

Military Deployment
Periodic Occupational and Environmental Monitoring Summary (POEMS):
Green Zone (Union I, Union III, Embassy/International Zone), Iraq
(2011 to 2016)

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) risk for Green Zone, Iraq that includes Forward Operating Base (FOB) Union I, FOB Union III, and Embassy International Zone. All other locations formerly located within the Green Zone have been closed. It presents a qualitative summary of health risks identified at this location and their potential medical implications. The report is based on information collected from 01 June 2011 through 31 December 2016 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.

This assessment assumes that environmental sampling at Green Zone 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 01 June 2011 through 31 December 2016.

The POEMS can be useful to inform healthcare providers and others of environmental conditions experienced by individuals deployed to Green Zone during the period of this assessment. However, it does not represent an individual exposure profile. Individual exposures depend on many variables. The length and duration of the exposure and where a person is located as well as what someone is doing while working and/or spending time outside are a few of these variables. 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 record on a Standard Form (SF) 600 (Chronological Record of Medical Care).

SITE DESCRIPTION: The International Zone, which is more commonly referred to as the Green Zone, was a 5.6 square mile area in central Baghdad that was the main base for Coalition and Iraqi Government officials in Iraq. There are several foreign embassy buildings, former palaces of Saddam Hussein and former Iraqi Military buildings and monuments located throughout the Green Zone. There were thirteen FOBs scattered throughout the Green Zone, most recently there were only two FOBs and the Embassy compound that were active during the timeframe of this assessment. The city of Baghdad sits on part of the delta lowland region of Iraq and the Green Zone is located on a vast plain bisected by the River Tigris. Baghdad has a subtropical arid climate and is the largest city in Iraq. Trailers called Containerized Housing Units (CHU) were used for housing of coalition forces as well as being used for latrines. Tents were used primarily for temporary housing, with a usual stay of two to three nights. In the past, the structures on the camps included hardened permanent structures, which were used primarily for workspaces.

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 Green Zone. 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 the Green Zone that includes FOB Union I, FOB Union III, and Embassy/International Zone:

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), Crimean-Congo hemorrhagic fever, sandfly fever, scrub typhus (mite-borne), leptospirosis, schistosomiasis, Tuberculosis (TB), rabies, Q fever, soil transmitted helminthes (hookworm, strongyloidiasis, cutaneous larva migrans); 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 CENTCOM policy. Other vector-borne endemic diseases (cutaneous leishmaniasis (acute), Crimean-Congo hemorrhagic fever, sandfly fever, scrub typhus (mite-borne)), may constitute a significant risk due to exposure to biting vectors. Risk is reduced to 'Low' by proper wear of the treated uniform, application of repellent to exposed skin, bed net use, and appropriate chemoprophylaxis, as well as minimizing areas of standing water and other vector-breeding areas. 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 soil transmitted helminthes (hookworm, strongyloidiasis, cutaneous larva migrans), risk may have been reduced by limiting exposure to soil contaminated with human or animal feces (including not sleeping on bare ground and not walking barefoot). For heat stress, risk can be greater during months of May through October, 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, 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 less than 10 micrometers in diameter (PM₁₀) from environmental dust, (including burn pits which might have existed), the PM₁₀ overall short-term health risk was not evaluated due to insufficient data for analysis. For inhalable fine particulate matter less than 2.5 micrometers in diameter (PM_{2.5}) from environmental dust (including burn pits which might have existed), the PM_{2.5} overall short-term health risk was not evaluated due to insufficient data for analysis. However, the Green Zone and vicinity area is a dust-prone desert environment with a subtropical arid climate, also subject to vehicle traffic. Consequently, exposures to PM₁₀ 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 PM₁₀ 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. Burn pits might have existed at Green Zone and vicinity (e.g., burn pits used by the local population); however, the PM₁₀ and the PM_{2.5} overall short-term health risks specifically for burn pits were not evaluated due to no environmental samples collected near burn pits provided for analysis— see Section 10.7. Where burn pits exist, exposures may vary, and exposures to high levels of PM₁₀ 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 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 while at Green Zone and vicinity. 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 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 the Green Zone that includes FOB Union I, FOB Union III, and Embassy/International Zone:

Air quality: For inhalable fine particulate matter less than 2.5 micrometers in diameter (PM_{2.5}) from environmental dust, (including burn pits which might have existed), the overall long-term health risk was not evaluated due to insufficient data for analysis. Inhalable coarse particulate matter less than 10 micrometers in diameter (PM₁₀) from environmental dust (including burn pits) was not evaluated for long-term health risk due to insufficient data for analysis and no available health guidelines. However, the Green Zone and vicinity area is a dust-prone desert environment with a subtropical arid climate, also subject to vehicle traffic, and conditions may have varied. Burn pits might have existed at Green Zone and vicinity (e.g., burn pits used by the local population); however, the PM₁₀ and the PM_{2.5} overall long-term health risks specifically for burn pits were not evaluated due to no environmental samples collected near burn pits provided for analysis— see Section 10.7. However, burn pit exposures may vary, as conditions may have varied. For inhalational exposure to high levels of

dust containing PM₁₀ and PM_{2.5}, such as during high winds or dust storms, and for exposures 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 dust and particulate matter 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 – Green Zone, 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: Not enough data were available for analysis to characterize health risk. Daily levels vary acute health effects (e.g., upper respiratory tract irritation) more pronounced during days with elevated PM levels. More serious effects are possible in susceptible persons (e.g., those with asthma/pre-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: Not enough data were available for analysis to characterize health risk. Daily levels vary acute health effects (e.g., upper respiratory tract irritation) more pronounced during days with elevated PM levels. More serious effects are possible in susceptible persons (e.g., those with asthma/pre-existing respiratory diseases).
	Long-term: No health guidelines		Long-term: No health guidelines
Particulate matter less than 2.5 micrometers in diameter (PM _{2.5})	Short-term: Not enough data were available for analysis to characterize health risk. Because Green Zone is situated in a dust-prone desert environment with a subtropical arid climate, a majority of the time mild acute (short-term) health effects are anticipated. Elevated 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: Not enough data were available for analysis to characterize health risk. Because Green Zone is situated in a dust-prone desert environment with a subtropical arid climate, a majority of the time mild acute (short-term) health effects are anticipated. Elevated 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: Not enough data were available for analysis to characterize health 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: Not enough data were available for analysis to characterize health 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/existing respiratory diseases).
ENDEMIC DISEASE			
Food borne/Waterborne (e.g., diarrhea-bacteriological)	Short-term: Variable, (bacterial diarrhea, hepatitis A, typhoid fever) to Moderate (diarrhea-cholera, diarrhea- protozoal, brucellosis and hepatitis E). If local food/water were consumed, 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: none identified		Long-term: No data available
Arthropod Vector Borne	Short-term: Variable, Moderate for leishmaniasis-cutaneous, Crimean-Congo hemorrhagic fever, sandfly fever, and typhus-miteborne; Low for West Nile fever, and plague.	Preventive measures include proper wear of treated uniform, application of repellent to exposed skin, and bed net use, minimizing areas of standing water and appropriate chemoprophylaxis.	Short-term: Low
	Long-term: Low (Leishmaniasis-visceral infection)		Long-term: No data available
Water-Contact (e.g., wading,	Short-term: Moderate for leptospirosis and schistosomiasis.	Control measures implemented: Avoid water	Short-term: Moderate for leptospirosis and schistosomiasis.

Source of Identified Health Risk ³	Unmitigated Health Risk Estimate ⁴	Control Measures Implemented	Residual Health Risk Estimate ⁴
swimming)	Long-term: No data available	contact and recreational water activities, properly wear of the uniform (especially footwear), and utilize protective coverings for cuts/abraded skin.	Long-term: No data available
Respiratory	Short-term: Variable; Moderate for tuberculosis (TB) to Low for meningococcal meningitis and Middle East respiratory syndrome coronavirus (MERS-CoV).	Providing adequate living and work space; medical screening; vaccination	Short-term: Low
	Long-term: No data available		Long-term: No data available
Animal Contact	Short-term: Variable; Moderate for rabies and Q-fever, and Low for anthrax and avian influenza.	Prohibiting contact with, adoption, or feeding of feral animals IAW U.S. Central Command (CENTCOM) General Order (GO) 1C. 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: No data available
	Long-term: Low (rabies)		Long-term: No data available
Soil-transmitted	Short-term: Moderate for soil transmitted helminthes (hookworm, strongyloidiasis, and cutaneous larva migrans).	Risk was reduced to Low by limiting exposure to soil contaminated with human or animal feces (including sleeping on bare ground, and walking barefoot).	Short-term: Low
	Long-term: No data available		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 to potentially lethal effects.	Risk reduced by avoiding contact, proper wear of uniform (especially footwear), and proper and timely treatment.	Short-term: Low; if encountered, effects of venom vary with species from mild, localized swelling to potentially lethal effects.
	Long-term: No data available		Long-term: No data available
HEAT/COLD STRESS			
Heat	Short-term: Variable; risk of heat injury is High for May – October, and Low for all other months.	Work-rest cycles, proper hydration and nutrition, and Wet Bulb Globe Temperature (WBGT) monitoring.	Short-term: Variable; risk of heat injury in unacclimatized or susceptible personnel is High for May – October, and Low for all other months.
	Long-term: Low, the long-term risk was 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, the long-term risk is 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 risk of cold stress/injury.	Risks from cold stress reduced with protective	Short-term: Low risk of cold stress/injury.

Source of Identified Health Risk ³	Unmitigated Health Risk Estimate ⁴	Control Measures Implemented	Residual Health Risk Estimate ⁴
	<p>Long-term: Low; long-term health implications from cold injuries are rare but can occur, especially from more serious injuries such as frostbite.</p>	<p>measures such as use of the buddy system, limiting exposure during cold weather, proper hydration and nutrition, and proper wear of issued protective clothing.</p>	<p>Long-term: Low; long-term health implications from cold injuries are rare but can occur, especially from more serious injuries such as frostbite.</p>
Burn Pits	<p>Short-term: Burn pits and/or incinerators might have existed within the Green Zone and vicinity (for example, burn pits used by the local population); however, there are no sampling data to indicate their presence or absence. Consequently, the PM₁₀ and the PM_{2.5} overall short-term health risks specifically for burn pits were not evaluated – see Section 10.7.</p>	<p>Risks reduced by limiting strenuous physical activities when air quality was especially poor; and action such as closing tent flaps, windows, and doors. Other control measures included locating burn pits downwind of camps, increased distance from troop populations, and improved waste segregation and management techniques.</p>	<p>Short-term: Burn pits and/or incinerators might have existed within the Green Zone and vicinity (for example, burn pits used by the local population); however, there are no sampling data to indicate their presence or absence. Consequently, the PM₁₀ and the PM_{2.5} overall short-term health risks specifically for burn pits were not evaluated – see Section 10.7.</p>
	<p>Long-term: Burn pits and/or incinerators might have existed within the Green Zone and vicinity (for example, burn pits used by the local population); however, there are no sampling data to indicate their presence or absence. Consequently, the PM₁₀ and the PM_{2.5} overall long-term health risks specifically for burn pits were not evaluated – see Section 10.7. Exposure to burn pit smoke is variable. Exposure to high levels of PM₁₀ 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.</p>		<p>Long-term: Burn pits and/or incinerators might have existed within the Green Zone and vicinity (for example, burn pits used by the local population); however, there are no sampling data to indicate their presence or absence. Consequently, the PM₁₀ and the PM_{2.5} overall long-term health risks specifically for burn pits were not evaluated – see Section 10.7. Exposure to burn pit smoke is variable. Exposure to high levels of PM₁₀ 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.</p>

¹This Summary Table provides a qualitative estimate of population-based short- and long-term health risks associated with the occupational environment conditions at Green Zone that includes Forward Operating Base (FOB) FOB Union I, FOB Union III, and Embassy International Zone. It does not represent an individual exposure profile. Actual individual exposures and health effects depend on many variables. For example, while a chemical may have been present in the environment, if a person did not inhale, ingest, or contact a specific dose of the chemical for adequate duration and frequency, then there may have been no health risk. Alternatively, a person at a specific location may have experienced a unique 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 1 June 2011 through 31 December 2016. 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.

³This Summary Table is organized by major categories of identified sources of health risk. It only lists those sub-categories specifically identified and addressed at Green Zone. The health risks are presented as Low, Moderate, High, or Extremely High for both acute and chronic 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 Army Public Health Center (APHC). Where applicable, “None Identified” is used when though a potential exposure is identified, and no health risks of either a specific acute or chronic health effects are determined. More detailed descriptions of OEH exposures that are evaluated but determined to pose no health risk are discussed in the following sections of this report.

⁴Health 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

Source of Identified Health Risk³	Unmitigated Health Risk Estimate⁴	Control Measures Implemented	Residual Health Risk Estimate⁴
<p>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.</p>			

1 Discussion of Health Risks Green Zone, 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 4). 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 5). Means are followed by standard deviation (SD). Risk characterization was based on the 95 percent 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

The city of Baghdad sits on part of the delta lowland region of Iraq and the Green Zone was located on a vast plain bisected by the River Tigris. Airborne environmental hazards within the Green Zone include wind-blown sand and dust and vehicle emissions. A cement plant used to be located on former Camp Blackhawk. There were several industrial operations in the area that include numerous oil refineries, food processing plants, tanneries, textile mills and metal fabrications. Typical military operations, including vehicular traffic, generators, and other local sources also contribute to the ambient environment at these locations.

Inhalational exposure to high levels of dust and particulate matter, such as during high winds or dust storms may 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) are at greatest risk of developing notable health effects.

2.2 Particulate matter

Particulate matter (PM) is a complex mixture of extremely small particles suspended in the air. The PM includes solid particles and liquid droplets emitted directly into the air by sources such as: power plants, motor vehicles, aircraft, generators, construction activities, fires, and natural windblown dust. The PM can include sand, soil, metals, volatile organic compounds (VOC), allergens, and other compounds such as nitrates or sulfates that are formed by condensation or transformation of combustion exhaust. The PM composition and particle size vary considerably depending on the source. Generally, PM of health concern is divided into two fractions: PM₁₀, which includes coarse particles with a diameter of 10 micrometers or less, and fine particles less than 2.5 micrometers (PM_{2.5}), which can reach the deepest regions of the lungs when inhaled. Exposure to excessive PM is linked to a variety of potential health effects.

2.3 Particulate matter, less than 10 micrometers (PM₁₀)

2.3.1 Exposure Guidelines:

Short Term (24-hour) PM₁₀ (micrograms per cubic meter, µg/m³):

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

Long-term PM₁₀ MEG (µg/m³):

- Not defined and not available.

2.3.2 Sample data/Notes:

One valid PM₁₀ air sample was collected on 22 December 2016 at FOB Union III. The 24-hour PM₁₀ concentration of 92 µg/m³ was well below the negligible MEG of 250 µg/m³. There were no other PM₁₀ samples available for this assessment.

2.3.3 Short-term health risks:

Not enough data were available to evaluate a short-term health risk.

2.3.4 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 PM₁₀ due to an inability to clearly link chronic health effects with chronic PM₁₀ exposure levels.

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

2.4.1 Exposure Guidelines:

Short Term (24-hour) PM_{2.5} (µg/m³):

- Negligible MEG = 65
- Marginal MEG = 250
- Critical MEG = 500

Long-term (1 year) PM_{2.5} MEGs (µg/m³):

- Negligible MEG = 15
- Marginal MEG = 65.

2.4.2 Sample data/Notes:

Six valid PM_{2.5} air samples were collected from 2013 to 2016. Two samples were taken at the Embassy/international zone in October 2013, two samples were taken in March 2015 at FOB Union I, and two samples were taken at Union III in April 2016. No samples were available from 2011, 2012 or 2014.

Four sample concentrations were below the short term negligible MEG and two samples were slightly over short term negligible MEG, but still below the marginal MEG.

2.4.3 Short-term health risks:

Not enough data were available to evaluate a short-term health risk.

2.4.4 Long-term health risks:

Not enough data were available to evaluate a long-term health risk.

2.5 Airborne Metals

2.5.1 Sample data/Notes:

Six valid PM_{2.5} airborne metal samples were collected at Green Zone from October 2013 to April 2016. Two samples were collected at the Embassy/International zone in 2013, two were taken at FOB Union I during 2015, and two were taken at FOB Union III in 2016. Lead was the only airborne metal detected and it did not exceed its corresponding 1 year negligible MEG.

2.5.2 Short-term health risks:

Not enough data were available to evaluate a short term health risk.

2.5.3 Long-term health risks:

Not enough data were available to evaluate a short term health risk.

2.6 Volatile Organic Compounds (VOC)

2.6.1 Sample data/Notes:

Two valid volatile organic chemical (VOC) air samples were collected (taken in March 2015 and January 2016) with 25 detected VOCs within the samples. Acrolein was the only VOC found at concentration over a one year negligible MEG but was well below its short term MEGs. There were not enough data to evaluate a health risk

2.6.2 Short and long-term health risks:

Not enough data were available to evaluate a short or long term health risk.

3 Soil

3.1 Site-Specific Sources Identified

The primary soil contamination exposure pathways are dermal contact and dust inhalation. Typical parameters analyzed for included semi volatile organic compounds (SVOCs), heavy metals, polychlorinated biphenyls (PCBs), pesticides, herbicides.

3.2 Sample data/Notes:

There were no samples available to evaluate.

3.3 Short-term health risk:

No data available to evaluate a short term health risk.

3.4 Long-term health risk:

No data available to evaluate a long term health risk.

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 are based on the administrative information provided on the field data sheets submitted with the samples taken over the timeframe being evaluated. It is assumed that 100% of all U.S. personnel at Green Zone will be directly exposed to reverse osmosis water purification unit (ROWPU) treated, disinfected fresh bulk water, bottled water, and untreated well water since this classification of water is primarily used for personal hygiene, showering, cooking, and for use at vehicle wash racks. Field data sheets indicate that bottled water is the only approved source of drinking water.

4.1 Drinking Water: Bottled or Packaged Water

4.1.1 Site-Specific Sources Identified

The OEHSAs for FOB Union I (April 2015) and FOB Union III (April 2016) listed Pearl as the brand of bottled water used at the sites.

4.1.2 Sample data/Notes:

There were no data available for any locations within the Green Zone.

4.1.3 Short-term and long-term health risk:

No sample data available to evaluate a short or long term health risk.

4.2 Non-Drinking Water: ROWPU

4.2.1 Site-Specific Sources Identified

Although the primary route of exposure for most microorganisms is ingestion of contaminated water, dermal exposure to some microorganisms, chemicals, and biologicals may also cause 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.

4.2.2 Sample data/Notes:

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

Two ROWPU treated water (Non-Drinking) samples from March 2015 and April 2016 were sampled at FOB Union III. All detected chemicals were below their corresponding long and short term MEGs. There were no other non-drinking water samples available to evaluate.

4.2.3 Short and long-term health risks:

Not enough data were available to evaluate a short or long term health risk.

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 1 June 2011 to 31 December 2016 timeframe (References 1 and 6).

5.2 Depleted Uranium (DU)

No specific hazard sources were documented in the DOEHRS or MESL from 1 June 2011 to 31 December 2016 timeframe (References 1 and 6).

5.3 Ionizing Radiation

No specific hazard sources were documented in the DOEHRS or MESL from 1 June 2011 to 31 December 2016 timeframe (References 1 and 6).

5.4 Non-Ionizing Radiation

No specific hazard sources were documented in the DOEHRS or MESL from 1 June 2011 to 31 December 2016 timeframe (References 1 and 6).

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. USCENTCOM MOD 11 (Reference 7) lists deployment requirements, to include immunizations and chemoprophylaxis, in effect during the timeframe of this POEMS.

6.1 Food borne 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. 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: 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 is consumed. Field conditions (including lack of hand washing and primitive sanitation) may facilitate 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

High, mitigated to Low: 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. 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 is consumed. Preventive Medicine measures reduced 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 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: The disease risk is Moderate during the warmer months when sandflies are most prevalent, but reduced to low with mitigation measures. 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 Crimean-Congo hemorrhagic fever

Moderate, mitigated to Low: Unmitigated risk is moderate, but reduced to low with mitigation measures. 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, mitigated to Low: Sandfly fever has a Moderate risk with potential disease rates from 1% to 10% per month; under worst case conditions disease rates can be as high as 50%. Mitigation measures reduced the risk to low. 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 occur. 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. 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. 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: 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, mitigated to Low: 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:

Low: Unmitigated Health risk of schistosomiasis and leptospirosis is Moderate during warmer months. Mitigation measures reduce the risk to Low. Confidence in the health 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. 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 personal protective equipment (PPE) when necessary for healthcare providers and detention facility personnel.

6.4.1 Tuberculosis (TB)

Moderate, mitigated to Low: Potential health risk to U.S. personnel is Moderate, mitigated to Low, year round. Transmission typically requires close and prolonged contact with an active case of pulmonary or laryngeal TB, although it also can occur with more incidental contact. Rates of latent TB (LTBI) may be elevated for personnel with prolonged indoor exposure to local populations. Tuberculin skin tests (TST) screening or blood test may be warranted in personnel with a history of prolonged close exposure to local populations.

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 Middle East respiratory syndrome coronavirus (MERS-CoV)

Low: 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 risks:

Low: Moderate (TB) to Low (for meningococcal meningitis and MERS-CoV). Overall risk was reduced to Low with mitigation measures. Confidence in the health risk estimate is high.

6.4.5 Long-term health risks:

None identified based on available data. Tuberculosis is evaluated as part of the post deployment health assessment (PDHA). A TB skin test is required post-deployment if potentially exposed and is based upon individual service policies.

6.5 Animal-Contact Diseases

6.5.1 Rabies

Moderate, mitigated to Low: Rabies posed a year-round moderate risk. 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. 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 six years or more after their last known risk exposure. Mitigation strategies included command emphasis of CENTCOM GO 1C, reduction of animal habitats, active pest management programs, and timely treatment of feral animal scratches/bites.

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. Pulmonary anthrax is contracted through inhalation of spores and is extremely rare. Mitigation measures included consuming approved food sources, proper food preparation, and cooking temperatures, avoidance of animals and farms, dust abatement when working in these areas, vaccinations, and proper PPE for personnel working with animals.

6.5.3 Q-Fever

Moderate, mitigated to Low: Potential health risk to U.S. personnel is Moderate, but mitigated to Low, 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. Mitigation strategies in place as listed in paragraph 6.5.2 except for vaccinations.

6.5.4 Avian influenza

Low: Potential health risk to U.S. personnel is Low. 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 percent in symptomatic cases. Mitigation strategies included avoidance of birds/poultry and proper cooking temperatures for poultry products.

6.5.5 Short-term health risks:

Low: The short-term unmitigated risk is Moderate for rabies, and Q-fever, to Low for anthrax, and avian influenza. Mitigation measures reduced the overall risk to Low. Confidence in risk estimate is high.

6.5.6 Long-term health risks:

Low: A Low long term risk exists for rabies because, in rare cases, the incubation period for rabies can be several years.

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

Low: Potential health risk to U.S. personnel is Low during warmer months (typically April through November) when vector activity is highest. 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 percent per month in most locations. However, rates in some focal areas with heavily contaminated soil could exceed 1 percent per month.

6.4.3 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.

6.4.4 Long-term health risks:

None identified based on available data.

7 Venomous Animals

All information below originated from the Armed Forces Pest Management Board (Reference 8) and the Clinical Toxinology Resources web site from the University of Adelaide, Australia (Reference 9). The species listed below have home ranges that overlap the location of the Green Zone, 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 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 wernerii*, *Mesobuthus caucasicus*, *Odontobuthus doriae*, *Orthochirus iraqus*, and *Orthochirus scrobiculosus*: Clinical effects unknown; there are a number of dangerous Buthid scorpions, but there are also some known to cause minimal effects only. Without clinical data it is unclear where this species fits within that spectrum.
- *Euscorpis italicus*: Mild envenoming only, not likely to prove lethal.
- *Hemiscorpis 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 viper): Potentially lethal envenoming, though unlikely.
- *Echis sochureki* (Sochurek's saw-scaled viper): Moderate to severe, potentially lethal envenoming.
- *Malpolon monspessulanus* (Montpellier snake), and *Pseudocerastes persicus fieldi* (Field's horned viper): Clinical effects varies, but unlikely to cause significant envenoming.
- *Macrovipera lebetina* subspecies *euphratica* (Levantine viper), *Vipera albicornuta* (white-horned viper), and *Walterinnesia 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 to potentially lethal effects. See effects of venom above. Mitigation strategies included avoiding contact, proper wear of uniform (especially footwear), and timely medical treatment. Confidence in the health risk estimate is low (Reference 4, Table 3-6).

7.5 Long-term health risk:

None identified.

8 Heat/Cold Stress

The Green Zone has a mostly dry climate ranging from 56 - 105 degrees Fahrenheit (°F), with yearly highs up reaching around 120 °F. Summers are long, hot, and dry with low humidity. The predominant wind direction from mid-June through mid-September is out of the North- Northeast and from April to June the wind is usually from a south-southeasterly direction.

8.1 Heat

Average monthly peak temperature during the summer months (June – September) was 111 °F. The health risk of heat stress/injury based on temperatures alone was Low (< 78 °F) from November – March, high (82-87.9°F) in April, and extremely high (≥ 88°F) from May – October. However, work intensity and clothing/equipment worn pose greater health risk of heat stress/injury than environmental factors alone (Reference 10). 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:

Low to High, mitigated to Low: The risk of heat injury was reduced to low through preventive measures such as work/rest cycles, proper hydration and nutrition, and monitoring Wet Bulb Globe Temperature (WBGT). Risk of heat injury in unacclimatized or susceptible populations (older, previous history of heat injury, poor physical condition, underlying medical/health conditions), and those under operational constraints (equipment, PPE, vehicles) is High from May – October, and Low for all other months. Confidence in the health risk estimate is low (Reference 4, 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 4, Table 3-6).

8.2 Cold

Winter (December – March) temperatures ranged from 41.2 °F to 49.3 °F. Even on warm days there could be a significant drop in temperature after sunset by as much as 40 °F. There was a risk of cold stress/injury when temperatures fell below 60 °F, which could occur from November – April. The health risk assessment for non-freezing cold injuries (chilblain, trench foot, and hypothermia) was Low based

on historical temperature and precipitation data. Frostbite was unlikely to occur because temperatures rarely dropped below freezing. However, personnel may have encountered significantly lower temperatures during field operations at higher altitudes. As with heat stress/injuries, cold stress/injuries were largely dependent on operational and individual factors instead of environmental factors alone. With protective measures in place the health risk assessment was low for cold stress/injury; confidence in the health risk estimate is medium.

8.2.1 Short-term health risks:

Low: The health risk of cold injury is Low. Confidence in the health risk estimate is 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 other than multiple standalone generators located at FOB Union I and Fob Union III were documented in the DOEHRS or MESL from 1 June 2011 to 31 December 2016 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 1 June 2011 to 31 December 2016 timeframe.

9.2.1 Short-term and Long-term health risks:

Not evaluated.

10 Unique Incidents/Concerns

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 that 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 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 Waste Sites/Waste Disposal

Hazardous Waste:

Union I: According to the 2015 OEHSA, everything is handled at the Embassy. There are no hazardous waste stored on site.

Union III: It was reported that 20 55-gallon drums of coolant and 20 55-gallon drums of used oil were stored at an accumulation point and disposed of offsite by contractors.

Information on hazardous waste was not available for all other locations included in this report.

Solid waste:

Union I: Solid waste is removed by contractors for disposal off site.

Union III: Solid waste is stored in covered receptacles throughout the camp and trash is picked up by contractors daily.

Information on solid waste was not available for any of the other locations included in this assessment.

10.3 Fuel/petroleum products/industrial chemical spills

Union I: There was no record of any past spills at the site and in 2015, there was no fuel point located on FOB Union I, refueling operations occurred at the embassy. No further information was available.

Union III: In 2016, there was no record of any past spills at the site and the fuel point storage site is managed by contractors. There were three 20,000-gallon containers of diesel fuel and one 20,000-gallon container of gasoline stored at the fuel point site.

Information was not available for any of the other locations included in this 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 and herbicides, 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, wasps, 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. No specific hazard sources were documented in DOEHRS or MESL data portal. There were no pesticide application reports in the MESL data portal for any locations located within the Green Zone.

10.4.3 Short-term and Long-term health risks

No data available to evaluate a health risk.

10.5 Asbestos

No data available to evaluate a health risk.

10.6 Lead Based Paint

No data available to evaluate a health risk.

10.7 Burn Pit

No burn pits were reported at FOB Union I or Union III from 2015 or 2016. No further information was available for other locations within the Green Zone. There were no known burn pits in the vicinity of the Green Zone; however it is possible that burning of waste did occur in the vicinity.

While not specific to the Green Zone 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 11). The Institute of Medicine committee's (Reference 11) 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 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.

10.7.2.3 Short and long-term health risk:

The available reports and data did not indicate that there were any known burn pits located on or in the vicinity of the Green Zone during the dates of this assessment (1 June 2011 through 31 December 2016). There was no data available to evaluate any burn pit specific health risk at the Green Zone.

11 References

1. Defense Occupational and Environmental Health Readiness System (referred to as the DOEHRs-EH database) at <https://doehrs-ih.csd.disa.mil/Doehrs/>. Department of Defense (DoD) Instruction 6490.03, *Deployment Health*, 2006.
2. DoDI 6055.05, Occupational and Environmental Health, 2008.
3. Joint Staff Memorandum (MCM) 0017-12, Procedures for Deployment Health Surveillance, 2012.
4. USAPHC TG230, June 2013 Revision.
5. Singh, A. and Singh, A.K., 2013. ProUCL Version 5.0. 00 Technical Guide-Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. EPA: Washington, WA, USA.
6. 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.

7. Modification 11 to United States Central Command Individual Protection and Individual Unit Deployment Policy, 2 December 2011.
8. Armed Forces Pest Management Board: <http://www.afpmb.org/content/venomous-animals-country-#Iraq>. U.S. Army Garrison - Forest Glen, Silver Spring, MD.
9. Clinical Toxinology Resources: <http://www.toxinology.com/>. University of Adelaide, Australia.
10. 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.
11. IOM (Institute of Medicine). 2011. Long-term health consequences of exposure to burn pits in Iraq and Afghanistan. Washington, DC: The National Academies Press.
12. Occupational and Environmental Health Site Assessment FOB Union I, 23 March 2015.
13. Occupational and Environmental Health Site Assessment FOB Union III, 4 April 2016.

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>