RioTinto

Kennecott Utah Copper
4700 Daybreak Parkway
South Jordan, Utah 84095
USA

Chris Kaiser, HSEQ Principal Advisor
Environmental Permitting and Regulation

March 21, 2011

UTAH DEPARTMENT OF
ENVIRONMENTAL QUALITY

DIVISION OF AIR QUALITY

Mr. Nando Meli
PO Box 144820
Salt Lake City, UT 84114-0482

Dear Mr. Meli:

Subject: Approval Order DAQE-AN0105710023-08

The Utah Department of Environmental Quality (DEQ) is receiving public comment on an Intent to Approve Modified Approval Order DAQE-AN0105710023-08 and on a proposed rule amendment to the Utah State Implementation Plan (SIP) Section IX, Control Measures for Area and Point Sources, Part H, Emissions Limits. Kennecott Utah Copper LLC (KUC) submits this public comment on the Intent to Approve and the proposed SIP rule amendment.

The current technical demonstrations for the Intent to Approve and the SIP rule amendment both satisfy the relevant legal requirements. However, several comments have been noted related to the use of a pit escape fraction and model results in a 1996 University of Utah study. Kennecott has taken the initiative to pursue a separate modeling effort to evaluate the escape fraction calculations published in the 1996 study "Airflow Patterns and Pit-Retention of Fugitive Dust for the Bingham Canyon Mine" by Ragula Bhaskar and Navin Tandon, Department of Mining Engineering, University of Utah. The attached documents describe the context for the modeling effort and present results of a computational fluid dynamics model simulation of the Bingham Canyon Mine.

Yours truly,

Chris Kaiser

Attachments

Rio Tinto

**Technical Memorandum:**

Kennecott Utah Copper LLC (KUC) submitted a Notice of Intent (NOI) application to secure an Approval Order (AO) to increase the annual material-moved limit of ore and waste rock material at the Bingham Canyon Mine (BCM). KUC is proposing to increase the BCM's material-moved limitation to 260,000,000 tpy during peak years from the currently permitted 197,000,000 tpy.

When particles, such as fugitive dust, are emitted within the pit-influence boundary, only a certain portion of what is originally emitted reaches the top of the pit and enters the general atmosphere (the so-called escape fraction). *Airflow Patterns and Pit-Retention of Fugitive Dust for the Bingham Canyon Mine* is a Computational Fluid Dynamic (CFD) study that predicts the escape fraction for different conditions at the BCM (Bhaskar and Tandon, 1996). The authors examined the influence that varying wind speed, wind direction, atmospheric stability, source location, source height, and particle size have on the calculated escape fraction.

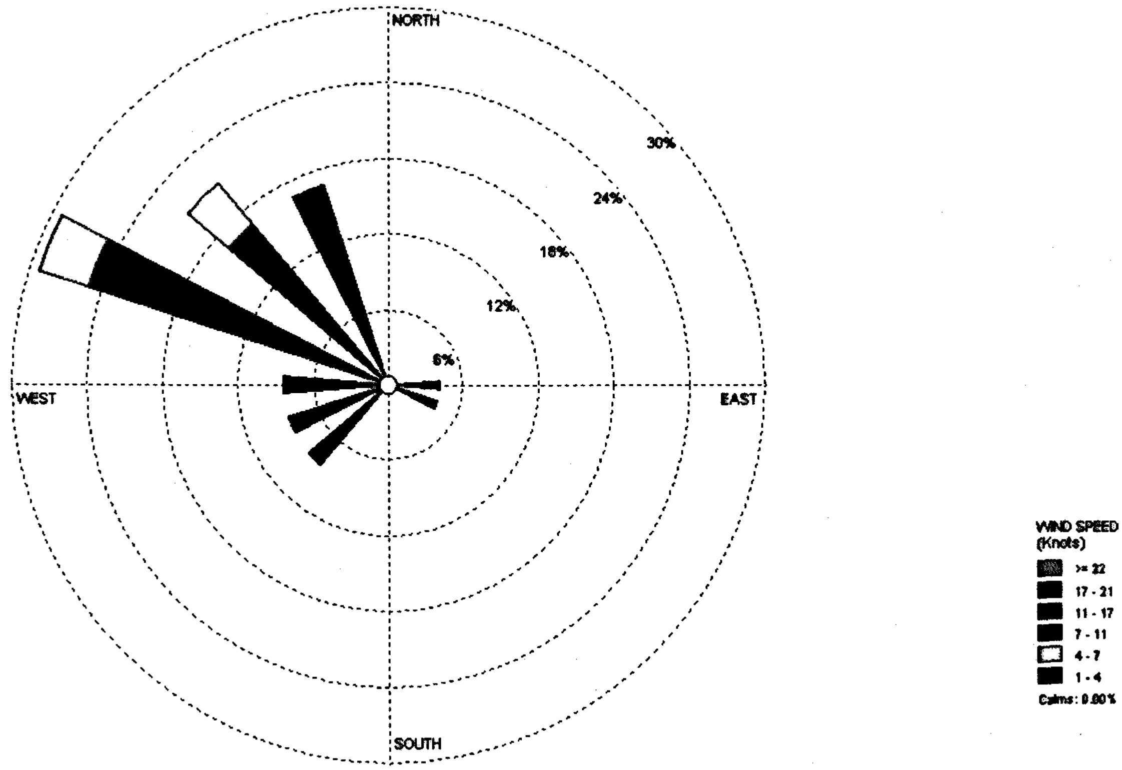
To estimate emissions, the approach of applying one escape fraction to all emission sources located within the pit influence boundary was taken. This approach required the selection of a single value for the escape fraction that is representative, but also conservative. As discussed in the NOI, an escape fraction of 20 percent was selected for $PM_{10}$ based on the results from Bhaskar and Tandon (1996).

The NOI also included an air quality modeling demonstration using the American Meteorological Society/EPA Regulatory Model (AERMOD) model to support the increase in material moved. AERMOD is an EPA-approved model that was used to predict ambient concentrations of $PM_{10}$. The modeling results indicated that the maximum combined concentration of modeled and monitored total $PM_{10}$ impact from the emissions after the proposed modification when added to the background concentration would be 144.2 $\mu g/m^3$, less than the 24-hr National Ambient Air Quality Standard (NAAQS) of 150 $\mu g/m^3$. It is important to note that these concentrations represent a modeled 24-hour maximum impact, and are not representative of continuous concentrations.

The modeled impact assumes to an average wind speed of 3.8 miles per hour (mph) from the west-northwest direction. The meteorological data were obtained from the nearby Herriman station. The Herriman meteorological data were supplied by the Utah Division of Air Quality (UDAQ) and are considered representative of the BCM location. Data for years 2004 through 2006 were used for the AERMOD analysis.

AERMOD modeling demonstrated that the modeled concentration used for comparison to the 24-hr NAAQS occurred on December 21, 2006. The average wind speed for this day was 3.8 miles per hour (mph) and the primary wind direction was from the west-northwest sector. The windrose for December 21, 2006 is shown in Figure 1 below.

**Figure 1. Windrose for December 21, 2006**




To further examine site specific pit retention for the BCM, KUC has done additional computational fluid dynamics (CFD) modeling. CFD is a mathematical analysis where pressure, velocity, and turbulence are calculated using equations for fluid flow and turbulence. Key aspects of this modeling are discussed below:

- The widely-used, commercially available ANSYS Fluent software was used. For this analysis, the standard k-epsilon turbulence model was used. The selection of the turbulence mode was consistent with that used in Bhaskar and Tandon (1996). Particulate dispersion was modeled using a time-dependent stochastic approach.

- The mine was modeled as an irregular shape roughly 2000 feet deep at its deepest point. For the simulations, the mine's topography was modeled in three dimensions based on the 2009 aerial survey.

RioTinto

- The simulations estimate the escape of particulate generated in the pit for a constant wind speed and wind direction: a steady-state value for the escape fraction is calculated.

Statistically significant quantities of $PM_{10}$ particulates were released from nine different locations in the mine as part of the modeling. The locations varied in both their horizontal and vertical placement. The particulates were released at a point seven feet above the ground at each of the nine locations. Particulates were released in the simulations at the bottom of the pit, at four middle-of-the-pit locations, and four off-the-edge-of-the-pit locations as shown in Attachment 1.

Results from the nine simulations estimated the pit escape fraction for $PM_{10}$ between 3 percent and 18 percent, depending on release location. These results are consistent, and in fact, lower than the escape fraction of 20% used in emission estimates for $PM_{10}$ for the BCM in the AERMOD modeling submitted in the NOI. The higher the escape fraction, the greater the emissions emitted to the atmosphere.

The pit escape fraction used in the emission estimates for AERMOD 20 percent was higher than the maximum CFD modeled results. In addition to this overestimation, the AERMOD analysis was based on very conservative assumptions as discussed below:

- AERMOD modeling was run for the peak year material movement of 260,000,000 tons per year, not an average material throughput between 2011 and 2028.

- It was assumed that all material was moved using the smallest 240-ton haul trucks which resulted in more miles travelled and higher emissions. In practice, the largest trucks available on the market will be used to haul ore and waste rock, thereby resulting in lower actual emissions.

- For the AEMROD analysis, a 20 percent increase was added to the already inflated daily emissions to account for any potential variability that may occur in BCM's day to day operations.

For the reasons stated above, the AERMOD analysis presented with the NOI is conservative. KUC has performed this limited amount of additional BCM specific CFD analysis. The results indicate that a 20 percent pit escape fraction for $PM_{10}$ is representative for the BCM, and in fact may overestimate the $PM_{10}$ emissions from the BCM.

# Attachment 1
# Bingham Canyon Mine
# Pit Retention Study

21 March 2011

**Prepared for:** Rio Tinto/Kennecott Utah Copper (KUC)

**Prepared by:** **Advanced Design and Simulation Group**
Keith Kibbee, PE
2020 SW 4th Ave.
Portland, OR 97201
keith.kibbee@ch2m.com
503-872-4573

CH2MHILL

## Table of Contents

## Introduction

KUC requested CH2M HILL's assistance with Computational Fluid Dynamics (CFD) modeling to support the use of an escape fraction specific to the Bingham Canyon Mine (mine). Emissions calculations and AERMOD analyses performed for the mine have utilized pit retention factor calculations documented in the 1996 report "Airflow Patterns and Pit-Retention of Fugitive Dust for the Bingham Canyon Mine" by Ragula Bhaskar and Navin Tandon, Department of Mining Engineering, University of Utah (U of U). The objective of this current effort is to perform a check on the reasonableness of the U of U study and to further explore other variables contributing to retention effectiveness of the pit.

## Technical Approach

The functional area of the mine is an irregular shape roughly 2000 feet deep at its deepest point. The site's terraced topography is modeled in three dimensions in this computer simulation. The model estimates pressure, velocity, and turbulence over the contours due to wind speed, wind direction, and atmospheric stability.

These physical phenomena and the resultant migration of particulate across the topography are characterized with airflow modeling based on computational fluid dynamics (CFD). CFD is a mathematical procedure whereby the fluid parameters of pressure, velocity, and turbulence are calculated by solving the governing partial differential equations for fluid flow and turbulence. The software that is used for this analysis is ANSYS Fluent. This software has been validated within numerous peer-reviewed journal publications for external flow simulations and buoyant plume studies. The turbulence model chosen for the analysis is the standard k-epsilon turbulence model because this was consistent with the approach used in the U of U study. Particulate dispersion is modeled using a time-dependent stochastic approach.

The simulations allow estimation of the escape of particulate generated in the pit for a variety of wind speeds and wind direction conditions at a steady state according to the following setup features:

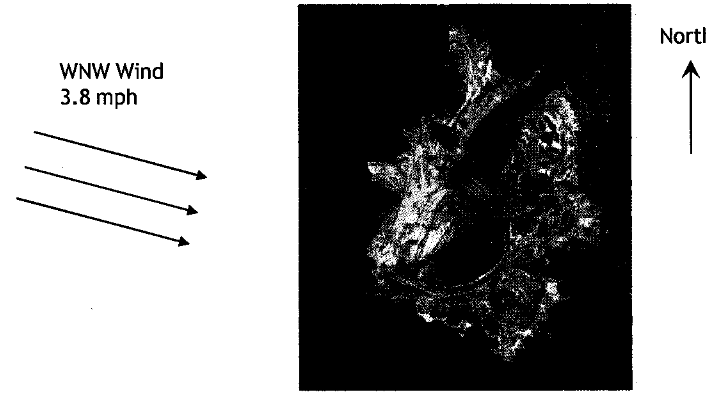
- One-thousand particles (a statistically significant quantity) are released from each of nine locations within the mine.
- A series of particle release scenarios are simulated at each release point. Scenarios in the series give successively longer durations for particles to move with the wind. The fraction of particles escaped for each scenario is summed to determine a steady state condition of particle motion.
- The fraction of particles generated at each source escaping the model boundary determine pit retention for that source location.

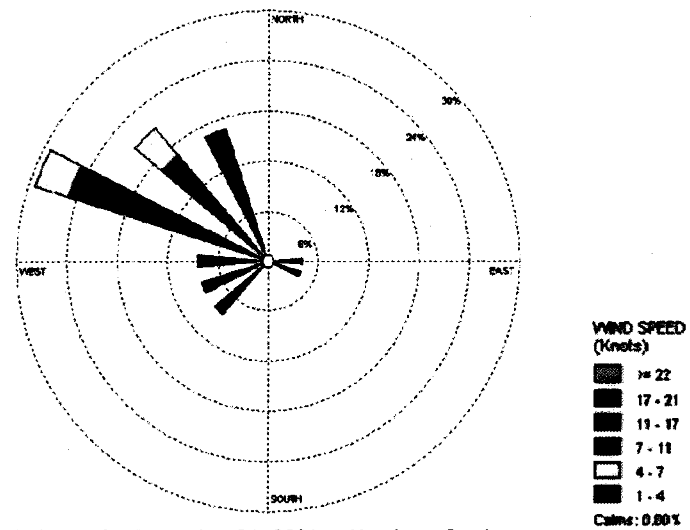
## Model Setup: Scenario parameters

The Notice of Intent (NOI) submitted by Kennecott Utah Copper LLC (KUC) for increasing the annual limit of material moved included an air quality modeling demonstration using the American Meteorological Society/EPA Regulatory Model (AERMOD) model to support the increase in material moved. AERMOD is an EPA-approved model that was used to predict ground level concentrations of $PM_{10}$. The modeling results indicated that the maximum combined concentration of modeled and monitored total $PM_{10}$ impact from the emissions after the proposed modification when added to the background concentration would be 144.2 µg/m³, less than the 24-hr National Ambient Air Quality Standard (NAAQS) of 150 µg/m³. It is important to note that these concentrations represent a modeled 24-hour maximum impact, and are not representative of continuous concentrations. This modeled impact corresponds to an average wind speed of 3.8 miles per hour (mph) from the West-Northwest direction. The meteorological data were obtained from the nearby Herriman Station.

The Herriman meteorological data was supplied by the Utah Division of Air Quality (UDAQ) and is considered representative of the mine location. Data for years 2004 through 2006 were used for the AERMOD analysis.

AERMOD modeling demonstrated that the maximum combined concentrations of modeled and monitored $PM_{10}$ after the proposed expansion occurred when the average wind speed was 3.8 miles per hour (mph) and the average wind direction was from the northwest sector. The current CFD model will simulate this condition of wind out of the west-northwest at 3.8 mph to estimate pit retention during these conditions.




Wind Rose for December 21, 2006 at Herriman Station

## Model Setup: Geometry

Model setup parameters have been chosen to closely approximate those used by the authors of the original U of U study.

The model shape and domain size have been set similar to the U of U study, albeit slightly larger due to an increase of mine footprint since 1996. Original model domain and current model domain are illustrated below. Model vertical limits extend to the mixing height calculated by the original study of approximately 14,000 ft above mean sea level. Depending on the topography, this top boundary is approximately 7,200 ft above the edge of the pit.

The primary source of data for the geography is a topographic contour plot produced during an aerial survey of the site conducted in 2009. The aerial survey did not include all of the area required by the model. The areas not covered by the aerial survey were stitched from USGS topography.

This topographical data set is translated to a simplified three-dimensional surface that is acceptable to the CFD simulation tools. A three-dimensional solution grid is created in the air-space above the ground to allow calculation of the variables of flow and the resultant particle paths.

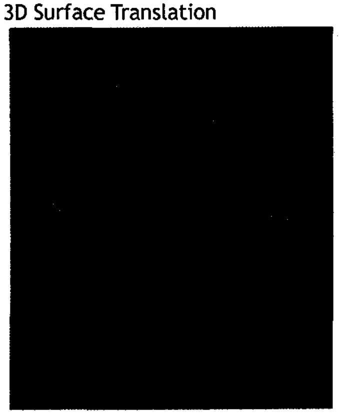
Topography from USGS

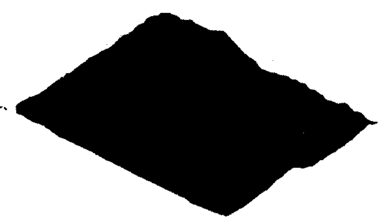
U of U model extent

Current CFD model extent

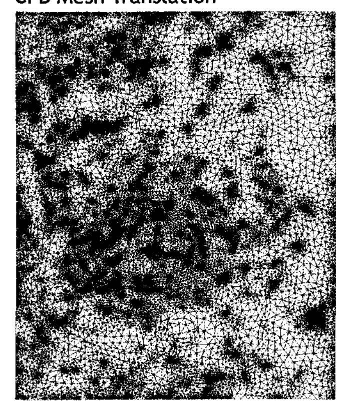
Contour line translation

3D Surface Translation





CFD Mesh Translation



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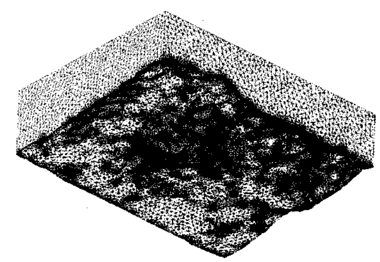
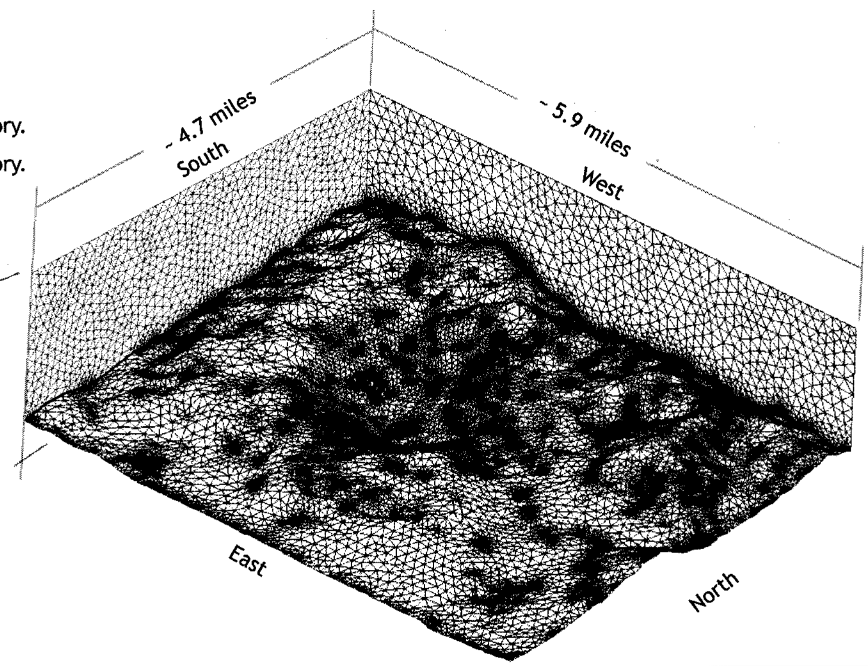


## Model Setup: Solution parameters based on U of U study

Many of the solution parameters were carried over from the U of U study into this model setup including the following:

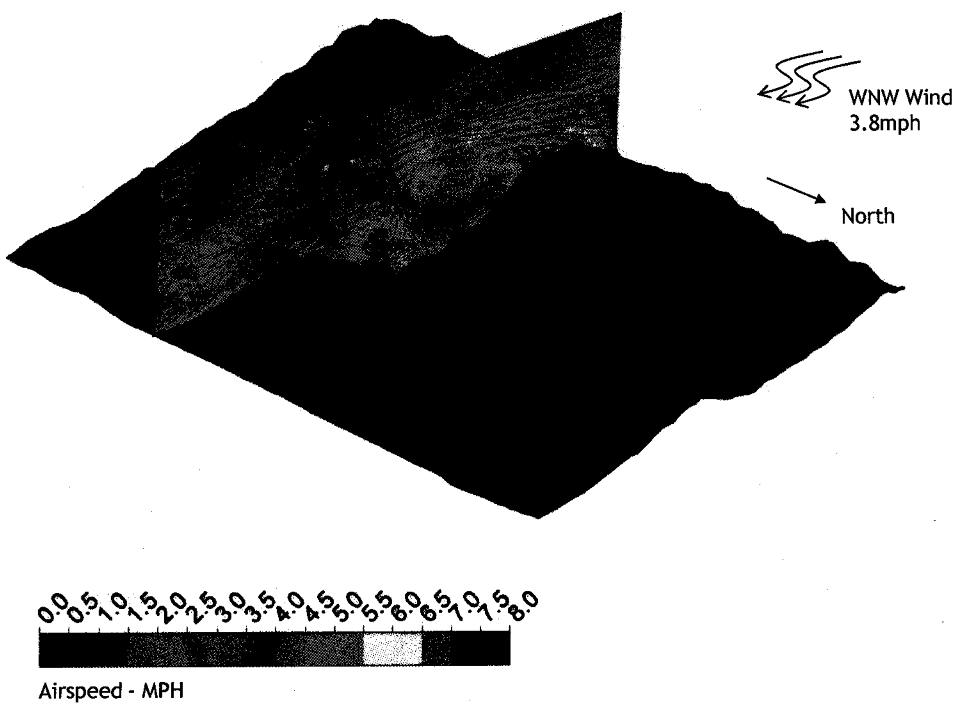
- Air Density: 1 kg/m$^3$ corresponding to the site elevation of 5,000ft above sea level.
- Air Viscosity: $1.21 \times 10^{-5}$ lbm/ft-sec
- Particle Density: 1000 kg/m$^3$
- Turbulence: Standard K-$\varepsilon$ Model
- Oncoming winds: Uniform atmospheric boundary layer profile.
- Mixing height boundary type: Symmetry.
- Surface roughness length: 15cm
- Model Boundaries:
  - Wind Inlet: Velocity inlet with no assumed atmospheric boundary layer profile
  - Other vertical boundaries Pressure-outlet allowing particle escape
  - Top: Symmetry; particle reflection
  - Ground surface: Wall boundary; 100% particle trap*; 15cm surface roughness height.
- Turbulent Kinetic Energy: Per U of U study Table 4.4 depending on atmospheric stability category.
- Turbulent Dissipation Rate: Per U of U study Table 4.4 depending on atmospheric stability category.
- Particle release: Time-dependent stochastic 'random-walk' approach.
- Particle size: $PM_{10}$




* Model boundary deposition is the action taken by a particle upon reaching model boundaries (e.g. ground, north side, east side, west side, south side, top). 100% trap at ground indicates that all particles impacting the ground are trapped there and do not escape the model boundaries.

## Flow Field Generation: WNW Wind @ 3.8mph

Wind Direction: WNW Wind
Wind Speed: 3.8 mph
Atm. Stability: Neutral

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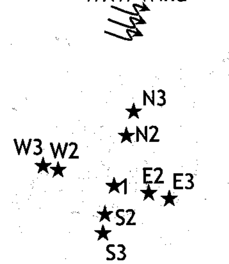
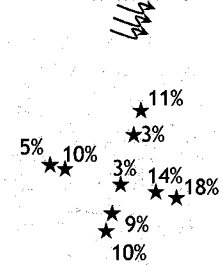
## Particle Tracking Results: *South particles*

| | |
|---|---|
| Wind Direction: | Out of the WNW |
| Wind Speed: | 3.8 mph |
| Atm. Stability: | Neutral |
| Particle Counting: | Steady state, continuous release |
| Ground Deposition: | 100% Trap |

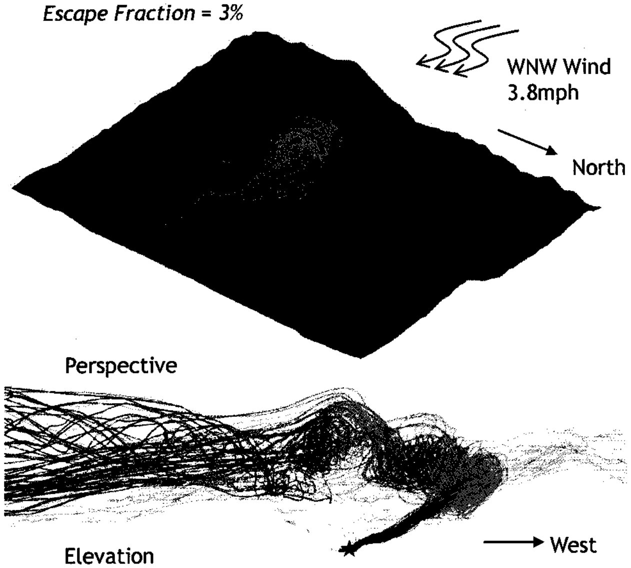


Release Points

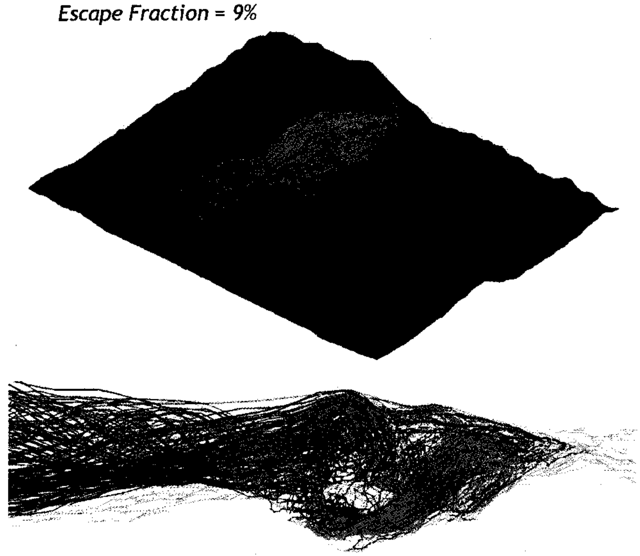


%Escape Summary

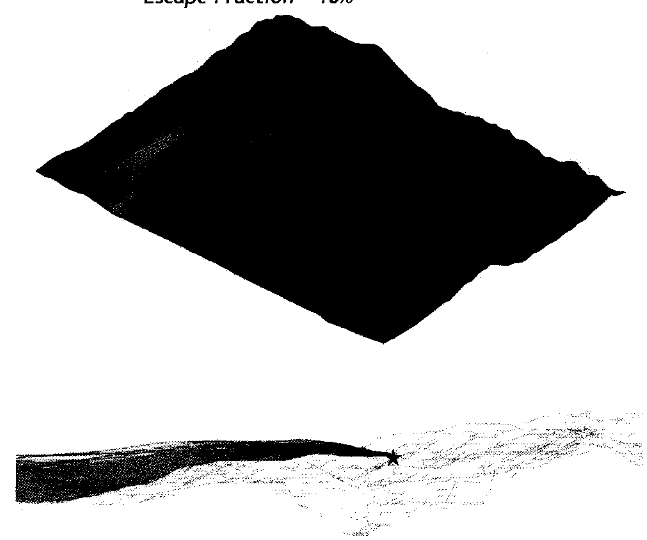
Particle Release 1
Location: Low in the center of the pit
Elevation: 7 feet above ground (4,447 ft MSL)
*Escape Fraction = 3%*

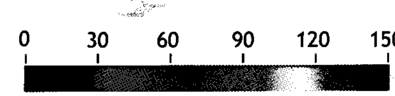



Particle Release S2
Location: Mid-way up pit slope
Elevation: 7 feet above ground (5,997 ft MSL)
*Escape Fraction = 9%*



Particle Release S3
Location: Pit ledge
Elevation: 7 feet above ground (7,440 ft MSL)
*Escape Fraction = 10%*





Particle Residence Time (minutes)

***(continued)***

| | | | |
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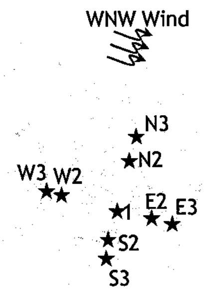
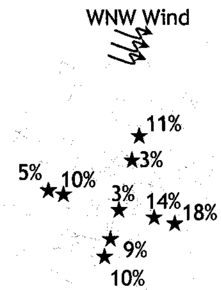
| CH2MHILL | Project #:414399<br>Date: 21 March 2011<br>File: KUC-T1b-r0 | Bingham Canyon Mine<br>Pit Retention Study | 8 |

## Particle Tracking Results: *North Particles*

*(continued)*

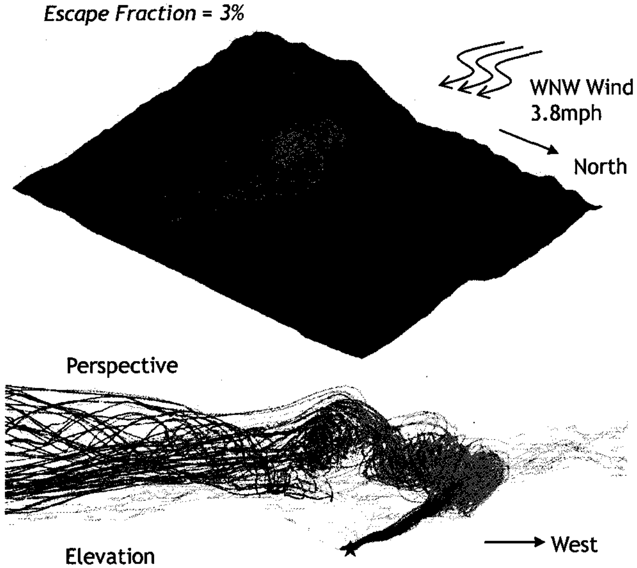



Release Points

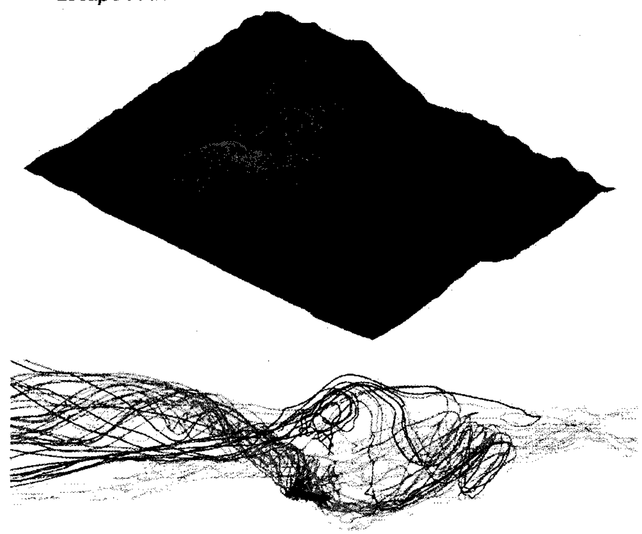



%Escape Summary

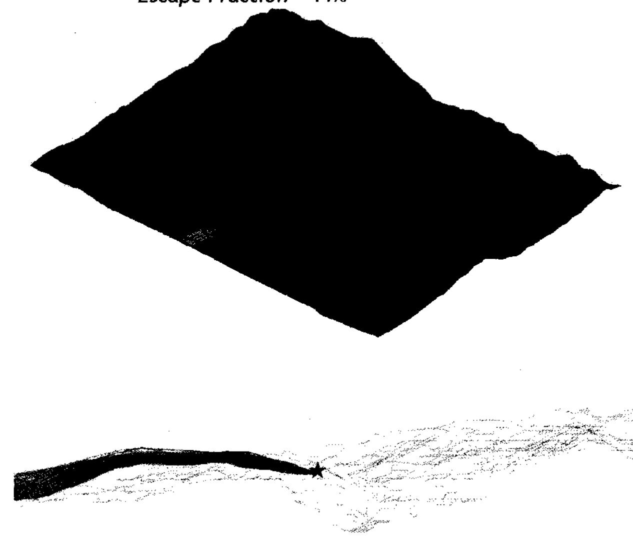
Particle Release 1
Location: Low in the center of the pit
Elevation: 7 feet above ground (4,447 ft MSL)
*Escape Fraction = 3%*

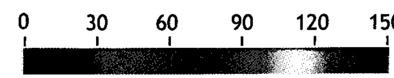



Particle Release N2
Location: Mid-way up pit slope
Elevation: 7 feet above ground (5,647 ft MSL)
*Escape Fraction = 3%*



Particle Release N3
Location: Pit ledge
Elevation: 7 feet above ground (6,597 ft MSL)
*Escape Fraction = 11%*

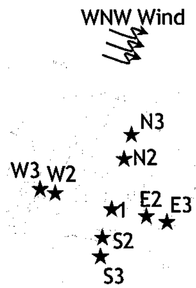




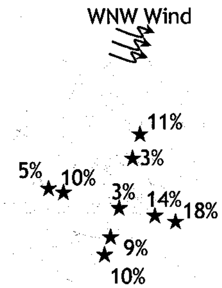

Particle Residence Time (minutes)

***(continued)***

## Particle Tracking Results: *East particles*
*(continued)*

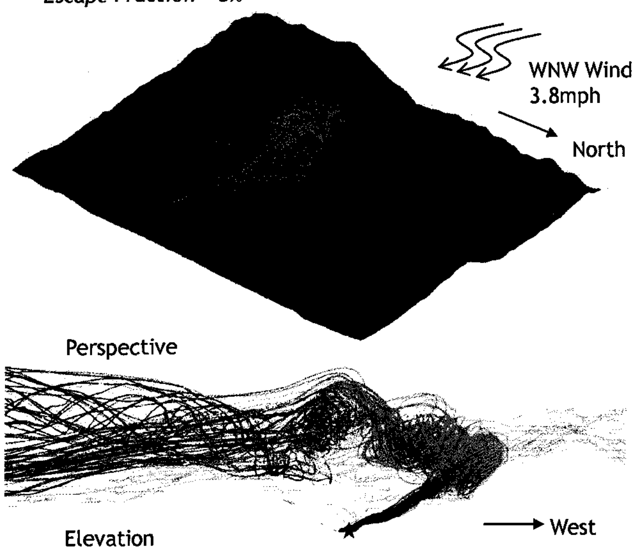



Release Points

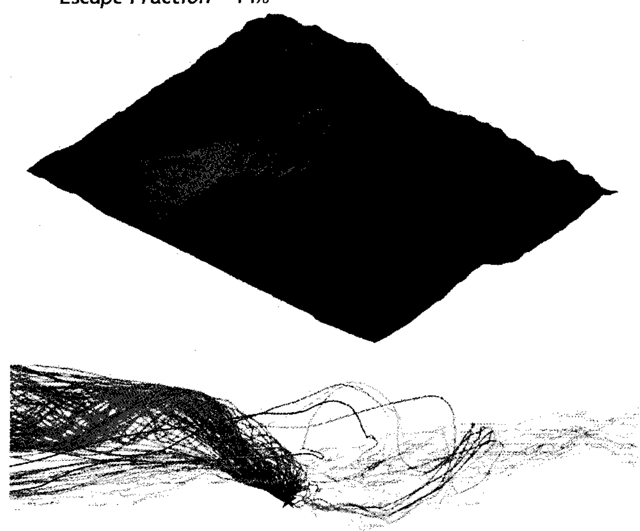



%Escape Summary

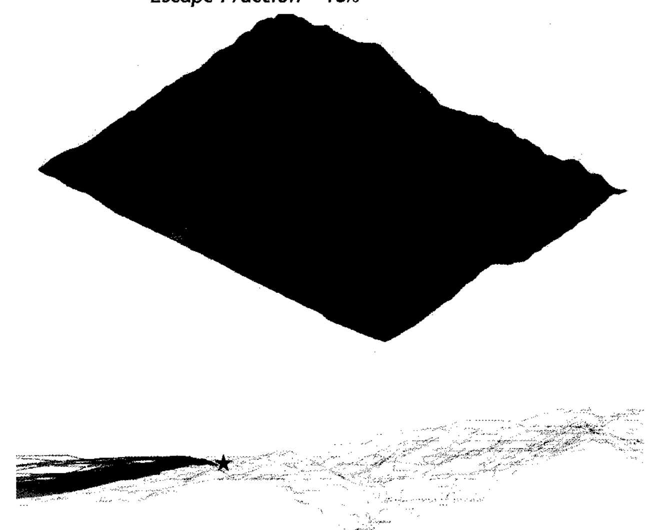
Particle Release 1
Location: Low in the center of the pit
Elevation: 7 feet above ground (4,447 ft MSL)
*Escape Fraction = 3%*

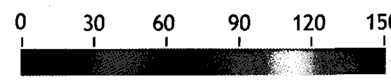



Particle Release E2
Location: Mid-way up pit slope
Elevation: 7 feet above ground (5,647 ft MSL)
*Escape Fraction = 14%*



Particle Release E3
Location: Pit ledge
Elevation: 7 feet above ground (6,947 ft MSL)
*Escape Fraction = 18%*



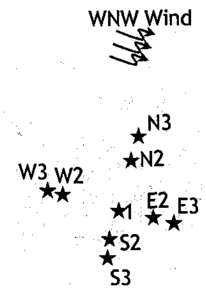



Particle Residence Time (minutes)

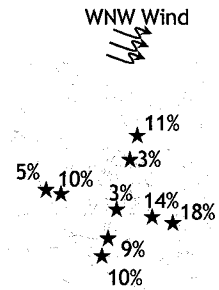
***(continued)***

## Particle Tracking Results: *West particles*

*(continued)*

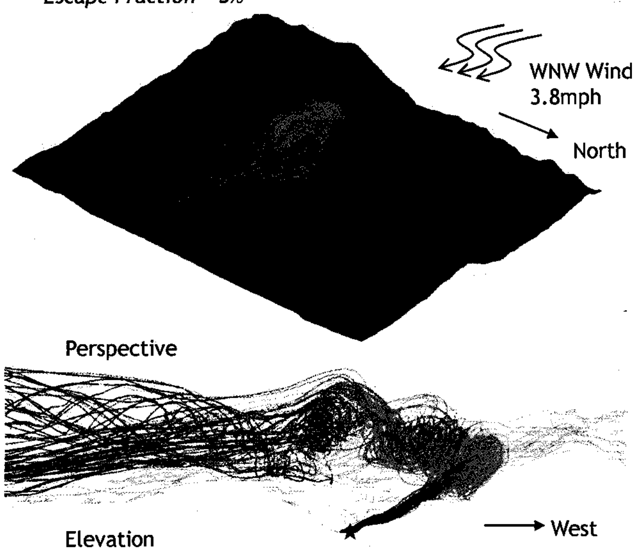



Release Points

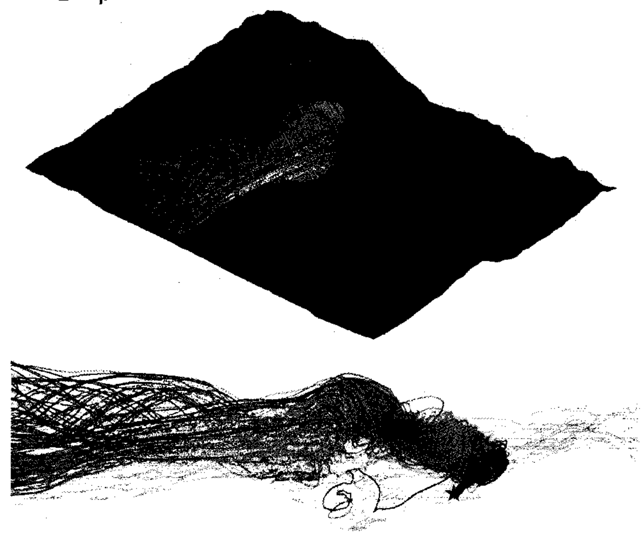



%Escape Summary

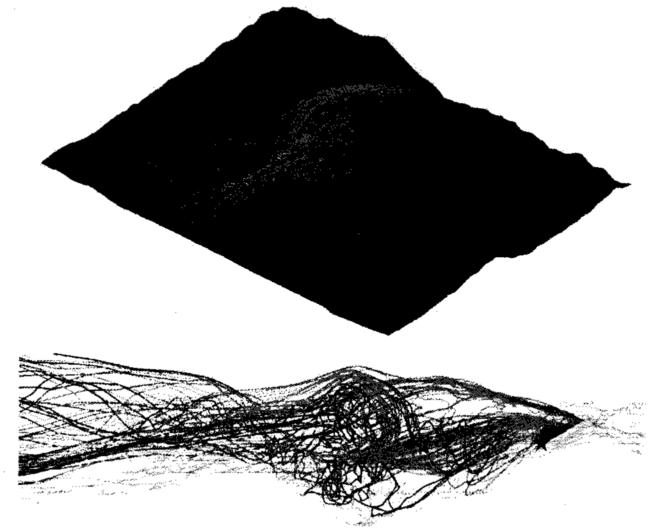
<u>Particle Release 1</u>
Location: Low in the center of the pit
Elevation: 7 feet above ground (4,447 ft MSL)
*Escape Fraction = 3%*

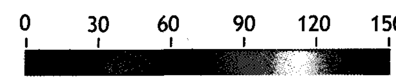



<u>Particle Release W2</u>
Location: Mid-way up pit slope
Elevation: 7 feet above ground (5,647 ft MSL)
*Escape Fraction = 10%*



<u>Particle Release W3</u>
Location: Pit ledge
Elevation: 7 feet above ground (7,547 ft MSL)
*Escape Fraction = 5%*



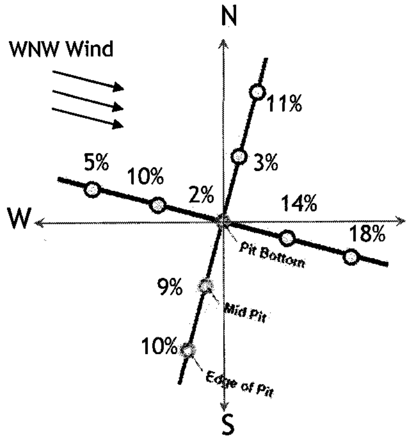



Particle Residence Time (minutes)

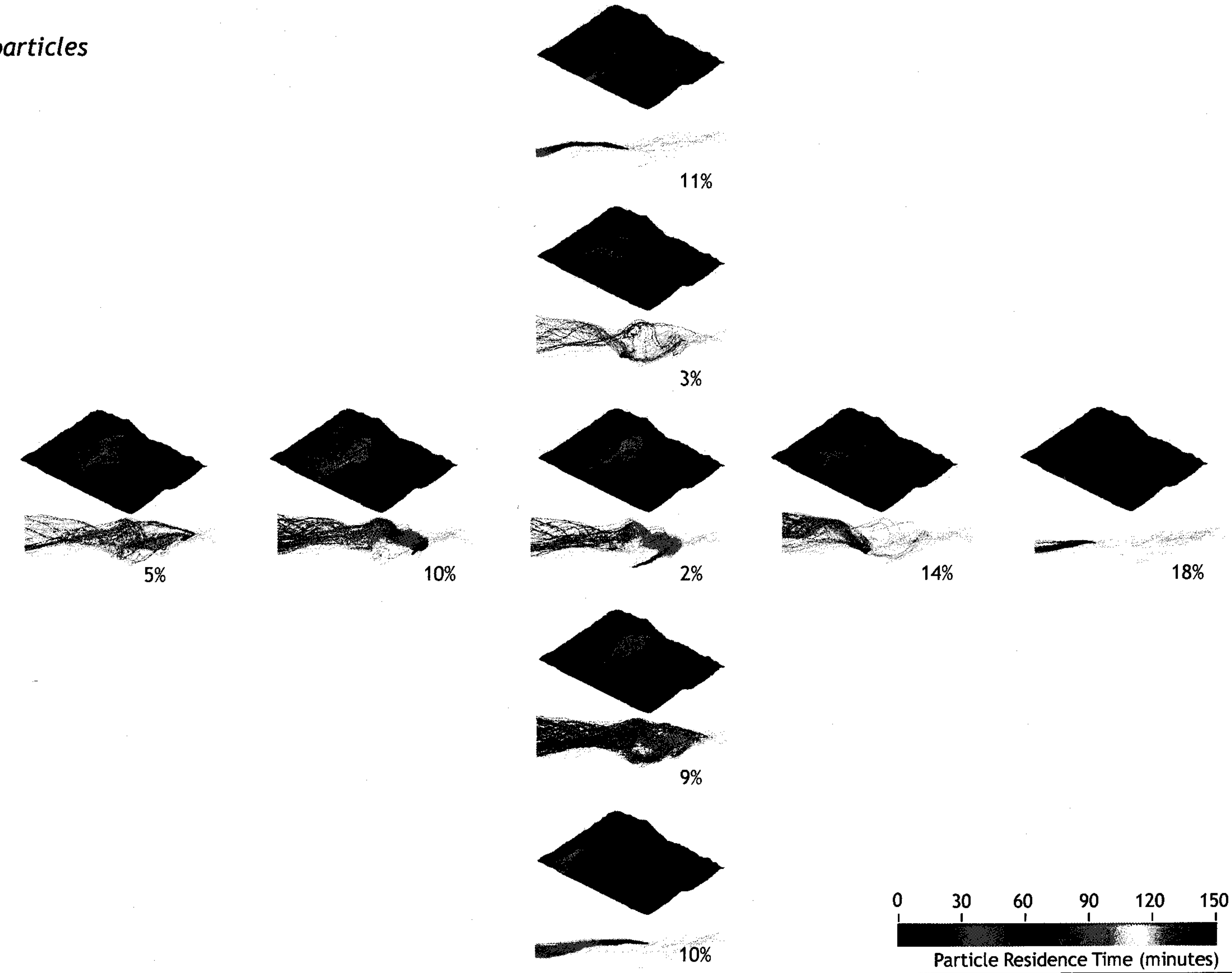
*(continued)*

## Particle Tracking Results Summary: *All particles*

*(concluded)*




%Escape Summary



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Kennecott Utah Copper
4700 Daybreak Parkway
South Jordan, Utah 84095
USA

Chris Kaiser, HSEQ Principal Advisor
Environmental Permitting and Regulation

March 21, 2011

UTAH DEPARTMENT OF
ENVIRONMENTAL QUALITY

DIVISION OF AIR QUALITY

Mr. Nando Meli
PO Box 144820
Salt Lake City, UT 84114-0482

Dear Mr. Meli:

Subject: Approval Order DAQE-AN0105710023-08 (General Comments)

The Utah Department of Environmental Quality (DEQ) is receiving public comment on an Intent to Approve Modified Approval Order DAQE-AN0105710023-08 and on a proposed rule amendment to the Utah State Implementation Plan (SIP) Section IX, Control Measures for Area and Point Sources, Part H, Emissions Limits. Kennecott Utah Copper LLC (KUC) submits this public comment on the Intent to Approve and the proposed SIP rule amendment. KUC's previously-submitted technical showings for the Intent to Approve and the SIP rule amendment both satisfy the relevant legal requirements. However, in order to attempt to address certain concerns raised in other public comments, KUC is submitting the following additional comments.

KUC appreciates the robust process that the Utah Department of Air Quality (UDAQ) has undertaken to review the Notice of Intent (NOI) and Technical Support Document (TSD) for the KUC proposal to increase the material moved limitation from 197 million tons per year to 260 million tons per year. While mining operations do generate dust, KUC has implemented industry leading control measures and with this proposal will implement enhanced measures to further minimize emissions. Dust control measures are administered through a Fugitive Dust Control Plan (FDCP), which is a permit condition, requiring regular updates, and active inspections by UDAQ. KUC is also voluntarily proposing an emissions cap for $PM_{10}$ and precursors as well as $PM_{2.5}$ and precursors. As UDAQ develops the State Implementation Plan (SIP) for $PM_{2.5}$ and ozone, KUC understands that the SIP may dictate additional source control strategies for our facilities as necessary to bring the air shed into attainment.

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Since monitoring data reflects real impacts to the air shed, KUC encourages members of the public to review the monitoring data available on the UDAQ website. Of all the monitors in the Salt Lake Valley, the $PM_{2.5}$ monitors in Herriman and Magna and the $PM_{10}$ monitor in Magna, which are closest to KUC operations, show the lowest annual average monitored values for particulates.

Additionally, KUC has operated a $PM_{10}$ monitor in Copperton since prior to 1994. All activities proposed through this mine expansion are similar in scope but on an incrementally larger scale than previous mining phases. It is reasonable to assume the ambient impacts observed from the proposed expansion will be consistent with those associated with previous mining expansion phases. Mining activities such as the 1999 material movement increase, Lower Bingham Canyon waste rock placement and Giant Leap pushback, over time have shown no discernable changes in monitored concentrations and we would expect the same from this expansion. KUC is voluntarily proposing an additional ambient air quality monitor in the lower Butterfield Canyon area (area of peak modeled impacts) as a permit condition to verify continued compliance with the National Ambient Air Quality Standards (NAAQS), and to provide the public with additional ambient monitoring data.

KUC has performed air dispersion modeling of the proposed emission rates using AERMOD to further demonstrate that air quality near the mine would not be adversely impacted by the expansion. The highest 24-hour concentration of $PM_{10}$ predicted by the model, including background, was below 150 micrograms per cubic meter ($\mu g/m^3$), the NAAQS for $PM_{10}$. In addition to this analysis, KUC used the UAM modeling to evaluate the impact of the increase in material moved at the Bingham Canyon Mine (BCM) consistent with the state 2005 $PM_{10}$ Maintenance Plan. At the request of UDAQ, KUC enhanced the UAM modeling analysis by integrating a CALPUFF modeling analysis. Although all modeling analyses show compliance with the NAAQS, KUC will voluntarily relinquish 5,845 tons of emission reduction credits. While voluntary, the credits will be relinquished consistent with the methodology established in the federal 1994 $PM_{10}$ SIP. These credits were generated from previous, verified emission reduction projects. Relinquishing these credits ensures that the 1994 attainment demonstration is maintained.

Not only has KUC analyzed the potential impacts for the proposed increase to 260 million tons of material moved at the BCM, KUC has also estimated the overall emissions changes for the combined Cornerstone projects.

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Overall, KUC estimates an emissions decrease of approximately 9 percent of $PM_{10}$ and precursors as well as $PM_{2.5}$ and precursors from the combined Cornerstone projects.

Responses to various comments generated throughout the public comment period are shown below.

**Category A: Technical comments on the Mine Air Approval Order, including overall mine emissions and impacts to ambient air quality**

**Comment AO.1**

With the proposed increase in mining activity, what will be the increase in air emissions?

**Response AO.1**

Based on the current and projected mine plans, KUC is requesting to increase the material moved limitation from 197,000,000 tons per year to 260,000,000 tons per year of ore and waste rock combined.

Pursuant to the federal Clean Air Act, the UDAQ New Service Review (NSR) program regulates stationary sources of emissions only. Emissions such as those from non-road mobile equipment like haul trucks are regulated pursuant to emission standards established by EPA pursuant to Title II of the Clean Air Act. With the proposed modification, there will be a small increase in stationary source emissions. Nevertheless, KUC has voluntarily proposed an emissions cap for $PM_{10}$ and precursors as well as $PM_{2.5}$ and precursors that include tailpipe and fugitive emissions.

Emissions from existing mobile and stationary equipment have been recalculated to maintain consistent methodology using the most current emission factors to provide an accurate estimate of emissions.[1] Table 1 provides a summary of emissions from the 197,000,000 tons per year (current) and 260,000,000 tons per year (future) material movement limitations. As is evident from Table 1, all listed air pollutants decrease from their current re-estimated PTEs to their future PTEs because KUC has committed to implementing new emissions controls strategies, such as changing its truck fleet to one with cleaner, bigger trucks, and using better dust control.

[1] EPA emission factors have been improved and updated, over time. Using a consistent set of emission factors allows for an "apples-to-apples" comparison of emissions at different operating levels.

**TABLE 1**
Current and Future Peak Year Potential to Emit (PTE) Summary for BCM

| Pollutant | Re-estimated Current BCM PTEs (197,000,000 tons per year) | Future BCM PTEs (260,000,000 tons per year) |
|---|---|---|
| $PM_{10}$ (tpy) | 1,686 | 1,513 |
| $PM_{2.5}$ (tpy) | 685 | 368 |
| $SO_2$ (tpy) | 97 | 6.56 |
| $NO_x$ (tpy) | 7,247 | 5,830 |
| CO (tpy) | 4,352 | 1,682 |
| VOC (tpy) | 947 | 314 |

**Comment AO.2**

Is Kennecott separating the BCM mine and the Copperton Concentrator in air permits to avoid the major source threshold of 100 tons per year?

**Response AO.2**

No, the BCM and Copperton Concentrator are considered a single source for Title V Part 70 applicability purposes. The Copperton Concentrator operates under a separate AO from the BCM for administrative convenience. (The emission units and control requirements are distinct for each operations and different individuals have responsibility for the Mine and concentrator.) Under R307-101, a Major Source is defined as "any stationary source of air pollutants which emits, or has the potential to emit, one hundred tons per year or more of any pollutant subject to regulation under the Clean Air Act…" Emissions of stationary sources (point sources) at the BCM and the Copperton Concentrator are shown in Table 2. The aggregated emissions from stationary sources at the BCM and Copperton Concentrator do not approach major source status.

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**TABLE 2**
Combined Emissions, Mine and Concentrator

| | Point Sources at BCM | Point Sources at Copperton Concentrator | Total Point Source Emissions |
|---|---|---|---|
| $PM_{10}$ Emissions (tpy) | 6.28 | 4.98 | 11.26 |
| $PM_{2.5}$ Emissions (tpy) | 2.60 | 1.85 | 4.45 |
| $SO_2$ Emissions (tpy) | 0.0002 | 0.00 | 0.0 |
| $NO_X$ Emissions (tpy) | 1.17 | 0.35 | 1.52 |
| CO Emissions (tpy) | 10.6 | 0.2 | 10.8 |
| VOC Emissions (tpy) | 0.20 | 0.01 | 0.21 |

**NOTE:**
Point Source emissions for the Copperton Concentrator include the proposed modifications at the Concentrator and are subject to review from UDAQ.

**Comment AO.3**

Has the University of Utah white paper regarding "Escape emissions" from the mine/pit ever been peer-reviewed by a qualified peer reviewer?

**Response AO.3**

The "Airflow Patterns and Pit-Retention of Fugitive Dust for the Bingham Canyon Mine" study was conducted by Dr. Ragula Bhaskar and Navin Tandon, Department of Mining Engineering at the University of Utah. The University of Utah is an accredited university with a very reputable academic and research program. Emissions modeled in the AERMOD analysis used an escape fraction developed from the University study. It is important to note that emissions estimates for the 1994 and 2005 demonstration analyses did not use an escape fraction; the SIP demonstration analyses assumed all particulates generated in the mine escape the pit. This is a highly conservative assumption as a large fraction of gaseous and particulate pollutants are observed to remain within the pit during severe inversions such as those modeled in the 1994 and 2005 SIPs.

Also important to note is that the Copperton monitor has not shown any discernable changes in monitored $PM_{10}$ concentrations associated with the previous mining phases mentioned above. This demonstrates that particulates settle in the BCM and that only a small portion of the particulates generated in the pit escape the mine.

The study later became part of a Master's thesis. Before a master's thesis is published at the University of Utah, the document is reviewed by a committee of at least three PhD level individuals with documented expertise in the area of study. In addition, the thesis is publicly defended by the author in a University setting. Copies of the Bhaskar study and the Tandon thesis are available at KUC for review.

**Comment AO.4**

Fugitive sources (haul roads) may cause a majority of the emissions at the mine. What is KUC doing to control fugitive dust and how is this reported to the UDAQ? How were the emissions from haul roads calculated for the NOI?

**Response AO.4**

A Fugitive Dust Control Plan (FDCP) detailing the dust control measures to be implemented at the BCM has been submitted to the UDAQ. As is currently done, each year KUC will report dust control measures implemented at the BCM during the previous year with details such as volume of water applied, commercial dust suppressant activity, etc.

Specifically, the FDCP requires that active ore and waste haulage roads within the Pit Influence Boundary will be water sprayed and/or treated with commercial dust suppressant as conditions warrant. Crushed road base material must be applied as necessary to active ore and waste haulage roads within the Pit Influence Boundary to enhance the effectiveness of fugitive dust control measures. Commercial dust suppressant must be applied to active ore and waste haulage roads outside of the Pit Influence Boundary no less than twice per year. Additionally, opacity surveys will be conducted monthly in areas where waste rock is being placed.

With the proposed modification, the average unpaved haul road distance for waste rock and ore will range from 4.5 miles round-trip to 8.3 miles round-trip over time as various areas are mined. The haul roads on which the haul trucks travel will be sprayed with water or commercial dust suppressants to control fugitive dust emissions throughout the year. Emissions of $PM_{10}$ and $PM_{2.5}$ were estimated using methodology from EPA's *AP-42, Fifth Edition*, Section 13.2.2 (EPA, 2006). For the portion of haul roads located within the Pit Influence Boundary, emissions are calculated with the pit escape fraction. The

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pit escape fraction represents the portion of the particulates not settling in the pit.

Based on EPA's emission calculation methodology, *AP-42, Fifth Edition*, Section 13.2.2, control efficiency on the haul roads with frequent watering per approaches 95 percent. However, emissions submitted with the NOI and used for permitting are based on UDAQ's default control factors, which are conservative. Per UDAQ policy, for haul roads within the Pit Influence Boundary, a default[2] control efficiency of 75 percent is used for watering and road base application. For haul roads outside the Pit Influence Boundary, a default control efficiency of 85 percent is used for application of commercial dust suppressants. The conservancy in estimating (or over-estimating) emissions may explain, in part, the relatively higher impacts shown by the air quality dispersion models compared to the actual ambient monitoring data.

The daily vehicle miles traveled (VMT) used to calculate the $PM_{10}$ emissions as an input for the AERMOD dispersion modeling analysis were based on the year 2016 material haulage of 260 million tons per year (tpy). Year 2016 is a projected peak year for emissions. The emission inventory calculated 9,425,000 annual VMT that would be required by the haul trucks to move the maximum proposed 260 million tpy of ore and waste material. This translates to 25,822 VMT per day if the annual VMT were evenly distributed throughout the year. However, the AERMOD modeling analysis assumed a conservative 20 percent daily variability factor that was applied to the average daily emissions to account for variability of BCM operations. Therefore, $PM_{10}$ emissions based on 30,986 VMT per day were modeled in AERMOD to demonstrate compliance with the 24-hr $PM_{10}$ National Ambient Air Quality Standard (NAAQS). KUC is proposing no change to the existing cap that limits the vehicle miles traveled by haul trucks to 30,000 VMT/day. Therefore haul road emissions will be effectively capped below modeled levels on a daily basis.

It was also assumed for a conservative maximum emissions estimate, that all material was hauled in 240-ton trucks to the farthest destination. In reality, the average truck fleet size is larger than 240-tons and a percentage of material would be on shorter haulage routes. Larger haul trucks on shorter hauls result in lower overall emissions.

[2] UDAQ's policy does allow the use of other factors; however, the more conservative defaults were utilized in this case.

**Comment AO.5**

How many acres of land will be disturbed by the mine expansion? Were these areas included in the emissions calculations done as part of the NOI? How was the escape fraction or pit retention of particulates used in the calculations?

**Response AO.5**

As a result of increased annual material moved to 260,000,000 tons of ore and waste rock it is estimated, according to the proposed mine plan, that approximately 565 total acres of land will be subject to active disturbance per year. Of that total, 310 acres (55 percent) are within the Pit Influence Boundary. Emissions of $PM_{10}$ were derived from the total PM emission factors estimated using methodology from the EPA's *AP-42, Fifth Edition*, Table 11.9-4 (EPA, 1998). $PM_{10}$ is estimated to be 47 percent of PM and $PM_{2.5}$ is estimated to be 15 percent of $PM_{10}$. Since the emission source is partially located within the Pit Influence Boundary, that portion of emissions is calculated with the pit escape fraction.

**Comment AO.6**

Is the Best Available Control Technology (BACT) assessment in the NOI complete?

**Response AO.6**

The BACT analysis has been divided into two sections. The first section includes BACT analysis for new emission sources (e.g., second in-pit crusher).

With the proposed increase in material movement, the existing emission sources will see an increase in material handled. The control measures for the existing sources have been through a historical review by UDAQ and considered BACT. Therefore the second section of the BACT in the NOI includes a discussion on control technologies that have already been identified as BACT by UDAQ. The BACT assessment in the NOI has been determined to be technically complete by UDAQ.

**Comment AO.7**

How were gaseous pollutants handled in the model? Was there a pit retention factor applied to $NO_x$ or other gaseous pollutants?

**Response AO.7**

In the NOI, it was assumed for emissions estimates and modeling that the escape fraction for all gaseous pollutants was 100 percent (i.e., no pit settling). This is a highly conservative approach as gaseous pollutants are believed to be retained in the pit during inversion conditions when formation of secondary particulates is most critical.

**Comment AO.8**

Was a pit escape fraction applied to all emission sources at the BCM?

**Response AO.8**

No, a pit escape fraction was not applied to all sources at the BCM. Section 3 of the NOI summarizes emissions at the BCM after the proposed increase in the annual movement of ore and waste rock material.

For fugitive and stationary emission sources of particulates located within the Pit Influence Boundary, $PM_{10}$ emissions are calculated taking into account a pit escape fraction of 20 percent. For $PM_{2.5}$, the escape fraction was determined to be 21 percent. These factors are based on *Airflow Patterns and Pit-Retention of Fugitive Dust for the Bingham Canyon Mine*, which predicts the escape fraction for different conditions at the BCM (Bhaskar and Tandon, 1996). Table 3 provides a summary of emission sources at the BCM and whether the source is located within the Pit Influence Boundary, outside the Pit Influence Boundary or both.

The analysis submitted with the NOI application is consistent with 1999 letter sent by Richard R. Long, EPA Director, Air and Radiation Program to Ursula Trueman UDAQ Executive Secretary which states that, "We are aware of the argument expressed by your staff that most $PM_{10}$ emissions never leave the Bingham Canyon Mine pit. While we believe this may be true for some or most of the ore hauling, which occurs entirely within the pit, we do not believe this is true for the projected emission increase in the permit action. The State's engineering review explains, on page 5, that most of the allowed increase in truck hauling will be for waste rock, not ore, which is hauled out of the pit to waste piles up to 3.5 miles away. We would not expect fugitive $PM_{10}$ emissions from that hauling to remain mostly in the pit. "

As discussed in the NOI, pit settling (via emissions estimations with the application of a pit escape fraction) is only accounted for the portion of the haul roads within the Pit Influence Boundary. Pit settling is not accounted for emission sources outside the Pit Influence Boundary such as waste rock placement areas and portions of haul roads.

**TABLE 3**
Particulate Emission Sources at BCM

| Emission Source | Source Located within Pit Influence Boundary | Source Located outside Pit Influence Boundary | Notes |
|---|---|---|---|
| Existing In-pit Crusher | Yes | | |
| New In-pit Crusher | Yes | | |
| Transfer Point C6/C7 | | Yes | |
| Transfer Point C7/C8 | | Yes | |
| Lime Silo (#1) | | Yes | |
| Lime Silo (#2) | | Yes | |
| Sample Preparation Building | Yes | | |
| Drilling Operations | Yes | | |
| Blasting Operations | Yes | | |
| Haul truck Loading | Yes | | |
| Truck Dumping to Primary In-pit Crusher | Yes | | |
| Truck Dumping to Secondary In-pit Crusher | Yes | | |
| Truck Dumping at Stockpile | Yes | | |
| Existing In-pit Enclosed Transfer Points | Yes | | |
| Existing In-pit Enclosed Additional Transfer Points (from crusher relocation) | Yes | | |

**TABLE 3**
Particulate Emission Sources at BCM

| Emission Source | Source Located within Pit Influence Boundary | Source Located outside Pit Influence Boundary | Notes |
|---|---|---|---|
| New In-pit Enclosed Transfer Points | Yes | | |
| Conveyor Transfer to Stacker | | Yes | |
| Drop to Coarse Ore Storage Pile | | Yes | |
| Coarse Ore to Reclaim Tunnel Vent | | Yes | |
| Truck Dumping of Waste Rock | | Yes | |
| Ore Stockpile | Yes | | |
| Disturbed Areas | Yes | Yes | 55% of the disturbed areas are expected to be located within the pit influence boundary and 45% of the disturbed areas outside the pit influence boundary. |
| Haul roads | Yes | Yes | Haul roads to the in-pit crusher are located within the pit influence boundary and a portion of haul roads to the waste rock placement areas will be outside the pit influence boundary. |

**TABLE 3**
Particulate Emission Sources at BCM

| Emission Source | Source Located within Pit Influence Boundary | Source Located outside Pit Influence Boundary | Notes |
|---|---|---|---|
| Road base crushing and screening plant | Yes | | |
| Track Dozers | Yes | Yes | Track dozers perform activities inside the pit influence boundary and outside the pit influence boundary. |
| Rubber-tire Dozers | Yes | | |
| Graders | Yes | Yes | Graders perform activities inside the pit influence boundary and outside the pit influence boundary. |
| Front end loaders | Yes | Yes | Front end loaders perform activities inside the pit influence boundary and outside the pit influence boundary. |

**Category B: Comments related to the State Implementation Plan(s)**

**Comment SIP.1**

How will the mine expansion impact the SIP? Have the impacts been documented? Should KUC wait until the SIP has received EPA approval before submitting their application for expansion? Why are these two activities being pursued in parallel?

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**Response SIP.1**

The BCM is currently limited by permit to an annual material moved limitation of 197,000,000 tons per year (tpy) for ore and waste rock, and KUC is requesting authorization to increase this amount to 260,000,000 tpy. A material moved limitation is also included in the federal 1994 SIP and state 2005 SIP for $PM_{10}$. The Technical Support Document submitted in August 2010 and subsequently revised in December 2010 and January 2011 assessed the implications of the proposed increase on the attainment and maintenance demonstrations that were relied upon in supporting the 1994 and 2005 $PM_{10}$ SIP actions. The Chemical Mass Balance (CMB) receptor model, in conjunction with emissions control and offset requirements, was used in support of the federal 1994 SIP attainment. The Urban Air shed Model with aerosols (UAM-AERO) was used in support of the state 2005 maintenance demonstration.

The three technical demonstrations (AERMOD modeling, CALPUFF and UAM modeling, 1994 SIP demonstration) show that the proposed increase in the material-moved limitation will not adversely affect attainment and maintenance of the $PM_{10}$ NAAQS.

KUC submitted a request to modify the current material movement limitation in both the state 2005 $PM_{10}$ SIP and the Bingham Canyon Mine Approval Order (AO). To ensure the public has sight of the entire proposal, both requests were submitted to the UDAQ for a parallel, but staggered review.

While the SIP rulemaking and the Mine AO require different technical demonstrations, the SIP rulemaking and the Mine AO are being pursued in parallel so that the regulators and the public can fully understand the scope of the technical demonstrations (air quality models) that Kennecott has produced. Additionally, Kennecott has made a third technical demonstration related to ambient air quality in the immediate vicinity of the mine.

The 2005 SIP rulemaking does not need to wait for EPA approval because it is a matter of Utah state law. The rulemaking pertains only to the state 2005 $PM_{10}$ SIP.

**Comment SIP.2**

What is KUC doing to assess the ambient air impacts from the proposed mine expansion? Will the mine expansion result in a violation of air quality standards?

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**Response to SIP.2**

The proposed modification meets all regulatory requirements under the Utah Administrative Code. KUC has demonstrated compliance with the NAAQS using AERMOD, the EPA approved model for evaluating near field impacts, as well as making technical demonstrations consistent with the state 2005 $PM_{10}$ Maintenance Plan SIP and the federal 1994 $PM_{10}$ SIP. Each of these demonstrations shows that the proposed modification will not result in a violation of the $PM_{10}$ NAAQS.

Furthermore, KUC has operated a $PM_{10}$ monitor in Copperton since prior to 1994. All activities proposed through this mine expansion are similar in scope but on an incrementally larger scale than previous mining phases. It is reasonable to assume the ambient impacts observed from the proposed expansion will be consistent with those associated with previous mining phases. Mining activities such as the 1999 material movement increase, Lower Bingham Canyon waste rock placement and Giant Leap pushback, over time have shown no discernable changes in monitored concentrations and we would expect the same from this expansion. Nevertheless, KUC is proposing an additional ambient air quality monitor in lower the Butterfield Canyon area (near peak modeled impacts) as a permit condition to verify continued compliance with the NAAQS, and to provide the public with additional ambient monitoring data.

**Comment SIP.3**

Was an attempt made to rerun the UAM model with adjusted numbers?

**Response SIP.3**

Because the previous UAM modeling files are unavailable, the use of the CALPUFF modeling system combined with the previous UAM modeling was used to evaluate the impact of the increase in material moved at the BCM. This approach was required by UDAQ. CALPUFF is a multi-layer, multi-species, non-steady-state Gaussian puff dispersion model that can simulate the effects of time- and space-varying meteorological conditions on pollutant transport, transformation, and removal. CALPUFF can use the 3-dimensional meteorological fields developed by the CALMET model or simple, single station winds. CALPUFF is well suited for this application as it handles very low wind speeds during inversion events and also has the ability to handle complex terrain. The results of the CALPUFF model were added to the predicted UAM concentrations to account for the total impacts after the increase in production.

Yours truly,

Chris Kaiser

RioTinto

Kennecott Utah Copper
4700 Daybreak Parkway
South Jordan, Utah 84095
USA

Chris Kaiser, HSEQ Principal Advisor
Environmental Permitting and Regulation

March 21, 2011

UTAH DEPARTMENT OF
ENVIRONMENTAL QUALITY

DIVISION OF AIR QUALITY

Mr. Nando Meli
PO Box 144820
Salt Lake City, UT 84114-0482

Dear Mr. Meli:

**Approval Order DAQE-AN0105710023-08, Response to EPA Comments**

Below are Kennecott Utah Copper LLC (KUC) responses to comments from US EPA regarding Utah's proposed revision to the Utah State Implementation Plan (SIP) Emission Limits and Operating Practices, Section IX.H.2.h and to Rule R307-110-17, Section IX and Part H, including the Technical Support document (TSD) prepared by KUC. This proposed revision is in support of the requested increase in movement of materials at the Bingham Canyon Mine (BCM) to 260 million tons per year from the current 197 million tons per year. Responses to comments on the "Intent-to-Approve" (ITA) (permit DAQE-IN0105710028-11, dated February 2, 2011) and the associated "New Source Plan Review" are also included below.

**Introduction**

On August 17, 2010, KUC submitted a Notice of Intent (NOI) application to increase the annual material-moved limit of ore and waste rock material at the BCM from 197 million tons per year to 260 million tons per year. The NOI application included:

- Emissions Summary – Potential to emit (peak year) emissions were estimated using the most current emissions methodology for all emission sources at the BCM. For fugitive and stationary emission sources of particulates located within the pit influence boundary, $PM_{10}$ emissions are calculated taking into account a representative but conservative pit escape fraction of 20 percent. For $PM_{2.5}$, the escape fraction was determined to be 21 percent. These factors are based on *Airflow Patterns and Pit-Retention of Fugitive Dust for the Bingham Canyon Mine*, which predicts the escape fraction for different conditions at the BCM (Bhaskar and Tandon, 1996). Pit escape fractions were not used to estimate emissions from mobile sources.
- Control Technology Analysis – A Best Available Control Technology analysis for haul roads and ore and waste rock transfer and handling sources was included in the application.

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- AERMOD Analysis – An AERMOD analysis was performed to demonstrate that the proposed modification will not result in a violation of the 24-hr $PM_{10}$ NAAQS in the near-field.

Emissions were estimated in the NOI using conservative assumptions. The AO for the BCM limits the maximum total mileage for ore and waste rock trucks to 30,000 miles per day. The daily vehicle miles traveled (VMT) used to calculate the $PM_{10}$ emissions as an input for the AERMOD dispersion modeling analysis were based on the peak year for haulage, 2016, with material haulage of 260 million tons per year (tpy). Using the emission inventory and distributing the VMTs throughout the year results in an estimate of 25,822 VMT per day. The AERMOD modeling analysis added an additional 20 percent daily variability factor that was applied to the average daily emissions. Therefore, $PM_{10}$ emissions based on 30,986 VMT per day were modeled in AERMOD to demonstrate compliance with the 24-hr $PM_{10}$ NAAQS as well as the limitation in the AO. In summary, the conservative assumptions included:

1) All material moved using the smallest haul trucks (results in more miles travelled, in practice the largest trucks available on the market will be used)
2) AERMOD modeling was run for the peak year, not an average of all years
3) A 20% increase was added to the already inflated vehicle miles to account for any potential variability that may occur

Based on the above assumptions, the currently 24-hr limit of 30,000 miles per day is protective of the daily $PM_{10}$ NAAQS.

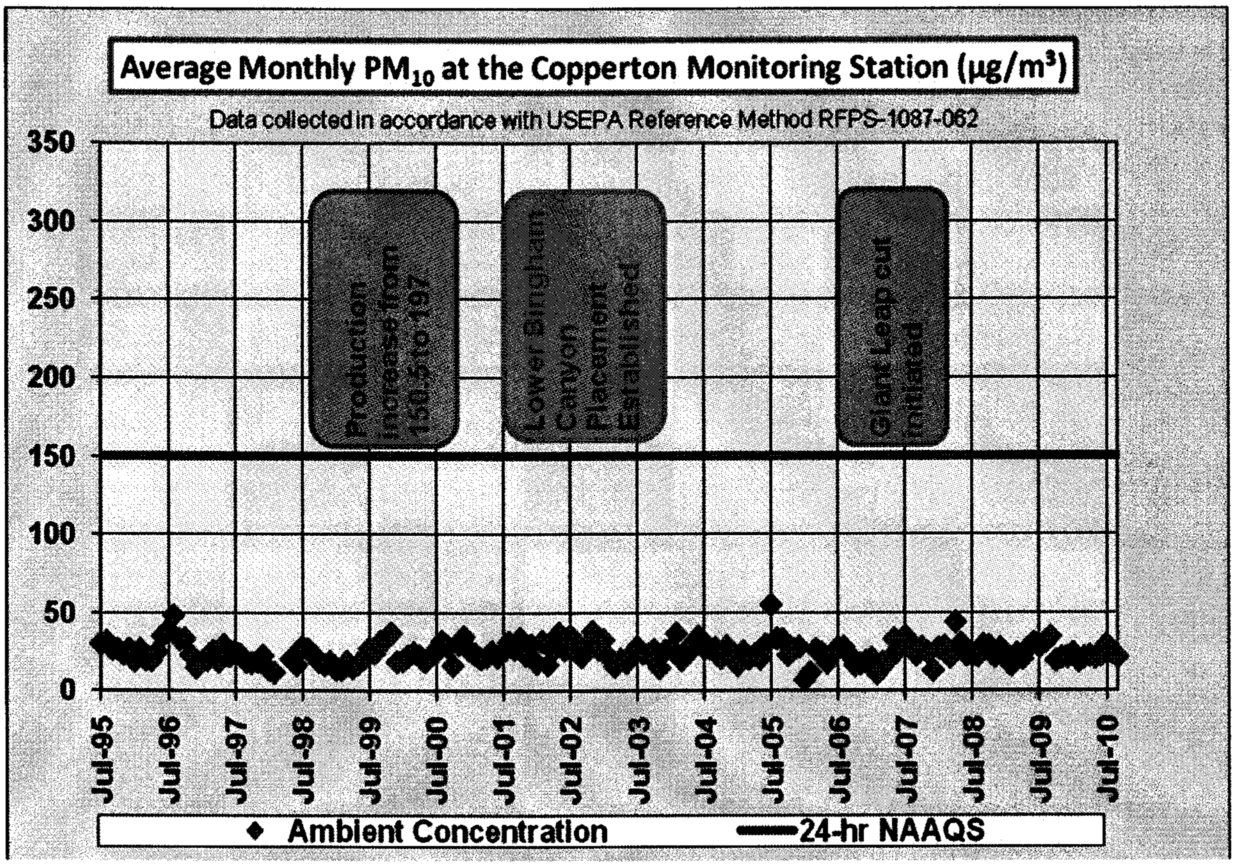
In conjunction with the NOI, KUC submitted a TSD assessing the implications of the proposed increase on the attainment and maintenance demonstrations that were relied upon in supporting the 1994 and 2005 $PM_{10}$ SIP actions. Technical demonstrations, consistent with the methodologies employed in the 1994 and 2005 PM10 SIPs, were completed in order to provide an accurate assessment of the potential effect of the proposed increase on the respective attainment and maintenance demonstrations. These technical demonstrations showed that the attainment demonstrations will be maintained. The respective technical demonstrations may be summarized as follows:

- 1994 demonstration – To offset the emissions increase associated with the BCM expansion, 5,485 tons of banked stack level $SO_2$ emission credits will be relinquished in addition to the 1,105 tons of banked $PM_{10}$ and $SO_2$ credits already relinquished in 1999. The analysis shows that the increase in the material-moved limitation is consistent with and satisfies the 1994 attainment and maintenance demonstration.

- 2005 demonstration - The analysis shows that increases to the UAM-AERO–modeled $NO_x$ and primary $PM_{10}$ will not cause any grid cell to exceed the total $PM_{10}$ NAAQS of 150 $\mu g/m^3$.

In addition, two ambient air quality monitors will be used to verify continued compliance. Although each of the analyses individually demonstrates that the proposed modification will not result in a violation of the $PM_{10}$ NAAQS and are consistent with the approved SIPs, KUC is proposing a new $PM_{10}$ ambient monitor in the Lower Butterfield Canyon area near modeled peak impacts.

KUC has operated a $PM_{10}$ monitor in Copperton since prior to 1994 at a location near one of the top modeled impact locations. All activities proposed through this mine expansion are similar in scope but on an incrementally larger scale than previous mining phases. It is reasonable to assume the ambient impacts observed from the proposed expansion will be consistent with those associated with previous mining phases. Mining activities such as the 1999 material movement increase, Lower Bingham Canyon waste rock placement and Giant Leap pushback, over time have shown no discernable changes in monitored concentrations and we would expect the same from this expansion (See Figure 1).




<u>General Comment: Lack of an analysis demonstrating impacts on the National Ambient Air Quality Standards (NAAQS)</u>

**Comment G.1: The Technical Support Document (TSD) and other documents for the proposed Kennecott SIP revision contain inadequate analyses for $PM_{10}$ and do not include an analysis of whether emissions associated with the Bingham Canyon Mine (BCM) expansion would interfere with other relevant NAAQS.**

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**Response to comment G.1:**
The TSD submitted to UDAQ is intended to demonstrate continued compliance with the $PM_{10}$ NAAQS in accordance with the respective technical analyses that formed the bases for the attainment and maintenance demonstrations contained in the 1994 $PM_{10}$ SIP and the 2005 $PM_{10}$ Maintenance plan.[1] Because the SIP rulemaking is limited to modifying the 2005 $PM_{10}$ SIP, only $PM_{10}$ and its precursors ($SO_2$ and $NO_X$) were included in the analysis. Additionally, to support the 1994 SIP modification, KUC is proposing to offset its $PM_{10}$ and $NO_X$ increases from all emission sources on a voluntary basis in a manner consistent with the offsetting provisions of the 1994 SIP and the Utah Administrative Code.

The project is expected to result in a decrease in $SO_2$ emissions due to KUC's transition to ultra-low sulfur diesel fuel. The analysis submitted to support the modification of the 1994 SIP was conservative as it did not account for any reductions in $SO_2$ emissions. To make the analysis further conservative, emission estimates for this analysis did not account for settling of the particulate in the pit. Haul road emissions, the biggest contributor to overall BCM particulate emissions, were estimated using the smallest haul truck travelling the farthest possible haul distance with the full tonnage of material.

The same level of conservatism was used in the analysis to support the 2005 $PM_{10}$ Maintenance plan. The analysis assumed the maximum impact from the increase in $NO_X$ and $PM_{10}$ emissions without accounting for the decrease in impacts from the decreased $SO_2$ emissions. In addition to the conservative assumptions listed above, the analysis for the 2005 Maintenance plan also assumed a 100% conversion of nitrogen oxides ($NO_x$) to nitrates (a secondary particulate component).

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[1] Kennecott understands that EPA has raised numerous concerns and questions that relate to the 2005 **$PM_{10}$ Maintenance plan that was submitted to EPA in September 2005. See 74 Fed. Reg. 62717 (Dec. 1, 2009)** (Approval and Promulgation of Air Quality Implementation Plans; Utah; Redesignation Request and Maintenance Plan for Salt Lake County; Utah County; Ogden City $PM_{10}$ Nonattainment Area). These comments are not intended to address those issues and Kennecott recognizes that additional modeling tools and analyses will likely be utilized in addressing ambient air quality demonstrations for particulate matter in the future. The analyses that Kennecott has provided in support of its request to move additional material at BCM are for the sole purpose of showing that the demonstrations that formed the bases for approving the 1994 SIP and 2005 Maintenance plan, respectively, are not adversely affected by the proposed increase in material moved; that is, attainment is demonstrated at the proposed production level of 260 tpy, ***given*** the modeling techniques and analyses that were approved and formed the basis for the 1994 SIP and 2005 Maintenance plan, respectively.

Though not required by regulation or as part of the SIP demonstration, KUC voluntarily submitted an AERMOD analysis to UDAQ of the near-field ground level impacts from the BCM after the increase in ore and waste rock movement to 260 million tons per year. The results from the AERMOD modeling were below the NAAQS for $PM_{10}$.

The BCM is located in Salt Lake County. The air shed has been designated as nonattainment for $PM_{2.5}$. UDAQ is in the process developing a SIP for $PM_{2.5}$. The SIP will dictate source control strategies and account for the relative reduction in $PM_{2.5}$ concentrations from the decrease in $SO_2$ emissions at the mine. KUC understands that additional controls, as dictated by the source control strategies, may be necessary under the SIP.

In addition to the BCM project, KUC has a variety of projects and initiatives that will contribute to the air shed's ability to attain other NAAQS. These include conversion of the Utah Power Plant units 1-3 from coal to combined cycle natural gas, installation of two natural gas combined heat and power units, idling reduction programs site-wide and demonstrated leadership in green buildings.

**Comment G.2: Regarding other NAAQS, EPA notes that the Wasatch Front is non-attainment for $PM_{2.5}$. Ammonium nitrate comprises more than 50 percent of the measured $PM_{2.5}$ on days that exceed the 24-hour $PM_{2.5}$ NAAQS and increased $NO_x$ emissions resulting from the BCM expansion will contribute to increased ambient concentrations of ammonium nitrate in the basin. This could result in more severe exceedences of the 24-hr $PM_{2.5}$ NAAQS thereby preventing attainment.**

**Response to comment G.2:**
Particulate emissions from the BCM operations settle in the pit and only a very small fraction escape the pit influence boundary into the atmosphere. During inversions, when there are no winds,[2] there have been observed cases of pit settling approaching 100 percent and retention of gaseous pollutants as well as primary particulates is believed to occur.

The air shed has been designated as nonattainment for $PM_{2.5}$. UDAQ is in the process developing a SIP for $PM_{2.5}$. At this time direct source contributions to ambient $PM_{2.5}$ concentrations are not known. As the $PM_{2.5}$ SIP is developed and an attainment strategy is developed, KUC understands that additional

[2] These are the meteorological conditions associated with elevated $PM_{10}$ concentrations.

controls as dictated by these strategies may be necessary under the SIP. KUC will meet the requirements of the applicable SIP as mandated in Section 110(l) of the CAA, but cannot commit to control strategies that have not yet been developed or shown to be effective.

**Comment G.3: The Wasatch Front also has exceeded the current 8-hour average ozone NAAQS of 75 ppb during 2007-2009. Thus, increased $NO_x$ emissions at the BCM could contribute to the severity of exceedences of the ozone NAAQS.**

**Response to comment G.3:**
A SIP has not been developed for the 8-hour ozone standard so specific control strategies have not been developed. As stated in the response to comment G.2, KUC will meet the requirements of the applicable SIP. Changes to the BCM emissions profile will be included in the development of the ozone SIP and appropriate control strategies will be implemented when they are developed. In the meantime, KUC and the BCM expansion are in compliance with developed $PM_{10}$ control strategies and approved regulations.

**Comment G.4: Any 110(l) analysis should also evaluate potential impacts on the nitrogen dioxide NAAQS.**

**Response to comment G.4:**
The area is expected to be in attainment of the 1-hour $NO_2$ standard. At this time, there is no indication that additional control strategies are required to maintain the NAAQS. As previously stated, if future additional control strategies are required to maintain the 1-hour $NO_2$ standard, KUC will implement the applicable requirements.

**Comment G.5: No analysis of the ambient air quality impact of an allowed increase in material movement and the associated emission increase at the BCM is presented in Utah's "New Source Plan Review (NSPR)."**

**Response to comment G.5:**
As specified in R307-410-4, air quality dispersion modeling is required only in areas that are in attainment for criteria pollutants. Consistently, UDAQ modeling guidelines specifically provide that, "The UDAQ currently does not require sources to perform dispersion modeling for pollutants that are not in attainment of the NAAQS, if that source is located in an area that is nonattainment for that pollutant."

Nonetheless, KUC performed AERMOD modeling to demonstrate the material movement increase would not cause an exceedences of the $PM_{10}$ NAAQS. This modeling is included in Appendix C of the NOI. Results from this analysis are summarized below.

| Scenario | Modeled Concentration (μg/m³) | Copperton, Utah, Background Concentration[a] | Total Concentration | Above 150 μg/m³ NAAQS? |
|---|---|---|---|---|
| 260,000,000 tpy material movement | 85.1 | 59.1 | 144.2 | No |

**NOTES:**
[a]Background concentration from the Copperton, Utah monitoring station

This analysis includes the following conservative assumptions:

1) The modeled emissions represent the total potential $PM_{10}$ emissions from the BCM, including those from current operations.
2) A background $PM_{10}$ concentration from the data measured at the Copperton, Utah monitor site is added to the modeled value.
3) All material was modeled as moved by using the smallest haul trucks (results in more miles travelled, in practice the largest trucks available on the market will be used)
4) AERMOD modeling was run for the peak year, not an average of all years
5) A 20% increase was added to the already inflated vehicle miles to account for any potential variability that may occur

It is likely that the measured data include emissions from current operations under some meteorological conditions. Therefore, addition of the modeled concentration and the background measured concentrations is likely double counting contributions from current operations. In addition, a new monitor will be installed in the Lower Butterfield Canyon area, near the peak modeled impacts, to further demonstrate compliance.

**<u>Comment 1. Inadequate Air Quality Modeling</u>**

**Comment 1.1: The current modeling is inadequate because of:**

1) **Modeling of banked emissions as though they will be emitted from Kennecott's 1,200 foot stack; and**

2) **The relative response factors (RRFs) based on total $PM_{10}$ mass without evaluating the RRFs for components of $PM_{10}$ as required by modeling guidance.**

**Response to comment 1.1:**
KUC used the current 2005 UAM modeling and the modeling of the banked emissions as it was completed for the 2005 Maintenance SIP. UDAQ is preparing a new modeling analysis for $PM_{2.5}$ which will include any changes at the BCM.

The modeling presented in the TSD is consistent with the 2005 Maintenance SIP that has been adopted into State law. Importantly, as noted above, this modeling analysis is not an attempt to resolve more fundamental issues that EPA has raised regarding the type of modeling demonstration that will be necessary for EPA to approve a ***future*** plan; it is simply an attempt to show that, the maintenance demonstration relied upon by the AQB when it approved the 2005 Maintenance Plan remains valid notwithstanding the proposed increase in material moved. Conservative assumptions were made so actual impacts are likely to be lower than the modeled values. The RFFs were kept consistent with the state-approved UDAQ modeling.

**Comment 1.2: EPA's assessment is that there is insufficient information for both the CALPUFF and AERMOD simulations described in the TSD that supplemented the UAM-AERO model, and the combination of CALPUFF simulations with UAM-AERO is insufficient. EPA recommends that the impacts of the BCM expansion be evaluated using the new CMAQ model simulations currently being developed by the State for the $PM_{2.5}$ attainment plan. Additional AERMOD simulations with updated emissions data are also recommended.**

**Response to comment 1.2:**
The $PM_{10}$ Maintenance plan was approved by the Utah Air Quality Board in 2005 as a matter of State law. Therefore, UDAQ considers the limitations established by the SIP to be enforceable notwithstanding that EPA has yet to take final action on the 2005 Maintenance plan. Accordingly, the material moved limitation must be changed in accordance with state law and in a manner that is consistent with the Board's approval in 2005.

It is KUC's understanding that any changes to the BCM operations will be included in the CMAQ model simulations currently being developed by UDAQ.

## Comment 2. Inadequate Analysis of Emission Offsets

**Comment 2.1: The use of banked $SO_2$ credits as offsets may not be valid. EPA has asked the State of Utah to provide evidence to validate the credits and to respond to identified concerns with the 1994 $PM_{10}$ SIP's offset provisions.**

**Response to comment 2.1:**
Offsets are being provided for the sole purpose of demonstrating that the 1994 attainment demonstration is not adversely affected by the increase in material moved. The offsets being relinquished are entirely consistent with the 1994 $PM_{10}$ SIP offset provisions - approved by EPA - which allow $PM_{10}$ offsetting by $PM_{10}$ precursors. KUC has submitted written confirmation to UDAQ that the emission reduction credits being relinquished meet the requirements of the offsetting program and are valid offsets.

The UDAQ maintains a registry of all available emission reduction credits in salt Lake County and other counties in the state (http://www.airquality.utah.gov/Permits/Emission_Offsets.htm). The registry shows the following as KUC's banked emissions.

| COMPANY | TYPE | TONS/YR |
|---|---|---|
| KENNECOTT | ALDH | 0.4 |
| KENNECOTT | CO | 14.1 |
| KENNECOTT | HF | 10.2 |
| KENNECOTT | NOX | 104.91 |
| KENNECOTT | SO2 | 16801.06 |
| KENNECOTT | TSP | 4.4 |
| KENNECOTT | VOC | 9.5 |
| KENNECOTT | PM10 | 226.19 |

The $SO_2$ credits were generated in 1996-1998 during the Smelter modernization project. The Smelter modernization project was completed in 1996 and reduced $SO_2$ emissions by 99.9%. The KUC Smelter continues to be one of the most advanced and cleanest smelters in the world.

**Comment 2.2: Assuming the banked credits are valid, EPA is still concerned because the $PM_{10}$ and $NO_x$ emissions at the BCM are not being emitted from a 1,200 foot stack but rather at ground level and at a significant distance from the smelter stack.**

**Response to comment 2.2:**
The 1994 $PM_{10}$ SIP attainment demonstration was based on receptor modeling which does not specify source emission heights but does include the relative impacts from sources as measured by the ambient air monitors. Therefore the offsetting program established in the 1994 $PM_{10}$ SIP does not distinguish between release heights. The receptor modeling does account for impacts from the 1,200 foot stack so the impacts from these emissions were included in the attainment demonstration and are creditable.

The AERMOD model accounts for source release parameters. The BCM was modeled with the increased material movement and no discounts for offsets with the AERMOD model. The highest $PM_{10}$ concentration predicted was below the $PM_{10}$ NAAQS. Relinquishing the credits will only further protect the NAAQS beyond what is predicted in AERMOD.

**Comment 2.3: Additional modeling [proposed inter-precursor trade of banked $SO_2$ emissions from the smelter for increases in $NO_x$ at the BCM] is required to show non-interference under the CAA section 110(l).**

**Response to comment 2.3:**
The 1994 SIP, as approved by EPA, allows the use of $PM_{10}$ precursors to offset direct $PM_{10}$ emissions. The 1994 federally-approved SIP and 2005 State maintenance plan requirements have been met.

**Comment 2.4: The NSPR does not:**

1) **Discuss the need to obtain emission offsets;**
2) **Indicate that the required offsets have been obtained;**
3) **Specify where the offsets were obtained; or**
4) **Verify that the offsets are enforceable.**

Without such analysis, EPA is unable to conclude that the offsets satisfy the requirement of R307-403.

**Response to comment 2.4:**
On February 7, 2011, KUC submitted a letter to UDAQ as notification of KUC's intention to relinquish credits. The NSRP did not include specific

language about the offsets because these offsets are not required under the requirements of UAC R307-403, and they are being voluntarily relinquished by KUC.

In the letter, KUC stated the following: "...To offset the emissions increase associated with the mine expansion, 5,485 tons of banked stack level $SO_2$ emission credits will be relinquished, upon final execution of the Bingham Canyon Mine Approval Order by the Division of Air Quality."

As stated in the TSD, the total emissions increase of $PM_{10}$ and $NO_x$, using the 1994 emission factors for consistency with the analysis, is 5,492 tons with the increase in material moved at the BCM. This does not include:

1) Reductions resulting from the use of lower sulfur fuels, and
2) The net reduction in $SO_x$ emissions as further assurance the $PM_{10}$ SIP will be maintained.

Using the methodology set forth in the 1994 $PM_{10}$ SIP, if emissions credits were required at a 1.2 to 1 ratio, KUC would relinquish 6,590 tons of offsets. KUC previously relinquished 1,105 tons in 1999, when an increase in material moved was approved from 150,500,000 tpy to 197,000,000 tpy. KUC will relinquish an additional 5,485 tons from $SO_2$ credits banked from the emission reductions at the Smelter in keeping with the 1994 SIP. KUC currently has approximately 12,000 tons of stack-level $SO_2$ credits banked with UDAQ. These credits were generated as a result of reductions in $SO_2$ emissions when the Smelter modernization project was voluntarily implemented in 1996.

**Comment 3. Insufficient Information for Emission Factors**

**Comment 3.1: EPA has serious concerns regarding the study - *Airflow Patterns and Pit-retention of Fugitive Dust for the Bingham Canyon Mine* (Bhaskar and Tandon, 1996). The concerns are as follows:**

1) **Most of the model sensitivity simulations were only performed at the pit bottom which could underestimate the amount of particulate released from sources that are located at other locations in the pit;**
2) **The TSD lacks the source location information to verify that the pit escape fraction has been appropriately applied;**
3) **The study does not compare the model-simulated concentrations to monitoring data; and**
4) **The TSD lacks information to verify that the pit escape fraction has not been applied in addition to model calculations that account for**

**the pit topography, essentially overestimating the effect of the pit and underestimating the impact to air quality.**

**Response to comment 3.1:**
To reasonably estimate emissions and perform the AERMOD modeling for the 24-hour $PM_{10}$ impact, one escape fraction for all particulate sources in the pit was used. This approach required the selection of a single value for the escape fraction that is representative but also conservative.

It is impossible for any one technical study to examine all possible scenarios; therefore, numerous conservative assumptions were made in deriving a single escape fraction of 20 percent from the data that is available in Bhaskar and Tandon (1996). Because conservative assumptions were made at every step in the process, the value of 20 percent is conservative for all cases and all times. The details of the conservative assumptions are included in Appendix D-2 of the NOI. They are summarized below:

- For all but two cases in Bhaskar and Tandon (1996), the maximum escape fraction from the sensitivity analyses is 12.6 percent or less. Consequently, a conservative value of 12.6 percent was used as the starting escape fraction.
- A 5.5 percent upward adjustment was made based on the difference between 100 percent trap and 100 percent ricochet from the two "worst case" scenarios. This is conservative because the difference for a less severe case would likely be less and because the actual scenario lies between 100 percent trap and 100 percent ricochet. Furthermore, based on theory, the actual scenario should be closer to 100 percent trap because generally small particles do not possess sufficient inertia to bounce off a surface (see, for example, section 19.4.2 of Atmospheric Chemistry and Physics by Seinfeld and Pandis, 2006). With this adjustment, the conservative 12.6 percent starting value was increased to 18.0 percent.
- To be even more conservative, a final escape fraction of 20 percent was chosen.

Appendix B of the NOI application provides detailed emissions calculations for all emission sources at the BCM, including the pit escape fraction for sources located within the pit influence boundary. The AERMOD analysis did not overestimate the effect of the pit as it did not use the built-in pit algorithm to determine impacts. The pit escape was used for particulates

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within the influence of the pit boundary. Gases were assumed to escape with no pit retention and likewise no pit retention factor was used for particulates outside of the pit influence boundary.

Yours truly,

Chris Kaiser