpy NO}_{\text{x source}} / 184 \text{ tpy NO}_{\text{x MERP}} + \\ &102.7 \text{ tpy VOC}_{\text{source}} / 1,049 \text{ tpy VOC}_{\text{MERP}} = 74\% \end{aligned}$$

The Tier-1, summed precursor method indicates that the Project's emissions will not cause increases in ozone concentrations in the project area that exceed the critical air quality thresholds.

3.1.14 Modeling Technique

Each site was modeled with appropriate meteorological data. The model output files from separate model runs were post-processed to generate combined results and output files for each pollutant and associated averaging periods.

Objectives of the AERMOD model execution and post-processing routines for modeling results include:

- Model each facility's emissions sources with meteorological data that is representative for the facility area.
- Add background pollutant concentrations that are representative for the facility area (and avoid double-counting). This includes adding representative paired-in-time background concentrations of PM₁₀ and PM_{2.5}.
- Account for impacts from all facilities at every receptor (and avoid double counting).
- Produce appropriate results of modeled impacts (all facilities) plus representative background in the form of the standard to compare to the NAAQS.

To accomplish these objectives, Air Sciences developed a plan for AERMOD model execution and results post-processing that is summarized in Figure 3-6. This schematic displays the key steps in model execution and results post-processing:

1. Each facility (i.e., EPS, WPS, TSF (Proposed Action [Alternative 2] and each alternative TSF site), FP&LF (Proposed Action (near Magma Junction), and the alternative location within the footprint of West Plant) are modeled separately with two years of representative (i.e., facility-specific) meteorological data, as described in Section 3.1.6.
2. Each facility's model produces impacts at each receptor in the entire receptor grid described in Section 3.1.5 of the Modeling Report.

3. The model run for each facility produces two output files of results in the form of the standard at every receptor in the grid:
 - i. Modeled impacts from facility sources
 - ii. Modeled impacts from facility sources plus representative background pollutant concentrations
 - For those pollutants where a single background concentration value will be used, as described in Table 3-8, the background value will be added to the modeled impact.
 - For 1-hour NO₂, 24-hour and annual PM_{2.5}, and 24-hour and annual PM₁₀, the temporal background profiles provided to AERMOD will be added to the modeled impact.
4. To use the most representative background for each receptor, each receptor is assigned to a specific facility as shown in Figure 3-7.

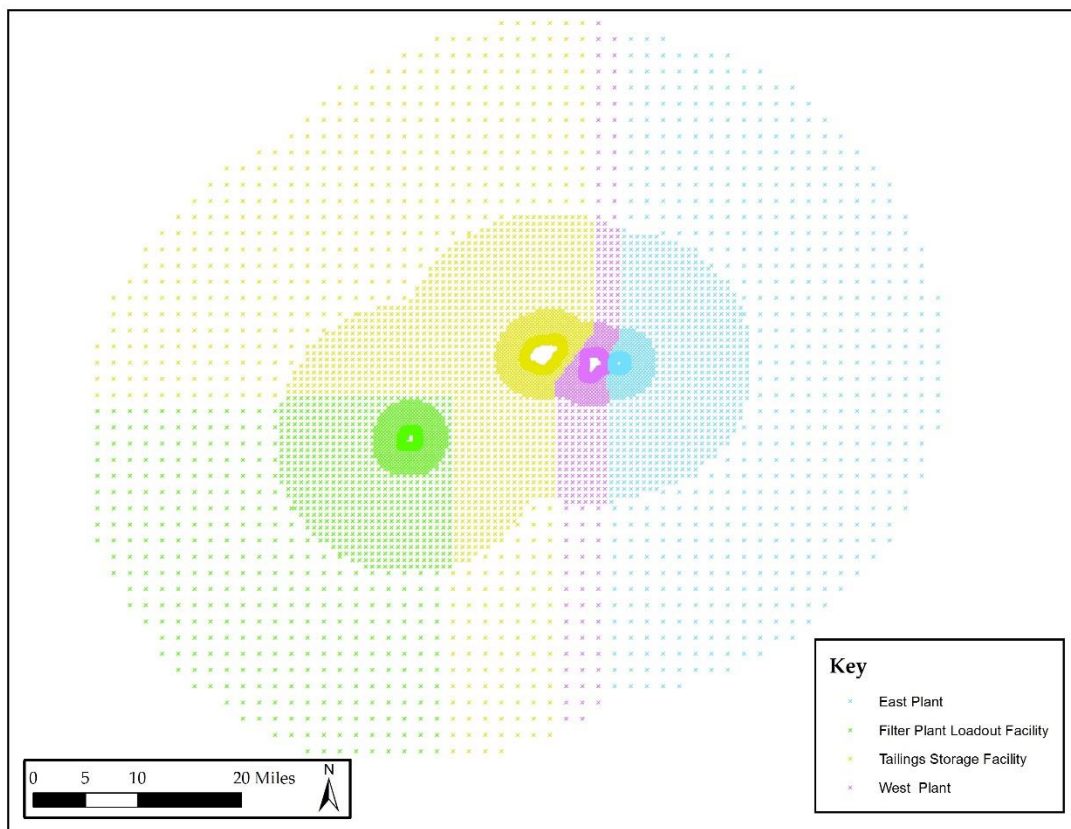
For the Proposed Action, post-processing routines (that are well documented and straightforward to replicate) were implemented to sum, at every facility-assigned receptor, that facility's modeled impacts, representative background, and the modeled form of the standard impact (e.g., high-3rd-high modeled concentration of 24-hour PM₁₀ at the receptor) for each of the other facilities. This method of adding the form of the standard impact is a more conservative approach than adding the paired-in-time modeled impacts from the other facilities.

The post-processing routines were applied similarly to assess the impacts to ambient air quality associated with the evaluated TSF alternatives.

Figure 3-6. Modeling and Post-Processing Schematic

AERMOD Run	Model Inputs				Model Outputs	
	Met. Data	Receptors	Emissions	Background	Facility-Only Impacts	Facility + Background
East Plant	East Plant	All	East Plant	PM: East Plant CO: ADEQ Report Other: East Plant	East Plant	East Plant + Background
West Plant	West Plant	All	West Plant	PM: West Plant CO: ADEQ Report Other: East Plant	West Plant	West Plant + Background
Alt 2 - TSF	Hewitt	All	TSF	PM: West Plant CO: ADEQ Report Other: East Plant	TSF	TSF + Background
Filter Plant	West Plant	All	Filter Plant	PM: West Plant CO: ADEQ Report Other: East Plant	Filter Plant	Filter Plant + Background
Alt - West Plant w/ Filter Plant	West Plant	All	West Plant	PM: West Plant CO: ADEQ Report Other: East Plant	West Plant	West Plant + Background
Alts 3, 4, 5 & 6 - TSF	Hewitt	All	Alts 3, 4, 5 & 6 - TSF	PM: West Plant CO: ADEQ Report Other: East Plant	Alts 3, 4, 5 & 6 - TSF	Alt TSF + Background
Post Processing						
Figure 3-7 Receptor Color		Figure 3-7 Specific Facility		Post Processing Result		
Blue		East Plant		East Plant + Background	+ West Plant	+ TSF
Magenta		West Plant		+ East Plant	West Plant + Background	+ TSF
Magenta		West Plant (Alt. with FP&LF)		+ East Plant	West Plant w/ FP&LF + Background	+ TSF
Orange		TSF (Alts 2, 3, 4, 5 & 6)		+ East Plant	+ West Plant	TSF + Background
Green		Filter Plant		+ East Plant	+ West Plant	Filter Plant + Background

Figure 3-7. Facility-Specific Paired Impacts-Plus-Background Assignments



3.1.15 AAQS Modeling Results

The AERMOD dispersion model results (plus background) for the Resolution Project proposed action and alternatives are provided and compared to the AAQS in Table 3-17.

Table 3-17. AAQS Modeling Results for the Proposed Action and Alternatives

Pollutant	Averaging Time	Alt. 2 Proposed Action ($\mu\text{g}/\text{m}^3$)	Alt. 3 Near West ($\mu\text{g}/\text{m}^3$)	Alt. 4 Silver King ($\mu\text{g}/\text{m}^3$)	Alt. 5 Peg Leg ($\mu\text{g}/\text{m}^3$)	Alt. 6 Skunk Camp ($\mu\text{g}/\text{m}^3$)	AAQS ($\mu\text{g}/\text{m}^3$)	Below AAQS (all)
CO	1 hour	8,080.8	8,080.7	8,099.8	8,079.8	8,090.5	40,000.0	Yes
	8 hours	3,558.8	3,558.8	3,559.7	3,558.2	3,559.3	10,000.0	Yes
NO ₂	1 hour	146.4	146.4	149.8	146.5	148.1	188.0	Yes
	1 year	4.7	4.7	4.7	4.2	4.2	100.0	Yes
PM ₁₀	24 hours	96.8	96.8	97.1	99.5	97.0	150.0	Yes
	1 year	24.5	24.4	24.5	23.5	21.2	50.0	Yes
PM _{2.5}	24 hours	17.7	17.7	17.8	17.7	17.8	35.0	Yes
	1 year	5.9	5.9	6.0	5.9	5.9	12.0	Yes
SO ₂	1 hour	116.6	116.6	117.1	116.6	116.6	196.0	Yes
	3 hours	86.4	86.4	86.4	86.4	86.4	1,300.0	Yes
	24 hours	20.4	20.4	20.4	20.4	20.4	365.0	Yes
	1 year	2.9	2.9	2.9	2.9	2.9	80.0	Yes

The results provided in Table 3-17 include the impacts from all of the modeled facilities plus the receptor-specific backgrounds, combined as described in Section 3.1.14. The appropriate design values used for comparison to the AAQS are provided in Table 3-8. Table 3-17 shows that the maximum total concentrations (Resolution Project sources' impacts plus background) do not exceed the applicable AAQS for the considered alternatives.

3.2 Class I Areas and ACEC Analyses

Pursuant to its obligations under NEPA, TNF is requiring an evaluation of potential air quality impacts due to emissions from the Project on Class I areas located within 100 km of the Project. Additionally, the U.S. Department of Interior, Bureau of Land Management (BLM) has designated certain areas under its management as Areas of Critical Environmental Concern (ACEC). The ACEC designation highlights areas where special management attention is needed to protect and prevent irreparable damage to important historic, cultural, and scenic values, fish or wildlife resources, or other natural system or processes; or to protect human life and safety from natural hazards.

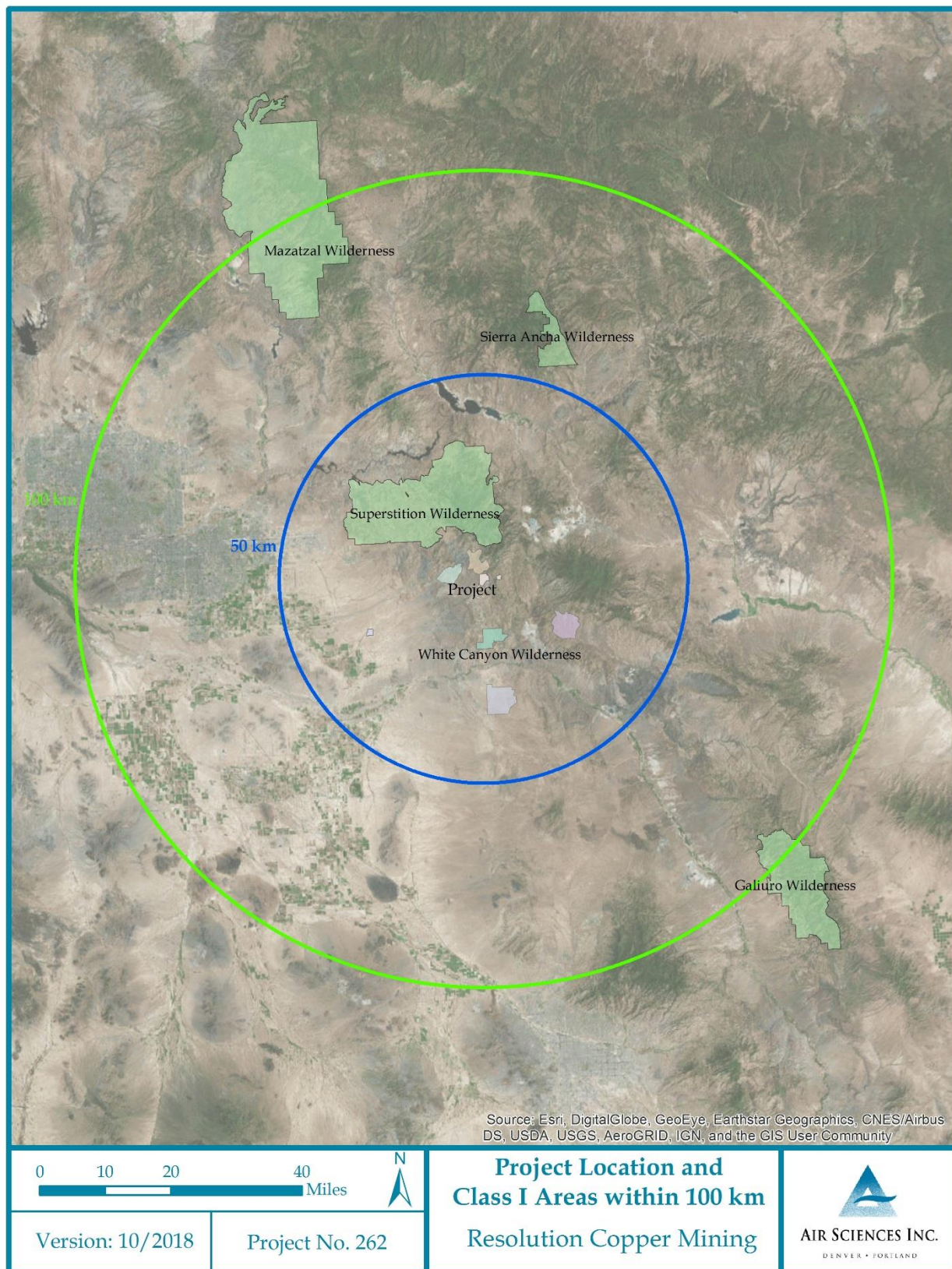
The Superstition Wilderness Area (SWA) is a Class I area in the near-field. SWA is located to the north of the Project and an assessment of potential air quality impacts at SWA was performed. An assessment of the potential air quality impacts due to emissions from the TSF alternatives and alternative location for the FP& LF was also performed.

The White Canyon ACEC is a 5,790-acre property, in the near-field, about 7 miles south of Superior, AZ against a boundary of the TNF that runs north-south through the southeast end of the Mineral Mountains. The TNF is requiring consideration of air quality impacts to important resources in the White Canyon ACEC (WC ACEC), and the following air quality analyses include an assessment of air quality impacts to the WC ACEC.

In the far-field analysis (farther than 50 km but less than 100 km), three Class I areas were evaluated in the EIS: Sierra Ancha Wilderness Area, Mazatzal Wilderness Area, and the Galiuro Wilderness Area.

The Resolution Copper Project location, Class I areas included in the analyses, and WC ACEC are shown in Figure 3-8.

Figure 3-8. Project Location and Class I Areas and ACEC within 100 km



This section describes the air dispersion modeling methods, procedures, and datasets used for the air quality analyses in the Class I areas and WC ACEC, including the following:

1. Class I air quality analysis to demonstrate impacts below the Class I PSD Increments in the near-field (less than 50 km), (Section 3.2.1);
2. Class I air quality analysis to demonstrate compliance with the Class I SILs in the far-field (greater than 50 km). , (Section3.2.2);
3. Visibility analysis in the near-field, (Section 3.2.3);
4. Visibility analysis in the far-field, (Section 3.2.4);
5. Acid deposition analysis in the near-field and far-field, (Section 3.2.5).

3.2.1 Class I Increment Analysis for the Near-Field Areas

The methods used to estimate the Project's emissions potential impacts to the increment standards within the SWA and WC ACEC (near-field areas) are similar to the methods for the Ambient Air Quality Analysis, detailed above in Section 3.1. Differences between the analyses include the forms of the design values, receptor sets, and the treatment of emergency generator and short-term underground mobile fugitive emissions at East Plant.

3.2.1.1 PSD Increment Standards and Design Values

The Class I air quality analysis provided in this report includes dispersion modeling to estimate impacts to be compared with the Class I PSD increments. The PSD increments (specified in Title 40 of the Code of Federal Regulations, Part 52 [40 CFR 52]) are provided in Table 3-18.

Table 3-18. Class I and Class II area Increments

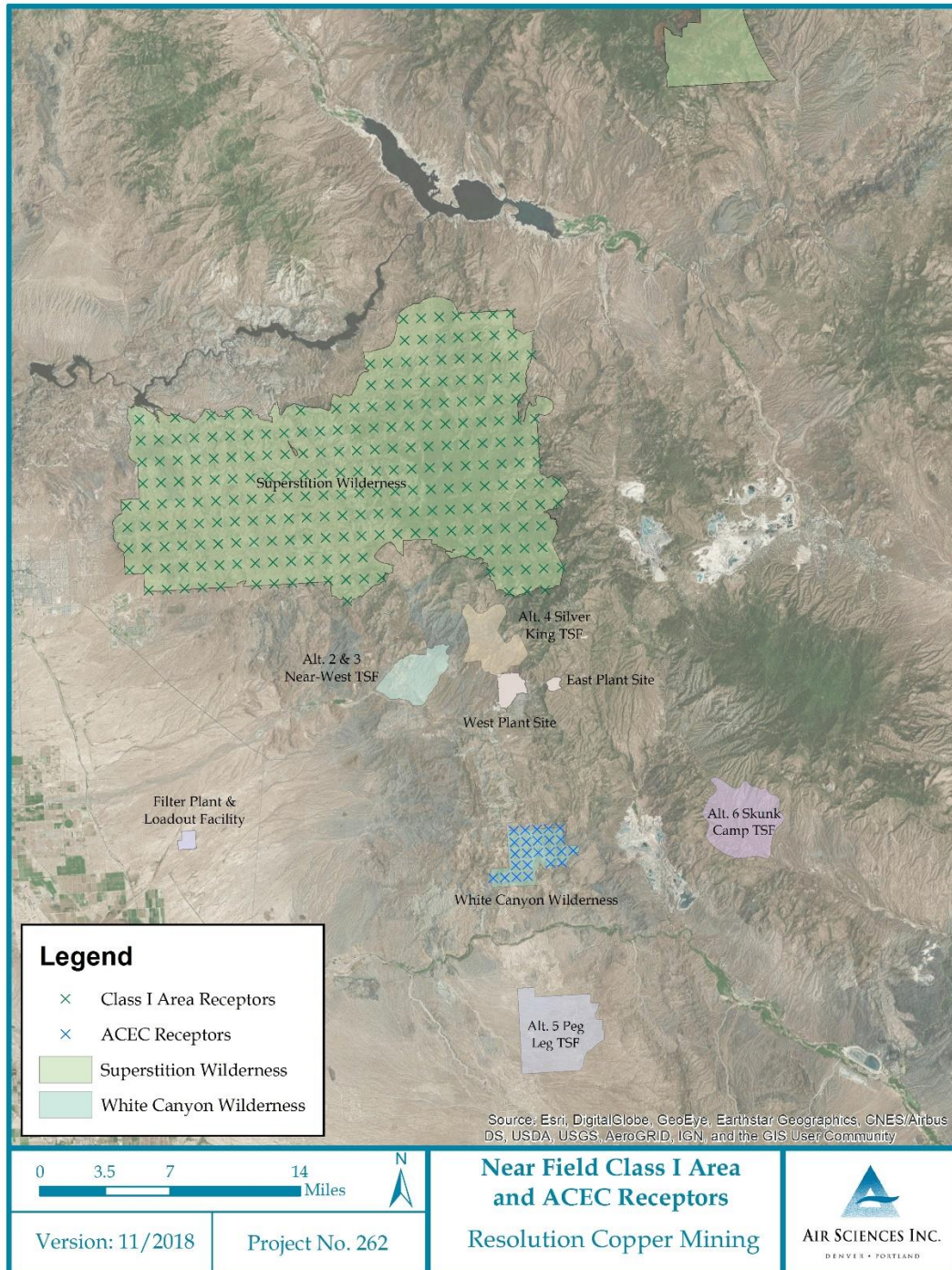
Pollutant	Averaging Time	Class I Area	Class II Area
		Increment	Increment
NO ₂	1 Year	2.5	25
PM _{2.5}	1 Year	1	4
	24 hours	2	9
PM ₁₀	1 Year	4	17
	24 hours	8	30
SO ₂	1 Year	2	20
	24 hours	5	91
	3 Hours	25	512

For any period, other than an annual period, the applicable maximum allowable increase may be exceeded during one such period per year at any one location. Therefore, for the short-term increment analyses, the modeled second highest concentration from the Project's emissions at each receptor was compared to the increment. For annual impacts, the annual concentration at the maximum modeled receptor (at each Class I area) was compared to the annual increment.

3.2.1.2 Near-Field Modeling Receptors

Receptors for the SWA Class I area were downloaded from the NPS Class I Area Receptors website (NPS 2018). For the WC ACEC area, gridded receptors with a 1-km grid spacing within the area were used. The near-field SWA Class I area and WC ACEC receptors are shown in Figure 3-9.

Figure 3-9. Receptors for the SWA Class I area and WC ACEC



3.2.1.3 Emissions for Near-Field Modeling

The emissions rates and characterization as described in Section 3.1.8 were modeled for the near-field increment analysis, with the following differences:

1. East Plant emergency generator emissions were not included.
2. Underground fugitive emissions from support equipment were modeled at annual average emission rates.

For the AAQS analysis, emergency generators were modeled as operating 500 hours per year, in order to capture maximum potential emissions. For the increment analysis, emergency generator emissions from the East Plant were excluded in order to represent a realistic worst-case scenario. During emergency conditions at the East Plant (when emergency generators may operate continuously), other emission sources associated with normal mining activity would not operate. In an emergency scenario, total emissions can reasonably be expected to be below the emission rates represented in the increment modeling. The non-emergency scenario represents the maximum actual emissions and is appropriate in determining increment impacts.

For the AAQS analysis, short-term emissions (except for the 1-hour NO₂ and SO₂) were modeled at the maximum hourly rates. This is similar in the increment analysis, except that the underground mobile fugitive emissions from vehicle travel (road dust) for support equipment were modeled at the annual average rate. The support equipment, in this context of modeling the underground activities, includes all equipment that does not handle or transport mining material. The emissions were modeled in this manner to more closely represent actual emissions from underground activities (and is consistent with applicable modeling guidance for increment impact assessment). A summary of the Resolution Project emissions for increment modeling input, by alternative, is provided in Table 3-19.

Table 3-19. Increment Modeling Emissions Summary by Alternative (ton/yr)

Alternative	Description	PM ₁₀	PM _{2.5}	CO	NO _x	SO ₂	VOC
Alt. 2	Near West, “wet”, modified centerline, subaqueous PAG	412.3	78.7	607.8	84.9	17.6	99.3
Alt. 3	Near West, thickened NPAG (“dry”), modified centerline, PAG under water cover and segregated	407.3	78.2	602.7	84.3	17.6	99.1
Alt. 4	Silver King, filtered tailings, two separate areas for NPAG and PAG	408.3	91.5	659.6	95.0	17.7	101.2
Alt. 5	Peg Leg centerline dam, thickened NPAG, separate PAG (downstream dam and water cover)	507.4	80.6	708.0	96.5	17.8	104.8
Alt. 6	Skunk Camp centerline dam, thickened NPAG, separate PAG (downstream dam and water cover)	412.5	78.6	604.3	84.4	17.6	99.1

3.2.1.4 Modeling Results for Near-Field Areas

Table 3-20 and Table 3-21 provide the maximum modeled concentrations and their comparison with the applicable increments for the SWA and WC ACEC, respectively, showing that the modeled concentrations within the SWA and WC ACEC are below the applicable PSD increments for all alternatives.

Table 3-20. Increment Modeling Results at the Superstition Wilderness Area

Pollutant	Averaging Time	Alt.-2 µg/m ³	Alt.-3 µg/m ³	Alt.-4 µg/m ³	Alt.-5 µg/m ³	Alt.-6 µg/m ³	Class I Increment	Below Increment
NO ₂	1 Year	0.072	0.071	0.109	0.038	0.040	2.5	Yes
PM _{2.5}	1 Year	0.065	0.064	0.119	0.047	0.049	1	Yes
	24 hours	1.483	1.483	1.539	1.454	1.492	2	Yes
PM ₁₀	1 Year	0.243	0.238	0.317	0.130	0.142	4	Yes
	24 hours	4.078	4.072	4.198	3.922	4.067	8	Yes
SO ₂	1 Year	0.006	0.006	0.008	0.006	0.006	2	Yes
	24 hours	0.985	0.985	0.986	0.984	0.985	5	Yes
	3 hours	4.368	4.368	4.372	4.360	4.363	25	Yes

Table 3-21. Increment Modeling Results at the White Canyon ACEC

Pollutant	Averaging Time	Alt.-2 µg/m ³	Alt.-3 µg/m ³	Alt.-4 µg/m ³	Alt.-5 µg/m ³	Alt.-6 µg/m ³	Class II Increment ¹⁸	Below Increment
NO ₂	1 Year	0.024	0.024	0.037	0.034	0.059	25	Yes
PM _{2.5}	1 Year	0.020	0.020	0.030	0.026	0.049	4	Yes
	24 hours	0.494	0.494	0.618	0.600	0.795	9	Yes
PM ₁₀	1 Year	0.046	0.045	0.062	0.095	0.164	17	Yes
	24 hours	1.327	1.321	1.550	1.985	2.300	30	Yes
SO ₂	1 Year	0.022	0.022	0.023	0.023	0.023	20	Yes
	24 hours	0.458	0.458	0.461	0.460	0.464	91	Yes
	3 hours	2.518	2.517	2.541	2.530	2.531	512	Yes

3.2.2 Class I SIL Analysis for Far-Field Areas

Resolution conducted three levels of increment/SIL analysis for the Class I areas that are farther than 50 km and less than 100 km from the project area (Sierra Ancha Wilderness Area, Mazatzal Wilderness Area, and the Galiuro Wilderness Area):

¹⁸ Class I increment standards are applicable only at mandatory or redesignated Federal Class I areas. The White Canyon ACEC is not a Class I area. Therefore, modeled impacts due to emissions from the Project are compared to Class II increment standards.

1. Q/D Screening Analysis;
2. AERMOD modeling at the extent of the near-field domain in the direction of each Class I area;
3. CALPUFF modeling at receptors within the Class I areas.

3.2.2.1 Q/D Screening Analysis

Per the FLAG guidance initial screening criteria methodology, the USDA - FS, TNF will consider a source located more than 50 km from a Class I area to have negligible impacts with respect to Class I AQRVs if the result of the calculation of the sources' total SO₂, NO_x, PM₁₀, and H₂SO₄ annual emissions (in tons per year, based on 24-hour maximum allowable emissions), divided by the distance (in km) from the Class I area equals 10 or less. This screening criteria method is referred to as the Q/D method (where "Q" refers to total annual emissions (tons) and "D" refers to distance to the Class I area (km)).

The Project's (Proposed Action) estimated maximum annual emissions of SO₂, NO_x, and PM₁₀ are shown in Table 3-22; no H₂SO₄ emissions are expected.¹⁹ The emissions represent the maximum mining activity (fugitive and mobile machinery) expected to occur during the LOM year 14 and process sources operating at maximum design capacity. These emission rates are based on maximum 24-hour mining/production rates (per FLAG guidance). A detailed emissions inventory for the Resolution Project is provided in Appendix A. Table 3-23 shows the distance to Class I areas within 100 km of the Project and the results of the Q/D calculation. The results of the Q/D analysis demonstrate that analyses of potential impacts to increment, visibility, and acid deposition are required for all three far-field Class I Wilderness Areas that are within 100 km of the Project.

¹⁹ Consistent with guidance, emission totals exclude emissions from intermittent sources (i.e., the maximum, non-emergency operating scenario is used for the Q/D analysis) and maximum daily wind erosion emissions are estimates from the hourly wind erosion calculations.

Table 3-22. Resolution Copper Estimated Maximum Daily Emissions

Pollutant	Max. Emissions (tons / year)
PM ₁₀	753.1
NO _x	267.2
SO ₂	54.1
Total (Q)	1074.4

Table 3-23. Q/D Analysis

Class I Area	Distance (D) (km)	Q / D (tpy / km)	More than 10?
Sierra Ancha Wilderness	52.9	20.3	Yes
Mazatzal Wilderness	75.3	14.3	Yes
Galiuro Wilderness	92.6	11.6	Yes

3.2.2.2 Increment Analysis at the Extent of the AERMOD Domain

To fully utilize the modeling results generated by the PCAQCD-approved near-field modeling methods using the EPA-preferred/recommended dispersion model, AERMOD, modeled impacts at receptors at the extent of the modeling domain in the direction of each of the Class I areas were compared to PSD increments to determine whether impacts should be analyzed using the CALPUFF modeling system or could be expected to be below the increment.

The emissions and methods applied to modeling impacts for comparison the PSD increment levels at the extent of the domain were identical to the described above in Section 3.2.1, except the receptors that were located in the arcs at 50 km extents in the direction of the respective far-field Class I areas. The analysis was performed for all alternatives.

The results of the modeled impacts from AERMOD at the extents are provided in Table 3-24, Table 3-25, and Table 3-26 for the Sierra Ancha, Mazatzal, and Galiuro Wilderness Areas, respectively. The tables show that the modeled impacts are below the PSD increments at the extent of the AERMOD modeling domain. Since concentrations from an emission source can be expected to decrease with increased distance, it is reasonable to expect that modeled AERMOD impacts will be below the increment thresholds within the Class I areas.

Table 3-24. Impacts at the Extent of the AERMOD Modeling Domain toward Sierra Ancha

Pollutant	Averaging Time	Alt.-2 µg/m³	Alt.-3 µg/m³	Alt.-4 µg/m³	Alt.-5 µg/m³	Alt.-6 µg/m³	Class II Increment	Below Increment
NO ₂	1 year	0.0045	0.0045	0.0066	0.0045	0.0047	2.5	Yes
PM ₁₀	24 hours	0.4068	0.4053	0.4601	0.3857	0.4014	8.0	Yes
	1 year	0.0167	0.0166	0.0173	0.0147	0.0154	4.0	Yes
PM _{2.5}	24 hours	0.1031	0.1028	0.1756	0.0903	0.0962	2.0	Yes
	1 year	0.0045	0.0045	0.0062	0.0039	0.0046	1.0	Yes
SO ₂	3 hours	0.3756	0.3756	0.3774	0.3760	0.3762	25.0	Yes
	24 hours	0.0791	0.0791	0.0792	0.0790	0.0791	5.0	Yes
	1 year	0.0015	0.0015	0.0015	0.0015	0.0015	2.0	Yes

Table 3-25. Impacts at the Extent of the AERMOD Modeling Domain toward Mazatzal

Pollutant	Averaging Time	Alt.-2 µg/m³	Alt.-3 µg/m³	Alt.-4 µg/m³	Alt.-5 µg/m³	Alt.-6 µg/m³	Class II Increment	Below Increment
NO ₂	1 year	0.0071	0.0070	0.0083	0.0046	0.0049	2.5	Yes
PM ₁₀	24 hours	0.3870	0.3848	0.3834	0.3221	0.3290	8.0	Yes
	1 year	0.0175	0.0172	0.0195	0.0144	0.0142	4.0	Yes
PM _{2.5}	24 hours	0.1158	0.1155	0.1563	0.1069	0.1113	2.0	Yes
	1 year	0.0063	0.0063	0.0084	0.0042	0.0045	1.0	Yes
SO ₂	3 hours	0.2925	0.2924	0.2923	0.2913	0.2919	25.0	Yes
	24 hours	0.0760	0.0760	0.0761	0.0759	0.0759	5.0	Yes
	1 year	0.0014	0.0014	0.0014	0.0014	0.0014	2.0	Yes

Table 3-26. Impacts at the Extent of the AERMOD Modeling Domain toward Galiuro

Pollutant	Averaging Time	Alt.-2 µg/m³	Alt.-3 µg/m³	Alt.-4 µg/m³	Alt.-5 µg/m³	Alt.-6 µg/m³	Class II Increment	Below Increment
NO ₂	1 year	0.0048	0.0048	0.0060	0.0091	0.0072	2.5	Yes
PM ₁₀	24 hours	0.2735	0.2722	0.2824	0.4617	0.3895	8.0	Yes
	1 year	0.0091	0.0090	0.0099	0.0259	0.0183	4.0	Yes
PM _{2.5}	24 hours	0.0723	0.0721	0.1610	0.0960	0.1246	2.0	Yes
	1 year	0.0040	0.0040	0.0048	0.0067	0.0062	1.0	Yes
SO ₂	3 hours	0.2282	0.2282	0.2307	0.2316	0.2369	25.0	Yes
	24 hours	0.0519	0.0519	0.0524	0.0524	0.0530	5.0	Yes
	1 year	0.0025	0.0025	0.0025	0.0026	0.0026	2.0	Yes

3.2.2.3 CALPUFF Modeling for Far Field Areas

The Project's potential impacts to the ARQVs of the far-field Class I areas were evaluated using the CALPUFF model. The CALPUFF model is an advanced non-steady state Lagrangian puff model that simulates the transport and chemical transformation of discrete puffs of pollutants released into the atmosphere. As wind flow changes geographically from hour to hour, the path of each puff is altered to follow the new wind direction. CALPUFF is the appropriate modeling platform for the far-field AQRV analyses.

The CALPUFF modeling system consists the following components:

CALMET - a diagnostic three-dimensional meteorological model

CALPUFF - an air quality dispersion model

CALSUM - a post-processing program to aggregate CALPUFF outputs

POSTUTIL - a post-processing program to prepare the CALSUM outputs for CALPOST

CALPOST - a post-processing package to extract modeling results

In addition, there are numerous other processors that are used to prepare geophysical (land use and terrain) data and meteorological (surface, upper-air, and precipitation) data. The modeling domain is 300 km by 300 km, centered around the facility. The domain size was selected to cover the 100 km from the source with an additional 50-km buffer to allow for puff recirculation.

3.2.2.3.1 Meteorological Data for CALPUFF

For this analysis, the CALMET processor was not used. Rather, Air Sciences contracted with Lakes Environmental (Lakes) to provide a three-year wind field dataset based on the Weather Research and Forecast Model (WRF). Lakes ran WRF and processed the output using the Mesoscale Model Interface (MMIF) Program to generate a CALPUFF-ready wind field dataset. Specifications of the dataset are:

- 300 km by 300 km at a 4-km resolution
- Three years of data (2015 to 2017)
- Lambert Conformal Conic Coordinate system: (RLAT0 = 33.266 N, RLON0 = 111.242W, XLAT1 = 32.766N, XLAT2 = 33.766 N. DATUM = NWS-84, XORIGKM = -150, YORGINKM = -150)
- Ten vertical levels (Face heights = 20, 40, 80, 160, 320, 640, 1200, 2000, 3000, 4000 meters)

- For the MMIF Program processing, PBL_RECALC was set to TRUE, and STABILITY was set to GOLDER.

The CALPUFF-ready wind field was evaluated against DS472.0 stations' observational data using the MMIFstat program. The available DS472.0 stations within the domain are listed in Table 3-27 and shown in Figure 3-10. The MMIFstat package performs statistics for air temperature, relative humidity, and winds. The metrics computed are those that have been commonly reported for mesoscale model evaluation for air quality modeling.

Table 3-27. DS472.0 Stations within CALPUFF Modeling Domain

Station ID	Station/City/Airport Name	Latitude (degrees)	Longitude (degrees)
KBXK	Buckeye	33.4204	-112.6862
KCGZ	Casa Grande	32.9549	-111.7668
KCHD	Chandler	33.27	-111.82
KDMA	Davis-Monthan AFB	32.1667	-110.8833
KDVT	Deer Valley	33.6903	-112.0656
KFFZ	Falcon Field	33.4667	-111.7333
KGEU	Glendale	33.527	-112.2953
KGYR	Goodyear	33.4167	-112.3833
KIWA	Willams Gateway	33.3	-111.6667
KLUF	Luke AFB	33.535	-112.3832
KPAN	Payson	34.2568	-111.3393
KPHX	Sky Harbor International	33.4333	-112.0167
KRYN	Ryan Field	32.1422	-111.1746
KSDL	Scottsdale	33.6225	-111.9083
KSOW	Show Low	34.2667	-110.0
KTUS	Tucson International	32.1167	-110.9333

Performance benchmarks were used to evaluate the WRF simulations. After a review of the literature, the list of applicable benchmarks is provided in

Table 3-28, with different benchmarks for simple and complex conditions. Wind speed parameters are provided in m/s, wind directions are in degrees (°) clockwise from north, temperatures values are in degrees Kelvin (°K), and mixing ratios are in grams per kilogram (g/kg) units in

Table 3-28. As the humidity benchmark is based on mixing ratio rather than relative humidity, a second step was needed to convert the hourly MMIFstat relative humidity output into mixing ratios for comparison to the benchmark.

Figure 3-10. Location of DS472.0 Stations

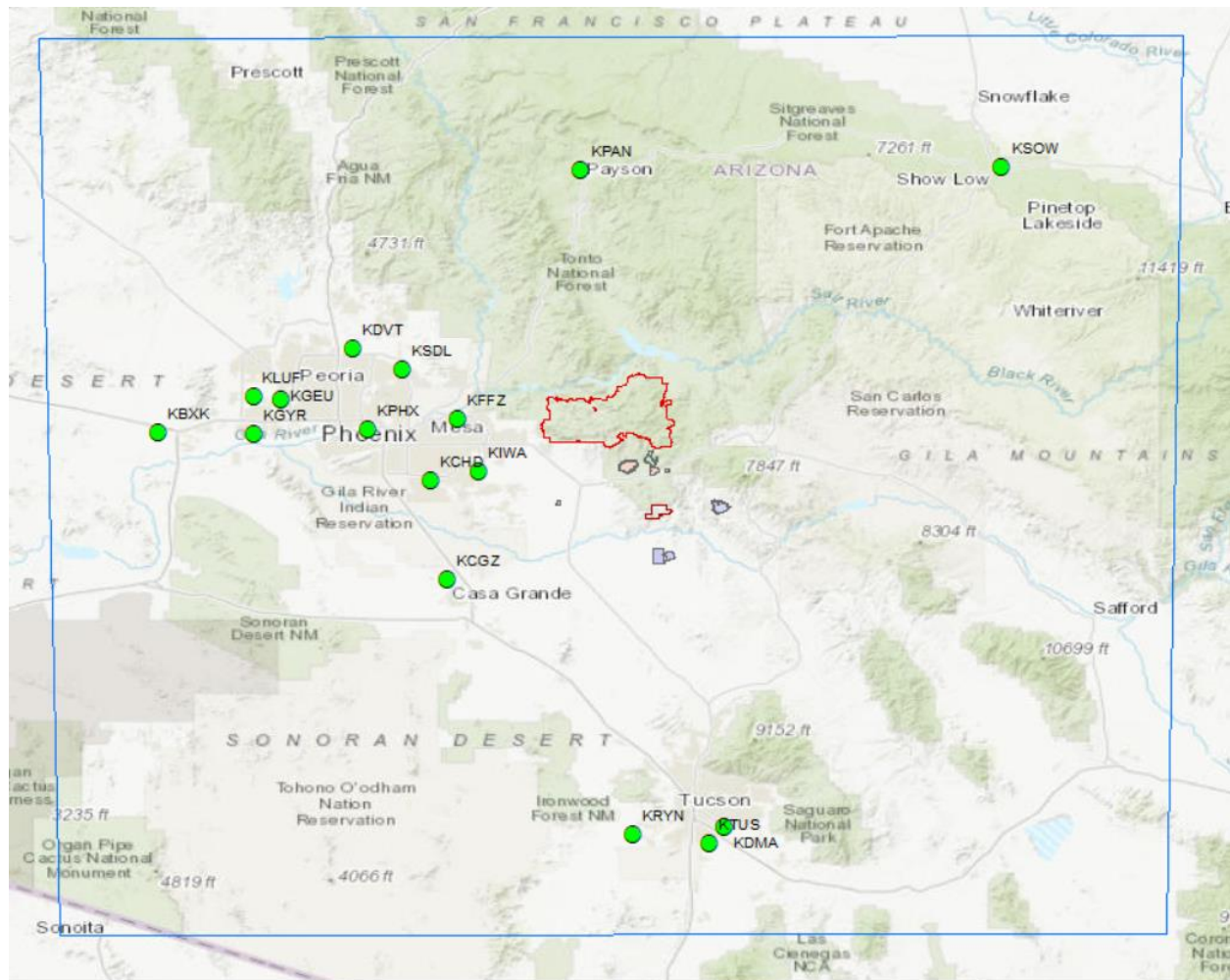


Table 3-28. Meteorological Model Performance Benchmarks

Parameter	Simple (Emery et al. 2001)	Complex (Kemball- Cook et al. 2005)	Complex (McNally, D. 2009)	Applied Benchmark
Wind Speed (m/s) Bias	$\leq \pm 0.5$	$\leq \pm 1.5$	--	$\leq \pm 1.5$
Wind Speed (m/s) RMSE	≤ 2.0	≤ 2.5	--	≤ 2.5
Wind Speed IOA	≥ 0.6	--	--	≥ 0.6
Wind Direction (°) Bias	$\leq \pm 10$	--	--	$\leq \pm 10$
Wind Direction (°) Error	≤ 30	≤ 55	--	≤ 55
Temperature (°K) Bias	$\leq \pm 0.5$	$\leq \pm 2.0$	$\leq \pm 1.0$	$\leq \pm 2.0$
Temperature (°K) Error	≤ 2.0	≤ 3.5	≤ 3.0	≤ 3.5
Temperature IOA	≥ 0.8	--	--	≥ 0.8
Mixing Ratio (g/kg) Bias	$\leq \pm 1.0$	$\leq \pm 0.8$	$\leq \pm 1.0$	$\leq \pm 1.0$
Mixing Ratio (g/kg) Error	≤ 2.0	≤ 2.0	≤ 2.0	≤ 2.0
Mixing Ratio IOA	≥ 0.6	--	--	≥ 0.6

The equations for bias, error, root mean square error (RMSE), and Index of Agreement (IOA) are given below.

$$Bias = \left[\frac{1}{N} \sum_i^N (P_i - O_i) \right]$$

$$Error = \left[\frac{1}{N} \sum_i^N (|P_i - O_i|) \right]$$

$$RMSE = \left[\frac{1}{N} \sum_i^N (P_i - O_i)^2 \right]^{0.5}$$

$$IOA = 1 - \left[\frac{\sum_i^N (P_i - O_i)^2}{\sum_i^N (|P_i - M| + |O_i - M|)^2} \right]$$

where N is the total number of valid entries over all sites and hours, P_i is the predicted (PRD) value for entry i , O_i is the observed (OBS) value for entry i , and M is the mean observation value.

As much of the modeling domain is in complex conditions, the complex conditions benchmarks were applied. Note that because these benchmarks have been used in annual meteorological modeling studies that include areas with complex terrain and more complicated meteorological conditions, they must be viewed as being applied as guidelines and not bright-line numbers, i.e., the purpose of these benchmarks is not to give a passing or failing grade to any one meteorological model application, but rather to put its results into the proper context of other models and meteorological datasets.

Table 3-29 and Figure 3-11 show the three-year domain-wide statistics for the entire meteorological dataset. The model meets the benchmarks except for the wind speed and mixing ratio IOAs (which are based on the simple terrain benchmarks).

Table 3-31 and Figure 3-11, Figure 3-12, Figure 3-13, and Figure 3-14 show the individual station statistics.

Figure 3-12, Figure 3-13, and Figure 3-14 show scatterplots of the observed versus predicted daily average wind speed, hourly wind direction, and daily average temperature, respectively, for each station for the three-year period.

The evaluation shows that the WRF data set generally performs well when values in the WRF dataset are compared to the benchmarks. For wind speed, temperature, and mixing ratio, the error and bias comparisons are within the performance benchmarks for all stations. For wind direction, the gross error is within the benchmark for all stations. The wind direction comparisons for some stations show a level of bias which is outside the benchmark, although on average the bias is within the benchmark. The IOAs generally do not show a performance on par with the benchmark, which could be due to the scale of the WRF nodes and complex terrain of the region. Overall, the good performance of the WRF dataset values against the benchmarks confirms that the WRF dataset can be considered to reasonably represent the meteorology of the modeling domain.

Table 3-29. Three-Year Meteorological Data Statistics

Parameter	Measure	Benchmark	3-yr Value	Meets Benchmark
Wind Speed (m/s)	Mean OBS		3.52	
	Mean PRD		3.56	
	Bias	$\leq \pm 0.5$	0.04	Yes
	Error		1.48	
	RMSE	≤ 2.5	1.84	Yes
	IOA	≥ 0.6	0.52	No
Wind Direction (°)	Mean OBS		190.2	
	Mean PRD		187.0	
	Bias	$\leq \pm 10$	7.66	Yes
	Error	≤ 55	46.7	Yes
Temperature (°K)	Mean OBS		295.7	
	Mean PRD		296.0	
	Bias	$\leq \pm 2$	0.34	Yes
	Error	≤ 3.5	1.9	Yes
	RMSE		2.3	
	IOA	≥ 0.8	0.91	Yes
Humidity Mixing Ratio (g/kg)	Mean OBS		6.06	
	Mean PRD		5.65	
	Bias	$\leq \pm 1$	-0.41	Yes
	Error	≤ 2	1.05	Yes
	RMSE		1.24	
	IOA	≥ 0.6	0.55	No

Figure 3-11. Three-Year Meteorological Data Statistics

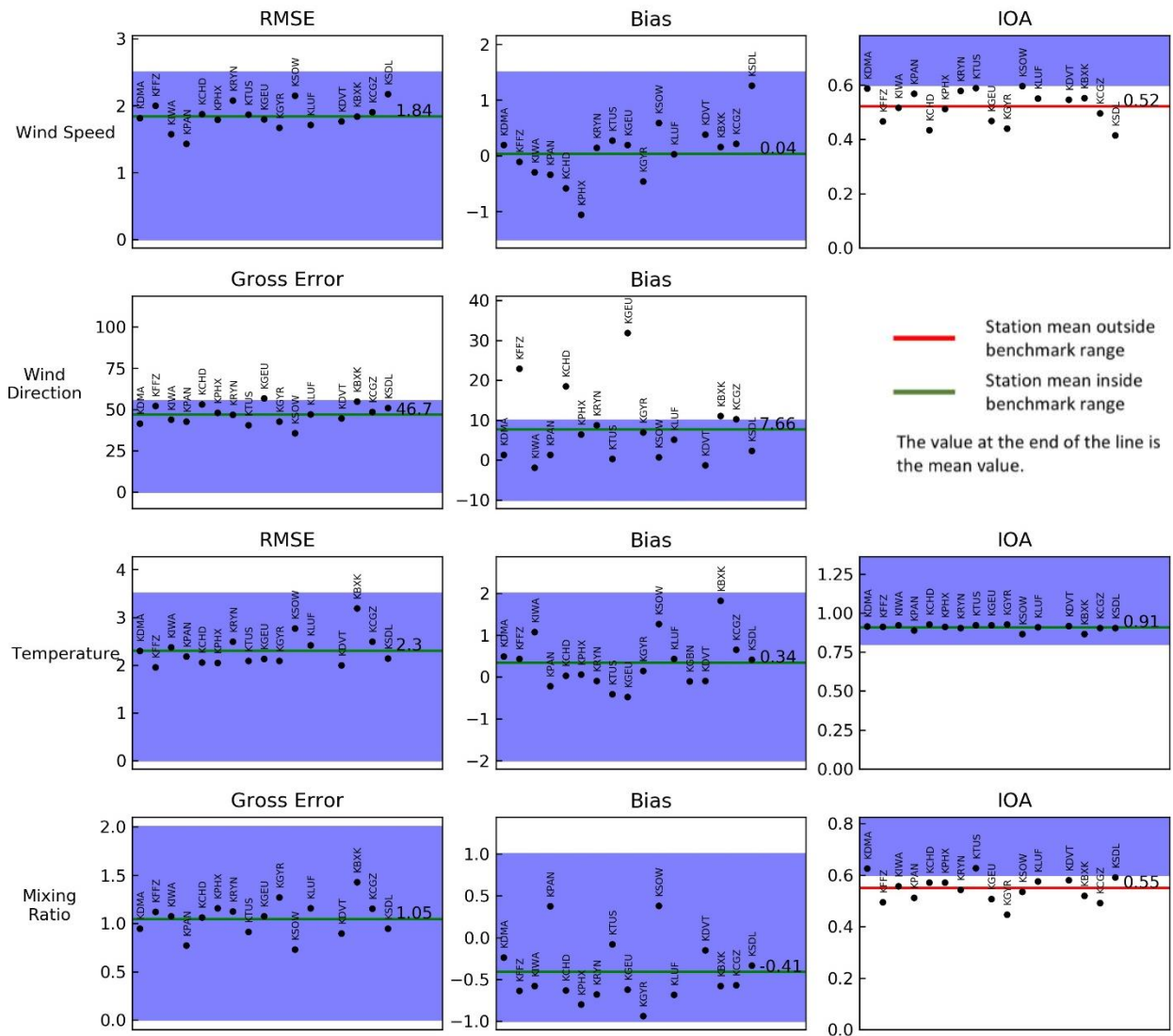


Table 3-30. Performance Statistics for Individual Stations

Parameter	KBXK	KCGZ	KCHD	KDMA	KDVT	KFFZ	KGEU	KGYR
Wind Speed (m/s) Mean OBS	3.20	3.43	3.75	3.53	3.29	4.02	3.36	3.71
Wind Speed (m/s) Mean PRD	3.36	3.64	3.18	3.73	3.67	3.91	3.56	3.25
Wind Speed (m/s) Bias	0.16	0.22	-0.58	0.20	0.38	-0.11	0.20	-0.46
Wind Speed - Gross Error	1.47	1.52	1.50	1.43	1.41	1.64	1.43	1.38
Wind Speed (m/s) RMSE	1.84	1.90	1.88	1.82	1.77	2.00	1.80	1.67
Wind Speed (m/s) IOA	0.55	0.50	0.43	0.59	0.55	0.47	0.47	0.44
Wind Direction (°) Mean OBS	166	193	210	189	171	209	173	183
Wind Direction (°) Mean PRD	166	202	206	190	169	175	193	190
Wind Direction (°) Bias	11.1	10.3	18.5	1.3	-1.3	23	32	7
Wind Direction (°) Gross Error	54.77	48.48	52.97	41.52	44.50	52.06	56.73	42.72
Temperature (°K) Mean OBS	295.83	296.51	298.43	294.63	296.65	299.42	299.27	298.57
Temperature (°K) Mean PRD	297.65	297.17	298.47	295.12	296.56	299.86	298.80	298.72
Temperature (°K) Bias	1.83	0.66	0.03	0.49	-0.09	0.44	-0.47	0.14
Temperature (°K) Gross Error	2.67	2.06	1.67	1.90	1.62	1.64	1.74	1.72
Temperature (°K) RMSE	3.19	2.49	2.05	2.30	2.00	1.96	2.13	2.09
Temperature (°K) IOA	0.87	0.91	0.93	0.91	0.92	0.91	0.92	0.93
Humidity (g/kg) Mean OBS	6.47	6.78	6.26	6.15	5.88	6.50	6.26	6.58
Humidity (g/kg) Mean PRD	5.89	6.21	5.63	5.91	5.73	5.87	5.64	5.64
Humidity (g/kg) Bias	-0.58	-0.57	-0.63	-0.24	-0.15	-0.63	-0.62	-0.94
Humidity (g/kg) Gross Error	1.43	1.15	1.06	0.95	0.89	1.12	1.08	1.27
Humidity (g/kg) IOA	1.81	1.35	1.24	1.13	1.08	1.30	1.23	1.43
Humidity (g/kg) RMSE	0.52	0.49	0.57	0.63	0.58	0.50	0.51	0.45

Table 3-31. Performance Statistics for Individual Stations (continued)

Parameter	KIWA	KLUF	KPAN	KPHX	KRYN	KSDL	KSOW	KTUS
Wind Speed (m/s) Mean OBS	3.19	3.16	3.35	3.39	3.99	2.66	4.66	3.70
Wind Speed (m/s) Mean PRD	2.90	3.19	3.02	2.33	4.14	3.92	5.25	3.98
Wind Speed (m/s) Bias	-0.29	0.03	-0.33	-1.05	0.14	1.26	0.59	0.28
Wind Speed - Gross Error	1.23	1.36	1.15	1.46	1.69	1.78	1.73	1.48
Wind Speed (m/s) RMSE	1.57	1.71	1.43	1.79	2.08	2.18	2.15	1.87
Wind Speed (m/s) IOA	0.52	0.55	0.57	0.51	0.58	0.42	0.60	0.59
Wind Direction (°) Mean OBS	164.78	220.68	189.50	173.95	220.89	204.62	187.30	187.23
Wind Direction (°) Mean PRD	165.83	205.86	181.32	184.27	223.63	173.20	178.89	191.44
Wind Direction (°) Bias	-1.88	5.21	1.36	6.43	8.82	2.38	0.70	0.34
Wind Direction (°) Gross Error	43.87	46.96	42.52	47.85	46.71	50.82	35.50	40.51
Temperature (°K) Mean OBS	295.61	296.76	288.72	298.18	297.61	297.02	284.28	295.39
Temperature (°K) Mean PRD	296.69	297.19	288.51	298.24	297.52	297.43	285.55	294.99
Temperature (°K) Bias	1.08	0.44	-0.21	0.06	-0.09	0.41	1.27	-0.41
Temperature (°K) Gross Error	1.98	2.01	1.80	1.69	2.05	1.76	2.28	1.73
Temperature (°K) RMSE	2.37	2.41	2.18	2.05	2.49	2.14	2.77	2.09
Temperature (°K) IOA	0.92	0.91	0.89	0.91	0.90	0.91	0.87	0.92
Humidity (g/kg) Mean OBS	6.44	6.67	4.64	6.39	6.30	5.94	4.09	6.01
Humidity (g/kg) Mean PRD	5.87	5.99	5.02	5.59	5.62	5.61	4.47	5.93
Humidity (g/kg) Bias	-0.58	-0.68	0.38	-0.80	-0.68	-0.33	0.38	-0.08
Humidity (g/kg) Gross Error	1.07	1.16	0.77	1.16	1.13	0.95	0.73	0.91
Humidity (g/kg) IOA	1.27	1.37	0.91	1.36	1.30	1.14	0.87	1.10
Humidity (g/kg) RMSE	0.56	0.58	0.51	0.57	0.54	0.59	0.54	0.63

Figure 3-12. OBS vs. PRD Daily Average Wind Speed Scatterplot by Station (m/s)

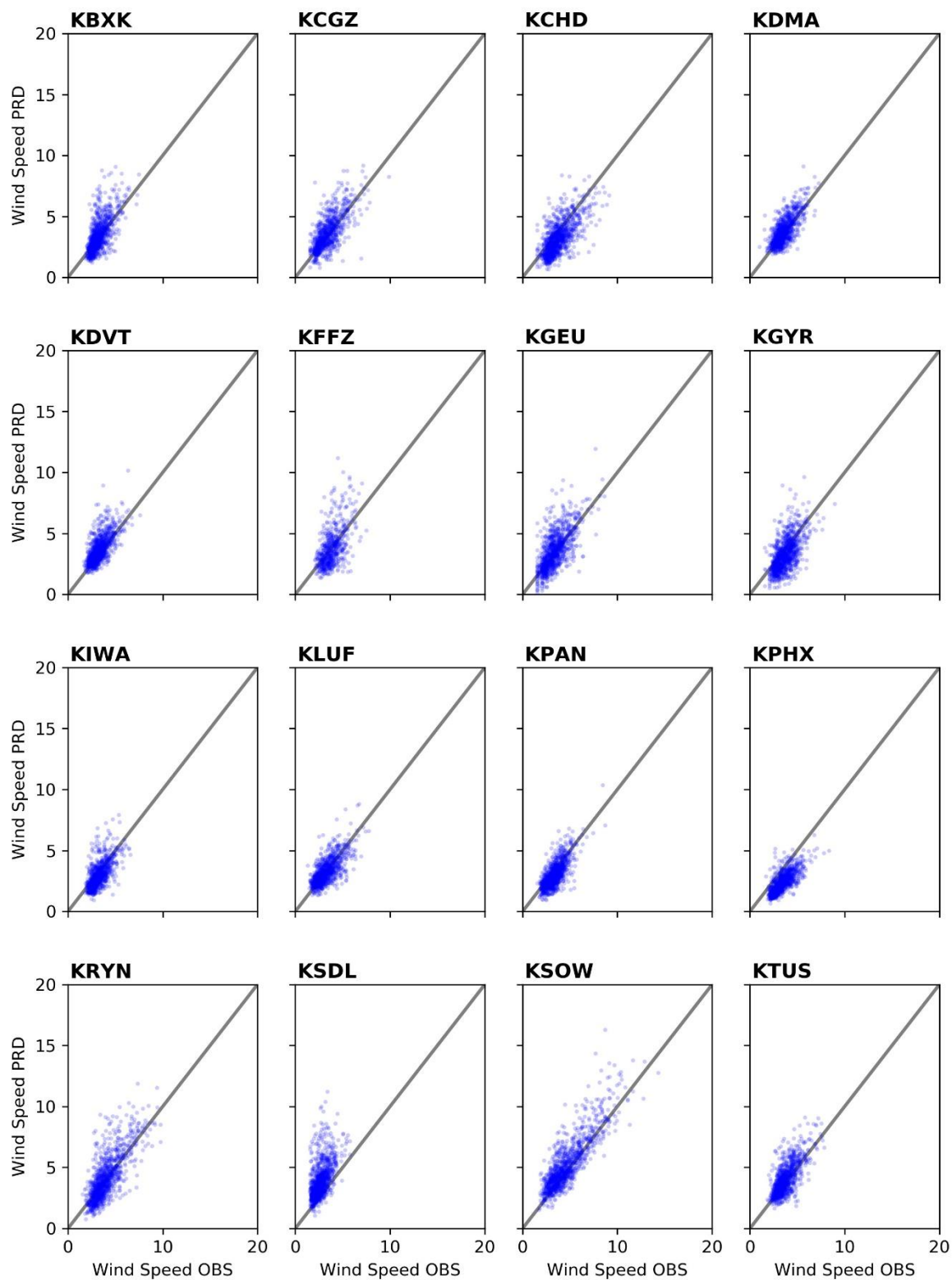
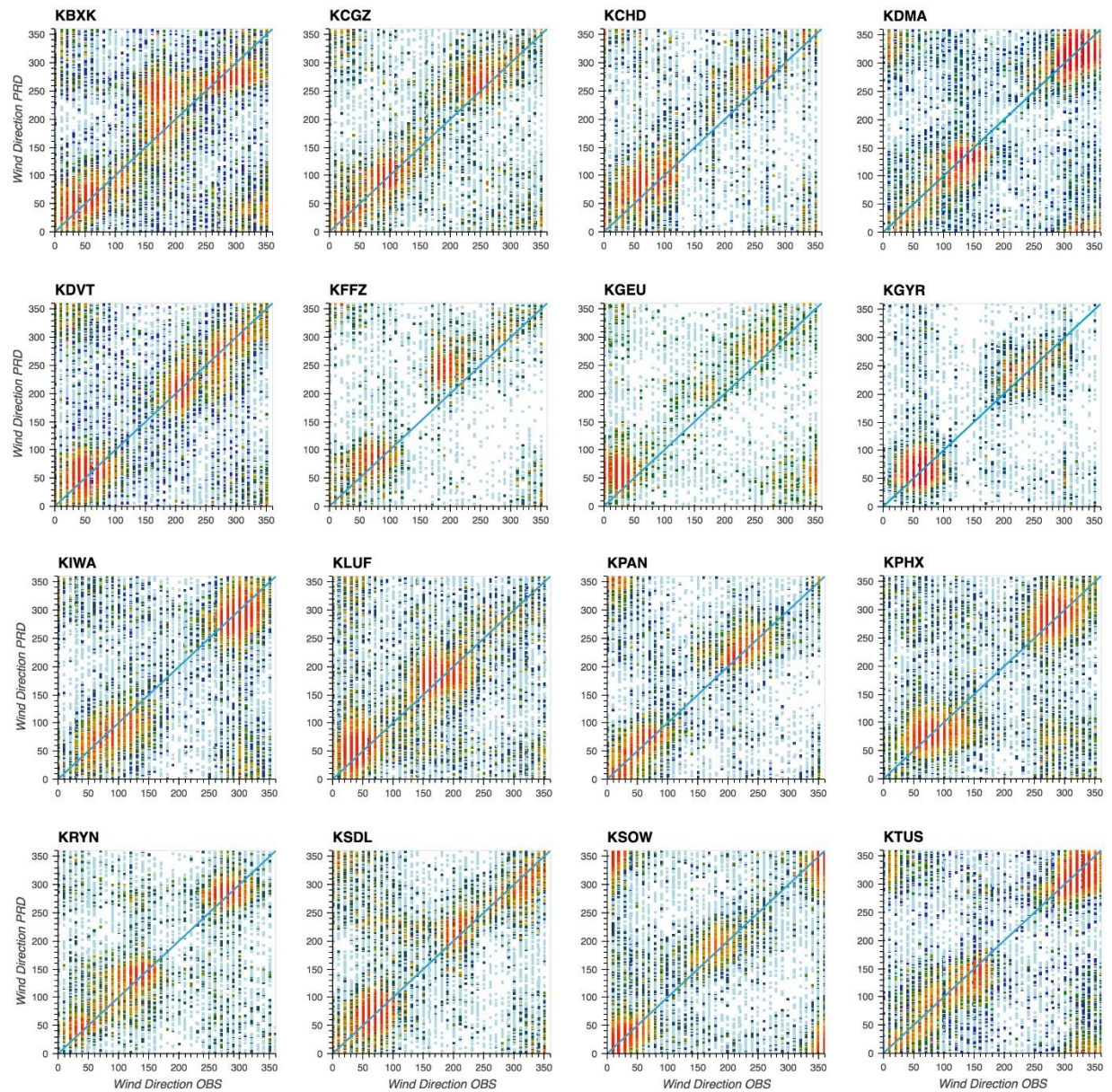
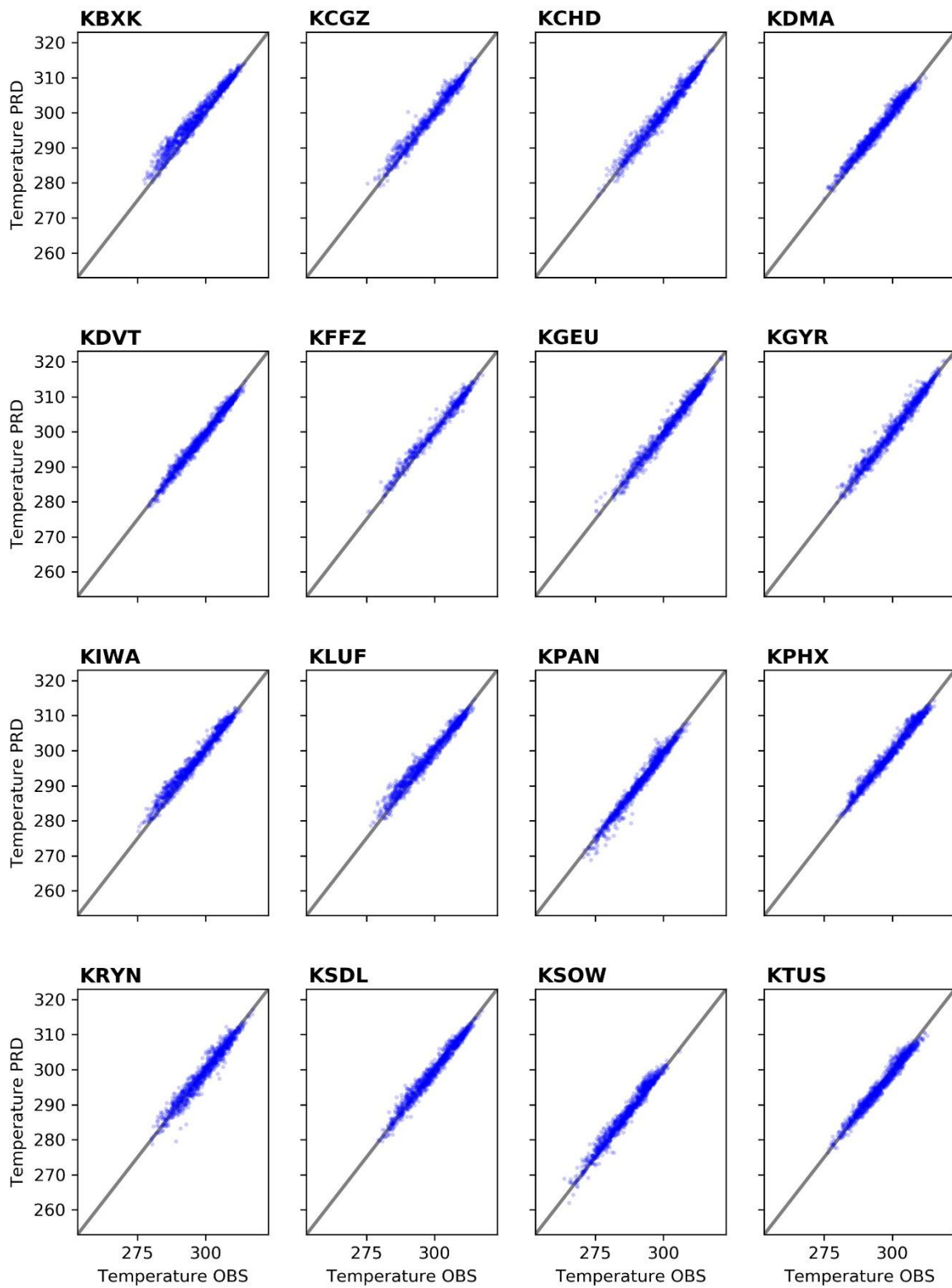


Figure 3-13. OBS vs. PRD Hourly Wind Direction Scatterplot by Station (°)



The marker color represents the number of counts (blue = low and red = high) in any wind direction bin. The blue line is the 1-to-1 line.

Figure 3-14 OBS vs. PRD Daily Average Temperature Scatterplot by Station (°K)



3.2.2.3.2 CALPUFF Source Characterization

Sources from the near-field AERMOD modeling files were used to build the CALPUFF inputs in order to maintain a setup consistent with the AERMOD runs as much as possible. Changes were only made when CALPUFF did not support the AERMOD implementation. The text below describes the differences.

In AERMOD, point sources that release at ambient air temperature (e.g., baghouses) were provided with a stack temperature of zero degrees Kelvin, which AERMOD then models as being released with the contemporaneous ambient temperature. For CALPUFF, these point sources are assumed to release at a stack temperature of 293.15 degrees Kelvin.

Access roads and rail roads were modeled in AERMOD using LINE sources. In CALPUFF, these sources were modeled as a set of widely spaced VOLUME sources, with a spacing of 250 m. The lateral dispersion components were set to road width (16 m for the roads, 10 m for the rails) divided by 4.3, the release heights were the same as the AERMOD LINE sources' (2.55 m for the roads, 3.86 m for the rails), and the vertical component of initial dispersion was set to double the release heights (5.1 m for roads, 7.71 m for rails).

3.2.2.3.3 Receptors for CALPUFF

Receptors for each Class I area, as provided via National Park Service website, were used. <https://www.nature.nps.gov/air/Maps/Receptors/index.cfm>.

3.2.2.3.4 Emissions for CALPUFF

Emissions input to the CALPUFF model were identical to the emissions described in Section 3.1.8.

3.2.2.3.5 CALPUFF Model Settings

The last approved regulatory versions of the models (CALPUFF - Version 5.8.5 - Level 151214, and CALPOST - Version 6.221 - Level 080724) were used. Table 3-32 provides the non-default CALPUFF settings for the far-field SIL analysis.²⁰

²⁰ The Significant Impact Levels (SIL) are pollutant-specific concentrations established by EPA. A proposed source that can demonstrate that modeled ambient air quality impacts are below the SILs is presumed to cause or contribute to a violation of the NAAQS or PSD increment.

Table 3-32. Non-Default Options for SIL Modeling in CALPUFF

Option	Setting	Notes
Control Information		
NSPEC	7	SO ₂ , SO ₄ , NO _x , HNO ₃ , NO ₃ , PMC, PMF
NSE	5	SO ₂ , SO ₄ , NO _x , PMC, PMF
Technical Options		
MCHEM	0	Chemistry turned off for increment
MWET	0	Deposition turned off for increment
MDRY	0	Deposition turned off for increment
MREG	0	When chemistry or deposition are turned off, MREG must be turned off
Map and Grid Controls		
PMAP	LCC	Per meteorological data
FEAST	0	Per meteorological data
FNORTH	0	Per meteorological data
UTMHEN	N	Per meteorological data
RLAT0	33.266N	Per meteorological data
RLON0	111.242W	Per meteorological data
XLAT1	32.766N	Per meteorological data
XLAT2	33.766N	Per meteorological data
DATUM	NWS-84	Per meteorological data
NX	75	Per meteorological data
NY	75	Per meteorological data
NZ	10	Per meteorological data
DGRIDKM	4	Per meteorological data
ZFACE	10 levels	Per meteorological data
XORIGKM	-150	Per meteorological data
YORIGKM	-150	Per meteorological data
IBCOMP	1	Per meteorological data
JBCOMP	1	Per meteorological data
IECOMP	75	Per meteorological data
JECOMP	75	Per meteorological data
LSAMP	F	Per meteorological data
IBSAMP	1	Per meteorological data
JBSAMP	1	Per meteorological data
IESAMP	75	Per meteorological data
JESAMP	75	Per meteorological data
MESHDN	1	Per meteorological data
Gaseous Dry Deposition	NA	Deposition turned off for increment
Particulate Deposition	NA	Deposition turned off for increment
Chemistry Parameters		
MOZ	NA	Chemistry turned off for increment
BCKO3	NA	Chemistry turned off for increment

Option	Setting	Notes
BCKNH3	NA	Chemistry turned off for increment
Miscellaneous Parameters		
IURB1	1	Per meteorological data
IURB2	1	Per meteorological data
SVMIN	0.5*6, 0.5*6	
WSCAT	ISC RURAL	
PLX0	ISC RURAL	

Table 3-32 shows that deposition and chemistry were turned off in the CALPUFF modeling options, along with the related regulatory switch (MREG). In default settings, chemistry and deposition can reduce modeled air concentrations by converting and depositing pollutants. By turning these settings off, conservative estimates of concentrations at the Class I area receptors are modeled.

3.2.2.4 Class I SILs and Design Values

Table 3-18 shows the Class I Area Significant Impact levels (SIL). The maximum concentration modeled with the CALPUFF modeling system were compared to the Class I SILs for each pollutant to determine compliance.

Table 3-33. Class I Area SILs

Pollutant	Averaging Time	Class I Area SIL
NO ₂	1 Year	0.1
PM _{2.5}	1 Year	0.05
	24 hours	0.27
PM ₁₀	1 Year	0.2
	24 hours	0.3
SO ₂	1 Year	0.1
	24 hours	0.2
	3 Hours	1

3.2.2.5 SIL Modeling Results for the Far-Field Areas

The results of the CALPUFF modeling are provided in Table 3-34, Table 3-35, and Table 3-36 for the Sierra Ancha, Mazatzal, and Galiuro Wilderness Areas, respectively. The tables show that the modeled impacts are below the Class I SILs for all receptors, pollutants, and averaging periods for all modeled alternatives.

Table 3-34. CALPUFF Modeling Results for the Sierra Ancha Wilderness Area

Pollutant	Averaging Time	Alt.-2 µg/m ³	Alt.-3 µg/m ³	Alt.-4 µg/m ³	Alt.-5 µg/m ³	Alt.-6 µg/m ³	Class I SIL	Below SIL
NO ₂	1 year	0.0022	0.0022	0.0026	0.0021	0.0021	0.1	Yes
PM ₁₀	24 hours	0.1220	0.1191	0.1295	0.1151	0.1056	0.3	Yes
	1 year	0.0036	0.0036	0.0041	0.0033	0.0030	0.2	Yes
PM _{2.5}	24 hours	0.0521	0.0521	0.0546	0.0522	0.0527	0.27	Yes
	1 year	0.0013	0.0013	0.0017	0.0012	0.0012	0.05	Yes
SO ₂	3 hours	0.0845	0.0845	0.0847	0.0845	0.0845	1	Yes
	24 hours	0.0194	0.0194	0.0195	0.0194	0.0194	0.2	Yes
	1 year	0.0003	0.0003	0.0003	0.0003	0.0003	0.1	Yes

Table 3-35. CALPUFF Modeling Results for the Mazatzal Wilderness Area

Pollutant	Averaging Time	Alt.-2 µg/m ³	Alt.-3 µg/m ³	Alt.-4 µg/m ³	Alt.-5 µg/m ³	Alt.-6 µg/m ³	Class I SIL	Below SIL
NO ₂	1 year	0.0014	0.0014	0.0014	0.0011	0.0010	0.1	Yes
PM ₁₀	24 hours	0.1243	0.1213	0.2141	0.1196	0.1037	0.3	Yes
	1 year	0.0034	0.0034	0.0028	0.0028	0.0019	0.2	Yes
PM _{2.5}	24 hours	0.0345	0.0345	0.0727	0.0338	0.0383	0.27	Yes
	1 year	0.0009	0.0009	0.0010	0.0007	0.0006	0.05	Yes
SO ₂	3 hours	0.0628	0.0628	0.0649	0.0629	0.0630	1	Yes
	24 hours	0.0166	0.0166	0.0172	0.0166	0.0166	0.2	Yes
	1 year	0.0002	0.0002	0.0002	0.0002	0.0002	0.1	Yes

Table 3-36. CALPUFF Modeling Results for the Galiuro Wilderness Area

Pollutant	Averaging Time	Alt.-2 µg/m ³	Alt.-3 µg/m ³	Alt.-4 µg/m ³	Alt.-5 µg/m ³	Alt.-6 µg/m ³	Class I SIL	Below SIL
NO ₂	1 year	0.0011	0.0011	0.0012	0.0019	0.0013	0.1	Yes
PM ₁₀	24 hours	0.1033	0.1009	0.0756	0.2190	0.1523	0.3	Yes
	1 year	0.0023	0.0022	0.0021	0.0065	0.0031	0.2	Yes
PM _{2.5}	24 hours	0.0214	0.0212	0.0215	0.0324	0.0327	0.27	Yes
	1 year	0.0007	0.0007	0.0008	0.0012	0.0009	0.05	Yes
SO ₂	3 hours	0.0211	0.0211	0.0214	0.0212	0.0213	1	Yes
	24 hours	0.0059	0.0059	0.0059	0.0060	0.0059	0.2	Yes
	1 year	0.0002	0.0002	0.0002	0.0002	0.0002	0.1	Yes

3.2.3 Visibility Impacts in the Near-Field

Plume blight is a distinct band or coherent layer of visible air pollution, often from a single pollution source. Particulate matter and nitrogen oxides in the plume scatter and absorb light so that the plume can appear brighter or darker than its viewing background (e.g., the sky or a terrain feature such as a mountain), or the pollution can reduce the contrast of the background view, or it can alter the color of the view. Three levels of visibility analysis are defined in the EPA's Workbook for Plume Visual Impact Screening and Analysis (Revised) (EPA 1992). These three levels of analysis imply varying degrees of accuracy in estimating visibility impacts from plume blight. For this Modeling Report, a Level-3 Near-Field Refined Analysis using PLUVUE II was used to estimate potential plume blight in the nearby SWA and WC ACEC. Level-3 analysis is considered to be a comprehensive analysis of the magnitude and frequency of occurrence of plume visual impacts as observed at a sensitive Class I area vista. PLUVUE II is a straight-line, simple terrain, Gaussian plume model designed to calculate the visual impairment from pollutants of a single point or area source. PLUVUE II uses the actual source location, receptor locations, meteorological conditions, and time of day to determine the geometries of the sun, plume, and observer for the optical calculations.

3.2.3.1 PLUVUE II Modeling

PLUVUE II was run in observer-mode to evaluate the view for five vistas within the Superstition Class I area and one in the White Canyon ACEC. The locations of these vistas, along with the project and alternatives locations, are shown in Table 3-37 and Figure 3-15. The observer locations were chosen at high points to provide the best vantage point for looking out over the terrain.

Each modeling scenario is comprised of emissions from East Plant, West Plant, and a tailing storage alternative. Since West Plant (WP) emissions are much lower than East Plant (EP), the WP emissions were combined with the EP source, and the two facilities were modeled as one. (Combining emission sources is necessary given the set-up requirements of the PLUVUE II model.) Then, EP was run in conjunction with a tailing storage alternative. Thus, there were four alternatives evaluated (EP with Near West TSF, EP with Silver King TSF, EP with Peg Leg TSF, and EP with Skunk Camp TSF). For evaluation purposes, the proposed action (Alternative 2) and Alternative 3 were assumed to be nearly identical and were consolidated.

Table 3-38 shows the maximum 24-hour operation emissions of NO_x, SO₂, and PM₁₀ for each alternative. Note that Table 3-38 does not include the windblown emissions from the tailings' storage. The TSF windblown emissions were determined on an hour-by-hour basis using the wind speed and windblown dust methodology from the AERMOD emissions inventory.

There is no recommended procedure for conducting analyses of multiple sources with PLUVUE II, so multiple coherent plumes should be treated individually or combined (FLAG Section 3.3.3). Given the distance between EP and the tailing storage facility (TSF) and elevation differences, the TSF and EP sources were modeled separately using different meteorological

datasets. For hours in which both the EP and TSF plume are visible from a particular vista, the plume impacts are added, regardless of whether the plumes actually overlap or not. This provides a conservative estimate of the merged plume impact.

Figure 3-15. Map of Vista Locations in Relation to Project

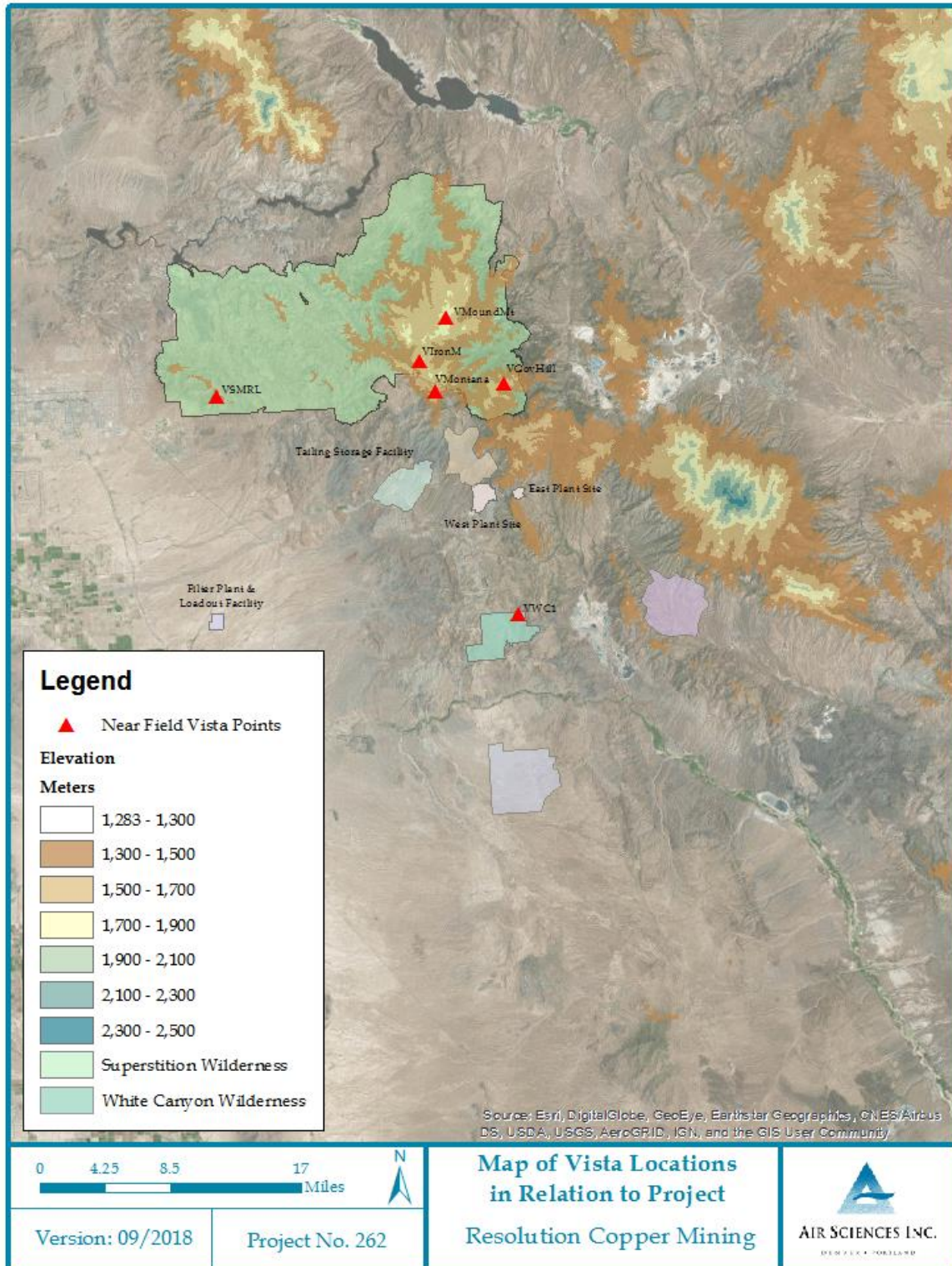


Table 3-37. Project and Vista Locations

Facility	ID	UTM-X (m)	UTM-Y (m)	Elevation (ft)
East Plant	EP	493,640	3,685,170	4,166
Tailings Storage	TSF	487,200	3,702,700	2,558
Silver King Alt	SK	488,390	3,688,599	3,046
Peg Leg Alt	PL	491,684	3,654,886	2,726
Skunk Camp Alt	SC	509,380	3,672,000	3,234
Superstition Observer Locations		UTM-X (m)	UTM-Y (m)	Elevation (ft)
Montana Mt.	VMontana	485,630	3,696,165	5,557
Government Hill	VGovHill	492,795	3,696,480	5,445
Iron Mountain	VIronM	484,180	3,699,270	6,056
Mound Mountain	VMoundMt	487,190	3,703,690	6,268
Superstition Mountain Ridge Line	VSMRL	462,750	3,696,925	5,057
White Canyon Observer Locations		UTM-X (m)	UTM-Y (m)	Elevation (ft)
White Canyon	VWC1	492,985	3,672,320	3,996

Table 3-38. PLUVUE Short-term (24-hour) Maximum Allowable Emissions (tons/day)

Source	NO _x	SO ₂	PM ₁₀
<u>Proposed Action</u>			
East Plant + West Plant	0.54	0.15	0.99
TSF Alt 2 (TSF)	0.17	0.003	1.02
Total	0.71	0.15	2.00
<u>Alternative 3</u>			
East Plant + West Plant	0.54	0.15	0.98
TSF Alt 3 (TSF)	0.17	0.003	0.99
Total	0.71	0.15	1.97
<u>Alternative 4</u>			
East Plant + West Plant	0.54	0.15	0.98
TSF Alt 4 (Silver King)	0.40	0.004	1.00
Total	0.93	0.15	1.98
<u>Alternative 5</u>			
East Plant + West Plant	0.54	0.15	0.98
TSF Alt 5 (Peg Leg)	0.21	0.004	1.43
Total	0.75	0.15	2.41
<u>Alternative 6</u>			
East Plant + West Plant	0.54	0.15	0.98
TSF Alt 6 (Skunk Camp)	0.17	0.003	1.01
Total	0.71	0.15	1.99

*Emissions from emergency generators have been removed from maximum 24-hour emissions; emergency generators will be used only in "upset conditions" and emissions from the emergency generators are not representative of maximum 24-hour emissions during normal operations.

^PM₁₀ emissions due to wind erosion have been removed from maximum 24-hour emissions; PLUVUE II emissions input were based on hourly emissions profiles for wind erosion from exposed surfaces (tailings dry beach, tailings dam, and subsidence area) using the fastest-mile method specified in AP-42, Section 13.2.5

For the Superstition Wilderness, plume trajectories were binned into representative directions passing through the Superstition Wilderness with 5-degree spacing as shown on Figure 3-16. In PLUVUE II, the user must specify the downwind locations along these trajectories where the chemistry and impairment calculations are made. As per the PLUVUE guidance, the first four downwind distance were set to 1, 2.5, 5, and 10 km in order to provide an accurate prediction of the oxidation of NO_x to NO₂. Beyond 10 km, an evaluation point was placed every 5 km until the Class I area was spanned. Although PLUVUE makes the calculation at each evaluation point, only points within the Class I area were considered. These points are identified by the blue dots in Figure 3-16.

For the White Canyon ACEC, a single plume trajectory was used for all plume paths that crossed into the area (shown as the green lines in Figure 3-16). The evaluation points were set to 1, 2.5, 5, 10 km, on the leading edge of the wilderness boundary, in the middle of the area, and on the back edge of the area.

Elevated terrain can block and channel airflow, especially during stable conditions, and it can also increase mechanical mixing and enhance diffusion. To account for this, the stability class was lowered by one step (e.g., from F to E) if the observer was at least 500 meters above the source or if there was terrain between the observer and the source. Complex terrain can also limit the distance and direction a given observer can see. The effects of plume obstruction on views within the Class I area were accounted for in the modeling. For each vista, the view distance can be defined at 15-degree increments. The viewing distance was set to the distance to blocking terrain or the edge of the wilderness area (whichever was closest), with a minimum value of 5 km. The view distances were determined by comparing terrain elevations along a view to the observer elevation. If the terrain exceeded the observer elevation, then the terrain was assumed blocked. Also, views with a plume offset angle of less than 11.25 degrees were eliminated.

The PLUVUE II model requires background pollutant levels for NO_x, NO₂, SO₂, PM₁₀, and ozone (O₃). For these pollutants, average monthly values were calculated from the three years (Quarter 2, 2012 through Quarter 1, 2015) of the EPS onsite monitoring data (shown in Table 3-39). The model also requires background visual range. For this analysis, FLAG 2010 monthly average natural conditions visual range values for the SWA were used (FLAG 2010, Table 10). Table 3-40 provides the average visual range conditions used.

Two years (2015 and 2016) of meteorological data were used for the analysis. For sources near the main project, the closest meteorological station was used (e.g., the East Plant tower for the East Plant source, the Hewitt tower for the TSF, and the West Plant tower for the Silver King area). The approach was to extract the needed parameters (wind speed and direction, temperature, relative humidity, mechanical and convective mixing height, ceiling height and cloud cover) from the AERMET files. Stability class, which is not in AERMOD, was calculated separately using the algorithm from MPRM.

Figure 3-16. Source Plume Trajectories

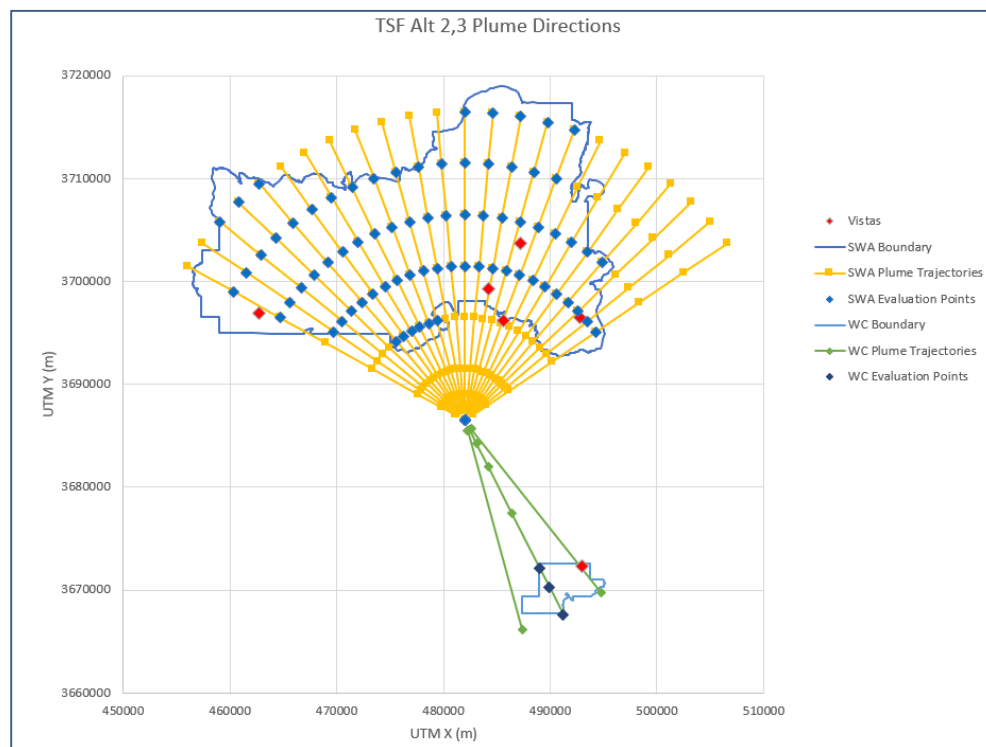
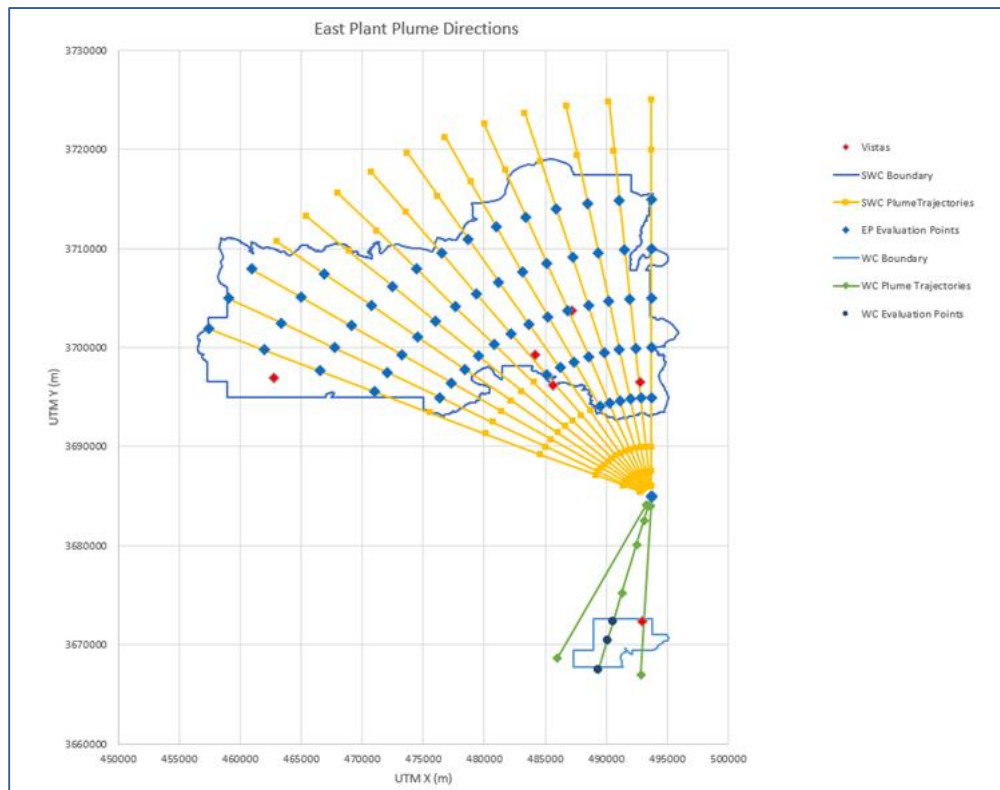


Figure 3-16. Source Plume Trajectories (continued)

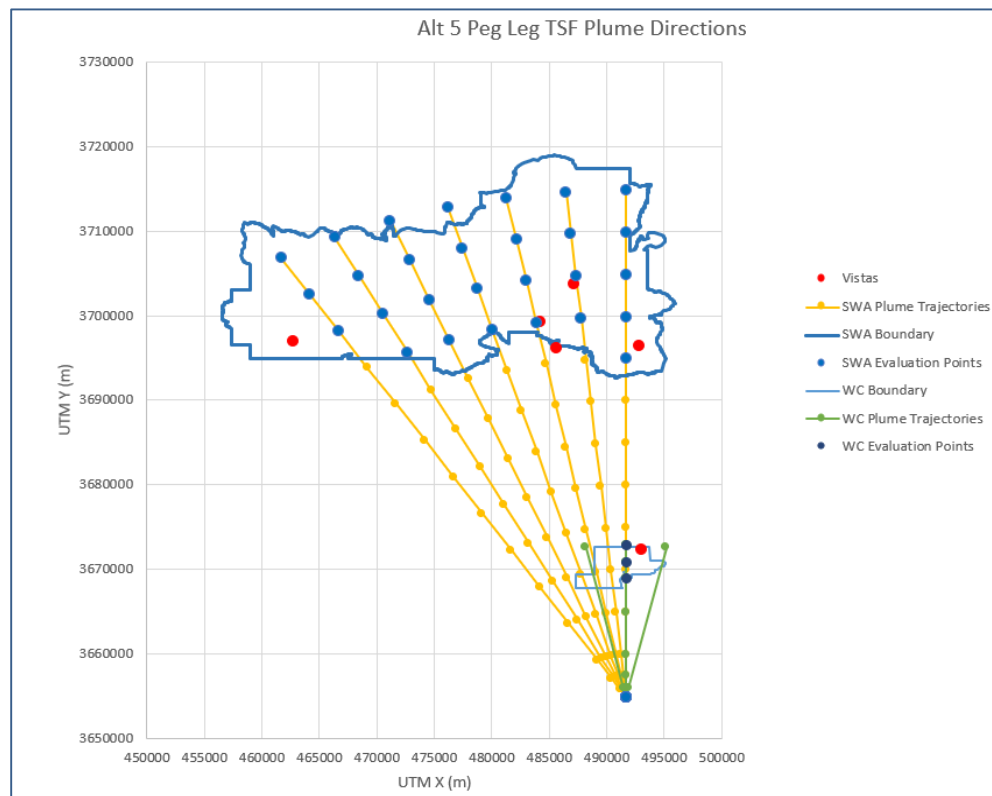
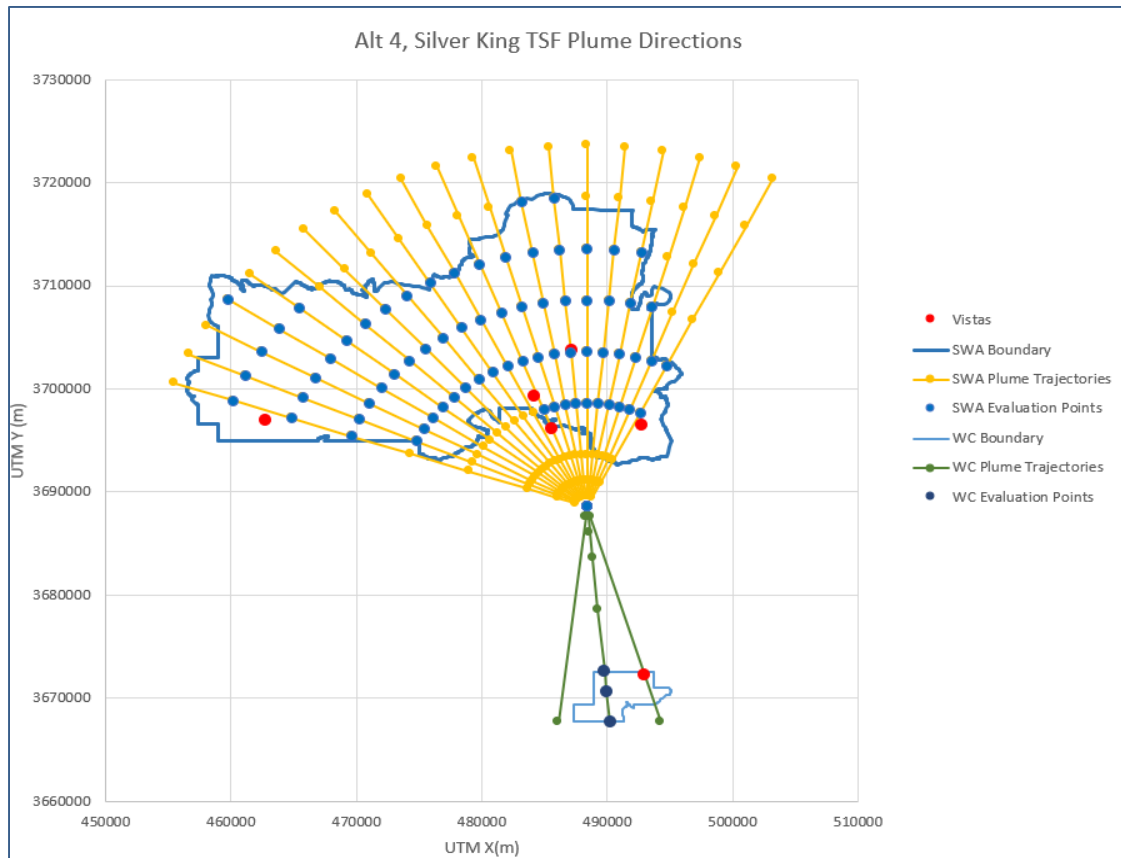
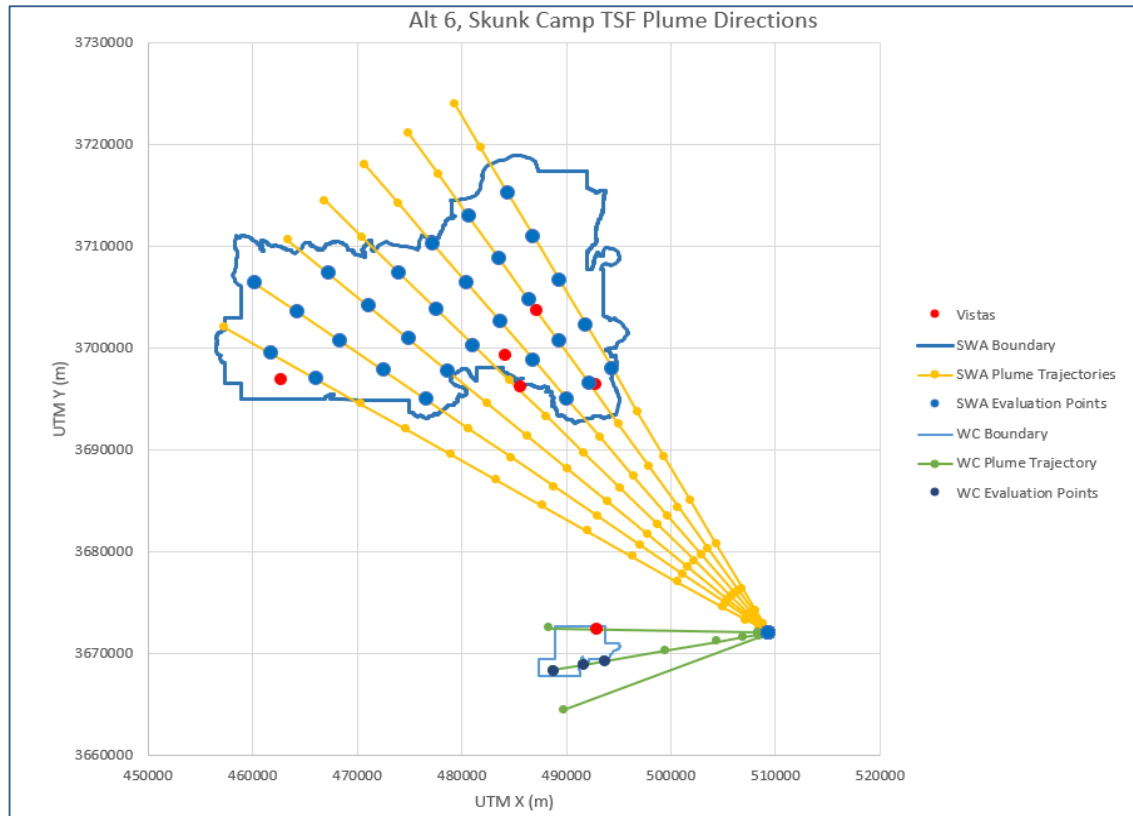


Figure 3-16. Source Plume Trajectories (continued)



For the Peg Leg and Skunk Camp alternatives, no nearby meteorological tower data were available, so meteorological data were extracted from the nearest nodes in the MMIF WRF wind field data used for the CALPUFF modeling. Since the MMIF WRF data includes stability class as one of the parameters, stability from the set was used and only adjusted so that the stability class only changed one step in an hour (as per MPRM).

Only daylight hours in which the wind blows towards the Class I area were evaluated. Each applicable hour was evaluated individually, with the wind speed, direction, relative humidity and temperature used. From this, statistics on the estimated frequency and magnitude of the impairment were calculated for the two-year period.

Table 3-39. Background Pollutant Concentrations for Visibility Modeling

Pollutant	Averaging Period	Background Concentration	
		ppb	($\mu\text{g}/\text{m}^3$)
SO ₂	Jan	0.880	2.26
	Feb	0.707	1.81
	Mar	0.547	1.40
	Apr	0.561	1.44
	May	0.616	1.58
	Jun	0.654	1.68
	Jul	0.601	1.54
	Aug	0.545	1.40
	Sep	0.407	1.04
	Oct	0.869	2.23
	Nov	0.848	2.18
	Dec	1.084	2.78
NO ₂	Jan	1.008	3.23
	Feb	0.965	3.09
	Mar	0.267	0.85
	Apr	0.886	2.84
	May	0.639	2.05
	Jun	0.635	2.04
	Jul	0.395	1.27
	Aug	0.436	1.40
	Sep	0.515	1.65
	Oct	1.075	3.44
	Nov	1.685	5.40
	Dec	1.371	4.40
NO _x	Jan	1.340	4.29
	Feb	1.221	3.91
	Mar	0.361	1.16
	Apr	1.090	3.49
	May	0.891	2.86
	Jun	0.906	2.90
	Jul	0.574	1.84
	Aug	0.691	2.22
	Sep	0.685	2.19
	Oct	1.527	4.89
	Nov	2.058	6.60
	Dec	1.638	5.25
O ₃	Jan	35.697	68.5
	Feb	40.935	78.6
	Mar	46.362	89.0
	Apr	50.611	97.2
	May	54.777	105.2
	Jun	45.109	86.6
	Jul	45.520	87.4
	Aug	43.912	84.3
	Sep	41.090	78.9
	Oct	41.906	80.5
	Nov	37.245	71.5
	Dec	36.033	69.2

Table 3-40. Average Visual Range Conditions for SWA (km)

Superstition Wilderness Area	
Jan	254
Feb	256
Mar	259
Apr	262
May	263
Jun	264
Jul	261
Aug	258
Sep	259
Oct	260
Nov	258
Dec	254
Average	259

FLAG2010, Table 10

3.2.3.2 Near-Field Visibility Analysis Results

Plume blight is evaluated using absolute contrast ($|C|$) and the difference in color contrast (ΔE). $|C|$ is the contrast parameter which accounts for the relative difference in intensity between a viewed object and its background. In PLUVUE II, the calculations are done at one wavelength ($0.55\ \mu\text{m}$), which is green in the middle of the spectrum. ΔE is a color contrast parameter that is calculated for the entire visible spectrum and indicates how different the brightness and color of the plume and background are. ΔE is probably the best single indicator of the perceptibility of a plume to both its contrast and its color with respect to a viewing background. An ΔE of 1.0 represents a condition where the viewer is actively looking for a sharp-edged plume under ideal viewing conditions with a uniform viewing background. Under more diffuse plume conditions, a plume with a ΔE of about 2 would be perceivable to many people. Thus, the larger the value, the greater the perceptibility of the plume. For a Level-3 analysis, the more conservative thresholds of $|C|=0.02$ and $\Delta E=1$ were used (FLAG, 2010). In contrast, the Level-1 and 2 use thresholds of $|C|=0.05$ and $\Delta E=2$, which correspond to an upper bound threshold of a casual observer in the field (EPA, 1992).

The model was run for each hour that the wind blew towards the wilderness areas to determine if the $|C|$ or ΔE were exceeded in that hour. The model considered view with sky, white, gray and black backgrounds. After the runs (roughly 30,000 total), the results were tabulated to determine the number of hours the threshold was exceeded for each alternative and vista as shown in Table 3-41 and in Figure 3-17, Figure 3-18, Figure 3-19, and Figure 3-20.

Table 3-41. PLUVUE II Results

Resolution PLUVUE 2 Modeling									
Total Hours:		17544							
Daylight hours:		8772							
Alternative 2,3: East Plant + TSF									
White Canyon:									
		Hours	Percent Daylight	Superstition Wilderness Area					Percent Daylight
				SRML	Montana	IronMt	MMT	GovH	
Number of daylight hours blows toward area		189	2.2%					2755	31.4%
Parameter	Viewing Background	Hours Over	Percent	Hours Over					Percent
Contrast	Sky	21	0.2%	266	412	388	332	408	4.7%
Delta E	Sky	17	0.2%	281	378	353	294	363	4.3%
Contrast	White	33	0.4%	319	450	429	408	387	5.1%
Delta E	White	30	0.3%	317	448	434	401	379	5.1%
Contrast	Gray	55	0.6%	565	340	353	337	219	6.4%
Delta E	Gray	28	0.3%	495	271	286	275	177	5.6%
Contrast	Black	114	1.3%	754	796	775	803	661	9.2%
Delta E	Black	67	0.8%	638	590	567	574	487	7.3%
Alternative 4: East Plant + Silver King									
White Canyon:									
		Hours	Percent Daylight	Superstition Wilderness Area					Percent Daylight
				SRML	Montana	IronMt	MMT	GovH	
Number of daylight hours blows toward area		162	1.8%					2384	27.2%
Parameter	Viewing Background	Hours Over	Percent	Hours Over					Percent
Contrast	Sky	34	0.4%	207	364	345	305	426	4.9%
Delta E	Sky	30	0.3%	226	328	313	279	379	4.3%
Contrast	White	43	0.5%	262	415	424	394	405	4.8%
Delta E	White	38	0.4%	259	389	394	367	357	4.5%
Contrast	Gray	54	0.6%	421	306	391	380	201	4.8%
Delta E	Gray	35	0.4%	374	249	301	297	143	4.3%
Contrast	Black	93	1.1%	595	783	849	930	715	10.6%
Delta E	Black	63	0.7%	502	568	609	640	501	7.3%
Alternative 5: East Plant + Peg Leg									
White Canyon:									
		Hours	Percent Daylight	Superstition Wilderness Area					Percent Daylight
				SRML	Montana	IronMt	MMT	GovH	
Number of daylight hours blows toward area		365	4.2%					1303	14.9%
Parameter	Viewing Background	Hours Over	Percent	Hours Over					Percent
Contrast	Sky	43	0.5%	178	262	255	223	281	3.2%
Delta E	Sky	31	0.4%	174	221	216	188	237	2.7%
Contrast	White	57	0.6%	204	265	273	260	247	3.1%
Delta E	White	51	0.6%	200	254	258	233	221	2.9%
Contrast	Gray	55	0.6%	322	193	217	187	132	3.7%
Delta E	Gray	31	0.4%	293	165	190	153	100	3.3%
Contrast	Black	156	1.8%	422	397	427	422	387	4.9%
Delta E	Black	87	1.0%	361	317	326	313	284	4.1%
Alternative 6: East Plant + Skunk Camp									
White Canyon:									
		Hours	Percent Daylight	Superstition Wilderness Area					Percent Daylight
				SRML	Montana	IronMt	MMT	GovH	
Number of daylight hours blows toward area		455	5.2%					1930	22.0%
Parameter	Viewing Background	Hours Over	Percent	Hours Over					Percent
Contrast	Sky	46	0.5%	171	256	249	218	276	3.1%
Delta E	Sky	41	0.5%	171	225	228	195	245	2.8%
Contrast	White	53	0.6%	209	263	277	261	247	3.2%
Delta E	White	49	0.6%	208	253	266	248	225	3.0%
Contrast	Gray	70	0.8%	327	212	241	205	144	3.7%
Delta E	Gray	48	0.5%	298	181	206	173	114	3.4%
Contrast	Black	143	1.6%	458	436	470	444	402	5.4%
Delta E	Black	87	1.0%	380	341	365	335	300	4.3%

Plumes from East Plant are in all of the alternatives, so the main difference in the impacts is due to the location and magnitude of the tailing storage alternatives.

Because White Canyon ACEC has a smaller footprint and is not in the path of a predominant wind direction downwind from the Project's emission sources, all alternatives are modeled to have a much lower frequency of impacting this area. Under worst-case conditions (e.g., |C| with a black background), plumes are slightly more visible in the Peg Leg (1.8% of daylight hours) and Skunk Camp (1.6%) alternatives than the northern alternatives (1.3% for Alt 2/3 and 1.1% at Silver King). For SWA, the wilderness footprint is much larger and some of the alternatives are relatively close to the boundary, so the frequency of impacts is higher. Under worst-case conditions (e.g., |C| with a black background), plumes from the Silver King alternative are most visible (10.6% of daylight hours), followed by the Alternatives 2/3 (9.2 %). Because Peg Leg (4.9%) and Skunk Camp (5.4%) alternatives are more distant (> 20 km) from the SWA boundary, their overall impact modeled with PLUVUE II is lower.

In all cases, the highest ΔE and |C| values are for the black backgrounds, which indicates that the plumes will be lighter in color (as shown in Figure 3-17 and Figure 3-18). Note that gray backgrounds are less problematic for views on the eastern side of the wilderness area than on the west (e.g., SMRL) where the plume is backlit from the morning sun.

Figures Figure 3-18 and Figure 3-19 show the |C| and ΔE values by background (sky, white, gray, and black) and alternatives for each vista. Each column shows the number of hours that the impact is modeled to be over the threshold and the color bands indicate the magnitude (in four impairment ranges). Note that the columns are not additive and should not be summed. The lowest bins (blue) represent hours in which the plume would be unlikely to be noticed by a casual observer. The other classes are more likely to be noticed by an observer. For the SWA, the northern sites have the highest impairment, ranging up to 350 hours/year. For the WC ACEC, the worst-case impacts are less frequent, ranging to about 50 hours per year.

Figure 3-20 shows the time of day the impacts occur using the maximum vista ΔE . The results indicate that > 85% of the impacts occur in the morning hours when wind speeds and plume dispersion are lower. At the WC ACEC, impacts show lower frequency of occurrence and still mostly occur in early morning hours. At the WC ACEC, the Alternative 6 (Silver King) scenario shows a higher percentage of impacts in afternoon hours.

Figure 3-17. Percent of Daylight Hours of Modeled Perceptible Visibility Impact (based on |C| with a black background)

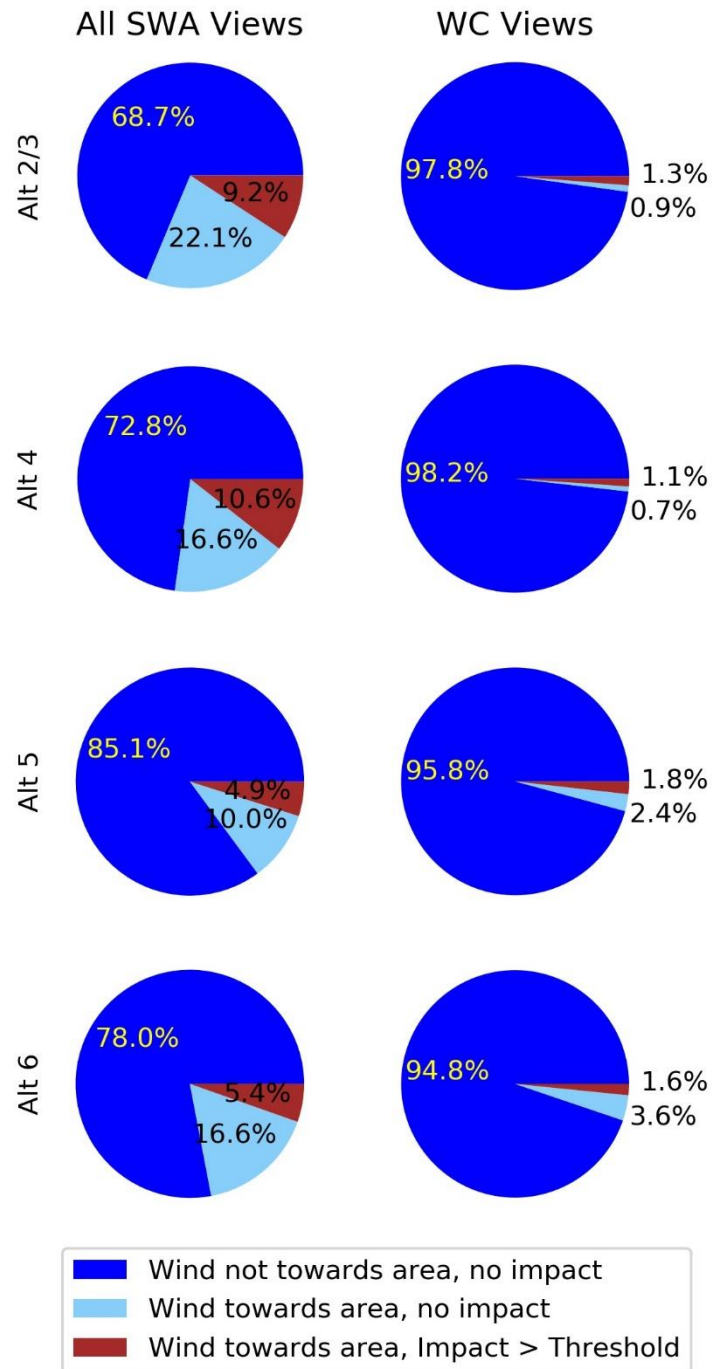


Figure 3-18. Color Contrast by Vista and Alternative

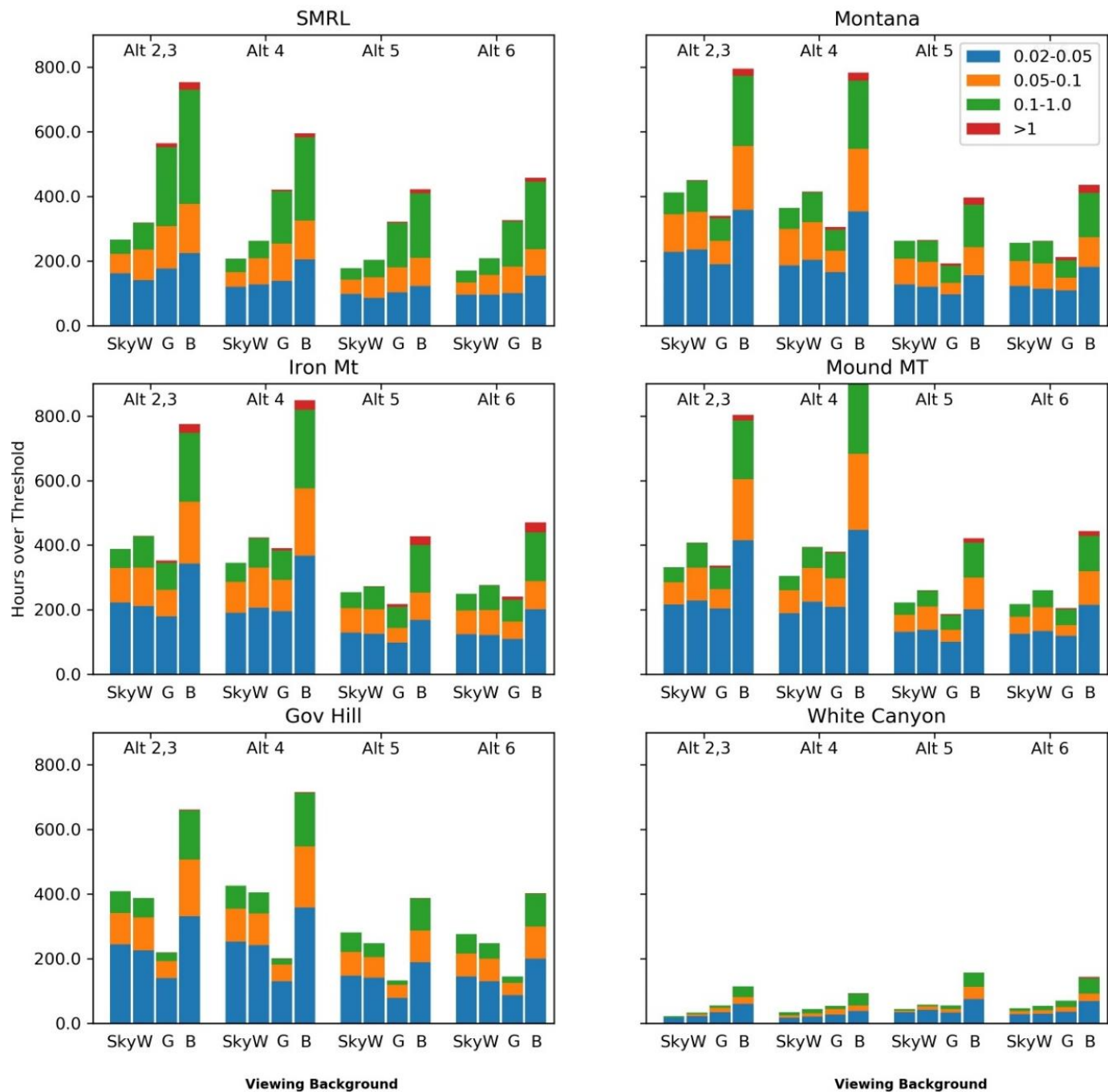


Figure 3-19. ΔE by Vista and Alternative

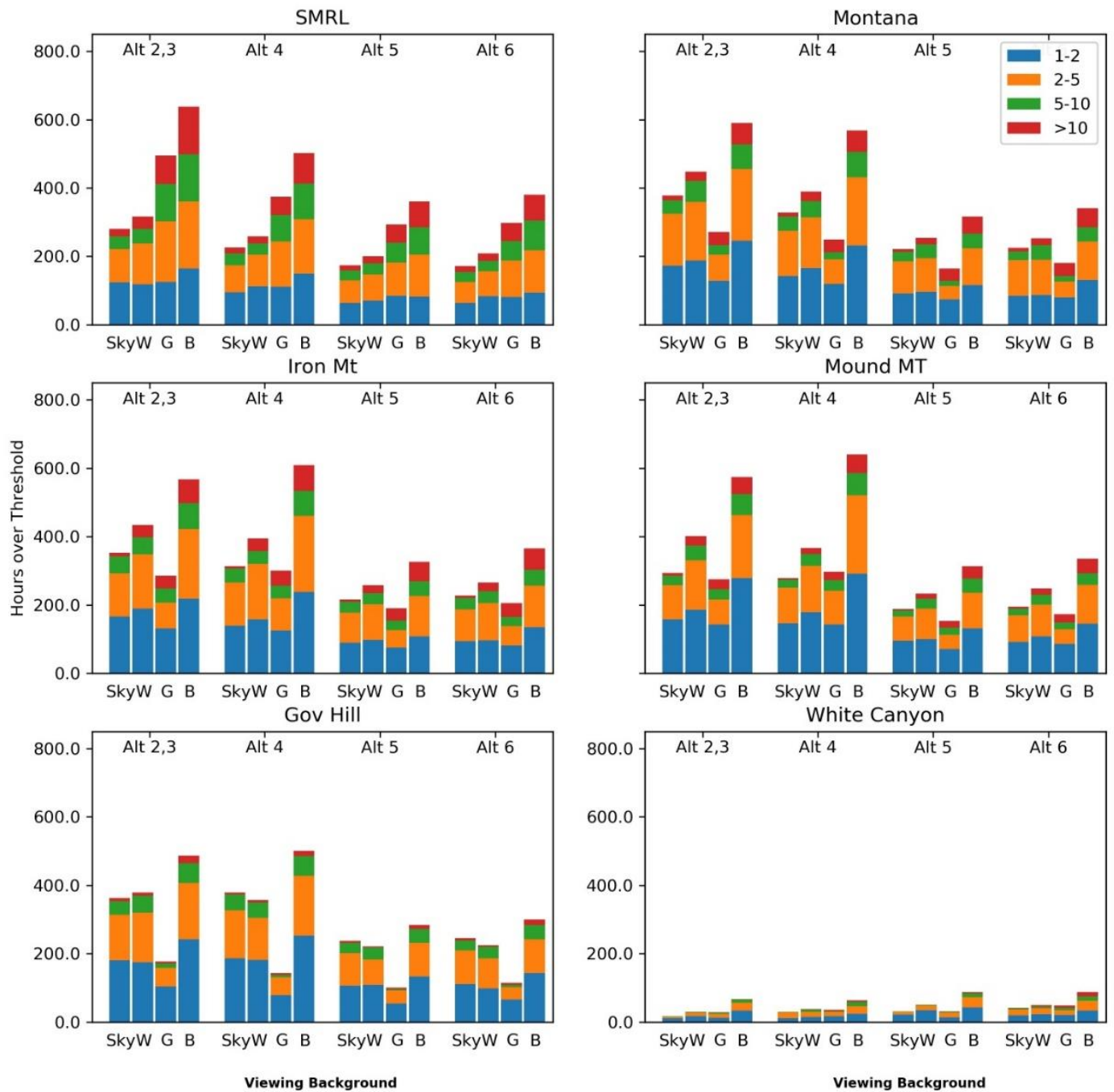
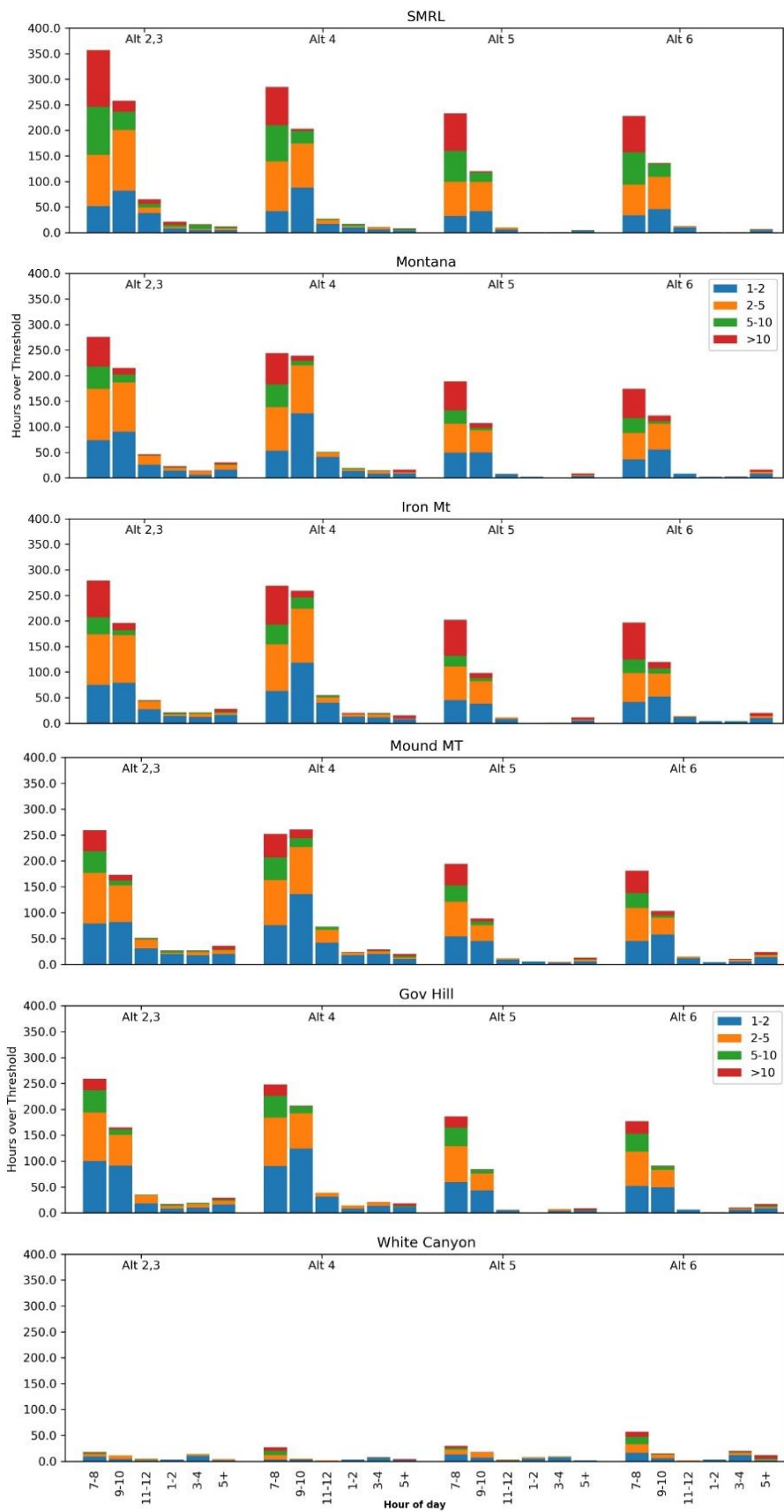


Figure 3-20. Vista Maximum ΔE by Hour



3.2.4 Visibility Impacts in the Far-Field

For the far field Class I areas (Sierra Ancha, Mazatzal, and Galiuro Wilderness Areas), the CALPUFF modeling system was used to estimate the 98th percentile change in light extinction due to the Project emissions for each of the Alternatives. In accordance with the FLAG 2010 report, the modeled extinction changes were compared to a 5% threshold to determine whether any of the Alternatives can be expected to contribute to regional haze visibility impacts.

3.2.4.1 CALPUFF Far-Field Visibility Modeling

The meteorological data, source characterization, receptors, and emissions used for the far-field analyses were identical to the far-field SIL analysis described above in Section 3.2.2.3.4. The visibility extinction threshold is compared to daily modeled visibility extinction, so the short-term emission rates were modeled. However, model settings were different than the SIL analysis; settings appropriate for visibility and deposition modeling were used. Table 3-42 provides the non-default CALPUFF settings for the far-field visibility and deposition analyses. The MESOPUFF II five-pollutant (SO₂, SO₄, NO_x, HNO₃, NO₃) conversion scheme was used.

Table 3-42. Non-Default Options for Visibility & Deposition Modeling in CALPUFF

Option	Setting	Notes
Control Information		
NSPEC	7	SO ₂ , SO ₄ , NO _x , HNO ₃ , NO ₃ , PMC, PMF
NSE	5	SO ₂ , SO ₄ , NO _x , PMC, PMF
Technical Options		
MCHEM	1	Default Option
MWET	1	Default Option
MDRY	1	Deposition turned off for SIL/increment analyses
MREG	0	When chemistry or deposition are turned off, MREG must be turned off
Map and Grid Controls		
PMAP	LCC	Per meteorological data
FEAST	0	Per meteorological data
FNORTH	0	Per meteorological data
UTMHEM	N	Per meteorological data
RLAT0	33.266N	Per meteorological data
RLON0	111.242W	Per meteorological data
XLAT1	32.766N	Per meteorological data
XLAT2	33.766N	Per meteorological data
DATUM	NWS-84	Per meteorological data
NX	75	Per meteorological data
NY	75	Per meteorological data
NZ	10	Per meteorological data
DGRIDKM	4	Per meteorological data
ZFACE	10 levels	Per meteorological data

Option	Setting	Notes
XORIGKM	-150	Per meteorological data
YORIGKM	-150	Per meteorological data
IBCOMP	1	Per meteorological data
JBCOMP	1	Per meteorological data
IECOMP	75	Per meteorological data
JECOMP	75	Per meteorological data
LSAMP	F	Per meteorological data
IBSAMP	1	Per meteorological data
JBSAMP	1	Per meteorological data
IESAMP	75	Per meteorological data
JESAMP	75	Per meteorological data
MESHDN	1	Per meteorological data
Gaseous Dry Deposition	*	See Table 3-43
Particulate Deposition	*	See Table 3-44
Chemistry Parameters		
MOZ	0	Monthly ozone background
BCKO3	*	See Table 3-45
BCKNH3	12*1	(NPS 2010)
Miscellaneous Parameters		
IURB1	1	Per meteorological data
IURB2	1	Per meteorological data
SVMIN	0.5*6, 0.5*6	
WSCAT	ISC RURAL	
PLX0	ISC RURAL	

The parameters used in CALPUFF's gaseous dry and particulate dry and wet deposition algorithms are provided in Table 3-43 and Table 3-44, respectively.

Table 3-43. Gaseous Dry Deposition Parameters

Pollutant	Diffusivity (cm ² /s)	Alpha Star	Reactivity	Mesophyll Resistance (s/cm)	Henry's Law
HNO ₃	0.1628	1	18	0	8.00E-08
NO _x	0.1656	1	8	5	3.5
SO ₂	0.1509	1,000	8	0	0.04

cm²/s = square centimeters per second; s/cm = seconds per centimeter

Table 3-44. Particulate Dry and Wet Deposition Parameters

Pollutant	Geometric Mass Mean Diameter (μm)	Geometric Standard Deviation (μm)	Liquid Scavenging Coefficients (s^{-1})	Frozen Precip. Scavenging Coefficients (s^{-1})
SO ₂	0.48	2	0.00003	0
SO ₄			0.0001	0.00003
NO _x			0	0
HNO ₃	0.48	2	0.00006	0
NO ₃			0.0001	0.00003
PMC			0.0001	0.00003
PMF	0.48	2	0.0001	0.00003

μm = micrometers; s^{-1} = inverse seconds

The monthly average ozone profile developed from Resolution's ozone monitoring site at East Plant is provided in Table 3-45. The background ammonia was taken from IWAQM guidance, which for arid lands is 1 ppb (EPA 1998).

Table 3-45. Monthly Average Ozone Values, Resolution East Plant Monitoring Site

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2015	34.5	42.9	48.4	53.7	53.5	49.3	40.9	46.5	40.2	39.3	39.2	36.5
2016	37.1	45.4	54.0	52.1	52.6	49.5	47.7	48.7	39.8	39.7	41.6	38.1
2017	38.9	42.3	48.9	54.9	52.8	42.2	36.9	47.1	45.5	45.0	39.2	42.6

3.2.4.2 POSTUTIL and CALPOST settings for Visibility

The POSTUTIL options to recalculate the HNO₃/NO₃ concentration partition prior to performing other actions were implemented. MNITRATE was set to 1 to recalculate the partition for the all source concentration fields (SO₄, NO₃, HNO₃). POSTUTIL was also set to read the input meteorological files to retrieve the humidity and temperature for the calculation.

CALPOST was set to conform to the configuration outlined in the FLAG guidance (by setting MVISCHECK = 1), which uses annual average aerosol levels and relative humidity factors to calculate the background light extinction (MVISBK = 8, M8_MODE = 5). The background hygroscopic and non-hygroscopic aerosol levels for annual average natural conditions from Table 6 of the FLAG guidance (NPS 2010) were used, provided in Table 3-46 for the selected Class I areas. The monthly average relative humidity (RH) adjustment factors from Tables 7 to 9 of the FLAG guidance were used, provided in Tables Table 3-47, Table 3-48, and Table 3-49.

Table 3-46. Class I Annual Average Natural Conditions - Concentrations and Rayleigh Scattering

	(NH ₄) ₂ SO ₄	NH ₄ NO ₃	OM	EC	Soil	CM	Sea Salt	Rayleigh
Class I Area	µg/m ³	µg/m ³	µg/m ³	µg/m ³	µg/m ³	µg/m ³	µg/m ³	Mm ⁻¹
Sierra Ancha	0.12	0.1	0.6	0.02	0.5	3	0.02	10
Mazatzal	0.12	0.1	0.6	0.02	0.5	3	0.02	10
Galiuro	0.12	0.1	0.6	0.02	0.5	3	0.03	10

NPS 2010, Table 6

Table 3-47. Class I Monthly f_L(RH) - Large (NH₄)₂SO₄ and NH₄NO₃ RH Adjustment Factors

Class I Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sierra Ancha	1.9	1.8	1.6	1.3	1.3	1.1	1.4	1.7	1.5	1.5	1.7	1.9
Mazatzal	1.9	1.8	1.6	1.3	1.3	1.1	1.4	1.6	1.5	1.5	1.6	1.9
Galiuro	1.8	1.7	1.5	1.2	1.2	1.1	1.4	1.7	1.5	1.4	1.6	1.9

Table 3-48. Class I Monthly f_S(RH) - Small (NH₄)₂SO₄ and NH₄NO₃ RH Adjustment Factors

Class I Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sierra Ancha	2.4	2.2	1.9	1.5	1.4	1.2	1.6	2.0	1.8	1.7	2.0	2.4
Mazatzal	2.4	2.2	1.9	1.5	1.4	1.2	1.5	1.9	1.7	1.7	1.9	2.3
Galiuro	2.2	2.0	1.7	1.3	1.3	1.1	1.6	2.0	1.8	1.6	1.8	2.3

Table 3-49. Class I Monthly f_{SS}(RH) - Sea Salt RH Adjustment Factors

Class I Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sierra Ancha	2.6	2.4	2.0	1.5	1.4	1.2	1.7	2.1	2.0	1.8	2.2	2.6
Mazatzal	2.6	2.4	2.0	1.5	1.4	1.2	1.7	2.1	1.9	1.8	2.1	2.6
Galiuro	2.4	2.2	1.8	1.4	1.3	1.2	1.8	2.2	1.9	1.7	2.0	2.5

3.2.4.3 Far-Field Visibility Analysis Results

The modeling results (98th percentile change in visible light extinction) for all alternative are shown in Table 3-50 for the Sierra Ancha, Mazatzal, and Galiuro Wilderness Areas. The results are compared with the extinction change threshold (5%). Table 3-50 shows that the expected changes in visibility in the far-field Class I areas are below the 5% threshold.

Table 3-50. Far-Field Class I Visibility Results

Class I Area	Alt.-2	Alt.-3	Alt.-4	Alt.-5	Alt.-6	Extinction Threshold	Below
Sierra Ancha	0.28%	0.28%	0.35%	0.28%	0.27%	5%	Yes
Mazatzal	0.15%	0.15%	0.15%	0.13%	0.14%	5%	Yes
Galiuro	0.13%	0.13%	0.16%	0.16%	0.15%	5%	Yes

3.2.5 Acid Deposition

In order to assess potential acid deposition impacts at the Class I areas and WC ACEC, Resolution performed an analysis to evaluate annual sulfur (S) and nitrogen (N) deposition due to project emissions. Guidance suggests that N and S deposition should be evaluated for areas closer than 50 km to the Project, as well as areas more than 50 km for which the Q/D result is greater than 10 (FLAG 2011). The SWA and WC ACEC are less than 50 km from the Project; as detailed above in Section 3.2.2.1, the Sierra Ancha, Mazatzal, and Galiuro Wilderness Areas are Class I areas for which the Q/D was greater than 10. Therefore, Resolution has modeled N and S deposition rates due to Project emissions in these areas. The estimate rates were compared to the Deposition Analysis Thresholds (DATs), as outlined in the Federal Land Managers' Interagency Guidance for Nitrogen and Sulfur Deposition Analyses (FLAG 2011). A DAT is defined as the additional amount of N or S deposition due to a new or modified source, below which estimated impacts from a proposed new or modified source are considered negligible. The DATs used for S and N (5 g/hectare/year) are applicable to western Federal Land Managers' (FLM) areas.

3.2.5.1 CALPUFF Modeling for N and S Deposition

The CALPUFF modeling system was selected and used to estimate deposition rates for each evaluated FLM area and for each of the Alternatives. Both dry and wet deposition were considered. The model source configuration was identical to the far-field visibility described above in Section 3.2.4.1. The DATs are an annual threshold, so the emissions were identical to long-term emissions described in Section 3.2.2.3.4. Receptors for the Class I areas and the WC ACEC are described above in Sections 3.2.1.2 and 3.2.2.3.3. Table 3-42 provides the non-default CALPUFF settings for the far-field visibility and deposition analyses. The MESOPUFF II five-pollutant (SO_2 , SO_4 , NO_x , HNO_3 , NO_3) conversion scheme was used as were POSTUTIL settings for N and S Deposition

POSTUTIL was used to process the modeled deposition rates into N and S. A factor is applied to each modeled species deposition rate based on molecular weights. The POSTUTIL settings used to perform this conversion are presented in Section 3.2.5.2.

The modeled nitrogen and sulfur deposition rates (g/hectare/year) are provided in Table 3-52 and Table 3-53 for all alternatives and FLM areas. As shown in the tables, the deposition rates were below the applicable DATs for all alternatives and areas.

Table 3-51. POSUTIL Settings for N and S Deposition

Option	Setting	Notes
Control Information		
NSPECINP	7	SO ₂ , SO ₄ , NO _x , HNO ₃ , NO ₃ , PMC, PMF
NSPECOUT	2	N
NSPECCMP	2	S
CSPECCMP	N	
SO ₂	0	
SO ₄	0.2917	
NO _x	0.3043	
HNO ₃	0.2222	
NO ₃	0.4516	
PMC	0	
PMF	0	
CSPECCMP	S	
SO ₂	0.5	
SO ₄	0.3333	
NO _x	0	
HNO ₃	0	
NO ₃	0	
PMC	0	
PMF	0	

3.2.5.2 N and S Deposition Analysis Results

The modeled nitrogen and sulfur deposition rates (g/hectare/year) are provided in Table 3-52 and Table 3-53 for all alternatives and FLM areas. As shown in the tables, the deposition rates were below the applicable DATs for all alternatives and areas.

Table 3-52. Nitrogen Deposition Modeling Results

Area	Alt.-2	Alt.-3	Alt.-4	Alt.-5	Alt.-6	DAT	Below
Superstition	2.68	2.67	4.18	2.38	2.39	5	Yes
White Canyon	1.16	1.15	1.48	1.77	2.94	5	Yes
Sierra Ancha	0.29	0.29	0.33	0.28	0.28	5	Yes
Mazatzal	0.19	0.19	0.18	0.17	0.15	5	Yes
Galiuro	0.09	0.09	0.10	0.15	0.11	5	Yes

Table 3-53. Sulfur Deposition Modeling Results

Area	Alt.-2	Alt.-3	Alt.-4	Alt.-5	Alt.-6	DAT	Below
Superstition	1.33	1.33	1.42	1.31	1.31	5	Yes
White Canyon	0.73	0.73	0.74	0.74	0.77	5	Yes
Sierra Ancha	0.16	0.16	0.16	0.16	0.16	5	Yes
Mazatzal	0.10	0.10	0.10	0.10	0.10	5	Yes
Galiuro	0.04	0.04	0.04	0.05	0.05	5	Yes

4.0 REFERENCES

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Appendix A – Detailed Emission Calculations

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: N. Tipple	
	PROJECT NO: 262		PAGE: 1	OF: 2
	SHEET: Gen Info			
SUBJECT: General Mining and Milling Information		DATE: October 12, 2018		

Mining Information

Mine Throughput		
	Production	
tonne/hr	8,940	Resolution
tonne/day	143,750	Resolution
tonne/yr	45,625,000	Resolution
ton/hr	9,855	
ton/day	158,457	
ton/yr	50,292,894	

Material Moisture Content and Wind Speed				
Location	Solids* %	Ore Moisture* Content %	Air/Wind Speed*	
			mph	m/s
EAST PLANT				
LHD/Ore Pass/Grizzly		4.0	1.4	0.6
Haulage Ore Flow		4.0	2.2	1.0
Primary Crushing Ore Flow		4.0	4.0	1.8
Lower Level Conveyor Ore Flow		4.0	2.4	1.1
Hoisting System Ore Flow		4.0	1.3	0.6
Upper Level Conveyor System Ore Flow		4.0	4.5	2.0
MILL				
Incline Conveyor to Mine Transfer Conveyor	96.0	4.0	1.3	**
Enclosed Stockpile	95.8	4.2	1.3	**
Stockpile Reclaim	95.8	4.2	1.3	**
SAG Feeder Conveyors		4.8 **	1.3	**
Pebble Recycle		4.8 **	1.3	**
Holoflite Dryer - In		4.8 **	1.3	**
Holoflite Dryer - Out		4.8 **	1.3	**
LOADOUT				
All		4.8 **	1.3	**

* Resolution
 ** AP-4, Ch. 13.2.4

Silt Content	
Surface	3.0% AP-42, Chapter 13.2.2, Related Information, r13s0202_dec03.xls

Conversions
1.10231 ton/tonne
907.185 kg/ton
2.237 mph/mps
24 hr/day
365 day/yr
8,760 hr/yr

Blue values are input; black values are calculated or linked

<p align="center">Air Sciences Inc.</p> <p align="center">AIR EMISSION CALCULATIONS</p>	PROJECT TITLE: Resolution Copper EI		BY: N. Tipple		
	PROJECT NO: 262		PAGE: 2	OF: 2	SHEET: Gen Info
	SUBJECT: General Mining and Milling Information		DATE: October 12, 2018		

Milling Information

Mill Throughput

	Coarse Ore Stockpile	Entering Each SAG Mill (2)	Each SAG Mill Processing (2)	Each Screen Screen O'Size (2)	Entering Each Ball Mill (4)
tonne/hr	8,940	4,296	4,296	1,060	7,011
tonne/day	143,750	94,875	94,875	23,390	154,808
tonne/yr	45,625,000	30,112,500	30,112,500	7,424,100	49,134,616
ton/hr	9,855	4,736	4,736	1,168	7,728
ton/day	158,457	104,582	104,582	25,783	170,646
ton/yr	50,292,894	33,193,310	33,193,310	8,183,660	54,161,579

Mill Throughput Continued

	Pebble Circuit	Moly Filter Cake to Dryer	Dried Moly Concentrate	Cu Concentrate Loadout
tonne/hr	1,042	10.0	9.0	414
tonne/day	23,000	238.0	213.0	9,942
tonne/yr	7,300,000	41,176.0	36,842.0	3,338,889
ton/hr	1,149	11	10	456
ton/day	25,353	262	235	10,959
ton/yr	8,046,863	45,389	40,611	3,680,491

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: N. Tipple		
	PROJECT NO: 262		PAGE: 1	OF: 2	SHEET: Summary_DISP
	SUBJECT: Facility-Wide Emissions		DATE: October 12, 2018		

FACILITY - CONTROLLED - EMISSIONS SUMMARY (INCLUDING FUGITIVES)

Location	Potential Emissions											
	CO		NO _x		SO ₂		PM ₁₀		PM _{2.5}		VOC	
	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr
EP Surface Subtotal	34.6	11.6	134	33.8	0.80	0.21	9.9	8.7	5.3	2.4	13.4	3.4
EP UG Subtotal	265	193	35.4	22.4	6.9	1.8	110	155	15.3	31.7	6.9	8.3
Mill Subtotal	42.0	43.3	10.1	15.8	5.2	15.0	26.5	36.4	4.9	10.9	23.3	68.9
Loadout Subtotal	18.6	25.3	6.8	5.7	3.0E-2	5.9E-2	0.77	2.5	0.26	0.52	1.1	1.5
Tailings Subtotal	119	343	14.7	40.7	0.25	0.73	84.9	249	13.5	40.2	7.7	20.6
FACILITY TOTAL	479	616	201	118	13.2	17.8	232	452	39.3	85.7	52.4	103

FACILITY - UNCONTROLLED - EMISSIONS SUMMARY (INCLUDING FUGITIVES)

Location	Potential Emissions											
	CO		NO _x		SO ₂		PM ₁₀		PM _{2.5}		VOC	
	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr
EP Surface Subtotal	34.6	11.6	134	33.8	0.80	0.21	100	51.7	18.5	8.4	13.4	3.4
EP UG Subtotal	265	193	35.4	22.4	6.9	1.8	1,866	2,271	288	483	6.9	8.3
Mill Subtotal	42.0	43.3	10.1	15.8	84.9	272	345	622	126	360	175	558
Loadout Subtotal	18.6	25.3	6.8	5.7	3.0E-2	5.9E-2	3.0	11.3	0.53	1.6	1.1	1.5
Tailings Subtotal	119	343	14.7	40.7	0.25	0.73	807	2,366	106	313	7.7	20.6
FACILITY TOTAL	479	616	201	118	92.9	275	3,122	5,323	538	1,166	204	592

Air Sciences Inc. AIR EMISSION CALCULATIONS					PROJECT TITLE: Resolution Copper EI				BY: N. Tipple					
					PROJECT NO: 262				PAGE: 2		OF: 2		SHEET: Summary_DISP	
					SUBJECT: Facility-Wide Emissions				DATE: October 12, 2018					
FACILITY - CONTROLLED - EMISSIONS SUMMARY (EXCLUDING FUGITIVES)														
Potential Emissions														
CO NO _x SO ₂ PM ₁₀ PM _{2.5} VOC														
Location	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr		
EP Surface Subtotal (NF)*	32.6	8.1	134	33.5	0.80	0.20	8.2	5.2	5.1	1.8	13.3	3.3		
EP UG Subtotal (NF)*							19.6	57.1	5.6	21.1				
Mill Subtotal (NF)*	16.1	10.6	3.8	10.8	4.5	14.8	5.4	17.1	2.2	7.6	20.6	66.0		
Loadout Subtotal (NF)*	3.9	0.96	0.35	8.7E-2	9.0E-3	2.2E-3	0.35	1.4	5.9E-2	0.21	1.7E-2	4.3E-3		
Tailings Subtotal (NF)*	3.9	0.96	0.35	8.7E-2	9.0E-3	2.2E-3	7.7E-3	1.9E-3	7.7E-3	1.9E-3	1.7E-2	4.3E-3		
FACILITY TOTAL	56.4	20.6	138	44.4	5.3	15.0	33.6	80.8	12.9	30.7	33.9	69.3		
(NF)* no fugitive or mobile emissions														
FACILITY - UNCONTROLLED - EMISSIONS SUMMARY (EXCLUDING FUGITIVES)														
Potential Emissions														
CO NO _x SO ₂ PM ₁₀ PM _{2.5} VOC														
Location	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr		
EP Surface Subtotal (NF)*	32.6	8.1	134	33.5	0.80	0.20	86.7	38.2	17.0	6.8	13.3	3.3		
EP UG Subtotal (NF)*							137	350	114	290				
Mill Subtotal (NF)*	16.1	10.6	3.8	10.8	84.2	272	144	454	105	342	172	555		
Loadout Subtotal (NF)*	3.9	0.96	0.35	8.7E-2	9.0E-3	2.2E-3	0.35	1.4	5.9E-2	0.21	1.7E-2	4.3E-3		
Tailings Subtotal (NF)*	3.9	0.96	0.35	8.7E-2	9.0E-3	2.2E-3	7.7E-3	1.9E-3	7.7E-3	1.9E-3	1.7E-2	4.3E-3		
FACILITY TOTAL	56.4	20.6	138	44.4	85.0	272	368	843	236	639	186	558		
(NF)* no fugitive or mobile emissions														

Air Sciences Inc. AIR EMISSION CALCULATIONS					PROJECT TITLE: Resolution Copper EI				BY: N. Tipple					
					PROJECT NO: 262				PAGE: 1		OF: 3		SHEET: Atty_DISP	
					SUBJECT: Emission by Class				DATE: October 12, 2018					
FACILITY - CONTROLLED - EMISSIONS SUMMARY (INCLUDING FUGITIVES)														
Location		Potential Emissions												
		CO		NO _x		SO ₂		PM ₁₀		PM _{2.5}		VOC		
		lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	
East Plant Surface														
Stack*		32.6	8.1	134	33.5	0.80	0.20	5.2	3.9	4.6	1.6	13.3	3.3	
Process Fugitive*								3.0	1.3	0.46	0.20			
Fugitive								1.7	3.4	0.20	0.57	3.3E-4	1.4E-3	
Mobile		2.0	3.4	0.32	0.35	3.3E-3	6.8E-3	5.3E-2	8.3E-2	2.0E-2	2.4E-2	9.7E-2	0.11	
Subtotal		34.6	11.6	134	33.8	0.80	0.21	9.9	8.7	5.3	2.4	13.4	3.4	
East Plant Underground														
Stack								3.9	17.1	3.8	16.4			
Process Fugitive								15.7	40.0	1.8	4.7			
Fugitive		109	26.7	20.9	5.1	6.7	1.6	90.0	96.9	9.0	9.7	4.8E-3	2.1E-2	
Mobile		155	167	14.6	17.3	0.14	0.15	0.73	0.87	0.73	0.87	6.9	8.2	
Subtotal		265	193	35.4	22.4	6.9	1.8	110	155	15.3	31.7	6.9	8.3	
Mill														
Stack*		16.1	10.6	3.8	10.8	4.5	14.8	1.8	6.5	1.7	6.0	20.6	65.9	
Process Fugitive*								3.6	10.5	0.55	1.6	1.7E-2	7.2E-2	
Fugitive		0.67	2.1	2.1	0.40	0.67	0.13	20.8	19.2	2.5	3.1	4.0E-3	1.7E-2	
Mobile		25.3	30.6	4.3	4.6	4.8E-2	5.6E-2	0.22	0.22	0.17	0.20	2.7	2.9	
Subtotal		42.0	43.3	10.1	15.8	5.2	15.0	26.5	36.4	4.9	10.9	23.3	68.9	
Loadout														
Stack*		3.9	0.96	0.35	8.7E-2	9.0E-3	2.2E-3	7.7E-3	1.9E-3	7.7E-3	1.9E-3	1.7E-2	4.3E-3	
Process Fugitive*								0.34	1.4	5.1E-2	0.21			
Fugitive								0.24	0.97	3.0E-2	0.12	3.1E-3	1.3E-2	
Mobile		14.7	24.4	6.4	5.6	2.1E-2	5.7E-2	0.17	0.20	0.17	0.19	1.0	1.5	
Subtotal		18.6	25.3	6.8	5.7	3.0E-2	5.9E-2	0.77	2.5	0.26	0.52	1.1	1.5	
Tailings														
Stack*		3.9	0.96	0.35	8.7E-2	9.0E-3	2.2E-3	7.7E-3	1.9E-3	7.7E-3	1.9E-3	1.7E-2	4.3E-3	
Process Fugitive*														
Fugitive								84.2	247	12.8	38.2	3.1E-2	0.13	
Mobile		115	342	14.4	40.6	0.24	0.72	0.71	2.0	0.71	2.0	7.7	20.5	
Subtotal		119	343	14.7	40.7	0.25	0.73	84.9	249	13.5	40.2	7.7	20.6	
FACILITY TOTAL		479	616	201	118	13.2	17.8	232	452	39.3	85.7	52.4	103	
*Stack and process fugitive sources considered "process" sources														

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Air Sciences Inc. AIR EMISSION CALCULATIONS						PROJECT TITLE: Resolution Copper EI				BY: D. Steen					
						PROJECT NO: 262				PAGE: 1		OF: 18		SHEET: EPS_DISP	
						SUBJECT: East Plant				DATE: October 12, 2018					
EAST PLANT - CONTROLLED UNDERGROUND - EMISSIONS SUMMARY															
Source ID	CO		NO _x		SO ₂		PM ₁₀		PM _{2.5}		VOC				
	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr			
2_EP_UG_DB	Drilling & Blasting														
EP_UG_DRILL							5.6E-2	4.1E-2	0.12	8.4E-2					
EP_UG_BLAST	109	26.7	20.9	5.1	6.7	1.6	1.6	0.40	0.19	4.7E-2					
2_EP_UG_EXTRACT	Extraction Level Ore Flow														
EP_UG_OVER							3.6E-2	9.1E-2	7.3E-2	0.19					
2_EP_UG_OREPASS	LHD/Ore Pass/Grizzly														
EP_UG_GRIZ							3.3	8.4	0.46	1.2					
2_EP_UG_RAIL	Haulage Ore Flow														
EP_UG_TRAIN							0.67	1.7	0.21	0.53					
EP_UG_COARSE							0.36	1.6	0.73	3.2					
2_EP_UG_1CRUSH	Primary Crushing Ore Flow														
EP_UG_FINE															
2_EP_UG_LOW_ORE	Lower Level Conveyor Ore Flow														
EP_UG_CV103															
EP_UG_CV104							8.1E-2	0.35	0.16	0.72					
EP_UG_CV105							0.73	1.9	0.23	0.58					
EP_UG_SILO							0.36	1.6	0.73	3.2					
EP_UG_FEED															
EP_UG_CV106_111															
EP_UG_Chute							0.73	1.9	0.23	0.58					
EP_UG_FLASK							0.54	2.4	1.1	4.8					
2_EP_UG_HOIST	Hoisting System Ore Flow														
EP_UG_SKIP															
EP_UG_BIN															
2_EP_UG_UP_ORE	Upper Level Conveyor System Ore Flow														
EP_UG_FEED112_115							0.36	1.6	0.73	3.2					
EP_UG_CV102_105															
EP_UG_INC_CONV115							1.6	4.2	0.51	1.3					
2_EP_UG_D	Non-Emergency Underground Diesel Fleet														
EP_UG_D_C	155	167	14.6	17.3	0.14	0.15	0.33	0.39	0.68	0.80	6.9	8.2			
EP_UG_D_DOZ							0.51	0.22	0.68	0.29					
EP_UG_D_FUG							39.0	43.4	8.0	8.9					
2_EP_UG_REF	Underground Refrigeration Plant														
EP_UG_COOL							8.5E-2	0.37	2.6E-2	0.12					
2_EP_UG_FUEL	Diesel Storage Tanks														
EP_UG_FUEL1											4.8E-3	2.1E-2			
3_EP_UG_TOTAL	265	193	35.4	22.4	6.9	1.8	50.4	70.3	14.8	29.7	6.9	8.3			

Air Sciences Inc. AIR EMISSION CALCULATIONS					PROJECT TITLE: Resolution Copper EI				BY: D. Steen					
					PROJECT NO: 262				PAGE: 2		OF: 18		SHEET: EPS_DISP	
					SUBJECT: East Plant				DATE: October 12, 2018					
EAST PLANT - CONTROLLED SURFACE - EMISSIONS SUMMARY														
Source ID	Potential Emissions													
	CO		NO _x		SO ₂		PM ₁₀		PM _{2.5}		VOC			
	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr		
2_EP_S_EGEN	Emergency Generators (Total)													
E_GEN1	15.1	3.8	27.7	6.9	3.3E-2	8.2E-3	0.86	0.22	0.86	0.22	5.6	1.4		
E_GEN2	2.6	0.65	4.9	1.2	5.6E-3	1.4E-3	0.15	3.7E-2	0.15	3.7E-2	0.96	0.24		
E_GEN3	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12		
E_GEN4	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12		
E_GEN5	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12		
E_GEN6	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12		
E_GEN7	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12		
E_GEN8	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12		
E_GEN9	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12		
E_GEN10	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12		
E_GEN11	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12		
E_GEN12	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12		
E_GEN13	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12		
E_GEN14	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12		
E_GEN15	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12		
E_GEN16	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12		
2_EP_S_REF	Surface Refrigeration Plant													
E_COOL1							0.10	0.46	1.6E-2	7.0E-2				
E_COOL2							0.10	0.46	1.6E-2	7.0E-2				
E_COOL3							0.10	0.46	1.6E-2	7.0E-2				
E_COOL4							0.10	0.46	1.6E-2	7.0E-2				
E_COOL5							0.10	0.46	1.6E-2	7.0E-2				
E_COOL6							0.10	0.46	1.6E-2	7.0E-2				
2_EP_S_CBP	Cement Batch Plant													
B_AGDEL							0.21	0.12	3.2E-2	1.8E-2				
B_SNDEL							0.11	6.1E-2	1.6E-2	9.3E-3				
B_AGCHUT							1.6E-2	1.1E-2	2.5E-3	1.6E-3				
B_SNCHUT							1.3E-2	5.3E-3	2.0E-3	8.5E-4				
B_AGSTOR							1.6E-2	1.1E-2	2.5E-3	1.6E-3				
B_SNSTOR							1.3E-2	5.3E-3	2.0E-3	8.5E-4				
B_WHOPLD							0.18	8.6E-2	2.7E-2	1.3E-2				
B_WHOPAG							1.6E-2	1.1E-2	2.5E-3	1.6E-3				
B_WHOPSN							1.3E-2	5.3E-3	2.0E-3	8.5E-4				
B_CEMSLO							2.6E-2	1.1E-2	3.9E-3	1.6E-3				
B_FLYSLO							4.8E-2	2.4E-2	7.2E-3	3.7E-3				
B_SILSLO							1.9E-2	5.2E-3	2.9E-3	7.9E-4				
B_SLOHOP							2.5E-3	1.0E-3	3.8E-4	1.6E-4				
B_SLOCNY							2.5E-3	1.0E-3	3.8E-4	1.6E-4				
B_SLOTRK							2.4	0.98	0.36	0.15				
2_EP_S_FUEL	Diesel Storage Tanks													
EP_S_FUEL1											3.3E-4	1.4E-3		
2_EP_S_WE	Miscellaneous Fugitives													
E_WE_RD							3.3E-2	0.14	4.9E-3	2.2E-2				
E_WE_EXP							2.6E-3	1.2E-2	4.0E-4	1.7E-3				
E_WE_SUB							0.35	1.2	5.2E-2	0.19				
EP_S_EFD							1.5E-2	0.62	3.6E-3	0.15				
EP_S_E_C	0.45	2.0	2.1E-2	9.2E-2	1.1E-3	4.9E-3	1.1E-2	5.0E-2	2.0E-3	8.9E-3	4.9E-3	2.1E-2		
EP_S_DFD							6.3E-2	0.47	1.6E-2	0.11				
EP_S_D_C	4.3E-2	3.3E-2	0.13	9.9E-2	4.0E-4	3.1E-4	3.2E-2	2.5E-2	9.3E-3	7.1E-3	9.6E-3	7.4E-3		
2_EP_S_D	Non-Emergency Surface Diesel Fleet													
EP_S_F_C	1.5	1.4	0.17	0.16	1.8E-3	1.6E-3	8.7E-3	8.1E-3	8.7E-3	8.1E-3	8.3E-2	7.7E-2		
EP_S_D_DOZ														
EP_S_D_FUG							1.2	0.92	0.12	9.2E-2				
3_EP_S_TOTAL	34.6	11.6	134	33.8	0.80	0.21	9.9	8.7	5.3	2.4	13.4	3.4		

Air Sciences Inc. AIR EMISSION CALCULATIONS						PROJECT TITLE: Resolution Copper EI				BY: D. Steen					
						PROJECT NO: 262				PAGE: 3		OF: 18		SHEET: EPS_DISP	
						SUBJECT: East Plant				DATE: October 12, 2018					

EAST PLANT - UNCONTROLLED UNDERGROUND - EMISSIONS SUMMARY													
Source ID	Potential Emissions												
	CO		NO _x		SO ₂		PM ₁₀		PM _{2.5}		VOC		
	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	
2_EP_UG_DB	Drilling & Blasting												
EP_UG_DRILL							0.12	9.1E-2	0.12	9.1E-2			
EP_UG_BLAST	109	26.7	20.9	5.1	6.7	1.6	3.6	0.87	0.21	5.0E-2			
2_EP_UG_EXTRACT	Extraction Level Ore Flow												
EP_UG_OVER							7.9E-2	0.20	7.9E-2	0.20			
2_EP_UG_OREPASS	LHD/Ore Pass/Grizzly												
EP_UG_GRIZ							85.7	219	85.7	219			
2_EP_UG_RAIL	Haulage Ore Flow												
EP_UG_TRAIN							1.5	3.8	0.22	0.57			
EP_UG_COARSE							1.5	3.8	0.22	0.57			
2_EP_UG_1CRUSH	Primary Crushing Ore Flow												
EP_UG_FINE							23.7	60.4	23.7	60.4			
2_EP_UG_LOW_ORE	Lower Level Conveyor Ore Flow												
EP_UG_CV103							1.6	4.1	0.24	0.62			
EP_UG_CV104							1.6	4.1	0.24	0.62			
EP_UG_CV105							1.6	4.1	0.24	0.62			
EP_UG_SILO							1.6	4.1	0.24	0.62			
EP_UG_FEED							1.6	4.1	0.24	0.62			
EP_UG_CV106_111							1.6	4.1	0.24	0.62			
EP_UG_Chute							1.6	4.1	0.24	0.62			
EP_UG_FLASK							1.6	4.1	0.24	0.62			
2_EP_UG_HOIST	Hoisting System Ore Flow												
EP_UG_SKIP							0.76	1.9	0.11	0.29			
EP_UG_BIN													
2_EP_UG_UP_ORE	Upper Level Conveyor System Ore Flow												
EP_UG_FEED112_115							3.6	9.2	0.55	1.4			
EP_UG_CV102_105							3.6	9.2	0.55	1.4			
EP_UG_INC_CONV115							3.6	9.2	0.55	1.4			
2_EP_UG_D	Non-Emergency Underground Diesel Fleet												
EP_UG_D_C	155	167	14.6	17.3	0.14	0.15	0.73	0.87	0.73	0.87	6.9	8.2	
EP_UG_D_DOZ							1.1	0.48	0.74	0.32			
EP_UG_D_FUG							1,724	1,919	172	192			
2_EP_UG_REF	Underground Refrigeration Plant												
EP_UG_COOL							0.19	0.82	2.9E-2	0.12			
2_EP_UG_FUEL	Diesel Storage Tanks												
EP_UG_FUEL1											4.8E-3	2.1E-2	
3 EP_UG TOTAL	265	193	35.4	22.4	6.9	1.8	1,866	2,271	288	483	6.9	8.3	

Air Sciences Inc. AIR EMISSION CALCULATIONS					PROJECT TITLE: Resolution Copper EI				BY: D. Steen					
					PROJECT NO: 262				PAGE: 4		OF: 18		SHEET: EPS_DISP	
					SUBJECT: East Plant				DATE: October 12, 2018					
EAST PLANT - UNCONTROLLED SURFACE - EMISSIONS SUMMARY														
Source ID	CO		NO _x		SO ₂		PM ₁₀		PM _{2.5}		VOC			
	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr		
2_EP_S_EGEN	Emergency Generators (Total)													
E_GEN1	15.1	3.8	27.7	6.9	3.3E-2	8.2E-3	0.86	0.22	0.86	0.22	5.6	1.4		
E_GEN2	2.6	0.65	4.9	1.2	5.6E-3	1.4E-3	0.15	3.7E-2	0.15	3.7E-2	0.96	0.24		
E_GEN3	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12		
E_GEN4	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12		
E_GEN5	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12		
E_GEN6	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12		
E_GEN7	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12		
E_GEN8	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12		
E_GEN9	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12		
E_GEN10	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12		
E_GEN11	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12		
E_GEN12	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12		
E_GEN13	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12		
E_GEN14	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12		
E_GEN15	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12		
E_GEN16	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12		
2_EP_S_REF	Surface Refrigeration Plant													
E_COOL1							0.10	0.46	1.6E-2	7.0E-2				
E_COOL2							0.10	0.46	1.6E-2	7.0E-2				
E_COOL3							0.10	0.46	1.6E-2	7.0E-2				
E_COOL4							0.10	0.46	1.6E-2	7.0E-2				
E_COOL5							0.10	0.46	1.6E-2	7.0E-2				
E_COOL6							0.10	0.46	1.6E-2	7.0E-2				
2_EP_S_CBP	Cement Batch Plant													
B_AGDEL							0.27	0.15	4.1E-2	2.3E-2				
B_SNDEL							0.13	7.6E-2	2.0E-2	1.2E-2				
B_AGCHUT							0.23	0.15	3.5E-2	2.3E-2				
B_SNCHUT							0.18	7.6E-2	2.8E-2	1.2E-2				
B_AGSTOR							0.23	0.15	3.5E-2	2.3E-2				
B_SNSTOR							0.18	7.6E-2	2.8E-2	1.2E-2				
B_WHOPLD							0.72	0.34	0.11	5.2E-2				
B_WHOPAG							0.23	0.15	3.5E-2	2.3E-2				
B_WHOPSN							0.18	7.6E-2	2.8E-2	1.2E-2				
B_CEMSLO							35.8	14.7	5.4	2.2				
B_FLYSLO							10.7	5.5	1.6	0.83				
B_SILSLO							4.3	1.2	0.65	0.18				
B_SLOHOP							0.25	0.10	3.8E-2	1.6E-2				
B_SLOCNY							0.25	0.10	3.8E-2	1.6E-2				
B_SLOTRK							27.9	11.6	4.2	1.7				
2_EP_S_FUEL	Diesel Storage Tanks													
EP_S_FUEL1											3.3E-4	1.4E-3		
2_EP_S_WE	Miscellaneous Fugitives													
E_WE_RD							0.33	1.4	4.9E-2	0.22				
E_WE_EXP							2.6E-2	0.12	4.0E-3	1.7E-2				
E_WE_SUB							0.35	1.5	5.2E-2	0.23				
EP_S_EFD							0.15	0.62	3.6E-2	0.15				
EP_S_E_C	0.45	2.0	2.1E-2	9.2E-2	1.1E-3	4.9E-3	1.1E-2	5.0E-2	2.0E-3	8.9E-3	4.9E-3	2.1E-2		
EP_S_DFD							0.63	0.47	0.16	0.11				
EP_S_D_C	4.3E-2	3.3E-2	0.13	9.9E-2	4.0E-4	3.1E-4	3.2E-2	2.5E-2	9.3E-3	7.1E-3	9.6E-3	7.4E-3		
2_EP_S_D	Non-Emergency Surface Diesel Fleet													
EP_S_F_C	1.5	1.4	0.17	0.16	1.8E-3	1.6E-3	8.7E-3	8.1E-3	8.7E-3	8.1E-3	8.3E-2	7.7E-2		
EP_S_D_DOZ														
EP_S_D_FUG							12.0	9.2	1.2	0.92				
3_EP_S_TOTAL	34.6	11.6	134	33.8	0.80	0.21	100	51.7	18.5	8.4	13.4	3.4		

Air Sciences Inc.	PROJECT TITLE:		BY:		
	Resolution Copper EI		D. Steen		
	PROJECT NO:		PAGE:	OF:	SHEET:
AIR EMISSION CALCULATIONS	262		5	18	EPS_DISP
	SUBJECT:		DATE:		
	East Plant		October 12, 2018		

EAST PLANT - CONTROLLED UNDERGROUND - EMISSION FACTORS							
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	Emission Factors						
Source ID	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	VOC	Units & Notes
2_EP_UG_DB	Drilling & Blasting						
EP_UG_DRILL							See "Drill & Blast" Sheet
EP_UG_BLAST							See "Drill & Blast" Sheet
2_EP_UG_EXTRACT	Extraction Level Ore Flow						
EP_UG_OVER				8.0E-5	8.0E-5		lb/ton
2_EP_UG_OREPASS	LHD/Ore Pass/Grizzly						
EP_UG_GRIZ				7.4E-4	5.0E-5		lb/ton
2_EP_UG_RAIL	Haulage Ore Flow						
EP_UG_TRAIN				1.5E-4	2.3E-5		lb/ton
EP_UG_COARSE	Dust Collectors (915,420 dscf/hr, 0.002 gr/dscf)						
2_EP_UG_ICRUSH	Primary Crushing Ore Flow						
EP_UG_FINE							Emissions accounted for in EP_UG_COARSE
2_EP_UG_LOW_ORE	Lower Level Conveyor Ore Flow						
EP_UG_CV103							Emissions accounted for in EP_UG_COARSE
EP_UG_CV104							Dust Collectors (207,495 dscf/hr, 0.002 gr/dscf)
EP_UG_CV105				1.6E-4	2.5E-5		lb/ton
EP_UG_SILO							Dust Collectors (915,420 dscf/hr, 0.002 gr/dscf)
EP_UG_FEED							Emissions accounted for in EP_UG_SILO
EP_UG_CV106_111							Emissions accounted for in EP_UG_SILO
EP_UG_Chute				1.6E-4	2.5E-5		lb/ton
EP_UG_FLASK							Dust Collectors (691,651 dscf/hr, 0.002 gr/dscf)
2_EP_UG_HOIST	Hoisting System Ore Flow						
EP_UG_SKIP							Emissions accounted for in EP_UG_FLASK
EP_UG_BIN							
2_EP_UG_UP_ORE	Upper Level Conveyor System Ore Flow						
EP_UG_FEED112_115							Dust Collectors (691,651 dscf/hr, 0.002 gr/dscf)
EP_UG_CV102_105							Emissions accounted for in EP_UG_FEED112_115
EP_UG_INC_CONV115				3.7E-4	5.6E-5		lb/ton
2_EP_UG_D	Non-Emergency Underground Diesel Fleet						
EP_UG_D_C							See "EP_Fleet" Sheet
EP_UG_D_DOZ							See "EP_Fleet" Sheet
EP_UG_D_FUG							See "EP_Fleet" Sheet
2_EP_UG_REF	Underground Refrigeration Plant						
EP_UG_COOL							See "EP Cooling" Sheet
2_EP_UG_FUEL	Diesel Storage Tanks						
EP_UG_FUEL1							See "Fuel Tanks" Sheet

Air Sciences Inc.	PROJECT TITLE:		BY:		
	Resolution Copper EI		D. Steen		
	PROJECT NO:	PAGE:	OF:	SHEET:	
AIR EMISSION CALCULATIONS	262	6	18	EPS_DISP	
	SUBJECT:	DATE:			
	East Plant	October 12, 2018			

EAST PLANT - CONTROLLED SURFACE - EMISSION FACTORS							
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Source ID	Emission Factors						
	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	VOC	Units & Notes
2_EP_S_EGEN	Emergency Generators (Total)						
E_GEN1							See "E_Gen" Sheet
E_GEN2							See "E_Gen" Sheet
E_GEN3							See "E_Gen" Sheet
E_GEN4							See "E_Gen" Sheet
E_GEN5							See "E_Gen" Sheet
E_GEN6							See "E_Gen" Sheet
E_GEN7							See "E_Gen" Sheet
E_GEN8							See "E_Gen" Sheet
E_GEN9							See "E_Gen" Sheet
E_GEN10							See "E_Gen" Sheet
E_GEN11							See "E_Gen" Sheet
E_GEN12							See "E_Gen" Sheet
E_GEN13							See "E_Gen" Sheet
E_GEN14							See "E_Gen" Sheet
E_GEN15							See "E_Gen" Sheet
E_GEN16							See "E_Gen" Sheet
2_EP_S_REF	Surface Refrigeration Plant						
E_COOL1							See "Cooling" Sheet
E_COOL2							See "Cooling" Sheet
E_COOL3							See "Cooling" Sheet
E_COOL4							See "Cooling" Sheet
E_COOL5							See "Cooling" Sheet
E_COOL6							See "Cooling" Sheet
2_EP_S_CBP	Cement Batch Plant						
B_AGDEL							See "BatchPlant" Sheet
B_SNDEL							See "BatchPlant" Sheet
B_AGCHUT							See "BatchPlant" Sheet
B_SNCHUT							See "BatchPlant" Sheet
B_AGSTOR							See "BatchPlant" Sheet
B_SNSTOR							See "BatchPlant" Sheet
B_WHOPLD							See "BatchPlant" Sheet
B_WHOPAG							See "BatchPlant" Sheet
B_WHOPSN							See "BatchPlant" Sheet
B_CEMSLO							See "BatchPlant" Sheet
B_FLYSLO							See "BatchPlant" Sheet
B_SILSLO							See "BatchPlant" Sheet
B_SLOHOP							See "BatchPlant" Sheet
B_SLOCNY							See "BatchPlant" Sheet
B_SLOTRK							See "BatchPlant" Sheet
2_EP_S_FUEL	Diesel Storage Tanks						
EP_S_FUEL1							See "Fuel Tanks" Sheet
2_EP_S_WE	Miscellaneous Fugitives						
E_WE_RD				0.2	0.0		ton/acre-yr
E_WE_EXP							See Wind Workbook
E_WE_SUB							See Wind Workbook
EP_S_EFD							See "Employees" Sheet
EP_S_E_C							See "Employees" Sheet
EP_S_DFD							See "Deliveries" Sheet
EP_S_D_C							See "Deliveries" Sheet
2_EP_S_D	Non-Emergency Surface Diesel Fleet						
EP_S_F_C							See "EP_Fleet" Sheet
EP_S_D_DOZ							See "EP_Fleet" Sheet
EP_S_D_FUG							See "EP_Fleet" Sheet

Air Sciences Inc.	PROJECT TITLE:		BY:		
	Resolution Copper EI		D. Steen		
	PROJECT NO:		PAGE:	OF:	SHEET:
AIR EMISSION CALCULATIONS	262		7	18	EPS_DISP
	SUBJECT:		DATE:		
	East Plant		October 12, 2018		

EAST PLANT - UNCONTROLLED UNDERGROUND - EMISSION FACTORS							
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Source ID	Emission Factors						
	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	VOC	Units & Notes
2_EP_UG_DB	Drilling & Blasting						
EP_UG_DRILL							See "Drill & Blast" Sheet
EP_UG_BLAST							See "Drill & Blast" Sheet
2_EP_UG_EXTRACT	Extraction Level Ore Flow						
EP_UG_OVER				8.0E-5	8.0E-5		lb/ton
2_EP_UG_OREPASS	LHD/Ore Pass/Grizzly						
EP_UG_GRIZ				8.7E-3	8.7E-3		lb/ton
2_EP_UG_RAIL	Haulage Ore Flow						
EP_UG_TRAIN				1.5E-4	2.3E-5		lb/ton
EP_UG_COARSE				1.5E-4	2.3E-5		lb/ton
2_EP_UG_ICRUSH	Primary Crushing Ore Flow						
EP_UG_FINE				2.4E-3	2.4E-3		lb/ton
2_EP_UG_LOW_ORE	Lower Level Conveyor Ore Flow						
EP_UG_CV103				1.6E-4	2.5E-5		lb/ton
EP_UG_CV104				1.6E-4	2.5E-5		lb/ton
EP_UG_CV105				1.6E-4	2.5E-5		lb/ton
EP_UG_SILO				1.6E-4	2.5E-5		lb/ton
EP_UG_FEED				1.6E-4	2.5E-5		lb/ton
EP_UG_CV106_111				1.6E-4	2.5E-5		lb/ton
EP_UG_Chute				1.6E-4	2.5E-5		lb/ton
EP_UG_FLASK				1.6E-4	2.5E-5		lb/ton
2_EP_UG_HOIST	Hoisting System Ore Flow						
EP_UG_SKIP				7.7E-5	1.2E-5		lb/ton
EP_UG_BIN	Upper Level Conveyor System Ore Flow						
2_EP_UG_UP_ORE	Upper Level Conveyor System Ore Flow						
EP_UG_FEED112_115				3.7E-4	5.6E-5		lb/ton
EP_UG_CV102_105				3.7E-4	5.6E-5		lb/ton
EP_UG_INC_CONV115				3.7E-4	5.6E-5		lb/ton
2_EP_UG_D	Non-Emergency Underground Diesel Fleet						
EP_UG_D_C							See "EP_Fleet" Sheet
EP_UG_D_DOZ							See "EP_Fleet" Sheet
EP_UG_D_FUG							See "EP_Fleet" Sheet
2_EP_UG_REF	Underground Refrigeration Plant						
EP_UG_COOL							See "EP Cooling" Sheet
2_EP_UG_FUEL	Diesel Storage Tanks						
EP_UG_FUEL1							See "Fuel Tanks" Sheet

Air Sciences Inc.	PROJECT TITLE:		BY:		
	Resolution Copper EI		D. Steen		
	PROJECT NO:	PAGE:	OF:	SHEET:	
AIR EMISSION CALCULATIONS	262	8	18	EPS_DISP	
	SUBJECT:	DATE:			
	East Plant	October 12, 2018			

EAST PLANT - UNCONTROLLED SURFACE - EMISSION FACTORS							
Source ID	Emission Factors						
	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	VOC	Units & Notes
2_EP_S_EGEN	Emergency Generators (Total)						
E_GEN1							See "E_Gen" Sheet
E_GEN2							See "E_Gen" Sheet
E_GEN3							See "E_Gen" Sheet
E_GEN4							See "E_Gen" Sheet
E_GEN5							See "E_Gen" Sheet
E_GEN6							See "E_Gen" Sheet
E_GEN7							See "E_Gen" Sheet
E_GEN8							See "E_Gen" Sheet
E_GEN9							See "E_Gen" Sheet
E_GEN10							See "E_Gen" Sheet
E_GEN11							See "E_Gen" Sheet
E_GEN12							See "E_Gen" Sheet
E_GEN13							See "E_Gen" Sheet
E_GEN14							See "E_Gen" Sheet
E_GEN15							See "E_Gen" Sheet
E_GEN16							See "E_Gen" Sheet
2_EP_S_REF	Surface Refrigeration Plant						
E_COOL1							See "Cooling" Sheet
E_COOL2							See "Cooling" Sheet
E_COOL3							See "Cooling" Sheet
E_COOL4							See "Cooling" Sheet
E_COOL5							See "Cooling" Sheet
E_COOL6							See "Cooling" Sheet
2_EP_S_CBP	Cement Batch Plant						
B_AGDEL							See "BatchPlant" Sheet
B_SNDEL							See "BatchPlant" Sheet
B_AGCHUT							See "BatchPlant" Sheet
B_SNCHUT							See "BatchPlant" Sheet
B_AGSTOR							See "BatchPlant" Sheet
B_SNSTOR							See "BatchPlant" Sheet
B_WHOPLD							See "BatchPlant" Sheet
B_WHOPAG							See "BatchPlant" Sheet
B_WHOPSN							See "BatchPlant" Sheet
B_CEMSLO							See "BatchPlant" Sheet
B_FLYSLO							See "BatchPlant" Sheet
B_SILSLO							See "BatchPlant" Sheet
B_SLOHOP							See "BatchPlant" Sheet
B_SLOCNY							See "BatchPlant" Sheet
B_SLOTRK							See "BatchPlant" Sheet
2_EP_S_FUEL	Diesel Storage Tanks						
EP_S_FUEL1							See "Fuel Tanks" Sheet
2_EP_S_WE	Miscellaneous Fugitives						
E_WE_RD				0.2	0.0		ton/acre-yr
E_WE_EXP							See Wind Workbook
E_WE_SUB							See Wind Workbook
EP_S_EFD							See "Employees" Sheet
EP_S_E_C							See "Employees" Sheet
EP_S_DFD							See "Deliveries" Sheet
EP_S_D_C							See "Deliveries" Sheet
2_EP_S_D	Non-Emergency Surface Diesel Fleet						
EP_S_F_C							See "EP_Fleet" Sheet
EP_S_D_DOZ							See "EP_Fleet" Sheet
EP_S_D_FUG							See "EP_Fleet" Sheet

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: D. Steen		
	PROJECT NO: 262		PAGE: 9	OF: 18	SHEET: EPS_DISP
	SUBJECT: East Plant		DATE: October 12, 2018		

EAST PLANT - UNDERGROUND - PROCESS RATES

Source ID	Process Rates		
	Unit/Hr	Unit/Yr	Units & Notes
2_EP_UG_DB Drilling & Blasting			
EP_UG_DRILL			See "Drill & Blast" Sheet
EP_UG_BLAST			See "Drill & Blast" Sheet
2_EP_UG_EXTRA Extraction Level Ore Flow			
EP_UG_OVER	985	5,029,289	ton
2_EP_UG_OREPA LHD/Ore Pass/Grizzly			
EP_UG_GRIZ	9,855	50,292,894	ton
2_EP_UG_RAIL Haulage Ore Flow			
EP_UG_TRAIN	9,855	50,292,894	ton
EP_UG_COARSE	9,855	50,292,894	ton
2_EP_UG_ICRUS Primary Crushing Ore Flow			
EP_UG_FINE	9,855	50,292,894	ton
2_EP_UG_LOW Lower Level Conveyor Ore Flow			
EP_UG_CV103	9,855	50,292,894	ton
EP_UG_CV104	9,855	50,292,894	ton
EP_UG_CV105	9,855	50,292,894	ton
EP_UG_SILO	9,855	50,292,894	ton
EP_UG_FEED	9,855	50,292,894	ton
EP_UG_CV106_111	9,855	50,292,894	ton
EP_UG_Chute	9,855	50,292,894	ton
EP_UG_FLASK	9,855	50,292,894	ton
2_EP_UG_HOIST Hoisting System Ore Flow			
EP_UG_SKIP	9,855	50,292,894	ton
EP_UG_BIN	9,855	50,292,894	ton
2_EP_UG_UP_OR Upper Level Conveyor System Ore Flow			
EP_UG_FEED112_115	9,855	50,292,894	ton
EP_UG_CV102_105	9,855	50,292,894	ton
EP_UG_INC_CONV115	9,855	50,292,894	ton
2_EP_UG_D Non-Emergency Underground Diesel Fleet			
EP_UG_D_C			See "EP_Fleet" Sheet
EP_UG_D_DOZ			See "EP_Fleet" Sheet
EP_UG_D_FUG			See "EP_Fleet" Sheet
2_EP_UG_REF Underground Refrigeration Plant			
EP_UG_COOL			See "EP Cooling" Sheet
2_EP_UG_FUEL Diesel Storage Tanks			
EP_UG_FUEL1	937	1,594,904	gal

Air Sciences Inc. AIR EMISSION CALCULATIONS		PROJECT TITLE: Resolution Copper EI		BY: D. Steen		
		PROJECT NO: 262		PAGE: 10	OF: 18	SHEET: EPS_DISP
		SUBJECT: East Plant		DATE: October 12, 2018		

EAST PLANT - SURFACE - PROCESS RATES			
Source ID	Process Rates		
	Unit/Hr	Unit/Yr	Units & Notes
2_EP_S_EGEN Emergency Generators (Total)			
E_GEN1			See "E_Gen" Sheet
E_GEN2			See "E_Gen" Sheet
E_GEN3			See "E_Gen" Sheet
E_GEN4			See "E_Gen" Sheet
E_GEN5			See "E_Gen" Sheet
E_GEN6			See "E_Gen" Sheet
E_GEN7			See "E_Gen" Sheet
E_GEN8			See "E_Gen" Sheet
E_GEN9			See "E_Gen" Sheet
E_GEN10			See "E_Gen" Sheet
E_GEN11			See "E_Gen" Sheet
E_GEN12			See "E_Gen" Sheet
E_GEN13			See "E_Gen" Sheet
E_GEN14			See "E_Gen" Sheet
E_GEN15			See "E_Gen" Sheet
E_GEN16			See "E_Gen" Sheet
2_EP_S_REF Surface Refrigeration Plant			
E_COOL1			See "Cooling" Sheet
E_COOL2			See "Cooling" Sheet
E_COOL3			See "Cooling" Sheet
E_COOL4			See "Cooling" Sheet
E_COOL5			See "Cooling" Sheet
E_COOL6			See "Cooling" Sheet
2_EP_S_CBP Cement Batch Plant			
B_AGDEL			See "BatchPlant" Sheet
B_SNDEL			See "BatchPlant" Sheet
B_AGCHUT			See "BatchPlant" Sheet
B_SNCHUT			See "BatchPlant" Sheet
B_AGSTOR			See "BatchPlant" Sheet
B_SNSTOR			See "BatchPlant" Sheet
B_WHOPLD			See "BatchPlant" Sheet
B_WHOPAG			See "BatchPlant" Sheet
B_WHOPSN			See "BatchPlant" Sheet
B_CEMSLO			See "BatchPlant" Sheet
B_FLYSLO			See "BatchPlant" Sheet
B_SILSLO			See "BatchPlant" Sheet
B_SLOHOP			See "BatchPlant" Sheet
B_SLOCNY			See "BatchPlant" Sheet
B_SLOTRK			See "BatchPlant" Sheet
2_EP_S_FUEL Diesel Storage Tanks			
EP_S_FUEL1	12.2	22,621	gal
2_EP_S_WE Miscellaneous Fugitives			
E_WE_RD		7.6	acre
E_WE_EXP		21.3	acre
E_WE_SUB		279	acre
EP_S_EFD			See "Employees" Sheet
EP_S_E_C			See "Employees" Sheet
EP_S_DFD			See "Deliveries" Sheet
EP_S_D_C			See "Deliveries" Sheet
2_EP_S_D Non-Emergency Surface Diesel Fleet			
EP_S_F_C			See "EP_Fleet" Sheet
EP_S_D_DOZ			See "EP_Fleet" Sheet
EP_S_D_FUG			See "EP_Fleet" Sheet

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: D. Steen		
	PROJECT NO: 262		PAGE: 11	OF: 18	SHEET: EPS_DISP
	SUBJECT: East Plant		DATE: October 12, 2018		

EAST PLANT - UNDERGROUND - CONTROLS				
Source ID	Control Technology		Control Efficiency	Notes
2 EP_UG_DB				
EP_UG_DRILL			0%	
EP_UG_BLAST			0%	
2 EP_UG_EXTRACT				
EP_UG_OVER			0%	
2 EP_UG_OREPASS				
EP_UG_GRIZ	moisture		0%	Control accounted for in EF
2 EP_UG_RAIL				
EP_UG_TRAIN	moisture		0%	Control accounted for in EF
EP_UG_COARSE	3	dust collectors		Control accounted for in emission calculation
2 EP_UG_ICRUSH				
EP_UG_FINE				Emissions accounted for in EP_UG_COARSE
2 EP_UG_LOW_ORE				
EP_UG_CV103				Emissions accounted for in EP_UG_COARSE
EP_UG_CV104	3	dust collectors		Control accounted for in emission calculation
EP_UG_CV105	moisture		0%	Control accounted for in EF
EP_UG_SILO	3	dust collectors		Control accounted for in emission calculation
EP_UG_FEED				Emissions accounted for in EP_UG_SILO
EP_UG_CV106_111				Emissions accounted for in EP_UG_SILO
EP_UG_Chute	moisture		0%	Control accounted for in EF
EP_UG_FLASK	6	dust collectors		Control accounted for in emission calculation
2 EP_UG_HOIST				
EP_UG_SKIP				Emissions accounted for in EP_UG_FLASK
EP_UG_BIN			0%	
2 EP_UG_UP_ORE				
EP_UG_FEED112_115	4	dust collectors		Control accounted for in emission calculation
EP_UG_CV102_105				Emissions accounted for in EP_UG_FEED112_115
EP_UG_INC_CONV115	moisture		0%	Control accounted for in EF
2 EP_UG_D				
EP_UG_D_C			0%	
EP_UG_D_DOZ	water suppression		95%	
EP_UG_D_FUG	water suppression		95%	AP-42, Figure 13.2.2-2, Rev. 11/06
2 EP_UG_REF				
EP_UG_COOL	drift eliminators			Control accounted for in EF
2 EP_UG_FUEL				
EP_UG_FUEL1			0%	

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: D. Steen		
	PROJECT NO: 262		PAGE: 12	OF: 18	SHEET: EPS_DISP
	SUBJECT: East Plant		DATE: October 12, 2018		

EAST PLANT - SURFACE - CONTROLS			
Source ID	Control Technology	Control Efficiency	Notes
2_EP_S_EGEN			
E_GEN1		0%	
E_GEN2		0%	
E_GEN3		0%	
E_GEN4		0%	
E_GEN5		0%	
E_GEN6		0%	
E_GEN7		0%	
E_GEN8		0%	
E_GEN9		0%	
E_GEN10		0%	
E_GEN11		0%	
E_GEN12		0%	
E_GEN13		0%	
E_GEN14		0%	
E_GEN15		0%	
E_GEN16		0%	
2_EP_S_REF			
E_COOL1	drift eliminators	0%	
E_COOL2	drift eliminators	0%	
E_COOL3	drift eliminators	0%	
E_COOL4	drift eliminators	0%	
E_COOL5	drift eliminators	0%	
E_COOL6	drift eliminators	0%	
2_EP_S_CBP			
B_AGDEL		0%	See "BatchPlant" Sheet
B_SNDEL		0%	See "BatchPlant" Sheet
B_AGCHUT		0%	See "BatchPlant" Sheet
B_SNCHUT		0%	See "BatchPlant" Sheet
B_AGSTOR		0%	See "BatchPlant" Sheet
B_SNSTOR		0%	See "BatchPlant" Sheet
B_WHOPLD		0%	See "BatchPlant" Sheet
B_WHOPAG		0%	See "BatchPlant" Sheet
B_WHOPSN		0%	See "BatchPlant" Sheet
B_CEMSLO		0%	See "BatchPlant" Sheet
B_FLYSLO		0%	See "BatchPlant" Sheet
B_SILSLO		0%	See "BatchPlant" Sheet
B_SLOHOP		0%	See "BatchPlant" Sheet
B_SLOCNY		0%	See "BatchPlant" Sheet
B_SLOTRK		0%	See "BatchPlant" Sheet
2_EP_S_FUEL			
EP_S_FUEL1		0%	
2_EP_S_WE			
E_WE_RD	chemical suppression	90%	AP-42, Figure 13.2.2-2, Rev. 11/06
E_WE_EXP	chemical suppression	90%	AP-42, Figure 13.2.2-2, Rev. 11/06
E_WE_SUB	precipitation	18%	
EP_S_EFD	chemical suppression	90%	AP-42, Figure 13.2.2-2, Rev. 11/06
EP_S_E_C		0%	AP-42, Figure 13.2.2-2, Rev. 11/06
EP_S_DFD	chemical suppression	90%	
EP_S_D_C		0%	
2_EP_S_D			
EP_S_F_C		0%	
EP_S_D_DOZ		0%	
EP_S_D_FUG	chemical suppression	90%	AP-42, Figure 13.2.2-2, Rev. 11/06

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI	BY: D. Steen		
	PROJECT NO: 262	PAGE: 13	OF: 18	SHEET: EPS_DISP
	SUBJECT: East Plant	DATE: October 12, 2018		

EAST PLANT - UNDERGROUND - SOURCE IDENTIFICATION	
Source ID	Source Identification
2_EP_UG_DB	Drilling & Blasting
EP_UG_DRILL	Drilling
EP_UG_BLAST	Blasting
2_EP_UG_EXTRACT	Extraction Level Ore Flow
EP_UG_OVER	Oversize Rock Drill Rig
2_EP_UG_OREPASS	LHD/Ore Pass/Grizzly
EP_UG_GRIZ	Grizzly with Rock Breaker and associated transfers in (LHD) & out (Chute via Ore Pass)
2_EP_UG_RAIL	Haulage Ore Flow
EP_UG_TRAIN	Chute to Haul Truck
EP_UG_COARSE	Haul Truck to Coarse Ore Bin
2_EP_UG_1CRUSH	Primary Crushing Ore Flow
EP_UG_FINE	Gyratory Crushers (3) and associated transfers in (Coarse Ore Bin) and out (Feeders)
2_EP_UG_LOW_ORE	Lower Level Conveyor Ore Flow
EP_UG_CV103	Feeders (FE-101 - 103) to Conveyors (CV-101 - 103) and Spillage Chute
EP_UG_CV104	Conveyors (CV-101 - 103) to Conveyor (CV-104)
EP_UG_CV105	Conveyor (CV-104) to Tilt Conveyor (CV-105)
EP_UG_SILO	Tilt Conveyor (CV-105) to Silos (S1-101 - 103)
EP_UG_FEED	Silos S1-101 thru S1-103 to Feeders FE-106 thru FE-111
EP_UG_CV106_111	Feeders (FE-106 - 111) to Conveyors (CV-106 - 111)
EP_UG_Chute	Conveyors (CV-106 - 111) to Shuttle Chutes (A - F)
EP_UG_FLASK	Shuttle Chutes (A - F) to Flasks (101 - 112)
2_EP_UG_HOIST	Hoisting System Ore Flow
EP_UG_SKIP	Flasks (101 - 112) to Skips (SS-101 - 112)
EP_UG_BIN	Skips (SS-101 - 112) to Bins (1 - 4) and Spillage Chute
2_EP_UG_UP_ORE	Upper Level Conveyor System Ore Flow
EP_UG_FEED112_115	Bins (1 - 4) to Discharge Feeders (12)
EP_UG_CV102_105	Discharge Feeders (12) to Conveyors (CV-112 - 115)
EP_UG_INC_CONV115	Conveyors (CV-112 - 115) to Incline Conveyor (CV-201)
2_EP_UG_D	Non-Emergency Underground Diesel Fleet
EP_UG_D_C	Underground Combustion
EP_UG_D_DOZ	Underground Fugitive Dust (Dozing)
EP_UG_D_FUG	Underground Fugitive Dust (Grading, Vehicle Travel)
2_EP_UG_REF	Underground Refrigeration Plant
EP_UG_COOL	Underground Cooling Towers
2_EP_UG_FUEL	Diesel Storage Tanks
EP_UG_FUEL1	Underground Usage and Volume Estimated (Estimated Quantity: 6)
3_EP_UG_TOTAL	EP UG Subtotal

Air Sciences Inc.	PROJECT TITLE:	BY:		
	Resolution Copper EI	D. Steen		
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	SUBJECT:	DATE:		
	East Plant	October 12, 2018		

EAST PLANT - SURFACE - SOURCE IDENTIFICATION				
Source ID	Source Identification			
2_EP_S_EGEN	Emergency Generators (Total)			
E_GEN1	Cat 516B - Diesel			
E_GEN2	Cat 3046C - Diesel			
E_GEN3	Caterpillar C175-16			
E_GEN4	Caterpillar C175-16			
E_GEN5	Caterpillar C175-16			
E_GEN6	Caterpillar C175-16			
E_GEN7	Caterpillar C175-16			
E_GEN8	Caterpillar C175-16			
E_GEN9	Caterpillar C175-16			
E_GEN10	Caterpillar C175-16			
E_GEN11	Caterpillar C175-16			
E_GEN12	Caterpillar C175-16			
E_GEN13	Caterpillar C175-16			
E_GEN14	Caterpillar C175-16			
E_GEN15	Caterpillar C175-16			
E_GEN16	Caterpillar C175-16			
2_EP_S_REF	Surface Refrigeration Plant			
E_COOL1	Surface Cooling Towers			
E_COOL2	Surface Cooling Towers			
E_COOL3	Surface Cooling Towers			
E_COOL4	Surface Cooling Towers			
E_COOL5	Surface Cooling Towers			
E_COOL6	Surface Cooling Towers			
2_EP_S_CBP	Cement Batch Plant			
B_AGDEL	Batch Plant Aggregate Delivery to Ground Storage			
B_SNDEL	Batch Plant Sand Delivery to Ground Storage			
B_AGCHUT	Batch Plant Aggregate Transfer to Conveyor Belt via Chute			
B_SNCHUT	Batch Plant Sand Transfer to Conveyor Belt via Chute			
B_AGSTOR	Batch Plant Aggregate Transfer to Elevated Storage			
B_SNSTOR	Batch Plant Sand Transfer to Elevated Storage			
B_WHOPLD	Batch Plant Weigh Hopper Loading (Aggregate & Sand)			
B_WHOPAG	Batch Plant Weigh Hopper Discharge to Truck Loading Conveyor (Agg)			
B_WHOPSN	Batch Plant Weigh Hopper Discharge to Truck Loading Conveyor (Sand)			
B_CEMSLO	Batch Plant Cement Unloading to Silo			
B_FLYSLO	Batch Plant Flyash Unloading to Silo			
B_SILSLO	Batch Plant Silica Fume Unloading to Silo			
B_SLOHOP	Batch Plant Cement & Flyash Discharge to Silo Weigh Hopper			
B_SLOCNY	Batch Plant Silo Weigh Hopper Discharge to Truck Loading Conveyor			
B_SLOTRK	Batch Plant Truck Loading			
2_EP_S_FUEL	Diesel Storage Tanks			
EP_S_FUEL1	Surface Usage and Volume Estimated (Estimated Quantity: 1)			
2_EP_S_WE	Miscellaneous Fugitives			
E_WE_RD	EPS Secondary Sources from Access Roads (Wind Erosion)			
E_WE_EXP	EPS Exposed Areas			
E_WE_SUB	EPS Exposed Subsidence Area			
EP_S_EFD	EPS Employee Fugitives			
EP_S_E_C	EPS Employee Combustion			
EP_S_DFD	EPS Delivery Fugitives			
EP_S_D_C	EPS Delivery Combustion			
2_EP_S_D	Non-Emergency Surface Diesel Fleet			
EP_S_F_C	Surface Combustion			
EP_S_D_DOZ	Surface Fugitive Dust (Dozing)			
EP_S_D_FUG	Surface Fugitive Dust (Grading, Vehicle Travel)			
3_EP_S_TOTAL	EP Surface Subtotal			

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI	BY: D. Steen		
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	SUBJECT: East Plant	DATE: October 12, 2018		

EAST PLANT - CONTROLLED UNDERGROUND - EF REFERENCE	
Source ID	Emission Factor Reference
2_EP_UG_DB	
EP_UG_DRILL	See "Drill & Blast" Sheet
EP_UG_BLAST	See "Drill & Blast" Sheet
2_EP_UG_EXTRACT	
EP_UG_OVER	AP-42, Table 11.19.2-2, Wet Drilling, Rev. 8/04
2_EP_UG_OREPASS	
EP_UG_GRIZ	AP-42, Table 11.19.2-2, Screening (controlled), Rev. 8/04
2_EP_UG_RAIL	
EP_UG_TRAIN	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 2.2 mph)
EP_UG_COARSE	Assumed Grain Loading (0.002 gr/dscf)
2_EP_UG_ICRUSH	
EP_UG_FINE	Emissions accounted for in EP_UG_COARSE
2_EP_UG_LOW_ORE	
EP_UG_CV103	Emissions accounted for in EP_UG_COARSE
EP_UG_CV104	Assumed Grain Loading (0.002 gr/dscf)
EP_UG_CV105	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 2.4 mph)
EP_UG_SILO	Assumed Grain Loading (0.002 gr/dscf)
EP_UG_FEED	Emissions accounted for in EP_UG_SILO
EP_UG_CV106_111	Emissions accounted for in EP_UG_SILO
EP_UG_Chute	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 2.4 mph)
EP_UG_FLASK	Assumed Grain Loading (0.002 gr/dscf)
2_EP_UG_HOIST	
EP_UG_SKIP	Emissions accounted for in EP_UG_FLASK
EP_UG_BIN	
2_EP_UG_UP_ORE	
EP_UG_FEED112_115	Assumed Grain Loading (0.002 gr/dscf)
EP_UG_CV102_105	Emissions accounted for in EP_UG_FEED112_115
EP_UG_INC_CONV115	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 4.5 mph)
2_EP_UG_D	
EP_UG_D_C	See "EP_Fleet" Sheet
EP_UG_D_DOZ	See "EP_Fleet" Sheet
EP_UG_D_FUG	See "EP_Fleet" Sheet
2_EP_UG_REF	
EP_UG_COOL	See "EP Cooling" Sheet
2_EP_UG_FUEL	
EP_UG_FUEL1	See "Fuel Tanks" Sheet

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: D. Steen		
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	SUBJECT: East Plant		DATE: October 12, 2018		

EAST PLANT - CONTROLLED SURFACE - EF REFERENCE	
Source ID	Emission Factor Reference
2_EP_S_EGEN	
E_GEN1	See "E_Gen" Sheet
E_GEN2	See "E_Gen" Sheet
E_GEN3	See "E_Gen" Sheet
E_GEN4	See "E_Gen" Sheet
E_GEN5	See "E_Gen" Sheet
E_GEN6	See "E_Gen" Sheet
E_GEN7	See "E_Gen" Sheet
E_GEN8	See "E_Gen" Sheet
E_GEN9	See "E_Gen" Sheet
E_GEN10	See "E_Gen" Sheet
E_GEN11	See "E_Gen" Sheet
E_GEN12	See "E_Gen" Sheet
E_GEN13	See "E_Gen" Sheet
E_GEN14	See "E_Gen" Sheet
E_GEN15	See "E_Gen" Sheet
E_GEN16	See "E_Gen" Sheet
2_EP_S_REF	
E_COOL1	See "Cooling" Sheet
E_COOL2	See "Cooling" Sheet
E_COOL3	See "Cooling" Sheet
E_COOL4	See "Cooling" Sheet
E_COOL5	See "Cooling" Sheet
E_COOL6	See "Cooling" Sheet
2_EP_S_CBP	
B_AGDEL	See "BatchPlant" Sheet
B_SNDEL	See "BatchPlant" Sheet
B_AGCHUT	See "BatchPlant" Sheet
B_SNCHUT	See "BatchPlant" Sheet
B_AGSTOR	See "BatchPlant" Sheet
B_SNSTOR	See "BatchPlant" Sheet
B_WHOPLD	See "BatchPlant" Sheet
B_WHOPAG	See "BatchPlant" Sheet
B_WHOPSN	See "BatchPlant" Sheet
B_CEMSLO	See "BatchPlant" Sheet
B_FLYSLO	See "BatchPlant" Sheet
B_SILSLO	See "BatchPlant" Sheet
B_SLOHOP	See "BatchPlant" Sheet
B_SLOCNY	See "BatchPlant" Sheet
B_SLOTRK	See "BatchPlant" Sheet
2_EP_S_FUEL	
EP_S_FUEL1	See "Fuel Tanks" Sheet
2_EP_S_WE	
E_WE_RD	AP-42, Table 11.9-4, Wind Erosion, Rev. 7/98
E_WE_EXP	AP-42, Chapter 13.2.5, Industrial Wind Erosion, Rev. 11/06
E_WE_SUB	AP-42, Chapter 13.2.5, Industrial Wind Erosion, Rev. 11/06
EP_S_EFD	See "Employees" Sheet
EP_S_E_C	See "Employees" Sheet
EP_S_DFD	See "Deliveries" Sheet
EP_S_D_C	See "Deliveries" Sheet
2_EP_S_D	
EP_S_F_C	See "EP_Fleet" Sheet
EP_S_D_DOZ	See "EP_Fleet" Sheet
EP_S_D_FUG	See "EP_Fleet" Sheet

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Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI	BY: D. Steen		
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	SUBJECT: East Plant	DATE: October 12, 2018		

EAST PLANT - UNCONTROLLED SURFACE - EF REFERENCE	
Source ID	Emission Factor Reference
2_EP_S_EGEN	
E_GEN1	See "E_Gen" Sheet
E_GEN2	See "E_Gen" Sheet
E_GEN3	See "E_Gen" Sheet
E_GEN4	See "E_Gen" Sheet
E_GEN5	See "E_Gen" Sheet
E_GEN6	See "E_Gen" Sheet
E_GEN7	See "E_Gen" Sheet
E_GEN8	See "E_Gen" Sheet
E_GEN9	See "E_Gen" Sheet
E_GEN10	See "E_Gen" Sheet
E_GEN11	See "E_Gen" Sheet
E_GEN12	See "E_Gen" Sheet
E_GEN13	See "E_Gen" Sheet
E_GEN14	See "E_Gen" Sheet
E_GEN15	See "E_Gen" Sheet
E_GEN16	See "E_Gen" Sheet
2_EP_S_REF	
E_COOL1	See "Cooling" Sheet
E_COOL2	See "Cooling" Sheet
E_COOL3	See "Cooling" Sheet
E_COOL4	See "Cooling" Sheet
E_COOL5	See "Cooling" Sheet
E_COOL6	See "Cooling" Sheet
2_EP_S_CBP	
B_AGDEL	See "BatchPlant" Sheet
B_SNDEL	See "BatchPlant" Sheet
B_AGCHUT	See "BatchPlant" Sheet
B_SNCHUT	See "BatchPlant" Sheet
B_AGSTOR	See "BatchPlant" Sheet
B_SNSTOR	See "BatchPlant" Sheet
B_WHOPLD	See "BatchPlant" Sheet
B_WHOPAG	See "BatchPlant" Sheet
B_WHOPSN	See "BatchPlant" Sheet
B_CEMSLO	See "BatchPlant" Sheet
B_FLYSLO	See "BatchPlant" Sheet
B_SILSLO	See "BatchPlant" Sheet
B_SLOHOP	See "BatchPlant" Sheet
B_SLOCNY	See "BatchPlant" Sheet
B_SLOTRK	See "BatchPlant" Sheet
2_EP_S_FUEL	
EP_S_FUEL1	See "Fuel Tanks" Sheet
2_EP_S_WE	
E_WE_EXP	AP-42, Chapter 13.2.5, Industrial Wind Erosion, Rev. 11/06
E_WE_SUB	AP-42, Chapter 13.2.5, Industrial Wind Erosion, Rev. 11/06
EP_S_EFD	See "Employees" Sheet
EP_S_E_C	See "Employees" Sheet
EP_S_DFD	See "Deliveries" Sheet
EP_S_D_C	See "Deliveries" Sheet
2_EP_S_D	
EP_S_F_C	See "EP_Fleet" Sheet
EP_S_D_DOZ	See "EP_Fleet" Sheet
EP_S_D_FUG	See "EP_Fleet" Sheet

Air Sciences Inc. AIR EMISSION CALCULATIONS					PROJECT TITLE: Resolution Copper EI				BY: D. Steen			
					PROJECT NO: 262				PAGE: 1	OF: 18	SHEET: WPS_DISP	
					SUBJECT: Mill				DATE: October 12, 2018			
MILL - CONTROLLED - EMISSIONS SUMMARY												
Source ID	Potential Emissions											
	CO		NO _x		SO ₂		PM ₁₀		PM _{2.5}		VOC	
	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr
2_M_DRLBST	Drilling & Blasting											
WPS_DRILL							0.12	7.2E-3	0.12	7.2E-3		
WPS_BLAST	0.67	2.1	2.1	0.40	0.67	0.13	0.13	2.5E-2	7.4E-3	1.4E-3		
2_M_MAT	Material Handling - Stockpile & SAG											
W_CVYXF1							0.73	1.9	0.11	0.28		
W_CVYXF2							0.73	1.9	0.11	0.28		
M_TRIPPR							0.73	1.9	0.11	0.28		
M_STOCKP							6.8E-3	1.7E-2	1.0E-3	2.6E-3		
M1_FEED												
M1_XFER							0.29	1.3	0.29	1.3		
M2_FEED												
M2_XFER							0.29	1.3	0.29	1.3		
2_M_SAG1	SAG Line 1											
M1_LOAD							0.27	0.95	4.1E-2	0.14		
M1_SAG												
M1_TROML												
M1_VIBRT												
M1_BALLA												
M1_BALLB												
2_M_SAG2	SAG Line 2											
M2_LOAD							0.27	0.95	4.1E-2	0.14		
M2_SAG												
M2_TROML												
M2_VIBRT												
M2_BALLA												
M2_BALLB												
2_M_PEBB	Pebble Recycle											
M_SCREEN							0.42	1.5	2.9E-2	0.10		
M_PEBREC							6.6E-2	0.23	9.9E-3	3.5E-2		
M_PEBBIN							6.6E-2	0.23	9.9E-3	3.5E-2		
M1_PEBFD							6.6E-2	0.23	9.9E-3	3.5E-2		
M2_PEBFD							6.6E-2	0.23	9.9E-3	3.5E-2		
M1_PEBCV							6.6E-2	0.23	9.9E-3	3.5E-2		
M2_PEBCV							6.6E-2	0.23	9.9E-3	3.5E-2		

Air Sciences Inc.					PROJECT TITLE:					BY:				
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AIR EMISSION CALCULATIONS					262					2	18	WPS_DISP		
					SUBJECT:					DATE:				
					Mill					October 12, 2018				
MILL - CONTROLLED - EMISSIONS SUMMARY CONT.														
Source ID	Potential Emissions													
	CO		NO _x		SO ₂		PM ₁₀		PM _{2.5}		VOC			
	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr		
2_M_MOLY_FL	Moly Flotation													
M_MLYFLT							6.3E-4	1.3E-3	9.5E-5	2.0E-4				
M_MLYBIN							5.6E-4	1.2E-3	8.5E-5	1.8E-4				
M_MLYBAG							5.6E-4	1.2E-3	8.5E-5	1.8E-4				
2_M_LIME	Lime System													
M1_LIMBN							1.4E-3	4.6E-3	1.4E-3	4.6E-3				
M1_LIMVM							1.2E-2	3.8E-2	1.2E-2	3.8E-2				
M1_LIMTK							1.2E-2	3.8E-2	1.2E-2	3.8E-2				
M2_LIMBN							1.4E-3	4.6E-3	1.4E-3	4.6E-3				
M2_LIMVM							1.2E-2	3.8E-2	1.2E-2	3.8E-2				
M2_LIMTK							1.2E-2	3.8E-2	1.2E-2	3.8E-2				
2_M_TALC	Moly/Talc Heat Treatment Process													
M_MLYHTR					4.2	13.6					20.2	65.1		
M_KILN_P							1.1	3.4	0.90	2.9				
M_KILN_C	1.3	5.9	2.3	10.2	0.29	1.3	0.13	0.55	0.13	0.55	0.14	0.63		
2_M_EGEN	Emergency Generators													
W_GEN1	3.9	0.96	0.35	8.7E-2	9.0E-3	2.2E-3	7.7E-3	1.9E-3	7.7E-3	1.9E-3	1.7E-2	4.3E-3		
W_GEN2	3.9	0.96	0.35	8.7E-2	9.0E-3	2.2E-3	7.7E-3	1.9E-3	7.7E-3	1.9E-3	1.7E-2	4.3E-3		
W_GEN3	3.9	0.96	0.35	8.7E-2	9.0E-3	2.2E-3	7.7E-3	1.9E-3	7.7E-3	1.9E-3	1.7E-2	4.3E-3		
2_M_FUEL	Diesel Storage Tanks													
M_FUEL1											4.0E-3	1.7E-2		
2_M_REAG	Reagent Storage, Handling, and Use													
M_SIPX							4.9E-3	1.9E-2	4.9E-3	1.9E-2				
M_MIBC											1.5E-2	6.7E-2		
M_NAHS														
M_FLOC1							9.3E-4	3.6E-3	9.3E-4	3.6E-3				
M_FLOC2							2.4E-4	8.6E-4	2.4E-4	8.6E-4				
M_CYTEC											1.1E-5	5.0E-5		
M_MCO											1.1E-3	4.8E-3		
2_M_D	Non-Emergency Diesel Fleet (mobile and stationary)													
M_CMBSTN	3.2	1.7	0.36	0.20	6.9E-3	3.8E-3	1.8E-2	1.0E-2	1.8E-2	1.0E-2	0.17	9.5E-2		
M_D_C_MOB	25.1	30.3	4.0	4.5	4.7E-2	5.5E-2	0.15	0.19	0.15	0.19	2.7	2.9		
M_D_DOZ							0.56	2.0	0.37	1.3				
M_D_FUG							19.9	16.6	2.0	1.7				
2_M_HEAT	Propane Building Heaters													
W_HEAT1	3.7E-3	1.6E-2	6.5E-3	2.8E-2	7.9E-4	3.5E-3	3.5E-4	1.5E-3	3.5E-4	1.5E-3	4.0E-4	1.7E-3		
W_HEAT2	5.4E-3	2.4E-2	9.3E-3	4.1E-2	1.1E-3	5.0E-3	5.0E-4	2.2E-3	5.0E-4	2.2E-3	5.7E-4	2.5E-3		
2_M_WE	Miscellaneous Fugitives													
W_WE_EXP							9.3E-3	4.1E-2	1.4E-3	6.1E-3				
M_S_EFD							1.8E-3	7.5E-2	4.4E-4	1.8E-2				
M_S_E_C	5.4E-2	0.24	2.5E-3	1.1E-2	1.3E-4	5.9E-4	1.4E-3	6.1E-3	2.5E-4	1.1E-3	5.9E-4	2.6E-3		
M_S_DFD							0.15	0.45	3.7E-2	0.11				
M_S_D_C	0.10	3.2E-2	0.30	9.5E-2	9.4E-4	3.0E-4	7.7E-2	2.4E-2	2.2E-2	6.9E-3	2.3E-2	7.2E-3		
3_M_TOTAL	42.0	43.3	10.1	15.8	5.2	15.0	26.5	36.4	4.9	10.9	23.3	68.9		

Air Sciences Inc. 				
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Air Sciences Inc. AIR EMISSION CALCULATIONS					PROJECT TITLE: Resolution Copper EI				BY: D. Steen					
					PROJECT NO: 262				PAGE: 4		OF: 18		SHEET: WPS_DISP	
					SUBJECT: Mill				DATE: October 12, 2018					
MILL - UNCONTROLLED - EMISSIONS SUMMARY CONT.														
Source ID		Potential Emissions												
		CO		NO _x		SO ₂		PM ₁₀		PM _{2.5}		VOC		
		lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	
2_M_MOLY_FL		Moly Flotation												
M_MLYFLT								6.3E-4	1.3E-3	9.5E-5	2.0E-4			
M_MLYBIN								5.6E-4	1.2E-3	8.5E-5	1.8E-4			
M_MLYBAG								5.6E-4	1.2E-3	8.5E-5	1.8E-4			
2_M_LIME		Lime System												
M1_LIMBN								1.9	6.4	1.9	6.4			
M1_LIMVM								1.2E-2	3.8E-2	1.2E-2	3.8E-2			
M1_LIMTK								1.2E-2	3.8E-2	1.2E-2	3.8E-2			
M2_LIMBN								1.9	6.4	1.9	6.4			
M2_LIMVM								1.2E-2	3.8E-2	1.2E-2	3.8E-2			
M2_LIMTK								1.2E-2	3.8E-2	1.2E-2	3.8E-2			
2_M_TALC		Moly/Talc Heat Treatment Process												
M_MLYHTR						83.9	270					172	554	
M_KILN_P								106	341	90.0	291			
M_KILN_C		1.3	5.9	2.3	10.2	0.29	1.3	0.13	0.55	0.13	0.55	0.14	0.63	
2_M_EGEN		Emergency Generators												
W_GEN1		3.9	0.96	0.35	8.7E-2	9.0E-3	2.2E-3	7.7E-3	1.9E-3	7.7E-3	1.9E-3	1.7E-2	4.3E-3	
W_GEN2		3.9	0.96	0.35	8.7E-2	9.0E-3	2.2E-3	7.7E-3	1.9E-3	7.7E-3	1.9E-3	1.7E-2	4.3E-3	
W_GEN3		3.9	0.96	0.35	8.7E-2	9.0E-3	2.2E-3	7.7E-3	1.9E-3	7.7E-3	1.9E-3	1.7E-2	4.3E-3	
2_M_FUEL		Diesel Storage Tanks												
M_FUEL1												4.0E-3	1.7E-2	
2_M_REAG		Reagent Storage, Handling, and Use												
M_SIPX								4.9E-3	1.9E-2	4.9E-3	1.9E-2			
M_MIBC												1.5E-2	6.7E-2	
M_NAHS														
M_FLOC1								2.7E-2	0.10	2.7E-2	0.10			
M_FLOC2								6.9E-3	2.4E-2	6.9E-3	2.4E-2			
M_CYTEC												1.1E-5	5.0E-5	
M_MCO												1.1E-3	4.8E-3	
2_M_D		Non-Emergency Diesel Fleet (mobile and stationary)												
M_CMBSTN		3.2	1.7	0.36	0.20	6.9E-3	3.8E-3	1.8E-2	1.0E-2	1.8E-2	1.0E-2	0.17	9.5E-2	
M_D_C_MOB		25.1	30.3	4.0	4.5	4.7E-2	5.5E-2	0.15	0.19	0.15	0.19	2.7	2.9	
M_D_DOZ								0.56	2.0	0.37	1.3			
M_D_FUG								199	166	19.8	16.5			
2_M_HEAT		Propane Building Heaters												
W_HEAT1		3.7E-3	1.6E-2	6.5E-3	2.8E-2	7.9E-4	3.5E-3	3.5E-4	1.5E-3	3.5E-4	1.5E-3	4.0E-4	1.7E-3	
W_HEAT2		5.4E-3	2.4E-2	9.3E-3	4.1E-2	1.1E-3	5.0E-3	5.0E-4	2.2E-3	5.0E-4	2.2E-3	5.7E-4	2.5E-3	
2_M_WE		Miscellaneous Fugitives												
W_WE_EXP								9.3E-2	0.41	1.4E-2	6.1E-2			
M_S_EFD								1.8E-2	7.5E-2	4.4E-3	1.8E-2			
M_S_E_C		5.4E-2	0.24	2.5E-3	1.1E-2	1.3E-4	5.9E-4	1.4E-3	6.1E-3	2.5E-4	1.1E-3	5.9E-4	2.6E-3	
M_S_DFD								1.5	0.45	0.37	0.11			
M_S_D_C		0.10	3.2E-2	0.30	9.5E-2	9.4E-4	3.0E-4	7.7E-2	2.4E-2	2.2E-2	6.9E-3	2.3E-2	7.2E-3	
3_M_TOTAL		42.0	43.3	10.1	15.8	84.9	272	345	622	126	360	175	558	

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: D. Steen		
	PROJECT NO: 262		PAGE: 5	OF: 18	SHEET: WPS_DISP
	SUBJECT: Mill		DATE: October 12, 2018		

MILL - CONTROLLED - EMISSION FACTORS

Source ID	Emission Factors						Units & Notes
	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	VOC	
2_M_DRLBST <i>Drilling & Blasting</i>							
WPS_DRILL							See "Drill & Blast" Sheet
WPS_BLAST							See "Drill & Blast" Sheet
2_M_MAT <i>Material Handling - Stockpile & SAG</i>							
W_CVYXF1				7.4E-5	1.1E-5		lb/ton
W_CVYXF2				7.4E-5	1.1E-5		lb/ton
M_TRIPPR				7.4E-5	1.1E-5		lb/ton
M_STOCKP				6.9E-5	1.0E-5		lb/ton
M1_FEED							Emissions accounted for in M1_XFER
M1_XFER							Dust Collector (1017014 dscf/hr, 0.002 gr/dscf)
M2_FEED							Emissions accounted for in M2_XFER
M2_XFER							Dust Collector (1017014 dscf/hr, 0.002 gr/dscf)
2_M_SAG1 <i>SAG Line 1</i>							
M1_LOAD				5.7E-5	8.6E-6		lb/ton
M1_SAG							wet process
M1_TROML							wet process
M1_VIBRT							wet process
M1_BALLA							wet process
M1_BALLB							wet process
2_M_SAG2 <i>SAG Line 2</i>							
M2_LOAD				5.7E-5	8.6E-6		lb/ton
M2_SAG							wet process
M2_TROML							wet process
M2_VIBRT							wet process
M2_BALLA							wet process
M2_BALLB							wet process
2_M_PEBB <i>Pebble Recycle</i>							
M_SCREEN				7.4E-4	5.0E-5		lb/ton
M_PEBREC				5.7E-5	8.6E-6		lb/ton
M_PEBBIN				5.7E-5	8.6E-6		lb/ton
M1_PEBFD				5.7E-5	8.6E-6		lb/ton
M2_PEBFD				5.7E-5	8.6E-6		lb/ton
M1_PEBCV				5.7E-5	8.6E-6		lb/ton
M2_PEBCV				5.7E-5	8.6E-6		lb/ton

Air Sciences Inc.	PROJECT TITLE:		BY:	
	Resolution Copper EI		D. Steen	
	PROJECT NO:	PAGE:	OF:	SHEET:
AIR EMISSION CALCULATIONS	262	6	18	WPS_DISP
	SUBJECT:	DATE:		
	Mill	October 12, 2018		

MILL - CONTROLLED - EMISSION FACTORS CONT.							
Source ID	Emission Factors						
	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	VOC	Units & Notes
2_M_MOLY_F Moly Flotation							
M_MLYFLT				5.7E-5	8.6E-6		lb/ton
M_MLYBIN				5.7E-5	8.6E-6		lb/ton
M_MLYBAG				5.7E-5	8.6E-6		lb/ton
2_M_LIME Lime System							
M1_LIMBN				3.4E-4	3.4E-4		lb/ton
M1_LIMVM				2.8E-3	2.8E-3		lb/ton
M1_LIMTK				2.8E-3	2.8E-3		lb/ton
M2_LIMBN				3.4E-4	3.4E-4		lb/ton
M2_LIMVM				2.8E-3	2.8E-3		lb/ton
M2_LIMTK				2.8E-3	2.8E-3		lb/ton
2_M_TALC Moly/Talc Heat Treatment Process							
M_MLYHTR							See "MolyTalc" Sheet
M_KILN_P							See "MolyTalc" Sheet
M_KILN_C							See "MolyTalc" Sheet
2_M_EGEN Emergency Generators							
W_GEN1							See "E_Gen" Sheet
W_GEN2							See "E_Gen" Sheet
W_GEN3							See "E_Gen" Sheet
2_M_FUEL Diesel Storage Tanks							
M_FUEL1							See "Fuel Tanks" Sheet
2_M_REAG Reagent Storage, Handling, and Use							
M_SIPX				0.16	0.16		lb/ton
M_MIBC							See "Reagents" Sheet
M_NAHS							See "Reagents" Sheet
M_FLOC1				5.5E-3	5.5E-3		lb/ton
M_FLOC2				5.5E-3	5.5E-3		lb/ton
M_CYTEC							See "Reagents" Sheet
M_MCO							See "Reagents" Sheet
2_M_D Non-Emergency Diesel Fleet (mobile and stationary)							
M_CMBSTN							See "Mill_Fleet" Sheet
M_D_C_MOB							See "Mill_Fleet" Sheet
M_D_DOZ							See "Mill_Fleet" Sheet
M_D_FUG							See "Mill_Fleet" Sheet
2_M_HEAT Propane Building Heaters							
W_HEAT1	7.5	13.0	1.6	0.70	0.70	0.80	lb/k-gal
W_HEAT2	7.5	13.0	1.6	0.70	0.70	0.80	lb/k-gal
2_M_WE Miscellaneous Fugitives							
W_WE_EXP							See Wind Workbook
M_S_EFD							See "Employees" Sheet
M_S_E_C							See "Employees" Sheet
M_S_DFD							See "Deliveries" Sheet
M_S_D_C							See "Deliveries" Sheet

Air Sciences Inc.	PROJECT TITLE:		BY:		
	Resolution Copper EI		D. Steen		
	PROJECT NO:	PAGE:	OF:	SHEET:	
AIR EMISSION CALCULATIONS	262	7	18	WPS_DISP	
	SUBJECT:	DATE:			
	Mill	October 12, 2018			

MILL - UNCONTROLLED - EMISSION FACTORS							
Source ID	Emission Factors						
	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	VOC	Units & Notes
2_M_DRLBST	Drilling & Blasting						
WPS_DRILL							See "Drill & Blast" Sheet
WPS_BLAST							See "Drill & Blast" Sheet
2_M_MAT	Material Handling - Stockpile & SAG						
W_CVYXF1				5.5E-4	1.1E-5		lb/ton
W_CVYXF2				5.5E-4	1.1E-5		lb/ton
M_TRIPPR				5.5E-4	1.1E-5		lb/ton
M_STOCKP				5.5E-4	1.0E-5		lb/ton
M1_FEED				6.9E-5	1.0E-5		lb/ton
M1_XFER				6.9E-5	1.0E-5		lb/ton
M2_FEED				6.9E-5	1.0E-5		lb/ton
M2_XFER				6.9E-5	1.0E-5		lb/ton
2_M_SAG1	SAG Line 1						
M1_LOAD				5.7E-5	8.6E-6		lb/ton
M1_SAG							No emissions - Wet Process
M1_TROML							No emissions - Wet Process
M1_VIBRT							No emissions - Wet Process
M1_BALLA							No emissions - Wet Process
M1_BALLB							No emissions - Wet Process
2_M_SAG2	SAG Line 2						
M2_LOAD				5.7E-5	8.6E-6		lb/ton
M2_SAG							No emissions - Wet Process
M2_TROML							No emissions - Wet Process
M2_VIBRT							No emissions - Wet Process
M2_BALLA							No emissions - Wet Process
M2_BALLB							No emissions - Wet Process
2_M_PEBB	Pebble Recycle						
M_SCREEN				8.7E-3	8.7E-3		lb/ton
M_PEBREC				5.7E-5	8.6E-6		lb/ton
M_PEBBIN				5.7E-5	8.6E-6		lb/ton
M1_PEBFD				5.7E-5	8.6E-6		lb/ton
M2_PEBFD				5.7E-5	8.6E-6		lb/ton
M1_PEBCV				5.7E-5	8.6E-6		lb/ton
M2_PEBCV				5.7E-5	8.6E-6		lb/ton

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: D. Steen		
	PROJECT NO: 262		PAGE: 8	OF: 18	SHEET: WPS_DISP
	SUBJECT: Mill		DATE: October 12, 2018		

MILL - UNCONTROLLED - EMISSION FACTORS CONT.							
Source ID	Emission Factors						
	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	VOC	Units & Notes
2_M_MOLY_F Moly Flotation							
M_MLYFLT				5.7E-5	8.6E-6		lb/ton
M_MLYBIN				5.7E-5	8.6E-6		lb/ton
M_MLYBAG				5.7E-5	8.6E-6		lb/ton
2_M_LIME Lime System							
M1_LIMBN				0.47	0.47		lb/ton
M1_LIMVM				2.8E-3	2.8E-3		lb/ton
M1_LIMTK				2.8E-3	2.8E-3		lb/ton
M2_LIMBN				0.47	0.47		lb/ton
M2_LIMVM				2.8E-3	2.8E-3		lb/ton
M2_LIMTK				2.8E-3	2.8E-3		lb/ton
2_M_TALC Moly/Talc Heat Treatment Process							
M_MLYHTR							See "MolyTalc" Sheet
M_KILN_P							See "MolyTalc" Sheet
M_KILN_C							See "MolyTalc" Sheet
2_M_EGEN Emergency Generators							
W_GEN1							See "E_Gen" Sheet
W_GEN2							See "E_Gen" Sheet
W_GEN3							See "E_Gen" Sheet
2_M_FUEL Diesel Storage Tanks							
M_FUEL1							See "Fuel Tanks" Sheet
2_M_REAG Reagent Storage, Handling, and Use							
M_SIPX				0.16	0.16		lb/ton
M_MIBC							See "Reagents" Sheet
M_NAHS							See "Reagents" Sheet
M_FLOC1				0.16	0.16		lb/ton
M_FLOC2				0.16	0.16		lb/ton
M_CYTEC							See "Reagents" Sheet
M_MCO							See "Reagents" Sheet
2_M_D Non-Emergency Diesel Fleet (mobile and stationary)							
M_CMBSTN							See "Mill_Fleet" Sheet
M_D_C_MOB							See "Mill_Fleet" Sheet
M_D_DOZ							See "Mill_Fleet" Sheet
M_D_FUG							See "Mill_Fleet" Sheet
2_M_HEAT Propane Building Heaters							
W_HEAT1	7.5	13.0	1.6	0.70	0.70	0.80	lb/k-gal
W_HEAT2	7.5	13.0	1.6	0.70	0.70	0.80	lb/k-gal
2_M_WE Miscellaneous Fugitives							
W_WE_EXP							See Wind Workbook
M_S_EFD							See "Employees" Sheet
M_S_E_C							See "Employees" Sheet
M_S_DFD							See "Deliveries" Sheet
M_S_D_C							See "Deliveries" Sheet

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: D. Steen		
	PROJECT NO: 262		PAGE: 9	OF: 18	SHEET: WPS_DISP
	SUBJECT: Mill		DATE: October 12, 2018		

MILL - PROCESS RATES

Source ID	Process Rates		
	Unit/Hr	Unit/Yr	Units & Notes
2_M_DRLBST Drilling & Blasting			
WPS_DRILL			See "Drill & Blast" Sheet
WPS_BLAST			See "Drill & Blast" Sheet
2_M_MAT Material Handling - Stockpile & SAG			
W_CVYXF1	9,855	50,292,894	ton
W_CVYXF2	9,855	50,292,894	ton
M_TRIPPR	9,855	50,292,894	ton
M_STOCKP	9,855	50,292,894	ton
M1_FEED	4,736	33,193,310	ton
M1_XFER	4,736	33,193,310	ton
M2_FEED	4,736	33,193,310	ton
M2_XFER	4,736	33,193,310	ton
2_M_SAG1 SAG Line 1			
M1_LOAD	4,736	33,193,310	ton
M1_SAG	4,736	33,193,310	ton
M1_TROML	4,736	33,193,310	ton
M1_VIBRT	4,736	33,193,310	ton
M1_BALLA	7,728	54,161,579	ton
M1_BALLB	7,728	54,161,579	ton
2_M_SAG2 SAG Line 2			
M2_LOAD	4,736	33,193,310	ton
M2_SAG	4,736	33,193,310	ton
M2_TROML	4,736	33,193,310	ton
M2_VIBRT	4,736	33,193,310	ton
M2_BALLA	7,728	54,161,579	ton
M2_BALLB	7,728	54,161,579	ton
2_M_PEBB Pebble Recycle			
M_SCREEN	1,149	8,046,863	ton
M_PEBREC	1,149	8,046,863	ton
M_PEBBIN	1,149	8,046,863	ton
M1_PEBFD	1,149	8,046,863	ton
M2_PEBFD	1,149	8,046,863	ton
M1_PEBCV	1,149	8,046,863	ton
M2_PEBCV	1,149	8,046,863	ton

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: D. Steen		
	PROJECT NO: 262		PAGE: 10	OF: 18	SHEET: WPS_DISP
	SUBJECT: Mill		DATE: October 12, 2018		

MILL - PROCESS RATES CONT.			
Source ID	Process Rates		
	Unit/Hr	Unit/Yr	Units & Notes
2_M_MOLY_F Moly Flotation			
M_MLYFLT	11.0	45,389	ton
M_MLYBIN	9.9	40,611	ton
M_MLYBAG	9.9	40,611	ton
2_M_LIME Lime System			
M1_LIMBN	4.1	27,279	ton
M1_LIMVM	4.1	27,279	ton
M1_LIMTK	4.1	27,279	ton
M2_LIMBN	4.1	27,279	ton
M2_LIMVM	4.1	27,279	ton
M2_LIMTK	4.1	27,279	ton
2_M_TALC Moly/Talc Heat Treatment Process			
M_MLYHTR			See "MolyTalc" Sheet
M_KILN_P			See "MolyTalc" Sheet
M_KILN_C			See "MolyTalc" Sheet
2_M_EGEN Emergency Generators			
W_GEN1			See "E_Gen" Sheet
W_GEN2			See "E_Gen" Sheet
W_GEN3			See "E_Gen" Sheet
2_M_FUEL Diesel Storage Tanks			
M_FUEL1	318	741,883	gal
2_M_REAG Reagent Storage, Handling, and Use			
M_SIPX	3.2E-2	241	ton
M_MIBC	1,392	441,713	gal
M_NAHS	8,749	2,776,973	gal
M_FLOC1	0.17	1,296	ton
M_FLOC2	4.4E-2	314	ton
M_CYTEC	240	76,078	gal
M_MCO	422	133,835	gal
2_M_D Non-Emergency Diesel Fleet (mobile and stationary)			
M_CMBSTN			See "Mill_Fleet" Sheet
M_D_C_MOB			See "Mill_Fleet" Sheet
M_D_DOZ			See "Mill_Fleet" Sheet
M_D_FUG			See "Mill_Fleet" Sheet
2_M_HEAT Propane Building Heaters			
W_HEAT1	5.0E-4	4.4	k-gal
W_HEAT2	7.2E-4	6.3	k-gal
2_M_WE Miscellaneous Fugitives			
W_WE_EXP		70.0	acre
M_S_EFD			See "Employees" Sheet
M_S_E_C			See "Employees" Sheet
M_S_DFD			See "Deliveries" Sheet
M_S_D_C			See "Deliveries" Sheet

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: D. Steen		
	PROJECT NO: 262		PAGE: 11	OF: 18	SHEET: WPS_DISP
	SUBJECT: Mill		DATE: October 12, 2018		

MILL - CONTROLS				
Source ID	Control Technology	Control Efficiency	Notes	
2_M_DRLBST Drilling & Blasting				
WPS_DRILL		0%		
WPS_BLAST		0%		
2_M_MAT Material Handling - Stockpile & SAG				
W_CVYXF1	moisture, enclosure	0%	Control accounted for in EF	
W_CVYXF2	moisture, enclosure	0%	Control accounted for in EF	
M_TRIPPR	moisture, enclosure	0%	Moist. & Enc. accounted for in EF	
M_STOCKP	moisture, enclosure with filter vents	99%	Moist. & Enc. accounted for in EF	
M1_FEED		0%	Emissions accounted for in M1_XFER	
M1_XFER	1 dust collector	0%	Control accounted for in emission calculation	
M2_FEED		0%	Emissions accounted for in M2_XFER	
M2_XFER	1 dust collector	0%	Control accounted for in emission calculation	
2_M_SAG1 SAG Line 1				
M1_LOAD	moisture, enclosure	0%	Control accounted for in EF	
M1_SAG	wet process	100%		
M1_TROML	wet process	100%		
M1_VIBRT	wet process	100%		
M1_BALLA	wet process	100%		
M1_BALLB	wet process	100%		
2_M_SAG2 SAG Line 2				
M2_LOAD	moisture, enclosure	0%	Control accounted for in EF	
M2_SAG	wet process	100%		
M2_TROML	wet process	100%		
M2_VIBRT	wet process	100%		
M2_BALLA	wet process	100%		
M2_BALLB	wet process	100%		
2_M_PEBB Pebble Recycle				
M_SCREEN	moisture, enclosure	50%	Control accounted for in EF	
M_PEBREC	moisture, enclosure	0%	Control accounted for in EF	
M_PEBBIN	moisture, enclosure	0%	Control accounted for in EF	
M1_PEBFD	moisture, enclosure	0%	Control accounted for in EF	
M2_PEBFD	moisture, enclosure	0%	Control accounted for in EF	
M1_PEBCV	moisture, enclosure	0%	Control accounted for in EF	
M2_PEBCV	moisture, enclosure	0%	Control accounted for in EF	

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI		BY: D. Steen		
	PROJECT NO: 262		PAGE: 12	OF: 18	SHEET: WPS_DISP
	SUBJECT: Mill		DATE: October 12, 2018		
AIR EMISSION CALCULATIONS					
MILL - CONTROLS CONT.					
Source ID	Control Technology	Control Efficiency	Notes		
2_M_MOLY_FL	Moly Flotation				
M_MLYFLT	moisture, enclosure	0%	Control accounted for in EF		
M_MLYBIN	moisture, enclosure	0%	Control accounted for in EF		
M_MLYBAG	moisture, enclosure	0%	Control accounted for in EF		
2_M_LIME	Lime System				
M1_LIMBN	bin vent	0%	Control accounted for in EF		
M1_LIMVM		0%			
M1_LIMTK		0%			
M2_LIMBN	bin vent	0%	Control accounted for in EF		
M2_LIMVM		0%			
M2_LIMTK		0%			
2_M_TALC	Moly/Talc Heat Treatment Process				
M_MLYHTR		SO2: 95%, VOC: 88%			
M_KILN_P		99%			
M_KILN_C		0%			
2_M_EGEN	Emergency Generators				
W_GEN1		0%			
W_GEN2		0%			
W_GEN3		0%			
2_M_FUEL	Diesel Storage Tanks				
M_FUEL1		0%			
2_M_REAG	Reagent Storage, Handling, and Use				
M_SIPX		0%			
M_MIBC		0%			
M_NAHS		0%			
M_FLOC1		0%			
M_FLOC2		0%			
M_CYTEC		0%			
M_MCO		0%			
2_M_D	Non-Emergency Diesel Fleet (mobile and stationary)				
M_CMBSTN		0%			
M_D_C_MOB		0%			
M_D_DOZ	enclosure with filter vents	0%			
M_D_FUG	chemical suppression	90%	AP-42, Figure 13.2.2-2, Rev. 11/06		
2_M_HEAT	Propane Building Heaters				
W_HEAT1		0%			
W_HEAT2		0%			
2_M_WE	Miscellaneous Fugitives				
W_WE_EXP	chemical suppression	90%	AP-42, Figure 13.2.2-2, Rev. 11/06		
M_S_EFD	chemical suppression	90%	AP-42, Figure 13.2.2-2, Rev. 11/06		
M_S_E_C		0%	AP-42, Figure 13.2.2-2, Rev. 11/06		
M_S_DFD	chemical suppression	90%	AP-42, Figure 13.2.2-2, Rev. 11/06		
M_S_D_C		0%	AP-42, Figure 13.2.2-2, Rev. 11/06		

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: D. Steen	
	PROJECT NO: 262		PAGE: 13	OF: 18
	SHEET: WPS_DISP			
SUBJECT: Mill		DATE: October 12, 2018		

MILL - SOURCE IDENTIFICATION	
Source ID	Source Identification
2_M_DRLBST	Drilling & Blasting
WPS_DRILL	Drilling
WPS_BLAST	Blasting
2_M_MAT	Material Handling - Stockpile & SAG
W_CVYXF1	Incline Conveyor to Mine Conveyor
W_CVYXF2	Mine Conveyor to Mine Transfer Conveyor (CV-002)
M_TRIPPR	Mine Transfer Conveyor (CV-002) to Stockpile Tripper Conveyor (CV-003)
M_STOCKP	Stockpile Tripper Conveyor (CV-003) to Covered SAG Mill Stockpile
M1_FEED	SAG Mill Stockpile to Reclaim Tunnel Feeders (FE-001 - 004) - SAG 1
M1_XFER	Reclaim Tunnel Feeders (FE001 - 004) to SAG 1 Conveyor (CV-004)
M2_FEED	SAG Mill Stockpile to Reclaim Tunnel Feeders (FE-005 - 008) - SAG 2
M2_XFER	Reclaim Tunnel Feeders (FE005 - 008) to SAG 2 Conveyor (CV-104)
2_M_SAG1	SAG Line 1
M1_LOAD	SAG 1 Conveyor (CV-004) to SAG Mill 1 (ML-001)
M1_SAG	SAG Mill 1 (ML-001)
M1_TROML	Trommel Screen 1 (SR-001) and associated transfer out (SR-002)
M1_VIBRT	Vibrating Screen (SR-002) and associated transfer out (oversize to CV-012)
M1_BALLA	Ball Mill 1A (ML-002) and associated transfers in and out
M1_BALLB	Ball Mill 1B (ML-003) and associated transfers in and out
2_M_SAG2	SAG Line 2
M2_LOAD	SAG 2 Conveyor (CV-104) to SAG Mill 2 (ML-001)
M2_SAG	SAG Mill 2 (ML-101)
M2_TROML	Trommel Screen 2 (SR-101) and associated transfer out (SR-003)
M2_VIBRT	Vibrating Screen (SR-003) and associated transfer out (oversize to CV-012)
M2_BALLA	Ball Mill 2A (ML-102) and associated transfers in and out
M2_BALLB	Ball Mill 2B (ML-103) and associated transfers in and out
2_M_PEBB	Pebble Recycle
M_SCREEN	SAG Mill Discharge Screens (SR-002 - 003) and associated transfers in (CV-012) and out (CV-013)
M_PEBREC	Recycle Conveyor 2 (CV-013) to Recycle Conveyor 3 (CV-014)
M_PEBBIN	Recycle Conveyor 3 (CV-014) to Pebble Bin (BN-002)
M1_PEBFD	Pebble Bin (BN-002) to Pebble Feeder 1 (FE-009)
M2_PEBFD	Pebble Bin (BN-002) to Pebble Feeder 2 (FE-109)
M1_PEBCV	Pebble Feeder 1 (FE-009) to SAG 1 Conveyor (CV-004)
M2_PEBCV	Pebble Feeder 2 (FE-109) to SAG 2 Conveyor (CV-104)

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: D. Steen		
	PROJECT NO: 262		PAGE: 14	OF: 18	SHEET: WPS_DISP
	SUBJECT: Mill		DATE: October 12, 2018		
MILL - SOURCE IDENTIFICATION CONT.					
Source ID	Source Identification				
2_M_MOLY_FL	Moly Flotation				
M_MLYFLT	Moly Concentrate Filter (FL-001) to Holoflite Dryers (DR001 - 002)				
M_MLYBIN	Holoflite Dryers (DR-001 - 002) to Moly Concentrate Day Bins (BN001 - 003)				
M_MLYBAG	Moly Concentrate Day Bins (BN001 - 003) to Moly Bagging System (MS-001)				
2_M_LIME	Lime System				
M1_LIMBN	Lime Bin 1 (BN-801) Loading (Discharge to Enclosed Screw Feeder)				
M1_LIMVM	Screw Feeder 1 (CV-801) to Vertimill 1 (ML-801)				
M1_LIMTK	Vertimill 1 (ML-801) to Milk of Lime Tank (TK-156)				
M2_LIMBN	Lime Bin 2 (BN-802) Loading (Discharge to Enclosed Screw Feeder)				
M2_LIMVM	Screw Feeder 2 (CV-802) to Vertimill 2 (ML-802)				
M2_LIMTK	Vertimill 2 (ML-802) to Milk of Lime Tank (TK-156)				
2_M_TALC	Moly/Talc Heat Treatment Process				
M_MLYHTR	Moly/Talc Heat Treatment Process				
M_KILN_P	Moly/Talc Rotary Dryer Process				
M_KILN_C	Moly/Talc Rotary Dryer Combustion				
2_M_EGEN	Emergency Generators				
W_GEN1	Caterpillar C18 Generator Set				
W_GEN2	Caterpillar C18 Generator Set				
W_GEN3	Caterpillar C18 Generator Set				
2_M_FUEL	Diesel Storage Tanks				
M_FUEL1	Mill Usage and Volume Estimated (Estimated Quantity: 5)				
2_M_REAG	Reagent Storage, Handling, and Use				
M_SIPX	SIPX (Sodium Isopropyl Xanthate)				
M_MIBC	MIBC (Methyl isobutyl carbonal)				
M_NAHS	NaHS (Sodium hydrosulfide solution)				
M_FLOC1	Flocculent (CIBA Magnafloc 155)				
M_FLOC2	Flocculent (CIBA Magnafloc 10)				
M_CYTEC	CYTEC 8989				
M_MCO	MCO (Non-polar flotation oil)				
2_M_D	Non-Emergency Diesel Fleet (mobile and stationary)				
M_CMBSTN	Mill Combustion (Stationary)				
M_D_C_MOB	Mill Combustion (Mobile)				
M_D_DOZ	Mill Fugitive Dust (Dozing)				
M_D_FUG	Mill Fugitive Dust (Grading, Vehicle Travel)				
2_M_HEAT	Propane Building Heaters				
W_HEAT1	Hydro House Propane Heater (0.045 MMBtu/hr)				
W_HEAT2	Hydro House Propane Heater (0.065 MMBtu/hr)				
2_M_WE	Miscellaneous Fugitives				
W_WE_EXP	WPS Exposed Areas				
M_S_EFD	WPS Employee Fugitives				
M_S_E_C	WPS Employee Combustion				
M_S_DFD	WPS Delivery Fugitives				
M_S_D_C	WPS Delivery Combustion				
3_M_TOTAL	Mill Subtotal				

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: D. Steen	
	PROJECT NO: 262	PAGE: 15	OF: 18	SHEET: WPS_DISP
	SUBJECT: Mill	DATE: October 12, 2018		

MILL - CONTROLLED - EF REFERENCE				
Source ID	Emission Factor Reference			
2_M_DRLBST	Drilling & Blasting			
WPS_DRILL	See "Drill & Blast" Sheet			
WPS_BLAST	See "Drill & Blast" Sheet			
2_M_MAT	Material Handling - Stockpile & SAG			
W_CVYXF1	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 1.3 mph)			
W_CVYXF2	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 1.3 mph)			
M_TRIPPR	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 1.3 mph)			
M_STOCKP	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.2% moist, 1.3 mph)			
M1_FEED	Emissions accounted for in M1_XFER			
M1_XFER	Manufacturer (Donaldson Torit) Specified Grain Loading			
M2_FEED	Emissions accounted for in M2_XFER			
M2_XFER	Manufacturer (Donaldson Torit) Specified Grain Loading			
2_M_SAG1	SAG Line 1			
M1_LOAD	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)			
M1_SAG	No emissions - Wet Process			
M1_TROML	No emissions - Wet Process			
M1_VIBRT	No emissions - Wet Process			
M1_BALLA	No emissions - Wet Process			
M1_BALLB	No emissions - Wet Process			
2_M_SAG2	SAG Line 2			
M2_LOAD	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)			
M2_SAG	No emissions - Wet Process			
M2_TROML	No emissions - Wet Process			
M2_VIBRT	No emissions - Wet Process			
M2_BALLA	No emissions - Wet Process			
M2_BALLB	No emissions - Wet Process			
2_M_PEBB	Pebble Recycle			
M_SCREEN	AP-42, Table 11.19.2-2, Screening (controlled), Rev. 8/04			
M_PEBREC	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)			
M_PEBBIN	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)			
M1_PEBFD	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)			
M2_PEBFD	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)			
M1_PEBCV	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)			
M2_PEBCV	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)			

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: D. Steen		
	PROJECT NO: 262	PAGE: 16	OF: 18	SHEET: WPS_DISP	
	SUBJECT: Mill		DATE: October 12, 2018		

MILL - CONTROLLED - EF REFERENCE CONT.					
Source ID	Emission Factor Reference				
2_M_MOLY_FL	Moly Flotation				
M_MLYFLT	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)				
M_MLYBIN	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)				
M_MLYBAG	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)				
2_M_LIME	Lime System				
M1_LIMBN	AP-42, Table 11.12-2, Cement Unloading to Elevated Storage Silo (pneumatic, controlled), Rev. 6/06				
M1_LIMVM	AP-42, Table 11.12-2, Weigh Hopper Loading (uncontrolled), Rev. 6/06				
M1_LIMTK	AP-42, Table 11.12-2, Weigh Hopper Loading (uncontrolled), Rev. 6/06				
M2_LIMBN	AP-42, Table 11.12-2, Cement Unloading to Elevated Storage Silo (pneumatic, controlled), Rev. 6/06				
M2_LIMVM	AP-42, Table 11.12-2, Weigh Hopper Loading (uncontrolled), Rev. 6/06				
M2_LIMTK	AP-42, Table 11.12-2, Weigh Hopper Loading (uncontrolled), Rev. 6/06				
2_M_TALC	Moly/Talc Heat Treatment Process				
M_MLYHTR	See "MolyTalc" Sheet				
M_KILN_P	See "MolyTalc" Sheet				
M_KILN_C	See "MolyTalc" Sheet				
2_M_EGEN	Emergency Generators				
W_GEN1	See "E_Gen" Sheet				
W_GEN2	See "E_Gen" Sheet				
W_GEN3	See "E_Gen" Sheet				
2_M_FUEL	Diesel Storage Tanks				
M_FUEL1	See "Fuel Tanks" Sheet				
2_M_REAG	Reagent Storage, Handling, and Use				
M_SIPX	AP-42, Table 11.12-2, Mixer Loading (uncontrolled), Rev. 6/06				
M_MIBC	See "Reagents" Sheet				
M_NAHS	See "Reagents" Sheet				
M_FLOC1	AP-42, Table 11.12-2, Mixer Loading (controlled), Rev. 6/06				
M_FLOC2	AP-42, Table 11.12-2, Mixer Loading (controlled), Rev. 6/06				
M_CYTEC	See "Reagents" Sheet				
M_MCO	See "Reagents" Sheet				
2_M_D	Non-Emergency Diesel Fleet (mobile and stationary)				
M_CMBSTN	See "Mill_Fleet" Sheet				
M_D_C_MOB	See "Mill_Fleet" Sheet				
M_D_DOZ	See "Mill_Fleet" Sheet				
M_D_FUG	See "Mill_Fleet" Sheet				
2_M_HEAT	Propane Building Heaters				
W_HEAT1	AP-42, Table 1.5-1 (industrial, propane boilers), Rev. 7/08				
W_HEAT2	AP-42, Table 1.5-1 (industrial, propane boilers), Rev. 7/08				
2_M_WE	Miscellaneous Fugitives				
W_WE_EXP	AP-42, Chapter 13.2.5, Industrial Wind Erosion, Rev. 11/06				
M_S_EFD	See "Employees" Sheet				
M_S_E_C	See "Employees" Sheet				
M_S_DFD	See "Deliveries" Sheet				
M_S_D_C	See "Deliveries" Sheet				

Air Sciences Inc.	PROJECT TITLE:		BY:			
	Resolution Copper EI		D. Steen			
	PROJECT NO:	PAGE:	OF:	SHEET:		
AIR EMISSION CALCULATIONS	262	17	18	WPS_DISP		
	SUBJECT:	DATE:				
	Mill	October 12, 2018				
MILL - UNCONTROLLED - EF REFERENCE						

Air Sciences Inc.	PROJECT TITLE:	BY:		
	Resolution Copper EI	D. Steen		
	PROJECT NO:	PAGE:	OF:	SHEET:
AIR EMISSION CALCULATIONS	262	18	18	WPS_DISP
	SUBJECT:	DATE:		
	Mill	October 12, 2018		
MILL - UNCONTROLLED - EF REFERENCE CONT.				
Source ID	Emission Factor Reference			
2_M_MOLY_FL	Moly Flotation			
M_MLYFLT	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)			
M_MLYBIN	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)			
M_MLYBAG	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)			
2_M_LIME	Lime System			
M1_LIMBN	AP-42, Table 11.12-2, Cement Unloading to Elevated Storage Silo (pneumatic, uncontrolled), Rev. 6/06			
M1_LIMVM	AP-42, Table 11.12-2, Weigh Hopper Loading (uncontrolled), Rev. 6/06			
M1_LIMTK	AP-42, Table 11.12-2, Weigh Hopper Loading (uncontrolled), Rev. 6/06			
M2_LIMBN	AP-42, Table 11.12-2, Cement Unloading to Elevated Storage Silo (pneumatic, uncontrolled), Rev. 6/06			
M2_LIMVM	AP-42, Table 11.12-2, Weigh Hopper Loading (uncontrolled), Rev. 6/06			
M2_LIMTK	AP-42, Table 11.12-2, Weigh Hopper Loading (uncontrolled), Rev. 6/06			
2_M_TALC	Moly/Talc Heat Treatment Process			
M_MLYHTR	See "MolyTalc" Sheet			
M_KILN_P	See "MolyTalc" Sheet			
M_KILN_C	See "MolyTalc" Sheet			
2_M_EGEN	Emergency Generators			
W_GEN1	See "E_Gen" Sheet			
W_GEN2	See "E_Gen" Sheet			
W_GEN3	See "E_Gen" Sheet			
2_M_FUEL	Diesel Storage Tanks			
M_FUEL1	See "Fuel Tanks" Sheet			
2_M_REAG	Reagent Storage, Handling, and Use			
M_SIPX	AP-42, Table 11.12-2, Mixer Loading (uncontrolled), Rev. 6/06			
M_MIBC	See "Reagents" Sheet			
M_NAHS	See "Reagents" Sheet			
M_FLOC1	AP-42, Table 11.12-2, Mixer Loading (uncontrolled), Rev. 6/06			
M_FLOC2	AP-42, Table 11.12-2, Mixer Loading (uncontrolled), Rev. 6/06			
M_CYTEC	See "Reagents" Sheet			
M_MCO	See "Reagents" Sheet			
2_M_D	Non-Emergency Diesel Fleet (mobile and stationary)			
M_CMBSTN	See "Mill_Fleet" Sheet			
M_D_C_MOB	See "Mill_Fleet" Sheet			
M_D_DOZ	See "Mill_Fleet" Sheet			
M_D_FUG	See "Mill_Fleet" Sheet			
2_M_HEAT	Propane Building Heaters			
W_HEAT1	AP-42, Table 1.5-1 (industrial, propane boilers), Rev. 7/08			
W_HEAT2	AP-42, Table 1.5-1 (industrial, propane boilers), Rev. 7/08			
2_M_WE	Miscellaneous Fugitives			
W_WE_EXP	AP-42, Chapter 13.2.5, Industrial Wind Erosion, Rev. 11/06			
M_S_EFD	See "Employees" Sheet			
M_S_E_C	See "Employees" Sheet			
M_S_DFD	See "Deliveries" Sheet			
M_S_D_C	See "Deliveries" Sheet			

Air Sciences Inc. AIR EMISSION CALCULATIONS				PROJECT TITLE: Resolution Copper EI				BY: D. Steen													
				PROJECT NO: 262				PAGE: 1	OF: 9	SHEET: TSF_DISP											
				SUBJECT: Tailings				DATE: October 12, 2018													
TAILINGS - CONTROLLED - EMISSIONS SUMMARY																					
Source ID	Potential Emissions																				
	CO		NO _x		SO ₂		PM ₁₀		PM _{2.5}		VOC										
	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr									
2_T_FUEL	Diesel Storage Tanks																				
T_FUEL1											3.1E-2	0.13									
2_T_D	Non-Emergency Diesel Fleet (mobile and stationary)																				
T_CMBSTN																					
T_D_C_MOB	115	341	14.4	40.6	0.24	0.72	0.71	2.0	0.71	2.0	7.7	20.5									
T_D_DOZ							3.9	12.0	2.6	7.9											
T_D_FUG							79.1	230	10.1	29.7											
2_T_GEN	Emergency Generators																				
T_GEN1	3.9	0.96	0.35	8.7E-2	9.0E-3	2.2E-3	7.7E-3	1.9E-3	7.7E-3	1.9E-3	1.7E-2	4.3E-3									
2_T_WE	Miscellaneous Fugitives																				
T_WE_RD							9.2E-2	0.40	1.4E-2	6.1E-2											
T_WE_EX							0.17	0.76	2.6E-2	0.11											
T_WE_EX2																					
T_S_EFD							0.93	3.9	9.3E-2	0.39											
T_S_E_C	0.22	0.92	1.0E-2	4.3E-2	5.5E-4	2.3E-3	5.6E-3	2.3E-2	1.0E-3	4.2E-3	2.4E-3	1.0E-2									
T_S_DFD																					
T_S_D_C																					
3 T TOTAL	119	343	14.7	40.7	0.25	0.73	84.9	249	13.5	40.2	7.7	20.6									

Air Sciences Inc. 				
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Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: D. Steen		
	PROJECT NO: 262		PAGE: 3	OF: 9	SHEET: TSF_DISP
	SUBJECT: Tailings		DATE: October 12, 2018		

TAILINGS - CONTROLLED - EMISSION FACTORS							
Source ID	Emission Factors						
	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	VOC	Units & Notes
2_T_FUEL	Diesel Storage Tanks						
T_FUEL1	See "Fuel Tanks" Sheet						
2_T_D	Non-Emergency Diesel Fleet (mobile and stationary)						
T_CMBSTN							
T_D_C_MOB	See "ALT EI" Sheet						
T_D_DOZ	See "ALT EI" Sheet						
T_D_FUG	See "ALT EI" Sheet						
2_T_GEN	Emergency Generators						
T_GEN1	See "E_Gen" Sheet						
2_T_WE	Miscellaneous Fugitives						
T_WE_RD				2E-01	3E-02		ton/acre-yr
T_WE_EX				5E-03	8E-04		ton/acre-yr
T_WE_EX2				5E-03	8E-04		ton/acre-yr
T_S_EFD	See "ALT EI" Sheet						
T_S_E_C	See "ALT EI" Sheet						
T_S_DFD	See "Deliveries" Sheet						
T_S_D_C	See "Deliveries" Sheet						

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: D. Steen		
	PROJECT NO: 262		PAGE: 4	OF: 9	SHEET: TSF_DISP
	SUBJECT: Tailings		DATE: October 12, 2018		

TAILINGS - UNCONTROLLED - EMISSION FACTORS							
Source ID	Emission Factors						Units & Notes
	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	VOC	
2_T_FUEL	Diesel Storage Tanks						
T_FUEL1							See "Fuel Tanks" Sheet
2_T_D	Non-Emergency Diesel Fleet (mobile and stationary)						
T_CMBSTN							
T_D_C_MOB							See "ALT EI" Sheet
T_D_DOZ							See "ALT EI" Sheet
T_D_FUG							See "ALT EI" Sheet
2_T_GEN	Emergency Generators						
T_GEN1							See "E_Gen" Sheet
2_T_WE	Miscellaneous Fugitives						
T_WE_RD				2E-01	3E-02		ton/acre-yr
T_WE_EX							ton/acre-yr
T_WE_EX2							ton/acre-yr
T_S_EFD							See "ALT EI" Sheet
T_S_E_C							See "ALT EI" Sheet
T_S_DFD							See "Deliveries" Sheet
T_S_D_C							See "Deliveries" Sheet

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: D. Steen	
	PROJECT NO: 262		PAGE: 5	OF: 9
	SHEET: TSF_DISP		DATE: October 12, 2018	
SUBJECT: Tailings				

TAILINGS - PROCESS RATES			
Source ID	Process Rates		
	Unit/Hr	Unit/Yr	Units & Notes
2_T_FUEL	Diesel Storage Tanks		
T_FUEL1	1,438	8,441,304	gal
2_T_D	Non-Emergency Diesel Fleet (mobile and stationary)		
T_CMBSTN	THIS SOURCE IS NOT USED DURING PRODUCTION PHASE		
T_D_C_MOB			
T_D_DOZ			
T_D_FUG			
2_T_GEN	Emergency Generators		
T_GEN1			See "E_Gen" Sheet
2_T_WE	Miscellaneous Fugitives		
T_WE_RD		21.3	acre
T_WE_EX		1,439	dry acre
T_WE_EX2			dry acre
T_S_EFD			See "ALT EI" Sheet
T_S_E_C			See "ALT EI" Sheet
T_S_DFD			See "Deliveries" Sheet
T_S_D_C			See "Deliveries" Sheet

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: D. Steen		
	PROJECT NO: 262		PAGE: 6	OF: 9	SHEET: TSF_DISP
	SUBJECT: Tailings		DATE: October 12, 2018		

TAILINGS - CONTROLS			
Source ID	Control Technology	Control Efficiency	Notes
2_T_FUEL	Diesel Storage Tanks		
T_FUEL1		0%	
2_T_D	Non-Emergency Diesel Fleet (mobile and stationary)		
T_CMBSTN		0%	
T_D_C_MOB		0%	
T_D_DOZ		0%	
T_D_FUG	chemical suppression	90%	AP-42, Figure 13.2.2-2, Rev. 11/06
2_T_GEN	Emergency Generators		
T_GEN1		0%	AP-42, Figure 13.2.2-2, Rev. 11/06
2_T_WE	Miscellaneous Fugitives		
T_WE_RD	chemical suppression	90%	AP-42, Figure 13.2.2-2, Rev. 11/06
T_WE_EX	sprinklers	90%	AP-42, Figure 13.2.2-2, Rev. 11/06
T_WE_EX2	sprinklers	90%	AP-42, Figure 13.2.2-2, Rev. 11/06
T_S_EFD	chemical suppression	90%	AP-42, Figure 13.2.2-2, Rev. 11/06
T_S_E_C		0%	AP-42, Figure 13.2.2-2, Rev. 11/06
T_S_DFD	chemical suppression	90%	AP-42, Figure 13.2.2-2, Rev. 11/06
T_S_D_C		0%	AP-42, Figure 13.2.2-2, Rev. 11/06

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE:	Resolution Copper EI			BY:	D. Steen																																								
	PROJECT NO:	262			PAGE:	7	OF:	9																																						
	SUBJECT:	Tailings			DATE:	October 12, 2018																																								
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Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE:	Resolution Copper EI			BY:	D. Steen		
	PROJECT NO:	262			PAGE:	8	OF:	9
	SUBJECT:	Tailings			DATE:	October 12, 2018		

TAILINGS - CONTROLLED - EF REFERENCE	
Source ID	Emission Factor Reference
2_T_FUEL	Diesel Storage Tanks
T_FUEL1	See "Fuel Tanks" Sheet
2_T_D	Non-Emergency Diesel Fleet (mobile and stationary)
T_CMBSTN	
T_D_C_MOB	Calculated from Uncontrolled Emissions in this sheet
T_D_DOZ	Calculated from Uncontrolled Emissions in this sheet
T_D_FUG	Calculated from Uncontrolled Emissions in this sheet
2_T_GEN	Emergency Generators
T_GEN1	See "E_Gen" Sheet
2_T_WE	Miscellaneous Fugitives
T_WE_RD	AP-42, Table 11.9-4, Wind Erosion, Rev. 7/98
T_WE_EX	AP-42, Chapter 13.2.5, Industrial Wind Erosion, Rev. 11/06
T_WE_EX2	AP-42, Chapter 13.2.5, Industrial Wind Erosion, Rev. 11/06
T_S_EFD	See "ALT EI" Sheet
T_S_E_C	See "ALT EI" Sheet
T_S_DFD	See "Deliveries" Sheet
T_S_D_C	See "Deliveries" Sheet

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE:	Resolution Copper EI			BY:	D. Steen																																						
	PROJECT NO:	262			PAGE:	9	OF:	9																																				
	SUBJECT:	Tailings			DATE:	October 12, 2018																																						
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Air Sciences Inc. <				
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Air Sciences Inc. AIR EMISSION CALCULATIONS					PROJECT TITLE: Resolution Copper EI					BY: D. Steen				
					PROJECT NO: 262					PAGE: 2		OF: 9	SHEET: FPLF_DISP	
					SUBJECT: Loadout					DATE: October 12, 2018				
LOADOUT - UNCONTROLLED - EMISSIONS SUMMARY														
Source ID		Potential Emissions												
		CO		NO _x		SO ₂		PM ₁₀		PM _{2.5}		VOC		
		lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	
2_L_CU_CONC		Copper Concentrate Loadout												
F_LDSTL								2.6E-2	0.11	3.9E-3	1.6E-2			
F_STLBLD								2.6E-2	0.11	3.9E-3	1.6E-2			
F_STLCOL								2.6E-2	0.11	3.9E-3	1.6E-2			
F_COLBLT								2.6E-2	0.11	3.9E-3	1.6E-2			
F_LDGHOP								2.6E-2	0.11	3.9E-3	1.6E-2			
F_HOPFED								2.6E-2	0.11	3.9E-3	1.6E-2			
F_FEDBLT								2.6E-2	0.11	3.9E-3	1.6E-2			
F_BLTTRP								2.6E-2	0.11	3.9E-3	1.6E-2			
F_TRPSTO								2.6E-2	0.11	3.9E-3	1.6E-2			
F_LDRHOP								2.6E-2	0.11	3.9E-3	1.6E-2			
F_HOPBLT								2.6E-2	0.11	3.9E-3	1.6E-2			
F_BLTCNV								2.6E-2	0.11	3.9E-3	1.6E-2			
F_CNVTRN								2.6E-2	0.11	3.9E-3	1.6E-2			
2_L_FUEL		Diesel Storage Tanks												
L_FUEL1												3.1E-3	1.3E-2	
2_L_GEN		Emergency Generators												
F_GEN1		3.9	0.96	0.35	8.7E-2	9.0E-3	2.2E-3	7.7E-3	1.9E-3	7.7E-3	1.9E-3	1.7E-2	4.3E-3	
2_L_D		Non-Emergency Diesel Fleet (mobile and stationary)												
F_CMBSTN														
L_D_C_MOB		8.3	20.4	0.94	2.3	1.9E-2	4.4E-2	4.7E-2	0.12	4.7E-2	0.12	0.44	1.1	
L_RR_LOAD		0.99	2.6	0.86	2.2	1.9E-3	8.2E-3	2.0E-2	5.1E-2	2.0E-2	5.1E-2	9.3E-2	0.24	
RR_OFF		5.4	1.2	4.6	1.0	3.6E-4	3.8E-3	0.11	2.4E-2	0.11	2.4E-2	0.50	0.11	
RR_ON														
2_L_S_WE		Miscellaneous Fugitives												
L_WE_RD								1.0	4.4	0.15	0.67			
L_S_EFD								1.4	5.3	0.14	0.53			
L_S_E_C		4.9E-2	0.21	2.3E-3	1.0E-2	1.2E-4	5.3E-4	1.3E-3	5.5E-3	2.2E-4	9.7E-4	5.3E-4	2.3E-3	
L_S_DFD														
L_S_D_C														
3 L TOTAL		18.6	25.3	6.8	5.7	3.0E-2	5.9E-2	3.0	11.3	0.53	1.6	1.1	1.5	

Air Sciences Inc.	PROJECT TITLE:		BY:		
	Resolution Copper EI		D. Steen		
	PROJECT NO:		PAGE:	OF:	SHEET:
AIR EMISSION CALCULATIONS	262		3	9	FPLF_DISP
	SUBJECT:		DATE:		
	Loadout		October 12, 2018		

LOADOUT - CONTROLLED - EMISSION FACTORS							
Source ID	Emission Factors						
	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	VOC	Units & Notes
2_L_CU_CONC	Copper Concentrate Loadout						
F_LDSTL				5.7E-5	8.6E-6		lb/ton
F_STLBLD				5.7E-5	8.6E-6		lb/ton
F_STLCOL				5.7E-5	8.6E-6		lb/ton
F_COLBLT				5.7E-5	8.6E-6		lb/ton
F_LDGHOP				5.7E-5	8.6E-6		lb/ton
F_HOPFED				5.7E-5	8.6E-6		lb/ton
F_FEDBLT				5.7E-5	8.6E-6		lb/ton
F_BLTTRP				5.7E-5	8.6E-6		lb/ton
F_TRPSTO				5.7E-5	8.6E-6		lb/ton
F_LDRHOP				5.7E-5	8.6E-6		lb/ton
F_HOPBLT				5.7E-5	8.6E-6		lb/ton
F_BLTCNV				5.7E-5	8.6E-6		lb/ton
F_CNVTRN				5.7E-5	8.6E-6		lb/ton
2_L_FUEL	Diesel Storage Tanks						
L_FUEL1							See "Fuel Tanks" Sheet
2_L_GEN	Emergency Generators						
F_GEN1							See "E_Gen" Sheet
2_L_D	Non-Emergency Diesel Fleet (mobile and stationary)						
F_CMBSTN							See "Loadout_Fleet" Sheet
L_D_C_MOB							See "Loadout_Fleet" Sheet
L_RR_LOAD							See "RailRoad" Sheet
RR_OFF							See "RailRoad" Sheet
RR_ON							See "RailRoad" Sheet
2_L_S_WE	Miscellaneous Fugitives						
L_WE_RD				0.2	0.0		ton/acre-yr
L_S_EFD							See "Employees" Sheet
L_S_E_C							See "Employees" Sheet
L_S_DFD							See "Deliveries" Sheet
L_S_D_C							See "Deliveries" Sheet

Air Sciences Inc.	PROJECT TITLE:		BY:		
	Resolution Copper EI		D. Steen		
	PROJECT NO:		PAGE:	OF:	SHEET:
AIR EMISSION CALCULATIONS	262		4	9	FPLF_DISP
	SUBJECT:		DATE:		
	Loadout		October 12, 2018		

LOADOUT - UNCONTROLLED - EMISSION FACTORS							
Source ID	Emission Factors						Units & Notes
	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	VOC	
2_L_CU_CONC	Copper Concentrate Loadout						
F_LDSTL				5.7E-5	8.6E-6		lb/ton
F_STLBLD				5.7E-5	8.6E-6		lb/ton
F_STLCOL				5.7E-5	8.6E-6		lb/ton
F_COLBLT				5.7E-5	8.6E-6		lb/ton
F_LDGHOP				5.7E-5	8.6E-6		lb/ton
F_HOPFED				5.7E-5	8.6E-6		lb/ton
F_FEDBLT				5.7E-5	8.6E-6		lb/ton
F_BLTTRP				5.7E-5	8.6E-6		lb/ton
F_TRPSTO				5.7E-5	8.6E-6		lb/ton
F_LDRHOP				5.7E-5	8.6E-6		lb/ton
F_HOPBLT				5.7E-5	8.6E-6		lb/ton
F_BLTCNV				5.7E-5	8.6E-6		lb/ton
F_CNVTRN				5.7E-5	8.6E-6		lb/ton
2_L_FUEL	Diesel Storage Tanks						
L_FUEL1							See "Fuel Tanks" Sheet
2_L_GEN	Emergency Generators						
F_GEN1							See "E_Gen" Sheet
2_L_D	Non-Emergency Diesel Fleet (mobile and stationary)						
F_CMBSTN							See "Loadout_Fleet" Sheet
L_D_C_MOB							See "Loadout_Fleet" Sheet
L_RR_LOAD							See "RailRoad" Sheet
RR_OFF							See "RailRoad" Sheet
RR_ON							See "RailRoad" Sheet
2_L_S_WE	Miscellaneous Fugitives						
L_WE_RD				0.2	0.0		ton/acre-yr
L_S_EFD							See "Employees" Sheet
L_S_E_C							See "Employees" Sheet
L_S_DFD							See "Deliveries" Sheet
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Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: D. Steen		
	PROJECT NO: 262		PAGE: 5	OF: 9	SHEET: FPLF_DISP
	SUBJECT: Loadout		DATE: October 12, 2018		

LOADOUT - PROCESS RATES

Source ID	Process Rates		
	Unit/Hr	Unit/Yr	Units & Notes
2_L_CU_CONC	<i>Copper Concentrate Loadout</i>		
F_LDSIL	456	3,680,491	ton
F_STLBLD	456	3,680,491	ton
F_STLCOL	456	3,680,491	ton
F_COLBLT	456	3,680,491	ton
F_LDGHOP	456	3,680,491	ton
F_HOPFED	456	3,680,491	ton
F_FEDBLT	456	3,680,491	ton
F_BLTTRP	456	3,680,491	ton
F_TRPSTO	456	3,680,491	ton
F_LDRHOP	456	3,680,491	ton
F_HOPBLT	456	3,680,491	ton
F_BLTCNV	456	3,680,491	ton
F_CNVTRN	456	3,680,491	ton
2_L_FUEL	<i>Diesel Storage Tanks</i>		
L_FUEL1	119	555,866	gal
2_L_GEN	<i>Emergency Generators</i>		
F_GEN1			See "E_Gen" Sheet
2_L_D	<i>Non-Emergency Diesel Fleet (mobile and stationary)</i>		
F_CMBSTN			See "Loadout_Fleet" Sheet
L_D_C_MOB			See "Loadout_Fleet" Sheet
L_RR_LOAD			See "RailRoad" Sheet
RR_OFF			See "RailRoad" Sheet
RR_ON			See "RailRoad" Sheet
2_L_S_WE	<i>Miscellaneous Fugitives</i>		
L_WE_RD		23.4	acre
L_S_EFD			See "Employees" Sheet
L_S_E_C			See "Employees" Sheet
L_S_DFD			See "Deliveries" Sheet
L_S_D_C			See "Deliveries" Sheet

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: D. Steen		
	PROJECT NO: 262		PAGE: 6	OF: 9	SHEET: FPLF_DISP
	SUBJECT: Loadout		DATE: October 12, 2018		
LOADOUT - CONTROLS					
Source ID	Control Technology	Control Efficiency	Notes		
2_L_CU_CONC	Copper Concentrate Loadout				
F_LDSTL	moisture, enclosure	0%	Control accounted for in EF		
F_STLBLD	moisture, enclosure	0%	Control accounted for in EF		
F_STLCOL	moisture, enclosure	0%	Control accounted for in EF		
F_COLBLT	moisture, enclosure	0%	Control accounted for in EF		
F_LDGHOP	moisture, enclosure	0%	Control accounted for in EF		
F_HOPFED	moisture, enclosure	0%	Control accounted for in EF		
F_FEDBLT	moisture, enclosure	0%	Control accounted for in EF		
F_BLTTRP	moisture, enclosure	0%	Control accounted for in EF		
F_TRPSTO	moisture, enclosure	0%	Control accounted for in EF		
F_LDRHOP	moisture, enclosure	0%	Control accounted for in EF		
F_HOPBLT	moisture, enclosure	0%	Control accounted for in EF		
F_BLTCNV	moisture, enclosure	0%	Control accounted for in EF		
F_CNVTRN	moisture, enclosure	0%	Control accounted for in EF		
2_L_FUEL	Diesel Storage Tanks				
L_FUEL1		0%			
2_L_GEN	Emergency Generators				
F_GEN1		0%			
2_L_D	Non-Emergency Diesel Fleet (mobile and stationary)				
F_CMBSTN		0%			
L_D_C_MOB		0%			
L_RR_LOAD		0%			
RR_OFF		0%			
RR_ON		0%			
2_L_S_WE	Miscellaneous Fugitives				
L_WE_RD	chemical suppression	90%			
L_S_EFD	chemical suppression	90%			
L_S_E_C		0%			
L_S_DFD	chemical suppression	90%			
L_S_D_C		0%			

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE:	D. Steen		
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	262	7	9	FPLF_DISP
	Loadout	October 12, 2018		

LOADOUT - SOURCE IDENTIFICATION	
Source ID	Source Identification
2_L_CU_CONC	Copper Concentrate Loadout
F_LDSTL	Concentrate Filters (FL-001 - 006) to Shuttle Conveyors (CV-001 - CV-006)
F_STLBLD	Shuttle Conveyors (CV-001 - CV-006) to Filter Building (BG-011)
F_STLCOL	Shuttle Conveyors (CV-001 - CV-006) to Collecting Conveyor (CV-010)
F_COLBLT	Collecting Conveyor (CV-010) to Belt Conveyor (CV-020)
F_LDGHOP	Concentrate Hopper (HP-011) Loading
F_HOPFED	Concentrate Hopper (HP-011) to Concentrate Feeder (FE-011)
F_FEDBLT	Concentrate Feeder (FE-011) to Belt Conveyor (CV-020)
F_BLTTRP	Belt Conveyor (CV-020) to Tripper Conveyor (CV-030)
F_TRPSTO	Tripper Conveyor (CV-030) to Storage and Loadout Shed (BG-012)
F_LDRHOP	Front End Loader (MS-002) to Load Out Hoppers (HP-012 - 015)
F_HOPBLT	Load Out Hoppers (HP-012 - 015) to Weigh Belt Feeders (FE-012 -015)
F_BLTCNV	Weigh Belt Feeders (FE-012 -015) to Load Out Conveyors (CV-031 - 034)
F_CNVTRN	Load Out Conveyors (CV-031 - 034) to Rail Cars
2_L_FUEL	Diesel Storage Tanks
L_FUEL1	Loadout Usage and Volume Estimated (Estimated Quantity: 4)
2_L_GEN	Emergency Generators
F_GEN1	Caterpillar C18 Generator Set
2_L_D	Non-Emergency Diesel Fleet (mobile and stationary)
F_CMBSTN	Loadout Combustion (Stationary)
L_D_C_MOB	Loadout Combustion (Mobile)
L_RR_LOAD	Rail line loading idle emissions (at loadout facility)
RR_OFF	Rail line hauling concentrate offsite (Far West to Magma Junction)
RR_ON	Rail line to onsite tailings facility (WPS to Far West) - Alt4 Only
2_L_S_WE	Miscellaneous Fugitives
L_WE_RD	Loadout Secondary Sources from Access Roads (Wind Erosion)
L_S_EFD	Loadout Employee Fugitives
L_S_E_C	Loadout Employee Combustion
L_S_DFD	Loadout Delivery Fugitives
L_S_D_C	Loadout Delivery Combustion
3_L_TOTAL	Loadout Subtotal

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: D. Steen	
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DATE: October 12, 2018				

LOADOUT - CONTROLLED - EF REFERENCE

Source ID	Emission Factor Reference
2_L_CU_CONC	Copper Concentrate Loadout
F_LDSTL	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)
F_STLBLD	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)
F_STLCOL	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)
F_COLBLT	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)
F_LDGHOP	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)
F_HOPFED	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)
F_FEDBLT	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)
F_BLTTRP	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)
F_TRPSTO	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)
F_LDRHOP	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)
F_HOPBLT	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)
F_BLTCNV	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)
F_CNVTRN	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)
2_L_FUEL	Diesel Storage Tanks
L_FUEL1	See "Fuel Tanks" Sheet
2_L_GEN	Emergency Generators
F_GEN1	See "E_Gen" Sheet
2_L_D	Non-Emergency Diesel Fleet (mobile and stationary)
F_CMBSTN	See "Loadout_Fleet" Sheet
L_D_C_MOB	See "Loadout_Fleet" Sheet
L_RR_LOAD	See "RailRoad" Sheet
RR_OFF	See "RailRoad" Sheet
RR_ON	See "RailRoad" Sheet
2_L_S_WE	Miscellaneous Fugitives
L_WE_RD	AP-42, Table 11.9-4, Wind Erosion, Rev. 7/98
L_S_EFD	See "Employees" Sheet
L_S_E_C	See "Employees" Sheet
L_S_DFD	See "Deliveries" Sheet
L_S_D_C	See "Deliveries" Sheet

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: D. Steen	
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LOADOUT - UNCONTROLLED - EF REFERENCE

Source ID	Emission Factor Reference
2_L_CU_CONC	Copper Concentrate Loadout
F_LDSTL	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)
F_STLBLD	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)
F_STLCOL	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)
F_COLBLT	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)
F_LDGHOP	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)
F_HOPFED	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)
F_FEDBLT	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)
F_BLTTRP	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)
F_TRPSTO	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)
F_LDRHOP	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)
F_HOPBLT	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)
F_BLTCNV	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)
F_CNVTRN	AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)
2_L_FUEL	Diesel Storage Tanks
L_FUEL1	See "Fuel Tanks" Sheet
2_L_GEN	Emergency Generators
F_GEN1	See "E_Gen" Sheet
2_L_D	Non-Emergency Diesel Fleet (mobile and stationary)
F_CMBSTN	See "Loadout_Fleet" Sheet
L_D_C_MOB	See "Loadout_Fleet" Sheet
L_RR_LOAD	See "RailRoad" Sheet
RR_OFF	See "RailRoad" Sheet
RR_ON	See "RailRoad" Sheet
2_L_S_WE	Miscellaneous Fugitives
L_WE_RD	AP-42, Table 11.9-4, Wind Erosion, Rev. 7/98
L_S_EFD	See "Employees" Sheet
L_S_E_C	See "Employees" Sheet
L_S_DFD	See "Deliveries" Sheet
L_S_D_C	See "Deliveries" Sheet

Air Sciences Inc.	PROJECT TITLE:		BY:		
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AIR EMISSION CALCULATIONS	262		2	8	EP_Fleet
	SUBJECT:		DATE:		
	Diesel Fleet Calculations - East Plant		October 12, 2018		

East Plant Diesel Machinery (Non-Emergency) - Emission Factors		Year 14					
Equipment	Rating kW	Quantity	CO* g/kW-hr	NOx* g/kW-hr	SO2** g/kW-hr	PM* g/kW-hr	VOC* g/kW-hr
Surface Loader - CAT 962K	165	2	3.5	0.40	-	2.0E-2	0.19
Surface Shotcrete Truck - Highway Legal	128	0	5.0	0.40	-	2.0E-2	0.19
Development LHD - Sandvik LH514	256	9	3.5	0.40	-	2.0E-2	0.19
Development Drill - Atlas Copco M2C	120	6	5.0	0.40	-	2.0E-2	0.19
Production Drill - Simba M6C	112	17	5.0	0.40	-	2.0E-2	0.19
Blind Bore Machine - Redbore 50 MDUR	0	1	electric	electric	electric	electric	electric
Powder Truck - Normet Charmec MF 605 DA	110	13	5.0	0.40	-	2.0E-2	0.19
Bolter - Atlas Copco Boltec MC	120	6	5.0	0.40	-	2.0E-2	0.19
Mechanized Shotcrete Sprayers - Normet Spraymec 6050 WP	96	6	5.0	0.40	-	2.0E-2	0.19
Transmixer Trucks - Normet Utimec LF 600	155	4	3.5	0.40	-	2.0E-2	0.19
UG Haul Trucks (40T)	375	4	3.5	0.40	-	2.0E-2	0.19
Scissor Trucks - Getman A64	129	5	5.0	0.40	-	2.0E-2	0.19
Cable Bolters - Atlas Copco Cabletec LC	120	10	5.0	0.40	-	2.0E-2	0.19
Production LHD - Sandvik LH514e	132	30	electric	electric	electric	electric	electric
2.3 yd LHD - Atlas Copco ST2G	86	3	5.0	0.40	-	2.0E-2	0.19
3.5 yd LHD - Atlas Copco ST3.5	136	4	3.5	0.40	-	2.0E-2	0.19
Mobile Rock Breaker - Sandvik LH514	256	5	3.5	0.40	-	2.0E-2	0.19
Medium Reach Rig - MacLean BH-3 Blockholer	147	2	3.5	0.40	-	2.0E-2	0.19
Water Cannon - Getman A64	120	3	5.0	0.40	-	2.0E-2	0.19
Fuel/Lube Truck - Normet Utimec	120	4	5.0	0.40	-	2.0E-2	0.19
Crane Truck - Getman A64	129	4	5.0	0.40	-	2.0E-2	0.19
Man Haul Vans - Miller Toyota	128	19	5.0	0.40	-	2.0E-2	0.19
Flat Deck Truck - Getman A64	129	4	5.0	0.40	-	2.0E-2	0.19
Crane Truck - Miller Toyota	128	4	5.0	0.40	-	2.0E-2	0.19
Generator Truck (LHD) - GETMAN A64	120	2	5.0	0.40	-	2.0E-2	0.19
UG Grader - CAT 140M2	144	3	3.5	0.40	-	2.0E-2	0.19
Forklift - CAT P36000	110	4	5.0	0.40	-	2.0E-2	0.19
UG Water Trucks - Getman A64	129	3	5.0	0.40	-	2.0E-2	0.19
Conveyor Maint Vehicle - Miller Crane Truck	128	2	5.0	0.40	-	2.0E-2	0.19
Scissor Lift - Miller Toyota	128	9	5.0	0.40	-	2.0E-2	0.19
Skid Steer Loader - CAT272D	71	2	5.0	0.40	-	2.0E-2	0.19
Raise Bore - Redbore 60	0	5	electric	electric	electric	electric	electric
UG Dozer - 2.9m Blade - CAT D6N	112	2	5.0	0.40	-	2.0E-2	0.19
Ore Haul Trucks - Powertrans T954	388	18	3.5	0.40	-	2.0E-2	0.19

* 40 CFR §1039.101, Table 1; 40 CFR § 89.112, Table 1

** SO2 emissions - mass balance based on 15 ppm S content (ULSD)

* 40 CFR §1039.101, Table 1; 40 CFR § 89.112, Table 1

** SO₂ emissions - mass balance based on 15 ppm S content (ULSD)

Air Sciences Inc.	PROJECT TITLE:		BY:		
	Resolution Copper EI		D. Steen		
	PROJECT NO:		PAGE:	OF:	SHEET:
AIR EMISSION CALCULATIONS	262		3	8	EP_Fleet
	SUBJECT:		DATE:		
	Diesel Fleet Calculations - East Plant		October 12, 2018		

East Plant Diesel Machinery (Non-Emergency) - Short-Term Emission					
Year 14					
	CO	NO _x	SO ₂ *	PM	VOC
Equipment	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr
Surface Loader - CAT 962K	1.5	0.17	1.8E-3	8.7E-3	8.3E-2
Surface Shotcrete Truck - Highway Legal					
Development LHD - Sandvik LH514	10.7	1.2	1.6E-2	6.1E-2	0.58
Development Drill - Atlas Copco M2C	0.79	6.3E-2	1.0E-3	3.2E-3	3.0E-2
Production Drill - Simba M6C	2.1	0.17	2.9E-3	8.4E-3	8.0E-2
Blind Bore Machine - Redbore 50 MDUR					
Powder Truck - Normet Charmec MF 605 DA	14.2	1.1	1.7E-2	5.7E-2	0.54
Bolter - Atlas Copco Boltec MC	0.79	6.3E-2	1.0E-3	3.2E-3	3.0E-2
Mechanized Shotcrete Sprayers - Normet Spraymec 6050 WP	3.8	0.30	6.2E-3	1.5E-2	0.14
Transmixer Trucks - Normet Utimec LF 600	4.3	0.49	9.2E-3	2.5E-2	0.23
UG Haul Trucks (40T)	10.4	1.2	1.7E-2	6.0E-2	0.57
Scissor Trucks - Getman A64	6.4	0.51	6.6E-3	2.6E-2	0.24
Cable Bolters - Atlas Copco Cabletec LC	1.3	0.11	1.7E-3	5.3E-3	5.0E-2
Production LHD - Sandvik LH514e					
2.3 yd LHD - Atlas Copco ST2G	1.7	0.14	9.2E-4	6.8E-3	6.5E-2
3.5 yd LHD - Atlas Copco ST3.5	2.5	0.29	1.8E-3	1.4E-2	0.14
Mobile Rock Breaker - Sandvik LH514					
Medium Reach Rig - MacLean BH-3 Blockholer	0.23	2.6E-2	3.5E-4	1.3E-3	1.2E-2
Water Cannon - Getman A64	3.6	0.29	4.0E-3	1.4E-2	0.14
Fuel/Lube Truck - Normet Utimec	4.8	0.38	5.3E-3	1.9E-2	0.18
Crane Truck - Getman A64	2.8	0.23	3.0E-3	1.1E-2	0.11
Man Haul Vans - Miller Toyota	24.1	1.9	4.4E-3	9.7E-2	0.92
Flat Deck Truck - Getman A64	5.1	0.41	5.3E-3	2.0E-2	0.19
Crane Truck - Miller Toyota	2.8	0.23	5.1E-4	1.1E-2	0.11
Generator Truck (LHD) - GETMAN A64	1.6	0.13	1.8E-3	6.3E-3	6.0E-2
UG Grader - CAT 140M2	2.0	0.23	2.7E-3	1.1E-2	0.11
Forklift - CAT P36000	2.9	0.23	1.5E-3	1.2E-2	0.11
UG Water Trucks - Getman A64	2.6	0.20	2.7E-3	1.0E-2	9.7E-2
Conveyor Maint Vehicle - Miller Crane Truck	2.5	0.20	4.6E-4	1.0E-2	9.7E-2
Scissor Lift - Miller Toyota	6.3	0.51	1.2E-3	2.5E-2	0.24
Skid Steer Loader - CAT272D	0.94	7.5E-2	8.5E-4	3.8E-3	3.6E-2
Raise Bore - Redbore 60					
UG Dozer - 2.9m Blade - CAT D6N	1.5	0.12	7.7E-4	5.9E-3	5.6E-2
Ore Haul Trucks - Powertrans T954	32.3	3.7	2.1E-2	0.18	1.8
East Plant Underground	155	14.6	0.14	0.73	6.9
East Plant Surface	1.5	0.17	1.8E-3	8.7E-3	8.3E-2
East Plant Total	157	14.7	0.14	0.74	7.0

* Calculated by mass balance using a 15% fuel contingency

* Calculated by mass balance using a 15% fuel contingency

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	PROJECT NO:		PAGE:	OF:	SHEET:
AIR EMISSION CALCULATIONS	262		4	8	EP_Fleet
	SUBJECT:		DATE:		
	Diesel Fleet Calculations - East Plant		October 12, 2018		

East Plant Diesel Machinery (Non-Emergency) - Long-Term Emission		Year 14				
	CO	NO _x	SO ₂ *	PM	VOC	
Equipment	ton/yr	ton/yr	ton/yr	ton/yr	ton/yr	
Surface Loader - CAT 962K	1.4	0.16	1.6E-3	8.1E-3	7.7E-2	
Surface Shotcrete Truck - Highway Legal						
Development LHD - Sandvik LH514	11.6	1.3	1.7E-2	6.6E-2	0.63	
Development Drill - Atlas Copco M2C	0.29	2.4E-2	3.9E-4	1.2E-3	1.1E-2	
Production Drill - Simba M6C	3.6	0.29	5.1E-3	1.4E-2	0.14	
Blind Bore Machine - Redbore 50 MDUR						
Powder Truck - Normet Charmec MF 605 DA	4.3	0.35	5.3E-3	1.7E-2	0.16	
Bolter - Atlas Copco Boltec MC	1.1	8.8E-2	1.4E-3	4.4E-3	4.2E-2	
Mechanized Shotcrete Sprayers - Normet Spraymec 6050 WP	1.6	0.13	2.7E-3	6.6E-3	6.2E-2	
Transmixer Trucks - Normet Utimec LF 600	4.9	0.56	1.1E-2	2.8E-2	0.27	
UG Haul Trucks (40T)	16.2	1.9	2.7E-2	9.3E-2	0.88	
Scissor Trucks - Getman A64	3.9	0.31	4.1E-3	1.6E-2	0.15	
Cable Bolters - Atlas Copco Cabletec LC	1.1	9.0E-2	1.5E-3	4.5E-3	4.3E-2	
Production LHD - Sandvik LH514e						
2.3 yd LHD - Atlas Copco ST2G	0.60	4.8E-2	3.2E-4	2.4E-3	2.3E-2	
3.5 yd LHD - Atlas Copco ST3.5	0.88	0.10	6.5E-4	5.0E-3	4.8E-2	
Mobile Rock Breaker - Sandvik LH514						
Medium Reach Rig - MacLean BH-3 Blockholer	4.2E-2	4.8E-3	6.5E-5	2.4E-4	2.3E-3	
Water Cannon - Getman A64	1.3	0.11	1.5E-3	5.3E-3	5.1E-2	
Fuel/Lube Truck - Normet Utimec	1.8	0.14	2.0E-3	7.1E-3	6.7E-2	
Crane Truck - Getman A64	2.1	0.17	2.2E-3	8.5E-3	8.0E-2	
Man Haul Vans - Miller Toyota	13.5	1.1	2.5E-3	5.4E-2	0.51	
Flat Deck Truck - Getman A64	1.8	0.14	1.9E-3	7.2E-3	6.8E-2	
Crane Truck - Miller Toyota	1.6	0.13	2.9E-4	6.3E-3	6.0E-2	
Generator Truck (LHD) - GETMAN A64	0.56	4.4E-2	6.2E-4	2.2E-3	2.1E-2	
UG Grader - CAT 140M2	1.4	0.16	1.9E-3	8.0E-3	7.6E-2	
Forklift - CAT P36000	2.0	0.16	1.1E-3	8.2E-3	7.7E-2	
UG Water Trucks - Getman A64	1.8	0.14	1.9E-3	7.2E-3	6.8E-2	
Conveyor Maint Vehicle - Miller Crane Truck	2.2	0.18	4.0E-4	8.8E-3	8.3E-2	
Scissor Lift - Miller Toyota	3.5	0.28	6.5E-4	1.4E-2	0.13	
Skid Steer Loader - CAT272D	0.35	2.8E-2	3.2E-4	1.4E-3	1.3E-2	
Raise Bore - Redbore 60						
UG Dozer - 2.9m Blade - CAT D6N	0.55	4.4E-2	2.9E-4	2.2E-3	2.1E-2	
Ore Haul Trucks - Powertrans T954	81.8	9.3	5.3E-2	0.47	4.4	
East Plant Underground	167	17.3	0.15	0.87	8.2	
East Plant Surface	1.4	0.16	1.6E-3	8.1E-3	7.7E-2	
East Plant Total	168	17.5	0.15	0.87	8.3	

* Calculated by mass balance using a 15% fuel contingency

* Calculated by mass balance using a 15% fuel contingency

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AIR EMISSION CALCULATIONS	262		5	8	EP_Fleet
	SUBJECT:		DATE:		
	Diesel Fleet Calculations - East Plant		October 12, 2018		

East Plant Diesel Machinery (Non-Emergency) - Fugitive Emissions from Vehicle Travel - Vehicle Specifications						Year 14
Equipment	Quantity	Ann. Op. Hours ^a	Speed ^b mph	Silt ^c %	Weight ^b ton	
Surface Loader - CAT 962K	2	1,862	5.0	3.0	29.4	
Surface Shotcrete Truck - Highway Legal	0	0	5.0	3.0	4.0	
Development LHD - Sandvik LH514	9	2,182	8.3	3.0	49.7	
Development Drill - Atlas Copco M2C	6	741	5.0	3.0	29.8	
Production Drill - Simba M6C	17	3,454	5.0	3.0	23.0	
Blind Bore Machine - Redbore 50 MDUR	1	2,443	0.0	3.0	34.2	
Powder Truck - Normet Charmec MF 605 DA	13	612	5.0	3.0	19.8	
Bolter - Atlas Copco Boltec MC	6	2,780	5.0	3.0	23.8	
Mechanized Shotcrete Sprayers - Normet Spraymec 6050 WP	6	860	5.0	3.0	14.9	
Transmixer Trucks - Normet Utimec LF 600	4	2,275	10.0	3.0	23.5	
UG Haul Trucks (40T)	4	3,115	8.3	3.0	58.3	
Scissor Trucks - Getman A64	5	1,225	5.0	3.0	12.5	
Cable Bolters - Atlas Copco Cabletec LC	10	1,704	5.0	3.0	33.1	
Production LHD - Sandvik LH514e	30	4,768	4.6	3.0	50.2	
2.3 yd LHD - Atlas Copco ST2G	3	701	8.3	3.0	16.5	
3.5 yd LHD - Atlas Copco ST3.5	4	701	8.3	3.0	22.2	
Mobile Rock Breaker - Sandvik LH514	5	0	5.0	3.0	16.0	
Medium Reach Rig - MacLean BH-3 Blockholer	2	372	5.0	3.0	21.5	
Water Cannon - Getman A64	3	745	5.0	3.0	20.0	
Fuel/Lube Truck - Normet Utimec	4	745	5.0	3.0	12.5	
Crane Truck - Getman A64	4	1,489	5.0	3.0	16.5	
Man Haul Vans - Miller Toyota	19	1,117	10.0	3.0	4.0	
Flat Deck Truck - Getman A64	4	701	10.0	3.0	12.0	
Crane Truck - Miller Toyota	4	1,117	5.0	3.0	17.0	
Generator Truck (LHD) - GETMAN A64	2	701	5.0	3.0	17.0	
UG Grader - CAT 140M2		grader-specific fugitive emissions on p. 8				
Forklift - CAT P36000	4	1,402	5.0	3.0	30.2	
UG Water Trucks - Getman A64	3	1,402	10.0	3.0	17.0	
Conveyor Maint Vehicle - Miller Crane Truck	2	1,730	5.0	3.0	17.0	
Scissor Lift - Miller Toyota	9	1,117	5.0	3.0	4.4	
Skid Steer Loader - CAT272D	2	745	5.0	3.0	5.1	
Raise Bore - Redbore 60	5	0	0.0	3.0	13.5	
UG Dozer - 2.9m Blade - CAT D6N		dozer-specific fugitive emissions on p. 8				
Ore Haul Trucks - Powertrans T954	18	5,061	6.7	3.0	211.1	
Surface Mean Fleet Weight					29.4	
Underground Mean Fleet Weight					41.1	

^a Per unit, including availability and utilization factors

^b Resolution

^c AP-42, Chapter 13.2.2 and 13.2.1 (SL in g/m²)

^a Per unit, including availability and utilization factors

^b Resolution

^c AP-42, Chapter 13.2.2 and 13.2.1 (SL in g/m²)

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: D. Steen		
	PROJECT NO: 262		PAGE: 6	OF: 8	SHEET: EP_Fleet
	SUBJECT: Diesel Fleet Calculations - East Plant		DATE: October 12, 2018		

East Plant Diesel Machinery (Non-Emergency) - Fugitive Emissions from Vehicle Travel - Emission Factors	Year 14
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Equipment	PM* <i>lb/VMT</i>	PM ₁₀ * <i>lb/VMT</i>	PM _{2.5} * <i>lb/VMT</i>
Surface Loader - CAT 962K	5.2	1.2	0.12
Surface Shotcrete Truck - Highway Legal	5.2	1.2	0.12
Development LHD - Sandvik LH514	6.0	1.4	0.14
Development Drill - Atlas Copco M2C	6.0	1.4	0.14
Production Drill - Simba M6C	6.0	1.4	0.14
Blind Bore Machine - Redbore 50 MDUR	6.0	1.4	0.14
Powder Truck - Normet Charmec MF 605 DA	6.0	1.4	0.14
Bolter - Atlas Copco Boltec MC	6.0	1.4	0.14
Mechanized Shotcrete Sprayers - Normet Spraymec 6050 WP	6.0	1.4	0.14
Transmixer Trucks - Normet Utimec LF 600	6.0	1.4	0.14
UG Haul Trucks (40T)	6.0	1.4	0.14
Scissor Trucks - Getman A64	6.0	1.4	0.14
Cable Bolters - Atlas Copco Cabletec LC	6.0	1.4	0.14
Production LHD - Sandvik LH514e	6.0	1.4	0.14
2.3 yd LHD - Atlas Copco ST2G	6.0	1.4	0.14
3.5 yd LHD - Atlas Copco ST3.5	6.0	1.4	0.14
Mobile Rock Breaker - Sandvik LH514	6.0	1.4	0.14
Medium Reach Rig - MacLean BH-3 Blockholer	6.0	1.4	0.14
Water Cannon - Getman A64	6.0	1.4	0.14
Fuel/Lube Truck - Normet Utimec	6.0	1.4	0.14
Crane Truck - Getman A64	6.0	1.4	0.14
Man Haul Vans - Miller Toyota	6.0	1.4	0.14
Flat Deck Truck - Getman A64	6.0	1.4	0.14
Crane Truck - Miller Toyota	6.0	1.4	0.14
Generator Truck (LHD) - GETMAN A64	6.0	1.4	0.14
UG Grader - CAT 140M2	6.0	1.4	0.14
Forklift - CAT P36000	6.0	1.4	0.14
UG Water Trucks - Getman A64	6.0	1.4	0.14
Conveyor Maint Vehicle - Miller Crane Truck	6.0	1.4	0.14
Scissor Lift - Miller Toyota	6.0	1.4	0.14
Skid Steer Loader - CAT272D	6.0	1.4	0.14
Raise Bore - Redbore 60	6.0	1.4	0.14
UG Dozer - 2.9m Blade - CAT D6N	6.0	1.4	0.14
Ore Haul Trucks - Powertrans T954	6.0	1.4	0.14

* Control from precip and water & chemical dust suppressant applied to emission factors

Unpaved Roads - Predictive Emission Factor Equation & Constants*				
	Empirical Constants for Industrial Roads			
$E = k \times (s / 12)^a \times (W / 3)^b \times (365 - P) / 365$	Constan	PM	PM ₁₀	PM _{2.5}
k, a, b - empirical constants	k	4.9	1.5	0.15
s - surface material silt content %	a	0.7	0.9	0.9
W - mean vehicle wt ton	b	0.45	0.45	0.45
P - Days of >0.01" Precip				

* AP-42, 13.2.2, Equation 1a & 2, Table 13.2.2-2, Industrial Roads, Rev. 8/04

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Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI			BY: D. Steen		
	PROJECT NO: 262			PAGE: 8	OF: 8	SHEET: EP_Fleet
	SUBJECT: Diesel Fleet Calculations - East Plant			DATE: October 12, 2018		
AIR EMISSION CALCULATIONS						

East Plant Diesel Machinery (Non-Emergency) - Fugitive Emissions from Grading/Dozing - Emissions (Short-Term & Long-Term)							Year 14
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Emission Factors						
Grading	PM	PM ₁₀	PM _{2.5}	EF Unit		
UG Grader - CAT 140M2	3.0	0.96	9.2E-2	lb/VMT		
Dozing						
UG Dozer - 2.9m Blade - CAT D6N	3.5	0.56	0.37	lb/hr		
Emissions						
		Operation	PM	PM ₁₀	PM _{2.5}	
Quantity		hr/yr	lb/hr	lb/hr	lb/hr	
						PM
						ton/yr
						PM ₁₀
						ton/yr
						PM _{2.5}
						ton/yr
Grading						
UG Grader - CAT 140M2	3	1,612	49.6	16.1	1.5	40.0 12.9 1.2
Dozing						
UG Dozer - 2.9m Blade - CAT D6N	2	856	7.0	1.1	0.74	3.0 0.48 0.32
Grading - East Plant Underground						
Grading - East Plant Surface						
Dozing - East Plant Underground						
Dozing - East Plant Surface						
Grading/Dozing - East Plant Total						

East Plant Underground Fleet - Uncontrolled Fugitive Dust Emissions							
		PM	PM ₁₀	PM _{2.5}	PM	PM ₁₀	PM _{2.5}
		lb/hr	lb/hr	lb/hr	ton/yr	ton/yr	ton/yr
Vehicle Travel & Grading - East Plant Underground		7,411	1,724	172	8,254	1,919	192
Dozing - East Plant Underground		7.0	1.1	0.74	3.0	0.48	0.32
Fugitive Dust - East Plant Underground Total		7,418	1,725	173	8,257	1,919	192

East Plant Surface Fleet - Uncontrolled Fugitive Dust Emissions							
		PM	PM ₁₀	PM _{2.5}	PM	PM ₁₀	PM _{2.5}
		lb/hr	lb/hr	lb/hr	ton/yr	ton/yr	ton/yr
Vehicle Travel & Grading - East Plant Surface		51.9	12.0	1.2	39.8	9.2	0.92
Dozing - East Plant Surface							
Fugitive Dust - East Plant Surface Total		51.9	12.0	1.2	39.8	9.2	0.92

Dozing and Grading Emission Factor Equations		AP-42, 11.9, Table 11.9-1 (overburden), Rev. 7/98				
		Scaling Factor				
		PM ₁₀	PM _{2.5}			
Dozing (PM)	E = (5.7 * s ^{1.2}) / (M ^{1.3})		0.105			
Dozing (PM ₁₅)	E = (1.0 * s ^{1.5}) / (M ^{1.4})	0.75				
Grading (PM)	E = 0.040 * S ^{2.5}		0.031			
Grading (PM ₁₅)	E = 0.051 * S ^{2.0}	0.6				
s = material silt content %		3.0	AP-42, Chapter 13.2.2, Related Information, r13s0202_dec03.xls			
M = material moisture content %		4.0	Resolution Copper			
S = mean vehicle speed mph		5.59	Phone Meeting with C. Pascoe 10/11/12 (9 km/hr)			
Fuel Contingency		15%	RCM Mine Data for Ari Modelling 2012.xlsx			

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI			BY: D. Steen			
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	SUBJECT: Diesel Fleet Calculations - Mill			DATE: October 12, 2018			
AIR EMISSION CALCULATIONS							
Mill Diesel Machinery (Non-Emergency)							
	Rating	Rating		EPA	Fuel	Ann. Op.	Load Factor
Mobile Equipment	kW	hp	Quantity	Tier	gal/hr	Hours	(%)**
Dozer (Coarse Ore Stockpile)	219	294	1	4	15	6,132	60%
Boom Truck (Pebble Crusher)	219	294	1	4	15	2,190	60%
Wheel Loader (2 yrs) - 992 class	189	254	2	4	13	6,130	60%
Forklift (Maintenance)	58	78	1	4	4	2,190	60%
Bobcat	58	78	2	4	4	2,920	60%
Flatbed Truck	146	196	1	4	10*	2,190	90%
Forklift (Moly Plant-Lg)	146	196	1	4	10*	2,920	60%
Stormwater Mgmt. Pump	153	205	3	4	10	1,095	90%
Stormwater Mgmt. Pump	388	520	0	4	27	1,095	90%
Flatbed Truck (1 ton, nonroad)	287	385	2	4	20	1,095	90%
Grader	117	157	1	4	8	2,190	60%
Backhoe	112	150	1	4	4	2,190	60%
Water Truck	219	294	2	4	15	2,190	60%
Boom Truck	117	157	1	4	8	2,190	60%
Fuel Lube Truck	224	300	1	4	3	4,380	90%
20T Crane	75	100	1	4	8	1,752	50%
60T Crane	117	157	1	4	8	876	50%
Mobile Air Compressor	44	59	2	4	3	1,095	90%
Light Tower	7	10	2	4	1	4,380	90%
Fusion Machine	44	59	1	4	3	2,190	90%
Lg Forklift (Warehouse)	146	196	1	4	10*	2,190	60%
Sm Forklift (Warehouse)	146	196	1	4	10*	2,190	60%
Highrail Maintenance Vehicle	146	196	1	4	10*	876	80%
Bucket Truck (Electrical)	146	196	1	4	10*	876	90%
Vacuum Truck	146	196	1	4	10*	876	90%
Man/Boom Lifts	146	196	2	4	10*	2,190	50%
Loader (Clean-up)-972 Class	146	196	1	4	10*	2,190	60%
* Conservative Assumption							
** Resolution							
Conversions							
453.592 g/lb							
2,000 lb/ton							
0.0015% ppm S in ULSD (GPA 2140)							
7.05 lb/gal							
1.00E+06 Btu/MMBtu							
1.998 SO ₂ /S							
1.341 hp/kw							
7,000 Btu/hp-hr AP-42, Table 3.4-1, Footnote e, Diesel, Rev. 10/96							
137,000 Btu/gal AP-42, Appendix A, Diesel, Rev. 9/85							
8,760 hr/yr							

Blue values are input; black values are calculated or linked.

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: D. Steen		
	PROJECT NO: 262		PAGE: 2	OF: 8	SHEET: Mill_Fleet
	SUBJECT: Diesel Fleet Calculations - Mill		DATE: October 12, 2018		

Mill Diesel Machinery (Non-Emergency) - Emission Factors

Equipment	Rating	Quantity	CO*	NO _x *	SO ₂ **	PM*	VOC*
	kW		g/kW-hr	g/kW-hr	g/kW-hr	g/kW-hr	g/kW-hr
Dozer (Coarse Ore Stockpile)	219	1	3.5	0.40	-	2.0E-2	0.19
Boom Truck (Pebble Crusher)	219	1	3.5	0.40	-	2.0E-2	0.19
Wheel Loader (2 yrs) - 992 class	189	2	3.5	0.40	-	2.0E-2	0.19
Forklift (Maintenance)	58	1	5.0	0.40	-	2.0E-2	0.19
Bobcat	58	2	5.0	0.40	-	2.0E-2	0.19
Flatbed Truck	146	1	3.5	0.40	-	2.0E-2	0.19
Forklift (Moly Plant-Lg)	146	1	3.5	0.40	-	2.0E-2	0.19
Stormwater Mgmt. Pump	153	3	3.5	0.40	-	2.0E-2	0.19
Stormwater Mgmt. Pump	388	0	3.5	0.40	-	2.0E-2	0.19
Flatbed Truck (1 ton, nonroad)	287	2	3.5	0.40	-	2.0E-2	0.19
Grader	117	1	5.0	0.40	-	2.0E-2	0.19
Backhoe	112	1	5.0	0.40	-	2.0E-2	0.19
Water Truck	219	2	3.5	0.40	-	2.0E-2	0.19
Boom Truck	117	1	5.0	0.40	-	2.0E-2	0.19
Fuel Lube Truck	224	1	3.5	0.40	-	2.0E-2	0.19
20T Crane	75	1	5.0	0.40	-	2.0E-2	0.19
60T Crane	117	1	5.0	0.40	-	2.0E-2	0.19
Mobile Air Compressor	44	2	5.0	4.7	-	3.0E-2	4.7
Light Tower	7	2	6.6	7.5	-	0.40	7.5
Fusion Machine	44	1	5.0	4.7	-	3.0E-2	4.7
Lg Forklift (Warehouse)	146	1	3.5	0.40	-	2.0E-2	0.19
Sm Forklift (Warehouse)	146	1	3.5	0.40	-	2.0E-2	0.19
Highrail Maintenance Vehicle	146	1	3.5	0.40	-	2.0E-2	0.19
Bucket Truck (Electrical)	146	1	3.5	0.40	-	2.0E-2	0.19
Vacuum Truck	146	1	3.5	0.40	-	2.0E-2	0.19
Man/Boom Lifts	146	2	3.5	0.40	-	2.0E-2	0.19
Loader (Clean-up)-972 Class	146	1	3.5	0.40	-	2.0E-2	0.19

* 40 CFR §1039.101, Table 1

** SO₂ emissions - mass balance based on 15 ppm S content (ULSD)

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI	BY: D. Steen		
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	SUBJECT: Diesel Fleet Calculations - Mill	DATE: October 12, 2018		

Mill Diesel Machinery (Non-Emergency) - Short-Term Emission

Equipment	CO <i>lb/hr</i>	NO_x <i>lb/hr</i>	SO₂* <i>lb/hr</i>	PM <i>lb/hr</i>	VOC <i>lb/hr</i>
Dozer (Coarse Ore Stockpile)	1.0	0.12	2.2E-3	5.8E-3	5.5E-2
Boom Truck (Pebble Crusher)	1.0	0.12	2.2E-3	5.8E-3	5.5E-2
Wheel Loader (2 yrs) - 992 class	1.8	0.20	3.8E-3	1.0E-2	9.5E-2
Forklift (Maintenance)	0.39	3.1E-2	5.8E-4	1.5E-3	1.5E-2
Bobcat	0.77	6.2E-2	1.2E-3	3.1E-3	2.9E-2
Flatbed Truck	1.0	0.12	2.2E-3	5.8E-3	5.5E-2
Forklift (Moly Plant-Lg)	0.68	7.7E-2	1.5E-3	3.9E-3	3.7E-2
Stormwater Mgmt. Pump	3.2	0.36	6.9E-3	1.8E-2	0.17
Stormwater Mgmt. Pump					
Flatbed Truck (1 ton, nonroad)	4.0	0.46	8.6E-3	2.3E-2	0.22
Grader	0.77	6.2E-2	1.2E-3	3.1E-3	2.9E-2
Backhoe	0.74	5.9E-2	5.8E-4	3.0E-3	2.8E-2
Water Truck	2.0	0.23	4.4E-3	1.2E-2	0.11
Boom Truck	0.77	6.2E-2	1.2E-3	3.1E-3	2.9E-2
Fuel Lube Truck	1.6	0.18	6.6E-4	8.9E-3	8.4E-2
20T Crane	0.41	3.3E-2	9.7E-4	1.6E-3	1.6E-2
60T Crane	0.64	5.1E-2	9.7E-4	2.6E-3	2.4E-2
Mobile Air Compressor	0.87	0.82	1.3E-3	5.2E-3	0.82
Light Tower	0.19	0.22	2.2E-4	1.2E-2	0.22
Fusion Machine	0.43	0.41	6.6E-4	2.6E-3	0.41
Lg Forklift (Warehouse)	0.68	7.7E-2	1.5E-3	3.9E-3	3.7E-2
Sm Forklift (Warehouse)	0.68	7.7E-2	1.5E-3	3.9E-3	3.7E-2
Highbail Maintenance Vehicle	0.90	0.10	1.9E-3	5.1E-3	4.9E-2
Bucket Truck (Electrical)	1.0	0.12	2.2E-3	5.8E-3	5.5E-2
Vacuum Truck	1.0	0.12	2.2E-3	5.8E-3	5.5E-2
Man/Boom Lifts	1.1	0.13	2.4E-3	6.4E-3	6.1E-2
Loader (Clean-up)-972 Class	0.68	7.7E-2	1.5E-3	3.9E-3	3.7E-2
Mill Stationary	3.2	0.36	6.9E-3	1.8E-2	0.17
Mill Mobile	25.1	4.0	4.7E-2	0.15	2.7
Mill Total	28.3	4.4	5.4E-2	0.16	2.8

* Calculated by mass balance using a 15% fuel contingency

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	Resolution Copper EI	D. Steen		
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AIR EMISSION CALCULATIONS	262	4	8	Mill_Fleet
	SUBJECT:	DATE:		
	Diesel Fleet Calculations - Mill	October 12, 2018		

Mill Diesel Machinery (Non-Emergency) - Long-Term Emission

Equipment	CO ton/yr	NO _x ton/yr	SO ₂ * ton/yr	PM ton/yr	VOC ton/yr
Dozer (Coarse Ore Stockpile)	3.1	0.36	6.7E-3	1.8E-2	0.17
Boom Truck (Pebble Crusher)	1.1	0.13	2.4E-3	6.3E-3	6.0E-2
Wheel Loader (2 yrs) - 992 class	5.4	0.61	1.2E-2	3.1E-2	0.29
Forklift (Maintenance)	0.42	3.4E-2	6.4E-4	1.7E-3	1.6E-2
Bobcat	1.1	9.0E-2	1.7E-3	4.5E-3	4.3E-2
Flatbed Truck	1.1	0.13	2.4E-3	6.3E-3	6.0E-2
Forklift (Moly Plant-Lg)	0.99	0.11	2.1E-3	5.6E-3	5.4E-2
Stormwater Mgmt. Pump	1.7	0.20	3.8E-3	1.0E-2	9.5E-2
Stormwater Mgmt. Pump					
Flatbed Truck (1 ton, nonroad)	2.2	0.25	4.7E-3	1.2E-2	0.12
Grader	0.85	6.8E-2	1.3E-3	3.4E-3	3.2E-2
Backhoe	0.81	6.5E-2	6.4E-4	3.2E-3	3.1E-2
Water Truck	2.2	0.25	4.8E-3	1.3E-2	0.12
Boom Truck	0.85	6.8E-2	1.3E-3	3.4E-3	3.2E-2
Fuel Lube Truck	3.4	0.39	1.4E-3	1.9E-2	0.18
20T Crane	0.36	2.9E-2	8.5E-4	1.4E-3	1.4E-2
60T Crane	0.28	2.3E-2	4.3E-4	1.1E-3	1.1E-2
Mobile Air Compressor	0.48	0.45	7.2E-4	2.9E-3	0.45
Light Tower	0.42	0.48	4.8E-4	2.5E-2	0.48
Fusion Machine	0.48	0.45	7.2E-4	2.9E-3	0.45
Lg Forklift (Warehouse)	0.74	8.5E-2	1.6E-3	4.2E-3	4.0E-2
Sm Forklift (Warehouse)	0.74	8.5E-2	1.6E-3	4.2E-3	4.0E-2
Highrail Maintenance Vehicle	0.39	4.5E-2	8.5E-4	2.3E-3	2.1E-2
Bucket Truck (Electrical)	0.44	5.1E-2	9.6E-4	2.5E-3	2.4E-2
Vacuum Truck	0.44	5.1E-2	9.6E-4	2.5E-3	2.4E-2
Man/Boom Lifts	1.2	0.14	2.7E-3	7.0E-3	6.7E-2
Loader (Clean-up)-972 Class	0.74	8.5E-2	1.6E-3	4.2E-3	4.0E-2
Mill Stationary	1.7	0.20	3.8E-3	1.0E-2	9.5E-2
Mill Mobile	30.3	4.5	5.5E-2	0.19	2.9
Mill Total	32.0	4.7	5.9E-2	0.20	3.0

* Calculated by mass balance using a 15% fuel contingency

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI	BY: D. Steen		
	PROJECT NO: 262	PAGE: 5	OF: 8	SHEET: Mill_Fleet
	SUBJECT: Diesel Fleet Calculations - Mill	DATE: October 12, 2018		

Mill Diesel Machinery (Non-Emergency) - Fugitive Emissions from Vehicle Travel - Vehicle Specifications

Equipment	Quantity	Ann. Op. Hours ^a	Speed ^b mph	Silt ^c %	Weight ^b ton
Dozer (Coarse Ore Stockpile)		<i>dozer-specific fugitive emissions on p. 8</i>			
Boom Truck (Pebble Crusher)	1	2,190	15	3.0	27
Wheel Loader (2 yrs) - 992 class			<i>paved surface</i>		
Forklift (Maintenance)			<i>paved surface</i>		
Bobcat			<i>paved surface</i>		
Flatbed Truck	1	2,190	25	3.0	27
Forklift (Moly Plant-Lg)			<i>paved surface</i>		
Stormwater Mgmt. Pump			<i>stationary</i>		
Stormwater Mgmt. Pump			<i>stationary</i>		
Flatbed Truck (1 ton, nonroad)	2	1,095	15	3.0	2
Grader		<i>grader-specific fugitive emissions on p. 8</i>			
Backhoe	1	2,190	5	3.0	12
Water Truck	2	2,190	15	3.0	10
Boom Truck	1	2,190	15	3.0	17
Fuel Lube Truck	1	4,380	15	3.0	50
20T Crane	1	1,752	10	3.0	27
60T Crane	1	876	10	3.0	45
Mobile Air Compressor	2	1,095	5	3.0	4
Light Tower	2	4,380	5	3.0	1
Fusion Machine	1	2,190	1	3.0	2
Lg Forklift (Warehouse)			<i>paved surface</i>		
Sm Forklift (Warehouse)			<i>paved surface</i>		
Highrail Maintenance Vehicle	1	876	5	3.0	2
Bucket Truck (Electrical)	1	876	15	3.0	12
Vacuum Truck	1	876	15	3.0	2
Man/Boom Lifts	2	2,190	5	3.0	12
Loader (Clean-up)-972 Class	1	2,190	5	3.0	23
Mean Vehicle Weight					13.8

^a Per unit, including availability and utilization factors

^b Resolution

^c AP-42, Ch4j

<p style="text-align: center;">Air Sciences Inc.</p> <p style="text-align: center;">AIR EMISSION CALCULATIONS</p>	PROJECT TITLE:	BY:		
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	SUBJECT:	DATE:		
	Diesel Fleet Calculations - Mill	October 12, 2018		

Mill Diesel Machinery (Non-Emergency) - Fugitive Emissions from Vehicle Travel - Emission Factors

Equipment	PM <i>lb/VMT</i>	PM₁₀ <i>lb/VMT</i>	PM_{2.5} <i>lb/VMT</i>
Dozer (Coarse Ore Stockpile)			
Boom Truck (Pebble Crusher)	3.7	0.85	8.5E-2
Wheel Loader (2 yrs) - 992 class			
Forklift (Maintenance)			
Bobcat			
Flatbed Truck	3.7	0.85	8.5E-2
Forklift (Moly Plant-Lg)			
Stormwater Mgmt. Pump			
Stormwater Mgmt. Pump			
Flatbed Truck (1 ton, nonroad)	3.7	0.85	8.5E-2
Grader			
Backhoe	3.7	0.85	8.5E-2
Water Truck	3.7	0.85	8.5E-2
Boom Truck	3.7	0.85	8.5E-2
Fuel Lube Truck	3.7	0.85	8.5E-2
20T Crane	3.7	0.85	8.5E-2
60T Crane	3.7	0.85	8.5E-2
Mobile Air Compressor	3.7	0.85	8.5E-2
Light Tower	3.7	0.85	8.5E-2
Fusion Machine	3.7	0.85	8.5E-2
Lg Forklift (Warehouse)			
Sm Forklift (Warehouse)			
Highrail Maintenance Vehicle	3.7	0.85	8.5E-2
Bucket Truck (Electrical)	3.7	0.85	8.5E-2
Vacuum Truck	3.7	0.85	8.5E-2
Man/Boom Lifts	3.7	0.85	8.5E-2
Loader (Clean-up)-972 Class	3.7	0.85	8.5E-2

Unpaved Roads - Predictive Emission Factor Equation & Constants*

	Empirical Constants for Industrial Roads			
$E = k \times (s / 12)^a \times (W / 3)^b \times (365 - P) / 365$	Constan	PM	PM ₁₀	PM _{2.5}
k, a, b - empirical constants	k	4.9	1.5	0.15
s - surface material silt content %	a	0.7	0.9	0.9
W - mean vehicle wt ton	b	0.45	0.45	0.45
P - Days of >0.01" Precip				

* AP-42, 13.2.2, Equation 1a & 2, Table 13.2.2-2, Industrial Roads, Rev. 8/04

<p style="text-align: center;">Air Sciences Inc.</p> <p style="text-align: center;">AIR EMISSION CALCULATIONS</p>	PROJECT TITLE:	BY:		
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Mill Diesel Machinery (Non-Emergency) - Fugitive Emissions from Vehicle Travel - Emissions (Short-Term & Long-Term)

Daily Unpaved Road Controls	
	Surface
days of <0.01" Precip	307

* Control efficiency is based on AP-42 Chapter 13.2.2, Unpaved Roads. Figure 13.2.2-2 provides the control efficiencies achievable with watering

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AIR EMISSION CALCULATIONS							

Mill Diesel Machinery (Non-Emergency) - Fugitive Emissions from Grading/Dozing - Emissions (Short-Term & Long-Term)							
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Emission Factors							
Grading	PM	PM ₁₀	PM _{2.5}	EF Unit			
Grader	3.0	0.96	9.2E-2	lb/VMT			
Dozing							
Dozer (Coarse Ore Stockpile)	3.5	0.56	0.37	lb/hr			

Emissions								
	Operatio	PM	PM ₁₀	PM _{2.5}	PM	PM ₁₀	PM _{2.5}	
	Quantit	hr/yr	lb/hr	lb/hr	ton/yr	ton/yr	ton/yr	
Grading								
Grader	1.0	2,519	16.5	5.4	0.51	20.8	6.7	0.65
Dozing								
Dozer (Coarse Ore Stockpile)*	1.0	7,052	3.5	0.56	0.37	12.4	2.0	1.3
Grading - Mill								
			16.5	5.4	0.51	20.8	6.7	0.65
Dozing - Mill								
			3.5	0.56	0.37	12.4	2.0	1.3
Grading/Dozing - Tailings Total								
			20.1	5.9	0.88	33.2	8.7	1.9

Mill Fleet - Uncontrolled Fugitive Dust Emissions								
	PM	PM ₁₀	PM _{2.5}	PM	PM ₁₀	PM _{2.5}		
	lb/hr	lb/hr	lb/hr	ton/yr	ton/yr	ton/yr		
Vehicle Travel & Grading - Mill								
			849	199	19.8	706	166	16.5
Dozing - Mill								
			3.5	0.56	0.37	12.4	2.0	1.3
Fugitive Dust - Mill Total								
			853	199	20.2	719	168	17.8

Dozing and Grading Emission Factor Equations							
AP-42, 11.9, Table 11.9-1 (overburden), Rev. 7/98							
		Scaling Factor					
		PM ₁₀	PM _{2.5}				
Dozing (PM)	E = (5.7 * s ^{1.3}) / (M ^{1.3})	0.105					
Dozing (PM ₁₅)	E = (1.0 * s ^{1.5}) / (M ^{1.4})	0.75					
Grading (PM)	E = 0.040 * S ^{2.5}	0.031					
Grading (PM ₁₅)	E = 0.051 * S ^{2.0}	0.6					
s = material silt content %		3.0	AP-42, Chapter 13.2.2, Related Information, r13s0202_dec03.xls				
M = material moisture content %		4.0	Resolution Copper				
S = mean vehicle speed mph		5.59	Phone Meeting with C. Pascoe 10/11/12 (9 km/hr)				
Fuel Contingency		15%	RCM Mine Data for Ari Modelling 2012.xlsx				

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: D. Steen		
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Tailings Diesel Machinery (Non-Emergency)	Year 15 (Max Fuel Use Year)
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	Equip	Rating	Rating		EPA	Fuel	Ann. Op.	Load Factor
Mobile Equipment*	Util	kW	hp	Quantity	Tier	gal/hr	Hours	(%)
Excavator 65t	70%	362	485	2	4	25	6,132	60%
Excavator 45t	70%	322	432	1	4	22	6,132	60%
Dozer (D8 Class)	70%	268	359	2	4	18	6,132	60%
Dozer (D9 Class)	70%	325	436	3	4	22	6,132	60%
D10 Dozer	70%	538	721	2	4	37	6,132	60%
Tractors	70%	186	250	6	4	13	6,132	60%
Scrapers (631K)	70%	425	570	2	4	29	6,132	60%
Grader (120 Class)	70%	103	138	2	4	7	6,132	60%
Compactor (825 Class)	70%	324	434	1	4	22	6,132	60%
Compactor (S74 Class)	70%	130	174	2	4	9	6,132	60%
Skid Steer 246 class	30%	71	95	2	4	5	2,628	60%
Boom Winch Truck 10t	30%	179	240	2	4	12	2,628	60%
Pipe welder - McElroy 1648	30%	19	25	1	4	1	2,628	90%
Pipe welder - McElroy 618	30%	13	18	1	4	1	2,628	90%
Water Truck/Dust Polymer Truck	70%	294	394	4	4	20	6,132	60%
Forklift	30%	110	148	2	4	8	2,628	60%
Telehandler	30%	83	111	1	4	6	2,628	60%
Service Truck - 1 ton	70%	308	413	8	4	21	6,132	90%
Small Truck (3/4t)	70%	308	413	20	4	21	6,132	90%
Boats	30%	56	75	1	4	4	2,628	60%
Air compressor	30%	75	100	1	4	5	2,628	60%
Portable diesel pumps (Godwin)	30%	19	25	2	4	1	2,628	60%
Light plants	40%	7	10	6	4	1	3,504	60%
Fuel Truck	70%	224	300	1	4	15	6,132	60%
40 ton haulage truck	70%	350	469	7	4	24	6,132	60%
Crusher	50%	746	1,000	1	4	51	4,380	60%
Screen	50%	75	100	1	4	5	4,380	60%
Conveyor	50%	261	350	1	4	18	4,380	60%
Genset - preprod	40%	373	500	0	4	26	3,504	60%

* Resolution

Conversions	
453.592 g/lb	
2,000 lb/ton	
0.0015% ppm S in ULSD (GPA 2140)	
7.05 lb/gal	
1.00E+06 Btu/MMBtu	
1.998 SO ₂ /S	
1.341 hp/kw	
7,000 Btu/lp-hr	AP-42, Table 3.4-1, Footnote e, Diesel, Rev. 10/96
137,000 Btu/gal	AP-42, Appendix A, Diesel, Rev. 9/85
8,760 hr/yr	

Blue values are input; black values are calculated or linked.

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Tailings Diesel Machinery (Non-Emergency) - Emission Factors

Equipment	Rating kW	Quantity	CO* g/kW-hr	NO_x* g/kW-hr	SO₂** g/kW-hr	PM* g/kW-hr	VOC* g/kW-hr
Excavator 65t	362	2	3.5	0.40	-	0.02	0.19
Excavator 45t	322	1	3.5	0.40	-	0.02	0.19
Dozer (D8 Class)	268	2	3.5	0.40	-	0.02	0.19
Dozer (D9 Class)	325	3	3.5	0.40	-	0.02	0.19
D10 Dozer	538	2	3.5	0.40	-	0.02	0.19
Tractors	186	6	3.5	0.40	-	0.02	0.19
Scrapers (631K)	425	2	3.5	0.40	-	0.02	0.19
Grader (120 Class)	103	2	5.0	0.40	-	0.02	0.19
Compactor (825 Class)	324	1	3.5	0.40	-	0.02	0.19
Compactor (S74 Class)	130	2	5.0	0.40	-	0.02	0.19
Skid Steer 246 class	71	2	5.0	0.40	-	0.02	0.19
Boom Winch Truck 10t	179	2	3.5	0.40	-	0.02	0.19
Pipe welder - McElroy 1648	19	1	6.6	7.5	-	0.40	7.5
Pipe welder - McElroy 618	13	1	6.6	7.5	-	0.40	7.5
Water Truck/Dust Polymer Truck	294	4	3.5	0.40	-	0.02	0.19
Forklift	110	2	5.0	0.40	-	0.02	0.19
Telehandler	83	1	5.0	0.40	-	0.02	0.19
Service Truck - 1 ton	308	8	3.5	0.40	-	0.02	0.19
Small Truck (3/4t)	308	20	3.5	0.40	-	0.02	0.19
Boats	56	1	5.0	4.7	-	0.03	4.7
Air compressor	75	1	5.0	0.40	-	0.02	0.19
Portable diesel pumps (Godwin)	19	2	6.6	7.5	-	0.40	7.5
Light plants	7	6	6.6	7.5	-	0.40	7.5
Fuel Truck	224	1	3.5	0.40	-	0.02	0.19
40 ton haulage truck	350	7	3.5	0.40	-	0.02	0.19
Crusher	746	1	3.5	3.5	-	0.04	0.19
Screen	75	1	5.0	0.40	-	0.02	0.19
Conveyor	261	1	3.5	0.40	-	0.02	0.19
Genset - preprod	373	0	3.5	0.40	-	0.02	0.19

* 40 CFR §1039.101, Table 1

** SO₂ emissions - mass balance based on 15 ppm S content (ULSD)

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Tailings Diesel Machinery (Non-Emergency) - Short-Term Emission

Equipment	CO lb/hr	NO_x lb/hr	SO₂* lb/hr	PM lb/hr	VOC lb/hr
Excavator 65t	3.4	0.38	7.2E-3	0.02	0.18
Excavator 45t	1.5	0.17	3.2E-3	8.5E-3	0.08
Dozer (D8 Class)	2.5	0.28	5.4E-3	0.01	0.13
Dozer (D9 Class)	4.5	0.52	9.7E-3	0.03	0.25
D10 Dozer	5.0	0.57	0.01	0.03	0.27
Tractors	5.2	0.59	0.01	0.03	0.28
Scrapers (631K)	3.9	0.45	8.5E-3	0.02	0.21
Grader (120 Class)	1.4	0.11	2.1E-3	5.4E-3	0.05
Compactor (825 Class)	1.5	0.17	3.2E-3	8.6E-3	0.08
Compactor (S74 Class)	1.7	0.14	2.6E-3	6.9E-3	0.07
Skid Steer 246 class	0.94	0.07	1.4E-3	3.7E-3	0.04
Boom Winch Truck 10t	1.7	0.19	3.6E-3	9.5E-3	0.09
Pipe welder - McElroy 1648	0.24	0.28	2.8E-4	0.01	0.28
Pipe welder - McElroy 618	0.18	0.20	2.0E-4	0.01	0.20
Water Truck/Dust Polymer Truck	5.4	0.62	0.01	0.03	0.30
Forklift	1.5	0.12	2.2E-3	5.8E-3	0.06
Telehandler	0.55	0.04	8.3E-4	2.2E-3	0.02
Service Truck - 1 ton	17.1	2.0	0.04	0.10	0.93
Small Truck (3/4t)	42.8	4.9	0.09	0.24	2.3
Boats	0.37	0.35	5.6E-4	2.2E-3	0.35
Air compressor	0.49	0.04	7.4E-4	2.0E-3	0.02
Portable diesel pumps (Godwin)	0.33	0.37	3.7E-4	0.02	0.37
Light plants	0.39	0.44	4.5E-4	0.02	0.44
Fuel Truck	1.0	0.12	2.2E-3	5.9E-3	0.06
40 ton haulage truck	11.3	1.3	0.02	0.06	0.62
Crusher	3.5	3.5	7.4E-3	0.04	0.19
Screen	0.49	0.04	7.4E-4	2.0E-3	0.02
Conveyor	1.2	0.14	2.6E-3	6.9E-3	0.07
Genset - preprod					
Tailings Stationary					
Tailings Mobile	120	18.0	0.25	0.76	8.0
Tailings Total	120	18.0	0.25	0.76	8.0

* Calculated by mass balance using a 15% fuel contingency

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: D. Steen		
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Tailings Diesel Machinery (Non-Emergency) - Long-Term Emission

Equipment	CO <i>ton/yr</i>	NO_x <i>ton/yr</i>	SO₂* <i>ton/yr</i>	PM <i>ton/yr</i>	VOC <i>ton/yr</i>
Excavator 65t	10.3	1.2	0.02	0.06	0.56
Excavator 45t	4.6	0.52	9.9E-3	0.03	0.25
Dozer (D8 Class)	7.6	0.87	0.02	0.04	0.41
Dozer (D9 Class)	13.8	1.6	0.03	0.08	0.75
D10 Dozer	15.3	1.7	0.03	0.09	0.83
Tractors	15.9	1.8	0.03	0.09	0.86
Scrapers (631K)	12.1	1.4	0.03	0.07	0.65
Grader (120 Class)	4.2	0.33	6.3E-3	0.02	0.16
Compactor (825 Class)	4.6	0.53	9.9E-3	0.03	0.25
Compactor (S74 Class)	5.3	0.42	7.9E-3	0.02	0.20
Skid Steer 246 class	1.2	0.10	1.9E-3	4.9E-3	0.05
Boom Winch Truck 10t	2.2	0.25	4.7E-3	0.01	0.12
Pipe welder - McElroy 1648	0.32	0.36	3.7E-4	0.02	0.36
Pipe welder - McElroy 618	0.23	0.26	2.6E-4	0.01	0.26
Water Truck/Dust Polymer Truck	16.7	1.9	0.04	0.10	0.91
Forklift	1.9	0.15	2.9E-3	7.6E-3	0.07
Telehandler	0.72	0.06	1.1E-3	2.9E-3	0.03
Service Truck - 1 ton	52.5	6.0	0.11	0.30	2.8
Small Truck (3/4t)	131	15.0	0.28	0.75	7.1
Boats	0.49	0.46	7.3E-4	2.9E-3	0.46
Air compressor	0.65	0.05	9.8E-4	2.6E-3	0.02
Portable diesel pumps (Godwin)	0.43	0.49	4.9E-4	0.03	0.49
Light plants	0.68	0.78	7.8E-4	0.04	0.78
Fuel Truck	3.2	0.36	6.9E-3	0.02	0.17
40 ton haulage truck	34.8	4.0	0.08	0.20	1.9
Crusher	7.6	7.6	0.02	0.09	0.41
Screen	1.1	0.09	1.6E-3	4.3E-3	0.04
Conveyor	2.6	0.30	5.7E-3	0.02	0.14
Genset - preprod					
Tailings Stationary					
Tailings Mobile	352	48.5	0.75	2.1	21.1
Tailings Total	352	48.5	0.75	2.1	21.1

* Calculated by mass balance using a 15% fuel contingency

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: D. Steen		
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Tailings Diesel Machinery (Non-Emergency) - Fugitive Emissions from Vehicle Travel - Vehicle Specifications

Equipment	Quantity	Ann. Op. Hours^a	Speed^b mph	Silt^c %	Weight^b ton
Excavator 65t	2	6,132	5	3.0	83
Excavator 45t	1	6,132	5	3.0	54
Dozer (D8 Class)		dozer-specific fugitive emissions on p. 8			
Dozer (D9 Class)		dozer-specific fugitive emissions on p. 8			
D10 Dozer		dozer-specific fugitive emissions on p. 8			
Tractors	6	6,132	5	3.0	13
Scrapers (631K)	2	6,132	5	3.0	72
Grader (120 Class)		grader-specific fugitive emissions on p. 8			
Compactor (825 Class)	1	6,132	2	3.0	39
Compactor (S74 Class)	2	6,132	2	3.0	18
Skid Steer 246 class	2	2,628	5	3.0	5
Boom Winch Truck 10t	2	2,628	15	3.0	12
Pipe welder - McElroy 1648	1	2,628	1	3.0	6
Pipe welder - McElroy 618	1	2,628	1	3.0	1
Water Truck/Dust Polymer Truck	4	6,132	15	3.0	50
Forklift	2	2,628	5	3.0	22
Telehandler	1	2,628	15	3.0	15
Service Truck - 1 ton	8	6,132	15	3.0	4
Small Truck (3/4t)	20	6,132	15	3.0	4
Boats		No Regular Travel on Unpaved Roads			
Air compressor		No Regular Travel on Unpaved Roads			
Portable diesel pumps (Godwin)		No Regular Travel on Unpaved Roads			
Light plants		No Regular Travel on Unpaved Roads			
Fuel Truck	1	6,132	15	3.0	13
40 ton haulage truck	7	6,132	13	3.0	58
Crusher		No Regular Travel on Unpaved Roads			
Screen		No Regular Travel on Unpaved Roads			
Conveyor		No Regular Travel on Unpaved Roads			
Genset - preprod		No Regular Travel on Unpaved Roads			
Mean Vehicle Weight					21.4

^a Per unit, including availability and utilization factors

^b Spec Sheets

^c AP-42, Chap

<p align="center">Air Sciences Inc.</p> <p align="center">AIR EMISSION CALCULATIONS</p>	PROJECT TITLE: Resolution Copper EI		BY: D. Steen		
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Tailings Diesel Machinery (Non-Emergency) - Fugitive Emissions from Vehicle Travel - Emission Factors

Equipment	PM <i>lb/VMT</i>	PM₁₀ <i>lb/VMT</i>	PM_{2.5} <i>lb/VMT</i>
Excavator 65t	4.5	1.0	0.10
Excavator 45t	4.5	1.0	0.10
Dozer (D8 Class)			
Dozer (D9 Class)			
D10 Dozer			
Tractors	4.5	1.0	0.10
Scrapers (631K)	4.5	1.0	0.10
Grader (120 Class)			
Compactor (825 Class)	4.5	1.0	0.10
Compactor (S74 Class)	4.5	1.0	0.10
Skid Steer 246 class	4.5	1.0	0.10
Boom Winch Truck 10t	4.5	1.0	0.10
Pipe welder - McElroy 1648	4.5	1.0	0.10
Pipe welder - McElroy 618	4.5	1.0	0.10
Water Truck/Dust Polymer Truck	4.5	1.0	0.10
Forklift	4.5	1.0	0.10
Telehandler	4.5	1.0	0.10
Service Truck - 1 ton	4.5	1.0	0.10
Small Truck (3/4t)	4.5	1.0	0.10
Boats			
Air compressor			
Portable diesel pumps (Godwin)			
Light plants			
Fuel Truck	4.5	1.0	0.10
40 ton haulage truck	4.5	1.0	0.10
Crusher			
Screen			
Conveyor			
Genset - preprod			

Unpaved Roads - Predictive Emission Factor Equation & Constants*				
	Empirical Constants for Industrial Roads			
E = k x (s / 12)^a x (W / 3)^b	Constan	PM	PM₁₀	PM_{2.5}
k, a, b - empirical constants	k	4.9	1.5	0.15
s - surface material silt content %	a	0.7	0.9	0.9
W - mean vehicle wt ton	b	0.45	0.45	0.45
P - Days of >0.01" Precip				

* AP-42, 13.2.2, Equation 1a & 2, Table 13.2.2-2, Industrial Roads, Rev. 8/04

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: D. Steen		
	PROJECT NO: 262		PAGE: 7	OF: 8	SHEET: Tailings_Fleet
	SUBJECT: Diesel Fleet Calculations - Tailings		DATE: October 12, 2018		

Tailings Diesel Machinery (Non-Emergency) - Fugitive Emissions from Vehicle Travel - Emissions (Short-Term & Long-Term)

Equipment	PM <i>lb/hr</i>	PM₁₀ <i>lb/hr</i>	PM_{2.5} <i>lb/hr</i>	PM <i>ton/yr</i>	PM₁₀ <i>ton/yr</i>	PM_{2.5} <i>ton/yr</i>
Excavator 65t	44.9	10.4	1.0	116	27.0	2.7
Excavator 45t	22.5	5.2	0.52	58.1	13.5	1.3
Dozer (D8 Class)						
Dozer (D9 Class)						
D10 Dozer						
Tractors	135	31.3	3.1	349	80.9	8.1
Scrapers (631K)	44.9	10.4	1.0	116	27.0	2.7
Grader (120 Class)						
Compactor (825 Class)	9.0	2.1	0.21	23.3	5.4	0.54
Compactor (574 Class)	18.0	4.2	0.42	46.5	10.8	1.1
Skid Steer 246 class	44.9	10.4	1.0	49.8	11.6	1.2
Boom Winch Truck 10t	135	31.3	3.1	150	34.7	3.5
Pipe welder - McElroy 1648	4.5	1.0	0.10	5.0	1.2	0.12
Pipe welder - McElroy 618	4.5	1.0	0.10	5.0	1.2	0.12
Water Truck/Dust Polymer Truck	270	62.6	6.3	698	162	16.2
Forklift	44.9	10.4	1.0	49.8	11.6	1.2
Telehandler	67.4	15.6	1.6	74.8	17.3	1.7
Service Truck - 1 ton	539	125	12.5	1,395	324	32.4
Small Truck (3/4t)	1,348	313	31.3	3,488	809	80.9
Boats						
Air compressor						
Portable diesel pumps (Godwin)						
Light plants						
Fuel Truck	67.4	15.6	1.6	174	40.5	4.0
40 ton haulage truck	393	91.2	9.1	1,017	236	23.6
Crusher						
Screen						
Conveyor						
Genset - preprod						
Vehicle Travel - Tailings Total	3,193	741	74.1	7,817	1,813	181

Daily Unpaved Road Controls

	Surface
days of <0.01" Precip	308

Daily Unpaved Road EF Multiplier

$E = EF(uncfl) \times (365 - P) / 365$	Surface
days of <0.01" Precip	1

Unpaved Road Controls

	Surface	Reference
$E = EF(uncfl) \times (365 - P) / 365$		
Days of >0.01" Precip	57	TSF Precip Data (days >0.01")
Water & Chemical Suppression*	90%	AP-42, Figure 13.2.2-2, Rev. 11/06

* Control efficiency is based on AP-42 Chapter 13.2.2, Unpaved Roads. Figure 13.2.2-2 provides the control efficiencies achievable with watering.

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI			BY: D. Steen		
	PROJECT NO: 262			PAGE: 8	OF: 8	SHEET: Tailings_Fleet
	SUBJECT: Diesel Fleet Calculations - Tailings			DATE: October 12, 2018		

Tailings Diesel Machinery (Non-Emergency) - Fugitive Emissions from Grading/Dozing - Emissions (Short-Term & Long-Term)									
Emission Factors									
Grading		PM		PM ₁₀		PM _{2.5}		EF Unit	
Graders		3.0		0.96		9.2E-2		lb/VMT	
Dozing									
Dozers		3.5		0.56		0.37		lb/hr	
Emissions									
		Operatio:		PM		PM ₁₀		PM _{2.5}	
		Quantit:		lb/hr		lb/hr		lb/hr	
		hr/yr		ton/yr		ton/yr		ton/yr	
Grading									
Grader (120 Class)		2.0 6,132		33.1 10.7		1.0		85.6 27.7 2.7	
Dozing									
Dozer (D8 Class)		2.0 6,132		7.0 1.1		0.74		18.2 2.9 1.9	
Dozer (D9 Class)		3.0 6,132		10.5 1.7		1.1		27.3 4.3 2.9	
D10 Dozer		2.0 6,132		7.0 1.1		0.74		18.2 2.9 1.9	
Grading - TSF				33.1 10.7		1.0		85.6 27.7 2.7	
Dozing - TSF				24.6 3.9		2.6		63.6 10.1 6.7	
Grading/Dozing - Tailings Total				57.7 14.6		3.6		149 37.8 9.3	

Tailings Fleet - Uncontrolled Fugitive Dust Emissions							
		PM		PM ₁₀		PM _{2.5}	
		lb/hr		lb/hr		lb/hr	
		ton/yr		ton/yr		ton/yr	
Vehicle Travel & Grading - Tailings		3,226 752		75.1		7,902 1,841 184	
Dozing - Tailings		24.6 3.9		2.6		63.6 10.1 6.7	
Fugitive Dust - Tailings Total		3,251 755		77.7		7,966 1,851 191	

Dozing and Grading Emission Factor Equations			AP-42, 11.9, Table 11.9-1 (overburden), Rev. 7/98.		
			Scaling Factor		
			PM ₁₀ PM _{2.5}		
Dozing (PM)	E = (5.7 * s ^{1.2}) / (M ^{1.3})		0.105		
Dozing (PM ₁₅)	E = (1.0 * s ^{1.5}) / (M ^{1.4})	0.75			
Grading (PM)	E = 0.040 * S ^{2.5}		0.031		
Grading (PM ₁₅)	E = 0.051 * S ^{2.0}	0.6			
s = material silt content %		3.0	AP-42, Chapter 13.2.2, Related Information, r13s0202_dec03.xls		
M = material moisture content %		4.0	Resolution Copper		
S = mean vehicle speed mph		5.59	Phone Meeting with C. Pascoe 10/11/12 (9 km/hr)		
Fuel Contingency		15%	RCM Mine Data for Ari Modelling 2012.xlsx		

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: D. Steen		
	PROJECT NO: 262		PAGE: 1	OF: 4	SHEET: Loadout_Fleet
	SUBJECT: Diesel Fleet Calculations - Loadout		DATE: October 12, 2018		

Loadout Diesel Machinery (Non-Emergency)

Mobile Equipment	References & Notes	Rating <i>kW</i>	Rating <i>hp</i>	Quantity	EPA Tier	Fuel <i>gal/hr</i>	Ann. Op. Hours	Load Factor (%)**
Loader	a	248	333	3	4	17	5,913	60%
Switch Engine	a	438	587	1	4	30	5,203	80%
Track Mobile	a	219	294	1	4	15	5,203	60%
Wheel Loader	a	75	100	1	4	13	876	60%
Sweeper	b	146	196	1	4	10*	876	60%

* Conservative Assumption
 ** Resolution

Conversions
453.592 g/lb
2,000 lb/ton
0.0015% ppm S in ULSD (GPA 2140)
7.05 lb/gal
1.00E+06 Btu/MMBtu
1.998 SO ₂ /S
1.341 hp/kw
7,000 Btu/hp-hr
137,000 Btu/gal

References & Notes
a, b Resolution

Blue values are input; black values are calculated or linked.

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: D. Steen		
	PROJECT NO: 262		PAGE: 2	OF: 4	SHEET: Loadout_Fleet
	SUBJECT: Diesel Fleet Calculations - Loadout		DATE: October 12, 2018		

Loadout Diesel Machinery (Non-Emergency) - Emission Factors

Equipment	Rating	Quantity	CO*	NO _x *	SO ₂ **	PM*	VOC*
	kW		g/kW-hr	g/kW-hr	g/kW-hr	g/kW-hr	g/kW-hr
Loader	248	3	3.5	0.40	-	2.0E-2	0.19
Switch Engine	438	1	3.5	0.40	-	2.0E-2	0.19
Track Mobile	219	1	3.5	0.40	-	2.0E-2	0.19
Wheel Loader	75	1	5.0	0.40	-	2.0E-2	0.19
Sweeper	146	1	3.5	0.40	-	2.0E-2	0.19

* 40 CFR §1039.101, Table 1

** SO₂ emissions - mass balance based on 15 ppm S content (ULSD)

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: D. Steen		
	PROJECT NO: 262		PAGE: 3	OF: 4	SHEET: Loadout_Fleet
	SUBJECT: Diesel Fleet Calculations - Loadout		DATE: October 12, 2018		

Loadout Diesel Machinery (Non-Emergency) - Short-Term Emission

Equipment	CO <i>lb/hr</i>	NO_x <i>lb/hr</i>	SO₂* <i>lb/hr</i>	PM <i>lb/hr</i>	VOC <i>lb/hr</i>
Loader	3.4	0.39	7.4E-3	2.0E-2	0.19
Switch Engine	2.7	0.31	5.8E-3	1.5E-2	0.15
Track Mobile	1.0	0.12	2.2E-3	5.8E-3	5.5E-2
Wheel Loader	0.49	3.9E-2	1.9E-3	2.0E-3	1.9E-2
Sweeper	0.68	7.7E-2	1.5E-3	3.9E-3	3.7E-2
Loadout Stationary					
Loadout Mobile	8.3	0.94	1.9E-2	4.7E-2	0.44
Loadout Total	8.3	0.94	1.9E-2	4.7E-2	0.44

* Calculated by mass balance using a 15% fuel contingency

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: D. Steen		
	PROJECT NO: 262		PAGE: 4	OF: 4	SHEET: Loadout_Fleet
	SUBJECT: Diesel Fleet Calculations - Loadout		DATE: October 12, 2018		

Loadout Diesel Machinery (Non-Emergency) - Long-Term Emission

Equipment	CO <i>ton/yr</i>	NO_x <i>ton/yr</i>	SO₂* <i>ton/yr</i>	PM <i>ton/yr</i>	VOC <i>ton/yr</i>
Loader	10.2	1.2	2.2E-2	5.8E-2	0.55
Switch Engine	7.0	0.80	1.5E-2	4.0E-2	0.38
Track Mobile	2.6	0.30	5.7E-3	1.5E-2	0.14
Wheel Loader	0.22	1.7E-2	8.3E-4	8.6E-4	8.2E-3
Sweeper	0.30	3.4E-2	6.4E-4	1.7E-3	1.6E-2
Loadout Stationary					
Loadout Mobile	20.4	2.3	4.4E-2	0.12	1.1
Loadout Total	20.4	2.3	4.4E-2	0.12	1.1

* Calculated by mass balance using a 15% fuel contingency

<p>Air Sciences Inc.</p> <p>AIR EMISSION CALCULATIONS</p>	PROJECT TITLE: Resolution Copper EI				BY: N. Tipple		
	PROJECT NO: 262				PAGE: 1	OF: 3	SHEET: Employees
	SUBJECT: Employee Fugitives				DATE: October 12, 2018		

Summary of Fugitive Emissions from Employee Commuting

CONTROLLED EMISSIONS (SHORT-TERM)

Location	PM lb/hr	PM ₁₀ lb/hr	PM _{2.5} lb/hr	NO _x lb/hr	SO ₂ lb/hr	CO lb/hr	VOC lb/hr
East Plant	8.5E-2	2.6E-2	5.6E-3	2.1E-2	1.1E-3	0.45	4.9E-3
Mill	1.0E-2	3.2E-3	6.8E-4	2.5E-3	1.3E-4	5.4E-2	5.9E-4
Tailings Storage Facility	4.0	0.93	9.4E-2	1.0E-2	5.5E-4	0.22	2.4E-3
Filter Plant and Loadout Facility	0.67	0.14	1.4E-2	2.3E-3	1.2E-4	4.9E-2	5.3E-4

CONTROLLED EMISSIONS (LONG-TERM)

Location	PM ton/yr	PM ₁₀ ton/yr	PM _{2.5} ton/yr	NO _x ton/yr	SO ₂ ton/yr	CO ton/yr	VOC ton/yr
East Plant	3.1	0.67	0.16	9.2E-2	4.9E-3	2.0	2.1E-2
Mill	0.38	8.1E-2	1.9E-2	1.1E-2	5.9E-4	0.24	2.6E-3
Tailings Storage Facility	14.0	3.3	0.33	4.3E-2	2.3E-3	0.92	1.0E-2
Filter Plant and Loadout Facility	2.5	0.53	5.4E-2	1.0E-2	5.3E-4	0.21	2.3E-3

UNCONTROLLED EMISSIONS (SHORT-TERM)

Location	PM lb/hr	PM ₁₀ lb/hr	PM _{2.5} lb/hr	NO _x lb/hr	SO ₂ lb/hr	CO lb/hr	VOC lb/hr
East Plant	0.75	0.16	3.8E-2	2.1E-2	1.1E-3	0.45	4.9E-3
Mill	9.1E-2	1.9E-2	4.6E-3	2.5E-3	1.3E-4	5.4E-2	5.9E-4
Tailings Storage Facility	40.0	9.3	0.93	1.0E-2	5.5E-4	0.22	2.4E-3
Filter Plant and Loadout Facility	6.7	1.4	0.14	2.3E-3	1.2E-4	4.9E-2	5.3E-4

UNCONTROLLED EMISSIONS (LONG-TERM)

Location	PM ton/yr	PM ₁₀ ton/yr	PM _{2.5} ton/yr	NO _x ton/yr	SO ₂ ton/yr	CO ton/yr	VOC ton/yr
East Plant	3.1	0.67	0.16	9.2E-2	4.9E-3	2.0	2.1E-2
Mill	0.38	8.1E-2	1.9E-2	1.1E-2	5.9E-4	0.24	2.6E-3
Tailings Storage Facility	140	32.6	3.3	4.3E-2	2.3E-3	0.92	1.0E-2
Filter Plant and Loadout Facility	24.7	5.3	0.53	1.0E-2	5.3E-4	0.21	2.3E-3

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: N. Tipple		
	PROJECT NO: 262		PAGE: 2	OF: 3	SHEET: Employees
	SUBJECT: Employee Fugitives		DATE: October 12, 2018		

Fugitive Dust from Employee Commuting				
Location	Daily Number of Vehicles*	one way VMT, ea*	Average Distance Travelled	
			RT VMT/day	RT VMT/yr
East Plant	332	1.9	1,262	460,484
Mill	318	0.2	153	55,714
Tailings Storage Facility	58	5.4	621	214,814
Filter Plant and Loadout F	18	3.8	138	50,195

* Resolution

Unpaved Roads - Equation & Constants*				
$E = k \times (s / 12)^a \times (W / 3)^b \times (365 - P) / 365$		Empirical Constants for Industrial Roads		
	Constan	PM	PM ₁₀	PM _{2.5}
k, a, b - empirical constants	k	4.9	1.5	0.15
s - surface material silt content %	a	0.7	0.9	0.9
W - mean vehicle wt ton	b	0.45	0.45	0.45

* AP-42, 13.2.2, Equation 1a & 2, Table 13.2.2-2, Unpaved Roads, Rev. 11/06

EMISSION FACTORS						
Location	Paved/Unpaved	Silt %*	Vehicle Weight ton**	PM lb/VMT	PM ₁₀ lb/VMT	PM _{2.5} lb/VMT
East Plant	Paved***	SL: 0.6	2.0	1.4E-2	2.8E-3	6.9E-4
Mill	Paved***	SL: 0.6	2.0	1.4E-2	2.8E-3	6.9E-4
Tailings Storage Facility	Unpaved	3.0	2.0	1.5	0.36	3.6E-2
Filter Plant and Loadout F	Unpaved	2.0	2.0	1.2	0.25	2.5E-2

* AP-42, Chapter 13.2.2 and 13.2.1 (SL in g/m)

** Estimate

*** AP-42, Chapter 13.2.1

CONTROLLED EMISSIONS						
Location	PM lb/hr	PM ₁₀ lb/hr	PM _{2.5} lb/hr	PM ton/yr	PM ₁₀ ton/yr	PM _{2.5} ton/yr
East Plant	7.4E-2	1.5E-2	3.6E-3	3.1	0.62	0.15
Mill	8.9E-3	1.8E-3	4.4E-4	0.37	7.5E-2	1.8E-2
Tailings Storage Facility	4.0	0.93	9.3E-2	14.0	3.3	0.33
Filter Plant and Loadout Facility	0.67	0.14	1.4E-2	2.5	0.53	5.3E-2

UNCONTROLLED EMISSIONS						
Location	PM lb/hr	PM ₁₀ lb/hr	PM _{2.5} lb/hr	PM ton/yr	PM ₁₀ ton/yr	PM _{2.5} ton/yr
East Plant	0.74	0.15	3.6E-2	3.1	0.62	0.15
Mill	8.9E-2	1.8E-2	4.4E-3	0.37	7.5E-2	1.8E-2
Tailings Storage Facility	40.0	9.3	0.93	140	32.5	3.3
Filter Plant and Loadout Facility	6.7	1.4	0.14	24.7	5.3	0.53

Conversions & Assumptions			Days of >0.01" Precip		
365 days of operation/yr			EP	64	EPS Precip Data (days >0.01")
2,000 lb/ton			Mill	58	WPS Precip Data (days >0.01")
24 hr/day			TSF	57	TSF Precip Data (days >0.01")
90% Control (Chemical Suppressant)			FPLF	57	TSF Precip Data (days >0.01")

Blue values are input; black values are calculated or linked.

<p style="text-align: center;">Air Sciences Inc.</p> <p style="text-align: center;">AIR EMISSION CALCULATIONS</p>	PROJECT TITLE:		BY:	
	Resolution Copper EI		N. Tipple	
	PROJECT NO:	PAGE:	OF:	SHEET:
	262	3	3	Employees
	SUBJECT:		DATE:	
	Employee Fugitives		October 12, 2018	

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: N. Tipple		
	PROJECT NO: 262		PAGE: 1	OF: 6	
	SHEET: E_Gen		DATE: October 12, 2018		
Emergency Generator - Emissions Summary					
Emergency Power Generation Emissions Summary - Short-Term					
Source	CO <i>lb/hr</i>	NO _x <i>lb/hr</i>	PM <i>lb/hr</i>	SO ₂ <i>lb/hr</i>	VOC <i>lb/hr</i>
East Plant - Existing Generators	17.7	32.5	1.0	3.8E-2	6.6
East Plant - New Generators	14.9	101	3.5	0.76	6.8
Mill Generators	11.6	1.0	2.3E-2	2.7E-2	5.1E-2
Tailings Generator	3.9	0.35	7.7E-3	9.0E-3	1.7E-2
Filter Plant (Loadout) Generator	3.9	0.35	7.7E-3	9.0E-3	1.7E-2
Emergency Power Generation Total	51.9	136	4.6	0.84	13.4
Emergency Power Generation Emissions Summary - Long-Term					
Source	CO <i>ton/yr</i>	NO _x <i>ton/yr</i>	PM <i>ton/yr</i>	SO ₂ <i>ton/yr</i>	VOC <i>ton/yr</i>
East Plant - Existing Generators	4.4	8.1	0.25	9.6E-3	1.6
East Plant - New Generators	3.7	25.3	0.88	0.19	1.7
Mill Generators	2.9	0.26	5.7E-3	6.7E-3	1.3E-2
Tailings Generator	0.96	8.7E-2	1.9E-3	2.2E-3	4.3E-3
Filter Plant (Loadout) Generator	0.96	8.7E-2	1.9E-3	2.2E-3	4.3E-3
Emergency Power Generation Total	13.0	33.9	1.1	0.21	3.4
Conversions					
1.341 <i>hp/kW</i> 453.592 <i>g/lb</i> 2,000 <i>lb/ton</i> 15 <i>ppm S in ULSD (GPA 2140)</i> 7.05 <i>lb/gal</i> AP-42, Appendix A (Distillate Oil), Rev. 9/85 1.00E+06 <i>Btu/MMBtu</i>					
<i>Blue values are input; black values are calculated or linked.</i>					

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: N. Tipple	
	PROJECT NO: 262		PAGE: 2	OF: 6
	SHEET: E_Gen			
SUBJECT: Emergency Power Generation Emissions		DATE: October 12, 2018		

Emergency Power Generation

East Plant - Existing Generators

Cat 516B - Diesel	2,628 hp	Resolution
	1,960 kW	
Model Year	2006	Assuming Tier II
Cat 3046C - Diesel	449 hp	Resolution
	335 kW	
Model Year	2001	Assuming Tier II
Break-Specific Fuel Consumption	7,000 Btu/hp-hr	AP-42, Table 3.4-1, Footnote e, Rev. 10/96
Diesel Heat Value	137,000 Btu/gal	AP-42, Appendix A, Rev. 9/85
Operation	500 hr/yr	Resolution
Power (All Engines)	21.5 MMBtu/hr	

Total Diesel Fuel Consumption	<i>gal/hr</i>	<i>gal/yr</i>
Cat 516B - Diesel	134	67,139
Cat 3046C - Diesel	23	11,471

Emission Factors	Cat 516B - Diesel	Cat 3046C - Diesel	Reference
CO	3.50 g/kW-h	3.50 g/kW-h	40 CFR § 89.112, Table 1, Tier II
NO _x	6.40 g/kW-h	6.60 g/kW-h	40 CFR § 89.112, Table 1, Tier II
PM	0.20 g/kW-h	0.20 g/kW-h	40 CFR § 89.112, Table 1, Tier II
VOC	1.30 g/kW-h	1.30 g/kW-h	40 CFR § 89.112, Table 1, Tier II
SO ₂	-	-	Mass balance based on 15 ppm S content (below)

Emissions	Cat 516B - Diesel <i>lb/hr</i>	Cat 516B - Diesel <i>ton/yr</i>	Cat 3046C - Diesel <i>lb/hr</i>	Cat 3046C - Diesel <i>ton/yr</i>	Total <i>lb/hr</i>	Total <i>ton/yr</i>
CO	15.1	3.8	2.6	0.65	17.7	4.4
NO _x	27.7	6.9	4.9	1.2	32.5	8.1
PM	0.86	0.22	0.15	3.7E-2	1.0	0.25
VOC	5.6	1.4	0.96	0.24	6.6	1.6
SO ₂ *	3.3E-2	8.2E-3	5.6E-3	1.4E-3	3.8E-2	9.6E-3

* Calculated by mass balance using a 15% fuel contingency

SO2 Mass Balance (Single Cat 516B - Diesel)

134 <i>gal</i> <i>hr</i>	7.05 <i>lb</i> <i>gal</i>	0.0015% S	64.06 <i>lb SO₂</i> 32.07 <i>lb-S</i>	(1 + 15%)	=	0.03 <i>lb SO₂</i> <i>hr</i>
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0.03 <i>lb SO₂</i> <i>hr</i>	500 <i>hr</i> <i>yr</i>	ton 2,000 <i>lb</i>	=	0.008 <i>ton SO₂</i> <i>yr</i>
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SO2 Mass Balance (Single Cat 3046C - Diesel)

23 <i>gal</i> <i>hr</i>	7.05 <i>lb</i> <i>gal</i>	0.0015% S	64.06 <i>lb SO₂</i> 32.07 <i>lb-S</i>	(1 + 15%)	=	0.006 <i>lb SO₂</i> <i>hr</i>
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0.01 <i>lb SO₂</i> <i>hr</i>	500 <i>hr</i> <i>yr</i>	ton 2,000 <i>lb</i>	=	0.0014 <i>ton SO₂</i> <i>yr</i>
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Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: N. Tipple	
	PROJECT NO: 262		PAGE: 3	OF: 6
	SUBJECT: Emergency Power Generation Emissions		DATE: October 12, 2018	

Emergency Power Generation - Continued

East Plant - New Generators

Engine Make and Model	Caterpillar C175-16	Caterpillar Standby 3100 kW Tier 4i Performance Data
Engine Output	3,263 kW	
	4,376 hp	Resolution
Break-Specific Fuel Consumption	7,000 Btu/hp-hr	AP-42, Table 3.4-1, Footnote e, Rev. 10/96
Diesel Heat Value	137,000 Btu/gal	AP-42, Appendix A, Rev. 9/85
Quantity	14	Resolution
Operation	500 hr/yr	Resolution
Power (All Engines)	428.8 MMBtu/hr	

Total Diesel Fuel Consumption	<i>gal/hr</i>	<i>gal/yr</i>
Single Generator	224	111,796
14 Generators	3,130	1,565,139

Emission Factors	Performance Data*	Reference
CO	0.11 g/hp-h	Caterpillar Standby 3100 kW Tier 4i Performance Data (worst case)
NO _x	0.75 g/hp-h	Caterpillar Standby 3100 kW Tier 4i Performance Data (worst case)
PM**	0.05 g/hp-h	Caterpillar Standby 3100 kW Tier 4i Performance Data (worst case)
VOC	0.05 g/hp-h	Caterpillar Standby 3100 kW Tier 4i Performance Data (worst case)
SO ₂	-	Mass balance based on 15 ppm S content (below)

*Performance data: Rated Speed Potential Site Variation: 1800 RPM
**Worst case emissions at 50% power (2,284 hp)

Emissions	Single Generator		14 Generators	
	<i>lb/hr</i>	<i>ton/yr</i>	<i>lb/hr</i>	<i>ton/yr</i>
CO	1.1	0.27	14.9	3.7
NO _x	7.2	1.8	101	25.3
PM	0.25	6.3E-2	3.5	0.88
VOC	0.48	0.12	6.8	1.7
SO ₂ *	5.4E-2	1.4E-2	0.76	0.19

* Calculated by mass balance using a 15% fuel contingency

SO2 Mass Balance (Single Caterpillar C175-16)

224 <i>gal/hr</i>	7.05 <i>#/gal</i>	0.0015% S	64.06 <i>lb SO₂</i>	(1 + 15%)	=	0.05 <i>lb SO₂/hr</i>
			32.07 <i>lb-S</i>			

0.05 <i># SO₂/hr</i>	500 <i>#/yr</i>	ton	=	0.014 <i>ton SO₂/yr</i>
		2,000 <i>#</i>		

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: N. Tipple	
	PROJECT NO: 262		PAGE: 4	OF: 6
	SHEET: E_Gen		DATE: October 12, 2018	
SUBJECT: Emergency Power Generation Emissions				

Emergency Power Generation - Continued

Mill Generators

Engine Make and Model	Caterpillar C18 Generator Set Resolution		
Diesel Generator	671 hp		
	500 kW	Cat Specs	
Model Year	2016		
Quantity	3	Resolution	
Break-Specific Fuel Consumption	7,000 Btu/hp-hr	AP-42, Table 3.4-1, Footnote e, Rev. 10/96	
Diesel Heat Value	137,000 Btu/gal	AP-42, Appendix A, Rev. 9/85	
Operation	500 hr/yr	Resolution	
Power (All Engines)	14.1 MMBtu/hr		
Fuel Consumption (Single Generator)	37 gal/hr	Cat Specs	
	18,500 gal/yr		
Fuel Consumption (3 Generators)	55,500 gal/yr		

Emission Factors	Emission Factor	Reference
CO	3.5 g/kW-h	40 CFR § 1039.101, Table 1
NO _x	0.2 g/hp-hr	Cat Specs
PM	0.005 g/hp-hr	Cat Specs
VOC	0.01 g/hp-hr	Cat Specs
SO ₂	-	Mass balance based on 15 ppm S content (below)

Emissions	Diesel Generators (3)	
	lb/hr	ton/yr
CO	11.6	2.9
NO _x	1.0	0.26
PM	2.3E-2	5.7E-3
VOC	5.1E-2	1.3E-2
SO ₂ *	2.7E-2	6.7E-3

* Calculated by mass balance using a 15% fuel contingency

SO2 Mass Balance (Single Diesel Generator)

37 g#t	7.05 lb	0.0015% S	64.06 lb SO ₂	(1 + 15%)	=	0.009 lb SO ₂
hr	g#t		32.07 lb-S			hr

0.009 lb SO ₂	500 hr	ton	=	0.0022 ton SO ₂
hr	yr	2,000 lb		yr

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: N. Tipple																						
	PROJECT NO: 262		PAGE: 5	OF: 6																					
	SHEET: E_Gen		DATE: October 12, 2018																						
Emergency Power Generation - Continued																									
Tailings Generator																									
Engine Make and Model	Caterpillar C18 Generator Set Resolution																								
Diesel Generator	671 hp																								
	500 kW	Cat Specs																							
Model Year	2016																								
Quantity	1	Resolution																							
Break-Specific Fuel Consumption	7,000 Btu/hp-hr	AP-42, Table 3.4-1, Footnote e, Rev. 10/96																							
Diesel Heat Value	137,000 Btu/gal	AP-42, Appendix A, Rev. 9/85																							
Operation	500 hr/yr	Resolution																							
Power (All Engines)	4.7 MMBtu/hr																								
Fuel Consumption (Single Generator)	37 gal/hr	Cat Specs																							
	18,500 gal/yr																								
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>Emission Factors</th> <th>Emission Factor</th> <th>Reference</th> </tr> <tr> <td>CO</td> <td>3.5 g/kW-h</td> <td>40 CFR § 1039.101, Table 1</td> </tr> <tr> <td>NO_x</td> <td>0.2 g/hp-hr</td> <td>Cat Specs</td> </tr> <tr> <td>PM</td> <td>0.005 g/hp-hr</td> <td>Cat Specs</td> </tr> <tr> <td>VOC</td> <td>0.01 g/hp-hr</td> <td>Cat Specs</td> </tr> <tr> <td>SO₂</td> <td>-</td> <td>Mass balance based on 15 ppm S content (below)</td> </tr> </table>					Emission Factors	Emission Factor	Reference	CO	3.5 g/kW-h	40 CFR § 1039.101, Table 1	NO _x	0.2 g/hp-hr	Cat Specs	PM	0.005 g/hp-hr	Cat Specs	VOC	0.01 g/hp-hr	Cat Specs	SO ₂	-	Mass balance based on 15 ppm S content (below)			
Emission Factors	Emission Factor	Reference																							
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SO ₂	-	Mass balance based on 15 ppm S content (below)																							
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>Emissions</th> <th colspan="2">Diesel Generator</th> </tr> <tr> <td></td> <th>lb/hr</th> <th>ton/yr</th> </tr> <tr> <td>CO</td> <td>3.9</td> <td>0.96</td> </tr> <tr> <td>NO_x</td> <td>0.35</td> <td>8.7E-2</td> </tr> <tr> <td>PM</td> <td>7.7E-3</td> <td>1.9E-3</td> </tr> <tr> <td>VOC</td> <td>1.7E-2</td> <td>4.3E-3</td> </tr> <tr> <td>SO₂*</td> <td>9.0E-3</td> <td>2.2E-3</td> </tr> </table>					Emissions	Diesel Generator			lb/hr	ton/yr	CO	3.9	0.96	NO _x	0.35	8.7E-2	PM	7.7E-3	1.9E-3	VOC	1.7E-2	4.3E-3	SO ₂ *	9.0E-3	2.2E-3
Emissions	Diesel Generator																								
	lb/hr	ton/yr																							
CO	3.9	0.96																							
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SO ₂ *	9.0E-3	2.2E-3																							
* Calculated by mass balance using a 15% fuel contingency																									
SO2 Mass Balance (Single Diesel Generator)																									
<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center; border-right: 1px solid black;">37 g# hr</td> <td style="text-align: center; border-right: 1px solid black;">7.05 # g#</td> <td style="text-align: center; border-right: 1px solid black;">0.0015% S</td> <td style="text-align: center; border-right: 1px solid black;">64.06 lb SO₂ 32.07 # S</td> <td style="text-align: center; border-right: 1px solid black;">(1 + 15%)</td> <td style="text-align: center;">=</td> <td style="text-align: center;">0.009 lb SO₂ hr</td> </tr> </table>					37 g# hr	7.05 # g#	0.0015% S	64.06 lb SO ₂ 32.07 # S	(1 + 15%)	=	0.009 lb SO ₂ hr														
37 g# hr	7.05 # g#	0.0015% S	64.06 lb SO ₂ 32.07 # S	(1 + 15%)	=	0.009 lb SO ₂ hr																			
<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center; border-right: 1px solid black;">0.009 # SO₂ ##</td> <td style="text-align: center; border-right: 1px solid black;">500 # yr</td> <td style="text-align: center; border-right: 1px solid black;">ton 2,000 #</td> <td style="text-align: center;">=</td> <td style="text-align: center;">0.0022 ton SO₂ yr</td> </tr> </table>					0.009 # SO ₂ ##	500 # yr	ton 2,000 #	=	0.0022 ton SO ₂ yr																
0.009 # SO ₂ ##	500 # yr	ton 2,000 #	=	0.0022 ton SO ₂ yr																					

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: N. Tipple	
	PROJECT NO: 262		PAGE: 6	OF: 6
	SHEET: E_Gen			
SUBJECT: Emergency Power Generation Emissions		DATE: October 12, 2018		

Emergency Power Generation - Continued

Filter Plant (Loadout) Generator

Engine Make and Model	Caterpillar C18 Generator Set	Resolution
Diesel Generator	671 hp	
	500 kW	Cat Specs
Model Year	2016	
Quantity	1	Resolution
Break-Specific Fuel Consumption	7,000 Btu/hp-hr	AP-42, Table 3.4-1, Footnote e, Rev. 10/96
Diesel Heat Value	137,000 Btu/gal	AP-42, Appendix A, Rev. 9/85
Operation	500 hr/yr	Resolution
Power (All Engines)	4.7 MMBtu/hr	
Fuel Consumption (Single Generator)	37 gal/hr	Cat Specs
	18,500 gal/yr	

Emission Factors	Emission Factor	Reference
CO	3.5 g/kW-h	40 CFR § 1039.101, Table 1
NO _x	0.2 g/hp-hr	Cat Specs
PM	0.005 g/hp-hr	Cat Specs
VOC	0.01 g/hp-hr	Cat Specs
SO ₂	-	Mass balance based on 15 ppm S content (below)

Emissions	Diesel Generator	
	lb/hr	ton/yr
CO	3.9	0.96
NO _x	0.35	8.7E-2
PM	7.7E-3	1.9E-3
VOC	1.7E-2	4.3E-3
SO ₂ *	9.0E-3	2.2E-3

* Calculated by mass balance using a 15% fuel contingency

SO2 Mass Balance (Single Diesel Generator)

37 gal	7.05 lb	0.0015% S	64.06 lb SO ₂	(1 + 15%)	=	0.009 lb SO ₂
hr	gal		32.07 lb S			hr

0.009 lb SO ₂	500 hr	ton	=	0.0022 ton SO ₂
hr	yr	2,000 lb		yr

<p align="center">Air Sciences Inc.</p> <p align="center">AIR EMISSION CALCULATIONS</p>	PROJECT TITLE: Resolution Copper EI		BY: N. Tipple	
	PROJECT NO: 262		PAGE: 1	OF: 1
	SUBJECT: Diesel Fuel Storage		SHEET: Fuel Tanks	
DATE: October 12, 2018				

Diesel Storage Tanks						
		EP Surface	EP UG ^a	Mill	Loadout	Tailings
Per Tank Fuel Usage ^b	gal/hr	12	156	64	30	120
Per Tank Fuel Usage ^b	gal/mo	1,885	22,151	12,365	11,581	58,620
Per Tank Fuel Usage ^b	gal/yr	22,621	265,817	148,377	138,966	703,442
Total Fuel Usage ^b	gal/hr	12	937	318	119	1,438
Total Fuel Usage ^b	gal/mo	1,885	132,909	61,824	46,322	703,442
Total Fuel Usage ^b	gal/yr	22,621	1,594,904	741,883	555,866	8,441,304
Fuel Tank Quantity		1	6	5	4	12
Fuel Tank Volume	gal	5,000	20,000	10,000	10,000	20,000
Fills Per Tank, Per Year		5	14	15	14	36
Diameter	ft	8	13	8	12	12
Length	ft	13	20	27	12	24
Orientation		Horizontal	Horizontal	Horizontal	Horizontal	Horizontal
Tank Contents		Diesel	Diesel	Diesel	Diesel	Diesel
Location		Superior, Arizona				
Per Tank VOC Emissions	lb/hr	3.3E-4	8.0E-4	7.9E-4	7.7E-4	2.5E-3
Per Tank VOC Emissions	lb/yr	2.87	7.03	6.94	6.72	22.31
Per Tank VOC Emissions	ton/yr	1.4E-3	3.5E-3	3.5E-3	3.4E-3	1.1E-2
Total VOC Emissions	lb/hr	3.3E-4	4.8E-3	4.0E-3	3.1E-3	3.1E-2
Total VOC Emissions	ton/yr	1.4E-3	2.1E-2	1.7E-2	1.3E-2	0.13

^a Resolution 6562 (2,000 m).

^b Including 15% contingency

Conversions
7.48052 ft ³ /gal
2,000 lb/ton
8,760 hr/yr
12 mo/yr

Blue values are input; black values are calculated or linked.

Air Sciences Inc. AIR EMISSION CALCULATIONS		PROJECT TITLE: Resolution Copper EI		BY: N. Tipple		
		PROJECT NO: 262		PAGE: 1	OF: 2	SHEET: Cooling
		SUBJECT: Cooling Tower Emissions		DATE: October 12, 2018		

COOLING TOWERS - PM/PM ₁₀ /PM _{2.5} EMISSION RATES						
Operation		Reference				
Surface Cooling Circulation	4,200 l/s	1,110 gal/s	Resolution			
Surface Drift Loss	0.005%	Resolution				
Cooling Capacity	135.0 MW	Resolution				
Underground Cooling Circulation	1,250 l/s	330 gal/s	Resolution			
Underground Drift Loss	0.005%	Resolution				
Cooling Tower Water Quality		Reference				
Total Dissolved Solids (TDS)	3,000 ppm	Resolution				
Drift		Reference				
Drift Mass Governed by		EPA Document: Effects of Pathogenic and Toxic Material Transport				
Atmospheric Dispersion		31.3%	Via Cooling Device Drift - Vol. 1 Technical Report			
			EPA 600 7-79-251a, 11/1979			
Surface Towers						
1,110 gal	8.33 lb	3,600 sec	0.005% (drift)	=	1663.62 lb water	
sec	gal water	hr			hr	
Underground Towers						
330 gal	8.33 lb	3,600 sec	0.005% (drift)	=	495.12 lb water	
sec	gal water	hr			hr	
PM Emissions						
Surface Towers						
1663.62 lb water	31.3%	3,000 lb PM	=	1.56 lb PM	=	6.84 ton PM
hr	(dispersion factor)*	1.0E+06 lb water		hr		yr
Underground Towers						
495.12 lb water	31.3%	3,000 lb PM	=	0.47 lb PM	=	2.04 ton PM
hr	(dispersion factor)*	1.0E+06 lb water		hr		yr
PM ₁₀ Emissions						
Surface Towers						
1.56 lb PM	0.403 lb PM ₁₀ *	=	0.63 lb PM ₁₀	=	2.76 ton PM ₁₀	
hr	lb PM		hr		yr	
Underground Towers						
0.47 lb PM	0.403 lb PM ₁₀ *	=	0.19 lb PM ₁₀	=	0.82 ton PM ₁₀	
hr	lb PM		hr		yr	
PM _{2.5} Emissions						
Surface Towers						
1.56 lb PM	0.061 lb PM _{2.5} *	=	0.096 lb PM _{2.5}	=	0.420 ton PM _{2.5}	
hr	lb PM		hr		yr	
Underground Towers						
0.47 lb PM	0.061 lb PM _{2.5} *	=	0.029 lb PM _{2.5}	=	0.125 ton PM _{2.5}	
hr	lb PM		hr		yr	

*See size fraction calculation on Page 2.

Blue values are input; black values are calculated or linked.

Air Sciences Inc.	PROJECT TITLE:		BY:		
	Resolution Copper EI		N. Tipple		
	PROJECT NO:	PAGE:	OF:	SHEET:	
AIR EMISSION CALCULATIONS	262	1	1	Reagents	
	SUBJECT:	DATE:			
	Liquid Reagent Tanks & Solid Reagent Usage	October 12, 2018			

LIQUID REAGENT STORAGE TANK CHARACTERISTICS AND EMISSIONS			
	VOC*	VOC	VOC
TANK EMISSIONS	(lb/yr)	lb/hr	ton/yr
MIBC (Methyl isobutyl carbonal)	134.9	1.5E-02	6.7E-02
MCO (Non-polar flotation oil)	9.5	1.1E-03	4.8E-03
CYTEC 8989	0.1	1.1E-05	5.0E-05
NaHS (Sodium hydrosulfide solution)			

* Calculated using EPA Tanks 4.0.9d

	Notes
MIBC (Methyl isobutyl carbonal)	1
Design Throughput	2
Average Throughput	2
Tank Diameter	2
Tank Height	2
Tank Volume	2

	Notes
CYTEC 8989	1
Design Throughput	2
Average Throughput	2
Tank Diameter	2
Tank Height	2
Tank Volume	2

1 Assuming 100% (CH₃)₂CHCH₂CH(OH)CH₃

2 Resolution

	Notes
MCO (Non-polar flotation oil)	1
Design Throughput	2
Average Throughput	2
Tank Diameter	2
Tank Height	2
Tank Volume	2

	Notes
NaHS (Sodium hydrosulfide solution)	1
Design Throughput	2, 3
Average Throughput	2, 3
Tank Diameter	1, 2
Tank Height	1, 2
Tank Volume	1, 2
Specific Gravity	2

1 Dithiophosphate, Cresol -p, & Non-Organic Components

2 Resolution

3 As shipped concentration 40% - 45% NaHS

Solid Reagent Use (Resolution)			
	(tonne/day)	(tonne/day)	
	(design)	(average)	(ton/yr)
Lime	89.7	67.8	4.1
SIPX*	690*	600*	0.03
CIBA 155	3.70	3.22	0.17
CIBA 10	0.96	0.78	0.04

* Units: kg/day

Conversions	
3.78541 l/gal	24 hr/day
264.172 gal/m ³	365 days/yr
8.35 lb/gal water	2,204.62 lb/tonne
3.28084 ft/m	907.185 kg/ton
1.10231 ton/tonne	2,000 lb/ton
8,760 hr/yr	

Blue values are input; black values are calculated or linked.

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: N. Tipple	
	PROJECT NO: 262		PAGE: 2	OF: 4
	SUBJECT: Drilling and Blasting		DATE: October 12, 2018	

West Plant Drilling

Emission Factors		Reference
PM ₁₀	8.0E-5 lb/ton	AP-42, Table 11.19.2-2 (wet drilling), Rev. 8/04

PM Scaling Factors		
PM	2.1	Ratio calculated based on particle size multiplier from AP-42, 13.2.4
PM ₁₀	1	
PM _{2.5}	1	

Production Drilling - Activity Information

Ore Quantity	164,300 tonne/yr
	1,414 tonne/hr
	181,110 ton/yr
	1,559 ton/hr

Production Drilling - Emissions

	lb/hr	ton/yr
PM	0.26	1.5E-2
PM ₁₀	0.12	7.2E-3
PM _{2.5}	0.12	7.2E-3

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: N. Tipple		
	PROJECT NO: 262		PAGE: 3	OF: 4	SHEET: Drill & Blast
	SUBJECT: Drilling and Blasting		DATE: October 12, 2018		

East Plant Blasting		Reference
Activity Information		
Blasting Agent Use	1,487,000 kg/yr	Resolution
	1,639 ton/yr	
No. of Blasts	487 blasts/yr	Resolution
	2 max blasts/day	Resolution
Operation	365 days/yr	
	24 hr/day	

Emission Factors		Reference
Emission Factor Equation	$TSP = 0.000014 \times A^{1.5}$	AP-42, Table 11.9-1 (blasting, overburden), Rev. 7/98
Where, A = Area per Blast	580 m ² (max per blast)	Resolution
	6,243 ft ² (max per blast)	Based on maximum blasts per day
TSP	6.91 lb/blast	
Where, A = Area per Blast	141,200 m ² (annual)	Resolution
	1,519,863 ft ² (annual)	
TSP	3,363 lb/yr	
CO	32.53 lb/ton	Resolution
NO _x	6.20 lb/ton	Resolution
SO ₂	2 lb/ton	AP-42, Table 13.3-1 (ANFO), Rev. 2/80

PM Scaling Factors		Reference
PM	1	AP-42, Table 11.9-1 (blasting, overburden), Rev. 7/98
PM ₁₀	0.52	AP-42, Table 11.9-1 (blasting, overburden), Rev. 7/98
PM _{2.5}	0.03	AP-42, Table 11.9-1 (blasting, overburden), Rev. 7/98

Emissions	(lb/blast)*	lb/hr*	(lb/day)*	ton/yr
PM	6.9	6.9	13.8	1.7
PM ₁₀	3.6	3.6	7.2	0.87
PM _{2.5}	0.21	0.21	0.41	5.0E-2
CO	109	109	219	26.7
NO _x	20.9	20.9	41.7	5.1
SO ₂	6.7	6.7	13.5	1.6

* Based on maximum of 2 blasts per day

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: N. Tipple		
	PROJECT NO: 262		PAGE: 4	OF: 4	SHEET: Drill & Blast
	SUBJECT: Drilling and Blasting		DATE: October 12, 2018		

West Plant Blasting		Reference
Activity Information		
Blasting Agent Use	118,300 kg/yr	Resolution
	130 ton/yr	
No. of Blasts	390 blasts/yr	Resolution
	2 max blasts/day	Resolution
Operation	365 days/yr	
	24 hr/day	

Emission Factors		Reference
Emission Factor Equation	$TSP = 0.000014 \times A^{1.5}$	AP-42, Table 11.9-1 (blasting, overburden), Rev. 7/98
Where, A = Area per Blast	63 m ² (max per blast)	Resolution
	678 ft ² (max per blast)	Based on maximum blasts per day
TSP	0.25 lb/blast	
Where, A = Area per Blast	14,400 m ² (annual)	Resolution
	155,000 ft ² (annual)	
TSP	96 lb/yr	
CO	32.53 lb/ton	Resolution
NO _x	6.20 lb/ton	Resolution
SO ₂	2 lb/ton	AP-42, Table 13.3-1 (ANFO), Rev. 2/80

PM Scaling Factors		Reference
PM	1	AP-42, Table 11.9-1 (blasting, overburden), Rev. 7/98
PM ₁₀	0.52	AP-42, Table 11.9-1 (blasting, overburden), Rev. 7/98
PM _{2.5}	0.03	AP-42, Table 11.9-1 (blasting, overburden), Rev. 7/98

Emissions	(lb/blast)*	lb/hr*	(lb/day)*	ton/yr
PM	0.25	0.25	0.49	4.8E-2
PM ₁₀	0.13	0.13	0.26	2.5E-2
PM _{2.5}	7.4E-3	7.4E-3	1.5E-2	1.4E-3
CO	10.9	10.9	21.8	2.1
NO _x	2.1	2.1	4.1	0.40
SO ₂	0.67	0.67	1.3	0.13

* Based on maximum of 2 blasts per day

Air Sciences Inc. <
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Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: N. Tipple		
	PROJECT NO: 262		PAGE: 1	OF: 1	SHEET: MolyTalc
	SUBJECT: Moly/Talc Heat Treatment		DATE: October 12, 2018		

Molybdenite / Talc Concentrate Heat Treatment Emissions					
		Long-Term Emissions*		Short-Term Emissions*	
SO ₂ Emissions					
Uncontrolled SO ₂ Emissions		245 tonne/yr	270 ton/yr	83.9 lb/hr	
SO ₂ Control Efficiency		95%		95%	
Controlled SO ₂ Emissions		12.3 tonne/yr	13.6 ton/yr	4.2 lb/hr	
VOC Emissions					
Uncontrolled VOC Emissions		503 tonne/yr	554 ton/yr	172 lb/hr	
VOC Control Efficiency		88%		88%	
Controlled VOC Emissions		59.1 tonne/yr	65.1 ton/yr	20.2 lb/hr	

* Resolution

Molybdenite / Talc Rotary Dryer - Throughput Rates and Process Emission Factors					
Dryer Throughput		62,603 tonne/yr	Resolution		
		69,008 ton/yr			
		9.7 tonne/hr	Resolution		
		10.7 ton/hr			
Dryer Heat Capacity		16.25 MMBtu/hr	Resolution		
Dryer Propane Usage		180 gal/hr			
		1,572,928 gal/yr			
Emission Factors	PM	10 lb/ton	AP-42, Table 12.3-3, Rev. 10/86		
	PM ₁₀	9.9 lb/ton	AP-42, Table 12.3-3, Rev. 10/86, With Particle Size Ratio		
	PM _{2.5}	8.4 lb/ton	AP-42, Table 12.3-3, Rev. 10/86, With Particle Size Ratio		
PM Control Efficiency		99.0%	EPA Air Pollution Control Technology Fact Sheet, Wet Electrostatic Precipitator		

Molybdenite / Talc Rotary Dryer - Process Emissions			
		lb/hr	ton/yr
Uncontrolled	PM	107	345
	PM ₁₀	106	341
	PM _{2.5}	90.0	291
Controlled	PM	1.1	3.5
	PM ₁₀	1.1	3.4
	PM _{2.5}	0.90	2.9

Molybdenite / Talc Rotary Dryer - Combustion Emissions			
Pollutant	lb/k-gal *	lb/hr	ton/yr
PM	0.7	0.13	0.55
SO ₂	1.6	0.29	1.3
NO _x	13	2.3	10.2
CO	7.5	1.3	5.9
VOC	0.8	0.14	0.63

AP-42, Table 1.5-1, Rev. 07/08

Conversions	
90.5 MMBtu/k-gal (AP-42, Appendix A)	
7,000 gr/lb	
0.0185% S in Propane (GPA 2140-97)	
44.08 lb/mol C ₃ H ₈	
359.05 SCF/lb-mol (0° F)	
100 SCF/100 SCF	
1.10231 ton/tonne	
2.20462 lb/kg	
2,000 lb/ton	

Blue values are input; black values are calculated or linked.

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper El				BY: N. Tipple		
	PROJECT NO: 262				PAGE: 1	OF: 3	SHEET: Deliveries
	SUBJECT: Delivery Fugitives				DATE: October 12, 2018		

Summary of Material and Equipment Deliveries							
CONTROLLED EMISSIONS (SHORT-TERM)							
Location	PM lb/hr	PM ₁₀ lb/hr	PM _{2.5} lb/hr	NO _x lb/hr	SO ₂ lb/hr	CO lb/hr	VOC lb/hr
East Plant	0.3	9.6E-2	2.5E-2	0.1	4.0E-4	4.3E-2	9.6E-3
Mill	0.8	0.2	5.9E-2	0.3	9.4E-4	0.1	2.3E-2
Tailings Storage Facility*							
Filter Plant and Loadout Facility*							
* Regular deliveries not scheduled for production phase.							
CONTROLLED EMISSIONS (LONG-TERM)							
Location	PM ton/yr	PM ₁₀ ton/yr	PM _{2.5} ton/yr	NO _x ton/yr	SO ₂ ton/yr	CO ton/yr	VOC ton/yr
East Plant	2.4	0.5	0.1	9.9E-2	3.1E-4	3.3E-2	7.4E-3
Mill	2.3	0.5	0.1	9.5E-2	3.0E-4	3.2E-2	7.2E-3
Tailings Storage Facility*							
Filter Plant and Loadout Facility*							
* Regular deliveries not scheduled for production phase.							
UNCONTROLLED EMISSIONS (SHORT-TERM)							
Location	PM lb/hr	PM ₁₀ lb/hr	PM _{2.5} lb/hr	NO _x lb/hr	SO ₂ lb/hr	CO lb/hr	VOC lb/hr
East Plant	3.2	0.7	0.2	0.1	4.0E-4	4.3E-2	9.6E-3
Mill	7.6	1.6	0.4	0.3	9.4E-4	0.1	2.3E-2
Tailings Storage Facility*							
Filter Plant and Loadout Facility*							
* Regular deliveries not scheduled for production phase.							
UNCONTROLLED EMISSIONS (LONG-TERM)							
Location	PM ton/yr	PM ₁₀ ton/yr	PM _{2.5} ton/yr	NO _x ton/yr	SO ₂ ton/yr	CO ton/yr	VOC ton/yr
East Plant	2.4	0.5	0.1	9.9E-2	3.1E-4	3.3E-2	7.4E-3
Mill	2.3	0.5	0.1	9.5E-2	3.0E-4	3.2E-2	7.2E-3
Tailings Storage Facility*							
Filter Plant and Loadout Facility*							
* Regular deliveries not scheduled for production phase.							

<p style="text-align: center;">Air Sciences Inc.</p> <p style="text-align: center;">AIR EMISSION CALCULATIONS</p>	PROJECT TITLE: Resolution Copper EI		BY: N. Tipple		
	PROJECT NO: 262		PAGE: 2	OF: 3	SHEET: Deliveries
	SUBJECT: Delivery Fugitives		DATE: October 12, 2018		

Fugitive Dust from Material and Equipment Deliveries						
Deliveries by Location	trips/yr	trips/day	trips/hr	one way VMT, ea**	VMT/yr	VMT/hr
East Plant	6,166	20	4	1.9	23,431	15
Mill	6,935	19	11	1.6	22,608	36
Tailings Storage Facility*	0	0		5.4	0	0
Filter Plant and Loadout Facility*	0	0		1.3	0	0

* Regular deliveries not scheduled for production phase.

** Resolution

Unpaved Roads - Equation & Constants*				
$E = k \times (s / 12)^a \times (W / 3)^b \times (365 - P) / 365$				
Empirical Constants for Industrial Roads				
Constant	PM	PM ₁₀	PM _{2.5}	
k, a, b - empirical constants	k	4.9	1.5	0.15
s - surface material silt content %	a	0.7	0.9	0.9
W - mean vehicle wt ton	b	0.45	0.45	0.45

* AP-42, 13.2.2, Equations 1a & 2, Table 13.2.2-2, Unpaved Roads, Rev. 11/06

EMISSION FACTORS						
Location	Paved/Unpaved	Silt %*	Vehicle Weight ton**	PM lb/VMT	PM ₁₀ lb/VMT	PM _{2.5} lb/VMT
East Plant	Paved***	SL: 0.6	28.3	0.21	4.2E-2	1.0E-2
Mill	Paved***	SL: 0.6	28.3	0.21	4.2E-2	1.0E-2
Tailings Storage Facility	Unpaved	3.0	28.3	5.1	1.2	0.12
Filter Plant and Loadout Facility	Unpaved	2.0	28.3	3.8	0.82	8.2E-2

* AP-42, Chapter 13.2.2 and 13.2.1 (SL in g/m²)

** Representative 18-Wheeler Weight (16.5 ton) and 40-ton Highway Limit

*** AP-42, Chapter 13.2.1

CONTROLLED EMISSIONS						
Location	PM lb/hr	PM ₁₀ lb/hr	PM _{2.5} lb/hr	PM ton/yr	PM ₁₀ ton/yr	PM _{2.5} ton/yr
East Plant	0.32	6.3E-2	1.6E-2	2.3	0.47	0.11
Mill	0.75	0.15	3.7E-2	2.3	0.45	0.11
Tailings Storage Facility*						
Filter Plant and Loadout Facility*						

Regular deliveries not scheduled for production phase.

*

UNCONTROLLED EMISSIONS						
Location	PM lb/hr	PM ₁₀ lb/hr	PM _{2.5} lb/hr	PM ton/yr	PM ₁₀ ton/yr	PM _{2.5} ton/yr
East Plant	3.2	0.63	0.16	2.3	0.47	0.11
Mill	7.5	1.5	0.37	2.3	0.45	0.11
Tailings Storage Facility*						
Filter Plant and Loadout Facility*						

Regular deliveries not scheduled for production phase.

*

Conversions & Assumptions			Days of >0.01" Precip		
453.592 g/lb			EP	64	EPS Precip Data (days >0.01")
2,000 lb/ton			Mill	58	WPS Precip Data (days >0.01")
24 hr/day			TSF	57	TSF Precip Data (days >0.01")
90% Control (Chemical Suppressant)			FPLF	57	TSF Precip Data (days >0.01")

Blue values are input; black values are calculated or linked.

Air Sciences Inc.	PROJECT TITLE:				BY:					
	Resolution Copper EI				N. Tipple					
	PROJECT NO:				PAGE:		OF:		SHEET:	
AIR EMISSION CALCULATIONS	262				3		3		Deliveries	
	SUBJECT:				DATE:					
	Delivery Fugitives				October 12, 2018					

Combustion Emissions from Deliveries								
		PM	PM ₁₀	PM _{2.5}	NO _x	SO ₂	CO	VOC
Location	VMT/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr
East Plant	15	3.2E-2	3.2E-2	9.3E-3	0.1	4.0E-4	4.3E-2	9.6E-3
Mill	36	7.7E-2	7.7E-2	2.2E-2	0.3	9.4E-4	0.1	2.3E-2
Tailings Storage Facility*	0							
Filter Plant and Loadout Facility*	0							
* Regular deliveries not scheduled for production phase.								
		PM	PM ₁₀	PM _{2.5}	NO _x	SO ₂	CO	VOC
Location	VMT/yr	ton/yr	ton/yr	ton/yr	ton/yr	ton/yr	ton/yr	ton/yr
East Plant	23,431	2.5E-2	2.5E-2	7.1E-3	9.9E-2	3.1E-4	3.3E-2	7.4E-3
Mill	22,608	2.4E-2	2.4E-2	6.9E-3	9.5E-2	3.0E-4	3.2E-2	7.2E-3
Tailings Storage Facility*	0							
Filter Plant and Loadout Facility*	0							
* Regular deliveries not scheduled for production phase.								
		PM	PM ₁₀	PM _{2.5}	NO _x	SO ₂	CO	VOC
Combustion Emission Factor*		g/VMT	g/VMT	g/VMT	g/VMT	g/VMT	g/VMT	g/VMT
		1.0	1.0	0.3	3.8	1.2E-2	1.3	0.3
* MOVES 2014a								

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: N. Tipple		
	PROJECT NO: 262		PAGE: 1	OF: 2	SHEET: BatchPlant
	SUBJECT: Concrete Batch Plant		DATE: October 12, 2018		

CONTROLLED EMISSIONS

Source Description	PM		PM ₁₀		PM _{2.5}	
	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr
Aggregate Delivery to Ground Storage	0.45	0.25	0.21	0.12	0.03	0.02
Sand Delivery to Ground Storage	0.23	0.13	0.11	0.06	0.02	9.3E-3
Aggregate Transfer to Conveyor Belt via Chute	0.03	0.02	0.02	0.01	2.5E-3	1.6E-3
Sand Transfer to Conveyor Belt via Chute	0.03	0.01	0.01	5.3E-3	2.0E-3	8.5E-4
Aggregate Transfer to Elevated Storage	0.03	0.02	0.02	0.01	2.5E-3	1.6E-3
Sand Transfer to Elevated Storage	0.03	0.01	0.01	5.3E-3	2.0E-3	8.5E-4
Weigh Hopper Loading (Aggregate & Sand)	0.31	0.15	0.18	0.09	0.03	0.01
Weigh Hopper Discharge to Truck Loading Conveyor (Agg)	0.03	0.02	0.02	0.01	2.5E-3	1.6E-3
Weigh Hopper Discharge to Truck Loading Conveyor (Sand)	0.03	0.01	0.01	5.3E-3	2.0E-3	8.5E-4
Cement Unloading to Silo	0.08	0.03	0.03	0.01	3.9E-3	1.6E-3
Flyash Unloading to Silo	0.09	0.04	0.05	0.02	7.2E-3	3.7E-3
Silica Fume Unloading to Silo	0.03	9.5E-3	0.02	5.2E-3	2.9E-3	7.9E-4
Cement & Flyash Discharge to Silo Weigh Hopper	4.3E-3	1.8E-3	2.5E-3	1.0E-3	3.8E-4	1.6E-4
Silo Weigh Hopper Discharge to Truck Loading Conveyor	4.3E-3	1.8E-3	2.5E-3	1.0E-3	3.8E-4	1.6E-4
Truck Loading*	8.8	3.7	2.4	0.98	0.36	0.15
Total	10.2	4.4	3.0	1.3	0.46	0.20

*Emissions for truck loading are based on quantity of cement and cement supplement, per AP-42 Chapter 11.12.

UNCONTROLLED EMISSIONS

Source Description	PM		PM ₁₀		PM _{2.5}	
	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr
Aggregate Delivery to Ground Storage	0.56	0.32	0.27	0.15	0.04	0.02
Sand Delivery to Ground Storage	0.28	0.16	0.13	0.08	0.02	0.01
Aggregate Transfer to Conveyor Belt via Chute	0.49	0.32	0.23	0.15	0.04	0.02
Sand Transfer to Conveyor Belt via Chute	0.39	0.16	0.18	0.08	0.03	0.01
Aggregate Transfer to Elevated Storage	0.49	0.32	0.23	0.15	0.04	0.02
Sand Transfer to Elevated Storage	0.39	0.16	0.18	0.08	0.03	0.01
Weigh Hopper Loading (Aggregate & Sand)	1.2	0.59	0.72	0.34	0.11	0.05
Weigh Hopper Discharge to Truck Loading Conveyor (Agg)	0.49	0.32	0.23	0.15	0.04	0.02
Weigh Hopper Discharge to Truck Loading Conveyor (Sand)	0.39	0.16	0.18	0.08	0.03	0.01
Cement Unloading to Silo	55.6	22.8	35.8	14.7	5.4	2.2
Flyash Unloading to Silo	30.7	15.6	10.7	5.5	1.6	0.83
Silica Fume Unloading to Silo	12.3	3.3	4.3	1.2	0.65	0.18
Cement & Flyash Discharge to Silo Weigh Hopper	0.43	0.18	0.25	0.10	0.04	0.02
Silo Weigh Hopper Discharge to Truck Loading Conveyor	0.43	0.18	0.25	0.10	0.04	0.02
Truck Loading*	100	41.7	27.9	11.6	4.2	1.7
Total	205	86.3	81.6	34.3	12.4	5.2

*Emissions for truck loading are based on quantity of cement and cement supplement, per AP-42 Chapter 11.12.

Conversions

2,000 lb/ton

Blue values are input; black values are calculated or linked.

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: N. Tipple		
	PROJECT NO: 262		PAGE: 2	OF: 2	SHEET: BatchPlant
	SUBJECT: Concrete Batch Plant		DATE: October 12, 2018		

Max Emission Scenario: Shotcrete

ACTIVITY RATES					
Source Description	Capacity ¹		Control Description		Reference
	ton/hr	ton/yr			
Aggregate Delivery to Ground Storage	81.0	91,386	Water Sprays	20%	2
Sand Delivery to Ground Storage	135	154,412	Water Sprays	20%	2
Aggregate Transfer to Conveyor Belt via Chute	70.8	91,386	Wind Break		
Sand Transfer to Conveyor Belt via Chute	185	154,412	Wind Break		
Aggregate Transfer to Elevated Storage	70.8	91,386	Wind Break		
Sand Transfer to Elevated Storage	185	154,412	Wind Break		
Weigh Hopper Loading (Aggregate & Sand)	255	245,797	Enclosure	75%	3
Weigh Hopper Discharge to Truck Loading Conveyor (Agg)	70.8	91,386	Enclosure		
Weigh Hopper Discharge to Truck Loading Conveyor (Sand)	185	154,412	Enclosure		
Cement Unloading to Silo	76.2	62,467	Dust Collector		
Flyash Unloading to Silo	9.8	9,947	Dust Collector		
Silica Fume Unloading to Silo	3.9	2,130	Dust Collector		
Cement & Flyash Discharge to Silo Weigh Hopper	89.8	74,544	Vent Filter	99%	4
Silo Weigh Hopper Discharge to Truck Loading Conveyor	89.8	74,544			
Truck Loading	345	320,341	Dust Collector		

1 Resolution Copper

2 AP-42, Table B2.-3, Spray Tower (PM_{2.5}), Rev. 9/90

3 Stationary Source Control Techniques Document for Fine Particulate Matter (EPA 1998), Table 6.1, Telescoping Chute

4 Stationary Source Control Techniques Document for Fine Particulate Matter (EPA 1998), Figure 5.3-2

EMISSION FACTORS							
Source Description	Uncontrolled			Controlled			Reference
	PM lb/ton	PM ₁₀ lb/ton	PM _{2.5} lb/ton	PM lb/ton	PM ₁₀ lb/ton	PM _{2.5} lb/ton	
Aggregate Delivery to Ground Storage	6.9E-03	3.3E-03	5.0E-04	5.5E-03	2.6E-03	4.0E-04	1
Sand Delivery to Ground Storage	2.1E-03	9.9E-04	1.5E-04	1.7E-03	7.9E-04	1.2E-04	2
Aggregate Transfer to Conveyor Belt via Chute	6.9E-03	3.3E-03	5.0E-04	4.9E-04	2.3E-04	3.5E-05	3
Sand Transfer to Conveyor Belt via Chute	2.1E-03	9.9E-04	1.5E-04	1.5E-04	6.9E-05	1.1E-05	4
Aggregate Transfer to Elevated Storage	6.9E-03	3.3E-03	5.0E-04	4.9E-04	2.3E-04	3.5E-05	3
Sand Transfer to Elevated Storage	2.1E-03	9.9E-04	1.5E-04	1.5E-04	6.9E-05	1.1E-05	4
Weigh Hopper Loading (Aggregate & Sand)	4.8E-03	2.8E-03	4.2E-04	1.2E-03	7.0E-04	1.1E-04	5
Weigh Hopper Discharge to Truck Loading Conveyor (Agg)	6.9E-03	3.3E-03	5.0E-04	4.9E-04	2.3E-04	3.5E-05	3
Weigh Hopper Discharge to Truck Loading Conveyor (Sand)	2.1E-03	9.9E-04	1.5E-04	1.5E-04	6.9E-05	1.1E-05	4
Cement Unloading to Silo	0.73	0.47	0.07	9.9E-04	3.4E-04	5.1E-05	6
Flyash Unloading to Silo	3.14	1.1	0.2	8.9E-03	4.9E-03	7.4E-04	7
Silica Fume Unloading to Silo	3.14	1.1	0.2	8.9E-03	4.9E-03	7.4E-04	7
Cement & Flyash Discharge to Silo Weigh Hopper	4.8E-03	2.8E-03	4.2E-04	4.8E-05	2.8E-05	4.2E-06	5
Silo Weigh Hopper Discharge to Truck Loading Conveyor	4.8E-03	2.8E-03	4.2E-04	4.8E-05	2.8E-05	4.2E-06	5
Truck Loading	1.118	0.31	0.0469	0.0980	0.0263	4.0E-03	8

1 AP-42 Table 11.12-2 based on section 13.2.4 equation 1 (Aggregate Transfers); Controlled 20% with water sprays

2 AP-42 Table 11.12-2 based on section 13.2.4 equation 1 (Sand Transfers); Controlled 20% with water sprays

3 AP-42 Table 11.12-2 based on section 13.2.4 equation 1 (Aggregate Transfers); Controlled wind speed (1.3 mph)

4 AP-42 Table 11.12-2 based on section 13.2.4 equation 1 (Sand Transfers); Controlled wind speed (1.3 mph)

5 AP-42 Table 11.12-2 (weigh hopper loading); PM_{2.5} factors based on Chapter 13.2.4 particle size multipliers

6 AP-42 Table 11.12-2 (cement unloading to elevated storage silo); PM_{2.5} factors based on Chapter 13.2.4 particle size multipliers

7 AP-42 Table 11.12-2 (cement supplement unloading to elevated storage silo); PM_{2.5} factors based on Chapter 13.2.4 particle size multipliers

8 AP-42 Table 11.12-2 (Truck Loading - truck mix); PM_{2.5} factors based on Chapter 13.2.4 particle size multipliers

Air Sciences Inc.				PROJECT TITLE:		BY:		
				Resolution Copper EI		D. Steen		
				PROJECT NO:		PAGE:	OF:	SHEET:
AIR EMISSION CALCULATIONS				262		1	2	RailRoad
				SUBJECT:		DATE:		
				Rail Line Combustion		July 27, 2018		
Locomotives				locomotive assumptions				
2,000	hp	Locomotive engine capacity (estimated)		Tier 4	engine rated emission			
2		locomotives per trip		average	speed based on terrain			
Rail distance								
20.9 mi	one-way	WPS to Far West (Onsite)						
6.7 mi	one-way	Far West to MJ (Offsite)		Alt2	Activity Scenario (Alternative)			
Train Speed								
10 mph	max	North or Rte 60						
25 mph	max	S. rte. 60						
6.67 mph	average	North or Rte 60						
16.67 mph	average	S. rte. 60						
2.4 hours	average	time from WPS to Far West						
0.4 hours	average	time from Far West to Magma Junction						
Emission Factors								
				PM	NOX	CO	VOC	
				g/bhp-hr	g/bhp-hr	g/bhp-hr	g/bhp-hr	
2005-2011		0.1	5.5	1.5	0.3	Tier 2		
2012-2014		0.1	5.5	1.5	0.3	Tier 3		
2015+		0.03	1.3	1.5	0.14	Tier 4		
TABLE 1 TO §1033.101 – LINE-HAUL LOCOMOTIVE EMISSION STANDARDS								

Air Sciences Inc.				PROJECT TITLE:				BY:																																																																																																																																																																																																																																																			
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AIR EMISSION CALCULATIONS				262				2		2		RailRoad																																																																																																																																																																																																																																															
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Loadout from FP&LF				100 cars per train				GPO																																																																																																																																																																																																																																																			
456 ton/hour				15 ppm S (ULSD)				GPO																																																																																																																																																																																																																																																			
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17.3 hours				loading time/ day																																																																																																																																																																																																																																																							
0.0048 g/hp-hr SO2 =																																																																																																																																																																																																																																																											
15 parts S				7.05 lb		64.06 SO2		gal diesel		0.007 MMBtu		453.592 g																																																																																																																																																																																																																																															
1,000,000				gal diesel		32.07 S		0.14 MMBtu		hp-hr		lb																																																																																																																																																																																																																																															
train W																																																																																																																																																																																																																																																											
16 ft		locomotive height		4.9 m																																																																																																																																																																																																																																																							
50 ft		typical RR ROW		7 m		rail bed		3 m		one way guidance (RoadW-VW+6m)																																																																																																																																																																																																																																																	
<table><tr><td>UTM1_E</td><td>UTM1_N</td><td>Elev1</td><td>UTM2_E</td><td>UTM2_N</td><td>Elev2</td><td>distance</td><td>Elev</td><td>% total</td><td>width</td><td>SigZ</td><td>init</td></tr><tr><td>(m)</td><td>(m)</td><td>(m)</td><td>(m)</td><td>(m)</td><td>(m)</td><td>(m)</td><td>(m)</td><td>%</td><td>m</td><td>(m)</td><td></td></tr><tr><td colspan="12">Rail line hauling concentrate offsite (Far West to Magma Junction)</td></tr><tr><td>RR_Offsite</td><td>453,418</td><td>3,666,075</td><td>463</td><td>462,062</td><td>3,672,632</td><td>511</td><td>10,850</td><td>487</td><td>40.4%</td><td>10.0</td><td>3.86</td></tr><tr><td colspan="12">Rail line to onsite tailings facility (WPS to Far West) - Alt4 Only</td></tr><tr><td>RR_Onsite1</td><td>462,062</td><td>3,672,632</td><td>511</td><td>472,780</td><td>3,680,551</td><td>616</td><td>13,326</td><td>563</td><td>42.1%</td><td>10</td><td>3.86</td></tr><tr><td>RR_Onsite2</td><td>472,780</td><td>3,680,551</td><td>616</td><td>473,827</td><td>3,681,797</td><td>634</td><td>1,628</td><td>625</td><td>5.1%</td><td>10</td><td>3.86</td></tr><tr><td>RR_Onsite3</td><td>473,827</td><td>3,681,797</td><td>634</td><td>475,468</td><td>3,682,792</td><td>659</td><td>1,919</td><td>646</td><td>6.1%</td><td>10</td><td>3.86</td></tr><tr><td>RR_Onsite4</td><td>475,468</td><td>3,682,792</td><td>659</td><td>475,817</td><td>3,683,276</td><td>668</td><td>597</td><td>663</td><td>1.9%</td><td>10</td><td>3.86</td></tr><tr><td>RR_Onsite5</td><td>475,817</td><td>3,683,276</td><td>668</td><td>476,357</td><td>3,683,229</td><td>671</td><td>542</td><td>670</td><td>1.7%</td><td>10</td><td>3.86</td></tr><tr><td>RR_Onsite6</td><td>476,357</td><td>3,683,229</td><td>671</td><td>476,388</td><td>3,683,695</td><td>670</td><td>467</td><td>671</td><td>1.5%</td><td>10</td><td>3.86</td></tr><tr><td>RR_Onsite7</td><td>476,388</td><td>3,683,695</td><td>670</td><td>478,018</td><td>3,685,033</td><td>674</td><td>2,109</td><td>672</td><td>6.7%</td><td>10</td><td>3.86</td></tr><tr><td>RR_Onsite8</td><td>478,018</td><td>3,685,033</td><td>674</td><td>480,183</td><td>3,684,192</td><td>680</td><td>2,322</td><td>677</td><td>7.3%</td><td>10</td><td>3.86</td></tr><tr><td>RR_Onsite9</td><td>480,183</td><td>3,684,192</td><td>680</td><td>481,147</td><td>3,684,158</td><td>690</td><td>965</td><td>685</td><td>3.0%</td><td>10</td><td>3.86</td></tr><tr><td>RR_Onsite10</td><td>481,147</td><td>3,684,158</td><td>690</td><td>481,638</td><td>3,683,430</td><td>710</td><td>879</td><td>700</td><td>2.8%</td><td>10</td><td>3.86</td></tr><tr><td>RR_Onsite11</td><td>481,638</td><td>3,683,430</td><td>710</td><td>482,998</td><td>3,683,091</td><td>720</td><td>1,401</td><td>715</td><td>4.4%</td><td>10</td><td>3.86</td></tr><tr><td>RR_Onsite12</td><td>482,998</td><td>3,683,091</td><td>720</td><td>483,522</td><td>3,682,631</td><td>726</td><td>697</td><td>723</td><td>2.2%</td><td>10</td><td>3.86</td></tr><tr><td>RR_Onsite13</td><td>483,522</td><td>3,682,631</td><td>726</td><td>484,294</td><td>3,682,996</td><td>739</td><td>855</td><td>732</td><td>2.7%</td><td>10</td><td>3.86</td></tr><tr><td>RR_Onsite14</td><td>484,294</td><td>3,682,996</td><td>739</td><td>487,104</td><td>3,682,964</td><td>793</td><td>2,810</td><td>766</td><td>8.9%</td><td>10</td><td>3.86</td></tr><tr><td>RR_Onsite15</td><td>487,104</td><td>3,682,964</td><td>793</td><td>488,221</td><td>3,683,276</td><td>816</td><td>1,159</td><td>804</td><td>3.7%</td><td>10</td><td>3.86</td></tr></table>												UTM1_E	UTM1_N	Elev1	UTM2_E	UTM2_N	Elev2	distance	Elev	% total	width	SigZ	init	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	%	m	(m)		Rail line hauling concentrate offsite (Far West to Magma Junction)												RR_Offsite	453,418	3,666,075	463	462,062	3,672,632	511	10,850	487	40.4%	10.0	3.86	Rail line to onsite tailings facility (WPS to Far West) - Alt4 Only												RR_Onsite1	462,062	3,672,632	511	472,780	3,680,551	616	13,326	563	42.1%	10	3.86	RR_Onsite2	472,780	3,680,551	616	473,827	3,681,797	634	1,628	625	5.1%	10	3.86	RR_Onsite3	473,827	3,681,797	634	475,468	3,682,792	659	1,919	646	6.1%	10	3.86	RR_Onsite4	475,468	3,682,792	659	475,817	3,683,276	668	597	663	1.9%	10	3.86	RR_Onsite5	475,817	3,683,276	668	476,357	3,683,229	671	542	670	1.7%	10	3.86	RR_Onsite6	476,357	3,683,229	671	476,388	3,683,695	670	467	671	1.5%	10	3.86	RR_Onsite7	476,388	3,683,695	670	478,018	3,685,033	674	2,109	672	6.7%	10	3.86	RR_Onsite8	478,018	3,685,033	674	480,183	3,684,192	680	2,322	677	7.3%	10	3.86	RR_Onsite9	480,183	3,684,192	680	481,147	3,684,158	690	965	685	3.0%	10	3.86	RR_Onsite10	481,147	3,684,158	690	481,638	3,683,430	710	879	700	2.8%	10	3.86	RR_Onsite11	481,638	3,683,430	710	482,998	3,683,091	720	1,401	715	4.4%	10	3.86	RR_Onsite12	482,998	3,683,091	720	483,522	3,682,631	726	697	723	2.2%	10	3.86	RR_Onsite13	483,522	3,682,631	726	484,294	3,682,996	739	855	732	2.7%	10	3.86	RR_Onsite14	484,294	3,682,996	739	487,104	3,682,964	793	2,810	766	8.9%	10	3.86	RR_Onsite15	487,104	3,682,964	793	488,221	3,683,276	816	1,159	804	3.7%	10	3.86
UTM1_E	UTM1_N	Elev1	UTM2_E	UTM2_N	Elev2	distance	Elev	% total	width	SigZ	init																																																																																																																																																																																																																																																
(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	%	m	(m)																																																																																																																																																																																																																																																	
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RR_Onsite1	462,062	3,672,632	511	472,780	3,680,551	616	13,326	563	42.1%	10	3.86																																																																																																																																																																																																																																																
RR_Onsite2	472,780	3,680,551	616	473,827	3,681,797	634	1,628	625	5.1%	10	3.86																																																																																																																																																																																																																																																
RR_Onsite3	473,827	3,681,797	634	475,468	3,682,792	659	1,919	646	6.1%	10	3.86																																																																																																																																																																																																																																																
RR_Onsite4	475,468	3,682,792	659	475,817	3,683,276	668	597	663	1.9%	10	3.86																																																																																																																																																																																																																																																
RR_Onsite5	475,817	3,683,276	668	476,357	3,683,229	671	542	670	1.7%	10	3.86																																																																																																																																																																																																																																																
RR_Onsite6	476,357	3,683,229	671	476,388	3,683,695	670	467	671	1.5%	10	3.86																																																																																																																																																																																																																																																
RR_Onsite7	476,388	3,683,695	670	478,018	3,685,033	674	2,109	672	6.7%	10	3.86																																																																																																																																																																																																																																																
RR_Onsite8	478,018	3,685,033	674	480,183	3,684,192	680	2,322	677	7.3%	10	3.86																																																																																																																																																																																																																																																
RR_Onsite9	480,183	3,684,192	680	481,147	3,684,158	690	965	685	3.0%	10	3.86																																																																																																																																																																																																																																																
RR_Onsite10	481,147	3,684,158	690	481,638	3,683,430	710	879	700	2.8%	10	3.86																																																																																																																																																																																																																																																
RR_Onsite11	481,638	3,683,430	710	482,998	3,683,091	720	1,401	715	4.4%	10	3.86																																																																																																																																																																																																																																																
RR_Onsite12	482,998	3,683,091	720	483,522	3,682,631	726	697	723	2.2%	10	3.86																																																																																																																																																																																																																																																
RR_Onsite13	483,522	3,682,631	726	484,294	3,682,996	739	855	732	2.7%	10	3.86																																																																																																																																																																																																																																																
RR_Onsite14	484,294	3,682,996	739	487,104	3,682,964	793	2,810	766	8.9%	10	3.86																																																																																																																																																																																																																																																
RR_Onsite15	487,104	3,682,964	793	488,221	3,683,276	816	1,159	804	3.7%	10	3.86																																																																																																																																																																																																																																																

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		SUBJECT: Hazardous Air Pollutants					DATE: October 12, 2018					
AIR EMISSION CALCULATIONS												
Hazardous Air Pollutants Emissions Summary												
CAS No.	Pollutant	ULSD Engines ton/yr	Process & Fug. Dust ton/yr	Reagents ton/yr	Diesel Tanks ton/yr	Propane Combustion ton/yr	Total ton/yr	POM				
106990	1,3-Butadiene	2.0E-2					2.0E-2					
83329	Acenaphthene	1.4E-3					1.4E-3	POM				
208968	Acenaphthylene	3.9E-3					3.9E-3	POM				
75070	Acetaldehyde	3.9E-1					3.9E-1					
107028	Acrolein	4.8E-2					4.8E-2					
120127	Anthracene	1.1E-3					1.1E-3	POM				
7440382	Arsenic	2.6E-3	5.4E-3			9.4E-8	8.0E-3					
56553	Benzo(a)anthracene	9.3E-4					9.3E-4	POM				
71432	Benzene	5.8E-1			1.5E-6	9.9E-7	5.8E-1					
50328	Benzo(a)pyrene	1.3E-4					1.3E-4	POM				
205992	Benzo(b)fluoranthene	2.1E-4					2.1E-4	POM				
191242	Benzo(g,h,l)perylene	3.3E-4					3.3E-4	POM				
207089	Benzo(k)fluoranthene	1.1E-4					1.1E-4	POM				
7440417	Beryllium	1.9E-3	3.8E-4			5.7E-9	2.3E-3					
92524	Biphenyl				1.9E-4		1.9E-4	POM				
7440439	Cadmium	1.9E-3	1.9E-4			5.2E-7	2.1E-3					
7440473	Chromium	1.9E-3	3.0E-2			6.6E-7	3.2E-2					
218019	Chrysene	4.0E-4					4.0E-4	POM				
7440484	Cobalt		4.0E-3			4.0E-8	4.0E-3					
53703	Dibenzo(a,h)anthracene	3.4E-4					3.4E-4	POM				
100414	Ethylbenzene				2.4E-5		2.4E-5					
206440	Fluoranthene	4.4E-3					4.4E-3	POM				
86737	Fluorene	1.6E-2					1.6E-2	POM				
50000	Formaldehyde	6.0E-1				3.5E-5	6.0E-1					
110543	Hexane				1.9E-3	8.5E-4	2.7E-3					
193395	Indeno(1,2,3-c,d)pyrene	2.5E-4					2.5E-4	POM				
7439921	Lead	5.8E-3	1.2E-2				1.8E-2					
7439965	Manganese	3.9E-3	3.4E-2			1.8E-7	3.7E-2					
7439976	Mercury	1.9E-3	6.4E-2			1.2E-7	6.6E-2					
91203	Naphthalene	6.1E-2			1.0E-3	2.9E-7	6.2E-2	POM				
7440020	Nickel	1.9E-3	5.2E-3			9.9E-7	7.1E-3					
85018	Phenanthrene	2.1E-2			2.3E-4		2.1E-2	POM				
108952	Phenol				1.2E-4		1.2E-4					
129000	Pyrene	2.9E-3					2.9E-3	POM				
7782492	Selenium	9.7E-3	1.3E-3			1.1E-8	1.1E-2					
100425	Styrene				6.0E-5		6.0E-5					
108883	Toluene	2.5E-1			6.0E-5	1.6E-6	2.5E-1					
1330207	Xylene	1.7E-1					1.7E-1					
95636	1,2,4-trimethylbenzene											
7783064	Hydrogen sulfide			2.6E-2			2.6E-2					
106445	p-Cresol			2.5E-5			2.5E-5					
79061	Acrylamide			1.5E-2			1.5E-2					
106467	Dichlorobenzene					5.7E-7	5.7E-7					
7440360	Antimony		4.2E-4				4.2E-4					
POM	POM (aggregated)					4.2E-8	4.2E-8	POM				
POM	Polycyclic Organic Matter Subtotal	1.1E-1	0.0E+0	0.0E+0	1.5E-3	3.3E-7	1.2E-1					
HAPs	All HAPs	2.2E+0	1.6E-1	4.1E-2	3.6E-3	8.9E-4	2.4E+0					
Conversions												
137,000 Btu/gal AP-42, Appendix A, Diesel, Rev. 9/85												
1,000,000 Btu/MMBtu												
2,000 lb/ton												
Blue values are input; black values are calculated or linked												

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper EI		BY: N. Tipple		
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HAPs Emissions for ULSD Engines (Small & Large)

CAS No.	Pollutant	POM	Small ULSD Engines* 1,002,891 MMBtu/yr***		Large ULSD Engines** 290,124 MMBtu/yr***	
			lb/MMBtu	ton/yr	lb/MMBtu	ton/yr
106990	1,3-Butadiene		3.9E-5	2.0E-2		
83329	Acenaphthene	POM	1.4E-6	7.1E-4	4.7E-6	6.8E-4
208968	Acenaphthylene	POM	5.1E-6	2.5E-3	9.2E-6	1.3E-3
75070	Acetaldehyde		7.7E-4	3.8E-1	2.5E-5	3.7E-3
107028	Acrolein		9.3E-5	4.6E-2	7.9E-6	1.1E-3
120127	Anthracene	POM	1.9E-6	9.4E-4	1.2E-6	1.8E-4
56553	Benzo(a)anthracene	POM	1.7E-6	8.4E-4	6.2E-7	9.0E-5
71432	Benzene		9.3E-4	4.7E-1	7.8E-4	1.1E-1
50328	Benzo(a)pyrene	POM	1.9E-7	9.4E-5	2.6E-7	3.7E-5
205992	Benzo(b)fluoranthene	POM	9.9E-8	5.0E-5	1.1E-6	1.6E-4
191242	Benzo(g,h,i)perylene	POM	4.9E-7	2.5E-4	5.6E-7	8.1E-5
207089	Benzo(k)fluoranthene	POM	1.6E-7	7.8E-5	2.2E-7	3.2E-5
218019	Chrysene	POM	3.5E-7	1.8E-4	1.5E-6	2.2E-4
53703	Dibenzo(a,h)anthracene	POM	5.8E-7	2.9E-4	3.5E-7	5.0E-5
206440	Fluoranthene	POM	7.6E-6	3.8E-3	4.0E-6	5.8E-4
86737	Fluorene	POM	2.9E-5	1.5E-2	1.3E-5	1.9E-3
50000	Formaldehyde		1.2E-3	5.9E-1	7.9E-5	1.1E-2
193395	Indeno(1,2,3-c,d)pyrene	POM	3.8E-7	1.9E-4	4.1E-7	6.0E-5
91203	Naphthalene	POM	8.5E-5	4.3E-2	1.3E-4	1.9E-2
85018	Phenanthrene	POM	2.9E-5	1.5E-2	4.1E-5	5.9E-3
129000	Pyrene	POM	4.8E-6	2.4E-3	3.7E-6	5.4E-4
108883	Toluene		4.1E-4	2.1E-1	2.8E-4	4.1E-2
1330207	Xylene		2.9E-4	1.4E-1	1.9E-4	2.8E-2
POM	Polycyclic Organic Matter Subtotal			8.43E-02		3.07E-02
HAPs	All HAPs			1.94E+00		2.28E-01

* AP-42, Table 3.3-2, Rev. 10/96, diesel engines (≤ 600 hp)

** AP-42, Tables 3.4-3 & 3.4-4, Rev. 10/96, large diesel engines (> 600 hp)

*** Calculated using a 15% fuel contingency

Diesel Combustion Metal Emissions

CAS No.	Pollutant	HAP	lb/10 ¹² Btu*	lb/MMBtu	ton/yr
7440382	Arsenic	HAP	4	4.0E-6	2.6E-3
7440417	Beryllium	HAP	3	3.0E-6	1.9E-3
7440439	Cadmium	HAP	3	3.0E-6	1.9E-3
7440473	Chromium	HAP	3	3.0E-6	1.9E-3
	Copper		6	6.0E-6	3.9E-3
7439921	Lead	HAP	9	9.0E-6	5.8E-3
7439976	Mercury	HAP	3	3.0E-6	1.9E-3
7439965	Manganese	HAP	6	6.0E-6	3.9E-3
7440020	Nickel	HAP	3	3.0E-6	1.9E-3
7782492	Selenium	HAP	15	1.5E-5	9.7E-3
	Zinc		4	4.0E-6	2.6E-3
Total Diesel Combustion Metal Emissions					3.8E-2

* AP-42, Table 1.3-10, Rev. 5/10

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HAPs Emissions from Process & Fugitive Dust				
Ore HAPs Concentrations & Emissions				
CAS No.	Pollutant	Concentration*	Emissions	PM Emissions
		%	ton/yr	PM ton/yr
7440360	Sb Antimony	0.0003%	4.2E-4	
7440382	As Arsenic	0.0040%	5.4E-3	East Plant 19.8
7440417	Be Beryllium	0.0003%	3.8E-4	Mill 21.8
7440439	Cd Cadmium	0.0001%	1.9E-4	Loadout 0.0
7440473	Cr Chromium	0.0222%	3.0E-2	Tailings 93.5
7440484	Co Cobalt	0.0030%	4.0E-3	Total 135.2
7439921	Pb Lead	0.0088%	1.2E-2	
7439965	Mn Manganese	0.0248%	3.4E-2	
7439976	Hg Mercury	0.0473%	6.4E-2	
7440020	Ni Nickel	0.0038%	5.2E-3	
7782492	Se Selenium	0.0010%	1.3E-3	

* Resolution

HAPs Emissions from Reagent Handling & Storage				
CAS No.	Pollutant	lb/yr	ton/yr	Source
7783064	Hydrogen sulfide*	51.4	2.6E-2	NaHS (Sodium hydrosulfide solution)
106445	p-Cresol*	0.05	2.5E-5	CYTEC 8989
79061	Acrylamide**		1.5E-2	Flocculent (CIBA Magnafloc 10 & 155)

* Calculated using EPA Tanks 4.0.9d

** Assuming all PM emitted from material transfer is Acrylamide

HAPs Emissions from Diesel Storage Tanks				
CAS No.	Pollutant	Weight Percent*	Emissions ton/yr	POM
71432	Benzene	0.001%	1.5E-6	
92524	Biphenyl	0.100%	1.9E-4	POM
100414	Ethyl benzene	0.013%	2.4E-5	
110543	Hexane	1.000%	1.9E-3	
91203	Naphthalene	0.550%	1.0E-3	POM
108952	Phenol	0.064%	1.2E-4	
100425	Styrene	0.032%	6.0E-5	
108883	Toluene	0.032%	6.0E-5	
85018	Phenanthrene	0.125%	2.3E-4	POM
POM	Polycyclic Organic Matter Subtotal	7.8E-3	1.5E-3	

* Resolution

<p style="text-align: center;">Air Sciences Inc.</p> <p style="text-align: center;">AIR EMISSION CALCULATIONS</p>	PROJECT TITLE: Resolution Copper EI		BY: N. Tipple		
	PROJECT NO: 262		PAGE: 1	OF: 1	SHEET: GHG
	SUBJECT: Direct Greenhouse Gases & CO ₂ e		DATE: October 12, 2018		

DIRECT GREENHOUSE GAS & CO₂ EQUIVALENT CALCULATIONS - PRELIMINARY

GHG Emission Factors

Pollutant	Fuel	EF kg/MMBtu	Reference
CO ₂	Propane	61.71	40 CFR Part 98, Table C-1 to Subpart C (11/13) LPG
CH ₄	Propane	3.0E-3	40 CFR Part 98, Table C-2 to Subpart C (11/13) Petroleum
N ₂ O	Propane	6.0E-4	40 CFR Part 98, Table C-2 to Subpart C (11/13) Petroleum
CO ₂	Diesel	73.96	40 CFR Part 98, Table C-1 to Subpart C (11/13) Distillate Fuel Oil #2
CH ₄	Diesel	3.0E-3	40 CFR Part 98, Table C-2 to Subpart C (11/13) Petroleum
N ₂ O	Diesel	6.0E-4	40 CFR Part 98, Table C-2 to Subpart C (11/13) Petroleum

Propane Fuel Use & Direct GHG Emissions

Contributor	MMBtu/hr	hr/yr	MMBtu/yr	CO ₂ tonne/yr*	CH ₄ tonne/yr*	N ₂ O tonne/yr*
Hydro House Heaters	0.11	8,760	964	59.5	2.9E-3	5.8E-4
Total			964	59.5	2.9E-3	5.8E-4

*metric tons per year

Diesel Fuel Use & Direct GHG Emissions

Contributor	Diesel Cons. gal/yr	+15% gal/yr	MMBtu/yr	CO ₂ tonne/yr**	CH ₄ tonne/yr**	N ₂ O tonne/yr**
East Plant Fleet	2,345,797	2,697,666	369,580	27,334	1.1	0.22
Mill Fleet	741,883	853,166	116,884	8,645	0.35	7.0E-2
Loadout Fleet	555,866	639,246	87,577	6,477	0.26	5.3E-2
Tailings Fleet	2,710,527	3,117,107	427,044	31,584	1.3	0.26
East Plant Emergency Generators	1,643,748	1,890,310	258,973	19,154	0.78	0.16
Mil Emergency Generators	55,500	63,825	8,744	647	2.6E-2	5.2E-3
Tailings Emergency Generators	18,500	21,275	2,915	216	8.7E-3	1.7E-3
Filter Plant Emergency Generators	18,500	21,275	2,915	216	8.7E-3	1.7E-3
Railroad	116,693	134,197	18,385	1,360	5.5E-2	1.1E-2
Total	8,207,014	9,438,066	1,293,015	95,631	3.9	0.78

*Calculated by mass balance using a 15% fuel contingency

**metric tons per year

Direct CO₂e Emissions

Greenhouse Gas	Emissions tonne/yr*	Global Warming Potential**	CO ₂ e tonne/yr*
Carbon Dioxide (CO ₂)	95,691	1	95,691
Methane (CH ₄)	3.9	25	97.0
Nitrous Oxide (N ₂ O)	0.78	298	231
Total			96,019

* metric tons per year

** 40 CFR Part 98, Table A-1 to Subpart A (11/13) Chemical-Specific GWPs

The revised draft guidance sets forth a reference point of 25,000 metric tons CO₂-equivalent GHG emissions on an annual basis below which a quantitative analysis of GHG emissions is not recommended unless quantification is easily accomplished, in light of the availability of quantification tools and appropriate input data.

Conversions

1,000 kg/metric ton

7,000 MMBtu/np-hr*

137,000 Btu/gal

AP42, Appendix A

1,000,000 Btu/MMBtu

* AP-42 Table 3.3-1, Footnote a & AP-42 Table 3.4-1, Footnote e

Blue values contain input, black values are calculated or linked

<p align="center">Air Sciences Inc.</p> <p align="center">AIR EMISSION CALCULATIONS</p>	PROJECT TITLE:	Resolution Copper			BY:	N. Tipple		
	PROJECT NO:	262			PAGE:	1	OF:	3
	SUBJECT:	Underground Scrubbing			SHEET:	UG Control		
					DATE:	October 12, 2018		

Underground Control Summary - Control Efficiencies (MODELING ONLY)

Combined Underground Scrubbing Efficiency for Particulate Pollutants

	PM	PM ₁₀	PM _{2.5}
Water Droplets in Shafts	30.7%	30.7%	4.5%
Heat Rejection Sprays	30.0%	30.0%	2.5%
Gravitational Settlement	60.4%	6.7%	0.4%
Effective Control	80.8%	54.7%	7.2%

Underground Control Summary - Emissions

Emissions for Particulate Pollutants (lb/hr)

	PM	PM ₁₀	PM _{2.5}
Controlled UG Emissions	82.4	50.4	14.8
Vented to Atmosphere	15.8	22.8	13.8

Emissions for Particulate Pollutants (ton/yr)

	PM	PM ₁₀	PM _{2.5}
Controlled UG Emissions	103.2	70.3	29.7
Vented to Atmosphere	19.8	31.8	27.5

Air Sciences Inc.

<div>Air Sciences Inc.</div> <div>AIR EMISSION CALCULATIONS</div>	PROJECT TITLE: Resolution Copper		BY: N. Tipple		
	PROJECT NO: 262		PAGE: 3	OF: 3	SHEET: UG Control
	SUBJECT: Underground Scrubbing		DATE: October 12, 2018		

Heat Rejection Sprays Scrubbing Efficiency for Particulate and Gaseous Pollutants

Pollutant	Scrubbing Efficiency*	Overall Efficiency**
PM _{2.5}	5.0%	2.5%
PM ₇	45.0%	22.5%
PM ₁₀	60.0%	30.0%

* Resolution (Moreby 2008)

** Efficiency assuming 50% of air passes through heat rejection sprays

Gravitational Settlement

Terminal Settling Velocity

$$v_t = \frac{d^2 g (\rho_s - \rho_a)}{18 \mu_a}$$

Stokes' Law

$$\eta = \frac{W_n L u_t}{Q_n} \quad \text{Air Pollution Control Theory, p. 240}$$

Where	Value	Unit	Reference
g = gravitational constant	9.81	m/s ²	
ρ _s = particle density (ore)	3,463	kg/m ³	McPherson, Ch. 20
ρ _a = air density	1,000	kg/m ³	
μ _a = air viscosity	1.8E-5	Ns/m ²	McPherson, Ch. 20
W ₉ = width of shaft 9	6.7	m	Resolution
W ₁₀ = width of shaft 10	8.5	m	Resolution
W ₁₄ = width of shaft 14	10	m	Resolution
L = length of chamber	> 2,000	m	Resolution
Q _n = chamber air flow rate	622	m ³ /s	Resolution

	Particle Size (d _p)		u _t	Efficiency, η (Settlement in Shafts)			
	μm	m		Shaft 9	Shaft 10	Shaft 14	Avg
PM _{2.5}	≤ 2.5	2.5E-6	4.66E-4	0.3%	0.4%	0.5%	0.4%
PM ₁₀	≤ 10	1.0E-5	7.46E-3	5.4%	6.8%	8.0%	6.7%
PM	≤ 30	3.0E-5	6.71E-2	48.2%	61.1%	71.9%	60.4%

List of References				
Value	Unit	Description	Location in EI	Reference
0.63	m/s	LHD/Ore Pass/Grizzly Wind Speed	Gen Info L26	EI Info Request, Resolution Copper
1.00	m/s	Rail Haulage Ore Flow Wind Speed	Gen Info L27	EI Info Request, Resolution Copper
1.79	m/s	Primary Crushing Ore Flow Wind Speed	Gen Info L28	EI Info Request, Resolution Copper
1.07	m/s	Lower Level Conveyor Ore Flow Wind Speed	Gen Info L29	EI Info Request, Resolution Copper
0.60	m/s	Hoisting System Ore Flow Wind Speed	Gen Info L30	EI Info Request, Resolution Copper
2.00	m/s	Upper Level Conveyor System Ore Flow Wind Speed	Gen Info L31	RCM Pre-feasibility Refrigeration and Ventilation Study, 2012, Pg. 25
4	%	UG Ore Moisture Content	Gen Info I26 - I31	General Plan of Operations, Section 4.4.4
96	%	Incline Conveyor to Mine Transfer Conveyor Solids Content	Gen Info G33	Mill Flowcharts (40000-FS-601 through 623)
95.8	%	Enclosed Stockpile Solids Content	Gen Info G34	Mill Flowcharts (40000-FS-601 through 623)
95.8	%	Stockpile Reclaim Solids Content	Gen Info G35	Mill Flowcharts (40000-FS-601 through 623)
4.8	%	Mill Moisture Content	Gen Info I36 - I39	Largest moisture content listed in AP-42, Ch. 13.2.4
4.8	%	Loadout Moisture Content	Gen Info I41	Largest moisture content listed in AP-42, Ch. 13.2.4
1.3	mph	Incline Conveyor to Mine Transfer Conveyor Wind Speed	Gen Info K33	Enclosure, Lowest wind speed listed in AP-42, Ch. 13.2.4
1.3	mph	General Enclosed Transfer Wind Speed	Gen Info K34 - K41	Enclosure, Lowest Wind Speed listed in AP-42, Ch. 13.2.4
8,940	tonne/hr	Coarse Ore Stockpile Throughput	Gen Info V17	Technical Memo: Process Plant Mass Balance Calculations for EI
143,750	tonne/day	Coarse Ore Stockpile Throughput	Gen Info V18	Technical Memo: Process Plant Mass Balance Calculations for EI
45,625,000	tonne/yr	Coarse Ore Stockpile Throughput	Gen Info V19	Technical Memo: Process Plant Mass Balance Calculations for EI
4,296	tonne/hr	Sag Mill Throughput	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
94,875	tonne/day	Sag Mill Throughput	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
30,112,500	tonne/yr	Sag Mill Throughput	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
10	tonne/hr	Moly Cake Throughput (WET)	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
238	tonne/day	Moly Cake Throughput (WET)	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
41,176	tonne/yr	Moly Cake Throughput (WET)	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
8.95	tonne/hr	Moly Cake Throughput (DRIED)	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
213	tonne/day	Moly Cake Throughput (DRIED)	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
36,842	tonne/yr	Moly Cake Throughput (DRIED)	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
multiple parameters		Batch Plant Info	BatchPlant	Tech Memo - Batch Plant Data
0.002	grain/dscf	Baghouse grain loading	East Plant_CALC, Column J	Manufacturer (Donaldson Torit) Specifications
0.0185	%	S in Propane	Mill_CALC B97	Standard: GPA 2140-97
0.002	grain/dscf	Baghouse grain loading	Mill_CALC, Column J	Manufacturer (Donaldson Torit) Specifications
0.045	MMBtu/hr	Hydro House Heater Rating	Mill_CALC BH75	EI Info Request, Resolution Copper
0.065	MMBtu/hr	Hydro House Heater Rating	Mill_CALC BH76	EI Info Request, Resolution Copper
10	[quantity]	Quantity of Cable Bolters	EP_Fleet K24	EI Info Request, Resolution Copper
multiple parameters		East Plant Equipment List	EP_Fleet	RCM Mine Data for Ari Modelling 2012.xlsx
4	[tier]	Minimum Engine Tier Rating	EP_Fleet, Column L	EI Info Request, Resolution Copper

Value	Unit	Description	List of References	
			Location in EI	Reference
15%	%	Fuel Contingency	Fleet & Egen SO2, Tank VOC, GHG, HAPs	mobile equipment estimate mpo for all alternatives.xlsx
multiple parameters		Vehicle Speeds	EP_Fleet, Column CA	EI Info Request, Resolution Copper Best Management Practices
3	%	Road Silt Content	EP_Fleet, Column CB	AP-42, Chapter 13.2.2, Related Information, r13s0202_dec03.xls
multiple parameters		Vehicle Weights	All Fleets	Meeting with C. Pascoe 5/7/14, Phone Meeting K. Ballard 5/14/14, Spec Sheets
90	%	Control of Unpaved Roads with Chemical Suppressant	Loadout Fleet	Chem_Suppressant_Memo_20150225.pdf
4	[tier]	Minimum Engine Tier Rating	Mill_Fleet, Column L	EI Info Request, Resolution Copper
multiple parameters		Miscellaneous Mill Fleet	Mill_Fleet	EquipmentHREst1252013.xlsx, Updated based on feedback from K. Ballard and R. Heig 4/16/14.
multiple parameters		Updates/Edits (ratings, hours, etc.)	Mill_Fleet	EI Info Request, Resolution Copper Best Management Practices
3	%	Road Silt Content	Mill_Fleet, Column CB	AP-42, Chapter 13.2.2, Related Information, r13s0202_dec03.xls
90	%	Control of Unpaved Roads	EP Fleet, Mill Fleet	Chem_Suppressant_Memo_20150225.pdf
4	[tier]	Minimum Engine Tier Rating	Loadout_Fleet, Column L	EI Info, Request, Resolution Copper
multiple parameters		Miscellaneous Mill Fleet	Loadout_Fleet	Per RCM Mine Data for Ari Modelling 2012.xlsx, Updated based on feedback from K. Ballard and R. Heig 4/16/14.
4	[tier]	Updates/Edits (ratings, hours, etc.)	Loadout_Fleet	EI Info Request, Resolution Copper
multiple parameters		Minimum Engine Tier Rating	Tailings_Fleet, Column L	EI Info Request, Resolution Copper
multiple parameters		Miscellaneous Tailings Fleet	Tailings_Fleet	Per mobile equipment estimate mpo.xlsx, and EquipmentHREst1252013.xlsx and phone call with K. Ballard 4/25/14., Updated based on feedback from K. Ballard and R. Heig 4/16/14
multiple parameters		Updates/Edits (ratings, hours, etc.)	Tailings_Fleet	EI Info Request, Resolution Copper Best Management Practices
3	%	Vehicle Speeds	Tailings_Fleet, Column CA	AP-42, Chapter 13.2.2, Related Information, r13s0202_dec03.xls
90	%	Road Silt Content	Tailings_Fleet, Column CB	Chem_Suppressant_Memo_20150225.pdf
332	[quantity]	Control of Unpaved Roads	Tailings Fleet	General Plan of Operations, Section 3.7.2
318	[quantity]	Number of Employees at East Plant	Employees E12	General Plan of Operations, Section 3.7.2
17	[quantity]	Number of Employees at Mill	Employees E13	General Plan of Operations, Section 3.7.2
17	[quantity]	Number of Employees at Loadout	Employees E14	General Plan of Operations, Section 3.7.2
18	[quantity]	Number of Employees at Tailings	Employees E15	General Plan of Operations, Section 3.7.2
3	%	AP-42, Chapter 13.2.2, Related Information, r13s0202_dec03.xls	Employees G32 - G35	AP-42, Chapter 13.2.2, Related Information, r13s0202_dec03.xls
2	ton	Average Vehicle Weight	Employees I32 - I35	Average Vehicle Weight in 2010, Time Magazine
90	%	Control of Unpaved Roads	Employees C62	AP-42, Figure 13.2.2-5, Rev. 11/06
14	[quantity]	East Plant Emergency Generator Quantity	E_Gen AN16	EI Info Request, Resolution Copper
500	hr/yr	East Plant Emergency Generator Hours of Operation	E_Gen W19, AN17, BE18, BV18, CM18	Email from K. Walch, 4/14/2014
6,562	ft	Depth of Mine	Fuel Tanks C30	2000 m, RCM Pre-feasibility Refrigeration and Ventilation Study, 2012, p. 9
4,200	l/s	Surface Cooling Tower Circulation Rate	Cooling G11	RCM Pre-feasibility Refrigeration and Ventilation Study, 2012, Section 8.3
0.005%	%	Drift Loss	Cooling G12, G16	Hatch. Condenser Cooling Tower Blowdown and Make-Up Water Requirement Review
1,250	l/s	UG Cooling Tower Circulation Rate	Cooling G15	RCM Pre-feasibility Refrigeration and Ventilation Study, 2012; 2 towers @ 625 l/s, each
3,000	ppm	Total Dissolved Solids Content	Cooling G20	RCM Pre-feasibility Refrigeration and Ventilation Study, 2012, Section 11.2
		Reagent Tank Volumes	Reagents	Design Criteria 2013 08 6.pdf (pg 25-27)

Value	Unit	Description	List of References	
			Location in EI	Reference
487	blasts/yr	East Plant Number of Blasts	Drill & Blast AN12	Tech Memo: Underground Blasting Face Area for Emissions Calculation
2	max blasts/day	East Plant Number of Blasts	Drill & Blast AN13	Tech Memo: Underground Blasting Face Area for Emissions Calculation
580	m ² (max daily)	East Plant Blast Area	Drill & Blast AN20	Tech Memo: Underground Blasting Face Area for Emissions Calculation
141,200	m ² (annual)	East Plant Blast Area	Drill & Blast AN23	Tech Memo: Underground Blasting Face Area for Emissions Calculation
32.53	lb/ton	CO EF	Drill & Blast AN26, BE26	NIOSH - Fumes Studies - Richard Mainiero, Emulsion
6.2	lb/ton	NOX EF	Drill & Blast AN27, BE27	NIOSH - Fumes Studies - Richard Mainiero, Emulsion
40	°C	Underground Temp	Flow C47	RCM Pre-feasibility Refrigeration and Ventilation Study, 2012, p. 12
6,562	ft	Depth of Mine	Flow I39	RCM Pre-feasibility Refrigeration and Ventilation Study, 2012, p. 9
18,950	acfm	Stockpile Reclaim Dust Collector Flow	Flow C27	Email from Eric Pedersen (M3) 3/27/14
22,500	a m ³ /hr	Crusher Dust Collector Flow	Flow C51	UG Flowsheet 0000
5,100	a m ³ /hr	Conveyor Transfer Dust Collector Flow	Flow C55	UG Flowsheet 0000
22,500	a m ³ /hr	Silos Dust Collector Flow	Flow C59	UG Flowsheet 0000
17,000	a m ³ /hr	Skip Loading Dust Collector Flow	Flow C63	UG Flowsheet 0000
17,000	a m ³ /hr	Bin Unloading Dust Collector Flow	Flow C67	UG Flowsheet 0000
64	days/year	EPS Precip Data (days >0.01")	Precip	2015-2016 Processed AERMET Precip Data (EP)
58	days/year	WPS Precip Data (days >0.01")	Precip	2015-2016 Processed AERMET Precip Data (WP)
57	days/year	TSF Precip Data (days >0.01")	Precip	2015-2016 Processed AERMET Precip Data (Hewitt)
57	days/year	TSF Precip Data (days >0.01")	Precip	2015-2016 Processed AERMET Precip Data (Hewitt)
21.3	acre	Exposed area at East Plant	WindblownDust B2	GIS Analysis with K. Ballard
279	acre	Exposed area at Subsidence Area	WindblownDust D15	RCML GTC 2017_09 GPO Estimated Areas of Caved Zones Based on Itasca July 2017 Report.pdf
70	acre	Exposed area at Mill	WindblownDust I2	GIS Analysis with K. Ballard
1,380	acre	Dry Beach	WindblownDust W5	180302R-Alt3A-TM-DustMgmt Rev B.pdf
59	acre	Dam Slope	WindblownDust W6	180302R-Alt3A-TM-DustMgmt Rev B.pdf
90	%	PM>10 Control (Water Droplet Scrubbing)	UG Control S12	RCM Exhaust Shaft Scrubbing Efficiency.pdf
40	%	PM4-10 Control (Water Droplet Scrubbing)	UG Control S13	RCM Exhaust Shaft Scrubbing Efficiency.pdf
10	%	PM<4 Control (Water Droplet Scrubbing)	UG Control S14	RCM Exhaust Shaft Scrubbing Efficiency.pdf
60	%	PM7 Control (Heat Rejection Sprays)	UG Control AN14	RCM Exhaust Shaft Scrubbing Efficiency.pdf
45	%	PM7 Control (Heat Rejection Sprays)	UG Control AN13	RCM Exhaust Shaft Scrubbing Efficiency.pdf
5	%	PM7 Control (Heat Rejection Sprays)	UG Control AN12	RCM Exhaust Shaft Scrubbing Efficiency.pdf
1.8E-5	Ns/m ²	Dynamic Viscosity of Air	UG Control AO45	The Aerodynamics, Sources, and Control of Airborne Dust Chapter 20.pdf
50	%	Air that Flows Through the Heat Rejection Sprays	UG Control AN16	RCM Exhaust Shaft Scrubbing Efficiency.pdf
6.7	m	width of shaft 9	UG Control AN46	RCM Pre-feasibility Refrigeration and Ventilation Study, 2012, p. 9
8.5	m	width of shaft 10	UG Control AN47	RCM Pre-feasibility Refrigeration and Ventilation Study, 2012, p. 9
10	m	width of shaft 14	UG Control AN48	RCM Pre-feasibility Refrigeration and Ventilation Study, 2012, p. 9
2,000	m	length of chamber	UG Control AN49	RCM Pre-feasibility Refrigeration and Ventilation Study, 2012, p. 9
622	m ³ /s	chamber air flowrate (all vents)	UG Control AN50	RCM Pre-feasibility Refrigeration and Ventilation Study, 2012, p. 49
multiple parameters		Concentration of HAPs/Metals in Ore	HAPs, Column BF	Average of 6 ore body samples (RES-009A, 017L, 017M, 023D, 025D, 002B).

Value	Unit	Description	List of References	
			Location in EI	Reference
multiple parameters		HAP emissions Weight Percent	HAPs, Column BF	Default data - EPCRA Section 313 Industry Guidance - Metal Mining Facilities, January 1999 (EPA 745-B-99-001), Table 3-8
multiple parameters		Ore Haul Trucks - Powertrans T954	EP_Fleet J45-N45	160T Powertrans Double RT Concept Underground.xlsx, units converted
multiple parameters		Average Distance Travelled, one way VMT, ea	Employees & Deliveries	GIS estimation with K. Ballard
2,628	hp	HP of Egen	E_Gen W11	Pinal County Air Quality, Permit Number B30993.0000
449	hp	HP of Egen	E_Gen W14	Pinal County Air Quality, Permit Number B30993.0000
4,376	hp	HP of Egens	E_Gen AN13	Caterpillar Standby 3100 kW Tier 4i Performance Data
multiple parameters		VOC Emission Calculations	Fuel Tanks G26 through K26	Calculated using by EPA Tanks 4.0.9d, 05/02/2014
135	MW	Cooling capacity	Cooling G13	RCM Pre-feasibility Refrigeration and Ventilation Study, 2012, Section 8.3
multiple parameters		MOVES Results (Deliveries & Employees)	Deliveries & Employees	MOVES 2014a
134.91	lb/yr	MIBC (Methyl isobutyl carbonal) - VOC Emissions	Reagents G13	MIBC (Methyl isobutyl carbonal) - EPA Tank 4.0.9d calculations
9.53	lb/yr	MCO (Non-polar flotation oil) - VOC Emissions	Reagents G14	MCO (Non-polar flotation oil) - EPA Tank 4.0.9d calculations
0.10	lb/yr	CYTEC 8989 - VOC Emissions	Reagents G15	CYTEC 8989 - EPA Tank 4.0.9d calculations
multiple parameters		Load Factors	All Fleets	Resolution, engine factor.xlsx
multiple parameters		West Plant and Filter Plant Mobile Equipment Specs	Mill_Fleet and Loadout_Fleet	West Plant & Filter Plant Mobile Eq.xlsx (R. Heig 2/16/13)
multiple parameters		West Plant, Filter Plant, Tailings Mobile Equipment Specs	Mill_Fleet Loadout_Fleet Tailings_Fleet	RCM Mine Data for Ari Modelling 2012.xlsx
1,500	kW	West Plant Egen demand	E_Gen Pg 4	9/30/2016, M3 Tech. Memo & CAT C18 Specs
500	kW	Filter Plant Egen demand	E_Gen Pg 6	9/30/2016, M3 Tech. Memo & CAT C18 Specs
500	kW	TSF Egen demand	E_Gen Pg 5	9/30/2016, M3 Tech. Memo & CAT C18 Specs
390	blasts/yr	West Plant Number of Blasts	Drill & Blast BE12	Tech Memo: Underground Blasting Face Area for Emissions Calculation
2	max blasts/day	West Plant Number of Blasts	Drill & Blast BE13	Tech Memo: Underground Blasting Face Area for Emissions Calculation
63	m ² (max daily)	West Plant Blast Area	Drill & Blast BE20	Tech Memo: Underground Blasting Face Area for Emissions Calculation
14,400	m ² (annual)	West Plant Blast Area	Drill & Blast BE23	Tech Memo: Underground Blasting Face Area for Emissions Calculation
164,300	tonne/yr	WP development rock drill and blast	Drill & Blast V21	Tech Memo: Underground Blasting Face Area for Emissions Calculation
1,414	tonne/hr	WP development rock drill and blast	Drill & Blast E22	Tech Memo: Underground Blasting Face Area for Emissions Calculation
118,300	kg/yr	WP blasting agent usage	Drill & Blast V22	Tech Memo: Underground Blasting Face Area for Emissions Calculation
2,065,200	tonne/yr	EP development rock drill and blast	Drill & Blast V22	Tech Memo: Underground Blasting Face Area for Emissions Calculation
1,414	tonne/hr	EP development rock drill and blast	Drill & Blast V22	Tech Memo: Underground Blasting Face Area for Emissions Calculation
1,487,000	kg/yr	EP blasting agent usage	Drill & Blast V22	Tech Memo: Underground Blasting Face Area for Emissions Calculation

Value	Unit	Description	List of References	
			Location in EI	Reference
502.6	tonne/yr	Long-Term uncontrolled fuel oil vapor	MolyTalc	Tech Memo: Molybdenite / Talc Concentrate Heat Treatment Emissions
59.1	tonne/yr	Long-Term controlled fuel oil vapor	MolyTalc	Tech Memo: Molybdenite / Talc Concentrate Heat Treatment Emissions
171.9	lb/hr	Short-Term uncontrolled fuel oil vapor	MolyTalc	Tech Memo: Molybdenite / Talc Concentrate Heat Treatment Emissions
20.2	lb/hr	Short-Term controlled fuel oil vapor	MolyTalc	Tech Memo: Molybdenite / Talc Concentrate Heat Treatment Emissions
245.3	tonne/yr	Long-Term uncontrolled SO2	MolyTalc	Tech Memo: Molybdenite / Talc Concentrate Heat Treatment Emissions
12.3	tonne/yr	Long-Term controlled SO2	MolyTalc	Tech Memo: Molybdenite / Talc Concentrate Heat Treatment Emissions
83.9	lb/hr	Short-Term uncontrolled SO2	MolyTalc	Tech Memo: Molybdenite / Talc Concentrate Heat Treatment Emissions
4.2	lb/hr	Short-Term controlled SO2	MolyTalc	Tech Memo: Molybdenite / Talc Concentrate Heat Treatment Emissions
62,603	tonne/yr	Long-Term filter cake throughput (through rotary dryer)	MolyTalc	Tech Memo: Molybdenite / Talc Concentrate Heat Treatment Emissions
9.7	tonne/hr	Short-Term filter cake throughput (through rotary dryer)	MolyTalc	Tech Memo: Molybdenite / Talc Concentrate Heat Treatment Emissions
99%		wet ESP control efficiency	MolyTalc	EPA Air Pollution Control Technology Fact Sheet, Wet Electrostatic Precipitator
10	lb/ton	Emission Factor for Concentrate Dryer	MolyTalc	AP-42 Chapter 12.3
1,042	tonne/hr	Pebble Recycle	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
23,000	tonne/day	Pebble Recycle	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
7,300,000	tonne/yr	Pebble Recycle	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
414	tonne/hr	Copper Concentrate Throughput	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
9,942	tonne/day	Copper Concentrate Throughput	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
3,338,889	tonne/yr	Copper Concentrate Throughput	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
1,060	tonne/hr	SAG Trommel Oversize	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
23,390	tonne/day	SAG Trommel Oversize	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
7,424,100	tonne/yr	SAG Trommel Oversize	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
7,011	tonne/hr	Ball Mill Feed	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
154,808	tonne/day	Ball Mill Feed	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
49,134,616	tonne/yr	Ball Mill Feed	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
6,166	trip/yr	EP Materials/Equipment Deliveries	Deliveries	GPO Section 3.4.2
20	trips/day	EP Materials/Equipment Deliveries	Deliveries	GPO Section 3.4.2
6,935	trip/yr	WP Materials/Equipment Deliveries	Deliveries	GPO Section 3.4.2
19	trips/day	WP Materials/Equipment Deliveries	Deliveries	GPO Section 3.4.2
0	trip/yr	TSF Materials/Equipment Deliveries	Deliveries	GPO Section 3.4.2
0	trips/day	TSF Materials/Equipment Deliveries	Deliveries	GPO Section 3.4.2
0	trip/yr	FPLF Materials/Equipment Deliveries	Deliveries	GPO Section 3.4.2
0	trips/day	FPLF Materials/Equipment Deliveries	Deliveries	GPO Section 3.4.2
11	trips/hr	WP Materials/Equipment Deliveries	Deliveries	GPO Section 3.4.2
16.25	MMBtu	Heat Capacity of Moly/Talc Rotary Dryer	MolyTalc	Tech Memo: Molybdenite / Talc Concentrate Heat Treatment Emissions
0.20	mi/RT	Distance of UG RT LHD	EP_Fleet	TruckandLoaderHaulageDistances.pptx
2.34	mi/RT	Distance of UG RT Haul	EP_Fleet	TruckandLoaderHaulageDistances.pptx

Appendix B – Model Input Parameters

Model ID	Description	Facility	UTM X (m, Zone 12)	UTM Y (m, Zone 12)	Elevation (m)	Release Height (m)	Temperature (°C)	Exit Velocity (m/s)	Stack Dia (m)
E_VENT1	EPS Exhaust Vent 1	EPS	493,683	3,685,100	1,272	21.1	24.0	19.1	7.4
E_VENT2	EPS Exhaust Vent 2	EPS	493,701	3,685,089	1,269	21.1	24.0	19.1	7.4
E_VENT3	EPS Exhaust Vent 3	EPS	493,718	3,685,078	1,268	21.1	24.0	19.1	7.4
E_VENT4	EPS Exhaust Vent 4	EPS	493,736	3,685,066	1,267	21.1	24.0	19.1	7.4
E_GEN1	EPS Cat 516B - Diesel	EPS	493,790	3,684,824	1,261	5.0	490.0	64.5	0.30
E_GEN2	EPS Cat 3046C - Diesel	EPS	493,820	3,684,824	1,255	5.0	490.0	11.0	0.30
E_GEN3	EPS Caterpillar C175-16 1	EPS	493,790	3,684,834	1,263	5.0	472.3	112.0	0.36
E_GEN4	EPS Caterpillar C175-16 2	EPS	493,790	3,684,843	1,267	5.0	472.3	112.0	0.36
E_GEN5	EPS Caterpillar C175-16 3	EPS	493,790	3,684,853	1,270	5.0	472.3	112.0	0.36
E_GEN6	EPS Caterpillar C175-16 4	EPS	493,790	3,684,862	1,272	5.0	472.3	112.0	0.36
E_GEN7	EPS Caterpillar C175-16 5	EPS	493,790	3,684,872	1,273	5.0	472.3	112.0	0.36
E_GEN8	EPS Caterpillar C175-16 6	EPS	493,790	3,684,882	1,274	5.0	472.3	112.0	0.36
E_GEN9	EPS Caterpillar C175-16 7	EPS	493,790	3,684,891	1,274	5.0	472.3	112.0	0.36
E_GEN10	EPS Caterpillar C175-16 8	EPS	493,820	3,684,834	1,255	5.0	472.3	112.0	0.36
E_GEN11	EPS Caterpillar C175-16 9	EPS	493,820	3,684,843	1,256	5.0	472.3	112.0	0.36
E_GEN12	EPS Caterpillar C175-16 10	EPS	493,820	3,684,853	1,257	5.0	472.3	112.0	0.36
E_GEN13	EPS Caterpillar C175-16 11	EPS	493,820	3,684,862	1,260	5.0	472.3	112.0	0.36
E_GEN14	EPS Caterpillar C175-16 12	EPS	493,820	3,684,872	1,264	5.0	472.3	112.0	0.36
E_GEN15	EPS Caterpillar C175-16 13	EPS	493,820	3,684,882	1,268	5.0	472.3	112.0	0.36
E_GEN16	EPS Caterpillar C175-16 14	EPS	493,820	3,684,891	1,269	5.0	472.3	112.0	0.36
E_COOL1	EPS Surface Cooling Towers 1	EPS	493,613	3,684,698	1,268	11.7	100.0	12.2	9.7
E_COOL2	EPS Surface Cooling Towers 2	EPS	493,613	3,684,716	1,268	11.7	100.0	12.2	9.7
E_COOL3	EPS Surface Cooling Towers 3	EPS	493,613	3,684,734	1,268	11.7	100.0	12.2	9.7
E_COOL4	EPS Surface Cooling Towers 4	EPS	493,647	3,684,698	1,268	11.7	100.0	12.2	9.7
E_COOL5	EPS Surface Cooling Towers 5	EPS	493,647	3,684,716	1,268	11.7	100.0	12.2	9.7
E_COOL6	EPS Surface Cooling Towers 6	EPS	493,647	3,684,734	1,268	11.7	100.0	12.2	9.7
M1_FEED	SAG Mill Stockpile to Reclaim Tunnel Feeders (FE-001 - 004) - SAG 1	WPS	490,184	3,686,096	960	46.4	Ambient	27.4	0.61
M1_XFER	Mill Reclaim Tunnel Feeders (FE001 - 004) to SAG 1 Conveyor (CV-004)	WPS	490,147	3,685,992	958	46.4	Ambient	27.4	0.61
M2_FEED	SAG Mill Stockpile to Reclaim Tunnel Feeders (FE-005 - 008) - SAG 2	WPS	490,228	3,686,080	973	46.4	Ambient	27.4	0.61
M2_XFER	Mill Reclaim Tunnel Feeders (FE005 - 008) to SAG 2 Conveyor (CV-104)	WPS	490,191	3,685,977	957	46.4	Ambient	27.4	0.61
M1_LOAD	Mill SAG 1 Conveyor (CV-004) to SAG Mill 1 (ML-001)	WPS	490,100	3,685,862	951	22.2	Ambient	0.001	0.001
M1_SAG	SAG Mill 1 (ML-001)	WPS	490,089	3,685,834	947	22.2	Ambient	0.001	0.001
M1_TROML	Mill Trommel Screen 1 (SR-001) and associated transfer out (SR-002)	WPS	490,089	3,685,834	947	22.2	Ambient	0.001	0.001
M1_VIBRT	Mill Vibrating Screen (SR-002) and associated transfer out (oversize to CV-012)	WPS	490,089	3,685,834	947	22.2	Ambient	0.001	0.001
M1_BALLA	Ball Mill 1A (ML-002) and associated transfers in and out	WPS	490,089	3,685,834	947	22.2	Ambient	0.001	0.001
M1_BALLB	Ball Mill 1B (ML-003) and associated transfers in and out	WPS	490,089	3,685,834	947	22.2	Ambient	0.001	0.001
M2_LOAD	Mill SAG 2 Conveyor (CV-104) to SAG Mill 2 (ML-001)	WPS	490,143	3,685,846	961	22.2	Ambient	0.001	0.001
M2_SAG	SAG Mill 2 (ML-101)	WPS	490,133	3,685,818	954	22.2	Ambient	0.001	0.001
M2_TROML	Mill Trommel Screen 2 (SR-101) and associated transfer out (SR-003)	WPS	490,133	3,685,818	954	22.2	Ambient	0.001	0.001
M2_VIBRT	Mill Vibrating Screen (SR-003) and associated transfer out (oversize to CV-012)	WPS	490,133	3,685,818	954	22.2	Ambient	0.001	0.001
M2_BALLA	WPS Fugitive Surface Emissions	WPS	490,133	3,685,818	954	22.2	Ambient	0.001	0.001
M2_BALLB	WPS Fugitive Surface Emissions	WPS	490,133	3,685,818	954	22.2	Ambient	0.001	0.001
M_SCREEN	WPS Fugitive Surface Emissions	WPS	490,116	3,685,839	952	22.2	Ambient	0.001	0.001
M_PEBREC	Mill Recycle Conveyor 2 (CV-013) to Recycle Conveyor 3 (CV-014)	WPS	490,116	3,685,839	952	22.2	Ambient	0.001	0.001

Model ID	Description	Facility	UTM X (m, Zone 12)	UTM Y (m, Zone 12)	Elevation (m)	Release Height (m)	Temperature (°C)	Exit Velocity (m/s)	Stack Dia (m)
M_PEBBIN	Mill Recycle Conveyor 3 (CV-014) to Pebble Bin (BN-002)	WPS	490,116	3,685,839	952	22.2	Ambient	0.001	0.001
M1_PEBFD	Mill Pebble Bin (BN-002) to Pebble Feeder 1 (FE-009)	WPS	490,116	3,685,839	952	22.2	Ambient	0.001	0.001
M2_PEBFD	Mill Pebble Bin (BN-002) to Pebble Feeder 2 (FE-109)	WPS	490,116	3,685,839	952	22.2	Ambient	0.001	0.001
M1_PBCV	Mill Pebble Feeder 1 (FE-009) to SAG 1 Conveyor (CV-004)	WPS	490,116	3,685,839	952	22.2	Ambient	0.001	0.001
M2_PBCV	Mill Pebble Feeder 2 (FE-109) to SAG 2 Conveyor (CV-104)	WPS	490,116	3,685,839	952	22.2	Ambient	0.001	0.001
M_MLYFLT	Mill Moly Concentrate Filter (FL-001) to Holoflite Dryers (DR001 - 002)	WPS	489,931	3,685,743	927	22.2	Ambient	0.001	0.001
M_MLYBIN	Mill Holoflite Dryers (DR-001 - 002) to Moly Concentrate Day Bins (BN001 - 003)	WPS	489,929	3,685,730	928	1.8	Ambient	0.001	0.001
M_MLYBAG	Mill Moly Concentrate Day Bins (BN001 - 003) to Moly Bagging System (MS-001)	WPS	489,929	3,685,730	928	1.8	Ambient	0.001	0.001
M1_LIMBN	Mill Lime Bin 1 (BN-801) Loading (Discharge to Enclosed Screw Feeder)	WPS	490,147	3,685,653	963	9.0	Ambient	0.001	0.001
M1_LIMVM	Mill Screw Feeder 1 (CV-801) to Vertimill 1 (ML-801)	WPS	490,133	3,685,658	959	9.0	Ambient	0.001	0.001
M1_LIMTK	Mill Vertimill 1 (ML-801) to Milk of Lime Tank (TK-156)	WPS	490,147	3,685,676	959	9.0	Ambient	0.001	0.001
M2_LIMBN	Mill Lime Bin 2 (BN-802) Loading (Discharge to Enclosed Screw Feeder)	WPS	490,151	3,685,665	961	9.0	Ambient	0.001	0.001
M2_LIMVM	Mill Screw Feeder 2 (CV-802) to Vertimill 2 (ML-802)	WPS	490,137	3,685,669	960	9.0	Ambient	0.001	0.001
M2_LIMTK	Mill Vertimill 2 (ML-802) to Milk of Lime Tank (TK-156)	WPS	490,147	3,685,676	959	9.0	Ambient	0.001	0.001
M_MLYHTR	Mill Moly/Talc Heat Treatment Process	WPS	489,945	3,685,729	928	22.3	10.0	0.3	0.30
M_KILN_P	Moly/Talc Rotary Dryer Process	WPS	489,944	3,685,720	929	22.3	10.0	0.3	0.30
M_KILN_C	Moly/Talc Rotary Dryer Combustion	WPS	489,944	3,685,720	929	22.3	10.0	0.3	0.30
W_GEN1	WPS Caterpillar C18 Generator Set 1	WPS	490,175	3,685,798	963	2.8	447.1	35.9	0.20
W_GEN2	WPS Caterpillar C18 Generator Set 2	WPS	490,173	3,685,792	962	2.8	447.1	35.9	0.20
W_GEN3	WPS Caterpillar C18 Generator Set 3	WPS	490,170	3,685,785	962	2.8	447.1	35.9	0.20
M_CMBSTN	Mill Combustion (Stationary)	WPS	490,036	3,685,487	955	3.8	204.0	135.9	0.10
W_HEAT1	WPS Hydro House Propane Heater (0.045 MMBtu/hr)	WPS	490,929	3,684,596	912	3.8	204.0	0.9	0.10
W_HEAT2	WPS Hydro House Propane Heater (0.065 MMBtu/hr)	WPS	490,948	3,684,599	913	3.8	204.0	1.3	0.10
F_LDSTL	FPLF Concentrate Filters (FL-001 - 006) to Shuttle Conveyors (CV-001 - CV-006)	FPLF	461,713	3,673,879	512	1.8	Ambient	0.001	0.001
F_STLBLD	FPLF Shuttle Conveyors (CV-001 - CV-006) to Filter Building (BG-011)	FPLF	461,687	3,673,854	512	1.8	Ambient	0.001	0.001
F_STLCOL	FPLF Shuttle Conveyors (CV-001 - CV-006) to Collecting Conveyor (CV-010)	FPLF	461,660	3,673,854	512	1.8	Ambient	0.001	0.001
F_COLBLT	FPLF Collecting Conveyor (CV-010) to Belt Conveyor (CV-020)	FPLF	461,649	3,673,865	512	1.8	Ambient	0.001	0.001
F_LDGHOP	FPLF Concentrate Hopper (HP-011) Loading	FPLF	461,647	3,673,868	512	1.8	Ambient	0.001	0.001
F_HOPFED	FPLF Concentrate Hopper (HP-011) to Concentrate Feeder (FE-011)	FPLF	461,647	3,673,868	512	1.8	Ambient	0.001	0.001
F_FEDBLT	FPLF Concentrate Feeder (FE-011) to Belt Conveyor (CV-020)	FPLF	461,647	3,673,868	512	1.8	Ambient	0.001	0.001
F_BLTTRP	FPLF Belt Conveyor (CV-020) to Tripper Conveyor (CV-030)	FPLF	461,569	3,673,876	511	1.8	Ambient	0.001	0.001
F_TRPSTO	FPLF Tripper Conveyor (CV-030) to Storage and Loadout Shed (BG-012)	FPLF	461,563	3,673,876	511	1.8	Ambient	0.001	0.001
F_LDRHOP	FPLF Front End Loader (MS-002) to Load Out Hoppers (HP-012 - 015)	FPLF	461,437	3,673,851	510	1.8	Ambient	0.001	0.001
F_HOPBLT	FPLF Load Out Hoppers (HP-012 - 015) to Weigh Belt Feeders (FE-012 -015)	FPLF	461,437	3,673,851	510	1.8	Ambient	0.001	0.001
F_BLTCNV	FPLF Weigh Belt Feeders (FE-012 -015) to Load Out Conveyors (CV-031 - 034)	FPLF	461,437	3,673,851	510	1.8	Ambient	0.001	0.001
F_CNVTRN	FPLF Load Out Conveyors (CV-031 - 034) to Rail Cars	FPLF	461,437	3,673,832	510	1.8	Ambient	0.001	0.001
F_GEN1	FPLF Caterpillar C18 Generator Set 4	FPLF	461,749	3,673,868	512	2.8	447.1	35.9	0.20
T_GEN1	TSF Caterpillar C18 Generator Set 5	TSF	485,241	3,687,293	805	2.8	447.1	35.9	0.20

Model ID	Description	Facility	UTM X (m, Zone 12)	UTM Y (m, Zone 12)	Elevation (m)	Release Height (m)	σ_{y0} (m)	σ_{z0} (m)
B_AGDEL	Batch Plant Aggregate Delivery to Ground Storage	EPS	493,671	3,684,924	1,272	1.8	1.0	1.6
B_SNDEL	Batch Plant Sand Delivery to Ground Storage	EPS	493,673	3,684,924	1,272	1.8	1.0	1.6
B_AGCHUT	Batch Plant Aggregate Transfer to Conveyor Belt via Chute	EPS	493,665	3,684,928	1,274	1.8	1.1	1.6
B_SNCHUT	Batch Plant Sand Transfer to Conveyor Belt via Chute	EPS	493,665	3,684,928	1,274	1.8	1.1	1.6
B_AGSTOR	Batch Plant Aggregate Transfer to Elevated Storage	EPS	493,651	3,684,923	1,275	1.8	1.1	1.6
B_SNSTOR	Batch Plant Sand Transfer to Elevated Storage	EPS	493,651	3,684,928	1,275	1.8	0.2	1.6
B_WHOPLD	Batch Plant Weigh Hopper Loading (Aggregate & Sand)	EPS	493,650	3,684,926	1,275	1.8	0.3	1.6
B_WHOPAG	Batch Plant Weigh Hopper Discharge to Truck Loading Conveyor (Agg)	EPS	493,650	3,684,929	1,275	1.8	1.1	1.6
B_WHOPSN	Batch Plant Weigh Hopper Discharge to Truck Loading Conveyor (Sand)	EPS	493,650	3,684,929	1,275	1.8	1.1	1.6
B_CEMSLO	Batch Plant Cement Unloading to Silo	EPS	493,645	3,684,929	1,277	1.8	3.3	1.6
B_FLYSLO	Batch Plant Flyash Unloading to Silo	EPS	493,645	3,684,926	1,277	1.8	5.8	1.6
B_SILSLO	Batch Plant Silica Fume Unloading to Silo	EPS	493,650	3,684,935	1,275	1.8	3.3	1.6
B_SLOHOP	Batch Plant Cement & Flyash Discharge to Silo Weigh Hopper	EPS	493,650	3,684,938	1,275	1.8	5.8	1.6
B_SLOCNY	Batch Plant Silo Weigh Hopper Discharge to Truck Loading Conveyor	EPS	493,649	3,684,941	1,275	1.8	1.2	1.6
B_SLOTRK	Batch Plant Truck Loading	EPS	493,650	3,684,945	1,276	1.8	1.1	1.6
W_CVYXF1	Incline Conveyor to Mine Conveyor	WPS	0	0	0	0.0	0.0	0.0
W_CVYXF2	WPS Mine Conveyor to Mine Transfer Conveyor (CV-002)	WPS	490,136	3,685,328	957	3.5	3.3	1.6
M_TRIPPR	Mill Mine Transfer Conveyor (CV-002) to Stockpile Tripper Conveyor (CV-003)	WPS	490,279	3,686,002	975	44.4	24.6	20.7
M_STOCKP	Mill Stockpile Tripper Conveyor (CV-003) to Covered SAG Mill Stockpile	WPS	490,184	3,686,036	969	44.4	24.6	20.7
M_SIPX	Mill SIPX (Sodium Isopropyl Xanthate)	WPS	490,131	3,685,752	951	15.0	1.1	7.0
M_MIBC	Mill MIBC (Methyl isobutyl carbonal)	WPS	490,132	3,685,754	951	15.0	1.1	7.0
M_NAHS	Mill NaHS (Sodium hydrosulfide solution)	WPS	490,135	3,685,753	951	15.0	1.1	7.0
M_FLOC1	Mill Flocculent (CIBA Magnafloc 155)	WPS	490,134	3,685,751	951	15.0	1.1	7.0
M_FLOC2	Mill Flocculent (CIBA Magnafloc 10)	WPS	490,138	3,685,749	952	15.0	1.1	7.0
M_CYTEC	Mill CYTEC 8989	WPS	490,139	3,685,752	952	15.0	1.1	7.0
M_MCO	Mill MCO (Non-polar flotation oil)	WPS	490,142	3,685,749	952	15.0	1.1	7.0
E_FUGS	EPS Fugitive Surface Emissions	EPS	493,633	3,684,853	1,281	5.0	98.8	4.7
W_FUGS	WPS Fugitive Surface Emissions	WPS	490,000	3,685,229	936	5.0	197.7	4.7
F_FUGS	FPLF Fugitive Surface Emissions	FPLF	461,606	3,673,866	512	5.0	58.1	4.7
T_FUGS	TSF Fugitive Surface Emissions	TSF	481,673	3,686,150	746	5.0	348.8	4.7

AREA Source Release Parameters

Model ID	Description	Facility	UTM X (m, Zone 12)	UTM Y (m, Zone 12)	UTM X (m, Zone 12)*	UTM Y (m, Zone 12)*	Elevation (m)	Release Height (m)	α _{x0} (m)	α _{y0} (m)	α _{z0} (m)**	Rotation (°)**
E_WE_EXP	EPS Exposed Areas	EPS	493,738	3,684,781			1,231	1.0	262.4	399.6	0.9	-54.0
E_WE_SUB	EPS Exposed Subsidence Area	EPS	494,354	3,683,028			1,278	1.0	1290.1	1,440.8	0.9	-27.5
W_WE_EXP	WPS Exposed Areas	WPS	489,301	3,683,810			899	1.0	838.4	1,669.0	0.9	0.5
T_WE_EX	TSF Exposed Areas	TSF	480,674	3,687,648			757	1.0	15.0	0.9		
E_RD01	EPS Delivery & Employee road emissions	EPS	495,456	3,685,978	495,355	3,685,835	1,220	2.6	16.0	2.4		
E_RD02	EPS Delivery & Employee road emissions	EPS	495,355	3,685,835	495,333	3,685,614	1,214	2.6	16.0	2.4		
E_RD03	EPS Delivery & Employee road emissions	EPS	495,333	3,685,614	495,101	3,685,520	1,202	2.6	16.0	2.4		
E_RD04	EPS Delivery & Employee road emissions	EPS	495,101	3,685,520	494,863	3,685,575	1,197	2.6	16.0	2.4		
E_RD05	EPS Delivery & Employee road emissions	EPS	494,863	3,685,575	494,647	3,685,550	1,190	2.6	16.0	2.4		
E_RD06	EPS Delivery & Employee road emissions	EPS	494,647	3,685,550	494,444	3,685,584	1,183	2.6	16.0	2.4		
E_RD07	EPS Delivery & Employee road emissions	EPS	494,444	3,685,584	494,310	3,685,542	1,184	2.6	16.0	2.4		
E_RD08	EPS Delivery & Employee road emissions	EPS	494,310	3,685,542	494,195	3,685,430	1,181	2.6	16.0	2.4		
E_RD09	EPS Delivery & Employee road emissions	EPS	494,195	3,685,430	493,906	3,684,591	1,224	2.6	16.0	2.4		
E_RD10	EPS Delivery & Employee road emissions	EPS	493,906	3,684,591	493,788	3,684,554	1,270	2.6	16.0	2.4		
E_RD11	EPS Delivery road emissions	EPS	493,788	3,684,554	493,659	3,684,558	1,270	2.6	16.0	2.4		
E_RD12	EPS Delivery road emissions	EPS	493,659	3,684,558	493,554	3,684,560	1,277	2.6	16.0	2.4		
E_RD13	EPS Delivery road emissions	EPS	493,554	3,684,560	493,553	3,684,587	1,286	2.6	16.0	2.4		
E_RD14	EPS Delivery road emissions	EPS	493,553	3,684,587	493,626	3,684,585	1,276	2.6	16.0	2.4		
E_RD15	EPS Delivery road emissions	EPS	493,626	3,684,585	493,659	3,684,558	1,268	2.6	16.0	2.4		
E_RD16	EPS Employee road emissions	EPS	493,788	3,684,554	493,711	3,684,668	1,266	2.6	16.0	2.4		
E_TP01	EPS Delivery & Employee road tailpipe emissions	EPS	495,456	3,685,978	495,355	3,685,835	1,220	2.6	16.0	2.4		
E_TP02	EPS Delivery & Employee road tailpipe emissions	EPS	495,355	3,685,835	495,333	3,685,614	1,214	2.6	16.0	2.4		
E_TP03	EPS Delivery & Employee road tailpipe emissions	EPS	495,333	3,685,614	495,101	3,685,520	1,202	2.6	16.0	2.4		
E_TP04	EPS Delivery & Employee road tailpipe emissions	EPS	495,101	3,685,520	494,863	3,685,575	1,197	2.6	16.0	2.4		
E_TP05	EPS Delivery & Employee road tailpipe emissions	EPS	494,863	3,685,575	494,647	3,685,550	1,190	2.6	16.0	2.4		
E_TP06	EPS Delivery & Employee road tailpipe emissions	EPS	494,647	3,685,550	494,444	3,685,584	1,183	2.6	16.0	2.4		
E_TP07	EPS Delivery & Employee road tailpipe emissions	EPS	494,444	3,685,584	494,310	3,685,542	1,184	2.6	16.0	2.4		
E_TP08	EPS Delivery & Employee road tailpipe emissions	EPS	494,310	3,685,542	494,195	3,685,430	1,181	2.6	16.0	2.4		
E_TP09	EPS Delivery & Employee road tailpipe emissions	EPS	494,195	3,685,430	493,906	3,684,591	1,224	2.6	16.0	2.4		
E_TP10	EPS Delivery & Employee road tailpipe emissions	EPS	493,906	3,684,591	493,788	3,684,554	1,270	2.6	16.0	2.4		
E_TP11	EPS Delivery road tailpipe emissions	EPS	493,788	3,684,554	493,659	3,684,558	1,270	2.6	16.0	2.4		
E_TP12	EPS Delivery road tailpipe emissions	EPS	493,659	3,684,558	493,554	3,684,560	1,277	2.6	16.0	2.4		
E_TP13	EPS Delivery road tailpipe emissions	EPS	493,554	3,684,560	493,553	3,684,587	1,286	2.6	16.0	2.4		
E_TP14	EPS Delivery road tailpipe emissions	EPS	493,553	3,684,587	493,626	3,684,585	1,276	2.6	16.0	2.4		
E_TP15	EPS Delivery road tailpipe emissions	EPS	493,626	3,684,585	493,659	3,684,558	1,268	2.6	16.0	2.4		
E_TP16	EPS Employee road tailpipe emissions	EPS	493,788	3,684,554	493,711	3,684,668	1,266	2.6	16.0	2.4		
W_RD01	WPS Employee road emissions	WPS	489,852	3,683,414	489,840	3,683,476	832	2.6	16.0	2.4		
W_RD02	WPS Employee road emissions	WPS	489,840	3,683,476	489,931	3,683,519	834	2.6	16.0	2.4		
W_RD03	WPS Employee road emissions	WPS	489,931	3,683,519	489,974	3,683,619	837	2.6	16.0	2.4		
W_RD04	WPS Employee road emissions	WPS	489,974	3,683,619	490,058	3,683,730	841	2.6	16.0	2.4		
W_RD05	WPS Employee road emissions	WPS	490,058	3,683,730	490,010	3,683,826	843	2.6	16.0	2.4		
W_RD06	WPS Delivery road emissions	WPS	488,859	3,684,639	488,912	3,684,810	887	2.6	16.0	2.4		
W_RD07	WPS Delivery road emissions	WPS	488,912	3,684,810	489,081	3,684,939	906	2.6	16.0	2.4		
W_RD08	WPS Delivery road emissions	WPS	489,081	3,684,939	488,952	3,685,077	910	2.6	16.0	2.4		
W_RD09	WPS Delivery road emissions	WPS	488,952	3,685,077	488,987	3,685,168	893	2.6	16.0	2.4		
W_RD10	WPS Delivery road emissions	WPS	488,987	3,685,168	489,588	3,685,693	922	2.6	16.0	2.4		
W_RD11	WPS Delivery road emissions	WPS	489,588	3,685,693	489,751	3,685,646	944	2.6	16.0	2.4		
W_RD12	WPS Delivery road emissions	WPS	489,751	3,685,646	490,047	3,685,523	940	2.6	16.0	2.4		
W_TP01	WPS Employee road tailpipe emissions	WPS	489,852	3,683,414	489,840	3,683,476	832	2.6	16.0	2.4		

AREA Source Release Parameters

Model ID	Description	Facility	UTM X (m, Zone 12)	UTM Y (m, Zone 12)	UTM X (m, Zone 12)*	UTM Y (m, Zone 12)*	Elevation (m)	Release Height (m)	σ_{x0} (m)	σ_{y0} (m)	σ_{z0} (m)**	Rotation (°)**
W_TP02	WPS Employee road tailpipe emissions	WPS	489,840	3,683,476	489,931	3,683,519	834	2.6	16.0	2.4		
W_TP03	WPS Employee road tailpipe emissions	WPS	489,931	3,683,519	489,974	3,683,619	837	2.6	16.0	2.4		
W_TP04	WPS Employee road tailpipe emissions	WPS	489,974	3,683,619	490,058	3,683,730	841	2.6	16.0	2.4		
W_TP05	WPS Employee road tailpipe emissions	WPS	490,058	3,683,730	490,010	3,683,826	843	2.6	16.0	2.4		
W_TP06	WPS Delivery road tailpipe emissions	WPS	488,859	3,684,639	488,912	3,684,810	887	2.6	16.0	2.4		
W_TP07	WPS Delivery road tailpipe emissions	WPS	488,912	3,684,810	489,081	3,684,939	906	2.6	16.0	2.4		
W_TP08	WPS Delivery road tailpipe emissions	WPS	489,081	3,684,939	488,952	3,685,077	910	2.6	16.0	2.4		
W_TP09	WPS Delivery road tailpipe emissions	WPS	488,952	3,685,077	488,987	3,685,168	893	2.6	16.0	2.4		
W_TP10	WPS Delivery road tailpipe emissions	WPS	488,987	3,685,168	489,588	3,685,693	922	2.6	16.0	2.4		
W_TP11	WPS Delivery road tailpipe emissions	WPS	489,588	3,685,693	489,751	3,685,646	944	2.6	16.0	2.4		
W_TP12	WPS Delivery road tailpipe emissions	WPS	489,751	3,685,646	490,047	3,685,523	940	2.6	16.0	2.4		
F_RD01	FPLF Delivery & Employee road emissions	FPLF	460,966	3,672,584	460,965	3,673,840	506	2.6	16.0	2.4		
F_RD02	FPLF Delivery & Employee road emissions	FPLF	460,965	3,673,840	460,991	3,673,902	507	2.6	16.0	2.4		
F_RD03	FPLF Delivery & Employee road emissions	FPLF	460,991	3,673,902	461,055	3,673,935	508	2.6	16.0	2.4		
F_RD04	FPLF Delivery & Employee road emissions	FPLF	461,055	3,673,935	461,578	3,673,935	510	2.6	16.0	2.4		
F_RD05	FPLF Employee road emissions	FPLF	461,578	3,673,935	461,579	3,673,973	511	2.6	16.0	2.4		
F_RD06	FPLF Delivery road emissions	FPLF	461,578	3,673,935	461,739	3,673,935	512	2.6	16.0	2.4		
F_TP01	FPLF Delivery & Employee road tailpipe emissions	FPLF	460,966	3,672,584	460,965	3,673,840	506	2.6	16.0	2.4		
F_TP02	FPLF Delivery & Employee road tailpipe emissions	FPLF	460,965	3,673,840	460,991	3,673,902	507	2.6	16.0	2.4		
F_TP03	FPLF Delivery & Employee road tailpipe emissions	FPLF	460,991	3,673,902	461,055	3,673,935	508	2.6	16.0	2.4		
F_TP04	FPLF Delivery & Employee road tailpipe emissions	FPLF	461,055	3,673,935	461,578	3,673,935	510	2.6	16.0	2.4		
F_TP05	FPLF Employee road tailpipe emissions	FPLF	461,578	3,673,935	461,579	3,673,973	511	2.6	16.0	2.4		
F_TP06	FPLF Delivery road tailpipe emissions	FPLF	461,578	3,673,935	461,739	3,673,935	512	2.6	16.0	2.4		
T_RD01	TSF Delivery & Employee road emissions	TSF	484,717	3,687,597	484,868	3,687,372	817	2.6	16.0	2.4		
T_RD02	TSF Delivery & Employee road emissions	TSF	484,868	3,687,372	484,840	3,687,614	816	2.6	16.0	2.4		
T_RD03	TSF Delivery & Employee road emissions	TSF	484,840	3,687,614	484,902	3,687,734	829	2.6	16.0	2.4		
T_RD04	TSF Delivery & Employee road emissions	TSF	484,902	3,687,734	485,140	3,687,737	830	2.6	16.0	2.4		
T_RD05	TSF Delivery & Employee road emissions	TSF	485,140	3,687,737	485,396	3,687,556	831	2.6	16.0	2.4		
T_RD06	TSF Delivery & Employee road emissions	TSF	485,396	3,687,556	485,483	3,687,201	838	2.6	16.0	2.4		
T_RD07	TSF Delivery & Employee road emissions	TSF	485,483	3,687,201	485,206	3,686,859	819	2.6	16.0	2.4		
T_RD08	TSF Delivery & Employee road emissions	TSF	485,206	3,686,859	485,244	3,686,713	793	2.6	16.0	2.4		
T_RD09	TSF Delivery & Employee road emissions	TSF	485,244	3,686,713	485,485	3,686,648	787	2.6	16.0	2.4		
T_RD10	TSF Delivery & Employee road emissions	TSF	485,485	3,686,648	485,743	3,686,373	795	2.6	16.0	2.4		
T_RD11	TSF Delivery & Employee road emissions	TSF	485,743	3,686,373	485,968	3,686,371	825	2.6	16.0	2.4		
T_RD12	TSF Delivery & Employee road emissions	TSF	485,968	3,686,371	485,978	3,686,468	847	2.6	16.0	2.4		
T_RD13	TSF Delivery & Employee road emissions	TSF	485,978	3,686,468	486,225	3,686,574	852	2.6	16.0	2.4		
T_RD14	TSF Delivery & Employee road emissions	TSF	486,225	3,686,574	486,374	3,686,722	857	2.6	16.0	2.4		
T_RD15	TSF Delivery & Employee road emissions	TSF	486,374	3,686,722	486,667	3,686,628	864	2.6	16.0	2.4		
T_RD16	TSF Delivery & Employee road emissions	TSF	486,667	3,686,628	486,848	3,686,719	866	2.6	16.0	2.4		
T_RD17	TSF Delivery & Employee road emissions	TSF	486,848	3,686,719	487,055	3,686,754	869	2.6	16.0	2.4		
T_RD18	TSF Delivery & Employee road emissions	TSF	487,055	3,686,754	487,322	3,687,277	878	2.6	16.0	2.4		
T_RD19	TSF Delivery & Employee road emissions	TSF	487,322	3,687,277	487,577	3,687,026	886	2.6	16.0	2.4		
T_RD20	TSF Delivery & Employee road emissions	TSF	487,577	3,687,026	487,776	3,686,967	887	2.6	16.0	2.4		
T_RD21	TSF Delivery & Employee road emissions	WPS	487,776	3,686,967	488,477	3,686,584	899	2.6	16.0	2.4		
T_RD22	TSF Delivery & Employee road emissions	WPS	488,477	3,686,584	488,646	3,686,733	921	2.6	16.0	2.4		
T_RD23	TSF Delivery & Employee road emissions	WPS	488,646	3,686,733	488,817	3,686,734	922	2.6	16.0	2.4		
T_RD24	TSF Delivery & Employee road emissions	WPS	488,817	3,686,734	488,992	3,686,591	929	2.6	16.0	2.4		
T_RD25	TSF Delivery & Employee road emissions	WPS	488,992	3,686,591	489,270	3,686,573	936	2.6	16.0	2.4		
T_RD26	TSF Delivery & Employee road emissions	WPS	489,270	3,686,573	489,554	3,686,278	938	2.6	16.0	2.4		
T_RD27	TSF Delivery & Employee road emissions	WPS	489,554	3,686,278	489,758	3,685,821	942	2.6	16.0	2.4		

AREA Source Release Parameters

Model ID	Description	Facility	UTM X (m, Zone 12)	UTM Y (m, Zone 12)	UTM X (m, Zone 12)*	UTM Y (m, Zone 12)*	Elevation (m)	Release Height (m)	σ_{x0} (m)	σ_{y0} (m)	σ_{z0} (m)**	Rotation (°)**
T_RD28	TSF Delivery & Employee road emissions	WPS	489,758	3,685,821	489,722	3,685,660	939	2.6	16.0	2.4		
T_RD29	TSF Delivery & Employee road emissions	WPS	489,722	3,685,660	489,860	3,685,620	936	2.6	16.0	2.4		
T_TP01	TSF Delivery & Employee road tailpipe emissions	TSF	484,717	3,687,597	484,868	3,687,372	817	2.6	16.0	2.4		
T_TP02	TSF Delivery & Employee road tailpipe emissions	TSF	484,868	3,687,372	484,840	3,687,614	816	2.6	16.0	2.4		
T_TP03	TSF Delivery & Employee road tailpipe emissions	TSF	484,840	3,687,614	484,902	3,687,734	829	2.6	16.0	2.4		
T_TP04	TSF Delivery & Employee road tailpipe emissions	TSF	484,902	3,687,734	485,140	3,687,737	830	2.6	16.0	2.4		
T_TP05	TSF Delivery & Employee road tailpipe emissions	TSF	485,140	3,687,737	485,396	3,687,556	831	2.6	16.0	2.4		
T_TP06	TSF Delivery & Employee road tailpipe emissions	TSF	485,396	3,687,556	485,483	3,687,201	838	2.6	16.0	2.4		
T_TP07	TSF Delivery & Employee road tailpipe emissions	TSF	485,483	3,687,201	485,206	3,686,859	819	2.6	16.0	2.4		
T_TP08	TSF Delivery & Employee road tailpipe emissions	TSF	485,206	3,686,859	485,244	3,686,713	793	2.6	16.0	2.4		
T_TP09	TSF Delivery & Employee road tailpipe emissions	TSF	485,244	3,686,713	485,485	3,686,648	787	2.6	16.0	2.4		
T_TP10	TSF Delivery & Employee road tailpipe emissions	TSF	485,485	3,686,648	485,743	3,686,373	795	2.6	16.0	2.4		
T_TP11	TSF Delivery & Employee road tailpipe emissions	TSF	485,743	3,686,373	485,968	3,686,371	825	2.6	16.0	2.4		
T_TP12	TSF Delivery & Employee road tailpipe emissions	TSF	485,968	3,686,371	485,978	3,686,468	847	2.6	16.0	2.4		
T_TP13	TSF Delivery & Employee road tailpipe emissions	TSF	485,978	3,686,468	486,225	3,686,574	852	2.6	16.0	2.4		
T_TP14	TSF Delivery & Employee road tailpipe emissions	TSF	486,225	3,686,574	486,374	3,686,722	857	2.6	16.0	2.4		
T_TP15	TSF Delivery & Employee road tailpipe emissions	TSF	486,374	3,686,722	486,667	3,686,628	864	2.6	16.0	2.4		
T_TP16	TSF Delivery & Employee road tailpipe emissions	TSF	486,667	3,686,628	486,848	3,686,719	866	2.6	16.0	2.4		
T_TP17	TSF Delivery & Employee road tailpipe emissions	TSF	486,848	3,686,719	487,055	3,686,754	869	2.6	16.0	2.4		
T_TP18	TSF Delivery & Employee road tailpipe emissions	TSF	487,055	3,686,754	487,322	3,687,277	878	2.6	16.0	2.4		
T_TP19	TSF Delivery & Employee road tailpipe emissions	TSF	487,322	3,687,277	487,577	3,687,026	886	2.6	16.0	2.4		
T_TP20	TSF Delivery & Employee road tailpipe emissions	TSF	487,577	3,687,026	487,776	3,686,967	887	2.6	16.0	2.4		
T_TP21	TSF Delivery & Employee road tailpipe emissions	WPS	487,776	3,686,967	488,477	3,686,584	899	2.6	16.0	2.4		
T_TP22	TSF Delivery & Employee road tailpipe emissions	WPS	488,477	3,686,584	488,646	3,686,733	921	2.6	16.0	2.4		
T_TP23	TSF Delivery & Employee road tailpipe emissions	WPS	488,646	3,686,733	488,817	3,686,734	922	2.6	16.0	2.4		
T_TP24	TSF Delivery & Employee road tailpipe emissions	WPS	488,817	3,686,734	488,992	3,686,591	929	2.6	16.0	2.4		
T_TP25	TSF Delivery & Employee road tailpipe emissions	WPS	488,992	3,686,591	489,270	3,686,573	936	2.6	16.0	2.4		
T_TP26	TSF Delivery & Employee road tailpipe emissions	WPS	489,270	3,686,573	489,554	3,686,278	938	2.6	16.0	2.4		
T_TP27	TSF Delivery & Employee road tailpipe emissions	WPS	489,554	3,686,278	489,758	3,685,821	942	2.6	16.0	2.4		
T_TP28	TSF Delivery & Employee road tailpipe emissions	WPS	489,758	3,685,821	489,722	3,685,660	939	2.6	16.0	2.4		
T_TP29	TSF Delivery & Employee road tailpipe emissions	WPS	489,722	3,685,660	489,860	3,685,620	936	2.6	16.0	2.4		
RR_OFF	Rail line hauling concentrate offsite (Far West to Magma Junction)	FPLF	453,418	3,666,075	462,062	3,672,632	487	3.9	10.0	3.6		

* A second coordinate indicates a LINE source, a subtype of the AREA source.

** Presence of these parameters indicate an AREA source that is not a LINE source.

Appendix C – Wind Erosion Calculations

<div>Air Sciences Inc.</div> <div>AIR EMISSION CALCULATIONS</div>	PROJECT TITLE:	NEPA Model Plan		BY:	D. Steen	
	PROJECT NO:	262-32		PAGE:	OF:	SHEET:
	SUBJECT:	Wind Erosion Emissions		1	3	Wind
				DATE:	October 12, 2018	

EAST PLANT FUGITIVE WIND EROSION EMISSIONS

Based on EPS Station Meteorological Data

AP-42, Sec. 13.2.5

Flat, u^*/u_{10}^+

0.053

AP-42, Sec. 13.2.5, p. 5

(A) $u_{10}^+ = 1.2 u_{10}$

Fastest mile wind speed at 10m, with a 1.2 factor to convert hourly wind speed to fastest mile.

(B, piles) $u^* = (U_g/U_t) \times 0.1 \times u_{10}^+$

(B, flat) $u^* = 0.053 \times u_{10}^+$

AZ Cu Mine Tailings

(C) $P = 58 (u^* - u_{t*})^2 + 25 (u^* - u_{t*})$; $P = 0$ for $u^* \leq u_{t*}$; where $u_{t*} =$

0.172 m/s

Threshold Friction Velocity AZ Cu. Mine Tailings

Flat Areas, Uncontrolled

Pollutant Scaling Factor

PM Emissions	72.2 (ton/acre-yr)	PM	1
PM10 Emissions	36.1 (ton/acre-yr)	PM10	0.5
PM2.5 Emissions	5.4 (ton/acre-yr)	PM2.5	0.075

17,544

Total hours (2015-2016)

7,084

Total hours in 2015-2016 with wind erosion emissions > 0

East Plant Wind Erosion

21

Maximum Erodible Area (acres)

Water Controlled

0.002

Disturbance Created Every Hour (acre/hr)

Control Eff. 90%

	Controlled	Uncontrolled	
PM Emissions	0.023	0.23	tpy
PM10 Emissions	0.012	0.12	tpy
PM2.5 Emissions	0.002	0.017	tpy

East Plant Subsidence

279

Maximum Erodible Area (acres)

Controlled by Precip; Per Year.

0.032

Disturbance Created Every Hour (acre/hr)

Control Eff. 18%

PM Emissions	1.31	1.59	tpy
PM10 Emissions	0.65	0.79	tpy
PM2.5 Emissions	0.10	0.12	tpy

Conversions:

453.6 g/lb

4,046.9 m²/acre

Final Air Quality Impacts Analysis
NEPA Formal Modeling Report Appendix C, Page 1

<div>Air Sciences Inc.</div> <div>AIR EMISSION CALCULATIONS</div>	PROJECT TITLE:	NEPA Model Plan		BY:	D. Steen	
	PROJECT NO:	262-32		PAGE:	OF:	SHEET:
	SUBJECT:	Wind Erosion Emissions		2	3	Wind
				DATE:	October 12, 2018	

WEST PLANT FUGITIVE WIND EROSION EMISSIONS

Based on WPS Meteorological Data

AP-42, Sec. 13.2.5

Flat, u^*/u_{10}^+

0.053

AP-42, Sec. 13.2.5, p. 5

(A) $u_{10}^+ = 1.2 u_{10}$

Fastest mile wind speed at 10m, with a 1.2 factor to convert hourly wind speed to fastest mile.

(B, piles) $u^* = (U_g/U_t) \times 0.1 \times u_{10}^+$

(B, flat) $u^* = 0.053 \times u_{10}^+$

(C) $P = 58 (u^* - u_{t*})^2 + 25 (u^* - u_{t*})$; $P = 0$ for $u^* \leq u_{t*}$; where $u_{t*} =$

AZ Cu Mine Tailings

0.172 m/s

Threshold Friction Velocity AZ Cu. Mine Tailings

Flat Areas, Uncontrolled

PM Emissions	72.2 (ton/acre-yr)
PM10 Emissions	36.1 (ton/acre-yr)
PM2.5 Emissions	5.4 (ton/acre-yr)

Pollutant Scaling Factor

PM	1
PM10	0.5
PM2.5	0.075

17,544

Total hours (2015-2016)

7,671

Number of Emissable hours in 2015-2016

West Plant

70

Maximum Erodible Area (acres)

0.008

Disturbance Created Every Hour (acre/hr)

Water Controlled

Control Eff. 90%

Controlled

Uncontrolled

PM Emissions	0.08	0.81	tpy
PM ₁₀ Emissions	0.04	0.41	tpy
PM _{2.5} Emissions	0.01	0.06	tpy

Air Sciences Inc.	PROJECT TITLE: NEPA Model Plan		BY: D. Steen		
	PROJECT NO: 262-32		PAGE: 3	OF: 3	SHEET: Wind
	SUBJECT: Wind Erosion Emissions		DATE: October 12, 2018		
AIR EMISSION CALCULATIONS					

TAILINGS STORAGE FACILITY FUGITIVE WIND EROSION EMISSIONS

Based on Hewitt Station Meteorological Data

AP-42, Sec. 13.2.5

Flat, u^*/u_{10}^+

0.053

AP-42, Sec. 13.2.5, p. 5

(A) $u_{10}^+ = 1.2 u_{10}$

Fastest mile wind speed at 10m, with a 1.2 factor to convert hourly wind speed to fastest mile.

(B, piles) $u^* = (U_r/U_t) \times 0.1 \times u_{10}^+$

(B, flat) $u^* = 0.053 \times u_{10}^+$

(C) $P = 58 (u^* - u_t^*)^2 + 25 (u^* - u_t^*)$; $P = 0$ for $u^* \leq u_t^*$; where $u_t^* =$

AZ Cu Mine Tailings

0.172 m/s

Threshold Friction Velocity AZ Cu. Mine Tailings

Flat Areas, Uncontrolled

PM Emissions

65.4 (ton/acre-yr)

PM10 Emissions

32.7 (ton/acre-yr)

PM2.5 Emissions

4.9 (ton/acre-yr)

Pollutant Scaling Factor

PM

1

PM10

0.5

PM2.5

0.075

17,544

Total hours (2015-2016)

8,401

Number of Emissable hours in 2015-2016

Year 41 Tailings Exposed Area

1,439

Maximum Erodible Area (acres)

0.164

Disturbance Created Every Hour (acre/hr)

Water Controlled

Control Eff.

90%

Controlled

Uncontrolled

PM Emissions

1.52

15.16

tpy

PM10 Emissions

0.76

7.58

tpy

PM2.5 Emissions

0.11

1.14

tpy

**Appendix D - Construction Emissions Inventory
(Proposed Action)**

Air Sciences Inc. <
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Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper Project		BY: D. Steen	
	PROJECT NO: 262-32-05		PAGE: 1	OF: 9 SHEET: West Plant
	SUBJECT: West Plant Construction Emissions		DATE: November 1, 2018	

West Plant Controlled Emissions Summary - Project Total (ton/proj)							
	PM	PM ₁₀	PM _{2.5}	CO	NO _x	SO ₂	VOC
Drilling	0.45	0.21	3.2E-2	--	--	--	--
Blasting	20.1	10.4	0.60	133	33.9	4.0	--
Mobile Equipment Combustion	3.9	3.9	3.9	68.5	76.4	0.13	76.4
Mobile Equipment - Fugitives	70.1	16.3	1.6	--	--	--	--
Dozing	38.5	6.1	4.0	--	--	--	--
Grading	20.9	6.0	0.65	--	--	--	--
Scraping	308	160	9.2	--	--	--	--
Employee and Delivery - Combustion	3.7E-2	3.7E-2	1.0E-2	0.14	8.3E-4	0.22	1.2E-2
Employee and Delivery - Fugitives	6.7	1.6	0.16	--	--	--	--
Wind Erosion	1.6	0.82	0.12	--	--	--	--
TOTAL	470	206	20.4	202	110	4.3	76.4

West Plant Controlled Emissions Summary - Annual (ton/yr)							
	PM	PM ₁₀	PM _{2.5}	CO	NO _x	SO ₂	VOC
Drilling	0.30	0.14	2.1E-2	--	--	--	--
Blasting	10.9	5.7	0.33	89.0	22.6	2.7	--
Mobile Equipment Combustion	2.6	2.6	2.6	45.6	50.9	8.4E-2	50.9
Mobile Equipment - Fugitives	46.8	10.8	1.1	--	--	--	--
Dozing	25.7	4.1	2.7	--	--	--	--
Grading	13.9	4.0	0.43	--	--	--	--
Scraping	205	107	6.2	--	--	--	--
Employee and Delivery - Combustion	2.5E-2	2.5E-2	6.8E-3	9.1E-2	5.6E-4	0.14	7.7E-3
Employee and Delivery - Fugitives	4.5	1.0	0.10	--	--	--	--
Wind Erosion	1.1	0.55	8.2E-2	--	--	--	--
TOTAL	311	136	13.5	135	73.5	2.9	50.9

West Plant Controlled Emissions Summary - Hourly (lb/hr)							
	PM	PM ₁₀	PM _{2.5}	CO	NO _x	SO ₂	VOC
Drilling	0.24	0.11	1.7E-2	--	--	--	--
Blasting	5.5	2.9	0.17	712	181	21.2	--
Mobile Equipment Combustion	2.4	2.4	2.4	42.7	47.6	5.1E-2	47.6
Mobile Equipment - Fugitives	56.1	13.0	1.3	--	--	--	--
Dozing	21.1	3.4	2.2	--	--	--	--
Grading	11.4	3.3	0.35	--	--	--	--
Scraping	164	85.4	4.9	--	--	--	--
Employee and Delivery - Combustion	0.13	0.13	3.1E-2	0.40	6.2E-3	2.2	4.6E-2
Employee and Delivery - Fugitives	63.5	14.7	1.5	--	--	--	--
Wind Erosion	0.25	0.13	1.9E-2	--	--	--	--
TOTAL	325	126	12.9	755	228	23.5	47.7

Blue entries are entered values, black entries are calculated or linked

Air Sciences Inc. <
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Air Sciences Inc.	PROJECT TITLE: Resolution Copper Project		BY: D. Steen		
	PROJECT NO: 262-32-05		PAGE: 4	OF: 9	SHEET: West Plant
	SUBJECT: West Plant Construction Emissions		DATE: November 1, 2018		
AIR EMISSION CALCULATIONS					

Mobile Equipment Combustion								
Operational Parameters								
	Engine Rating			EPA	Fuel	Project	Annual	Hours
Mobile Equipment	kW	hp	Quantity	Tier	gal/hr	Hours	Hours *	Per Unit
D-9T Dozer	325	436	6	3	22	21,917	14,611	3,653
Grader Cat 160M (16')	159	213	3	3	11	10,958	7,305	3,653
Cat 623G Scraper 18-23CY	294	394	3	3	20	10,958	7,305	3,653
Compactor Vib Cat CB-54C 67"	102	137	2	3	7	5,479	3,653	2,740
Water Truck (8,000 gallons)	294	394	2	3	20	4,870	3,247	2,435
Fuel/Lube Truck	224	300	1	3	15	3,456	2,304	3,456
Cat 336DL 1.56 CY Excavator	200	268	2	3	14	5,479	3,653	2,740
Cat 980 Loader 7.5 CY	325	436	1	3	22	2,740	1,827	2,740
Haul Truck 740 CAT	350	469	1	3	24	1,370	913	1,370
4x4 3/4T Pickup Gas	308	413	3	3	21	11,250	7,500	3,750

* Scaled down from 18 months to 12 months

Diesel Emission Factors *				
	PM	CO	NO _x	VOC
Equipment	g/kW-hr	g/kW-hr	g/kW-hr	g/kW-hr
D-9T Dozer	0.2	3.5	4.0	4.0
Grader Cat 160M (16')	0.2	3.5	4.0	4.0
Cat 623G Scraper 18-23CY	0.2	3.5	4.0	4.0
Compactor Vib Cat CB-54C 67"	0.3	5.0	4.0	4.0
Water Truck (8,000 gallons)	0.2	3.5	4.0	4.0
Fuel/Lube Truck	0.2	3.5	4.0	4.0
Cat 336DL 1.56 CY Excavator	0.2	3.5	4.0	4.0
Cat 980 Loader 7.5 CY	0.2	3.5	4.0	4.0
Haul Truck 740 CAT	0.2	3.5	4.0	4.0

* 40 CFR §1039.101, Table 1

Gasoline Emission Factors *					
	PM	CO	NO _x	SO ₂	VOC
Equipment	g/mi	g/mi	g/mi	g/mi	g/mi
4x4 3/4T Pickup Gas	0.099	3.88	0.18	0.01	0.04

* MOVES 2014a

Fuel Conversions		
1.998 SO ₂ /S	7,000 Btu/hp-hr	AP-42, Table 3.4-1, Footnote e, Diesel, Rev. 10/96
1.341 hp/kw	137,000 Btu/gal	AP-42, Appendix A, Diesel, Rev. 9/85
0.0015% ppm S in ULSD (GPA 2140)		
7.05 lb/gal		

Air Sciences Inc.	PROJECT TITLE: Resolution Copper Project						BY: D. Steen					
	PROJECT NO: 262-32-05						PAGE: 5		OF: 9		SHEET: West Plant	
	SUBJECT: West Plant Construction Emissions						DATE: November 1, 2018					
AIR EMISSION CALCULATIONS												

Mobile Equipment Combustion - Continued

Fleet Emissions

Equipment	PM		CO		NO _x		SO ₂ *		VOC	
	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr
D-9T Dozer	0.86	1.0	15.0	18.3	17.2	20.9	4.6E-3	3.4E-2	17.2	20.9
Grader Cat 160M (16')	0.21	0.26	3.7	4.5	4.2	5.1	2.3E-3	8.5E-3	4.2	5.1
Cat 623G Scraper 18-23CY	0.39	0.47	6.8	8.3	7.8	9.5	4.2E-3	1.5E-2	7.8	9.5
Compactor Vib Cat CB-54C 67"	0.13	0.12	2.2	2.1	1.8	1.6	1.5E-3	2.7E-3	1.8	1.6
Water Truck (8,000 gallons)	0.26	0.21	4.5	3.7	5.2	4.2	4.2E-3	6.9E-3	5.2	4.2
Fuel/Lube Truck	9.9E-2	0.11	1.7	2.0	2.0	2.3	3.2E-3	3.7E-3	2.0	2.3
Cat 336DL 1.56 CY Excavator	0.18	0.16	3.1	2.8	3.5	3.2	3.0E-3	5.4E-3	3.5	3.2
Cat 980 Loader 7.5 CY	0.14	0.13	2.5	2.3	2.9	2.6	4.6E-3	4.2E-3	2.9	2.6
Haul Truck 740 CAT	0.15	7.0E-2	2.7	1.2	3.1	1.4	5.1E-3	2.3E-3	3.1	1.4
4x4 3/4T Pickup Gas	9.8E-3	1.2E-2	0.38	0.48	1.8E-2	2.2E-2	1.8E-2	1.2E-3	4.2E-3	5.2E-3
TOTAL	2.4	2.6	42.7	45.6	47.6	50.9	5.1E-2	8.4E-2	47.6	50.9

* SO₂ emissions - mass balance based on 15 ppm S content (ULSD)

Fleet Emissions (18-Month Project)

Equipment	PM ton/proj	CO ton/proj	NO _x ton/proj	SO ₂ * ton/proj	VOC ton/proj
D-9T Dozer	1.6	27.5	31.4	5.1E-2	31.4
Grader Cat 160M (16')	0.38	6.7	7.7	1.3E-2	7.7
Cat 623G Scraper 18-23CY	0.71	12.4	14.2	2.3E-2	14.2
Compactor Vib Cat CB-54C 67"	0.18	3.1	2.5	4.1E-3	2.5
Water Truck (8,000 gallons)	0.32	5.5	6.3	1.0E-2	6.3
Fuel/Lube Truck	0.17	3.0	3.4	5.5E-3	3.4
Cat 336DL 1.56 CY Excavator	0.24	4.2	4.8	8.1E-3	4.8
Cat 980 Loader 7.5 CY	0.20	3.4	3.9	6.4E-3	3.9
Haul Truck 740 CAT	0.11	1.8	2.1	3.5E-3	2.1
4x4 3/4T Pickup Gas	1.8E-2	0.72	3.3E-2	1.8E-3	7.8E-3
TOTAL	3.9	68.5	76.4	0.13	76.4

* SO₂ emissions - mass balance based on 15 ppm S content (ULSD)

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Air Sciences Inc.	PROJECT TITLE: Resolution Copper Project		BY: D. Steen	
	PROJECT NO: 262-32-05		PAGE: 8	OF: 9
	SUBJECT: West Plant Construction Emissions		SHEET: West Plant	
AIR EMISSION CALCULATIONS			DATE: November 1, 2018	

Employee and Delivery Emissions									
Employees and Deliveries									
	Max Hourly*			Average Annual**			Average Project		
	Distance (mi/hr)			Distance (mi/yr)			Distance (mi/proj)		
	No. Trips	One Way	RT	No. Trips	One Way	RT	No. Trips	One Way	RT
Employee	519	0.2	0.5	56,500	0.2	0.5	84,750	0.2	0.5
Delivery	11	1.6	3.3	6,269	1.6	3.3	9,404	1.6	3.3
* Traffic Impact Analysis									
** Resolution Copper MPO									

Combustion Emission Factors *								Mean Vehicle Weight				Quantity **	
	PM	PM10	PM2.5	NOx	SO2	CO	VOC						
	g/VMT	g/VMT	g/VMT	g/VMT	g/VMT	g/VMT	g/VMT						
Employee	9.9E-2	9.9E-2	1.8E-2	1.8E-1	9.6E-3	3.9E+0	4.2E-2						
Delivery	9.7E-1	9.7E-1	2.8E-1	3.8E+0	1.2E-2	1.3E+0	2.9E-1						
* MOVES 2014a													

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper Project		BY: D. Steen	
	PROJECT NO: 262-32-05		PAGE: 9	OF: SHEET: 9 West Plant
	SUBJECT: West Plant Construction Emissions		DATE: November 1, 2018	

Wind Erosion from Exposed Areas

269.4	Maximum Erodible Area (acres)		
2,500	number of disturbance hours (per year)	50 wk/yr	140023 Construction Emissions 07-26-2017.doc
0.11	Disturbance Created Every Hour (acre/hr)	5 days/wk	140023 Construction Emissions 07-26-2017.doc
Water Sprays & Tactifiers	Control Technology	10 hr/day	140023 Construction Emissions 07-26-2017.doc
90%	Control Efficiency		

PM	PM ₁₀	PM _{2.5}	PM	PM ₁₀	PM _{2.5}	PM	PM ₁₀	PM _{2.5}
lb/hr	lb/hr	lb/hr	ton/yr	ton/yr	ton/yr	ton/proj	ton/proj	ton/proj
2.5	1.3	0.19	11.0	5.5	0.82	16.4	8.2	1.2

PM	PM ₁₀	PM _{2.5}	PM	PM ₁₀	PM _{2.5}	PM	PM ₁₀	PM _{2.5}
lb/hr	lb/hr	lb/hr	ton/yr	ton/yr	ton/yr	ton/proj	ton/proj	ton/proj
0.25	0.13	1.9E-2	1.1	0.55	8.2E-2	1.6	0.82	0.12

AP-42, Sec. 13.2.5

Flat, u^*/u_{10+} 0.053 AP-42, Sec. 13.2.5, p. 5

(A) $u_{10+} = 1.2 u_{10}$ Fastest mile wind speed at 10m, with a 1.2 factor to convert hourly wind speed to fastest mile.

(B, piles) $u^* = (U_s/U_r) \times 0.1 \times u_{10+}$

(B, flat) $u^* = 0.053 \times u_{10+}$

(C) $P = 58 (u^* - u_{t^*})^2 + 25 (u^* - u_{t^*})$; $P = 0$ for $u^* \leq u_{t^*}$; where $u_{t^*} =$ 0.172 m/s Threshold Friction Velocity, AZ Cu Mine Tailings

Air Sciences Inc.	PROJECT TITLE: Resolution Copper Project					BY: D. Steen		
	PROJECT NO: 262-32-05					PAGE: 1	OF: 9	SHEET: East Plant
	SUBJECT: East Plant Construction Emissions					DATE: November 1, 2018		

East Plant Controlled Emissions Summary - Project Total (ton/proj)							
	PM	PM ₁₀	PM _{2.5}	CO	NO _x	SO ₂	VOC
Drilling	0.48	0.23	3.4E-2	--	--	--	--
Blasting	20.1	10.4	0.60	94.8	24.1	2.8	--
Mobile Equipment Combustion	1.9	1.9	1.9	34.2	38.2	6.3E-2	38.2
Mobile Equipment - Fugitives	33.0	7.7	0.77	--	--	--	--
Dozing	19.3	3.1	2.0	--	--	--	--
Grading	10.5	3.0	0.32	--	--	--	--
Scraping	146	76.0	4.4	--	--	--	--
Employee and Delivery - Combustion	5.9E-2	5.9E-2	1.4E-2	0.18	3.0E-3	1.1	2.1E-2
Employee and Delivery - Fugitives	25.1	5.8	0.58	--	--	--	--
Wind Erosion	0.46	0.23	3.5E-2	--	--	--	--
TOTAL	257	108	10.7	129	62.3	4.0	38.2

East Plant Controlled Emissions Summary - Annual (ton/yr)							
	PM	PM ₁₀	PM _{2.5}	CO	NO _x	SO ₂	VOC
Drilling	0.48	0.23	3.4E-2	--	--	--	--
Blasting	20.1	10.4	0.60	94.8	24.1	2.8	--
Mobile Equipment Combustion	1.9	1.9	1.9	34.2	38.2	6.3E-2	38.2
Mobile Equipment - Fugitives	33.0	7.7	0.77	--	--	--	--
Dozing	19.3	3.1	2.0	--	--	--	--
Grading	10.5	3.0	0.32	--	--	--	--
Scraping	146	76.0	4.4	--	--	--	--
Employee and Delivery - Combustion	5.9E-2	5.9E-2	1.4E-2	0.18	3.0E-3	1.1	2.1E-2
Employee and Delivery - Fugitives	25.1	5.8	0.58	--	--	--	--
Wind Erosion	0.46	0.23	3.5E-2	--	--	--	--
TOTAL	257	108	10.7	129	62.3	4.0	38.2

East Plant Controlled Emissions Summary - Hourly (lb/hr)							
	PM	PM ₁₀	PM _{2.5}	CO	NO _x	SO ₂	VOC
Drilling	0.38	0.18	2.7E-2	--	--	--	--
Blasting	10.2	5.3	0.30	758	192	22.6	--
Mobile Equipment Combustion	2.2	2.2	2.2	37.9	42.2	5.1E-2	42.2
Mobile Equipment - Fugitives	46.9	10.9	1.1	--	--	--	--
Dozing	17.6	2.8	1.8	--	--	--	--
Grading	11.4	3.3	0.35	--	--	--	--
Scraping	117	60.8	3.5	--	--	--	--
Employee and Delivery - Combustion	0.27	0.27	5.8E-2	0.68	1.9E-2	7.2	0.10
Employee and Delivery - Fugitives	195	45.2	4.5	--	--	--	--
Wind Erosion	0.11	5.3E-2	7.9E-3	--	--	--	--
TOTAL	401	131	13.9	797	235	29.9	42.3

Air Sciences Inc.	PROJECT TITLE:		Resolution Copper Project		BY:		D. Steen			
	PROJECT NO:		262-32-05		PAGE:		3	OF: 9	SHEET:	East Plant
	SUBJECT:		East Plant Construction Emissions		DATE:		November 1, 2018			
AIR EMISSION CALCULATIONS										
Blasting										
Material Moved	5,134,891 tonne/proj									
	5,660,242 ton/proj									
	5,660,242 ton/yr									
Blasting Agent Use	2,567 tonne/yr									Resolution Copper Project Technical Memorandum – Construction Emissions
	2,830 ton/yr									
	2,830 ton/proj									
Number of Blasts	250 blasts/yr									Resolution Copper Project Technical Memorandum – Construction Emissions
	250 blasts/proj									
	1 max blasts/day									Resolution Copper Project Technical Memorandum – Construction Emissions
Operation	250 days/yr									Resolution Copper Project Technical Memorandum – Construction Emissions
	10 hr/day									Resolution Copper Project Technical Memorandum – Construction Emissions
Emission Factors										
References										
Emission Factor Equation	TSP = 0.000014 x A ^{1.5} lb/blast		AP-42, Tab. 11.9-1, 7/98 (blasting, overburden)							
Where, A = Area per Blast	8,073 ft ²		Where, A = Area per Year	2,018,233 ft ²	2,018,233 ft ²					
TSP	10.2 lb/blast		TSP	40,141 lb/proj	40,141 lb/year					
CO	67 lb/ton-ANFO		AP-42, Table 13.3-1 (ANFO), Rev. 2/80							
NO _x	17 lb/ton-ANFO		AP-42, Table 13.3-1 (ANFO), Rev. 2/80							
SO ₂	2 lb/ton-ANFO		AP-42, Table 13.3-1 (ANFO), Rev. 2/80							
PM Scaling Factors										
PM	1									
PM ₁₀	0.52		AP-42, Tab. 11.9-1, 7/98 (blasting, overburden)							
PM _{2.5}	0.03		AP-42, Tab. 11.9-1, 7/98 (blasting, overburden)							
Emissions										
	lb/blast	lb/hr *	ton/yr	ton/proj						
PM	10.2	10.2	20.1	20.1						
PM ₁₀	5.3	5.3	10.4	10.4						
PM _{2.5}	0.30	0.30	0.60	0.60						
CO	758	758	94.8	94.8						
NO _x	192	192	24.1	24.1						
SO ₂	22.6	22.6	2.8	2.8						
* Based on maximum of 1 blasts per day										

* Based on maximum of 1 blasts per day

<div>Air Sciences Inc.</div> <div>AIR EMISSION CALCULATIONS</div>	PROJECT TITLE:	BY:		
	Resolution Copper Project	D. Steen		
	PROJECT NO:	PAGE:	OF:	SHEET:
	262-32-05	4	9	East Plant
	SUBJECT:	DATE:		
	East Plant Construction Emissions	November 1, 2018		

Mobile Equipment Combustion

Operational Parameters

Mobile Equipment	Engine Rating		Quantity	EPA	Fuel	Project	Annual	Hours
	kW	hp		Tier	gal/hr	Hours *	Hours	Per Unit
D-9T Dozer	325	436	5	3	22	10,958	10,958	2,192
Grader Cat 160M (16')	159	213	3	3	11	5,479	5,479	1,826
Cat 623G Scraper 18-23CY	294	394	3	3	20	5,479	5,479	1,826
Compactor Vib Cat CB-54C 67"	102	137	2	3	7	2,740	2,740	1,370
Water Truck (8,000 gallons)	294	394	1	3	20	2,435	2,435	2,435
Fuel/Lube Truck	224	300	1	3	15	1,728	1,728	1,728
Cat 336DL 1.56 CY Excavator	200	268	2	3	14	2,740	2,740	1,370
Cat 980 Loader 7.5 CY	325	436	1	3	22	1,370	1,370	1,370
Haul Truck 740 CAT	350	469	1	3	24	685	685	685
4x4 3/4T Pickup Gas	308	413	3	3	21	5,625	5,625	1,875

* Project duration is expected to be 12 months

Diesel Emission Factors *

	PM	CO	NO _x	VOC
Equipment	g/kW-hr	g/kW-hr	g/kW-hr	g/kW-hr
D-9T Dozer	0.2	3.5	4.0	4.0
Grader Cat 160M (16')	0.2	3.5	4.0	4.0
Cat 623G Scraper 18-23CY	0.2	3.5	4.0	4.0
Compactor Vib Cat CB-54C 67"	0.3	5.0	4.0	4.0
Water Truck (8,000 gallons)	0.2	3.5	4.0	4.0
Fuel/Lube Truck	0.2	3.5	4.0	4.0
Cat 336DL 1.56 CY Excavator	0.2	3.5	4.0	4.0
Cat 980 Loader 7.5 CY	0.2	3.5	4.0	4.0
Haul Truck 740 CAT	0.2	3.5	4.0	4.0

* 40 CFR §1039.101, Table 1

Gasoline Emission Factors *

	PM	CO	NO _x	SO ₂	VOC
Equipment	<i>g/mi</i>	<i>g/mi</i>	<i>g/mi</i>	<i>g/mi</i>	<i>g/mi</i>
4x4 3/4T Pickup Gas	0.099	3.88	0.18	0.01	0.04

* MOVES 2014a

Fuel Conversions

1.998 SO ₂ /S	7,000 Btu/hp-hr	AP-42, Table 3.4-1, Footnote e, Diesel, Rev. 10/96
1.341 hp/kw	137,000 Btu/gal	AP-42, Appendix A, Diesel, Rev. 9/85
0.0015% ppm S in ULSD (GPA 2140)		
7.05 lb/gal		

Air Sciences Inc.

Air Sciences Inc.	PROJECT TITLE: Resolution Copper Project				BY: D. Steen		
	PROJECT NO: 262-32-05				PAGE: 6	OF: 9	SHEET: East Plant
	SUBJECT: East Plant Construction Emissions				DATE: November 1, 2018		
AIR EMISSION CALCULATIONS							

Mobile Equipment - Fugitives							
		Project	Annual	Hours	Speed *	Weight **	Silt ***
Mobile Equipment	Quantity	Hours	Hours	Per Unit	mph	ton	%
D-9T Dozer	5	10,958	10,958	2,192	Dozer specs on page 7		
Grader Cat 160M (16')	3	5,479	5,479	1,826	Grader specs on page 7		
Cat 623G Scraper 18-23CY	3	5,479	5,479	1,826	Scraper specs on page 7		
Compactor Vib Cat CB-54C 67"	2	2,740	2,740	1,370	2	14.3	3.0
Water Truck (8,000 gallons)	1	2,435	2,435	2,435	15	50.2	3.0
Fuel/Lube Truck	1	1,728	1,728	1,728	15	12.5	3.0
Cat 336DL 1.56 CY Excavator	2	2,740	2,740	1,370	2	38.6	3.0
Cat 980 Loader 7.5 CY	1	1,370	1,370	1,370	2	19.6	3.0
Haul Truck 740 CAT	1	685	685	685	15	58.3	3.0
4x4 3/4T Pickup Gas	3	5,625	5,625	1,875	15	4.0	3.0
Mean Vehicle Weight						23.5	

* Resolution Copper

** Equipment Specification Sheets

*** Related Information to AP-42, Chapter 13.2.2 (r13s0202_dec03.xls)

3 %

Unpaved Roads - Predictive Emission Factor Equation & Constants*				
	Empirical Constants for Industrial Roads			
E = k x (s / 12) ^a x (W / 3) ^b	Constant	PM	PM ₁₀	PM _{2.5}
k, a, b - empirical constants	k	4.9	1.5	0.15
s - surface material silt content %	a	0.7	0.9	0.9
W - mean vehicle wt ton	b	0.45	0.45	0.45
P - Days of >0.01" Precip				

AP-42, 13.2.2, Equation 1a & 2, Table 13.2.2-2, Industrial Roads, Rev. 11/06

Unpaved Road Controls		
Surface	Reference	
E = EF(uncctl) x (365 - P) / 365		
Days of >0.01" Precip	64	East Plant met data 2015-2016 (long-term emissions only)
Water & Chemical Suppression *	90%	AP-42, Figure 13.2.2-2, Rev. 11/06

Control efficiency is based on AP-42 Chapter 13.2.2, Unpaved Roads. Figure 13.2.2-2 provides the control efficiencies achievable.

Mobile Equipment	Emission Factors (lb/VMT)			Estimated Emissions (Controlled)								
	PM	PM ₁₀	PM _{2.5}	PM			PM ₁₀			PM _{2.5}		
				lb/lr	ton/yr	ton/proj	lb/lr	ton/yr	ton/proj	lb/lr	ton/yr	ton/proj
Compactor Vib Cat CB-54C 67"	4.7	1.1	0.11	1.9	1.1	1.1	0.43	0.25	0.25	4.3E-2	2.5E-2	2.5E-2
Water Truck (8,000 gallons)	4.7	1.1	0.11	7.0	7.1	7.1	1.6	1.6	1.6	0.16	0.16	0.16
Fuel/Lube Truck	4.7	1.1	0.11	7.0	5.0	5.0	1.6	1.2	1.2	0.16	0.12	0.12
Cat 336DL 1.56 CY Excavator	4.7	1.1	0.11	1.9	1.1	1.1	0.43	0.25	0.25	4.3E-2	2.5E-2	2.5E-2
Cat 980 Loader 7.5 CY	4.7	1.1	0.11	0.94	0.53	0.53	0.22	0.12	0.12	2.2E-2	1.2E-2	1.2E-2
Haul Truck 740 CAT	4.7	1.1	0.11	7.0	2.0	2.0	1.6	0.46	0.46	0.16	4.6E-2	4.6E-2
4x4 3/4T Pickup Gas	4.7	1.1	0.11	21.1	16.3	16.3	4.9	3.8	3.8	0.49	0.38	0.38
TOTAL				46.9	33.0	33.0	10.9	7.7	7.7	1.1	0.77	0.77

Air Sciences Inc.

Air Sciences Inc.				PROJECT TITLE:			BY:			
				Resolution Copper Project			D. Steen			
				PROJECT NO:			PAGE: OF: SHEET:			
AIR EMISSION CALCULATIONS				262-32-05			8 9 East Plant			
				SUBJECT:			DATE:			
				East Plant Construction Emissions			November 1, 2018			
Employee and Delivery Emissions										
Employees and Deliveries										
Max Hourly*				Average Annual**			Average Project			
Distance (mi/hr)				Distance (mi/yr)			Distance (mi/proj)			
	No. Trips	One Way	RT	No. Trips	One Way	RT	No. Trips	One Way	RT	
Employee	219	1.9	3.8	63,750	1.9	3.8	63,750	1.9	3.8	
Delivery	11	1.9	3.8	7,968	1.9	3.8	7,968	1.9	3.8	
* Traffic Impact Analysis										
** Resolution Copper MPO										
Combustion Emission Factors *										
	PM	PM10	PM2.5	NOx	SO2	CO	VOC			
	g/VMT	g/VMT	g/VMT	g/VMT	g/VMT	g/VMT	g/VMT			
Employee	9.9E-2	9.9E-2	1.8E-2	1.8E-1	9.6E-3	3.9E+0	4.2E-2			
Delivery	9.7E-1	9.7E-1	2.8E-1	3.8E+0	1.2E-2	1.3E+0	2.9E-1			
* MOVES 2014a										
Mean Vehicle Weight										
Employee		2	ton	135,000						
Delivery *	Empty	16.5	ton	14,237						
	Payload	23.5	ton							
	Average	28.3	ton							
Mean Vehicle Wt		4.5	ton							
* Based on typical 18-wheeler and 80,000 lb highway limit										
** Total number of trips expected for construction fleet										
Unpaved Roads - Equation, Constants, & Emission Factors *										
E = k x (s / 12) ^a x (W / 3) ^b				Empirical Constants for Industrial Roads			Emission Factors (lb/VMT)			
				Constant	PM	PM10	PM2.5	PM	PM10	PM2.5
k, a, b - empirical constants				k	4.9	1.5	0.15	2.2	0.52	5.2E-2
s - surface material silt content (%) **				a	0.7	0.9	0.9			
W - mean vehicle wt (ton) ***				b	0.45	0.45	0.45			
* AP-42, 13.2.2, Equations 1a & 2, Table 13.2.2-2, Unpaved Roads, Rev. 11/06										
** Related Information to AP-42, Chapter 13.2.2 (r13s0202_dec03.xls)										
*** AP-42, 13.2.2, Equations 1a & 2, Table 13.2.2-2, Unpaved Roads, Rev. 11/08										
Unpaved Road Controls										
Surface				Reference						
E = EF(unctl) x (365 - P) / 365										
Days of >0.01" Precip				East Plant met data 2015-2016 (long-term emissions only)						
Water & Chemical Suppression *				AP-42, Figure 13.2.2-2, Rev. 11/06						
* Control efficiency is based on AP-42 Chapter 13.2.2, Unpaved Roads. Figure 13.2.2-2 provides the control efficiencies achievable.										
Combustion Emissions										
	PM	PM10	PM2.5	NOx	SO2	CO	VOC			
	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr			
Employee	0.18	0.18	3.2E-2	0.33	1.8E-2	7.1	7.7E-2			
Delivery	8.9E-2	8.9E-2	2.5E-2	0.35	1.1E-3	0.12	2.7E-2			
	ton/yr	ton/yr	ton/yr	ton/yr	ton/yr	ton/yr	ton/yr			
Employee	2.6E-2	2.6E-2	4.7E-3	4.8E-2	2.6E-3	1.0	1.1E-2			
Delivery	3.2E-2	3.2E-2	9.2E-3	0.13	4.0E-4	4.3E-2	9.6E-3			
	ton/proj	ton/proj	ton/proj	ton/proj	ton/proj	ton/proj	ton/proj			
Employee	2.6E-2	2.6E-2	4.7E-3	4.8E-2	2.6E-3	1.0	1.1E-2			
Delivery	3.2E-2	3.2E-2	9.2E-3	0.13	4.0E-4	4.3E-2	9.6E-3			
Unpaved Road Emissions (Controlled)										
	PM	PM10	PM2.5							
	lb/hr	lb/hr	lb/hr							
Employee	186	43.0	4.3							
Delivery	9.3	2.2	0.22							
	ton/yr	ton/yr	ton/yr							
Employee	22.3	5.2	0.52							
Delivery	2.8	0.65	6.5E-2							
	ton/proj	ton/proj	ton/proj							
Employee	22.3	5.2	0.52							
Delivery	2.8	0.65	6.5E-2							

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper Project		BY: D. Steen	
	PROJECT NO: 262-32-05		PAGE: 9	OF: SHEET: 9 East Plant
	SUBJECT: East Plant Construction Emissions		DATE: November 1, 2018	

Wind Erosion from Exposed Areas

<div style="color: blue;">121.8</div> 2,500 0.05 Water Sprays & Tactifiers <div style="color: blue;">90%</div>	Maximum Erodible Area (acres) number of disturbance hours (per year) Disturbance Created Every Hour (acre/hr) Control Technology Control Efficiency	<div style="color: blue;">50</div> wk/yr <div style="color: blue;">5</div> days/wk <div style="color: blue;">10</div> hr/day	140023 Construction Emissions 07-26-2017.doc 140023 Construction Emissions 07-26-2017.doc 140023 Construction Emissions 07-26-2017.doc
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PM <i>lb/hr</i>	PM ₁₀ <i>lb/hr</i>	PM _{2.5} <i>lb/hr</i>	PM <i>ton/yr</i>	PM ₁₀ <i>ton/yr</i>	PM _{2.5} <i>ton/yr</i>	PM <i>ton/proj</i>	PM ₁₀ <i>ton/proj</i>	PM _{2.5} <i>ton/proj</i>
1.1	0.53	7.9E-2	4.6	2.3	0.35	4.6	2.3	0.35

PM <i>lb/hr</i>	PM ₁₀ <i>lb/hr</i>	PM _{2.5} <i>lb/hr</i>	PM <i>ton/yr</i>	PM ₁₀ <i>ton/yr</i>	PM _{2.5} <i>ton/yr</i>	PM <i>ton/proj</i>	PM ₁₀ <i>ton/proj</i>	PM _{2.5} <i>ton/proj</i>
0.11	5.3E-2	7.9E-3	0.46	0.23	3.5E-2	0.46	0.23	3.5E-2

AP-42, Sec. 13.2.5
Flat, u^*/u_{10+} 0.053 AP-42, Sec. 13.2.5, p. 5
(A) $u_{10+} = 1.2 u_{10}$ Fastest mile wind speed at 10m, with a 1.2 factor to convert hourly wind speed to fastest mile.
(B, piles) $u^* = (U_s/U_r) \times 0.1 \times u_{10+}$
(B, flat) $u^* = 0.053 \times u_{10+}$
(C) $P = 58 (u^* - u_{t*})^2 + 25 (u^* - u_{t*})$; $P = 0$ for $u^* \leq u_{t*}$; where $u_{t*} =$ 0.172 m/s Threshold Friction Velocity, AZ Cu Mine Tailings

<p>Air Sciences Inc.</p> <p>AIR EMISSION CALCULATIONS</p>	PROJECT TITLE: Resolution Copper Project				BY: D. Steen		
	PROJECT NO: 262-32-05				PAGE: 1	OF: 9	SHEET: Filter Plant
	SUBJECT: Filter Plant Construction Emissions				DATE: November 1, 2018		

Filter Plant Controlled Emissions Summary - Project Total (ton/proj)							
	PM	PM ₁₀	PM _{2.5}	CO	NO _x	SO ₂	VOC
Drilling	--	--	--	--	--	--	--
Blasting	--	--	--	--	--	--	--
Mobile Equipment Combustion	1.2	1.2	1.2	20.8	23.0	3.8E-2	23.0
Mobile Equipment - Fugitives	35.1	8.1	0.81	--	--	--	--
Dozing	6.1	0.97	0.64	--	--	--	--
Grading	3.3	0.95	0.10	--	--	--	--
Scraping	42.6	22.1	1.3	--	--	--	--
Employee and Delivery - Combustion	1.8E-2	1.8E-2	3.3E-3	3.4E-2	1.8E-3	0.72	7.8E-3
Employee and Delivery - Fugitives	15.9	3.7	0.37	--	--	--	--
Wind Erosion	0.30	0.15	2.2E-2	--	--	--	--
TOTAL	104	37.2	4.4	20.8	23.0	0.76	23.0

Filter Plant Controlled Emissions Summary - Annual (ton/yr)							
	PM	PM ₁₀	PM _{2.5}	CO	NO _x	SO ₂	VOC
Drilling	--	--	--	--	--	--	--
Blasting	--	--	--	--	--	--	--
Mobile Equipment Combustion	0.79	0.79	0.79	13.8	15.3	2.5E-2	15.3
Mobile Equipment - Fugitives	23.4	5.4	0.54	--	--	--	--
Dozing	4.1	0.65	0.43	--	--	--	--
Grading	2.2	0.63	6.8E-2	--	--	--	--
Scraping	28.4	14.8	0.85	--	--	--	--
Employee and Delivery - Combustion	1.2E-2	1.2E-2	2.2E-3	2.2E-2	1.2E-3	0.48	5.2E-3
Employee and Delivery - Fugitives	10.6	2.5	0.25	--	--	--	--
Wind Erosion	0.20	9.8E-2	1.5E-2	--	--	--	--
TOTAL	69.7	24.8	2.9	13.9	15.3	0.51	15.3

Filter Plant Controlled Emissions Summary - Hourly (lb/hr)							
	PM	PM ₁₀	PM _{2.5}	CO	NO _x	SO ₂	VOC
Drilling	--	--	--	--	--	--	--
Blasting	--	--	--	--	--	--	--
Mobile Equipment Combustion	1.0	1.0	1.0	18.0	20.0	3.9E-2	20.0
Mobile Equipment - Fugitives	33.6	7.8	0.78	--	--	--	--
Dozing	3.5	0.56	0.37	--	--	--	--
Grading	3.8	1.1	0.12	--	--	--	--
Scraping	22.7	11.8	0.68	--	--	--	--
Employee and Delivery - Combustion	5.0E-2	5.0E-2	8.9E-3	9.1E-2	4.8E-3	2.0	2.1E-2
Employee and Delivery - Fugitives	51.1	11.9	1.2	--	--	--	--
Wind Erosion	4.5E-2	2.2E-2	3.4E-3	--	--	--	--
TOTAL	116	34.2	4.2	18.1	20.1	2.0	20.1

Blue entries are entered values, black entries are calculated or linked

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<p align="center">Air Sciences Inc.</p> <p align="center">AIR EMISSION CALCULATIONS</p>	PROJECT TITLE: Resolution Copper Project		BY: D. Steen	
	PROJECT NO: 262-32-05		PAGE: 3	OF: SHEET: 9 Filter Plant
	SUBJECT: Filter Plant Construction Emissions		DATE: November 1, 2018	

Blasting

Material Moved	0 tonne/proj 0 ton/proj 0 ton/yr	
Blasting Agent Use	0 tonne/yr 0 ton/proj 0 ton/yr	Resolution Copper Project Technical Memorandum – Construction Emissions
Number of Blasts	0 blasts/yr 0 blasts/proj 0 max blasts/day	Resolution Copper Project Technical Memorandum – Construction Emissions
Operation	250 days/yr 10 hr/day	Resolution Copper Project Technical Memorandum – Construction Emissions Resolution Copper Project Technical Memorandum – Construction Emissions

Emission Factors		References
Emission Factor Equation	TSP = 0.000014 x A ^{1.5} lb/blast	AP-42, Tab. 11.9-1, 7/98 (blasting, overburden)
Where, A = Area per Blast	0 ft ²	Where, A = Area per Year
TSP	0.0 lb/blast	TSP
CO	67 lb/ton-ANFO	AP-42, Table 13.3-1 (ANFO), Rev. 2/80
NO _x	17 lb/ton-ANFO	AP-42, Table 13.3-1 (ANFO), Rev. 2/80
SO ₂	2 lb/ton-ANFO	AP-42, Table 13.3-1 (ANFO), Rev. 2/80

PM Scaling Factors

PM	1	
PM ₁₀	0.52	AP-42, Tab. 11.9-1, 7/98 (blasting, overburden)
PM _{2.5}	0.03	AP-42, Tab. 11.9-1, 7/98 (blasting, overburden)

Emissions	lb/blast	lb/hr *	ton/yr	ton/proj
PM	--	--	--	--
PM ₁₀	--	--	--	--
PM _{2.5}	--	--	--	--
CO	--	--	--	--
NO _x	--	--	--	--
SO ₂	--	--	--	--

* Based on maximum of 0 blasts per day

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Air Sciences Inc.	PROJECT TITLE: Resolution Copper Project		BY: D. Steen	
	PROJECT NO: 262-32-05		PAGE: 8	OF: 9
	SUBJECT: Filter Plant Construction Emissions		SHEET: Filter Plant	
AIR EMISSION CALCULATIONS			DATE: November 1, 2018	

Employee and Delivery Emissions									
Employees and Deliveries									
	Max Hourly*			Average Annual**			Average Project		
	Distance (mi/hr)			Distance (mi/yr)			Distance (mi/proj)		
	No. Trips	One Way	RT	No. Trips	One Way	RT	No. Trips	One Way	RT
Employee	30	3.8	7.6	14,750	3.8	7.6	22,125	3.8	7.6
Delivery	8	1.3	2.6	Combined with WPS and TSF			Combined with WPS and TSF		
* Traffic Impact Analysis									
** Resolution Copper MPO									

Combustion Emission Factors *							
	PM	PM10	PM2.5	NOx	SO2	CO	VOC
	g/VMT	g/VMT	g/VMT	g/VMT	g/VMT	g/VMT	g/VMT
Employee	9.9E-2	9.9E-2	1.8E-2	1.8E-1	9.6E-3	3.9E+0	4.2E-2
Delivery	9.7E-1	9.7E-1	2.8E-1	3.8E+0	1.2E-2	1.3E+0	2.9E-1
* MOVES 2014a							

Mean Vehicle Weight				Quantity **	
Employee		2	ton	135,000	
Delivery *	Empty	16.5	ton	14,237	
	Payload	23.5	ton		
	Average	28.3	ton		
Mean Vehicle Wt		4.5	ton		
* Based on typical 18-wheeler and 80,000 lb highway limit					
** Total number of trips expected for construction fleet					

Unpaved Roads - Equation, Constants, & Emission Factors *										
E = k x (s / 12) ^a x (W / 3) ^b				Empirical Constants for Industrial Roads			Emission Factors (lb/VMT)			
				Constant	PM	PM10	PM2.5	PM	PM10	PM2.5
k, a, b - empirical constants				k	4.9	1.5	0.15	2.2	0.52	5.2E-2
s - surface material silt content (%) **				a	0.7	0.9	0.9			
W - mean vehicle wt (ton) ***				b	0.45	0.45	0.45			
* AP-42, 13.2.2, Equations 1a & 2, Table 13.2.2-2, Unpaved Roads, Rev. 11/06										
** Related Information to AP-42, Chapter 13.2.2 (r13s0202_dec03.xls)										
*** AP-42, 13.2.2, Equations 1a & 2, Table 13.2.2-2, Unpaved Roads, Rev. 11/08										

Unpaved Road Controls		
	Surface	Reference
E = EF(unctl) x (365 - P) / 365		
Days of >0.01" Precip	57	Hewitt met data 2015-2016 (long-term emissions only)
Water & Chemical Suppression *	90%	AP-42, Figure 13.2.2-2, Rev. 11/06
* Control efficiency is based on AP-42 Chapter 13.2.2, Unpaved Roads. Figure 13.2.2-2 provides the control efficiencies achievable.		

Combustion Emissions							
	PM	PM10	PM2.5	NOx	SO2	CO	VOC
	lb/yr	lb/yr	lb/yr	lb/yr	lb/yr	lb/yr	lb/yr
Employee	5.0E-2	5.0E-2	8.9E-3	9.1E-2	4.8E-3	2.0	2.1E-2
Delivery	--	--	--	--	--	--	--
	ton/yr	ton/yr	ton/yr	ton/yr	ton/yr	ton/yr	ton/yr
Employee	1.2E-2	1.2E-2	2.2E-3	2.2E-2	1.2E-3	0.48	5.2E-3
Delivery	--	--	--	--	--	--	--
	ton/proj	ton/proj	ton/proj	ton/proj	ton/proj	ton/proj	ton/proj
Employee	1.8E-2	1.8E-2	3.3E-3	3.4E-2	1.8E-3	0.72	7.8E-3
Delivery	--	--	--	--	--	--	--

Unpaved Road Emissions (Controlled)			
	PM	PM10	PM2.5
	lb/yr	lb/yr	lb/yr
Employee	51.1	11.9	1.2
Delivery	--	--	--
	ton/yr	ton/yr	ton/yr
Employee	10.6	2.5	0.25
Delivery	--	--	--
	ton/proj	ton/proj	ton/proj
Employee	15.9	3.7	0.37
Delivery	--	--	--

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper Project		BY: D. Steen	
	PROJECT NO: 262-32-05		PAGE: 9	OF: SHEET: 9 Filter Plant
	SUBJECT: Filter Plant Construction Emissions		DATE: November 1, 2018	

Wind Erosion from Exposed Areas

48.5	Maximum Erodible Area (acres)		
2,500	number of disturbance hours (per year)	50 wk/yr	140023 Construction Emissions 07-26-2017.doc
0.02	Disturbance Created Every Hour (acre/hr)	5 days/wk	140023 Construction Emissions 07-26-2017.doc
Water Sprays & Tactifiers	Control Technology	10 hr/day	140023 Construction Emissions 07-26-2017.doc
90%	Control Efficiency		

PM lb/hr	PM ₁₀ lb/hr	PM _{2.5} lb/hr	PM ton/yr	PM ₁₀ ton/yr	PM _{2.5} ton/yr	PM ton/proj	PM ₁₀ ton/proj	PM _{2.5} ton/proj
0.45	0.22	3.4E-2	2.0	0.98	0.15	3.0	1.5	0.22

PM lb/hr	PM ₁₀ lb/hr	PM _{2.5} lb/hr	PM ton/yr	PM ₁₀ ton/yr	PM _{2.5} ton/yr	PM ton/proj	PM ₁₀ ton/proj	PM _{2.5} ton/proj
4.5E-2	2.2E-2	3.4E-3	0.20	9.8E-2	1.5E-2	0.30	0.15	2.2E-2

AP-42, Sec. 13.2.5

Flat, u^*/u_{10+} **0.053** AP-42, Sec. 13.2.5, p. 5

(A) $u_{10+} = 1.2 u_{10}$ Fastest mile wind speed at 10m, with a 1.2 factor to convert hourly wind speed to fastest mile.

(B, piles) $u^* = (U_s/U_r) \times 0.1 \times u_{10+}$

(B, flat) $u^* = 0.053 \times u_{10+}$ Threshold Friction Velocity, AZ Cu Mine Tailings

(C) $P = 58 (u^* - u_{t^*})^2 + 25 (u^* - u_{t^*})$; $P = 0$ for $u^* \leq u_{t^*}$; where $u_{t^*} =$ **0.172** m/s

Air Sciences Inc.	PROJECT TITLE: Resolution Copper Project					BY: D. Steen		
	PROJECT NO: 262-32-05					PAGE: 1	OF: 9	SHEET: Alt2 Corridor
	SUBJECT: Alt2 Corridor Construction Emissions					DATE: November 1, 2018		

Tailings Corridor Controlled Emissions Summary - Project Total (ton/proj)

	PM	PM ₁₀	PM _{2.5}	CO	NO _x	SO ₂	VOC
Drilling	0.026	0.012	0.002	--	--	--	--
Blasting	0.29	0.153	0.009	7.80	1.98	0.23	--
Mobile Equipment Combustion	1.26	1.26	1.26	22.07	23.87	0.04	23.86
Mobile Equipment - Fugitives	140	58.1	4.7	--	--	--	--
Dozing	9.4	1.5	0.99	--	--	--	--
Grading	8.2	2.3	0.25	--	--	--	--
Scraping	90.1	46.8	2.7	--	--	--	--
Employee and Delivery - Combustion				--	--	--	--
Employee and Delivery - Fugitives				--	--	--	--
Wind Erosion	0.25	0.13	1.9E-2	--	--	--	--
TOTAL	249	110	9.9	29.9	25.9	0.27	23.9

Tailings Corridor Controlled Emissions Summary - Annual (ton/yr)

	PM	PM ₁₀	PM _{2.5}	CO	NO _x	SO ₂	VOC
Drilling	0.018	0.008	0.001	--	--	--	--
Blasting	0.16	0.08	0.005	5.20	1.32	0.16	--
Mobile Equipment Combustion	0.84	0.84	0.84	14.72	15.92	0.03	15.91
Mobile Equipment - Fugitives	93.2	38.8	3.1	--	--	--	--
Dozing	6.3	1.00	0.66	--	--	--	--
Grading	5.5	1.6	0.17	--	--	--	--
Scraping	60.0	31.2	1.8	--	--	--	--
Employee and Delivery - Combustion				--	--	--	--
Employee and Delivery - Fugitives				--	--	--	--
Wind Erosion	0.17	8.4E-2	1.3E-2	--	--	--	--
TOTAL	166	73.6	6.6	19.9	17.2	0.18	15.9

Tailings Corridor Controlled Emissions Summary - Hourly (lb/hr)

	PM	PM ₁₀	PM _{2.5}	CO	NO _x	SO ₂	VOC
Drilling	0.01	0.01	0.00	--	--	--	--
Blasting	0.08	0.04	0.00	41.61	10.56	1.24	--
Mobile Equipment Combustion	1.31	1.31	1.31	22.86	25.22	0.04	25.21
Mobile Equipment - Fugitives	102	37.4	3.3	--	--	--	--
Dozing	7.0	1.1	0.74	--	--	--	--
Grading	7.6	2.2	0.24	--	--	--	--
Scraping	48.0	25.0	1.4	--	--	--	--
Employee and Delivery - Combustion				--	--	--	--
Employee and Delivery - Fugitives				--	--	--	--
Wind Erosion	3.8E-2	1.9E-2	2.9E-3	--	--	--	--
TOTAL	166	67.1	7.1	64.5	35.8	1.3	25.2

Blue entries are entered values , black entries are calculated or linked

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Air Sciences Inc.	PROJECT TITLE: Resolution Copper Project		BY: D. Steen		
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	SUBJECT: Alt2 Corridor Construction Emissions		DATE: November 1, 2018		
AIR EMISSION CALCULATIONS					

Employee and Delivery Emissions

Employees and Deliveries*

	Max Hourly			Average Annual			Average Project		
	No. Trips	Distance (mi/hr)		No. Trips	Distance (mi/yr)		No. Trips	Distance (mi/proj)	
		One Way	RT		One Way	RT		One Way	RT
Employee	0				Combined with WPS			Combined with WPS	
Delivery	0			0	0.0	0.0	0	0.0	0.0

* No Additional Deliveries or Employees Expected for Corridor Construction

Combustion Emission Factors *

	PM	PM ₁₀	PM _{2.5}	NO _x	SO ₂	CO	VOC
	g/VMT	g/VMT	g/VMT	g/VMT	g/VMT	g/VMT	g/VMT
Employee	9.9E-2	9.9E-2	1.8E-2	1.8E-1	9.6E-3	3.9E+0	4.2E-2
Delivery	9.7E-1	9.7E-1	2.8E-1	3.8E+0	1.2E-2	1.3E+0	2.9E-1

* MOVES 2014a

Mean Vehicle Weight

		Quantity **		
Employee	2	ton	0	
Delivery *	Empty	16.5	ton	0
	Payload	23.5	ton	
	Average	28.3	ton	
Mean Vehicle Wt		ton		

* Based on typical 18-wheeler and 80,000 lb highway limit

** Total number of trips expected for construction fleet

Unpaved Roads - Equation, Constants, & Emission Factors *

E = k x (s / 12)^a x (W / 3)^b

	Empirical Constants for Industrial Roads				Emission Factors (lb/VMT)		
	Constant	PM	PM ₁₀	PM _{2.5}	PM	PM ₁₀	PM _{2.5}
k, a, b - empirical constants	k	4.9	1.5	0.15			
s - surface material silt content (%) **	a	0.7	0.9	0.9			
W - mean vehicle wt (ton) ***	b	0.45	0.45	0.45			

* AP-42, 13.2.2, Equations 1a & 2, Table 13.2.2-2, Unpaved Roads, Rev. 11/06

** Related Information to AP-42, Chapter 13.2.2 (r13s0202_dec03.xls)

*** AP-42, 13.2.2, Equations 1a & 2, Table 13.2.2-2, Unpaved Roads, Rev. 11/08

Unpaved Road Controls

	Surface	Reference
E = EF(unctl) x (365 - P) / 365		
Days of >0.01" Precip	57	Hewitt met data 2015-2016 (long-term emissions only)
Water & Chemical Suppression *	90%	AP-42, Figure 13.2.2-2, Rev. 11/06

* Control efficiency is based on AP-42 Chapter 13.2.2, Unpaved Roads. Figure 13.2.2-2 provides the control efficiencies achievable.

Combustion Emissions

	PM	PM ₁₀	PM _{2.5}	NO _x	SO ₂	CO	VOC
	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr
Employee	--	--	--	--	--	--	--
Delivery	--	--	--	--	--	--	--
	ton/yr	ton/yr	ton/yr	ton/yr	ton/yr	ton/yr	ton/yr
Employee	--	--	--	--	--	--	--
Delivery	--	--	--	--	--	--	--
	ton/proj	ton/proj	ton/proj	ton/proj	ton/proj	ton/proj	ton/proj
Employee	--	--	--	--	--	--	--
Delivery	--	--	--	--	--	--	--

Unpaved Road Emissions (Controlled)

	PM	PM ₁₀	PM _{2.5}
	lb/hr	lb/hr	lb/hr
Employee	--	--	--
Delivery	--	--	--
	ton/yr	ton/yr	ton/yr
Employee	--	--	--
Delivery	--	--	--
	ton/proj	ton/proj	ton/proj
Employee	--	--	--
Delivery	--	--	--

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Wind Erosion from Exposed Areas

45.4	Maximum Erodible Area (acres)		
2,500	number of disturbance hours (per year)	50 wk/yr	140023 Construction Emissions 07-26-2017.doc
0.02	Disturbance Created Every Hour (acre/hr)	5 days/wk	140023 Construction Emissions 07-26-2017.doc
Water Sprays & Tactifiers	Control Technology	10 hr/day	140023 Construction Emissions 07-26-2017.doc
90%	Control Efficiency		

PM	PM ₁₀	PM _{2.5}	PM	PM ₁₀	PM _{2.5}	PM	PM ₁₀	PM _{2.5}
lb/hr	lb/hr	lb/hr	ton/yr	ton/yr	ton/yr	ton/proj	ton/proj	ton/proj
0.38	0.19	2.9E-2	1.7	0.84	0.13	2.5	1.3	0.19

PM	PM ₁₀	PM _{2.5}	PM	PM ₁₀	PM _{2.5}	PM	PM ₁₀	PM _{2.5}
lb/hr	lb/hr	lb/hr	ton/yr	ton/yr	ton/yr	ton/proj	ton/proj	ton/proj
3.8E-2	1.9E-2	2.9E-3	0.17	8.4E-2	1.3E-2	0.25	0.13	1.9E-2

AP-42, Sec. 13.2.5

Flat, u^*/u_{10+} 0.053 AP-42, Sec. 13.2.5, p. 5

(A) $u_{10+} = 1.2 u_{10}$ Fastest mile wind speed at 10m, with a 1.2 factor to convert hourly wind speed to fastest mile.

(B, piles) $u^* = (U_s/U_r) \times 0.1 \times u_{10+}$

(B, flat) $u^* = 0.053 \times u_{10+}$ Threshold Friction Velocity, AZ Cu Mine Tailings

(C) $P = 58 (u^* - u_{t^*})^2 + 25 (u^* - u_{t^*})$; $P = 0$ for $u^* \leq u_{t^*}$; where $u_{t^*} =$ 0.172 m/s

Air Sciences Inc. AIR EMISSION CALCULATIONS	PROJECT TITLE: Resolution Copper Project					BY: D. Steen		
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Tailings Storage Facility (Alternative 2) Controlled Emissions Summary - Project Total (ton/proj)							
	PM	PM ₁₀	PM _{2.5}	CO	NO _x	SO ₂	VOC
Drilling	2.1	0.97	0.15	--	--	--	--
Blasting	56.8	29.5	1.7	408	103	12.2	--
Crushing and Screening	445.1	162.6	24.6	--	--	--	--
Combustion	14.9	14.9	14.9	259	317	0.48	317
Mobile Equipment - Fugitives	520	121	12.1	--	--	--	--
Dozing	47.3	7.5	5.0	--	--	--	--
Grading				--	--	--	--
Scraping	90.1	46.8	2.7	--	--	--	--
Employee and Delivery - Combustion	--	--	--	--	--	--	--
Employee and Delivery - Fugitives	--	--	--	--	--	--	--
Wind Erosion	14.0	7.0	1.1	--	--	--	--
TOTAL	1,190	390	62.1	667	421	12.6	317

Tailings Storage Facility (Alternative 2) Controlled Emissions Summary - Annual (ton/yr)							
	PM	PM ₁₀	PM _{2.5}	CO	NO _x	SO ₂	VOC
Drilling	0.69	0.32	4.9E-2	--	--	--	--
Blasting	10.9	5.7	0.33	136	34.5	4.1	--
Crushing and Screening	148.4	54.2	8.2	--	--	--	--
Combustion	5.0	5.0	5.0	86.3	106	0.16	106
Mobile Equipment - Fugitives	173	40.2	4.0	--	--	--	--
Dozing	15.8	2.5	1.7	--	--	--	--
Grading				--	--	--	--
Scraping	30.0	15.6	0.90	--	--	--	--
Employee and Delivery - Combustion	--	--	--	--	--	--	--
Employee and Delivery - Fugitives	--	--	--	--	--	--	--
Wind Erosion	4.7	2.3	0.35	--	--	--	--
TOTAL	389	126	20.5	222	140	4.2	106

Tailings Storage Facility (Alternative 2) Controlled Emissions Summary - Hourly (lb/hr)							
	PM	PM ₁₀	PM _{2.5}	CO	NO _x	SO ₂	VOC
Drilling	0.55	0.26	3.9E-2	--	--	--	--
Blasting	5.5	2.9	0.17	986	250	29.4	--
Crushing and Screening	33.9	12.4	1.9	--	--	--	--
Combustion	3.9	3.9	3.9	67.4	79.9	4.2E-2	79.9
Mobile Equipment - Fugitives	182	42.2	4.2	--	--	--	--
Dozing	14.1	2.2	1.5	--	--	--	--
Grading				--	--	--	--
Scraping	24.0	12.5	0.72	--	--	--	--
Employee and Delivery - Combustion	--	--	--	--	--	--	--
Employee and Delivery - Fugitives	--	--	--	--	--	--	--
Wind Erosion	1.3	0.63	9.5E-2	--	--	--	--
TOTAL	265	76.9	12.5	1,054	330	29.5	79.9

Blue entries are entered values , black entries are calculated or linked

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Drilling

Project Duration

36 months

Email from K. Ballard (4/13/2018)

Material Quantity

7,358,841 tonne/yr

22,076,523 tonne/proj

8,111,724 ton/yr

24,335,172 ton/proj

3,245 ton/hr

Operation

250 days/yr

10 hr/day

Resolution Copper Project Technical Memorandum – Construction Emissions

Resolution Copper Project Technical Memorandum – Construction Emissions

Emission Factors	References
PM ₁₀ 8.0E-5 lb/ton	AP-42, Table 11.19.2-2 (wet drilling), Rev. 8/04
PM Scaling Factors	
PM 0.74	AP-42, Chapter 13.2.4-4, 11/06
PM ₁₀ 0.35	AP-42, Chapter 13.2.4-4, 11/06
PM _{2.5} 0.053	AP-42, Chapter 13.2.4-4, 11/06

Emissions	lb/hr	ton/yr	ton/proj
PM	0.55	0.69	2.1
PM ₁₀	0.26	0.32	0.97
PM _{2.5}	3.9E-2	4.9E-2	0.15

Conversions

2,000 lb/ton

1.1023 ton/tonne

3.2808 ft/m

100 cm/m

453.592 g/lb

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Dozing/Grading/Scraping Emissions				
Dozing and Grading Emission Factor EquationsAP-42, 11.9, Table 11.9-1 (overburden), Rev. 7/98.				
		Scaling Factors		
		PM10	PM2.5	
Dozing (PM)	E lb/hr = (5.7 *(s) 1.2) / (M 1.3)		0.105	
Dozing (PM15)	E lb/hr = (1.0 * (s) 1.5) / (M 1.4)	0.75		
Grading (PM)	E (lb/VMT) = 0.040 * S 2.5		0.031	
Grading (PM15)	E (lb/VMT) = 0.051 * S 2.0	0.6		
s = material silt content % □	3.0	Related Information to AP-42, Chapter 13.2.2 (r13s0202_dec03.xls)		
M = material moisture content %	4.0	Resolution Copper		
S = mean vehicle speed mph □	7.1	AP-42, Table 11.9-3 (mph)		

Scraping Emission FactorAP-42, 11.9, Table 11.9-4 (topsoil), Rev. 7/98.			
Topsoil removal by scraper	Scaling FactorAP-42, Tab. 11.9-1, 7/98 (blasting, overburden)		
PM	0.058 lb/ton	PM10	PM2.5
		0.52	0.03

Scraping Operational Parameters			
Cut Volume	1,024,380 m³	Resolution Copper Project Technical Memorandum – Construction Emissions	
Specific Gravity	2.75 g/cm³	Resolution Copper Project Technical Memorandum – Construction Emissions	
	3,105,263 ton/proj		
	1,035,088 ton/yr		
	414 ton/hr		

Emission Factors				
Emission Factors				
Mobile Equipment	Unit	PM	PM10	PM2.5
D-9T Dozer	lb/hr	3.5	0.56	0.37
Grader Cat 160M (16')*	lb/VMT	5.4	1.5	0.17
Cat 623G Scraper 18-23CY	lb/ton	5.8E-2	3.0E-2	1.7E-3

Total Emissions									
Estimated Emissions									
Mobile Equipment	lb/hr	PM	ton/proj	PM10			PM2.5		
		ton/yr		ton/proj	lb/hr	ton/yr	ton/proj	lb/hr	ton/yr
D-9T Dozer	14.1	15.8	47.3	2.2	2.5	7.5	1.5	1.7	5.0
Grader Cat 160M (16')									
Cat 623G Scraper 18-23CY	24.0	30.0	90.1	12.5	15.6	46.8	0.72	0.90	2.7
TOTAL	38.1	45.8	137	14.7	18.1	54.4	2.2	2.6	7.7

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<p align="center">Air Sciences Inc.</p> <p align="center">AIR EMISSION CALCULATIONS</p>	PROJECT TITLE: Resolution Copper Project	BY: D. Steen
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Wind Erosion from Exposed Areas

150.0 Maximum Erodible Area (acres)
 2,500 number of disturbance hours (per year) 50 wk/yr 140023 Construction Emissions 07-26-2017.doc
 0.06 Disturbance Created Every Hour (acre/ 5 days/w 140023 Construction Emissions 07-26-2017.doc
 Precipitation Control Technology (Hewitt Precip Dat 10 hr/day 140023 Construction Emissions 07-26-2017.doc
 16% Control Efficiency (Applied to Long-Term Emissions Only)

Emissions (Uncontrolled)

PM	PM ₁₀	PM _{2.5}	PM	PM ₁₀	PM _{2.5}	PM	PM ₁₀	PM _{2.5}
lb/hr	lb/hr	lb/hr	ton/yr	ton/yr	ton/yr	ton/proj	ton/proj	ton/proj
1.3	0.63	9.5E-2	5.5	2.8	0.42	16.6	8.3	1.2

Emissions (Controlled)

PM	PM ₁₀	PM _{2.5}	PM	PM ₁₀	PM _{2.5}	PM	PM ₁₀	PM _{2.5}
lb/hr	lb/hr	lb/hr	ton/yr	ton/yr	ton/yr	ton/proj	ton/proj	ton/proj
1.3	0.63	9.5E-2	4.7	2.3	0.35	14.0	7.0	1.1

AP-42, Sec. 13.2.5

Flat, u^*/u_{10+} 0.053 AP-42, Sec. 13.2.5, p. 5

(A) $u_{10+} = 1.2 u$ Fastest mile wind speed at 10m, with a 1.2 factor to convert hourly wind speed to fastest mile.

(B, piles) $u^* = (U_s/U_r) \times 0.1 \times u_{10+}$

(B, flat) $u^* = 0.053 \times u_{10+}$

(C) $P = 58 (u^* - u_{t^*})^2 + 25 (u^* - u_{t^*})$; $P = 0$ for $u^* \leq u_{t^*}$; u 0.172 m/s

Threshold Friction Velocity, AZ Cu Mine Tailings