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

MCHB-TS-RDE

08 FEB 2008

MEMORANDUM FOR Command Surgeon (LTC (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 Volatile Organic Compound Samples, Camp Fallujah, Iraq, 12–14 December 2007, U_IRQ_FALLUJAH_CM_A17_20071214

1. The enclosed report details the occupational and environmental health (OEH) risk characterization for six ambient air volatile organic compound (VOC) samples collected by Combat Logistics Battalion 8, 2nd Marine Logistics Group (Forward) personnel from Camp Fallujah, Iraq, 12–14 December 2007.

2. The OEH risk estimate for exposure to VOCs in the ambient air at Camp Fallujah, Iraq is **low**. While peak benzene concentrations were above the long-term 1 year military exposure guideline, overall concentrations do not represent levels at which chronic or acute effects would be expected. Therefore exposure to the benzene or other VOCs in the ambient air at Camp Fallujah, Iraq is expected to have little or no impact on unit readiness.

FOR THE COMMANDER:

(b) (6)

Director, Health Risk Management

Encl

CF: (w/encl)
CLB-8, 2nd MLG (Environmental Health Officer/LT (b) (6)
MNC-I (Command Surgeon/MAJ (b)
ARCENT (Command Surgeon/COL (b) (6)
ARCENT (Command Surgeon/MAJ (b) (6)
CFLCC (Command Surgeon/MAJ (b) (6)
MNF-W (Preventive Medicine Operations Chief/HMC (b)
MNF-W (Base Operations Support Director/CDR (b) (6)
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NMCPHC (Expeditionary Preventive Medicine/Mr. (b) (6)
USACHPPM-EUR (MCHB-AE-EE/Mr. (b) (6)

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

DEPLOYMENT OCCUPATIONAL AND ENVIRONMENTAL
HEALTH RISK CHARACTERIZATION
AMBIENT AIR VOLATILE ORGANIC COMPOUND SAMPLES
CAMP FALLUJAH, IRAQ
12–14 DECEMBER 2007
U_IRQ_FALLUJAH_CM_A17_20071214

USCHPPM

Readiness Thru Health

DEPLOYMENT OCCUPATIONAL AND ENVIRONMENTAL HEALTH RISK CHARACTERIZATION AMBIENT AIR VOLATILE ORGANIC COMPOUND SAMPLES CAMP FALLUJAH, IRAQ 12–14 DECEMBER 2007 U_IRQ_FALLUJAH_CM_A17_20071214

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.

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 the above-mentioned location.

3. SCOPE. This assessment addresses the analytical results of six volatile organic compounds (VOCs) air samples collected from Camp Fallujah, Iraq, 12–14 December 2007. 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 obtained to assess the potential for adverse health effects to troops routinely and continuously breathing the ambient air at Camp Fallujah, Iraq. Information from the field data sheets and e-mail correspondence indicated that the two samples on 12 December 2007 were collected from an area downwind of the burn pit smoke plumes. This is the southeast portion of the camp and less than 10 percent of the personnel are expected to be exposed. The remaining four samples are from the South Camp and Belleau Wood areas. Numerous generators are present in these areas. The exposure rate for these samples was indicated to be 25 to50 percent of the camp population.

Personnel are expected to remain at Camp Fallujah for approximately 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 (DESP) 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 brief one time or intermittent exposures. The underlying toxicological basis for the MEGs is addressed in the RD 230. It is noted that toxicological information about potential health effects varies among different chemicals; thus, 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.

6. HAZARD IDENTIFICATION.

a. Sample Information. Six valid samples and three associated field blanks were submitted for analysis.

b. Laboratory Analysis. The six valid samples and three field blanks were analyzed by the USACHPPM–Headquarters laboratory for VOCs. Concentrations of VOCs detected above the laboratory reporting limit were compared to MEGs presented in TG 230. Appendix A provides a summary of the samples assessed in this report. Appendix B contains a summary of the sample results. Appendix C presents detailed laboratory results.

c. Assessment.

(1) Benzene. Benzene was detected at concentrations well above the 1-year MEG of 39 micrograms per cubic meter (µg/m^3) in the two samples collected downwind of the burn pit. Therefore, benzene is identified as a potential health threat requiring further assessment. Benzene is typically found in the air from emissions of burning coal and oil, gasoline service stations and motor vehicle exhaust. It is not uncommon to detect benzene in the ambient air at burn pits. Benzene was not detected at concentrations greater than the 1-year MEG in the samples collected at South Camp and Belleau Wood.

(2) Other Parameters. None of the other parameters detected in the samples were present at concentrations greater than their respective MEGs. Therefore, no potential health threats were identified and the risk estimate for exposure to those VOCs in the ambient air is considered **low**.

7. HAZARD ASSESSMENT.

a. Hazard Severity. The hazard severity for the potential health threat of concern was determined by comparison of detected concentrations to the MEGs published in TG 230 and using TG 230, Table 3–1. Benzene can cause acute effects as well as chronic effects under appropriate exposure conditions. Chronic (long-term) inhalation exposure has caused various disorders in the blood, including reduced numbers of red blood cells and aplastic anemia, in occupational settings. Reproductive effects have been reported for women exposed by inhalation to high levels, and adverse effects on the developing fetus have been observed in animal tests. Increased incidences of leukemia (cancer of the tissues that form white blood cells) have been observed in humans occupationally exposed to benzene. The U.S. Environmental Protection Agency has classified benzene as a Group A human carcinogen. However, such effects occur when exposures are continuous for long periods. Since the average benzene concentration for all of the samples (38 µg/m^3) was below the 1-year MEG (39 µg/m^3) no chronic effects are expected. Brief or short-term inhalation exposure to benzene may cause acute effects such as drowsiness, dizziness, headaches, as well as eye, skin, and respiratory tract irritation. At high concentrations unconsciousness can occur. Since the peak benzene concentrations of benzene from the burn pit samples (115 and 94 µg/m^3) were below the short term MEGs (14-day MEG =160 µg/m^3 and 8-hour MEG=1600 µg/m^3), no (acute) health effects are expected during the mission. Therefore, acute and chronic hazard severity levels are both considered **negligible**.

b. Hazard Probability. The hazard probability was based on an approximation of the percentage of personnel that would be exposed to an identified hazard above the MEG (in terms of concentration and as well as exposure assumptions) and using TG 230, Table 3–2. Though some personnel may be exposed to smoke plumes when wind patterns may change, the vast majority of personnel are not exposed to the smoke plumes or benzene on a daily basis. Due to wind direction variation, the probability that personnel through out Camp Fallujah, Iraq would be

exposed to concentrations of benzene above the 1-year MEG is considered **occasional**. For the samples collected downwind of the burn pit, since the area was said to be non-populated, the probability that personnel will be exposed to the smoke plumes on a daily basis in that area is considered **unlikely**.

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 the identified hazard. Table 1 summarizes the risk estimate for the identified hazard. The risk estimate for exposure to VOCs in the ambient air at Camp Fallujah, Iraq is considered **low**. According to TG 230, Table 3–5, confidence in the risk estimate is considered **low** because only one burn pit sampling event has occurred, the source of benzene is not known, and it is unknown if these results are consistently representative of the burn pit or entire camp. 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.

Table 1. Risk Estimate Summary for Exposure to VOCs in the Ambient Air, Camp Fallujah, Iraq, 12-14 December 2007

Parameter	Exposure	Hazard Severity	Hazard Probability	Hazard-Specific Risk Estimate	Operational Risk Estimate	Confidence
Benzene	Acute	NEGLIGIBLE	UNLIKELY	LOW	LOW	LOW
Benzene	Chronic	NEGLIGIBLE	OCCASIONAL	LOW		
Other VOCs	None detected at concentrations greater than a MEG			LOW		

8. CONCLUSION. The OEH risk estimate for exposure to VOCs in the ambient air at Camp Fallujah, Iraq is **low**. While peak concentrations of benzene were above the long-term screening value (1 year MEG), overall concentrations due not represent levels at which chronic or acute effects would be expected. Therefore exposure to the benzene or other VOCs in the ambient air at Camp Fallujah, Iraq is expected to have little or no impact on unit readiness. However, the confidence in the risk estimate is considered **low** because only one burn pit sampling event has occurred, the source of benzene is unknown, and/or it is unknown if these results are consistently representative of the burn pit or entire camp.

9. RECOMMENDATIONS AND NOTE.

a. Recommendations.

(1) Reduce exposure to the area downwind of the burn pit and to areas in close proximity to generators as much as possible to reduce the potential for adverse health effects.

(2) Resample the surrounding areas of the burn pit in multiple sites including locations downwind and upwind from the burn pit to better characterize the adjacent ambient air.

(3) 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 VOC concentrations in the ambient air to which personnel are typically exposed, and to increase confidence in risk estimates at this location.

(4) Minimize the amount of plastics disposed in the burn pit through recycling, use of reusable flatware in dining facilities, and other pollution reduction methods.

(5) Avoid having any personal downwind of the burn pit if or when petroleum products are used to aid the burning of trash in the burn pit.

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 location are collected, a new OEH risk assessment will be completed.

10. POINTS OF CONTACT. The USACHPPM points of contact for this assessment are Ms. (b) (6) and Mr. (b) (6). Ms. (b) (6) may be contacted at e-mail (b) (6), and Mr. (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)
Acting Program Manager
Deployment Environmental Surveillance

APPENDIX A

SAMPLING SUMMARY

Table A–1. Summary for Ambient Air Samples Collected from Camp Fallujah, Iraq, 12–14 December 2007

Field Identification Number	DESP Identification Number	Sample Location	Collection Date	Tube Identification Number	Sample Duration	Invalid Sample (Yes/No)
IRQ+FALLUJ_TO17_07346_P	IRQ_2769_TO17_07346_01	AL FALLUJAH	12-Dec-07	C4667	478	No
IRQ_FALLUJ_TO17_07346_C	IRQ_2769_TO17_07346_02	AL FALLUJAH	12-Dec-07	C4785	478	No
IRQ_FALLUJ_TO17_07347_C	IRQ_2769_TO17_07347_01	AL FALLUJAH	13-Dec-07	C4690	480	No
IRQ_FALLUJ_TO17_07347_P	IRQ_2769_TO17_07347_02	AL FALLUJAH	13-Dec-07	C4891	480	No
IRQ_FALLUJ_TO17_07348_C	IRQ_2769_TO17_07348_01	AL FALLUJAH	14-Dec-07	C4865	480	No
IRQ_FALLUJ_TO17_07348_P	IRQ_2769_TO17_07348_02	AL FALLUJAH	14-Dec-07	C4867	480	No

APPENDIX B

SAMPLE RESULTS SUMMARY

Table B–1. Results Summary for Ambient Air Samples Collected from Camp Fallujah, Iraq, 12–14 December 2007

						Military Exposure Guidelines					
		Detection Rate		Concentration (µg/m^3)					1-hour		
Parameter detected above laboratory limit	Units	# detected / # samples	# detected above MEG / # samples	Maximum	Average	1-year	14-days	8-hours	Minimal	Severe	Significant
Benzene	µg/m^3	6 / 6	2 / 6	114.77582	37.67233	39	160	1600	160000	3200000	480000
n-Butylbenzene	µg/m^3	2 / 6	0 / 6	3.67256	1.19859	96	No MEG	No MEG	130000	4000000	750000
sec-Butylbenzene	µg/m^3	1 / 6	0 / 6	0.68205	0.33497	25	No MEG	No MEG	No MEG	No MEG	No MEG
Chlorobenzene	µg/m^3	3 / 6	0 / 6	1.41656	0.72272	400	No MEG	No MEG	130000	4000000	2000000
Cyclohexane	µg/m^3	2 / 6	0 / 6	2.81722	0.7912	4100	No MEG	No MEG	3000000	4000000	4000000
Decane	µg/m^3	5 / 6	0 / 6	11.54235	3.73209	No MEG	No MEG	No MEG	7500	25000000	50000
Ethylbenzene	µg/m^3	4 / 6	0 / 6	41.97217	13.82606	3000	11000	440000	540000	8700000	3500000
Hexane	µg/m^3	6 / 6	0 / 6	8.39443	4.02064	4300	4300	180000	530000	3900000	880000
Isopropylbenzene	µg/m^3	2 / 6	0 / 6	20.46143	6.02858	2700	No MEG	No MEG	250000	4000000	250000
Methylene chloride	µg/m^3	1 / 6	0 / 6	3.54958	0.81111	2100	2100	175000	700000	14000000	2600000
n-Propylbenzene	µg/m^3	2 / 6	0 / 6	4.51201	1.42545	25	No MEG	No MEG	No MEG	No MEG	No MEG
Styrene	µg/m^3	4 / 6	0 / 6	78.69781	25.66023	2000	No MEG	No MEG	210000	4300000	1100000

Table B–1. Results Summary for Ambient Air Samples Collected from Camp Fallujah, Iraq, 12–14 December 2007

						Military Exposure Guidelines					
		Detection Rate		Concentration (µg/m^3)					1-hour		
Parameter detected above laboratory limit	Units	# detected / # samples	# detected above MEG / # samples	Maximum	Average	1-year	14-days	8-hours	Minimal	Severe	Significant
Toluene	µg/m^3	6 / 6	0 / 6	104.34166	35.29153	4600	11000	750000	750000	11000000	2000000
1,3,5-Trimethylbenzene	µg/m^3	2 / 6	0 / 6	2.4134	0.8496	3100	No MEG	No MEG	No MEG	No MEG	No MEG
1,2,4-Trimethylbenzene	µg/m^3	2 / 6	0 / 6	4.09229	1.25985	3100	No MEG	No MEG	No MEG	No MEG	No MEG
o-Xylene	µg/m^3	2 / 6	0 / 6	6.29582	2.27054	11000	11000	440000	650000	3900000	870000
4-Isopropyltoluene	µg/m^3	2 / 6	0 / 6	0.99684	0.4483	No MEG	No MEG	No MEG	No MEG	No MEG	No MEG
Methylcyclopentane	µg/m^3	5 / 6	0 / 6	1.14776	0.69502	No MEG	No MEG	No MEG	No MEG	No MEG	No MEG
m,p-Xylene	µg/m^3	4 / 6	0 / 6	7.34513	2.59725	No MEG	No MEG	No MEG	No MEG	No MEG	No MEG

Notes:
Highlighted parameters indicate those constituents detected above a MEG
µg/m^3 - microgram per cubic meter
No MEG - MEG not established

APPENDIX C

DETAILED SAMPLE RESULTS

Table C–1. Analytical Results for Ambient Air Samples Collected from Camp Fallujah, Iraq, 12–14 December 2007

		Field ID	IRQ+FALLUJ_TO17_07346_P	IRQ_FALLUJ_TO17_07346_C	IRQ_FALLUJ_TO17_07347_C
		DESP ID	IRQ_2769_TO17_07346_01	IRQ_2769_TO17_07346_02	IRQ_2769_TO17_07347_01
		Location	AL FALLUJAH	AL FALLUJAH	AL FALLUJAH
		Collection Date	12-Dec-07	12-Dec-07	13-Dec-07
		Collection Time	9:45	9:45	10:00
Parameter	Chemical Abstract Number	Units	Concentration	Concentration	Concentration
1,1,1,2-Tetrachloroethane	630206	µg/m^3	< 0.521708	< 0.524652	< 0.54609
1,1,1-Trichloroethane	71556	µg/m^3	< 0.521708	< 0.524652	< 0.54609
1,1,2,2-Tetrachloroethane	79345	µg/m^3	< 0.521708	< 0.524652	< 0.54609
1,1,2-Trichloroethane	79005	µg/m^3	< 0.521708	< 0.524652	< 0.54609
1,1-Dichloroethane	75343	µg/m^3	< 0.521708	< 0.524652	< 0.54609
1,1-Dichloroethene	75354	µg/m^3	< 0.521708	< 0.524652	< 0.54609
1,1-Dichloropropene	563586	µg/m^3	< 0.521708	< 0.524652	< 0.54609
1,2,3-Trichlorobenzene	87616	µg/m^3	< 1.304271	< 1.31163	< 1.365225
1,2,3-Trichloropropane	96184	µg/m^3	< 0.521708	< 0.524652	< 0.54609
1,2,4-Trichlorobenzene	120821	µg/m^3	< 0.521708	< 0.524652	< 0.54609
1,2,4-Trimethylbenzene	95636	µg/m^3	**2.399858**	**4.092286**	< 0.54609
1,2-Dibromo-3-chloropropane	96128	µg/m^3	< 0.521708	< 0.524652	< 0.54609

Table C–1. Analytical Results for Ambient Air Samples Collected from Camp Fallujah, Iraq, 12–14 December 2007 (continued)

			Field ID	IRQ+FALLUJ_TO17_07346_P	IRQ_FALLUJ_TO17_07346_C	IRQ_FALLUJ_TO17_07347_C
			DESP ID	IRQ_2769_TO17_07346_01	IRQ_2769_TO17_07346_02	IRQ_2769_TO17_07347_01
			Location	AL FALLUJAH	AL FALLUJAH	AL FALLUJAH
			Collection Date	12-Dec-07	12-Dec-07	13-Dec-07
			Collection Time	9:45	9:45	10:00
Parameter	Chemical Abstract Number	Units		Concentration	Concentration	Concentration
1,2-Dibromoethane	106934	µg/m^3		< 0.521708	< 0.524652	< 0.54609
1,2-Dichlorobenzene	95501	µg/m^3		< 0.521708	< 0.524652	< 0.54609
1,2-Dichloroethane	107062	µg/m^3		< 0.521708	< 0.524652	< 0.54609
1,2-Dichloropropane	78875	µg/m^3		< 0.521708	< 0.524652	< 0.54609
1,3,5-Trimethylbenzene	108678	µg/m^3		**1.617296**	**2.4134**	< 0.54609
1,3-Dichlorobenzene	541731	µg/m^3		< 0.521708	< 0.524652	< 0.54609
1,3-Dichloropropane	142289	µg/m^3		< 0.521708	< 0.524652	< 0.54609
1,4-Dichlorobenzene	106467	µg/m^3		< 0.521708	< 0.524652	< 0.54609
2,2-Dichloropropane	594207	µg/m^3		< 0.521708	< 0.524652	< 0.54609
2-Chlorotoluene	95498	µg/m^3		< 0.521708	< 0.524652	< 0.54609
4-Chlorotoluene	106434	µg/m^3		< 0.521708	< 0.524652	< 0.54609
4-Isopropyltoluene	99876	µg/m^3		**0.62605**	**0.996839**	< 0.54609
Benzene	71432	µg/m^3		**114.775822**	**94.437376**	**6.00699**
Bromobenzene	108861	µg/m^3		< 0.521708	< 0.524652	< 0.54609
Bromochloromethane	74975	µg/m^3		< 0.521708	< 0.524652	< 0.54609
Bromodichloromethane	75274	µg/m^3		< 0.521708	< 0.524652	< 0.54609
Bromoform	75252	µg/m^3		< 0.521708	< 0.524652	< 0.54609
Carbon tetrachloride	56235	µg/m^3		< 0.521708	< 0.524652	< 0.54609
Chlorobenzene	108907	µg/m^3		**1.2521**	**1.416561**	**0.873744**
Chloroform	67663	µg/m^3		< 0.521708	< 0.524652	< 0.54609

Table C–1. Analytical Results for Ambient Air Samples Collected from Camp Fallujah, Iraq, 12–14 December 2007 (continued)

			Field ID	IRQ+FALLUJ_TO17_07346_P	IRQ_FALLUJ_TO17_07346_C	IRQ_FALLUJ_TO17_07347_C
			DESP ID	IRQ_2769_TO17_07346_01	IRQ_2769_TO17_07346_02	IRQ_2769_TO17_07347_01
			Location	AL FALLUJAH	AL FALLUJAH	AL FALLUJAH
			Collection Date	12-Dec-07	12-Dec-07	13-Dec-07
			Collection Time	9:45	9:45	10:00
Parameter	Chemical Abstract Number	Units		Concentration	Concentration	Concentration
Cyclohexane	110827	µg/m^3		**2.817225**	< 0.524652	**0.873744**
Cyclopentane	287923	µg/m^3		< 0.521708	< 0.524652	< 0.54609
Decane	124185	µg/m^3		**7.825624**	**11.542346**	**0.600699**
Dibromochloromethane	124481	µg/m^3		< 0.521708	< 0.524652	< 0.54609
Dibromomethane	74953	µg/m^3		< 0.521708	< 0.524652	< 0.54609
Ethylbenzene	100414	µg/m^3		**39.128121**	**41.972167**	< 0.54609
Hexachlorobutadiene	87683	µg/m^3		< 0.521708	< 0.524652	< 0.54609
Hexane	110543	µg/m^3		**4.956229**	**8.394433**	**1.965924**
Isooctane	540841	µg/m^3		< 0.521708	< 0.524652	< 0.54609
Isopropylbenzene	98828	µg/m^3		**13.042707**	**20.461432**	< 1.365225
Methylcyclopentane	96377	µg/m^3		**1.147758**	**0.944374**	**0.600699**
Methylene chloride	75092	µg/m^3		< 0.521708	< 0.524652	**3.549585**
Styrene	100425	µg/m^3		**73.039159**	**78.697814**	< 0.54609
Tetrachloroethene {PCE}	127184	µg/m^3		< 0.521708	< 0.524652	< 0.54609
Toluene	108883	µg/m^3		**104.341656**	**99.683897**	**2.020533**
Trichloroethene {TCE}	79016	µg/m^3		< 0.521708	< 0.524652	< 0.54609
cis-1,2-Dichloroethene	156592	µg/m^3		< 0.521708	< 0.524652	< 0.54609
cis-1,3-Dichloropropene	10061015	µg/m^3		< 0.521708	< 0.524652	< 0.54609
m,p-Xylene	E966689	µg/m^3		**6.260499**	**7.345129**	**0.709917**

Table C–1. Analytical Results for Ambient Air Samples Collected from Camp Fallujah, Iraq, 12–14 December 2007 (continued)

		Field ID	IRQ+FALLUJ_TO17_07346_P	IRQ_FALLUJ_TO17_07346_C	IRQ_FALLUJ_TO17_07347_C
		DESP ID	IRQ_2769_TO17_07346_01	IRQ_2769_TO17_07346_02	IRQ_2769_TO17_07347_01
		Location	AL FALLUJAH	AL FALLUJAH	AL FALLUJAH
		Collection Date	12-Dec-07	12-Dec-07	13-Dec-07
		Collection Time	9:45	9:45	10:00
Parameter	Chemical Abstract Number	Units	Concentration	Concentration	Concentration
n-Butylbenzene	104518	µg/m^3	**2.452029**	**3.672565**	< 0.54609
n-Propylbenzene	103651	µg/m^3	**2.973737**	**4.512008**	< 0.54609
o-Xylene	95476	µg/m^3	**6.260499**	**6.295825**	< 0.54609
sec-Butylbenzene	135988	µg/m^3	< 0.521708	**0.682048**	< 0.54609
tert-Butylbenzene	98066	µg/m^3	< 0.521708	< 0.524652	< 0.54609
trans-1,2-Dichloroethene	156605	µg/m^3	< 0.521708	< 0.524652	< 0.54609
trans-1,3-Dichloropropene	10061026	µg/m^3	< 0.521708	< 0.524652	< 0.54609

Note: Where parameters are not detected in a sample during analyses, half of the laboratory reportable limit is used in the average.

Table C–1. Analytical Results for Ambient Air Samples Collected from Camp Fallujah, Iraq, 12–14 December 2007 (continued)

		Field ID	IRQ_FALLUJ_TO17_07347_P	IRQ_FALLUJ_TO17_07348_C	IRQ_FALLUJ_TO17_07348_P
		DESP ID	IRQ_2769_TO17_07347_02	IRQ_2769_TO17_07348_01	IRQ_2769_TO17_07348_02
		Location	AL FALLUJAH	AL FALLUJAH	AL FALLUJAH
		Collection Date	13-Dec-07	14-Dec-07	14-Dec-07
		Collection Time	10:00	10:10	10:10
Parameter	Chemical Abstract Number	Units	Concentration	Concentration	Concentration
1,1,1,2-Tetrachloroethane	630206	µg/m^3	< 0.536251	< 0.526759	< 0.524769
1,1,1-Trichloroethane	71556	µg/m^3	< 0.536251	< 0.526759	< 0.524769
1,1,2,2-Tetrachloroethane	79345	µg/m^3	< 0.536251	< 0.526759	< 0.524769
1,1,2-Trichloroethane	79005	µg/m^3	< 0.536251	< 0.526759	< 0.524769
1,1-Dichloroethane	75343	µg/m^3	< 0.536251	< 0.526759	< 0.524769
1,1-Dichloroethene	75354	µg/m^3	< 0.536251	< 0.526759	< 0.524769
1,1-Dichloropropene	563586	µg/m^3	< 0.536251	< 0.526759	< 0.524769
1,2,3-Trichlorobenzene	87616	µg/m^3	< 1.340626	< 1.316898	< 1.311923
1,2,3-Trichloropropane	96184	µg/m^3	< 0.536251	< 0.526759	< 0.524769
1,2,4-Trichlorobenzene	120821	µg/m^3	< 0.536251	< 0.526759	< 0.524769
1,2,4-Trimethylbenzene	95636	µg/m^3	< 0.536251	< 0.526759	< 0.524769
1,2-Dibromo-3-chloropropane	96128	µg/m^3	< 0.536251	< 0.526759	< 0.524769
1,2-Dibromoethane	106934	µg/m^3	< 0.536251	< 0.526759	< 0.524769
1,2-Dichlorobenzene	95501	µg/m^3	< 0.536251	< 0.526759	< 0.524769
1,2-Dichloroethane	107062	µg/m^3	< 0.536251	< 0.526759	< 0.524769
1,2-Dichloropropane	78875	µg/m^3	< 0.536251	< 0.526759	< 0.524769
1,3,5-Trimethylbenzene	108678	µg/m^3	< 0.536251	< 0.526759	< 0.524769

Table C–1. Analytical Results for Ambient Air Samples Collected from Camp Fallujah, Iraq, 12–14 December 2007 (continued)

		Field ID	IRQ+FALLUJ_TO17_07346_P	IRQ_FALLUJ_TO17_07346_C	IRQ_FALLUJ_TO17_07347_C
		DESP ID	IRQ_2769_TO17_07346_01	IRQ_2769_TO17_07346_02	IRQ_2769_TO17_07347_01
		Location	AL FALLUJAH	AL FALLUJAH	AL FALLUJAH
		Collection Date	12-Dec-07	12-Dec-07	13-Dec-07
		Collection Time	9:45	9:45	10:00
Parameter	Chemical Abstract Number	Units	Concentration	Concentration	Concentration
1,3-Dichlorobenzene	541731	µg/m^3	< 0.536251	< 0.526759	< 0.524769
1,3-Dichloropropane	142289	µg/m^3	< 0.536251	< 0.526759	< 0.524769
1,4-Dichlorobenzene	106467	µg/m^3	< 0.536251	< 0.526759	< 0.524769
2,2-Dichloropropane	594207	µg/m^3	< 0.536251	< 0.526759	< 0.524769
2-Chlorotoluene	95498	µg/m^3	< 0.536251	< 0.526759	< 0.524769
4-Chlorotoluene	106434	µg/m^3	< 0.536251	< 0.526759	< 0.524769
4-Isopropyltoluene	99876	µg/m^3	< 0.536251	< 0.526759	< 0.524769
Benzene	71432	µg/m^3	**1.984127**	**3.581964**	**5.247691**
Bromobenzene	108861	µg/m^3	< 0.536251	< 0.526759	< 0.524769
Bromochloromethane	74975	µg/m^3	< 0.536251	< 0.526759	< 0.524769
Bromodichloromethane	75274	µg/m^3	< 0.536251	< 0.526759	< 0.524769
Bromoform	75252	µg/m^3	< 0.536251	< 0.526759	< 0.524769
Carbon tetrachloride	56235	µg/m^3	< 0.536251	< 0.526759	< 0.524769
Chlorobenzene	108907	µg/m^3	< 0.536251	< 0.526759	< 0.524769
Chloroform	67663	µg/m^3	< 0.536251	< 0.526759	< 0.524769
Cyclohexane	110827	µg/m^3	< 0.536251	< 0.526759	< 0.524769
Cyclopentane	287923	µg/m^3	< 0.536251	< 0.526759	< 0.524769
Decane	124185	µg/m^3	< 0.536251	**1.106195**	**1.049538**
Dibromochloromethane	124481	µg/m^3	< 0.536251	< 0.526759	< 0.524769
Dibromomethane	74953	µg/m^3	< 0.536251	< 0.526759	< 0.524769

Table C–1. Analytical Results for Ambient Air Samples Collected from Camp Fallujah, Iraq, 12–14 December 2007 (continued)

		Field ID	IRQ+FALLUJ_TO17_07346_P	IRQ_FALLUJ_TO17_07346_C	IRQ_FALLUJ_TO17_07347_C
		DESP ID	IRQ_2769_TO17_07346_01	IRQ_2769_TO17_07346_02	IRQ_2769_TO17_07347_01
		Location	AL FALLUJAH	AL FALLUJAH	AL FALLUJAH
		Collection Date	12-Dec-07	12-Dec-07	13-Dec-07
		Collection Time	9:45	9:45	10:00
Parameter	Chemical Abstract Number	Units	Concentration	Concentration	Concentration
Ethylbenzene	100414	µg/m^3	< 0.536251	**0.790139**	**0.524769**
Hexachlorobutadiene	87683	µg/m^3	< 0.536251	< 0.526759	< 0.524769
Hexane	110543	µg/m^3	**1.394251**	**3.63464**	**3.778338**
Isooctane	540841	µg/m^3	< 0.536251	< 0.526759	< 0.524769
Isopropylbenzene	98828	µg/m^3	< 1.340626	< 1.316898	< 1.311923
Methylcyclopentane	96377	µg/m^3	< 0.536251	**0.579435**	**0.629723**
Methylene chloride	75092	µg/m^3	< 0.536251	< 0.526759	< 0.524769
Styrene	100425	µg/m^3	< 0.536251	**1.053519**	**0.629723**
Tetrachloroethene {PCE}	127184	µg/m^3	< 0.536251	< 0.526759	< 0.524769
Toluene	108883	µg/m^3	**1.233376**	**2.423093**	**2.046599**
Trichloroethene {TCE}	79016	µg/m^3	< 0.536251	< 0.526759	< 0.524769
cis-1,2-Dichloroethene	156592	µg/m^3	< 0.536251	< 0.526759	< 0.524769
cis-1,3-Dichloropropene	10061015	µg/m^3	< 0.536251	< 0.526759	< 0.524769
m,p-Xylene	E966689	µg/m^3	< 0.536251	**0.737463**	< 0.524769
n-Butylbenzene	104518	µg/m^3	< 0.536251	< 0.526759	< 0.524769
n-Propylbenzene	103651	µg/m^3	< 0.536251	< 0.526759	< 0.524769
o-Xylene	95476	µg/m^3	< 0.536251	< 0.526759	< 0.524769
sec-Butylbenzene	135988	µg/m^3	< 0.536251	< 0.526759	< 0.524769
tert-Butylbenzene	98066	µg/m^3	< 0.536251	< 0.526759	< 0.524769

Table C–1. Analytical Results for Ambient Air Samples Collected from Camp Fallujah, Iraq, 12–14 December 2007 (continued)

		Field ID	IRQ+FALLUJ_TO17_07346_P	IRQ_FALLUJ_TO17_07346_C	IRQ_FALLUJ_TO17_07347_C
		DESP ID	IRQ_2769_TO17_07346_01	IRQ_2769_TO17_07346_02	IRQ_2769_TO17_07347_01
		Location	AL FALLUJAH	AL FALLUJAH	AL FALLUJAH
		Collection Date	12-Dec-07	12-Dec-07	13-Dec-07
		Collection Time	9:45	9:45	10:00
Parameter	Chemical Abstract Number	Units	Concentration	Concentration	Concentration
trans-1,2-Dichloroethene	156605	µg/m^3	< 0.536251	< 0.526759	< 0.524769
trans-1,3-Dichloropropene	10061026	µg/m^3	< 0.536251	< 0.526759	< 0.524769