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Resolution Copper Project Air Quality Impacts Analysis Modeling Plan for NEPA

PREPARED FOR:
RESOLUTION COPPER MINING, LLC

PROJECT NO. 262
JUNE 2018

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LIST OF ABBREVIATIONS

°F	Degrees Fahrenheit
μg/m³	Micrograms Per Cubic Meter
μm	Micrometer
μm³	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
BPIP-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
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/cm³	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
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
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 Plan for the National Environmental Policy Act (Modeling Plan) was prepared for submittal to Tonto National Forest (TNF) in preparation of an Environmental Impact Statement (EIS) to evaluate and disclose the potential environmental effects from the proposed Project. The Modeling Plan has been prepared to be consistent with the Resolution Copper Project General Plan of Operations (GPO) and pertinent local, state,[1] and federal[2] requirements.

This Modeling Plan includes a description of the methods and data sets that are planned to be 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 by Resolution Copper to demonstrate compliance with the applicable Pinal County Air Quality Control District (PCAQCD) and National Ambient Air Quality Standards (NAAQS), as required by the permit application requirements in applicable PCAQCD rules.[3]

This Modeling Plan is the product of several rounds of review and consultations with several regulatory agencies (TNF, ADEQ, and PCAQCD) and the TNF's third-party contractor, SWCA Environmental Consultants.

This Modeling Plan includes the following information:

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

[2] "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)

[3] The "Air Quality Impacts Analysis Modeling Plan for Permitting" has been approved by PCAQCD 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.

- 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 are being evaluated in the EIS

- Detailed descriptions of the methodologies chosen for executing 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 Plan includes specific technical details about the Project and the air quality analyses to be 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 to be used for the air quality analyses. The air quality analyses will be consistent with the methodologies and technical details provided in this Modeling Plan.

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 a previously disturbed area and include a mine site where Shaft 9 was constructed in the 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.

The ore processing operations will be located at the West Plant Site (WPS), approximately 6 miles west of the EPS. A copper concentrate Filtration Plant and Concentrate Loadout Facility (FP&LF) will be constructed 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 assessment will assess 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 will assess 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 dividing the deposit into smaller strips, or panels, so that the ore can be removed in a safe and efficient manner.

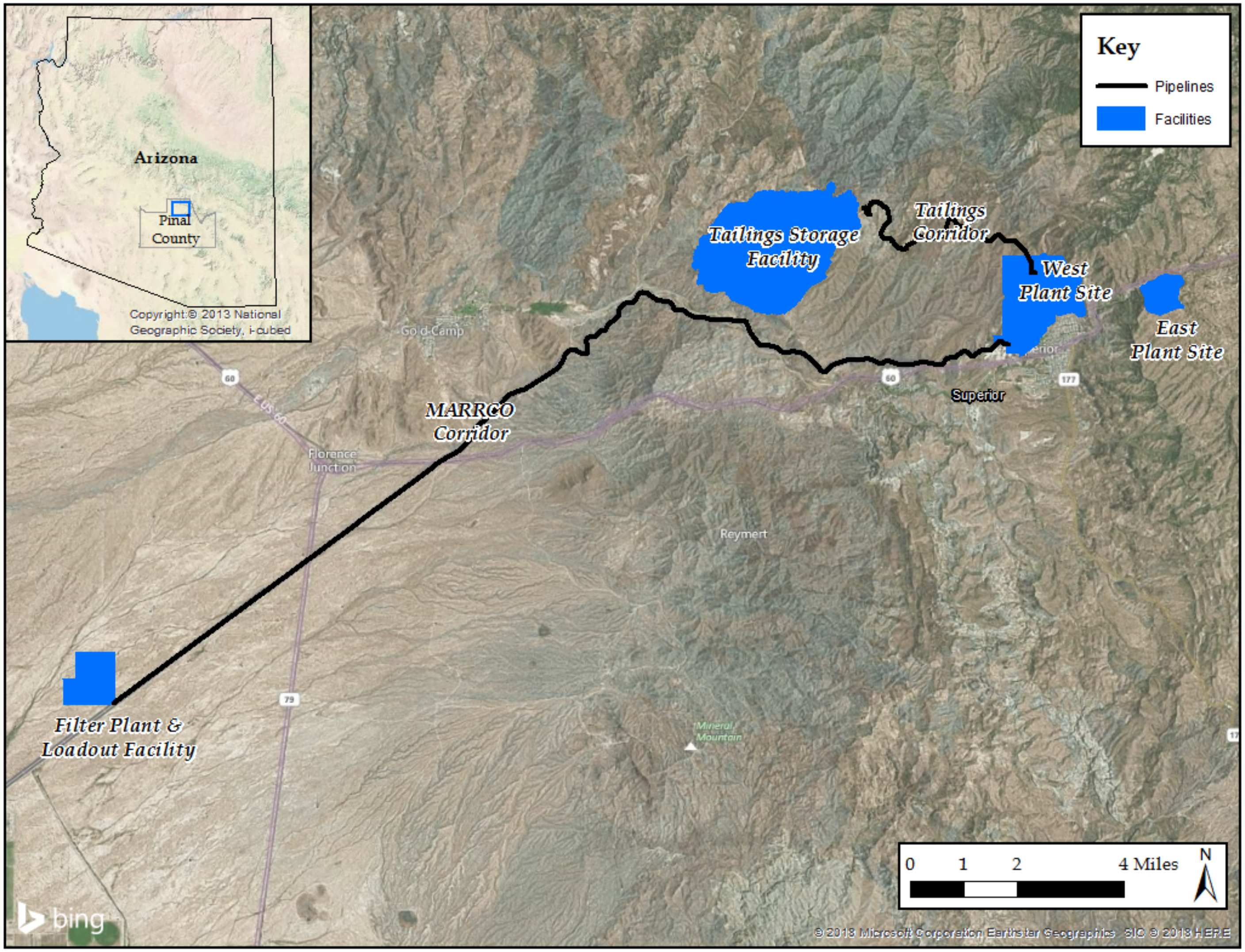
The benefits of a panel cave mine at the Resolution Project include limited development of rock piles at the surface and no large open pits with terraced pit walls. One result of panel cave mines is surface subsidence or settling above the ore deposit. Surface subsidence occurs as the material above 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).

Ore production from the underground operations is expected to be a nominal 132,000 tons per day after an extensive construction and ramp-up period, with a maximum throughput of approximately 165,000 tons per day.

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.

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 modified 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 modified proposed action TSF includes centerline construction and two tailings streams[4] (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 DEIS has been determined by the USFS as well as some additional alternatives that have been presented for consideration. Each alternative will be evaluated for potential impacts to air quality resources. The alternatives are:

1 – No Action

2 – Modified Proposed Action – Near West (slurry tailings; unlined; subaqueous PAG; centerline embankment). Location: west of the WPS and north of Queen Station within the TNF.

3 – Modified Proposed action – Near West (thin lift/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, lined PAG cell). Location: North of WPS.

5 – Peg Leg (slurry tailings; line PAG cell; other selective lining, true centerline dam). Location: Approximately 29 km south of the WPS and 25 km east of Florence, AZ.

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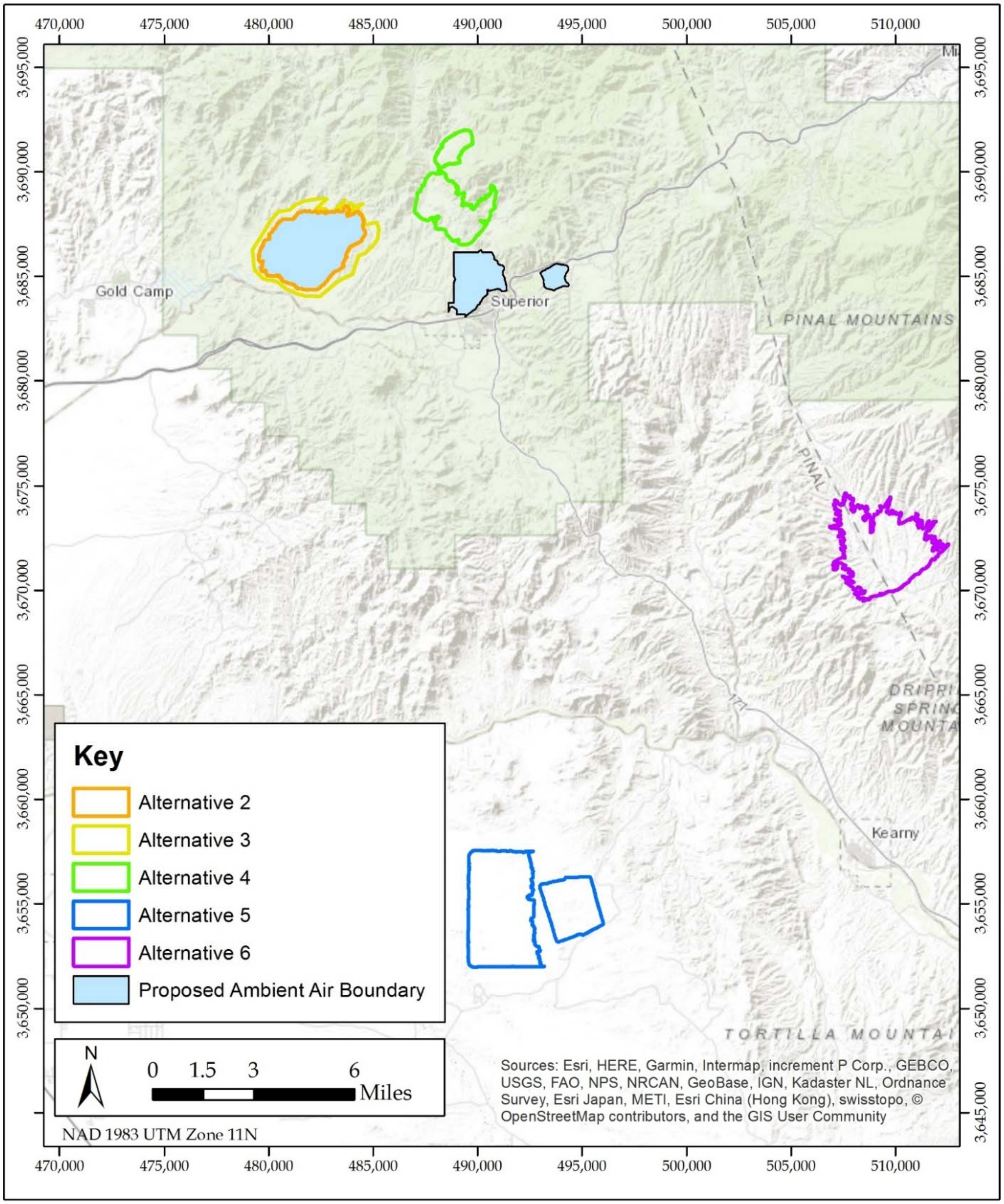
[4] "Scavenger" (85%, non-potentially acid generating [NPAG]) and "cleaner" (15% potentially acid generating [PAG]).

6 – Skunk Camp (slurry tailings; lined PAG cell; true centerline dam). Location: Approximately 15 miles south east of Superior, AZ.

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

Figure 2-2. TSF Locations



2.2.4 MARRCO Corridor

The existing MARRCO Corridor extends northeast from Magma past the highway crossing at US 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 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-hour-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

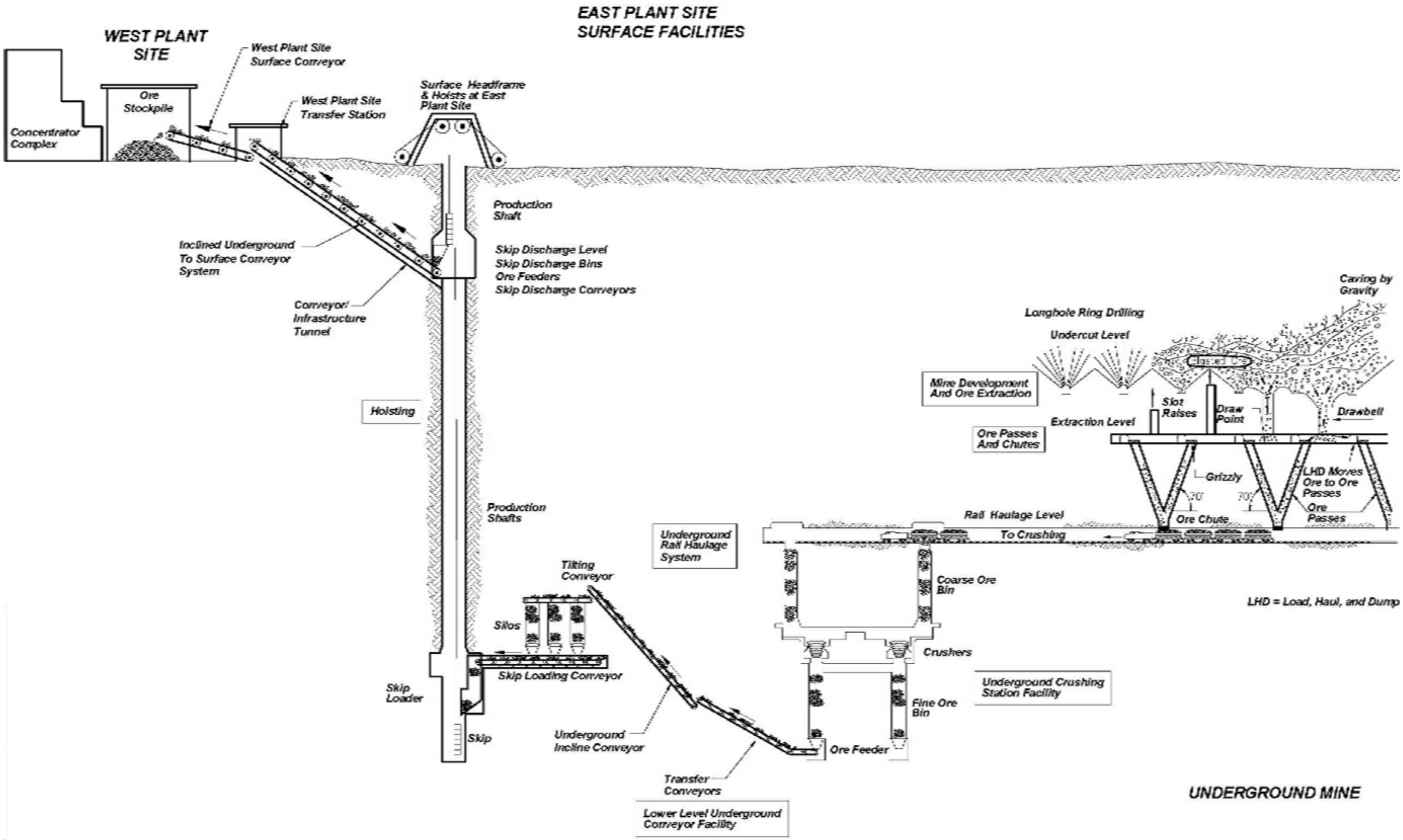
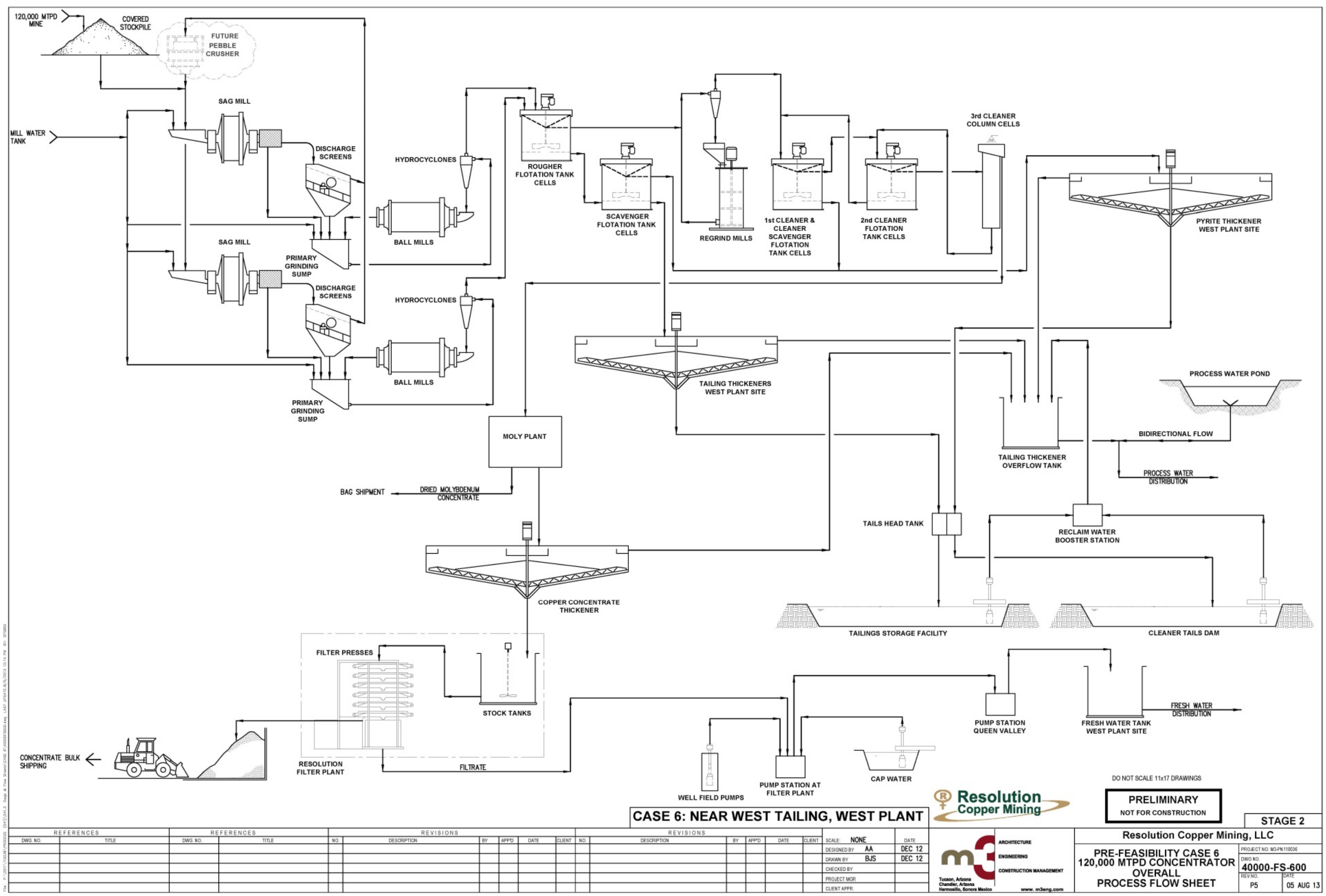


Figure 2-4. Process Flow Diagram – Ore Processing and Transport Operations



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 caving 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 tailpipe and nonroad engine 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 (nonroad engine) emissions will be compliant with applicable EPA emission standards.

Three additional mine features act as controls that reduce modeled particulate emissions from underground sources: water droplets in mine shafts, heat rejection sprays, and gravitational settlement. These features' 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, PM_{10} = 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 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, PM_{10}, 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 nonroad 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.

2.5.3 WPS – Ore Processing

The coarse ore transported from the EPS via an underground conveyor system drops onto an overland stockpile 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 occur and 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 2-6 shows the locations of the modeled sources at the WPS.

Figure 2-5. EPS Modeled Source Locations

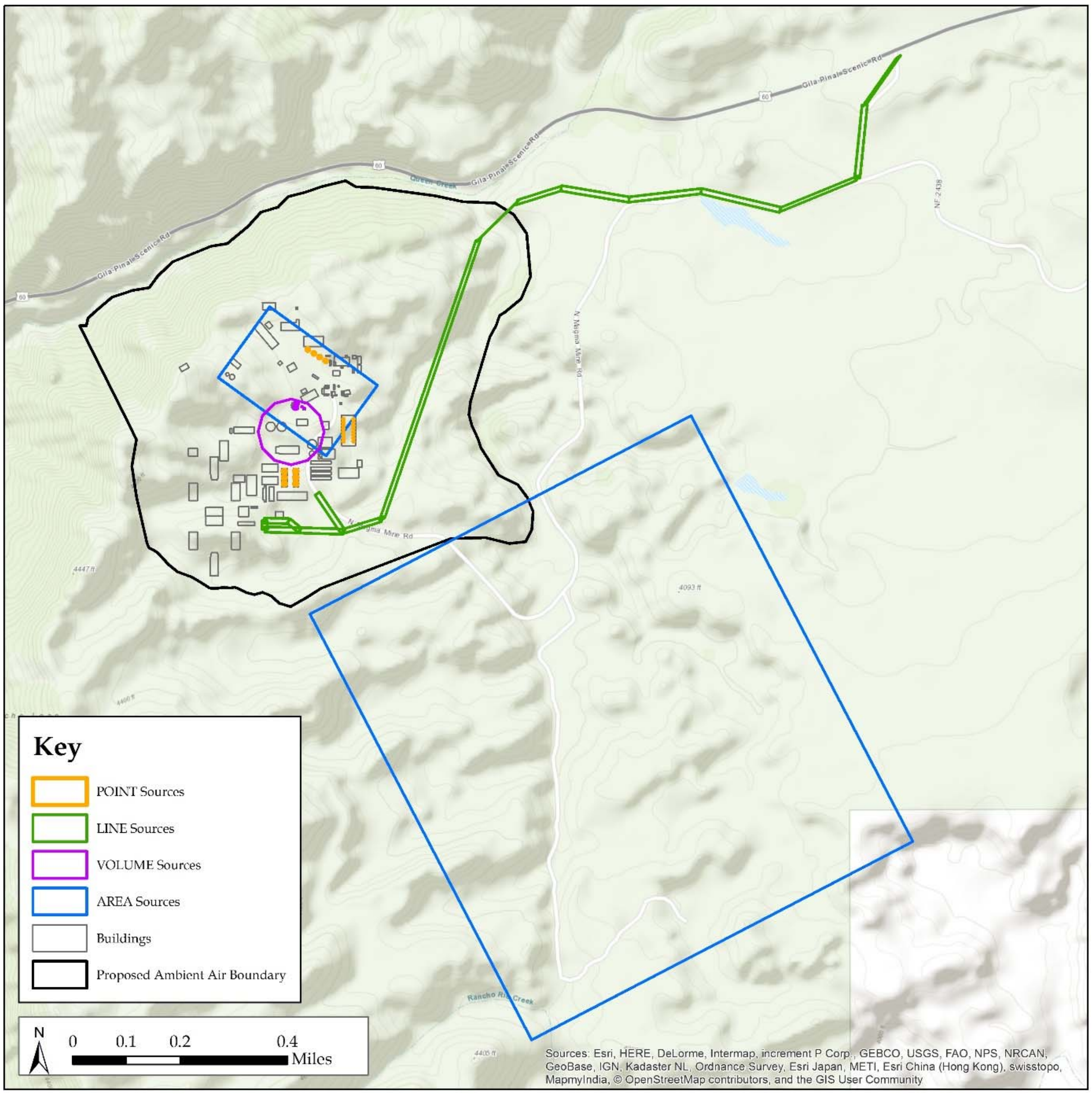
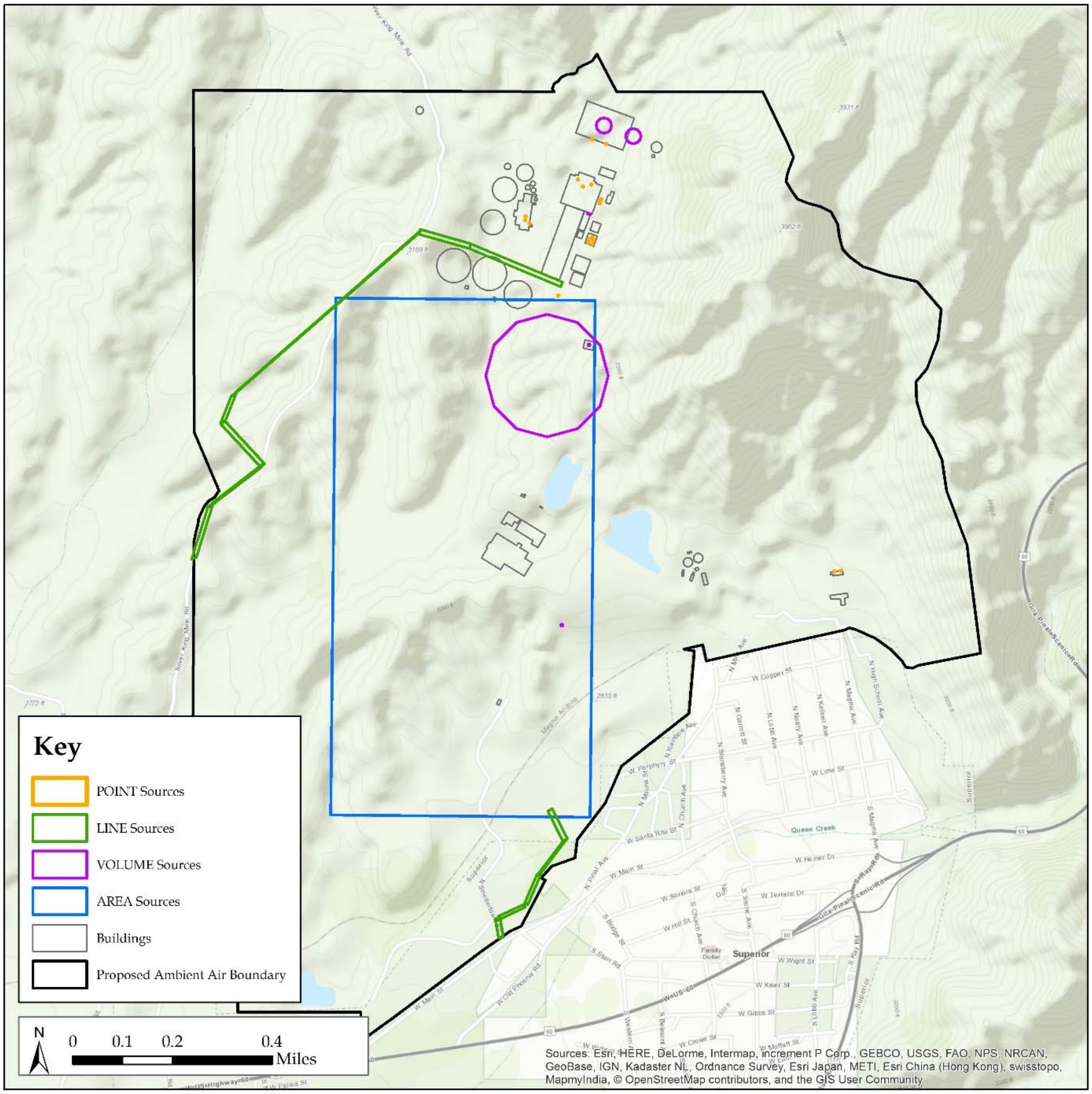


Figure 2-6. WPS Modeled Source Locations



The end product from the Resolution Project will include copper and molybdenum concentrates.

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. SO_2 emissions from the processing of molybdenum concentrate will be controlled by a gas quencher and packed bed scrubber.

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.

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.

2.5.5 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 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 2-7. Filter Plant & Load-out Facility Modeled Source Locations

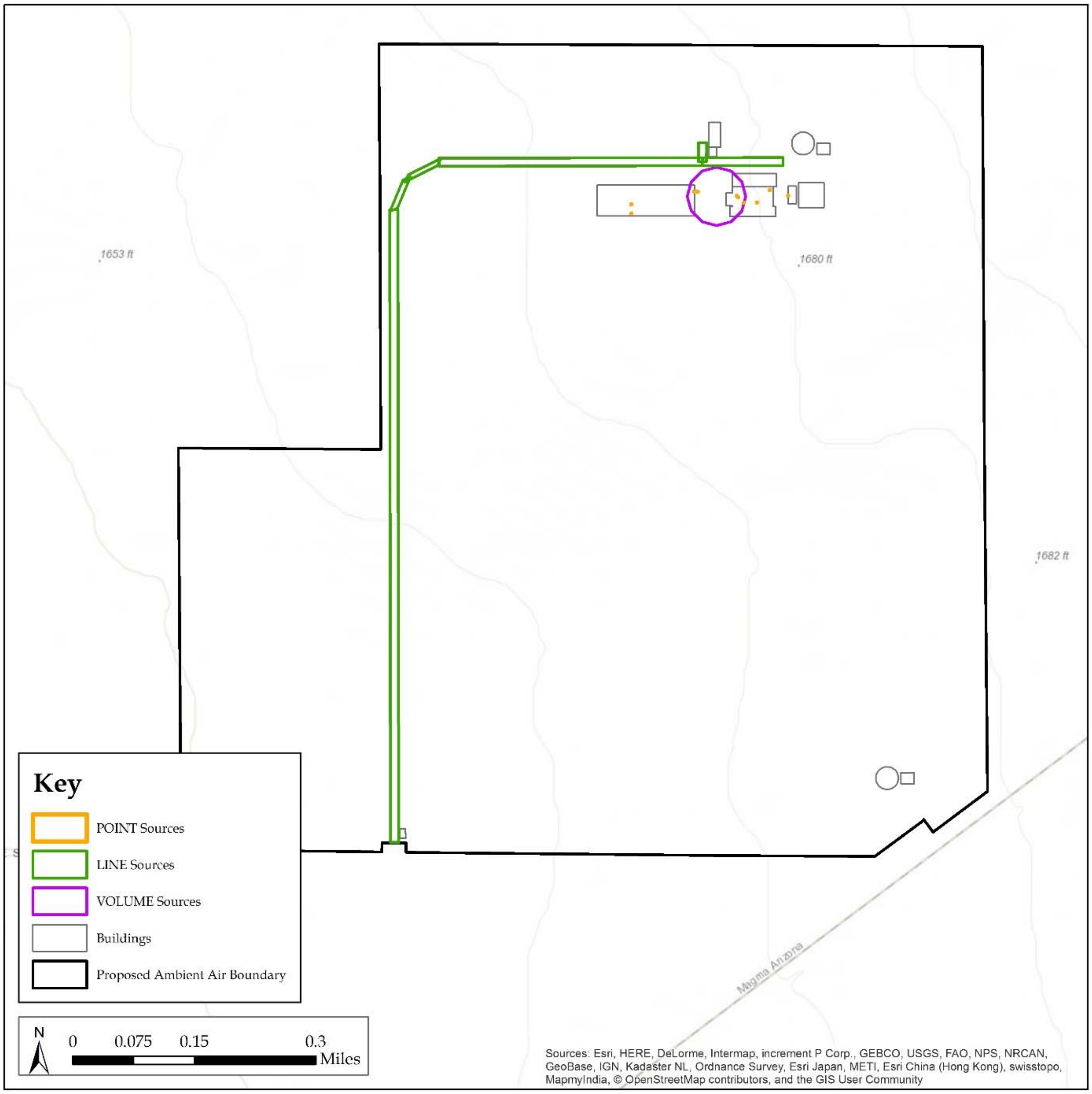


Figure 2-8. Alternative 2 (Preferred Alternative) Near West TSF Modeled Source Locations

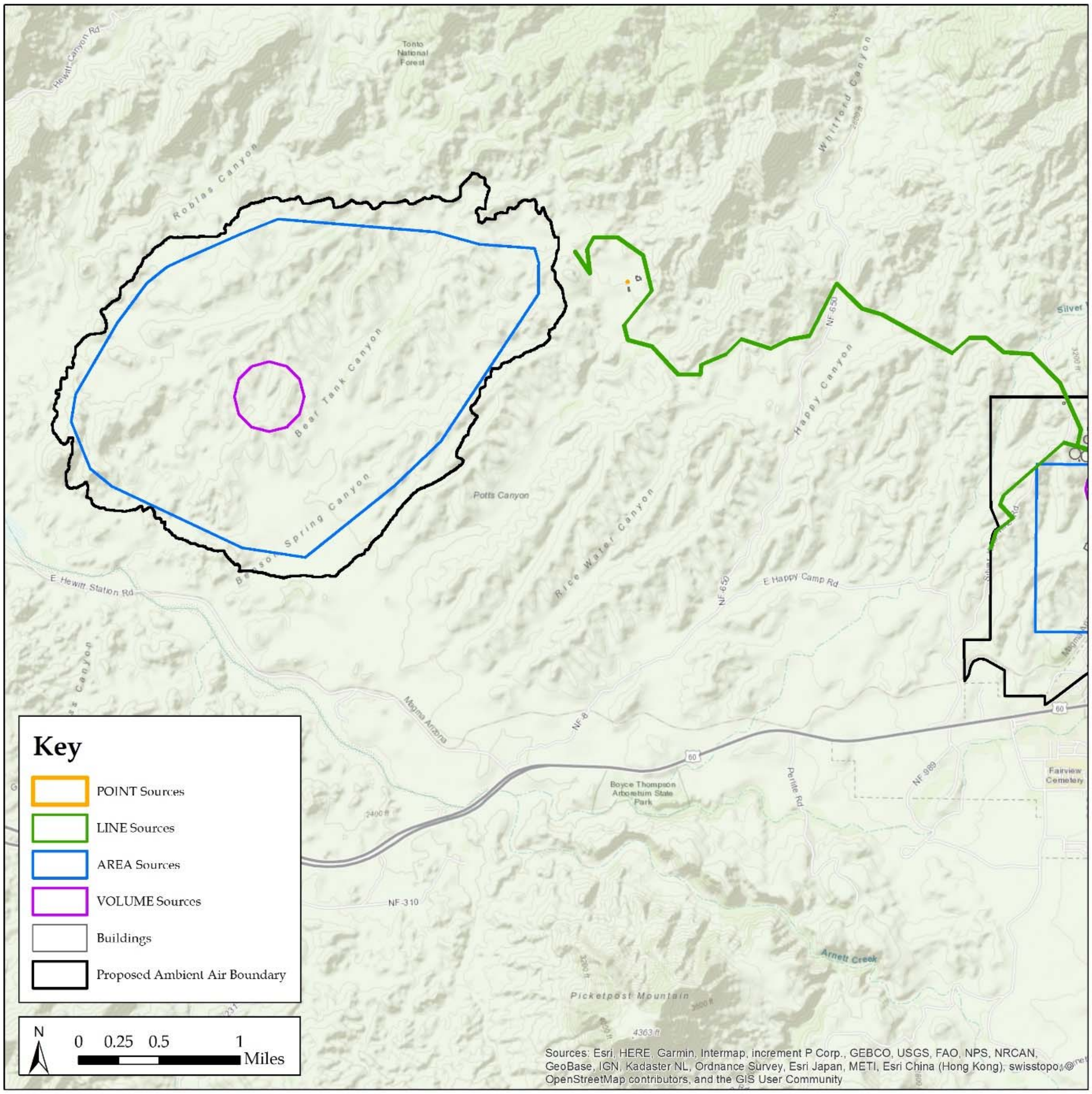


Figure 2-9. Alternative 3 Near West Modified TSF Modeled Source Locations

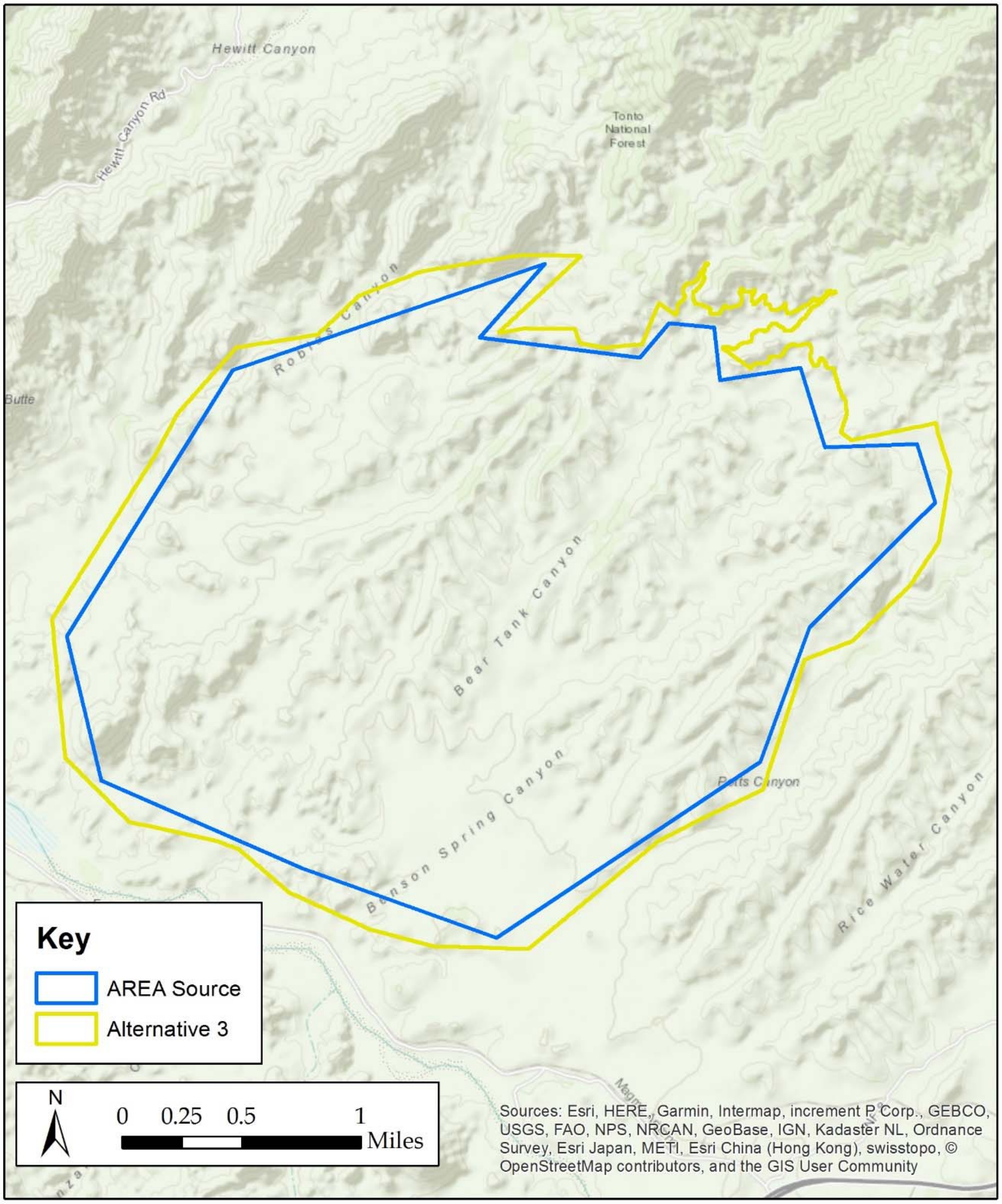


Figure 2-10. Alternative 4 Silver King Filtered TSF Modeled Source Locations

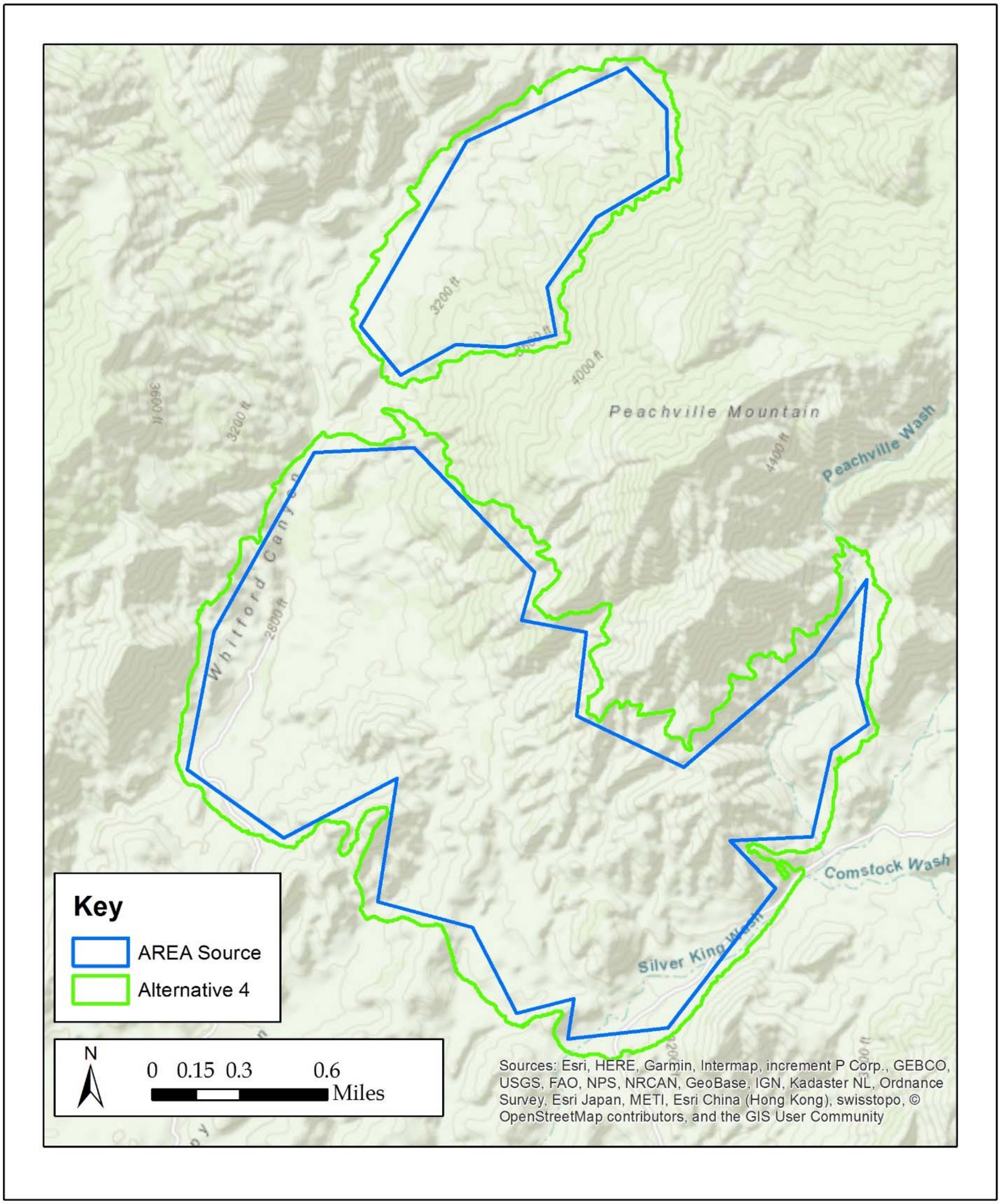


Figure 2-11. Alternative 5 Peg Leg TSF Modeled Source Locations

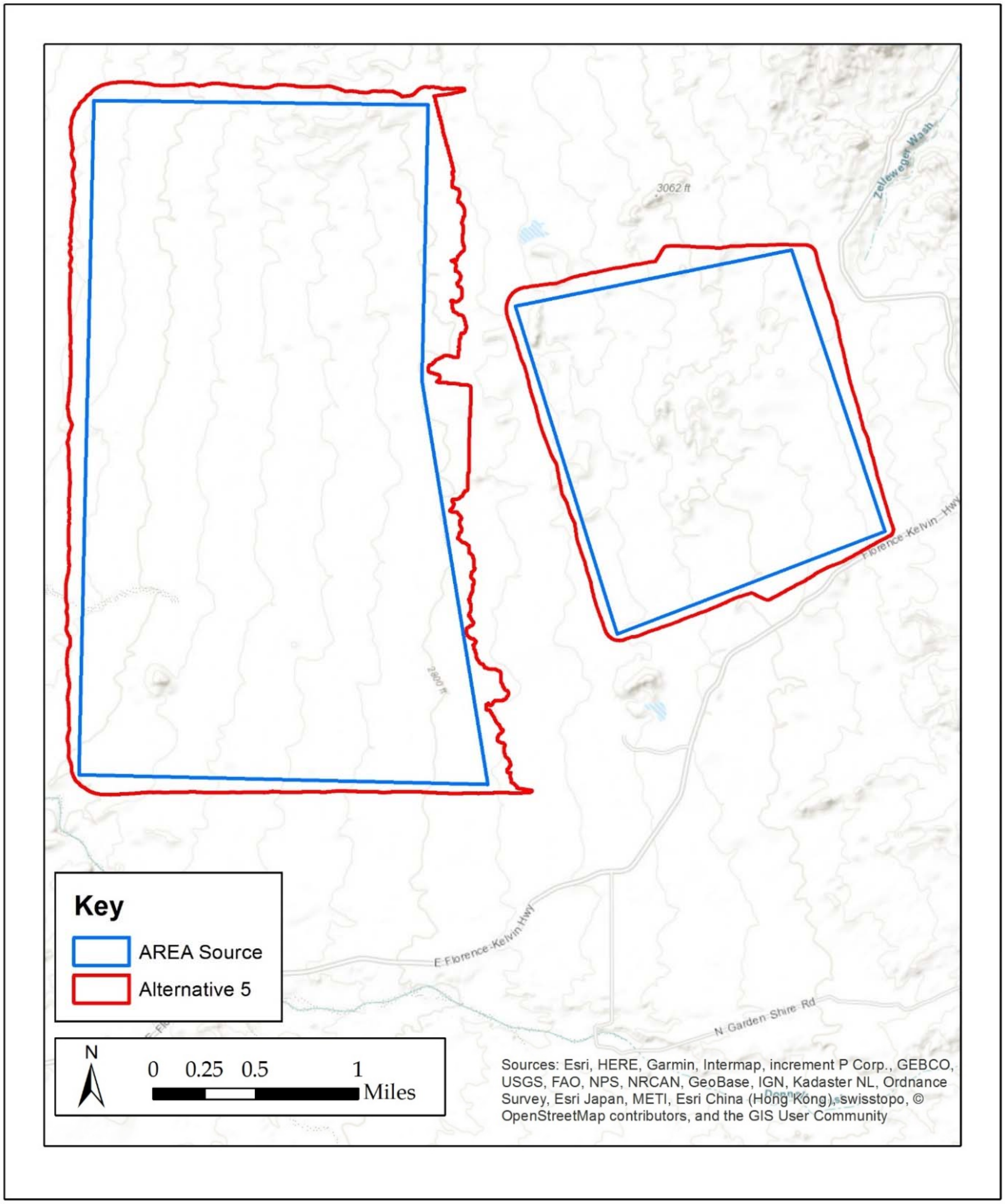
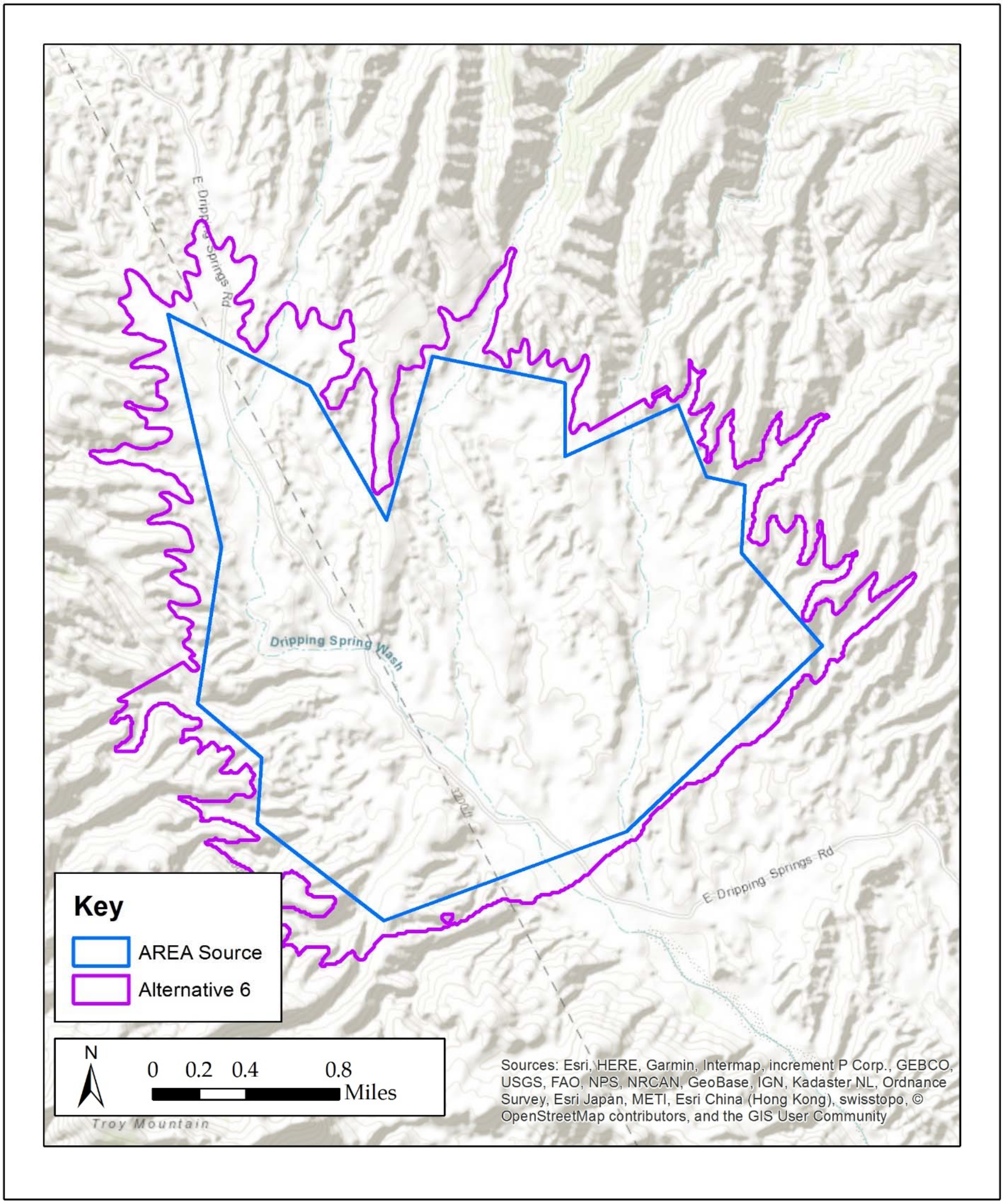


Figure 2-12. Alternative 6 Skunk Camp TSF Modeled Source Locations



2.6 Annual Emission Estimates

Emissions due to underground sources at the EPS will include: dust emissions[5] from underground mining activities (drilling, blasting, material handling and transfers, and crushing) and combustion emissions[6] 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	7.7	17.1	14.8	66.0
	Fugitive	2.1	0.4	3.1	19.2	0.1	0.02
	Mobile	30.6	4.6	0.2	0.2	0.1	2.9
	Subtotal	43.3	15.8	11.0	36.5	15.0	68.9
Loadout	Process	1.0	0.1	0.2	1.4	0.002	0.004
	Fugitive	0	0	0.1	1.0	0	0.01
	Mobile	20.6	2.3	0.1	0.1	0.04	1.1
	Subtotal	21.5	2.4	0.4	2.5	0.05	1.1
TSF	Process	1.0	0.1	0.002	0.002	0.002	0.004
	Fugitive	0	0	25.6	198.7	0	0.1
	Mobile	352.8	48.5	2.1	2.1	0.7	21.1
	Subtotal	353.8	48.6	27.7	200.8	0.8	21.2
Facility Wide	Process	20.6	44.4	30.8	80.8	15.0	69.3
	Fugitive	28.8	5.5	39.1	319.1	1.8	0.2
	Mobile	574.0	73.2	3.3	3.4	1.0	33.4
	Total	623.4	123.1	73.2	403.4	17.8	102.9

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

5 PM, $PM_{2.5}$, and PM_{10}

6 $PM_{2.5}$, PM_{10}, Carbon Monoxide (CO), Oxides of Nitrogen (NO_X), Sulfur Dioxide (SO_2), Volatile Organic Compounds (VOC), and greenhouse gases

(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 wane by LOM year 14. Further, the maximum area susceptible to wind erosion at the TSF is expected to occur during LOM year 27. Therefore, to be comprehensive and conservative, the peak blasting activity that will occur during development and the maximum susceptible TSF area have been combined with LOM year 14 and used in this analysis. 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 PM_{10} Nonattainment area. The FP&LF will be located in the West Pinal PM_{10} 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-wide[7] process emissions[8] to the major source thresholds. Since some of the sources will be located in moderate PM_{10} nonattainment areas, a 100 ton/yr major source threshold is used for PM_{10}. 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	30.8	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

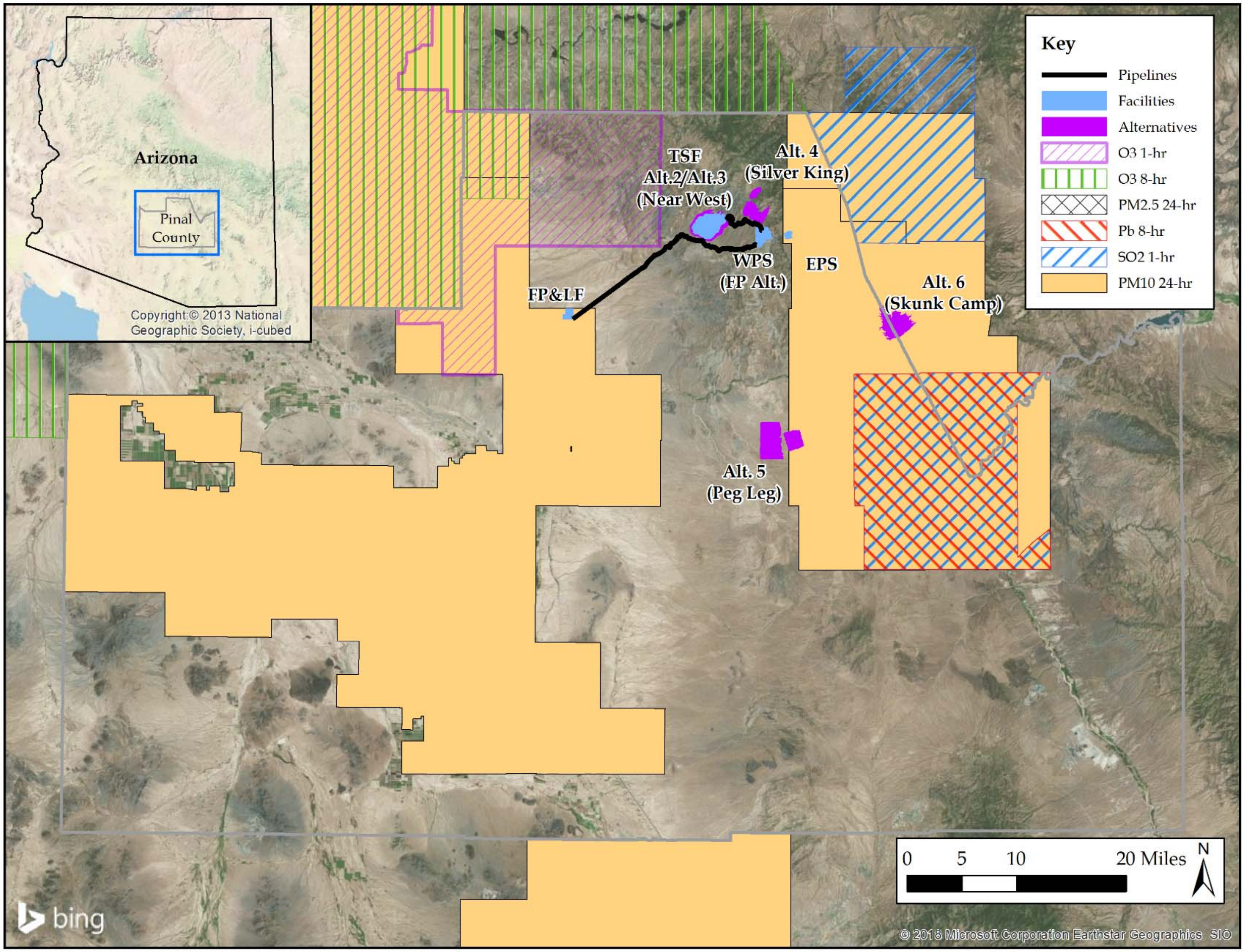
NSR = New Source Review

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 proposed air quality analysis will follow the guidelines for non-major (minor) sources set forth in ADEQ 2015a.

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

[8] For purposes of this comparison, all process emissions are assumed to be "point" source emissions. Fugitive and tailpipe/nonroad 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 Plan, is being is being prepared to demonstrate 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 (μg/m³) 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 will be used for compliance demonstration.

Table 2-6. AAQS for Compliance Demonstration

Pollutant	Averaging Period	AAQS (ppm)	AAQS (μg/m³)	AAQS Form
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	98th 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	98th 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	99th 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 μg/m³.

(3) PCAQCD standard is 65 μg/m³.

(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 (O_3) and $PM_{2.5}$. Unlike the other criteria pollutants that are directly emitted from sources, O_3 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 SO_2 and NO_x (precursor emissions for secondary $PM_{2.5}$) and VOC and NO_X (precursor emissions for O_3) 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 3.1.15 Secondary $PM_{2.5}$ and O_3 Formation describes the non-modeling approach, consistent with federal guidance, that will be used to characterize the Projects 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

These monitoring data are periodically reviewed and are anticipated to be approved by PCAQCD for the proposed air quality analysis.

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 preferred site of the TSF. Data from the Hewitt station will be available to support future modeling of particulate emissions from the TSF. Details and data summaries for the Hewitt station data have been provided to PCAQCD quarterly.

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 PM_{10}, $PM_{2.5}$, NO_X, SO_2, and O_3 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, SO_2, and O_3 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 PM_{10} and $PM_{2.5}$ samplers on a monthly basis. A more detailed description of these quality control procedures can be found in the Monitoring Plan (which has been approved by PCAQCD on November 15, 2011 and July 28, 2016). The procedures have been designed to meet the quality system requirements in 40 CFR Part 58, Appendix A.

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 3.1.9.

3.0 AIR QUALITY ANALYSES

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

- Proposed Action – Operations (TSF Alternative 2 – Far West; FP&LF near Magma Junction)
- Alternatives - Operations
  - FP&LF located within the footprint of West Plant
  - 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 – Far West; FP&LF near Magma Junction).

3.1 Ambient Air Quality Impacts Analysis (Near-field)

3.1.1 Model Selection

The most recent version of the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) modeling system will be 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 analysis (up to 50 km) in 40 CFR 51, Appendix W.

3.1.2 Pollutants and Averaging Periods

The proposed air quality analysis will include 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 will be used for compliance demonstration.

Table 3-1. Pollutants and Averaging Periods

Pollutant	Averaging Period	Compliance Design Value
CO	8-Hour	2nd High
	1-Hour	
NO_2	Annual	
	1-Hour	8th High (98th percentile, averaged over 3 years)
$PM_{2.5}$	Annual	
	24-Hour	8th High (98th percentile, averaged over 3 years)
PM_{10}	Annual	
	24-Hour	Not to be exceeded more than once per year on average over 3 years
SO_2	Annual	
	24-Hour	2nd High
	3-Hour	2nd High
	1-Hour	4th High (99th percentile, averaged over 3 years)

3.1.3 Building Downwash

The effects of the building-induced downwash will be incorporated into this analysis. The building downwash parameters will be calculated using the most recent version of the Building Profile Input Program with the Plume Rise Model Enhancement (BPIP-PRIME, version 04274). Planned building locations and dimensions will be 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 has determined ambient air boundaries (AAB) that delineate where public access is effectively precluded. Future air quality modeling will include receptors along Resolution's ambient air boundary and receptor grids outside the ambient air boundary.

Pursuant to EPA guidance, and consistent with ADEQ 2015a, Section 3.4, the effective ambient air boundary 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:

- 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.

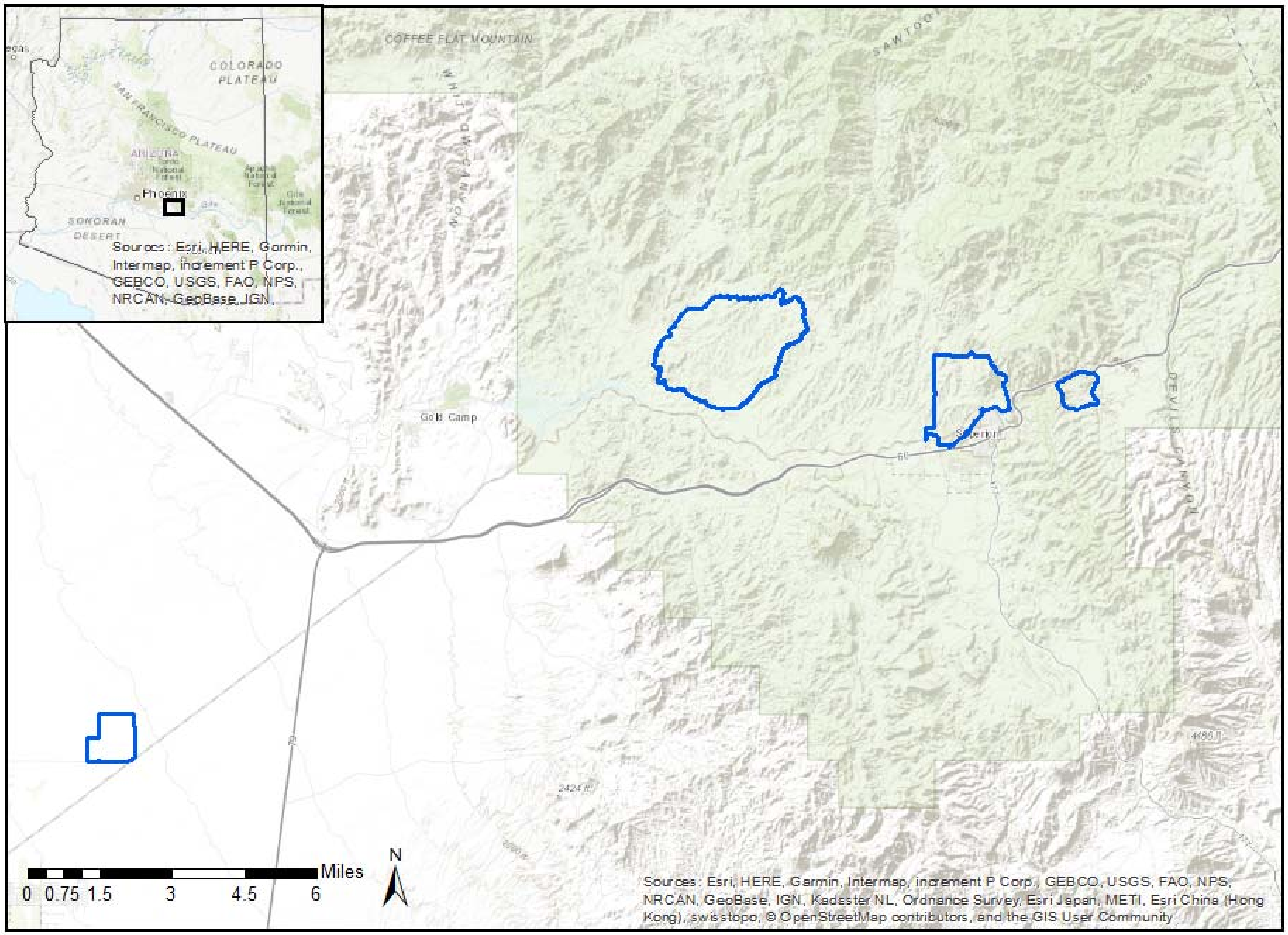
- Natural Barrier/Steep Terrain – Steep slopes around the project areas will serve as natural barriers or impediments to site access. In general, steep terrain is considered to be terrain with a grade of 25 to 30 percent or greater.

- 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 shacks, 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 proposed ambient air boundaries for the Proposed Action are shown in Figure 3-1. The ambient air boundaries for the alternative TSF locations will be the footprints shown in Figure 2-2.

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



3.1.5 Modeling Receptors

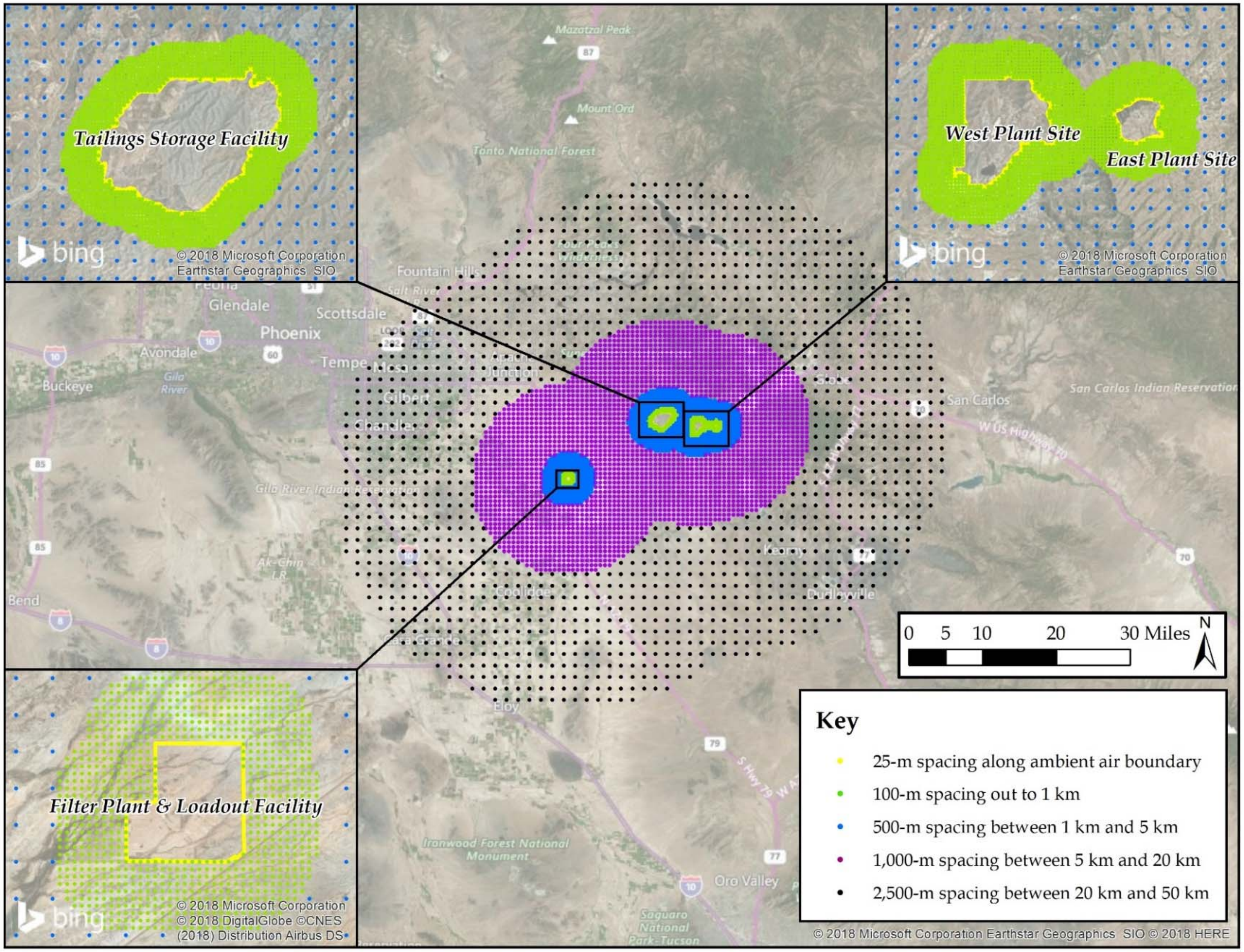
A series of nested receptor grids will be used for this analysis to estimate ambient pollutant concentrations resulting from the potential emissions. The following receptor spacing and extents around each facility, in accordance with ADEQ 2015a, Section 3.6, will be used for this analysis:

- 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 and or within the Class I Superstition Wilderness Area and the White Canyon Area of Critical Environmental Concern (ACEC)

The most recent version of the AERMOD terrain preprocessor, AERMAP (version 11103), will be used to develop the receptor elevations and hill heights. A 10-m resolution United States Geological Survey (USGS) National Elevation Dataset (NED) file will be used for this processing.

A sample receptor network is presented in Figure 3-2. Receptor networks surrounding the alternative TSF facilities will be developed per the receptor spacing and extents listed above.

Figure 3-2. Sample 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 l year of site specific data is required*" for an air quality modeling analysis (40 CFR 51, Appendix W, 8.3.1.2 b.).

For this analysis, Resolution Copper is proposing to use 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 and reviewed and approved by PCAQCD. 9 The EPS sources will be modeled using the EPS meteorological data (tower sensors mounted at 10-meter height), the tailings facilities (the Proposed Action and alternatives) will be modeled using the Hewitt meteorological data (SoDAR data collected at 10-meter increments from 20 meters to 190 meters),[9] [10]and West Plant, the FP&LF, and MARRCO Corridor will be modeled using the WPS meteorological data (tower sensors mounted at 10-meter height).

The most recent version of the AERMOD meteorological preprocessor (AERMET) will be used to generate AERMOD-input-ready hourly meteorological files for this analysis. Each of the site-specific data sets will be 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.

The locations of the onsite monitoring and related 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

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[9] In the absence of valid SoDAR data for any given hour(s) in the 2-year meteorological data set, the 20-meter Hewitt tower wind speed and direction data will be substituted.

[10] An analysis to verify the representativeness of the Hewitt SoDAR meteorological data for modeling the alternative TSF sites will be performed. Alternative meteorological data (e.g., National Weather Service) will be identified and processed for use in the AERMOD modeling, if necessary.

Figure 3-4.

3.1.7 Adjusted Friction Velocity Calculation Method

EPA has integrated ADJ_U* as a regulatory default option in the AERMET (ver. 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.

Figure 3-3. Location of Monitoring Stations

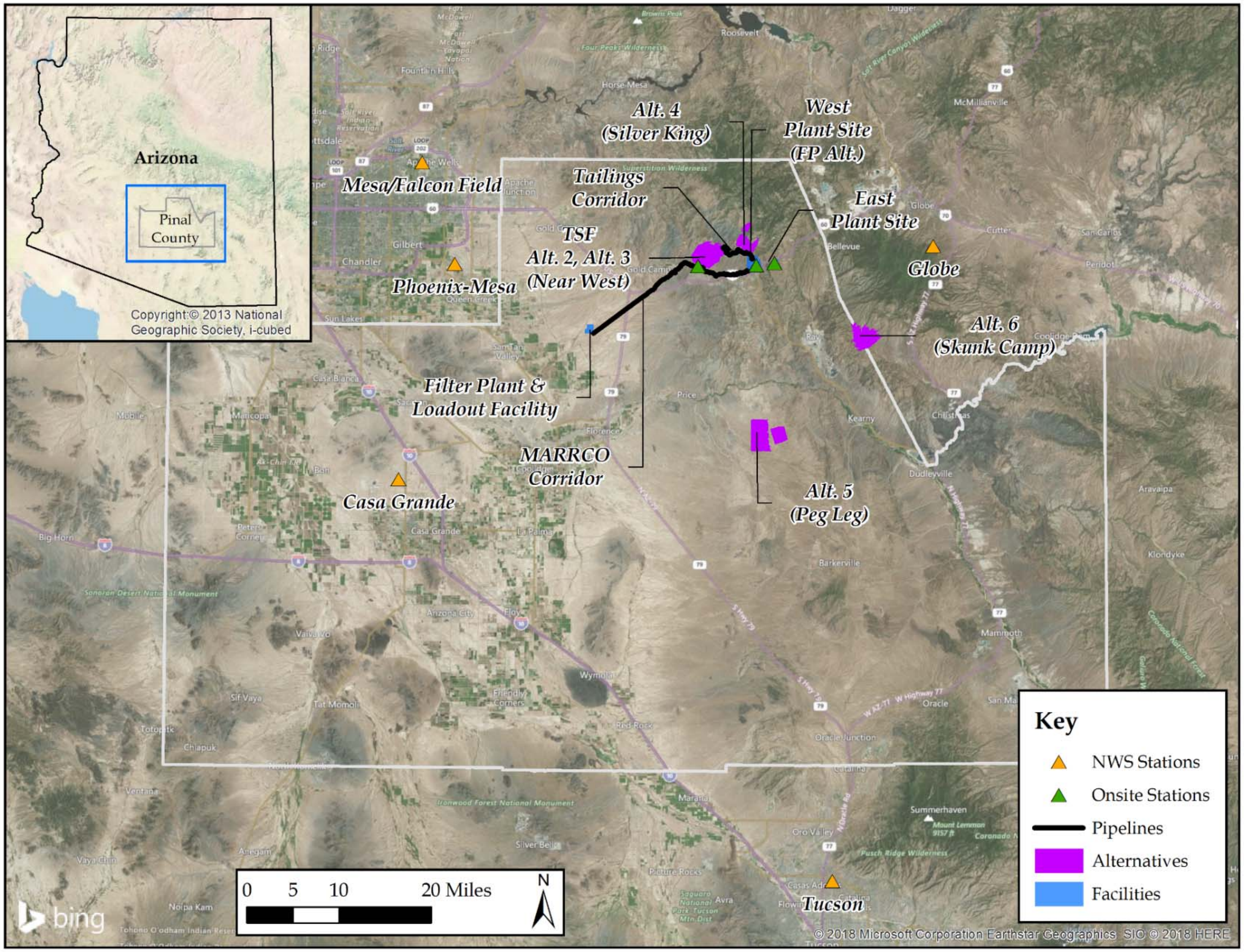
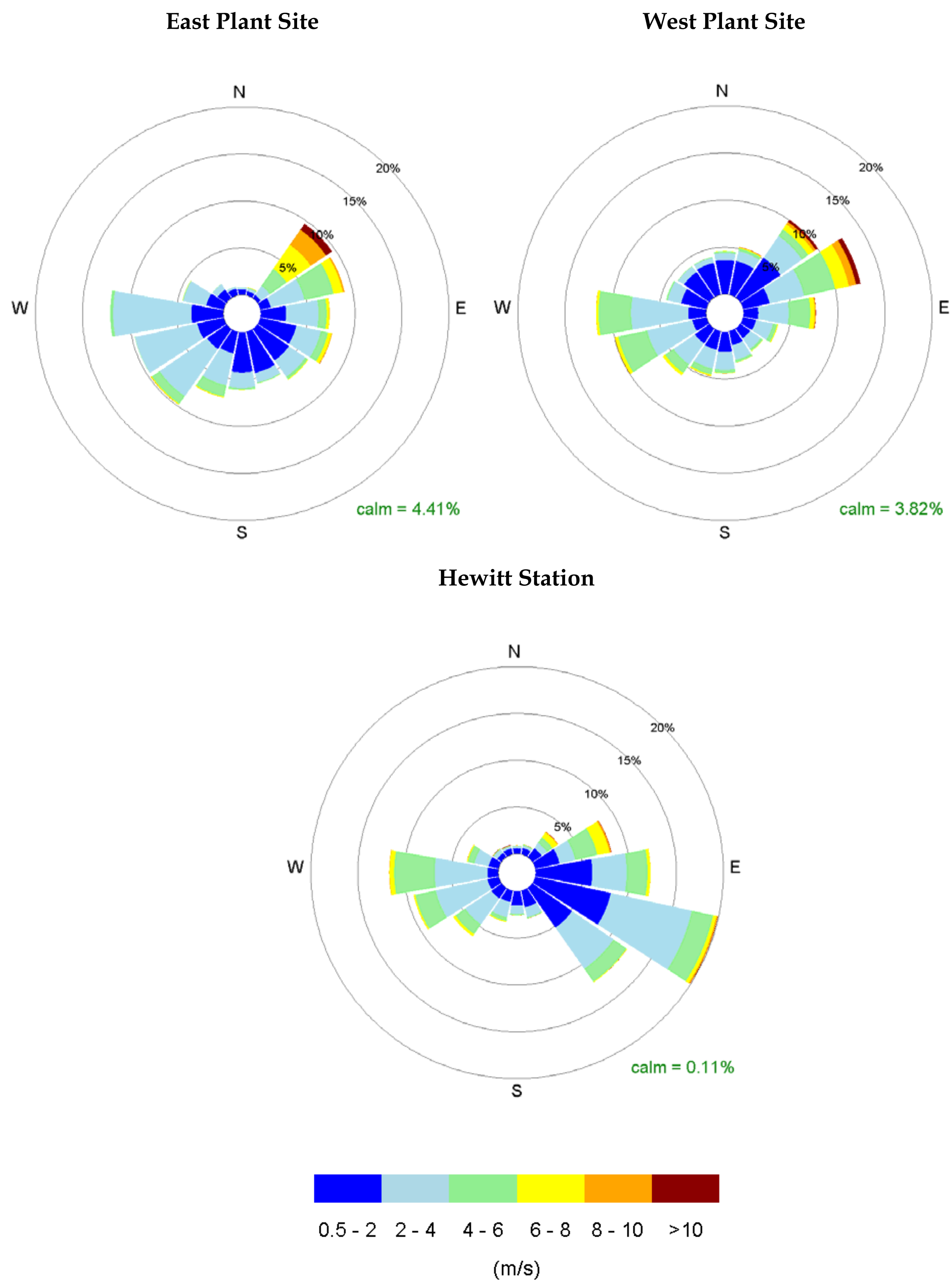


Figure 3-4. Wind Frequency Distribution for Resolution Monitoring Stations, 2015-2016



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 under predict 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 proposes to use the ADJ_U* option for modeling. When processing the meteorological data with AERMET and ADJ_U*, Resolution Copper proposes to remove site-specific turbulence parameters so that AERMOD may be run in the default mode. This adjustment to the meteorological data addresses two important matters to improve the model:

1. AERMOD may be run in the default mode.

2. The possibility that AERMOD will under predict impacts when the ADJ_U* option is used is reduced.

3.1.8 Surface Characteristics for AERMET Processing

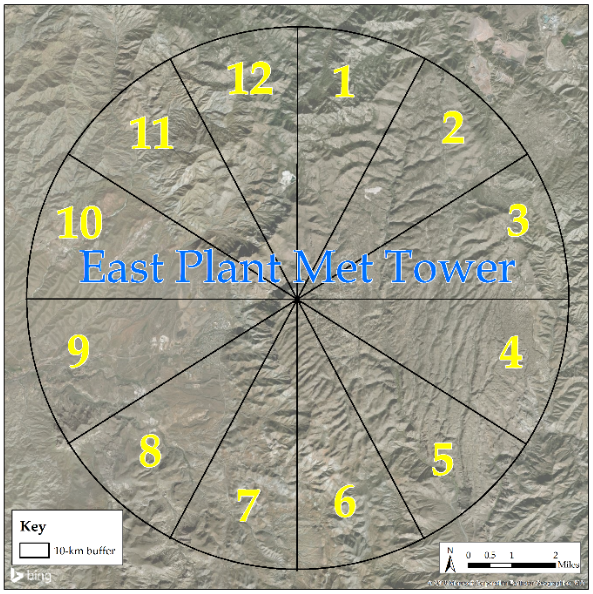
AERMET requires the input of three surface boundary layer parameters: midday Bowen ratio (B_o), midday albedo (r), and surface roughness length (z_o). These parameters are dependent on the land use and vegetative cover of the area being evaluated. The EPA has provided the recommended methods for determining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

The most recent version of AERSURFACE will be 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.

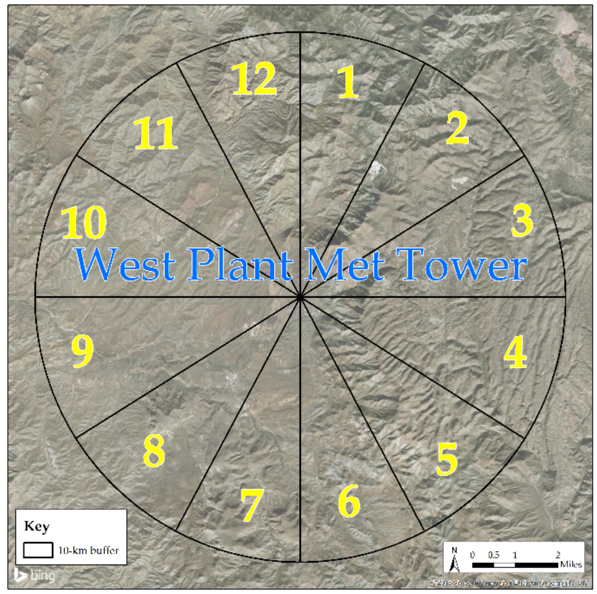
AERSURFACE will be run for each onsite meteorological tower location with 12 sectors (30-degree increments starting at north). High-resolution aerial photographs showing a 10-km radius and the surface roughness length segments around the three onsite meteorological towers are provided in Figure 3-5 for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

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

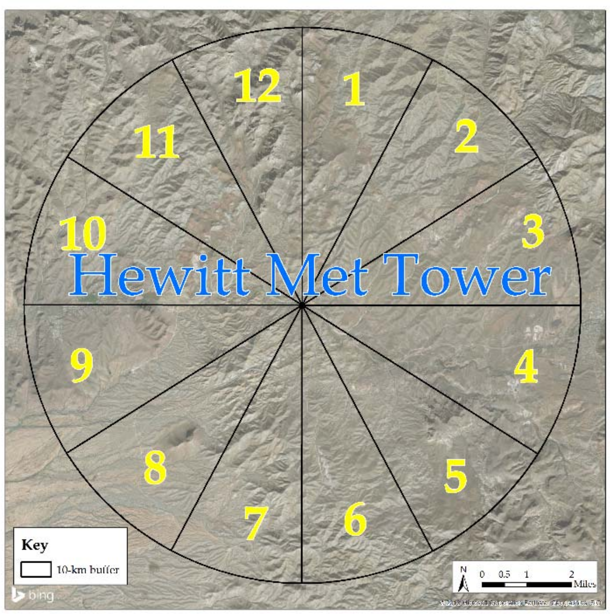
East Plant Site



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 will be 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_o) 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_o) 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_o) 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

3.1.9 Background Concentrations

3.1.9.1 NAAQS

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 will be added to the modeled concentrations due to project emissions. The total concentration (background plus modeled impact) will account for air pollution sources that influence air quality in the project area but are 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.

Based on data availability and completeness, years were selected on a per-pollutant basis as 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 NO_2 (1-hour), a temporally varying background developed from the EPS monitoring station hourly data will be used.

A paired-sums approach for PM_{10} and $PM_{2.5}$ will be used. In this method, for total ambient 24-hour $PM_{10}/PM_{2.5}$ concentrations to be compared to the 24-hour NAAQS, the modeled impact for each calendar day is added to the measured onsite $PM_{10}/PM_{2.5}$ concentration for that day in accordance with ADEQ 2015a, Section 7.4.1. This method more accurately characterizes predicted total ambient $PM_{10}/PM_{2.5}$ concentrations because of the correlations between meteorological conditions, monitored $PM_{10}/PM_{2.5}$ concentrations, and modeled concentrations. The availability of contemporaneously monitored $PM_{10}/PM_{2.5}$ concentrations and meteorological data allows for the monitored PM concentration to be compared in time with the modeled concentration.

Within the monitored particulate data set for use in the paired-sums approach, there are days of elevated PM_{10} 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 that are considered representative of the project area when mining operations occur, 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 (4) 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 (10) 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, 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 A 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 (3) days (out of the possible ten days) were removed from the background data set.

For the paired-sums approach to add monitored background $PM_{10}/PM_{2.5}$ 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 data set will be substituted for using the following two-tier gap-filling procedure specified by PCAQCD (K. Walch email, August 28, 2017):

- Tier 1 - Any missing PM_{10} or $PM_{2.5}$ data should be filled using the measured PM_{10} 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.

- When the monitoring data are missing at the closest monitoring location, a monthly gap-fill value shall be determined for each monitoring site. For $PM_{10,}$ the highest monitored concentration for the month averaged over 3 years shall be used. For $PM_{2.5,}$ the second-highest monitored concentration for the month averaged over 3 years 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. Proposed Background Concentrations

Pollutant	Averaging Period	Background Concentration (μg/m³)	Value	Unit	Form of Background Concentration
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 24-Hour	Profile	--	--	24-hour Monitored Concentration Paired with Modeled Impact Concentration for Same Day
East Plant PM_{10}	Annual 24-Hour	Profile	--	--	24-hour Monitored Concentration Paired with Modeled Impact Concentration for Same Day
West Plant $PM_{2.5}$	Annual 24-Hour	Profile	--	--	24-hour Monitored Concentration Paired with Modeled Impact Concentration for Same Day
West Plant PM_{10}	Annual 24-Hour	Profile	--	--	24-hour Monitored Concentration Paired with Modeled Impact Concentration for Same Day
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	99th Percentile of the Annual Distribution of Daily Maximum 1-Hour Values Averaged Over 3 Years (2013, 2015, 2016)

*ppb = parts per billion

3.1.10 Emissions and Characterization

3.1.10.1 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 maximum potential Resolution Project 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 (Non-Emergency)	7.7	10.5	29.6	79.7	14.8
Fugitive	28.8	5.5	39.1	319.1	1.8
Mobile	574.0	73.2	3.3	3.4	1.0
Emergency	13.0	33.9	1.1	1.1	0.2
Total	623.4	123.1	73.2	403.4	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.[11]

For process sources, all short-term (up to 24-hour, except for intermittent sources for 1-hour averaging periods, addressed in Section 3.1.13) and long-term (annual) model input emissions will be based on maximum hourly process rates. For fugitive and mobile sources, both short-term and long-term averaging periods' model input emissions will be calculated based on average annual hourly emissions with the exception of long-term emissions from traffic on unpaved roads, which will be calculated using the precipitation correction factor discussed in AP-42, Chapter 13.2.2.

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

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

Emissions from surface activities at the EPS and TSF (fugitive dust and tailpipe emissions) will be aggregated and assigned to appropriate modeled fugitive activity locations. Each model input fugitive location will be appropriately characterized as a VOLUME or an AREA source. The applicable model input physical parameters for VOLUME and AREA sources will be 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 C and are subject to change.

[11] 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.

Hourly emissions profiles for wind erosion from exposed surfaces (tailings dry beach, tailings dam, and subsidence area) will be developed using the fastest-mile method specified in AP-42, Section 13.2.5. Using this method, each hourly wind speed will be converted to a fastest mile by multiplying it by a factor of 1.2.[12] The estimated hourly fastest-mile values will be 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) will be calculated using AP-42, Section 13.2.5, Equation 3. Hourly wind erosion potentials will be 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 will be input into AERMOD using an external file and the HOUREMIS keyword in the input file. Sample wind erosion emission calculations are provided in 4.0Appendix D.

3.1.10.2 Source Emissions - Alternatives

A comprehensive emissions inventory for the Resolution 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 Alternatives emissions inventory.

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

For process sources, all short-term (up to 24-hour, except for intermittent sources for 1-hour averaging periods) and long-term (annual) model input emissions will be based on maximum hourly process rates. For fugitive and mobile sources, both short-term and long-term averaging periods' model input emissions will be calculated based on average annual hourly emissions except for long-term emissions from traffic on unpaved roads, which will be calculated using the precipitation correction factor discussed in AP-42, Chapter 13.2.2.

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

Stationary process sources with exhaust stacks, such as generators, will be modeled as POINT sources with actual release characteristics. The fugitive process sources, such as uncontrolled ore transfers, will be characterized as VOLUME sources in the model.

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

Source-specific model input emission rates will be 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) will be developed using the fastest-mile method specified in AP-42, Section 13.2.5. Using this method, each hourly wind speed will be converted to a fastest mile by multiplying it by a factor of 1.2. The estimated hourly fastest-mile values will be 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) will be calculated using AP-42, Section 13.2.5, Equation 3. Hourly wind erosion potentials will be 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 3-10.

Table 3-10. Maximum Potential Annual Emissions Summary by Alternative (ton/yr)

Alternative	**PM_{10}**	**$PM_{2.5}$**	**CO**	**NO_X**	**SO_2**	**VOC**
1 – No Action	-	-	-	-	-	-
2 – Near West Modified Proposed Action	247.2	34.7	353.8	48.6	0.7	21.1
3 – Near West Modified Proposed Action (thin lift/PAG cell)	242.2	34.2	348.7	48.0	0.7	20.8
4 – Silver King (filtered)	194.2	34.0	387.1	44.4	0.8	21.7
5 – Peg Leg	349.6	41.4	454.0	60.2	1.0	26.5
6 – Skunk Camp	247.5	34.7	350.3	48.1	0.7	20.8

3.1.10.3 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. [13]

For process sources, all short-term (up to 24-hour, except for intermittent sources for 1-hour averaging periods, addressed in Section 3.1.13) and long-term (annual) model input emissions will be based on maximum hourly process rates. For fugitive and mobile sources, both short-term and long-term averaging periods' model input emissions will be calculated based on average annual hourly emissions except for long-term emissions from traffic on unpaved roads, which will be calculated using the precipitation correction factor discussed in AP-42, Chapter 13.2.2.

Stationary process sources with exhaust stacks, such as generators, will be modeled as POINT sources with actual release characteristics. The fugitive process sources, such as uncontrolled ore transfers, will be characterized as VOLUME sources in the model.

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

Source-specific model input emission rates will be 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) will be developed using the fastest-mile method specified in AP-42, Section 13.2.5. Using this method, each hourly wind speed will be converted to a fastest mile by multiplying it by a factor of 1.2. The estimated hourly fastest-mile values will be 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

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[13] 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.

particulate per square meter of erodible surface) will be calculated using AP-42, Section 13.2.5, Equation 3. Hourly wind erosion potentials will be 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 3-11. A detailed emissions inventory for the Resolution Project construction phase is provided in 1.1.1.1.1.1.1.1Appendix A.

Table 3-11. Maximum Potential Annual Emissions Summary for Construction Activities (Proposed Action) (ton/yr)

Location	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC
West Plant	251	23	105	66	2	51
East Plant	191	17	129	62	4	38
TSF Corridor	80	8	29	28	0	28
TSF (Alt. 2)	89	14	203	110	4	76
Filter Plant	41	4	14	15	1	15
Total	651	67	480	282	11	208

3.1.10.4 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 will 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 (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 are expected to be the same or less than the estimated emissions to construct the Proposed Action (Alternative 2 – Near West) (see Table 3-11).

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 (see Table 3-11). 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.

3.1.11 Coordinate System

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

3.1.12 NO_2 Modeling

The NO_X emissions from the combustion sources are principally composed of nitric oxide (NO) and NO_2. Once in the atmosphere, the NO can convert to NO_2 through chemical reactions with ambient O_3. 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 NO_2 impacts:

- Tier 1: Assume total conversion of NO to NO_2.
- Tier 2: Assume representative equilibrium NO_2/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, will be used to estimate the NO_2 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 NO_2 formation by comparing the estimated maximum NO_X concentration and the ambient O_3 concentration. The model assumes a total NO-to-NO_2 conversion when the ambient O_3 concentration is greater than the estimated maximum NO_X concentration; otherwise, it is limited by the ambient O_3 concentration (Cole and Summerhays 1979).

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

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

- Background O_3 Concentrations – The use of the OLM option in AERMOD requires the input of O_3 concentrations. The O_3 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 will use the onsite (EPS) monitored hourly O_3 data.
- Ambient Equilibrium NO_2/NO_X Ratio – The AERMOD default NO_2/NO_X ambient equilibrium ratio of 0.9 will be 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.[14]

- In-Stack NO_2/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 NO_2/NO_X ratios for different combustion source categories. Based on this research, 0.11 is an appropriate NO_2/NO_X ratio for diesel combustion engines and is therefore proposed for 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 is proposing to use 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 proposes to use the preliminary 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, the 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 NO_2 background concentration profile will be integrated into AERMOD using the BACKGRND keyword. For this purpose, a monthly hour-of-day NO_2 concentration profile developed from the onsite (EPS) monitored hourly NO_2 data will be used and is provided in Table 3-12 in ppb. This profile consists of the highest value for each monthly hour-of-day per ADEQ 2015a.

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[14] 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 3-12. Monthly Hour-of-Day NO_2 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

3.1.13 Treatment of Intermittent Sources for NO_2 and SO_2 1-Hour Analyses

In its most recent guidance on NO_2 and SO_2 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 NO_2 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 will be 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 NO_2 and SO_2 1-hour analyses.

3.1.14 Particulate Modeling

Default particulate modeling methods, including deposition (AERMOD Method 1, to account for depletion due to particulate settling), will be used for estimating PM_{10} 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 3-13. This table also provides the particle densities in grams per cubic centimeter (g/cm^3) for each broad source category and associated reference.

Table 3-13. 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 3-14. 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 3-14. Proposed Deposition Parameters for Ore Handling Emissions

Step	Parameter	PM_{10} Bin 0 (1)	PM_{10} Bin 1	PM_{10} Bin 2	PM_{10} Bin 3	$PM_{2.5}$ Bin 0 (1)	$PM_{2.5}$ 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 (µm³)	2.14	8.18	65.45	523.60	2.14	8.18
4	Mean Spherical Volume (µm³)	--	5.16	36.82	294.52	--	5.16
5	Mass Mean Diameter (µm)	--	2.14	4.13	8.25	--	2.14
	Particle Density (g/cm³)	--	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 3-14 are described below. All example calculations provided in these steps are for PM_{10} 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: $4/3 \times \pi \times (\text{Bin Upper Diameter} \div 2)^3$.

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 3-15.

Table 3-15. Proposed Deposition Parameters by Source Category

Source Category	Parameter	PM10					PM2.5		
		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/cm³)	--	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/cm³)	--	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/cm³)	--	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/cm³)	--	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/cm³)	--	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/cm³)	--	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/cm³)	--	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/cm³)	--	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/cm³)	--	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/cm³)	--	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.

3.1.15 Secondary $PM_{2.5}$ and O_3 Formation

3.1.15.1 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 SO_2 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/m^3, $PM_{2.5}$ annual = 0.2 g/μm^3; 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:

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

3.1.15.2 $PM_{2.5}$ Analysis

The estimated annual NO_X and SO_2 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 $\mu g/m^3$) and the daily $PM_{2.5}$ critical air quality threshold (1.2 $\mu g/m^3$).

The NO_2 and SO_2 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 SO_2 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:

Daily $PM_{2.5}$ = 84 tpy NOx_{source}/1,115 tpy NOx_{MERP} +

17.2 tpy $SO2_{source}$/225 tpy $SO2_{MERP}$ = 16%

Annual $PM_{2.5}$ = 84 tpy NOx_{source}/3,184 tpy NOx_{MERP} +

17.2 tpy $SO2_{source}$/2,289 tpy $SO2_{MERP}$ = 4%

The Tier-1, summed precursor method indicates that the Project's emissions will not cause increases to secondary PM2.5 concentrations in the project area that exceed the critical air quality thresholds.

3.1.15.3 Ozone Analysis

The estimated annual NO_X and VOC emissions from the Project are well below the lowest (most conservative) illustrative O_3 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 O_3 from the Project would be expected to be below the critical air quality threshold (1 ppb).

The NOx and VOC precursor contributions to to 8-hour daily O_3 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 NOx and VOC precursors on 8-hour daily O_3.

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

$$\text{8-hour } O3 = 84 \text{ tpy } NOx_{source}/184 \text{ tpy } NOx_{MERP} + 86.6 \text{ tpy } VOC_{source}/1{,}049 \text{ tpy } VOC_{MERP} = 54\%$$

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.

3.1.16 Modeling Technique

Each site will be modeled with appropriate meteorological data. The model output files from the two separate model runs will be 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 PM_{10} 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 has 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) will be 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 will produce impacts at each receptor in the entire receptor grid described in Section 3.1.5 of the Modeling Plan.

3. The model run for each facility will produce two (2) 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 NO_2, 24-hour and annual $PM_{2.5}$, and 24-hour and annual PM_{10}, 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) will be 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 PM_{10} 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 will be applied similarly to assess the impacts to ambient air quality associated with the evaluated TSF alternatives.

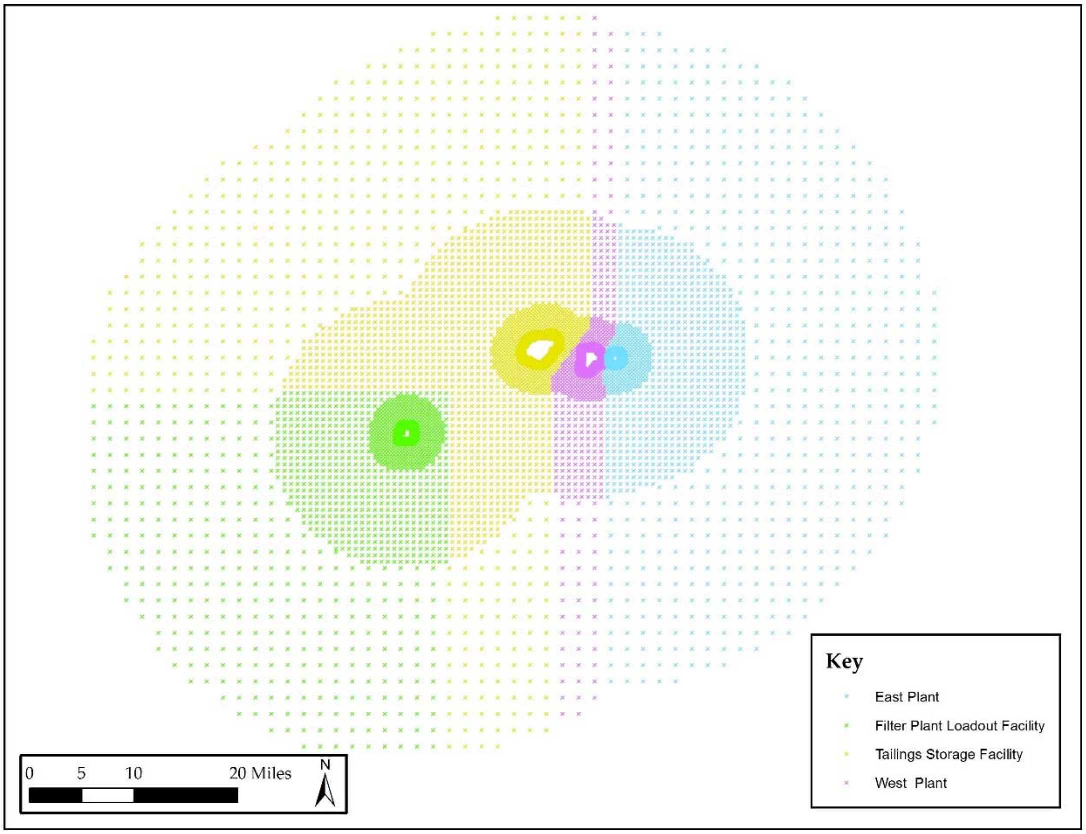
Figure 3-6. Modeling and Post-Processing Schematic

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	+ Filter Plant
Magenta	West Plant	+ East Plant	West Plant + Background	+ TSF	+ Filter Plant
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	+ Filter Plant
Green	Filter Plant	+ East Plant	+ West Plant	+ TSF	Filter Plant + Background

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



3.1.17 Analysis Report

The proposed air quality analysis including results will be packaged in a report format. An electronic copy of the report and digital modeling files (model input, output, preprocessor files, terrain data, etc.) associated with the analysis will be provided on digital media.

3.2 Class I Areas and ACEC Analysis

3.2.1 Class I Areas

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 50 km of the Project. The Superstition Wilderness Area (SWA) is located to the north of the Project, and an assessment of potential air quality impacts to the SWA will be performed. An assessment of the potential air quality impacts due to emissions from the TSF alternatives and alternative location for the FP& LF will also be performed.

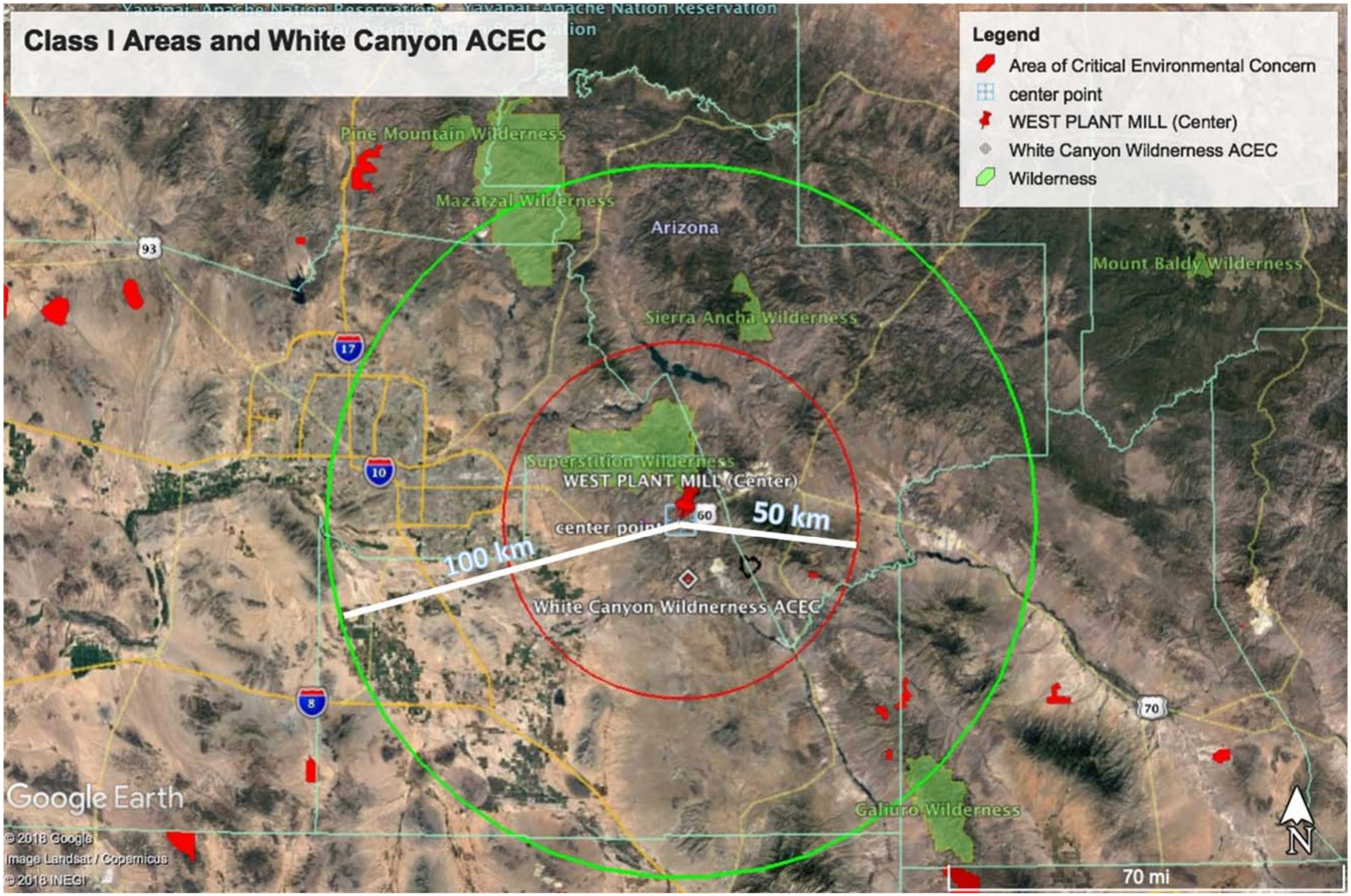
Additionally, the USDA – FS, TNF is requiring that potential impacts to AQRVs be assessed for Class I areas that are within 100 km of the Project. The three far-field Class I areas to be evaluated in the EIS are: Sierra Ancha Wilderness Area, Mazatzal Wilderness Area, and the Galiuro Wilderness Area.

The Resolution Copper Project location and the Class I areas for which air quality analyses are being required are shown on Figure 3-8.

3.2.2 Areas of Critical Environmental Concern

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 White Canyon ACEC is a 5,790-acre property 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, and the air quality analyses being prepared for the EIS will include an assessment of air quality impacts to the White Canyon ACEC. The White Canyon ACEC is also shown on Figure 3-8.

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



3.2.3 Near-Field (Within 50 Kilometers of Project) Analyses

Near-field (within 50 km of the Project) analyses of potential impacts to the Superstition Wilderness Area and the White Canyon Area of Considerable Environmental Concern will be performed and documented in the EIS.

3.2.3.1 Ambient Air Quality Impacts and Impacts to AQRVs

The most recent version of the AERMOD modeling system will be used for the near-field air quality analysis to estimate the potential impacts to AAQS and increment standards due to the Project's emissions. Near-field potential impacts to AAQS and increment standards due to emissions from the alternative TSFs and FP&LF will also be evaluated with AERMOD. The methodology for executing AERMOD is described in detail in the above sections of this Modeling Plan. The AERMOD modeling system is listed as the recommended model for short-range analysis (up to 50 km) in 40 CFR 51, Appendix W.

Estimated air quality concentrations modeled for the SWA and WC ACEC will be used to estimate deposition and to assess the potential impacts to AQRVs in these areas. Total annual sulfur (S) and nitrogen (N) deposition from the Project will be modeled. Total S and N deposition will be based on the S or N component of the compound. Both dry and wet deposition will be considered. Deposition impacts will be compared to the Deposition Analysis Thresholds (DATs) as outlined in the Federal Land Managers' Interagency Guidance for Nitrogen and Sulfur Deposition Analyses (U.S. Forest Service 2011). A DAT is defined as the additional amount of N or S deposition within a Federal Land Manager (FLM) area, below which estimated impacts from a proposed new or modified source are considered negligible. In cases where a source's impact equals or exceeds the DAT, the TNF will make a project specific assessment of whether the projected increase in deposition would likely result in an "adverse impact" on resources considering existing AQRV conditions, the magnitude of the expected increase, and other factors. The DATs to be used for S (0.005 kilograms/hectare/year) and N (0.010 kg/ha/yr) in the SWA and WC ACEC are the values provided in the Federal Land Managers' Interagency Guidance for Nitrogen and Sulfur Deposition Analyses for western FLM areas.

3.2.3.2 Visibility Impacts at SWA and WC ACEC

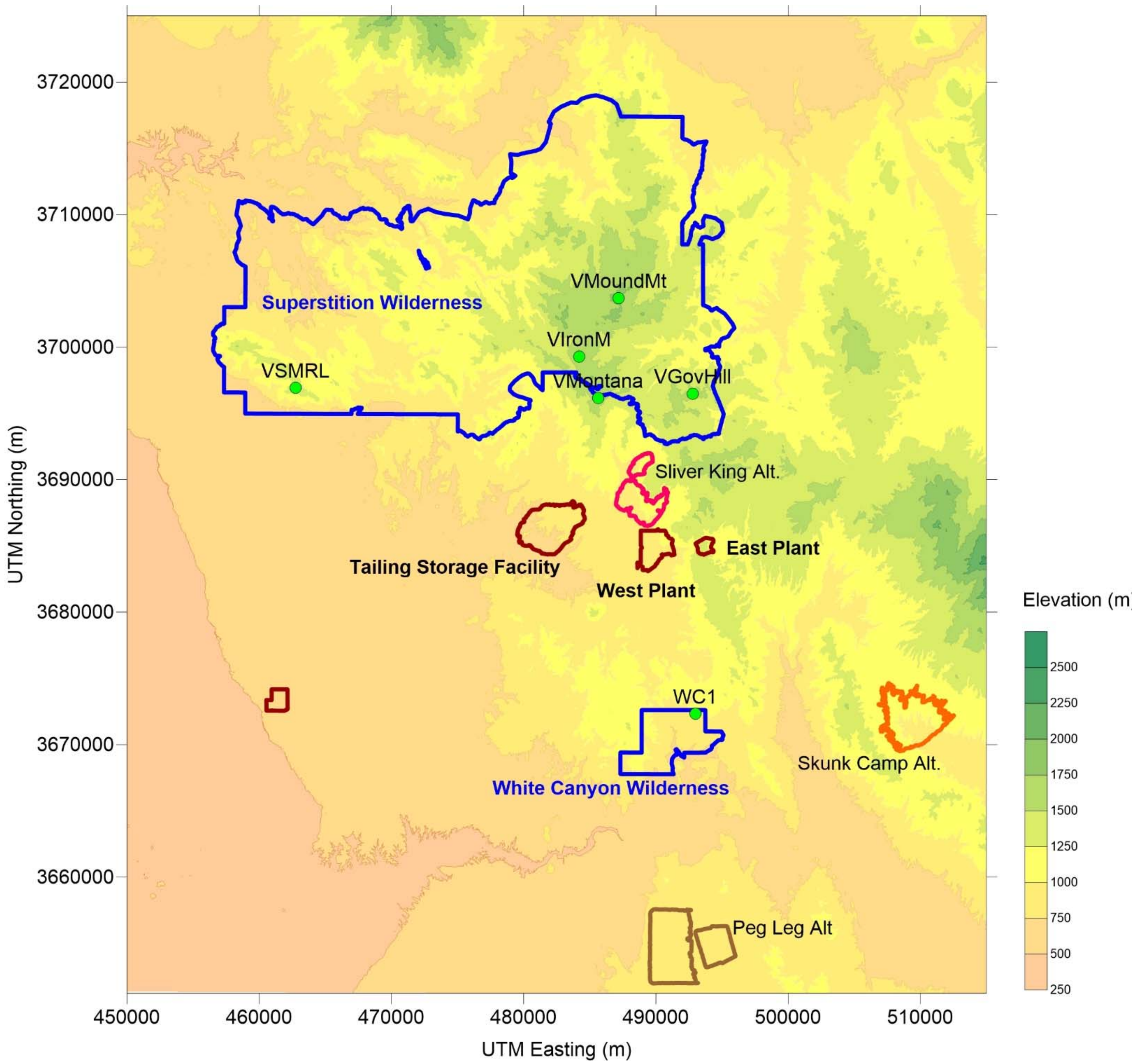
Plume blight is a distinct band or coherent layer of visible air pollution, often from a single pollution source. Particulate matter and nitrogen oxides in the plume scatter and absorb light so that the plume can appear brighter or darker than its viewing background (e.g., the sky or a terrain feature 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 Plan, it is assumed that a Level 3 Near Field Refined Analysis using PLUVUE II will be needed 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.

PLUVUE II will be run in observer-mode to evaluate the view for five vistas within the Superstition Class I area and in the White Canyon Wilderness area. The locations of these vistas, along with the project, are shown in Table 3-16 and in Figure 3-9. The observer locations were chosen at high points to provide the best vantage point for looking out over the terrain. Note that all these Superstition vistas are more than 500 meters above the project site.

Table 3-16. Project and Vista Locations

Facility	ID	UTM-X (m)	UTM-Y (m)	Elevation (ft)	
East Plant	EP	493,640	3,685,170	4,200	
West Plant	WP	490,700	3,684,770	3,400	
Tailings Storage	TSF	487,200	3,702,700	2,600	
Superstition Observer Locations		UTM-X (m)	UTM-Y (m)	Elevation (ft)	Closest distance to Project (km)
Montana Mt.	VMontana	485,630	3,696,165	5,557	8.6
Government Hill	VGovHill	492,795	3,696,480	5,445	10.8
Iron Mountain	VIronM	484,180	3,699,270	6,056	11.3
Mound Mountain	VMoundMt	487,190	3,703,690	6,268	16.4
Superstition Mountain Ridge Line	VSMRL	462,750	3,696,925	5,057	20.3
White Canyon Observer Locations		UTM-X (m)	UTM-Y (m)	Elevation (ft)	Closest distance to Project (km)
White Canyon	VWC1	492,985	3,672,320	3,996	14.0

Figure 3-9. Map of Vista Locations in Relation to Project



Short-term (24-hour) maximum allowable emissions from the various project sites are shown in Table 3-17 for the PLUVUE II modeling scenarios that will be run. Since West Plant (WP) emissions are much lower than East Plant (EP), the WP emissions will be combined with the EP source, and the two facilities will be modeled as one. Because there is no recommended procedure for conducting analyses of multiple sources with PLUVUE II, multiple coherent plumes should be treated individually or combined into a representative single source (FLAG Section 3.3.3). Because of the distance between WP and TSF and elevation differences, the tailing storage facility (TSF) and EP sources will be modeled separately. Based on Figure 3-9, only a narrow range of directions (e.g., winds blowing to the WNW) could result in plumes from TSF and EP to potentially merge. Under these directions, emissions from EP will be merged with the TSF emissions. Similar logic for merging emissions will be employed for PLUVUE II modeling runs for the TSF alternatives. For the analysis, maximum 24-hour operation emissions of NO_X, SO_2, and PM_{10} will be used. For the TSF windblown emissions, the emission rate will be determined by the wind speed.

Table 3-17. PLUVUE Short-term (24-hour) Maximum Allowable Emissions (tons/day)

Source	NO_X	SO_2	PM_{10}
Proposed Action			
East Plant + West Plant	0.54	0.15	0.99
TSF Alt 2	0.22	0.006	1.23
Total	0.76	0.15	2.21
Alternative 3			
East Plant + West Plant	0.54	0.15	0.99
TSF Alt 3	0.22	0.01	1.20
Total	0.76	0.15	2.19
Alternative 4			
East Plant + West Plant + TSF Alt 4	0.73	0.15	1.87
Alternative 5			
East Plant + West Plant	0.54	0.15	0.99
TSF Alt 5	0.26	0.004	1.68
Total	0.80	0.15	2.66
Alternative 6			
East Plant + West Plant	0.54	0.15	0.99
TSF Alt 6	0.22	0.01	1.22
Total	0.76	0.16	2.21

*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.
^PM_{10} Emissions due to wind erosion have been removed from maximum 24-hour emissions; PLUVUE II emissions input will be 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

Only daylight hours in which the wind blows towards the Class I area will be evaluated. Each applicable hour will be evaluated individually, with the wind speed, direction, relative humidity and temperature used based on two years of on-site meteorological. From this, the statistics on the frequency and magnitude of the impairment will be quantified for the two-year period.

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 is lowered by one step (e.g., from F to E) if the elevation between the observer and the source increases by 500 meters or more. 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 will be accounted for in the modeling. Also, all views with a plume offset angle of less than 11.25 degrees will be eliminated.

The PLUVUE II model requires background pollutant levels for NO_X, NO_2, SO_2, PM_{10}, and ozone (O_3). For these pollutants, average monthly values will be calculated from the three years (Quarter 2, 2012 through Quarter 1, 2015) of the EPS on-site monitoring data (shown in Table 3-18). The model also requires the background visual range. Monthly average visual range data will be obtained from the Queen Valley (QUVA1) IMPROVE nephelometer site and will be calculated using three years of data (May 11, 2007 to May 10, 2010) and from visual range data collected at the Superstition Wilderness Area (data from 2000–2004 are shown in Table 3-19).

Table 3-18. Background Pollutant Concentrations for Visibility Modeling

Pollutant	Averaging Period	Background Concentration ppb	Background Concentration (μg/m³)
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 3-19. Average Visual Range Conditions for SWA (km)

Superstition Wilderness	
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

FLAG, Table 10

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. ΔE is a color contrast parameter that provides a single measure of the difference between two arbitrary colors as perceived by humans. For this analysis, the thresholds of |C|=0.02 and ΔE=1 will be used (FLAG, 2010).

Per FLAG guidance, reporting of visibility modeling results will take into account: geographic extent, intensity, duration, frequency, and time of visibility impairment, and how these factors correlate with: (1) times of visitor use of the SWA and (2) the frequency and timing of natural conditions that reduce visibility.

3.2.4 Far-Field (beyond 50 km out to 100 km from Project) Analyses

Resolution will conduct three levels of analyses for the Class I areas that are farther than 50 km and less than 100 km from the project area:

1. Q/D Screening Analysis
2. Using AERMOD modeled impacts at receptors at the extent of the modeling domain in the direction of the Class I areas
3. Using CALPUFF modeled impacts at receptors located on the boundary of the Class I areas

3.2.4.1 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 SO_2, NO_x, PM_{10}, and H_2SO_4 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 annual emissions of SO_2, NO_x, PM_{10}, and H_2SO_4 are shown in Table 3-20.[15] 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 annual 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 3-21 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 AQRVs (including visibility) are required for all three Class I Wilderness Areas.

Table 3-20. Resolution Copper Estimated Annual Emissions

Pollutant	Max. Emissions (tons / year)[16]
PM_{10}	693.2
NO_X	279.3
SO_2	54.1
H_2SO_4	0.026
Total (Q)	**1026.6**

Table 3-21. Q/D Analysis

Class I Area	Distance (D) (km)	Q / D (tpy / km)	More than 10?
Sierra Ancha Wilderness	52.9	19.4	Yes
Mazatzal Wilderness	75.3	13.6	Yes
Galiuro Wilderness	92.6	11.1	Yes

3.2.4.2 AERMOD Impacts at the Extent of the Modeling 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 the Class I areas will be compared to PSD increments and Air Quality Related Values.

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[15] Consistent with guidance, emission totals have been adjusted by removing emissions from intermittent sources (i.e., emergency generators (maximum, non-emergency operating scenario is used for Q/D analysis)) and by removing a portion of the TSF wind erosion emissions.

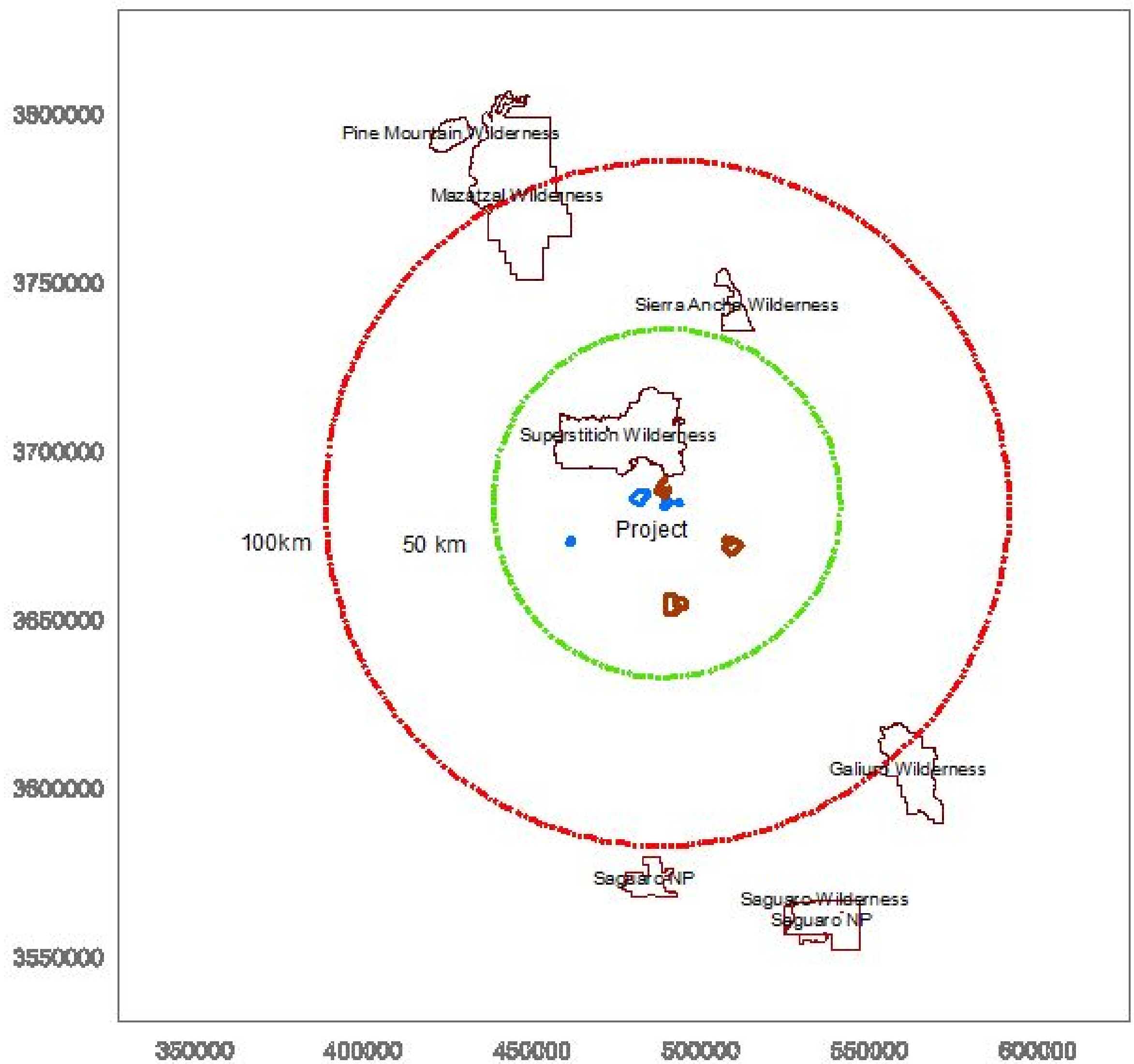
[16] The emissions are taken from the January 12, 2018, draft emission inventories prepared by Air Sciences Inc.

3.2.4.3 CALPUFF Modeling

For the far-field analysis, Class I areas within 100 km of the project will be evaluated for PSD increments and visibility impacts. This will include the following Class I areas: Galiuro Wilderness Area, Mazatzal Wilderness Area, Saguaro National Park, and the Sierra Ancha Wilderness Area.

Figure 3-10 shows the proposed modeling domain. The 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.

Figure 3-10. Far-Field Modeling Domain



For the Class I far-field analyses, the CALPUFF dispersion model will be used. 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.

The appropriate modeling platform for the far-field AQRV analysis is CALPUFF (FLAG, 2010). The modeling system consists of three main components: CALMET (a diagnostic three-dimensional meteorological model), CALPUFF (an air quality dispersion model), and CALPOST (a postprocessing package). In addition, there are numerous other processors that are used to prepare geophysical (land use and terrain) data and meteorological data (surface, upper air, and precipitation data). 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 data set. Specifications of the data set 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 will be evaluated against DS472.0 stations' observational data using the MMIFstat Program. For this evaluation, observational sites that are in the proximity of the project and the Class I areas will be used.

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

CALPUFF will be run assuming wet and dry deposition and gravitational settling. Setting will be set to conform to the EPA long-range transport guidance (MREG = 1). CALPUFF - Version 5.8.5 - Level 151214 and CALPOST - Version 6.221 - Level 080724) will be used. The model will be run using the facility-controlled emissions for both the 24-hour maximum and annual emissions. The alternative TSFs and FP&LF alternative location will also be modeled.

3.2.4.3.1 Ambient Air Quality Impacts and Impacts to AQRVs

The most recent version of the CALPUFF modeling system (as described above) will be used for the far-field air quality analysis to estimate the potential impacts to AAQS and increment standards at the SAWA, MWA, and GWA due to the Project's emissions. CALSUM will be used to quantify modeled impacts due the Proposed Action and to evaluate impacts associated with alternative TSF sites. The model setup and inputs required for executing CALPUFF is described in section 3.2.4.3, above.

Estimated air quality concentrations modeled for the SAWA, MWA, and GWA will be used to estimate deposition and to assess the potential impacts to AQRVs in these Class I areas. Total annual sulfur (S) and nitrogen (N) deposition from the Project will be modeled. Total S and N will be based on the sulfur or nitrogen component of the compound. Both dry and wet deposition will be considered. Deposition impacts will be compared to the Deposition Analysis Thresholds (DATs) as outlined in the "Federal Land Managers' Interagency Guidance for Nitrogen and Sulfur Deposition Analyses" (U.S. Forest Service 2011). A DAT is defined as the additional amount of N or S deposition within a Federal Land Manager (FLM) area, below which estimated impacts from a proposed new or modified source are considered negligible. In cases where a source's impact equals or exceeds the DAT, the TNF will make a project specific assessment of whether the projected increase in deposition would likely result in an "adverse impact" on resources considering existing AQRV conditions, the magnitude of the expected increase, and other factors. The DATs to be used for S (0.005 kilograms/hectare/year) and N (0.010 kg/ha/yr) in the SAWA, MWA, and GWA are the values provided in the Federal Land Managers' Interagency Guidance for Nitrogen and Sulfur Deposition Analyses for western FLM areas.

3.2.4.3.2 Visibility Impacts at SAWA, MWA, and GWA

For visibility, maximum 24-hr emissions of SO_2, NO_X, H_2SO_4, fine PM, and coarse PM will be modeled using CALPUFF. For the chemistry, the MESOPUFF II five pollutant (SO_2, SO_4, NO_x, HNO_3, NO_3) conversion scheme will be used. Monthly average ozone from a nearby regional monitor will be used. The background ammonia will be taken from IWAQM guidance, which for arid lands is 1 ppb.

CALPOST will be set to conform to the FLAG configuration (MVSICHECK = 1), which uses Method 8 with sub mode 5 to calculate the background light extinction (MVISBK =8, M8_MODE = 5).

The background hygroscopic and non-hygroscopic aerosol levels from Table 6 from FLAG 2010 (
Table 3-22) and the relative humidity adjustment factors from Tables 7-9 of FLAG 2010 will be used based on annual average natural conditions. If the 98th percentile change in extinction is less than 5 percent, then the TNF will conclude that the source is not expected to contribute to regional haze. If this level is exceeded, then an additional impacts analysis will be conducted.

Table 3-22. Annual Average Natural Conditions

Class I Area	$(NH_4)_2SO_4$ µg/m³	NH_4NO_3 µg/m³	OM µg/m³	EC µg/m³	Soil µg/m³	CM µg/m³	Sea Salt µg/m³	Rayleigh Mm^{-1}
Sierra Ancha Wilderness	0.12	0.1	0.6	0.02	0.5	3	0.02	10
Mazatzal Wilderness	0.12	0.1	0.6	0.02	0.5	3	0.02	10
Galiuro Wilderness	0.12	0.1	0.6	0.02	0.5	3	0.03	10

FLAG, Table 6

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Appendix A – Detailed Emission Calculations

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI			BY: N. Tipple
	PROJECT NO: 262	PAGE: 1	OF: 2	SHEET: Gen Info
AIR EMISSION CALCULATIONS	SUBJECT: General Mining and Milling Information			DATE: June 28, 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

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: N. Tipple		
	PROJECT NO: 262	PAGE: 2	OF: 2	SHEET: Gen Info
AIR EMISSION CALCULATIONS	SUBJECT: General Mining and Milling Information	DATE: June 28, 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.	PROJECT TITLE: Resolution Copper EI	BY: N. Tipple		
AIR EMISSION CALCULATIONS	PROJECT NO: 262	PAGE: 1	OF: 2	SHEET: Summary_DISP
	SUBJECT: Facility-Wide Emissions	DATE: June 28, 2018		

FACILITY - CONTROLLED - EMISSIONS SUMMARY (INCLUDING 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	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	36.5	4.9	11.0	23.3	68.9
Loadout Subtotal	12.2	21.5	1.3	2.4	2.8E-2	4.7E-2	0.64	2.5	0.14	0.45	0.46	1.1
Tailings Subtotal	124	354	18.4	48.6	0.26	0.75	81.0	201	11.0	27.7	8.0	21.2
FACILITY TOTAL	**478**	**623**	**199**	**123**	**13.2**	**17.8**	**228**	**403**	**36.6**	**73.2**	**52.1**	**103**

FACILITY - UNCONTROLLED - EMISSIONS SUMMARY (INCLUDING 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	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	12.2	21.5	1.3	2.4	2.8E-2	4.7E-2	2.8	11.2	0.40	1.5	0.46	1.1
Tailings Subtotal	124	354	18.4	48.6	0.26	0.75	768	1,898	79.8	198	8.0	21.2
FACILITY TOTAL	**478**	**623**	**199**	**123**	**92.9**	**275**	**3,083**	**4,854**	**512**	**1,051**	**204**	**592**

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI			BY: N. Tipple
	PROJECT NO: 262	PAGE: 2	OF: 2	SHEET: Summary_DISP
AIR EMISSION CALCULATIONS	SUBJECT: Facility-Wide Emissions	DATE: June 28, 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	7.7	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**	**13.0**	**30.8**	**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.	PROJECT TITLE: Resolution Copper EI		BY: N. Tipple
	PROJECT NO: 262	PAGE: 1 OF: 3	SHEET: Atty_DISP
AIR EMISSION CALCULATIONS	SUBJECT: Emission by Class		DATE: June 28, 2018

F A C I L I T Y - C O N T R O L L E D - E M I S S I O N S S U M M A R Y (I N C L U D I N G F U G I T I V E S)

	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*
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	6.6	1.7	6.1	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	36.5	4.9	11.0	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	8.4	20.6	0.94	2.3	1.9E-2	4.5E-2	4.8E-2	0.12	4.7E-2	0.12	0.44	1.1
Subtotal	12.2	21.5	1.3	2.4	2.8E-2	4.7E-2	0.64	2.5	0.14	0.45	0.46	1.1
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							80.3	199	10.2	25.6	3.1E-2	0.13
Mobile	120	353	18.0	48.5	0.25	0.75	0.76	2.1	0.76	2.1	8.0	21.1
Subtotal	124	354	18.4	48.6	0.26	0.75	81.0	201	11.0	27.7	8.0	21.2
FACILITY TOTAL	***478***	***623***	***199***	***123***	***13.2***	***17.8***	***228***	***403***	***36.6***	***73.2***	***52.1***	***103***

**Stack and process fugitive sources considered "process" sources*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI			BY: N. Tipple
	PROJECT NO: 262	PAGE: 2	OF: 3	SHEET: Atty_DISP
AIR EMISSION CALCULATIONS	SUBJECT: Emission by Class	DATE: June 28, 2018		

FACILITY - UNCONTROLLED - EMISSIONS SUMMARY (INCLUDING 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*
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**							*81.6*	*34.3*	*12.4*	*5.2*		
Fugitive							*13.5*	*13.4*	*1.5*	*1.6*	*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*	*100*	*51.7*	*18.5*	*8.4*	*13.4*	*3.4*
East Plant Underground												
*Stack**							*42.9*	*110*	*26.6*	*67.9*		
*Process Fugitive**							*94.1*	*240*	*87.1*	*222*		
Fugitive	*109*	*26.7*	*20.9*	*5.1*	*6.7*	*1.6*	*1,729*	*1,920*	*173*	*192*	*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*	*1,866*	*2,271*	*288*	*483*	*6.9*	*8.3*
Mill												
*Stack**	*16.1*	*10.6*	*3.8*	*10.8*	*84.2*	*272*	*111*	*359*	*94.3*	*305*	*172*	*555*
*Process Fugitive**							*32.8*	*94.2*	*10.7*	*36.9*	*1.7E-2*	*7.2E-2*
Fugitive	*0.67*	*2.1*	*2.1*	*0.40*	*0.67*	*0.13*	*201*	*169*	*20.7*	*18.0*	*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*	*84.9*	*272*	*345*	*622*	*126*	*360*	*175*	*558*
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							*2.4*	*9.7*	*0.30*	*1.2*	*3.1E-3*	*1.3E-2*
Mobile	*8.4*	*20.6*	*0.94*	*2.3*	*1.9E-2*	*4.5E-2*	*4.8E-2*	*0.12*	*4.7E-2*	*0.12*	*0.44*	*1.1*
Subtotal	*12.2*	*21.5*	*1.3*	*2.4*	*2.8E-2*	*4.7E-2*	*2.8*	*11.2*	*0.40*	*1.5*	*0.46*	*1.1*
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							*767*	*1,895*	*79.0*	*196*	*3.1E-2*	*0.13*
Mobile	*120*	*353*	*18.0*	*48.5*	*0.25*	*0.75*	*0.76*	*2.1*	*0.76*	*2.1*	*8.0*	*21.1*
Subtotal	*124*	*354*	*18.4*	*48.6*	*0.26*	*0.75*	*768*	*1,898*	*79.8*	*198*	*8.0*	*21.2*
FACILITY TOTAL	***478***	***623***	***199***	***123***	***92.9***	***275***	***3,083***	***4,854***	***512***	***1,051***	***204***	***592***

**Stack and process fugitive sources considered "process" sources*

Resolution Copper Project
Annual Emissions Inventory - Summary Table
Revision - June 28, 2018

	CO	**NO_X**	**SO_2**	**PM_{10}**	**$PM_{2.5}$**	**VOC**
	ton/yr	*ton/yr*	*ton/yr*	*ton/yr*	*ton/yr*	*ton/yr*
Total - Facility-Wide	*623*	*123*	*17.8*	*403*	*73.2*	*103*
All Facilities - Process	*20.6*	*44.4*	*15.0*	*80.8*	*30.8*	*69.3*
Major Source Threshold	**100**	**100**	**100**	**100**	**100**	**100**
All Facilities - Fugitive	*28.8*	*5.5*	*1.8*	*319*	*39.1*	*0.19*
All Facilities - Mobile	*574*	*73.2*	*1.0*	*3.4*	*3.3*	*33.4*
East Plant						
Process	*8.1*	*33.5*	*0.20*	*62.3*	*22.9*	*3.3*
Fugitive	*26.7*	*5.1*	*1.6*	*100*	*10.3*	*2.3E-2*
Mobile	*170*	*17.7*	*0.15*	*0.95*	*0.89*	*8.3*
Mill						
Process	*10.6*	*10.8*	*14.8*	*17.1*	*7.7*	*66.0*
Fugitive	*2.1*	*0.40*	*0.13*	*19.2*	*3.1*	*1.7E-2*
Mobile	*30.6*	*4.6*	*5.6E-2*	*0.22*	*0.20*	*2.9*
Loadout						
Process	*0.96*	*8.7E-2*	*2.2E-3*	*1.4*	*0.21*	*4.3E-3*
Fugitive				*0.97*	*0.12*	*1.3E-2*
Mobile	*20.6*	*2.3*	*4.5E-2*	*0.12*	*0.12*	*1.1*
Tailings						
Process	*0.96*	*8.7E-2*	*2.2E-3*	*1.9E-3*	*1.9E-3*	*4.3E-3*
Fugitive				*199*	*25.6*	*0.13*
Mobile	*353*	*48.5*	*0.75*	*2.1*	*2.1*	*21.1*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: N. Tipple		
	PROJECT NO: 262	PAGE: 1	OF: 18	SHEET: EPS_DISP
AIR EMISSION CALCULATIONS	SUBJECT: East Plant	DATE: June 28, 2018		

E A S T   P L A N T - C O N T R O L L E D   U N D E R G R O U N D - E M I S S I O N S   S U M M A R Y

	Potential Emissions											
	CO		**NO_X**		**SO_2**		**PM_{10}**		**$PM_{2.5}$**		**VOC**	
Source ID	*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							*7.3*	*18.6*	*0.49*	*1.3*		
2_EP_UG_RAIL	*Haulage Ore Flow*											
EP_UG_TRAIN							*1.5*	*3.8*	*0.22*	*0.57*		
EP_UG_COARSE							*0.78*	*3.4*	*0.78*	*3.4*		
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							*0.18*	*0.78*	*0.18*	*0.78*		
EP_UG_CV105							*1.6*	*4.1*	*0.24*	*0.62*		
EP_UG_SILO							*0.78*	*3.4*	*0.78*	*3.4*		
EP_UG_FEED												
EP_UG_CV106_111												
EP_UG_Chute							*1.6*	*4.1*	*0.24*	*0.62*		
EP_UG_FLASK							*1.2*	*5.2*	*1.2*	*5.2*		
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							*0.79*	*3.5*	*0.79*	*3.5*		
EP_UG_CV102_105												
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							*5.6E-2*	*2.4E-2*	*3.7E-2*	*1.6E-2*		
EP_UG_D_FUG							*86.2*	*95.9*	*8.6*	*9.6*		
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***	***110***	***155***	***15.3***	***31.7***	***6.9***	***8.3***

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI			BY: N. Tipple		
AIR EMISSION CALCULATIONS	PROJECT NO: 262			PAGE: 2	OF: 18	SHEET: EPS_DISP
	SUBJECT: East Plant			DATE: June 28, 2018		

E A S T   P L A N T - C O N T R O L L E D   S U R F A C E - E M I S S I O N S   S U M M A R Y

	Potential Emissions											
	CO		NO_X		SO_2		PM_{10}		$PM_{2.5}$		VOC	
Source ID	*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*											
W_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.	PROJECT TITLE: Resolution Copper EI	BY: N. Tipple		
AIR EMISSION CALCULATIONS	PROJECT NO: 262	PAGE: 3	OF: 18	SHEET: EPS_DISP
	SUBJECT: East Plant	DATE: June 28, 2018		

EAST PLANT - UNCONTROLLED UNDERGROUND - EMISSIONS SUMMARY

	Potential Emissions											
	CO		NO_X		SO_2		PM_{10}		$PM_{2.5}$		VOC	
Source ID	*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.	PROJECT TITLE: Resolution Copper EI			BY: N. Tipple
	PROJECT NO: 262	PAGE: 4	OF: 18	SHEET: EPS_DISP
AIR EMISSION CALCULATIONS	SUBJECT: East Plant	DATE: June 28, 2018		

EAST PLANT - UNCONTROLLED SURFACE - EMISSIONS SUMMARY

	Potential Emissions											
	CO		NO_X		SO_2		PM_{10}		$PM_{2.5}$		VOC	
Source ID	*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*											
W_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**

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AIR EMISSION CALCULATIONS	SUBJECT: East Plant	DATE: June 28, 2018		

E A S T   P L A N T - C O N T R O L L E D   U N D E R G R O U N D - E M I S S I O N   F A C T O R S

	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_1CRUSH	*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*

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AIR EMISSION CALCULATIONS	SUBJECT: East Plant	DATE: June 28, 2018		

EAST PLANT - CONTROLLED SURFACE - EMISSION FACTORS

	Emission Factors						
Source ID	**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*						
W_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*

EAST PLANT - UNCONTROLLED UNDERGROUND - EMISSION FACTORS

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_1CRUSH	*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							
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*

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EAST PLANT - UNCONTROLLED SURFACE - EMISSION FACTORS

	Emission Factors						
Source ID	**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*						
W_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*

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EAST PLANT - UNDERGROUND - PROCESS RATES

	Process Rates		
Source ID	**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_1CRUS *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_OI *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*

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EAST PLANT - SURFACE - PROCESS RATES

	Process Rates		
Source ID	**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*			
W_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*

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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_EXTR/			
EP_UG_OVER		*0%*	
2_EP_UG_OREP/			
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_1CRUS			
EP_UG_FINE			*Emissions accounted for in EP_UG_COARSE*
2_EP_UG_LOW_			
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_OI			
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%*	

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E A S T P L A N T - S U R F A C E - C O N T R O L S

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			
W_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*

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	PROJECT NO: 262	PAGE: 13	OF: 18	SHEET: EPS_DISP
AIR EMISSION CALCULATIONS	SUBJECT: East Plant	DATE: June 28, 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***

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AIR EMISSION CALCULATIONS	SUBJECT: East Plant		DATE: June 28, 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***
W_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.	PROJECT TITLE: Resolution Copper EI		BY: N. Tipple	
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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_1CRUSH	
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*

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AIR EMISSION CALCULATIONS	SUBJECT: East Plant	DATE: June 28, 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	
W_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*

EAST PLANT - UNCONTROLLED 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, 11.19.2, Wet Drilling, Rev. 8/04*
2_EP_UG_OREPASS	
EP_UG_GRIZ	*AP-42, Table 11.19.2-2, Screening (uncontrolled), 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	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 2.2 mph)*
2_EP_UG_1CRUSH	
EP_UG_FINE	*AP-42, Table 11.19.2-2, Tertiary Crushing (uncontrolled), Rev. 8/04*
2_EP_UG_LOW_ORE	
EP_UG_CV103	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 2.4 mph)*
EP_UG_CV104	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 2.4 mph)*
EP_UG_CV105	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 2.4 mph)*
EP_UG_SILO	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 2.4 mph)*
EP_UG_FEED	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 2.4 mph)*
EP_UG_CV106_111	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 2.4 mph)*
EP_UG_Chute	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 2.4 mph)*
EP_UG_FLASK	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 2.4 mph)*
2_EP_UG_HOIST	
EP_UG_SKIP	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 1.3 mph)*
EP_UG_BIN	
2_EP_UG_UP_ORE	
EP_UG_FEED112_115	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 4.5 mph)*
EP_UG_CV102_105	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 4.5 mph)*
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*

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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*

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AIR EMISSION CALCULATIONS	SUBJECT: Mill		DATE: June 28, 2018	

M I L L - C O N T R O L L E D - E M I S S I O N S S U M M A R Y

	Potential Emissions											
	CO		NO_X		SO_2		PM_{10}		$PM_{2.5}$		VOC	
Source ID	*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							*0.30*	*1.3*	*0.30*	*1.3*		
M2_FEED												
M2_XFER							*0.30*	*1.3*	*0.30*	*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: Resolution Copper EI	BY: N. Tipple		
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AIR EMISSION CALCULATIONS	SUBJECT: Mill	DATE: June 28, 2018		

MILL - CONTROLLED - EMISSIONS SUMMARY CONT.

	Potential Emissions											
	CO		NO_X		SO_2		PM_{10}		$PM_{2.5}$		VOC	
Source ID	*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***	***36.5***	***4.9***	***11.0***	***23.3***	***68.9***

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: N. Tipple		
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AIR EMISSION CALCULATIONS	SUBJECT: Mill	DATE: June 28, 2018		

M I L L - U N C O N T R O L L E D - E M I S S I O N S S U M M A R Y

	Potential Emissions											
	CO		NO_X		SO_2		PM_{10}		$PM_{2.5}$		VOC	
Source ID	*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							*5.4*	*13.9*	*0.11*	*0.28*		
W_CVYXF2							*5.4*	*13.9*	*0.11*	*0.28*		
M_TRIPPR							*5.4*	*13.9*	*0.11*	*0.28*		
M_STOCKP							*5.4*	*13.9*	*0.10*	*0.26*		
M1_FEED							*0.33*	*1.1*	*4.9E-2*	*0.17*		
M1_XFER							*0.33*	*1.1*	*4.9E-2*	*0.17*		
M2_FEED							*0.33*	*1.1*	*4.9E-2*	*0.17*		
M2_XFER							*0.33*	*1.1*	*4.9E-2*	*0.17*		
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							*10.0*	*35.0*	*10.0*	*35.0*		
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*		

MILL - UNCONTROLLED - EMISSIONS SUMMARY CONT.

	Potential Emissions											
	CO		NO_X		SO_2		PM_{10}		$PM_{2.5}$		VOC	
Source ID	*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.	PROJECT TITLE: Resolution Copper EI	BY: N. Tipple		
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AIR EMISSION CALCULATIONS	SUBJECT: Mill	DATE: June 28, 2018		

MILL - CONTROLLED - EMISSION FACTORS

		Emission Factors						
Source ID		**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					*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 (1045398 dscf/hr, 0.002 gr/dscf)*
M2_FEED								*Emissions accounted for in M2_XFER*
M2_XFER								*Dust Collector (1045398 dscf/hr, 0.002 gr/dscf)*
2_M_SAG1	*SAG Line 1*							
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	*SAG Line 2*							
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	*Pebble Recycle*							
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*

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AIR EMISSION CALCULATIONS	SUBJECT: Mill		DATE: June 28, 2018	

MILL - CONTROLLED - EMISSION FACTORS CONT.

	Emission Factors						
Source ID	**CO**	**NO_X**	**SO_2**	**PM_{10}**	**$PM_{2.5}$**	**VOC**	**Units & Notes**
2_M_MOLY_FL *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*

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	SUBJECT: Mill	DATE: June 28, 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.	PROJECT TITLE: Resolution Copper EI	BY: N. Tipple		
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AIR EMISSION CALCULATIONS	SUBJECT: Mill	DATE: June 28, 2018		

MILL - UNCONTROLLED - EMISSION FACTORS CONT.

	Emission Factors						
Source ID	**CO**	**NO_X**	**SO_2**	**PM_{10}**	**$PM_{2.5}$**	**VOC**	**Units & Notes**
2_M_MOLY_FL *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*

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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*

MILL - PROCESS RATES CONT.

Source ID	Process Rates Unit/Hr	Unit/Yr	Units & Notes
2_M_MOLY_FL *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*

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M I L L - C O N T R O L S

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*

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*

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M I L L - S O U R C E I D E N T I F I C A T I O N

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)*

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***

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M I L L - C O N T R O L L E D - E F R E F E R E N C E

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)*

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*

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M I L L - U N C O N T R O L L E D - E F R E F E R E N C E

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, 6.1 mph)*
W_CVYXF2	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 6.1 mph)*
M_TRIPPR	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 6.1 mph)*
M_STOCKP	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 6.1 mph)*
M1_FEED	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.2% moist, 1.3 mph)*
M1_XFER	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.2% moist, 1.3 mph)*
M2_FEED	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.2% moist, 1.3 mph)*
M2_XFER	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.2% moist, 1.3 mph)*
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 (uncontrolled), 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)*

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M I L L - U N C O N T R O L L E D - E F R E F E R E N C E C O N T .

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*

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T A I L I N G S - C O N T R O L L E D - E M I S S I O N S S U M M A R Y

	Potential Emissions											
	CO		NO_X		SO_2		PM_{10}		$PM_{2.5}$		VOC	
Source ID	*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	*120*	*352*	*18.0*	*48.5*	*0.25*	*0.75*	*0.76*	*2.1*	*0.76*	*2.1*	*8.0*	*21.1*
T_D_DOZ							*3.9*	*10.1*	*2.6*	*6.7*		
T_D_FUG							*75.2*	*184*	*7.5*	*18.4*		
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_BCH							*0.17*	*0.73*	*2.5E-2*	*0.11*		
T_WE_DAM							*7.1E-3*	*3.1E-2*	*1.1E-3*	*4.7E-3*		
T_S_EFD							*0.93*	*3.3*	*9.3E-2*	*0.33*		
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	***124***	***354***	***18.4***	***48.6***	***0.26***	***0.75***	***81.0***	***201***	***11.0***	***27.7***	***8.0***	***21.2***

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T A I L I N G S - U N C O N T R O L L E D - E M I S S I O N S S U M M A R Y

	Potential Emissions											
	CO		NO_X		SO_2		PM_{10}		$PM_{2.5}$		VOC	
Source ID	*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	*120*	*352*	*18.0*	*48.5*	*0.25*	*0.75*	*0.76*	*2.1*	*0.76*	*2.1*	*8.0*	*21.1*
T_D_DOZ							*3.9*	*10.1*	*2.6*	*6.7*		
T_D_FUG							*752*	*1,841*	*75.1*	*184*		
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							*0.92*	*4.0*	*0.14*	*0.61*		
T_WE_BCH							*1.7*	*7.3*	*0.25*	*1.1*		
T_WE_DAM							*7.1E-2*	*0.31*	*1.1E-2*	*4.7E-2*		
T_S_EFD							*9.3*	*32.5*	*0.93*	*3.3*		
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	***124***	***354***	***18.4***	***48.6***	***0.26***	***0.75***	***768***	***1,898***	***79.8***	***198***	***8.0***	***21.2***

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T A I L I N G S - C O N T R O L L E D - E M I S S I O N F A C T O R S

	Emission Factors						
Source ID	**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							*See "Tailings_Fleet" Sheet*
T_D_C_MOB							*See "Tailings_Fleet" Sheet*
T_D_DOZ							*See "Tailings_Fleet" Sheet*
T_D_FUG							*See "Tailings_Fleet" 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_BCH							*ton/acre-yr*
T_WE_DAM							*ton/acre-yr*
T_S_EFD							*See "Employees" Sheet*
T_S_E_C							*See "Employees" Sheet*
T_S_DFD							*See "Deliveries" Sheet*
T_S_D_C							*See "Deliveries" Sheet*

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T A I L I N G S - U N C O N T R O L L E D - E M I S S I O N F A C T O R S

	Emission Factors						
Source ID	**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							*See "Tailings_Fleet" Sheet*
T_D_C_MOB							*See "Tailings_Fleet" Sheet*
T_D_DOZ							*See "Tailings_Fleet" Sheet*
T_D_FUG							*See "Tailings_Fleet" 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_BCH							*ton/acre-yr*
T_WE_DAM							*ton/acre-yr*
T_S_EFD							*See "Employees" Sheet*
T_S_E_C							*See "Employees" Sheet*
T_S_DFD							*See "Deliveries" Sheet*
T_S_D_C							*See "Deliveries" Sheet*

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T A I L I N G S - P R O C E S S R A T E S

	Process Rates		
Source ID	**Unit/Hr**	**Unit/Yr**	**Units & Notes**
2_T_FUEL	*Diesel Storage Tanks*		
T_FUEL1	*1,438*	*8,441,443*	*gal*
2_T_D	*Non-Emergency Diesel Fleet (mobile and stationary)*		
T_CMBSTN			*See "Tailings_Fleet" Sheet*
T_D_C_MOB			*See "Tailings_Fleet" Sheet*
T_D_DOZ			*See "Tailings_Fleet" Sheet*
T_D_FUG			*See "Tailings_Fleet" Sheet*
2_T_GEN	*Emergency Generators*		
T_GEN1			*See "E_Gen" Sheet*
2_T_WE	*Miscellaneous Fugitives*		
T_WE_RD		*21.3*	*acre*
T_WE_BCH		*1,380*	*dry acre*
T_WE_DAM		*59.0*	*dry acre*
T_S_EFD			*See "Employees" Sheet*
T_S_E_C			*See "Employees" Sheet*
T_S_DFD			*See "Deliveries" Sheet*
T_S_D_C			*See "Deliveries" Sheet*

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T A I L I N G S - C O N T R O L S

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_BCH	*sprinklers*	*90%*	*AP-42, Figure 13.2.2-2, Rev. 11/06*
T_WE_DAM	*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*

TAILINGS - SOURCE IDENTIFICATION

Source ID	Source Identification
2_T_FUEL	***Diesel Storage Tanks***
T_FUEL1	*Tailings Usage and Volume Estimated (Estimated Quantity: 12)*
2_T_D	***Non-Emergency Diesel Fleet (mobile and stationary)***
T_CMBSTN	*Tailings Combustion (Stationary)*
T_D_C_MOB	*Tailings Combustion (Mobile)*
T_D_DOZ	*Tailings Fugitive Dust (Dozing)*
T_D_FUG	*Tailings Fugitive Dust (Grading, Vehicle Travel)*
2_T_GEN	***Emergency Generators***
T_GEN1	*Caterpillar C18 Generator Set*
2_T_WE	***Miscellaneous Fugitives***
T_WE_RD	*TSF Secondary Sources from Access Roads (Wind Erosion)*
T_WE_BCH	*TSF Exposed Areas - Beach*
T_WE_DAM	*TSF Exposed Areas - Dam*
T_S_EFD	*TSF Employee Fugitives*
T_S_E_C	*TSF Employee Combustion*
T_S_DFD	*TSF Delivery Fugitives*
T_S_D_C	*TSF Delivery Combustion*
3_T_TOTAL	***Tailings Subtotal***

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T A I L I N G S - C O N T R O L L E D - E F R E F E R E N C E

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	*See "Tailings_Fleet" Sheet*
T_D_C_MOB	*See "Tailings_Fleet" Sheet*
T_D_DOZ	*See "Tailings_Fleet" Sheet*
T_D_FUG	*See "Tailings_Fleet" 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_BCH	*AP-42, Chapter 13.2.5, Industrial Wind Erosion, Rev. 11/06*
T_WE_DAM	*AP-42, Chapter 13.2.5, Industrial Wind Erosion, Rev. 11/06*
T_S_EFD	*See "Employees" Sheet*
T_S_E_C	*See "Employees" Sheet*
T_S_DFD	*See "Deliveries" Sheet*
T_S_D_C	*See "Deliveries" Sheet*

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TAILINGS - UNCONTROLLED - 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	*See "Tailings_Fleet" Sheet*
T_D_C_MOB	*See "Tailings_Fleet" Sheet*
T_D_DOZ	*See "Tailings_Fleet" Sheet*
T_D_FUG	*See "Tailings_Fleet" 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_BCH	*AP-42, Table 11.9-4, Wind Erosion, Rev. 7/98*
T_WE_DAM	*AP-42, Table 11.9-4, Wind Erosion, Rev. 7/98*
T_S_EFD	*See "Employees" Sheet*
T_S_E_C	*See "Employees" Sheet*
T_S_DFD	*See "Deliveries" Sheet*
T_S_D_C	*See "Deliveries" Sheet*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: N. Tipple		
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AIR EMISSION CALCULATIONS	SUBJECT: Loadout	DATE: June 28, 2018		

LOADOUT - CONTROLLED - EMISSIONS SUMMARY

	Potential Emissions											
	CO		NO_X		SO_2		PM_{10}		$PM_{2.5}$		VOC	
Source ID	*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
2_L_S_WE	*Miscellaneous Fugitives*											
L_WE_RD							0.10	0.44	1.5E-2	6.7E-2		
L_S_EFD							0.14	0.53	1.4E-2	5.3E-2		
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	**12.2**	**21.5**	**1.3**	**2.4**	**2.8E-2**	**4.7E-2**	**0.64**	**2.5**	**0.14**	**0.45**	**0.46**	**1.1**

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI		BY: N. Tipple	
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	SUBJECT: Loadout		DATE: June 28, 2018	

LOADOUT - UNCONTROLLED - EMISSIONS SUMMARY

	Potential Emissions											
	CO		NO_X		SO_2		PM_{10}		$PM_{2.5}$		VOC	
Source ID	*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
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	**12.2**	**21.5**	**1.3**	**2.4**	**2.8E-2**	**4.7E-2**	**2.8**	**11.2**	**0.40**	**1.5**	**0.46**	**1.1**

L O A D O U T - C O N T R O L L E D - E M I S S I O N F A C T O R S

	Emission Factors						
Source ID	**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*
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*

LOADOUT - UNCONTROLLED - EMISSION FACTORS

	Emission Factors						
Source ID	**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*
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*

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LOADOUT - PROCESS RATES

	Process Rates		
Source ID	Unit/Hr	Unit/Yr	Units & Notes
2_L_CU_CONC	*Copper Concentrate Loadout*		
F_LDSTL	*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	*Diesel Storage Tanks*		
L_FUEL1	*119*	*555,866*	*gal*
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*
2_L_S_WE	*Miscellaneous Fugitives*		
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*

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L O A D O U T - C O N T R O L S

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%*	
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%*	

L O A D O U T - S O U R C E I D E N T I F I C A T I O N

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)*
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***

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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*
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*

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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*
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*

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AIR EMISSION CALCULATIONS	SUBJECT: Diesel Fleet Calculations - East Plant	DATE: June 28, 2018		

East Plant Diesel Machinery (Non-Emergency) Year 14

Equipment*	Rating kW	Rating hp	Quantity	EPA Tier**	Fuel gal/hr	Ann. Op. Hours***	Load Factor (%)*
Surface Loader - CAT 962K	165	221	2	4	6	1,862	60%
Surface Shotcrete Truck - Highway Legal	128	172	0	4	1	0	60%
Development LHD - Sandvik LH514	256	343	9	4	12	2,182	60%
Development Drill - Atlas Copco M2C	120	161	6	4	7	741	10%
Production Drill - Simba M6C	112	150	17	4	7	3,454	10%
Blind Bore Machine - Redbore 50 MDUR	0	0	1	X	0	2,443	0%
Powder Truck - Normet Charmec MF 605 DA	110	148	13	4	6	612	90%
Bolter - Atlas Copco Boltec MC	120	161	6	4	7	2,780	10%
Mechanized Shotcrete Sprayers - Normet Spraymec 6050 WP	96	129	6	4	7	860	60%
Transmixer Trucks - Normet Utimec LF 600	155	208	4	4	11	2,275	90%
UG Haul Trucks (40T)	375	503	4	4	20	3,115	90%
Scissor Trucks - Getman A64	129	173	5	4	6	1,225	90%
Cable Bolters - Atlas Copco Cabletec LC	120	161	10	4	7	1,704	10%
Production LHD - Sandvik LH514e	132	177	30	X	0	4,768	60%
2.3 yd LHD - Atlas Copco ST2G	86	115	3	4	2	701	60%
3.5 yd LHD - Atlas Copco ST3.5	136	182	4	4	3	701	60%
Mobile Rock Breaker - Sandvik LH514	256	343	5	4	12	0	90%
Medium Reach Rig - MacLean BH-3 Blockholer	147	197	2	4	7	372	10%
Water Cannon - Getman A64	120	161	3	4	6	745	90%
Fuel/Lube Truck - Normet Utimec	120	161	4	4	6	745	90%
Crane Truck - Getman A64	129	173	4	4	6	1,489	50%
Man Haul Vans - Miller Toyota	128	172	19	4	1	1,117	90%
Flat Deck Truck - Getman A64	129	173	4	4	6	701	90%
Crane Truck - Miller Toyota	128	172	4	4	1	1,117	50%
Generator Truck (LHD) - GETMAN A64	120	161	2	4	6	701	60%
UG Grader - CAT 140M2	144	193	3	4	6	1,402	60%
Forklift - CAT P36000	110	148	4	4	3	1,402	60%
UG Water Trucks - Getman A64	129	173	3	4	6	1,402	60%
Conveyor Maint Vehicle - Miller Crane Truck	128	172	2	4	1	1,730	90%
Scissor Lift - Miller Toyota	128	172	9	4	1	1,117	50%
Skid Steer Loader - CAT272D	71	95	2	4	3	745	60%
Raise Bore - Redbore 60	0	0	5	X	0	0	0%
UG Dozer - 2.9m Blade - CAT D6N	112	150	2	4	3	745	60%
Ore Haul Trucks - Powertrans T954 *	388	520	18	4	8	5,061	60%

* *Resolution*

** *Minimum Tier 4 assumed. X denotes a unit with 0 kW rating, electric assumed*

*** *Per unit, including availability and utilization factors*

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*

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

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East Plant Diesel Machinery (Non-Emergency) - Emission Factors **Year 14**

Equipment	Rating *kW*	Quantity	CO* *g/kW-hr*	NO_X* *g/kW-hr*	SO_2** *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*

** *SO_2 emissions - mass balance based on 15 ppm S content (ULSD)*

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East Plant Diesel Machinery (Non-Emergency) - Short-Term Emission **Year 14**

Equipment	CO *lb/hr*	NO_X *lb/hr*	SO_2* *lb/hr*	PM *lb/hr*	VOC *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*

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East Plant Diesel Machinery (Non-Emergency) - Long-Term Emission **Year 14**

Equipment	CO ton/yr	NO_X ton/yr	SO_2* ton/yr	PM ton/yr	VOC 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*

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

Per unit, including availability and utilization factors

[a] *Resolution*

[b] *AP-42, Chapter 13.2.2 and 13.2.1 (SL in g/m²*

[c]

East Plant Diesel Machinery (Non-Emergency) - Fugitive Emissions from Vehicle Travel - Emission Factors **Year 14**

Equipment	PM* *lb/VMT*	PM_{10}* *lb/VMT*	$PM_{2.5}$* *lb/VMT*
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			
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			
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*

$E = k \times (s / 12)^a \times (W / 3)^b \times (365 - P) / 365$

	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
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 EMISSION CALCULATIONS	SUBJECT: Diesel Fleet Calculations - East Plant	DATE: June 28, 2018		

East Plant Diesel Machinery (Non-Emergency) - Fugitive Emissions from Vehicle Travel - Emissions (Short-Term & Long-Term) **Year 14**

Equipment	PM *lb/hr*	PM_{10} *lb/hr*	$PM_{2.5}$ *lb/hr*	PM *ton/yr*	PM_{10} *ton/yr*	$PM_{2.5}$ *ton/yr*
Surface Loader - CAT 962K	51.9	12.0	1.2	39.8	9.2	0.92
Surface Shotcrete Truck - Highway Legal						
Development LHD - Sandvik LH514	452	105	10.5	493	114	11.4
Development Drill - Atlas Copco M2C	181	42.0	4.2	67.0	15.6	1.6
Production Drill - Simba M6C	513	119	11.9	885	205	20.5
Blind Bore Machine - Redbore 50 MDUR						
Powder Truck - Normet Charmec MF 605 DA	392	90.9	9.1	120	27.8	2.8
Bolter - Atlas Copco Boltec MC	181	42.0	4.2	251	58.3	5.8
Mechanized Shotcrete Sprayers - Normet Spraymec 6050 WP	181	42.0	4.2	77.8	18.0	1.8
Transmixer Trucks - Normet Utimec LF 600	241	56.0	5.6	274	63.7	6.4
UG Haul Trucks (40T)	201	46.6	4.7	313	72.6	7.3
Scissor Trucks - Getman A64	151	35.0	3.5	92.3	21.4	2.1
Cable Bolters - Atlas Copco Cabletec LC	302	70.0	7.0	257	59.6	6.0
Production LHD - Sandvik LH514e	833	193	19.3	1,987	461	46.1
2.3 yd LHD - Atlas Copco ST2G	151	35.0	3.5	52.8	12.3	1.2
3.5 yd LHD - Atlas Copco ST3.5	201	46.6	4.7	70.4	16.3	1.6
Mobile Rock Breaker - Sandvik LH514						
Medium Reach Rig - MacLean BH-3 Blockholer	60.3	14.0	1.4	11.2	2.6	0.26
Water Cannon - Getman A64	90.5	21.0	2.1	33.7	7.8	0.78
Fuel/Lube Truck - Normet Utimec	121	28.0	2.8	44.9	10.4	1.0
Crane Truck - Getman A64	121	28.0	2.8	89.8	20.8	2.1
Man Haul Vans - Miller Toyota	1,146	266	26.6	640	148	14.8
Flat Deck Truck - Getman A64	241	56.0	5.6	84.5	19.6	2.0
Crane Truck - Miller Toyota	121	28.0	2.8	67.4	15.6	1.6
Generator Truck (LHD) - GETMAN A64	60.3	14.0	1.4	21.1	4.9	0.49
UG Grader - CAT 140M2						
Forklift - CAT P36000	121	28.0	2.8	84.5	19.6	2.0
UG Water Trucks - Getman A64	181	42.0	4.2	127	29.4	2.9
Conveyor Maint Vehicle - Miller Crane Truck	60.3	14.0	1.4	52.2	12.1	1.2
Scissor Lift - Miller Toyota	271	63.0	6.3	152	35.2	3.5
Skid Steer Loader - CAT272D	60.3	14.0	1.4	22.5	5.2	0.52
Raise Bore - Redbore 60						
UG Dozer - 2.9m Blade - CAT D6N						
Ore Haul Trucks - Powertrans T954	728	169	16.9	1,842	427	42.7
Vehicle Travel - East Plant Underground	**7,361**	**1,708**	**171**	**8,214**	**1,906**	**191**
Vehicle Travel - East Plant Surface	**51.9**	**12.0**	**1.2**	**39.8**	**9.2**	**0.92**
Vehicle Travel - East Plant Total	**7,413**	**1,720**	**172**	**8,254**	**1,915**	**191**

Annual Unpaved Road Controls

	Surface	UG	Reference
Days of >0.01" Precip	64	0**	*EPS Precip Data (days >0.01'')*
Water & Chemical Suppression*	90%*	95%	*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.*

** *Control efficiency is based on AP-42 Chapter 13.2.2, Unpaved Roads. Underground will be constantly watered due to wet conditions.*

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East Plant Diesel Machinery (Non-Emergency) - Fugitive Emissions from Grading/Dozing - Emissions (Short-Term & Long-Term) **Year 14**

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

	Quantity	**Operation** *hr/yr*	**PM** *lb/hr*	**PM_{10}** *lb/hr*	**$PM_{2.5}$** *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			**49.6**	**16.1**	**1.5**	**40.0**	**12.9**	**1.2**
Grading - East Plant Surface								
Dozing - East Plant Underground			**7.0**	**1.1**	**0.74**	**3.0**	**0.48**	**0.32**
Dozing - East Plant Surface								
Grading/Dozing - East Plant Total			**56.7**	**17.2**	**2.3**	**43.0**	**13.4**	**1.6**

East Plant Underground Fleet - Uncontrolled Fugitive Dust Emissions

	PM *lb/hr*	**PM_{10}** *lb/hr*	**$PM_{2.5}$** *lb/hr*	**PM** *ton/yr*	**PM_{10}** *ton/yr*	**$PM_{2.5}$** *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 *lb/hr*	**PM_{10}** *lb/hr*	**$PM_{2.5}$** *lb/hr*	**PM** *ton/yr*	**PM_{10}** *ton/yr*	**$PM_{2.5}$** *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}	Scaling Factor $PM_{2.5}$	
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*

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Mill Diesel Machinery (Non-Emergency)

Mobile Equipment	Rating *kW*	Rating *hp*	Quantity	EPA Tier	Fuel *gal/hr*	Ann. Op. Hours	Load Factor (%)**
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.

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Mill Diesel Machinery (Non-Emergency) - Emission Factors

Equipment	Rating *kW*	Quantity	CO* *g/kW-hr*	NO_X* *g/kW-hr*	SO_2** *g/kW-hr*	PM* *g/kW-hr*	VOC* *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*

** *SO_2 emissions - mass balance based on 15 ppm S content (ULSD)*

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

Equipment	CO *lb/hr*	NO_X *lb/hr*	SO_2* *lb/hr*	PM *lb/hr*	VOC *lb/hr*
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
Highrail 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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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*

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AIR EMISSION CALCULATIONS	SUBJECT: Diesel Fleet Calculations - Mill	DATE: June 28, 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)		*dozer-specific fugitive emissions on p. 8*			
Boom Truck (Pebble Crusher)	1	2,190	15	3.0	27
Wheel Loader (2 yrs) - 992 class			*paved surface*		
Forklift (Maintenance)			*paved surface*		
Bobcat			*paved surface*		
Flatbed Truck	1	2,190	25	3.0	27
Forklift (Moly Plant-Lg)			*paved surface*		
Stormwater Mgmt. Pump			*stationary*		
Stormwater Mgmt. Pump			*stationary*		
Flatbed Truck (1 ton, nonroad)	2	1,095	15	3.0	2
Grader		*grader-specific fugitive emissions on p. 8*			
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)			*paved surface*		
Sm Forklift (Warehouse)			*paved surface*		
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, Chaţ*

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AIR EMISSION CALCULATIONS	SUBJECT: Diesel Fleet Calculations - Mill	DATE: June 28, 2018		

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

Equipment	PM *lb/VMT*	PM_{10} *lb/VMT*	$PM_{2.5}$ *lb/VMT*
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			
$E = k \times (s / 12)^a \times (W / 3)^b \times (365 - P) / 365$	**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. 8/04*

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

Equipment	PM *lb/hr*	PM_{10} *lb/hr*	$PM_{2.5}$ *lb/hr*	PM *ton/yr*	PM_{10} *ton/yr*	$PM_{2.5}$ *ton/yr*
Dozer (Coarse Ore Stockpile)						
Boom Truck (Pebble Crusher)	55.3	12.8	1.3	50.9	11.8	1.2
Wheel Loader (2 yrs) - 992 class						
Forklift (Maintenance)						
Bobcat						
Flatbed Truck	92.1	21.4	2.1	84.8	19.7	2.0
Forklift (Moly Plant-Lg)						
Stormwater Mgmt. Pump						
Stormwater Mgmt. Pump						
Flatbed Truck (1 ton, nonroad)	111	25.6	2.6	50.9	11.8	1.2
Grader						
Backhoe	18.4	4.3	0.43	17.0	3.9	0.39
Water Truck	111	25.6	2.6	102	23.6	2.4
Boom Truck	55.3	12.8	1.3	50.9	11.8	1.2
Fuel Lube Truck	55.3	12.8	1.3	102	23.6	2.4
20T Crane	36.8	8.5	0.85	27.1	6.3	0.63
60T Crane	36.8	8.5	0.85	13.6	3.1	0.31
Mobile Air Compressor	36.8	8.5	0.85	17.0	3.9	0.39
Light Tower	36.8	8.5	0.85	67.9	15.7	1.6
Fusion Machine	3.7	0.85	8.5E-2	3.4	0.79	7.9E-2
Lg Forklift (Warehouse)						
Sm Forklift (Warehouse)						
Highrail Maintenance Vehicle	18.4	4.3	0.43	6.8	1.6	0.16
Bucket Truck (Electrical)	55.3	12.8	1.3	20.4	4.7	0.47
Vacuum Truck	55.3	12.8	1.3	20.4	4.7	0.47
Man/Boom Lifts	36.8	8.5	0.85	33.9	7.9	0.79
Loader (Clean-up)-972 Class	18.4	4.3	0.43	17.0	3.9	0.39
Vehicle Travel - Mill Total	**833**	**193**	**19.3**	**685**	**159**	**15.9**

Daily Unpaved Road Controls

	Surface
days of <0.01" Precip	307

Daily Unpaved Road EF Multiplier

	Surface
days of <0.01" Precip	1

Annual Unpaved Road Controls

	Surface	Reference
Days of >0.01" Precip	58	*WPS 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*

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Mill 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**
Grader	3.0	0.96	9.2E-2	*lb/VMT*
Dozing				
Dozer (Coarse Ore Stockpile)	3.5	0.56	0.37	*lb/hr*

Emissions

	Quantity	Operation *hr/yr*	PM *lb/hr*	PM_{10} *lb/hr*	$PM_{2.5}$ *lb/hr*	PM *ton/yr*	PM_{10} *ton/yr*	$PM_{2.5}$ *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 *lb/hr*	PM_{10} *lb/hr*	$PM_{2.5}$ *lb/hr*	PM *ton/yr*	PM_{10} *ton/yr*	$PM_{2.5}$ *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}	Scaling Factor $PM_{2.5}$	
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*

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Tailings Diesel Machinery (Non-Emergency) Year 15 (Max Fuel Use Year)

Mobile Equipment*	Equip Util	Rating *kW*	Rating *hp*	Quantity	EPA Tier	Fuel *gal/hr*	Ann. Op. Hours	Load Factor (%)
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/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.

Tailings Diesel Machinery (Non-Emergency) - Emission Factors

Equipment	Rating *kW*	Quantity	CO* *g/kW-hr*	NO_X* *g/kW-hr*	SO_2** *g/kW-hr*	PM* *g/kW-hr*	VOC* *g/kW-hr*
Excavator 65t	362	2	3.5	0.40	-	2.0E-2	0.19
Excavator 45t	322	1	3.5	0.40	-	2.0E-2	0.19
Dozer (D8 Class)	268	2	3.5	0.40	-	2.0E-2	0.19
Dozer (D9 Class)	325	3	3.5	0.40	-	2.0E-2	0.19
D10 Dozer	538	2	3.5	0.40	-	2.0E-2	0.19
Tractors	186	6	3.5	0.40	-	2.0E-2	0.19
Scrapers (631K)	425	2	3.5	0.40	-	2.0E-2	0.19
Grader (120 Class)	103	2	5.0	0.40	-	2.0E-2	0.19
Compactor (825 Class)	324	1	3.5	0.40	-	2.0E-2	0.19
Compactor (S74 Class)	130	2	5.0	0.40	-	2.0E-2	0.19
Skid Steer 246 class	71	2	5.0	0.40	-	2.0E-2	0.19
Boom Winch Truck 10t	179	2	3.5	0.40	-	2.0E-2	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	-	2.0E-2	0.19
Forklift	110	2	5.0	0.40	-	2.0E-2	0.19
Telehandler	83	1	5.0	0.40	-	2.0E-2	0.19
Service Truck - 1 ton	308	8	3.5	0.40	-	2.0E-2	0.19
Small Truck (3/4t)	308	20	3.5	0.40	-	2.0E-2	0.19
Boats	56	1	5.0	4.7	-	3.0E-2	4.7
Air compressor	75	1	5.0	0.40	-	2.0E-2	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	-	2.0E-2	0.19
40 ton haulage truck	350	7	3.5	0.40	-	2.0E-2	0.19
Crusher	746	1	3.5	3.5	-	4.0E-2	0.19
Screen	75	1	5.0	0.40	-	2.0E-2	0.19
Conveyor	261	1	3.5	0.40	-	2.0E-2	0.19
Genset - preprod	373	0	3.5	0.40	-	2.0E-2	0.19

* *40 CFR §1039.101, Table 1*

** *SO_2 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*	SO_2* *lb/hr*	PM *lb/hr*	VOC *lb/hr*
Excavator 65t	3.4	0.38	7.2E-3	1.9E-2	0.18
Excavator 45t	1.5	0.17	3.2E-3	8.5E-3	8.1E-2
Dozer (D8 Class)	2.5	0.28	5.4E-3	1.4E-2	0.13
Dozer (D9 Class)	4.5	0.52	9.7E-3	2.6E-2	0.25
D10 Dozer	5.0	0.57	1.1E-2	2.8E-2	0.27
Tractors	5.2	0.59	1.1E-2	3.0E-2	0.28
Scrapers (631K)	3.9	0.45	8.5E-3	2.2E-2	0.21
Grader (120 Class)	1.4	0.11	2.1E-3	5.4E-3	5.2E-2
Compactor (825 Class)	1.5	0.17	3.2E-3	8.6E-3	8.1E-2
Compactor (S74 Class)	1.7	0.14	2.6E-3	6.9E-3	6.5E-2
Skid Steer 246 class	0.94	7.5E-2	1.4E-3	3.7E-3	3.6E-2
Boom Winch Truck 10t	1.7	0.19	3.6E-3	9.5E-3	9.0E-2
Pipe welder - McElroy 1648	0.24	0.28	2.8E-4	1.5E-2	0.28
Pipe welder - McElroy 618	0.18	0.20	2.0E-4	1.1E-2	0.20
Water Truck/Dust Polymer Truck	5.4	0.62	1.2E-2	3.1E-2	0.30
Forklift	1.5	0.12	2.2E-3	5.8E-3	5.5E-2
Telehandler	0.55	4.4E-2	8.3E-4	2.2E-3	2.1E-2
Service Truck - 1 ton	17.1	2.0	3.7E-2	9.8E-2	0.93
Small Truck (3/4t)	42.8	4.9	9.2E-2	0.24	2.3
Boats	0.37	0.35	5.6E-4	2.2E-3	0.35
Air compressor	0.49	3.9E-2	7.4E-4	2.0E-3	1.9E-2
Portable diesel pumps (Godwin)	0.33	0.37	3.7E-4	2.0E-2	0.37
Light plants	0.39	0.44	4.5E-4	2.4E-2	0.44
Fuel Truck	1.0	0.12	2.2E-3	5.9E-3	5.6E-2
40 ton haulage truck	11.3	1.3	2.4E-2	6.5E-2	0.62
Crusher	3.5	3.5	7.4E-3	3.9E-2	0.19
Screen	0.49	3.9E-2	7.4E-4	2.0E-3	1.9E-2
Conveyor	1.2	0.14	2.6E-3	6.9E-3	6.6E-2
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*

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Tailings 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*
Excavator 65t	10.3	1.2	2.2E-2	5.9E-2	0.56
Excavator 45t	4.6	0.52	9.9E-3	2.6E-2	0.25
Dozer (D8 Class)	7.6	0.87	1.6E-2	4.3E-2	0.41
Dozer (D9 Class)	13.8	1.6	3.0E-2	7.9E-2	0.75
D10 Dozer	15.3	1.7	3.3E-2	8.7E-2	0.83
Tractors	15.9	1.8	3.4E-2	9.1E-2	0.86
Scrapers (631K)	12.1	1.4	2.6E-2	6.9E-2	0.65
Grader (120 Class)	4.2	0.33	6.3E-3	1.7E-2	0.16
Compactor (825 Class)	4.6	0.53	9.9E-3	2.6E-2	0.25
Compactor (S74 Class)	5.3	0.42	7.9E-3	2.1E-2	0.20
Skid Steer 246 class	1.2	9.9E-2	1.9E-3	4.9E-3	4.7E-2
Boom Winch Truck 10t	2.2	0.25	4.7E-3	1.2E-2	0.12
Pipe welder - McElroy 1648	0.32	0.36	3.7E-4	1.9E-2	0.36
Pipe welder - McElroy 618	0.23	0.26	2.6E-4	1.4E-2	0.26
Water Truck/Dust Polymer Truck	16.7	1.9	3.6E-2	9.5E-2	0.91
Forklift	1.9	0.15	2.9E-3	7.6E-3	7.3E-2
Telehandler	0.72	5.8E-2	1.1E-3	2.9E-3	2.7E-2
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	5.2E-2	9.8E-4	2.6E-3	2.5E-2
Portable diesel pumps (Godwin)	0.43	0.49	4.9E-4	2.6E-2	0.49
Light plants	0.68	0.78	7.8E-4	4.1E-2	0.78
Fuel Truck	3.2	0.36	6.9E-3	1.8E-2	0.17
40 ton haulage truck	34.8	4.0	7.5E-2	0.20	1.9
Crusher	7.6	7.6	1.6E-2	8.6E-2	0.41
Screen	1.1	8.6E-2	1.6E-3	4.3E-3	4.1E-2
Conveyor	2.6	0.30	5.7E-3	1.5E-2	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*

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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, Chapter 13.2.2*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: N. Tipple		
	PROJECT NO: 262	PAGE: 6	OF: 8	SHEET: Tailings_Fleet
AIR EMISSION CALCULATIONS	SUBJECT: Diesel Fleet Calculations - Tailings	DATE: June 28, 2018		

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

Equipment	PM *lb/VMT*	PM_{10} *lb/VMT*	$PM_{2.5}$ *lb/VMT*
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			
$E = k \times (s / 12)^a \times (W / 3)^b$	**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. 8/04*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: N. Tipple		
	PROJECT NO: 262	PAGE: 7	OF: 8	SHEET: Tailings_Fleet
AIR EMISSION CALCULATIONS	SUBJECT: Diesel Fleet Calculations - Tailings	DATE: June 28, 2018		

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

Equipment	PM *lb/hr*	PM_{10} *lb/hr*	$PM_{2.5}$ *lb/hr*	PM *ton/yr*	PM_{10} *ton/yr*	$PM_{2.5}$ *ton/yr*
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 (S74 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(uncntl) x (365 -P) / 365	Surface
days of <0.01" Precip	1

Unpaved Road Controls

	Surface	Reference
E = EF(unctl) x (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.	PROJECT TITLE: Resolution Copper EI	BY: N. Tipple		
	PROJECT NO: 262	PAGE: 8	OF: 8	SHEET: Tailings_Fleet
AIR EMISSION CALCULATIONS	SUBJECT: Diesel Fleet Calculations - Tailings	DATE: June 28, 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

	Quantity	**Operation** *hr/yr*	**PM** *lb/hr*	**PM_{10}** *lb/hr*	**$PM_{2.5}$** *lb/hr*	**PM** *ton/yr*	**PM_{10}** *ton/yr*	**$PM_{2.5}$** *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 *lb/hr*	**PM_{10}** *lb/hr*	**$PM_{2.5}$** *lb/hr*	**PM** *ton/yr*	**PM_{10}** *ton/yr*	**$PM_{2.5}$** *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}	Scaling Factor $PM_{2.5}$	
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: N. Tipple		
	PROJECT NO: 262	PAGE: 1	OF: 4	SHEET: Loadout_Fleet
AIR EMISSION CALCULATIONS	SUBJECT: Diesel Fleet Calculations - Loadout	DATE: June 28, 2018		

Loadout Diesel Machinery (Non-Emergency)

Mobile Equipment	References & Notes	Rating *kW*	Rating *hp*	Quantity	EPA Tier	Fuel *gal/hr*	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*	*AP-42, Table 3.4-1, Footnote e, Diesel, Rev. 10/96*
137,000	*Btu/gal*	*AP-42, Appendix A, Diesel, Rev. 9/85*

References & Notes	
a, b	*Resolution*

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

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: N. Tipple		
	PROJECT NO: 262	PAGE: 2	OF: 4	SHEET: Loadout_Fleet
AIR EMISSION CALCULATIONS	SUBJECT: Diesel Fleet Calculations - Loadout	DATE: June 28, 2018		

Loadout Diesel Machinery (Non-Emergency) - Emission Factors

Equipment	Rating *kW*	Quantity	CO* *g/kW-hr*	NO_X* *g/kW-hr*	SO_2** *g/kW-hr*	PM* *g/kW-hr*	VOC* *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*

** *SO_2 emissions - mass balance based on 15 ppm S content (ULSD)*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: N. Tipple		
	PROJECT NO: 262	PAGE: 3	OF: 4	SHEET: Loadout_Fleet
AIR EMISSION CALCULATIONS	SUBJECT: Diesel Fleet Calculations - Loadout	DATE: June 28, 2018		

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

Equipment	CO *lb/hr*	NO_X *lb/hr*	SO_2* *lb/hr*	PM *lb/hr*	VOC *lb/hr*
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.	PROJECT TITLE: Resolution Copper EI	BY: N. Tipple		
	PROJECT NO: 262	PAGE: 4	OF: 4	SHEET: Loadout_Fleet
AIR EMISSION CALCULATIONS	SUBJECT: Diesel Fleet Calculations - Loadout	DATE: June 28, 2018		

Loadout 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*
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*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI		BY: N. Tipple	
	PROJECT NO: 262	PAGE: 1	OF: 3	SHEET: Employees
AIR EMISSION CALCULATIONS	SUBJECT: Employee Fugitives		DATE: June 28, 2018	

Summary of 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

Fugitive Dust from Employee Commuting

Location	Daily Number of Vehicles*	Average Distance Travelled *one way VMT, ea**	*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 Facility	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 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, 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 Facility	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^2)*
** *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

365	*days of operation/yr*
2,000	*lb/ton*
24	*hr/day*
90%	*Control (Chemical Suppressant)*

	Days of >0.01" Precip	
EP	64	*EPS Precip Data (days >0.01'')*
Mill	58	*WPS Precip Data (days >0.01'')*
TSF	57	*TSF Precip Data (days >0.01'')*
FPLF	57	*TSF Precip Data (days >0.01'')*

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

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: N. Tipple		
AIR EMISSION CALCULATIONS	PROJECT NO: 262	PAGE: 3	OF: 3	SHEET: Employees
	SUBJECT: Employee Fugitives	DATE: June 28, 2018		

Combustion Emissions from Employee Commuting

Location	VMT/day	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	1,262	1.1E-2	1.1E-2	2.0E-3	2.1E-2	1.1E-3	0.45	4.9E-3
Mill	153	1.4E-3	1.4E-3	2.5E-4	2.5E-3	1.3E-4	5.4E-2	5.9E-4
Tailings Storage Facility	621	5.6E-3	5.6E-3	1.0E-3	1.0E-2	5.5E-4	0.22	2.4E-3
Filter Plant and Loadout Facility	138	1.3E-3	1.3E-3	2.2E-4	2.3E-3	1.2E-4	4.9E-2	5.3E-4

Location	VMT/yr	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	460,484	5.0E-2	5.0E-2	8.9E-3	9.2E-2	4.9E-3	2.0	2.1E-2
Mill	55,714	6.1E-3	6.1E-3	1.1E-3	1.1E-2	5.9E-4	0.24	2.6E-3
Tailings Storage Facility	214,814	2.3E-2	2.3E-2	4.2E-3	4.3E-2	2.3E-3	0.92	1.0E-2
Filter Plant and Loadout Facility	50,195	5.5E-3	5.5E-3	9.7E-4	1.0E-2	5.3E-4	0.21	2.3E-3

Emission Factor*	PM g/VMT	PM_{10} g/VMT	$PM_{2.5}$ g/VMT	NO_X g/VMT	SO_2 g/VMT	CO g/VMT	VOC g/VMT
	9.9E-2	9.9E-2	1.8E-2	0.18	9.6E-3	3.9	4.2E-2

* *MOVES 2014a*

Conversions & Assumptions

453.592 *g/lb*
2,000 *lb/ton*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI			BY: N. Tipple
AIR EMISSION CALCULATIONS	PROJECT NO: 262	PAGE: 1	OF: 6	SHEET: E_Gen
	SUBJECT: Emergency Power Generation Emissions	DATE: June 28, 2018		

Emergency Generator - Emissions Summary

Emergency Power Generation Emissions Summary - Short-Term

Source	**CO** *lb/hr*	**NO_X** *lb/hr*	**PM** *lb/hr*	**SO_2** *lb/hr*	**VOC** *lb/hr*
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** *ton/yr*	**NO_X** *ton/yr*	**PM** *ton/yr*	**SO_2** *ton/yr*	**VOC** *ton/yr*
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	*hp/kW*	
453.592	*g/lb*	
2,000	*lb/ton*	
15	*ppm S in ULSD (GPA 2140)*	
7.05	*lb/gal*	*AP-42, Appendix A (Distillate Oil), Rev. 9/85*
1.00E+06	*Btu/MMBtu*	

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

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI			BY: N. Tipple
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AIR EMISSION CALCULATIONS	SUBJECT: Emergency Power Generation Emissions	DATE: June 28, 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	*gal/hr*	*gal/yr*
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		Cat 3046C - Diesel		Total	
		lb/hr	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*
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)

$$\frac{134\ \text{gal}}{\text{hr}} \times \frac{7.05\ \text{lb}}{\text{gal}} \times 0.0015\%\ S \times \frac{64.06\ \text{lb } SO_2}{32.07\ \text{lb } S} \times (1 + 15\%) = \frac{0.03\ \text{lb } SO_2}{\text{hr}}$$

$$\frac{0.03\ \text{lb } SO_2}{\text{hr}} \times \frac{500\ \text{hr}}{\text{yr}} \times \frac{\text{ton}}{2{,}000\ \text{lb}} = \frac{0.008\ \text{ton } SO_2}{\text{yr}}$$

SO2 Mass Balance (Single Cat 3046C - Diesel)

$$\frac{23\ \text{gal}}{\text{hr}} \times \frac{7.05\ \text{lb}}{\text{gal}} \times 0.0015\%\ S \times \frac{64.06\ \text{lb } SO_2}{32.07\ \text{lb } S} \times (1 + 15\%) = \frac{0.006\ \text{lb } SO_2}{\text{hr}}$$

$$\frac{0.01\ \text{lb } SO_2}{\text{hr}} \times \frac{500\ \text{hr}}{\text{yr}} \times \frac{\text{ton}}{2{,}000\ \text{lb}} = \frac{0.0014\ \text{ton } SO_2}{\text{yr}}$$

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI			BY: N. Tipple
AIR EMISSION CALCULATIONS	PROJECT NO: 262	PAGE: 3	OF: 6	SHEET: E_Gen
	SUBJECT: Emergency Power Generation Emissions	DATE: June 28, 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	*gal/hr*	*gal/yr*
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	
	lb/hr	*ton/yr*	*lb/hr*	*ton/yr*
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)

$$\frac{224\ \text{gal}}{\text{hr}} \times \frac{7.05\ \text{lb}}{\text{gal}} \times 0.0015\%\ S \times \frac{64.06\ \text{lb } SO_2}{32.07\ \text{lb } S} \times (1 + 15\%) = \frac{0.05\ \text{lb } SO_2}{\text{hr}}$$

$$\frac{0.05\ \text{lb } SO_2}{\text{hr}} \times \frac{500\ \text{hr}}{\text{yr}} \times \frac{\text{ton}}{2{,}000\ \text{lb}} = \frac{0.014\ \text{ton } SO_2}{\text{yr}}$$

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI			BY: N. Tipple
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AIR EMISSION CALCULATIONS	SUBJECT: Emergency Power Generation Emissions			DATE: June 28, 2018

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 Genera	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)

$$\frac{37\ gal}{hr} \times \frac{7.05\ lb}{gal} \times 0.0015\%\ S \times \frac{64.06\ lb\ SO_2}{32.07\ lb\ S} \times (1 + 15\%) = \frac{0.009\ lb\ SO_2}{hr}$$

$$\frac{0.009\ lb\ SO_2}{hr} \times \frac{500\ hr}{yr} \times \frac{ton}{2{,}000\ lb} = \frac{0.0022\ ton\ SO_2}{yr}$$

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 Genera	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)

$$\frac{37\ \cancel{gal}}{hr} \times \frac{7.05\ \cancel{lb}}{\cancel{gal}} \times 0.0015\%\ \cancel{S} \times \frac{64.06\ lb\ SO_2}{32.07\ \cancel{lb\ S}} \times (1 + 15\%) = \frac{0.009\ lb\ SO_2}{hr}$$

$$\frac{0.009\ \cancel{lb}\ SO_2}{\cancel{hr}} \times \frac{500\ \cancel{hr}}{yr} \times \frac{ton}{2{,}000\ \cancel{lb}} = \frac{0.0022\ ton\ SO_2}{yr}$$

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 Genera	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)

$$\frac{37\ \text{gal}}{\text{hr}} \times \frac{7.05\ \text{lb}}{\text{gal}} \times 0.0015\%\ S \times \frac{64.06\ \text{lb}\ SO_2}{32.07\ \text{lb}\ S} \times (1 + 15\%) = \frac{0.009\ \text{lb}\ SO_2}{\text{hr}}$$

$$\frac{0.009\ \text{lb}\ SO_2}{\text{hr}} \times \frac{500\ \text{hr}}{\text{yr}} \times \frac{\text{ton}}{2{,}000\ \text{lb}} = \frac{0.0022\ \text{ton}\ SO_2}{\text{yr}}$$

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: N. Tipple		
	PROJECT NO: 262	PAGE: 1	OF: 1	SHEET: Fuel Tanks
AIR EMISSION CALCULATIONS	SUBJECT: Diesel Fuel Storage	DATE: June 28, 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	58,621
Per Tank Fuel Usage[b]	*gal/yr*	22,621	265,817	148,377	138,966	703,454
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	703,454
Total Fuel Usage[b]	*gal/yr*	22,621	1,594,904	741,883	555,866	8,441,443
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) ft belo*

[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.	PROJECT TITLE: Resolution Copper EI		BY: N. Tipple	
AIR EMISSION CALCULATIONS	PROJECT NO: 262	PAGE: 1	OF: 2	SHEET: Cooling
	SUBJECT: Cooling Tower Emissions	DATE: June 28, 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 Atmospheric Dispersion	31.3%	*EPA Document: Effects of Pathogenic and Toxic Material Transport 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: Resolution Copper EI		BY: N. Tipple	
	PROJECT NO: 262	PAGE: 2	OF: 2	SHEET: Cooling
AIR EMISSION CALCULATIONS	SUBJECT: Cooling Tower Emissions		DATE: June 28, 2018	

COOLING TOWERS - PM/PM_{10}/$PM_{2.5}$ EMISSION RATES - Continued

PM_{10}, $PM_{2.5}$ Multiplier Calculation

Operation		Reference
Water TDS	3,000 *ppm*	*Resolution*
Calcium Carbonate Density	2.7 *g/cc*	*Perry's Chemical Engineer's Handbook, Sixth Edition, p. 3-10.*
Volume of a Sphere	$V = 4 / 3 * \pi * r^3$	

Water Drop Size and Mass Distribution*

Droplet Dia. (micron)	(% mass)	Water Droplet Vol. (cc)	Water Droplet Mass (g)	Solids Mass (g)	Solids Vol. (cc)	Solids Dia. (micron)	% mass <10, <2.5 (microns)
22	0.4	5.6E-09	5.6E-09	1.7E-11	6.2E-12	2.3	
29	1.5	1.3E-08	1.3E-08	3.8E-11	1.4E-11	3.0	1.9
44	3.8	4.5E-08	4.5E-08	1.3E-10	5.0E-11	4.6	
58	2.1	1.0E-07	1.0E-07	3.1E-10	1.1E-10	6.0	
65	1.9	1.4E-07	1.4E-07	4.3E-10	1.6E-10	6.7	
87	1.6	3.4E-07	3.4E-07	1.0E-09	3.8E-10	9.0	
108	1.4	6.6E-07	6.6E-07	2.0E-09	7.3E-10	11.2	12.6
120	1.3	9.0E-07	9.0E-07	2.7E-09	1.0E-09	12.4	
132	1.1	1.2E-06	1.2E-06	3.6E-09	1.3E-09	13.7	
144	1.3	1.6E-06	1.6E-06	4.7E-09	1.7E-09	14.9	
174	5.8	2.8E-06	2.8E-06	8.3E-09	3.1E-09	18.0	
300	5.0	1.4E-05	1.4E-05	4.2E-08	1.6E-08	31.1	
450**	4.2	4.8E-05	4.8E-05	1.4E-07	5.3E-08	46.6	
Total	31.3						

* *Effects of Pathogenic and Toxic Material Transport Via Cooling Device Drift - Vol. 1 Technical Report. EPA 600 7-79-251a, Nov. 1979.*

** *Maximum droplet size governed by atmospheric dispersion.*

PM_{10}/PM multiplier = **0.40**

$PM_{2.5}$/PM multiplier = **0.06**

Conversions	
8,760	*hr/yr*
60	*min/hr*
2,000	*lb/ton*
3.78541	*l/gal*
8.33	*lb/gal water*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI			BY: N. Tipple
	PROJECT NO: 262	PAGE: 1	OF: 1	SHEET: Reagents
AIR EMISSION CALCULATIONS	SUBJECT: Liquid Reagent Tanks & Solid Reagent Usage			DATE: June 28, 2018

LIQUID REAGENT STORAGE TANK CHARACTERISTICS AND EMISSIONS

TANK EMISSIONS	VOC* (lb/yr)	VOC lb/hr	VOC 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*

MIBC (Methyl isobutyl carbonal)			Notes: 1
Design Throughput	5,268	l/day	2
	1,392	gal/day	
Average Throughput	4,581	l/day	2
	441,713	gal/yr	
Tank Diameter	4.4	m	2
	14.4	ft	
Tank Height	5.4	m	2
	17.7	ft	
Tank Volume	67.3	m^3	2
	17,779	gal	

1 *Assuming 100% $(CH_3)_2CHCH_2CH(OH)CH_3$*
2 *Resolution*

CYTEC 8989			Notes: 1
Design Throughput	908	l/day	2
	240	gal/day	
Average Throughput	789	l/day	2
	76,078	gal/yr	
Tank Diameter	3.7	m	2
	12.1	ft	
Tank Height	4.7	m	2
	15.4	ft	
Tank Volume	39.8	m^3	2
	10,514	gal	

1 *Dithiophosphate, Cresol -p, & Non-Organic Components*
2 *Resolution*

MCO (Non-polar flotation oil)			Notes: 1
Design Throughput	1,597	l/day	2
	422	gal/day	
Average Throughput	1,388	l/day	2
	133,835	gal/yr	
Tank Diameter	3.9	m	2
	12.8	ft	
Tank Height	4.9	m	2
	16.1	ft	
Tank Volume	45.6	m^3	2
	12,046	gal	

1 *Emissions calculated based on 100% Distillate fuel oil no. 2*
2 *Resolution*

NaHS (Sodium hydrosulfide solution)			Notes: 1
Design Throughput	41.4	tonnes/day	2, 3
	8,749	gal/day	
Average Throughput	36.0	tonnes/day	2, 3
	2,776,973	gal/yr	
Tank Diameter	7.5	m	1, 2
	24.6	ft	
Tank Height	8.5	m	1, 2
	27.9	ft	
Tank Volume	334.4	m^3	1, 2
	88,339	gal	
Specific Gravity	1.25		2

1 *Stainless Steel Heated and Insulated Tank*
2 *Resolution*
3 *As shipped concentration 40% - 45% NaHS*

Solid Reagent Use *(Resolution)*

	(tonne/day) (design)	(tonne/day) (average)	(ton/hr)	(ton/yr)
Lime	89.7	67.8	4.1	27,279
SIPX*	690*	600*	0.03	241
CIBA 155	3.70	3.22	0.17	1,296
CIBA 10	0.96	0.78	0.04	314

* *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.	PROJECT TITLE: Resolution Copper EI	BY: N. Tipple		
AIR EMISSION CALCULATIONS	PROJECT NO: 262	PAGE: 1	OF: 4	SHEET: Drill & Blast
	SUBJECT: Drilling and Blasting	DATE: June 28, 2018		

East 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	2,065,200	*tonne/yr*
	1,414	*tonne/hr*
	2,276,491	*ton/yr*
	1,559	*ton/hr*

Production Drilling - Emissions	*lb/hr*	*ton/yr*
PM	0.26	0.19
PM_{10}	0.12	9.1E-2
$PM_{2.5}$	0.12	9.1E-2

Conversions	
1.10231	*ton/tonne*
907.185	*kg/ton*
3.28084	*ft/m*
10.7639	*ft^2/m^2*
8,760	*hr/yr*
2,000	*lb/ton*

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

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.	PROJECT TITLE: Resolution Copper EI			BY: N. Tipple
	PROJECT NO: 262	PAGE: 3	OF: 4	SHEET: Drill & Blast
AIR EMISSION CALCULATIONS	SUBJECT: Drilling and Blasting			DATE: June 28, 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	$TSP = 0.000014 \times A^{1.5}$	*lb/blast*	*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.	PROJECT TITLE: Resolution Copper EI		BY: N. Tipple	
	PROJECT NO: 262	PAGE: 4	OF: 4	SHEET: Drill & Blast
AIR EMISSION CALCULATIONS	SUBJECT: Drilling and Blasting		DATE: June 28, 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	$TSP = 0.000014 \times A^{1.5}$	*lb/blast*	*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.	PROJECT TITLE: Resolution Copper EI		BY: N. Tipple	
	PROJECT NO: 262	PAGE: 1	OF: 1	SHEET: Flow
AIR EMISSION CALCULATIONS	SUBJECT: Flow Calculations (EPA Method 19)		DATE: June 28, 2018	

Stockpile Reclaim Dust Collectors *(Donaldson Torit DFO 4-32)*

Linear Interpolation (Pressure Based on Elevation)

Elevation	Pressure	Pressure	
ft	*kPa*	*atm*	
2,500*	92.5*	0.91	
2,888**	91.2	0.90	*West Plant Elevation/Pressure*
3,000*	90.8*	0.90	

* *www.engineeringtoolbox.com/air-altitude-pressure-d_462.html*
** *Google Earth*

56.77 F (WP Met Data)
0.90 atm
68.0 F, standard temp.

18,950 acfm*
17,423 scfm
1,045,398
* Resolution *Reference 76 - Email from Eric Pedersen (M3) 3/27/14*

Underground Reclaim Dust Collectors

Linear Interpolation (Pressure Based on Elevation)

Elevation	*Pressure*	*Pressure*	
ft	kPa	atm	
-2,000*	109*	1.08	
-2,386	110.5	1.09	Mine Elevation/Pressure
-2,500*	111*	1.10	

* www.engineeringtoolbox.com/air-altitude-pressure-d_462.html

Elevation Calculation

4,176	EP Elevation*
6,562	Mine Depth**
-2,386	Mine Elevation

* *Google Earth*
** Resolution

40.0	°C	Resolution
1.09	*atm*	
68	*F, standard temp.*	
22,500	*a m³/hr*	Resolution
794,581	*acfh*	for crushers
915,420	*scfh*	
5,100	*a m³/hr*	Resolution
180,105	*acfh*	for conveyor transfer
207,495	*scfh*	
22,500	*a m³/hr*	Resolution
794,581	*acfh*	for silos
915,420	*scfh*	
17,000	*a m³/hr*	Resolution
600,350	*acfh*	for skip loading
691,651	*scfh*	
17,000	*a m³/hr*	Resolution
600,350	*acfh*	for bin unloading
691,651	*scfh*	

Conversions

101.3	*kPa/atm*
60	min/hr
35.31	ft^3/m^3

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

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI		BY: N. Tipple		
	PROJECT NO: 262		PAGE: 1	OF: 1	SHEET: MolyTalc
AIR EMISSION CALCULATIONS	SUBJECT: Moly/Talc Heat Treatment		DATE: June 28, 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_3H_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.	PROJECT TITLE: Resolution Copper EI		BY: N. Tipple	
	PROJECT NO: 262	PAGE: 1	OF: 3	SHEET: Deliveries
AIR EMISSION CALCULATIONS	SUBJECT: Delivery Fugitives		DATE: June 28, 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.*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: N. Tipple		
	PROJECT NO: 262	PAGE: 2	OF: 3	SHEET: Deliveries
AIR EMISSION CALCULATIONS	SUBJECT: Delivery Fugitives	DATE: June 28, 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/m^2)*
** *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

453.592	*g/lb*
2,000	*lb/ton*
24	*hr/day*
90%	*Control (Chemical Suppressant)*

Days of >0.01" Precip		
EP	64	*EPS Precip Data (days >0.01'')*
Mill	58	*WPS Precip Data (days >0.01'')*
TSF	57	*TSF Precip Data (days >0.01'')*
FPLF	57	*TSF Precip Data (days >0.01'')*

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

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: N. Tipple		
	PROJECT NO: 262	PAGE: 3	OF: 3	SHEET: Deliveries
AIR EMISSION CALCULATIONS	SUBJECT: Delivery Fugitives	DATE: June 28, 2018		

Combustion Emissions from Deliveries

Location	VMT/hr	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	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.*

Location	VMT/yr	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	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.*

Combustion Emission Factor*	PM g/VMT	PM_{10} g/VMT	$PM_{2.5}$ g/VMT	NO_X g/VMT	SO_2 g/VMT	CO g/VMT	VOC g/VMT
	1.0	1.0	0.3	3.8	1.2E-2	1.3	0.3

* *MOVES 2014a*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: N. Tipple		
	PROJECT NO: 262	PAGE: 1	OF: 2	SHEET: BatchPlant
AIR EMISSION CALCULATIONS	SUBJECT: Concrete Batch Plant	DATE: June 28, 2018		

CONTROLLED EMISSIONS

	PM		PM_{10}		$PM_{2.5}$	
Source Description	*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	3.2E-2	1.8E-2
Sand Delivery to Ground Storage	0.23	0.13	0.11	6.1E-2	1.6E-2	9.3E-3
Aggregate Transfer to Conveyor Belt via Chute	3.5E-2	2.2E-2	1.6E-2	1.1E-2	2.5E-3	1.6E-3
Sand Transfer to Conveyor Belt via Chute	2.8E-2	1.2E-2	1.3E-2	5.3E-3	2.0E-3	8.5E-4
Aggregate Transfer to Elevated Storage	3.5E-2	2.2E-2	1.6E-2	1.1E-2	2.5E-3	1.6E-3
Sand Transfer to Elevated Storage	2.8E-2	1.2E-2	1.3E-2	5.3E-3	2.0E-3	8.5E-4
Weigh Hopper Loading (Aggregate & Sand)	0.31	0.15	0.18	8.6E-2	2.7E-2	1.3E-2
Weigh Hopper Discharge to Truck Loading Conveyor (Agg)	3.5E-2	2.2E-2	1.6E-2	1.1E-2	2.5E-3	1.6E-3
Weigh Hopper Discharge to Truck Loading Conveyor (Sand)	2.8E-2	1.2E-2	1.3E-2	5.3E-3	2.0E-3	8.5E-4
Cement Unloading to Silo	7.5E-2	3.1E-2	2.6E-2	1.1E-2	3.9E-3	1.6E-3
Flyash Unloading to Silo	8.7E-2	4.4E-2	4.8E-2	2.4E-2	7.2E-3	3.7E-3
Silica Fume Unloading to Silo	3.5E-2	9.5E-3	1.9E-2	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

	PM		PM_{10}		$PM_{2.5}$	
Source Description	*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	4.1E-2	2.3E-2
Sand Delivery to Ground Storage	0.28	0.16	0.13	7.6E-2	2.0E-2	1.2E-2
Aggregate Transfer to Conveyor Belt via Chute	0.49	0.32	0.23	0.15	3.5E-2	2.3E-2
Sand Transfer to Conveyor Belt via Chute	0.39	0.16	0.18	7.6E-2	2.8E-2	1.2E-2
Aggregate Transfer to Elevated Storage	0.49	0.32	0.23	0.15	3.5E-2	2.3E-2
Sand Transfer to Elevated Storage	0.39	0.16	0.18	7.6E-2	2.8E-2	1.2E-2
Weigh Hopper Loading (Aggregate & Sand)	1.2	0.59	0.72	0.34	0.11	5.2E-2
Weigh Hopper Discharge to Truck Loading Conveyor (Agg)	0.49	0.32	0.23	0.15	3.5E-2	2.3E-2
Weigh Hopper Discharge to Truck Loading Conveyor (Sand)	0.39	0.16	0.18	7.6E-2	2.8E-2	1.2E-2
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	3.8E-2	1.6E-2
Silo Weigh Hopper Discharge to Truck Loading Conveyor	0.43	0.18	0.25	0.10	3.8E-2	1.6E-2
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.*

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Max Emission Scenario: Shotcrete

ACTIVITY RATES

	Capacity[1]		Control Description		Reference
Source Description	*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

	Uncontrolled			Controlled			Reference
	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$	
Source Description	*lb/ton*	*lb/ton*	*lb/ton*	*lb/ton*	*lb/ton*	*lb/ton*	
Aggregate Delivery to Ground Storage	0.0069	0.0033	0.0005	0.00552	0.00264	0.0004	1
Sand Delivery to Ground Storage	0.0021	0.00099	0.00015	0.00168	0.000792	0.00012	2
Aggregate Transfer to Conveyor Belt via Chute	0.0069	0.0033	0.00050	0.00049	0.00023	0.000035	3
Sand Transfer to Conveyor Belt via Chute	0.0021	0.00099	0.00015	0.00015	0.000069	0.000011	4
Aggregate Transfer to Elevated Storage	0.0069	0.0033	0.0005	0.00049	0.00023	0.000035	3
Sand Transfer to Elevated Storage	0.0021	0.00099	0.00015	0.00015	0.000069	0.000011	4
Weigh Hopper Loading (Aggregate & Sand)	0.0048	0.0028	0.0004	0.0012	0.0007	0.000106	5
Weigh Hopper Discharge to Truck Loading Conveyor (Agg)	0.0069	0.0033	0.00050	0.00049	0.00023	0.000035	3
Weigh Hopper Discharge to Truck Loading Conveyor (Sand)	0.0021	0.00099	0.00015	0.00015	0.000069	0.000011	4
Cement Unloading to Silo	0.73	0.47	0.07	0.00099	0.00034	0.0001	6
Flyash Unloading to Silo	3.14	1.1	0.2	0.0089	0.0049	0.001	7
Silica Fume Unloading to Silo	3.14	1.1	0.2	0.0089	0.0049	0.001	7
Cement & Flyash Discharge to Silo Weigh Hopper	0.0048	0.0028	0.0004	0.000048	0.000028	0.00000424	5
Silo Weigh Hopper Discharge to Truck Loading Conveyor	0.0048	0.0028	0.0004	0.000048	0.000028	0.00000424	5
Truck Loading	1.118	0.31	0.0469	0.0980	0.0263	0.004	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*

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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	1.96E-02					**1.96E-02**	
83329	Acenaphthene	1.35E-03					**1.35E-03**	POM
208968	Acenaphthylene	3.79E-03					**3.79E-03**	POM
75070	Acetaldehyde	3.88E-01					**3.88E-01**	
107028	Acrolein	4.75E-02					**4.75E-02**	
120127	Anthracene	1.10E-03					**1.10E-03**	POM
7440382	Arsenic	2.55E-03	4.83E-03			9.45E-08	**7.38E-03**	
56553	Benzo(a)anthracene	9.27E-04					**9.27E-04**	POM
71432	Benzene	5.73E-01			1.50E-06	9.92E-07	**5.73E-01**	
50328	Benzo(a)pyrene	1.29E-04					**1.29E-04**	POM
205992	Benzo(b)fluoranthene	2.01E-04					**2.01E-04**	POM
191242	Benzo(g,h,l)perylene	3.21E-04					**3.21E-04**	POM
207089	Benzo(k)fluoranthene	1.07E-04					**1.07E-04**	POM
7440417	Beryllium	1.91E-03	3.38E-04			5.67E-09	**2.25E-03**	
92524	Biphenyl				1.87E-04		**1.87E-04**	POM
7440439	Cadmium	1.91E-03	1.66E-04			5.20E-07	**2.08E-03**	
7440473	Chromium	1.91E-03	2.68E-02			6.61E-07	**2.87E-02**	
218019	Chrysene	3.85E-04					**3.85E-04**	POM
7440484	Cobalt		3.58E-03			3.97E-08	**3.58E-03**	
53703	Dibenzo(a,h)anthracene	3.39E-04					**3.39E-04**	POM
100414	Ethylbenzene				2.43E-05		**2.43E-05**	
206440	Fluoranthene	4.36E-03					**4.36E-03**	POM
86737	Fluorene	1.64E-02					**1.64E-02**	POM
50000	Formaldehyde	6.02E-01				3.54E-05	**6.02E-01**	
110543	Hexane				1.87E-03	8.50E-04	**2.72E-03**	
193395	Indeno(1,2,3-c,d)pyrene	2.44E-04					**2.44E-04**	POM
7439921	Lead	5.74E-03	1.07E-02				**1.64E-02**	
7439965	Manganese	3.82E-03	3.00E-02			1.79E-07	**3.38E-02**	
7439976	Mercury	1.91E-03	5.72E-02			1.23E-07	**5.91E-02**	
91203	Naphthalene	6.02E-02			1.03E-03	2.88E-07	**6.12E-02**	POM
7440020	Nickel	1.91E-03	4.61E-03			9.92E-07	**6.53E-03**	
85018	Phenanthrene	2.03E-02			2.34E-04		**2.05E-02**	POM
108952	Phenol				1.20E-04		**1.20E-04**	
129000	Pyrene	2.90E-03					**2.90E-03**	POM
7782492	Selenium	9.56E-03	1.20E-03			1.13E-08	**1.08E-02**	
100425	Styrene				5.99E-05		**5.99E-05**	
108883	Toluene	2.43E-01			5.99E-05	1.61E-06	**2.43E-01**	
1330207	Xylene	1.69E-01					**1.69E-01**	
95636	1,2,4-trimethylbenzene							
7783064	Hydrogen sulfide			2.57E-02			**2.57E-02**	
106445	p-Cresol			2.50E-05			**2.50E-05**	
79061	Acrylamide			1.48E-02			**1.48E-02**	
106467	Dichlorobenzene					5.67E-07	**5.67E-07**	
7440360	Antimony		3.72E-04				**3.72E-04**	
POM	POM (aggregated)					4.17E-08	**4.17E-08**	POM
POM	*Polycylic Organic Matter Subtotal*	*1.13E-01*	*0.00E+00*	*0.00E+00*	*1.45E-03*	*3.30E-07*	*1.14E-01*	
HAPs	All HAPs	2.19E+00	1.40E-01	4.05E-02	3.59E-03	8.92E-04	2.37E+00	

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

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HAPs Emissions for ULSD Engines (Small & Large)

			Small ULSD Engines* 1,002,898 MMBtu/yr***		Large ULSD Engines** 271,739 MMBtu/yr***	
CAS No.	**Pollutant**	**POM**	*lb/MMBtu*	*ton/yr*	*lb/MMBtu*	*ton/yr*
106990	1,3-Butadiene		3.91E-05	1.96E-02		
83329	Acenaphthene	POM	1.42E-06	7.12E-04	4.68E-06	6.36E-04
208968	Acenaphthylene	POM	5.06E-06	2.54E-03	9.23E-06	1.25E-03
75070	Acetaldehyde		7.67E-04	3.85E-01	2.52E-05	3.42E-03
107028	Acrolein		9.25E-05	4.64E-02	7.88E-06	1.07E-03
120127	Anthracene	POM	1.87E-06	9.38E-04	1.23E-06	1.67E-04
56553	Benzo(a)anthracene	POM	1.68E-06	8.42E-04	6.22E-07	8.45E-05
71432	Benzene		9.33E-04	4.68E-01	7.76E-04	1.05E-01
50328	Benzo(a)pyrene	POM	1.88E-07	9.43E-05	2.57E-07	3.49E-05
205992	Benzo(b)fluoranthene	POM	9.91E-08	4.97E-05	1.11E-06	1.51E-04
191242	Benzo(g,h,l)perylene	POM	4.89E-07	2.45E-04	5.56E-07	7.55E-05
207089	Benzo(k)fluoranthene	POM	1.55E-07	7.77E-05	2.18E-07	2.96E-05
218019	Chrysene	POM	3.53E-07	1.77E-04	1.53E-06	2.08E-04
53703	Dibenzo(a,h)anthracene	POM	5.83E-07	2.92E-04	3.46E-07	4.70E-05
206440	Fluoranthene	POM	7.61E-06	3.82E-03	4.03E-06	5.48E-04
86737	Fluorene	POM	2.92E-05	1.46E-02	1.28E-05	1.74E-03
50000	Formaldehyde		1.18E-03	5.92E-01	7.89E-05	1.07E-02
193395	Indeno(1,2,3-c,d)pyrene	POM	3.75E-07	1.88E-04	4.14E-07	5.62E-05
91203	Naphthalene	POM	8.48E-05	4.25E-02	1.30E-04	1.77E-02
85018	Phenanthrene	POM	2.94E-05	1.47E-02	4.08E-05	5.54E-03
129000	Pyrene	POM	4.78E-06	2.40E-03	3.71E-06	5.04E-04
108883	Toluene		4.09E-04	2.05E-01	2.81E-04	3.82E-02
1330207	Xylene		2.85E-04	1.43E-01	1.93E-04	2.62E-02
POM	*Polycylic Organic Matter Subtotal*			*8.43E-02*		*2.87E-02*
HAPs	**All HAPs**			**1.94E+00**		**2.14E-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	4.00E-06	2.55E-03
7440417	Beryllium	HAP	3	3.00E-06	1.91E-03
7440439	Cadmium	HAP	3	3.00E-06	1.91E-03
7440473	Chromium	HAP	3	3.00E-06	1.91E-03
	Copper		6	6.00E-06	3.82E-03
7439921	Lead	HAP	9	9.00E-06	5.74E-03
7439976	Mercury	HAP	3	3.00E-06	1.91E-03
7439965	Manganese	HAP	6	6.00E-06	3.82E-03
7440020	Nickel	HAP	3	3.00E-06	1.91E-03
7782492	Selenium	HAP	15	1.50E-05	9.56E-03
	Zinc		4	4.00E-06	2.55E-03
Total Diesel Combustion Metal Emissions					**3.76E-02**

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

HAPs Emissions for Propane Combustion

Propane Sources

Source	Operation *hr/yr*	Throughput *MMBtu/hr*	Throughput *MMBtu/yr*
Hydro House Propane Heater (0.045 MMBtu/hr)	8,760	0.045	394.2
Hydro House Propane Heater (0.065 MMBtu/hr)	8,760	0.065	569.4
Total		**0.11**	**963.6**

Propane HAP & Metal Emissions

CAS No.	Pollutant	Emission Factor* *lb/MMScf*	Emission Factor* *lb/MMBtu***	Emissions *ton/yr*
71432	Benzene	2.10E-03	2.06E-06	9.92E-07
106467	Dichlorobenzene	1.20E-03	1.18E-06	5.67E-07
50000	Formaldehyde	7.50E-02	7.35E-05	3.54E-05
110543	Hexane	1.80E+00	1.76E-03	8.50E-04
91203	Naphthalene	6.10E-04	5.98E-07	2.88E-07
108883	Toluene	3.40E-03	3.33E-06	1.61E-06
POM	POM (aggregated)	8.82E-05	8.65E-08	4.17E-08
7440382	Arsenic	2.00E-04	1.96E-07	9.45E-08
7440417	Beryllium	1.20E-05	1.18E-08	5.67E-09
7440439	Cadmium	1.10E-03	1.08E-06	5.20E-07
7440473	Chromium	1.40E-03	1.37E-06	6.61E-07
7440484	Cobalt	8.40E-05	8.24E-08	3.97E-08
7439965	Manganese	3.80E-04	3.73E-07	1.79E-07
7439976	Mercury	2.60E-04	2.55E-07	1.23E-07
7440020	Nickel	2.10E-03	2.06E-06	9.92E-07
7782492	Selenium	2.40E-05	2.35E-08	1.13E-08
	Total HAPs			**8.92E-04**

**AP-42, Table 1.4-3 & 1.4-4 (7/98) Natural Gas Combustion*

***Natural Gas Higher Heating Value* 1,020 *Btu/scf*

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HAPs Emissions from Process & Fugitive Dust

Ore HAPs Concentrations & Emissions

CAS No.		Pollutant	Concentration* %	Emissions ton/yr
7440360	Sb	Antimony	0.0003%	3.72E-04
7440382	As	Arsenic	0.0040%	4.83E-03
7440417	Be	Beryllium	0.0003%	3.38E-04
7440439	Cd	Cadmium	0.0001%	1.66E-04
7440473	Cr	Chromium	0.0222%	2.68E-02
7440484	Co	Cobalt	0.0030%	3.58E-03
7439921	Pb	Lead	0.0088%	1.07E-02
7439965	Mn	Manganese	0.0248%	3.00E-02
7439976	Hg	Mercury	0.0473%	5.72E-02
7440020	Ni	Nickel	0.0038%	4.61E-03
7782492	Se	Selenium	0.0010%	1.20E-03

* *Resolution*

PM Emissions

	PM ton/yr
East Plant	19.8
Mill	21.9
Loadout	0.0
Tailings	79.2
Total	**120.9**

HAPs Emissions from Reagent Handling & Storage

CAS No.	Pollutant	lb/yr	ton/yr	Source
7783064	Hydrogen sulfide*	51.4	2.57E-02	NaHS (Sodium hydrosulfide solution)
106445	p-Cresol*	0.05	2.50E-05	CYTEC 8989
79061	Acrylamide**		1.48E-02	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%	1.50E-06	
92524	Biphenyl	0.100%	1.87E-04	POM
100414	Ethyl benzene	0.013%	2.43E-05	
110543	Hexane	1.000%	1.87E-03	
91203	Naphthalene	0.550%	1.03E-03	POM
108952	Phenol	0.064%	1.20E-04	
100425	Styrene	0.032%	5.99E-05	
108883	Toluene	0.032%	5.99E-05	
85018	Phenanthrene	0.125%	2.34E-04	POM
POM	*Polycylic Organic Matter Subtotal*	7.75E-03	1.45E-03	

* *Resolution*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: N. Tipple		
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AIR EMISSION CALCULATIONS	SUBJECT: Direct Greenhouse Gases & CO_2e	DATE: June 28, 2018		

DIRECT GREENHOUSE GAS & CO_2 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_2O	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_2O	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_2O *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_2O *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	2,710,572	3,117,158	427,051	31,585	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
Total	**8,090,366**	**9,303,921**	**1,274,637**	**94,272**	**3.8**	**0.76**

**Calculated by mass balance using a 15% fuel contingency*
***metric tons per year*

Direct CO_2e Emissions

Greenhouse Gas	Emissions *tonne/yr**	Global Warming Potential**	CO_2e *tonne/yr**	
Carbon Dioxide (CO_2)	94,332	1	94,332	
Methane (CH_4)	3.8	25	95.7	
Nitrous Oxide (N_2O)	0.77	298	228	
Total			**94,655**	**direct emissions > 25,000 metric tons per year**

** 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 tons*	
7,000	*MMBtu/hp-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*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper		BY: N. Tipple	
	PROJECT NO: 262	PAGE: 1	OF: 3	SHEET: UG Control
AIR EMISSION CALCULATIONS	SUBJECT: Underground Scrubbing	DATE: June 28, 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.	PROJECT TITLE: Resolution Copper		BY: N. Tipple	
	PROJECT NO: 262	PAGE: 2	OF: 3	SHEET: UG Control
AIR EMISSION CALCULATIONS	SUBJECT: Underground Scrubbing	DATE: June 28, 2018		

Exhaust Shaft Dust Scrubbing Efficiency for PM_{10} and $PM_{2.5}$

Water droplets in the shaft will remove at least:

90% Particulate matter greater than 10 µm*
40% Particulate matter between 4 and 10 µm*
10% Particulate matter less than 4 µm*
** Resolution (Moreby 2008)*

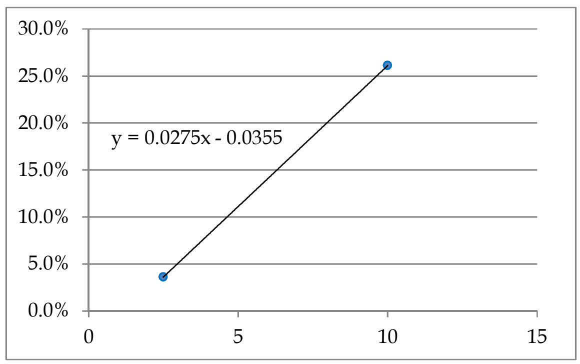
PM_4 Scrubbing Efficiency: 10%
PM_{10} Scrubbing Efficiency: Between 10% and 40%

To find PM_{10} scrubbing efficiency, solve for particulate distribution:

PM_{10} *lb/hr*	$PM_{2.5}$ *lb/hr*	PM *lb/hr*
110	15.3	422

** RESO EI 20140404.xlsx*

	Maximum particle size (µm)		
	2.5	10	30
Distribution:	3.6%	26.1%	100.0%



Fraction of particles with max size of 4 µm (x = 4) is 8.1%

PM_4/PM_{10} Ratio 31.1%
$PM_{2.5}/PM_4$ Ratio 44.6%

Exhaust Shaft Dust Scrubbing Efficiency	
PM_{10}	30.7%
$PM_{2.5}$	4.5%

Air Sciences Inc.	PROJECT TITLE: Resolution Copper			BY: N. Tipple
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AIR EMISSION CALCULATIONS	SUBJECT: Underground Scrubbing			DATE: June 28, 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

Stokes' Law

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

$$\eta = \frac{W_n L u_t}{Q_n}$$ *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*	*m/s*	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%

Ref No	Value	Unit	Description	List of References Location in EI	Reference
1	0.63	m/s	LHD/Ore Pass/Grizzly Wind Speed	Gen Info L26	EI Info Request, Resolution Copper
2	1.00	m/s	Rail Haulage Ore Flow Wind Speed	Gen Info L27	EI Info Request, Resolution Copper
3	1.79	m/s	Primary Crushing Ore Flow Wind Speed	Gen Info L28	EI Info Request, Resolution Copper
4	1.07	m/s	Lower Level Conveyor Ore Flow Wind Speed	Gen Info L29	EI Info Request, Resolution Copper
5	0.60	m/s	Hoisting System Ore Flow Wind Speed	Gen Info L30	EI Info Request, Resolution Copper
6	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
7	4	%	UG Ore Moisture Content	Gen Info I26 - I31	General Plan of Operations, Section 4.4.4
8	96	%	Incline Conveyor to Mine Transfer Conveyor Solids Content	Gen Info G33	Mill Flowcharts (40000-FS-601 through 623)
9	95.8	%	Enclosed Stockpile Solids Content	Gen Info G34	Mill Flowcharts (40000-FS-601 through 623)
10	95.8	%	Stockpile Reclaim Solids Content	Gen Info G35	Mill Flowcharts (40000-FS-601 through 623)
11	4.8	%	Mill Moisture Content	Gen Info I36 - I39	Largest moisture content listed in AP-42, Ch. 13.2.4
12	4.8	%	Loadout Moisture Content	Gen Info I41	Largest moisture content listed in AP-42, Ch. 13.2.4
13	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
14	1.3	mph	General Enclosed Transfer Wind Speed	Gen Info K34 - K41	Enclosure, Lowest Wind Speed listed in AP-42, Ch. 13.2.4
15	8,940	tonne/hr	Coarse Ore Stockpile Throughput	Gen Info V17	Technical Memo: Process Plant Mass Balance Calculations for EI
16	143,750	tonne/day	Coarse Ore Stockpile Throughput	Gen Info V18	Technical Memo: Process Plant Mass Balance Calculations for EI
17	45,625,000	tonne/yr	Coarse Ore Stockpile Throughput	Gen Info V19	Technical Memo: Process Plant Mass Balance Calculations for EI
18	4,296	tonne/hr	Sag Mill Throughput	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
19	94,875	tonne/day	Sag Mill Throughput	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
20	30,112,500	tonne/yr	Sag Mill Throughput	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
21	10	tonne/hr	Moly Cake Throughput (WET)	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
22	238	tonne/day	Moly Cake Throughput (WET)	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
23	41,176	tonne/yr	Moly Cake Throughput (WET)	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
24	8.95	tonne/hr	Moly Cake Throughput (DRIED)	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
25	213	tonne/day	Moly Cake Throughput (DRIED)	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
26	36,842	tonne/yr	Moly Cake Throughput (DRIED)	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
27	multiple parameters		Batch Plant Info	BatchPlant	Tech Memo - Batch Plant Data
28	0.002	grain/dscf	Baghouse grain loading	East Plant_CALC, Column J	Manufacturer (Donaldson Torit) Specifications
29	0.0185	%	S in Propane	Mill_CALC B97	Standard: GPA 2140-97
30	0.002	grain/dscf	Baghouse grain loading	Mill_CALC, Column J	Manufacturer (Donaldson Torit) Specifications
31	0.045	MMBtu/hr	Hydro House Heater Rating	Mill_CALC BH75	EI Info Request, Resolution Copper
32	0.065	MMBtu/hr	Hydro House Heater Rating	Mill_CALC BH76	EI Info Request, Resolution Copper
33	10	[quantity]	Quantity of Cable Bolters	EP_Fleet K24	EI Info Request, Resolution Copper
34	multiple parameters		East Plant Equipment List	EP_Fleet	RCM Mine Data for Ari Modelling 2012.xlsx
35	4	[tier]	Minimum Engine Tier Rating	EP_Fleet, Column L	EI Info Request, Resolution Copper
36	15%	%	Fuel Contingency	Fleet & Egen SO2, Tank VOC, GHG, HAPs	mobile equipment estimate mpo for all alternatives.xlsx
37	multiple parameters		Vehicle Speeds	EP_Fleet, Column CA	EI Info Request, Resolution Copper Best Management Practices
38	3	%	Road Silt Content	EP_Fleet, Column CB	AP-42, Chapter 13.2.2, Related Information, r13s0202_dec03.xls
39	multiple parameters		Vehicle Weights	All Fleets	Meeting with C. Pascoe 5/7/14, Phone Meeting K. Ballard 5/14/14, Spec Sheets
40	90	%	Control of Unpaved Roads with Chemical Suppressant	Loadout Fleet	Chem_Suppressant_Memo_20150225.pdf
41	4	[tier]	Minimum Engine Tier Rating	Mill_Fleet, Column L	EI Info Request, Resolution Copper
42	multiple parameters		Miscellaneous Mill Fleet Updates/Edits (ratings, hours, etc.)	Mill_Fleet	EquipmentHREst1252013.xlsx, Updated based on feedback from K. Ballard and R. Heig 4/16/14.
43	multiple parameters		Vehicle Speeds	Mill_Fleet, Column CA	EI Info Request, Resolution Copper Best Management Practices
44	3	%	Road Silt Content	Mill_Fleet, Column CB	AP-42, Chapter 13.2.2, Related Information, r13s0202_dec03.xls
45	90	%	Control of Unpaved Roads	EP Fleet, Mill Fleet	Chem_Suppressant_Memo_20150225.pdf
46	4	[tier]	Minimum Engine Tier Rating	Loadout_Fleet, Column L	EI Info, Request, Resolution Copper
47	multiple parameters		Miscellaneous Mill Fleet Updates/Edits (ratings, hours, etc.)	Loadout_Fleet	Per RCM Mine Data for Ari Modelling 2012.xlsx, Updated based on feedback from K. Ballard and R. Heig 4/16/14.
48	4	[tier]	Minimum Engine Tier Rating	Tailings_Fleet, Column L	EI Info Request, Resolution Copper
49	multiple parameters		Miscellaneous Tailings Fleet Updates/Edits (ratings, hours, etc.)	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
50	multiple parameters		Vehicle Speeds	Tailings_Fleet, Column CA	EI Info Request, Resolution Copper Best Management Practices
51	3	%	Road Silt Content	Tailings_Fleet, Column CB	AP-42, Chapter 13.2.2, Related Information, r13s0202_dec03.xls
52	90	%	Control of Unpaved Roads	Tailings Fleet	Chem_Suppressant_Memo_20150225.pdf
53	332	[quantity]	Number of Employees at East Plant	Employees E12	General Plan of Operations, Section 3.7.2
54	318	[quantity]	Number of Employees at Mill	Employees E13	General Plan of Operations, Section 3.7.2
55	17	[quantity]	Number of Employees at Loadout	Employees E14	General Plan of Operations, Section 3.7.2
56	18	[quantity]	Number of Employees at Tailings	Employees E15	General Plan of Operations, Section 3.7.2
57	3	%	Road Silt Content	Employees G32 - G35	AP-42, Chapter 13.2.2, Related Information, r13s0202_dec03.xls

List of References

Ref No	Value	Unit	Description	Location in EI	Reference
58	2	ton	Average Vehicle Weight	Employees I32 - I35	Average Vehicle Weight in 2010, Time Magazine
59	90	%	Control of Unpaved Roads	Employees C62	AP-42, Figure 13.2.2-5, Rev. 11/06
60	14	[quantity]	East Plant Emergency Generator Quantity	E_Gen AN16	EI Info Request, Resolution Copper
61	500	hr/yr	East Plant Emergency Generator Hours of Operation	E_Gen W19, AN17, BE18, BV18, CM18	Email from K. Walch, 4/14/2014
62	6,562	ft	Depth of Mine	Fuel Tanks C30	2000 m, RCM Pre-feasibility Refrigeration and Ventilation Study, 2012, p. 9
63	4,200	l/s	Surface Cooling Tower Circulation Rate	Cooling G11	RCM Pre-feasibility Refrigeration and Ventilation Study, 2012, Section 8.3
64	0.005%	%	Drift Loss	Cooling G12, G16	Hatch. Condenser Cooling Tower Blowdown and Make-Up Water Requirement Review
65	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
66	3,000	ppm	Total Dissolved Solids Content	Cooling G20	RCM Pre-feasibility Refrigeration and Ventilation Study, 2012, Section 11.2
67			Reagent Tank Volumes	Reagents	Design Criteria 2013 08 6.pdf (pg 25-27)
68	487	blasts/yr	East Plant Number of Blasts	Drill & Blast AN12	Tech Memo: Underground Blasting Face Area for Emissions Calculation
69	2	max blasts/day	East Plant Number of Blasts	Drill & Blast AN13	Tech Memo: Underground Blasting Face Area for Emissions Calculation
70	580	m^2 (max daily)	East Plant Blast Area	Drill & Blast AN20	Tech Memo: Underground Blasting Face Area for Emissions Calculation
71	141,200	m^2 (annual)	East Plant Blast Area	Drill & Blast AN23	Tech Memo: Underground Blasting Face Area for Emissions Calculation
72	32.53	lb/ton	CO EF	Drill & Blast AN26, BE26	NIOSH - Fumes Studies - Richard Mainiero, Emulsion
73	6.2	lb/ton	NOX EF	Drill & Blast AN27, BE27	NIOSH - Fumes Studies - Richard Mainiero, Emulsion
74	40	°C	Underground Temp	Flow C47	RCM Pre-feasibility Refrigeration and Ventilation Study, 2012, p. 12
75	6,562	ft	Depth of Mine	Flow I39	RCM Pre-feasibility Refrigeration and Ventilation Study, 2012, p. 9
76	18,950	acfm	Stockpile Reclaim Dust Collector Flow	Flow C27	Email from Eric Pedersen (M3) 3/27/14
77	22,500	a m^3/hr	Crusher Dust Collector Flow	Flow C51	UG Flowsheet 0000
78	5,100	a m^3/hr	Conveyor Transfer Dust Collector Flow	Flow C55	UG Flowsheet 0000
79	22,500	a m^3/hr	Silos Dust Collector Flow	Flow C59	UG Flowsheet 0000
80	17,000	a m^3/hr	Skip Loading Dust Collector Flow	Flow C63	UG Flowsheet 0000
81	17,000	a m^3/hr	Bin Unloading Dust Collector Flow	Flow C67	UG Flowsheet 0000
82	64	days/year	EPS Precip Data (days >0.01")	Precip	2015-2016 Processed AERMET Precip Data (EP)
83	58	days/year	WPS Precip Data (days >0.01")	Precip	2015-2016 Processed AERMET Precip Data (WP)
84	57	days/year	TSF Precip Data (days >0.01")	Precip	2015-2016 Processed AERMET Precip Data (Hewitt)
85	57	days/year	TSF Precip Data (days >0.01")	Precip	2015-2016 Processed AERMET Precip Data (Hewitt)
86	21.3	acre	Exposed area at East Plant	WindblownDust B2	GIS Analysis with K. Ballard
87	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
88	70	acre	Exposed area at Mill	WindblownDust I2	GIS Analysis with K. Ballard
89	1,380	acre	Dry Beach	WindblownDust W5	180302R-Alt3A-TM-DustMgmt Rev B.pdf
90	59	acre	Dam Slope	WindblownDust W6	180302R-Alt3A-TM-DustMgmt Rev B.pdf
91	90	%	PM>10 Control (Water Droplet Scrubbing)	UG Control S12	RCM Exhaust Shaft Scrubbing Efficiency.pdf
92	40	%	PM4-10 Control (Water Droplet Scrubbing)	UG Control S13	RCM Exhaust Shaft Scrubbing Efficiency.pdf
93	10	%	PM<4 Control (Water Droplet Scrubbing)	UG Control S14	RCM Exhaust Shaft Scrubbing Efficiency.pdf
94	60	%	PM7 Control (Heat Rejection Sprays)	UG Control AN14	RCM Exhaust Shaft Scrubbing Efficiency.pdf
95	45	%	PM7 Control (Heat Rejection Sprays)	UG Control AN13	RCM Exhaust Shaft Scrubbing Efficiency.pdf
96	5	%	PM7 Control (Heat Rejection Sprays)	UG Control AN12	RCM Exhaust Shaft Scrubbing Efficiency.pdf
97	1.8E-5	Ns/m^2	Dynamic Viscosity of Air	UG Control AO45	The Aerodynamics, Sources, and Control of Airborne Dust Chapter 20.pdf
98	50	%	Air that Flows Through the Heat Rejection Sprays	UG Control AN16	RCM Exhaust Shaft Scrubbing Efficiency.pdf
99	6.7	m	width of shaft 9	UG Control AN46	RCM Pre-feasibility Refrigeration and Ventilation Study, 2012, p. 9
100	8.5	m	width of shaft 10	UG Control AN47	RCM Pre-feasibility Refrigeration and Ventilation Study, 2012, p. 9
101	10	m	width of shaft 14	UG Control AN48	RCM Pre-feasibility Refrigeration and Ventilation Study, 2012, p. 9
102	2,000	m	length of chamber	UG Control AN49	RCM Pre-feasibility Refrigeration and Ventilation Study, 2012, p. 9
103	622	m^3/s	chamber air flowrate (all vents)	UG Control AN50	RCM Pre-feasibility Refrigeration and Ventilation Study, 2012, p. 49
104	multiple parameters		Concentration of HAPs/Metals in Ore	HAPs, Column BF	Average of 6 ore body samples (RES-009A, 017L, 017M, 023D, 025D, 002B).
105	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
106	multiple parameters		Ore Haul Trucks - Powertrans T954	EP_Fleet J45-N45	160T Powertrans Double RT Concept Underground.xlsx, units converted
107	multiple parameters		Average Distance Travelled, one way VMT, ea	Employees & Deliveries	GIS estimation with K. Ballard
108	2,628	hp	HP of Egen	E_Gen W11	Pinal County Air Quality, Permit Number B30993.0000
109	449	hp	HP of Egen	E_Gen W14	Pinal County Air Quality, Permit Number B30993.0000
110	4,376	hp	HP of Egens	E_Gen AN13	Caterpillar Standby 3100 kW Tier 4i Performance Data
111	multiple parameters		VOC Emission Calculations	Fuel Tanks G26 through K26	Calculated using by EPA Tanks 4.0.9d, 05/02/2014
112	135	MW	Cooling capacity	Cooling G13	RCM Pre-feasibility Refrigeration and Ventilation Study, 2012, Section 8.3
113	multiple parameters		MOVES Results (Deliveries & Employees)	Deliveries & Employees	MOVES 2014a
114	134.91	lb/yr	MIBC (Methyl isobutyl carbonal) - VOC Emissions	Reagents G13	MIBC (Methyl isobutyl carbonal) - EPA Tank 4.0.9d calculations
115	9.53	lb/yr	MCO (Non-polar flotation oil) - VOC Emissions	Reagents G14	MCO (Non-polar flotation oil) - EPA Tank 4.0.9d calculations
116	0.10	lb/yr	CYTEC 8989 - VOC Emissions	Reagents G15	CYTEC 8989 - EPA Tank 4.0.9d calculations
117	multiple parameters		Load Factors	All Fleets	Resolution, engine factor.xlsx
118	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)
119	multiple parameters		West Plant, Filter Plant, Tailings Mobile Equipment Specs	Mill_Fleet Loadout_Fleet Tailings_Fleet	RCM Mine Data for Ari Modelling 2012.xlsx
120	1,500	kW	West Plant Egen demand	E_Gen Pg 4	9/30/2016, M3 Tech. Memo & CAT C18 Specs
121	500	kW	Filter Plant Egen demand	E_Gen Pg 6	9/30/2016, M3 Tech. Memo & CAT C18 Specs
122	500	kW	TSF Egen demand	E_Gen Pg 5	9/30/2016, M3 Tech. Memo & CAT C18 Specs
123	390	blasts/yr	West Plant Number of Blasts	Drill & Blast BE12	Tech Memo: Underground Blasting Face Area for Emissions Calculation
124	2	max blasts/day	West Plant Number of Blasts	Drill & Blast BE13	Tech Memo: Underground Blasting Face Area for Emissions Calculation
125	63	m^2 (max daily)	West Plant Blast Area	Drill & Blast BE20	Tech Memo: Underground Blasting Face Area for Emissions Calculation
126	14,400	m^2 (annual)	West Plant Blast Area	Drill & Blast BE23	Tech Memo: Underground Blasting Face Area for Emissions Calculation
127	164,300	tonne/yr	WP development rock drill and blast	Drill & Blast V21	Tech Memo: Underground Blasting Face Area for Emissions Calculation
128	1,414	tonne/hr	WP development rock drill and blast	Drill & Blast E22	Tech Memo: Underground Blasting Face Area for Emissions Calculation
129	118,300	kg/yr	WP blasting agent usage	Drill & Blast V22	Tech Memo: Underground Blasting Face Area for Emissions Calculation
130	2,065,200	tonne/yr	EP development rock drill and blast	Drill & Blast V22	Tech Memo: Underground Blasting Face Area for Emissions Calculation
131	1,414	tonne/hr	EP development rock drill and blast	Drill & Blast V22	Tech Memo: Underground Blasting Face Area for Emissions Calculation
132	1,487,000	kg/yr	EP blasting agent usage	Drill & Blast V22	Tech Memo: Underground Blasting Face Area for Emissions Calculation
133	502.6	tonne/yr	Long-Term uncontrolled fuel oil vapor	MolyTalc	Tech Memo: Molybdenite / Talc Concentrate Heat Treatment Emissions
134	59.1	tonne/yr	Long-Term controlled fuel oil vapor	MolyTalc	Tech Memo: Molybdenite / Talc Concentrate Heat Treatment Emissions
135	171.9	lb/hr	Short-Term uncontrolled fuel oil vapor	MolyTalc	Tech Memo: Molybdenite / Talc Concentrate Heat Treatment Emissions
136	20.2	lb/hr	Short-Term controlled fuel oil vapor	MolyTalc	Tech Memo: Molybdenite / Talc Concentrate Heat Treatment Emissions
137	245.3	tonne/yr	Long-Term uncontrolled SO2	MolyTalc	Tech Memo: Molybdenite / Talc Concentrate Heat Treatment Emissions
138	12.3	tonne/yr	Long-Term controlled SO2	MolyTalc	Tech Memo: Molybdenite / Talc Concentrate Heat Treatment Emissions
139	83.9	lb/hr	Short-Term uncontrolled SO2	MolyTalc	Tech Memo: Molybdenite / Talc Concentrate Heat Treatment Emissions
140	4.2	lb/hr	Short-Term controlled SO2	MolyTalc	Tech Memo: Molybdenite / Talc Concentrate Heat Treatment Emissions
141	62,603	tonne/yr	Long-Term filter cake throughput (through rotary dryer)	MolyTalc	Tech Memo: Molybdenite / Talc Concentrate Heat Treatment Emissions
142	9.7	tonne/hr	Short-Term filter cake throughput (through rotary dryer)	MolyTalc	Tech Memo: Molybdenite / Talc Concentrate Heat Treatment Emissions
143	99%		wet ESP control efficiency	MolyTalc	EPA Air Pollution Control Technology Fact Sheet, Wet Electrostatic Precipitator
144	10	lb/ton	Emission Factor for Concentrate Dryer	MolyTalc	AP-42 Chapter 12.3

List of References

Ref No	Value	Unit	Description	Location in EI	Reference
145	1,042	tonne/hr	Pebble Recycle	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
146	23,000	tonne/day	Pebble Recycle	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
147	7,300,000	tonne/yr	Pebble Recycle	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
148	414	tonne/hr	Copper Concentrate Throughput	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
149	9,942	tonne/day	Copper Concentrate Throughput	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
150	3,338,889	tonne/yr	Copper Concentrate Throughput	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
151	1,060	tonne/hr	SAG Trommel Oversize	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
152	23,390	tonne/day	SAG Trommel Oversize	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
153	7,424,100	tonne/yr	SAG Trommel Oversize	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
154	7,011	tonne/hr	Ball Mill Feed	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
155	154,808	tonne/day	Ball Mill Feed	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
156	49,134,616	tonne/yr	Ball Mill Feed	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
157	6,166	trip/yr	EP Materials/Equipment Deliveries	Deliveries	GPO Section 3.4.2
158	20	trips/day	EP Materials/Equipment Deliveries	Deliveries	GPO Section 3.4.2
159	6,935	trip/yr	WP Materials/Equipment Deliveries	Deliveries	GPO Section 3.4.2
160	19	trips/day	WP Materials/Equipment Deliveries	Deliveries	GPO Section 3.4.2
161	0	trip/yr	TSF Materials/Equipment Deliveries	Deliveries	GPO Section 3.4.2
162	0	trips/day	TSF Materials/Equipment Deliveries	Deliveries	GPO Section 3.4.2
163	0	trip/yr	FPLF Materials/Equipment Deliveries	Deliveries	GPO Section 3.4.2
164	0	trips/day	FPLF Materials/Equipment Deliveries	Deliveries	GPO Section 3.4.2
165	11	trips/hr	WP Materials/Equipment Deliveries	Deliveries	GPO Section 3.4.2
166	16.25	MMBtu	Heat Capacity of Moly/Talc Rotary Dryer	MolyTalc	Tech Memo: Molybdenite / Talc Concentrate Heat Treatment Emissions
167	0.20	mi/RT	Distance of UG RT LHD	EP_Fleet	TruckandLoaderHaulageDistances.pptx
168	2.34	mi/RT	Distance of UG RT Haul	EP_Fleet	TruckandLoaderHaulageDistances.pptx

Appendix B – Construction Emissions Inventory (Proposed Action)

Air Sciences Inc.	PROJECT TITLE: Resolution Copper Project	BY: D. Steen
	PROJECT NO: 262-32-05	PAGE: 1 OF: 1 SHEET: Summary
AIR EMISSION CALCULATIONS	SUBJECT: Contsruction EI	DATE: June 28, 2018

Controlled Emissions Summary - Project Total (*ton/proj*)

	PM	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC	Duration (mo)
West Plant Construction Emissions	895	391	35.6	158	99.0	5.0	76.4	18
East Plant Construction Emissions	603	230	21.4	130	62.3	10.1	38.3	12
TSF Corridor Construction Emissions	250	111	10.8	43.0	42.6	0.22	41.3	18
TSF Prep Construction Emissions	879	278	41.8	610	331	12.5	228	36
Filter Plant Construction Emissions	192	69.5	7.3	20.9	23.0	2.0	23.0	18
TOTAL	**2,818**	**1,080**	**117**	**962**	**558**	**29.9**	**407**	**-**

Controlled Emissions Summary - Annual (*ton/yr*)

	PM	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC
West Plant Construction Emissions	556	251	22.8	105	66.0	2.0	50.9
East Plant Construction Emissions	433	191	17.4	129	62.3	4.0	38.2
TSF Corridor Construction Emissions	195	80.1	8.4	28.7	28.4	0.15	27.5
TSF Prep Construction Emissions	286	88.8	13.7	203	110	4.2	76.0
Filter Plant Construction Emissions	104	40.9	4.3	13.9	15.3	0.51	15.3
TOTAL	**1,573**	**651**	**66.6**	**480**	**282**	**10.8**	**208**

Controlled Emissions Summary - Hourly (*lb/hr*)

	PM	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC
West Plant Construction Emissions	465	204	19.1	473	157	13.1	47.6
East Plant Construction Emissions	377	158	15.6	726	217	21.7	42.2
TSF Corridor Construction Emissions	167	67.6	7.6	57.9	42.5	0.79	36.1
TSF Prep Construction Emissions	271	79.3	12.3	1,045	317	29.5	66.3
Filter Plant Construction Emissions	109	38.6	4.5	18.0	20.0	0.76	20.1
TOTAL	**1,388**	**548**	**59.1**	**2,320**	**753**	**65.8**	**212**

Air Sciences Inc.	PROJECT TITLE: Resolution Copper Project	BY: D. Steen
	PROJECT NO: 262-32-05	PAGE: 1 OF: 9 SHEET: West Plant
AIR EMISSION CALCULATIONS	SUBJECT: West Plant Construction Emissions	DATE: June 28, 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	89.0	22.6	2.7	--
Mobile Equipment Combustion	3.9	3.9	3.9	68.5	76.4	0.13	76.4
Mobile Equipment - Fugitives	438	189	15.6	--	--	--	--
Dozing	38.5	6.1	4.0	--	--	--	--
Grading	20.9	6.0	0.65	--	--	--	--
Scraping	308	160	9.2	--	--	--	--
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	1.6	0.82	0.12	--	--	--	--
TOTAL	**895**	**391**	**35.6**	**158**	**99.0**	**5.0**	**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	59.3	15.0	1.8	--
Mobile Equipment Combustion	2.6	2.6	2.6	45.6	50.9	8.4E-2	50.9
Mobile Equipment - Fugitives	292	126	10.4	--	--	--	--
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	**556**	**251**	**22.8**	**105**	**66.0**	**2.0**	**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	430	109	12.8	--
Mobile Equipment Combustion	2.4	2.4	2.4	42.7	47.6	5.1E-2	47.6
Mobile Equipment - Fugitives	253	105	8.8	--	--	--	--
Dozing	21.1	3.4	2.2	--	--	--	--
Grading	11.4	3.3	0.35	--	--	--	--
Scraping	164	85.4	4.9	--	--	--	--
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	0.25	0.13	1.9E-2	--	--	--	--
TOTAL	**465**	**204**	**19.1**	**473**	**157**	**13.1**	**47.6**

Blue entries are entered values, *black entries are calculated or linked*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper Project	BY: D. Steen
	PROJECT NO: 262-32-05	PAGE: 2 OF: 9 SHEET: West Plant
AIR EMISSION CALCULATIONS	SUBJECT: West Plant Construction Emissions	DATE: June 28, 2018

Drilling

Project Duration	18	*months*	*Email from Resolution (4/13/2018)*
Material Quantity	3,211,740	*tonne/yr*	
	4,817,610	*tonne/proj*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	3,540,333	*ton/yr*	
	5,310,500	*ton/proj*	
	1,416	*ton/hr*	
Operation	250	*days/yr*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	10	*hr/day*	*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	0.24	0.30	0.45
PM_{10}	0.11	0.14	0.21
$PM_{2.5}$	1.7E-2	2.1E-2	3.2E-2

Conversions	
2,000	*lb/ton*
1.1023	*ton/tonne*
3.2808	*ft/m*
100	*cm/m*
453.592	*g/lb*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper Project	BY: D. Steen		
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Blasting

Material Moved	4,817,610	*tonne/proj*	
	5,310,500	*ton/proj*	
	3,540,333	*ton/yr*	
Blasting Agent Use	2,409	*tonne/proj*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	2,655	*ton/proj*	
	1,770	*ton/yr*	
Number of Blasts	375	*blasts/proj*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	250	*blasts/yr*	
	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	$TSP = 0.000014 \times A^1$	*lb/blast*	*AP-42, Tab. 11.9-1, 7/98 (blasting, overburden)*				
Where, A = Area per Blast	5,382	*ft²*	Where, A = Area per Year	2,018,233	*ft²*	1,345,489	*ft²*
TSP	5.5	*lb/blast*	TSP	40,141	*lb/proj*	21,850	*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	5.5	5.5	10.9	20.1
PM_{10}	2.9	2.9	5.7	10.4
$PM_{2.5}$	0.17	0.17	0.33	0.60
CO	430	430	59.3	89.0
NO_X	109	109	15.0	22.6
SO_2	12.8	12.8	1.8	2.7

** Based on maximum of 1 blasts per day*

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Mobile Equipment Combustion

Operational Parameters

Mobile Equipment	Engine Rating kW	Engine Rating hp	Quantity	EPA Tier	Fuel gal/hr	Project Hours	Annual 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 6:	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

** Scalled down from 18 months to 12 months*

Diesel Emission Factors *

Equipment	PM g/kW-hr	CO g/kW-hr	NO_X g/kW-hr	VOC 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 6:	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 *

Equipment	PM g/mi	CO g/mi	NO_X g/mi	SO_2 g/mi	VOC 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			

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Mobile Equipment Combustion - Continued

Fleet Emissions

	PM		CO		NO_X		SO_2*		VOC	
Equipment	*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**

** SO_2 emissions - mass balance based on 15 ppm S content (ULSD)*

Fleet Emissions (18-Month Project)

	PM	CO	NO_X	SO_2*	VOC
Equipment	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*	*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**

** SO_2 emissions - mass balance based on 15 ppm S content (ULSD)*

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Mobile Equipment - Fugitives

Mobile Equipment	Quantity	Project Hours	Annual Hours	Hours Per Unit	Speed * *mph*	Weight ** *ton*	Silt *** *%*
D-9T Dozer	6	21,917	14,611	3,653	*Dozer specs on page 7*		
Grader Cat 160M (16')	3	10,958	7,305	3,653	*Grader specs on page 7*		
Cat 623G Scraper 18-23CY	3	10,958	7,305	3,653	*Grader specs on page 7*		
Compactor Vib Cat CB-54C 67"	2	5,479	3,653	2,740	2	14.3	3.0
Water Truck (8,000 gallons)	2	4,870	3,247	2,435	15	50.2	3.0
Fuel/Lube Truck	1	3,456	2,304	3,456	15	12.5	3.0
Cat 336DL 1.56 CY Excavator	2	5,479	3,653	2,740	2	38.6	3.0
Cat 980 Loader 7.5 CY	1	2,740	1,827	2,740	2	19.6	3.0
Haul Truck 740 CAT	1	1,370	913	1,370	15	58.3	3.0
4x4 3/4T Pickup Gas	3	11,250	7,500	3,750	15	4.0	3.0
Mean Vehicle Weight						25.7	

** 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			
$E = k \times (s / 12)^a \times (W / 3)^b$	**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(unctl) x (365 - P) / 365		
Days of >0.01" Precip	58	*West 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.*

	Emission Factors *(lb/VMT)*			Estimated Emissions (Controlled)								
	PM	PM_{10}	$PM_{2.5}$		PM			PM_{10}			$PM_{2.5}$	
Mobile Equipment				*lb/hr*	*ton/yr*	*ton/proj*	*lb/hr*	*ton/yr*	*ton/proj*	*lb/hr*	*ton/yr*	*ton/proj*
Compactor Vib Cat CB-54C 67	4.9	1.1	0.11	2.0	1.5	2.2	0.45	0.35	0.52	4.5E-2	3.5E-2	5.2E-2
Water Truck (8,000 gallons)	4.9	1.1	0.11	14.6	10.0	15.0	3.4	2.3	3.5	0.34	0.23	0.35
Fuel/Lube Truck	4.9	1.1	0.11	7.3	7.1	10.6	1.7	1.6	2.5	0.17	0.16	0.25
Cat 336DL 1.56 CY Excavator	4.9	1.1	0.11	2.0	1.5	2.2	0.45	0.35	0.52	4.5E-2	3.5E-2	5.2E-2
Cat 980 Loader 7.5 CY	4.9	1.1	0.11	0.98	0.75	1.1	0.23	0.17	0.26	2.3E-2	1.7E-2	2.6E-2
Haul Truck 740 CAT	4.9	1.1	0.11	7.3	2.8	4.2	1.7	0.65	0.98	0.17	6.5E-2	9.8E-2
4x4 3/4T Pickup Gas	4.9	1.1	0.11	22.0	23.1	34.6	5.1	5.4	8.0	0.51	0.54	0.80
TOTAL				**56.1**	**46.8**	**70.1**	**13.0**	**10.8**	**16.3**	**1.3**	**1.1**	**1.6**

Dozing/Grading/Scraping Emissions

Dozing and Grading Emission Factor Equations	*AP-42, 11.9, Table 11.9-1 (overburden), Rev. 7/98.*		Scaling Factors	
			PM_{10}	$PM_{2.5}$
Dozing (PM)	E lb/hr = (5.7 *(s) 1.2) / (M 1.3)			0.105
Dozing (PM_{15})	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 (PM_{15})	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)*		

Sraping Emission Factor					*AP-42, 11.9, Table 11.9-4 (topsoil), Rev. 7/98.*
Topsoil removal by scraper			Scaling Factor		*AP-42, Tab. 11.9-1, 7/98 (blasting, overburden)*
PM	0.058	*lb/ton*	PM_{10}	$PM_{2.5}$	
			0.52	0.03	

Scraping Operational Parameters

Cut Volume	3,503,716	*m^3*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
Specific Gravity	2.75	*g/cm^3*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	10,621,020	*ton/proj*	
	7,080,680	*ton/yr*	
	2,832	*ton/hr*	

Emission Factors

Mobile Equipment	**Unit**	**PM**	**PM_{10}**	**$PM_{2.5}$**
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								
	PM			**PM_{10}**			**$PM_{2.5}$**		
Mobile Equipment	*lb/hr*	*ton/yr*	*ton/proj*	*lb/hr*	*ton/yr*	*ton/proj*	*lb/hr*	*ton/yr*	*ton/proj*
D-9T Dozer	21.1	25.7	38.5	3.4	4.1	6.1	2.2	2.7	4.0
Grader Cat 160M (16')	11.4	13.9	20.9	3.3	4.0	6.0	0.35	0.43	0.65
Cat 623G Scraper 18-23CY	164	205	308	85.4	107	160	4.9	6.2	9.2
TOTAL	**197**	**245**	**367**	**92.1**	**115**	**172**	**7.5**	**9.3**	**13.9**

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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 *

	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

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 *

$E = k \times (s / 12)^a \times (W / 3)^b$

		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	2.2	0.52	5.2E-2
s - surface material silt content (*%*) **	3.0	a	0.7	0.9	0.9			
W - mean vehicle wt (*ton*) ***	4.5	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	58	*West 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.*

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	5.4E-2	5.4E-2	9.6E-3	9.9E-2	5.3E-3	2.1	2.3E-2
Delivery	7.7E-2	7.7E-2	2.2E-2	0.30	9.4E-4	0.10	2.3E-2
	ton/yr	*ton/yr*	*ton/yr*	*ton/yr*	*ton/yr*	*ton/yr*	*ton/yr*
Employee	3.0E-3	3.0E-3	5.2E-4	5.4E-3	2.9E-4	0.12	1.3E-3
Delivery	2.2E-2	2.2E-2	6.2E-3	8.6E-2	2.7E-4	2.9E-2	6.5E-3
	ton/proj	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*
Employee	4.4E-3	4.4E-3	7.9E-4	8.1E-3	4.3E-4	0.17	1.9E-3
Delivery	3.3E-2	3.3E-2	9.3E-3	0.13	4.0E-4	4.3E-2	9.7E-3

Unpaved Road Emissions (Controlled)

	PM	PM_{10}	$PM_{2.5}$
	lb/hr	*lb/hr*	*lb/hr*
Employee	55.5	12.9	1.3
Delivery	8.0	1.9	0.19
	ton/yr	*ton/yr*	*ton/yr*
Employee	2.5	0.59	5.9E-2
Delivery	1.9	0.44	4.4E-2
	ton/proj	*ton/proj*	*ton/proj*
Employee	3.8	0.88	8.8E-2
Delivery	2.9	0.67	6.7E-2

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Wind Erosion from Exposed Areas

269.4	Maximum Erodible Area (acres)	*Exposed Areas (Except TSF).xlsx*		
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			

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*
2.5	1.3	0.19	11.0	5.5	0.82	16.4	8.2	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*
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/u10+* 0.053 *AP-42, Sec. 13.2.5, p. 5*

(A) u10+ = 1.2 u10 Fastest mile wind speed at 10m, with a 1.2 factor to convert hourly wind speed to fastest mile.

(B, piles) u = (Us/Ur) × 0.1 × u10+*

(B, flat) u = 0.053 × u10+* *Threshold Friction Velocity, AZ Cu Mine Tailings*

(C) P = 58 (u - ut*)2 + 25 (u* - ut*); P = 0 for u* ≤ ut*; where ut* =* 0.172 *m/s*

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	209	89.8	7.5	--	--	--	--
Dozing	19.3	3.1	2.0	--	--	--	--
Grading	10.5	3.0	0.32	--	--	--	--
Scraping	146	76.0	4.4	--	--	--	--
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	0.46	0.23	3.5E-2	--	--	--	--
TOTAL	**603**	**230**	**21.4**	**130**	**62.3**	**10.1**	**38.3**

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	209	89.8	7.5	--	--	--	--
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	**433**	**191**	**17.4**	**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	688	175	20.5	--
Mobile Equipment Combustion	2.2	2.2	2.2	37.9	42.2	5.1E-2	42.2
Mobile Equipment - Fugitives	193	77.8	6.8	--	--	--	--
Dozing	17.6	2.8	1.8	--	--	--	--
Grading	11.4	3.3	0.35	--	--	--	--
Scraping	117	60.8	3.5	--	--	--	--
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	0.11	5.3E-2	7.9E-3	--	--	--	--
TOTAL	**377**	**158**	**15.6**	**726**	**217**	**21.7**	**42.2**

Blue entries are entered values, black entries are calculated or linked

Drilling

Project Duration	12	*months*	*Email from K. Ballard (4/13/2018)*
Material Quantity	5,134,891	*tonne/yr*	
	5,134,891	*tonne/proj*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	5,660,242	*ton/yr*	
	5,660,242	*ton/proj*	
	2,264	*ton/hr*	
Operation	250	*days/yr*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	10	*hr/day*	*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	0.38	0.48	0.48
PM_{10}	0.18	0.23	0.23
$PM_{2.5}$	2.7E-2	3.4E-2	3.4E-2

Conversions	
2,000	*lb/ton*
1.1023	*ton/tonne*
3.2808	*ft/m*
100	*cm/m*
453.592	*g/lb*

Blasting

Material Moved	5,134,891	*tonne/proj*	
	5,660,242	*ton/proj*	
	5,660,242	*ton/yr*	
Blasting Agent Use	2,567	*tonne/proj*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	2,830	*ton/proj*	
	2,830	*ton/yr*	
Number of Blasts	250	*blasts/proj*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	250	*blasts/yr*	
	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	$TSP = 0.000014 \times A^{1.5}$	*lb/blast*	*AP-42, Tab. 11.9-1, 7/98 (blasting, overburden)*				
Where, A = Area per Blast	8,073	*ft²*	Where, A = Area per Year	2,018,233	*ft²*	2,018,233	*ft²*
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	688	688	94.8	94.8
NO_X	175	175	24.1	24.1
SO_2	20.5	20.5	2.8	2.8

** Based on maximum of 1 blasts per day*

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Mobile Equipment Combustion

Operational Parameters

Mobile Equipment	Engine Rating kW	Engine Rating hp	Quantity	EPA Tier	Fuel gal/hr	Project Hours *	Annual Hours	Hours Per Unit	
D-9T Dozer	325	436	5	3	22	10,958	10,958	2,192	5T3
Grader Cat 160M (16')	159	213	3	3	11	5,479	5,479	1,826	4T3
Cat 623G Scraper 18-23CY	294	394	3	3	20	5,479	5,479	1,826	5T3
Compactor Vib Cat CB-54C 67	102	137	2	3	7	2,740	2,740	1,370	3T3
Water Truck (8,000 gallons)	294	394	1	3	20	2,435	2,435	2,435	5T3
Fuel/Lube Truck	224	300	1	3	15	1,728	1,728	1,728	4T3
Cat 336DL 1.56 CY Excavator	200	268	2	3	14	2,740	2,740	1,370	4T3
Cat 980 Loader 7.5 CY	325	436	1	3	22	1,370	1,370	1,370	5T3
Haul Truck 740 CAT	350	469	1	3	24	685	685	685	5T3
4x4 3/4T Pickup Gas	308	413	3	3	21	5,625	5,625	1,875	5T3

** Project duration is expected to be 12 months*

Diesel Emission Factors *

Equipment	PM g/kW-hr	CO g/kW-hr	NO_X g/kW-hr	VOC 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 *

Equipment	PM g/mi	CO g/mi	NO_X g/mi	SO_2 g/mi	VOC 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			

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Mobile Equipment Combustion - Continued

Fleet Emissions

	PM		CO		NO_X		SO_2*		VOC	
Equipment	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*
D-9T Dozer	0.72	0.79	12.5	13.7	14.3	15.7	4.6E-3	2.5E-2	14.3	15.7
Grader Cat 160M (16')	0.21	0.19	3.7	3.4	4.2	3.8	2.3E-3	6.4E-3	4.2	3.8
Cat 623G Scraper 18-23CY	0.39	0.36	6.8	6.2	7.8	7.1	4.2E-3	1.2E-2	7.8	7.1
Compactor Vib Cat CB-54C 67	0.13	9.2E-2	2.2	1.5	1.8	1.2	1.5E-3	2.0E-3	1.8	1.2
Water Truck (8,000 gallons)	0.13	0.16	2.3	2.8	2.6	3.2	4.2E-3	5.1E-3	2.6	3.2
Fuel/Lube Truck	9.9E-2	8.5E-2	1.7	1.5	2.0	1.7	3.2E-3	2.7E-3	2.0	1.7
Cat 336DL 1.56 CY Excavator	0.18	0.12	3.1	2.1	3.5	2.4	3.0E-3	4.1E-3	3.5	2.4
Cat 980 Loader 7.5 CY	0.14	9.8E-2	2.5	1.7	2.9	2.0	4.6E-3	3.2E-3	2.9	2.0
Haul Truck 740 CAT	0.15	5.3E-2	2.7	0.92	3.1	1.1	5.1E-3	1.7E-3	3.1	1.1
4x4 3/4T Pickup Gas	9.8E-3	9.2E-3	0.38	0.36	1.8E-2	1.7E-2	1.8E-2	8.9E-4	4.2E-3	3.9E-3
TOTAL	**2.2**	**1.9**	**37.9**	**34.2**	**42.2**	**38.2**	**5.1E-2**	**6.3E-2**	**42.2**	**38.2**

** SO_2 emissions - mass balance based on 15 ppm S content (ULSD)*

Fleet Emissions (18-Month Project)

	PM	CO	NO_X	SO_2*	VOC
Equipment	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*
D-9T Dozer	0.79	13.7	15.7	2.5E-2	15.7
Grader Cat 160M (16')	0.19	3.4	3.8	6.4E-3	3.8
Cat 623G Scraper 18-23CY	0.36	6.2	7.1	1.2E-2	7.1
Compactor Vib Cat CB-54C 67	9.2E-2	1.5	1.2	2.0E-3	1.2
Water Truck (8,000 gallons)	0.16	2.8	3.2	5.1E-3	3.2
Fuel/Lube Truck	8.5E-2	1.5	1.7	2.7E-3	1.7
Cat 336DL 1.56 CY Excavator	0.12	2.1	2.4	4.1E-3	2.4
Cat 980 Loader 7.5 CY	9.8E-2	1.7	2.0	3.2E-3	2.0
Haul Truck 740 CAT	5.3E-2	0.92	1.1	1.7E-3	1.1
4x4 3/4T Pickup Gas	9.2E-3	0.36	1.7E-2	8.9E-4	3.9E-3
TOTAL	**1.9**	**34.2**	**38.2**	**6.3E-2**	**38.2**

** SO_2 emissions - mass balance based on 15 ppm S content (ULSD)*

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Mobile Equipment - Fugitives

Mobile Equipment	Quantity	Project Hours	Annual Hours	Hours Per Unit	Speed * *mph*	Weight ** *ton*	Silt *** *%*
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	*Grader 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			
$E = k \times (s / 12)^a \times (W / 3)^b$	**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(unctl) 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.*

	Emission Factors *(lb/VMT)*			Estimated Emissions (Controlled)								
	PM	**PM_{10}**	**$PM_{2.5}$**		**PM**			**PM_{10}**			**$PM_{2.5}$**	
Mobile Equipment				*lb/hr*	*ton/yr*	*ton/proj*	*lb/hr*	*ton/yr*	*ton/proj*	*lb/hr*	*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**

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Dozing/Grading/Scraping Emissions

Dozing and Grading Emission Factor Equations	*AP-42, 11.9, Table 11.9-1 (overburden), Rev. 7/98.*	Scaling Factors PM_{10}	Scaling Factors $PM_{2.5}$
Dozing (PM)	E lb/hr = (5.7 *(s) 1.2) / (M 1.3)		0.105
Dozing (PM_{15})	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 (PM_{15})	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)*

Sraping Emission Factor *AP-42, 11.9, Table 11.9-4 (topsoil), Rev. 7/98.*

Topsoil removal by scraper		Scaling Factor PM_{10}	Scaling Factor $PM_{2.5}$
PM	0.058 *lb/ton*	0.52	0.03

AP-42, Tab. 11.9-1, 7/98 (blasting, overburden)

Scraping Operational Parameters

Cut Volume	1,867,233	*m^3*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
Specific Gravity	2.45	*g/cm^3*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	5,042,771	*ton/proj*	
	5,042,771	*ton/yr*	
	2,017	*ton/hr*	

Emission Factors

Mobile Equipment	Unit	Emission Factors PM	Emission Factors PM_{10}	Emission Factors $PM_{2.5}$
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								
	PM			PM_{10}			$PM_{2.5}$		
Mobile Equipment	*lb/hr*	*ton/yr*	*ton/proj*	*lb/hr*	*ton/yr*	*ton/proj*	*lb/hr*	*ton/yr*	*ton/proj*
D-9T Dozer	17.6	19.3	19.3	2.8	3.1	3.1	1.8	2.0	2.0
Grader Cat 160M (16')	11.4	10.5	10.5	3.3	3.0	3.0	0.35	0.32	0.32
Cat 623G Scraper 18-23CY	117	146	146	60.8	76.0	76.0	3.5	4.4	4.4
TOTAL	**146**	**176**	**176**	**66.9**	**82.1**	**82.1**	**5.7**	**6.7**	**6.7**

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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	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

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 *

$E = k \times (s / 12)^a \times (W / 3)^b$

		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	2.2	0.52	5.2E-2
s - surface material silt content (%) **	3.0	a	0.7	0.9	0.9			
W - mean vehicle wt (*ton*) ***	4.5	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
$E = EF(unctl) \times (365 - P) / 365$		
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.*

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	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	PM_{10}	$PM_{2.5}$
	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

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Wind Erosion from Exposed Areas

121.8	Maximum Erodible Area (acres)	*Exposed Areas (Except TSF).xlsx*		
2,500	number of disturbance hours (per year)	50	wk/yr	*140023 Construction Emissions 07-26-2017.doc*
0.05	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			

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*
1.1	0.53	7.9E-2	4.6	2.3	0.35	4.6	2.3	0.35

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*
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/u10+* 0.053 *AP-42, Sec. 13.2.5, p. 5*

(A) u10+ = 1.2 u10 *Fastest mile wind speed at 10m, with a 1.2 factor to convert hourly wind speed to fastest mile.*

(B, piles) u = (Us/Ur) × 0.1 × u10+*

(B, flat) u = 0.053 × u10+* *Threshold Friction Velocity, AZ Cu Mine Tailings*

(C) P = 58 (u - ut*)2 + 25 (u* - ut*); P = 0 for u* ≤ ut*; where ut* =* 0.172 *m/s*

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Tailings Corridor Controlled Emissions Summary - Project Total (*ton/proj*)

	PM	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC
Drilling	2.6E-2	1.2E-2	1.9E-3	--	--	--	--
Blasting	0.29	0.15	8.8E-3	5.2	1.3	0.16	--
Mobile Equipment Combustion	2.2	2.2	2.2	37.8	41.3	6.8E-2	41.3
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	**250**	**111**	**10.8**	**43.0**	**42.6**	**0.22**	**41.3**

Tailings Corridor Controlled Emissions Summary - Annual (*ton/yr*)

	PM	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC
Drilling	1.8E-2	8.3E-3	1.3E-3	--	--	--	--
Blasting	0.16	8.3E-2	4.8E-3	3.5	0.88	0.10	--
Mobile Equipment Combustion	1.4	1.4	1.4	25.2	27.6	4.6E-2	27.5
Mobile Equipment - Fugitives	118	44.3	4.0	--	--	--	--
Dozing	9.4	1.5	0.99	--	--	--	--
Grading	5.1	1.5	0.16	--	--	--	--
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	**195**	**80.1**	**8.4**	**28.7**	**28.4**	**0.15**	**27.5**

Tailings Corridor Controlled Emissions Summary - Hourly (*lb/hr*)

	PM	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC
Drilling	1.4E-2	6.6E-3	1.0E-3	--	--	--	--
Blasting	8.1E-2	4.2E-2	2.4E-3	25.2	6.4	0.75	--
Mobile Equipment Combustion	1.9	1.9	1.9	32.8	36.1	3.9E-2	36.1
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	**167**	**67.6**	**7.6**	**57.9**	**42.5**	**0.79**	**36.1**

Blue entries are entered values, *black entries are calculated or linked*

Drilling

Project Duration	18	*months*	*Email from Resolution (4/13/2018)*
Material Quantity	187,803	*tonne/yr*	
	281,705	*tonne/proj*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	207,017	*ton/yr*	
	310,526	*ton/proj*	
	83	*ton/hr*	
Operation	250	*days/yr*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	10	*hr/day*	*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	1.4E-2	1.8E-2	2.6E-2
PM_{10}	6.6E-3	8.3E-3	1.2E-2
$PM_{2.5}$	1.0E-3	1.3E-3	1.9E-3

Conversions	
2,000	*lb/ton*
1.1023	*ton/tonne*
3.2808	*ft/m*
100	*cm/m*
453.592	*g/lb*

Blasting

Material Moved	281,705	*tonne/proj*	
	310,526	*ton/proj*	
	207,017	*ton/yr*	
Blasting Agent Use	140.9	*tonne/proj*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	155	*ton/proj*	
	104	*ton/yr*	
Number of Blasts	375	*blasts/proj*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	250	*blasts/yr*	
	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	$TSP = 0.000014 \times A^1$	*lb/blast*	*AP-42, Tab. 11.9-1, 7/98 (blasting, overburden)*				
Where, A = Area per Blast	323	ft^2	Where, A = Area per Year	121,094	ft^2	80,729	ft^2
TSP	0.1	*lb/blast*	TSP	590	*lb/proj*	321	*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	8.1E-2	8.1E-2	0.16	0.29
PM_{10}	4.2E-2	4.2E-2	8.3E-2	0.15
$PM_{2.5}$	2.4E-3	2.4E-3	4.8E-3	8.8E-3
CO	25.2	25.2	3.5	5.2
NO_X	6.4	6.4	0.88	1.3
SO_2	0.75	0.75	0.10	0.16

** Based on maximum of 1 blasts per day*

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Mobile Equipment Combustion

Operational Parameters

Mobile Equipment	Engine Rating *kW*	*hp*	Quantity	EPA Tier	Fuel *gal/hr*	Project Hours	Annual Hours *	Hours Per Unit	
D-9T Dozer	325	436	3	3	22	8,039	5,359	2,680	5T3
Grader Cat 160M (16')	159	213	2	3	11	4,020	2,680	2,010	4T3
Cat 623G Scraper 18-23CY	294	394	1	3	20	1,340	893	1,340	5T3
Compactor Vib Cat CB-54C 67	102	137	3	3	7	7,602	5,068	2,534	3T3
Water Truck (8,000 gallons)	294	394	3	3	20	8,039	5,359	2,680	5T3
Fuel/Lube Truck	224	300	2	3	15	5,760	3,840	2,880	4T3
Cat 336DL 1.56 CY Excavator	200	268	1	3	14	2,880	1,920	2,880	4T3
Cat 980 Loader 7.5 CY	325	436	1	3	22	1,440	960	1,440	5T3
Haul Truck 740 CAT	350	469	1	3	24	720	480	720	5T3
4x4 3/4T Pickup Gas	308	413	2	3	21	5,760	3,840	2,880	5T3

** Scalled down from 18 months to 12 months*

Diesel Emission Factors *

Equipment	PM *g/kW-hr*	CO *g/kW-hr*	NO_X *g/kW-hr*	VOC *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 *

Equipment	PM *g/mi*	CO *g/mi*	NO_X *g/mi*	SO_2 *g/mi*	VOC *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*			

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Mobile Equipment Combustion - Continued

Fleet Emissions

	PM		CO		NO_X		SO_2*		VOC	
Equipment	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*
D-9T Dozer	0.43	0.38	7.5	6.7	8.6	7.7	4.6E-3	1.2E-2	8.6	7.7
Grader Cat 160M (16')	0.14	9.4E-2	2.5	1.6	2.8	1.9	2.3E-3	3.1E-3	2.8	1.9
Cat 623G Scraper 18-23CY	0.13	5.8E-2	2.3	1.0	2.6	1.2	4.2E-3	1.9E-3	2.6	1.2
Compactor Vib Cat CB-54C 6	0.20	0.17	3.4	2.8	2.7	2.3	1.5E-3	3.7E-3	2.7	2.3
Water Truck (8,000 gallons)	0.39	0.35	6.8	6.1	7.8	6.9	4.2E-3	1.1E-2	7.8	6.9
Fuel/Lube Truck	0.20	0.19	3.5	3.3	3.9	3.8	3.2E-3	6.1E-3	3.9	3.8
Cat 336DL 1.56 CY Excavator	8.8E-2	8.5E-2	1.5	1.5	1.8	1.7	3.0E-3	2.8E-3	1.8	1.7
Cat 980 Loader 7.5 CY	0.14	6.9E-2	2.5	1.2	2.9	1.4	4.6E-3	2.2E-3	2.9	1.4
Haul Truck 740 CAT	0.15	3.7E-2	2.7	0.65	3.1	0.74	5.1E-3	1.2E-3	3.1	0.74
4x4 3/4T Pickup Gas	3.3E-3	6.3E-3	0.13	0.25	6.0E-3	1.1E-2	6.0E-3	6.1E-4	1.4E-3	2.7E-3
TOTAL	**1.9**	**1.4**	**32.8**	**25.2**	**36.1**	**27.6**	**3.9E-2**	**4.6E-2**	**36.1**	**27.5**

** SO_2 emissions - mass balance based on 15 ppm S content (ULSD)*

Fleet Emissions (18-Month Project)

	PM	CO	NO_X	SO_2*	VOC
Equipment	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*
D-9T Dozer	0.58	10.1	11.5	1.9E-2	11.5
Grader Cat 160M (16')	0.14	2.5	2.8	4.7E-3	2.8
Cat 623G Scraper 18-23CY	8.7E-2	1.5	1.7	2.8E-3	1.7
Compactor Vib Cat CB-54C 6	0.26	4.3	3.4	5.6E-3	3.4
Water Truck (8,000 gallons)	0.52	9.1	10.4	1.7E-2	10.4
Fuel/Lube Truck	0.28	5.0	5.7	9.1E-3	5.7
Cat 336DL 1.56 CY Excavator	0.13	2.2	2.5	4.3E-3	2.5
Cat 980 Loader 7.5 CY	0.10	1.8	2.1	3.3E-3	2.1
Haul Truck 740 CAT	5.6E-2	0.97	1.1	1.8E-3	1.1
4x4 3/4T Pickup Gas	9.4E-3	0.37	1.7E-2	9.1E-4	4.0E-3
TOTAL	**2.2**	**37.8**	**41.3**	**6.8E-2**	**41.3**

** SO_2 emissions - mass balance based on 15 ppm S content (ULSD)*

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Mobile Equipment - Fugitives

Mobile Equipment	Quantity	Project Hours	Annual Hours	Hours Per Unit	Speed * *mph*	Weight ** *ton*	Silt *** *%*
D-9T Dozer	2	5,359	5,359	2,680	*Dozer specs on page 7*		
Grader Cat 160M (16')	2	4,287	2,680	2,010	*Grader specs on page 7*		
Cat 623G Scraper 18-23CY	1	1,308	893	1,340	*Grader specs on page 7*		
Compactor Vib Cat CB-54C 67"	2	4,922	5,068	2,534	2	14.3	3.0
Water Truck (8,000 gallons)	1	1,786	5,359	2,680	15	50.2	3.0
Fuel/Lube Truck	1	1,250	3,840	2,880	15	12.5	3.0
Cat 336DL 1.56 CY Excavator	1	2,880	1,920	2,880	2	38.6	3.0
Cat 980 Loader 7.5 CY	1	1,440	960	1,440	2	19.6	3.0
Haul Truck 740 CAT	1	720	480	720	15	58.3	3.0
4x4 3/4T Pickup Gas	2	5,760	3,840	2,880	15	4.0	3.0
Mean Vehicle Weight						24.0	

** 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			
$E = k \times (s / 12)^a \times (W / 3)^b$	**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(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.*

	Emission Factors *(lb/VMT)*			Estimated Emissions (Controlled)								
	PM	**PM_{10}**	**$PM_{2.5}$**	**PM**			**PM_{10}**			**$PM_{2.5}$**		
Mobile Equipment				*lb/hr*	*ton/yr*	*ton/proj*	*lb/hr*	*ton/yr*	*ton/proj*	*lb/hr*	*ton/yr*	*ton/proj*
Compactor Vib Cat CB-54C 6:	4.7	1.1	0.11	1.9	2.0	2.0	0.44	0.47	0.46	4.4E-2	4.7E-2	4.6E-2
Water Truck (8,000 gallons)	4.7	1.1	0.11	7.1	16.0	5.3	1.6	3.7	1.2	0.16	0.37	0.12
Fuel/Lube Truck	4.7	1.1	0.11	7.1	11.5	3.7	1.6	2.7	0.87	0.16	0.27	8.7E-2
Cat 336DL 1.56 CY Excavator	4.7	1.1	0.11	0.95	0.77	1.1	0.22	0.18	0.27	2.2E-2	1.8E-2	2.7E-2
Cat 980 Loader 7.5 CY	4.7	1.1	0.11	0.95	0.38	0.57	0.22	8.9E-2	0.13	2.2E-2	8.9E-3	1.3E-2
Haul Truck 740 CAT	4.7	1.1	0.11	7.1	1.4	2.2	1.6	0.33	0.50	0.16	3.3E-2	5.0E-2
4x4 3/4T Pickup Gas	4.7	1.1	0.11	14.2	11.5	17.2	3.3	2.7	4.0	0.33	0.27	0.40
TOTAL				**39.3**	**43.7**	**32.2**	**9.1**	**10.1**	**7.5**	**0.91**	**1.0**	**0.75**

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Dozing/Grading/Scraping Emissions

Dozing and Grading Emission Factor Equations *AP-42, 11.9, Table 11.9-1 (overburden), Rev. 7/98.*

		Scaling Factors PM_{10}	Scaling Factors $PM_{2.5}$
Dozing (PM)	E lb/hr = (5.7 *(s) 1.2) / (M 1.3)		0.105
Dozing (PM_{15})	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 (PM_{15})	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 Factor *AP-42, 11.9, Table 11.9-4 (topsoil), Rev. 7/98.*

Topsoil removal by scraper		Scaling Factor PM_{10}	Scaling Factor $PM_{2.5}$	*AP-42, Tab. 11.9-1, 7/98 (blasting, overburden)*
PM	0.058 *lb/ton*	0.52	0.03	

Scraping Operational Parameters

Cut Volume	1,024,380	*m^3*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
Specific Gravity	2.75	*g/cm^3*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	3,105,263	*ton/proj*	
	2,070,175	*ton/yr*	
	828	*ton/hr*	

Emission Factors

Mobile Equipment	Unit	Emission Factors PM	PM_{10}	$PM_{2.5}$
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								
	PM			PM_{10}			$PM_{2.5}$		
Mobile Equipment	*lb/hr*	*ton/yr*	*ton/proj*	*lb/hr*	*ton/yr*	*ton/proj*	*lb/hr*	*ton/yr*	*ton/proj*
D-9T Dozer	7.0	9.4	9.4	1.1	1.5	1.5	0.74	0.99	0.99
Grader Cat 160M (16')	7.6	5.1	8.2	2.2	1.5	2.3	0.24	0.16	0.25
Cat 623G Scraper 18-23CY	48.0	60.0	90.1	25.0	31.2	46.8	1.4	1.8	2.7
TOTAL	**62.7**	**74.6**	**108**	**28.3**	**34.2**	**50.7**	**2.4**	**2.9**	**3.9**

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	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 *

$E = k \times (s / 12)^a \times (W / 3)^b$

		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 (%) **	3.0	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)	*Exposed Areas (Except TSF).xlsx*		
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			

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*
0.38	0.19	2.9E-2	1.7	0.84	0.13	2.5	1.3	0.19

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*
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/u10+* 0.053 *AP-42, Sec. 13.2.5, p. 5*

(A) u10+ = 1.2 u10 *Fastest mile wind speed at 10m, with a 1.2 factor to convert hourly wind speed to fastest mile.*

(B, piles) u = (Us/Ur) × 0.1 × u10+*

(B, flat) u = 0.053 × u10+* *Threshold Friction Velocity, AZ Cu Mine Tailings*

(C) P = 58 (u - ut*)2 + 25 (u* - ut*); P = 0 for u* ≤ ut*; where ut* =* 0.172 *m/s*

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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	--
Mobile Equipment Combustion	11.6	11.6	11.6	203	228	0.38	228
Mobile Equipment - Fugitives	657	175	19.7	--	--	--	--
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	**879**	**278**	**41.8**	**610**	**331**	**12.5**	**228**

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	--
Mobile Equipment Combustion	3.9	3.9	3.9	67.5	76.0	0.13	76.0
Mobile Equipment - Fugitives	219	58.3	6.6	--	--	--	--
Dozing	15.8	2.5	1.7	--	--	--	--
Grading				--	--	--	--
Scraping	30.0	15.6	0.90	--	--	--	--
Employee and Delivery - Combustion	8.1E-3	8.1E-3	2.3E-3	3.2E-2	1.0E-4	1.1E-2	2.4E-3
Employee and Delivery - Fugitives	0.72	0.17	1.7E-2	--	--	--	--
Wind Erosion	4.7	2.3	0.35	--	--	--	--
TOTAL	**286**	**88.8**	**13.7**	**203**	**110**	**4.2**	**76.0**

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	--
Mobile Equipment Combustion	3.4	3.4	3.4	58.8	66.3	2.6E-2	66.3
Mobile Equipment - Fugitives	220	56.9	6.4	--	--	--	--
Dozing	14.1	2.2	1.5	--	--	--	--
Grading				--	--	--	--
Scraping	24.0	12.5	0.72	--	--	--	--
Employee and Delivery - Combustion	2.4E-2	2.4E-2	7.0E-3	9.6E-2	3.0E-4	3.2E-2	7.3E-3
Employee and Delivery - Fugitives	2.2	0.50	5.0E-2	--	--	--	--
Wind Erosion	1.3	0.63	9.5E-2	--	--	--	--
TOTAL	**271**	**79.3**	**12.3**	**1,045**	**317**	**29.5**	**66.3**

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*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	8,111,724	*ton/yr*	
	24,335,172	*ton/proj*	
	3,245	*ton/hr*	
Operation	250	*days/yr*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	10	*hr/day*	*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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Blasting

Material Moved	22,076,523	*tonne/proj*	
	24,335,172	*ton/proj*	
	8,111,724	*ton/yr*	
Blasting Agent Use	11,038.3	*tonne/proj*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	12,168	*ton/proj*	
	4,056	*ton/yr*	
Number of Blasts	750	*blasts/proj*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	250	*blasts/yr*	
	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	$TSP = 0.000014 \times A^1$	*lb/blast*	*AP-42, Tab. 11.9-1, 7/98 (blasting, overburden)*				
Where, A = Area per Blast	5,382	*ft^2*	Where, A = Area per Year	4,036,467	*ft^2*	1,345,489	*ft^2*
TSP	5.5	*lb/blast*	TSP	113,535	*lb/proj*	21,850	*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	5.5	5.5	10.9	56.8
PM_{10}	2.9	2.9	5.7	29.5
$PM_{2.5}$	0.17	0.17	0.33	1.7
CO	986	986	136	408
NO_X	250	250	34.5	103
SO_2	29.4	29.4	4.1	12.2

** Based on maximum of 1 blasts per day*

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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	4	3	22	26,902	8,967	6,726	5T3
Grader Cat 160M (16')	159	213	0	3	11	0	0		4T3
Cat 623G Scraper 18-23CY	294	394	0	3	20	0	0		5T3
Compactor Vib Cat CB-54C 6.	102	137	2	3	7	11,801	3,934	5,901	3T3
Water Truck (8,000 gallons)	294	394	1	3	20	5,380	1,793	5,380	5T3
Fuel/Lube Truck	224	300	1	3	15	5,656	1,885	5,656	4T3
Cat 336DL 1.56 CY Excavator	200	268	3	3	14	21,210	7,070	7,070	4T3
Cat 980 Loader 7.5 CY	325	436	0	3	22	0	0		5T3
Haul Truck 740 CAT	350	469	14	3	24	98,981	32,994	7,070	5T3
4x4 3/4T Pickup Gas	308	413	3	3	21	18,854	6,285	6,285	5T3

** Scalled down from 36 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 6.	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*			

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Mobile Equipment Combustion - Continued

Fleet Emissions

	PM		CO		NO_X		SO_2*		VOC	
Equipment	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*
D-9T Dozer	0.57	0.64	10.0	11.2	11.5	12.9	4.6E-3	2.1E-2	11.5	12.9
Grader Cat 160M (16')										
Cat 623G Scraper 18-23CY										
Compactor Vib Cat CB-54C 6.	0.13	0.13	2.2	2.2	1.8	1.8	1.5E-3	2.9E-3	1.8	1.8
Water Truck (8,000 gallons)	0.13	0.12	2.3	2.0	2.6	2.3	4.2E-3	3.8E-3	2.6	2.3
Fuel/Lube Truck	9.9E-2	9.3E-2	1.7	1.6	2.0	1.9	3.2E-3	3.0E-3	2.0	1.9
Cat 336DL 1.56 CY Excavator	0.26	0.31	4.6	5.5	5.3	6.2	3.0E-3	1.0E-2	5.3	6.2
Cat 980 Loader 7.5 CY										
Haul Truck 740 CAT	2.2	2.5	37.8	44.6	43.2	50.9	5.1E-3	8.4E-2	43.2	50.9
4x4 3/4T Pickup Gas	3.3E-3	1.0E-2	0.13	0.40	6.0E-3	1.9E-2	4.4E-3	1.0E-3	1.4E-3	4.4E-3
TOTAL	**3.4**	**3.9**	**58.8**	**67.5**	**66.3**	**76.0**	**2.6E-2**	**0.13**	**66.3**	**76.0**

** SO_2 emissions - mass balance based on 15 ppm S content (ULSD)*

Fleet Emissions (18-Month Project)

	PM	CO	NO_X	SO_2*	VOC
Equipment	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*
D-9T Dozer	1.9	33.7	38.6	6.3E-2	38.6
Grader Cat 160M (16')					
Cat 623G Scraper 18-23CY					
Compactor Vib Cat CB-54C 6.	0.40	6.6	5.3	8.7E-3	5.3
Water Truck (8,000 gallons)	0.35	6.1	7.0	1.1E-2	7.0
Fuel/Lube Truck	0.28	4.9	5.6	9.0E-3	5.6
Cat 336DL 1.56 CY Excavator	0.94	16.4	18.7	3.1E-2	18.7
Cat 980 Loader 7.5 CY					
Haul Truck 740 CAT	7.6	134	153	0.25	153
4x4 3/4T Pickup Gas	3.1E-2	1.2	5.6E-2	3.0E-3	1.3E-2
TOTAL	**11.6**	**203**	**228**	**0.38**	**228**

** SO_2 emissions - mass balance based on 15 ppm S content (ULSD)*

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Mobile Equipment - Fugitives

Mobile Equipment	Quantity	Project Hours	Annual Hours	Hours Per Unit	Speed * *mph*	Weight ** *ton*	Silt *** *%*
D-9T Dozer	4	26,902	8,967	6,726	*Dozer specs on page 7*		
Grader Cat 160M (16')	0	0	0		*Grader specs on page 7*		
Cat 623G Scraper 18-23CY	0	0	0		*Grader specs on page 7*		
Compactor Vib Cat CB-54C 67"	2	11,801	3,934	5,901	2	14.3	3.0
Water Truck (8,000 gallons)	1	5,380	1,793	5,380	15	50.2	3.0
Fuel/Lube Truck	1	5,656	1,885	5,656	15	12.5	3.0
Cat 336DL 1.56 CY Excavator	3	21,210	7,070	7,070	2	38.6	3.0
Cat 980 Loader 7.5 CY	0	0	0		2	19.6	3.0
Haul Truck 740 CAT	14	98,981	32,994	7,070	15	58.3	3.0
4x4 3/4T Pickup Gas	3	18,854	6,285	6,285	15	4.0	3.0
Mean Vehicle Weight						43.1	

** 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			
$E = k \times (s / 12)^a \times (W / 3)^b$	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(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.*

	Emission Factors *(lb/VMT)*			Estimated Emissions (Controlled)								
	PM	PM_{10}	$PM_{2.5}$	PM			PM_{10}			$PM_{2.5}$		
Mobile Equipment				*lb/hr*	*ton/yr*	*ton/proj*	*lb/hr*	*ton/yr*	*ton/proj*	*lb/hr*	*ton/yr*	*ton/proj*
Compactor Vib Cat CB-54C 6.	6.2	1.4	0.14	2.5	2.0	6.1	0.57	0.47	1.4	5.7E-2	4.7E-2	0.14
Water Truck (8,000 gallons)	6.2	1.4	0.14	9.2	7.0	21.0	2.1	1.6	4.9	0.21	0.16	0.49
Fuel/Lube Truck	6.2	1.4	0.14	9.2	7.4	22.1	2.1	1.7	5.1	0.21	0.17	0.51
Cat 336DL 1.56 CY Excavator	6.2	1.4	0.14	3.7	3.7	11.0	0.86	0.85	2.6	8.6E-2	8.5E-2	0.26
Cat 980 Loader 7.5 CY	6.2	1.4	0.14									
Haul Truck 740 CAT	6.2	1.4	0.14	129	129	386	30.0	29.8	89.5	3.0	3.0	9.0
4x4 3/4T Pickup Gas	6.2	1.4	0.14	27.7	24.5	73.5	6.4	5.7	17.1	0.64	0.57	1.7
TOTAL				**182**	**173**	**520**	**42.2**	**40.2**	**121**	**4.2**	**4.0**	**12.1**

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Dozing/Grading/Scraping Emissions

Dozing and Grading Emission Factor Equations *AP-42, 11.9, Table 11.9-1 (overburden), Rev. 7/98.*

		Scaling Factors	
		PM_{10}	$PM_{2.5}$
Dozing (PM)	E lb/hr = (5.7 *(s) 1.2) / (M 1.3)		0.105
Dozing (PM_{15})	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 (PM_{15})	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 Factor *AP-42, 11.9, Table 11.9-4 (topsoil), Rev. 7/98.*

Topsoil removal by scraper		Scaling Factor		*AP-42, Tab. 11.9-1, 7/98 (blasting, overburden)*
PM	0.058 *lb/ton*	PM_{10}	$PM_{2.5}$	
		0.52	0.03	

Scraping Operational Parameters

Cut Volume	1,024,380	m^3	*Resolution Copper Project Technical Memorandum – Construction Emissions*
Specific Gravity	2.75	g/cm^3	*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**	**PM_{10}**	**$PM_{2.5}$**
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								
	PM			**PM_{10}**			**$PM_{2.5}$**		
Mobile Equipment	***lb/hr***	***ton/yr***	***ton/proj***	***lb/hr***	***ton/yr***	***ton/proj***	***lb/hr***	***ton/yr***	***ton/proj***
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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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	Combined with WPS			Combined with WPS			Combined with WPS		
Delivery	Combined with WPS			998	3.8	7.6	2,994	3.8	7.6

** Traffic Impact Analysis*

*** Resolution Copper MPO*

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*	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 *

$E = k \times (s / 12)^a \times (W / 3)^b$

		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	2.2	0.52	5.2E-2
s - surface material silt content (%) **	3.0	a	0.7	0.9	0.9			
W - mean vehicle wt (*ton*) ***	4.5	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	8.1E-3	8.1E-3	2.3E-3	3.2E-2	1.0E-4	1.1E-2	2.4E-3
	ton/proj	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*
Employee	--	--	--	--	--	--	--
Delivery	2.4E-2	2.4E-2	7.0E-3	9.6E-2	3.0E-4	3.2E-2	7.3E-3

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	0.72	0.17	1.7E-2
	ton/proj	*ton/proj*	*ton/proj*
Employee	--	--	--
Delivery	2.2	0.50	5.0E-2

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Wind Erosion from Exposed Areas

150.0	Maximum Erodible Area (acres)	*Exposed Areas (Except TSF).xlsx*	
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/hr)	5 days/wk	*140023 Construction Emissions 07-26-2017.doc*
Precipitation	Control Technology (Hewitt Precip Data)	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/u10+* 0.053 *AP-42, Sec. 13.2.5, p. 5*

(A) u10+ = 1.2 u10 Fastest mile wind speed at 10m, with a 1.2 factor to convert hourly wind speed to fastest mile.

(B, piles) u = (Us/Ur) × 0.1 × u10+*

(B, flat) u = 0.053 × u10+* *Threshold Friction Velocity, AZ Cu Mine Tailings*

(C) P = 58 (u - ut*)2 + 25 (u* - ut*); P = 0 for u* ≤ ut*; where ut* =* 0.172 *m/s*

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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	87.1	32.2	2.8	--	--	--	--
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	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	0.30	0.15	2.2E-2	--	--	--	--
TOTAL	**192**	**69.5**	**7.3**	**20.9**	**23.0**	**2.0**	**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	58.1	21.5	1.9	--	--	--	--
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	**104**	**40.9**	**4.3**	**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	62.8	20.8	1.9	--	--	--	--
Dozing	3.5	0.56	0.37	--	--	--	--
Grading	3.8	1.1	0.12	--	--	--	--
Scraping	21.8	11.4	0.65	--	--	--	--
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	4.5E-2	2.2E-2	3.4E-3	--	--	--	--
TOTAL	**109**	**38.6**	**4.5**	**18.0**	**20.0**	**0.76**	**20.1**

Blue entries are entered values, black entries are calculated or linked

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Drilling

Project Duration	18	*months*	*Email from K. Ballard (4/13/2018)*
Material Quantity	0	*tonne/yr*	
	0	*tonne/proj*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	0	*ton/yr*	
	0	*ton/proj*	
	0	*ton/hr*	
Operation	260	*days/yr*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	10	*hr/day*	*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	--	--	--
PM_{10}	--	--	--
$PM_{2.5}$	--	--	--

Conversions	
2,000	*lb/ton*
1.1023	*ton/tonne*
3.2808	*ft/m*
100	*cm/m*
453.592	*g/lb*

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Blasting

Material Moved	0	*tonne/proj*	
	0	*ton/proj*	
	0	*ton/yr*	
Blasting Agent Use	0	*tonne/proj*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	0	*ton/proj*	
	0	*ton/yr*	
Number of Blasts	0	*blasts/proj*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	0	*blasts/yr*	
	0	*max blasts/day*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
Operation	260	*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	*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	0	*ft^2*	0	*ft^2*
TSP	0.0	*lb/blast*	TSP	0	*lb/proj*	0	*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	--	--	--	--
PM_{10}	--	--	--	--
$PM_{2.5}$	--	--	--	--
CO	--	--	--	--
NO_X	--	--	--	--
SO_2	--	--	--	--

** Based on maximum of 0 blasts per day*

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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	1	3	22	3,466	2,311	3,466	5T3
Grader Cat 160M (16')	159	213	1	3	11	1,733	1,155	1,733	4T3
Cat 623G Scraper 18-23CY	294	394	1	3	20	1,899	1,266	1,899	5T3
Compactor Vib Cat CB-54C 67	102	137	1	3	7	2,847	1,898	2,847	3T3
Water Truck (8,000 gallons)	294	394	1	3	20	3,466	2,311	3,466	5T3
Fuel/Lube Truck	224	300	1	3	15	2,880	1,920	2,880	4T3
Cat 336DL 1.56 CY Excavator	200	268	1	3	14	2,880	1,920	2,880	4T3
Cat 980 Loader 7.5 CY	325	436	1	3	22	1,440	960	1,440	5T3
Haul Truck 740 CAT	350	469	1	3	24	720	480	720	5T3
4x4 3/4T Pickup Gas	308	413	1	3	21	2,880	1,920	2,880	5T3

** Scalled 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*			

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Mobile Equipment Combustion - Continued

Fleet Emissions

	PM		CO		NO_X		SO_2*		VOC	
Equipment	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*
D-9T Dozer	0.14	0.17	2.5	2.9	2.9	3.3	4.6E-3	5.4E-3	2.9	3.3
Grader Cat 160M (16')	7.0E-2	4.0E-2	1.2	0.71	1.4	0.81	2.3E-3	1.3E-3	1.4	0.81
Cat 623G Scraper 18-23CY	0.13	8.2E-2	2.3	1.4	2.6	1.6	4.2E-3	2.7E-3	2.6	1.6
Compactor Vib Cat CB-54C 6.	6.7E-2	6.4E-2	1.1	1.1	0.90	0.85	1.5E-3	1.4E-3	0.90	0.85
Water Truck (8,000 gallons)	0.13	0.15	2.3	2.6	2.6	3.0	4.2E-3	4.9E-3	2.6	3.0
Fuel/Lube Truck	9.9E-2	9.5E-2	1.7	1.7	2.0	1.9	3.2E-3	3.0E-3	2.0	1.9
Cat 336DL 1.56 CY Excavator	8.8E-2	8.5E-2	1.5	1.5	1.8	1.7	3.0E-3	2.8E-3	1.8	1.7
Cat 980 Loader 7.5 CY	0.14	6.9E-2	2.5	1.2	2.9	1.4	4.6E-3	2.2E-3	2.9	1.4
Haul Truck 740 CAT	0.15	3.7E-2	2.7	0.65	3.1	0.74	5.1E-3	1.2E-3	3.1	0.74
4x4 3/4T Pickup Gas	3.3E-3	3.1E-3	0.13	0.12	6.0E-3	5.7E-3	6.0E-3	3.0E-4	1.4E-3	1.3E-3
TOTAL	**1.0**	**0.79**	**18.0**	**13.8**	**20.0**	**15.3**	**3.9E-2**	**2.5E-2**	**20.0**	**15.3**

** SO_2 emissions - mass balance based on 15 ppm S content (ULSD)*

Fleet Emissions (18-Month Project)

	PM	CO	NO_X	SO_2*	VOC
Equipment	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*
D-9T Dozer	0.25	4.3	5.0	8.1E-3	5.0
Grader Cat 160M (16')	6.1E-2	1.1	1.2	2.0E-3	1.2
Cat 623G Scraper 18-23CY	0.12	2.2	2.5	4.0E-3	2.5
Compactor Vib Cat CB-54C 6.	9.6E-2	1.6	1.3	2.1E-3	1.3
Water Truck (8,000 gallons)	0.22	3.9	4.5	7.3E-3	4.5
Fuel/Lube Truck	0.14	2.5	2.8	4.6E-3	2.8
Cat 336DL 1.56 CY Excavator	0.13	2.2	2.5	4.3E-3	2.5
Cat 980 Loader 7.5 CY	0.10	1.8	2.1	3.3E-3	2.1
Haul Truck 740 CAT	5.6E-2	0.97	1.1	1.8E-3	1.1
4x4 3/4T Pickup Gas	4.7E-3	0.18	8.6E-3	4.6E-4	2.0E-3
TOTAL	**1.2**	**20.8**	**23.0**	**3.8E-2**	**23.0**

** SO_2 emissions - mass balance based on 15 ppm S content (ULSD)*

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Mobile Equipment - Fugitives

Mobile Equipment	Quantity	Project Hours	Annual Hours	Hours Per Unit	Speed * *mph*	Weight ** *ton*	Silt *** *%*
D-9T Dozer	1	3,466	2,311	3,466	*Dozer specs on page 7*		
Grader Cat 160M (16')	1	1,733	1,155	1,733	*Grader specs on page 7*		
Cat 623G Scraper 18-23CY	1	1,899	1,266	1,899	*Grader specs on page 7*		
Compactor Vib Cat CB-54C 67"	1	2,847	1,898	2,847	2	14.3	3.0
Water Truck (8,000 gallons)	1	3,466	2,311	3,466	15	50.2	3.0
Fuel/Lube Truck	1	2,880	1,920	2,880	15	12.5	3.0
Cat 336DL 1.56 CY Excavator	1	2,880	1,920	2,880	2	38.6	3.0
Cat 980 Loader 7.5 CY	1	1,440	960	1,440	2	19.6	3.0
Haul Truck 740 CAT	1	720	480	720	15	58.3	3.0
4x4 3/4T Pickup Gas	1	2,880	1,920	2,880	15	4.0	3.0
Mean Vehicle Weight						28.2	

** 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			
$E = k \times (s / 12)^a \times (W / 3)^b$	**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(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.*

	Emission Factors *(lb/VMT)*			Estimated Emissions (Controlled)								
	PM	PM_{10}	$PM_{2.5}$	PM			PM_{10}			$PM_{2.5}$		
Mobile Equipment				*lb/hr*	*ton/yr*	*ton/proj*	*lb/hr*	*ton/yr*	*ton/proj*	*lb/hr*	*ton/yr*	*ton/proj*
Compactor Vib Cat CB-54C 6.	5.1	1.2	0.12	1.0	0.82	1.2	0.24	0.19	0.28	2.4E-2	1.9E-2	2.8E-2
Water Truck (8,000 gallons)	5.1	1.2	0.12	7.6	7.4	11.2	1.8	1.7	2.6	0.18	0.17	0.26
Fuel/Lube Truck	5.1	1.2	0.12	7.6	6.2	9.3	1.8	1.4	2.2	0.18	0.14	0.22
Cat 336DL 1.56 CY Excavator	5.1	1.2	0.12	1.0	0.82	1.2	0.24	0.19	0.29	2.4E-2	1.9E-2	2.9E-2
Cat 980 Loader 7.5 CY	5.1	1.2	0.12	1.0	0.41	0.62	0.24	9.6E-2	0.14	2.4E-2	9.6E-3	1.4E-2
Haul Truck 740 CAT	5.1	1.2	0.12	7.6	1.5	2.3	1.8	0.36	0.54	0.18	3.6E-2	5.4E-2
4x4 3/4T Pickup Gas	5.1	1.2	0.12	7.6	6.2	9.3	1.8	1.4	2.2	0.18	0.14	0.22
TOTAL				**33.6**	**23.4**	**35.1**	**7.8**	**5.4**	**8.1**	**0.78**	**0.54**	**0.81**

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Dozing/Grading/Scraping Emissions

Dozing and Grading Emission Factor Equations	*AP-42, 11.9, Table 11.9-1 (overburden), Rev. 7/98.*	Scaling Factors	
		PM_{10}	$PM_{2.5}$
Dozing (PM)	E lb/hr = (5.7 *(s) 1.2) / (M 1.3)		0.105
Dozing (PM_{15})	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 (PM_{15})	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)*

Sraping Emission Factor		*AP-42, 11.9, Table 11.9-4 (topsoil), Rev. 7/98.*	
Topsoil removal by scraper		Scaling Factor	*AP-42, Tab. 11.9-1, 7/98 (blasting, overburden)*
PM	0.058 *lb/ton*	PM_{10}	$PM_{2.5}$
		0.52	0.03

Scraping Operational Parameters

Cut Volume	484,240 *m^3*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
Specific Gravity	2.75 *g/cm^3*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	1,467,905 *ton/proj*	
	978,603 *ton/yr*	
	376 *ton/hr*	

Emission Factors

		Emission Factors		
Mobile Equipment	**Unit**	**PM**	**PM_{10}**	**$PM_{2.5}$**
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								
	PM			**PM_{10}**			**$PM_{2.5}$**		
Mobile Equipment	*lb/hr*	*ton/yr*	*ton/proj*	*lb/hr*	*ton/yr*	*ton/proj*	*lb/hr*	*ton/yr*	*ton/proj*
D-9T Dozer	3.5	4.1	6.1	0.56	0.65	0.97	0.37	0.43	0.64
Grader Cat 160M (16')	3.8	2.2	3.3	1.1	0.63	0.95	0.12	6.8E-2	0.10
Cat 623G Scraper 18-23CY	21.8	28.4	42.6	11.4	14.8	22.1	0.65	0.85	1.3
TOTAL	**29.2**	**34.6**	**52.0**	**13.0**	**16.0**	**24.1**	**1.1**	**1.3**	**2.0**

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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	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*	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 *

$E = k \times (s / 12)^a \times (W / 3)^b$

		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	2.2	0.52	5.2E-2
s - surface material silt content (%) **	3.0	a	0.7	0.9	0.9			
W - mean vehicle wt (*ton*) ***	4.5	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	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	PM_{10}	$PM_{2.5}$
	lb/hr	*lb/hr*	*lb/hr*
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	--	--	--

Wind Erosion from Exposed Areas

48.5	Maximum Erodible Area (acres)	*Exposed Areas (Except TSF).xlsx*			
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				

Emissions (Uncontrolled)

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

Emissions (Controlled)

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/u10+* 0.053 *AP-42, Sec. 13.2.5, p. 5*

(A) u10+ = 1.2 u10 Fastest mile wind speed at 10m, with a 1.2 factor to convert hourly wind speed to fastest mile.

(B, piles) u = (Us/Ur) × 0.1 × u10+*

(B, flat) u = 0.053 × u10+* *Threshold Friction Velocity, AZ Cu Mine Tailings*

(C) P = 58 (u - ut*)2 + 25 (u* - ut*); P = 0 for u* ≤ ut*; where ut* =* 0.172 *m/s*

Appendix C – Model Input Parameters

POINT Source Release 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	28.2	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	28.2	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	28.2	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	28.2	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

POINT Source Release 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)
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_PEBCV	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_PEBCV	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

VOLUME Source Release Parameters

Model ID	Description	Facility	UTM X (m, Zone 12)	UTM Y (m, Zone 12)	Elevation (m)	Release Height (m)	σ_{yo} (m)	σ_{zo} (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)	σ_{xo} (m)	σ_{yo} (m)	σ_{zo} (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_BCH	TSF Exposed Areas - Beach	TSF	482,268	3,685,749			777	1.0	3412.9	2,234.9	0.9	-18.9
T_WE_DAM	TSF Exposed Areas - Dam	TSF	482,268	3,685,749			777	1.0	3412.9	2,234.9	0.9	-18.9
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_{xo} (m)	σ_{yo} (m)	σ_{zo} (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_{xo} (m)	σ_{yo} (m)	σ_{zo} (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		

** 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 D – Wind Erosion Calculations

Air Sciences Inc.	PROJECT TITLE: NEPA Model Plan	BY: D. Steen		
	PROJECT NO: 262-32	PAGE: 1	OF: 3	SHEET: Wind
AIR EMISSION CALCULATIONS	SUBJECT: Wind Erosion Emissions	DATE: June 29, 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) $u^* = (U_s/U_r) \times 0.1 \times u_{10}^+$
(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 $u^* \le u_t^*$; where u_t^* = 0.172 m/s Threshold Friction Velocity AZ Cu. Mine Tailings

	Flat Areas, Uncontrolled		Pollutant	Scaling Factor
PM Emissions	70.8	(ton/acre-yr)	PM	1
PM10 Emissions	35.4	(ton/acre-yr)	PM10	0.5
PM2.5 Emissions	5.3	(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 — Water Controlled
21 Maximum Erodible Area (acres) — Control Eff. **90%**
0.002 Disturbance Created Every Hour (acre/hr)

	Controlled	Uncontrolled	
PM Emissions	2.93	29.32	tpy
PM_{10} Emissions	1.47	14.66	tpy
$PM_{2.5}$ Emissions	0.22	2.20	tpy

East Plant Subsidence — Controlled by Precip; Per Year.
279 Maximum Erodible Area (acres) — Control Eff. **18%**
0.032 Disturbance Created Every Hour (acre/hr)

PM Emissions	5.00	6.06	tpy
PM_{10} Emissions	2.50	3.03	tpy
$PM_{2.5}$ Emissions	0.37	0.45	tpy

Conversions:
453.6 g/lb
4,046.9 m^2/acre

Air Sciences Inc.	PROJECT TITLE: NEPA Model Plan	BY: D. Steen		
	PROJECT NO: 262-32	PAGE: 2	OF: 3	SHEET: Wind
AIR EMISSION CALCULATIONS	SUBJECT: Wind Erosion Emissions	DATE: June 29, 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) $u^* = (U_s/U_r) \times 0.1 \times u_{10}^+$
(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 $u^* \le u_t^*$; where u_t^* = 0.172 m/s Threshold Friction Velocity AZ Cu. Mine Tailings

	Flat Areas, Uncontrolled		Pollutant	Scaling Factor
PM Emissions	76.0	(ton/acre-yr)	PM	1
PM10 Emissions	38.0	(ton/acre-yr)	PM10	0.5
PM2.5 Emissions	5.7	(ton/acre-yr)	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	0.16	1.62	tpy
PM_{10} Emissions	0.08	0.81	tpy
$PM_{2.5}$ Emissions	0.01	0.12	tpy

Air Sciences Inc.	PROJECT TITLE: NEPA Model Plan	BY: D. Steen
	PROJECT NO: 262-32	PAGE: 3 OF: 3 SHEET: Wind
AIR EMISSION CALCULATIONS	SUBJECT: Wind Erosion Emissions	DATE: June 29, 2018

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) $u^* = (U_s/U_r) \times 0.1 \times u_{10}^+$

(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	65.0 (ton/acre-yr)	PM	1
PM10 Emissions	32.5 (ton/acre-yr)	PM10	0.5
PM2.5 Emissions	4.9 (ton/acre-yr)	PM2.5	0.075

17,544 Total hours (2015-2016)
8,401 Number of Emissable hours in 2015-2016

<u>Year 41 Tailings Beach Area</u>

1,380 Maximum Erodible Area (acres)
0.158 Disturbance Created Every Hour (acre/hr)

Water Controlled Control Eff. **90%**

	Controlled	Uncontrolled	
PM Emissions	2.91	29.08	tpy
PM_{10} Emissions	1.45	14.54	tpy
$PM_{2.5}$ Emissions	0.22	2.18	tpy

<u>Year 41 Tailings Dam Area</u>

59 Maximum Erodible Area (acres)
0.007 Disturbance Created Every Hour (acre/hr)

Water Controlled Control Eff. **90%**

	Controlled	Uncontrolled	
PM Emissions	0.12	1.24	tpy
PM_{10} Emissions	0.06	0.62	tpy
$PM_{2.5}$ Emissions	0.01	0.09	tpy