Military Deployment
Periodic Occupational and Environmental Monitoring Summary (POEMS):
Mosul Airfield and vicinity, Iraq
Calendar Years: 2003 to 2012

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, *See REFERENCES*.

PURPOSE: This POEMS documents the Department of Defense (DoD) assessment of occupational and environmental health (OEH) risks for Mosul Airfield, Al Kindi, Camp Courage, Camp Diamondback, Camp Marez, Combat Outpost (COP) Rabiy, and COP Scorpion. 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 7 May 2003 through 10 April 2012 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 Mosul Airfield and vicinity 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 7 May 2003 through 10 April 2012.

The POEMS can be useful to inform healthcare providers and others of environmental conditions experienced by individuals deployed to Mosul Airfield and vicinity 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 record on a Standard Form (SF) 600 (Chronological Record of Medical Care).

SITE DESCRIPTION: Mosul Airfield was a large airbase controlled by U.S. Forces. Mosul Airfield is located approximately 369 kilometers north of Baghdad and is in Mosul City-the third largest city in Iraq and northern Iraq's major center for trade, industry, and communications. The Tigris River bisects the city and the area is primarily agricultural, with most of the local infrastructure and industry supporting agricultural activities. This POEMS includes Camp Marez, Camp Diamondback, and Camp Courage. Camp Marez is located in Mosul City and is formerly known as Forward Operating Base (FOB) Glory/Fire Base Glory. Camp Diamondback is located west of Mosul Airfield. Camp Courage is located in Mosul City at Saddam Hussein's Palace of Swords and was formerly known as Post Freedom. Al Kindi is located roughly five kilometers north of Mosul Airfield. Al Kindi housed the largest missile development site in Iraq. Combat Outpost (COP) Rabiy is a COP located in Mosul City. COP Scorpion is a COP located roughly 22 kilometers south of Mosul City. Risk levels are general for the area and may not be specific to particular base camps.

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 Mosul Airfield and vicinity. As indicated in the detailed sections that follow Table 2, controls established to reduce health risk were factored into this assessment. In some cases, e.g. ambient air, specific controls are noted, but not routinely available/feasible.

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

Short-term health risks & medical implications:

The following hazards may be associated with potential acute health effects in some personnel during deployment at Mosul Airfield and vicinity that includes Al Kindi, Camp Courage, Camp Diamondback, Camp Marez, COP Rabiy, and COP Scorpion:

Inhalable coarse particulate matter less than 10 micrometers in diameter (PM_{10}); 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, typhus-miteborne, leptospirosis, schistosomiasis, Tuberculosis (TB), rabies, Q fever); heat stress; and PM_{10} from the Al Mishraq sulfur fire incident. 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. For other vector-borne endemic diseases (cutaneous leishmaniasis (acute), Crimean-Congo hemorrhagic fever, sandfly fever, typhus-miteborne), these diseases may constitute a significant risk due to exposure to biting vectors; risk reduced to 'Low' by proper wear of the treated uniform, application of repellent to exposed skin, bed net use, and appropriate chemoprophylaxis, 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. 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 (PM_{10}), the PM_{10} overall short-term risk was 'Low to Moderate.' For inhalable fine particulate matter less than 2.5 micrometers in diameter ($PM_{2.5}$), the $PM_{2.5}$ overall short-term risk was not characterized due to insufficient data. However, 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. For burn pits, the short-term risk for PM_{10} was 'none identified based on limited data' and the short-term risk for $PM_{2.5}$ was 'not characterized due to insufficient data' - see Section 10.7. For the Al Mishraq sulfur fire incident, June 2003, the PM10 overall short-term risk was 'Low to High' - See Section 10.8 and the USAPHC factsheet on the Al Mishraq sulfur fire incident (Reference 18) for more details. For burn pits and the Al Mishraq sulfur fire incident, exposures may vary, and exposure to high levels of PM_{10} and to $PM_{2.5}$ in the smoke may also result in mild to more serious short-term health effects (e.g., eye, nose or throat and lung irritation) in some personnel and certain subgroups while at this site. Although most 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 during their time at Mosul Airfield and vicinity. Personnel who reported with symptoms or required treatment while at this site 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 Mosul Airfield and vicinity that includes Al Kindi, Camp Courage, Camp Diamondback, Camp Marez, COP Rabiy, and COP Scorpion:

Air quality:

For inhalable fine particulate matter less than 2.5 micrometers in diameter ($PM_{2.5}$), the overall long-term risk was not evaluated due to insufficient data. Inhalable coarse particulate matter less than 10 micrometers in diameter (PM_{10}) was not evaluated for long-term risk due to no available health guidelines. However, the area is a dusty desert environment, and conditions may have varied. In addition, for burn pits, the long-term risk for $PM_{2.5}$ was not characterized due to insufficient limited data, PM_{10} was not evaluated for long-term risk due to no available health guidelines); however, conditions may have varied – see Section 10.7. For inhalational exposure to high levels of dust, PM_{10} and $PM_{2.5}$, such as during high winds or dust storms, and for exposure to burn pit smoke, it is considered possible that some otherwise healthy personnel who were exposed for a long-term period to dust and particulate matter could develop certain health conditions (e.g., reduced lung function, cardiopulmonary disease). Personnel with a history of asthma or cardiopulmonary disease could potentially be more likely to develop such chronic health conditions. While the 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).

Al Mishraq sulfur fire incident, June 2003: It is plausible that pulmonary conditions in some individuals could be associated with exposure to the 2003 Mishraq State sulfur fire event. Constrictive bronchiolitis is included, because this condition has been scientifically associated with very high exposures to SO_2. While personnel exposure levels and duration varied considerably, individual risk factors or susceptibilities may play a role. Since the actual group of all exposed persons is not definitively known, and since it is not a routine diagnosis, it is possible that exposed personnel may have this outcome. The 2010 USAPHC report (Reference 19) included several suggested courses of action, including standardized medical evaluations for exposed personnel presenting with shortness of breath or dyspnea on exertion. See Section 10.8 and the USAPHC factsheet on the Al Mishraq sulfur fire incident (Reference 18) for more details.

Multiple members of the 1/24 Battalion (BN) Stryker Brigade Combat Team (SBCT) reported a variety of long-term health effects and concerns—see Section 10.9. The USAPHC engaged in fact finding for areas of exposure and potential health implications. Little objective information was available regarding potential exposures and limited environmental monitoring was conducted. Health effects reported by Unit members did not have clear associations with potential exposures that were identified by the Unit. While available data were limited, long-term health effects were not expected based on the information available. Additionally, a disease cluster was not evident (Reference 20).

Table 2. Population-Based Health Risk Estimates - Mosul Airfield and vicinity that includes Al Kindi, Camp Courage, Camp Diamondback, Camp Marez, COP Rabiy, and COP Scorpion [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: Low to Moderate, 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: Low to Moderate, 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		Long-term: No health guidelines
Particulate matter less than 2.5 micrometers in diameter ($PM_{2.5}$)	Short-term: Insufficient data were available to characterize risk.	Limiting strenuous physical activities when air quality is especially poor; and actions such as closing tent flaps, windows, and doors.	Short-term: Insufficient data were available to characterize risk.
	Long-term: Insufficient data were available to characterize risk.		Long-term: Insufficient data were available to characterize risk.
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, swimming)	Short-term: Moderate for leptospirosis and schistosomiasis.		Short-term: Moderate for leptospirosis and schistosomiasis.
	Long-term: No data available		Long-term: No data available
Respiratory	Short-term: Variable; Moderate for tuberculosis (TB) to Low for meningococcal meningitis.	Providing adequate living and work space; medical screening; vaccination.	Short-term: Low
	Long-term: No data available		Long-term: No data available

Source of Identified Health Risk[3]	Unmitigated Health Risk Estimate[4]	Control Measures Implemented	Residual Health Risk Estimate[4]
Animal Contact	Short-term: Variable; Moderate for rabies and Q-fever, and Low for Anthrax and H5N1 avian influenza. Long-term: Low (Rabies)	Prohibiting contact with, adoption, or feeding of feral animals 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: 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 (e.g. *P. lineolatus*) to potentially lethal effects (e.g. *V. albicornuta*). Long-term: No data available	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 (e.g. *P. lineolatus*) to potentially lethal effects (e.g. *V. albicornuta*). Long-term: No data available
HEAT/COLD STRESS			
Heat	Short-term: Low to Extremely High; Risk of heat injury is Extremely High in August, High in July, Moderate in June, 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.	Work-rest cycles, proper hydration and nutrition, and Wet Bulb Globe Temperature (WBGT) monitoring.	Short-term: Low; Risk of heat injury in unacclimatized or susceptible personnel is Extremely High in August, High in July, Moderate in June, and Low for all other months. 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. Long-term: Low; Long-term health implications from cold injuries are rare but can occur, especially from more serious injuries such as frost bite.	Risks from cold stress reduced with protective measures such as use of the buddy system, limiting exposure during cold weather, proper hydration and nutrition, and proper wear of issued protective clothing.	Short-term: Low risk of cold stress/injury. Long-term: Low; Long-term health implications from cold injuries are rare but can occur, especially from more serious injuries such as frost bite.

Source of Identified Health Risk[3]	Unmitigated Health Risk Estimate[4]	Control Measures Implemented	Residual Health Risk Estimate[4]
Unique Incidents/ Concerns			
Burn Pits	Short-term: No risk from PM_{10} and airborne metals. Insufficient data available to assess risk from $PM_{2.5}$.	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 prevailing winds, increased distance from troop populations, and improved waste segregation and management techniques.	Short-term: No risk from PM_{10} and airborne metals. Insufficient data available to assess risk from $PM_{2.5}$.
	Long-term: PM_{10} not assessed because health guidelines are not available. Insufficient data available to assess risk from PM_{10} airborne metals and $PM_{2.5}$.		Long-term: PM_{10} not assessed because health guidelines are not available. Insufficient data available to assess risk from PM_{10} airborne metals and $PM_{2.5}$.
Al Mishraq Sulfur Fire Incident	Short-term: Low to High for PM10 exposure. None from PM_{10} metals, polycyclic aromatic hydrocarbons, and semi-volatile organic compounds in air. None from chemicals in soil. Exposure to high levels of hydrogen sulfide or sulfur dioxide may cause irritation of the eyes, nose, and throat, and coughing.		Short-term: Low to High for PM_{10} exposure. None from PM_{10} metals, polycyclic aromatic hydrocarbons, and semi-volatile organic compounds in air. None from chemicals in soil. Exposure to high levels of hydrogen sulfide or sulfur dioxide may cause irritation of the eyes, nose, and throat, and coughing.
	Long-term: None from PM_{10} metals, polycyclic aromatic hydrocarbons, and semi-volatile organic compounds in air. None from chemicals in soil. It is plausible that exposure to high levels of hydrogen sulfide or sulfur dioxide may be associated with pulmonary conditions such as constrictive bronchiolitis.		Long-term: None from PM_{10} metals, polycyclic aromatic hydrocarbons, and semi-volatile organic compounds in air. None from chemicals in soil. It is plausible that exposure to high levels of hydrogen sulfide or sulfur dioxide may be associated with pulmonary conditions such as constrictive bronchiolitis.

[1]This Summary Table provides a qualitative estimate of population-based short- and long-term health risks associated with the occupational environment conditions at Mosul Airfield and vicinity that includes Al Kindi, Camp Courage, Camp Diamondback, Camp Marez, COP Rabiy, and COP Scorpion. 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 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 7 May 2003 through 10 April 2012. 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 Mosul Airfield and vicinity. 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 (Provisional). 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.

[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 Mosul Airfield and vicinity, 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 (USAPHC) Technical Guide 230, *Environmental Health Risk Assessment and Chemical Exposure Guidelines for Deployed Military Personnel* (USAPHC TG 230) (Reference 9). 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.

2 Air

2.1 Site-Specific Sources Identified

Mosul Airfield and vicinity are situated in a dusty semi-arid desert environment. Inhalational exposure to high levels of dust and particulate matter, such as during high winds or dust storms, may 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: PM_{10}, 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 (PM_{10})

2.3.1 Exposure Guidelines:

Short Term (24-hour) PM_{10} ($\mu g/m^3$):

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

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

- Not defined and not available.

2.3.2 Sample data/Notes:

A total of 35 valid PM_{10} air samples were collected from 2003 – 2010. The range of 24-hour PM_{10} concentrations was 74 $\mu g/m^3$ – 479 $\mu g/m^3$ with an average concentration of 273 $\mu g/m^3$.

2.3.3 Short-term health risks:

Low to Moderate: The short-term PM_{10} health risk assessment is Low to Moderate based on average and peak PM_{10} sample concentrations, and the likelihood of exposure at these hazard severity levels. Therefore, on typical days, exposure to PM_{10} was likely to range between little or no impact on accomplishing the mission. Peak exposures could have occurred, increasing the health risk level (Reference 9, Table 3-2). Under peak exposures exposure to PM_{10} was expected to degrade mission capabilities and could have resulted in reduced mission capability if hazards occurred during the mission.

Daily average health risk levels for PM_{10} show no hazard for 43%, low health risk for 50%, moderate health risk for 7%, and high health risk for 0% of the time. Confidence in the short-term PM_{10} health risk assessment is medium (Reference 9, Table 3-6).

The hazard severity for average PM_{10} concentrations in samples was negligible. The results indicate that during exposures at the negligible hazard severity level a few personnel may have experienced notable eye, nose, and throat irritation, however most personnel will experience only mild effects (Reference 9, Table 3-11). Those with a history of asthma or cardiopulmonary disease are expected to experience increased symptoms.

For the highest observed PM_{10} sample concentration, the hazard severity was marginal. During peak exposures at the marginal hazard severity level, a majority of personnel will experience notable eye, nose, and throat irritation and some respiratory effects (Reference 9, Table 3-11). Those with a history of asthma or cardiopulmonary disease are expected to experience increased symptoms.

2.3.4 Long-term health risk:

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

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

2.4.1 Exposure Guidelines:

Short Term (24-hour) $PM_{2.5}$ (µg/m^3):

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

Long-term (1year) $PM_{2.5}$ MEGs (µg/m^3):

- Negligible MEG = 15
- Marginal MEG = 65.

2.4.2 Sample data/Notes:

A total of 11 valid $PM_{2.5}$ air samples were collected from 2003 to 2010. The range of 24-hour $PM_{2.5}$ concentrations was 71 µg/m^3 – 114 µg/m^3 with an average concentration of 101 µg/m^3.

2.4.3 Short-term and long-term health risks:

Insufficient data were available to characterize risk from $PM_{2.5}$.

2.5 Airborne Metals

2.5.1 Sample data/Notes:

A total of 40 valid PM_{10} airborne metal samples and a total of 11 valid $PM_{2.5}$ airborne metal samples were collected at Mosul Airfield and vicinity from 17 May 2003 to 6 April 2010. Airborne metals in PM_{10} and $PM_{2.5}$ were not detected above the short-term or long-term MEGs.

2.5.2 Short-term and long-term health risks:

None identified based on the available sampling data.

2.6 Polycyclic Aromatic Hydrocarbons (PAHs) and Semi-Volatile Organic Compounds (SVOCs)

2.6.1 Sample data/Notes:

A total of one valid air sample containing PAHs and SVOCs was collected in 2003. Airborne PAHs and SVOCs were not detected above the short-term MEGs. Long-term MEGs for the analyzed PAH and SVOC pollutants were unavailable.

2.6.2 Short-term health risks:

None identified based on the available sampling data.

2.6.3 Long-term health risks:

Not Evaluated-no available health guidelines. Long-term MEGs for the analyzed PAH and SVOC pollutants were unavailable.

3 Soil

3.1 Site-Specific Sources Identified

3.2 Sample data/Notes:

A total of 26 valid surface soil samples were collected from 7 May 2003 to 14 May 2009, to assess OEH risk to deployed personnel. 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. The percent of the population exposed to soil and associated dust in the sampled areas was 75%. For the risk assessment, personnel are assumed to remain at this location for 6 months to 1 year.

3.3 Short-term health risk:

Not an identified source of health risk. Currently, sampling data for soil are not evaluated for short term (acute) health risks**.**

3.4 Long-term health risk:

None identified based on available sample data. No parameters exceeded 1-year Negligible MEGs.

4 Water

In order to assess the health risk to U.S. personnel from exposure to water in theater, the APHC identified the most probable exposure pathways. These are based on the administrative information provided on the field data sheets submitted with the samples taken over the time period being evaluated. Based on the information provided by the field, samples for untreated water samples that were associated with complete exposure pathways were assessed as potential health hazards.

4.1 Drinking Water

4.1.1 Site-Specific Sources Identified

A total of four valid water samples from Mosul Airfield and vicinity were collected from 2007 to 2012 and evaluated for drinking or ingestion exposure.

4.1.2 Sample data/Notes:

To assess the potential for adverse health effects to troops, the following assumptions were made about dose and duration: A conservative (protective) assumption was that personnel routinely ingested 5 liters per day (L/day) of bottled water for up to 365 days (1-year). It was further assumed that control measures were not used.

4.1.3 Short-term and long-term health risk:

None identified based on available sample data. All collected samples were below the short and long-term Negligible MEGs.

4.2 Non-Drinking Water: Disinfected

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. A total of 18 non-drinking water samples from 2003 to 2009 were evaluated for this health risk assessment. Sulfate was detected at levels above the short-term MEG in 2004, 2006, and 2007. However, insufficient data were available to characterize risk from sulfate.

4.2.3 Short -term health risks:

None identified based on available sample data. All sampled parameters (except sulfate) were below the short-term Negligible MEGs. Insufficient data were available to characterize risk from sulfate.

4.2.4 Long-term health risks:

None identified based on available sample data. All sampled parameters were below the long-term Negligible MEGs.

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 Environmental Surveillance Library (MESL) from the 7 May 2003 through 10 April 2012 timeframe.

5.2 Depleted Uranium (DU)

No specific hazard sources were documented in the DOEHRS or MESL from the 7 May 2003 through 10 April 2012 timeframe.

5.3 Ionizing Radiation

No specific hazard sources were documented in the DOEHRS or MESL from the 7 May 2003 through 10 April 2012 timeframe. However, personnel should be trained to avoid areas with signs indicating operations involving radiation producing devices, sealed radiation sources, or unshielded radioactive material unless they are specifically trained and equipped to assess the hazard.

5.4 Non-Ionizing Radiation

No specific hazard sources were documented in the DOEHRS or MESL from the 7 May 2003 through 10 April 2012 timeframe. However, operator and maintenance personnel should be aware of safety precautions associated with their radio frequency radiating sources. Observance of the safety precautions will preclude personnel from exposure to radio frequency radiation that exceeds the Department of the Army and Department of Defense standards.

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

6.1 Foodborne and Waterborne Diseases

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

viral gastroenteritis (e.g., norovirus) and food poisoning (e.g., *Bacillus cereus*, *Clostridium perfringens*, *Staphylococcus*) may occur. 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. 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. 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 occurred. This disease is associated with a low risk estimate.

6.2.9 Short -term health risks:

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

6.2.10 Long -term health risks:

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

6.3 Water Contact Diseases

Tactical operations or recreational activities that involve extensive contact with surface water such as lakes, streams, rivers, or flooded fields may result in significant exposure to leptospirosis and schistosomiasis. Arid portions of Iraq without permanent or persistent bodies of surface water do not support transmission of leptospirosis or schistosomiasis. Risk was restricted primarily to areas along rivers and lakes. These diseases can debilitate personnel for up to a week or more. Leptospirosis risk typically increases during flooding. In addition, although not specifically assessed in this document, bodies of surface water are likely to be contaminated with human and animal waste. Activities such as wading or swimming may result in exposure to enteric diseases including diarrhea and hepatitis via incidental ingestion of water. Prolonged water contact also may lead to the development of a variety of potentially debilitating skin conditions including bacterial or fungal dermatitis. 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. The Army Surgeon General has defined increased risk in deployed Soldiers as indoor exposure to locals or third country nationals of greater than one hour per week in a highly endemic active TB region. Additional mitigation included active case isolation in negative pressure rooms, where available.

6.4.2 Meningococcal meningitis

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

6.4.3 Short-term health risks:

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

6.4.4 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 1B, 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 H5N1 avian influenza

Low: Potential health risk to U.S. personnel is Low. Although H5N1 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 H5N1 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.

7 Venomous Animal/Insect

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

7.1 Spiders

- *Latrodectus pallidus*: Clinical effects uncertain, but related to medically important species, therefore 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 werneri Odontobuthus doriae*, and *Orthochirus scrobiculosus*: Clinical effects unknown; there are a number of dangerous Buthid scorpions, but ther are also some known to cause minimal effects only. Without clinical data it is unclear where this species fits within that spectrum.

- *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

- *Hemorrhois ravergieri*, *Psammophis schokari*, *Pseudocyclophis persicus*, and *Telescopus fallax*: Clinical effects unknown, but unlikely to cause significant envenoming.

- *Macrovipera lebetina* subspecies e*uphratica* and subspecies *obtusa, and Vipera albicornuta*: Severe envenoming possible, potentially lethal.

- *Platyceps rhodorachis* and *Psammophis lineolatus*: Mild envenoming only, not likely to prove lethal.

- *Walterinnesia aegyptia*: Clinical effects unknown, but potentially lethal envenoming, though unlikely, cannot be excluded.

7.4 Short-term health risk:

Low: If encountered, effects of venom vary with species from mild localized envenoming (e.g. *P. lineolatus*) to potentially lethal effects (e.g., *V. albicornuta*). 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 9, Table 3-6).

7.5 Long-term health risk:

None identified.

8 Heat/Cold Stress

8.1 Heat

Summer (June - September) monthly mean daily maximum temperatures range from 78 degrees Fahrenheit (°F) to 89 °F based on historical climatological data. The health risk of heat stress/injury based on temperatures alone is Low (< 78 °F) from September – May, Moderate (78-81.9°F) in June, high (82-87.9°F) in July, and extremely high (≥ 88°F) in August. However, work intensity and clothing/equipment worn pose greater health risk of heat stress/injury than environmental factors alone (Reference 6). 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 Extremely 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 Extremely High in August, High in July, Moderate in June, and Low from September to May. Confidence in the health risk estimate is low (Reference 9, 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 9, Table 3-6).

8.2 Cold

8.2.1 Short-term health risks:

Winter (December - March) mean daily minimum temperatures range from 19 °F to 27 °F based on historical climatological data. Because even on warm days a significant drop in temperature after sunset by as much as 40 °F can occur, there is a risk of cold stress/injury. The risk assessment for Non-Freezing Cold Injuries (NFCI), such as chilblain, trench foot, and hypothermia, is Low based on historical temperature and precipitation data. Frostbite is unlikely to occur because temperatures rarely drop below freezing. However, personnel may encounter significantly lower temperatures during field operations at higher altitudes. As with heat stress/injuries, cold stress/injuries are largely dependent on operational and individual factors instead of environmental factors alone.

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

8.2.2 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

The major source of continuous environmental noise is aircraft operations at the airfield. Concrete T-Walls are in place in most locations surrounding the airfield to protect billeting areas that can provide an acoustical barrier to deflect the sound pressure generated from aircraft operations. Environmental noise from stand-alone generators in the proximity of the billeting area have some form of an acoustical barrier, absorption, damping, and/or vibration isolation material to minimize the noise in both working and living areas. Continuous noise has the potential to impact sleep quality, however insufficient information exists to assess the level of risk.

9.1.1 Short and long-term health risks:

Not evaluated. No available continuous noise evaluation information. No identified health risks.

9.2 Impulse

No specific hazard sources were documented in the DOEHRS or MESL from the 7 May 2003 through 10 April 2012 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 which the personnel are required to perform to complete their mission. The health risk associated with these hazards depends on a number of elements including what materials are used, how long the exposure last, what 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

10.2.1 Solid wastes, when stored improperly, provide harborage and food sources for filth flies and rodents. Quantitative information about solid waste management was unavailable. However, it was reported that dumpsters needed to be cleaned to reduce the number of flies and the dining hall had two solid waste deficiencies (uncovered trash receptacles and cardboard boxes were used as trash receptacles at the food lines).

10.2.2 Short-term and long-term risk: Unknown. Although improper solid waste storage issues were observed, there is no further data with which to assess risk levels.

10.3 Fuel/petroleum products/industrial chemical spills

10.3.1 Camp Marez

Spills were visibly noticeable at the Camp Marez storage facility and created a potential complete exposure pathway to personnel working at the location and personnel down gradient from the site. Spills were observed during petroleum, oil, and lubricants (POL) operations and discharge of POL contaminated water from secondary containment onto the surface is the current practice. This creates a potentially complete exposure pathway to personnel working at the fuel farm, personnel conducting refuel operations, and personnel down gradient of the site.

10.3.2 Camp Diamondback

There was no evidence of damaged electrical substations on Camp Diamondback or areas on the site that stored polychlorinated biphenyls.

10.3.3 Camp Courage

The hazardous waste and hazardous material storage facility at Camp Courage provides sufficient cover and secondary containment of the stored containers.

10.3.4 Short-term and Long-term risks: Unknown. Although spills were observed there is no further data with which to assess risk levels.

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. Monthly pesticide application reports in the MESL data portal for list the usage of pesticides on the sites. For each pesticide product applied during this period, the EPA approved label has been archived, providing a framework on how each pesticide was handled and applied (see below).

10.4.1 Rodenticides

Bifenthrin, brodifacoum, bromadiolone, difenacoum, diphacinone, hydramethylnon, n-ethyl perfluorooctanesulfonamide, polybutylenes, polyisobutylenes were used to control rodents.

10.4.2 Insecticides

Insecticides used to control ants, beetles, bees, chiggers, cockroaches, crickets, fleas, flies, gnats, grasshoppers, hornets, mosquito larva, mosquitos, moths, sand flies, scorpions, silverfish, SPIDERS, termites, ticks, wasps, and weevils included: (S)-methoprene, amidinohydrazone, *Bacillus thuringiensis* subspecies israelensis, bifenthrin, boric acid, brodifacoum, bromadiolone, carbaryl, cypermethrin, deltamethrin, d-trans allethrin, fipronil, hydramethylnon, imidacloprid, lambda-cyhalothrin, methomyl, nithiazine, permethrin, phenothrin, piperonyl butoxide, polybutylenes, polyisobutylenes, pyrethrins, resmerithrin , ß-cyfluthrin, trimethlamine, Z-9 tricosene.

10.4.2 Herbicides

Glyphosate was used to control weeds.

10.4.3 Short-term and Long-term health risks

No specific hazard sources were documented in DOEHRS or MESL data portal from 7 May 2003 through 10 April 2012.

10.5 Asbestos

No specific hazard sources were documented in DOEHRS or MESL data portal from 7 May 2003 through 10 April 2012.

10.6 Lead Based Paint

No specific hazard sources were documented in DOEHRS or MESL data portal from 7 May 2003 through 10 April 2012.

10.7 Burn Pit

While not specific to Mosul Airfield and vicinity, 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 7). The committee's review of the literature and the data suggests that service in Iraq or Afghanistan (i.e., a broader consideration of air

pollution than exposure only to burn pit emissions) may be associated with long-term health effects, particularly in susceptible (e.g., those who have asthma) or highly exposed subpopulations, such as those who worked at the burn pit. Such health effects would be due mainly to high ambient concentrations of PM from both natural and anthropogenic sources, including military sources. If that broader exposure to air pollution turns out to be relevant, potentially related health effects of concern 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.

10.7.1 PM_{10}

10.7.1.1 Exposure Guidelines:

Short Term (24-hour) PM_{10} ($\mu g/m^3$):
- Negligible MEG = 250
- Marginal MEG = 420
- Critical MEG = 600

Long-term PM_{10} MEG ($\mu g/m^3$):
- Not defined and not available.

10.7.1.2 Sample data/Notes:

A total of three valid PM_{10} air samples were collected in 2010. The samples were collected in the same 24-hour period for a PM_{10} concentration of 74 $\mu g/m^3$. PM_{10} concentrations were not detected above the short-term MEGs.

10.7.1.3 Short-term health risks:

None identified based on the available sampling data.

10.7.1.4 Long-term health risk:

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

10.7.2 $PM_{2.5}$

10.7.2.1 Exposure Guidelines:

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

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

10.7.2.2 Sample data/Notes:

A total of 11 valid $PM_{2.5}$ air samples were collected from 2003 to 2010. The range of 24-hour $PM_{2.5}$ concentrations was 71 $\mu g/m^3$ – 114 $\mu g/m^3$ with an average concentration of 101 $\mu g/m^3$.

10.7.2.3 Short-term and long-term health risks:

Insufficient data were available to characterize risk from $PM_{2.5}$.

10.7.3 Airborne Metals

10.7.3.1 Sample data/Notes:

A total of six valid PM_{10} airborne metal samples and a total of 11 valid $PM_{2.5}$ airborne metal samples were collected at Mosul Airfield and vicinity from 17 May 2003 to 6 April 2010. Airborne metals in PM_{10} and $PM_{2.5}$ were not detected above the short-term or long-term MEGs.

10.7.3.2 Short-term and long-term health risks:

None identified based on the available sampling data.

10.8 Al Mishraq Sulfur Fire Incident

In June 2003 a fire accidentally ignited at the Al Mishraq State Sulfur Mine Plant in Iraq, approximately 50 kilometers south of Mosul Airfield. The fire burned for approximately three weeks and satellite imagery showed some limited northerly movement of the smoke plume reaching the Mosul Airfield area. Varying degrees of intermittent exposure could have occurred to personnel at Mosul Airfield. Some anecdotal reports of odors suggest that hydrogen sulfide or sulfur dioxide may have reached the Mosul Airfield area, no field samples were collected from this area. Very high exposures to hydrogen sulfide or sulfur dioxide may cause irritation of the eyes, nose, and throat, and coughing. Such exposures may also cause constrictive bronchiolitis and is considered to be plausibly associated with exposure to the Al Mishraq State sulfur fire event (Reference 18).

10.8.1 PM_{10}

10.8.1.1 Exposure Guidelines:

Short Term (24-hour) PM_{10} ($\mu g/m^3$):

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

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

- Not defined and not available.

10.8.1.2 Sample data/Notes:

A total of nine valid PM_{10} air samples were collected from the Al Mishraq State Sulfur Mine Plant in 2003. The range of 24-hour PM_{10} concentrations was 139 $\mu g/m^3$ – 746 $\mu g/m^3$ with an average concentration of 279 $\mu g/m^3$.

10.8.1.3 Short-term health risks:

Low to High: The short-term PM_{10} health risk assessment is Low to High based on average and peak PM_{10} sample concentrations, and the likelihood of exposure at these hazard severity levels. Therefore, on typical days, exposure to PM_{10} was likely to range between little or no impact on accomplishing the mission. Peak exposures could have occurred, increasing the health risk level (Reference 9, Table 3-2). Under peak exposures exposure to PM_{10} significant degradation of mission capabilities in terms of the required mission standard, inability to accomplish all parts of the mission, or inability to complete the mission to standard was expected if hazards occurred during the mission.

Daily average health risk levels for PM_{10} show no hazard for 75%, low health risk for 12.5%, and high health risk for 12.5% of the time. Confidence in the short-term PM_{10} health risk assessment is low due to the small sample size (Reference 9, Table 3-6).

The hazard severity for average PM_{10} concentrations in samples was negligible. The results indicate that during exposures at the negligible hazard severity level a few personnel may have experienced notable eye, nose, and throat irritation, however most personnel will experience only mild effects (Reference 9, Table 3-11). Those with a history of asthma or cardiopulmonary disease are expected to experience increased symptoms.

For the highest observed PM_{10} sample concentration, the hazard severity was critical. During peak exposures at the critical hazard severity level, most if not all personnel were expected to experience very notable eye, nose, and throat irritation and respiratory effects. Visual acuity was expected to be impaired, as is overall aerobic capacity. Some personnel were expected to not be able to perform assigned duties. Some lost duty days were expected (Reference 9, Table 3-11). Those with a history of asthma or cardiopulmonary disease are expected to experience more severe symptoms.

10.8.1.4 Long-term health risk:

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

10.8.2 Airborne Metals

10.8.2.1 Sample data/Notes:

A total of 11 valid PM_{10} airborne metal samples were collected from the Al Mishraq State Sulfur Mine Plant in 2003. Airborne metals in PM_{10} were not detected above the short-term or long-term MEGs.

10.8.2.2 Short-term and long-term health risks:

None identified based on the available sampling data.

10.8.3 PAHs and SVOCs

10.8.3.1 Sample data/Notes:

A total of one valid air sample containing PAHs and SVOCs was collected from the Al Mishraq State Sulfur Mine Plant in 2003. Airborne PAHs and SVOCs were not detected above the short-term MEGs. Long-term MEGs for the analyzed PAH and SVOC pollutants were unavailable.

10.8.3.2 Short-term health risks:

None identified based on the available sampling data.

10.8.3.3 Long-term health risks:

Not Evaluated-no available health guidelines. Long-term MEGs for the analyzed PAH and SVOC pollutants were unavailable.

10.8.4 Soil Samples

10.8.4.1 Sample data/Notes:

A total of three valid surface soil samples were collected from the Al Mishraq State Sulfur Mine Plant in 2003. No parameters exceeded 1-year Negligible MEGs.

10.8.4.2 Short-term health risk:

Not an identified source of health risk. Currently, sampling data for soil are not evaluated for short term (acute) health risks**.**

10.8.4.3 Long-term health risk:

None identified based on available sample data. No parameters exceeded 1-year Negligible MEGs.

10.9 1/24 BN SBCT Health and Environmental Exposure Concerns

Multiple members of the 1/24 BN SBCT reported a variety of health conditions that included liver cancer, lymphoma, Crohn's disease, and undiagnosed symptoms and health concerns. The USAPHC engaged in fact finding for areas of exposure and potential health implications. Little objective information was available regarding potential exposures and limited environmental monitoring was conducted. Health effects reported by Unit members did not have clear associations with potential exposures that were identified by the Unit. While available data were limited, long-term health effects were not expected based on the information available. Additionally, a disease cluster was not evident (Reference 20).

11 References

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

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

12. Occupational and Environmental Health Surveillance Summary Assessment, Mosul, Iraq. 4 March 2004.

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16. USACHPPM, Health Assessment of 2003 Al Mishraq Sulfur Fire Incident. 1 July 2007.

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19. USAPHC, USAPHC Epidemiological Consultation No. 64-FF-064C-07, Mishraq Sulfur Fire Environmental Exposure Assessment. June 2010.

20. USAPHC, Deployment and Environmental Health Surveillance Investigation of 1/24 BN SBCT Mosul, Iraq 2004-2005. November 2014.

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/
DoD Health Readiness Policy and Oversight (HRP&O) Phone: (800) 497-6261. https://health.mil/Military-Health-Topics/Health-Readiness