Military Deployment
Periodic Occupational and Environmental Monitoring Summary (POEMS): Al Asad Air Base (AB), Iraq: 2014 to 2015

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) 0017-12, (References 1-3).

PURPOSE: This POEMS documents the Department of Defense (DOD) assessment of occupational and environmental health (OEH) risks for Al Asad Air Base (AB), Iraq. It presents a qualitative summary of health risks identified at these locations and their potential medical implications. The report is based on information collected from September 2014 through December 2015 to include deployment OEH surveillance 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.

This assessment assumes that environmental sampling at Al Asad AB during this period was performed at representative exposure points selected to characterize health risks at the *population–level*. Due to the nature of environmental sampling, the data upon which this report is based may not be fully representative of all the fluctuations in environmental quality or capture unique occurrences. While one might expect health risks pertaining to historic or future conditions at this site to be similar to those described in this report, the health risk assessment is limited to September 2014 through December 2015.

The POEMS can be useful to inform healthcare providers and others of environmental health conditions experienced by individuals deployed to Al Asad AB during the period of this assessment. However, it does not represent an individual exposure profile. Individual exposures depend on many variables such as; how long, how often, where, and what someone is doing while working and/or spending time outside. Individual outdoor activities and associated routes of exposure are extremely variable and cannot be identified from or during environmental sampling. Individuals who sought medical treatment related to OEH exposures while deployed should have exposure/treatment noted in their medical records on a Standard Form (SF) 600 (Chronological Record of Medical Care).

SITE DESCRIPTION: Al Asad AB, previously known by the Iraqis as Qadisiyah Air Base, is located in the Al Anbar Province of Iraqi. The air base was originally built in 1985 to support the Iraqi Air Force and expanded in 1995 to a final footprint of approximately 42 square kilometers (km^2). It is located approximately 10 km southwest of the city of Khan al Baghdadi, 12 km west from the Euphrates River and approximately 225 km northwest of Baghdad. It was the second largest air base used by U.S. Forces in Iraq during operation Iraqi Freedom. During the war in Iraq, Al Asad Air Base served as the home to the 2nd and 3rd Marine Aircraft Wings and I and II Marine Expeditionary Force (2008-2010) (Reference 4).

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 Al Asad AB. 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.

POEMS
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 Al Asad AB, Iraq:

Food/waterborne diseases (e.g., bacterial diarrhea, hepatitis A, typhoid/paratyphoid fever, diarrhea-cholera, diarrhea-protozoal, brucellosis, hepatitis E); other endemic diseases (cutaneous leishmaniasis (acute), leishmaniasis - visceral, Crimean-Congo hemorrhagic fever, sandfly fever, leptospirosis, schistosomiasis, Tuberculosis (TB), rabies, Q fever); and heat stress. For food/waterborne diseases (e.g., bacterial diarrhea, hepatitis A, typhoid/paratyphoid fever, diarrhea-cholera, diarrhea-protozoal, brucellosis, hepatitis E), if ingesting local food and water, the health effects can temporarily incapacitate personnel (diarrhea) or result in prolonged illness (hepatitis A, typhoid/paratyphoid 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 U.S. Central Command (CENTCOM) policy. For other vector-borne endemic diseases (cutaneous leishmaniasis (acute), leishmaniasis - visceral, Crimean-Congo hemorrhagic fever, sandfly fever), 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, bed net use, as well as minimizing areas of standing water and other vector-breeding areas. For water contact diseases (leptospirosis and 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 during months of June through August, and greater for susceptible persons including those older than 45, of low fitness level, unacclimatized, or with underlying medical conditions, and those under operational constraints (equipment, personal protective equipment (PPE), vehicles). Risks from heat stress may have been reduced with preventive medicine controls, work-rest cycles, proper hydration and nutrition, and mitigation.

Air quality: For inhalable coarse particulate matter (PM) less than 10 micrometers in diameter (PM_{10}) from environmental dust, the PM_{10} overall short-term health risk was not evaluated due to insufficient data. For inhalable fine PM less than 2.5 micrometers in diameter ($PM_{2.5}$) from environmental dust, the $PM_{2.5}$ overall short-term health risk was not evaluated due to insufficient data. However, the Al Asad AB area is an arid and dust-prone desert environment, also subject to vehicle traffic. Consequently, exposures to PM_{10} and $PM_{2.5}$ may vary, as conditions may vary, and 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, particularly exposures to high levels of dust such as during high winds or dust storms. 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. A burn pit is located at Al Asad AB; however, the PM_{10} and the $PM_{2.5}$ overall short-term health risks specifically for burn pits were not evaluated due to insufficient environmental samples collected near burn pits provided for analysis– see Section 10.8. Where burn pits exist, exposures may vary, and exposures to high levels of PM_{10} and $PM_{2.5}$ from smoke may 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. Although most short-term health effects from exposure to PM 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 while at Al Asad AB. Personnel who reported with symptoms or required treatment while at site(s) with burn pit activity should have exposure and treatment noted in medical record (e.g., electronic medical record and/or on a (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 Al Asad AB, Iraq:

Air quality: For inhalable fine PM less than 2.5 micrometers in diameter ($PM_{2.5}$) from environmental dust, the overall long-term health risk was not evaluated due to insufficient data. Inhalable coarse PM less than 10 micrometers in diameter (PM_{10}) from environmental dust was not evaluated for long-term health risk due to no available health guidelines. However, the Al Asad AB area is an arid and dust-prone desert environment, also subject to vehicle traffic, and conditions may have varied. A burn pit is located at Al Asad AB; however, the PM_{10} and the $PM_{2.5}$ overall long-term health risks specifically for burn pits were not evaluated due to insufficient environmental samples collected near burn pits provided for analysis– see Section 10.8. However, burn pit exposures may vary, as conditions may have varied. For inhalational exposure to high levels of dust containing PM_{10} and $PM_{2.5}$, such as during high winds or dust storms, and for exposures to burn pit smoke, it

Long-term health risks & medical implications (continued):
is considered possible that some otherwise healthy personnel, who were exposed for a long-term period to dust and PM, 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 dust and PM exposures and exposures to burn pits are acknowledged, at this time there were 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/barrels, incinerators, occupational or specific personal dosimeter data) 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 – Al Asad AB, Iraq [1, 2]

Source of Identified Health Risk[3]	Unmitigated Health Risk Estimate[4]	Control Measures Implemented	Residual Health Risk Estimate[4]
AIR			
Particulate matter less than 10 micrometers in diameter (PM_{10})	Short-term: No data available. Daily levels vary; acute health effects (e.g., upper respiratory tract irritation) more pronounced during peak days. More serious effects are possible in susceptible persons (e.g., those with asthma/existing respiratory diseases).	Limiting strenuous physical activities when air quality is especially poor; and actions such as closing tent flaps, windows, and doors.	Short-term: No data available. Daily levels vary; acute health effects (e.g., upper respiratory tract irritation) more pronounced during peak days. More serious effects are possible in susceptible persons (e.g., those with asthma/existing respiratory diseases).
	Long-term: No health guidelines and insufficient data were available for health risk analysis.		Long-term: No health guidelines and insufficient data were available for health risk analysis.
Particulate matter less than 2.5 micrometers in diameter ($PM_{2.5}$)	Short-term: Data not representative of annual exposure and insufficient to characterize risk. Daily levels vary; acute health effects (e.g., upper respiratory tract irritation) more pronounced during peak days. More serious effects are possible in susceptible persons (e.g., those with asthma/existing respiratory diseases).	Limiting strenuous physical activities when air quality is especially poor; and actions such as closing tent flaps, windows, and doors.	Short-term: Data not representative of annual exposure and insufficient to characterize risk. Daily levels vary; acute health effects (e.g., upper respiratory tract irritation) more pronounced during peak days. More serious effects are possible in susceptible persons (e.g., those with asthma/existing respiratory diseases).
	Long-term: Data not representative of annual exposure and insufficient to characterize risk. A small percentage of personnel may be at increased risk for developing chronic conditions, particularly those more susceptible to acute effects (e.g., those with asthma/pre-existing respiratory diseases).		Long-term: Data not representative of annual exposure and insufficient to characterize risk. A small percentage of personnel may be at increased risk for developing chronic conditions, particularly those more susceptible to acute effects (e.g., those with asthma/pre-existing respiratory diseases).
ENDEMIC DISEASE			
Food borne/Waterborne (e.g., diarrhea-bacteriological)	Short-term: High, (Bacterial diarrhea, Hepatitis A, Typhoid fever) to Moderate (Diarrhea-cholera, Diarrhea-protozoal, Brucellosis, 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
	Long-term: Not an identified source of health risk.		Long-term: No data available
Arthropod Vector Borne	Short-term: Moderate (Leishmaniasis-cutaneous, Leishmaniasis- visceral, Crimean-Congo hemorrhagic fever, Sandfly fever) to Low (Sindbis, Rickettsioses, Typhus-murine, West Nile fever).	Preventive measures include proper wear of treated uniform, application of repellent to exposed skin and bed net use.	Short-term: Low

Source of Identified Health Risk[3]	Unmitigated Health Risk Estimate[4]	Control Measures Implemented	Residual Health Risk Estimate[4]
	Long-term: Low (Leishmaniasis-visceral infection)		Long-term: No data available
Water-Contact (e.g., wading, swimming)	Short-term: Moderate for Leptospirosis and Schistosomiasis.	Control measures implemented: Avoid water contact and recreational water activities, properly wear of the uniform (especially footwear), and utilize protective coverings for cuts/abraded skin.	Short-term: Low to none Leptospirosis and Schistosomiasis.
	Long-term: No data available		Long-term: No data available
Respiratory	Short-term: Moderate [Tuberculosis (TB)] and Low (Meningococcal meningitis, Middle East Respiratory Syndrome-Coronavirus).	Providing adequate work and living space; medical screening, and vaccination.	Short-term: Low to none
	Long-term: No data available		Long-term: No data available
Animal Contact	Short-term: Moderate (Rabies and Q-fever), Low (Anthrax and Avian Influenza)	Prohibiting contact with, adoption, or feeding of feral animals in accordance with (IAW) U.S. Central Command (CENTCOM) General Order (GO) 1B. Risks are further reduced in the event of assessed contact by prompt post-exposure rabies prophylaxis IAW The Center for Disease Control's (CDC) Advisory Committee on Immunization Practices guidance.	Short-term: Low to none
	Long-term: Low (Rabies)		Long-term: No data available
Soil-Contact	Short-term: Moderate [soil transmitted helminthes (hookworm, strongyloidiasis, cutaneous larva migrans)].	Risk reduced by avoiding/minimizing contact with soil.	Short-term: Low
	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., *Scorpiops lindbergi*) to potentially lethal effects (e.g., *Gloydius halys*).	Risk reduced by avoiding contact, proper wear of the uniform (especially footwear), and timely treatment.	Short-term: Low, if encountered, effects of venom vary with species from mild localized swelling (e.g., *Scorpiops lindbergi*) to potentially lethal effects (e.g., *Gloydius halys*).
	Long-term: Not an identified source of health risk.		Long-term: No data available
HEAT/COLD STRESS			
	Short-term: Low to Moderate		Short-term: Low

Source of Identified Health Risk[3]	Unmitigated Health Risk Estimate[4]	Control Measures Implemented	Residual Health Risk Estimate[4]
Heat	Long-term: Low, However, the health 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.	Work-rest cycles, proper hydration and nutrition, and Wet Bulb Globe Temperature (WBGT) monitoring.	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	Short-term: Low	Risks from cold stress reduced with protective measures such as use of the buddy system, limiting exposure during cold weather, proper wear of issued protective clothing, and proper nutrition and hydration.	Short-term: Low risk of cold stress/injury.
	Long-term: Low, Long-term health implications from cold injuries were rare but could occur, especially from more serious injuries such as frostbite.		Long-term: Low; Long-term health implications from cold injuries were rare but could occur, especially from more serious injuries such as frostbite.
NOISE			
Continuous (Flightline, Power Production)	Short-term: High to Low, High risk to individuals working near major noise sources without proper hearing protection.	Hearing protection used by personnel in higher risk areas	Short-term: Low risk to the majority of personnel and to individuals working near major noise sources who use proper hearing protection.
	Long-term: High to Low, High risk to individuals working near major noise sources without proper hearing protection.		Long-term: Low risk to the majority of personnel and to individuals working near major noise sources who use proper hearing protection.
UNIQUE INCIDENTS/ CONCERNS			
Burn Pits	Short-term: Insufficient data to evaluate health risk; however, there is a burn pit located at Al Asad AB – see section 10.8. Exposure to burn pit (or incinerator or burn barrel) smoke is variable. Exposure to high levels of PM_{10} and $PM_{2.5}$ from smoke may 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.	Risks reduced by limiting strenuous physical activities when air quality is especially poor; and action such as closing tent flaps, windows, and doors. Other control measures include locating burn pits downwind of prevailing winds, increased distance from troop populations, and improved waste segregation and management techniques.	Short-term: Insufficient data to evaluate health risk; however, there is a burn pit located at Al Asad AB – see section 10.8. Exposure to burn pit (or incinerator or burn barrel) smoke is variable. Exposure to high levels of PM_{10} and $PM_{2.5}$ from smoke may 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.

Source of Identified Health Risk[3]	Unmitigated Health Risk Estimate[4]	Control Measures Implemented	Residual Health Risk Estimate[4]
	Long-term: Insufficient data to evaluate health risk and no available guidelines for PM_{10}; however, there is a burn pit located at Al Asad AB – see section 10.8. Exposure to burn pit (or incinerator or burn barrel) smoke is variable. Exposure to high levels of PM_{10} and $PM_{2.5}$ in the smoke may be associated with some otherwise healthy personnel, who were exposed for a long-term period, possibly developing 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.		Long-term: Insufficient data to evaluate health risk and no available guidelines for PM_{10}; however, there is a burn pit located at Al Asad AB – see section 10.8. Exposure to burn pit (or incinerator or burn barrel) smoke is variable. Exposure to high levels of PM_{10} and $PM_{2.5}$ in the smoke may be associated with some otherwise healthy personnel, who were exposed for a long-term period, possibly developing 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.

[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 Al Asad AB. 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 is based on specific environmental sampling data and reports obtained from September 2014 through December 2015. Sampling locations are assumed to be representative of exposure points for the camp population but may not reflect all the fluctuations in environmental quality or capture unique exposure incidents.

[3] This Summary Table is organized by major categories of identified sources of health risk. It only lists those sub-categories specifically identified and addressed at Al Asad AB. The health risks are presented as Low, Moderate, High or Extremely High for both short- and long-term health effects. The health risk level is based on an assessment of both the potential severity of the health effects that could be caused and probability of the exposure that would produce such health effects. Details can be obtained from the U.S. Army Public Health Center (Provisional) [APHC (Prov)]. Where applicable, "None Identified" is used when a potential exposure was identified, no health risk of either a specific short- or long-term health effects were determined. More detailed descriptions of OEH exposures that were evaluated but determined to pose no health risk are discussed in the following sections of this report.

[4] Health risks in this Summary Table are 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 Al Asad AB, Iraq by Source

The following sections provide additional information about the OEH conditions summarized above. All risk assessments were performed using the methodology described in the U. S. Army Public Health Command Technical Guide 230, *Environmental Health Risk Assessment and Chemical Exposure Guidelines for Deployed Military Personnel* (Reference 5). All OEH risk estimates represent residual risk after accounting for preventive controls in place. Occupational exposures and exposures to endemic diseases are greatly reduced by preventive measures. For environmental exposures related to airborne dust, there are limited preventive measures available, and available measures have little efficacy in reducing exposure to ambient conditions.

The ProUCL version 5.0 software package was used for statistical analyses (Reference 6). Means are followed by standard deviation (SD). Risk characterization was based on the 95% upper confidence level of the arithmetic mean (95% UCL) or the arithmetic mean depending on the quality and quantity of the data being evaluated. The sample mean is an uncertain estimate of the true mean of the population exposure point concentration (PEPC). The 95% UCL reduces the uncertainty inherent in the sample mean and states with a higher level of confidence that the mean PEPC is no greater than the 95% UCL.

2 Air

2.1 Site-Specific Sources Identified

Personnel deployed to Al Asad AB were exposed to various airborne contaminants as identified by monitoring and sampling efforts between September 2014 and December 2015. Sources of airborne contaminants at the base camp included diesel vehicle and generator exhaust, dust from unpaved roads and surfaces, operation of one cement plant, aircraft exhaust, incinerators, and burn pits. In addition, dust storms, periods of high winds, and vehicle traffic passing through moon dust (very fine silts with the consistency of talcum powder) contributed to PM exposures above health-based MEGs at Al Asad AB.

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

2.2.1 Exposure Guidelines:

Short-term (24-hour) PM_{10} (micrograms per cubic meter, ($\mu g/m^3$):

- Negligible MEG = 250
- Marginal MEG = 420
- Critical MEG = 600

Long-term PM_{10} MEG ($\mu g/m^3$):

- Not defined and not available.

2.2.2 Sample data/Notes:

There were no PM_{10} samples from Al Asad AB.

2.2.3 Short-term and long-term health risks:

Not Evaluated.

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

2.3.1 Exposure Guidelines:

Short-term (24-hour) $PM_{2.5}$ ($\mu g/m^3$):
- Negligible MEG = 65
- Marginal MEG = 250
- Critical MEG = 500

Long-term (1-year) $PM_{2.5}$ MEGs ($\mu g/m^3$):
- Negligible MEG = 15
- Marginal MEG = 65

2.3.2 Sample data/Notes:

Twenty-five valid $PM_{2.5}$ samples were collected in February (n=7), April (n=10) and September (n=8) 2015. The range of 24-hour $PM_{2.5}$ concentrations was 15 $\mu g/m^3$ – 375 $\mu g/m^3$ with an average concentration of 104 $\mu g/m^3$, SD=86. There were no sampling data for 2014.

2.3.3 Short-term and long-term health risks:

Not Evaluated. The data were not representative of annual exposure and were insufficient to characterize the potential short-term and long-term health risks from $PM_{2.5}$ exposure to U.S. personnel.

2.4 Airborne Metals from PM_{10} and $PM_{2.5}$:

2.4.1 Samples data/Notes:

Twenty-five valid $PM_{2.5}$ airborne metal samples were collected at Al Asad AB in 2015 only. There were no sampling data for 2014. There were no PM_{10} airborne metal samples.

2.4.2 Short-term and long-term health risks:

No metals exceeded their respective Negligible MEGS. However, data were not representative of annual exposure and were insufficient to characterize the potential short-term and long-term health risks from $PM_{2.5}$ airborne metal exposure to U.S. personnel.

2.5 Volatile Organic Compounds (VOCs)

The likely sources of VOCs on Al Asad AB were the result of fuel storage and transfers between storage tanks, vehicles and aircraft and vehicle and aircraft emissions.

2.5.1 Sample data/Notes:

Thirteen valid VOC air samples were collected at Al Asad AB in February (three samples), April (six samples) and September (four samples) 2015. There were no sampling data for 2014.

2.5.2 Short-term and long-term health risks:

No VOCs exceeded their respective Negligible MEGS. The data were not representative of annual exposure and were insufficient to characterize the potential short-term and long-term health risks from VOCs exposure to U.S. personnel.

3 Soil

3.1 Site-Specific Sources Identified

3.1.1 Sample data/Notes:

Three valid soil samples were collected at Al Asad AB in February (one sample) and April (two samples) 2015. The three composite samples were taken at the running track, in the living area, and in the burn pit area. There were no sampling data for 2014.

The primary soil contamination exposure pathways are via dermal contact and dust inhalation. Typical parameters analyzed for included semi volatile organic compounds (SVOCs), heavy metals, polychlorinated biphenyls (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 this location for 6 months to 1 year.

3.1.2 Short-term health risk:

Currently, sampling data for soil are not evaluated for short-term (acute) health risks.

3.1.3 Long-term health risk:

No parameters exceeded 1-year Negligible MEGs.

4 Water

In order to assess the risk to U.S. personnel from exposure to water in theater, the Army Public Health Center (Provisional) (APHC (Prov)) identified the most probable exposure pathways based on available information. The water exposures considered were the ingestion of water used for drinking and the use of water for non-drinking purposes (such as personal hygiene, or showering).

4.1 Drinking Water

4.1.1 Site-Specific Sources Identified:

There were no drinking water samples from Al Asad AB.

4.1.2 Short-term and long-term health risks:

Not Evaluated.

4.2 Water: Used for Other Purposes (Personal Hygiene, Showering, etc.)

U.S. personnel used the ROWPU-treated water supply and raw well water at Al Asad AB for non-drinking purposes (i.e., personal hygiene, and showering, etc.).

4.2.1 Sample data/Notes:

Six valid water samples representing non-drinking water were collected 2015 from ROWPU-treated water (three samples) and untreated, raw well water sources (three samples). There were no sampling data for 2014.

4.2.2 Short-term and long-term health risks:

Chloride (2,900 milligram/Liter (mg/L)) exceeded its respective 14-day 15L/day MEG (1500 mg/L). However, the data were not representative of annual exposure and were insufficient to characterize the potential short-term and long-term health risks from nondrinking water exposure to U.S. personnel.

5 Military Unique

5.1 Chemical Biological, Radiological, Nuclear (CBRN) Weapons

No specific hazard sources were documented in the Defense Occupational and Environmental Health Readiness System (DOEHRS) or the Military Exposure Surveillance Library (MESL) from September 2014 to December 2015 timeframe (References 1 and 7).

5.2 Depleted Uranium (DU)

No specific hazard sources were documented in the DOEHRS or the MESL from September 2014 to December 2015 timeframe (References 1 and 7).

5.3 Ionizing Radiation

No specific hazard sources were documented in the DOEHRS or the MESL from September 2014 to December 2015 timeframe (References 1 and 7).

5.4 Non-Ionizing Radiation

No specific hazard sources were documented in the DOEHRS or the MESL from September 2014 to December 2015 timeframe (References 1 and 7).

6 Endemic Diseases

This document lists the endemic diseases reported in the region, its specific health risks and severity and general health information about the diseases. CENTCOM Modification (MOD) 12 (Reference 8) lists deployment requirements, to include immunizations and chemoprophylaxis, in effect during the timeframe of this POEMS.

6.1 Foodborne and Waterborne Diseases

Foodborne 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. Key disease risks are summarized below:

Mitigation strategies were in place and included consuming food and water from approved sources, vaccinations (when available), frequent hand washing, and general sanitation practices.

6.1.1 Diarrheal diseases (bacteriological):

High, mitigated to Low: Unmitigated health risk to U.S. personnel was High year round. Diarrheal diseases (bacteriological) could be 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 facilitate person-to-person spread and epidemics. Typically, these result in 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:

High, mitigated to Low: Unmitigated health risk to U.S. personnel was High year round. U.S. Personnel did not drink untreated water, and vaccination for Hepatitis A is required for deployment into the CENTCOM Area of Responsibility (AOR). Hepatitis A typically occurs after consumption of fecally contaminated food or water or through direct fecal-oral transmission under conditions of poor hygiene and sanitation. Field conditions (including primitive sanitation, lack of hand washing) may facilitate outbreaks driven by person-to-person spread. A typical case involves 1 to 3 weeks of debilitating symptoms, sometimes initially requiring inpatient care; recovery and return to duty may require a month or more.

6.1.3 Typhoid/paratyphoid Fever:

High, mitigated to Low: Unmitigated health risk to U.S. personnel was High year round. Risk was typically highest following spring floods. Typhoid and paratyphoid fever are acquired through the consumption of fecally contaminated food or water. The two diseases are clinically similar, and in areas where they are endemic, typhoid typically accounts for 90% of cases. Asymptomatic carriers are common with typhoid and contribute to sustained transmission. In countries with a mixture of primitive and modern sanitation and hygiene, outbreaks of typhoid fever can occur and may involve all age groups. A small number of cases (less than 1% per month attack rate) could occur among unvaccinated personnel consuming local food, water, or ice. With appropriate treatment, typhoid and paratyphoid fever are debilitating febrile illnesses typically requiring 1 to 7 days of supportive care, followed by return to duty.

6.1.4 Diarrhea – protozoal:

Moderate, mitigated to Low: Unmitigated health risk to U.S. personnel was Moderate year round. Risk was typically highest following spring floods. In general, *Cryptosporidium* spp., *Entamoeba histolytica*, and *Giardia lamblia* were the most common protozoal causes of diarrhea wherever sanitary conditions were significantly below U.S. standards. A small number of cases (less than 1% per month attack rate) could occur among personnel consuming local food, water, or ice. Outbreaks affecting a higher percentage of personnel were possible with *Cryptosporidium*. Symptomatic cases may vary in severity; typically mild disease demonstrating recovery and return to duty in less than 72 hours with appropriate therapy; severe cases may require 1 to 7 days of supportive care, followed by return to duty.

6.1.5 Brucellosis:

Moderate, mitigated to Low: Unmitigated health risk to U.S. personnel was Moderate year round. Brucellosis is a common disease in cattle, sheep, goats, swine, and some wildlife species in most developing countries. Humans contract brucellosis through consumption of contaminated dairy products (or foods made with such products) or by occupational exposures to infected animals. The health risk from direct animal contact was likely to be highest in rural areas where livestock were present. The health risk from contaminated dairy products exists countrywide, including urban areas. Rare cases (less than 0.1% per month attack rate) could occur among personnel consuming local dairy products or having direct contact with livestock. With appropriate treatment, brucellosis is a febrile illness of variable severity, potentially requiring inpatient care; convalescence is usually over 7 days even with appropriate treatment.

6.1.6 Diarrhea – cholera:

Moderate, mitigated to Low: Unmitigated health risk to U.S. personnel was Moderate year round. Development of symptomatic cholera requires exposure to large inoculums and typically is associated with ingestion of heavily contaminated food or water. Person-to-person spread of cholera occurs very infrequently, if at all. The majority of infections (75% or more, depending on biotype) among healthy adults are very mild or asymptomatic. Only a small percentage of infections are severe. Because cholera frequently causes serious public health impact, cholera cases are more likely to be reported under the International Health Regulations than other types of diarrhea. Rare cases (less than 0.1% per month attack rate) could occur among personnel consuming local food, water, or ice. Most symptomatic cases are mild, with recovery and return to duty in less than 72 hours on appropriate outpatient treatment; severe cases may require 1-7 days of supportive or inpatient care, followed by return to duty.

6.1.7 Hepatitis E:

Moderate, mitigated to Low: Unmitigated health risk to U.S. personnel was Moderate year round. Risk was typically highest following spring floods. Hepatitis E occurs in four major genotypes. Genotypes 1 and 2, found primarily in Africa and Asia, cause large numbers of sporadic cases, as well as large outbreaks. Fecal contamination of drinking water is the most common source of exposure for these genotypes. Large outbreaks are usually associated with particularly severe breakdowns in baseline sanitation, as often occurs during heavy rainfall which increases mixing of sewage and drinking water sources. Secondary household cases from person-to-person transmission are uncommon. Unlike hepatitis A, where local populations living in poor sanitary conditions were usually highly immune from childhood exposures,

immunity levels for hepatitis E were often much lower, even in areas of extremely poor sanitation. Typically, outbreaks of hepatitis E occur primarily among adults. Although data are insufficient to assess potential disease rates, we cannot rule out rates approaching 1% per month among personnel consuming local food, water, or ice. Rates may exceed 1% per month for personnel heavily exposed during outbreaks in the local population. Typical case involves 1 to 3 weeks of debilitating symptoms, sometimes initially requiring inpatient care; recovery and return to duty may require a month or more.

6.1.8 Short-term health risk:

Low: The overall short-term unmitigated health risk associated with other foodborne and waterborne diseases at Al Asad AB was considered High (bacterial diarrhea, hepatitis A, typhoid fever) and Moderate (diarrhea-protozoal, diarrhea-cholera, brucellosis, hepatitis E) if local food or water was consumed. Confidence in the risk estimate was medium.

6.1.9 Long-term health risk:

None identified based on available data. Confidence in the risk estimate was medium.

6.2 Arthropod Vector-Borne Diseases

During the warmer months, the climate and ecological habitat support populations of arthropod vectors, including mosquitoes, ticks, mites, and sandflies. Significant disease transmission is sustained countrywide, including urban areas. Mitigation strategies were in place and included proper wear of treated uniforms, application of repellent to exposed skin, and use of bed nets and chemoprophylaxis (when applicable). Additional methods included the use of pesticides, reduction of pest/breeding habitats, and engineering controls.

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, mitigated to Low: Unmitigated health risk to U.S. personnel was Moderate with seasonal transmission (March-November). Leishmaniasis is transmitted by sand flies. A small number of cases (less than 1% per month attack rate) could occur among personnel exposed to sandfly bites in areas with infected people, rodents, dogs, or other reservoir animals. In groups of personnel exposed to heavily infected sandflies in focal areas, attack rates can be very high (over 50%). 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 Sandfly fever:

Moderate, mitigated to Low: Unmitigated health risk to U.S. personnel was Moderate with seasonal transmission (May-June and September-October). The disease is transmitted by sandflies, which typically bite at night and breed in dark places rich in organic matter, particularly in rodent or other animal burrows. Rare cases are possible. Although data are insufficient to assess potential disease rates, 1% to 10% of personnel could be affected per month; under worst conditions disease rates can be as high as 50% with no mitigation measures in place. Incidents can result in debilitating febrile illness typically requiring 1 to 7 days of supportive care followed by return to duty.

6.2.4 Crimean-Congo hemorrhagic fever:

Moderate, mitigated to Low: Unmitigated health risk to U.S. personnel was Moderate year round. Crimean-Congo hemorrhagic fever (CCHF) infections can occur as sporadic cases or clusters of cases, and are associated with tick bites or occupational contact with blood or secretions from infected animals. Outbreaks of CCHF occur infrequently. It is a very severe illness typically requiring intensive care with fatality rates from 5% to 50%.

6.2.5 Sindbis (and Sindbis-like viruses):

Low: Unmitigated health risk to U.S. personnel was Low with seasonal transmission (April-November). 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.

6.2.6 Rickettsioses, tickborne (spotted fever group):

Low: Unmitigated health risk to U.S. personnel was Low with seasonal transmission (April-November). 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.

6.2.7 Typhus-murine (fleaborne):

Low: Unmitigated health risk to U.S. personnel was Low year round. Typhus-murine is assessed as present, but at unknown levels. Rare cases are possible among personnel exposed to rodents (particularly rats) and fleabites. 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: Unmitigated health risk to U.S. personnel was Low with seasonal transmission (April-November). West Nile fever was present and maintained by the bird population and mosquitoes that help to transfer the diseases from birds to humans. The majority of infections in young, healthy adults are asymptomatic although it can result in fever, headache, tiredness, and body aches, occasionally with a skin rash (on the trunk of the body) and swollen lymph glands. West Nile fever is a febrile illness typically requiring 1-7 days of inpatient care followed by return to duty; convalescence may be prolonged.

6.2.9 Short-term health risk:

Low: The overall short-term unmitigated health risk associated with arthropod vector-borne diseases at Al Asad AB was considered Moderate (for sandfly fever, leishmaniasis (cutaneous and visceral), and Crimean-Congo hemorrhagic fever) and Low (for rickettsioses, typhus-murine (fleaborne), West Nile fever, and sindbis). Preventive measures such as proper wear of treated uniforms and application of repellent to exposed skin reduced the health risk to Low to none for arthropod vector-vector borne diseases. Confidence in the risk estimate was medium.

6.2.10 Long-term health risk:

Low: The unmitigated risk is Moderate for leishmaniasis-visceral (chronic). Risk was 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. Mitigation strategies were in place and included avoiding water contact and recreational water activities, proper wear of uniform (especially footwear), and protective coverings for cuts/abraded skin.

6.3.1 Leptospirosis:

Moderate, mitigated to Low: Unmitigated health risk to U.S. personnel was Moderate with seasonal transmission (April-November). Human infections occur 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 *Leptospira* present in the soil passes directly into surface waters. *Leptospira* 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.

6.3.2 Schistosomiasis:

Moderate, mitigated to Low: Unmitigated health risk to U.S. personnel was Moderate with seasonal transmission (April-November). 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 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.

6.3.3 Short-term health risk:

Low: The overall short-term unmitigated health risk associated with water contact diseases at Al Asad AB was considered Moderate (for leptospirosis and schistosomiasis). Preventive measures such as avoiding water contact and recreational water activities and protective coverings for cuts/abraded skin reduced the health risk from low to none. Confidence in the risk estimate was medium.

6.3.4 Long-term health risk:

None identified based on available data. Confidence in the risk estimate was medium.

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. Mitigation strategies were in place and included routine medical screenings, vaccination, enforcing minimum space allocation in housing units, implementing head-to-toe sleeping in crowded housing units, implementation of proper PPE when necessary for healthcare providers and detention facility personnel.

6.4.1 Tuberculosis (TB):

Moderate, mitigated to Low: Unmitigated health risk to U.S. personnel was Moderate year round. Tuberculosis (TB) is usually transmitted through close and prolonged exposure to an active case of pulmonary or laryngeal TB, but can also occur with incidental contact. Individuals with prolonged indoor exposure to the local population are at increased risk for latent TB infection.

6.4.2 Meningococcal meningitis:

Low: Unmitigated health risk to U.S. personnel was Low year round. Meningococcal meningitis is transmitted from person to person through droplets of respiratory or throat secretions. Risk is comparable to the U.S. among unvaccinated personnel who have close contact with the local population. Close and prolonged contact facilitates the spread of this disease. Meningococcal meningitis is a potentially very severe disease typically requiring intensive care; fatalities may occur in 5-15% of cases.

6.4.3 Middle East Respiratory Syndrome-Coronavirus (MERS-CoV):

Low: Unmitigated health risk to U.S. personnel was Low year round. Although no cases have been reported in Iraq, Middle East respiratory syndrome coronavirus (MERS-CoV) is known to occur within the region. Most MERS patients developed severe acute respiratory illness with symptoms of fever, cough, and shortness of breath. MERS-CoV has spread from ill people to others through close contact, such as caring for or living with an infected person. The incubation period for MERS-CoV is usually about 5 to 6 days, but can range from 2 to 14 days. Currently, there is no vaccine to prevent MERS-CoV infection.

6.4.4 Short-term health risk:

Low: The overall short-term unmitigated health risk associated with respiratory diseases at Al Asad AB was considered Moderate (for tuberculosis) to Low (for meningococcal meningitis and MERS-CoV). Preventive measures such as vaccination and routine medical screenings reduced the health risk to low to none. Confidence in the risk estimate was medium.

6.4.5 Long-term health risk:

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, mitigated to Low: Unmitigated health risk to U.S. personnel was Moderate year round. Occurrence in local animals was well above U.S. levels due to the lack of organized control programs. Dogs were the primary reservoir of rabies in Iraq, and a frequent source of human exposure. In June 2008, the New Jersey Health department in The United States reported a confirmed case of rabies in a mixed-breed dog recently imported from Iraq (Reference 9). 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. No cases of rabies acquired in Iraq have been identified in U.S. Service Members to date. The vast majority (>99%) of persons who develop rabies disease will do so within a year after a risk exposure, there have been rare reports of individuals presenting with rabies disease up to 6 years or more after their last known risk exposure. Mitigation strategies included command emphasis of CENTCOM GO 1B, reduction of animal habitats, active pest management programs, and timely treatment of feral animal scratches/bites.

6.5.2 Q-Fever:

Moderate, mitigated to Low: Unmitigated health risk to U.S. personnel was Moderate year round. Rare cases were possible among personnel exposed to aerosols from infected animals, with clusters of cases possible in some situations. Significant outbreaks (affecting 1-50%) could 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. Q-Fever is a debilitating febrile illness, sometimes presenting as pneumonia, typically requiring 1 to 7 days of inpatient care followed by return to duty. Mitigation strategies include consuming approved food sources, avoidance of animals and farms, dust abatement when working in these areas (wet mop, water sprayed on high volume traffic areas, etc.), and proper PPE for personnel working with animals, and immunization.

6.5.3 Anthrax:

Low: Unmitigated health risk to U.S. personnel was Low year round. Cutaneous and gastrointestinal anthrax are the most common forms of naturally occurring infection; cutaneous anthrax is transmitted by direct contact with infected animals or carcasses, including hides. Eating undercooked infected meat can result in contracting gastrointestinal anthrax. Pulmonary anthrax is contracted through inhalation of spores and is extremely rare. Cutaneous anthrax typically requires 1 to 7 days of supportive care with subsequent return to duty; gastrointestinal anthrax typically requires hospitalization, and has a high fatality rate if untreated. Mitigation strategies include consuming approved food sources, avoidance of animals and farms, dust abatement when working in these areas (wet mop, water sprayed on high volume traffic areas, etc.), and proper PPE for personnel working with animals, and immunization.

6.5.4 Avian Influenza:

Low: Unmitigated health risk to U.S. personnel was Low year round. Although avian influenza (AI) is easily transmitted among birds, bird-to-human transmission is extremely inefficient. Human-to-human transmission appears to be exceedingly rare, even with relatively close contact. Extremely rare cases (less than 0.01% per month attack rate) could occur. Incidence could result in very severe illness with fatality rate higher than 50% in symptomatic cases. Mitigation strategies included avoidance of birds/poultry and proper cooking temperatures for poultry products.

6.5.5 Short-term health risk:

Low to None: The overall short-term unmitigated health risk associated with animal contact diseases at Al Asad AB was considered Moderate (for rabies, Q-fever) to Low (for anthrax, avian influenza). Preventive measures such as consuming approved food sources;

immunization; and avoidance of animals and farms reduced the health risk to low to none. Confidence in risk estimate was medium.

6.5.6 Long-term health risk:

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

6.6 Soil-transmitted helminths (hookworm, strongyloidiasis, cutaneous larva migrans)

Low: Unmitigated health risk to U.S. personnel was Low with seasonal transmission (April-November). Risk reduced with mitigation measures. A small number of cases (less than 0.1% per month attack rate) could occur among personnel with direct skin exposure to soil contaminated with human or animal feces (including sleeping on bare ground, walking barefoot). Initial skin symptoms typically are mild and are not debilitating. However, systemic symptoms of fever, cough, abdominal pain, nausea, and diarrhea may develop weeks to months after initial infection with hookworm or *Strongyloides*. More severe infections with high worm burden may be debilitating in some cases. Rates of infection in U.S. personnel will be highly variable, depending on specific local environmental conditions. Rates of infection in U.S. personnel are expected to be less than 1% per month in most locations. However, rates in some focal areas with heavily contaminated soil could exceed 1% per month.

6.6.1 Short-term health risks:

Low: Low for soil transmitted helminthes. Overall risk was further reduced with mitigation measures. Confidence in the health risk estimate is high.

6.6.2 Long-term health risks:

None identified based on available data.

7 Venomous Animals

All information was taken directly from the Armed Forces Pest Management Board (Reference 10) and the Clinical Toxinology Resources web site from the University of Adelaide, Australia (Reference 11). The species listed below have home ranges that overlap the location of Al Asad AB, and may present a health risk if they are encountered by personnel. See Section 10.3 for more information about pesticides and pest control measures.

7.1 Spiders

- *Latrodectus pallidus*: Clinical effects uncertain, but related to medically important species, therefore major 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 jakesi*, *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 this species fits 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 cerastes* (horned viper) and *Cerastes gasperettii* (Gasperetti's horned viper): Potentially lethal envenoming, though unlikely.
- *Echis sochureki* (Sochurek's saw-scaled viper): *M*oderate to severe, potentially lethal envenoming.
- *Malpolon moilensis* (Hooded Malpolon), *Malpolon monspessulanus* (Montpellier snake),
  Pseudocyclophis Persicus (Persian horned viper)*, and Pseudocerastes persicus fieldi* (Field's horned viper): Clinical effects unknown, but unlikely to cause significant envenoming.
- *Macrovipera lebetina* subspecies e*uphratica* and subspecies *obtuse* (Levantine viper),*and*
  Vipera albicornuta (white-horned viper) and *Walternnesia aegyptia* (black desert cobra): Severe envenoming possible, potentially lethal.

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*). Confidence in the health risk estimate is low (Reference 5, Table 3-6).

7.5 Long-term health risk

None identified.

8 Heat/Cold Stress

Average temperatures in Iraq range from higher than 118 degrees Fahrenheit (°F) in July and August to below freezing in January based on historical climatological data from the U.S. Air Force Combat Climatology Center, 14th Weather Squadron (Reference 12). Most of the rainfall occurs from December through April and averages between 3.9 - 7.1 inches annually. Roughly, 90% of the annual rainfall occurs between November and April, most of it in the winter months from December through March. The remaining six months, particularly the hottest ones of June, July, and August, are dry.

The summer months are marked by two kinds of wind phenomena. The southern and southeasterly *sharqi*, a dry, dusty wind with occasional gusts of 50 miles per hour, occurs from

April to early June and again from late September through November. It may last for a day at the beginning and end of the season but for several days at other times. This wind is often accompanied by violent dust storms that may rise to heights of several thousand meters (m) and close airports for brief periods. From mid-June to mid-September the prevailing wind, called the shamal, is from the north and northwest. It is a steady wind, absent only occasionally during this period. The very dry air brought by this shamal permits intensive sun heating of the land surface, but the breeze has some cooling effect. Heat stress/injuries and cold stress/injuries are largely dependent on operational and individual factors instead of environmental factors alone (Reference 13).

8.1 Heat

8.1.1 Short-term health risk:

Low: The short-term health risk of heat injury was High in unacclimated personnel. Preventive measures such as work-rest cycles; and proper hydration reduced the health risk to low.

8.1.2 Long-term health risk:

Low: The long-term health 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 health implications from heat injuries were rare but could occur–especially from more serious heat injuries such as heat stroke. It was possible that high heat in conjunction with various chemical exposures could increase long-term health risks, though specific scientific evidence was not conclusive. Confidence in these risk estimates was medium.

8.2 Cold

Short-term and Long-term health risks: The risk of cold injury was Low. Confidence in this risk estimate was medium.

9 Noise

9.1 Continuous:

Aircraft operations have the potential to cause significant noise hazard to flight line and helicopter landing zone support personnel. Because of the potential noise hazard inherent in the helicopter landing zone, personnel are required to wear dual hearing protection when working on the flightline.

Personnel residing in close proximity to generators will routinely be exposed to noise levels as high as 82.0 decibels (dB). Although this is below the 85 dB threshold requiring hearing protection, it still presents a concern for hearing conservation.

9.1.1 Short-term health risk:

Low: The short-term risk of noise injury with appropriate hearing protection use is Low. Few exposed personnel (if any) are expected to have noticeable health effects during mission.

9.1.2 Long-term health risk:

Low to Moderate: The long-term risk of noise injury with appropriate hearing protection use is Low with few exposed personnel (if any) are expected to develop delayed onset, irreversible effects. If protective measures are not used, the risk is elevated to Moderate and many exposed personnel are plausibly expected to develop delayed onset, irreversible effects.

9.2 Impulse:

No specific hazard sources were documented in the DOEHRS or the MESL from September 2014 to December 2015 (References 1 and 7).

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 exposures last, what is 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 Fuel/Petroleum Products/Industrial Chemical Spills

No specific hazard sources were documented in the DOEHRS or the MESL from September 2014 to December 2015 (References 1 and 7).

10.3 Pesticides/Pest Control

No specific hazard sources were documented in the DOEHRS or the MESL from September 2014 to December 2015 (References 1 and 7).

10.4 Waste Sites/Waste Disposal

A 100 square meter (m^2) burn pit was constructed 100 m west of the camp for disposal of solid waste. A burn barrel was also used within the camp for disposal of Regulated Medical Waste (RMW). Due to prevailing wind patterns and subsequent migration of the smoke plume, the burn pit was closed. Another 100-m^2 burn pit was constructed approximately 500 m west of the camp for disposal of solid waste. A 10-m^2 burn pit was constructed within the camp to replace the burn barrel used for the disposal of RMW (Reference 14).

10.5 General Sanitation

No specific hazard sources were documented in the DOEHRS or the MESL from September 2014 to December 2015 (References 1 and 7).

10.6 Lead- based Paint

No specific hazard sources were documented in the DOEHRS or the MESL from September 2014 to December 2015 (References 1 and 7).

10.7 Asbestos

No specific hazard sources were documented in the DOEHRS or the MESL from September 2014 to December 2015 (References 1 and 7).

10.8 Burn Pits

In December 2014, a burn pit was constructed 100 m west of the basecamp. This burn pit was closed due to prevailing winds and subsequent migration of the smoke plume. In March 2015, another burn pit was constructed approximately 500 m west of the camp to replace the closed burn pit (Reference 14). A 10- m^2 burn pit was also constructed within the camp to replace a burn barrel used for the disposal of RMW. In the notes for Al Asad AB, six air samples were taken at locations near the burn pit. Short-term and long-term health risks could not be assessed due to insufficient data quantity.

While not specific to Al Asad AB, the consolidated epidemiological and environmental sampling and 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 15). The Institute of Medicine committee's (Reference 15) 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 are respiratory and cardiovascular effects and cancer. Susceptibility to the PM health effects could 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.

11 References[1]

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

2. Department of Defense. 2008. DoDI 6055.05, Occupational and Environmental Health.

3. Joint Chiefs of Staff. 2012. Joint Staff Memorandum (MCM) 0017.12, Procedures for Deployment Heallth Surveillance.

4. Occupational and Environmental Health Site Assessment (OEHSA), Al Asad, Iraq. 223rd Medical Detachment (Preventive Medicine), February 2015.

5. U.S. Army Public Health Center. June 2013 Revision. Technical Guide 230, Final Environmental Health Risk Assessment and Chemical Exposure Guidelines for Deployed Military Personnel.

6. Singh, A. and Singh, A.K., 2013. ProUCL Version 5.0. Technical Guide-Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. EPA: Washington, WA, USA.

7. Department of Defense. 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.

8. U.S. Central Command. 2013. Modification 12 to United States Central Command Individual Protection and Individual Unit Deployment Policy, 02 December 2013.

9. Center for Disease Control and Prevention (CDC). 2012. Imported Human Rabies in a U. S. Army Soldier. Morbidity and Mortality Weekly Report, 4 May 2012. 61(17):302-305.

10. Armed Forces Pest Management Board: https://www.acq.osd.mil/eie/afpmb/docs/lhd/venomous_animals_bycountry.pdf. U.S. Army Garrison – Forest Glen, Silver Spring, MD.

[1] NOTE. The data are currently assessed using the 2013 TG 230 document. The general method involves an initial review of the data, which eliminates all chemical substances not detected above 1-yr negligible MEG. 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 is only evaluated for long-term risk). This is performed by deriving separate short-term and long-term population exposure level 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 is Low. If levels are higher than negligible then there is 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 non-drinking water (such as that used for personal hygiene or cooking), the 'consumption rate' is limited to 2 L/day (similar to the EPA) which is derived by multiplying the 5 L/day MEG by a factor of 2.5 to conservatively assess non-drinking uses of water.

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

12. U.S. Air Force Combat Climatology Center. 14th Weather Squadron. https://notus2.afccc.af.mil/SCISPublic/.

13. Goldman RF. Ch1: 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. 2001.

14. Department of the Army. Subject: Summary of Responsible Parties Regarding the Use of Open-Air Burn Pits, Camp Havoc, Al Asad, Iraq, 14 April 2015.

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

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 Deputy Assistant Secretary of Defense for Health Readiness Policy and Oversight (HRP&O).
Army Public Health Center 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.med.navy.mil/sites/nmcphc/Pages/Home.aspx
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 Health Readiness Policy and Oversight (HRP&O) Phone: (800) 497-6261. http://fhpr.dhhq.health.mil/home.aspx