

Military Deployment
Periodic Occupational and Environmental Monitoring Summary (POEMS):
Basra-Qarmat Ali and vicinity; Qarmat Ali, and the Al Basrah Oil Terminal (ABOT)
Iraq, 2003 to Close (12/31/2011):

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

PURPOSE: This POEMS documents the U.S. Department of Defense (DoD) assessment of base camp level Occupational and Environmental Health Surveillance (OEHS) exposure data for Basra-Qarmat Ali, Iraq, and vicinity. It presents the identified health risks and assessments along with associated medical implications. The findings are based on information collected from 1 March 2003 through 31 December 2011 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.¹

SITE DESCRIPTION:

Basra is the capital city of the Basra Governorate in southern Iraq near the Kuwaiti border and the Persian Gulf. Basra is the second largest and most populous city in Iraq. It is located between the Shatt-Al-Arab and Basra waterways and canals and streams run throughout the city. Notable bases inside of the city of Basra included Combat Outpost (COP) Perry, Basra Palace, the Old State Building, and Camp Wessam. Other areas in Basra where military personnel were located include the Qarmat Ali water treatment plant, the Basra Operations Center, Thar Allah's offices and the Haniyah district. All of the locations in this vicinity were analyzed collectively. Health risk levels were for the general area and may not have been specific to each base camp. The ABOT is an offshore oil marine loading terminal located off the southeastern coast of Iraq in the northern Persian Gulf. Health risk levels for the ABOT were assessed separately from the locations in this vicinity and are included in Section 10.9 of this POEMS.

SUMMARY: Summarized below are the key health risk estimates that present a moderate or greater risk of medical concern along with recommended follow-on medical actions, if any, that providers should be aware of. The table on the following pages provides a list of all the identified health risks at Basra-Qarmat Ali and vicinity. As indicated in the detailed sections that follow the table, controls that have been effectively established to reduce health risk levels have been factored into this overall assessment. In some cases (e.g., ambient air), specific controls are noted but not routinely available/feasible.

¹ While this assessment may reflect similar exposures and health risks pertaining to historic or future conditions at this site, the underlying data were limited to the time period(s) and area(s) sampled and thus may not reflect fluctuations or unique occurrences. It also may not be fully representative of all the fluctuations during the timeframe. To the extent that the data allow, this summary describes the general ambient conditions at the site and characterizes the health risks at the *population-level*. While useful to inform providers and others of potential health effects and associated medical implications, it does not represent an individual exposure profile. Actual individual exposures and specific resulting health effects depended on many variables and, should be addressed in individual medical records by providers as appropriate at the time of an evaluation of a unique exposure.

Short-term health risks & medical implications:

The following may have caused acute health effects in some personnel during deployment at Basra-Qarmat Ali and vicinity:

Inhalable coarse particulate matter less than 10 micrometers in diameter (PM₁₀); inhalable fine particulate matter less than 2.5 micrometers in diameter (PM_{2.5}); food/waterborne diseases (e.g., bacterial diarrhea, hepatitis A, typhoid fever, brucellosis, diarrhea-cholera, diarrhea-protozoal); other endemic diseases (cutaneous leishmaniasis, Crimean-Congo hemorrhagic fever, sandfly fever, leptospirosis, schistosomiasis, Tuberculosis (TB), rabies, Q fever); and heat stress. For food/waterborne diseases (e.g., bacterial diarrhea, hepatitis A, typhoid fever, brucellosis, diarrhea-cholera, diarrhea-protozoal), if ingesting local food and water, the health effects can temporarily incapacitate personnel (diarrhea) or result in prolonged illness (hepatitis A, typhoid fever, brucellosis). 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, Crimean-Congo hemorrhagic fever, sandfly fever), these diseases may constitute a significant risk due to exposure to biting vectors; risk reduced to Low by proper wear of the treated uniform, application of repellent to exposed skin and bed net, and appropriate chemoprophylaxis. For water contact diseases (leptospirosis, schistosomiasis) activities involving extensive contact with surface water increase risk. For respiratory diseases (TB), personnel in close-quarter conditions could have been at risk for person-to-person spread. Animal contact diseases (rabies, Q fever), pose year-round risk. For heat stress, risk can be greater for susceptible persons including those older than 45, of low fitness level, unacclimatized, or with underlying medical conditions. Risks from heat stress may have been reduced with preventive medicine controls, work-rest cycles, and mitigation.

In 2003, the Qarmat Ali Water Treatment Plant (WTP), which provided industrial grade water used in Iraq's oil production, had inadequate hygiene practices and deterioration of storage containers resulting in sodium dichromate contamination surrounding the area. DoD personnel were present at the Qarmat Ali WTP from April to October 2003. In September 2003, the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) sampled soil and air and assessed site risks and potential health risks. Medical evaluations of the personnel present at the site concluded that the site hazards were mitigated by containment and exposure reduction measures at the site, corroborating the low short-term risk estimate. See Section 10.4 for a summary of this incident and references.

Air quality: For PM₁₀ and PM_{2.5}, exposures may result in mild to more serious short-term health effects (e.g., eye, nose or throat and lung irritation) in some personnel while at this site, 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. There were burn pits and incinerators at Basra-Qarmat Ali and vicinity. For burn pits and incinerators, exposures to high levels of PM₁₀ and PM_{2.5} in the smoke may also result in mild to more serious short-term health effects (e.g., eye, nose or throat and lung irritation) in some personnel and certain subgroups while at this site. Although most effects from exposure to particulate matter and burn pit/incinerator 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 Basra-Qarmat Ali 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 hazards associated with potential long-term health effects at Basra-Qarmat Ali and vicinity include inhalable fine particulate matter less than 2.5 micrometers in diameter (PM_{2.5}) and Leishmaniasis-visceral infection. Leishmaniasis is transmitted by sand flies. Visceral leishmaniasis (a more latent form of the disease) causes a severe febrile illness, which typically requires hospitalization with convalescence over 7 days. The leishmaniasis parasites may survive for years in infected individuals. Consequently, this infection may go unrecognized until infections become symptomatic years later.

In 2003, the Qarmat Ali WTP, which provided industrial grade water used in Iraq's oil production, had inadequate hygiene practices and deterioration of storage containers, resulting in sodium dichromate contamination surrounding the area. DoD personnel were present at the Qarmat Ali WTP from April to October 2003. In September 2003, USACHPPM sampled soil and air and assessed site risks and potential health risks. Medical evaluations of the personnel present at the site concluded that the site hazards were mitigated by containment and exposure reduction measures at the site. Long-term adverse health effects related to chromium exposure were not expected based on the relatively brief exposure. See Section 10.4 for a summary of this incident and references.

Air quality: Although fine particulate matter less than 10 micrometers in diameter (PM₁₀) was not evaluated for long-

term risk due to no available health guidelines, the area was a dusty desert environment. There were burn pits and refuse incinerators present at Basra-Qarmat Ali and vicinity. For inhalational exposure to high levels of dust and PM_{2.5}, such as during high winds or dust storms, and for exposure to burn pit/incinerator 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 particulate matter exposures are documented and archived, 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, 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).

POEMS

**Table 1. Population-Based Health Risk Estimates –
Basra-Qarmat Ali and vicinity, Iraq^{1, 2}**

Source of Identified Health Risk ³	Unmitigated Health Risk Estimate ⁴	Control Measures Implemented	Residual Health Risk Estimate ⁴
AIR			
PM ₁₀	Short-term: Low to High. Daily levels vary, acute health effects (e.g., upper respiratory tract irritation) more pronounced during peak days. More serious effects were possible in susceptible persons (e.g., those with asthma/existing respiratory diseases).		Short-term: Low to High. Daily levels vary, acute health effects (e.g., upper respiratory tract irritation) more pronounced during peak days. More serious effects were possible in susceptible persons (e.g., those with asthma/existing respiratory diseases).
	Long-term: No health guidelines		Long-term: No health guidelines
PM _{2.5}	Short-term: Low to Moderate. Low short-term health risks for typical exposures, and Moderate health risks for peak exposures. A majority of the time mild acute (short term) health effects are anticipated; certain peak levels may produce mild eye, nose, or throat irritation in some personnel and pre-existing health conditions (e.g., asthma, or cardiopulmonary diseases) may be exacerbated.	Limiting strenuous physical activities when air quality is especially poor; and actions such as closing tent flaps, windows, and doors	Short-term: Low to Moderate. Low short-term health risks for typical exposures, and Moderate health risks for peak exposures. A majority of the time mild acute (short term) health effects are anticipated; certain peak levels may produce mild eye, nose, or throat irritation in some personnel and pre-existing health conditions (e.g., asthma, or cardiopulmonary diseases) may be exacerbated.
	Long-term: Moderate. Small percentage of persons may be at increased risk for developing chronic conditions. Particularly those more susceptible to acute effects (e.g., those with asthma/existing respiratory diseases).		Long-term: Moderate. Small percentage of persons may be at increased risk for developing chronic conditions (particularly those more susceptible to acute (short term) effects (e.g., those with asthma/existing respiratory diseases).
Water			
Consumed Water	Short-term: Insufficient data were available to determine risk.	USAPHC (VETCOM prior to 2010) Approved Bottled Water; Potable water only from approved water sources	Short-term: Insufficient data were available to determine risk.
	Long-term: Insufficient data were available to determine risk.		Long-term: Insufficient data were available to determine risk.
Water for Other Purposes	Short-term: None identified based on available sample data.	Water policy indicated treatment in accordance with the standards applicable to its intended use	Short-term: None identified based on available sample data.
	Long-term: None identified based on available sample data.		Long-term: None identified based on available sample data.
Endemic Disease			
Food borne/Waterborne (e.g., diarrhea-bacteriological)	Short-term: Low to High; High (bacterial diarrhea, hepatitis A, typhoid fever) to Moderate (diarrhea-cholera, diarrhea-protozoal, brucellosis) to Low (hepatitis E). If ingested local food/water, the health effects could have temporarily incapacitated personnel (diarrhea) or resulted in	Preventive measures included Hepatitis A and Typhoid fever vaccination and consumption of food and water only from approved sources.	Short-term: Low to none

	prolonged illness (hepatitis A, Typhoid fever, hepatitis E, brucellosis).		
	Long-term: none identified		Long-term: No data available
Arthropod Vector Borne	Short-term: None to Moderate; Moderate (leishmaniasis - cutaneous [acute], Crimean-Congo hemorrhagic fever, sandfly fever) to Low (rickettsioses, typhus-fleaborne, sindbis, West Nile fever). No hazard present from malaria.	Preventive measures included proper wear of the treated uniform and application of repellent to exposed skin and bed net, and appropriate chemoprophylaxis.	Short-term: Low
	Long-term: Moderate for Leishmaniasis-visceral infection.		Long-term: No data available
Water-Contact (e.g. wading, swimming)	Short-term: Moderate (schistosomiasis and leptospirosis).		Short-term: Moderate (schistosomiasis and leptospirosis).
	Long-term: No data available		Long-term: No data available
Respiratory	Short-term: Low to Moderate; Moderate (tuberculosis [TB]) to Low (meningococcal meningitis).		Short-term: Low; TB was evaluated as part of the PDHA (Post Deployment Health Assessment). A TB skin test was required post-deployment if potentially exposed.
	Long-term: No data available		Long-term: No data available
Animal Contact	Short-term: Low to Moderate; Moderate (rabies, Q-fever) to Low short-term health risk (due to rare occurrence) for H5N1 avian influenza.	Enforcement of CENTCOM General Order 1B mitigates rabies risk by prohibiting contact with, adoption, or feeding of feral animals. Risks are further reduced in the event of assessed contact by prompt post-exposure rabies prophylaxis IAW the CDC's ACIP guidelines.	Short-term: No data available
	Long-term: Low (Rabies)		Long-term: No data available
VENOMOUS ANIMAL/ INSECTS			
Snakes, scorpions, and spiders	Short-term: Low; If encountered, effects of venom varied with species from mild localized swelling (e.g. schokari sand racer) to potentially lethal effects (e.g. horned viper).		Short-term: Low; If encountered, effects of venom varied with species from mild localized swelling (e.g. schokari sand racer) to potentially lethal effects (e.g. horned viper).
	Long-term: No data available		Long-term: No data available
HEAT/COLD STRESS			
Heat	Short-term: Low to High; Risk of heat injury in unacclimatized personnel was High for May – October, and Low for all other months.	Risks from heat stress may have been reduced with preventive medicine controls, work-rest cycles, and mitigation.	Short-term: Low to High; Risk of heat injury in unacclimatized personnel was High for May – October, and Low for all other months.
	Long-term: Low. The long-term risk was Low. However, the risk may have been 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 was Low. However, the risk may have been 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	Risks from cold stress	Short-term: Low risk of cold

	stress/injury. Long-term: Low; Long-term health implications from cold injuries were rare but can occur, especially from more serious injuries such as frost bite.	may have been reduced with protective measures.	stress/injury. Long-term: Low; Long-term health implications from cold injuries were rare but can occur, especially from more serious injuries such as frost bite.
Unique Incidents/Concerns			
Industrial chemical spills	Short-term: Low health risk from sodium dichromate exposure at Qarmat Ali WTP.	Contaminated ground covered by asphalt and gravel; use of appropriate Personal Protective Equipment on site.	Short-term: Low health risk from sodium dichromate exposure at Qarmat Ali WTP.
	Long-term: Low health risk from sodium dichromate exposure at Qarmat Ali WTP.	Contaminated ground covered by asphalt and gravel; use of appropriate Personal Protective equipment on site.	Long-term: Low health risk from sodium dichromate exposure at Qarmat Ali WTP.

¹ This Summary Table provides a qualitative estimate of population-based short- and long-term health risks associated with the general ambient and occupational environment conditions at Basra-Qarmat Ali and vicinity, Iraq. It does not represent a unique individual exposure profile. Actual individual exposures and health effects depend on many variables. For example, while a chemical may 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 have resulted in a significant individual exposure. Any such person seeking medical care should have their specific exposure documented in an SF600.

² This assessment was based on specific data and reports obtained from the 12 May 2003 through 3 November 2011 timeframe. It was considered a current representation of general site conditions but may not reflect certain fluctuations or unique exposure incidents. Acute health risk estimates were generally consistent with field-observed health effects.

³ This Summary Table was organized by major categories of identified sources of health risk. It only lists those sub-categories specifically identified and addressed at Basra-Qarmat Ali and vicinity, Iraq. The health risks are presented as Low, Moderate, High or Extremely High for both acute and chronic health effects. The health risk level was based on an assessment of both the potential severity of the health effects that could be caused and probability of the exposure that would produce such health effects. Details can be obtained from the Army Public Health Command (APHC)/Army Institute of Public Health (AIPH). Where applicable, "None Identified" was used when though an exposure was identified, no health risk of either a specific acute or chronic health effects were determined. More detailed descriptions of OEH exposures that were evaluated but determined to pose no health risk are discussed in the following sections of this report.

⁴ Health risks in this Summary Table were based on quantitative surveillance thresholds (e.g. endemic disease rates; host/vector/pathogen surveillance) or screening levels, e.g., Military Exposure Guidelines (MEGs) for chemicals. Some previous assessment reports may have provided 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 made 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 Basra-Qarmat Ali, Iraq by Source

The following sections describe the major source categories of potential health risk that were evaluated at Basra-Qarmat Ali, Iraq and vicinity. For each category, the evaluation process included identifying what, if any, specific sub-categories/health concerns were present. This initial step resulted in “screening out” certain sub-categories that posed no identifiable health risk (for example if all data were below screening levels). While these sections may include sub-categories that have been determined to present no identifiable health risk, the summary table on the previous page only contains those sub-categories that were determined to pose moderate or higher potential health risks.

2 Air

2.1 Site-Specific Sources Identified

Basra-Qarmat Ali and vicinity is situated in a dusty semi-arid desert environment. Inhalational exposure to high levels of dust and particulate matter, such as during high winds or dust storms may have resulted in mild to more serious short-term health effects (e.g., eye, nose or throat and lung irritation) in some personnel. Additionally, certain subgroups of the deployed forces (e.g., those with pre-existing asthma/cardio pulmonary conditions) were at greatest risk of developing notable health effects.

2.2 Particulate matter, less than 10 micrometers (PM₁₀)

2.2.1 Sample data/Notes:

Exposure Guidelines:

Short-term (24-hour) PM₁₀ micrograms per square meters (µg/m³): Negligible MEG=250, Marginal MEG=420, Critical MEG=600.

Long-term PM₁₀ MEG (µg/m³): Not Available.

A total of 53 valid PM₁₀ air samples were collected in Basra-Qarmat Ali and vicinity from 1 March 2003 through 31 December 2011. The range of 24-hour PM₁₀ concentrations was 61 µg/m³ – 1722 µg/m³ with an average concentration of 290 µg/m³.

2.2.2 Short-term health risks:

Low to High: The short-term PM₁₀ health risk assessment in Basra-Qarmat Ali and vicinity was low based on average PM₁₀ concentrations and low to high based on peak PM₁₀ concentrations. Therefore, on typical days, exposure to PM₁₀ was likely to have little or no impact on accomplishing the mission. In theater medical resources should not have been needed for protection and treatment as a result of exposure to PM₁₀ levels on a typical day. Mission capabilities should not have been affected. Peak exposures could have occurred, increasing the health risk level (Reference 6, Table 3-2). Under peak exposures mission capabilities may have been degraded and may have required in-theater medical countermeasures and resources or mission capabilities may have been significantly degraded in terms of the required mission standard, inability to accomplish all parts of the mission, or inability to complete the mission.

Daily average health risk levels for PM₁₀ showed no hazard for 67.4%, low health risk for 20.9%, moderate health risk for 2.3%, and high health risk for 9.3% of the time. Confidence in the short-term PM₁₀ health risk assessment was low (Reference 6, Table 3-6).

The hazard severity was negligible for average PM₁₀ concentrations in Basra-Qarmat Ali and vicinity. During typical exposures at the negligible hazard severity level (250 ug/m³ - 420 ug/m³), a few personnel may have experienced notable eye, nose, and throat irritation; most personnel would have experienced only mild effects. Those with a history of asthma or cardiopulmonary disease were expected to experience increased symptoms at the negligible hazard severity levels.

The hazard severity was negligible to critical for the peak PM₁₀ concentration in Basra-Qarmat Ali and vicinity. During peak exposures at the critical hazard severity level (greater than 600 ug/m³), most if not all personnel would have experienced very notable eye, nose, and throat irritation and respiratory effects. Visual acuity was impaired, as was overall aerobic capacity. Some personnel would not have been able to perform assigned duties. Some lost-duty days were expected. During peak exposures at the negligible hazard severity level (250 ug/m³ - 420 ug/m³), a few personnel may have experienced notable eye, nose, and throat irritation; most personnel would have experienced only mild effects. Those with a history of asthma or cardiopulmonary disease were expected to experience increased symptoms at the critical and negligible hazard severity levels.

2.2.3 Long-term health risk:

Not Evaluated-no available health guidelines. The U.S. Environmental Protection Agency (EPA) retracted its long-term standard (National Ambient Air Quality Standard) for PM₁₀ due to an inability to clearly link chronic health effects with chronic PM₁₀ exposure levels.

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

2.3.1 Sample data/Notes:

Exposure Guidelines:

Short-term (24-hour) PM_{2.5} MEGs (µg/m³): Negligible MEG=65, Marginal MEG=250, Critical MEG=500.

Long-term PM_{2.5} MEGs: Negligible MEG=15, Marginal MEG=65.

A total of 49 valid PM_{2.5} air samples were collected in Basra-Qarmat Ali and vicinity from 1 March 2003 through 31 December 2011. The range of 24-hour PM_{2.5} concentrations was 13 µg/m³ – 411 µg/m³ with an average concentration of 91 µg/m³.

2.3.2 Short-term health risks:

Low to Moderate: The short-term PM_{2.5} health risk assessment in Basra-Qarmat Ali and vicinity was low based on average PM_{2.5} concentrations and low to moderate based on peak PM_{2.5} concentrations. Therefore, on typical days, exposure to PM_{2.5} was likely to have little or no impact on accomplishing the mission. In theater medical resources should not have been needed for protection and treatment as a result of exposure to PM_{2.5} levels on a typical day. Mission capabilities should not have been affected. Peak exposures could have occurred,

increasing the health risk level (Reference 6, Table 3-2). Under peak exposures mission capabilities may have been degraded in terms of the required mission standard and would have resulted in reduced mission capabilities, and may have required limited in-theater medical countermeasures and resources.

Daily average health risk levels for PM_{2.5} at Basra-Qarmat Ali and vicinity showed no hazard for 34.1% and low health risk for 65.9% of the time. Confidence in the short-term PM_{2.5} health risk assessment was low (Reference 6, Table 3-6).

The hazard severity was negligible for average PM_{2.5} exposures in Basra-Qarmat Ali and vicinity. During typical exposures at the negligible hazard severity level (65 ug/m³ - 250 ug/m³), a few personnel may have experienced notable eye, nose, and throat irritation; most personnel would have experienced only mild effects. Those with a history of asthma or cardiopulmonary disease were expected to experience increased symptoms at the negligible hazard severity levels.

The hazard severity was negligible to moderate for the peak PM_{2.5} exposure in Basra-Qarmat Ali and vicinity. During peak exposures at the moderate hazard severity level (250 ug/m³ - 500 ug/m³), a majority of personnel may have experienced notable eye, nose, and throat irritation and some respiratory effects. Significant aerobic activity would have increased risk. Those with a history of asthma or cardiopulmonary disease were expected to experience increased symptoms. During peak exposures at the negligible hazard severity level (65 ug/m³ - 250 ug/m³), a few personnel may have experienced notable eye, nose, and throat irritation; most personnel would have experienced only mild effects. Those with a history of asthma or cardiopulmonary disease were expected to experience increased symptoms at the negligible hazard severity levels. Those with a history of asthma or cardiopulmonary disease were expected to experience increased symptoms at the moderate and negligible hazard severity levels.

2.3.3 Long-term health risk:

Moderate: PM_{2.5} in Basra-Qarmat Ali and vicinity had an average concentration in 2009 (68 ug/m³) and 2010 (111 ug/m³) that exceeded the long-term 1 year negligible MEG (15 ug/m³). The long-term health risk assessment for PM_{2.5} concentrations were low based on average PM_{2.5} concentrations. Therefore, there was no specific medical action required for long-term exposure to PM_{2.5}.

The hazard severity was marginal for long-term PM_{2.5} exposures in Basra-Qarmat Ali and vicinity. During long-term exposures at the marginal hazard severity level, many exposed personnel were plausibly expected to develop delayed onset, irreversible effects. Confidence in the health risk assessment was low (Reference 6, Table 3-6).

2.4 Airborne Metals from PM₁₀

2.4.1 Sample data/Notes:

A total of 53 valid PM₁₀ air samples collected in Basra-Qarmat Ali and vicinity from 12 May 2003 – 3 November 2011 were analyzed for metals. No metals were detected at levels above the short or long-term MEGs.

2.4.2 Short-term and Long-term health risks:

None identified based on available sampling data. All detected contaminants were below applicable 1-year negligible MEGs.

2.5 Airborne Metals from PM_{2.5}

2.5.1 Sample data/Notes:

A total of 49 valid PM_{2.5} air samples were collected in Basra-Qarmat Ali and vicinity from 12 May 2003 – 3 November 2011 and analyzed for metals. No metals were detected at levels above the short or long-term MEGs.

2.5.2 Short- and long-term health risks:

None identified based on available sampling data. All detected contaminants were below applicable 1-year negligible MEGs.

3 Soil

3.1 Site-Specific Sources Identified

3.2 Sample data/Notes:

A total of 11 valid soil samples were collected in Basra-Qarmat Ali and vicinity in 2009 to assess OEH health risk to deployed personnel.

The primary soil contamination exposure pathways were dermal contact and dust inhalation. Typical parameters analyzed for included semi-volatile organic compounds, heavy metals, polychlorinated biphenyls, insecticides, fungicides, herbicides, and polycyclic aromatic hydrocarbons (PAH). For the risk assessment, personnel were 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 AIPH identified the most probable exposure pathways. These were based on the administrative information provided on the field data sheets submitted with the samples taken over the time

period being evaluated. Based on the information provided from the field, all untreated water samples were associated with municipal source water and complete exposure pathways were associated with those samples. Therefore, untreated samples were assessed as potential health hazards. It was assumed that 100% of all U.S. personnel at Basra-Qarmat Ali and vicinity were directly exposed to Reverse Osmosis Water Purification Unit (ROWPU) treated and disinfected fresh bulk water and municipal water, since this classification of water was primarily used for personal hygiene, showering, cooking, and for use at vehicle wash racks.

4.1 Drinking Water: ROWPU Water

4.1.1 Site-Specific Sources Identified

There were two ROWPU water sources sampled at Basra-Qarmat Ali and vicinity.

4.1.2 Sample data/Notes:

To assess the potential for adverse health effects to troops the following assumptions were made: All U.S. personnel at this location were assumed to remain at this site for approximately 1 year. A conservative (protective) assumption was that personnel routinely consumed less than 15 liters per day (L/day) of water for up to 365 days (1-year). It was further assumed that control measures and/or personal protective equipment were not used.

A total of two ROWPU water samples were taken in Basra-Qarmat Ali and vicinity from 2008 and 2009. Although average and peak perchlorate concentrations were above the long-term negligible MEG, a short-term negligible MEG was unavailable and data were insufficient to characterize health risk associated with perchlorate drinking water exposure. None of the other analyzed chemicals were found at concentrations above short or long-term MEGs.

4.1.3 Short-term and long-term health risk:

None identified based on available sample data. All detected chemicals in samples were below the short- and long-term Negligible MEGs. Data were insufficient to characterize health risk associated with perchlorate exposure.

4.2 Non-Drinking Water

4.2.1 Site-Specific Sources Identified

Although the primary route of exposure for most microorganisms was ingestion of the contaminated water, dermal exposure to some microorganisms, chemicals, and biologicals may have also caused adverse health effects. Complete exposure pathways included 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: All U.S. personnel at this location were expected to remain at this site for approximately 1 year. A conservative (protective) assumption was that personnel routinely consumed less

than 5L/day of non-drinking water for up to 365 days (1-year). It was further assumed that control measures and/or personal protective equipment were not used.

A total of twenty-two non-drinking samples taken in Basra-Qarmat Ali and vicinity were collected in 2003, 2004, 2006, 2008, 2009, 2010, and 2011 and were evaluated for this health risk assessment. No chemicals were detected at levels above the short or long-term MEGs.

4.2.3 Short-term and long-term health risks:

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

5 Military Unique

5.1 Chemical Biological, Radiological Nuclear (CBRN) Weapons

No specific hazard sources were documented in Defense Occupational and Environmental Health Readiness System (DOEHRS), or the Military Exposure Surveillance Library (MESL) from 1 March 2003 through 3 November 2011.

5.2 Depleted Uranium (DU)

No specific hazard sources were documented in DOEHRS or MESL from 1 March 2003 through 3 November 2011.

5.3 Ionizing Radiation

No specific hazard sources were documented in DOEHRS or MESL from 1 March 2003 through 3 November 2011.

5.4 Non-ionizing Radiation

No specific hazard sources were documented in DOEHRS or MESL from 1 March 2003 through 3 November 2011.

6 Endemic Disease²

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

6.1 Foodborne and Waterborne Diseases

Food borne and waterborne diseases in the area were transmitted through the consumption of local food and water. Local unapproved food and water sources (including ice) were heavily contaminated with pathogenic bacteria, parasites, and viruses to which most U.S. Service

² NOTE: "Risk" level refers to both severity of disease (without controls, for example vaccinations) and probability of disease based on local rates/endemic status. Diseases described were those that presented greater risk when compared with U.S. conditions. Most identified disease risks could and were being mitigated with military preventive medicine measures/policies.

Members had little or no natural immunity. Diarrheal diseases could be expected to temporarily incapacitate a very high percentage of personnel within days if local food, water, or ice was consumed. 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 have occurred.

6.1.1 Diarrheal diseases (bacteriological)

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

6.1.2 Hepatitis A, typhoid fever, and diarrhea-protozoal

Low to High: High, Mitigated Low: Unmitigated health risk to U.S. personnel was high year round. Mitigation was in place to reduce the risks to low, US Personnel did not drink untreated water, and vaccination with Hepatitis A and typhoid fever vaccination is required for deployment into the CENTCOM AOR. Hepatitis A, typhoid fever, and diarrhea-protozoa could cause prolonged illness. Hepatitis A and typhoid fever could cause prolonged illness in a small percentage of personnel, (less than 1 percent per month) and have a high risk estimate if no preventive medicine measures were taken. However, because the U.S. Central Command deployment requirements mandated that all deployed U.S. Forces, including civilians and contractors, were to be vaccinated for Hepatitis A and Typhoid fever, no risk was identified for U.S. Forces from Hepatitis A and Typhoid fever. Diarrhea-cholera and diarrhea-protozoal had a moderate risk estimate if no preventive medicine measures were taken, although cases for all were rare. However, much rarer, other potential diseases in this area included diarrhea-cholera and brucellosis with a moderate risk estimate and Hepatitis E with a low risk estimate.

6.1.3 Short-term health risks:

Low to High: The overall unmitigated short-term risk associated with Food borne and Waterborne diseases at Basra-Qarmat Ali and vicinity was considered High (for bacterial diarrhea, hepatitis A, typhoid fever) to Moderate (for diarrhea-cholera, diarrhea-protozoal, brucellosis) to Low (for hepatitis E) if local food or water was consumed. Preventive Medicine measures such as vaccinations reduced the risk estimate to none (for Hepatitis A and Typhoid fever). Additionally, U.S. Forces were provided food and water from approved sources. Confidence in risk estimate is medium.

6.1.4 Long-term health risks:

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

6.2 Arthropod Vector-Borne Diseases

During the warmer months (typically from April through November), the climate and ecological habitat supported populations of arthropod vectors, including mosquitoes, ticks, and sandflies. Significant disease transmission was sustained countrywide, including urban areas. In addition, other vector-borne diseases were transmitted at low or unknown levels and may have constituted a significant risk.

6.2.1 Malaria

None: In the Basra-Qarmat Ali and vicinity region indigenous transmission of malaria had been eliminated by 2008, reducing risk among personnel exposed to mosquito bites to none. Malaria chemoprophylaxis was not a deployment requirement for Iraq.

6.2.2 Leishmaniasis

Moderate: Leishmaniasis is transmitted by sand flies. Potential health risk to U.S. personnel was Moderate year round, but reduced to low with mitigation measures. For U.S. personnel, risk mitigation included proper wear of treated uniforms, application of repellent to exposed skin, and minimizing outdoor activities (when possible) between dusk and dawn. The disease risk is highest when sand flies are most prevalent in March through November. 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 US when infections become symptomatic years later. However, in the Basra-Qarmat Ali and vicinity region there were only a small number of cases (less than 1 percent per month attack rate). Cutaneous infection was unlikely to be debilitating, though lesions can be disfiguring. Visceral leishmaniasis causes a severe febrile illness, which typically requires hospitalization with convalescence over 7 days. The risk was moderate for both forms of the disease.

6.2.3 Crimean-Congo hemorrhagic fever

Moderate: Unmitigated risk was moderate, but reduced to low with mitigation measures. For U.S. personnel, risk mitigation included proper wear of treated uniforms and application of repellent to exposed skin. Crimean-Congo hemorrhagic fever most commonly occurred in rare cases (less than 0.1 percent per month attack rate) and was transmitted by tick bites or occupational contact with blood or secretions from infected animals. It is a very severe illness typically requiring intensive care with fatality rates from five to fifty percent. The risk was moderate but cases were rare.

6.2.4 Sandfly fever

Moderate: Sandfly fever had a moderate risk although it was estimated that potential disease rates were from 1 percent to 10 percent of personnel could be affected per month under worst-case conditions. It is transmitted by sandflies and occurs more commonly in children though adults still at risk. Incidents could have resulted in debilitating febrile illness typically requiring 1-7 days of supportive care followed by return to duty.

6.2.5 Rickettsioses, tickborne

Low: **Rickettsioses** disease was assessed as present, but levels at Basra-Qarmat Ali and vicinity were unknown; rare cases were possible among personnel exposed to tick bites.

Incidents could have resulted in a potentially debilitating febrile illness, which may have required 1 to 7 days of supportive care followed by return to duty. More prolonged and severe infections may have occurred with rare fatalities. Fatality rates in untreated cases may have been higher. The risk was low for rickettsioses.

6.2.6 Typhus-fleaborne

Low: Typhus-fleaborne had a low risk estimate although it was assessed as present, levels were unknown. Rare cases were possible among personnel exposed to rodents and flea bites. Debilitating febrile illness typically required 1 to 7 days of inpatient care, followed by return to duty.

6.2.7 West Nile fever

Low: West Nile fever was present and was maintained by the bird population and mosquitoes that help to transfer the diseases from birds to humans. The majority of infections in young, healthy adults were asymptomatic although it can result in fever, headache, tiredness, and body aches, occasionally with a skin rash (on the trunk of the body) and swollen lymph glands. This disease was associated with a low risk estimate.

6.2.8 Sindbis

Low: Sindbis presented a negligible risk (extremely rare cases) among personnel exposed to mosquito bites. Debilitating febrile illness were often accompanied by a rash, and typically required 1 to 7 days of supportive care. Significant arthralgias could persist for several weeks or more in some cases.

6.2.9 Short -term health risks:

Low to Moderate: Unmitigated risk was Moderate (for leishmaniasis-cutaneous (acute), Crimean-Congo hemorrhagic fever, Sandfly fever,); and Low (for rickettsioses, typhus-fleaborne, sindbis and West Nile fever). No hazard was present from malaria. Risk was reduced to low by proper wear of treated uniform and application of repellent to exposed skin. Confidence in risk estimate is medium.

6.2.10 Long -term health risks:

Moderate (for leishmaniasis-visceral [chronic]). Confidence in risk estimate is medium.

6.3 Water Contact Diseases

Tactical operations or recreational activities that involved extensive contact with surface water such as lakes, streams, rivers, or flooded fields may have resulted in significant exposure to leptospirosis and schistosomiasis. Risk was restricted primarily to areas along rivers and lakes. These diseases could have debilitated personnel for up to a week or more. Leptospirosis risk typically increased during flooding.

6.3.1 Schistosomiasis

Moderate: Schistosomiasis cases could occur in rare cases (less than 0.1% per month attack rate) among personnel wading or swimming in fecally contaminated bodies of water such as lakes, streams, or irrigated fields. Mild infections were generally asymptomatic. In very heavy acute infections, a febrile illness (acute schistosomiasis) may have occurred, especially with *S. japonicum* and *S. mansoni*, requiring hospitalization and convalescence over 7 days.

6.3.1 Leptospirosis

Moderate: Leptospirosis was present in Iraq but at unknown levels. Human infection occurred through exposure to water or soil contaminated by infected animals and was associated with wading, and swimming in contaminated, untreated open water. The occurrence of flooding after heavy rainfall facilitated the spread of the organism because, as water saturated the environment, leptospirosis present in the soil passed directly into surface waters. Leptospirosis can enter the body through cut or abraded skin, mucous membranes, and conjunctivae. Ingestion of contaminated water can also lead to infection. The acute generalized illness associated with infection can 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 have resulted in personnel being temporarily debilitated with leptospirosis.

6.3.2 Short -term health risks:

Moderate: For schistosomiasis and leptospirosis. Confidence in risk estimate is medium.

6.3.3 Long -term health risks:

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

6.4 Respiratory Diseases

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

6.4.1 Tuberculosis (TB)

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

6.4.2 Meningococcal meningitis

Low: Meningococcal meningitis posed a low risk and was transmitted from person to person through droplets of respiratory or throat secretions. Close and prolonged contact facilitated the spread of this disease.

6.4.3 Short-term health risks:

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

6.4.4 Long-term health risks:

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

6.5 Animal-Contact Diseases

6.5.1 Rabies

Low to Moderate: Rabies posed a year-round moderate risk, when unmitigated. General Order 1B mitigated rabies risk by prohibiting contact with, adoption, or feeding of feral animals. No cases were reported in US personnel during this time frame. Occurrence in Iraq in the feral animal population was well above U.S. levels due to the lack of organized control programs. Dogs were the primary sources of human exposure to rabies in Iraq, and canine rabies was the most common rabies strain. 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.

6.5.2 Anthrax

Low: Anthrax posed a year-round low risk, but cases were rare. Anthrax is a naturally occurring infection; cutaneous anthrax is transmitted by direct contact with infected animals or carcasses, including hides. Eating undercooked infected meat can result in contracting Gastrointestinal Anthrax however risks could have been eliminated through proper food preparation and consumption of food from approved sources. Pulmonary Anthrax is contracted through inhalation of spores and was extremely rare.

6.5.3 Q-Fever

Moderate: Q-Fever posed a year-round moderate risk. Rare cases were possible among personnel exposed to direct contact with infected livestock and domesticated animals or contaminated manure straw or dust in areas where herd animals were sheltered and grazed. Significant outbreaks (affecting 1-50 percent) 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.

6.5.4 H5N1 avian influenza

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

6.5.5 Short-term health risks:

Low to Moderate: Moderate (for rabies and Q-fever) to Low (for anthrax and H5N1 avian influenza) short-term risk due to rare occurrence. Confidence in risk estimate is medium.

6.5.6 Long-term health risks:

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

7 Venomous Animal/Insect

No specific hazard sources for Basra-Qarmat Ali and vicinity were documented in the DOEHS or MESL. A number of medically relevant venomous species had home ranges that overlapped the location of Basra-Qarmat Ali and vicinity and may have presented a health risk when encountered by personnel.

7.1 Spiders

- White widow spider (*Latrodectus pallidus*): Clinical effects were uncertain, but it is related to medically important species, therefore major envenoming could not be excluded.

7.2 Scorpions

- Fattail scorpion (*Androctonus crassicauda*): Severe envenoming was possible, potentially lethal. Cardiotoxicity may be direct or indirect, but is a feature of severe envenoming, with cardiac arrhythmias, cardiac failure. Hypovolaemic hypotension was possible in severe cases due to fluid loss through vomiting and sweating. Most stings caused only severe local pain which could be treated using local anesthetic infiltration. Systemic envenoming could develop rapidly, though occasionally may have been delayed in onset, so caution in assessment was required.
- *Hemiscorpius lepturus*: Severe envenoming was possible, potentially lethal. Stings caused local necrosis and variable, sometimes fatal systemic effects, including haemolysis, cardiac failure, and CNS effects.
- *Hottentotta saulcyi*, *Hottentotta scaber*, and *Hottentotta schach*: Moderate envenoming was possible but unlikely to prove lethal. Stings by these scorpions were likely to cause only short lived local effects, such as pain, without systemic effects.
- Israel pillar tail scorpion (*Orthochirus scrobiculosus*): Clinical effects were unknown; there were a number of dangerous Buthid scorpions, but also others known to caused minimal effects only. Without clinical data it was unclear where these species fits within that spectrum.
- Large-clawed scorpion (*Scorpio maurus*): Mild envenoming only, not likely to prove lethal. Stings by these scorpions were likely to cause only short lived local effects, such as pain, without systemic effects.

7.3 Snakes

- Horned viper (*Cerastes cerastes* and *Cerastes gasperettii*): Potentially lethal envenoming, though unlikely. Bites may have caused mild to moderate coagulopathy; severe coagulopathy not reported but cannot be excluded. Shock secondary to fluid shifts due to local tissue injury was possible in severe cases. Significant local and systemic effects, including coagulopathy could have occurred, so all cases should have been managed as potentially severe. Systemic envenoming with coagulopathy required antivenom therapy.
 - *Echis sochureki*: *Echis* bites cause moderate to severe, potentially lethal envenoming, requiring urgent assessment & treatment, including IV fluids, IV antivenom and good wound care. Bites may cause moderate to severe coagulopathy and haemorrhagins causing extensive bleeding. Shock secondary to fluid shifts due to local tissue injury is likely in severe cases.
 - Montpellier snake (*Macrovipera lebetina* subspecies *euphratica* and subspecies *obtuse*): Severe envenoming was possible, potentially lethal. Moderate to severe coagulopathy and haemorrhagins causing extensive bleeding. Renal damage was a recognized complication, usually secondary to coagulopathy. All cases should have been managed as potentially severe.
 - Steppe Ribbon Racer (*Psammophis lineolatus*): Mild envenoming only, not likely to prove lethal. Required symptomatic treatment only. No antivenom available.
 - Schokari Sand Racer (*Psammophis schokari*): Clinical effects unknown, but unlikely to cause significant envenoming, most unlikely to be dangerous. Bites were likely to cause either no effects or only mild local effects. Required symptomatic treatment only.
 - Dark-headed Dwarf Racer (*Pseudocyclophis persicus*): Clinical effects unknown, but unlikely to cause significant envenoming, most unlikely to be dangerous. Limited clinical data suggested bites resulted in local effects only. Role of antivenom most uncertain and unlikely to be required.
 - Desert Black Snake (*Walterinnesia aegyptia*): Clinical effects unknown, but potentially lethal envenoming, though unlikely, could not have been excluded. Local pain, swelling, probably not necrosis, general systemic effects, possibly flaccid paralysis was expected due to bites.. Antivenom was available and used at first sign of paralysis or for intractable general systemic effects, such as persistent vomiting not responding to antiemetics.

7.4 Short-term health risk:

Low: If encountered, effects of venom varied with species from mild localized effects (e.g. schokari sand racer) to potentially lethal effects (e.g. horned viper). See effects of venom above. Confidence in the health risk estimate is low (Reference 6 Table 3-6).

7.5 Long-term health risk:

None identified.

8 Heat/Cold Stress

Basra-Qarmat Ali and vicinity are located in Basra, the capital city of the Basra Governorate in southern Iraq near the Kuwaiti border and the Persian Gulf. Basra is located between the Shatt-Al-Arab and Basra waterways and canals and streams run throughout the city. Basra has a hot desert climate, although it receives slightly more precipitation than inland locations.

8.1 Heat

Average monthly peak temperature during the summer months (June – September) was 106 degrees Fahrenheit (°F). The health risk of heat stress/injury based on temperatures alone was Low (< 78 °F) from December – March, high (82-87.9°F) in April, and extremely high (≥ 88°F) from May – October. However, work intensity and clothing/equipment worn posed greater health risk of heat stress/injury than environmental factors alone (Reference 7).

8.1.1 Short-term health risk:

Low to High: High health risk of heat injury in unacclimatized personnel from May – October, and Low for all other months. The risk of heat injury was reduced through preventive measures. Because the occurrence of heat stress/injury was strongly dependent on operational factors (work intensity and clothing), confidence in the health risk estimate is low (Reference 6, Table 3-6).

8.1.2 Long-term health risk:

Low: Long-term health implications from heat injuries were rare but could occur, especially from more serious injuries such as heat stroke. However, the health risk may have been greater to certain susceptible persons—those older (i.e., greater than 45 years), in lesser physical shape, or with underlying medical/health conditions. The long-term health risk was Low; confidence in the health risk estimates is medium (Reference 6, Table 3-6).

8.2 Cold

Winter (December – March) low temperatures ranged from 48 °F to 55 °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 – March. 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 was Low. Confidence in the health risk estimate is medium.

8.1.2 Long-term health risk:

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

9 Noise

9.1 Continuous

No specific hazard sources were documented in DOEHRS or MESL from 1 March 2003 through 3 November 2011.

9.1.1 Short-term and Long-term health risks:

No continuous noise evaluations were conducted, not evaluated.

9.2 Impulse

No specific hazard sources were documented in DOEHRS or MESL from 1 March 2003 through 3 November 2011.

9.2.1 Short-term and Long-term health risks:

No impulse noise evaluations were conducted, not evaluated.

10 Unique Incidents/Concerns

10.1 Potential environmental contamination sources

DoD personnel were exposed to various chemical, physical, ergonomic, and biological hazards in the course of performing their mission. These types of hazards depended on the mission of the unit and the operations and tasks which the personnel were required to perform to complete their mission. The health risk associated with these hazards depended on a number of elements including what materials were used, how long the exposure lasted, what was done to the material, the environment where the task or operation was performed, and what controls were used. The hazards could 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 occurred when performing maintenance task such as painting, grinding, welding, engine repair, or movement through contaminated areas. Exposures to these occupational hazards could occur through inhalation (air), skin contact, or ingestion; however exposures through air were generally associated with the highest health risk.

10.2 Food Sanitation

A search of the DOEHRS and MESL from 1 March 2003 through 31 December 2011 yielded limited food sanitation inspection records in the locations associated with Basra-Qarmat Ali for 2004, 2009, and 2011. Food sanitation deficiencies found in the locations associated with Basra-Qarmat Ali are summarized below.

The following discrepancies that raised health risks for transmission of foodborne illness were identified on at least one occasion: Raw meat was stored improperly above cooked foods and fruits. Refrigerators contained unlabeled food and used improper thawing procedures. Food was handled without wearing gloves. Rinse water and leftovers were not maintained at proper temperatures. Flies were present in all locations and were present at the dining facilities. Dry goods were stored outside of the dining facilities in boxes that were open to the environment. Latrines were at times not stocked with hand sanitizer. Water in the hand washing stations had no chlorine and tested positive for total coliform.

10.2.1 Short-term and Long-term health risks

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

10.3 Waste Sites/Waste Disposal

Lack of proper sanitation at the bulk trash point significantly contributed to the fly populations at the locations associated with Basra-Qarmat Ali. Recommendations were made to use lids on trash cans to prevent breeding of flies and to use wooden containers to hold the trash cans and prevent scattering of trash by the wind.

10.3.1 Short-term and Long-term health risks

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

10.4 Fuel/petroleum products/industrial chemical spills

The Qarmat Ali WTP provided industrial grade water that was used in Iraq's oil production process. Water for this process was treated with sodium dichromate to reduce the corrosion of the oil production facility's pipes and other equipment. Inadequate hygiene practices and deterioration of storage containers by the natural elements resulted in sodium dichromate contamination within and on the soils surrounding the sodium dichromate mixing building and storage area. DoD personnel were present at the Qarmat Ali WTP from April to October 2003 to escort and guard Kellogg, Brown, and Root (KBR) workers or to assist in the restoration of the oil infrastructure at Qarmat Ali WTP. National Guard personnel and DoD civilians were present at the site for a short period of time (an average exposure time of 8 hours per day for 20 days). The ground surrounding the sodium dichromate mixing building and storage area was covered by asphalt and gravel to limit further exposure to contaminated soil. In September 2003, the U.S. Army Center for Health Promotion and Preventive Medicine sampled soil and air and assessed the site risks and potential health risks to DoD personnel. (See References 12 and 13 for more information.)

10.4.1 Short-term health risks:

Low: Complete medical evaluations and whole blood chromium testing of the roster identified personnel present at the site concluded that the site hazards were mitigated by containment and exposure reduction measures at the site, corroborating the low risk estimate.

10.4.1 Long-term health risks:

Low: Long-term adverse health effects related to chromium exposure, such as nasal passage cancer and lung cancer, were not expected based on the relatively brief exposure.

10.5 Pesticides/Pest Control:

No specific hazard sources were documented in DOEHS or MESL data portal from 1 March 2003 through 31 December 2011.

10.6 Asbestos

No specific hazard sources were documented in DOEHS or MESL from 1 March 2003 through 3 November 2011.

10.7 Lead Based Paint

No specific hazard sources were documented in DOEHS or MESL from 1 March 2003 through 3 November 2011.

10.8 Burn Pit

While not specific to Basra-Qarmat Ali and vicinity, the consolidated epidemiological and environmental sampling studies on burn pits that have been conducted to date were unable to say whether an association does or does not exist between exposures to emissions from the burn pits and long-term health effects (Reference 8). The committee's review of the literature and the data suggests that service in Iraq (i.e., a broader consideration of air pollution than exposure only to burn pit emissions) might 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.

10.8.1 Particulate matter, less than 2.5 micrometers (PM_{2.5}) associated with a burn pit or incinerator

10.8.1.1 Sample data/Notes:

Exposure Guidelines:

Short-term (24-hour) PM_{2.5} MEGs (µg/m³): Negligible MEG=65, Marginal MEG=250, Critical MEG=500.

Long-term PM_{2.5} MEGs: Negligible MEG=15, Marginal MEG=65.

A total of 6 valid PM_{2.5} air samples were collected from 24 September 2009 – 8 December 2010 in the vicinity of an Iraqi burn pit at Camp Wessam or a refuse incinerator in Basra. The range of 24-hour PM_{2.5} concentrations was 29 µg/m³ – 85 µg/m³ with an average concentration of 48 µg/m³. The average PM_{2.5} concentrations were below the short-term PM_{2.5} negligible MEG and below the long-term PM_{2.5} marginal MEG. The peak PM_{2.5} concentrations were slightly above the short-term PM_{2.5} negligible MEG and the long-term PM_{2.5} marginal MEG.

A total of 1 valid PM_{2.5} air sample was collected on 8 December 2010 in the vicinity of an Iraqi burn pit at Camp Wessam. The 24-hour PM_{2.5} concentration was 85 µg/m³ and was above the short-term and long-term PM_{2.5} negligible MEGs.

Data were insufficient to characterize health risk associated with PM_{2.5} exposure from burn pits or incinerators at Basra-Qarmat Ali.

10.8.1.2 Short-term and Long-term health risks:

Data were insufficient to characterize health risk associated with PM_{2.5} exposure from burn pits or incinerators at Basra-Qarmat Ali.

10.8.2 Airborne Metals from PM_{2.5} associated with a burn pit or incinerator

10.8.2.1 Sample data/Notes:

A total of 6 valid PM_{2.5} air samples were collected from 24 September 2009 – 8 December 2010 in the vicinity of an Iraqi burn pit at Camp Wessam or a refuse incinerator in Basra and analyzed for metals. No metals were detected at levels above the short or long-term MEGs.

A total of 1 valid PM_{2.5} air sample was collected on 8 December 2010 in the vicinity of an Iraqi burn pit at Camp Wessam and analyzed for metals. No metals were detected at levels above the short or long-term MEGs.

10.8.2.2 Short- and long-term health risks:

None identified based on available sampling data. All detected contaminants were below applicable 1-year negligible MEGs.

10.9 Al Basrah Oil Terminal (ABOT)

The ABOT is an offshore oil marine loading terminal located off the southeastern coast of Iraq in the northern Persian Gulf. The facility consists of a four berths capable of loading very large crude oil carriers. Personnel deployed to ABOT were potentially exposed to residual volatile organic compounds that were displaced from an oil tanker's storage tanks each time an oil tanker was filled with crude oil and to particulate matter. Samples collected at the ABOT were analyzed separately from samples collected in Basra because the ABOT is roughly 150 kilometers away from Basra.

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

10.9.1.1 Sample data/Notes:

Exposure Guidelines:

Short-term (24-hour) PM_{2.5} MEGs (µg/m³): Negligible MEG=65, Marginal MEG=250, Critical MEG=500.

Long-term PM_{2.5} MEGs: Negligible MEG=15, Marginal MEG=65.

A total of 3 valid PM_{2.5} air samples were collected at the ABOT from 19 December 2008 – 14 November 2009. The range of 24-hour PM_{2.5} concentrations was 15 µg/m³ – 188 µg/m³ with an average concentration of 102 µg/m³.

10.9.1.2 Short- and long-term health risks:

Although the average and peak PM_{2.5} concentrations were above the short-term and long-term PM_{2.5} negligible MEGs, data were insufficient to characterize health risk associated with PM_{2.5} exposure at the ABOT.

10.9.2 Airborne Metals from PM_{2.5}:

10.9.2.1 Sample data/Notes:

A total of 3 valid PM_{2.5} air samples were collected at the ABOT from 19 December 2008 – 14 March 2009 and analyzed for metals. No metals were detected at levels above the short or long-term MEGs.

10.9.2.2 Short- and long-term health risks:

None identified based on available sampling data. All detected contaminants were below applicable 1-year negligible MEGs.

10.9.3 Volatile Organic Compounds (VOC):

10.9.3.1 Sample data/Notes:

A total of 5 valid air samples collected at the ABOT from 14 March 2009 – 4 January 2010 were analyzed for VOCs. None of the analyzed VOCs were detected at concentrations above short-term MEGs. Benzene, hexane, and vinyl acetate were detected at concentrations above the long-term MEGs; however data were insufficient to characterize health risk associated with benzene, hexane, and vinyl acetate.

10.9.3.2 Short-term health risks:

None identified based on the available sampling data. No parameters exceeded 14-day Negligible MEGs.

10.9.3.3 Long-term health risks:

None identified based on the available sampling data. Data were insufficient to characterize health risk associated with benzene, hexane, and vinyl acetate exposure.

10.9.3.4 Navy and Marine Corps Public Health Center VOC and Hydrogen Sulfide (H₂S) Assessment:

The Navy and Marine Corps Public Health Center (NMCPHC) conducted personal and area air monitoring at the ABOT in 2010 (Reference 13). Samples were collected between 5 May 2010 and 18 May 2010 and were analyzed for VOCs and H₂S. Sample results were compared to

site-specific MEGs developed by NMCPHC and to the American Conference of Government Hygienists Threshold Limit Values to determine if exposure to the measured concentrations was acceptable.

10.9.3.4.1 Short-term health risk conclusions:

Risk from exposure to VOCs was low and exposure at the sampled concentrations was expected to have no adverse impact on accomplishment of the military mission. H₂S concentrations displaced from ship tanks that previously carried crude oil were of sufficient high concentration to exceed all applicable Occupational Exposure Limits and were a cause for concern due to acute health effects such as nausea and vomiting.

10.9.3.4.2 Long-term health risk conclusions:

Risk from exposure to VOCs and H₂S was low and long-term health effects were not expected.

10.9.4 Water:

In order to assess the health risk to U.S. personnel from exposure to water in theater, the AIPH identified the most probable exposure pathways. These were based on the administrative information provided on the field data sheets submitted with the samples taken over the time period being evaluated. Based on the information provided from the field, it was assumed that 100% of all U.S. personnel at the ABOT were directly exposed to ROWPU treated bulk water, primarily used for personal hygiene, showering, and cooking. No drinking water samples were collected at the ABOT.

10.9.4.1 Site-Specific Sources Identified:

Although the primary route of exposure for most microorganisms was ingestion of the contaminated water, dermal exposure to some microorganisms, chemicals, and biologicals may have also caused adverse health effects. Complete exposure pathways included brushing teeth, personal hygiene, preparing food for cooking, or during dermal contact at wash racks.

10.9.4.2 Sample data/Notes:

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

A total of two non-drinking samples taken in at the ABOT in 2009 were evaluated for this health risk assessment. No chemicals were detected at levels above the short or long-term MEGs.

10.9.4.3 Short-term and long-term health risks:

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

10.9.5 Waste Sites/Waste Disposal:

Sanitation was generally acceptable in the containerized living units in the ABOT. Food was stored properly and trash was emptied routinely.

10.9.5.1 Short-term and Long-term health risks

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

11 References³

1. Casarett and Doull's Toxicology: the Basic Science of Poisons, Chapter 2- Principles of Toxicology; Fifth Edition, McGraw Hill, New York.
2. 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.
3. DoDI 6055.05, Occupational and Environmental Health, 2008.
4. 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.
5. JCSM (MCM) 0028-07, Procedures for Deployment Health Surveillance, 2007.
6. USA PHC TG230, June 2010 Revision.
7. 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.
8. IOM (Institute of Medicine). 2011. Long-term health consequences of exposure to burn pits in Iraq and Afghanistan. Washington, DC: The National Academies Press.
9. USACHPPM 2008 Particulate Matter Factsheet; 64-009-0708, 2008.
10. Clinical Toxinology Resources: <http://www.toxinology.com/>. University of Adelaide, Australia.
11. USACHPPM 2009. Deployment Occupational and Environmental Health Survey and Operational Risk Assessment Qarmat Ali Industrial Water Treatment Plant, Basrah, Iraq, 30 September – 2 November 2003.
12. USAPHC 2011. Fact Sheet 64-012-0811. Health Assessment of 2003 Qarmat Ali Water Treatment Plant Sodium Dichromate Incident. Status Update: August 2011.
13. Navy and Marine Corps Public Health Center 2010. Assessment of Personnel Exposures to Volatile Organic Compounds (VOCs) and Hydrogen Sulfide (H₂S) From Crude Oil Loading Operation at the Al Basrah Oil Terminal (ABOT). 27 September 2010.

³ NOTE. The data were assessed using the 2010 version of TG230 (Reference 6). The general method involved an initial review of the data which eliminated all chemical substances not detected above 1-yr negligible MEGs. Those substances screened out were not considered acute or chronic health hazards so were not assessed further. For remaining substances, acute and chronic health effects were evaluated separately for air water (soil was only evaluated for long term risk). This was performed by deriving separate short-term and long term population exposure level and estimates (referred to as population exposure point concentrations (PEPC)) that were compared to MEGs derived for similar exposure durations. If less than or equal to negligible MEG the risk was Low. If levels are higher than negligible then there was a chemical-specific toxicity and exposure evaluation by appropriate SMEs, which included comparison to any available marginal, critical, or catastrophic MEGs. For drinking water 15 L/day MEGs were used for the screening while site specific 5-15 L/day were used for more detailed assessment. For nondrinking water (such as that used for personal hygiene or cooking) the 'consumption rate' was limited to 2 L/day (similar to the EPA) which was derived by multiplying the 5 L/day MEG by a factor of 2.5. This value was used to conservatively assess non-drinking uses of water.

12 Where Do I Get More Information?

If a provider feels that the Service member's or Veteran's current medical condition may be attributed to specific OEH exposures at this deployment location, he/she can contact the Service-specific organization below. Organizations external to DoD should contact DoD Force Health Protection and Readiness (FHP & R).

Army Institute of Public Health Phone: (800) 222-9698. <http://phc.amedd.army.mil/>

Navy and Marine Corps Public Health Center (NMCPHC) (formerly NEHC) Phone: (757) 953-0700. <http://www-nehc.med.navy.mil>

U.S. Air Force School of Aerospace Medicine (USAFSAM) (formerly AFIOH) Phone: (888) 232-3764. <http://www.wpafb.af.mil/afrl/711hpw/usafsam.asp>

DoD Force Health Protection and Readiness (FHP & R) Phone: (800) 497-6261.
<http://fhp.osd.mil>