APPENDIX E-2

Response to AERMOD Comments

Response to UDAQ NOI – Appendix C, AERMOD Comments

TO: UDAQ

COPIES: KUC

FROM: CH2M HILL

DATE: January 3, 2011

On August 17, 2010, Kennecott Utah Copper (KUC) submitted a notice of intent (NOI) to the Utah Division of Air Quality (UDAQ) to increase the annual material moved limit at the Bingham Canyon Mine (BCM) from 197 million tons per year (tpy) to 260 million tpy of ore and waste rock combined. Included as an attachment to the NOI, an ambient air quality analysis for PM_{10} was submitted using the EPA-approved AERMOD modeling system.

On November 1, 2010, UDAQ supplied comments on the AERMOD analysis attachment to the NOI. The intention of this memorandum is to provide responses to UDAQ's comments and to provide the additional information necessary to document that the analysis is representative of the BCM.

The format of this document is to first present UDAQ's comment (in order as received), and then follow each comment with a response.

Comment 1: *Page C-1, p2, the first sentence in the second paragraph states that the BCM expansion project is not subject to UAC-R307-410, since it is located in a NAA. Yet on C-5, p3, the NOI states that the analysis was conducted following guidance and procedures outlined in 40 CFR 51, Appendix W. This is similar to the requirement spelled out in R307-410-3. If R307-410-3 does not apply to the analysis, what benchmarks or criteria should the analysis meet for it to be considered representative and complete?*

Response to Comment 1: While modeling is not required under UAC-R307-410, modeling guidelines have long been established by EPA. These guidelines and procedures, outlined in 40 CFR 51, Appendix W, have been developed to ensure models are correctly applied. Wherever possible, source-specific information and model set-ups have been implemented. The use of source-specific model applications within the guidance established by EPA are intended to improve the model's ability to more accurately estimate the impacts of sources such as the BCM. Additionally, KUC and its consultants have engaged UDAQ to discuss key decisions relating to the modeling effort due to the unique nature of the source being modeled. For example, we discussed with UDAQ the use of a third-party study, specific to KUC's pit, to address pit retention in lieu of the more generic algorithm offered by AERMOD.

Comment 2: *The coordinate system used in the analysis is unclear. The placement of point sources is not consistent with NAD 27 or NAD 83 when overlaid onto Google Earth. Limebin 1 & 2 and conveyor drops c6_c7 and c7_c8 do not appear to be properly located under either coordinate system. The receptor grid locations may also be off at some locations. For review purposes, the analysis would best be served if it appeared in NAD 83, which is consistent and verifiable through Google Earth.*

Response to Comment 2: The source locations and facility boundaries were provided by GIS mapping using the KUC BCM layout. Small and insignificant discrepancies converting from the KUC BCM layout to UTM NAD27 used in AERMOD could be the result of converting between coordinate systems. Additionally, most of the discrepancies occur north of where a majority of the mining operations and resulting emissions occur. Between the two coordinate systems, distances between emission locations and receptors at the northern end of the mine controlled area are preserved; therefore, updating the coordinate system to a NAD83 would not alter the main model conclusions.

Comment 3: *The dispersion analysis uses a traveled road width of 100 feet to simulate the entrainment of wheel dust in the model. The actual initial width of a plume release from tire traffic should be equal to the width of the wheel stance on the vehicle, plus a reasonable amount of distance on either side of the vehicle to account for wheel turbulence(~60 ft). The mine trucks move somewhere between 7 - 25 MPH and do not produce very much wheel turbulence. Please provide a rational for using an initial source width of 100 ft to represent fugitive dust entrainment from a moving vehicle.*

Response to Comment 3: The lateral distance of 100 ft is consistent with an approximate representation of a line source by a series of volume sources as described in the ISC users manual Volume 2 Pages 1-82, Figures 1-8. According to the user's manual, the length of a side is 50 ft and the center to center distance between the successive volume sources is 100 ft. The 100 ft distance corresponds to the larger of the two lateral dimensions and is representative of fugitive dust entrainment from a haul truck at the BCM.

Comment 4: *The dispersion analysis uses a single-size area source to simulate emissions released from the Bingham Mine below pit-top elevation. The area source is rectangular in shape, uses a base elevation of 7425 feet, and is aligned 24 degrees from north. The model appears sensitive to the base elevation and alignment of the rectangular source. Dependent on the elevation, the maximum area of impact will shift around to boundaries with elevation levels consistent with the base elevation. This base elevation is consistent with the south wall height, but is 600-700 higher than the east and north facing walls where emissions would also escape into the Salt Lake Valley. It is unclear why the base elevation was chosen, and another base height may be more representative.*

Response to Comment 4: The base elevation of the main pit was calculated by the EPA AERMAP program using 7.5-minute digital elevation model (DEM) data obtained from the United States Geological Survey (USGS). Using AERMAP to determine the base elevation for the source is an acceptable method for determining the base elevation of the source.

The alignment and dimensions of the area source were selected to best cover a majority of the pit and provide conservative (potentially higher) modeled impacts from mine emissions. Using a smaller area to represent the entire pit would result in a higher emissions rate per area squared coming out the top of the pit compared to the actual foot print of the pit opening - a full oval covering the entire pit. The area of an oval used to represent the pit would be approximately 7.3 million square meters while the current rectangular area source in the model is approximately 5.6 million square meters, therefore making the analysis conservative.

Comment 5: *The mine area over which the source is laid is fairly round in shape, and does not appear to take on an oval shape consistent with the chosen rectangular dimensions. Some clarification on this would be helpful.*

Response to Comment 5: Similar to *Response to Comment 4*, the rectangular shape covering the pit was used to simplify the pit source since emissions generated from the pit already account for control efficiency due to pit retention. The rectangular area modeled covers a majority of the pit area, while also being smaller than the overall existing pit area. The modeled smaller area is more conservative based on emissions generated per square area coming out of the top of the pit since the same total lb/hr emission rate is used out the top of the pit. The higher lb/hr per square area emission rate would lead to higher ground level impacts predicted by the AERMOD model. The rectangular source is aligned to best cover the pit and is a conservative assumption.

Comment 6: *The size and location of the area source used to simulate emission releases from inside the pit area are inconsistent with dimensions commonly associated with pit –type releases. The model uses a single area source the approximate size of the mine pit located over the center of the mine. This type of area source representation would be appropriate for a very shallow pit. Kennecott's pit is deep and the analysis assumes pit retention physics apply. In such cases, the pollutant would be released from a limited area at the upwind or downwind side of the pit, depending on the pit shape. If the pit is shaped such that there is recirculation of the air in the pit, the pollutant will be released from a small area on the upwind side of the pit. In Kennecott's fluid analysis however, the north-south flow test indicated there would not be recirculation, and the pollutant would be released from a small area on the downwind side. Other wind directions were evaluated for recirculation, and the analysis assumed the air flowed through the pit without any recirculation. The AERMOD model's own pit retention algorithm resizes and relocates the area source, depending on the particular hourly wind conditions. Kennecott's does not incorporate these physical aspects into part of the pit retention methodology, and assumes the emissions are released across the entire top of the mining area. Overestimating a pollutants release area increasing the initial plume volume and decreases the mass per unit volume ratio, resulting in lower concentration predictions from the model. Please provide more information to support the dimensions used for the MAIN area source parameters, and its location.*

Response to Comment 6: The AERMOD pit retention algorithm and source type are not appropriate for the BCM due to the unique conditions that exist at the mine. Therefore, the source was modeled as an area source because the emission calculations for the BCM expansion already used the characteristics of the pit to control emissions released from the top. The emissions escape fraction was determined by evaluating the University of Utah Computational Fluid Dynamics computer modeling of the pit. See section D-1 of the original NOI for a review of the study. The pit retention factor applied was conservative (large fraction of emissions escaping) regardless of the location of the source (upwind or downwind). Therefore, source placement was already being conservatively accounted for.

The angle orientation of the pit was selected to best place a rectangular area source within the pit extents. Also, as noted in *Response to Comment 5*, the pit was modeled as an area source that has a smaller overall area compared to the full top of the pit area. Therefore, the emissions would be more conservative because the emissions per square area being emitted from the top of the pit would be higher.

Comment 7: *The hourly emission rate used to simulate the 24-hour period was 1.2 times higher than the annual estimate divided by 8760 hours of operation. It is unclear if this factor accurately reflects a worst-case fluctuation in the hourly emission rate. More information on this issue would be helpful.*

Response to Comment 7: The emissions calculations for the mine were calculated on an annual basis assuming that operations occur 8760 hours per year. However, previous conversations with UDAQ indicated that dividing the annual lb/yr emissions by 8760 and distributing throughout the mine may underestimate the worst case daily emissions. To address this, 20% was added to the average daily emissions to conservatively account for any daily variability in regards to operation or location of the activities during a single day. The 20% variability would be conservative because the mine activity has little variability in day-to-day operations.

Comment 8: *The model apportions truck hauling emissions outside the pit into three areas. More information is needed to determine if truck haul emissions are apportioned correctly.*

Response to Comment 8: Haul truck traffic apportionment was based on conversations with KUC BCM staff and representative of the mine plan. See attached Figure 1 for apportionment of haul road traffic outside the pit.

Comment 9: *Kennecott staff said that a fair amount of dozer work takes place on the bench dumping areas to distribute the overburden and building up the dumping-off areas. This was evident during our recent site visit. The analysis did not include emissions of any other fugitive dust activity other than truck haul traffic and dumping outside the pit area.*

Response to Comment 9: The PM_{10} bulldozer emissions at the mine are approximately 13 tpy of the total 1,425 tpy PM_{10} emissions generated by the mine. The emissions generated by the bulldozers are currently placed completely within the main pit for the AERMOD analysis. However, if the bulldozer PM_{10} emissions are distributed outside of the main pit along the haul roads, little impact on the AERMOD modeling analysis is expected since the increase in the hourly emission rate at each volume source would be minimal.

Comment 10: *Appendix C1 - PM_{10} Ambient Monitoring: The methodology used to choose a representative background concentration excludes seemingly valid representative background values. The methodology relies on the assumption that the sample should be discarded if:*

a. the alignment of the winds were such to place the mining operation in the upwind quadrant of the monitor at any time during the 24-hour period during which the sample was collected, or
b. the sample is influenced by natural dust events during days with high wind gust. Specific to this analysis are the landfills and dry sand beaches of the Great Salt Lake.

The analysis excludes the top six values based on an assumption that during the sample day, the winds were from the southwest, and the source may have significantly contributed to the sample concentration collected. A review of the meteorology associated with six cases indicated that during five of the sample periods, winds were from that quadrant for less than six hours during the 24-hour sample period, sometimes only for one or two hours. The analysis also dismissed the values 'due to the presence of gusting winds during the sample period'. Most of these events are simple diurnal shift in wind direction or moderate frontal passages which are commonly occurring events, and have not been classified as exceptional events by UDAQ or EPA.

Further review of the associated meteorology for the 24-hour sample period indicated that several of the sample concentrations were incorrectly excluded. Kennecott's dispersion model analysis was run to estimate the source's contribution to the monitor on the reported sample days. The model was run using the analysis' meteorology for the sample days listed in Table 1 on page C1-2. A list of the sample dates, monitored values and the contribution to the sample from the source during the sample period are listed below. Contributions from point source C6_C7 were also evaluated since this source is located about 350 feet WSW of the monitor.

Sample Date	Monitored Concentration ($\mu g/m^3$)	Contribution from Source ($\mu g/m^3$)	Contribution from C6_C7 ($\mu g/m^3$)	% of Sample
05/18/2007	139.3[ad]	2.2	0.1	1
09/10/2005	93.9[d]	1.1	0.3	1
07/21/2005	81.5[be]	4.3	1.1	5
12/30/2003	77.7[d]	Not Modeled		
07/15/2005	67.1[e]	6.4	3.2	10
07/06/2005	66.9[e]	7.6	3.0	11
10/27/2007	65.0[e]	Not Modeled		
02/04/2004	59.1[cd]	11.8	1.0	20

a. Value excluded due to missed collection period.
b. UDAQ Selected Representative Background Concentration
c. Kennecott NOI Selected Representative Background Concentration
d. Sample excludable due to extreme high wind event or significant contribution to the sample from the subject source.
e. Valid as a sample for consideration as a representative background concentration minus source's modeled contribution. Average hourly wind speed for the sample period equal to or less than average wind speed reported by KUC Mine AEI

The sample collected on 05/18/2007 was excluded due to a missed sample period.

The 09/10/2005 sample with its average wind speed of 13.1 mph should be excluded since it was collected during an extremely high-wind event. The 24-hour period of meteorology associated with the sample period is inconsistent with meteorological conditions that result

> *in the highest model predicted impacts, such that the pairing of the two concentrations would represent a physical impossibility.*
>
> *The sample collected on 07/21/2005 best meets the criteria for a representative background concentration for the area east of the Bingham Mine. The sample was collected during a period where the winds were moderate and contribution from the mine was minimal. Samples collected on 07/06/05, 07/15/05, and 10/27/07 also meet the criteria for consideration as background concentrations; however, the sample collected on 10/27/07 should be modeled to estimate any contribution from the source prior to its inclusion.*

It is unclear from the review why the sample collected on 02/04/2004 is considered more representative as a background concentration then the samples collected on 7/21/05, 7/06/05, 7/15/05, or 10/27/07. Clarification is needed.

Response to Comment 10: The justification for determining appropriate PM_{10} background concentration for the BCM AERMOD modeling followed the procedures outlined in 40 CFR 51 Appendix W Section 8.2. Only days when winds blew from the predominant sector based on the meteorological monitoring data were removed from determining a representative PM_{10} background concentration. This is because the AERMOD modeling analysis conservatively modeled all emissions associated with the 260 million tpy extraction and not just the incremental increase from the currently permitted 197 million tpy at the BCM. The value selected in the NOI is conservatively the 8th highest monitored value at the Copperton monitor since the current operations are included in the monitored concentrations.

The BCM is currently listed in the PM_{10} SIP, and it can be assumed that emissions from the mine, during periods when the meteorological data show winds blowing from the mine to the monitor, would influence the monitor values. As mentioned above, since the AERMOD modeling conservatively assumes emissions from all operations concurrently, not just the incremental increase in operations from the mine, any periods when mine operations could contribute to the monitored concentration were removed as not representative only to the AERMOD modeling background analysis. These excluded values were not labeled as invalid monitor values.

Therefore, the 59.1 $\mu g/m^3$ is an appropriate background concentration for the AERMOD analysis. The technical memorandum in Appendix C-1 of the NOI supports the conclusion following guidance from 40 CFR 51 Appendix W.