DEPARTMENT OF THE ARMY
US ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE
5158 BLACKHAWK ROAD
ABERDEEN PROVING GROUND MD 21010-5403

23 MAR 2009

MCHB-TS-RDE

MEMORANDUM FOR Command Surgeon (MAJ (b) (6)), U.S. Central Command, 7115 South Boundary Boulevard, MacDill Air Force Base, FL 33621-5101

SUBJECT: Deployment Occupational and Environmental Health Risk Characterization, Ambient Air Particulate Matter Samples, Bucca, Iraq, 16–24 January 2009, U_IRQ_BUCCA_CM_A10_2.5_20090124

1. The enclosed assessment details the risk characterization for 15 ambient air samples collected by Task Force 115 and 485th Medical Detachment – Preventive Medicine personnel at Bucca, Iraq, 16–24 January 2009. Six additional samples were invalid due to sampler failure, battery failure, or damaged sampling media.

2. The occupational and environmental health risk estimate for exposure to particulate matter less than 2.5 and 10 micrometers in diameter ($PM_{2.5}$ and PM_{10}) and metals in the ambient air at Bucca, Iraq is **moderate** due to PM_{10}. Exposure to the ambient air may have a significant impact on unit readiness if the hazard occurs during the mission.

FOR THE COMMANDER:

(b) (6)

Encl

Director, Health Risk Management

MCHB-TS-RDE
SUBJECT: Deployment Occupational and Environmental Health Risk Characterization, Ambient Air Particulate Matter Samples, Bucca, Iraq, 16–24 January 2009, U_IRQ_BUCCA_CM_A10_2.5_20090124

CF: (w/encl)
485th MED DET PM (Commander/CPT (b) (6)
485th MED DET PM (CPT (b) (6)
485th MED DET PM (SSG (b) (6)
MNC-I (Command Surgeon/LTC (b) (6)
MNF-I CJ148 (Commander/CDR (b) (6)
ARCENT (Command Surgeon/LTC (b) (6)
ARCENT (Force Health Protection Chief/COL (b) (6)
CFLCC/USA 3RD MDSC (CPT (b) (6)
44th MEDCOM (PM CLIN OPS/SFC (b) (6))
44th MEDCOM (Environmental Science Officer/LTC (b) (6)
44th MEDCOM (Preventive Medicine Officer/COL (b) (6)
421st MMB (Preventive Medicine OIC/1LT (b) (6)
421st MMB (Preventive Medicine NCO/SSG (b) (6)
USACHPPM-EUR (MCHB-AE-EE/CPT (b) (6)

U.S. Army Center for Health Promotion and Preventive Medicine

DEPLOYMENT OCCUPATIONAL AND ENVIRONMENTAL
HEALTH RISK CHARACTERIZATION
AMBIENT AIR PARTICULATE MATTER SAMPLES
BUCCA, IRAQ
16–24 JANUARY 2009
U_IRQ_BUCCA_CM_A10-2.5_20090124

Preventive Medicine Survey: 40-5f1

USCHPPM

Readiness Thru Health

DEPLOYMENT OCCUPATIONAL AND ENVIRONMENTAL
HEALTH RISK CHARACTERIZATION
AMBIENT AIR PARTICULATE MATTER SAMPLES
BUCCA, IRAQ
16–24 JANUARY 2009
U_IRQ_BUCCA_CM_A10-2.5_20090124

1. REFERENCES.

a. Department of the Army, Field Manual (FM) 5–19, Composite Risk Management, 21 August 2006.

b. U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) Technical Guide (TG) 230, Chemical Exposure Guidelines for Deployed Military Personnel, Version 1.3, May 2003 with the January 2004 addendum.

c. USACHPPM Reference Document (RD) 230, Chemical Exposure Guidelines for Deployed Military Personnel, Version 1.3, May 2003 with January 2004 addendum.

d. Memorandum, USACHPPM (MCHB-TS-RDE), 27 January 2007, Subject: Deployment Operational Risk Characterization Method for Particulate Matter (PM).

2. PURPOSE. According to U.S. Department of Defense medical surveillance requirements, this occupational and environmental health (OEH) risk characterization documents the identification and assessment of chemical hazards that pose potential health and operational risks to deployed troops. Specifically, the samples and information provided on the associated field data sheets were used to estimate the operational health risk associated with exposure to identified chemical hazards in the air at Bucca Iraq.

3. SCOPE. This assessment addresses the analytical results for 15 valid ambient air samples collected from Bucca Iraq, 16–24 January 2009. These samples are limited in time, area, and media. Therefore, this report should not be considered a complete assessment of the overall OEH hazards to which troops may be exposed at this location. However, this assessment has been performed using operational risk management (ORM) doctrine FM 5–19, and the relatively conservative (protective) assumptions and methods provided in TG 230, to facilitate decision making that can minimize the likelihood of significant risks.

4. BACKGROUND AND EXPOSURE ASSUMPTIONS. The samples were collected to assess the potential for adverse health effects to troops routinely and continuously breathing the ambient air at Bucca, Iraq. Twelve samples each of PM less than 2.5 micrometers ($PM_{2.5}$) and nine samples each of PM less than 10 micrometers (PM_{10}) were collected. Four PM_{10} and two $PM_{2.5}$ samples were invalid. All samples were collected near the Bucca square, yard, burn pit

tower, incinerator, and burn pit at Bucca. The field data sheets indicated that the samples were collected: near a non-active burn pit located near a scrap metal yard; near an active solid waste incinerator; and the Bucca Square samples were near the dining facility (DFAC), shopping, and post exchange. Personnel are expected to remain at this location for more than 1 year. A conservative (protective) assumption is that all personnel inhale the ambient air for 24 hours/day for 365 days (1 year). In addition, it is assumed that control measures and/or personal protective equipment are not used.

5. METHOD.

a. General. The USACHPPM Deployment Environmental Surveillance Program uses the TG 230 methodology and associated military exposure guidelines (MEGs) to assess identified hazards and estimate risk in a manner consistent with doctrinal risk management procedures and terminology. This method includes identification of the hazard(s), assessment of the hazard severity and probability, and determination of a risk estimate and associated level of confidence. As part of the hazard identification step, the long-term (1-year) MEGs are used as screening criteria to identify those hazards that are potential health threats. These 1-year MEGs represent exposure concentrations at or below which no significant health effects (including delayed or chronic disease or significant increased risk of cancer) are anticipated even after 1 year of continuous daily exposures. Short-term MEGs are used to assess one time or intermittent exposures. The underlying toxicological basis for the MEGs is addressed in the RD 230. Since toxicological information about potential health effects varies among different chemicals, the determination of severity of effects when MEGs are exceeded involves professional judgment. Hazards with exposure concentrations greater than MEGs are identified as potential health threats, carried through the hazard assessment process, and assigned a risk estimate consistent with ORM methodology. Hazards that are either not detected or are present only at levels below the 1-year MEGs are not considered health threats and, therefore, are automatically assigned a low operational risk estimate.

b. Assessment of Ambient Air Particulate Matter. The PM is one of six air pollutants for which the U.S. Environmental Protection Agency (USEPA) has promulgated National Ambient Air Quality Standards (NAAQS) in the interest of protecting public health. In addition, the USEPA developed the Air Quality Index (AQI) to communicate daily air quality to the public using six descriptive categories ranging from “good” to “hazardous.” The AQI categories for PM are based on concentration ranges that are grouped according to the severity of health concerns. The USACHPPM uses the AQI categories to characterize the operational risk from PM. If any PM sample concentration is above the threshold of the AQI “good” quality air category, it is identified as a hazard. Hazard severity is determined by comparing the average PM concentration for a specific location and timeframe to PM concentration ranges identified as either negligible or marginal. Negligible concentration levels correspond to mild respiratory effects among generally healthy troops, with more significant effects among sensitive persons,

such as asthmatics or those with existing cardiopulmonary disease. Marginal concentration levels are expected to pose more significant health effects among both healthy personnel, and those with pre-existing sensitivities. Hazard probability is based on the frequency that anticipated exposures are above a threshold that is representative of the hazard severity category.

6. HAZARD IDENTIFICATION.

a. Sample Information. Two valid samples were collected with the Mini-Vol™ apparatus. Fifteen valid samples were collected with the Deployable Particulate Sampler (DPS™) apparatus. Of these, ten samples were $PM_{2.5}$ and five samples were PM_{10}. Six samples were invalid due to sampler failure, battery failure, or damaged sampling media. (Mini-Vol™ is a registered trademark of Airmetrics; DPS™ is a trademark of SKC, Inc.)

b. Laboratory Analysis. All samples were analyzed for $PM_{2.5}$ or $PM_{10,}$ and metals. Detected metals identified above the laboratory reportable limit were compared to MEGs presented in TG 230, while $PM_{2.5}$ and PM_{10} concentrations were assessed using the process described in the Method section, paragraph 5. Appendix A shows a summary of the samples assessed in this report. Appendix B shows a sample results summary table. Appendix C shows complete analytical results for individual samples.

c. Assessment.

(1) The PM. Since both the $PM_{2.5}$ and PM_{10} were measured at concentrations above the AQI "good" range, $PM_{2.5}$ and PM_{10} are identified as potential health threats requiring further assessment. The PM air pollutants include solid particles and liquid droplets emitted directly into the air by sources, such as, power plants, motor vehicles, aircraft, generators, construction activities, fires, and natural windblown dust. The PM can include dust, silica, soil, metals, organic compounds, allergens, and compounds; for example, nitrates or sulfates that are formed by condensation or transformation of combustion exhaust. The PM chemical composition and size vary considerably depending on the source. Primary sources of $PM_{2.5}$ and PM_{10} at the specified location are assumed to be windblown dust and sand.

(2) Metals. No detected metals were found at concentrations greater than their respective MEGs. Therefore, the OEH risk estimate for exposure to metals completed in the lab analysis in the ambient air at this location is considered **low**.

7. HAZARD ASSESSMENT.

a. Hazard Severity. The hazard severity for the potential health threats of concern was determined by comparison of $PM_{2.5}$ and PM_{10} concentrations to the AQI and using the process described in the Method section, paragraph 5. The average concentration of $PM_{2.5}$ was

51 micrograms per cubic meter (µg/m^3) and the average PM_{10} concentration was 192 µg/m^3. These concentrations fall within the ranges of concentrations that are believed to pose significant health concerns to susceptible groups, which in the military can include asthmatics or persons with pre-existing cardiopulmonary disease. Otherwise, generally healthy troops may have some eye, nasal, or throat irritation causing little or no impact on unit readiness. Therefore, the hazard severity for both $PM_{2.5}$ and PM_{10} is considered **negligible**.

b. Hazard Probability. Although the average $PM_{2.5}$ and PM_{10} sample concentrations were within the negligible severity range, it is important to examine the individual samples to determine whether the average concentrations are dominated by outliers or if it they are representative of typical exposures. The hazard probability reflects the likelihood that the exposures at the location are represented by the concentrations used to determine the hazard severity.

(1) The $PM_{2.5}$. The probability that the severity of a hazard is negligible is based on a comparison of individual sample concentrations to the $PM_{2.5}$ 24-hour NAAQS of 35 µg/m^3. During this sampling event, the range of $PM_{2.5}$ concentrations was 15-115 µg/m^3, and 4 of 5 (80 percent) sampling days were above 35 µg/m^3 on average. Since the assumption is that all or most personnel at this location are equally exposed to the ambient air, the probability that personnel will be exposed to $PM_{2.5}$ concentrations above 35 µg/m^3 is considered **likely**.

(2) The PM_{10}. The probability that the severity of a hazard is negligible is based on a comparison of individual sample concentrations to the PM_{10} 24-hour NAAQS of 150 µg/m^3. During this sampling event, the range of PM_{10} sample concentrations was 116–306 µg/m^3, and 2 of 2 (100 percent) sampling days were above 150 µg/m^3 on average. Since the assumption is that all or most personnel at this location are equally exposed to the ambient air, the probability that personnel will be exposed to PM_{10} concentrations greater than 150 µg/m^3 is considered **frequent**.

c. Risk Estimate and Confidence. The hazard severity and probability levels described above were used with the ORM matrix in TG 230, Table 3–3, or FM 5–19 to provide a risk estimate for exposure to each identified hazard. Table 1 summarizes the risk estimate for each identified hazard. The risk estimate for exposure to PM in the ambient air at Bucca, Iraq is considered **moderate**. The risk estimate for exposure to the ambient air at this location is based on the highest identified hazard risk estimate (PM_{10}). Confidence in the risk estimate is considered **low** because it is unclear if the samples represent conditions to which personnel are typically exposed for the deployment duration. In general, the confidence level in risk estimates is usually low to medium due to consistent lack of specific exposure information associated with troop movement and activity patterns; other routes/sources of potential OEH hazards not identified; and uncertainty regarding impacts of multiple chemicals present, particularly those affecting the same body organs/systems.

Deployment OEH Risk Characterization, Ambient Air PM Samples, Bucca, Iraq, 16–24 Jan 09, U_IRQ_BUCCA_CM_A10-2.5_20090124

Table 1. Risk Estimate Summary for Exposure to Ambient Air at Bucca, Iraq

Parameter	Hazard Severity	Hazard Probability	Hazard-Specific Risk Estimate	Operational Risk Estimate	Confidence
PM_{10}	NEGLIGIBLE	FREQUENT	MODERATE	MODERATE	LOW
$PM_{2.5}$	NEGLIGIBLE	LIKELY	LOW		
Metals	No parameters detected above a MEG		LOW		

8. CONCLUSION. The OEH risk estimate for exposure to $PM_{2.5}$, PM_{10}, and metals in the ambient air at Bucca, Iraq is **moderate** due to $PM_{10.}$ Exposure to the ambient air may have a significant impact on unit readiness of the hazard occurs during the mission. Confidence in the risk estimate is considered **low**.

9. RECOMMENDATIONS AND NOTE.

a. Recommendations.

(1) Continue to collect samples from this location at least once every 6 days for the deployment duration (or as long as possible) to better characterize the $PM_{2.5,}$ $PM_{10,}$ and metals ambient air concentrations to which personnel are typically exposed.

(2) Restrict outdoor physical activities where possible during periods of visibly high particulate levels.

(3) Inform preventive medicine and medical personnel of potential health effects resulting from exposures to the measured levels of ambient PM and associated heavy metals. Disease Non-Battle Injury (DNBI) rates of respiratory diseases, particularly asthma, should be followed and assessed during periods of high PM levels. If elevated DNBI respiratory illness rates (that is, above two standard deviations), or an increase in the incidence or severity of asthma, are noted during periods of high PM levels, ensure appropriate medical surveillance-related items are documents. If assistance and/or information are needed on environmental health effects and/or medical implications from exposure to PM and associated heavy metals, please contact the USACHPPM–Headquarters Environmental Medicine Program at commercial 001 (410) 436-2714.

b. Note. This OEH risk assessment is specific to the exposure assumptions identified above and the sample results assessed in this report. If the assumed exposure scenario changes, provide updated information so that the risk estimate can be reassessed. If additional samples from this site and/or area are collected, a new OEH risk assessment will be completed.

10. POINTS OF CONTACT. The USACHPPM points of contact for this assessment are Mr. (b) (6) and Ms. (b) (6). Mr. (b) (6) may be contacted at e-mail (b) (6); Ms. (b) (6) may be contacted at e-mail (b) (6) or DSN (b) (6) or commercial (b) (6).

(b) (6)
Environmental Scientist
Deployment Environmental Surveillance Program

Approved by:

(b) (6)
MAJ, MS
Program Manager
Deployment Environmental Surveillance

APPENDIX A
SAMPLING SUMMARY
AMBIENT AIR SAMPLES
BUCCA, IRAQ
16–24 JANUARY 2009

Sample ID	Field/Local Sample ID	Location	Start Date/Time	Exposure Notes	Sample Time	PM Mini-Vol Sampler Serial #
00000LTG	IRQ_BUCCA_09016_PM 25MV	BUCCA	2009/01/16 0944	Incinerator, scrap metal lay down yard adjacent to location	1440.0 min	3348
00000LTH	IRQ_BUCCA_09016_PM 25MV_B	BUCCA	2009/01/16 1023	burn pit	1440.0 min	4210
00000LRI	IRQ_BUCCA_09021_PM 2.5DPS	BUCCA	2009/01/21 1039	Scrap Metal Yard Located next to sampling site. Active solid waste incinerator at location	1440.0 min	47-08-2878
00000LRJ	IRQ_BUCCA_09021_PM 2.5DPS_B	BUCCA	2009/01/21 1000	Burn Pit not active Clear day	1440.0 min	47-08-2877
00000LT3	IRQ_BUCCA_083354_P M2.5DPS	BUCCA	2008/12/21 1530	Burn pit	1440.0 min	47-08-1501
00000LT4	IRQ_BUCCA_09022_PM 2.5DPS	BUCCA	2009/01/22 1022	Burn pit not active at time sample was picked up	1445.0 min	47-08-2178
00000LT5	IRQ_BUCCA_09022_PM 2.5DPS_B	BUCCA	2009/01/22 1108	clear day, wind speed 5.4 mph	1442.0 min	47-08-2180
00000LT6	IRQ_BUCCA_09022_PM 2.5DPS_C	BUCCA	2009/01/22 1150	clear day, wind speed 1.2 mph; high traffic area, main DFAC and shopping area	1445.0 min	47-08-2181
00000LT7	IRQ_BUCCA_09023_PM 2.5DPS	BUCCA	2009/01/23 1032	burn pit active at time sample was picked up	1440.0 min	47-08-2184
00000LT8	IRQ_BUCCA_09023_PM 2.5DPS_B	BUCCA	2009/01/23 1114	clear day	1440.0 min	47-08-2152
00000LT9	IRQ_BUCCA_09023_PM 10DPS	BUCCA	2009/01/23 1148	clear day	1440.0 min	47-08-2185

Deployment OEH Risk Characterization, Ambient Air PM Samples, Bucca, Iraq, 16–24 Jan 09, U_IRQ_BUCCA_CM_A10-2.5_20090124

Sample ID	Field/Local Sample ID	Location	Start Date/Time	Exposure Notes	Sample Time	PM Mini-Vol Sampler Serial #
00000LTA	IRQ_BUCCA_09023_PM 10DPS_B	BUCCA	2009/01/24 1047	burn pit active at time sample was picked up	0.00 min	47-08-2183
00000LTB	IRQ_BUCCA_09022_PM 10DPS	BUCCA	2009/01/22 1115	clear day	1444.0 min	47-08-2179
00000LTC	IRQ_BUCCA_09022_PM 10DPS_B	BUCCA	2009/01/22 1034	burn pit was not active at time sample picked up	1448.0 min	47-08-2177
00000LTD	IRQ_BUCCA_09021_PM 10DPS	BUCCA	2009/01/21 1007	burn pit was not active at time sample picked up, center of 3 burn pits	1438.0 min	47-08-2876

APPENDIX B

SAMPLE RESULTS SUMMARY
AMBIENT AIR SAMPLES
16–24 JANUARY 2009

Analyte	Units	Result		Samples (Valid)		USACHPPM TG230 Military Exposure Guidelines	
						1yr	
		Max	Avg	#	# > RL	# > MEG	MEG
PM 2.5	µg/m^3	115	51	10	10	10	15
PM 10	µg/m^3	306	192	5	5	5	50

Note:
Highlighted values indicate the parameter was detected at a concentration above a MEG

APPENDIX C

DETAILED SAMPLE RESULTS
AMBIENT AIR SAMPLES
BUCCA, IRAQ
16–24 JANUARY 2009

Sample ID		00000LTG	00000LTH	00000LRI	00000LRJ	00000LT3
Field/Local Sample ID		IRQ_BUCCA_09016_PM25MV	IRQ_BUCCA_09016_PM25MV_B	IRQ_BUCCA_09021_PM2.5DPS	IRQ_BUCCA_09021_PM2.5DPS_B	IRQ_BUCCA_083354_PM2.5DPS
Country		Iraq	Iraq	Iraq	Iraq	Iraq
Location		BUCCA	BUCCA	BUCCA	BUCCA	BUCCA
Start Date		2009/01/16 0944	2009/01/16 1023	2009/01/21 1039	2009/01/21 1000	2008/12/21 1530
Analyte	Units	Results				
Antimony	µg/m^3	< 0.13767	< 0.13773	< 0.066774	< 0.066774	< 0.069444
Arsenic	µg/m^3	< 0.068837	< 0.068865	< 0.033387	< 0.033387	< 0.034722
Beryllium	µg/m^3	< 0.068837	< 0.068865	< 0.033387	< 0.033387	< 0.034722
Cadmium	µg/m^3	< 0.068837	< 0.068865	< 0.033387	< 0.033387	< 0.034722
Chromium	µg/m^3	< 0.068837	< 0.068865	< 0.033387	< 0.033387	< 0.034722
Lead	µg/m^3	< 0.13767	< 0.13773	< 0.066774	< 0.066774	< 0.069444
Manganese	µg/m^3	< 0.27535	< 0.27546	< 0.13355	< 0.13355	< 0.13889
Nickel	µg/m^3	< 0.068837	< 0.068865	< 0.033387	< 0.033387	< 0.034722
PM 10	µg/m^3					
PM 2.5	µg/m^3	62	115	50	52	56
Vanadium	µg/m^3	< 0.27535	< 0.27546	< 0.13355	< 0.13355	< 0.13889
Zinc	µg/m^3	< 0.68837	< 0.68865	< 0.33387	< 0.33387	< 0.34722

Deployment OEH Risk Characterization, Ambient Air PM Samples, Bucca, Iraq, 16–24 Jan 09,
U_IRQ_BUCCA_CM_A10-2.5_20090124

Sample ID		00000LT4	00000LT5	00000LT6	00000LT7	00000LT8
Field/Local Sample ID		IRQ_BUCCA_09022_PM2.5DPS	IRQ_BUCCA_09022_PM2.5DPS_B	IRQ_BUCCA_09022_PM2.5DPS_C	IRQ_BUCCA_09023_PM2.5DPS	IRQ_BUCCA_09023_PM2.5DPS_B
Country		Iraq	Iraq	Iraq	Iraq	Iraq
Location		BUCCA	BUCCA	BUCCA	BUCCA	BUCCA
Start Date		2009/01/22 1022	2009/01/22 1108	2009/01/22 1150	2009/01/23 1032	2009/01/23 1114
Analyte	Units	Results				
Antimony	µg/m^3	< 0.066542	< 0.063622	< 0.062913	< 0.060916	< 0.063710
Arsenic	µg/m^3	< 0.033271	< 0.031811	< 0.031456	< 0.030458	< 0.031855
Beryllium	µg/m^3	< 0.033271	< 0.031811	< 0.031456	< 0.030458	< 0.031855
Cadmium	µg/m^3	< 0.033271	< 0.031811	< 0.031456	< 0.030458	< 0.031855
Chromium	µg/m^3	< 0.033271	< 0.031811	< 0.031456	< 0.030458	< 0.031855
Lead	µg/m^3	< 0.066542	< 0.063622	< 0.062913	< 0.060916	< 0.063710
Manganese	µg/m^3	< 0.13308	< 0.12724	< 0.12583	< 0.12183	< 0.12742
Nickel	µg/m^3	< 0.033271	< 0.031811	< 0.031456	< 0.030458	< 0.031855
PM 10	µg/m^3					
PM 2.5	µg/m^3	52	45	31	15	32
Vanadium	µg/m^3	< 0.13308	< 0.12724	< 0.12583	< 0.12183	< 0.12742
Zinc	µg/m^3	< 0.33271	< 0.31811	< 0.31456	< 0.30458	< 0.31855

Deployment OEH Risk Characterization, Ambient Air PM Samples, Bucca, Iraq, 16–24 Jan 09,
U_IRQ_BUCCA_CM_A10-2.5_20090124

Sample ID		00000LT9	00000LTA	00000LTB	00000LTC	00000LTD
Field/Local Sample ID		IRQ_BUCCA_09023_PM10DPS	IRQ_BUCCA_09023_PM10DPS_B	IRQ_BUCCA_09022_PM10DPS	IRQ_BUCCA_09022_PM10DPS_B	IRQ_BUCCA_09021_PM10DPS
Country		Iraq	Iraq	Iraq	Iraq	Iraq
Location		BUCCA	BUCCA	BUCCA	BUCCA	BUCCA
Start Date		2009/01/23 1148	2009/01/23 1047	2009/01/22 1115	2009/01/22 1034	2009/01/21 1007
Analyte	Units	Results				
Antimony	µg/m^3	< 0.063131	0.088508	< 0.064722	< 0.067049	< 0.068177
Arsenic	µg/m^3	< 0.031566	< 0.034041	< 0.032361	< 0.033525	< 0.034089
Beryllium	µg/m^3	< 0.031566	< 0.034041	< 0.032361	< 0.033525	< 0.034089
Cadmium	µg/m^3	< 0.031566	< 0.034041	< 0.032361	< 0.033525	< 0.034089
Chromium	µg/m^3	< 0.031566	< 0.034041	< 0.032361	< 0.033525	< 0.034089
Lead	µg/m^3	< 0.063131	< 0.068083	< 0.064722	< 0.067049	< 0.068177
Manganese	µg/m^3	< 0.12626	< 0.13617	< 0.12944	< 0.13410	< 0.13635
Nickel	µg/m^3	< 0.031566	< 0.034041	< 0.032361	< 0.033525	< 0.034089
PM 10	µg/m^3	116	306	154	201	183
PM 2.5	µg/m^3					
Vanadium	µg/m^3	< 0.12626	< 0.13617	< 0.12944	< 0.13410	< 0.13635
Zinc	µg/m^3	< 0.31566	< 0.34041	< 0.32361	< 0.33525	< 0.34089

Notes:
< X.XX - Below laboratory reporting limit (X.XX)
Laboratory reporting limit is parameter and sample specific