BMI COMPLEX OFF SITE/PHASE IIIA
AIR MONITORING SUMMARY REPORT
Revision 2
(with TRUCK EXHAUST EMISSIONS ADDENDUM)

Prepared for:

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NOVEMBER 4, 2009

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1.0 INTRODUCTION

Basic Remediation Company (BRC) retained Converse Consultants (Converse) and Tetra Tech EM Inc. (Tetra Tech) to complete a brief air monitoring project to evaluate off site emissions from material hauling operations at the Eastside Area of the Basic Remediation Company property located in Clark County, Nevada. This off site air monitoring project was the first of a 3-phased approach to evaluate emissions from waste material hauling, dry pit excavations, and the Corrective Area Management Unit (CAMU) slit trench excavations.

Tetra Tech set up two temporary air-monitoring stations along Warm Springs Road and collected upwind and downwind air samples twice per week from November 4, 2008 – December 2, 2008. One additional sample was collected on December 27, 2008 from each station to evaluate background emissions when no material hauling was occurring. Equipment was set up at each of the two stations to collect ambient air samples over a twelve hour (hr) period from approximately 7:00 P.M. to 7:00 A.M.

The sampling parameters were based on the BRC *Perimeter Air Monitoring Plan* (PAMP) (October 2008) and *Revised Draft BMI Complex Air Quality Monitoring Project – Phase III – Summary of Sampling Approach and Chemicals of Concern at Eastside and CAMU Areas* (Tetra Tech October 2008) reviewed and approved by the Nevada Division of Environmental Protection (NDEP). Two identical air-monitoring stations were constructed and the sampling equipment at each of the two sites consisted of:

- Three identical polyurethane foam (PUF) hi-volume federal reference method (FRM) samplers designed to collect samples on three PUF cartridges for analysis of organic compounds contained in the U.S. Environmental Protection Agency (EPA) compendium methods TO-4, TO-9 and TO-13

- One portable BGI PQ100 low-volume FRM (PQ100) sampler designed to collect samples on 47mm Teflon filters for analysis of total suspended particulate (TSP) and total metal

- One SKC Model 224-PCXR8 (SKC) low-volume sample pump designed to collect samples on mixed cellulose ester (MCE) filters for analysis of asbestos using National Institute for Occupational Safety and Health (NIOSH) Method 7400 for phase contrast microscopy

- One Honda EB 6500 gasoline-powered generators (or equivalent)

This report summarizes sample collection, analyses methodology, and analytical data collected between November 4, 2008 and December 27, 2008. The sampling approach, methodology, and summary of activities are presented in Section 2.0. The analytical data results are presented in Section 3.0. A summary of vehicle exhaust research data is presented in Section 3.5. NDEP comments and BRC response to comments on the previous draft are presented in Appendix A; field documentation forms are provided in Appendix B; laboratory analytical data reports are provided in Appendix C (on CD); calibration and sample volume calculation worksheets are provided in Appendix D; a CD containing an electronic copy of the report, Table 3, and Appendix C is provided in Appendix E.

2.0 SAMPLING APPROACH

Two temporary air monitoring stations were set up along Warm Springs Road in Henderson, Nevada to collect air samples during nighttime material hauling operations from the Eastside area to the CAMU area.

2.1 SITE SELECTION AND LOCATIONS

Based on the prevailing wind direction at the BMI Complex, two air monitoring stations were placed along the north and south side of Warm Springs Road. Site OFF02 was located to represent potential upwind conditions and Site OFF01 was located to represent potential downwind conditions. The air monitoring station locations are presented in Figure 1.

2.2 SAMPLING EQUIPMENT CALIBRATION AND OPERATION

Tetra Tech assembled and calibrated the PUF, PQ100, and SKC air samplers prior to sample collection and after equipment had been serviced (battery changes). All samplers were calibrated using National Institute of Standards and Testing (NIST) or other authoritative reference certified equipment.

The initial calibrations on the PUF, BGI PQ100, and SKC samplers only required minor adjustments to set correct flow rates, but no major adjustments or equipment failures were observed. All equipment was checked again before sample collection began to ensure the correct flow rate(s) and timer operation.

Tetra Tech performed all calibrations according to EPA reference methods and all equipment was found to be within the calibration acceptance criteria prior to sample collection and equipment was operating within project goals. Equipment calibration worksheets are provided in Appendix D.

All samplers were powered by portable gas-powered generators for each sample event. At the beginning of each sample event, Tetra Tech transported the generators and air sampling equipment to each sample station. Samplers were set up and programmed at each station prior to sampling and subsequently removed after the completion of each sample event. Each station consisted of a sampling platform enclosed in an approximately 16 foot (ft) by 16 ft by 8 ft high chain link fence secured with a locking gate. Air samplers were secured to the platforms during the sample events.

The sampling approach proposed by BRC and Tetra Tech and approved by NDEP was to collect 12-hr samples twice per week from approximately 7:00 P.M. to 7:00 A.M. over a four week period during daily nighttime hauling operations. In addition, meteorological data was collected during the hauling operations to determine upwind and downwind locations. This data is presented in Table 1.

The first sample event occurred on November 4, 2008 and sampling continued through December 2, 2008. Based on subsequent discussions with NDEP, BRC and Tetra Tech agreed to collect additional samples on December 27, 2008 to evaluate background emissions when material hauling was not occurring. A generator was stolen from site OFF01 on or about November 20, 2008 and as a result no samples were collected on November 21, 2008. In addition, only one sample was collected during the week of Thanksgiving (November 27, 2008).

All sample parameters were documented on BMI Complex field documentation forms before and after each sample event. In total, eight sample events were completed on the following dates:

- November 4, November 7, November 10, November 14, November 18, November 25, December 2, December 8 (Field Blank) and December 27, 2008 (background/non-hauling sample)

2.3 SAMPLE NOMENCLATURE

All samples collected at the BMI Complex were given a sample ID according to the sample location and sample date as follows:

- OFF01-110408 (where OFF denotes off site location, 01 denotes site #1 and 0110408 denotes that sample was collected on November 4, 2008)

2.4 SAMPLE PARAMETERS

Air samples were collected at the established monitoring stations for the analysis of site related chemicals including organochlorine pesticides, Polychlorinated Dibenzo-p-dioxins (PCDDs), Polychlorinated Dibenzo-p-furans (PCDFs), Polychlorinated biphenyls (PCBs), VOCs/SVOCs, TSP, metals, and asbestos fibers. The sampling and analysis procedures are summarized below. For all samples collected at the BMI Complex, field blanks were collected on a frequency of 10 percent (one in 10 samples) for quality control purposes. Upon completion of each sample event, the samples and associated information was recorded on chain-of-custody (COC) sheets and submitted to the respective laboratories for analysis. The COC included the sample identification number, sample location, sample time, beginning and ending

flow rate (to calculate sample volume) and the required analysis. A summary of sample collection, sample handling, and analysis specifications procedures is provided in Table 2.

2.4.1 ORGANIC COMPOUNDS

At each sampling location, three PUF samplers were used to collect PUF samples for the analysis of organochlorine pesticides, PCDDs, PCDFs, PCBs, and VOCs/SVOCs using EPA Compendium Methods TO-4, TO-9, and TO-13. The PUF samplers draw approximately 0.2 cubic meters per minute of ambient air onto a 102 millimeter (mm) diameter quartz glass filter followed by a polyurethane foam plug and XAD resin contained in a glass cartridge. The TO-9 and TO-13 samples were analyzed using gas chromatography and mass spectrometry (GC/MS) and the TO-4 samples were analyzed using GC/Multi-Detector Detection (GC/MD). All PUF (organic) samples were submitted with COC form(s) to Air Toxics Ltd. Laboratory and Frontier Ltd. Laboratory for analysis. A summary of sample collection, sample handling, and analysis specifications procedures is provided in Table 2.

2.4.2 TOTAL SUSPENDED PARTICULATE MATTER AND METALS

At each sampling location, one PQ100 sampler was used to collect samples for TSP and metals. The PQ100 sampler draws approximately 0.0167 cubic meters per minute (approximately 12 total cubic meters) of ambient air onto the filter media. The TSP and metals samples were collected using 47 mm Teflon filter media and analyzed using USEPA Compendium Method IO-2.1 (gravimetric analysis). The TSP samples underwent additional analysis for metals using USEPA Compendium Method IO-3.3 X-Ray Fluorescence (Protocol number 6). All TSP and metals samples were submitted with COC form(s) to Chester Labnet Laboratory for analysis. A summary of sample collection, sample handling, and analysis specifications procedures is provided in Table 2.

2.4.3 ASBESTOS

At each sampling location, one SKC low volume sampler was used to collect samples for asbestos analysis using NIOSH Method 7400. The sampling system consisted of a low-flow pump attached to a 25-millimeter MCE filter. The SKC samplers draw approximately 1 liter per minute (lpm) (approximately 720 total liters) of ambient air onto the MCE filter. The samples were analyzed using NIOSH Method 7400 (Phase Contrast Light Microscopy). All asbestos samples were submitted with COC form(s) to AESL Laboratory for analysis. A summary of sample collection, sample handling, and analysis specifications procedures is provided in Table 2.

2.5 SIGNIFICANT SITE-RELATED EVENTS

A generator was stolen from site OFF01 on or about November 20, 2008 and as a result no samples were collected on November 21, 2008. Upon discovery, Tetra Tech personnel immediately notified BRC and Weston Solutions personnel and filed a police report with the Henderson Police Department.

3.0 ANALYTICAL RESULTS

The air quality sample data collected at the off site locations represents a wide range of chemical compounds as presented in the PAMP. All sample data was compared to EPA Region 3 risk-based concentrations (RBC) table (April 2006), EPA Region 9 preliminary remediation goals (PRG) table (October 2004), and EPA Region 6 human health medium-specific screening levels (MSSL) table (March 2008) to determine if ambient concentrations exceeded criteria. In most cases the RBC, PRG, and MSSL were either identical or very close in chemical concentration.

The sample results demonstrate that the majority of organic (PUF) compounds were not detected in measurable concentrations in ambient air at the off site locations. However, a limited number of organic compounds were detected and have been further evaluated. In addition, TSP, metals, and airborne fibers were detected. A summary of analytical results for each subset of chemical compounds is provided below.

3.1 UPWIND AND DOWN WIND ANALYSIS

Tetra Tech developed an approach for the quantification of upwind versus downwind air quality monitoring data collected during this short-term air sampling project at the BMI Complex Site. The objective of the upwind/downwind evaluation is to evaluate if the material hauling operations contributed to the degradation of the existing air quality in the vicinity of the work area. However, it must be noted that this analysis was performed with a very limited meteorological dataset of only seven sample events and only represents meteorological conditions measured during November and December 2008.

3.1.1 DATA SUMMARY

The upwind/downwind evaluation was conducted using meteorological data and on-site data collected at sites OFF01 and OFF02. Meteorological data including wind speed and direction were measured continuously at the on-site meteorological monitoring station operated by Tetra Tech near the Eastside entrance gate.

3.1.2 APPROACH

The general approach for conducting the upwind/downwind evaluation consists of the following steps:

- Determine predominant wind directions
- Assign upwind/downwind stations
- Compare upwind/downwind results
- Determine those air sample results that exceeded either the RBC or PRG screening criteria
- Conduct a statistical analysis

3.1.3 DETERMINE PREDOMINANT WIND DIRECTION

If the wind is variable, assigning a predominant wind direction may be subject to qualitative interpretations. Tetra Tech defined predominant wind direction based on the following criteria:

- At least 50 percent of wind direction measurements occur in two quadrants (southeast-southwest, or northeast-northwest)
- Wind direction determined to be from the south if the average wind direction was between 165 and 195 degrees
- Wind direction determined to be from the southwest if the average wind direction was between 195 and 225 degrees
- Wind direction determined to be from the southeast if the average wind direction was between 135 and 165 degrees
- Wind direction determined to be from the west if the average wind direction was between 226 and 270 degrees

3.1.4 ASSIGN UPWIND/DOWNWIND STATIONS

Meteorological data was recorded for the duration of the eight sample events and the prevailing wind direction was generally from the southwest and southeast. A summary of meteorological data during the sample events is presented in Table 1 below.

TABLE 1
METEOROLGICAL DATA RECORD DURING OFF SITE AIR SAMPLING
NOVEMBER 4 – DECEMBER 27, 2008
HENDERSON, NEVADA

Sample Date	Average Wind Degrees	Average Wind Speed (m/s)	Quadrant Wind Blowing From	Respective Upwind Site	Respective Downwind Site
11/3-11/4/08	202	3.7	SW	OFF02	OFF01
11/6-11/7/08	193.2	1.03	S	OFF02	OFF01
11/10-11/11/08	167.8	0.8	S	OFF02	OFF01
11/13-11/14/08	170.5	1	S	OFF02	OFF01
11/17-11/18/08	166.8	0.7	S	OFF02	OFF01
11/24-11/25/08	164.7	0.9	SE	OFF02	OFF01
12/1-12/2/08	176.7	0.6	S	OFF02	OFF01
12/26-12/27/08	226.8	1.58	W	Indeterminate	Indeterminate

3.1.5 COMPARE UPWIND/DOWNWIND RESULTS

To meet project objectives the upwind concentrations of chemical constituents were compared to their corresponding downwind concentrations. The comparison consisted of calculating the percent difference between the upwind and downwind concentrations. This has been completed for all detected chemical compounds.

3.2 TSP AND METALS RESULTS

TSP was detected in all samples and concentrations ranged from 3.85 µg/m^3 to 87.77 µg/m^3. The average concentration was 27.75 µg/m^3. No screening criteria or federal standards currently exist for TSP. An analysis of the percent difference calculation between the upwind site (OFF02) and downwind site (OFF01) demonstrated an average percent difference of less than one percent. Therefore it does not appear that material hauling directly impacted ambient TSP concentrations. A complete summary and statistical analysis of all TSP results are presented in Table 3.

Metals were detected in a majority of the TSP samples and concentrations were reported with an uncertainty of plus/minus 2 standard deviations. The XRF detection method identifies concentrations in extremely low concentration ranges (of less than 0.001 µg/m^3). The results were compared to the RBC,

PRG, and MSSL screening criterion (of those available) and four metals exceeded the criterion: Manganese, Cobalt, Arsenic, and Cadmium. These metals are discussed below.

Manganese concentrations ranged from 0.06 µg/m^3 to 1.23 µg/m^3 and the average concentration was 0.35 µg/m^3. The Manganese PRG and MMSL of 0.051 µg/m^3 (RBC of 0.052 µg/m^3) was exceeded by all sixteen samples.

Cobalt concentrations ranged from 0.0003 µg/m^3 to 0.02 µg/m^3 and the average concentration was 0.0037 µg/m^3. The Cobalt PRG and MSSL of 0.001 µg/m^3 was exceeded by six samples. Three of these samples were collected at Site OFF01 and three samples were collected at Site OFF02.

Arsenic concentrations ranged from 0.0003 µg/m^3 to 0.0023 µg/m^3 and the average concentration was 0.0011 µg/m^3. The Arsenic PRG of 0.0004 µg/m^3, RBC of 0.00041 µg/m^3, and MSSL of 0.00045 µg/m^3 was exceeded by four samples. Two of these samples were collected at Site OFF01 and two samples were collected at Site OFF02.

Cadmium concentrations ranged from 0.0014 µg/m^3 to 0.0059 µg/m^3 and the average concentration was 0.0038 µg/m^3. The Cadmium RBC of 0.001 µg/m^3 and PRG/MSSL of 0.0011 µg/m^3 were exceeded by four samples. Two of those samples were collected at Site OFF01 and two samples were collected at Site OFF02.

It must be noted that all Cobalt, Arsenic, and Cadmium concentrations were reported at less than three times the XRF analytical uncertainty and have been flagged.

With the limited metals dataset, it is difficult to draw any conclusions regarding air quality impacts from material hauling. However, Manganese warrants further discussion due to the overwhelming amount of exceedances. A review of the *BMI Complex Perimeter Background Air Monitoring Summary Report* (Tetra Tech, September 2008) demonstrates that the Manganese screening criteria was exceeded by nine out of 33 samples. Furthermore, an analysis of the percent difference calculation between the upwind site (OFF02) and downwind site (OFF01) demonstrated an average percent difference of approximately -24 percent. Therefore it does not appear that material hauling directly impacted ambient Manganese concentrations. A complete summary and statistical analysis of metals results are presented in Table 3.

3.3 ORGANIC COMPOUND RESULTS

Only two out of twenty seven Organochlorine pesticides (TO-4) chemical compounds were detected above laboratory detection limits and included alpha-BHC and 4,4'-DDE and were only detected during two sample events on 11/25/09 and 12/2/09. Alpha-BHC and 4,4'-DDE were detected at both the upwind site (OFF02) and downwind site (OFF01) on 12/2/09 and Alpha-BHC was only detected at the upwind site (OFF02) on 11/25/08. With only two sample events resulting in detections for each of these compounds this is not enough data to draw conclusions. However, an upwind versus downwind statistical analysis completed for the 12/2/09 event demonstrated a drop of approximately 68 percent and 72 percent for Alpha-BHC and 4,4'-DDE, respectively. A complete summary and statistical analysis of Organochlorine pesticides (TO4A) chemical compounds results are presented in Table 3.

Twenty three PCDDs/PCDFS (TO-9) chemical compounds were detected above laboratory detection limits, but in extremely low concentrations, ranging from 0.02 picograms (pg)/m^3 (0.00000002 µg/m^3) to 9.89 pg/m^3 (0.00000989 µg/m^3). The total toxic equivalent value (TEQ) was calculated for each of the upwind and downwind samples and compared to the 2,3,7,8-TCDD screening value of 0.045 pg/m^3. The upwind versus downwind statistical analysis completed for the data appears to show a consistent increase in concentrations from upwind to downwind. However, five out of seven sample events during hauling operations had TEQ values that exceeded the 0.045 pg/m^3 screening value at the upwind site and all seven sample events during hauling operations exceeded the 0.045 pg/m^3 screening value at the downwind site. In addition, the downwind sample collected on the non-haul day (12/27/09) exceeded the 0.045 pg/m^3 screening criteria. The extremely low sample concentrations coupled with variations in sample volumes could explain the differences in upwind/downwind concentrations during the hauling days. Based on these factors, it is difficult to draw any conclusions from this data or conclusively attribute impacts from material hauling. A complete summary and statistical analysis of PCDDs/PCDFS (TO-9) chemical compounds results are presented in Table 3.

Fourteen VOCs/SVOCs (TO-13) chemical compounds were detected above laboratory detection limits. Of the eighteen detected compounds, two exceeded RBC, PRG, or MSSL screening criteria and included 1,4-Dichlorobenzene and Hexachlorobenzene. Three 1,4-Dichlorobenzene samples exceeded the screening criteria; two from the downwind site and one from the upwind site. Eleven Hexachlorobenzene samples exceeded the screening criteria; five from the downwind site and six from the upwind site. The upwind versus downwind statistical analysis completed for this data shows a consistent increase in

measureable concentrations from upwind to downwind and prompted the additional sample event on December 27, 2008 when material hauling was not occurring. BRC believes that significant haul truck emissions could explain the increase in upwind versus downwind VOCs/SVOCs concentrations and initiated subsequent discussions with NDEP. Further discussion is provided in Section 3.5.

Five (of the fourteen) chemical compounds were detected during the December 27, 2008 (background) sample event and Hexachlorobenzene exceeded the screening criteria for both the upwind and downwind sites demonstrating that other potential sources of these compounds were prevalent in the vicinity of the monitoring sites and may help to better explain the complex nature of chemical emissions near the off site monitoring locations. A complete summary and statistical analysis of VOCs/SVOCs (TO-13) chemical compounds results are presented in Table 3.

3.4 ASBESTOS RESULTS

The asbestos samples were analyzed using NIOSH Method 7400 PCM. The PCM method gives a number index of airborne fibers. It is primarily used for estimating asbestos concentrations, though PCM does not differentiate between asbestos and other fibers. Asbestos fibers include chrysotile, cummingtonite-grunerite asbestos (amosite), anthophyllite asbestos, tremolite asbestos, crocidolite, and actinolite asbestos and any of these minerals which have been chemically treated or altered. The precise chemical formulation of each species varies with the location from which it was mined. Therefore, the use of PCM is a generally accepted method for screening airborne fibers. The Occupational Safety and Health Administration (OSHA) has set an exposure limit of 0.1 fiber per cubic centimeter (cc) of air as an 8-hour time-weighted average (TWA) and a limit of 1.0 fiber per cc averaged over a sampling period of thirty (30) minutes.

The asbestos samples ranged in concentration from 0 fibers per cc to 0.0026 fibers per cc and the average concentration was 0.0013 fibers per cc. The OSHA TWA limit of 0.1 fibers per cc was not exceeded in any samples and asbestos concentrations at the off site locations were consistent with asbestos concentrations during the perimeter background sampling. A complete summary of all asbestos results are presented in Table 3.

3.5 TRUCK EXHAUST AIR SAMPLE COLLECTION ISSUES AND VEHICLE EMISSIONS DATA ADDENDUM

After the report was submitted on April 3, 2009, NDEP and its consultants as well as BRC engaged in a series of discussions relating to whether emissions from the exhaust of the various on-road and off-road vehicles (such as the large 40-ton haul trucks or the numerous maintenance vehicles) associated with the remediation effort, could have contributed to some of the observed concentrations of dioxins and chlorinated organic compounds (such as Hexachlorobenzene, dichlorobenzenes, etc.) at the monitoring stations.

After ruling out direct testing based on reasons provided below, BRC investigated this issue using literature search and a weight-of-evidence approach and has concluded that the observations of the chlorinated compounds at the monitoring sites were more than likely not from the exhaust emissions of the haul trucks and other vehicles, including from traffic unrelated to the project. BRC has also therefore concluded that the observations were likely not related to the waste materials being transported via the haul trucks to the BRC CAMU from the Eastside.

Briefly, the waste materials are transported using 40-ton haul trucks. Prior to crossing the public roads between the Eastside and the CAMU areas, the waste materials are covered using tarps and inspected. Also, extensive decontamination procedures (such as body, undercarriage, and tire washing) are conducted at the Eastside and at the CAMU stations. It should be noted that the haul trucks as well as the other support vehicles were often idling at the CAMU decontamination station for extended periods, in order to undergo decontamination activities after delivery of waste material and prior to returning to the Eastside area. The two offsite monitors (one on either side of Warm Springs Road) in question were located proximate to the CAMU decontamination station.

3.5.1 TECHNICAL ISSUES ASSOCIATED WITH DIRECT TRUCK EXHAUST SAMPLING

Initially, and in order to directly settle the issue, BRC as well as NDEP's consultants contemplated sampling the exhausts of representative trucks in order to determine if chlorinated organic compounds and dioxins may be present. However, discussions with other experts (such as at the Desert Research Institute (DRI), University of West Virginia (UWV), University of California, Riverside (UCR), and others including various laboratories) such as Southwest Research Institute (SwRI) and DRI indicated that the

sampling of such exhausts is not trivial and that assuring the collection of representative samples is very difficult. Specifically, BRC determined that:

1. Extreme diesel exhaust temperatures would not facilitate traditional ambient air quality sampling equipment (i.e. temperatures would destroy sampling equipment);
2. To obtain a representative sample, stack emission testing equipment and a mobile laboratory would be required. However, in general, this type of equipment is not designed to collect samples from vehicle exhaust systems. Therefore, equipment would have to be adapted or modified. In addition, measurement protocols would have to be developed in order to ascertain if unbiased samples could be collected. It was BRC's opinion that collecting representative and unbiased samples would be very difficult;
3. For example, assuming that numerous modifications could be made to collect such exhaust samples, the sampling could only be done over a short period of time (less than 2 hours) and the results would not account for long term vehicle operation (non-idling) and additional assumptions would be required to extrapolate data for long term exposure scenarios

Based on all of the attendant practical difficulties, considerable costs, as well as lack of assurance that the samples would be representative and unbiased, the direct sampling approach was set aside.

3.5.2 SURVEY OF TECHNICAL LITERATURE

BRC and NDEP next undertook an extensive literature review in order to determine if others had detected and quantified the emissions of chlorinated organic compounds and dioxins. First, the manufacturers of the John Deere and Caterpillar trucks were contacted to determine if they had any data in this regard. They did not. Manufacturers of Cummins, another truck engine manufacturer were also contacted and they did not have useful information either. Next, various studies, generally conducted in the past decade were reviewed. Although not all of the studies reviewed had relevant data, the following studies provided useful information.

(a) The assumption that dioxins are formed and present in the exhaust of diesel engine exhaust was confirmed in a paper by Mr. Stanislaw Szwaja, titled "Dioxins – The Uncontrolled Toxic Content of Exhaust Gases from IC Engines."[1]

(b) Hexachlorobenze formation from diesel exhaust was confirmed as by Oberg and Bergstrom. They note that "…[T]he production of polychlorinated dioxins and dibenzofurans shows a strong correlation with the production of hexachlorobenzene. Hexachlorobenzene can be used as an indicator for the production of chlorinated aromatics…"[2] The EMEP/CORINAIR Guidebook also notes that "[O]n the whole, processes resulting in dioxins/furans formation lead also to HCB emissions."[3] Finally, the "Public Health Statement," a summary chapter from the Toxicological Profile for Hexachlorobenzene, periodically issued by the Agency for Toxic Substances and Disease Registry (ATSDR) notes that small amounts of hexachlorobenzene can also be produced during combustion processes.[4]

(c) The Szwaja paper referenced above also notes that "…appearance of precursors such as PCBs and chlorinated cyclic hydrocarbons (particularly chlorinated benzenes) as substrates are seen as favorable environment for creating dioxins…"

(d) Finally, a study in the Vancouver, WA area confirmed that chlorinated compounds, including various methyl benzenes and PAHs were present in detectable amounts in the ambient air. [5]

In addition, the following papers and sources were reviewed but did not appear to have useful information:

(e) Relationship between Composition and Toxicity of Motor Vehicle Emission Samples by Jacob D. McDonald, et al., Environmental Health Perspectives, Volume 112, No, 15, p. 1527, November 2004.

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[1] Journal of KONES Internal Combustion Engines, 2002, No. 1-2.

[2] Oberg, T., and J.G.T. Bergstrom, Hexachlorobenzene as an Indicator of Dioxin Production from Combustion. Available on the Internet.
[3] Sources of Hexachlorobenzene Emissions, BHCB-2, EMEP/CORINAIR, September 2005.
[4] http://www.atsdr.cdc.gov/toxprofiles/tp90.html.
[5] Final Report, Vancouver 2005 Ambient Air Toxics Monitoring Review, January 26, 2007, Southwest Clean Air Agency.

(f) Day-of-Week Patterns in Toxic Air Contaminants in Southern California, by Jeff Austin, Journal of the Air & Waste Management Association, Volume 53, July 2003.

Based on the above, the overall conclusions from the literature survey were as follows:

1. Dioxin emissions from diesel fueled vehicles have been detected and quantified; however, such studies have generally been conducted using formulations of diesel that are different from the low-sulfur diesels in use at the remediation project, making direct comparisons ineffective. However, it is more likely than not that diesel combustion exhaust from trucks will definitely contain dioxin compounds;
2. Since all prior heavy duty vehicle studies have generally been conducted in settings like tunnels, with free-flowing traffic, quantitative emission factors for the truck idling situation at BRC could not be developed;
3. All of the heavy duty trucks in use on the remediation project use modern particulate filters that capture much of the diesel particulates, unlike data reported in older-style vehicles, in the literature – making quantitative assessments impossible;
4. The literature indicates that hexachlorobenzene and other chlorinated benzenes are likely associative (to dioxins) compound that are also formed during diesel combustion. Again, no quantitative comparable data were found in the literature;
5. The literature strongly indicates that certain chlorinated compounds are also associated with diesel combustion. Again no quantitative comparable data were found in the literature;
6. In summary, the literature provides strong support that dioxin compounds, hexachlorobenzene, and chlorinated compounds can be formed (and therefore emitted) during diesel combustion. However, quantification of the emissions of these compounds for the situation at BRC (i.e., for the type of trucks and fuel and for the idling mode of operation) could not be determined.

Based on the above referenced research literature, it is BRC's conclusion is as follows:

1. Emissions from diesel fueled heavy duty vehicles may be the source of observed chlorinated compounds at the monitoring site. In addition, other non-project diesel vehicles and non-diesel vehicles, whether from the project or otherwise could also have contributed to the detections of chlorinated compounds.

2. These emissions could have originated from the moving and idling haul trucks transporting waste as well as other project support vehicles. In addition, BRC believes that the monitors could have been influenced, during each sampling event, by non-project traffic (including large trucks) along Boulder Highway.
3. The detection of these compounds at the monitoring sites does not imply that they could have originated from the wastes themselves because other compounds that are known to be present in the wastes (such as various metals and pesticides) were not consistently observed in the monitoring data.
4. BRC's opinion, based on the weight of the evidence discussed above, that the transport and hauling of the wetted waste materials via the tarp-covered trucks, did not result in waste material releases by the act of hauling.

3.6 PATH FORWARD/NEXT STEPS

The off-site sampling represents a significant effort by BRC to address concerns regarding material handling and hauling from the Eastside area to the CAMU area. The sampling was conducted from approximately 7PM to 7AM. Therefore, it can be assumed that normal sources of daytime emissions are reduced and the ambient air concentrations collected at the off-site sampling locations is sufficient to demonstrate that no significant air quality impacts were generated by the material hauling. BRC also conducted a test on a day when no hauling was taking place and demonstrated that compounds similar to those observed during hauling days was also present. This confirms that emissions of such compounds is from sources other than hauling. Finally, as discussed in Section 3.5 above, BRC conducted a literature survey of emissions from truck exhaust and showed, based on a weight-of-evidence analysis, that the observed compounds could plausibly be explained by truck exhaust emissions. In addition, the emissions of such compounds from normal, gasoline-powered vehicular traffic cannot be eliminated as well.

Based on all of the above, BRC believes that it has addressed the goals of the sampling and no additional steps are planned.

4.0 REFERENCES

Basic Remediation Company 2006. "*Perimeter Air Monitoring Plan for Soil Remediation Activities, BMI Upper and Lower Ponds and Ditches, Clark County, Nevada*." August 2006. Revised 2008.

Occupational Safety and Health Administration. 1994. *"Asbestos and Other Fibers by PCM."* August 1994

U.S. EPA 1999. *"Compendium Method TO-4A Determination of Pesticides and Polychlorinated Biphenyls in Ambient Air Using High Volume Polyurethane Foam (PUF) Sampling Followed by Gas Chromatographic/Multi-Detector Detection (GC/MD)"*

U.S. EPA 1999. *"Compendium Method TO-9A Determination Of Polychlorinated, Polybrominated And Brominated/Chlorinated Dibenzo-p-Dioxins And Dibenzofurans In Ambient Air."* January 1999.

U.S. EPA 1999. "Compendium Method TO-13A Determination of Polycyclic Aromatic Hydrocarbons (PAHs) in Ambient Air Using Gas *Chromatography/Mass Spectrometry (GC/MS."* January 1999.

U.S. EPA 1999. *"Compendium Method IO-3.3 Determination of Metals in Ambient Particulate Matter Using X-Ray Fluorescence (XRF) Spectroscopy."* June 1999.

APPENDIX A

NDEP COMMENTS AND BRC RESPONSE TO COMMENTS

APPENDIX B

FIELD DOCUMENTATION FORMS

APPENDIX C

LABORATORY ANALYTICAL RESULTS (ON CD)

APPENDIX D

CALIBRATION AND SAMPLE VOLUME CALCULATION WORKSHEETS

APPENDIX E

CD CONTAINING ELECTRONIC COPY OF REPORT AND TABLES

FIGURES

FIGURE 1 INSERTED HERE

TABLES

TABLE 2
SAMPLE COLLECTION SAMPLE HANDLING AND ANALYSIS SPECIFICATIONS FOR OFF SITE AIR-SAMPLING STATIONS
BMI COMPLEX HENDERSON, NEVADA

Analytical Parameter	Equipment Manufacturer/ Model	Sample Media	Sample Frequency/ Sample Events	Sample Handling Temperature/ hold time	Laboratory/ Analytical Method
Organochlorine Pesticides (TO-4A)	Tisch Environmental/ TE-1000	Polyurethane foam cartridge/102 mm quartz fiber filter	24hr. cont. sample/every 3 days/10 events	<4°C/7 days	Air Toxics Ltd./Method TO-4A
PCDDs/PCDFs (TO-9A)	Tisch Environmental/ TE-1000	Polyurethane foam cartridge/102 mm quartz fiber filter	24hr. cont. sample/every 3 days/10 events	<4°C/7 days	Frontier Ltd./Method TO-9A
VOCs/SVOCs (TO-13A)	Tisch Environmental/ TE-1000	Polyurethane foam cartridge/102 mm quartz fiber filter	24hr. cont. sample/every 3 days/10 events	<4°C/7 days	Air Toxics Ltd./Method TO-13A
TSP/Metals	BGI, Inc./PQ100	47mm Teflon fiber filter	24hr. cont. sample/every 3 days/10 events	None/30 days	Chester Labnet/ Method IO-2.1; Method IO-3.3
Asbestos	SKC, Inc. 224-PCXR8	25mm mixed cellulose ester filter	24hr. cont. sample/every 3 days/10 events	None/N/A	AES Laboratory/ NIOSH 7400

Notes:

< = less than
°C = degree Celsius
cont. = continuous
hr = hour
PM_{10} = particulate matter less than 10-microns
mm = millimeter
N/A = not applicable
$\mu g/m^3$ = microgram per cubic meter

TABLE 3
OFF SITE AIR SAMPLING SUMMARY DATA, BMI COMPLEX, HENDERSON, NEVADA
(ON CD)