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

12 JUN 2007

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, Kirkuk Air Base, Iraq, 22–24 April 2008, U_IRQ_KIRKUK_CM_A17_20080424

1. The enclosed report details the occupational and environmental health (OEH) risk characterization for 11 valid volatile organic compound (VOC) ambient air samples collected by 506th Air Expeditionary Group/ Expeditionary Medical Squadron personnel from Kirkuk Air Base (AB), Iraq, 22–24 April 2008.

2. The OEH risk estimate for exposure to VOCs in the ambient air at Kirkuk AB, Iraq is **low**. While peak concentrations of benzene were above the 1-year military exposure guideline (MEG), they were not consistently above the MEG and they were less than the short-term MEGs. Exposure to the ambient air at Kirkuk AB, Iraq is expected to have little or no impact on unit readiness.

FOR THE COMMANDER:

(b) (6)

Encl

Director, Health Risk Management

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

DEPLOYMENT OCCUPATIONAL AND ENVIRONMENTAL
HEALTH RISK CHARACTERIZATION
AMBIENT AIR VOLATILE ORGANIC COMPOUND SAMPLES
KIRKUK AIR BASE, IRAQ
22–24 APRIL 2008
U_IRQ_KIRKUK_CM_A17_20080424

USCHPPM

Readiness Thru Health

DEPLOYMENT OCCUPATIONAL AND ENVIRONMENTAL
HEALTH RISK CHARACTERIZATION
AMBIENT AIR VOLATILE ORGANIC COMPOUND SAMPLES
KIRKUK AB, IRAQ
22–24 APRIL 2008
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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 11 valid volatile organic compounds (VOCs) air samples collected from Kirkuk Air Base (AB), Iraq, 22–24 April 2008. 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 Kirkuk AB, Iraq. Two co-located samples were collected from both the self-help laundry in the Air Force village (assumed all personnel exposed) and from the hazardous waste storage area (estimated less than 10 percent of personnel exposed) on three consecutive days. No significant weather conditions were reported, though it was indicated that burn pit smoke was blowing into the hazardous waste storage area on 23 April 2008. It is expected that personnel

will be exposed to the ambient air at these sample sites for a deployment duration of approximately 1 year. In addition, it is assumed that control measures and/or personal protective equipment are not used.

5. METHOD. 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 brief 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.

6. HAZARD IDENTIFICATION.

a. Sample Information. Twelve samples and six field blanks were submitted for analysis. One sample was invalid due to a sampler malfunction (22 April 2008–hazardous waste storage area sample).

b. Laboratory Analysis. The 11 valid samples and six 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 and a table showing concentrations of parameters that were detected above their MEGs by site and day. Appendix C presents detailed laboratory results.

c. Assessment.

(1) Benzene. Benzene was detected above its MEG (39 micrograms per cubic meter ($\mu g/m^3$)) at concentrations ranging from 50–84 $\mu g/m^3$ in three of the 11 samples. 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.

(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.

(1) General. The hazard severity is based on an approximation of the percentage of personnel anticipated to exhibit health effects when exposed to hazard concentrations at or above an exposure guideline. In addition, the hazard severity depends on the nature of the health effects and the magnitude of the estimated exposure concentration relative to the comparison guideline. The hazard severity is determined by comparing the estimated exposure concentration to MEGs published in TG 230 and by using TG 230, Table 3–1, as a guide.

(2) Benzene. 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 (19 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 from the self-help laundry facility (84 µg/m^3) and the hazardous waste storage area (50 and 61 µg/m^3) were below the short-term MEGs (14-day MEG equals 160 µg/m^3 and 8-hour MEG equals 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.

(1) General. The hazard probability is based on an approximation of the percentage of personnel that would be exposed to an identified hazard above a guideline (in terms of concentration, exposure duration and frequency, and intake rate). The hazard probability for

VOCs is determined by comparing the estimated exposure concentration to MEGs published in TG 230 and by using TG 230, Table 3–2, as a guide. For VOCs, the hazard probability reflects the likelihood that the exposures at a specific location are represented by the samples used to determine the hazard severity.

(2) Benzene. Benzene in the ambient air can be attributed to several causes including fumes from generators and burning waste. Exposure to benzene in the ambient air can vary depending on weather conditions (such as, rain, wind) and distance from the source. During the three consecutive sampling days, benzene was not detected at either sample site on the first day of sampling, but was detected at its peak concentration in one of the co-located samples at only one of the sample sites on the next day (making the sample result uncertain). It was also detected at consistent concentrations below the MEG at one sample site and relatively consistent concentrations above the MEG at the other sample site on the last day (see Table B–2). Based on this variation in detected concentrations and the percent of personnel estimated to be exposed at the two samples sites, the probability that personnel will be exposed to benzene above the MEG is considered **seldom**.

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 Kirkuk AB, Iraq is considered **low**. Using TG 230, Table 3–5 as a guide, confidence in the risk estimate is considered **low** because these are the first samples collected at this location since 2005 and the samples were collected on consecutive days and may not be representative of the entire AB. 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, Kirkuk AB, Iraq

Parameter	Hazard Severity	Hazard Probability	Hazard-Specific Risk Estimate	Operational Risk Estimate	Confidence
Benzene	NEGLIGIBLE	SELDOM	LOW	LOW	LOW
Other VOCs	None detected at concentrations exceeding their MEGs				

8. CONCLUSION. The OEH risk estimate for exposure to VOCs in the ambient air at Kirkuk AB, Iraq is **low**. While peak concentrations of benzene were above the 1-year MEG, they were not consistently above the MEG and they were less than the short-term MEGs. Exposure to the ambient air at Kirkuk AB, Iraq is expected to have little or no impact on unit readiness.

Confidence in the risk estimate is considered **low** because these are the first samples collected from this location since 2005 and the samples were collected on consecutive days and may not be representative of the entire AB.

9. RECOMMENDATION AND NOTE.

a. Recommendation. Attempt 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. Continue to sample each site with three sorbent tubes that represent two co-located samples and a field blank.

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 CPT (b) (6) and Mr. (b) (6). CPT (b) (6) may be contacted at e-mail (b) (6); 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)
MAJ, MS
Program Manager
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APPENDIX A

SAMPLING SUMMARY

Table A–1. Summary for Ambient Air Samples Collected, Kirkuk AB, Iraq, 22–24 April 2008

Sample ID	Field/Local Sample ID	Location	Start Date/Time	Exposure Notes	Sample Time	Sample Tube ID
000006ST	IRQ_KIRKUK_TO17_08112_01	KIRKUK AB	2008/04/22 1140		480.0 min	C5548,C5492
000006SX	IRQ_KIRKUK_TO17_08112_03	KIRKUK AB	2008/04/22 1130		480.0 min	C5458,C5549
000006T0	IRQ_KIRKUK_TO17_08112_04	KIRKUK AB	2008/04/22 1130		480.0 min	C5551,C5549
000006T2	IRQ_KIRKUK_TO17_08113_01	KIRKUK AB	2008/04/23 1418		480.0 min	C5080,C5247
000006T4	IRQ_KIRKUK_TO17_08113_02	KIRKUK AB	2008/04/23 1418		480.0 min	C5178,C5247
000006T5	IRQ_KIRKUK_TO17_08113_03	KIRKUK AB	2008/04/23 1406	SMOKE FROM BURN PIT IS BLOWING INTO HAZARDOUS WASTE STORAGE AREA	474.0 min	C5455,C5461
000006T8	IRQ_KIRKUK_TO17_08113_04	KIRKUK AB	2008/04/23 1400		480.0 min	C5478,C5461
000006T9	IRQ_KIRKUK_TO17_08114_01	KIRKUK AB	2008/04/24 1403		480.0 min	C5256,C5015
000006TC	IRQ_KIRKUK_TO17_08114_02	KIRKUK AB	2008/04/24 1403		480.0 min	C5246,C5015
000006TG	IRQ_KIRKUK_TO17_08114_03	KIRKUK AB	2008/04/24 1415		480.0 min	C5350,C5553
000006TJ	IRQ_KIRKUK_TO17_08114_04	KIRKUK AB	2008/04/24 1415		480.0 min	C5476,C5553

APPENDIX B

SAMPLE RESULTS SUMMARY

Table B–1. Results Summary for Ambient Air Samples Collected, Kirkuk AB, Iraq, 22–24 April 2008

Analyte	Units	Result		Samples (Valid)		CHPPM TG230 Military Exposure Guidelines 1yr	
		Max	Avg	#	# > RL	# >	Value
1,2,3-Trichlorobenzene	µg/m^3	2.5915	0.47784	11	1	0	15000[a]
1,2,4-Trichlorobenzene	µg/m^3	0.91463	0.3254	11	1	0	1400
1,2,4-Trimethylbenzene	µg/m^3	3.2622	1.6312	11	8	0	3100
1,2-Dibromo-3-chloropropane	µg/m^3	0.55894	0.29307	11	1	1[b]	0.14
1,3,5-Trimethylbenzene	µg/m^3	1.0874	0.56771	11	6	0	3100
1,4-Dichlorobenzene	µg/m^3	0.7414	0.31028	11	1	0	1700
Benzene	µg/m^3	84.025	18.524	11	5	3	39
Carbon tetrachloride	µg/m^3	0.73975	0.52341	11	8	0	320
Chlorobenzene	µg/m^3	1.1687	0.43021	11	2	0	400
Cyclohexane	µg/m^3	3.6487	1.1647	11	6	0	4100
Decane	µg/m^3	4.021	2.1814	11	8	0	7500
Ethylbenzene	µg/m^3	30.996	6.3726	11	8	0	3000
Hexane	µg/m^3	36.994	11.966	11	10	0	4300
Isooctane	µg/m^3	4.2975	1.0397	11	4	No MEG	
Isopropylbenzene	µg/m^3	9.9342	2.0015	11	2	0	2700
m,p-Xylene	µg/m^3	8.8968	3.5528	11	8	0	11000[a]
Methylcyclopentane	µg/m^3	5.7649	2.0019	11	8	No MEG	

Table B–1. Results Summary for Ambient Air Samples Collected, Kirkuk AB, Iraq, 22–24 April 2008 (continued)

Analyte	Units	Result		Samples (Valid)		CHPPM TG230 1yr	
		Max	Avg	#	# > RL	# >	Value
Methylene chloride	µg/m^3	23.725	2.3997	11	1	0	2100
n-Butylbenzene	µg/m^3	0.81301	0.36347	11	2	0	96
n-Propylbenzene	µg/m^3	1.1826	0.45698	11	3	0	25
o-Xylene	µg/m^3	2.7437	1.561	11	8	0	11000
Styrene	µg/m^3	35.569	6.4576	11	3	0	2000
Toluene	µg/m^3	52.887	13.707	11	7	0	4600

Notes:
Highlighted parameters indicate those constituents detected above a MEG
µg/m^3 - microgram per cubic meter
No MEG - MEG not established
[a] – 1-hour minimal air MEG used when 1-year, 14-day, and 8-hour air MEGs not available
[b] – Detected concentration is likely due to laboratory contamination and thus, is not assessed as a hazard

Table B–2. Sample Concentrations of Benzene by Sampling Date and Site at Kirkuk AB, Iraq, 22–24 April 2008

Sampling Date	Concentrations at Sampling Site (µg/m^3)			
	Self-Help Laundry		Hazardous Waste Storage Area	
22-Apr-2008	ND	ND	ND	INVALID
23-Apr-2008	ND	84	ND	ND
24-Apr-2008	2.6	2.6	50	61

Note:
ND - not detected

APPENDIX C

DETAILED SAMPLE RESULTS

Table C–1. Analytical Results for Ambient Air Samples Collected, Kirkuk AB, Iraq, 22–24 April 2008

Sample ID			000006ST	000006SX	000006T0	000006T2	000006T4	000006T5
Field/Local Sample ID			IRQ_KIRKUK_TO17_08112_01	IRQ_KIRKUK_TO17_08112_03	IRQ_KIRKUK_TO17_08112_04	IRQ_KIRKUK_TO17_08113_01	IRQ_KIRKUK_TO17_08113_02	IRQ_KIRKUK_TO17_08113_03
Country			Iraq	Iraq	Iraq	Iraq	Iraq	Iraq
Location			KIRKUK AB	KIRKUK AB	KIRKUK AB	KIRKUK AB	KIRKUK AB	KIRKUK AB
Start Date			2008/04/22 1140	2008/04/22 1130	2008/04/22 1130	2008/04/23 1418	2008/04/23 1418	2008/04/23 1406
Analyte	CAS	Units	Results					
1,1,1,2-Tetrachloroethane	630-20-6	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409
1,1,1-Trichloroethane	71-55-6	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409
1,1,2,2-Tetrachloroethane	79-34-5	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409
1,1,2-Trichloroethane	79-00-5	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409
1,1-Dichloroethane	75-34-3	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409
1,1-Dichloroethene	75-35-4	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409
1,1-Dichloropropene	563-58-6	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409
1,2,3-Trichlorobenzene	87-61-6	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409
1,2,3-Trichloropropane	96-18-4	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409
1,2,4-Trichlorobenzene	120-82-1	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409
1,2,4-Trimethylbenzene	95-63-6	µg/m^3	< 0.56132	< 0.60597	< 0.53694	1.1958	3.2622	1.4674
1,2-Dibromo-3-chloropropane	96-12-8	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409
1,2-Dibromoethane	106-93-4	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409

Table C–1. Analytical Results for Ambient Air Samples Collected, Kirkuk AB, Iraq, 22–24 April 2008 (continued)

Sample ID			000006ST	000006SX	000006T0	000006T2	000006T4	000006T5
Field/Local Sample ID			IRQ_KIRKUK_TO17_08112_01	IRQ_KIRKUK_TO17_08112_03	IRQ_KIRKUK_TO17_08112_04	IRQ_KIRKUK_TO17_08113_01	IRQ_KIRKUK_TO17_08113_02	IRQ_KIRKUK_TO17_08113_03
Country			Iraq	Iraq	Iraq	Iraq	Iraq	Iraq
Location			KIRKUK AB	KIRKUK AB	KIRKUK AB	KIRKUK AB	KIRKUK AB	KIRKUK AB
Start Date			2008/04/22 1140	2008/04/22 1130	2008/04/22 1130	2008/04/23 1418	2008/04/23 1418	2008/04/23 1406
Analyte	CAS	Units	Results					
1,2-Dichlorobenzene	95-50-1	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409
1,2-Dichloroethane	107-06-2	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409
1,2-Dichloropropane	78-87-5	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409
1,3,5-Trimethylbenzene	108-67-8	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	1.0874	< 0.52409
1,3-Dichlorobenzene	541-73-1	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409
1,3-Dichloropropane	142-28-9	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409
1,4-Dichlorobenzene	106-46-7	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	0.7414	< 0.52409
2,2-Dichloropropane	594-20-7	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409
2-Chlorotoluene	95-49-8	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409
4-Chlorotoluene	106-43-4	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409
4-Isopropyltoluene	99-87-6	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409
Benzene	71-43-2	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 1.2998	84.025	< 1.3102
Bromobenzene	108-86-1	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409
Bromochloromethane	74-97-5	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409
Bromodichloromethane	75-27-4	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409
Bromoform	75-25-2	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409
Carbon tetrachloride	56-23-5	µg/m^3	< 0.56132	< 0.60597	< 0.53694	0.57192	0.64255	0.52409
Chlorobenzene	108-90-7	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409
Chloroform	67-66-3	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409
cis-1,2-Dichloroethene	156-59-2	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409

Table C–1. Analytical Results for Ambient Air Samples Collected, Kirkuk AB, Iraq, 22–24 April 2008 (continued)

Sample ID			000006ST	000006SX	000006T0	000006T2	000006T4	000006T5
Field/Local Sample ID			IRQ_KIRKUK_TO17_08112_01	IRQ_KIRKUK_TO17_08112_03	IRQ_KIRKUK_TO17_08112_04	IRQ_KIRKUK_TO17_08113_01	IRQ_KIRKUK_TO17_08113_02	IRQ_KIRKUK_TO17_08113_03
Country			Iraq	Iraq	Iraq	Iraq	Iraq	Iraq
Location			KIRKUK AB	KIRKUK AB	KIRKUK AB	KIRKUK AB	KIRKUK AB	KIRKUK AB
Start Date			2008/04/22 1140	2008/04/22 1130	2008/04/22 1130	2008/04/23 1418	2008/04/23 1418	2008/04/23 1406
Analyte	CAS	Units	Results					
cis-1,3-Dichloropropene	10061-01-5	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409
Cyclohexane	110-82-7	µg/m^3	< 0.56132	< 0.60597	< 0.53694	0.93586	1.9276	3.4066
Cyclopentane	287-92-3	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 1.2998	< 1.2357	< 1.3102
Decane	124-18-5	µg/m^3	< 0.56132	< 0.60597	< 0.53694	1.1438	2.5702	3.1445
Dibromochloromethane	124-48-1	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409
Dibromomethane	74-95-3	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409
Ethylbenzene	100-41-4	µg/m^3	< 0.56132	< 0.60597	< 0.53694	0.98785	3.2127	1.0482
Hexachlorobutadiene	87-68-3	µg/m^3	< 1.4033	< 1.5149	< 1.3424	< 1.2998	< 1.2357	< 1.3102
Hexane	110-54-3	µg/m^3	< 0.56132	1.1513	1.6108	10.398	13.345	31.445
Isooctane	540-84-1	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	0.54369	4.2975
Isopropylbenzene	98-82-8	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409
m,p-Xylene		µg/m^3	< 0.56132	< 0.60597	< 0.53694	2.5996	8.8968	3.6686
Methylcyclopentane	96-37-7	µg/m^3	< 0.56132	< 0.60597	< 0.53694	1.7157	2.7679	5.7649
Methylene chloride	75-09-2	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	23.725	< 0.52409
n-Butylbenzene	104-51-8	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409
n-Propylbenzene	103-65-1	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	0.49427	< 0.52409
o-Xylene	95-47-6	µg/m^3	< 0.56132	< 0.60597	< 0.53694	1.0398	2.4713	1.6247
sec-Butylbenzene	135-98-8	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409
Styrene	100-42-5	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	0.64255	< 0.52409
tert-Butylbenzene	98-06-6	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409

Table C–1. Analytical Results for Ambient Air Samples Collected, Kirkuk AB, Iraq, 22–24 April 2008 (continued)

		Sample ID	000006ST	000006SX	000006T0	000006T2	000006T4	000006T5
		Field/Local Sample ID	IRQ_KIRKUK_TO17_08112_01	IRQ_KIRKUK_TO17_08112_03	IRQ_KIRKUK_TO17_08112_04	IRQ_KIRKUK_TO17_08113_01	IRQ_KIRKUK_TO17_08113_02	IRQ_KIRKUK_TO17_08113_03
		Country	Iraq	Iraq	Iraq	Iraq	Iraq	Iraq
		Location	KIRKUK AB	KIRKUK AB	KIRKUK AB	KIRKUK AB	KIRKUK AB	KIRKUK AB
		Start Date	2008/04/22 1140	2008/04/22 1130	2008/04/22 1130	2008/04/23 1418	2008/04/23 1418	2008/04/23 1406
Analyte	CAS	Units	Results					
Tetrachloroethene {PCE}	127-18-4	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409
Toluene	108-88-3	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	52.887	9.4335
trans-1,2-Dichloroethene	156-60-5	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409
trans-1,3-Dichloropropene	10061-02-6	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409
Trichloroethene {TCE}	79-01-6	µg/m^3	< 0.56132	< 0.60597	< 0.53694	< 0.51992	< 0.49427	< 0.52409

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 Kirkuk AB, Iraq, 22–24 April 2008 (continued)

Sample ID			000006T8	000006T9	000006TC	000006TG	000006TJ
Field/Local Sample ID			IRQ_KIRKUK_TO17_08113_04	IRQ_KIRKUK_TO17_08114_01	IRQ_KIRKUK_TO17_08114_02	IRQ_KIRKUK_TO17_08114_03	IRQ_KIRKUK_TO17_08114_04
Country			Iraq	Iraq	Iraq	Iraq	Iraq
Location			KIRKUK AB	KIRKUK AB	KIRKUK AB	KIRKUK AB	KIRKUK AB
Start Date			2008/04/23 1400	2008/04/24 1403	2008/04/24 1403	2008/04/24 1415	2008/04/24 1415
Analyte	CAS	Units	Results				
1,1,1,2-Tetrachloroethane	630-20-6	µg/m^3	< 0.50677	< 0.50813	< 0.47305	< 0.61646	< 0.49077
1,1,1-Trichloroethane	71-55-6	µg/m^3	< 0.50677	< 0.50813	< 0.47305	< 0.61646	< 0.49077
1,1,2,2-Tetrachloroethane	79-34-5	µg/m^3	< 0.50677	< 0.50813	< 0.47305	< 0.61646	< 0.49077
1,1,2-Trichloroethane	79-00-5	µg/m^3	< 0.50677	< 0.50813	< 0.47305	< 0.61646	< 0.49077
1,1-Dichloroethane	75-34-3	µg/m^3	< 0.50677	< 0.50813	< 0.47305	< 0.61646	< 0.49077
1,1-Dichloroethene	75-35-4	µg/m^3	< 0.50677	< 0.50813	< 0.47305	< 0.61646	< 0.49077
1,1-Dichloropropene	563-58-6	µg/m^3	< 0.50677	< 0.50813	< 0.47305	< 0.61646	< 0.49077
1,2,3-Trichlorobenzene	87-61-6	µg/m^3	< 0.50677	2.5915	< 0.47305	< 0.61646	< 0.49077
1,2,3-Trichloropropane	96-18-4	µg/m^3	< 0.50677	< 0.50813	< 0.47305	< 0.61646	< 0.49077
1,2,4-Trichlorobenzene	120-82-1	µg/m^3	< 0.50677	0.91463	< 0.47305	< 0.61646	< 0.49077
1,2,4-Trimethylbenzene	95-63-6	µg/m^3	1.8244	1.5752	1.9868	2.5891	3.19
1,2-Dibromo-3-chloropropane	96-12-8	µg/m^3	< 0.50677	0.55894	< 0.47305	< 0.61646	< 0.49077
1,2-Dibromoethane	106-93-4	µg/m^3	< 0.50677	< 0.50813	< 0.47305	< 0.61646	< 0.49077
1,2-Dichlorobenzene	95-50-1	µg/m^3	< 0.50677	< 0.50813	< 0.47305	< 0.61646	< 0.49077
1,2-Dichloroethane	107-06-2	µg/m^3	< 0.50677	< 0.50813	< 0.47305	< 0.61646	< 0.49077
1,2-Dichloropropane	78-87-5	µg/m^3	< 0.50677	< 0.50813	< 0.47305	< 0.61646	< 0.49077
1,3,5-Trimethylbenzene	108-67-8	µg/m^3	0.60812	0.81301	0.8988	0.67811	0.78524
1,3-Dichlorobenzene	541-73-1	µg/m^3	< 0.50677	< 0.50813	< 0.47305	< 0.61646	< 0.49077
1,3-Dichloropropane	142-28-9	µg/m^3	< 0.50677	< 0.50813	< 0.47305	< 0.61646	< 0.49077
1,4-Dichlorobenzene	106-46-7	µg/m^3	< 0.50677	< 0.50813	< 0.47305	< 0.61646	< 0.49077

Table C–1. Analytical Results for Ambient Air Samples Collected from Kirkuk AB, Iraq, 22–24 April 2008 (continued)

Sample ID			000006T8	000006T9	000006TC	000006TG	000006TJ
Field/Local Sample ID			IRQ_KIRKUK_TO17_08113_04	IRQ_KIRKUK_TO17_08114_01	IRQ_KIRKUK_TO17_08114_02	IRQ_KIRKUK_TO17_08114_03	IRQ_KIRKUK_TO17_08114_04
Country			Iraq	Iraq	Iraq	Iraq	Iraq
Location			KIRKUK AB	KIRKUK AB	KIRKUK AB	KIRKUK AB	KIRKUK AB
Start Date			2008/04/23 1400	2008/04/24 1403	2008/04/24 1403	2008/04/24 1415	2008/04/24 1415
Analyte	CAS	Units	Results				
2,2-Dichloropropane	594-20-7	µg/m^3	< 0.50677	< 0.50813	< 0.47305	< 0.61646	< 0.49077
2-Chlorotoluene	95-49-8	µg/m^3	< 0.50677	< 0.50813	< 0.47305	< 0.61646	< 0.49077
4-Chlorotoluene	106-43-4	µg/m^3	< 0.50677	< 0.50813	< 0.47305	< 0.61646	< 0.49077
4-Isopropyltoluene	99-87-6	µg/m^3	< 0.50677	< 0.50813	< 0.47305	< 0.61646	< 0.49077
Benzene	71-43-2	µg/m^3	< 1.2669	50.305	61.497	2.5891	2.552
Bromobenzene	108-86-1	µg/m^3	< 0.50677	< 0.50813	< 0.47305	< 0.61646	< 0.49077
Bromochloromethane	74-97-5	µg/m^3	< 0.50677	< 0.50813	< 0.47305	< 0.61646	< 0.49077
Bromodichloromethane	75-27-4	µg/m^3	< 0.50677	< 0.50813	< 0.47305	< 0.61646	< 0.49077
Bromoform	75-25-2	µg/m^3	< 0.50677	< 0.50813	< 0.47305	< 0.61646	< 0.49077
Carbon tetrachloride	56-23-5	µg/m^3	0.60812	0.66057	0.52036	0.73975	0.63801
Chlorobenzene	108-90-7	µg/m^3	< 0.50677	1.1687	1.1353	< 0.61646	< 0.49077
Chloroform	67-66-3	µg/m^3	< 0.50677	< 0.50813	< 0.47305	< 0.61646	< 0.49077
cis-1,2-Dichloroethene	156-59-2	µg/m^3	< 0.50677	< 0.50813	< 0.47305	< 0.61646	< 0.49077
cis-1,3-Dichloropropene	10061-01-5	µg/m^3	< 0.50677	< 0.50813	< 0.47305	< 0.61646	< 0.49077
Cyclohexane	110-82-7	µg/m^3	3.6487	< 0.50813	< 0.47305	0.86305	0.68708
Cyclopentane	287-92-3	µg/m^3	< 1.2669	< 1.2703	< 1.1826	< 1.5412	< 1.2269
Decane	124-18-5	µg/m^3	3.5474	3.811	4.021	2.1576	2.7483
Dibromochloromethane	124-48-1	µg/m^3	< 0.50677	< 0.50813	< 0.47305	< 0.61646	< 0.49077
Dibromomethane	74-95-3	µg/m^3	< 0.50677	< 0.50813	< 0.47305	< 0.61646	< 0.49077
Ethylbenzene	100-41-4	µg/m^3	1.1149	30.996	29.329	1.2329	1.3251

Table C–1. Analytical Results for Ambient Air Samples Collected from Kirkuk AB, Iraq, 22–24 April 2008 (continued)

Sample ID			000006T8	000006T9	000006TC	000006TG	000006TJ
Field/Local Sample ID			IRQ_KIRKUK_TO17_08113_04	IRQ_KIRKUK_TO17_08114_01	IRQ_KIRKUK_TO17_08114_02	IRQ_KIRKUK_TO17_08114_03	IRQ_KIRKUK_TO17_08114_04
Country			Iraq	Iraq	Iraq	Iraq	Iraq
Location			KIRKUK AB	KIRKUK AB	KIRKUK AB	KIRKUK AB	KIRKUK AB
Start Date			2008/04/23 1400	2008/04/24 1403	2008/04/24 1403	2008/04/24 1415	2008/04/24 1415
Analyte	CAS	Units	Results				
Hexachlorobutadiene	87-68-3	µg/m^3	< 1.2669	< 1.2703	< 1.1826	< 1.5412	< 1.2269
Hexane	110-54-3	µg/m^3	36.994	6.0976	8.0419	10.48	11.779
Isooctane	540-84-1	µg/m^3	4.1555	< 0.50813	0.52036	< 0.61646	< 0.49077
Isopropylbenzene	98-82-8	µg/m^3	< 0.50677	9.6545	9.9342	< 0.61646	< 0.49077
m,p-Xylene		µg/m^3	3.8515	4.8272	4.7305	4.7468	4.9077
Methylcyclopentane	96-37-7	µg/m^3	5.5745	0.71138	0.99342	1.9727	1.6686
Methylene chloride	75-09-2	µg/m^3	< 0.50677	< 0.50813	< 0.47305	< 0.61646	< 0.49077
n-Butylbenzene	104-51-8	µg/m^3	< 0.50677	0.81301	0.75689	< 0.61646	< 0.49077
n-Propylbenzene	103-65-1	µg/m^3	< 0.50677	1.1687	1.1826	< 0.61646	< 0.49077
o-Xylene	95-47-6	µg/m^3	1.7737	2.6931	2.7437	1.911	2.0612
sec-Butylbenzene	135-98-8	µg/m^3	< 0.50677	< 0.50813	< 0.47305	< 0.61646	< 0.49077
Styrene	100-42-5	µg/m^3	< 0.50677	35.569	32.641	< 0.61646	< 0.49077
tert-Butylbenzene	98-06-6	µg/m^3	< 0.50677	< 0.50813	< 0.47305	< 0.61646	< 0.49077
Tetrachloroethene {PCE}	127-18-4	µg/m^3	< 0.50677	< 0.50813	< 0.47305	< 0.61646	< 0.49077
Toluene	108-88-3	µg/m^3	10.135	35.061	25.545	9.2469	7.3616
trans-1,2-Dichloroethene	156-60-5	µg/m^3	< 0.50677	< 0.50813	< 0.47305	< 0.61646	< 0.49077
trans-1,3-Dichloropropene	10061-02-6	µg/m^3	< 0.50677	< 0.50813	< 0.47305	< 0.61646	< 0.49077
Trichloroethene {TCE}	79-01-6	µg/m^3	< 0.50677	< 0.50813	< 0.47305	< 0.61646	< 0.49077