APPENDIX B

SITE HEALTH AND SAFETY PLAN

CONTENTS

FIGURES

TABLES

ABBREVIATIONS AND ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
CPR	cardiopulmonary resuscitation
DI	deionized
DOT	Department of Transportation
EMS	Emergency Medical Services
EPA	U.S. Environmental Protection Agency
ESH&Q	Environmental, Safety, Health, and Quality
FID	flame ionization detector
HASP	Health and Safety Plan
HEPA	high-efficiency particulate air
HSA	hollow-stem auger
HSO	Health and Safety Officer
IDW	investigation-derived waste
IR	Installation Restoration
IRP	Installation Restoration Program
LO/TO	lock-out/tag-out
MSDS	Material Safety Data Sheets
NIOSH	National Institute for Occupational Safety and Health
O&M	operation and maintenance
OSHA	Occupational Safety and Health Administration
PEL	permissible exposure limit
PEL/TWA	permissible exposure limit/time-weighted average
PID	photoionization detector
POC	Point of Contact
ppb	part(s) per billion
PPE	personal protective equipment
ppm	part(s) per million
PW	Public Works
QAO	Quality Assurance Officer
QC	Quality Control
RPM	Remedial Project Manager
SAP	Sampling and Analysis Plan
SHSO	Site Health and Safety Officer

SHSP	Site Health and Safety Plan
SSO	Site Safety Officer
STEL	short-term exposure limit
TLV	threshold limit value
TWA	time-weighted average
VOC	volatile organic compound
USACE	United States Army Corp of Engineers
U.S. EPA	United States Environmental Protection Agency
UV	ultraviolet

PROJECT TEAM

The following persons will be provided copies of the approved Site Health and Safety Plan and any subsequent revisions.

Title	Name and Contact Information
Battelle Project Manager and Project Engineer	Keith Fields Battelle Memorial Institute 505 King Avenue Columbus, OH 43201 (614) 424-7723 fieldsk@battelle.org
Battelle Project Quality Assurance Officer	Pam Rodgers Battelle Memorial Institute 505 King Avenue Columbus, OH 43201 (614) 424-4624 rodgersp@battelle.org
Battelle Project QC Manager and Health and Safety Officer	Jennifer Ickes Battelle Memorial Institute 505 King Avenue Columbus, OH 43201 (614) 424-3723 ickesj@battelle.org
Battelle Site Health and Safety Manager	David Clexton Battelle Memorial Institute 7029 Fern Place Carlsbad, CA 92009 (760) 476-9144 clextond@battelle.org
Battelle Project Geologists	Andrew Barton Battelle Memorial Institute 505 King Avenue Columbus, OH 43201 (614) 424-7656 bartona@battelle.org David Clexton Battelle Memorial Institute 7029 Fern Place Carlsbad, CA 92009 (760) 476-9144 clextond@battelle.org

Section 1.0: ADMINISTRATIVE INFORMATION

This Site Health and Safety Plan (SHSP) is written for work performed by Battelle at the National Aeronautics and Space Administration (NASA) Jet Propulsion Laboratory (JPL), Pasadena, California. This SHSP is intended to meet the requirements of:

- United States Army Corp of Engineering (USACE) Safety and Health Manual, EM 385-1-1 (November, 2003)
- Title 29, Code of Federal Regulations (CFR) 1910 and 29 CFR 1926
- EPA Standard Operating Safety Guidelines for Hazardous Waste Operations (1986)
- Navy/Marine Corps Installation and Restoration (IR) Manual (August 2000)
- California Code of Regulations, Title 8 Section 5192

1.1 Scope of Site Health and Safety Plan

This SHSP has been prepared for use by Battelle project personnel and their subcontractors for work at NASA JPL. The plan is written for the specific site conditions, purposes, tasks, dates and personnel specified. If these conditions change, this plan must be amended and reviewed by those named in Section 1.2.

All site activities will be performed in accordance with the documents listed above, especially 29 CFR 1910.120. All Battelle employees involved in fieldwork at NASA JPL will have completed the required training programs, maintained qualification through annual refresher training, are under a program of medical surveillance and are certified to wear respiratory protection as specified in 29 CFR part 1910.134. Full details of the Battelle safety training, respiratory protection, and medical surveillance programs are given in the Battelle Environment, Safety, Health and Quality (ESH&Q) Training Program (Battelle, 2002a), Respiratory Protection Program (Battelle, 2001a), and the Chemical Safety Information Program - Medical Consultation (Battelle, 2002b), respectively.

This SHSP was prepared from the best available information concerning site conditions at the time. The health and safety specifications in this SHSP are based on reasonable knowledge that chemicals, such as volatile organic chemicals, including carbon tetrachloride and trichloroethene (TCE), perchlorate, and 1,4-dioxane are present in soil and groundwater.

1.2 Key Personnel and Responsibilities

Key Battelle personnel for this project include:

- Project Manager and Project Engineer – Keith Fields
- Project Geologists – Andrew Barton, David Clexton
- Certified Industrial Hygienist (CIH) – Gary Carlin
- Health and Safety Officer (HSO) – Jennifer Ickes
- Site Health and Safety Officer (SHSO) – David Clexton

All project field staff have completed comprehensive health and safety training, which meets the requirement of Title 29 Code of Federal Regulations – Part 1910.120 (29 CFR 1910.120). The SHSO will have:

- Completed the required training for this project assignment
- The responsibility for completing the required field forms and reports.
- The authority to modify and stop work, or remove personnel from the site if working conditions may affect on-site and off-site health and safety.
- First Aid and cardiopulmonary resuscitation (CPR) certifications and be trained in blood borne pathogens control.

Specific project safety responsibilities for these key personnel are detailed below.

1.2.1 Project Manager Responsibilities. As the Project Manager, Mr. Keith Fields is responsible for generating, organizing, and compiling the SHSP, which describes planned field activities and potential hazards that may be encountered at the site. Mr. Fields also is responsible for ensuring that adequate training and site safety briefing(s), including the provision of safety equipment, are provided to the project field staff. Mr. Fields will provide a copy of this SHSP to each member of the project field staff and one copy to each subcontractor prior to the initiation of field activities. Associated health and safety responsibilities will include:

- Coordinating the activities of all field personnel, including their signed acknowledgement of the SHSP.
- Selecting the SHSO and field personnel for the work to be undertaken on site.
- Ensuring that the assigned tasks are being completed as planned and are kept on schedule.
- Providing authority and resources to ensure that the SHSO is able to implement and manage safety procedures.
- Preparing reports and recommendations about the project to the client and concerned personnel.
- Ensuring that the SHSO is aware of all provisions of this SHSP and that all on-site personnel are instructed about safety practices and emergency procedures as defined in this SHSP.
- Ensuring that the SHSO is monitoring site safety.

1.2.2 HSO/CIH Responsibilities. The HSO, Ms. Jennifer Ickes, and/or CIH, Mr. Gary Carlin is responsible for developing and coordinating the health and safety program outlined in this SHSP. They are also responsible for reviewing and approving the SHSP for accuracy and incorporating any new information or guidelines that aid the Project Manager and SHSO in further definition and control of the potential health and safety hazards associated with this project. Ms. Ickes/Mr. Carlin also have the authority to suspend or modify work practices for safety reasons and to dismiss individuals whose site conduct endangers the health and safety of others.

1.2.3 SHSO Responsibilities. The SHSO, Mr. Dave Clexton, has a direct line of authority from the HSO to implement specific health and safety requirements for specific site activities, and for ensuring that all team members, including subcontractors, comply with the SHSP. It is Mr. Clexton's

responsibility to inform the subcontractors and other field personnel of chemical and physical hazards, as he becomes aware of them. Mr. Clexton has the authority to suspend work if he feels the operations threaten the health and safety of the field team or the surrounding population. Mr. Clexton is responsible for completing and submitting the following forms (Attachment 1):

- Safety Compliance Agreement
- Tailgate Safety Meeting Form
- Air Monitoring Data Sheet
- Accident/Incident Analysis Form

Additional SHSO responsibilities include, but are not limited to, the following:

- Evaluating weather conditions and chemical hazard information and making recommendations to the Project Manager about any modification to this SHSP or personal protective equipment (PPE) requirements to maintain personnel safety.
- Approving all field personnel working on site, taking into consideration their level of training, physical capacity and their eligibility to wear protective equipment necessary for the assigned tasks.
- Monitoring the compliance of field personnel for the routine and proper use of protective equipment that has been required for each task.
- Enforcing the "buddy system" as appropriate for site activities.
- Posting location and route to the nearest medical facility and arranging for emergency transportation to the nearest medical facility.
- Posting the telephone numbers of local public emergency services.
- Entering the exclusion zone, for rescue of personnel only, after emergency services have been notified and appropriate precautions taken. Response effort must be within the level of training of the SHSO and appropriate equipment must be available.
- Observing field team members for signs of exposure, stress, or other condition related to pre-existing physical conditions or site work activities.

1.2.4 Project Field Staff Responsibilities. The project field staff is responsible for ensuring that activities are performed in accordance with the approved SHSP, and that deviations from the SHSP are based upon encountered field conditions that are well documented in field notes. The project field staffs' health and safety responsibilities include:

- Following the SHSP and the direction of the SHSO.
- Reporting to the SHSO any unsafe conditions or practices.
- Reporting to the Project Manager and SHSO all facts pertaining to incidents that result in injury or exposure to toxic materials.
- Reporting to the Project Manager any equipment malfunctions or deficiencies.
- Reviewing the SHSP as necessary.

It is the responsibility of individual organizations involved in field activities to ensure understanding of and compliance to the SHSP by its on-site employees or representatives working in controlled areas. Failure by any person to adhere to this SHSP may result in their removal from the site.

1.2.5 Subcontractor Responsibilities. Battelle is the lead and prime contractor for the activities associated with this project and, therefore, is responsible for subcontractor health and safety while under contract with Battelle and engaged in work at NASA JPL. Battelle will inform subcontractors of the site emergency response procedures, and any potential fire, explosion, health, safety, or other hazard by making this SHSP and site information available on-site. All Battelle subcontractors are responsible for:

- Attending the health and safety briefing given by the SHSO covering the requirements of this SHSP,
- Providing their own, company-provided, personal protective equipment (PPE),
- Providing documentation that their employees have been health and safety trained in accordance with applicable federal, state, and local laws and regulations,
- Providing evidence of medical surveillance and medical approvals for their employees,
- Designating their own Site Safety Officer (SSO) responsible for ensuring that their employees comply with their own Health and Safety Plan (HASP), as well as this Battelle SHSP, and taking any other additional measures required by their site activities,
- Signing the Safety Compliance Agreement Form (Attachment 1) as a part of standard safety protocol. All field personnel performing onsite work will sign the Safety Compliance Agreement Form. Individuals who refuse to sign this agreement will be prohibited from working on this project.

1.2.6 Site-Specific Safety Briefing. A site-specific safety/pre-entry briefing will be held daily prior to the start of any site activities at NASA JPL; and at other times as necessary to ensure that all field personnel and visitors are aware of the health and safety hazards at the site.

Section 2.0: PROJECT TASKS

The major Battelle tasks associated with this contract include the following:

- Mobilization
- Collection of soil and groundwater samples
- Investigation-derived waste (IDW) disposal
- Demobilization

Tasks that will be completed by Battelle subcontractors include the following:

- Geophysical survey
- Installation of monitoring wells and soil borings
- Collection of soil and groundwater samples

Subcontractors are required to prepare their own HASP for the soil boring drilling and monitoring well installation. The Battelle HSO will review the subcontractors HASP to ensure the HASP covers all aspects of the subcontractors' responsibilities for this project. The hazard risk assessment provided in the following section is for risks Battelle field personnel might encounter while working on site.

Section 3.0: HAZARD/RISK ASSESSMENT

This section describes chemical, physical, and environmental hazards anticipated, and the control measures to be implemented to minimize or eliminate each hazard. Section 3.1 discusses hazards associated with the project tasks listed in Section 2.0. Section 3.2 discusses the chemicals of interest at JPL and includes information such as exposure limits and signs and symptoms of exposure. Section 3.3 discusses physical hazards identified with this site including those associated with fire, use of heavy equipment, slip-trip-fall, lifting, tool and equipment use, and heat stress. Section 3.4 discusses biological hazards associated with the physical location of the site including contact with flora/fauna.

Daily tailgate safety meetings will be held at the start of each workday to discuss potential chemical, physical and environmental hazards and preventative safety measures. Attendance will be mandatory for all employees and a Tailgate Safety Meeting Form (Attachment 1) will be completed. The information provided in this section will be used to augment daily safety meetings intended to heighten safety and hazard awareness on the job.

3.1 Hazards Associated with Battelle Tasks

In performing the Battelle project tasks, hazards associated with mobilization/demobilization, soil boring and monitoring well installation, collection of soil and groundwater samples, and disposal of IDW may be encountered. These hazards are discussed in detail in the following sections.

3.1.1 Hazards Associated with Mobilization and Demobilization. The main hazards associated with mobilization and demobilization of field personnel and equipment are electrical shock from overhead power wires, objects striking the heads of field personnel, and general site hazards such as heat and biological hazards. Methods of mitigating these hazards are listed in Table B-1.

3.1.2 Hazards Associated with Soil Boring and Well Installation. The main hazards associated with soil boring and groundwater monitoring well installation are listed in Table B-1 and include electrical shock, flying particulates, objects striking the head, and inhalation and contact of organic vapors.

Drilling equipment will be operated, inspected, and maintained according to manufacturers operating manuals. Battelle will subcontract the drilling and installation of all wells at JPL. Battelle field personnel will be present during these activities to supervise and to monitor the health and safety of field personnel.

Prior to the start of any drilling activities a general survey of the site will be completed. This survey will include all overhead hazards and any underground utilities or hazards. The survey results and maps will be used to determine any previously unknown hazards; this information will be discussed in the Pre-Entry Tailgate Meeting and will assist in determining the exact location of monitoring wells. A geophysical survey also will be conducted to determine the presence and location of underground utilities.

3.1.3 Hazards Associated with the Collection of Soil and Groundwater Samples. The main hazards associated with the collection of soil and groundwater samples is contact with potentially contaminated soil and/or groundwater. Level D PPE will be worn by field personnel to protect against contact with contaminated materials. Prior to the collection of any samples, a handheld photoionization detector (PID) or flame ionization detector (FID) will be used to screen for the presence of VOCs. Breathing zone readings will be taken periodically (approximately every 15 minutes), unless the SHSO determines that more frequent monitoring is required.

Table B-1. Hazard Sources and Mitigation During Field Activities at JPL

Hazard	Project Tasks	Mitigation Methods
Slips, trips, and falls	All tasks	Maintain good housekeeping. Limit access to work area with boundary marking tape and signs. Slip, trip, and fall hazards will be addressed through an ongoing proactive housekeeping program that eliminates elements in the work area that have potential for causing substantial loss of footing.
Electrical shock	Mobilization, installation and development of monitoring wells, and demobilization	All major electrical work (wiring, control panel construction, etc.) will be subcontracted to a qualified electrical contractor. Care will be taken to de-energize and ground any electrical equipment prior to any necessary repair work. Before undertaking any repair work, the energy source will be either permanently disconnected or temporarily tagged and kept locked to prevent the equipment from accidentally energizing. The key will be kept under control of the SHSO. Personnel performing repair work shall have been trained on lock-out/tag-out (LO/TO) procedures.
Flying particulate	Installation of monitoring wells and soil borings	All site personnel will wear hard hats and safety glasses with side shields during drilling.
Objects striking head	Mobilization, installation and development of monitoring wells, and demobilization	Hard hats will be worn in the vicinity of overhead hazards (e.g., in the drilling rig area).
Explosion/Fire	All tasks	Open-flame ignition sources will be restricted from the work area (smoking, etc.). No smoking is permitted in the work zones. Any free-phase petroleum or gasoline will be stored in appropriate containers. Signs indicating flammable liquids will be posted where appropriate. Appropriate fire extinguishers will be available to site personnel during field activities.
Inhalation and contact of organic vapors	Installation of monitoring wells and soil borings; sampling of wells	If conditions require upgrading to air-purifying respirations (Level C PPE), an addendum to the document will be submitted for review and approval. Remain upwind whenever possible. Wear disposable gloves and safety glasses with side shields when handling soil and sampling groundwater.

Table B-1. Hazard Sources and Mitigation During Field Activities at JPL (Continued)

Hazard	Project Tasks	Mitigation Methods
Contact with detergent, samples, or solvent	Decontaminating sampling equipment	Level D PPE is typically adequate. Wear coveralls and gloves. Wear safety goggles when preparing and using decontamination solutions Maintain good housekeeping. No eating, smoking, or drinking on site.
Contact with scorpions, snakes, spiders, or other hazardous flora or fauna	All tasks	Do not place hands into areas that have not been visually inspected, e.g., reaching overhead onto ledges or into holes. Wear coveralls, safety-toed shoes, and gloves. Perform periodic self-checks for ticks and insect bites. Use Insect repellent when necessary. Workers will not be allowed to work near insects where an unreasonable risk is present. Workers should inform the SHSO of any insect allergies.
Solar Radiation	All tasks	Protective clothing, eyewear, or sunblock will be worn.
Weather extremes	All tasks	Use dress consistent with conditions. Implement workers rotation and rest period schedules. Adjust work day to take advantage of the cooler parts of the day. Maintain constant telephone communication between on-site and off-site personnel to insure good physical condition of on-site personnel. Frequently consume water or an electrolytic beverage to prevent dehydration.

3.1.4 Hazards Associated with IDW Disposal. The main hazards associated with IDW disposal include contact with contaminated soil, wastewater, detergents, and solvents. Disposal of potentially contaminated soil from drilling and well installation activities will be completed as described in OU-3 Additional Investigation Work Plan. During soil disposal activities field personnel will wear proper Level D PPE. Any IDW and wastewater created under this effort will be disposed of off-site. During this

process, Level D PPE will be worn by field personnel to protect against contact with contaminated wastewater. All hazardous waste collected under this Task Order will be disposed of off-site.

3.2 Hazards Associated with Chemicals Substances at JPL

A list of the chemicals identified to be in the soil and groundwater and their associated exposure limits are presented in Table B-2. Material Safety Data Sheets (MSDS) information for compounds listed in Table B-2 is provided in Attachment 2. Permissible Exposure Levels (PELs) are Occupational Safety and Health Administration (OSHA) permissible exposure limits for airborne concentrations of toxic substances measured as an 8-hour Time-Weighted Average (TWA). The OSHA PELs are the recognized levels to which the site monitoring will adhere. Short-Term Exposure Limits (STELs) are OSHA short-term limits measured as a 15-minute TWA. OSHA requires that controls be implemented when employee exposure exceeds these limits. The Threshold Limit Values (TLVs) are health and safety guidelines recommended by the American Conference of Governmental Industrial Hygienists (ACGIH). If contaminant levels exceed greater than 50% of the TLV or PEL and persist for greater than 10 minutes, engineering and/or administrative control measures will be implemented. During soil boring and monitoring well installation activities, field personnel have the potential to be exposed to both contaminated soil and groundwater and contaminants in the vapor phase. Risk of contamination from site assessment activities comes mainly from contaminants in the vapor phase.

Table B-2. Primary Health Hazards and Exposure Limits for Chemical Substances at JPL

Compound	OSHA PELs[(a)]		ACGIH TLVs[(b)]		Primary Health Hazard
	TWA	STEL	TWA	STEL	
Carbon tetrachloride	10 ppm	NA	5 ppm	10 ppm	Affects liver, causes cancer
1,1-DCE [(c)]	5 ppm	NA	NA	NA	Harmful if ingested, inhaled or absorbed through the skin; reproductive; cancer
1,2-DCA[(c)]	50 ppm	100 ppm (OSHA Ceiling) (Z-2 Table)	NA	10 ppm	Skin irritant; liver; cancer
PCE	100 ppm	NA	25 ppm	100 ppm	Irritation; CNS
TCE	100 ppm	NA	50 ppm	100 ppm	CNS; headache; liver
Perchlorates	NA	NA	NA	NA	Skin irritant; respiratory
Chromium (hexavalent)	NA	1 mg/10 m^3 (CEILING) as Chromic Acid (Z-2 Table)	0.05 mg/m^{3**} 0.01 mg/m^{3***}	NA	Effects liver, kidney and respiratory system Causes cancer
Chromium (III)	0.5 mg/m^3	NA	0.5 mg/m^3	NA	Irritation; dermatitis
1,4-Dioxane	100	NA	20 ppm	NA	Irritation; liver; kidney

(a) Occupational Health Guidelines for Chemical Hazards (NIOSH, 1995).

(b) *TLVs and BEIs, Threshold Limit Values for Chemical Substances and Physical Agents Biological Exposure Indices* (ACGIH, 2004).

(c) Hazardous Substances Databank (HSDB) (U.S. National Library of Medicine, accessed at http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB January 2003)

** = Water-soluble Cr VI compounds

*** = Insoluble Cr VI compounds

NA = Not applicable.

3.2.1 Carbon Tetrachloride (CCl_4). CCl_4 is a colorless liquid with a melting point of -23°C and a boiling point of 77 °C. Its vapor pressure is 91mm Hg at 20 °C. Carbon tetrachloride is classified as a group B2 carcinogen meaning it is a probable human carcinogen. Inhalation and ingestion of CCl_4 very harmful and can sometimes be fatal. It is an irritant that could lead to dermatitis if contacted with the skin. Kidney or liver damage may result from long-term use of carbon tetrachloride. It can also affect the central nervous system (CNS) and cause damage or cancer to the eyes, skin, and lungs. CCl_4 is incompatible with alkali metals, chemically active metals, strong oxidizing agents, allyl alcohol, fluorine, and strong bases. It should be kept away from heat and possible sources of ignition.

3.2.2 1,1-Dichloroethene (1,1-DCE). 1,1-DCE is a colorless liquid at room temperature with a mild, sweet odor. Its boiling and melting point are 31.7 °C and –122.5°C, respectively. It has a vapor pressure of 591 mmHg at 25°C and density of 1.213 g/cm^3 at 20°C (ATSDR, 1997). The main use of 1,1-DCE is to produce copolymers such as polyvinylidene chloride, acrylonitrile, vinyl chloride, and methyacrylonitrile. The copolymers are used in flexible films, such as SARAN and VELON, and as a flame retardant for fiber, carpet backing and piping. They are also used in flexible packaging materials and as an adhesive (OEHHA, 2000).

Based on EPA guidelines, 1,1-dichloroethylene was assigned to weight-of-evidence group C, possible human carcinogen (Faust, 1994). Inhalation of 1,1-DCE at low levels over a long period of time can cause damage to the CNS, liver and lungs (ATSDR, 1995). High-level exposure health effects include loss of breath and fainting, effects on the CNS and death from hepatotoxicity and nephrotoxicity (OEHHA, 2000; ATSDR, 1995).

3.2.3 1,2-Dichloroethane (1,2-DCA). 1,2-DCA is a colorless, heavy and flammable liquid which evaporates quickly at room temperature and has a sweet odor and taste. Its vapor pressure at 25°C is 79.1 mmHg and density is 1.23 g/cm^3 at 20°C. Its melting and boiling point are –35.5°C and 83.5°C, respectively (ATSDR, 2001).

1,2-DCA is classified as a group B2 carcinogen, which means it is a probable human carcinogen through the oral and inhalation routes (Opresko, 1994). The routes of exposure to humans are absorption through the lungs, gastrointestinal system, and skin. It is distributed throughout the body, but concentrates in the adipose tissue and is generally excreted with soluble urinary metabolites. Some health effects caused by exposure to 1,2-DCA are bronchitis, central nervous system depression, dizziness, vomiting, partial paralysis, liver and kidney damage, hemorrhages throughout the body, and death (Opresko, 1994).

1,2-DCA is mainly used in the manufacturing of vinyl chloride and other compounds including PCE, TCE, and 1,1,1-trichloroethane. Other uses are as a solvent to degrease metals, as well as a fumigant and lead-scavenging agent in gasoline. It is also used in paints, coatings, adhesives, varnishes, finish removers, soaps, and scouring agents (Opresko, 1994).

3.2.4 Tetrachloroethene (PCE). PCE is a nonflammable, colorless liquid at room temperature with a sweet odor. Its vapor pressure at 25°C is 18.47 mmHg and density is 1.6227 g/ml. Its melting and boiling point are –19°C and 121°C, respectively (ATSDR, 1997b). PCE is used as a solvent in the dry-cleaning operations and for degreasing metals (ATSDR, 1997a). It is also used to dissolve greases, fats, waxes and oils without harming fibers. It is a chemical intermediate and has also been used to treat hookworm and some nematode infestations (ATSDR, 1997b).

PCE has been classified as a group B2 to C carcinogen, which means it is a possible to probable human carcinogen. PCE enters the body through the lungs and digestive tract, but not through the skin. Oral and inhalation exposure to PCE target the liver and kidney and the central nervous system is also affected by

inhalation of PCE. Exposure to high concentrations can cause headache, nausea, sleepiness, difficulty speaking and walking, dizziness, confusion, unconsciousness, and death. Some women have also experienced menstrual problems and spontaneous abortion when exposed to PCE (Daugherty, 1993).

3.2.5 Trichloroethene (TCE). TCE is a nonflammable, colorless liquid at room temperature which has a sweet odor and evaporates easily. Its vapor pressure at 25°C is 74 mmHg and density at 20°C is 1.465 g/ml. Its melting and boiling points are –87.1°C and 86.7°C, respectively (ATSDR, 1997). Currently, TCE is primarily used as a solvent to degrease metals and for fats, waxes, resins and oils (Faust, 1993). It is used in the manufacturing of other chemicals. It can also be found in paint removers, spot removers, adhesives, and typewriter correction fluid (ATSDR, 1997). It was once used as an anesthetic, fumigant, disinfectant and to extract caffeine from coffee (Faust, 1993). Production of TCE naturally occurs from marine macroalgae and microalgae (ATSDR, 1997).

TCE is classified as a group 2A carcinogen, which means it is a probable human carcinogen. Humans are exposed to TCE through oral, inhalation and dermal routes (ATSDR, 1997). The primary target organs are the liver, kidney, central nervous system, cardiovascular system, hematopoietic system, and reproduction. Some health effects of TCE include headaches; dizziness; poor concentration; impaired heart function; unconsciousness, nerve, kidney and liver damage; and death (Faust, 1993).

3.2.6 Perchlorate. Perchlorate (ClO_4^-) is the most oxygenated member of a series of four anions made up of chlorine and oxygen (OEHHA, 2002). The anion has a charge of negative one, and can form an acid or a salt in combination with H^+ or another cation such as sodium, potassium, or ammonium ion (OEHHA, 2002). Perchlorate salts dissociate completely in water. Ammonium perchlorate (NH_4ClO_4) is a white, crystalline solid used as an oxidizer in rocket propellant fuel. Perchlorate salts are also used in explosives, pyrotechnics and flares, tanning and finishing leather, electroplating, aluminum refining, rubber manufacture, the production of paints and enamels, and as a mordant for fabrics and dyes (HSDB, 2002; OEHHA, 2002).

Potassium perchlorate was used in the late 1950s and 1960s as an antithyroid agent in treatment of hyperthyroidism (i.e., Graves' Disease) until reports of severe hematological effects occurred. European physicians began using it again in the 1980s as long as the dose remained below 1,000 mg/day. A serious human health effect is the disruption of thyroid hormone production because perchlorate blocks the transport of iodine to the thyroid gland. Two hormones, triiodothyronine (T3), and thyroxine (T4), help regulate the body's metabolism and physical growth. When blockage occurs, the thyroid's iodide reserves are reduced, thus decreasing production of T3 and T4. When levels of T3 and T4 decrease, the pituitary gland and the hypothalamus gland, which regulate thyroid hormones, increase their own hormone production to compensate for the low levels of T3 and T4. Too much or too little thyroid hormone can lead to disease (OEHHA, 2002). Perchlorate can cross the placenta, thus affecting the developing fetus. For children, in utero and up until three years of age, thyroid hormone is critical to normal brain and physical development.

3.2.7 Hexavalent Chromium. The properties of hexavalent chromium vary with the different compounds. It is a solid at room temperature and is typically orange, red or yellow in color. Hexavalent chromium is generally soluble in water; however, the degree of solubility is dependent on the compound. For example, the solubility of lead chromate is 5.8 µg/L and sodium dichromate has a solubility of 230 g/100 cc at 0°C. Zinc chromate, on the other hand, is insoluble in water. The melting and boiling points also vary widely among the compounds. Some compounds decompose at temperatures between 170°C and 500°C (ASTDR, 2000).

The use of hexavalent chromium can be found in many industries including chrome plating, electroplating, stainless steel welding, leather tanning, wood preserving and chemical manufacturing (ATSDR, 2000). It is used to make stainless and heat resisting steel, for corrosion resistance, in high temperature research, in industrial water treatment, in astringents and antiseptics, in dyes and pigments and in batteries, candles, paints, rubber and cement (USDHH, 2001; ASTDR, 2000).

Hexavalent chromium enters the body through inhalation, ingestion and dermal contact. Exposure to chromium can cause nosebleeds, ulcers and holes in the nasal septum, upset stomach, ulcers, kidney, liver and lower respiratory tract damage, gastrointestinal irritation, dizziness, headaches, burns on the skin, blisters, skin ulcers, labored breathing, cancer and death (ATSDR, 2000). Hexavalent chromium is classified in group A which means it is a known human carcinogen. Exposure to hexavalent chromium usually causes respiratory system, lung or stomach cancer (ATSDR, 2000).

3.2.8 Trivalent Chromium. The properties of trivalent chromium vary among the different chromium compounds. The color varies from blue-green to purple to brown or black. It is a solid at room temperature. The melting point is between 60°C (for chromium (III) nitrate) and 2,266°C (chromium (III) oxide). At high temperatures, chromium compounds decompose (e.g. chromium (III) nitrate at 100°C), sublime (e.g. chromium (III) chloride at 1300°C), or boils (e.g. chromium (III) oxide at 4,000°C). Trivalent chromium compounds are primarily insoluble, but some compounds are soluble or slightly soluble (ATSDR, 2000).

Trivalent chromium is used in the production of metals and alloys, as brick lining for high-temperature furnaces, in manufacturing chemicals, for chrome plating, leather tanning, wood preserving, and in dyes and pigments (ATSDR, 2000). Trivalent chromium generally enters the atmosphere through emissions from coal and oil burning and steel production (ATSDR, 2000). Atmospheric fallout and precipitation are the primary means of removing trivalent chromium from the atmosphere. In water, trivalent chromium is precipitated and is then buried in the sediment. In soil, it is transported by runoff or as dust (USEPA, 1998).

Trivalent chromium is classified in group D which means it is not classified as a human carcinogen (USEPA, 1998). Trivalent chromium can enter the body through inhalation, ingestion and dermal contact. The body does not generally absorb large amounts of trivalent chromium (Daughtery, 1992). Health effects caused by exposure to trivalent chromium include coughing, wheezing, asthma, and inhibits DNA replication (ATSDR, 2000; USEPA, 1998).

3.2.9 1,4-Dioxane. 1,4-Dioxane is a colorless, flammable liquid at room temperature and has a pleasant odor. It has a boiling and melting point of 101.5°C and 11.8°C, respectively (OEHHA, 2002) Its vapor pressure is 30 mmHg at 20°C (USEPA, 2002). 1,4-Dioxane is miscible with water, aromatic solvents and oils. (OEHHA, 2002)

Uses of 1,4-dioxane include a degreasing agent, a component of paint and varnish removers, and a wetting and dispersion agent in the textile industry. It is also used as a solvent in chemical synthesis, a fluid for scintillation counting, and a dehydrating agent in the preparation of tissue sections of histology (OEHHA, 2002). It is a solvent for cellulose acetate, ethyl cellulose, benzyl cellulose, resins, oils, waxes, dyes, and other organic and inorganic compounds (USEPA, 2002). It is also a solvent for specific applications in biological procedures. It is also a stabilizer for chlorinated solvents such as 1,1,1-trichloroethane. It is a reagent for laboratory research and testing. In the past it was used as a solvent in coatings, sealants, adhesives, cosmetics and pharmaceuticals (USDHH, 2001).

1,4-Dioxane is classified as a group B2 carcinogen, which means it is a probable human carcinogen. Exposure to 1,4-dioxane is generally from inhalation, ingestion or dermal contact. It is very mobile in the environment due to its volatility and solubility in water. 1,4-Dioxane may cause drowsiness, vertigo, headache, irritation of the eyes, nose, throat, lungs and skin, nausea, vomiting, hepatic and renal lesions, coma, or death (USEPA, 2002). The target organs used to determine the hazard index are the alimentary system, kidney, and circulatory system (OEHHA, 2002).

3.3 Physical Hazards

The following subsections describe the physical hazards associated with the additional site assessment activities at NASA JPL.

3.3.1 Flammability/Explosive Nature. It is unlikely that explosive atmospheres will be encountered during field activities. The following standard safety procedures will be implemented to minimize the potential of explosive atmospheres and ensure that the proper equipment is present in case of fire:

- All field vehicles and heavy equipment will be equipped with type-ABC fire extinguisher. Fire extinguishers will be mounted on the vehicles where field personnel can easily access them. A fire extinguisher check, including inspecting gauges, hoses, and tanks, must me done monthly to ensure proper operation of the equipment.
- When necessary, a fire watch and fire extinguisher or other fire-fighting equipment should be made available.
- Open fires and burning are prohibited. Smoking will be prohibited in all areas where flammable, combustible, or oxidizing materials are stored or are in use.

The following procedures should be implemented for refueling of vehicles:

- Refuel only in pre-designated outdoor areas.
- Shut off vehicle engines when not in use.
- No smoking is allowed.
- Do not over-fill fuel tanks.

The following apply to the storage and dispensing of flammable materials:

- All tanks containing flammables should be labeled with the contents in 4-inch-high letters.
- All flammable chemicals will be stored in flammable cabinets.

3.3.2 Hazards Associated with Heavy Equipment. The hazards associated with the operation of heavy equipment can be effectively managed through adequate training and constant awareness. Consistent visual or verbal contact with the equipment operator will facilitate such awareness. All mobile equipment operators will have had the required training and should demonstrate the necessary skills to operate heavy equipment. Mobile equipment will not obstruct roadways, walkways, electrical lines, etc. Proper distance from overhead power lines should be observed. All personnel working around heavy equipment will wear hard hats, safety-toed boots, and orange vests.

3.3.3 Slip-Trip-Fall Hazards. While it is difficult to prevent slip-trip-fall hazards, these hazards can be minimized through good housekeeping, proper site control measures and by keeping the work area

free of obstructions. Personnel will be required to perform fieldwork in pairs (buddy system) so that immediate assistance will be available should a slip/trip/fall occur. Slip, trip, and fall hazards will be addressed through an ongoing proactive housekeeping program that eliminates elements in the work area that have potential for causing substantial loss of footing.

3.3.4 Lifting Hazards. Field operations often require that physical labor tasks be performed. All employees should employ proper lifting procedures. Additionally, employees should not attempt to lift bulky or heavy objects (over 60 pounds) without assistance.

3.3.5 Tool and Equipment Hazards. Hazards present during the use of tools and equipment are generally associated with improper tool handling and inadequate maintenance. Management of these hazards requires a rigorous maintenance of tools and equipment and effective training of employees in the proper use of these tools. Electrically powered tools have inherent physical hazards. Hand-held power tools, including jackhammers, should be held firmly. This equipment will create vibrations during their operations. Proper safety procedures will be implemented during their operations.

Electrical cords should have unbroken insulation and should not be exposed to water or other liquids. A ground fault circuit interrupter (GFCI) outlet or cord must be used in any area where water may be present. Large power tools and equipment should be lifted properly to prevent back injuries.

Safety glasses with side shields, ear protection, and safety-toed boots will be worn while operating powered tools or equipment.

3.3.6 Heat Stress Hazards. Work under this project may be required in hot environments depending on the time of year. During hot or humid days, or during the performance of strenuous work, extra precautions will be necessary to reduce the potential for heat stress. Implementation of worker rotation and rest period schedules, and adjustment of the workday to take advantage of the cooler parts of the day may be used to prevent exposure to heat stress hazards. Whenever possible, shade will be utilized or provided to field personnel to help mitigate heat stress hazards. Any adjustments to workday schedules that deviate from normal business hours will be cleared with the appropriate personnel. Also, frequent consumption of water or an electrolytic beverage is necessary to prevent dehydration. The levels of heat stress are characterized in Table B-3.

Factors which increase the risk of heat induced problems are as follows:

- High physical exertion.
- Being unaccustomed to working in heat.
- Wearing protective clothing that traps body heat
- Age - older people may have less body water and lower sweat gland efficiency.
- Being overweight, which makes the body work harder to perform tasks.
- Medications that can interfere with normal body reactions to heat.

Table B-3. Signs and Symptoms of Heat Related Illnesses and Treatments

Heat Induced Problems			
Problem	**Body Response**	**Signs and Symptoms**	**Treatment**
Heat Cramps	• The body loses too much salt from heavy exertion in heat.	• Painful spasms of muscles used during work.	• Increase fluid intake with electrolytes (Unless otherwise indicated by a doctor). • Take frequent breaks, preferably in a cool area.
Heat Exhaustion	• The body can't replace fluids and/or salt lost in sweating. • Perspiration in heat is important because it cools the body as it evaporates.	• Weakness, dizziness, nausea. • Pale or flushed appearance. • Sweating, moist and clammy skin.	• Move to a cool place. • Loosen clothes and apply cool compresses. • Drink water slowly. • Elevate feet 8-12 inches.
Heat Stroke	• The body no longer sweats and holds so much heat that body temperature reaches dangerous levels. • **Heat stroke is a medical EMERGENCY and can lead to delirium, convulsions, unconsciousness, or death.**	• DRY, hot reddish skin, and lack of sweating. • High body temperature and strong, rapid pulse. • Chills • Confusion	• **Treat as a MEDICAL EMERGENCY!** • Call for EMS or a doctor immediately! • Move to a cool area immediately. • Use cool water to soak person's clothes and body. • Fan the body. • Don't give fluids if victim is unconscious.

EMS = Emergency Medical Services

3.3.7 Noise. The effects of exposure to loud noise from the operation of heavy equipment can include the following:

- Workers being startled, annoyed, or distracted.
- Physical damage to the ear, pain, and temporary and/or permanent hearing loss. Factors that contribute to hearing damage are noise levels [given in decibel units dB(A)] and the and the duration of exposure.
- Communication interference that may increase potential hazards due to the inability to warn of danger and the proper safety precautions to be taken.

Excessive noise exposure requires that feasible administrative or engineering controls be utilized when employees are subjected to sound levels exceeding the required standard. Hearing protection shall be used in high noise areas (exceeding 85 dBA--generally where noise levels require personnel to raise their voices to be heard) or where designated by the SHSO.

3.3.8 General Site Safety. Numerous safety hazards may exist at the site, including holes or ditches, steep grades, uneven terrain, etc. In addition, protective equipment can impair a worker's agility, hearing and vision, which can result in an increased risk of an accident. Site personnel should constantly look out for potential safety hazards, and should immediately contact their supervisors of any new hazards so that mitigative action can be taken.

3.4 Biological Hazards

There are several biological hazards to which personnel may be exposed while performing work at the NASA JPL site. These hazards may include snake bites (a variety of snakes present at JPL, but not all are poisonous), insect bites (i.e., mosquitoes, deer flies, chiggers, and ticks) and stings (i.e., bees and wasps), and exposure to pathogenic (disease producing) microorganisms. Animal and bird droppings often contain mold, fungus, bacteria or viruses that represent a significant respiratory hazard. If encountered, personnel will be instructed to avoid touching droppings. In addition, the following recommendations apply to site workers:

- Personnel should inspect each other for ticks and signs of infected bites during breaks when working in designated areas.
- Personnel with severe allergies must work in areas away from known/suspected hazards.
- Personnel with allergies to bee stings or other insect bites should notify the SHSO when reporting on this site. They should also carry emergency antidotes on them whenever possible. Supervisors on site should be prepared to deal with the medical emergencies that may result when personnel with allergies receive bites or stings.

Paramedics will be summoned for serious injuries. First aid procedures for biological hazards will follow the program set up by the American Red Cross.

Section 4.0: SITE CONTROL

This section describes the methods by which the activities associated with the OU-3 additional investigation will be controlled to minimize access from non-essential personnel and reduce the potential for transportation of chemical constituents outside of the area of investigation.

4.1 Work Area Control

Proximity to field activities will be limited to reduce the probability of occurrence of physical injury and chemical exposure of field personnel, visitors, and the public. Work area control will be achieved through the use of zones (exclusion zone, contamination reduction zone, and support zone). The three work area control zones for the construction of new monitoring wells and soil borings will be similar to the OU-1 remediation system. The area immediately surrounding the mud rotary drill rig and support vehicle will be designated the exclusion zone. The exclusion zone and contamination reduction zone will be designated with traffic cones and/or caution tape. Non-Battelle personnel will be directed away from this area using traffic cones and caution tape if required. All soil and groundwater samples collected during the field work will be processed in the exclusion zone. The decontamination of drilling equipment using a portable decontamination trailer will be performed in the contamination reduction zone. The area outside of the exclusion/contaminant reduction zone will be considered the support zone. The first aid kit will be kept in the support zone.

4.2 Decontamination Control

All nondisposable field equipment will be decontaminated before each use and between samples to avoid cross-contamination between samples and to ensure the health and safety of the field crews. Areas for decontamination will be coordinated with the SHSO before sample collections begins. All decontamination water will be collected in approved 55-gallon drums or a poly-tank and will be disposed of off-site within 90 days.

Drilling equipment will be decontaminated by hot pressure washing. Decontamination of drilling equipment will be performed in a portable decontamination trailer.

In general, the following decontamination procedure will be used for nondisposable sampling equipment and PPE. Commercially available distilled (DI) water and reagent-grade methanol will be used as intermediate rinses. The final rinse will use high-performance liquid chromatography (HPLC)-grade water (or equivalent). The following sequence will be used to clean all field equipment and sampling devices:

- Wash the samplers with Liquinox™ detergent and DI water and clean them with a stiff-bristle brush.
- Rinse with DI water.
- Rinse with methanol.
- Rinse with HPLC-grade water (or equivalent).
- Place the sampling equipment on a clean surface and air dry.

Section 5.0: PERSONNEL PROTECTION

The possibility of exposure to chemicals in soil and groundwater presents a minimal potential health risk to site workers and proximate base personnel. Installation of monitoring wells and soil and groundwater sampling present a minimal opportunity to contact contaminants of concern in high concentrations. This section discusses the use of personal protective equipment (PPE) and air monitoring to minimize any potential health risks.

5.1 EPA Levels of Protection

There are four levels of EPA-mandated personal protection: Levels A, B, C and D. The level of protection to be utilized throughout the duration of this Task Order will be EPA Level D, as based on known contaminant levels and previous work performed at the JPL. If necessary, based on the exposure limits listed in Table B-2, respiratory protection and engineering or work-practice controls will be used to minimize exposure and to protect workers and JPL personnel. If site conditions change and a higher degree of protection is required, the SHSO will consult the HSO/CIH and the required changes in PPE with be made. A change in the level of PPE will result in this SHSP being amended and reviewed by the HSO/CIH. It is the responsibility of the field personnel to inspect all PPE prior to use. Evaluation of the effectiveness of the Battelle PPE program will be examined by the SHSO following the guidelines established in the Battelle PPE Program Manual (Battelle, 2001b).

Level D protection will consist of the following, depending on activities to be performed:

- Hard hat
- Coveralls/standard work clothing or chemical-resistant Tyvek
- Goggles or safety glasses with protective side shields
- Safety-toed boots
- Nitrile gloves (or equivalent)
- Hearing protection
- Protection against ultraviolet (UV) rays (sun block, hats, long sleeves), as necessary
- In the event of PPE upgrade, an available half-face or full-face, air purifying respirator with National Institute for Occupational Safety and Health (NIOSH) approved combination organic vapor/acid gases/P-100 cartridges (yellow/magenta)*

Hard hats, hearing protection, and PPE listed above are required during drilling operations at JPL. Field personnel will be required to have an air-purifying respirator available during soil boring and monitoring well installation activities. All personnel who may be required to wear a respirator will have their assigned respirator fit-tested before the beginning of the project.

5.2 Air Monitoring Procedures

Screening for the presence of VOCs while conducting fieldwork is generally done with a handheld PID or FID. During all project tasks, breathing zone readings will be taken periodically (approximately every 15 minutes), unless the SHSO determines that more frequent monitoring is required. Field personnel will perform a daily calibration of the PID/FID and operate the instrument according to the manufacturer's instructions. The air monitoring results will be compared to the action levels identified in Table B-2.

Depending on the concentrations encountered during air monitoring, the appropriate PPE will be selected. The daily air monitoring results and calibration information will be written in the Air Monitoring Data Sheet (Attachment 1). Air monitoring will accomplish the following tasks:

1. Ensure that proper PPE, work practices, and engineering controls are being used at the site;
2. Ensure that site personnel are not exposed to concentrations of hydrocarbon compounds exceeding the PELs; and
3. Quantify the concentrations of ionizable hydrocarbon compounds at the wellhead and the workers' breathing zone.

The PID/FID will be inspected and tested prior to use in the field. The instruction manual will be available for all field equipment so that trouble-shooting and routine repairs can be conducted in the field. Any problems with the operation of these units during the survey will be documented, along with corrective action and the results of performance verification.

Field instrument maintenance will be documented in the field logbook for each field instrument used during field activities. Field equipment will be maintained when routine inspections indicate the need for maintenance. If a piece of equipment needs repair, a list of the field equipment manufacturers' addresses, telephone numbers, and points of contact will be maintained on site during field activities. Field equipment routine maintenance may include the following:

- Removing surface dirt and debris
- Replacing/cleaning filters/membranes when needed
- Ensuring proper storage of equipment
- Charging battery packs when not in use
- Maintaining spare and replacement parts in field to minimize downtime.

Section 6.0: GENERAL SAFETY RULES

The following section outlines the general safety rules associated with the OU-3 additional investigation activities, including recommended equipment safety guidelines and decontamination safety.

6.1 Recommended Equipment Safety Guidelines

Equipment maintenance and safety is the responsibility of the operator. The following information is provided as general guidelines for safe site practices:

- Inspect the route of travel before moving equipment off-road. Note the presence of rocks, trees, erosion, and uneven surfaces.
- Approach changes in grade squarely to avoid shifting loads or unexpected unweighting.
- Use a spotter (person at grade) to provide guidance when vertical and lateral clearance is questionable.
- Locate overhead and buried utilities prior to removal operations. Treat overhead electrical lines as if they were energized.
- Contact the appropriate utility agencies to deactivate overhead or underground services that may interfere with sampling operations. Only authorized and trained personnel should attempt to handle utilities.
- Note wind speed and direction to prevent overhead utility lines from contacting equipment.
- Allow at least 20 feet clearance from overhead utility lines.
- Contact appropriate utility agencies to survey, mark, and flag locations of buried utility lines.
- Tools, materials, and supplies will be stored properly and in a secured area.
- Maintain working surfaces free of obstructions or potentially hazardous substances.
- Store gasoline only in containers specifically designed for such use.

Personnel must wear prescribed PPE, as appropriate, during the field activities. Contamination avoidance should be practiced at all times. Personnel must employ the "buddy system" at all times and maintain communications with each other. In some situations, such as work in isolated locations, additional monitoring may be needed to establish the proper level of protection before the sampling team can proceed. No activities in enclosed or confined spaces will be permitted under this Task Order.

6.2 Decontamination Safety

Decontamination procedures can pose hazards under certain circumstances, particularly when chemical decontamination solutions are used. Most of the equipment used on site will be decontaminated by washing, or a series of washings, followed by a series of rinses using generous amounts of deionized (DI) water (see Section 4.2). Exposure to hazardous materials and decontamination solutions will be controlled by the use of appropriate personal protective clothing and accessories, which includes safety glasses, nitrile gloves, and safety-toed boots. MSDS information for methanol (methyl alcohol) and

Liquinox™ are provided in Attachment 2. Decontamination of equipment by steam cleaning will be done away from general personnel.

Section 7.0: EMERGENCY PROCEDURES

The following section outlines the procedures to be followed in the case of an emergency in association with the OU-3 additional investigation activities, including those associated with communication, site evacuation, first aid, decontamination, and emergency assistance.

7.1 Communications

A communication program will be implemented during the project. Workers are to use the buddy system at all times and be cognizant of the reduction of communication abilities in high-noise areas. The specific hand signals to be used during the project will be discussed in the tailgate safety meeting and will include, but are not limited to, the following:

- Closed fist – Stop work
- Hand crossed above head – Personal injury
- Hand gripping throat – Can not talk; having difficulty breathing
- Grip partner's wrist – Can not talk; leave area immediately
- Hands on top of head – Need assistance
- Thumbs up – OK, I am all right, I understand
- Thumbs down – No, negative

7.2 Site Evacuation Procedures

In case of emergencies an air horn, or an equivalent device that can generate at least 80 dBA of noise, will be used as the evacuation warning. One long blast from the horn will be understood to mean immediate evacuation from the exclusion zone. Personnel working on the site will immediately make their way to the designated gathering point for a "head count". The gathering point will be site and activity dependent and therefore will vary. The SHSO will determine the gathering point based on the location of work to be performed and notify all site personnel at the daily tailgate meeting.

In the event that an emergency requires the evacuation from the JPL, the parking lot of the Huntington Memorial Hospital will be the designated emergency gathering location. The route to the hospital is presented in Figure B-1. Driving distance is approximately 2.4 miles with an approximate travel time of six minutes. The emergency evacuation plan will be discussed in the first pre-entry tailgate meeting and as necessary when new personnel arrive on site.

7.3 First Aid

A fire extinguisher and a first aid kit, containing the American Red Cross first aid manual, will be stationed in each field vehicle. The following personnel are trained in first aid, CPR, and blood borne pathogens: David Clexton (SHSO) and Jennifer Ickes (HSO).

JPL's Medical/Fire Service Station is located on-site and can be reached by dialing 3-3333 from any on-site telephone. If an injured individual requires further attention, the individual will be immediately transported to Huntington Memorial Hospital. A map illustrating the route to the hospital is presented as Figure B-1. Section 7.4 discusses decontamination procedures in the event of a medical emergency. A copy of this SHSP will accompany the injured worker(s) to the medical facility. All accidents, without regard to severity, will be documented by the SHSO on the Accident/Incident Analysis Form (Attachment 1). The Accident/Incident form will be forwarded to the HSO and Project Manager within 24 hours. An

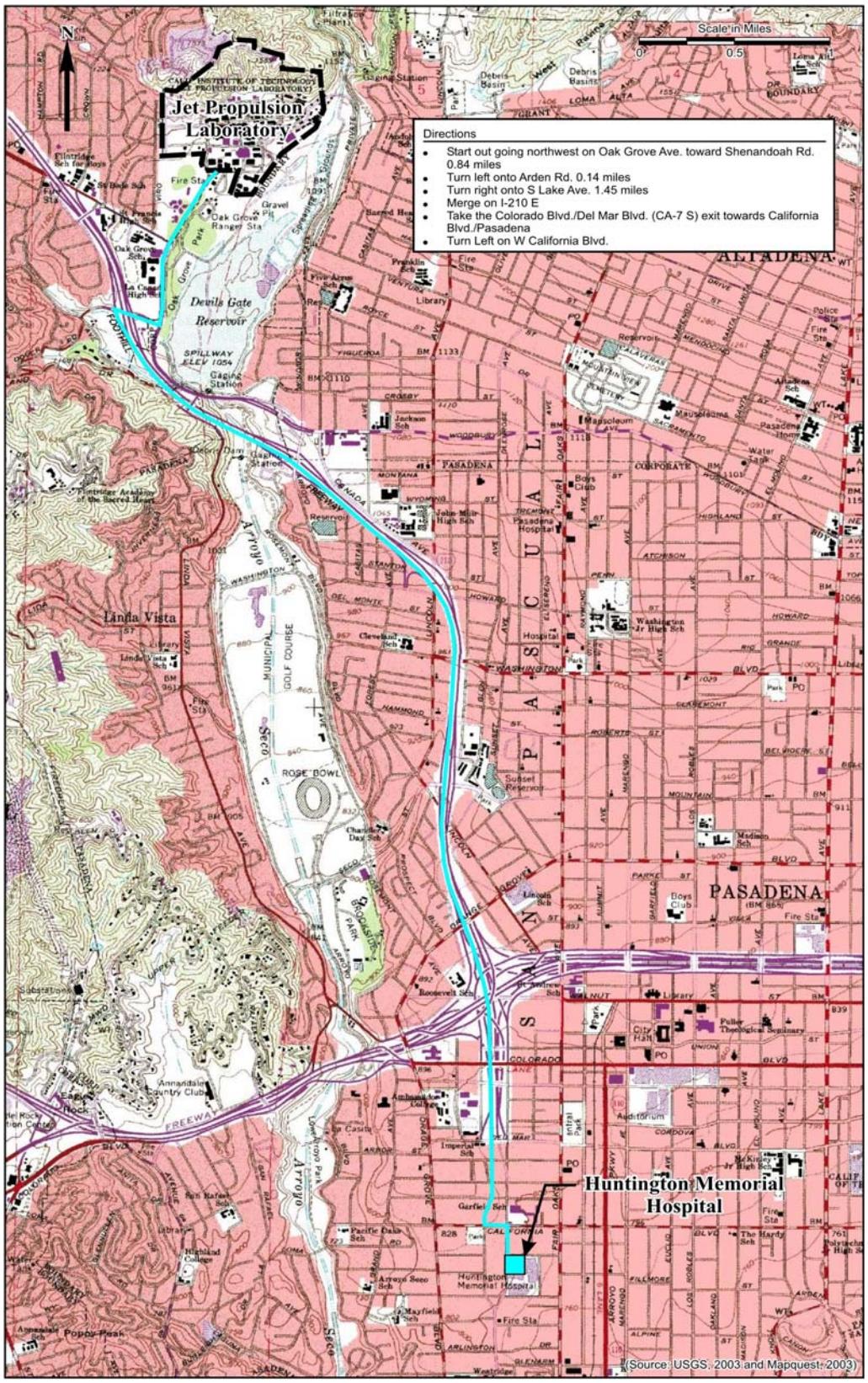

Figure B-1. Hospital Location Map and Site Evacuation Route

analysis of the accident will be conducted by the HSO/CIH following the guidelines in the Battelle Accident/ Incident Reporting and Investigation Program Manual (Battelle, 2001c).

General first aid procedures are outlined below:

- **Skin/Eye Contact**: Use copious amounts of soap and water. Wash/rinse affected area thoroughly, then provide appropriate medical attention. An eyewash station and an emergency shower or drench system will be located in the contamination reduction zone and/or support zone as appropriate. The affected area should be rinsed for at least 15 minutes upon chemical contact.
- **Inhalation**: Move to fresh air and, if necessary, decontaminate and transport to hospital. Any loss of consciousness or exposure to airborne toxic substances, even if the individual appears to have fully recovered, will require immediate treatment by a qualified physician.
- **Ingestion**: Notify Poison Control Center and emergency medical facility and transport to nearest emergency medical facility immediately.
- **Puncture Wound or Laceration**: Decontaminate and transport to emergency medical facility. Apply direct compression to stop or slow the flow of blood.
- **Biological Hazard**: Identify the specific animal responsible for the injury (if possible), notify the nearest emergency medical facility and transport the affected worker there immediately.

All personnel should be aware of the potential to transmit disease from contact with body fluids. Personnel should assume that all bodily fluids are potentially infectious and use appropriate precautions. Controls to be considered are as follows:

- Use of the victim's hand to control initial bleeding;
- Use of available PPE (Tyvek®, gloves) to prevent contact;
- Wash promptly after contact with body fluids;
- Use barrier mask while giving CPR;
- Decontaminate any area contaminated with bodily fluids with a 10:1 solution of water to bleach as soon as possible.

7.4 Decontamination During Medical Emergencies

If emergency life-saving first aid and/or medical treatment is required, decontamination procedures may be limited or omitted. If the contamination does not present a hazard to the rescue personnel, life-saving care may be instituted immediately. If contamination will present a risk to rescue personnel, minimal decontamination should be performed to allow initiation of aid. If contamination presents a significant risk to rescue personnel then decontamination will need to be performed until the contamination no longer posses a risk.

Medical assistance personnel should be notified prior to transporting the victim if the victim may be contaminated. Assurance must be made that the medical personnel at the receiving area are able and willing to handle a victim who is contaminated. Site personnel will accompany contaminated victims to the medical facility to advise facility personnel on matters involving decontamination. A copy of this SHSP will be brought along with the victim.

7.5 Emergency Assistance

The name, telephone number, and location of police, fire, and other emergency response agencies will be posted in the support zone. If emergency personnel are called to the site, efforts will be made to accommodate their safety operations.

Emergency Services	
Ambulance	911
Fire Department	911
Highway Patrol	911
Police	911
Poison Control Center	(800) 222-1222
Dept. of Environmental Health Services	(800) 258-6942
National Response Center, Toxic Chemicals and Oil Spills	(800) 424-8802
NASA-JPL Security Fire/Medical Service	3-3333 (on-site telephones only)
NASA Security and Safety Officer	(818) 354-6053

Medical Centers	
Huntington Memorial Hospital 100 W California Blvd. Pasadena, CA 91105-3010	(626) 397-5000
Verdugo Hills Hospital 1812 Verdugo Blvd Glendale, CA 91208-1407	(818) 790-7100

Battelle Personnel	
Keith Fields, Project Manager	Office: (614) 424-7723 Mobile: (760) 427-8282
Gary Carlin, CIH	Office: (614) 424-4929 Mobile (614) 348-5785
Jennifer Ickes, HSO	Office: (614) 424-3723
Dave Clexton, SHSO	Office: (760) 476-9144 Mobile: (760) 427-8013
NASA JPL Field Office:	Phone: (626) 345-0598 Fax: (626) 345-0698

Section 8.0: SPILL AND DISCHARGE CONTROL

Spill and discharge control has been developed to prevent the contamination of soils, water, uncontaminated areas/surfaces, equipment or material by the release of a hazardous substance or material other than in an authorized manner. The California EPA Office of Emergency Services will be notified immediately of any spills or releases at (800) 260-3972.

The following spill control equipment will be made available at all times:

- Clay, kitty litter, or other appropriate spill absorbent material.
- 55-gallon drums.
- Shovels.
- Decontamination supplies and protective clothing.
- Eyewash station

Regardless of the type of spill (liquid or solid), the following measures will be taken to isolate the spilled material(s):

- Isolate and contain the hazardous spill area.
- Restrict access of unauthorized personnel.
- Prevent contact with the spilled material.
- Relocate materials and personnel upwind and upgradient of the spilled material.

Section 9.0: MEDICAL SURVEILLANCE

Battelle's Medical Surveillance Program is based on the requirements outlined in 29 CFR 1910.120 and 1910.1030 and is described in the following section.

9.1 Contents of Medical Examination

All Battelle and subcontractor project personnel working on-site will have undergone either a baseline or annual medical screening examination within 11 months prior to participation in fieldwork. Medical screening is conducted annually thereafter, and consists of the following:

- Medical and occupational history
- Physical examination, with particular attention to the cardiopulmonary system, general physical fitness, skin, blood forming, hepatic, renal, and nervous systems. Testing includes a urinalysis, blood analysis, and a pulmonary function test.
- Additional tests, including a hearing test, a vision test, and an electrocardiogram.

Medical approval is required for personnel who need to wear respiratory protection equipment. During the annual physical the medical evaluator will determine an individual's physical fitness for respirator usage. Based on this examination, the physician will certify in writing whether the individual is capable of full participation in the program, or whether that person must work within certain restrictions. Personnel may be excluded from this project for medical reasons. Any person suffering a lost-time injury or illness must have medical approval prior to returning to work.

9.2 Record Keeping

All medical records must be maintained by the employer for a period of at least 30 years after the employee's termination of employment, in accordance with OSHA regulations on confidentially and record keeping.

Prior to the initiation of work, subcontractors will submit to Battelle HSO/CIH copies of medical fitness certifications for each employee to be assigned to the site. The certifications will state that the employee has received a medical examination within the previous 12 months and has been determined fit to perform onsite work.

Section 10: TRAINING

As required by OSHA regulations (29 CFR 1910.120), all Battelle and subcontractor personnel involved in hazardous waste site operations are required to receive an initial 40 hours of health and safety training and receive refresher training annually. All site personnel will complete this general (not site-specific) training before assignment to the project. Battelle is responsible and accountable for ensuring that Battelle staff are trained and qualified to carry out their assigned responsibilities on this project.

In addition, the onsite management, supervisors and the SHSO will receive additional specialized hazardous waste operations management. This training will include, but shall not be limited to, the following:

- The employer's health and safety program
- Hazard communication program (29 CFR 1910.1200 and CCR Title 8, Section 5194)
- Associated employee-training program
- PPE program (29 CFR 1910 Subpart I and CCR Title 8, Section 3380)
- Spill containment program
- Health hazard monitoring procedures and techniques
- CPR/First Aid training (29 CFR 1910.151 and CCR, Title 8, Section 3400) and blood borne pathogens control (29 CFR 1910.1030 and CCR, Title 8, Section 5193)
- Fire extinguisher training (29 CFR 1910.157 and CCR, Title 8, Section 6151).

The HSO will keep copies of the certification for the completion of all training for all site workers on-site in a file. Workers without such certification will not be allowed to work at the site. Prior to commencement of field operations at the project site, personnel will receive site-specific training (briefed in the tailgate safety meeting), this training will include a review of all information contained in this SHSP with particular emphasis on the following:

- Types and anticipated levels of hazardous substances known to be present on-site, their PELs, health effects, and exposure routes.
- The need for PPE.
- The importance of maintenance and attention to proper fit of PPE.
- Prescribed decontamination procedures.
- Safe work practices, such as proper site entry and egress, and proper hygiene during meal and rest breaks.
- Recognition, in oneself and others, of physical conditions requiring immediate medical attention, especially heat stress, and simple first aid application measures.
- Procedures to be followed in case of emergencies.

In addition to the 40-hour training, Battelle personnel involved in the field operations will have had an at least three (3) days of supervised field experience on similar kinds of projects.

Section 11.0: ADVERSE WEATHER CONDITIONS

In case of adverse weather conditions, the Project Manager or SHSO will determine if work can continue without endangering the health and safety of the field workers. The SHSO will monitor the weather during the A.M. and P.M. hours and will document it in the field logbook.

Some of the items to be considered prior to determining the continuance of work are:

- Potential for heat/cold stress and heat/cold-related injuries.
- Dangerous weather-related working conditions (high winds, dust storms).
- Limited visibility.
- Potential for electrical storms/thunder lightening. No outdoor activities will be permitted during electrical storms.

Section 12.0: REFERENCES

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ATTACHMENT 1

HEALTH AND SAFETY FORMS

Safety Compliance Agreement Form

Site:
Contract No.:
Project No.:
SHSO:

I acknowledge that I have read the information in this Health & Safety Plan. I understand the site hazards as described and agree to comply with the contents of the plan.

Signature & Printed Name	Company	Date

TAILGATE SAFETY MEETING FORM

Date:_____ Time:_____ Job Number:_____

Client:_____ Address:_____

Site Location:_____

Scope of Work:_____
SAFETY TOPICS PRESENTED
Protective Clothing/Equipment:_____
Chemical Hazards:_____
Physical Hazards:_____
Special Equipment:_____
Emergency Procedures:_____
Hospital:_____ Phone:_____ Ambulance Phone:_____
Hospital Address and Route: _____
_____

ATTENDEES

NAME PRINTED	SIGNATURE

Meeting Conducted by:_____ Signed by:_____
Site Safety Officer:_____ Construction Manager:_____

AIR MONITORING DATA SHEET

DATE	TIME	LOCATION	INSTRUMENT READING	COMMENTS

Site Safety Officer:_____ Date:_____

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Accident/Incident Analysis

Supervisor or investigator to complete the first and second sections/blocks and return all copies to Division ES&H Representative within 48 hours or two working days of accident/incident date.

Type or Print Clearly

Employee's Name	Payroll Number	Division and Location Name	Dept. or Org. No.

Job Assignment at Time of Accident/Incident

Time in Job Assignment
☐ 0-14 days ☐ 15-90 days ☐ 3 mos. to 1 yr. ☐ 1-3 yrs. ☐ 4-10 yrs. ☐ more than 10 yrs.

Job Assigned was a Routine Part of Job
☐ Yes ☐ No

Date of Accident/Incident

Time
AM PM

Date Reported to You—Please Specify, if Other
☐ Same as Accident/Incident ☐ Other

Injury Treated by at Time of Accident/Incident
☐ First Aid ☐ EMT ☐ Health Services ☐ No Treatment

Specify Treatment Facility and Doctor, if Known

Describe Treatment Provided

Injury Type (cut, bruise, strain, etc.)

Injury Location (hand, foot, lower back, etc.)

Extent of Injury (minor, severe, length of cut, etc.)

Describe What Happened (Detail **what** the employee was doing—**where** the accident/incident occurred—**what** tools, equipment, or people were involved? Remember, facts are important, fault finding is not.)

Additional Comments (Use a separate sheet of paper if necessary)

Last Day Worked (if lost time)

Date Returned or Expected Date

Describe Property Damage (if any)

Approximate Costs Associated With Property Damage

Supervisor's or Investigator's Analysis and Action

Analysis of Causes (Keep in mind, accidents/incidents generally have more than one cause or contributing cause(s).)	**Corrective Actions Taken by You or Others** (What action(s) has (have) been taken to reduce the potential recurrence of a similar accident/incident?)
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.

Employee's Signature (if available)	Print Supervisor's or Investigator's Name	Supervisor's or Investigator's Initials	Date Initialed	Date Rec'd by ES&H Rep.

Manager's Comments/Actions (if any)

Initials Date

Division ES&H Representative's Comments/Actions

Initials Date

Distribution: Return all copies to Division ES&H Representative for appropriate distribution to staff and management.

ES&H-002,02/95 (REV. 0)

ATTACHMENT 2

MATERIAL SAFETY DATA SHEETS