Volume 3

Final Remedial Investigation/Feasibility
Study Workplan & Associated Documents

Crab Orchard National Wildlife Refuge, Marion, IL

Additional and Uncharacterized Sites

Health & Safety Plan

April, 2006

Prepared by:

NewFields

CRA
Conestoga-Rovers & Associates

ENTRIX

Prepared on behalf of:

General Dynamics
Ordnance and Tactical Systems

HEALTH AND SAFETY PLAN

VOLUME 3

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NWR
MARION, ILLINOIS WILLIAMSON COUNTY
(Final)

APRIL 2006

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LIST OF ACRONYMS/ABBREVIATIONS

APR	Air Purifying Respirator
AUS OU	Additional and Uncharacterized Sites Operable Unit
CFR	Code of Federal Regulations
CONWR	Crab Orchard National Wildlife Refuge
COPC	Constituents of Potential Concern
CRA	Conestoga-Rovers & Associates
CRZ	Contaminant Reduction Zone
DEET	Diethyltoluamide
DPT	Direct Push Technology
ENTRIX	ENTRIX Inc.
EZ	Exclusion Zone
FWS	Fish and Wildlife Service
GD-OTS	General Dynamics Ordnance and Tactical Systems, Inc.
HSP	Health and Safety Plan
IDLH	Immediate Danger to Life and Health
IDW	Investigative-Derived Waste
IOP	Illinois Ordnance Plant
mg/m^3	Milligrams Per Cubic Meter
NewFields	NewFields Companies, L.L.C.
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PA/SI	Preliminary Assessment/Site Inspection
PEL	Permissible Exposure Limit
PFD	Personal Floatation Device
ppm	Parts Per Million
PID	Photoionization Detector
PPE	Personal Protective Equipment
PVC	Polyvinyl Chloride
Refuge	Crab Orchard National Wildlife Refuge
RELs	Recommended Exposure Limits
RI/FS	Remedial Investigation/Feasibility Study
RMSF	Rocky Mountain Spotted Fever
SSO	Site Safety Officer
STEL	Short-term Exposure Limit
SZ	Support Zone
TLV	Threshold Limit Value
TNT	2,4,6-Trinitrotoluene
UXO	Unexploded Ordnance
USEPA	United States Environmental Protection Agency
USCG	United States Coast Guard

1.0 GENERAL

This Health & Safety Plan (HSP) has been prepared to address activities to be conducted in selected areas at the Crab Orchard National Wildlife Refuge ("CONWR" or "Refuge"). The activities outlined in the Remedial Investigation/Feasibility Study (RI/FS) Scope of Work will involve drilling, excavating, monitoring well installations, and soil, sediment, surface water, and groundwater sampling within the limits of the Additional and Uncharacterized Sites Operable Unit (AUS OU) and project support areas. While conducting these activities, personnel may come in contact with soils, sediment, surface water, groundwater, and debris which potentially contain hazardous materials. To ensure that any direct contact with potentially contaminated material by NewFields Companies, L.L.C. (NewFields), Conestoga-Rovers & Associates (CRA), and ENTRIX. (ENTRIX) personnel is minimized, this HSP was developed. Subcontractors shall develop HSPs which are specific to their work tasks.

This HSP is designed to ensure the following:

i) NewField's, CRA's, and ENTRIX's Site personnel are not adversely exposed to the compounds of concern as well as the physical and biological hazards present;

ii) Public welfare or the environment are not adversely impacted by off-Site migration of contaminated materials due to work activities conducted at the AUS OUs; and

iii) CRA's and ENTRIX's operations, procedures, and equipment will meet the requirements of 29 Code of Federal Regulations (CFR) 1910.120, Hazardous Waste Operations and Emergency Response, and the applicable subparts of 29 CFR 1926 and 29 CFR 1910.

For the purpose of this HSP, all RI activities carried out on the AUS OU Sites and support areas involving contact with potentially contaminated materials will be considered contaminated operations requiring personal protective equipment (PPE). Similar activities occurring off the AUS OU Sites and support areas are considered non-contaminated operations requiring a modified level of PPE from that for field work.

All RI operations at the AUS OU Sites will be conducted in accordance with the provisions of the HSP. Cost and/or scheduling considerations will not be considered as justification for modifying this plan.

The Refuge is located near Marion, Illinois. The 32 AUS OU Sites to be investigated are provided as Figure 1.1. A hospital route map is provided on Figure 1.2.

2.0 AUS OUs CHARACTERIZATION AND HAZARD ANALYSIS

The Refuge is located approximately 5 miles west of the City of Marion, Illinois. The Refuge consists of approximately 43,500 acres of forests, grassland areas, cropland, wetlands, and industrial areas. A portion of the area now occupied by the Refuge was operated as the Illinois Ordnance Plant (IOP) during World War II. The IOP occupied approximately 22,000 acres and contained 534 buildings and various utilities, including steam generation; water, sewage, and wastewater treatment facilities; and a railroad line. The IOP operations consisted of seven load lines: three of which were 2,4,6-trinitrotoluene (TNT) melt-pour operations for shells, bombs, and mines, and the other four lines were for the production of boosters, detonators, primers, and fuses for shells, bombs, and mines. Access to and egress from the Refuge areas can be obtained from various locations. A map showing the locations of the AUS OUs is provided as Figure 1.1.

The soil and groundwater at the AUS OUs may have been adversely impacted by past activities. The soil and groundwater is potentially contaminated with various constituents of potential concern (COPCs). A summary of the COPCs and their related health effects are presented in Table 2.1. A summary of the notable contamination in each AUS OU site to be investigated is presented in Section 4.0 of the RI/FS Work Plan. The table entitled "AUS OU Sites Recommended for Remedial Investigation" was previously completed by Fish and Wildlife Services (FWS) and included in a report entitled "Preliminary Assessment/Site Inspection Report (PA/SI)" (FWS, 2003). There are a total of 32 AUS OUs to be investigated.

The activities to be performed as part of the RI will include:

- sediment and surface water sampling;
- groundwater monitoring activities;
- soil boring, monitoring well, and piezometer installation activities;
- surveying activities;
- sampling activities; and
- surface and subsurface unexploded ordnance (UXO) avoidance activities.

Risks associated with these activities will be minimized by implementing engineering controls, safe work practices, and the proper use of PPE. Table 2.2 summarizes the potential hazards associated with activities at the AUS OU Sites.

2.1 BIOLOGICAL HAZARDS

Biological hazards may include poison ivy, poison oak, poison sumac, snakes, thorny bushes and trees, ticks, mosquitoes, bees/wasps, and other pests.

2.1.1 TICK-BORNE DISEASES

Lyme Disease, Erlichiosis, and Rocky Mountain Spotted Fever (RMSF) are diseases transmitted by ticks and occur throughout the United States during spring, summer, and fall.

Lyme Disease: The disease commonly occurs in summer and is transmitted by the bite of infected ticks. "Hot spots" in the United States include New York, New Jersey, Pennsylvania, Massachusetts, Connecticut, Rhode Island, Minnesota, and Wisconsin. Few cases have been identified in other states.

Erlichiosis: The disease also commonly occurs in summer and is transmitted by the bite of infected ticks. "Hot spots" in the United States include New York, Massachusetts, Connecticut, Rhode Island, Minnesota, and Wisconsin. Few cases have been identified in other states.

These diseases are transmitted primarily by the Deer Tick, which is smaller and redder than the common Wood Tick. The disease may be transmitted by immature ticks, which are small and hard to see. The tick may be as small as a period on this page.

Symptoms of Lyme disease include a rash or a peculiar red spot, like a bull's eye, which expands outward in a circular manner. The victim may have headache, weakness, fever, a stiff neck, swelling and pain in the joints, and eventually, arthritis. Symptoms of Erlichiosis include muscle and joint aches, and flu-like symptoms, but there is typically no skin rash.

Rocky Mountain Spotted Fever: This disease is transmitted via the bite of an infected tick. The tick must be attached 4 to 6 hours before the disease-causing organism (*Rickettsia rickettsii*) becomes reactivated and can infect humans. The primary symptom of RMSF is the sudden appearance of a moderate-to-high fever. The fever may persist for 2 to 3 weeks. The victim may also have a headache, deep muscle pain, and chills. A

rash appears on the hands and feet on about the third day and eventually spreads to all parts of the body. For this reason, RMSF may be confused with measles or meningitis. The disease may cause death if untreated, but if identified and treated promptly, death is uncommon.

Control: Tick repellent containing diethyltoluamide (DEET) should be used in tick-infested areas, and pants legs should be tucked into boots. In addition, workers should search the entire body every 3 or 4 hours for attached ticks. Ticks should be removed promptly and carefully without crushing, since crushing can squeeze the disease-causing organism into the skin. A gentle and steady pulling action should be used to avoid leaving the head or mouth parts in the skin. Hands should be protected with surgical gloves when removing ticks.

2.1.2 POISONOUS PLANTS

Poison ivy, poison sumac, and poison oak may be present in the work area. Personnel should be alerted to its presence, and instructed on methods to prevent exposure.

Control: The main control is to avoid contact with the plant, cover arms and hands, and frequently wash potentially exposed skin. Particular attention must be given to avoiding skin contact with objects or protective clothing that have touched the plants. Treat every surface that may have touched the plant as contaminated, and practice contamination avoidance. If skin contact is made, the area should be washed immediately with soap and water, and observed for signs of reddening.

2.1.3 POISONOUS SNAKES

The possibility of encountering snakes exists, specifically for personnel working in wooded/vegetated areas. Snake venoms are complex and include proteins, some of which have enzymatic activity. The effects produced by venom include neurotoxic effects with sensory, motor, cardiac, and respiratory difficulties; cytotoxic effects on red blood cells, blood vessels, heart muscle, kidneys, and lungs; defects in coagulation; and effects from local release of substances by enzymatic actions. Other noticeable effects of venomous snake bites include swelling, edema, and pain around the bite, and the development of ecchymosis (the escape of blood into tissues from ruptured blood vessels).

Control: To minimize the threat of snake bites and insect hazards, all personnel walking through vegetated areas must be aware of the potential for encountering snakes and the need to avoid actions promoting encounters, such as turning over logs, etc. If a snake bite occurs, an attempt should be made to kill the snake for identification. The victim must be transported to the nearest hospital within 30 minutes; first aid consists of applying a constriction band and washing the area around the wound to remove any unabsorbed venom.

In areas where snakes may be encountered, affected personnel are required to wear leather work gloves and snakeproof chaps and/or snakeproof boots. Additionally, a snake bite kit is to be readily available at all times.

2.2 UNEXPLODED ORDNANCE (UXO)

Due to the past history of operations at the AUS OU Sites, the potential for UXO exists in some AUS OUs. Loaded ordnance or significant quantities of explosives in one place are most likely to be associated with burning grounds, detonation areas, holding/storage ponds, transfer ditches, test fire ranges, and burial areas. Section 14.0 summarizes potential UXO areas and protocols for UXO avoidance.

2.3 BUDDY SYSTEM

All on-Site personnel must use the buddy system while performing work within the Exclusion Zone (EZ). Visual contact must be maintained between crew members at all times, and crew members must observe each other for signs of chemical exposure, heat, or cold stress. Indications of adverse effects include, but are not limited to:

i) changes in complexion and skin coloration;

ii) changes in coordination;

iii) excessive salivation and pupillary response; and

iv) changes in speech pattern.

Team members must also be aware of potential exposure to possible safety hazards, unsafe acts, or noncompliance with safety procedures. Employees must inform their partners or fellow team members of non-visible effects of exposure to toxic materials. The symptoms of such exposure may include:

i) headaches;

ii) dizziness;

iii) nausea;

iv) blurred vision;

v) cramps; and

vi) irritation of eyes, skin, or respiratory tract.

If protective equipment or noise levels impair communications, prearranged hand signals must be used for communication. Personnel must stay within line of sight of another team member.

3.0 BASIS

The Occupational Safety and Health Administration (OSHA) Standards and Regulations contained in Title 29, CFR, Parts 1910 and 1926 (29 CFR 1910 and 1926) including the amended sections in 29 CFR 1910.120 and current Recommended Exposure Limits (RELs) as provided by the National Institute for Occupational Safety and Health (NIOSH) provide the basis for this Health and Safety Plan. Some of the specifications within this section are in addition to OSHA regulations and reflect the positions of the United States Environmental Protection Agency (USEPA), the NIOSH, and the United States Coast Guard (USCG) regarding procedures required to ensure safe operations at potential hazardous waste sites.

The safety and health of the public and AUS OU personnel and the protection of the environment will take precedence over cost and schedule considerations for all project work.

4.0 RESPONSIBILITIES AND ADMINISTRATION

The following individuals are designated to carry out stated job responsibilities related to this project.

General Dynamics Ordnance and Tactical Systems, Inc. (GD-OTS)	Susan Taylor	(618) 993-9465
Project Manager on Behalf of GD-OTS	Dave Trainor	(608) 442-5223
CRA Project Manager	Steven Wanner	(317) 381-0677
CRA Field Supervisor and SSO	Walter Pochron	(773) 380-9933 or Office Trailer During Field Activities
ENTRIX Project Manager	Jody Kubitz	(847) 842-1882
ENTRIX Field Supervisor	B.J. Seagrist	(847) 842-1882
CRA Project Industrial Hygienist	Craig Gephardt	(716) 297-6150
ENTRIX Project Industrial Hygienist	B.J. Seagrist	(847) 842-1882

The Site Health and Safety Officer (SSO) is identified above. The SSO will supervise the implementation of the HSP and will make all decisions regarding operations and work stoppages due to health and safety considerations.

The responsibilities of the SSO are as follows:

i) control and maintain AUS OU access;

ii) implement the HSP at the initiation of field work;

iii) conduct the pre-entry safety briefing for all AUS OU personnel with regard to the HSP and other safety requirements to be observed during field work, including:

   a) potential hazards,

   b) personal hygiene principles,

   c) PPE,

   d) respiratory protection equipment usage,

   e) boat safety training, and

   f) emergency response procedures.

iv) hold "tailgate" meetings to discuss health and safety issues during each part of the days work;

v) review and modify the HSP as more information becomes available concerning the hazardous materials involved;

vi) supervise and enforce safety equipment usage;

vii) supervise and inspect equipment cleaning;

viii) train personnel in safety equipment usage and emergency procedures;

ix) monitor the health and safety program under direction of an industrial hygienist;

x) suspend work activity if unsafe working conditions develop;

xi) inform workers of the nature of chemical exposure risk as required by the "Right-to-Know" Law;

xii) recommend a medical examination when a worker appears to require it;

xiii) coordinate the Emergency Response Plan;

xiv) assure that safety equipment is provided, maintained, and accessible to AUS OU personnel;

xv) maintain a log with a sign in/out sheet for personnel performing activities and visitors entering the AUS OU Sites (visitors related to the RI);

xvi) assure that workers comply with the "buddy system" while working in the AUS OUs; and

xvii) investigate all accidents, injuries, illnesses, spills, fires, incidents, and near misses.

All personnel working at the Refuge on investigative tasks associated with the RI will be required to review the HASP and the sign the Health and Safety Plan Acknowledgment Form presented as Appendix A. On a daily basis all on-Site personnel (personnel performing activities) will be required to log-in on the sign in/out sheet/log book which will be maintained in the main office trailer. All visitors and oversight personnel (visitors/oversight related to the RI activities) will also be required to sign in and out on this same sign in/out sheet/log book. These visitors and oversight personnel will also be required to provide contact information (cell phone number) on the log-in and will be instructed to adhere to prescribed safety protocols. A copy of the HASP will be maintained in the main office trailer at all times.

5.0 MEDICAL SURVEILLANCE

In accordance with requirements detailed in 29 CFR 1910.120(f), NewFields, CRA, and ENTRIX personnel (including contractors and/or subcontractors with the exception of surveying and utility location contractors) who may be exposed to potentially contaminated materials will have received, within 1 year prior to starting field activities, medical surveillance by a licensed physician or physician's group.

Medical records for all AUS OU personnel will be maintained by their respective employers. The medical records will detail the tests that were taken and will include a copy of the consulting physician's statement regarding the tests and the employee's suitability for work.

Each employer will ensure that its personnel involved in AUS OU work will have all necessary medical examinations prior to commencing work which requires respiratory protection or exposure to hazardous materials. Personnel not obtaining medical certification will not perform work within contaminated areas.

Interim medical surveillance will be completed if an individual exhibits poor health or high stress responses due to activity in the AUS OU or when accidental exposure to elevated concentrations of contaminants occurs.

6.0 TRAINING

All personnel, including subcontractor personnel, will be required to have completed the necessary training in accordance with 29 CFR 1910.120 (e) prior to participating in any work activity at the AUS OU.

On-site management and supervisors directly responsible for, or who supervise employees engaged in field investigation activities, will have 40 hours initial training, and three days of supervised field experience and at least eight additional hours of specialized training at the time of job assignment on such topics as, but not limited to, the employer's safety and health program and the associated employee training program, personal protective equipment program, spill containment program, and health hazard monitoring procedure and techniques.

General site workers (such as sampling personnel, equipment operators, general laborers and supervisory personnel) engaged in sample collection activities which may potentially expose workers to hazardous substances and health hazards will have a minimum of 40 hours of instruction off the site, and a minimum of three days actual field experience under the direct supervision of a trained experienced supervisor.

Workers on site only occasionally for a specific limited task (such as land surveying or utility locating subcontractors, with the exception of public utility locating personnel) and who are unlikely to be exposed over permissible exposure limits and published exposure limits will have received a minimum of 24 hours of instruction off the site, and the minimum of one day actual field experience under the direct supervision of a trained, experienced supervisor.

Supervisory personnel and general site workers, will receive eight hours of hazardous waste site worker refresher training annually.

Each employer will be responsible for maintaining the necessary documentation, including training records, to demonstrate that its employees and subcontractor personnel have the appropriate training and are in compliance with 29 CFR 1910.120 (e). Employers will provide copies of training records for personnel participating in the work to CRA and a copy of these records will be maintained in the site trailer under the custody of the Field Supervisor.

Prior to commencing investigative activities, an AUS OU-specific pre-entry safety briefing will be conducted. Topics covered during the pre-entry safety briefing will include:

i) AUS OU-specific health and safety hazards;

ii) level of PPE required;

iii) safe use of equipment;

iv) decontamination procedures; and

v) emergency response procedures.

All personnel who attend this briefing will sign the Health and Safety Plan Acknowledgment Form presented as Appendix A.

All personnel working in an AUS OU will attend daily safety ("tailgate") meetings. These meetings will be conducted by the SSO and will cover specific health and safety issues, AUS OU activities, changes in AUS OU conditions, and a review of topics covered in the Site-specific pre-entry briefing. Topics discussed in the safety meetings will be documented along with the signatures of personnel who attend.

In operational areas and areas where UXO is a potential concern, Site workers will receive Site-specific training to alert them to the presence of security requirements, vehicular and other operational-related hazards, and the potential presence of UXO.

7.0 WORK AREAS

Specific work areas, as defined below, will be delineated by temporary fencing or a flagged line.

a) Exclusion Zone (EZ) - This zone will include all areas where potentially contaminated soils or materials are to be handled (i.e., the immediate perimeter around a borehole or groundwater monitoring well where sampling or other investigative activity that may result in contact with contaminated environmental media is being performed) and all areas where contaminated equipment or personnel perform decontamination operations (i.e., the main decontamination pad in AUS 04W and remote decontamination pads set up during the work. The size of the exclusion zone will be specific to the given location and will be established by sampling personnel. Personnel entering this area are required to wear the PPE as defined in Section 8. A wind direction indication device (i.e., flagging, windsock, etc.) will be mounted in the vicinity of any EZ during Site activities. Eating, drinking, and smoking are not permitted in this area.

b) Contaminant Reduction Zone (CRZ) - This zone will occur at the interface of the EZ and Support Zone (SZ) and will provide access for the transfer of construction materials and investigative equipment to the EZ, the decontamination of vehicles prior to leaving the EZ, the decontamination of personnel and clothing prior to entering the Support Zone, and for the physical segregation of the SZ and EZ. In general, at investigative locations, the CRZ would include the perimeter around the sampling point where equipment and support vehicles are staged, which will be demarcated with flagging tape to discourage entry by untrained personnel. In the main support area, the CRZ will include the access area to the main decontamination pad.

c) Support Zone (SZ) - This area is the portion of the investigation area defined as the area outside EZ and the CRZ. Procedures will be implemented to prevent active or passive migration of contamination from the EZ and CRZ into the SZ. In the main support area, the SZ will include the office trailers and equipment and supply storage areas.

8.0 PERSONAL PROTECTIVE EQUIPMENT

Engineering controls and work practices designed to reduce and maintain employee exposure at or below the Permissible Exposure Limits (PELs) for the contaminants of concern will be implemented. Whenever engineering controls and work practices are not feasible, a reasonable combination of engineering controls, work practices, and PPE shall be used to reduce and maintain employee exposure at or below the permissible exposure limits for the contaminants of concern.

All AUS OU personnel shall be equipped with PPE appropriate for the nature of work being completed. All safety equipment and protective clothing shall be kept clean, well-maintained, and intact.

Safety equipment and apparel as required will be Level D, Modified Level D, and Level C PPE (as determined by the action levels set forth in Section 10.0) within the EZ, and CRZ, as appropriate.

Level D PPE

Type	*Properties*	*Item*
Foot protection	Steel-toe/reinforced shank	Boots/Waders
Foot protection	Chemical resistant (latex/rubber)	OverbootsHead
protection	Meets ANSI Z89.1 standard	Hard hat
Hand protection	Chemical resistant (nitrile)	Inner gloves
Hand protection	Puncture/tear resistant (Leather/cotton, if necessary, based on weather conditions)	Outer gloves
Eye protection	Meets ANSI Z87.1 standard	Glasses/goggles with side shields
Body protection	Fully covers arms/legs	Long pants/long-sleeved shirt

Modified Level D PPE

Type	*Properties*	*Item*
Foot protection	Steel-toe/reinforced shank	Boot
Foot protection	Chemical resistant (latex/rubber)	Overboots
Head protection	Meets ANSI Z89.1 standard	Hard hat

Hand protection	Chemical resistant (nitrile)	Inner gloves
Hand protection	Chemical resistant, puncture/ tear resistant (nitrile)	Outer gloves
Eye protection	Meets ANSI Z-87.1 standard	Glasses/goggles with side shields
Body protection	Hazardous dust/particulate resistant (tyvek)	Coverall

Level C PPE

Type	***Properties***	***Item***
Foot protection	Steel-toe/reinforced shank	Boots
Foot protection	Chemical resistant (latex)	Overboots
Head protection	Meets ANSI Z89.1 standard	Hard hat
Hand protection	Chemical resistant (nitrile)	Inner gloves
Hand protection	Chemical resistant, puncture/ tear resistant (nitrile)	Outer gloves
Body protection	Chemical/splash resistant (poly-tyvek)	Coverall
Respiratory protection	NIOSH approved	Full-face air-purifying respirator with organic vapor/acid gas/HEPA filter

Additional protective equipment guidelines to be implemented include:

i) prescription eyeglasses in use during investigative activities will be safety glasses with side shields;

ii) contact lenses will not be permitted on the AUS OU Sites;

iii) protective gloves (leather palm) will be worn over nitrile gloves by personnel involved in any drilling activities;

iv) during periods of respirator usage, respirator cartridges and filters will be changed daily, or upon breakthrough, whichever occurs first;

v) personnel who have not passed a respirator fit test will not be permitted to enter or work in the EZ;

vi) personnel required to wear a respirator will not be permitted to have beards, or long sideburns or mustaches that interfere with the proper fit of the respirator;

vii) all PPE worn during investigative activities will be decontaminated or discarded at the end of each work day;

viii) duct tape will be used to ensure that disposable coveralls and gloves are tightly secured when personnel are working within the EZ; and

ix) no watches, rings, or other accessories will be permitted during drilling and sampling activities.

x) steel-toe shoes will only be required in areas where equipment/heavy supplies requires such protection. For example, a steel-toe shoe would not be required for general sediment or surface water sampling but would be required during drilling and monitoring well sampling activities where heavy equipment and supplies are present that could cause foot injury.

xi) personnel conducting steam-cleaning operations shall wear PPE consistent with Modified Level D, including Tyvek coveralls.

9.0 BOAT SAFETY

As part of the RI, surface water and sediment samples may be collected from a small boat. The field sampling team will be trained in boat safety through the review of the following safety guidelines and any additional manufacturer's safety guidelines and/or recommendations with the field SSO and/or the CRA Field Supervisor prior to entering a boat and sampling from a boat:

- the sampling team will inspect the boat to determine whether any cracks or damage is present. The boat will not be used if damage is documented;
- the sampling team will assess the electric motor and oars to verify that they are in working order;
- each of the persons on the sampling team will don a personal flotation device (PFD) that is appropriate for his/her body size. The PFD will be inspected to verify that there is no damage present; and
- only the appropriate number of sampling team members will enter the boat based on the boat manufacturer's recommendations.

The CRA Field Supervisor and SSO will ensure that these guidelines are followed.

10.0 RESPIRATOR PROGRAM

Prior to arriving at the AUS OU, all personnel will have received training in the use of and have been fit tested for a full-facepiece respirator. Companies employing individuals required to perform intrusive work at the AUS OU shall have a written respiratory program that complies with 29 CFR 1910.134.

During intrusive activities, a photoionization detector (PID) will be used to determine if organic vapors and some inorganic gases are present in the breathing space; a particulate monitor (Miniram or equivalent) will be used to determine the level of particulates present in the breathing zone. A background reading will be established prior to commencing work activities at each work location.

When PID readings are encountered above background in the breathing zone, the SSO will begin sampling for vinyl chloride via colorimetric tubes. Colorimetric sampling will be utilized to identify the contaminants(s) of concern. This will allow the SSO to set the proper action level(s). If sustained levels of vinyl chloride are detected above its Permissible Exposure Limit/Threshold Limit Value (PEL/TLV) of 1 part per million (ppm), then Level B respiratory protection will be required. Work in the area will cease until the appropriate respiratory protection equipment and contingency plan can be developed.

Sustained (greater than 5 minutes) meter readings to determine the level of respiratory protection necessary during field activities will be:

Sustained Photoionization Organic Vapor Reading Above Background (without vinyl chloride present)	***Protection Level (without vinyl chloride present)***
0 - 10 ppm	Level D (verify vinyl chloride not present)
10 - 25 ppm	Level C
>25 ppm	shut down activities

Sustained Particulate Reading Above Background	*Protection Level*
0 – 0.1 mg/m^3	Level D
0.1 – 2.5 mg/m^3	Level C
>2.5 mg/m^3	shut down activities

Five consecutive minutes of readings above action levels is appropriate as it is more conservative than the 15 minutes that OSHA references for a short-term exposure limit (STEL).

Work will be stopped and the work area will be allowed to vent if monitoring indicates that any of the following conditions exist:

i) organic vapors or particulate are present at concentrations which present Immediate Danger to Life and Health (IDLH) conditions or in excess of the protection factor afforded by the air purifying respirator (whichever is lower);

ii) the oxygen content of the air is less than 19.5 percent or above 22.5 percent; and

iii) organic vapor concentrations in the breathing zone exceed 25 ppm.

Air monitoring should continue, at a safe distance, if operations are stopped due to action level exceedences, to determine if a threat to the surrounding community exists.

Any changes to the protection level will be communicated to the SSO prior to continuation of the work. The respiratory protection program is presented in Appendix B.

11.0 JUSTIFICATION

These action levels assume that all NIOSH criteria for using an air purifying respirator (APR) have been met. An APR can typically be worn in concentrations of up to 50 times the TLV for a given contaminant unless the identified contaminant precludes the use of Level C (tetrachloroethylene at 25 ppm and vinyl chloride at 1 ppm). All of the contaminants of concern have TLVs or PELs higher than 1 ppm. The particulate action level is based on a conservative approach which takes into account contaminant(s) PEL and PEL for soil/dust mixture. Because of differences in sensitivities with direct reading instruments, a 50 percent safety factor is included when determining action levels. Therefore, the calculation to determine when a respirator could no longer be used would be:

1 ppm (TLV) x 50 (protection factor) x 0.5 (50% safety factor) = 25 ppm

1 mg/m^3 (TLV) x 50 (protection factor) x 0.5 (50% safety factor) = 2.5 mg/m^3

The primary routes of exposure of contaminants to individuals performing field investigative tasks include direct contact, ingestion, and inhalation. The risk of exposure due to direct contact and ingestion will be minimized through the proper use of PPE as described in Section 8.0 and by exercising ordinary caution during sampling activities. In order to minimize exposure by the inhalation pathway, the respirator and air monitoring programs discussed in Sections 10.0 and 13.0 will be undertaken.

12.0 PERSONAL HYGIENE

All personnel performing or supervising work within the EZ shall adhere to the personal hygiene-related provisions of this section.

AUS OU personnel found to be disregarding the personal hygiene-related provisions of this HSP will, at the discretion of the SSO, be barred from performing further work.

The following equipment/facilities shall be available for the personal hygiene of all personnel:

i) suitable disposable outerwear, gloves, respiratory protection, and footwear on a daily basis for the use of AUS OU personnel;

ii) disposal containers for used disposable outerwear; and

iii) potable water and a suitable sanitation facility.

The following regulations for personnel actively participating in the field sampling program shall be enforced:

i) AUS OU personnel will wear appropriate PPE when in the EZ;

ii) used disposable outerwear will not be reused if deemed to be unsuitable to provide the necessary protection, and when removed will be placed inside disposal containers provided for that purpose;

iii) smoking, eating, and drinking will be prohibited within the EZ. These activities will be permitted only within designated areas; and

iv) AUS OU personnel will thoroughly cleanse their hands, face, neck area, and other exposed areas before smoking, eating, or drinking and before leaving the AUS OU.

13.0 AIR MONITORING

During the progress of intrusive work, air quality will be monitored on a continuous basis. During non-intrusive work air monitoring will be conducted on a periodic basis.

The air monitoring program will consist of monitoring with a PID for organic vapors and a particulate monitor for particulates in the breathing space. Operation and calibration procedures will be according to manufacturers' instructions. Calibration and maintenance records will be kept in the field log.

Identification of volatile organic vapor or particulate levels in excess of the action levels cited in Section 10.0 shall be reported to the SSO who will determine when PPE should be upgraded, control measures implemented (soil/plastic sheeting covers, dust suppression, etc.), or operations be shut down and restarted.

If work is stopped because action levels have been exceeded, air monitoring will continue from a safe distance to determine if there is a threat to the surrounding community.

14.0 UNEXPLODED ORDNANCE (UXO) AVOIDANCE

14.1 OVERVIEW

Due to the past history of operations, the potential for UXO exists in some areas of the Refuge. Based on the available information about the Refuge contained in the Preliminary Assessment/Site Inspection (PA/SI) (FWS, 2003), discussions with FWS personnel, and discussions with the UXO subcontractor (EOD Technology, Inc.), it has been determined to conduct the RI investigations under the assumption that UXOs were not present in formal production or storage areas, namely that the IOP and its successive contractors followed basic explosives safety protocols and regulations. Based on experience at other Army Ammunition Plants that would have been operated in a similar fashion, explosives and ordnance production followed very stringent requirements related to explosives accountability.

Accordingly, the primary concern in production areas is explosives residue on the ground and in sumps, but loaded ordnance are normally not an issue. Sump sampling is not being conducted as part of the investigation, as such, is not currently an issue. The explosives residues that would be encountered both on the surface and in the subsurface soils will not be in pure form due to degradation over time (as chemically unstable compounds and mixture with soil/water). In addition, explosives generally do not pose an explosive hazard unless confined or in the presence of an adequate initiating force. In the absence of either/both, the explosives residues might, at most, deflagrate (burn) rather than detonate. Accordingly, the risk associated with encountering the explosives residues in this project would be comparable to encountering a combustible solid.

Loaded ordnance or significant quantities of explosives in one place are most likely to be associated with burning grounds, detonation areas, holding/storage ponds, transfer ditches, test fire ranges, and burial areas. Based on a review of the available operational information about the Refuge the following sites will require UXO avoidance activities prior to and during field investigative activities.

AUS-0A02B

- Ordnance waste outside the south fence line.
- Suspected burn pad located to the southwest of the IOP Booster Load Line.

AUS-0A06

- Buried explosives adjacent to Igloos HE-7-11 and HE-7-12.

AUS-0A10

- Former burial of ignitable/explosive waste in pits (pits were closed, but status of waste is not known).

AUS-A11N and AUS-A11S

- Former burning trenches at 11N.
- Ponds and ditches at 11S.

AUS-0A12

- Propellant and explosives storage ponds.
- Burn ground.

AUS-0A13

- Nitroglycerine contamination near the loading dock.

AUS-0061

- Explosives testing/disposal.
- Trenches potentially containing explosives.

AUS-0062

- Any proposed locations within the landfill footprint.

AUS-0066

- Ordnance waste and explosives waste.

AUS-0067

- Unknown use.

AUS-0069

- Scrap metal and mine bodies found alongside the hayfield.

AUS-106A

- Drums in disposal area east of Building 11.

Figure 14.1 illustrates the portions of the Refuge where UXO avoidance activities will be performed. Under no circumstances are intrusive investigative activities to be initiated prior to completion of the UXO surface avoidance activities described in Section 14.2.

14.2 SURFACE UXO AVOIDANCE ACTIVITIES

Prior to conducting any intrusive investigations in the areas identified above, surface UXO avoidance activities will be conducted to clear pathways to sampling locations. A qualified contractor, such as EOD Technologies, Inc. of Knoxville, Tennessee, with properly trained and experienced personnel will perform surface and subsurface UXO avoidance.

As the name implies, UXO avoidance activities will be completed during Phase I to allow sampling teams to avoid UXO and proceed with field investigative activities. If a subsurface anomaly is identified by the magnetometer during Phase I activities, the potential UXO location will be conspicuously marked by the UXO avoidance contractor with posts and flagging tape and its location will be communicated to all AUS OU personnel during the daily health and safety briefings. These locations will be further investigated during Phase II and the specifics of the investigation and associated health and safety precautions will be detailed in the Phase II RI Work Plan.

Sampling locations will be moved as appropriate to avoid potential UXO.

In the areas identified as requiring UXO avoidance, the initial AUS OU UXO pathway avoidance activities will begin prior to the mobilization of drilling equipment and project investigative teams. Prior to commencing any investigative activities at the identified AUS OUs, surface UXO avoidance will be performed to establish routes to the investigative locations. The routes to the sampling locations will be a minimum of 10 feet or, if vehicular access is required, twice the width of the widest vehicle to be used at the investigative location. The UXO avoidance team will conspicuously and frequently mark the approach pathways using fluorescent green stakes and fluorescent green flagging tape to ensure that personnel will not stray from the cleared pathways. A sufficiently large area will be cleared around the investigative locations to allow the drilling equipment to maneuver on and off the drilling location. At a minimum, this area will be a 25-foot radius around the boring location but may be larger depending on specific needs. The cleared investigative borehole locations will also be clearly marked by UXO personnel using fluorescent orange painted stakes and fluorescent orange flagging tape. If the UXO contractor identifies an unexplained anomaly, the approach

pathway will be diverted around the anomaly or the investigative location will be moved away from the anomaly.

The initial AUS OU access activities will begin by providing the UXO subcontractor with maps of the AUS OUs along with instructions as to where to initiate UXO avoidance activities and what sequence to perform these activities. CRA and/or ENTRIX personnel will accompany the UXO avoidance teams and provide assistance with identification of the best pathways of approach to the individual soil, monitoring wells, and sediment and surface water sampling locations. However, CRA and ENTRIX personnel will not enter any area prior to the completion of UXO surface avoidance activity.

Once the pathways to the investigation locations are selected, the UXO contractor will then conduct UXO avoidance activities to the locations, as well as to the area to be investigated (i.e., soil borings, monitoring well locations, etc.). Surface UXO avoidance activities are expected to be non-intrusive. The pathways and investigative locations cleared by the UXO subcontractor will be clearly marked in the field with fluorescent green stakes and fluorescent green flagging tape to ensure that personnel will not stray from the cleared pathways. If field personnel find the access markings to be damaged or missing, this situation will be immediately communicated to the Field Supervisor or the Assistant Field Supervisor and the area will be cleared again by the UXO contractor prior to conducting any work.

The UXO contractor (including UXO Technician and Safety Observer) will document all surface UXO avoidance activities. The UXO contractor will notify the ENTRIX or CRA Field Supervisor and the CRA Assistant Field Supervisor when areas have been cleared for access and sampling. The CRA/ENTRIX Field Supervisor will communicate the status of UXO avoidance activities to the field personnel. **Under no circumstances are field sampling teams authorized to initiate investigative activities or enter a suspect UXO area without direct authorization of the CRA/ENTRIX Field Supervisor or the Assistant Field Supervisor/SSO during Phase I investigations.** The status of UXO avoidance activities will be discussed by the SSO during daily health and safety briefings.

In operational areas and areas where UXO is a potential concern, crews conducting non-invasive work (surveying, utility locates, tree/brush clearing, etc.) will receive Site-specific briefings to alert them to the presence of security requirements, vehicular and other operational-related hazards, and the potential presence of UXO. These briefings will be provided by the SSO.

14.3 SUBSURFACE UXO AVOIDANCE ACTIVITIES

In the identified potential UXO areas where intrusive investigative activities are to be performed, downhole UXO avoidance activities will be conducted. For subsurface soil borings (depths greater than 4 feet below grade) and monitoring well installations, downhole UXO avoidance activities will be required. Each 2-foot sampling interval will be cleared during borehole advancement beginning at 4 feet below ground surface. The UXO personnel will clear each subsequent 2-foot sampling interval to a minimum depth of 10 feet using a down hole magnetometer. Upon reaching a depth of 10 feet below ground surface, downhole UXO avoidance activities may be terminated if undisturbed native soil is present. Otherwise, downhole UXO avoidance activities will continue until undisturbed native soil is encountered.

Subsurface soil borings for soil sample collection will be advanced using Direct Push Technology (DPT) technology. The DPT rig will also be used to conduct the initial 10-foot avoidance activities at a number of the monitoring well locations. Downhole UXO avoidance will be conducted inside the DPT borehole following removal of the DPT sampling probe. In the event that the borehole wall collapsed, the borehole could be re-advanced to the target depth and a 2-inch diameter polyvinyl chloride (PVC) pipe installed to facilitate downhole UXO avoidance activities.

15.0 COMMUNICATIONS

Emergency numbers including the police department, fire department, ambulance, hospital, and appropriate Regulatory agencies will be prominently posted near the field office telephone(s). In the event of an emergency, the SSO will be notified to coordinate necessary emergency response actions.

Prior to initiating investigative activities, the route to the emergency medical facility will be verified to ensure preparedness to respond to any work-related injuries.

16.0 EMERGENCY AND FIRST AID EQUIPMENT

Safety equipment will be available for use by field personnel and will be located and maintained at the field office. The safety equipment will include, but is not limited to, the following:

i) a portable emergency eye wash;

ii) one ABC type dry chemical fire extinguisher; and

iii) a first-aid kit for a minimum of 10 personnel.

Information on heat stress and cold stress is provided in Appendix C. Severe weather emergency procedures are outlined in Appendix D.

17.0 EMERGENCY RESPONSE PLAN

Prior to commencing work, an emergency response plan shall be developed. The plan is intended to provide immediate response to a serious occurrence such as injury, explosion or fire. A list of emergency contact numbers is presented as Table 17.1 of this HSP. A hospital route map is provided on Figure 1.2. This map will be posted in all trailers and common area(s).

Communication between work areas and the command post, located within the support zone, will be via verbal communication, auto horn, or two-way radio. The SSO will use the nearest telephone on Site or may be in the possession of a mobile telephone to communicate with outside emergency and medical facilities. A mustering point will be communicated to personnel prior to the initiation of daily activities.

The following signals shall be established for use with auto or compressed air-type horns:

i) 1 Long Blast (2-Second Duration): evacuate exclusion area, meet at CRZ or designated area;

ii) 1 Long Blast with 2 Short Blasts: prepare for removal of injured personnel, evacuate work area; and

iii) 3 Short Blasts: all clear.

The following hand signals will be used by downrange field teams in conjunction with the "buddy" system. These signals are very important when working with heavy equipment. They shall be known by the entire field team before operations commence.

Signal	*Meaning*
• Hand Gripping Throat	Out of Air; Can't Breathe
• Grip Partner's Wrist	Leave Area Immediately
• Hands on Top of Head	Need Assistance
• Thumbs Up	Ok, I'm All Right, I Understand
• Thumbs Down	No, Negative

In the event of injury to AUS OU personnel, the following protocol will be followed:

i) notify the SSO;

ii) evacuate all personnel upwind;

iii) exit area;

iv) decontaminate personnel if possible, and administer appropriate first aid. If personnel cannot be decontaminated, alert hospital to possible problems of contamination; and

v) transport personnel to the medical facility along a predefined route.

Prior to commencing the work, a meeting will be held with GD-OTS safety and emergency response personnel to establish emergency procedures and notification procedures for work to be performed within or near active industrial areas. The emergency response plan will be modified as necessary to incorporate GD-OTS emergency contingency plans and procedures. This information will be communicated to site personnel by the SSO.

18.0 EQUIPMENT AND PERSONNEL DECONTAMINATION

Site control procedures will be implemented to minimize the amount of contact by Site personnel with potentially impacted materials, and to protect the public from impacted materials present at the Site.

The work zones described in Section 7.0 will be established to implement these site control procedures.

- Exclusion Zone (EZ) – Work in the EZ will be performed in modified Level D PPE or higher based on the requirements of this HSP. Workers will don the appropriate PPE in the CRZ prior to entering the EZ.
- Contamination Reduction Zone (CRZ) – Personnel entering the EZ will don the required PPE in the CRZ. Workers leaving the EZ will decontaminate and remove PPE in the CRZ. Washing and removal of outer gloves and outer foot covers will be performed in the CRZ prior to their removal. This can be accomplished using a solution of detergent/potable water and a brush in a 5 gallon pail. Tyvek suits, if worn, also will be removed in the CRZ. All used disposable PPE will be placed into plastic trash bags and sealed pending transport to the disposal area. A separate personnel wash station with a detergent solution and potable water for rinse will also be maintained in the CRZ.
- Support Zone (SZ) – The uncontaminated zone where administrative and other support functions such as first aid, communications, equipment supply, and emergency information are located.

Equipment and personnel decontamination procedures will be utilized to implement the site control procedures. Equipment decontamination procedures are described in the Site-specific Sampling and Analysis Plan (SAP).

Personnel working in the CRZ and supervising the decontamination procedures will be required to work in the same level of protection as personnel working in the EZ, and will undergo the same decontamination procedures prior to exiting the CRZ as those personnel exiting the EZ. Personnel working in the CRZ will wear Modified Level D protection or Level C protection should conditions warrant. Level D protection may be worn in the CRZ if authorized by the SSO. The levels of protection and their required PPE are discussed in Section 8.0.

Potable water may be used from any municipal water treatment system. The use of an untreated potable water supply is not an acceptable substitute.

All personnel will remove their protective clothing and wash their hands, face, neck area, and other exposed areas before entering the lunch and break areas to eat, drink, or smoke.

19.0 CONTAMINATION MIGRATION CONTROL

19.1 VEHICLES

All vehicles and equipment used within the EZ will be decontaminated in the CRZ as determined necessary by the SSO prior to leaving the support area. Decontamination, when required, will consist of the thorough cleaning of those parts of the equipment which come in contact with potentially contaminated material.

Personnel engaged in vehicle decontamination will wear protective equipment including suitable disposable clothing, respiratory protection, and face shields.

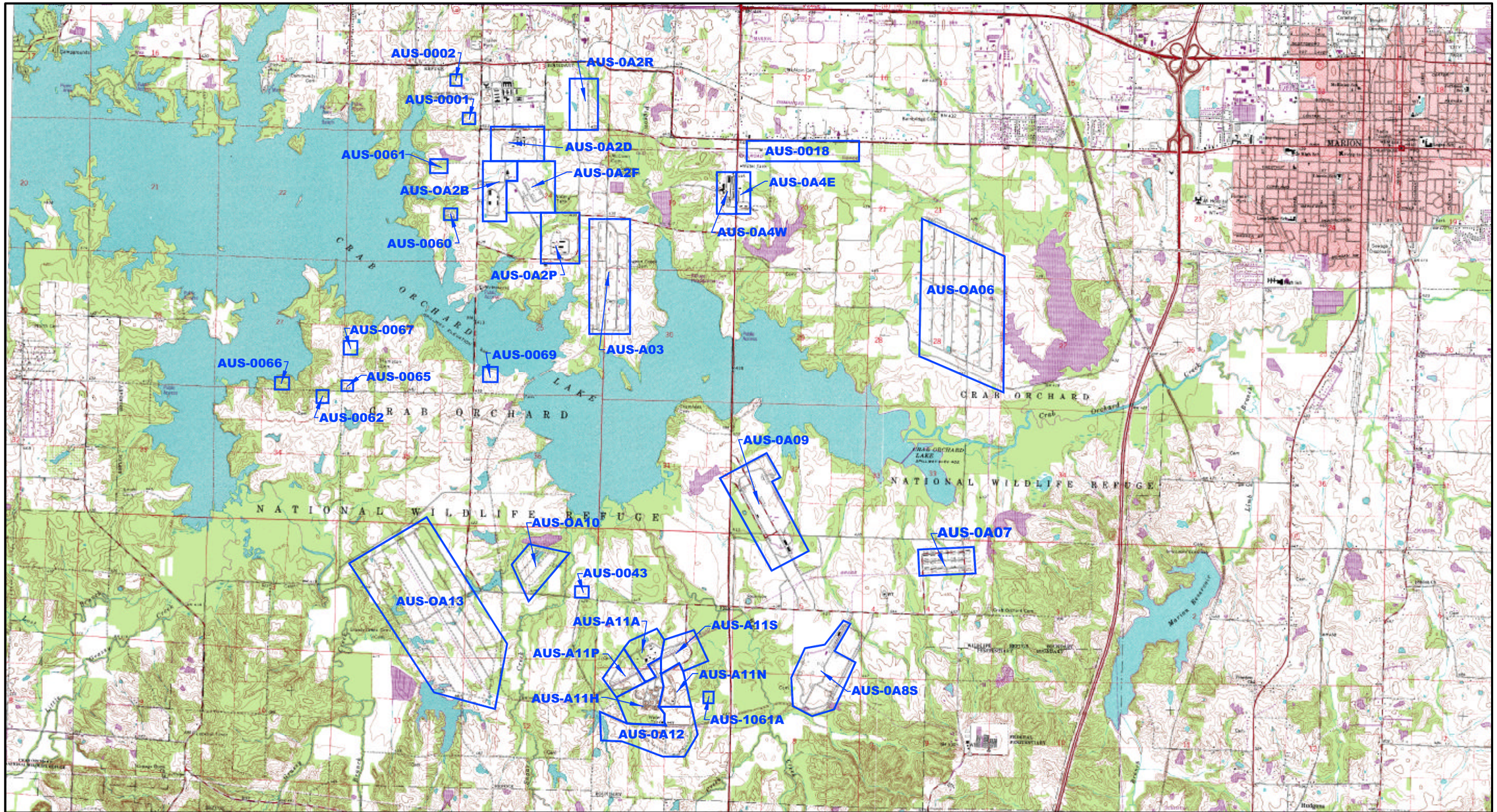
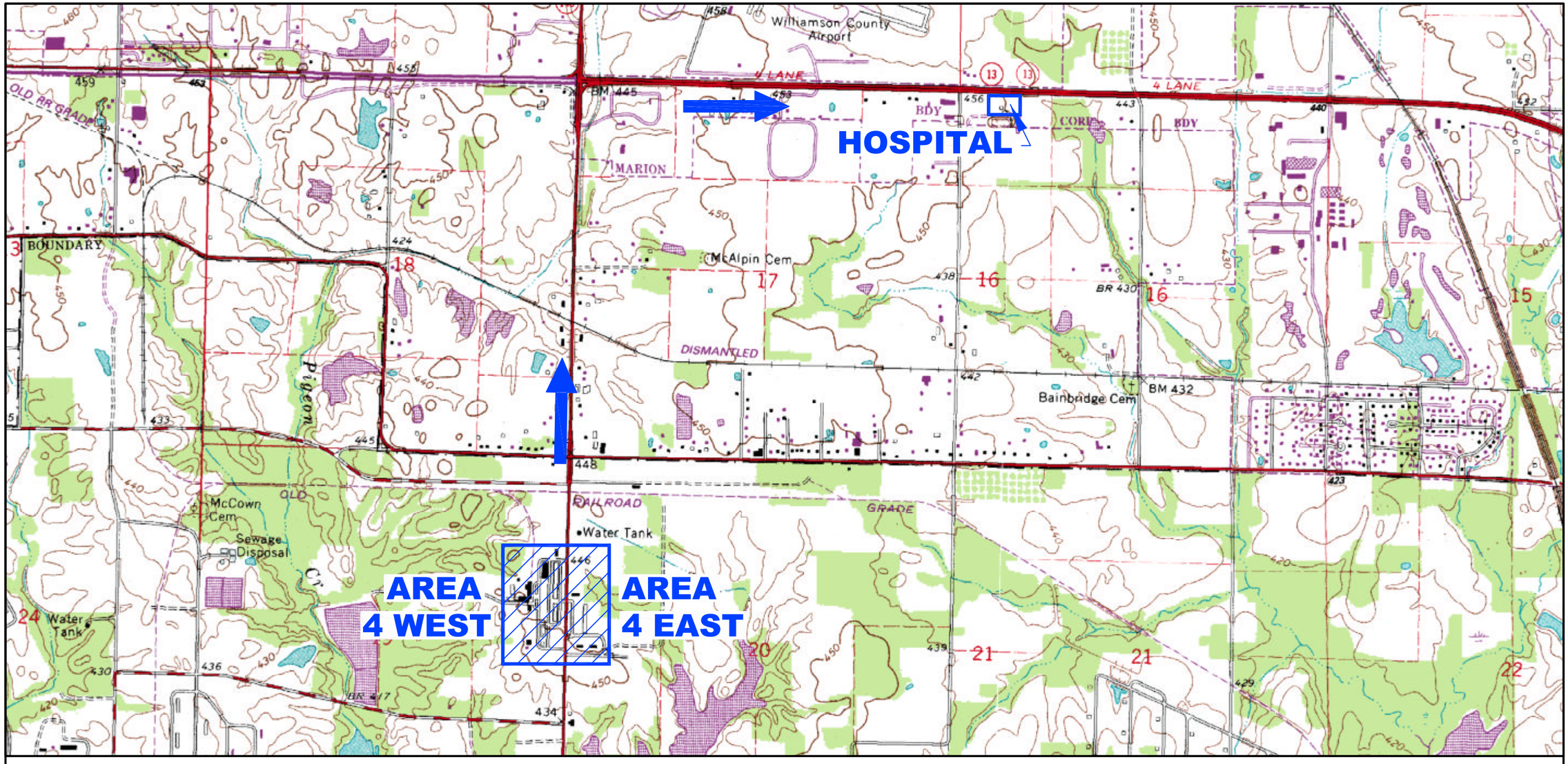


FIGURE 1.1

AUS OU SITES
CRAB ORCHARD NWR
Marion, Illinois

31756-10(003)GN-CO001 JAN 30/2006



Directions to the Hospital:

From Area 4E Highway 148 north 1.6 miles to
Highway13 (Deyoung Street). Turn right and proceed
east on Highway 13 approximately 1.4 miles to Heartland Regional Medical

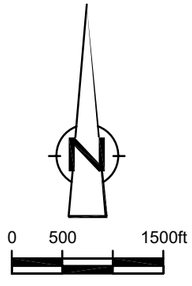


FIGURE 1.2

HEARTLAND REGIONAL MEDICAL
3333 WEST DEYOUNG STREET
CRAB ORCHARD NWR
Marion, Illinois

31756-10(003)GN-CO002 JAN 30/2006

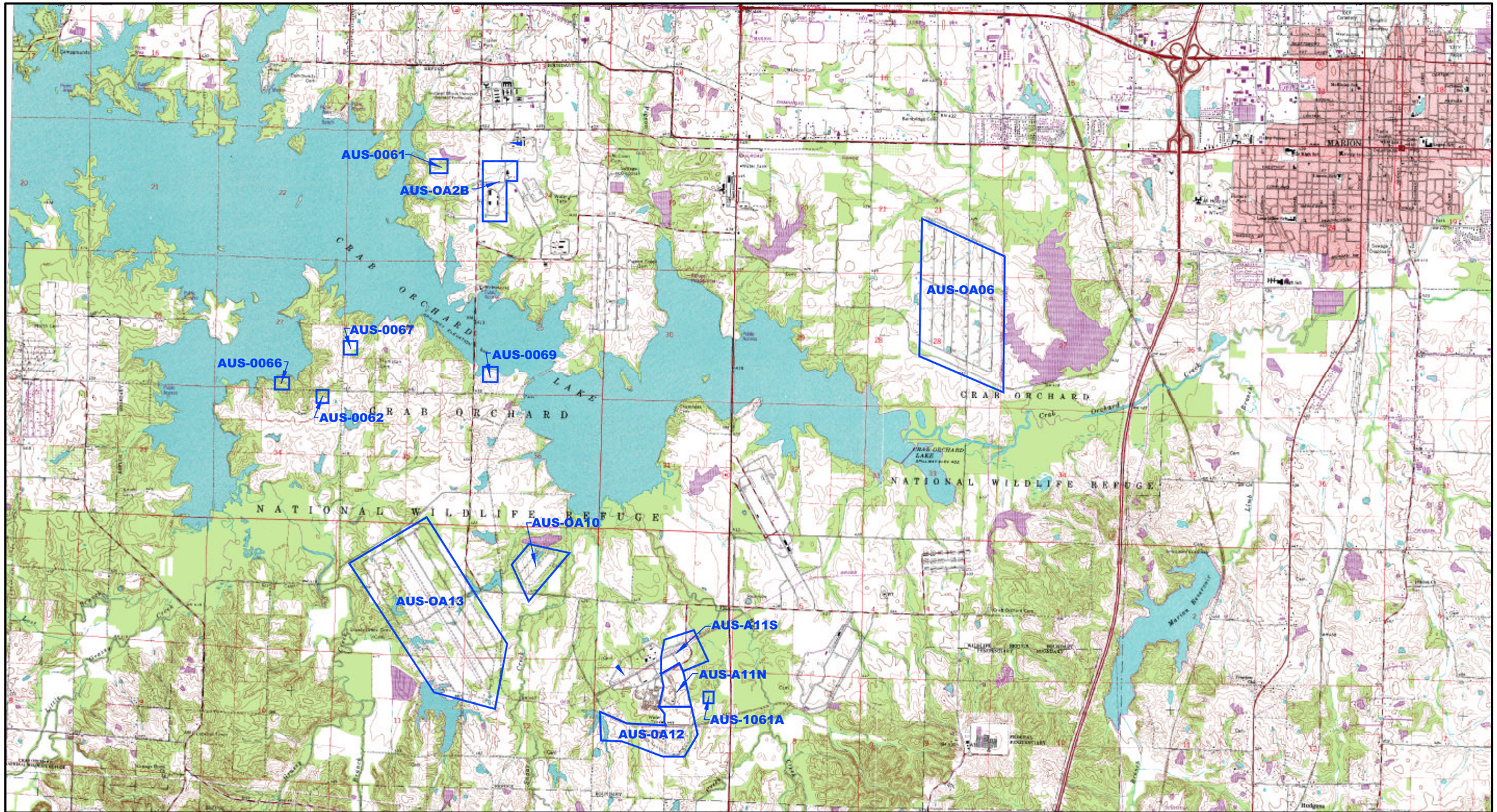


FIGURE 14.1

UXO AVOIDANCE AREAS
CRAB ORCHARD NWR
Marion, Illinois

31756-10(003)GN-CO003 JAN 30/2006

TABLE 2.1

CONSTITUENTS OF POTENTIAL CONCERN
CRAB ORCHARD NWR
MARION, ILLNOIS

CAS	Constituent	TLV	REL	PEL	IDLH	IP	Flammability Range	Exposure	Symptoms of Exposure	Other
91-57-6	**2-METHYLNAPHTHALENE**	N/A	N/A	N/A	N/A	N/A	N/A	Inhalation, Ingestion, Contact	N/A	N/A
7440-38-2	**ARSENIC**	.01 mg/m3	C .002 mg/m3	.010 mg/m3	5 mg/m3	N/A	Non-combustible solid	Inhalation, Absorptive, Contact, Ingestion	Ulceration of nasal septum, skin, GI disturbances, respiratory irritation	Potential carcinogen, dermatitis, peripheral neuropathy, hyperpigmentation of skin. Liver, kidneys, lymphatic system.
56-55-3	**BENZO(A)ANTHRACENE**	N/A	N/A	N/A	N/A	N/A	N/A	Inhalation, Absorptive, Contact, Ingestion	N/A	IARC / NTP probable human carcinogen.
50-32-8	**BENZO(A)PYRENE**	N/A (Formerly 0.2 mg/m3)	N/A	N/A (Formerly 0.2 mg/m3)	N/A	N/A	N/A	Inhalation, Absorptive, Contact, Ingestion	Skin irritation. Mucous membrane irritation, dermatitis, bronchitis, cough, dyspnea, conjunctivitis, photosensitization, pulmonary edema, reproductive effects and leukemia. Skin contact: erythema, pigmentation,	A poison via subcutaneous, intraperitoneal and intrarenal routes. A potential carcinogen, tumorigen, neoplastigen and teratogen. Reproductive effects. Human mutagen. May also cause keratoses
205-99-2	**BENZO(B)FLUORANTHENE**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Potential occupational carcinogen.
53-70-3	**DIBENZ(A,H)ANTHRACENE**	N/A	N/A	N/A	N/A	N/A	N/A	Inhalation, Absorptive, Contact, Ingestion	N/A	Potential occupational carcinogen. Absorbed through the skin.
91-20-3	**NAPHTHALENE**	10 ppm, STEL 15 ppm	10 ppm, ST 15 ppm	10 ppm	250 ppm	8.12 eV	0.9% - 5.9%	Inhalation, Absorptive, Contact, Ingestion	Irritation eyes; headache, confusion, excitement, malaise (vague feeling of discomfort); nausea, vomiting, abdominal pain; irritation of bladder; profuse sweating	Jaundice; hematuria (blood in the urine), renal shutdown; dermatitis, optical neuritis, corneal damage
121-82-4	**RDX**	0.5 mg/m3 [skin]	1.5 mg/m3 ST 3 mg/m3 [skin]	None	ND	N/A	Combustible solid	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin; headache, irritability, lassitude (weakness, exhaustion), tremor, nausea, dizziness, vomiting, insomnia, convulsions	Combustible Solid [EXPLOSIVE!]

TABLE 2.1

CONSTITUENTS OF POTENTIAL CONCERN
CRAB ORCHARD NWR
MARION, ILLNOIS

CAS	Constituent	TLV	REL	PEL	IDLH	IP	Flammability Range	Exposure	Symptoms of Exposure	Other
72-54-8	**4,4'-DDD**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
50-29-3	**4,4'-DDT**	1 mg/m3	Ca 0.5 mg/m3	1 mg/m3 [skin]	Ca [500 mg/m3]	N/A	N/A	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin; paresthesia tongue, lips, face; tremor; anxiety, dizziness, confusion, malaise (vague feeling of discomfort), headache, lassitude (weakness, exhaustion); convulsions; paresis hands; vomiting	Potential occupational carcinogen
60-57-1	**DIELDRIN**	0.25 mg/m3	Ca 0.25 mg/m3 [skin]	0.25 mg/m3 [skin]	Ca [50 mg/m3]	N/A	N/A	Inhalation, skin absorption, ingestion, skin and/or eye contact	Headache, dizziness; nausea, vomiting, malaise (vague feeling of discomfort), sweating; myoclonic limb jerks; clonic, tonic convulsions; coma	Potential occupational carcinogen. In animals: liver, kidney damage
5103-74-2	**GAMMA-CHLORDANE**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
309-00-2	**ALDRIN**	0.25 mg/m3	Ca 0.25 mg/m3 [skin]	Ca 0.25 mg/m3 [skin]	Ca 25 mg/m3 [skin]	N/A	N/A	Inhalation, skin absorption, ingestion, skin and/or eye contact	Headache, dizziness; nausea, vomiting, malaise (vague feeling of discomfort); myoclonic jerks of limbs; clonic, tonic convulsions; coma	Hematuria (blood in the urine), azotemia. Potential occupational carcinogen.
118-74-1	**HEXACHLOROBENZENE**	N/A	N/A	N/A	N/A	N/A	N/A	Inhalation, skin absorption, ingestion, skin and/or eye contact	N/A	Carcinogen. Mutagen. Toxic - may cause genetic damage. Reproductive hazard. Photosensitizer.
606-20-2 (25321-14-6, 2-4DNT)	**2,6-DINITROTOLUENE (2-4-DNT)**	0.2 mg/m3	Ca TWA 1.5 mg/m3 [skin]	1.5 mg/m3 [skin]	Ca 50 mg/m3 [skin]	N/A	N/A	Inhalation, skin absorption, ingestion, skin and/or eye contact	Anoxia, cyanosis; anemia, jaundice	Reproductive effects. Potential occupational carcinogen.

TABLE 2.1

CONSTITUENTS OF POTENTIAL CONCERN
CRAB ORCHARD NWR
MARION, ILLNOIS

CAS	*Constituent*	*TLV*	*REL*	*PEL*	*IDLH*	*IP*	*Flammability Range*	*Exposure*	*Symptoms of Exposure*	*Other*
(156-59-2,) 540-59-0, [540-59-0 (sym) 156-59-2 (cis) 156-60-5 (trans)]	**CIS-1,2-DICHLOROETHYLENE**	200 ppm	200 ppm	200 ppm	1000 ppm	9.65 eV	5.6%-12.8%	Inhalation, Ingestion, Contact	Irritation eyes, respiratory system; central nervous system depression	
79-01-6	**TRICHLOROETHYLENE (TCE)**	50 ppm	25 ppm	100 ppm	1000 ppm	9.5 eV	8% - 10.5%	Inhalation, Ingestion, Contact	Eye irritant, fatigue, tremors, nausea, vomiting, cardiac arrythmia, headache, visual disturbance, dizziness, drowsiness	Dermatitis; cardiac arrhythmias, paresthesia; liver injury; Potential occupational carcinogen.
127-18-4	**TETRACHLOROETHYLENE(PCE)**	25 ppm	LFC, Ca	100 ppm, C 200 ppm, 300 ppm (5-minute maximum peak in any 3-hours)	Ca 150 ppm	9.32 eV	8% - 10.5%	Inhalation, Ingestion, Contact	Light headedness, dizziness, upset stomach, irritation eyes, skin, nose, throat, or respiratory system; flush face, neck; incoordination; headache, drowsiness; skin redness.	Potential liver damage; Potential occupational carcinogen.
75-01-4	**VINYL CHLORIDE**	1 ppm	1 ppm	1 ppm	NI	9.99 eV	3.6% - 33%	Inhalation, Contact (liquid)	Fatigue, abdominal pain, GI bleeding, pallor or cyan of extremities	Enlarged liver, frostbite from evap. of liquid. Targets: Central nervous, blood, respiratory, and lymphatic systems

TLV - Threshold Limit Value
ppm - Parts Per Million
mg/m3 - Milligram Per Cubic Meter
REL - Recommended Exposure Limit
(C) - Denotes 15 minute Ceiling Level

LFC - Lowest Feasible Concentration
PEL - Permissible Exposure Limit
IDLH - Immediate Danger to Life and Health
IP - Ionization Potential
eV - Electron Volt

NI - No Information
N/A - Not Available
N/E - None Established
Ca - Cancer causing agent or suspect cancer causing agent.
STEL - Short-Term Exposure Limit

TABLE 2.2

AUS OU HAZARD ANALYSIS
CRAB ORCHARD NWR
MARION, ILLINOIS

Activities	***Hazards***	***Prevention***
Surface Soil Sampling, Soil Boring, Monitoring Well, Piezometer Installation Oversight	Chemical hazards due to inhalation and dermal contact	Proper use of PPE Level C, Modified Level D, or Level D based on realtime air monitoring and established protection levels
	Biological Hazards	Proper PPE, exercising ordinary caution, use of buddy system during AUS Area activities
	- Potential contact with poison ivy Bites and/or stings from ticks, bees, mosquitoes, wasps, and snakes	Proper use of PPE Keep first aid supplied readily available, including antidote kit for those allergic to bees or wasps Wear snake chaps if snakes are present
	- Exposure to temperature extremes	Monitor for heat or cold stress Participate in on-Site training programs
	- Bloodborne pathogens	Participate in on-Site training programs
	Physical hazards associated with operation of excavation equipment	Maintain a safe distance from equipment
	- Moving or backing vehicles	Use a spotter around moving or backing equipment
	- Electrical Hazards	Avoid overhead power lines (20 feet) Ground fault circuit interrupters (GFCIs) will be used to reduce the hazard of electrical shock. Electrical equipment will be approved. Do not stand in water when handling equipment. Check and mark underground utilities
	Physical hazards including steep grades and unstable surfaces while transporting heavy equipment	Use "buddy system" during AUS Area activities
	High noise level	Use hearing protection
	Slip, trip, fall	Clean mud, snow or grease from shoes and equipment

TABLE 2.2

AUS OU HAZARD ANALYSIS
CRAB ORCHARD NWR
MARION, ILLINOIS

Activities	*Hazards*	*Prevention*
Surface Soil Sampling, Soil Boring, Monitoring Well, Piezometer Installation Oversight (continued)	Potential back injuries from lifting heavy objects	Practice safe lifting techniques Participate in on-Site training programs
	Severe weather	During severe weather conditions work activities will be reduced or suspended.
	UXO (Unexploded Ordinances)	Stay in identified / screened areas
Groundwater Monitoring and Sampling Activities	Chemical hazards due to inhalation and dermal contact	Proper use of PPE Level C, Modified Level D, or Level D based on realtime air monitoring and established protection levels
	Biological Hazards	Proper PPE, exercising ordinary caution, use of buddy system during AUS Area activities
	- Potential contact with poison ivy Bites and/or stings from ticks, bees, mosquitoes, wasps, and snakes	Proper use of PPE Keep first aid supplied readily available, including antidote kit for those allergic to bees or wasps Wear snake chaps if snakes are present
	- Exposure to temperature extremes	Monitor for heat or cold stress Participate in on-Site training programs
	- Bloodborne pathogens	Participate in on-Site training programs
	- Moving or backing vehicles	Use a spotter around moving or backing equipment
	- Electrical Hazards	Avoid overhead power lines (20 feet) Ground fault circuit interrupters (GFCIs) will be used to reduce the hazard of electrical shock. Electrical equipment will be approved. Do not stand in water when handling equipment. Check and mark underground utilities

TABLE 2.2

AUS OU HAZARD ANALYSIS
CRAB ORCHARD NWR
MARION, ILLINOIS

Activities	*Hazards*	*Prevention*
Groundwater Monitoring and Sampling Activities (continued)	Physical hazards including steep grades and unstable surfaces while transporting heavy equipment	Use "buddy system" during AUS Area activities
	High noise level	Use hearing protection
	Slip, trip, fall	Clean mud, snow or grease from shoes and equipment
	Potential back injuries from lifting heavy objects	Practice safe lifting techniques Participate in on-Site training programs
	Severe weather	During severe weather conditions work activities will be reduced or suspended.
	UXO	Stay in identified / screened areas
Sediment and Surface Water Sampling	Chemical hazards due to inhalation and dermal contact	Proper use of PPE Level C, Modified Level D, or Level D based on realtime air monitoring and established protection levels
	Biological Hazards	Proper PPE, exercising ordinary caution, use of buddy system
	- Potential contact with poison ivy Bites and/or stings from ticks, bees, mosquitoes, wasps, and snakes	Proper use of PPE Keep first aid supplied readily available, including antidote kit for those allergic to bees or wasps Wear snake chaps if snakes are present Watch for snakes when getting in and out of boat or reaching into the water.
	- Exposure to temperature extremes	Monitor for heat or cold stress Participate in on-Site training programs
	- Bloodborne pathogens	Participate in on-Site training programs
	- Moving or backing vehicles (boat trailers)	Use a spotter around moving or backing equipment Check and mark underground utilities

TABLE 2.2

AUS OU HAZARD ANALYSIS
CRAB ORCHARD NWR
MARION, ILLINOIS

Activities	*Hazards*	*Prevention*
Sediment and Surface Water Sampling (continued)	Physical hazards including steep grades and unstable surfaces while transporting heavy equipment	Use "buddy system" during AUS Area activities
	Slip, trip, fall	Clean mud, snow or grease from shoes and equipment Use "buddy system" to enter/exit boat
	Potential back injuries from lifting heavy objects (batteries)	Practice safe lifting techniques Participate in on-Site training programs
	Severe weather	During severe weather conditions work activities will be reduced or suspended.
	UXO	Stay in identified / screened areas
	Boating	Observe good boating safety rules
Surveying	Chemical hazards due to inhalation and dermal contact	Proper use of PPE Level C, Modified Level D, or Level D based on realtime air monitoring and established protection levels
	Biological Hazards	Proper PPE, exercising ordinary caution, use of buddy system during AUS Area activities
	- Potential contact with poison ivy Bites and/or stings from ticks, bees, mosquitoes, wasps, and snakes	Proper use of PPE Keep first aid supplied readily available, including antidote kit for those allergic to bees or wasps Wear snake chaps if snakes are present
	- Exposure to temperature extremes	Monitor for heat or cold stress Participate in on-Site training programs
	- Bloodborne pathogens	Participate in on-Site training programs
	Physical hazards associated with operation of excavation equipment	Maintain a safe distance from equipment
	- Moving or backing vehicles	Use a spotter around moving or backing equipment

TABLE 2.2

AUS OU HAZARD ANALYSIS
CRAB ORCHARD NWR
MARION, ILLINOIS

Activities	***Hazards***	***Prevention***
Surveying (continued)	- Electrical Hazards	Avoid overhead power lines (20 feet)
		Ground fault circuit interrupters (GFCIs) will be used to reduce the hazard of electrical shock.
		Electrical equipment will be approved.
		Do not stand in water when handling equipment.
		Check for marked underground utilities
	Physical hazards including steep grades and unstable surfaces while transporting heavy equipment	Use "buddy system" during AUS Area activities
	High noise level	Use hearing protection
	Slip, trip, fall	Clean mud, snow or grease from shoes and equipment
	Potential back injuries from lifting heavy objects	Practice safe lifting techniques Participate in on-Site training programs
	Severe weather	During severe weather conditions work activities will be reduced or suspended.
	UXO	Stay in identified / screened areas

TABLE 17.1

EMERGENCY CONTACTS
CRAB ORCHARD NWR
MARION, ILLINOIS

Agency/Firm	*Emergency Telephone Number*	*Business Telephone Number*
Local Emergency Services		
Fire Department	911	
Police Department	911	
Ambulance	911	
Hospital (Heartland Regional Medical Center) 3333 W. DeYoung Street Marion, Illinois		(618) 998-7000
Illinois Emergency Services & Disaster Agency		(800) 782-7860
Williamson County Emergency Service		(618) 993-2323
National Poison Center		(800) 942-5969
National Response Center		(800) 424-8802
Site Office Trailer		TBD
Project Manager on Behalf of GD-OTS - David Trainor		(608) 442-5223
GD-OTS On-Site Contact - Susan Taylor		(618) 993-9465
CRA Industrial Hygiene - Craig Gebhardt		(716) 297-6150
CRA Project Manager - Steven Wanner		(317) 381-0677
CRA Field Supervisor - Walter Pochron		(773) 380-9933
CRA Assistant Field Supervisor/HSO - Kevin Burns		(317) 381-0677
ENTRIX Project Manager - Todd Williams		(847) 842-1882
ENTRIX Field Supervisor/HSO - B.J. Seagrist		(847) 842-1882

Directions to the Hospital: **From Area 4W (Office Trailer location): Highway 148 north 1.5 miles to Illinois Route 13 (West DeYoung Street). Turn right and proceed east on Route 13 approximately 1.5 miles to Heartland Regional Medical Center, located opposite the Williamson County Regional Airport.**

APPENDIX A

HEALTH AND SAFETY PLAN
ACKNOWLEDGMENT FORM

APPENDIX A

HEALTH AND SAFETY PLAN ACKNOWLEDGEMENT FORM

The following employees have read and understood the attached Health and Safety Plan:

Name	*Employer*	*Date*

APPENDIX B

RESPIRATORY PROTECTION PROGRAM

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1.0 RESPIRATORY PROTECTION

1.1 PRACTICE

The primary control of respiratory hazards shall be accomplished, whenever feasible, through the use of engineering controls, hazard substitution, revised work practices, or other administrative controls. However, when such controls are not feasible, appropriate respiratory protection shall be used in accordance with the procedures established in this SOP. Any deviation from the requirements set forth must have approval from a CRA's or ELM's Industrial Hygienist (IH).

1.1.1 AUTHORIZATION

Employees requiring respiratory protection must have authorization from an IH. Office management shall notify an IH of respirator needs. The work situation will then be assessed and a respirator will be issued based on the hazard(s) the individual is exposed to. Reassessment of the hazard and the individual's needs will be repeated periodically.

1.1.2 MEDICAL SURVEILLANCE

All personnel designated to use respirators must successfully complete a physical exam as part of the medical requirements placed on persons exposed to hazardous substances and for users of respiratory protection (29 CFR 1910.134 and 1910.120). The medical exam will be repeated annually. All medical data will be reviewed by a consulting occupational physician. The physician will generate a written opinion on the suitability of the employee to wear a respirator.

1.1.3 AIR QUALITY

When air supplied respirators are used, the breathing air shall meet the Compressed Gas Association (CGA-CG7.1) Standards for Grade D breathing air or better.

1.1.4 AIR CYLINDERS

Cylinders used to supply breathing air are tested and maintained as prescribed in Shipping Container Specifications (49 CFR 178). SCBA cylinders are approximately 2400 psi pressure when full. Compressed air cylinders are visually inspected annually and

hydrostatically tested once every 5 years for steel cylinders and once every 3 years for composite cylinders. These test dates are stamped on the cylinder for future reference.

1.2 FIT TESTING

1.2.1 QUALITATIVE OR QUANTITATIVE FIT TESTING

Fit testing of the respirator will be conducted by an IH or other designated, trained personnel following the medical evaluation. All users of respirators must be fit tested to assure proper protection. Only the brand and size a person is fitted for is allowed to be used in the field. DO NOT SUBSTITUTE RESPIRATORS FOR A BRAND AND SIZE THAT YOU HAVE NOT BEEN PROPERLY FITTED FOR. The fit test will be accomplished quantitatively for full face APRs. After fit testing, the employee will be issued an authorization card. This card serves as a reference for the proper type of respirator to use as well as prima facie proof of proper medical and training clearance for regulatory purposes.

1.2.2 POSITIVE & NEGATIVE FIT TESTING

All personnel will be instructed in the proper method of testing respirator fit by use of the **Positive & Negative** pressure test. This test is to be done by the user each and every time a respirator is donned. This test is performed to help the wearer assess respirator function and find gross leaks between the face and facepiece. This positive-negative pressure test checks the presence and functioning of the respirator valves as well as leakage that may occur due to improper cartridge seal or respirator face fit.

1.2.2.1 POSITIVE PRESSURE

1) Block off the exhalation valve cover openings.

   MSA: Exhalation valve cover can be blocked with the palm of the hand.

   Scott: Exhalation valve covers have front openings as well as four small side openings. These openings are difficult to block off with the hands. However, a small piece of flexible material such as Saran wrap or latex can be used.

   North: Exhalation valve cover has long narrow openings around its perimeter. These can be blocked by encircling the fingers around the valve cover.

2) The person exhales gently, creating a slight positive pressure within the facepiece. The positive pressure should be maintained for at least 10 seconds.

3) If no outward leakage is detected, the person has passed the test.

4) If leakage is detected (usually felt as a cool sensation against the skin or a loss of pressure), the respirator is either malfunctioning or a gross leak between the face and facepiece is present. The following should be done when a failure occurs: Re-don or readjust the respirator.

If the facepiece continues to lose pressure, although previous positive or negative pressure tests performed with that respirator had passed, it is probably malfunctioning. Consult Industrial Hygiene. It is also possible that there are new scars or wrinkles, beard growth, missing teeth or dentures, significant weight gain or loss, etc. to cause gross leakage into the facepiece. When such new conditions exist, reevaluation of the respirator in a test atmosphere is necessary.

1.2.2.2 NEGATIVE PRESSURE

1) Block off the respirator cartridge inlet openings.

   MSA: Cartridges can be blocked with the palms of the hands or with disposable latex gloves.

   Scott: Cartridges can be blocked by using the palms of the hands or with gloves.

   North: Cartridges can be blocked only with gloves.

2) Inhale gently, holding the negative pressure for at least 10 seconds.

3) If no inward leakage of air is detected, the person has passed the test.

4) If leakage is detected, see 4 above.

1.2.3 EXCEPTIONS

1.2.3.1 FACIAL HAIR

Any individual with facial hair which protrudes into the sealing surface of the masks will be refused fitting. Fitting, issuance, and use will be based on clean shaven faces only. Employees with facial hair which interferes with respirator fit are not permitted to work at sites where respiratory protection must be worn.

1.2.3.2 GLASSES

Employees who wear prescription glasses and must wear a full face respirator shall be fitted with special eyeglass adapters. Contact lenses are not permitted to be worn with any type of respiratory protection.

1.3 TRAINING

Proper training of respirator users is required to insure that all respirators will provide adequate protection against respiratory hazards and so that the user will understand the device's limitations. The training will include the following elements:

1) An explanation of the nature of respiratory hazards and what may happen if the respirator is not used properly.
2) A description of what engineering and administrative controls may be utilized to reduce the effects of the respiratory hazard and why respirators are required.
3) An explanation of the various types of respirators and why specific types have been selected.
4) A discussion of the function, capabilities and limitations of respirator cartridges.
5) Instruction in the inspection, fit, and maintenance of the respirator.
6) Instructions in recognizing and handling emergency situations.

1.4 MAINTENANCE AND CARE OF RESPIRATORS

A program for the maintenance and care of respirators will include the following:

1) Inspection for defects;
2) Cleaning and disinfecting;
3) Repair/miscellaneous maintenance; and
4) Storage.

1.4.1 INSPECTION FOR DEFECTS

Employees shall inspect their respirators before each use. A respirator that is not routinely used but is kept ready for emergency use shall be inspected after each use and at least monthly to assure that it is in satisfactory condition. SCBA shall be inspected monthly if kept for emergency response (i.e., long duration site remediation).

Inspection shall include a check of the tightness of the connections and the condition of the face piece, headbands, valves, breathing tubes, and canisters. Rubber or elastic parts shall be inspected for pliability and signs of deterioration. Any respirator with worn or defective parts will be immediately taken out of service.

Before and after each use, respirators will be inspected for the following:

1) Tightness of connections and condition of the facepiece;
2) The headstraps or head harness should be examined for: breaks, loss of elasticity, broken or malfunctioning buckles and attachments, and excessively worn head-harness serrations that might permit slippage;
3) Valves and valve seats;
4) Connecting tube and canisters, air or oxygen cylinders;
5) Rubber or elastomer parts for pliability and deterioration; and
6) Regulators, fittings, and gauges.

The following contains inspection information for various types of respirators.

Air Purifying Respirators

1) Check rubber facepiece for dirt, pliability of rubber, deterioration and cracks, tears, holes, or distortion from improper storage.
2) Check straps for breaks, tears, loss of elasticity, broken snaps, and proper tightness.
3) Check valves (exhalation and inhalation) for holes, warpage, cracks, etc. After removing its cover, the exhalation valve should be examined for: foreign material, distortion, defective or missing valve cover, or improper installation of valve into the valve seat.
4) Check filters or cartridges for dents, corrosion, etc. (loose or missing gaskets, improperly seated cartridges).

5) Check for cracked or badly scratched lenses in full facepieces; incorrectly mounted lens, broken or missing mounting clips.

Atmosphere-Supplying Respirators

1) Check appropriate items above.
2) Check air supply system for breaks or kinks in supply hoses and detachable coupling attachments.
3) Follow manufacturer's recommendations for the specific equipment.
4) Check air supply level and warning devices.

1.4.2 CLEANING AND DISINFECTING

The respirator must be washed after each day's use. If the respirator is shared it must also be disinfected according to the manufacturer's instructions. Organic solvents of any kind must not be used for cleaning. Air purifying filters must not be wetted.

1.4.2.1 CLEANING

1) Remove any filters, cartridges or canisters and, if required by the manufacturer, straps and speaking diaphragms from the facepiece. Remove regulators on airline or SCBA.
2) Wash respirator parts excluding cartridges and canisters in warm (not to exceed 140°F), soapy water or in a product specifically designed by respirator manufacturers for this purpose. A plastic bristle hand brush may be helpful in removing dirt from respirator parts.
3) Rinse all parts thoroughly in warm water.
4) Air dry all parts.
5) Reassemble the respirator and insert new cartridges if needed.
6) Place the respirator in a plastic bag or container and seal it for storage. The respirator facepiece should be stored in its normal position so as not to distort the elastomer.

1.4.2.2 DISINFECTION

1) Disinfection should be done with a cleaner/disinfection agent purchased from the respirator vendor. If that material is not available the following NIOSH procedures can be followed:

   a) Immerse the respirator body for two minutes in a 50 ppm chlorine solution (about 2 ml bleach to 1 liter of water). Rinse thoroughly in clean water and air dry.

   b) Immerse the respirator body for two minutes in an aqueous solution of iodine (add 0.8 ml of iodine in 1 liter water). The iodine is about 7% ammonium and potassium iodide, 45% alcohol and 48% water. Rinse thoroughly in clean water and air dry.

2) Immersion times have to be limited to minimize damage to the respirator. The solutions can age rubber and rust metal parts.

   NOTE: The air-purifying elements must be removed from the respirator prior to cleaning and sanitizing the respirator. Never allow the air-purifying elements to come in contact with water or cleaning/sanitizing solution.

1.4.3 STORAGE

Respirators must be stored to protect them from contamination and mechanical damage at all times when not in use. New, cleaned, or reconditioned respirators are to be kept in a clean, sealed plastic bag or container, stored in a normal position. The plastic bag should be labeled with the users name. A suitable cabinet or drawer should be used to protect respirators and supplies from dirt, extremes of temperature, or bright sunlight. They are not to be left in vehicles or on site perimeter fences, in change sheds, etc.

APPENDIX C

HEAT STRESS AND COLD STRESS PROCEDURES

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1.0 COLD STRESS

1.1 OVERVIEW

Fatal exposures to cold have been reported in employees failing to escape from low environmental air temperatures or from immersion in low temperature water. Hypothermia, a condition in which the body's deep core temperature falls significantly below 98.6°F, can be life threatening. A drop in core temperature to 95°F or lower must be prevented.

Air temperature is not sufficient to determine the cold hazard of the work environment. The wind-chill must be considered as it contributes to the effective temperature. The body's physiologic defense against cold includes constriction of the blood vessels, inhibition of the sweat glands to prevent loss of heat via evaporation, glucose production, and involuntary shivering to produce heat by rapid muscle contraction.

The frequency of accidents increases with cold temperature exposures as the body's nerve impulses slow down, individuals react sluggishly, and numb extremities make for increased clumsiness. Additional safety hazards include ice, snow blindness, reflections from snow, and possible skin burns from contact with cold metal.

There are certain predisposing factors that make an individual more susceptible to cold stress. It is the responsibility of the project team members to inform the Health and Safety Officer to monitor an individual, if necessary, or use other means of preventing/reducing the individual's likelihood of experiencing a cold related illness or disorder.

1.2 PREDISPOSING FACTORS

Predisposing factors that will increase an individual's susceptibility to cold stress are listed below:

- Dehydration: The use of diuretics and/or alcohol, or diarrhea can cause dehydration. Dehydration reduces blood circulation to the extremities.
- Fatigue During Physical Activity: Exhaustion reduces the body's ability to constrict blood vessels. This results in the blood circulation occurring closer to the surface of the skin and the rapid loss of body heat.

- Age: Some older and very young individuals may have an impaired ability to sense cold.
- Alcohol Consumption: Alcohol dilates the blood vessels near the skin surface resulting in excessive body heat loss.
- Sedative Drugs: Sedatives may interfere with the transmission of impulses to the brain, thereby interfering with the body's physiological defense against cold. Some prescription drugs may react the same way.
- Poor Circulation: Vasoconstriction of peripheral vessels reduces blood flow to the skin surface.
- Heavy Work Load: Heavy work loads generate metabolic heat and make an individual perspire even in extremely cold environments. If perspiration is absorbed by the individual's clothing and is in contact with the skin, cooling of the body will occur.
- The Use of PPE: PPE usage which traps sweat inside the PPE may increase an individual's susceptibility to cold stress.
- Lack of Acclimatization: Acclimatization, the gradual introduction of workers into a cold environment, allows the body to physiologically adjust to cold working conditions.
- History of Cold Injury: Previous injury from cold exposures may result in increased cold sensitivity.

1.3 PREVENTION OF COLD STRESS

There are a variety of measures that can be implemented to prevent or reduce the likelihood of employees developing cold related ailments and disorders. These include acclimatization, fluid and electrolyte replenishment, eating a well balanced diet, wearing warm clothing, the provision of shelter from the cold, thermal insulation of metal surfaces, adjusting work schedules, and employee education.

- Acclimatization: Acclimatization is the gradual introduction of workers into the cold environment to allow their bodies to physiologically adjust to cold working conditions. However, the physiologic changes are usually minor and require repeated uncomfortably cold exposures to induce them.
- Fluid and Electrolyte Replenishment: Cold, dry air can cause employees to lose significant amounts of water through the skin and lungs. Dehydration affects the flow of blood to the extremities and increases the risk of cold injury. Warm,

sweet, caffeine-free, non-alcoholic drinks, and soup are good sources to replenish body fluids.

- Eating a Well-Balanced Diet: Restricted diets including low salt diets can deprive the body of elements needed to withstand cold stress. Eat high energy foods throughout the day.
- Warm Clothing: It is beneficial to maintain air space between the body and outer layers of clothing in order to retain body heat. However, the insulating effect provided by such air spaces is lost when the skin or clothing is wet.

The parts of the body most important to keep warm are the feet, hands, head and face. As much as 40 percent of body heat can be lost when the head is exposed.

Recommended clothing includes:

- Inner layers (t-shirts, shorts, socks) should be of a thin, thermal insulating material.
- Wool or thermal trousers. Denim is not a good protective fabric.
- Felt-lined, rubber-bottomed, leather-upper boots with a removable felt insole is preferred. Change socks when wet.
- Wool shirts/sweaters should be worn over inner layer.
- A wool cap is good head protection. Use a liner under a hard hat.
- Mittens are better insulators than gloves.
- Face masks or scarves are good protection against wind.
- Tyvek/poly-coated Tyvek provides good wind protection.
- Wear loose fitting clothing, especially footwear.
- Carry extra clothing in your vehicle.
- Shelters with heaters should be provided for the employees' rest periods if possible. Sitting in a heated vehicle is a viable option. Care should be taken that the exhaust is not blocked and that windows are partially open to provide ventilation.
- At temperatures of 30°F (-1°C) or lower, cover metal tool handles with thermal insulating material if possible.
- Schedule work during the warmest part of the day if possible, rotate personnel and adjust the work/rest schedule to enable employees to recover from the effects of cold stress.

1.3.1 EMPLOYEE EDUCATION

Employees have already been trained to recognize and treat the effects of cold stress during their 40-hour training. Signs, symptoms and treatment of cold stress should be reviewed in project safety meetings where applicable. The buddy system will help in preventing cold stress once the employees are trained to recognize the signs and symptoms of cold stress.

1.3.2 COLD STRESS PREVENTION GUIDELINES

It may not be practically feasible to implement all the above prevention measures. Follow the guidelines given below when the ambient air temperature is -5°F (-20°C) or lower:

- Contact the project manager or the industrial hygienist to determine if the project team should be on site in such temperatures;
- Dress warm;
- Replenish fluids and electrolytes at regular intervals;
- Provide shelter from the cold; and
- Adjust work/rest schedules.

1.3.3 ADJUST WORK-REST SCHEDULES

Follow the work/rest schedule on Table C.1. It is based on the cooling power of air which is a function of wind speed and ambient air temperature.

1.4 FIRST-AID TREATMENT GUIDELINES

The following describes symptoms of different stages in cold stress and the related first-aid treatment guidelines.

1.4.1 FROSTBITE

Stages

Incipient (frost nip)	May be painless. Tips of ears, nose, cheeks, fingers, toes, chin affected. Skin blanched white.
Superficial	Affects skin/tissue just beneath skin; turns purple as it thaws. Skin is firm, waxy; tissue beneath is soft, numb.
Deep	Tissue beneath skin is solid, waxy, white with purplish tinge. Entire tissue depth is affected.

First-Aid

Incipient	Warm by applying firm pressure - blow warm breath on spot or submerge in warm water (102°F to 110°F) (39°C to 43°C). Do not rub the area.
Superficial	Provide dry coverage, steady warmth; submerge in warm water.
Deep	Hospital care is needed. Do not thaw frostbitten part if needed to walk on. Do not thaw if there is danger of refreezing. Apply dry clothing over frostbite. Submerge in water; do not rub.

1.4.2 GENERAL HYPOTHERMIA

Stages

- Shivering
- Indifference
- Decreased Consciousness
- Unconsciousness
- Death

Symptoms

- Muscle Tension
- Uncontrollable Shivering
- Glassy Stare
- Decreased Muscle Function
- Speech Distortion
- Blue, Puffy Skin
- Slow Pulse
- Shallow Breathing
- Coordination Loss
- Stumbling
- Forgetfulness
- Freezing Extremities
- Dilated Pupils
- Fatigue

Emergency Response

- Keep person dry; replace wet clothing.
- Apply external heat to both sides of patient using available heat sources, including other bodies.
- Give warm liquids - not coffee or alcohol - after shivering stops and if conscious.
- Handle gently.
- Transport to medical facility as soon as possible.
- If more than 30 minutes from a medical facility, warm person with other bodies.

2.0 HEAT STRESS

2.1 OVERVIEW

Heat induced occupational illnesses, injuries, and reduced productivity occur in situations in which the total heat load (environmental plus metabolic) exceeds the body's capacities to maintain normal body functions without excessive strain. Heat stress is the sum of the heat generated in the body plus the heat gained from the environment minus the heat lost from the body to the environment. The body's response to heat stress is called heat strain. The level of heat stress at which excessive heat strain will result depends on the heat tolerance of the individual. Certain predisposing factors may reduce an individual's ability to tolerate heat stress.

Using PPE may put a hazardous waste worker at an increased risk of developing heat stress. Health effects may range from heat rash or heat fatigue to serious illness or death. Heat stress is caused by a number of interacting factors, including environmental conditions such as temperature and relative humidity, protective clothing which limits natural heat loss through perspiration, workload, and the individual characteristics of the worker.

It is the responsibility of the project team members to inform the HSO or industrial hygienist if any of the predisposing factors listed below apply to them. This enables the HSO to monitor the individual if necessary, or use other means of preventing/reducing the individual's likelihood of experiencing a heat related illness or disorder.

2.2 PREDISPOSING

Predisposing factors that will increase the individual's susceptibility to heat stress are listed below:

- Lack of Physical Fitness: Such individuals experience more physiological strain including a higher heart rate, a higher body temperature, less efficient sweating, and slightly higher oxygen consumption as compared to fit individuals.
- Obesity: Overweight individuals produce more heat per unit surface area than thin individuals and have a lowered ability to dissipate heat.
- Age: Older individuals may have a decreased ability to cope with heat stress.
- Dehydration: Dehydrated individuals will have a decreased ability to cool the body by sweating. Diarrhea can cause dehydration.

- Alcohol, Medications and Drug Use: Alcohol consumption may dehydrate individuals and certain medications/drugs may act as diuretics. Hence, the individual may have a decreased ability to lose heat by sweating.
- Infection, Sunburn, Illness and Certain Chronic Diseases: These factors may interfere with the body's normal mechanisms to lose heat.
- Heart Conditions or Circulatory Problems: Heat stress may place an additional strain on the heart and circulatory system that could harm the individual as well as decrease the individual's physiologic response.
- Low Salt Diet: Could affect the individual's electrolyte balance.
- Pregnancy
- Previous History of Heat Stroke or Heat Exhaustion: May increase the individual's susceptibility to heat stress.
- Heavy Work Load: Will generate metabolic heat thereby increasing the heat stress placed on the individual
- The Use of PPE Over Light Summer Clothing: This will decrease the ability of an individual to lose heat by sweating as evaporative cooling can no longer occur.
- Lack of Acclimatization: Acclimatization is the gradual introduction of workers into a hot environment to allow their bodies to physiologically adjust to hot working conditions. Acclimatized individuals generally have lower heart rates and lower body temperatures. In addition, they sweat sooner and more profusely and even have more dilute sweat (thereby losing less electrolytes) than non-acclimatized individuals.

2.3 PREVENTION OF HEAT STRESS

There are a variety of measures that can be implemented to prevent or reduce the likelihood of employees developing heat stress related disorders. These include fluid and electrolyte replenishment, the provision of shelter from the sun and heat, work schedule adjustment, the use of cooling devices, acclimatization, heat stress monitoring, and employee education, as discussed below:

- Fluid and Electrolyte Replenishment: Personnel should drink about 16 ounces of water before starting work and drink water at every break. To encourage water consumption, cool water and disposable cups should be made available. The normal thirst mechanism is not sensitive enough to ensure that enough water will be drunk to replace lost sweat. When heavy sweating occurs, personnel should be encouraged to drink more. Replacing body fluids with Gatorade is an

option. It is advisable to have Gatorade on site if the air temperature is 70°F (21°C) or more and the workers are performing tasks with a moderate to heavy work load in chemical resistant clothing.

- Shelter From the Sun and Heat: Air-conditioned (if possible) or shaded areas should be made available for rest periods. Sitting in an air-conditioned truck is an acceptable option.
- Work Schedule Adjustment: Scheduling work for early mornings and/or late afternoons will avoid the hottest parts of the day and reduce the heat stress placed on personnel. Rotation of personnel will help reduce overexertion of workers and adjusting the work-rest schedule will help personnel recover from the effects of heat stress periodically.
- Use of Cooling Devices: The use of cooling devices like field showers, hose-down areas, or cooling vests should be considered for project tasks that involve heavy work loads in chemical resistant clothing.
- Acclimatization: Acclimatization is the gradual introduction of workers into a hot environment to allow their body to physiologically adjust to hot working conditions. Acclimatized individuals generally have lower heart rates and lower body temperatures. In addition, they sweat sooner and more profusely and even have more dilute sweat (thereby losing less electrolytes) than non-acclimatized individuals.
- Heat Stress Monitoring: Monitoring hot environments for potential heat stress should be initiated when the ambient air temperature is in excess of 70°F (21°C). There are several ways to monitor heat stress: measuring heart rate, oral temperature, loss of body weight, and the Wet Bulb Globe Temperature using a Reuter-Stokes or Quest Electronics heat stress monitor.
- Employee Education: Workers have already been trained to recognize and treat the effects of heat stress during the 40-hour training course. Signs, symptoms and treatment of heat stress should be discussed in site safety meetings. The buddy system will help in preventing heat stress once the employees are trained to recognize the signs and symptoms of heat stress.

2.3.1 PREVENTION PRACTICES

It may not be practically feasible to implement all of the above prevention measures. The following has been developed as a field guide for use in actual field situations.

Ambient air temperature is 70°F (21°C) or more:

- Replenish fluids and electrolytes. Drink cool (50°F to 60°F/10°C to 15°C) fluids hourly. The fluids should be caffeine-free and non-alcoholic. Do not wait until you are thirsty. Your normal thirst mechanism is not sufficient to overcome the effects of dehydration. If you feel thirsty, you are already becoming dehydrated.
- Provide shelter from the sun and heat.

Ambient air temperature is 70°F (21°C) or more and chemical-resistant clothing is being used:

- Same as above;
- Adjust work schedules if feasible; and
- Initiate heat stress monitoring and/or the use of cooling devices.

2.3.2 HEAT STRESS MONITORING

Heat stress monitoring may be performed by monitoring the heart rate. Heart rate should be measured at the beginning of the work shift, at regular intervals and at the start of each rest period.

1) If the heart rate is <110 beats per minute (bpm), personnel may continue the current work/rest schedule.
2) If the heart rate is >110 bpm, take a 10 minute break. Monitor heart rate at the end of the rest period. If not <110 bpm, rest until the heart rate is <110 bpm. Reduce the current work time between breaks by approximately one hour. If the next scheduled monitoring session shows a heart rate of >110 bpm once again, reduce the work time between breaks by one hour.

2.4 HEAT STRESS FIRST AID

2.4.1 HEAT CRAMPS

Cause: Excessive water loss/electrolyte imbalance.

Symptoms	First-Aid Guidelines
Muscular pain in arms, legs, abdomen	Administer sips of Gatorade (1/2 glass every 15 minutes)
Faintness, dizziness, exhaustion	Do not massage cramping muscles
Normal temp, cool moist skin	Relax person

2.4.2 HEAT EXHAUSTION

Cause: Large amount of water loss; blood circulation diminishes.

Symptoms	First-Aid Guidelines
Moist, clammy, skin, usually pale	Move to a cool place
Dilated pupils	Apply cold, wet compresses to skin
Weak, dizzy, nauseous, headache	Raise feet 8 to 12 inches
Normal or low body temperature	Administer sips of Gatorade (1/2 glass every 15 minutes)
	Get medical attention

2.4.3 HEAT STROKE

Cause: Body overheats; temperature rises; no sweating occurs

Symptoms	First-Aid Guidelines
No sweating occurs	Get emergency medical assistance ASAP
Dry, hot skin, usually red	Remove from sunlight
Constricted pupils	Wet down body with cool water or rubbing alcohol
Hot body temperature (105°F to 110°F/40.5°C to 43.5°C)	Elevate head/shoulders
Strong, rapid pulse	Wrap in wet, cold wrapping
Unconsciousness may occur	Once cooled to 102°F (38.9°C), stop cooling measures
Muscular twitching	

TABLE C-1

WORK/REST SCHEDULE
FOR A 4-HOUR WORK SHIFT

Air Temperature with Sunny Sky		*Work/Break Schedule (Minutes)*				
°F	*°C*	*No Wind*	*5 mph Wind*	*10 mph Wind*	*15 mph Wind*	*20 mph Wind*
-05 to -09	-20 to -23	Normal	Normal	Normal	55/10	40/10
-10 to -14	-23 to -26	Normal	Normal	Normal	40/10	20/10
-15 to -19	-26 to -28	Normal	Normal	40/10	20/10	10/10
-20 to -24	-29 to -31	Normal	40/10	20/10	Stop	Stop
-25 to -29	-32 to -34	40/10	20/10	10/10	Stop	Stop
-30 to -34	-35 to -37	20/10	Stop	Stop	Stop	Stop
-35 and Below	-38 and Below	Stop	Stop	Stop	Stop	Stop

Notes:

Schedule applies only to employees in dry clothing.
Schedule applies to any 4-hour work period with **moderate to heavy work activity**, with warm-up periods of 10 minutes in a warm location and with an extended break (e.g., lunch) in a warm location. For light-to-moderate work: apply schedule one step lower. For example, at -25°F with no noticeable wind, there should be a maximum work period of 20 minutes and then a 10-minute break.

This table addresses the health hazards related to cold weather work. The practicality of working under a work/rest schedule, together with the ability of the necessary equipment to function properly in cold weather, may be more restrictive than the health hazards and also need to be considered.

The cold stress schedule applies to light or sedentary work activities. Light to moderate work activities can be moved down one level, moderate to heavy work activities can be moved down two levels if workers are acclimated, have proper protective clothing, and show no signs of cold stress.

The following is suggested as a guide for wind velocity if accurate information is not available

5 mph Wind: Light flag moves.
10 mph Wind: Light flag fully extended.
15 mph Wind: Raises newspaper sheet.
20 mph Wind: Blowing and drifting snow.

APPENDIX D

SEVERE WEATHER EMERGENCY PROCEDURES

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SEVERE WEATHER

1.0 SCOPE

As most projects are conducted outside, the potential for severe weather must be considered. Thunderstorms, tornadoes, and winter storms can develop quickly, jeopardizing worker safety. The following emergency procedures are to be followed in case of severe weather.

2.0 THUNDERSTORMS AND LIGHTNING

Monitor weather conditions at all times while working. Monitor for a sign of an impending storm such as increased cloudiness, darkened skies, and increased wind. If any of these signs are observed, listen to a radio for the latest weather information or contact a local weather reporting service.

When a thunderstorm accompanied by lightning is in the project area, cease work immediately. All powered equipment, such as drill rigs, are to be shut down.

Seek shelter inside nearby buildings or trailers. If there are no buildings nearby, seek shelter inside your vehicle.

If you are caught outside, do not stand beneath tall, isolated trees or telephone poles. Avoid areas projecting above the landscape such as hilltops. In open areas, go to a low place such as a ravine or valley. Stay away from open water, metal equipment, wire fences, and metal pipes. If you are in a group of people in the open, spread out, staying several yards apart.

If you are caught in a level field or open area far from shelter and you feel your hair stand on end, lightning may be about to strike you. Drop to your knees and bend forward, putting your hands on your knees. **DO NOT LIE FLAT ON THE GROUND**.

If someone has been struck by lightning, monitor life signs and begin administering mouth-to-mouth resuscitation or cardiopulmonary resuscitation as needed. Send for help. Check conscious victims for burns, especially at the fingers and toes and next to buckles and jewelry. Administer first aid for shock. Do not let the victim walk around.

3.0 TORNADOES

Tornadoes usually develop from thunderstorms and normally occur at the trailing edge of the storm. Most tornadoes occur in the months of April, May, June, and July in the late afternoon and early evening hours.

When storms are predicted for the project area, monitor weather conditions on a radio. A tornado watch is issued when favorable conditions exist for the development of a tornado. A tornado warning is issued by the local weather service office whenever a tornado has actually been sighted or is strongly indicated by radar.

If a tornado warning is issued, seek shelter immediately. If there are permanent buildings located on site, go there immediately, moving toward interior hallways or small rooms on the lowest floor.

If a tornado warning is issued and you are in a vehicle or a site trailer, leave and go to the nearest building. If there are no buildings nearby, go in the nearest ditch, ravine, or culvert, with your hands shielding your head.

If a tornado is sighted or a warning issued while you are in open country, lie flat in a ditch or depression. Hold onto something on the ground, such as a bush or wooden fence post, if possible.

Once a tornado has passed the site, site personnel are to assemble at the designated assembly area to determine if anyone is missing. Administer first aid and seek medical attention as needed.

4.0 WINTER STORMS

When snow or ice storms are predicted for the project area, site personnel should monitor weather conditions on a radio. A winter storm watch is issued when a storm has formed and is approaching the area. A winter storm warning is issued when a storm is imminent and immediate action is to be taken.

When a storm watch is issued, monitor weather conditions and prepare to halt site activities. Notify the field supervisor (ELM or CRA) of the situation. Seek shelter at site buildings or leave the site and seek warm shelter. If you are caught in a severe winter storm while traveling, seek warm shelter if road conditions prevent safe travel.

If you are stranded in a vehicle during a winter storm:

- STAY IN THE VEHICLE, disorientation comes quickly in blowing and drifting snow;
- wait for help;
- keep a window open an inch or so to avoid carbon monoxide poisoning;
- run the engine and heater sparingly;
- keep watch - do not let everyone sleep at the same time; and
- exercise occasionally.