THIRD QUARTER 2005
AIR QUALITY MONITORING REPORT
YERINGTON MINE SITE

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SECTION 1.0
INTRODUCTION

This Air Quality Monitoring Report presents a summary of air quality monitoring conducted by Atlantic Richfield Company (ARC) at the Yerington Mine Site during the third quarter of 2005 ("3Q 2005"). Monitoring activities were conducted according to the draft *Air Quality Monitoring Work Plan for the Yerington Mine Site* ("Work Plan") prepared by Brown and Caldwell on December 22, 2004 (Brown and Caldwell, 2004a) and conditionally approved by the U.S. Environmental Protection Agency ("EPA") on January 19, 2005. Air quality monitoring was conducted on the National Ambient Air Quality Standards (NAAQS) monitoring schedule, which consists of sampling on every sixth day.

Air quality monitoring was conducted at six locations located around the perimeter of the site (AM-1 through AM-6, shown on Figure 1). Each location was established to assess potential fugitive dust emissions from the site and monitor: 1) particulate matter of a diameter of 10 microns or less (PM_{10}) with a high volume sampler; 2) total suspended particulates (TSP) with a separate high volume air sampler; and 3) concentrations of selected metals and radiochemicals collected on the PM_{10} and TSP filters. Monitoring location AM-1 was established with a second PM_{10} high volume air sampler, co-located with the primary sampler, for duplicate analyses. Monitoring location AM-6 was sited near the site meteorological station.

SECTION 2.0
FIELD ACTIVITIES

Field activities during 3Q 2005 consisted of calibration, auditing, monitoring, and maintenance. A summary of these activities is presented in Table 1. Field activities were conducted according to Standard Operating Procedures (SOPs) provided in the Work Plan, the *Quality Assurance Project Plan, Yerington Mine Site* (Brown and Caldwell, 2003) and the revised *Site Health and Safety Plan* (Brown and Caldwell, 2005).

2.1 Calibration

Calibration activities consisted of quarterly calibration of the high volume air samplers and the semi-annual calibration for the meteorological station.

2.1.1 High Volume Air Sampler Calibration

The Work Plan specified that the high volume air samplers would be calibrated according to the following schedule:

- Upon installation;
- After any motor maintenance;
- Once every quarter (3 months); and
- After 360 hours.

All TSP high volume air samplers were recalibrated during August 6 to 7, 2005 following routine motor maintenance. All PM_{10} high volume air samplers were recalibrated on August 17, 18, and 25, 2005 following routine motor maintenance. Air sampler AM-1-PM10-DUP was recalibrated on September 6, 2005 following the replacement of the mass flow controller.

The Work Plan specified a minimum of five calibration points for all high volume samplers. In addition, three calibration points must be within 1.02 to 1.24 cubic meters per minute (m^3/min) for the PM_{10} high volume air samplers. The Work Plan also specified a calibration correlation coefficient greater than 0.99 for all high volume samplers. The calibration data sheets and charts

for each high volume air sampler are provided in Appendix A. All calibration requirements were met. The EPA representative, Tetra Tech EM Inc., conducted audits of the high volume air sampler calibration that are described in Section 2.2.

2.1.2 Meteorological Station Calibration

The Work Plan specified that the calibration of the meteorological station would be conducted at the start of the program and on a semi-annual basis thereafter. Semi-annual calibration was conducted during July 27 to 28, 2005 and the report is included as Appendix B. At the time of the calibration, all meteorological sensors were operating within criteria, except for the wind direction sensor as described below.

- The wind direction cross arm was aligned north to south; however, the mounting ring was off 5 degrees east. In addition, the wind direction potentiometer was off by 5 degrees east. The combined error was 10 degrees east resulting in all recorded directions to be 10 degrees less than the actual direction. The mounting ring was re-aligned and the potentiometer adjusted to correct the errors. The potentiometer had some play that was taken out with an improvised spacer so that it would hold alignment better when tightened. All affected directional data have been corrected for presentation in this report.

2.2 Auditing

During the second quarter (June 13 to 14, 2005), the EPA representative conducted an audit during that consisted of:

- Evaluation of high volume air sampler operations, filter handling, and filter preparation/removal, and documentation; and
- EPA and manufacturer-approved audit of high volume air samplers.

The audit was documented in the *2nd Quarter 2005 Air Quality Oversight and Audit Summary Report* prepared by Tetra Tech EM Inc. on August 26, 2005 and is included in Appendix C of this report. The EPA representative determined that, at the time of the audit, all high volume air samplers met the requirements designated in the audit procedures. In addition, Brown and Caldwell field personnel were observed correctly performing the filter loading, unloading,

handling, and following documentation procedures. There was one finding by the EPA representative, described below, that required corrective action. The corrective action taken by Brown and Caldwell follows the item in parentheses.

- The high volume air sampler clocks were incorrectly adjusted for daylight savings time and the EPA representative indicated that the protocol for air sampling is to remain on standard local time throughout the year. (Brown and Caldwell subsequently adjusted all clocks back one hour on June 20, 2005.)

During the current reporting period, the EPA representative conducted an audit during September 28 to 29, 2005 that consisted of:

- EPA and manufacturer-approved audit of high volume air samplers using a certified audit orifice; and
- Prevention of Significant Deterioration (PSD) audit and evaluation of the meteorological station.

The audit was documented in the *3rd Quarter 2005 Air Quality and Meteorological Monitoring Audit Report* prepared by Tetra Tech EM Inc. on November 4, 2005 (provided as Appendix C of this report). The EPA representative determined that at the time of the audit all high volume air samplers successfully passed all audit criteria. No equipment failures, leaks, or anomalies were observed during the audit procedure. At the time of the audit, all meteorological sensors were operating within PSD-audit criteria, except for the tipping bucket rain gauge. This finding by the EPA representative is described below and the corrective action taken by Brown and Caldwell follows in parentheses.

- The EPA representative was not able to obtain any readings from the precipitation sensor. After investigating the wiring configurations, he observed that the sensor wire appeared to have been damaged and severed where the wire connects to the base of the tower. Unless previous calibration results and/or site documentation can demonstrate the sensor was working at that time, precipitation results should be flagged as suspect since the previous audit on January 13, 2005. (Brown and Caldwell subsequently replaced the wire on October 17, 2005 and the affected data have been flagged.)

2.3 Monitoring

Monitoring activity consisted of air monitoring and meteorological monitoring, as described below.

2.3.1 Air Monitoring

The Work Plan specified that air monitoring would be conducted according to the NAAQS monitoring schedule for PM_{10}. Air monitoring during 3Q 2005 was conducted every sixth day beginning with Event 27 on July 3, 2005 through Event 41 on September 25, 2005 for a total of 15 events. Field data sheets and total volume calculations are provided in Appendix D.

Sample volumes were calculated using the average daily temperature and barometric pressure from the meteorological station, and calibration chart slopes and intercepts as specified in the *Reference Method for the Determination of Particulate Matter as PM-10 in the Atmosphere* (USEPA, 1998a) and the *Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High-Volume Method)* (USEPA, 1998b). The sample volumes for PM_{10} and TSP samples are summarized in Tables 2 and 3, respectively. Note that during Event 37 on September 1, 2005, the mass flow controller on high volume air sampler AM-1-PM10-DUP was erratic and a sample volume could not be determined (see section 2.4.1).

2.3.2 Meteorological Monitoring

Meteorological monitoring was conducted with the meteorological station during 3Q 2005. The following parameters were measured:

- Precipitation in inches;
- Temperature in degrees Fahrenheit (ºF);
- Relative humidity in percent;
- Barometric pressure in milliBars (mBar);
- Solar radiation in kiloJoules per square meter (kJ/m^2);
- Wind speed in miles per hour (mph); and
- Wind direction in degrees.

Meteorological data was collected from the station at 15-minute intervals from July 1, 2005 to September 30, 2005. Selected meteorological data is summarized on Table 4 for monitoring events this reporting period.

2.4 Maintenance

Maintenance activity consisted of troubleshooting, part replacement, and routine maintenance on the high volume air samplers and routine maintenance and part replacement on the meteorological station.

2.4.1 High Volume Air Sampler

During Event 37 on September 1, 2005, the mass flow controller on high volume air sampler AM-1-PM10-DUP was erratic. The AM-1-PM10-DUP mass flow controller was replaced on September 6, 2005. Minor routine maintenance included the replacement of recorder pens for the Dickson chart recorders and re-greasing of shim plates on the PM_{10} high volume air samplers.

The Work Plan specified that motor brushes would be checked or replaced every 300 to 500 hours of operation. Cumulative operational hours for each blower motor are presented in Appendix E. After the completion of Event 34 on August 14, 2005, nearly all of the motors for PM_{10} high volume air samplers had accumulated between 394 and 431.9 hours of operation. Motors in the PM_{10} high volume air samplers were replaced on August 17, 18 and 25, 2005. By the end of the third quarter, motors in the TSP high volume air samplers had accumulated 216 hours of operation. Motor brush replacement for all TSP high volume air samplers is scheduled for the beginning of next quarter.

Preventative maintenance was planned this reporting period to supply sampling location AM-5 with electrical power from Sierra Pacific Power as a backup to power supplied by the mine. Evaluation of the nearby circuit supplying power to the pumps for the evaporation ponds indicated no available capacity. Since there were no electrical power disruptions to sampling

location AM-5 this reporting period, this preventative maintenance has been put on hold indefinitely.

2.4.2 Meteorological Station

Routine maintenance conducted on the meteorological station during this reporting period consisted of ensuring that the tipping bucket was aligned to vertical. The bearings for the wind speed/direction sensor were removed and replaced, and the wind direction sensor was adjusted, on July 27th and 28th, 2005.

SECTION 3.0
AIR QUALITY DATA VERIFICATION AND VALIDATION

Severn Trent Laboratories performed the gravimetric analyses of PM_{10} and TSP filters, and chemical analysis of metals and radiochemicals present on both PM_{10} and TSP filters, for Events 27 (July 3, 2005) through 41 (September 25, 2005). Analytical results were provided by the laboratory electronically in a format specified by Brown and Caldwell. The laboratory electronic data deliverables (EDDs) were uploaded automatically into the project database, which consists of a Microsoft SQL Server database with a Microsoft Access user interface. The analytical results are provided electronically on compact disc in Microsoft Excel format in Appendix F. The laboratory reports are provided electronically on compact disc in Adobe Acrobat portable document format (PDF) in Appendix G.

3.1 Data Verification

All air quality data was verified according to the quality control (QC) criteria provided in the Work Plan. The items listed in the following table were verified for analytical data.

Data Verification Requirements	
Review Item	Checked During Data Verification
Case Narrative	X
Chain-of-Custody Documentation	X
Summary of Results	X
Holding Times	X
Method Blank Analysis Results	X
Field/Trip Blank Analysis Results	X
Surrogate Standard Percent Recoveries (%R)	X
Laboratory Control Samples (LCS) - %R	X
LCS/LCS Duplicate (LCSD) - Relative Percent Difference (RPD)	X
Field Duplicate (FD) - RPD	X

A detailed QC report is provided for the 3Q 2005 in Appendix H. In summary, the verification indicates that the analytical data generated during 3Q 2005 are usable with no data flagged as rejected. Notable findings from the QC report are provided below:

- Data Completeness: The Work Plan specified a data completeness goal of quarterly valid data retrieval of 80 percent for air quality data. The completeness goal was to be tracked for each of the six monitoring locations (AM-1 through AM-6). If one or more of the high volume air samplers malfunctioned during a sampling event, such that valid data could not be retrieved, then a makeup run could be conducted on the immediately following 3-day event specified in the NAAQS schedule. Fifteen sampling events were conducted during 3Q 2005, as summarized in Table 5. There was one exception to the sampling and analysis plan this reporting period. During Event 37 on September 1, 2005, the mass flow controller on the duplicate high volume air sampler AM-1-PM10-DUP was erratic and a sample volume could not be determined. A total of 180 primary samples were collected out of 180 planned. The actual completeness for air quality data was calculated to be 100 percent, which exceeds the 80 percent program goal.

- Sample Hold Time: All samples were analyzed within sample hold time.

- Field Duplicates: The Work Plan specified a collection frequency goal of 10 percent for field duplicates. Field duplicates were collected for every event, except one at location AM-1 with a co-located high volume air sampler (AM-1-PM10-DUP). The total number of primary samples targeted during this reporting period was 180. A total of 14 field duplicate samples were collected, as summarized in Table 6. The actual frequency of field duplicate collection was 7.8 percent, which is below the program goal of 10 percent; however, the EPA and ARC agreed that only one high volume sampler would be co-located for duplicate analysis. Field duplicate precision for metals and radiochemicals are provided in Table 6. Four primary/field duplicate sample pairs had a relative percent difference (RPD) higher than 60 percent for copper, lead, manganese, nickel, zinc, gross beta and radium-228 as explained in Appendix H.

- Field Blanks and Trip Blanks: The Work Plan specified a collection frequency goal of 5 percent for field blanks and 5 percent for trip blanks. Seven field blanks and 11 trip blanks were collected during this reporting period as shown on Tables 7a and 7b. The total number of primary samples targeted during this reporting period was 180. The actual frequency of field blank collection was 3.8 which is below the program goal of 5 percent. Additional field blanks are scheduled for the following quarter. The actual frequency of trip blank collection was 6.1 percent which exceeds the program goal of 5 percent. A total of 238 results were qualified due to the presence of beryllium, lead, mercury, vanadium, gross alpha, radium-226, radium-228 and thorium-230 in associated field/trip blanks as described in Appendix H. It is worth noting that mercury was found in 50% of the field/trip blanks, thus qualifying over 25 percent of the mercury results as not detected. Radium-228 was found in 72 percent of the blanks, thus qualifying over 50 percent of those results as not detected. Field procedures for sample handling were reviewed, and no sample collection issues were identified.

- Method Blanks: A total of 104 results were qualified as estimated due to the presence of beryllium, mercury, zinc, vanadium and radium-228 in associated method blanks as described in Appendix H.

3.2 Data Validation

The Work Plan specified that 10 percent of the air quality data would be validated by a third party. The data validation reports are provided electronically on compact disc in Adobe Acrobat PDF in Appendix I. The data verification requirement was mainly concerned with metals and radiological analyses since gravimetric analytical methods specify minimal QC. Third party data validation was conducted by Veridian Environmental for the Sample Delivery Groups (SDGs) associated with the monitoring events indicated below:

Status of 3rd Party Data Validation				
Event	**SDGs**	**Chemical Analyses**	**Veridian Report Dated**	**Included in Appendix I**
3	G5H260309	Metals	November 2, 2005	x
3	30354	Radiochemicals	In progress	
13	G5H260363	Metals	November 2, 2005	x
13	30401	Radiochemicals	In progress	
23	G5F170169 G5F170175	Metals	August 31, 2005	x
23	29297	Radiochemicals	In progress	
33	G5H100234	Metals	October 25, 2005	x
33	30037	Radiochemicals	In progress	

SECTION 4.0
METEOROLOGICAL DATA VALIDATION

Meteorological data was downloaded electronically from the meteorological station on approximately a weekly basis. The electronic files were uploaded automatically into the project database. The complete meteorological data are provided electronically on compact disc in Microsoft Excel format in Appendix J.

All meteorological data were validated according to the criteria provided in the Work Plan. The validation routines were programmed in Microsoft Visual Basic and incorporated into the Microsoft Access database as modules that can be run on a selected date range. The validation results are provided in the following sections for data completeness, wind speed, wind direction, temperature, solar radiation, barometric pressure, and relative humidity.

In summary, the verification indicates that the meteorological data generated during this period are usable with the exception of 16 records flagged as rejected as explained below.

4.1 Data Completeness

The Work Plan specified a data completeness goal of quarterly valid data retrieval of 90 percent for meteorological data. Three months of meteorological data were collected during 3Q 2005 as summarized in Table 8. A total of 8,816 data were collected out of 8,832 planned. The actual completeness for meteorological data was calculated to be 99.8 percent, which exceeded the program goal of 90 percent. A total of 16 records from 6:00 p.m. on July 27, 2005 through 11:00 a.m. on July 28, 2005 were flagged as rejected due to maintenance on the meteorological station (it is a routine practice to flag data as rejected during maintenance, calibration and auditing).

4.2 Wind Speed

The Work Plan specified three validation criteria for wind speed:

- Less than zero or greater than 56 mph [25 meters per second (m/s)];

- Does not vary by more than 0.2 mph (0.1 m/s) for 3 consecutive hours; and
- Does not vary by more than 1.1 mph (0.5 m/s) for 12 consecutive hours.

No wind speed records were flagged for any of the three criteria during this reporting period.

4.3 Wind Direction

The Work Plan specified three validation criteria for wind direction:

- Less than zero or greater than 360°;
- Does not vary by more than 1 degree for more than 3 consecutive hours; and
- Does not vary by more than 10 degrees for 18 consecutive hours.

No wind direction records were flagged for any of the three criteria during this reporting period. However, records were modified based on the calibration results discussed in Section 2.1.2. A total of 18,795 records were modified from 4:15 p.m. on January 13, 2005 through 12:00 p.m. on July 28, 2005. The records were modified by adding 10 degrees to the existing measurement. The appropriate change was made for situations where the existing measurement was 350 degrees or greater.

4.4 Temperature

The Work Plan specified four validation criteria for temperature:

- Greater than the local record high;
- Less than the local record low;
- Greater than a 18°F (10 degrees Celsius or °C) change from the previous hour; and
- Does not vary by more than 1°F (0.5°C) for 12 consecutive hours.

The following temperature records provide high and low temperatures recorded by the meteorological station by month:

Site Temperatures Compared to Local Records				
	Site Data (ºF)		Local Record[1] (ºF)	
2005	High	Low	High	Low
July	100.30	50.99	107	30
August	96.00	45.88	106	26
September	90.70	34.30	100	19

[1]Source: NWS/COOP Station 269229 located in Yerington, Nevada

These data include local record highs and lows from National Weather Service Cooperative Observer Program (NWS/COOP) Station 269229 in Yerington, Nevada. No temperature records were flagged for being either greater than the local record high or less than the local record low.

4.5 Solar Radiation

The Work Plan specified the following two validation criteria for solar radiation:

- Greater Than Zero at Night: The times for sunset and sunrise were obtained for every day of the year for Yerington, Nevada from the Astronomical Applications Department of the U.S. Naval Observatory. For the purposes of evaluating this criterion, night was defined as the meteorological station measurement readings that occurred between the time for sunset and sunrise on a given day. A total of 1,136 records were flagged for this criterion. The majority of records (985) that were flagged were less than 1 kJ/m^2 which, given the sensitivity of the sensor, is generally considered to be zero. The remaining flagged records (from 1 to 64 kJ/m^2) occurred right at the calculated sunrise or sunset. The solar radiation data was determined to be usable (no corrective action necessary).

- Greater Than the Maximum Possible for the Date and Latitude: The maximum possible solar radiation for the middle day of each month for Yerington, Nevada was calculated using *Evaporation, Evapotranspiration, and Climatic Data – Developments in Atmospheric Science 22* (Burman, et. al., 1994) and summarized below. The solar radiation measurements from the meteorological station were totaled for each day during this reporting period and compared to the maximum possible. A total of 290 records were flagged for this criterion during this reporting period.

Maximum Solar Radiation[1] (kJ/m^2 day)	
July	31,801
August	28,478
September	23,661

4.6 Barometric Pressure

The Work Plan specified two validation criteria for barometric pressure:

- Greater than the local record high; and
- Less than the local record low.

Local record highs and lows were obtained from the Automated Weather Observing Station (AWOS) 93102 located in Fallon Naval Air Station, Nevada. For purposes of comparison, the mean sea level pressure was estimated using a modified National Oceanic and Atmospheric Administration (NOAA) method. No barometric pressure records were flagged for either criterion during this reporting period.

4.7 Relative Humidity

The Work Plan specified two validation criteria for relative humidity which are described below followed by a discussion of the validation results.

- Less than 30 Percent During Precipitation Events: For the purposes of evaluating this criterion, a precipitation event was defined as a precipitation reading greater than zero inches. A total of 19 records were flagged for this criterion during this reporting period.

- Varies by 30 Percent of the Local Average for 24 Consecutive Hours: Local average relative humidity by month was obtained from AWOS Station 93102 located in Fallon Naval Air Station, Nevada. No records were flagged for this criterion during this reporting period.

Local Average Relative Humidity[1]	
July	28%
August	30%
September	35%

[1]Source: AWOS Station 93102 located in Fallon Naval Air Station, Nevada

SECTION 5.0
SUMMARY AND DISCUSSION OF RESULTS

This section summarizes the results of air quality analyses and meteorological monitoring, and discusses possible non-statistical correlations between selected data. Note that background concentrations of particulate matter, metals and radiochemicals have yet to be determined, and would be required prior to a meaningful interpretation of the analytical results.

5.1 Air Quality Data

Air quality data generated during this reporting period consisted of gravimetric analysis of PM_{10} and TSP filters, and chemical analyses of metals and radiochemicals present on both PM_{10} and TSP filters. The analytical results for the 3Q 2005 are summarized in tabular format and provided in Appendix K. Note that the quantity of chemical analyses performed on the filters affects the detection limits achievable for the project since each analysis requires a portion of the total filter be sectioned for digestion. In general, the less filter area available for digestion corresponds to less of the chemical available to measure, which results in higher detection limits.

5.1.1 Gravimetric PM_{10} Results

Analytical results for PM_{10} are summarized in Appendix K and the masses ranged from 12,200 to 80,300 µg. The masses detected on the PM_{10} filters were divided by the sample volumes in cubic meters in Table 2 to calculate PM_{10} concentrations in micrograms per cubic meter ($\mu g/m^3$), summarized in Table 9. As presented below, PM_{10} concentrations ranged from 7.0 to 48.1 $\mu g/m^3$:

Gravimetric PM_{10} Results					
Location	**Count**	**Minimum**	**Maximum**	**Average**	**Std. Dev.**
AM-1-PM10	15	7.7	20.6	12.9	3.3
AM-1-PM10-DUP	14	7.8	18.2	12.2	3.0
AM-2-PM10	15	7.3	17.6	12.0	3.1
AM-3-PM10	15	7.0	18.9	11.9	3.2
AM-4-PM10	15	8.7	25.7	16.9	5.4
AM-5-PM10	15	7.0	25.3	15.0	4.8
AM-6-PM10	15	10.5	48.1	22.9	9.5

The PM_{10} concentrations are charted on Figure 2, and observations from the chart are described below:

- Average PM_{10} concentrations (12.0 to 22.9 $\mu g/m^3$) by monitoring location in 3Q 2005 were about two times greater than average concentrations (6.3 to 9.4 $\mu g/m^3$) in the previous quarter.
- Average PM_{10} concentrations at monitoring locations AM-4 through AM-6 were higher than average concentrations at monitoring locations AM-1 through AM-3 this reporting period. Monitoring location AM-3 had the lowest average PM_{10} concentration of 11.9 $\mu g/m^3$ this reporting period. Monitoring location AM-6 during this reporting period exhibited the highest average PM_{10} concentration (22.9 $\mu g/m^3$) for the entire year to date.
- Average PM_{10} concentrations by monitoring event were highest during Event 29 on July 15, 2005, Event 37 on September 1, 2005, and Event 40 on September 19, 2005.
- The maximum PM_{10} concentration of 48.1 $\mu g/m^3$ for this reporting period occurred at AM-6-PM10 during Event 40 on September 19, 2005.

The current NAAQS primary standard for PM_{10} (50 $\mu g/m^3$) is averaged over a year at each monitoring location. NAAQS also specifies that each monitoring location have no more than one measurement per year above 150 $\mu g/m^3$ averaged over 24 hours. Average PM_{10} concentrations by monitoring location during 3Q 2005 ranged from 12.0 to 22.9 $\mu g/m^3$, which are well below the primary standard of 50 $\mu g/m^3$.

5.1.2 Gravimetric TSP Results

Analytical results for TSP are summarized in Appendix K and ranged from 32,700 to 350,800 µg. The masses detected on the PM_{10} filters were divided by the sample volumes in cubic meters in Table 3 to calculate TSP concentrations in $\mu g/m^3$, which are summarized in Table 10. TSP concentrations ranged from 18.3 to 192.6 $\mu g/m^3$, which are summarized below:

Gravimetric TSP Results					
Location	**Count**	**Minimum**	**Maximum**	**Average**	**Std. Dev.**
AM-1-TSP	15	21.6	53.8	33.8	7.8
AM-2-TSP	15	19.4	44.5	29.6	7.4
AM-3-TSP	15	20.0	52.0	29.1	8.3
AM-4-TSP	15	21.7	55.5	38.6	11.9
AM-5-TSP	15	18.3	55.6	36.1	10.3
AM-6-TSP	15	22.6	192.6	58.1	41.0

The TSP concentrations (Figure 3) indicated the following:

- Average TSP concentrations at monitoring locations AM-4 through AM-6 were higher than average concentrations at monitoring locations AM-1 through AM-3 this reporting period. Monitoring location AM-3 had the lowest average TSP concentration of 29.1 $\mu g/m^3$ this reporting period. Monitoring location AM-6 had the highest average TSP concentration of 58.1 $\mu g/m^3$ this reporting period.
- Average TSP concentrations by monitoring event were similar to PM_{10} concentrations in that the highest measurements were during Event 29 on July 15, 2005, Event 37 on September 1, 2005, and Event 40 on September 19, 2005.
- The maximum TSP concentration of 192.6 $\mu g/m^3$ for this reporting period occurred at AM-6-PM10 during Event 40 on September 19, 2005.

Prior to 1987, the NAAQS primary standard for particulate matter was measured as TSP, and was set at 75 $\mu g/m^3$ averaged over a year at each monitoring location. Average TSP concentrations by monitoring location during 3Q 2005 ranged from 29.1 to 58.1 $\mu g/m^3$, which are well below the TSP primary standard of 75 $\mu g/m^3$, which was discontinued by EPA in 1987 (note that after 1987, the NAAQS primary standard for particulate matter was measured as PM_{10}).

5.1.3 Metals Results

A total of 21 metals were analyzed from PM_{10} and TSP filters by the methods indicated below.

- ICP: five metals (aluminum, calcium, iron, magnesium, and sodium) were analyzed by inductively coupled plasma (ICP).
- ICP/MS: fifteen metals (arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc) were analyzed by inductively coupled plasma/mass spectrometry (ICP/MS).
- CVAA: mercury was analyzed by cold vapor atomic adsorption (CVAA).

Analytical results for metals detected on PM_{10} and TSP filters are summarized in Appendix K. The masses detected on the PM_{10} filters were divided by the sample volumes in Table 2 to calculate the metals concentrations summarized in Table 9. The masses detected on the TSP

filters were divided by the sample volumes in Table 3 to calculate the metals concentrations summarized in Table 10.

A brief discussion of each metal is provided below in alphabetical order. The quantity of detections on PM_{10} and TSP filters are provided for each metal. For metals with more than one detection, the average concentration is provided. Non-detected results were included in the average concentration calculation by assuming the metal was present at the detection limit. This assumption may result in some averages having a high bias compared to the actual average concentration.

- Aluminum: Aluminum was detected on all 104 PM_{10} filters analyzed this reporting period. The average aluminum concentration measured on PM_{10} filters was 0.20 $\mu g/m^3$. Aluminum was detected on all 90 TSP filters analyzed this reporting period. The average aluminum concentration measured on TSP filters was 0.52 $\mu g/m^3$.
- Arsenic: Arsenic was not detected on any PM_{10} filters analyzed this reporting period at detection limits down to 0.95 nanograms per cubic meter (ng/m^3). Arsenic was detected on nine of 90 TSP filters analyzed this reporting period. The average arsenic concentration measured on TSP filters was 1.1 ng/m^3.
- Barium: Barium was not detected on any PM_{10} filters analyzed this reporting period at detection limits down to 17 ng/m^3. Barium was detected on five of 90 TSP filters analyzed this reporting period. The average barium concentration measured on TSP filters was 19 ng/m^3.
- Beryllium: Beryllium was detected on 45 of 104 PM_{10} filters analyzed this reporting period. The average beryllium concentration measured on PM_{10} filters was 0.009 ng/m^3. Beryllium was detected on 73 of 90 TSP filters analyzed this reporting period. The average beryllium concentration measured on TSP filters was 0.021 ng/m^3.
- Cadmium: Cadmium was detected on 41 of 104 PM_{10} filters analyzed this reporting period. The average cadmium concentration measured on PM_{10} filters was 0.037 ng/m^3. Cadmium was detected on 78 of 90 TSP filters analyzed this reporting period. The average cadmium concentration measured on TSP filters was 0.055 ng/m^3.
- Calcium: Calcium was detected on ten of 104 PM_{10} filters analyzed this reporting period. The average calcium concentration measured on PM_{10} filters was 0.53 $\mu g/m^3$. Calcium was detected on 71 of 90 TSP filters analyzed this reporting period. The average calcium concentration measured on TSP filters was 0.73 $\mu g/m^3$.
- Chromium, Total: Chromium was not detected on any PM_{10} or TSP filters analyzed this reporting period at detection limits down to 5.1 ng/m^3.

- Cobalt: Cobalt was not detected on any PM_{10} filters analyzed this reporting period at detection limits down to 1.8 ng/m^3. Cobalt was detected on one of 104 TSP filters analyzed this reporting period at a concentration of 2.7 ng/m^3.
- Copper: Copper was detected on all 104 PM_{10} filters analyzed this reporting period. The average copper concentration measured on PM_{10} filters was 14 ng/m^3. Copper was detected on all 90 TSP filters analyzed this reporting period. The average copper concentration measured on TSP filters was 62 ng/m^3.
- Iron: Iron was detected on all 104 PM_{10} filters analyzed this reporting period. The average iron concentration measured on PM_{10} filters was 0.28 µg/m^3. Iron was detected on all 90 TSP filters analyzed this reporting period. The average iron concentration measured on TSP filters was 0.67 µg/m^3.
- Lead: Lead was detected on 90 of 104 PM_{10} filters analyzed this reporting period. The average lead concentration measured on PM_{10} filters was 0.92 ng/m^3. Lead was detected on 85 of 90 TSP filters analyzed this reporting period. The average lead concentration measured on TSP filters was 1.4 ng/m^3.
- Magnesium: Magnesium was detected on all 104 PM_{10} filters analyzed this reporting period. The average magnesium concentration measured on PM_{10} filters was 0.15 µg/m^3. Magnesium was detected on all 90 TSP filters analyzed this reporting period. The average magnesium concentration measured on TSP filters was 0.34 µg/m^3.
- Manganese: Manganese was detected on all 104 PM_{10} filters analyzed this reporting period. The average manganese concentration measured on PM_{10} filters was 8.4 ng/m^3. Manganese was detected on all 90 TSP filters analyzed this reporting period. The average manganese concentration measured on TSP filters was 20 ng/m^3.
- Mercury: Mercury was detected on 42 of 104 PM_{10} filters analyzed this reporting period. The average mercury concentration measured on PM_{10} filters was 0.015 ng/m^3. Mercury was detected on 50 of 90 TSP filters analyzed this reporting period. The average mercury concentration measured on TSP filters was 0.019 ng/m^3.
- Molybdenum: Molybdenum was detected on two of 104 PM_{10} analyzed this reporting period. The average molybdenum concentration measured on PM_{10} filters was 0.66 ng/m^3. Molybdenum was detected on five of 90 TSP filters analyzed this reporting period. The average molybdenum concentration measured on TSP filters was 0.61 ng/m^3.
- Nickel: Nickel was detected on one of 104 PM_{10} filters during this reporting period at a concentration of 2.0 ng/m^3. Nickel was detected on one of 104 TSP filters during this reporting period at a concentration of 1.9 ng/m^3.
- Selenium: Selenium was not detected on any PM_{10} filters analyzed this reporting period at detection limits down to 0.85 ng/m^3. Selenium was detected on two of 90 TSP filters analyzed this reporting period. The average selenium concentration measured on TSP filters was 0.95 ng/m^3.
- Silver: Silver was detected on 48 of 104 PM_{10} filters analyzed this reporting period. The average silver concentration measured on PM_{10} filters was 0.012 ng/m^3. Silver was

detected on 88 of 90 TSP filters analyzed this reporting period. The average silver concentration measured on TSP filters was 0.029 ng/m^3.

- Sodium: Sodium was not detected on any PM_{10} or TSP filters analyzed this reporting period at detection limits down to 1.0 µg/m^3.
- Vanadium: Vanadium was detected on 36 of 104 PM_{10} filters analyzed this reporting period. The average vanadium concentration measured on PM_{10} filters was 2.0 ng/m^3. Vanadium was detected on 57 of 90 TSP filters analyzed this reporting period. The average vanadium concentration measured on TSP filters was 2.5 ng/m^3.
- Zinc: Zinc was detected on 38 of 104 PM_{10} filters analyzed this reporting period. The average zinc concentration measured on PM_{10} filters was 4.7 ng/m^3. Zinc was detected on 72 of 90 TSP filters analyzed this reporting period. The average zinc concentration measured on TSP filters was 7.2 ng/m^3.

Two metals (chromium and sodium) were not detected on either PM_{10} or TSP filters this reporting period. Six additional metals (arsenic, barium, cobalt, molybdenum, nickel, and selenium) had very few (ten or fewer) detections. With the exception of a few molybdenum and nickel results in the single to double digit ng/m^3 range, the majority of TSP results were greater than PM_{10} results for metals analyses from samples collected during the same event and at the same monitoring location.

5.1.4 Radiochemical Results

A total of 10 radiochemicals were analyzed from PM_{10} and TSP filters using the following methods for 104 PM_{10} and 90 TSP samples described below.

- Gas Proportional Counters: gross alpha and gross beta were analyzed by EPA Method 900.0 and radium-228 was analyzed by EPA Method 904.0.
- Alpha Scintillation Counter: radium-226 was analyzed by EPA Method 903.1.
- Alpha Spectrometry: three species of thorium (228, 230, and 232) were analyzed by Standard Method 7500-U-C and ASTM Method D-5174 and three species of uranium (234, 235, and 238) were analyzed by EPA Method 908.0.

Analytical results for the radiochemicals detected on PM_{10} and TSP filters are summarized in Appendix K. The activity values detected on the PM_{10} filters were divided by the sample volumes in Table 2 to calculate radiochemical concentrations, which are summarized in Table

11. The activity values detected on the TSP filters were divided by the sample volumes in Table 3 to calculate radiochemical concentrations, which are summarized in Table 12. A brief discussion of each radiochemical is provided below. Analytical results are presented in femtoCuries (1,000 femtoCuries = 1 picoCurie) for ease of presentation.

The quantity of detections on PM_{10} and TSP filters are provided for each radiochemical. For radiochemicals with more than one detection, the average concentration is provided. Non-detected results were included in the average concentration calculation by assuming that the radiochemical was present at the detection limit. This assumption may result in some averages having a high bias compared to the actual average concentration.

- Gross Alpha: Gross alpha was detected on 52 of 104 PM_{10} filters analyzed this reporting period. The average gross alpha concentration measured on PM_{10} filters was 3.13 femtoCuries per cubic meter (fCi/m^3). Gross alpha was detected on 63 of 90 TSP filters analyzed this reporting period. The average gross alpha concentration measured on TSP filters was 3.45 fCi/m^3.
- Gross Beta: Gross beta was detected on all 104 PM_{10} and all 90 TSP filters. The average gross beta concentration measured on PM_{10} filters was 19.8 fCi/m^3. The average gross beta concentration measured on TSP filters was 22.9 fCi/m^3.
- Radium-226: Radium-226 was detected on 26 of 104 PM_{10} filters analyzed this reporting period. The average radium-226 concentration measured on PM_{10} filters was 0.356 fCi/m^3. Radium-226 was detected on 24 of 90 TSP filters analyzed this reporting period. The average radium-226 concentration measured on TSP filters was 0.32 fCi/m^3.
- Radium-228: Radium-228 was detected on 26 of 104 PM_{10} filters analyzed this reporting period. The average radium-228 concentration measured on PM_{10} filters was 2.13 fCi/m^3. Radium-228 was detected on 17 of 90 TSP filters analyzed this reporting period. The average radium-228 concentration measured on TSP filters was 2.17 fCi/m^3.
- Thorium-228: Thorium-228 was not detected on any PM_{10} filters analyzed this reporting period at detection limits down to 0.006 ± 0.004 fCi/m^3. Thorium-228 was detected on seven of 90 TSP filters analyzed this reporting period. The average thorium-228 concentration measured on TSP filters was 0.18 fCi/m^3.
- Thorium-230: Thorium-230 was detected on ten of 104 PM_{10} filters analyzed this reporting period. The average thorium-230 concentration measured on PM_{10} filters was 0.12 fCi/m^3. Thorium-230 was detected on 20 of 90 TSP filters analyzed this reporting period. The average thorium-230 concentration measured on TSP filters was 0.145 fCi/m^3.

- Thorium-232: Thorium-232 was not detected on any PM_{10} filters analyzed this reporting period at detection limits down to 0.005 ± 0.004 fCi/m^3. Thorium-232 was detected on five of 90 TSP filters analyzed this reporting period. The average thorium-232 concentration measured on TSP filters was 0.096 fCi/m^3.
- Uranium-234: Uranium-234 was detected on two of 104 PM_{10} filters analyzed this reporting period. The average uranium-234 concentration measured on PM_{10} filters was 0.34 fCi/m^3. Uranium-234 was not detected on any TSP filters analyzed this reporting period at detection limits down to 0.07 ± 0.084 fCi/m^3.
- Uranium-235: Uranium-235 was not detected on any PM_{10} or TSP filters analyzed this reporting period at detection limits down to 0.059 ± 0.052 fCi/m^3.
- Uranium-238: Uranium-238 was detected from one of 104 PM_{10} filters analyzed this reporting period at a concentration of 0.454 ± 0.334 fCi/m^3. Uranium-238 was not detected on any TSP filters analyzed this reporting period at detection limits down to 0.063 ± 0.047 fCi/m^3.

5.2 Meteorological Data

Meteorological data generated during this reporting period consisted of precipitation, temperature, relative humidity, barometric pressure, solar radiation, wind speed, and wind direction. These meteorological parameters are summarized in Table 13 and discussed below.

5.2.1 Precipitation

Total monthly precipitation measured by the meteorological station increased from approximately 0.1 inches in July to approximately 0.5 inches in August and September.

5.2.2 Temperature

The average, minimum, and maximum temperatures for each month in this reporting period are presented in Table 13. The average monthly temperature measured by the meteorological station decreased from approximately 79ºF in July to 62ºF in September.

5.2.3 Relative Humidity

The average, minimum, and maximum relative humidity for each month in this reporting period are presented in Table 13. The average monthly relative humidity measured by the meteorological station increased from approximately 28 percent in July and August to approximately 33 percent in September.

5.2.4 Barometric Pressure

The average, minimum, and maximum barometric pressures for each month in this reporting period are presented in Table 13. The average monthly barometric pressure measured by the meteorological station was constant at approximately 867 mBar from July through September.

5.2.5 Solar Radiation

Total monthly solar radiation measured by the meteorological station decreased from approximately 872,000 kJ/m^2 in July to approximately 649,000 kJ/m^2 in September.

5.2.6 Wind Speed

Wind speed measured by the meteorological station ranged from approximately zero to 32 mph (14 m/s). The highest wind speeds occurred in late July, early and late August, and late September.

Wind speed for each monitoring event is provided in Figure 4. The daily average, minimum, maximum, and standard deviation of all wind speed observations for each monitoring day are indicated on the chart. Monitoring Event 27 on July 3, 2005, Event 28 on July 9, 2005, and Event 30 on July 21, 2005 had the highest average wind speeds.

Wind speed frequency is presented in Figure 5. The wind speed measurements have been grouped according to general wind speed classes [e.g., 5 – 10 mph (2.2 – 4.5 m/s)]. The frequency of wind speed measurements is indicated for each wind speed class. The frequency distribution of wind speeds during 3Q 2005 was similar to the previous quarter with the majority (56 percent) of measurements between 1 – 5 mph (0.45 – 2.2 m/s). Approximately 25 percent of the total measurements were between 5 – 10 mph (2.2 – 4.2 m/s). Maximum wind speeds (greater than 20 mph or 8.9 m/s) during 3Q 2005 represented 1.9 percent of the measurements which was a decrease from the previous quarter with 7.5 percent.

5.2.7 Wind Direction

Wind direction measurements collected over a period of time are best summarized by wind rose plots. These plots group wind direction measurements into ranges of degrees (0 to 22.5, 22.5 to 45, etc.) and represents the ranges by a vector on a radial chart. The length of the vector is determined by the number of measurements in that range compared to the total number of measurements. In addition, a wind rose plot may provide information on wind speed by coloring the vectors that correspond to wind speed ranges. Wind rose plots were created using WRPLOT View software by Lakes Environmental to display both wind direction and wind speed. The data was formatted in Lakes format which has the requirements outlined below.

- Hourly Readings: Multiple readings per hour were averaged to provide a single hourly reading. An algorithm was used to average readings whose difference exceeded 180 degrees.
- Rounding: Wind direction in degrees was rounded to the nearest 10 degrees. Wind speed in mph was converted to knots, and then rounded to the nearest integer.

Wind rose plots are provided in Appendix L for the entire reporting period, for each month and for each monitoring event. As shown on the wind rose plot for 3Q 2005, the predominant wind directions were from the southwest to the northeast and from the northeast to the southwest. The wind directions for 3Q 2005 were variable with no direction accumulating more than 10 percent of the total measurements. Note, however, that during maximum wind speed conditions (greater than 20 mph or 8.9 m/s), wind direction is predominantly from the southwest to the northeast.

5.3 Correlation of Meteorological Data

Three non-statistical correlations are discussed below: PM_{10} concentration vs. wind speed; particulate matter concentration vs. wind direction/monitoring location; and PM_{10} vs. TSP concentration.

5.3.1 PM_{10} Concentration versus Wind Speed

A dual axis chart of PM_{10} concentration and wind speed for each monitoring location is provided in Appendix M (a statistical correlation was not performed), which presents daily average and standard deviation of all wind speed observations for each monitoring day. These data indicate

that sample events and locations with elevated PM_{10} concentration (Events 29, 37, and 40) do not generally correspond to the events with the greatest average wind speed (Events 27, 28, and 30).

5.3.2 Particulate Matter Concentration versus Wind Direction

The average PM_{10} and TSP concentrations measured during this reporting period at each monitoring location are presented on Figures 6 and 7, respectively. Note that monitoring locations that are to the south and southwest (AM-1 through AM-3) have average particulate matter concentrations that are noticeably less than those measured at the locations which are to the north and northwest (AM-4 through AM-6):

- For PM_{10} results, the south-southeast locations had average measurements of 11.9 to 12.9 $\mu g/m^3$ compared to north-northwest locations which had average measurements of 15.0 to 22.9 $\mu g/m^3$.
- For TSP results, the south-southeast locations had average measurements of 29.1 to 33.8 $\mu g/m^3$ compared to north-northwest locations which had average measurements of 36.1 to 58.1 $\mu g/m^3$.

Wind direction was quite variable during 3Q 2005, and it is difficult to identify predominantly upwind or downwind monitoring locations. Monitoring results do not indicate a general correlation between particulate matter concentration and overall wind direction. However, if only maximum wind speed conditions (greater than 20 mph or 8.9 m/s) are considered, the predominant wind direction from the southwest to the northeast correlates well with higher particulate matter loading measured at locations to the northeast.

5.3.3 PM_{10} Concentration versus TSP Concentration

A bar chart of gravimetric PM_{10} concentration and gravimetric TSP for each monitoring location is provided in Appendix N. The PM_{10} particles in the atmosphere are assumed to be a subset of all suspended particles of various sizes (i.e., TSP) and the charts indicate that PM_{10} measurements were consistently less than TSP measurements this reporting period. The minimum, maximum, average, and standard deviation are provided in the table below for PM_{10} concentration as a percentage of TSP concentration.

On average, PM_{10} concentrations during this period measured at all locations represented 41 percent of TSP concentrations. The small standard deviation relative to the average indicates that there is a good general correlation between PM_{10} concentration and TSP concentration:

PM_{10} Concentration as a Percentage of TSP Concentration				
Count[1]	**Minimum**	**Maximum**	**Average**	**Std. Dev.**
90	25%	55%	41%	5%

[1]Includes data from 15 events (Events 27 through 41) at 6 locations (AM-1 through -6).

SECTION 6.0

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