Military Deployment
Periodic Occupational and Environmental Monitoring Summary (POEMS):
Camp Ar Ramadi and vicinity, Iraq, Calendar Years: 2003 – 2011

AUTHORITY: This periodic occupational and environmental monitoring summary (POEMS) has been developed in accordance with Department of Defense (DoD) Instructions 6490.03, 6055.05, and JCSM (MCM) 0028-07, *See REFERENCES.*

PURPOSE: This POEMS documents the DoD assessment of base camp level Occupational and Environmental Health Surveillance (OEHS) exposure data for Camp Ar Ramadi, Iraq and vicinity to include Camp Adalla, Camp Ali, Anbar Training Center, Camp Blue Diamond, Camp Corrigedor, Combat Outpost (COP) Eagle, Camp Hurricane Point, Camp Lewis, and Camp Tash. It presents the identified health risks and assessments along with associated medical implications. The findings were based on information collected from 23 July 2003 through the 2011 withdrawl of U.S. Forces to include deployment OEHS sampling and monitoring data (e.g. air, water, and soil), field investigation and health assessment reports, as well as country and area-specific information on endemic diseases. While this assessment may reflect similar exposures and health risks pertaining to historic or future conditions at this site, the underlying data were limited to the time period(s) and area(s) sampled and thus may not reflect fluctuations or unique occurrences. It also may not be fully representative of all the fluctuations during the timeframe. To the extent that the data allow, this summary describes the general ambient conditions at the site and characterizes the health risks at the *population–level*. While useful to inform providers and others of potential health effects and associated medical implications, it does not represent an individual exposure profile. Actual individual exposures and specific resulting health effects depend on many variables and should be addressed in individual medical records by providers as appropriate at the time of an evaluation of a unique exposure.

SITE DESCRIPTION:

Ar Ramadi is situated about 110 km west of Baghdad on the Euphrates River and forms the south-west point of the "Sunni Triangle". It is the capital and the largest city of the Anbar Province. Ar Ramadi is located in a fertile, irrigated, alluvial plain, and spans a distance of more than 60 km along the Euphrates River.

SUMMARY: Conditions that may pose a Moderate or greater health risk are summarized in Table 1. Table 2 provides population based risk estimates for identified OEH conditions at for Camp Ar Ramadi and vicinity. As indicated in the detailed sections that follow Table 2, controls established to reduce health risk were factored into this assessment. In some cases, e.g. ambient air, specific controls are noted, but not routinely available/feasible.

Table 1: Summary of Occupational and Environmental Conditions with MODERATE or Greater Health Risk

Short-term health risks & medical implications:

The following hazards may be associated with potential acute health effects in some personnel during deployment at Camp Ar Ramadi and vicinity to include Camp Adalla, Camp Ali, Anbar Training Center, Camp Blue Diamond, Camp Corrigedor, COP Eagle, Camp Hurricane Point, Camp Lewis, and Camp Tash:

Inhalable coarse particulate matter less than 10 micrometers in diameter (PM_{10}); inhalable fine particulate matter less than 2.5 micrometers in diameter ($PM_{2.5}$); food/waterborne diseases (e.g., bacterial diarrhea, hepatitis A, typhoid fever, brucellosis, diarrhea-cholera, diarrhea-protozoal, hepatitis E); other endemic diseases (malaria, cutaneous leishmaniasis, Crimean-Congo hemorrhagic fever, sandfly fever, typhus-miteborne, leptospirosis, schistosomiasis, Tuberculosis (TB), rabies, Q fever); and heat stress. For food/waterborne diseases (e.g., bacterial diarrhea, hepatitis A, typhoid fever, brucellosis, diarrhea-cholera, diarrhea-protozoal, hepatitis E), if ingesting local food and water, the health effects can temporarily incapacitate personnel (diarrhea) or result in prolonged illness (hepatitis A, typhoid fever, brucellosis, hepatitis E). Risks from food/waterborne diseases may have been reduced with preventive medicine controls and mitigation, which includes hepatitis A and typhoid fever vaccinations and only drinking from approved water sources in accordance with standing CENTCOM policy. For other vector-borne endemic diseases (malaria, cutaneous leishmaniasis, Crimean-Congo hemorrhagic fever, sandfly fever, typhus-miteborne), these diseases may constitute a significant risk due to exposure to biting vectors; risk reduced to Low by proper wear of the treated uniform, application of repellent to exposed skin and bed net, and appropriate chemoprophylaxis. For water contact diseases (leptospirosis, schistosomiasis) activities involving extensive contact with surface water increase risk. For respiratory diseases (TB), personnel in close-quarter conditions could have been at risk for person-to-person spread. Animal contact diseases (rabies, Q fever), pose year-round risk. For heat stress, risk can be greater for susceptible persons including those older than 45, of low fitness level, unacclimatized, or with underlying medical conditions. Risks from heat stress may have been reduced with preventive medicine controls, work-rest cycles, and mitigation.

Air quality: For PM_{10} and $PM_{2.5}$, exposures may result in mild to more serious short-term health effects (e.g., eye, nose or throat and lung irritation) in some personnel while at this site. For PM_{10} and $PM_{2.5}$, certain subgroups of the deployed forces (e.g., those with pre-existing asthma/cardio-pulmonary conditions) are at greatest risk of developing notable health effects. Likewise, for burn pits, exposures to high levels of PM_{10} and $PM_{2.5}$ in the smoke may also result in mild to more serious short-term health effects (e.g., eye, nose or throat and lung irritation) in some personnel and certain subgroups while at this site. Although most effects from exposure to particulate matter and burn pit smoke should have resolved post-deployment, providers should be prepared to consider the relationship between deployment exposures and current complaints. Some individuals may have sought treatment for acute respiratory irritation during their time at Camp Adalla, Camp Ali, Anbar Training Center, Camp Ar Ramadi, Camp Blue Diamond, Camp Corrigedor, COP Eagle, Camp Hurricane Point, Camp Lewis, and Camp Tash. Personnel who reported with symptoms or required treatment while at this site should have exposure/treatment noted in medical record (e.g., electronic medical record and/or on a Standard Form (SF) 600 (*Chronological Record of Medical Care*).

Long-term health risks & medical implications:

The following hazards may be associated with potential chronic health effects in some personnel during deployment at Camp Ar Ramadi and vicinity to include Camp Adalla, Camp Ali, Anbar Training Center, Camp Blue Diamond, Camp Corrigedor, COP Eagle, Camp Hurricane Point, Camp Lewis, and Camp Tash:

Air Quality: For inhalational exposure to high levels of dust and $PM_{2.5}$, such as during high winds or dust storms, and for exposure to burn pit smoke, it is considered possible that some otherwise healthy personnel who were exposed for a long-term period to dust and particulate matter could develop certain health conditions (e.g., reduced lung function, cardiopulmonary disease). Personnel with a history of asthma or cardiopulmonary disease could potentially be more likely to develop such chronic health conditions. While the PM exposures are documented and archived, at this time there are no specific recommended, post-deployment medical surveillance evaluations or treatments. Providers should still consider overall individual health status (e.g., any underlying conditions/susceptibilities) and any potential unique individual exposures (such as burn pits, occupational exposures, or specific personal dosimeter data) and individual behaviors when assessing individual concerns. Certain individuals may need to be followed/evaluated for specific occupational exposures/injuries (e.g., annual audiograms as part of the medical surveillance for those enrolled in the Hearing Conservation Program; and personnel covered by Respiratory Protection Program and/or Hazardous Waste/Emergency Responders Medical Surveillance).

Table 2. Population-Based Health Risk Estimates for Camp Ar Ramadi to include Camp Adalla, Camp Ali, Anbar Training Center, Camp Blue Diamond, Camp Corrigedor, COP Eagle, Camp Hurricane Point, Camp Lewis, and Camp Tash, Iraq [1, 2]

Source of Identified Health Risk[3]	Unmitigated Health Risk Estimate[4]	Control Measures Implemented	Residual Health Risk Estimate[4]
AIR			
PM_{10}	Short-term: Low to High, Daily levels vary, acute health effects (e.g., upper respiratory tract irritation) more pronounced during peak days. More serious effects were possible in susceptible persons (e.g., those with asthma/existing respiratory diseases).		Short-term: Low to High, Daily levels vary, acute health effects (e.g., upper respiratory tract irritation) more pronounced during peak days. More serious effects were possible in susceptible persons (e.g., those with asthma/existing respiratory diseases).
	Long-term: No health guidelines		Long-term: No health guidelines
$PM_{2.5}$	Short-term: Low to Moderate, A majority of the time mild acute (short term) health effects were anticipated; certain peak levels may produce mild eye, nose, or throat irritation in some personnel and pre-existing health conditions (e.g., asthma, or cardiopulmonary diseases) may be exacerbated.	Limiting strenuous physical activities when air quality is especially poor; and actions such as closing tent flaps, windows, and doors	Short-term: Low to Moderate, A majority of the time mild acute (short term) health effects were anticipated; certain peak levels may produce mild eye, nose, or throat irritation in some personnel and pre-existing health conditions (e.g., asthma, or cardiopulmonary diseases) may be exacerbated.
	Long-term: Moderate, A small percentage of persons may have been at increased risk for developing chronic conditions. Particularly those more susceptible to acute effects (e.g., those with asthma/existing respiratory diseases).		Long-term: Moderate, A small percentage of persons may have been at increased risk for developing chronic conditions. Particularly those more susceptible to acute effects (e.g., those with asthma/existing respiratory diseases).
Water			
Consumed Water	Short-term: Insufficient data were available to determine risk.	APHC (former VETCOM) Approved Bottled Water; Potable water only from approved water sources	Short-term: Insufficient data were available to determine risk.
	Long-term: Insufficient data were available to determine risk.		Long-term: Insufficient data were available to determine risk.
Water for Other Purposes	Short-term: Low, ROWPU-treated (non-drinking) water at Camp Blue Diamond from exposure to antimony in non-drinking water was Low.	Water treated in accordance with standards applicable to its intended use	Short-term: Low, ROWPU-treated (non-drinking) water at Camp Blue Diamond from exposure to antimony in non-drinking water was Low.
	Long-term: None identified based on available sample data.		Long-term: None identified based on available sample data.
Endemic Disease			
Food borne/ Waterborne (e.g.,diarrhea-bacteriological)	Short-term: Variable, Moderate to High, (bacterial diarrhea, Hepatitis A, Typhoid fever) to Moderate (Diarrhea-cholera, diarrhea-protozoal, Brucellosis and Hepatitis E). If ingesting local food/water, the health effects can temporarily incapacitate personnel (diarrhea) or result in prolonged illness (Hepatitis A, Typhoid fever, Brucellosis, Hepatitis E).	Preventive measures include Hepatitis A and Typhoid fever vaccination and consumption of food and water only from approved sources.	Short-term: Low to none

Source of Identified Health Risk[3]	Unmitigated Health Risk Estimate[4]	Control Measures Implemented	Residual Health Risk Estimate[4]
	Long-term: none identified		Long-term: No data available
Arthropod Vector Borne	Short-term: Variable Low to Moderate, (Malaria, leishmaniasis-cutaneous, Crimean-Congo hemorrhagic fever, sandfly fever and typhus-miteborne), Low (West Nile fever, and Plague).	Preventive measures include proper wear of the treated uniform and application of repellent to exposed skin and bed net, and appropriate chemoprophylaxis.	Short-term: Low
	Long-term: Low (Leishmaniasis-visceral infection)		Long-term: No data available
Water-Contact (e.g. wading, swimming)	Short-term: Moderate for leptospirosis and schistosomiasis.		Short-term: Moderate for leptospirosis and schistosomiasis.
	Long-term: No data available		Long-term: No data available
Respiratory	Short-term: Low to Moderate; Moderate for tuberculosis (TB) to Low for meningococcal meningitis.	TB is evaluated as part of the PDHA (Post Deployment Health Assessment). A TB skin test is required post-deployment if potentially exposed.	Short-term: Low
	Long-term: No data available		Long-term: No data available
Animal Contact	Short-term: Low to Moderate; Moderate (Rabies and Q-fever), Low (Anthrax and H5N1 avian influenza)	General Order 1B mitigates rabies risk by prohibiting contact with, adoption, or feeding of feral animals. Risks are further reduced in the event of assessed contact by prompt post-exposure rabies prophylaxis IAW the CDC's ACIP guidelines.	Short-term: No data available
	Long-term: Low (Rabies)		Long-term: No data available
VENOMOUS ANIMAL/ INSECTS			
Snakes, scorpions, and spiders	Short-term: Low; If encountered, effects of venom vary with species from mild localized swelling (e.g. *S. maurus*) to potentially lethal effects (e.g. *V. albicornuta*).	Risk reduced with proper and timely treatment.	Short-term: Low; If encountered, effects of venom vary with species from mild localized swelling (e.g. *S. maurus*) to potentially lethal effects (e.g. *V. albicornuta*).
	Long-term: No data available		Long-term: No data available
HEAT/COLD STRESS			
Heat	Short-term: Low to High; Risk of heat injury in unacclimatized personnel was High for May – September.	Risks from heat stress may have been reduced with preventive medicine controls, work-rest cycles, and mitigation.	Short-term: Low to High; Risk of heat injury in unacclimatized personnel was High for May – September.
	Long-term: Low; However, the risk may be greater to certain susceptible persons–those older (i.e., greater than 45 years), in lesser physical shape, or with underlying medical/health conditions.		Long-term: Low; However, the risk may be greater to certain susceptible persons–those older (i.e., greater than 45 years), in lesser physical shape, or with underlying medical/health conditions.
Cold	Long-term: Low risk of cold stress/injury.	Risks from cold stress may have been reduced with protective measures such as use of the buddy system in cold weather, and	Long-term: Low risk of cold stress/injury.
	Long-term: Low; Long-term health implications from cold injuries were rare but can occur, especially from more serious injuries such as frost		Long-term: Low; Long-term health implications from cold injuries were rare but can occur, especially from more serious injuries such as frost

Source of Identified Health Risk[3]	Unmitigated Health Risk Estimate[4]	Control Measures Implemented	Residual Health Risk Estimate[4]
	bite.	proper wear of protective clothing.	bite.
Unique Incidents/ Concerns			
Pesticides/ Pest Control	Short-term: Low health risk from pesticide exposure.	See Section 10.4	Short-term: Low health risk from pesticide exposure.
	Long-term: Low health risk from pesticide exposure.	See Section 10.4	Long-term: Low health risk from pesticide exposure.
Burn Pit PM_{10}	Short-term: Hazard severity negligible to critical. However, the limited available data were insufficient to characterize potential health risks. Acute health effects (e.g., upper respiratory tract irritation) more pronounced during peak days. More serious effects were possible in susceptible persons (e.g., those with asthma/existing respiratory diseases).	Control measures may have included locating burn pits downwind of prevailing winds, increased distance from living and working areas when possible, and improved waste segregation and management techniques	Short-term: Hazard severity negligible to critical. However, the limited available data were insufficient to characterize potential health risks. Acute health effects (e.g., upper respiratory tract irritation) more pronounced during peak days. More serious effects were possible in susceptible persons (e.g., those with asthma/existing respiratory diseases).
	Long-term: No health guidelines		Long-term: No health guidelines
Burn Pit $PM_{2.5}$	Short-term: Hazard severity marginal. However, the limited available data were insufficient to characterize potential health risks. A majority of the time mild acute (short term) health effects were anticipated; certain peak levels may produce mild eye, nose, or throat irritation in some personnel and pre-existing health conditions (e.g., asthma, or cardiopulmonary diseases) may be exacerbated.		Short-term: Hazard severity marginal. However, the limited available data were insufficient to characterize potential health risks. A majority of the time mild acute (short term) health effects were anticipated; certain peak levels may produce mild eye, nose, or throat irritation in some personnel and pre-existing health conditions (e.g., asthma, or cardiopulmonary diseases) may be exacerbated.
	Long-term: Hazard severity marginal. However, the limited available data were insufficient to characterize potential health risks. A small percentage of persons may have been at increased risk for developing chronic conditions. Particularly those more susceptible to acute effects (e.g., those with asthma/existing respiratory diseases).		Long-term: Hazard severity marginal. However, the limited available data were insufficient to characterize potential health risks. A small percentage of persons may have been at increased risk for developing chronic conditions. Particularly those more susceptible to acute effects (e.g., those with asthma/existing respiratory diseases).

[1] This Summary Table provides a qualitative estimate of population-based short- and long-term health risks associated with the general ambient and occupational environment conditions at Camp Ar Ramadi and vicinity to include Camp Adalla, Camp Ali, Anbar Training Center, Camp Blue Diamond, Camp Corrigedor, COP Eagle, Camp Hurricane Point, Camp Lewis, and Camp Tash, Iraq. It does not represent a unique individual exposure profile. Actual individual exposures and health effects depend on many variables. For example, while a chemical may be present in the environment, if a person does not inhale, ingest, or contact a specific dose of the chemical for adequate duration and frequency, then there may be no health risk. Alternatively, a person at a specific location may experience a unique exposure which could result in a significant individual exposure. Any such person seeking medical care should have their specific exposure documented in an SF600.

[2] This assessment was based on specific data and reports obtained from the 23 July 2003 through 18 December 2010 timeframe. It was considered a current representation of general site conditions but may not reflect certain fluctuations or unique exposure incidents. Acute health risk estimates are generally consistent with field-observed health effects.

[3] This Summary Table was organized by major categories of identified sources of health risk. It only lists those sub-categories specifically identified and addressed at Camp Adalla, Camp Ali, Anbar Training Center, Camp Ar Ramadi, Camp Blue Diamond, Camp Corrigedor, Combat COP Eagle, Camp Hurricane Point, Camp Lewis, and Camp Tash, Iraq. The health risks are presented as Low, Moderate, High or Extremely High for both acute and chronic health effects. The health risk level was based on an assessment of both the potential severity of the health effects that could have been caused and probability of the exposure that could produce such health effects. Details can be obtained from the APHC/AIPH. Where applicable, "None Identified" was used when though an exposure was identified, no health risk of either a specific acute or chronic health effects were determined. More detailed descriptions of OEH exposures that were evaluated but

Source of Identified Health Risk[3]	Unmitigated Health Risk Estimate[4]	Control Measures Implemented	Residual Health Risk Estimate[4]
determined to pose no health risk are discussed in the following sections of this report.			
[4] Health risks in this Summary Table were based on quantitative surveillance thresholds (e.g. endemic disease rates; host/vector/pathogen surveillance) or screening levels, e.g. Military Exposure Guidelines (MEGs) for chemicals. Some previous assessment reports may provide slightly inconsistent health risk estimates because quantitative criteria such as MEGs may have changed since the samples were originally evaluated and/or because this assessment makes use of all historic site data while previous reports may have only been based on a select few samples.			

1 Discussion of Health Risks at Camp Ar Ramadi and Vicinity, Iraq by Source

The following sections describe the major source categories of potential health risk that were evaluated at Camp Ar Ramadi, Iraq and vicinity to include Camp Adalla, Camp Ali, Anbar Training Center, Camp Blue Diamond, Camp Corrigedor, Combat Outpost (COP) Eagle, Camp Hurricane Point, Camp Lewis, and Camp Tash. For each category, the evaluation process includes identifying what, if any, specific sub-categories/health concerns are present. This initial step results in "screening out" certain sub-categories that pose no identifiable health risk (for example if all data was below screening levels). While these sections may include sub-categories that have been determined to present no identifiable health risk, the summary table on the previous page only contains those sub-categories that were determined to pose identified potential health risks.

2 Air

2.1 Site-Specific Sources Identified

Camp Ar Ramadi, Iraq and vicinity were situated in a dusty semi-arid desert environment. Inhalational exposure to high levels of dust and particulate matter, such as during high winds or dust storms, may have resulted result in mild to more serious short-term health effects (e.g., eye, nose or throat and lung irritation) in some personnel. Additionally, certain subgroups of the deployed forces (e.g., those with pre-existing asthma/cardio pulmonary conditions) were at greatest risk of developing notable health effects. Additional exposures from the DoD use of open burn pits to dispose of waste/refuse such as paper, plastic, and wood may have also occurred. The risk assessment for air samples taken near the burn pits are presented in section 10.5. All other samples obtained were used to represent the overall ambient air conditions of the site, and are presented below.

2.2 *Particulate matter, less than10 micrometers* (PM_{10})

2.2.1 Sample data/Notes:

Exposure Guidelines:
Short-term (24-hour) PM_{10} (µg/m^3): Negligible MEG=250, Marginal MEG=420, Critical MEG=600.
Long-term PM_{10} MEG (µg/m^3): Not Available.

Camp Ar Ramadi: A total of 16 PM_{10} air samples were collected from 10 April 2005 to 7 May 2009 (No data available for 2008). The range of 24-hour PM_{10} concentrations was 56 µg/m^3 – 793 µg/m^3 with an average concentration of 334 µg/m^3.

Camp Blue Diamond: A total of 5 PM_{10} air samples were collected from 11 to 19 May 2004. The range of 24-hour PM_{10} concentrations was 126 µg/m^3 – 515 µg/m^3 with an average concentration of 289 µg/m^3. Data were insufficient to characterize potential health risks associated with PM_{10} exposure.

Camp Hurricane Point: A total of 5 PM_{10} air samples were collected from 20 June to 11 July 2004. The range of 24-hour PM_{10} concentrations was 102 µg/m^3 – 240 µg/m^3 with an average concentration of 164 µg/m^3. Data were insufficient to characterize potential health risks associated with PM_{10} exposure.

2.2.2 Short-term health risks:

Low to High: The short-term risk assessment was Low for typical PM_{10} concentrations, and High for the peak PM_{10} concentration at Camp Ar Ramadi. A Low health risk suggests that expected losses have little or no impact on accomplishing the mission, with little to no in-theater medical resources anticipated for protection and treatment. A High health risk suggests that significant degradation of

mission capabilities in terms of the required mission standard, inability to accomplish all parts of the mission, or inability to complete the mission to standard if hazards occurred during the mission. Daily average health risk levels for PM_{10} show no hazard for 44%, low health risk for 19%, moderate health risk for 25%, and a High health risk 12% of the time. Confidence in the short-term PM_{10} health risk assessment was low (Reference 10, Table 3-6).

The short-term typical hazard severity was negligible. During typical exposures at the negligible hazard severity level (250 ug/m^3 - 420 ug/m^3), a few personnel may have experienced notable eye, nose, and throat irritation; most personnel may have experienced only mild effects. Pre-existing health conditions (e.g., asthma, or cardiopulmonary diseases) may have been exacerbated. For the highest observed PM_{10} concentration, the short-term hazard severity was marginal. During peak exposures at the marginal hazard severity level (420 ug/m^3 - 600 ug/m^3), a majority of personnel may have experienced notable eye, nose, and throat irritation and some respiratory effects. Some lost duty days were expected. Significant aerobic activity may have increased risk. Those with a history of asthma or cardiopulmonary disease were expected to have experienced increased symptoms. Confidence in short-term PM_{10} risk assessment was low (Reference 10, Table 3-6).

2.2.3 Long-term health risk:

Not Evaluated-no available health guidelines. The U. S. Environmental Protection Agency (EPA) has retracted its long-term standard (national ambient air quality standards, NAAQS) for PM_{10} due to an inability to clearly link chronic health effects with chronic PM_{10} exposure levels.

2.3 Particulate Matter, less than 2.5 *micrometers* ($PM_{2.5}$)

2.3.1 Sample data/Notes:

Exposure Guidelines:
Short-term (24-hour) $PM_{2.5}$ MEGs (µg/m^3): Negligible MEG=65, Marginal MEG=250, Critical MEG=500.
Long-term $PM_{2.5}$ MEGs: Negligible MEG=15, Marginal MEG=65.

Camp Ar Ramadi: a total of 14 $PM_{2.5}$ air samples were collected from 10 April 2005 to 12 June 2010 (No data available from 2006-2008). The range of 24-hour $PM_{2.5}$ concentrations was 33 µg/m^3 – 507 µg/m^3 with an average concentration of 126 µg/m^3.

Camp Blue Diamond: A total of 5 $PM_{2.5}$ air samples were collected from 2-7 June 2004. The range of 24-hour $PM_{2.5}$ concentrations was 32 µg/m^3 – 64 µg/m^3 with an average concentration of 48 µg/m^3. Data were insufficient to characterize potential health risks associated with $PM_{2.5}$ exposure.

Camp Hurricane Point: A total of 5 $PM_{2.5}$ air samples were collected from 22 June to 9 July 2004. The range of 24-hour $PM_{2.5}$ concentrations was 20 µg/m^3 – 68 µg/m^3 with an average concentration of 45 µg/m^3. Data were insufficient to characterize potential health risks associated with $PM_{2.5}$ exposure.

Camp Lewis: A total of 3 $PM_{2.5}$ air samples were collected from 13 June to 2 December 2009. The range of 24-hour $PM_{2.5}$ concentrations was 44 µg/m^3 – 430 µg/m^3 with an average concentration of 184 µg/m^3. Data were insufficient to characterize potential health risks associated with $PM_{2.5}$ exposure.

2.3.2 Short-term health risks:

Low to Moderate: The short-term risk assessment was Low for typical $PM_{2.5}$ concentrations, and Moderate for the peak $PM_{2.5}$ concentration at Camp Ar Ramadi (Reference 10,Table 3-2). A Low health risk suggests that expected losses have had little or no impact on accomplishing the mission,

with little to no in-theater medical resources anticipated for protection and treatment. Whereas a Moderate health risk suggests that mission capabilities may have been degraded, and may have required limited in-theater medical countermeasures and resources. Daily average health risk levels for $PM_{2.5}$ show no hazard for 36%, low health risk for 57%, moderate health risk for 0%, and a High health risk 7% of the time. Confidence in the short-term $PM_{2.5}$ health risk assessment was low (Reference 10, Table 3-6.

The short-term typical hazard severity was negligible. During typical exposures at the negligible hazard severity level (65 ug/m^3 - 250 ug/m^3), a few personnel may have experienced notable eye, nose, and throat irritation; most personnel may have experienced only mild effects. Pre-existing health conditions (e.g., asthma, or cardiopulmonary diseases) may have been exacerbated. For the highest observed $PM_{2.5}$ concentration, the short-term hazard severity was critical. During peak exposures at the critical hazard severity level (> 500 ug/m^3), most if not all personnel may have experienced very notable eye, nose, and throat irritation and respiratory effects. Visual acuity may have been impaired, as was overall aerobic capacity. Some personnel may not have been able to perform assigned duties. Lost duty days were expected. Those with a history of asthma or cardiopulmonary disease may have experienced more severe symptoms. Confidence in short-term $PM_{2.5}$ risk assessment was low (Reference 10, Table 3-6).

2.3.3 Long-term health risks:

Moderate: The long-term health risk assessment was Moderate at Camp Ar Ramadi and vicinity. A Moderate health risk level suggests that long-term exposure to $PM_{2.5}$ may have required limited future medical surveillance activities and related resources (Reference 10, Table 3-3). Confidence in the long-term $PM_{2.5}$ health risk assessment was low (Reference 10, Table 3-6).

The hazard severity was marginal (> 65 µg/m^3) for average $PM_{2.5}$ exposures. With repeated exposures above the marginal hazard severity threshold, it was plausible that development of chronic health conditions such as reduced lung function or exacerbated chronic bronchitis, chronic obstructive pulmonary disease (COPD), asthma, atherosclerosis, or other cardiopulmonary diseases could have occurred in generally healthy troops. Those with a history of asthma or cardiopulmonary disease were considered to have been at particular risk. (Reference 10, Table 3-11).

2.4 Airborne Metals from PM_{10}

2.4.1 Sample data/Notes:

Camp Ar Ramadi: A total of 16 PM_{10} air samples were collected from 10 April 2005 to 7 May 2009 (no data available for 2008) for the analysis of airborne metals.

Camp Blue Diamond: A total of 5 PM_{10} air samples were collected from 11 to 19 May 2004 for the analysis of airborne metals.

2.4.2 Short- and long-term health risks:

None identified based on the available sampling data. No detected PM_{10} airborne metal chemical contaminants from Camp Ar Ramadi, or Camp Blue Diamond had a peak concentration greater than the 1 year negligible MEG concentrations and are therefore not considered a health hazard. However, data from Camp Blue Diamond were insufficient to characterize potential health risks associated with PM_{10} airborne metal exposure.

2.5 Volatile Organic Compounds (VOC)

2.5.1 Sample data/Notes:

Camp Ar Ramadi: A total of 6 Volatile Organic Chemical (VOC) samples were collected in 2005.

Camp Blue Diamond: A total of 2 VOC samples were collected in 2005.

2.5.2 Short and long-term health risks:

None identified based on the available sampling data. No VOCs were detected at concentrations greater than the short- or long-term negligible MEGs. However, data were insufficient to characterize potential health risks associated with VOC exposure.

3 Soil

3.1 Site-Specific Sources Identified

Soil samples field data sheets from 2003 and 2005 indicate that the soil at Camp Ar Ramadi was sprayed with diesel fuel to control dust.

3.2 Sample data/Notes:

The primary soil contamination exposure pathways are dermal contact and dust inhalation. Typical parameters analyzed for included SVOCs, heavy metals, PCBs, pesticides, herbicides. If the contaminant was known or suspected, other parameters may have been analyzed for (i.e. total petroleum hydrocarbons (TPH) and polycyclic aromatic hydrocarbons (PAH) near fuel spills). For the risk assessment, personnel are assumed to remain at these locations for 6 months to 1 year.

Camp Adalla: A single valid surface soil samples was collected on 7 May 2009 to assess OEH health risk to deployed personnel. The percent of the population exposed to soil and associated dust in the sampled areas was > 75%.

Camp Ar Ramadi: A total of 17 valid surface soil samples were collected from 23 July 2003 to 8 May 2010 to assess OEH health risk to deployed personnel. The percent of the population exposed to soil and associated dust in the sampled areas was > 75% for 6 samples, 50 – 75% for 5 samples, 25 - 50% for 1 sample, and < 25% for 5 samples.

Camp Blue Diamond: A total of 18 valid surface soil samples were collected from 29 September 2003 to 24 April 2007 to assess OEH health risk to deployed personnel. The percent of the population exposed to soil and associated dust in the sampled areas was > 75% for 16 samples, and 50 – 75% for 2 samples.

Camp Corrigedor: A single valid surface soil samples was collected on 28 May 2007 to assess OEH health risk to deployed personnel. The percent of the population exposed to soil and associated dust in the sampled areas was 25 - 50%.

COP Eagle: A total of 2 valid surface soil samples were collected on 7 May 2009 to assess OEH health risk to deployed personnel. The percent of the population exposed to soil and associated dust in the sampled areas was 50 – 75% for 1 sample and 25 - 50% for 1 sample.

Camp Hurricane Point: A total of 6 valid surface soil samples were collected from 29 August 2003 to 23 April 2007 to assess OEH health risk to deployed personnel. No data were available from 2006. The

percent of the population exposed to soil and associated dust in the sampled areas was > 75% for 6 samples.

Camp Tash: A total of 2 valid surface soil samples were collected on 13 May 2009 to assess OEH health risk to deployed personnel. The percent of the population exposed to soil and associated dust in the sampled areas was > 75% for 1 sample, and 50 < 75% for 1 sample.

3.3 Short-term health risk:

Not an identified source of health risk. Sampling data for soil were not evaluated for short-term (acute) health risks**.**

3.4 Long-term health risk:

None identified based on available sample data. No parameters in any of the aforementioned samples exceeded 1-year Negligible MEGs.

4 Water

In order to assess the health risk to U.S. personnel from exposure to water in theater, the APHC identified the most probable exposure pathways. These were based on the administrative information provided on the field data sheets submitted with the samples taken over the time period being evaluated. Based on field data sheets from Camp Ali, Anbar Training Center, Camp Ar Ramadi, Camp Blue Diamond, Camp Corrigedor, and Camp Hurricane Point samples for untreated water were associated with source water for treatment and no exposure pathways were associated with these samples. Therefore, untreated samples were not assessed as potential health hazards. It was assumed that 100% of all U.S. personnel were directly exposed to Reverse Osmosis Water Purification Unit (ROWPU) and/or disinfected treated water, since this classification of water was primarily used for personal hygiene, showering, cooking, and for use at vehicle wash racks. Field data sheets indicate that bottled water was the only approved source of drinking water.

4.1 Non-Drinking Water: ROWPU/Disinfected

Although the primary route of exposure for most microorganisms was ingestion of contaminated water, dermal exposure to some microorganisms, chemicals, and biologicals may also have caused adverse health effects. Complete exposure pathways would include drinking, brushing teeth, personal hygiene, cooking, providing medical and dental care using a contaminated water supply or during dermal contact at vehicle or aircraft wash racks.

4.1.1 Site-Specific Sources Identified

The source water for ROWPU / treated non-drinking water for sites sampled in the Camp Ar Ramadi vicinity was from the Euphrates River.

4.1.2 Sample data/Notes:

To assess the potential for adverse health effects to troops the following assumptions were made: All U.S. personnel at a location were expected to remain at that site for approximately 1 year. A conservative (protective) assumption was that personnel routinely consumed less than 5 L/day of non-drinking water for up to 365 days (1-year). It was further assumed that control measures and/or personal protective equipment were not used.

Camp Ali: A single ROWPU and/or treated (non-drinking) water sample collected on 17 December 2010 was evaluated for this health risk assessment. Small amounts of 3,5-dichlorobenzoic acid (0.00029 mg/L), and delta-Hexachlorocyclohexane (0.000025 mg/L) were detected below the Limit of Quantitation (LOQ) at Camp Ali in a single sample. Because there were no short- or long-term MEGS for 3,5-dichlorobenzoic acid, or delta-Hexachlorocyclohexane, these chemicals were not included in the risk assessment. No chemicals were detected at levels above the short or long-term MEGs. However, data were insufficient to characterize potential health risks associated with exposure to ROWPU and/or treated (non-drinking) water.

Anbar Training Center: A single ROWPU and/or treated (non-drinking) water sample collected on 18 December 2010 was evaluated for this health risk assessment. No chemicals were detected at levels above the short- or long-term MEGs. However, data were insufficient to characterize potential health risks associated with exposure to ROWPU and/or treated (non-drinking) water.

Camp Ar Ramadi: A total of 8 ROWPU and/or treated (non-drinking) water samples from 28 July 2004 to 10 November 2010 were evaluated for this health risk assessment. No chemicals were detected at levels above the short- or long-term MEGs.

Camp Blue Diamond: A total of 8 ROWPU and/or treated (non-drinking) samples from 2 April 2004 to 5 October 2010 (no data available for 2008 - 2009) were evaluated for this health risk assessment. Antimony was detected in 3 of 8 samples. The range of antimony concentrations was 0.003 mg/L – 0.036 mg/L with an average concentration of 0.0064 mg/L. The peak concentration was just above the negligible short-term (non-drinking) MEG of 0.035 mg/L in a single sample. No other chemicals were detected at levels above the short- or long-term MEGs.

Camp Corrigedor: A total of 3 ROWPU and/or treated (non-drinking) samples from 11 - 12 May 2005 and 28 May 2007 were evaluated for this health risk assessment. No chemicals were detected at levels above the short- or long-term MEGs. However, data were insufficient to characterize potential health risks associated with exposure to ROWPU and/or treated (non-drinking) water.

Camp Hurricane Point: A total of 5 ROWPU and/or treated (non-drinking) samples from 27 July 2004 to 22 August 2007 (no data available for 2006) were evaluated for this health risk assessment. No chemicals were detected at levels above the short- or long-term MEGs. However, data were insufficient to characterize potential health risks associated with exposure to ROWPU and/or treated (non-drinking) water.

4.1.3 Short-term health risks:

The health risk from ROWPU-treated (non-drinking) water at Camp Blue Diamond from exposure to antimony in non-drinking water was Low. Confidence in the risk assessment is low because of limited sample data (Reference 10, Table 3-6).

4.1.3 Long-term health risks:

None identified based on available sample data.

4.2 Drinking Water: Bottled

4.2.1 Site-Specific Sources Identified

4.2.2 Sample data/Notes:

To assess the potential for adverse health effects to troops, the following assumptions were made about dose and duration: A conservative (protective) assumption was that personnel routinely ingested 15 L/day of bottled water for up to 365 days (1-year). It was further assumed that control measures were not used. A single valid bottled water sample was collected on 2 April 2004. No chemicals were detected at levels above the short- or long-term MEGs. However, data were insufficient to characterize potential health risks associated with exposure to bottled water.

4.2.3 Short-term health risk:

None identified based on available data.

4.2.4 Long-term health risk:

None identified based on available data.

5 Military Unique

5.1 Chemical Biological, Radiological Nuclear (CBRN) Weapons

Multiple chlorine exposures from vehicle borne improvised explosive device (VBIED) occurred in the vicinity of Ramadi, Iraq from 23 July 2003 through 18 December 2010 timeframe (Reference 12).

No specific hazard sources were documented in the Defense Occupational and Environmental Health Readiness System (DOEHRS), or the Military Exposure Surveillance Library (MESL) data portal from 23 July 2003 through 18 December 2010 timeframe.

5.1.1 Short and long-term health risks:

Not Evaluated.

5.2 Depleted Uranium (DU)

No specific hazard sources were documented in the Defense Occupational and Environmental Health Readiness System (DOEHRS), or the Military Exposure Surveillance Library (MESL) data portal from 23 July 2003 through 18 December 2010 timeframe.

5.2.1 Short and long-term health risks:

Not Evaluated.

5.3 Ionizing Radiation

No specific hazard sources were documented in the DOEHRS or MESL data portal from 23 July 2003 through 18 December 2010 timeframe.

5.3.1 Short and long-term health risks:

Not Evaluated.

5.4 Non-Ionizing Radiation

No specific hazard sources were documented in the DOEHRS or MESL data portal from 23 July 2003 through 18 December 2010 timeframe.

5.4.1 Short and long-term health risks:

Not Evaluated.

6 Endemic Disease

This document lists the endemic diseases reported in the region, its specific health risks and severity and general health information about the diseases.

6.1 Foodborne and Waterborne Diseases

Food borne and waterborne diseases in the area are transmitted through the consumption of local food and water. Local unapproved food and water sources (including ice) are heavily contaminated with pathogenic bacteria, parasites, and viruses to which most U.S. Service Members have little or no natural immunity. Effective host nation disease surveillance does not exist within the country. Only a small fraction of diseases are identified or reported in host nation personnel. Diarrheal diseases are expected to temporarily incapacitate a very high percentage of U.S. personnel within days if local food, water, or ice is consumed. Hepatitis A and typhoid fever infections typically cause prolonged illness in a smaller percentage of unvaccinated personnel. Vaccinations are required for DOD personnel and contractors. In addition, although not specifically assessed in this document, significant outbreaks of viral gastroenteritis (e.g., norovirus) and food poisoning (e.g., *Bacillus cereus*, *Clostridium perfringens*, *Staphylococcus*) may occur.

6.1.1 Diarrheal diseases (bacteriological)

High: Diarrheal diseases are expected to temporarily incapacitate a very high percentage of personnel (potentially over 50% per month) within days if local food, water, or ice was consumed. Field conditions (including lack of hand washing and primitive sanitation) may facilitated person-to-person spread and epidemics. Typically mild disease treated in outpatient setting; recovery and return to duty in less than 72 hours with appropriate therapy. A small proportion of infections may require greater than 72 hours limited duty, or hospitalization.

6.1.2 Hepatitis A, typhoid/paratyphoid fever, and diarrhea-protozoal

Low to High: Unmitigated health risk to U.S. personnel is high year round for hepatitis A and typhoid/paratyphoid fever, and Moderate for diarrhea-protozoal. Mitigation was in place to reduce the risks to low; U.S. Personnel did not drink untreated water, and vaccination with hepatitis A and typhoid fever is required for deployment into the U.S. Central Command (CENTCOM) Area of Responsibility. Hepatitis A, typhoid/paratyphoid fever, and diarrhea-protozoal disease may cause prolonged illness in a small percentage of personnel (less than 1% per month). Although much rarer, other potential diseases in this area that are also considered a Moderate risk include: hepatitis E, diarrhea-cholera, and brucellosis.

6.1.3 Short-term Health Risks:

Low: The overall unmitigated short-term risk associated with food borne and waterborne diseases are considered High (bacterial diarrhea, hepatitis A, typhoid/paratyphoid fever) to Moderate (diarrhea-cholera, diarrhea-protozoal, brucellosis) to Low (hepatitis E) if local food or water was consumed.

Preventive Medicine measures such as vaccinations reduce the risk estimate to none for Hepatitis A and typhoid/paratyphoid fever. Additionally, U.S. Forces were provided food and water from approved sources reducing the risk to low. Confidence in the health risk estimate was high.

6.1.4 Long-term Health Risks:

None identified based on available data.

6.2 Arthropod Vector-Borne Diseases

During warmer months (typically from April through November), ecological conditions support populations of arthropod vectors, including mosquitoes, ticks, and sandflies, with variable rates of disease transmission. A variety of vector-borne diseases occur at low or unknown levels; as a group, these diseases may constitute a significant risk in the absence of mitigation measures. Personnel exposed to mosquitoes, ticks, sandflies, or other biting vectors were at risk during day or night.

6.2.1 Malaria

None: Indigenous transmission of malaria in Iraq was eliminated as of 2008 reducing risk among personnel exposed to mosquito bites to None.

6.2.2 Leishmaniasis

Moderate: Potential health risk to U.S. personnel is Moderate year round, but reduced to low with mitigation measures. For U.S. personnel, risk mitigation included proper wear of treated uniforms, application of repellent to exposed skin, and minimizing outdoor activities (when possible) between dusk and dawn. Leishmaniasis is transmitted by sand flies. The disease risk is Moderate during the warmer months when sandflies are most prevalent. There are two forms of the disease; cutaneous (acute form) and visceral (a more latent form of the disease). The leishmaniasis parasites may survive for years in infected individuals and this infection may go unrecognized by physicians in the U.S. when infections become symptomatic years later. Cutaneous infection is unlikely to be debilitating, though lesions may be disfiguring. Visceral leishmaniasis disease can cause severe febrile illness which typically requires hospitalization with convalescence over 7 days.

6.2.3 Crimean-Congo hemorrhagic fever

Moderate: Unmitigated risk is moderate, but reduced to low with mitigation measures. For U.S. personnel, risk mitigation includes proper wear of treated uniforms and application of repellent to exposed skin. Crimean-Congo hemorrhagic fever occurs in rare cases (less than 0.1% per month attack rate in indigenous personnel) and is transmitted by tick bites or occupational contact with blood or secretions from infected animals. The disease typically requires intensive care with fatality rates from 5% to 50%.

6.2.4 Sandfly fever

Moderate: Sandfly fever has a Moderate risk with potential disease rates from 1% to 10% per month under worst case conditions. The disease is transmitted by sandflies and occurs more commonly in children though adults are still at risk. Sandfly fever disease typically resulted in debilitating febrile illness requiring 1 to 7 days of supportive care followed by return to duty.

6.2.5 Sindbis (and Sindbis-like viruses)

Low: Sindbis and sindbis-like viruses are maintained in a bird-mosquito cycle in rural areas and occasionally caused limited outbreaks among humans. The viruses are transmitted by a variety of *Culex* mosquito species found primarily in rural areas. A variety of bird species may serve as reservoir or amplifying hosts. Extremely rare cases (less than 0.01% per month attack rate) could have occurred seasonally (April - November). Debilitating febrile illness often accompanied by rash, typically requires 1 to 7 days of supportive care; significant arthralgias may persist for several weeks or more in some cases. This disease is associated with a low health risk estimate.

6.2.6 *Rickettsioses, tickborne (spotted fever group)*

Low: Rare cases (less than 0.1% per month) of rickettsioses disease are possible among personnel exposed to tick bites. Rickettsioses are transmitted by multiple species of hard ticks, including *Rhipicephalus* spp., which are associated with dogs. Other species of ticks, including *Ixodes* are also capable of transmitting rickettsial pathogens in this group. In addition to dogs, various rodents and other animals also may serve as reservoirs. Ticks are most prevalent from April through November. Incidents can result in debilitating febrile illness, which may require 1 to 7 days of supportive care followed by return to duty. The health risk of rickettsial disease is Low.

6.2.7 *Typhus-murine (fleaborne)*

Low: Typhus-murine has a Low risk estimate and is assessed as present, but at unknown levels. Rare cases are possible among personnel exposed to rodents (particularly rats) and flea bites. Incidents may result in debilitating febrile illness typically requiring 1 to 7 days of supportive care followed by return to duty.

6.2.8 West Nile fever

Low: West Nile fever is present. The disease is maintained by the bird population and transmitted to humans via mosquito vector. Typically, infections in young, healthy adults were asymptomatic although fever, headache, tiredness, body aches (occasionally with a skin rash on trunk of body), and swollen lymph glands can occurred. This disease is associated with a low risk estimate.

6.2.9 Short -term health risks:

Low: The unmitigated risk is moderate for leishmaniasis - cutaneous (acute), Crimean-Congo hemorrhagic fever, and sandfly fever; Low for, sindbis, rickettsioses-tickborne, typhus-fleaborne, and West Nile fever. No hazard from malaria (2008 - 2011). Risk is reduced to Low by proper wear of the uniform and application of repellent to exposed skin. Confidence in the risk estimate is high.

6.2.10 Long -term health risks:

Low: The unmitigated risk is moderate for leishmaniasis-visceral (chronic). Risk is reduced to Low by proper wear of the uniform and application of repellent to exposed skin. Confidence in the risk estimate is high.

6.3 Water Contact Diseases

Tactical operations or recreational activities that involve extensive contact with surface water such as lakes, streams, rivers, or flooded fields may result in significant exposure to leptospirosis and schistosomiasis. Arid portions of Iraq without permanent or persistent bodies of surface water do not support transmission of leptospirosis or schistosomiasis. Risk was restricted primarily to areas along rivers and lakes. These diseases can debilitate personnel for up to a week or more. Leptospirosis risk

typically increases during flooding. In addition, although not specifically assessed in this document, bodies of surface water are likely to be contaminated with human and animal waste. Activities such as wading or swimming may result in exposure to enteric diseases including diarrhea and hepatitis via incidental ingestion of water. Prolonged water contact also may lead to the development of a variety of potentially debilitating skin conditions including bacterial or fungal dermatitis.

6.3.1 Leptospirosis

Moderate: Human infections occur seasonally (typically April through November) through exposure to water or soil contaminated by infected animals and is associated with wading, and swimming in contaminated, untreated open water. The occurrence of flooding after heavy rainfall facilitates the spread of the organism because as water saturates the environment leptospirosis present in the soil passes directly into surface waters. Leptospirosis can enter the body through cut or abraded skin, mucous membranes, and conjunctivae. Infection may also occur from ingestion of contaminated water. The acute, generalized illness associated with infection may mimic other tropical diseases (for example, dengue fever, malaria, and typhus), and common symptoms include fever, chills, myalgia, nausea, diarrhea, cough, and conjunctival suffusion. Manifestations of severe disease can include jaundice, renal failure, hemorrhage, pneumonitis, and hemodynamic collapse. Recreational activities involving extensive water contact may result in personnel being temporarily debilitated with leptospirosis. This disease is associated with a Moderate health risk estimate.

6.3.2 Schistosomiasis

Moderate: Humans are the principal reservoir for schistosomes; humans shed schistosome eggs in urine or feces. Animals such as cattle and water buffalo may also be significant reservoirs. Rare cases (less than 0.1% per month attack rate) may occur seasonally (typically April through November) among personnel wading or swimming in lakes, streams, or irrigated fields which were frequently contaminated with human and animal waste containing schistosome eggs. In groups with prolonged exposure to heavily contaminated foci, attack rates may exceed 10%. Exceptionally heavy concentrations of schistosomes may occur in discrete foci, which were difficult to distinguish from less contaminated areas. In non-immune personnel exposed to such foci, rates of acute schistosomiasis may be over 50%. Mild infections are generally asymptomatic. In very heavy acute infections, a febrile illness (acute schistosomiasis) may occur, especially with *Schistosoma japonicum* and *S. mansoni*, requiring hospitalization and convalescence over 7 days. This disease is associated with a Moderate health risk estimate.

6.3.3 Short -term health risks:

Moderate: for schistosomiasis and leptospirosis. Confidence in risk estimate is high.

6.3.4 Long -term health risks:

None identified based on available data.

6.4 Respiratory Diseases

Although not specifically assessed in this document, deployed U.S. forces may be exposed to a wide variety of common respiratory infections in the local population. These include influenza, pertussis, viral upper respiratory infections, viral and bacterial pneumonia, and others. The U.S. military populations living in close-quarter conditions are at risk for substantial person-to-person spread of respiratory pathogens. Influenza is of particular concern because of its ability to debilitate large numbers of unvaccinated personnel for several days.

6.4.1 Tuberculosis (TB)

Moderate: Tuberculosis (TB) poses a moderate year round risk to U.S. personnel in Iraq. Tuberculosis is usually transmitted through close and prolonged exposure to an active case of pulmonary or laryngeal tuberculosis, but may also occur with incidental contact. The Army Surgeon General has defined increased risk in deployed Soldiers as indoor exposure to locals or third country nationals of greater than one hour per week in a highly endemic active TB region.

6.4.2 Meningococcal meningitis

Low: Meningococcal meningitis poses a Low risk and is transmitted from person to person through droplets of respiratory or throat secretions. Close and prolonged contact facilitates the spread of this disease. Meningococcal meningitis is potentially a very severe disease typically requiring intensive care; fatalities may occur in 5-15% of cases.

6.4.3 Short-term health risks:

Low to Moderate: Moderate (tuberculosis) to Low (for meningococcal meningitis). Confidence in the health risk estimate was high.

6.4.4 Long-term health risks:

None identified based on available data. TB was evaluated as part of the Post Deployment Health Assessment (PDHA). A TB skin test was required post-deployment if potentially exposed and was based upon individual service policies.

6.5 Animal-Contact Diseases

6.5.1 Rabies

Moderate: Rabies poses a year round Moderate risk. Prevalence in feral and wildlife populations is well above U.S. levels due to the lack of organized control programs and the presence of feral animals. Dogs are the primary reservoir for rabies in Iraq, related to low vaccination rates, and account for the great majority of human exposures. There is spillover from dogs into jackals, foxes, mongeese, and other wild mammals. Rabies is transmitted by exposure to the virus-laden saliva of an infected animal, typically through bites, but could occur from scratches contaminated with the saliva. Typically the time period from exposure to the onset of symptoms is 2 – 12 weeks, but can rarely take several years. General Order 1B mitigates rabies risk by prohibiting contact with, adoption, or feeding of feral animals. No cases were reported in U.S. personnel at these locations during this time frame.

6.5.2 Anthrax

Low: Anthrax cases are rare in indigenous personnel, and pose a Low risk to U.S. personnel. Anthrax is a naturally occurring infection; cutaneous anthrax is transmitted by direct contact with infected animals or carcasses, including hides. Eating undercooked infected meat may result in contracting gastrointestinal anthrax. However, risk is eliminated through proper food preparation and consumption of food from approved sources. Pulmonary anthrax is contracted through inhalation of spores and is extremely rare.

6.5.3 Q-Fever

Moderate: Potential health risk to U.S. personnel is Moderate year round. Rare cases are possible among personnel exposed to aerosols from infected animals, with clusters of cases possible in some situations. Significant outbreaks (affecting 1-50%) can occur in personnel with heavy exposure to barnyards or other areas where animals are kept. Unpasteurized milk may also transmit infection. The primary route of exposure is respiratory, with an infectious dose as low as a single organism. Incidence could result in debilitating febrile illness, sometimes presenting as pneumonia, typically requiring 1 to 7 days of inpatient care followed by return to duty.

6.5.4 H5N1 avian influenza

Low: H5N1 avian influenza poses a year-round low risk. No illnesses were reported in U.S. personnel, however those who had close contact with birds or poultry had an increased risk of H5N1 infection.

6.5.5 Short-term health risks:

Low to Moderate: The short-term risk is Moderate for rabies, and Q-fever, to Low for anthrax, and H5N1 avian influenza. Confidence in risk estimate is high.

6.5.6 Long-term health risks:

Low: The long term risk for rabies is Low because the incubation period for rabies can be several years in rare cases.

7 Venomous Animal/Insect

All information was taken directly from the Clinical Toxicology Resources web site from the University of Adelaide, Australia (Reference 2). The species listed below have home ranges that overlap the location of Camp Ar Ramadi and vicinity, and may present a health risk if they are encountered by personnel. See Section 9 for more information about pesticides and pest control measures.

7.1 Spiders

- *Latrodectus pallidus*: Clinical effects uncertain, but related to medically important species, therefore severe envenoming cannot be excluded.

7.2 Scorpions

- *Androctonus crassicauda* (black scorpion): Severe envenoming possible and potentially lethal, however most stings cause only severe local pain.

- *Buthacus leptochelys*, *Buthacus macrocentrus*, *Compsobuthus matthiesseni*, *Compsobuthus werneri, Odontobuthus doriae*, *Orthochirus iraqus*, and *Orthochirus scrobiculosus*: Clinical effects unknown; there are a number of dangerous Buthid scorpions, but also others known to cause minimal effects only. Without clinical data it is unclear where these species fit within that spectrum.

- *Euscorpius italicus and Scorpio maurus:* Mild envenoming only, not likely to prove lethal.

- *Hemiscorpius lepturus*: Severe envenoming possible, potentially lethal.

- *Hottentotta saulcyi*, *Hottentotta scaber*, and *Hottentotta schach*: Moderate envenoming possible but unlikely to prove lethal.

7.3 Snakes

- *Cerastes gasperettii* (Gasperetti's horned sand viper): Potentially lethal envenoming, though unlikely.

- *Hemorrhis ravergieri* (mountain racer), *Psammophis lineolatus* (Teer snake), *Psammophis schokari* (Teer snake), *Telescopus fallax* (Mediterranean cat snake) and *Telescopus tessellatus* (Soosan viper): Clinical effects unknown, but unlikely to cause significant envenoming.

- *Macrovipera lebetina obtuse* (Levantine viper)*, Macrovipera lebetina turanica* (Levantine viper), *Vipera albicornuta* (white-horned Viper): Severe envenoming possible, potentially lethal.

- *Malpolon monspessulanus* (Montpellier snake): Moderate envenoming possible but unlikely to prove lethal.

- *Platyceps rhodorachis* (Jan's desert racer): Mild envenoming only, not likely to prove lethal. *Walterinnesia aegyptia* (Black Desert Cobra): Clinical effects unknown, but potentially lethal envenoming, though unlikely, cannot be excluded.

7.4 Short-term health risk:

Low: If encountered, effects of venom vary with species from mild localized swelling (e.g. *S. maurus*) to potentially lethal effects (e.g. *V. albicornuta*). See effects of venom above. Confidence in the health risk estimate is low (Reference 10, Table 3-6).

7.5 Long-term health risk:

None identified.

8 Heat/Cold Stress

8.1 Heat

Summer (June - September) monthly mean temperatures ranged from 83 °F to 113 °F with an average temperature of 99 °F based on historical climatological data from the U.S. Air Force Combat Climatology Center, 14th Weather Squadron. The health risk of heat stress/injury based on temperatures alone was Low (< 78 °F) from November – March, Moderate (78-81.9°F) for April, High (82-87.9°F) for October, and extremely high (≥ 88°F) from May - September. However, work intensity and clothing/equipment worn posed greater health risk of heat stress/injury than environmental factors alone (Goldman 2001). Managing risk of hot weather operations included monitoring work/rest periods, proper hydration, and taking individual risk factors (e.g. acclimation, weight, and physical conditioning) into consideration. Risk of heat stress/injury was reduced with preventive measures.

8.1.1 Short-term health risk:

Moderate to High: Risk of heat injury in unacclimatized personnel is Moderate for October, and High from May - September. Confidence in the health risk estimate was low (Reference 10, Table 3-6).

8.1.2 Long-term health risk:

Low: The long-term risk is Low. However, the risk may be greater for certain susceptible persons– those older (i.e., greater than 45 years), in lesser physical shape, or with underlying medical/health conditions. Long-term health implications from heat injuries are rare but may occur, especially from

more serious injuries such as heat stroke. It is possible that high heat in conjunction with various chemical exposures may increase long-term health risks, though specific scientific evidence is not conclusive. Confidence in these risk estimates is medium (Reference 10, Table 3-6).

8.2 Cold

8.2.1 Short-term health risks:

Winter (December - March) monthly mean temperatures range from 28 °F to 66 °F with an average temperature of 60 °F based on historical climatological data from the U.S. Air Force Combat Climatology Center, 14th Weather Squadron. Cold stress/injury can occur when temperatures fall below 60 °F. Because even on warm days a significant drop in temperature after sunset by as much as 40 °F can occur, there is a risk of cold stress/injury from October – April. The risk assessment for Non-Freezing Cold Injuries (NFCI), such as chilblain, trench foot, and hypothermia, is Low based on historical temperature and precipitation data. Frostbite is unlikely to occur because temperatures rarely drop below freezing. However, personnel may encounter significantly lower temperatures during field operations at higher altitudes. As with heat stress/injuries, cold stress/injuries are largely dependent on operational and individual factors instead of environmental factors alone.

Low: The health risk of cold injury was Low. Confidence in the health risk estimate was medium.

8.1.2 Long-term health risk:

Low: The health risk of cold injury is Low. Confidence in the health risk estimate is high.

9 Noise

9.1 Continuous

No specific hazard sources were documented in the DOEHRS or MESL from 23 July 2003 through 18 December 2010 timeframe.

9.1.1 Short and long-term health risks:

Not evaluated

9.2 Impulse

No specific hazard sources were documented in the DOEHRS or MESL from 23 July 2003 through 18 December 2010 timeframe.

9.2.1 Short-term and Long-term health risks:

Not evaluated.

10 Other Unique Occupational Hazards

10.1 Potential environmental contamination sources

DoD personnel are exposed to various chemical, physical, ergonomic, and biological hazards in the course of performing their mission. These types of hazards depend on the mission of the unit and the operations and tasks which the personnel are required to perform to complete their mission. The health

risk associated with these hazards depends on a number of elements including what materials are used, how long the exposure last, what was done to the material, the environment where the task or operation is performed, and what controls are used. The hazards can include exposures to heavy metal particulates (e.g. lead, cadmium, manganese, chromium, and iron oxide), solvents, fuels, oils, and gases (e.g. carbon monoxide, carbon dioxide, oxides of nitrogen, and oxides of sulfur). Most of these exposures occur when performing maintenance task such as painting, grinding, welding, engine repair, or movement through contaminated areas. Exposures to these occupational hazards can occur through inhalation (air), skin contact, or ingestion; however exposures through air are generally associated with the highest health risk.

10.2 Food Sanitation

A search of the DOEHRS and MESL data portal from 23 July 2003 through 18 December 2010 yielded limited food sanitation inspection records at Anbar Training Center, Camp Ar Ramadi, Camp Blue Diamond, Camp Hurricane Point. Base camp assessments conducted at these sites were all rated either Amber or Green, indicating the overall sanitary conditions and controls at these sites did not present a significant health risk. No unsatisfactory base camp assessments, surveys or inspection reports were identified from the archived files examined.

10.2.1 Short-term and Long-term health risks

Not evaluated. Insufficient quantity and quality of data were available for an accurate health risk assessment.

10.3 Waste Sites/Waste Disposal

Base camp assessments conducted at Anbar Training Center, Camp Ar Ramadi, Camp Blue Diamond, and Camp Hurricane Point were all rated either Amber or Green, indicating the overall sanitary conditions and controls at these sites did not present a significant health risk. No unsatisfactory base camp assessments, surveys or inspection reports were identified from the archived files examined.

10.3.1 Short-term and Long-term health risks

Not evaluated. Insufficient quantity and quality of data were available for an accurate health risk assessment.

10.4 Pesticides/Pest Control:

The health risk of exposure to pesticide residues is considered within the framework of typical residential exposure scenarios, based on the types of equipment, techniques, and pesticide products that have been employed, such as enclosed bait stations for rodenticides, various handheld equipment for spot treatments of insecticides, vertebrate pesticides, and a number of ready-to-use (RTU) methods such as aerosol cans and baits. The control of rodents required the majority of pest management inputs, with the acutely toxic rodenticides staged as solid formulation lethal baits placed in tamper-resistant bait stations indoors and outdoors throughout cantonment areas. Nuisance insects, including biting and stinging insects such as bees, and ants, also required significant pest management inputs. Use of pesticides targeting against these pests generally involved selection of compounds with low mammalian toxicity and short-term residual using pinpoint rather than broadcast application techniques. A total of 27 monthly pesticide application reports in the MESL for Camp Ar Ramadi (January 2005 to July 2006), and Camp Blue Diamond (March 2005 to July 2006) list the usage of pesticides on these sites. For each pesticide product applied during this period, the EPA approved label has been archived, providing a framework how each pesticide handled and applied (see below).

10.4.1 Rodenticides

Brodifacoum, and bromadiolone were used to control rodents.

10.4.2 Insecticides

Insecticides used to control ants, bees, cockroaches, fleas, flies, mosquitoes, and spiders incude: abamectin B1, *Bacillus thuringiensis* subspecies *israelensis*, DEET (95%), deltamethrin, ß-cyfluthrin, cypermethrin, fipronil, Imidacloprid, lambda-cyhalothrin, malathion, methomyl, (S)-methoprene, n-octyl bicycloheptene dicarboximide, nithiazine, (z)-9- tricosene, polybutylenes, piperonyl butoxide, pyrethrins, and resmethrin were used to control insects.

10.4.2 Feral and wild animals

Ketamine was used to control/immobilization of feral and wild animals.

10.4.3 Short-term and Long-term health risks

Low: Long term health risk was Low. Confidence in the health risk assessment was medium (Reference 10, Table 3-6).

10.5 Burn pits

Burn pits were present and operating at Camp Adalla, Camp Ar Ramadi, Camp Corrigedor, and COP Eagle during the 23 July 2003 through 18 December 2010 timeframe, and remained operational until camp closures (Reference 12). There were no burn pits present at Camp Blue Diamond, Camp Hurricane Point, or Camp Tash. No burn pit information was found in the DOEHRS and MESL data portal from 23 July 2003 through 18 December 2010 for the Anbar Training Center, Camp Ali, or Camp Lewis.

While not specific to Camp Ar Ramadi and vicinity, the consolidated epidemiological and environmental sampling studies on burn pits that have been conducted as of the date of this publication have been unable to determine whether an association does or does not exist between exposures to emissions from the burn pits and long-term health effects (Reference 7). The committee's review of the literature and the data suggests that service in Iraq or Afghanistan (i.e., a broader consideration of air pollution than exposure only to burn pit emissions) may be associated with long-term health effects, particularly in susceptible (e.g., those who have asthma) or highly exposed subpopulations, such as those who worked at the burn pit. Such health effects would be due mainly to high ambient concentrations of PM from both natural and anthropogenic sources, including military sources. If that broader exposure to air pollution turns out to be relevant, potentially related health effects of concern were respiratory and cardiovascular effects and cancer. Susceptibility to the PM health effects may be exacerbated by other exposures, such as stress, smoking, local climatic conditions, and co-exposures to other chemicals that affect the same biologic or chemical processes. Individually, the chemicals measured at burn pit sites in the study were generally below concentrations of health concern for general populations in the United States. However, the possibility of exposure to mixtures of the chemicals raises the potential for health outcomes associated with cumulative exposure to combinations of the constituents of burn pit emissions and emissions from other sources.

10.5.1 Particulate Matter, less than 10 micrometers (PM_{10})

10.5.1.1 Sample data/Notes:

Exposure Guidelines:
Short-term (24-hour) PM_{10} ($\mu g/m^3$): Negligible MEG=250, Marginal MEG=420, Critical MEG=600
Long-term (1-year) PM_{10} MEG ($\mu g/m^3$): Not Available.

Camp Ar Ramadi: A total of 3 PM_{10} air samples were collected from 29 May 2007 to 23 January 2009 (No data available for 2008). The range of 24-hour PM_{10} concentrations was 137 $\mu g/m^3$ – 731 $\mu g/m^3$ with an average concentration of 363 $\mu g/m^3$. The short-term hazard severity was marginal for typical PM_{10} concentrations, and critical for the peak PM_{10} concentration. However, data were insufficient to characterize potential health risks associated with PM_{10} exposure.

Camp Adalla: A single PM_{10} air sample was collected on 7 May 2009. The 24-hour PM_{10} sample had a concentrations was 345 $\mu g/m^3$. The short-term hazard severity was negligible. However, data was insufficient to characterize potential health risks associated with PM_{10} exposure.

COP Eagle: A single PM_{10} air sample was collected on 6 May 2009. The 24-hour PM_{10} sample had a concentrations was 313 $\mu g/m^3$. The short-term hazard severity was negligible. However, data was insufficient to characterize potential health risks associated with PM_{10} exposure.

10.5.1.2 Short-term health risks:

Not Evaluated. Peak PM_{10} concentration was at the short-term negligible (Camp Adalla and COP Eagle), and critical (Camp Ar Ramadi) hazard severity level. However, the limited available data were insufficient to characterize potential health risks associated with PM_{10} exposure.

10.5.1.3 Long-term health risk:

Not Evaluated-no available health guidelines. The EPA has retracted its long-term NAAQS for PM_{10} due to an inability to clearly link chronic health effects with chronic PM_{10} exposure levels.

10.5.2 Particulate Matter, less than 2.5 micrometers ($PM_{2.5}$)

10.5.2.1 Sample data/Notes:

Exposure Guidelines:
Short-term (24-hour) $PM_{2.5}$ MEGs ($\mu g/m^3$): Negligible MEG=65, Marginal MEG=250, Critical MEG=500;
Long-term (1-year) $PM_{2.5}$ MEGs: Negligible MEG=15, Marginal MEG=65.

Camp Ar Ramadi: A total of 3 $PM_{2.5}$ air samples were collected from 19-21 June 2009. The range of 24-hour $PM_{2.5}$ concentrations was 42 $\mu g/m^3$ – 498 $\mu g/m^3$ with an average concentration of 202 $\mu g/m^3$. The short-term hazard severity was negligible for typical PEPCs, and marginal for the peak PEPC. The long-term hazard severity for typical $PM_{2.5}$ concentrations was marginal. However, data were insufficient to characterize potential health risks associated with $PM_{2.5}$ exposure.

COP Eagle: A single $PM_{2.5}$ air sample was collected on 6 May 2009. The 24-hour $PM_{2.5}$ sample had a concentrations was 100 $\mu g/m^3$. The short and long-term hazard severity was marginal. However, the data was insufficient to characterize potential health risks associated with $PM_{2.5}$ exposure.

10.5.2.2 Short-term health risks:

Not Evaluated. Peak $PM_{2.5}$ concentration was at the short-term marginal hazard severity level at Camp Ar Ramadi and COP Eagle. However, the limited available data were insufficient to characterize potential health risks associated with PM_{10} exposure.

10.5.2.3 Long-term health risks:

Not Evaluated. Typical $PM_{2.5}$ concentration was at the long-term marginal hazard severity level at Camp Ar Ramadi and COP Eagle. However, the limited available data were insufficient to characterize potential health risks associated with PM_{10} exposure.

10.5.3 Airborne Metals from PM_{10}

10.5.3.1 Sample data/Notes:

Camp Ar Ramadi: A total of 3 PM_{10} air samples were collected from 29 May 2007 to 23 January 2009 (No data available for 2008) for the analysis of airborne metals. None of the analyzed metals in the collected samples were found at concentrations above the 1-year negligible MEGs. However, data were insufficient to characterize potential health risks associated with PM_{10} airborne metal exposure.

10.5.3.2 Short-term health risks:

None identified based on available data.

10.5.1.3 Long-term health risk:

Not Evaluated-no available health guidelines. The EPA has retracted its long-term NAAQS for PM_{10} due to an inability to clearly link chronic health effects with chronic PM_{10} exposure levels.

10.5.4 Volatile Organic Compounds (VOC)

10.5.4.1 Sample data/Notes:

Camp Hurricane Point: A total of 2 TO-17 VOC samples were collected in 2005. None of the analyzed VOC pollutants were found at concentrations above short or long-term MEGs. However, data were insufficient to characterize health risk associated with VOC exposure.

10.5.4.2 Short and long-term health risks:

None identified based on the available sampling data.

11 References[1]

1. Casarett and Doull's Toxicology: the Basic Science of Exposures, Chapter 2- Principles of Toxicology; Fifth Edition, McGraw Hill, New York.

2. Clinical Toxinology Resources: http://www.toxinology.com/. University of Adelaide, Australia.

3. Defense Occupational and Environmental Health Readiness System (referred to as the DOEHRS-IH (EH) database) at https://doehrs-ih.csd.disa.mil/Doehrs/. Department of Defense (DoD) Instruction 6490.03, *Deployment Health*, 2006.

4. DoDI 6055.05, Occupational and Environmental Health, 2008.

5. DoD MESL Data Portal: https://mesl.apgea.army.mil/mesl/.Some of the data and reports used may be classified or otherwise have some restricted distribution.

6. Goldman RF. 2001. Introduction to heat-related problems in military operations. *In*: Textbook of military medicine: medical aspects of harsh environments Vol. 1, Pandolf KB, and Burr RE (Eds.), Office of the Surgeon General, Department of the Army, Washington DC.

7. IOM (Institute of Medicine). 2011. Long-term health consequences of exposure to burn pits in Iraq and Afghanistan. Washington, DC: The National Academies Press.

8. Joint Staff Memorandum (MCM) 0028-07, Procedures for Deployment Health Surveillance, 2007.

9. National Center for Medical Intelligence (NCMI). 2010. Defense Intelligence Report: (U) Baseline Infectious Disease Risk Assessment CENTCOM: Iraq. Defense Intelligence Agency, https://www.intelink.gov/ncmi/index.php

10. USA PHC TG230, June 2010 Revision, Environmental Health Risk Assessment and Chemical Exposure Guidelines for Deployed Military Personnel.

11. USACHPPM, 2008 Particulate Matter Factsheet; 64-009-0708, 2008.

12. U.S. Army Central Command, Infrastructure Spatial Intelligence Portal. Contains engineering, construction, and other infrastructure-related data and reports for locations within the ARCENT AO. Some of the data and reports used may be classified or otherwise have some restricted distribution.

[1] NOTE. The data are currently assessed using the APHC 2010 TG230. The general method involves an initial review of the data which eliminates all chemical substances not detected above 1-yr negligible MEGs. Those substances screened out are not considered acute or chronic health hazards so are not assessed further. For remaining substances, acute and chronic health effects are evaluated separately for air and water (soil was only evaluated for long term risk). This was performed by deriving separate short-term and long term population exposure level and estimates (referred to as population exposure point concentrations, PEPC) that are compared to MEGs derived for similar exposure durations. If less than or equal to negligible MEG the risk was Low. If levels are higher than negligible then there was a chemical-specific toxicity and exposure evaluation by appropriate SMEs, which includes comparison to any available marginal, critical or catastrophic MEGs. For drinking water 15 L/day MEGs are used for the screening while site specific 5-15 L/day are used for more detailed assessment. For nondrinking water (such as that used for personal hygiene or cooking) the 'consumption rate' was limited to 2 L/day (similar to the EPA) which was derived by multiplying the 5 L/day MEG by a factor of 2.5. This value was used to conservatively assess non drinking uses of water.

12 Where Do I Get More Information?

If a provider feels that the Service member's or Veteran's current medical condition may be attributed to specific OEH exposures at this deployment location, he/she can contact the Service-specific organization below. Organizations external to DoD should contact DoD Force Health Protection and Readiness (FHP & R).
Army Institute of Public Health Phone: (800) 222-9698. http://phc.amedd.army.mil/
Navy and Marine Corps Public Health Center (NMCPHC) (formerly NEHC) Phone: (757) 953-0700. http://www-nehc.med.navy.mil
U.S. Air Force School of Aerospace Medicine (USAFSAM) (formerly AFIOH) Phone: (888) 232-3764. http://www.wpafb.af.mil/afrl/711hpw/usafsam.asp
DoD Force Health Protection and Readiness (FHP & R) Phone: (800) 497-6261. http://fhp.osd.mil