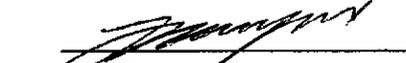


APPENDIX B

Site Safety and Health Plan

**SITE SAFETY AND HEALTH PLAN
EXPANDED SI FSIP
BENICIA ARSENAL, BENICIA, CALIFORNIA**

Prepared by:



Ms. Tammy Cox
Health and Safety Specialist

Date: April 7, 2004

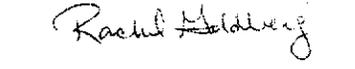
Reviewed/Approved by:



Ms. Anne Baptiste, CIH
Health and Safety Director

Date: April 7, 2004

Reviewed/Approved by:



Ms. Rachel Goldberg
Site Safety Officer

Date: April 7, 2004

Effective Dates:

4/7/04 to 4/7/05

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1.0 INTRODUCTION

This Expanded SI will take place at the former Benicia Arsenal located in Benicia, California, about 25 miles northeast of San Francisco. During its active life, this facility served the United States Army as a principal depot for ordnance and ordnance stores, issuance, manufacture and testing of small arms.

The overall approach will include: 1) identifying any DoD-related contamination based on the highest risk to human health and the environment, 2) determining if additional data is necessary to characterize the impact and 3) if additional data is necessary to characterize the impact then delineate the impact of contamination. If contamination is found that indicates only a post-Army impact (e.g. the occurrence of methyl-tert-butyl ether), no further action will be conducted to investigate non-DoD-related contamination at those sites.

Sites selected for investigation were chosen based on previous investigations and the Preliminary Assessment (PA) (FA/BC, 2003a). The PA identified 62 sites where further action was recommended (FAR). These sites are located in all areas of the Former Arsenal, but are generally grouped within each area and are associated with the primary activity for each area (e.g. industrial activities in Area I) (Figure B-1).

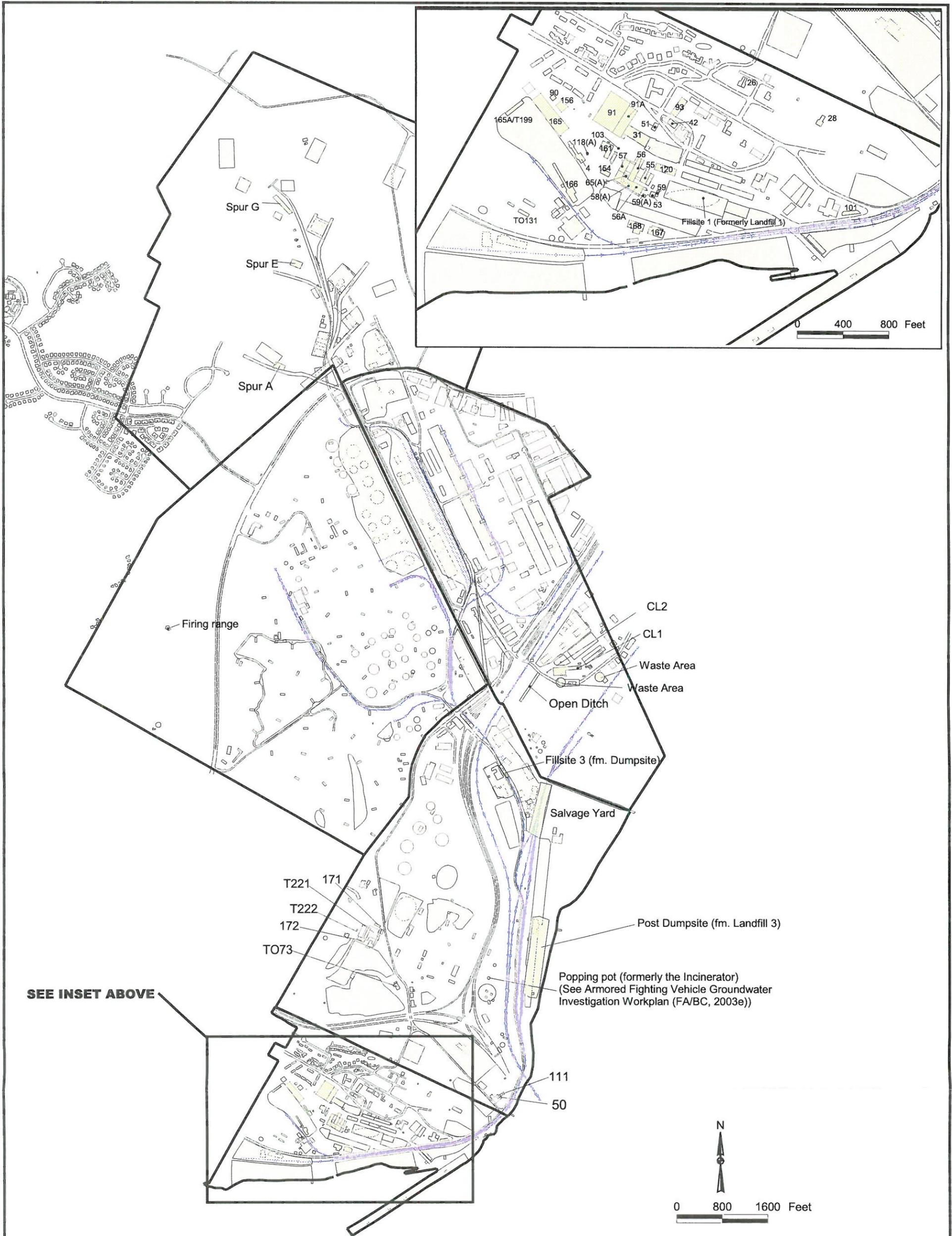
Soil and groundwater samples will be collected with some selected soil samples at predetermined boring locations. A Cone Penetrometer (CPT) will be the predominant method used for collection of soil and groundwater samples. Monitoring wells will be installed using a hollow stem auger drill rig.

2.0 KEY PERSONNEL

The key personnel for this site specific Site Safety Health Plan (SSHP) are:

- Program Manager: Mr. Dave Zuber
- Health and Safety Director: Ms. Anne Baptiste, Certified Industrial Hygienist
- Project Manager: Ms. Wendy Linck
- Site Safety Officers: Ms. Wendy Linck and Ms. Rachel Goldberg

Descriptions of responsibilities for each key personnel and subcontractor are included in the General SSHP (Brown and Caldwell, 1999). The Field Mobile Laboratory has their own SSHP. Brown and Caldwell will adhere to the Field Mobile Laboratory SSHP when inside the lab.



Legend

- No DoD Action indicated (NDAI) Sites
- Expanded SI Sites
- Buildings
- Arsenal Boundary
- Main Roads
- Rail Road

Figure B-1
Expanded SI Area Map
Expanded SI SSHP
 Benicia Arsenal, Benicia, CA

2.1 Project Contacts

The following is a reference list of project contacts.

USACE:

Ms. Meegan Nagy, Project Manager
(916) 557-7257
Mr. David Elskamp, Certified Industrial Hygienist
(916) 557-7903

BC Program Manager:

Mr. Dave Zuber
(916) 444-0123
(916) 853-5318 (direct)

BC Project Manager:

Ms. Wendy Linck
(916) 444-0123
(916) 853-5325 (direct)

BC Health & Safety Director:

Ms. Anne Baptiste, JD, CIH
(858) 571-6734 (direct)
(858) 637-0677 (pager)

BC Site Safety Officers:

Ms. Rachel Goldberg (925) 210-2512 (direct) (925) 899-0744 (cell)	Ms. Wendy Linck (916) 853-5325 (direct) (916) 838-2504 (cell)
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2.2 Emergency Telephone Numbers

Emergency telephone numbers are as follows:

Name or Business/Telephone Number

Fire, Police and Ambulance	(707) 745-3411 or 3412
Mr. Dave Zuber, Program Manager	(916) 444-0123 or (916) 853-5318
Ms. Wendy Linck, Project Manager	(916) 444-0123 or (916) 853-5325
Ms. Anne Baptiste, JD, CIH	(858) 571-6734 or (858) 637-0677

3.0 HAZARD ANALYSIS

The site specific potential hazards to personnel working have been identified as chemical hazards, physical hazards, and biological hazards. Each potential hazard, the potential for exposure, and recommended control for all the sites are presented in Table B-1.

3.1 Chemical Hazards

Groundwater samples will be collected with some selected soil samples at predetermined boring locations. Selected boring locations will be converted into monitoring wells.

A Cone Penetrometer (CPT) will be the predominant method used for collection of soil and groundwater samples. Monitoring wells will be installed using a hollow stem auger drill rig.

The chemical related health hazards of this project would primarily be from petroleum, oils, and lubricants (specifically benzene and total petroleum hydrocarbon [TPH]), and solvents (specifically trichloroethane [TCE]) that may be found in soil or groundwater. However, exposures to these chemical related health hazards are minimal, since possible direct exposure through soil sampling is not proposed for this investigation. Exposure to heavy metals (i.e., lead) may also occur.

The primary routes for exposure from benzene, TCE, and other solvents at this site may result from inhalation and skin contact. Worker exposures to metal dusts are commonly a result of inhalation. A more detailed discussion of each of the chemical compounds or groups is presented below. Potential chemical hazards, exposure limits and chemical characteristics for key chemicals that may be present at the site are listed in Table B-2.

3.1.1 Benzene

Benzene is regulated by OSHA as an occupational carcinogen and has been associated with leukemia. Acute health effects include irritation to the eyes, nose and respiratory system, headache, giddiness, nausea and anorexia. Benzene exposure can also lead to disturbances in gait, dermatitis and bone marrow depression.

The other BTEX compounds (toluene, ethylbenzene and xylenes) may cause irritation to the eyes, nose and respiratory system, and dermatitis. Acute exposure can lead to central nervous system effects including headache, dizziness, confusion and irritability. Exposure to toluene may also result in pupil dilatation, nervousness, reproductive toxicity and insomnia. Elevated concentrations of xylene isomers may lead to corneal damage, and gastrointestinal symptoms including abdominal pain, nausea and vomiting.

Table B-1. Potential Hazards and Recommended Controls for Expanded SI Activities

Potential hazards	Recommended controls
Chemical exposure	The minimum level of proper PPE during activities is Modified Level D. This level is considered adequate to protect individuals from exposure to petroleum hydrocarbon constituents. Air monitoring will be performed with a PID meter to monitor the air quality in and around the work zone during drilling activities. Based on original response criteria (Table B-5_ benzene and vinyl chloride detector tubes will be used to evaluate chemical exposure to personnel.
Back injury	Sampling using a hand auger is anticipated for this project that would require excessive lifting and twisting. In general, high manual labor causes high stress forces on the back. Use proper lifting techniques, proper tools, vacuum bailers, two person rotations and adequate back support during all field tasks. Proper lifting techniques may also vary with task. Therefore, these techniques will also be addressed in the daily site safety briefings. Refer to the Ergonomics Program of the FA/BC Health and Safety Program Manual (103; p. 7-9).
Noise	Heavy equipment is anticipated for this project (i.e., drilling rig), such that hearing protection may be necessary. A hearing conservation program will be implemented to determine exposure to workers for each piece of equipment that commonly requires hearing protection (backhoe and drilling rig). Noise exposure monitoring will be conducted initially by the Site Safety Officer with assistance from the Health and Safety Director to determine correct hearing protection for this type of equipment to be used for the rest of the project. Refer to the Noise/Hearing Conservation section in the FA/BC Health and Safety Program Manual (210; p. 44-45). In general, use hearing protection whenever the noise levels are such that conversation is impaired without raising the voice level.
Drum handling	Drum handling is not anticipated for this project. In general, drums may be used to store soil or water as a result of drilling or excavation operations. Utilize appropriate drum handling equipment (dollies, lift gates, etc.) and avoid manual lifting of filled or partially filled drums.
Migration of contamination	A work zone will be delineated before start of drilling activities. An area within the work zone will be established for decontamination prior to exiting the site. The decontamination area must be away from the actual working area.
Exposure to potentially contaminated soil/water	Modified Level D PPE is the minimum level required for this project. All personnel will don the appropriate level of PPE upon entering the work area and then use proper decontamination procedures before exiting the work zone. Workers will exit the work zone before eating.
Slips, trips and falls	The proper footwear for this project will include steel-toed boots upon entering the work zone. Wear proper footwear and anticipate footing hazards (i.e., steep slopes, potholes, and uneven surfaces).
Utilities/electrical	Have all utilities (underground and overhead) located and documented prior to initiation of drilling activities. Maintain a minimum distance of 21 feet clearance between any energized line of 370 (kv) or less, and any part of a drill rig, boom, or other piece of equipment at all times. If voltage is between 370 kv and 550 kv, then maintain a minimum distance of 27 feet. If voltage is between 550 kv and 1,000 kv, then maintain a minimum distance of 42 feet (8 CCR Division 1, Chapter 4, Subchapter 5, Group 2, Article 37, Section 2946, If work is to be conducted. In the vicinity of overhead electrical utilities, the owner of the overhead line will be contacted to determine the maximum voltage.
Heavy equipment and backhoes	Drilling equipment will be necessary for this project. Personnel communication and wearing proper PPE during work activities is essential for the protection of workers at the site. See the Trenching, Drilling and Heavy Equipment SOPs for specifics. The competent person for trenching will be the on-site.
Unexploded ordnance	There are no unexploded ordnance hazards anticipated for this project.
Biological hazards	The project is in an area where animals, insects, or animal droppings may be present. Modified Level D PPE will be donned for this project, unless conditions indicate an infestation of insects, mold, or animal droppings. Significant amounts of which would cause work stoppage. Be aware of spiders inside well boxes or insect swarms on buildings or in trees. Be aware of peak hours of mosquito activity from dusk to dawn. The areas within the Expanded SI have a slight biological hazard for mosquito contact. Follow recommended mosquito control listed under the Biological Hazard section of this SSHP.
Radiological hazards	There are no radiological hazards anticipated for this project.

Table B-2. Chemical Exposure Limits and Characteristics Controls for Expanded SI

Constituent	IP ^a	OVA ^b relative response percent	TLV ^c 8-hour TWA	PEL ^d 8-hour TWA	IDLH ^e level	Flammable range percent	Odor threshold, ppm	Notes ^f	Potential symptoms of exposure ^g
CHEMICALS									
Benzene	9.24	185	0.5 ppm	1 ppm	500 ppm	1.3-7.9	4.68	Ca, 65	irritation to eyes, nose, respiratory system, giddiness, headache, nausea, staggered gait, fatigue, anorexia, lassitude, dermatitis, bone marrow, depression
Ethylbenzene	8.76	111	100 ppm	100 ppm	800 ppm	1.0-6.7	0.25-200		irritation to eyes, muscle membranes, headache, dermatitis, narcosis, coma
Toluene	8.82	126	50 ppm	50 ppm	500 ppm	1.2-7.1	0.17-40		fatigue, weakness, confusion, euphoria, dizziness, headache, dilated pupils, lassitude, nervousness, muscle fatigue, insomnia, paresthesia, dermatitis
Trichloroethene	9.5	54	50 ppm	25 ppm	1,000 ppm	8-10.5		Ca, 65	headache, vertigo, visual disturbance, tremors, somnolence, nausea, vomiting, irritation to eyes, dermatitis, cardiac arrhythmias, paresthesia
Xylene	8.56	111	100 ppm	100 ppm	900 ppm	1.0-7.0	0.05-200		dizziness, drowsiness, excitement, incoherence, staggered gait, irritation to eyes, nose, throat, corneal vacuolization, anorexia, nausea, vomiting, abdominal pain, dermatitis
Vinyl Chloride	10.00	35	1	1	Ca - NA	3.6 - 33	Unknown	Ca, 65	The eyes may be immediately and severely irritated. Symptoms can resemble mild alcohol intoxication. Lightheadedness, some nausea, and dulling of visual and auditory responses may develop in acute exposures.
N-nitroso-dimethylamine	8.69	NA	NA	NA	NA	NA	NA	NA	nausea, vomiting, diarrhea, abdominal cramps; headache; fever; enlarged liver, jaundice; decreased liver, kidney and pulmonary function.
N-nitrosodi-n-propylamine	NA	NA	NA	NA	NA	NA	NA	NA	The effects of short- or long-term exposures to NDPrA on human health have not been studied. anticipated to be a human carcinogen.
METALS									
Lead	NA	NA	0.05 mg/m ³	0.05 mg/m ³	100 mg/m ³	NC		65	weakness, lassitude, insomnia, facial pallor, pal eye, anorexia, low weight, malnutrition, constipation, abdominal pain, colic, anemia, gingival lead line, tremor, paralysis of the wrists and ankles, encephalopathy, nephropathy, irritation to eyes, hypotension

^a Ionization potential in electron-volts.

^b Century Organic Vapor Analyzer relative response to the compound in percent with methane calibration.

^c Threshold Limit Value as the airborne 8-hour TWA established by the American Conference of Governmental Industrial Hygienist (ACGIH), 1999.

^d Permissible Exposure as the airborne 8-hour TWA established by the OSHA.

^e Immediately Dangerous to Life and Health level as published in the National Institute for Occupational Safety and Health (NIOSH), Pocket Guide to Chemical Hazards, 1994 edition.

^f Hazard category; Ca-Carcinogen; C-Ceiling; S-Skin absorption; 65 - Proposition 65 chemicals known to the State of California to cause cancer or reproductive harm.

^g Sources: NIOSH Pocket Guide to Chemical Hazards, June, 1994; Amdur, Mar O; Doull, John; Klaassen, Curtis, D., Toxicology, The Basic Science of Poisons, fourth Edition, 1993; and Merck & Co. Inc. The Merck Index, 1996.

^h IP varies with chromium compound.

NA = not applicable or not available

NC = noncombustible

PAHs = polyaromatic hydrocarbons

NE = not established

NF = non-flammable

3.1.2 Total Petroleum Hydrocarbons

TPH refers to heavy hydrocarbons that may present a fire hazard in extreme circumstances, such as the presence of flame, excessive heat or strong oxidizers. An exposure limit for TPH has not been established due to the varied chemical composition. Presently, there are no known chronic health hazards associated with TPH.

3.1.3 Oils

Oils are not considered flammable, only combustible. Because of their low vapor pressure, they do not typically constitute an inhalation hazard unless working conditions include extremely hot temperatures or create excessive airborne oil-contaminated dust. These conditions are not anticipated.

3.1.4 Oxygenated Solvents

Oxygenated solvents are flammable liquids such as acetone and methyl ethyl ketone. In high concentrations, inhalation of these materials can cause anesthesia with dizziness being the usual symptom. They do not display serious chronic effects (acetone is found in the human body). These materials are very flammable. They cannot be readily detected by PID, but are easily detected by flame ionization detectors (FID). These materials have considerable odor and can be readily recognized by smell at levels well below those requiring protection.

3.1.5 Inorganic Lead

To present a health hazard, lead must be in such a form as to gain entrance into the body or tissue in measurable quantities. The primary mode of entry that is of concern is inhalation of lead dust, and secondary, is ingestion if poor personal hygiene is practiced. Lead is a cumulative poison. It is stored in the body and acts as a cellular poison to all organ systems before symptoms and disability is evident. Lead poisoning creates a red cell anemia and damages organs and tissues of the body such as kidneys, liver, blood vessels, nervous system and reproductive organs. Chemical and physical properties may vary depending upon the specific lead compound.

Lead is considered a carcinogen and reproductive toxin and has an airborne Permissible Exposure Limit (PEL) of 0.05 mg/m³. The blood lead action level for adults is equal to or less than 30 milligrams per deciliters (mg/dl) of blood. There is no safe level of lead exposure for children. Therefore, decontamination of adults and their clothing is a primary concern.

3.1.6 Vinyl Chloride

Vinyl chloride is a flammable, colorless gas with a pleasant ethereal odor at high concentrations. It reacts with copper, oxidizers, aluminum, peroxides, iron, and steel. Vinyl chloride gas is absorbed by inhalation. Skin absorption of the vapor has been suggested but experimental evidence is presently lacking. Vinyl chloride is a skin irritant, and contact with the liquid may cause frostbite upon evaporation. The eyes may be immediately and severely irritated. Vinyl chloride depresses the central nervous system causing symptoms that resemble mild alcohol intoxication. Lightheadedness, some nausea, and dulling of visual and auditory responses may develop in acute exposures. Death from severe vinyl chloride exposure has been reported. Vinyl chloride is regarded as a human carcinogen, and a causal agent of angiosarcoma of the liver. Excess cancer of the lung and the lymphatic and nervous systems has also been reported.

3.1.7 Trichloroethylene (TCE)

TCE is a colorless liquid with a chloroform-like odor. It is a combustible liquid that burns with difficulty. TCE is incompatible with strong caustics and alkalis; chemically active metals such as barium, lithium, sodium, magnesium, titanium, and beryllium. TCE reacts slowly with water to form hydrochloric acid. Routes of exposure include inhalation, ingestion, skin and/or eye contact. TCE acts as a narcotic that causes depression of the central nervous system. The symptoms of acute exposure include skin irritation, dizziness, poor coordination, drowsiness, increased reaction time, unconsciousness, and death. TCE is a potential occupational carcinogen.

3.1.8 N-nitrosodimethylamine (NDMA)

NDMA is a yellow, oily liquid with a faint, characteristic odor. It is a combustible liquid and is incompatible with strong oxidizers. Routes of exposure include inhalation, skin absorption, ingestion, skin and/or eye contact. The symptoms of acute exposure include nausea, vomiting, diarrhea, abdominal cramps; headache; fever; enlarged liver, jaundice; decreased liver, kidney and pulmonary function. NDMA is a potential occupational carcinogen.

3.1.9 N-nitrosodi-n-propylamine (NDPrA)

NDPrA is a yellow liquid at room temperature. The routes of entry include inhalation, ingestion, and skin absorption and eye contact. The effects of short- or long-term exposures to NDPrA on human health have not been studied. Little is known about the health effects of short exposures to NDPrA in experimental animals except that eating or drinking certain amounts of this chemical can cause liver disease and death. Long-term exposure of experimental animals to NDPrA in food or drinking water causes cancer of the liver, esophagus, and nasal cavities. Although human studies are not available, the animal evidence indicates that it is reasonable to expect that exposure to NDPrA could cause liver disease and cancer in humans. The Department of Health and Human Services (DHHS) has determined that NDPrA may reasonably be anticipated to be a human carcinogen.

3.2 Physical Hazards

Physical hazards are safety hazards associated with heavy equipment used for drilling as well as heat stress or cold stress, physical injury, noise, electrical hazards, fire hazards and biological hazards. Each potential hazard is described in detail within Forsgren/BC H&S Program Manual. Some level of personal protective equipment (PPE) is necessary for virtually all field sampling activities for protection against physical and/or chemical hazards. Anticipated field equipment for the Expanded SI can be found in Section 5.0, Table B-3.

3.2.1 Fire Safety

Fire is a potential hazard due to equipment malfunction. Before beginning any work activities, locate fire extinguishers and other emergency equipment. A fire extinguisher will be carried with the sampling vehicle. Do not block the path to this emergency equipment with work materials. Be familiar with the type of extinguishers and what kind of fire they are designated to put out. All job locations must have applicable fire extinguishers.

- Type A extinguishers put out ordinary combustibles such as paper, wood and some plastics.
- Type B extinguishers put out flammable liquids like oil and gasoline.
- Type C extinguishers put out electrical fires.
- Type ABC extinguishers put out all three types of fires.

In addition to potential fire hazard due to equipment malfunction, fire hazard during field operations is a potential for operating vehicles and equipment in and around dry grass, weeds, or other plant material. To reduce potential for vegetative fires, weeds, grass and dry brush will be cleared from work-areas prior to operating equipment. Vehicles will be operated on paved and dirt roads wherever possible. When off-road travel is necessary, areas with tall weeds or grasses will be avoided.

3.2.2 Biological Hazards

Biological hazards are generally not anticipated because most of the fieldwork will be performed in and around buildings, However if conditions indicate that biological hazards may exist such as an infestation of insects, mold or animal droppings, the Health and Safety staff will be contacted to determine the appropriate control measure prior to proceeding with work. A further listing of biological hazards can be found in the General SSHP for the Benicia Arsenal.

West Nile Virus (WNV). WNV is a potentially serious illness generally spread by the bite of an infected mosquito. Mosquitoes are WNV carriers that become infected when they feed on infected birds. Infected mosquitoes can then spread WNV to humans and other animals when they bite. Experts believe WNV is established as a seasonal epidemic in North America that flares up in the

summer and continues into the fall. The following precautions should be made to help prevent mosquito bites.

- Review and plan work for possibility of mosquito infestation.
- Wear long sleeves and pants to work site. Apply repellent containing DEET to clothing.
- Be aware of peak hours of mosquito activity - dusk to dawn.
- Drain or avoid sources of standing water.
- Report dead bird to local health organizations.
- Check with local agencies to see if there is an organized mosquito control program in the area.

Check with the CDC (www.CDC.gov) or the Brown and Caldwell Health and Safety staff for further precautions if site work is a concern. Report any suspect symptoms to the Site Safety Officer or Project Manager immediately.

4.0 TRAINING REQUIREMENTS

There are no special training requirements anticipated for this site. General training requirements for all BC staff working on site are described in the General SSHP (Brown and Caldwell, 1999).

5.0 PERSONAL PROTECTIVE EQUIPMENT

The minimum required level of personal protection for all the sites at all times is modified Level D. A list of field equipment can be found on Table B-3, Field Equipment. Based on the environmental monitoring plan, if conditions warrant, there will be an upgrade to Level C to protect personnel. Descriptions of other levels of PPE are described in the FA/BC Health and Safety Program Manual (301 and 302; p. 1-24) (FA/BC, 1998) and the General SSHP (Brown and Caldwell, 1999).

5.1 Modified Level "D" Equipment Specifications

<input checked="" type="checkbox"/> Hard	<input checked="" type="checkbox"/> Hearing Protection
<input checked="" type="checkbox"/> Steel Toed Boots	<input type="checkbox"/> Coveralls or Tyvek
<input type="checkbox"/> Surgical Gloves	<input type="checkbox"/> Poly-Coated Tyvek
<input type="checkbox"/> Face Shield	<input checked="" type="checkbox"/> Neoprene, Nitrile or Rubber Gloves – Outer
<input checked="" type="checkbox"/> Goggles	<input checked="" type="checkbox"/> Reflective Traffic Vests
<input checked="" type="checkbox"/> Safety Glasses	<input type="checkbox"/> Other Equipment
<input checked="" type="checkbox"/> Work Gloves	

* To be worn when working near roads.

5.2 Level "C" Equipment Specifications

<input checked="" type="checkbox"/> Hard Hat	<input checked="" type="checkbox"/> Coveralls or Tyvek
<input checked="" type="checkbox"/> Steel Toed Boots	<input type="checkbox"/> Poly-Coated Tyvek
<input type="checkbox"/> Face Shield	<input type="checkbox"/> Cotton Work Gloves
<input checked="" type="checkbox"/> Surgical Gloves - Inner	<input checked="" type="checkbox"/> Neoprene, Nitrile or Rubber Gloves - Outer
<input type="checkbox"/> Goggles	<input type="checkbox"/> Chemical Resistant Safety Boots
<input checked="" type="checkbox"/> Safety Glasses	<input checked="" type="checkbox"/> Half or full-face respirator with organic vapor/acid gas cartridges. (P-100)
<input checked="" type="checkbox"/> Hearing Protection	<input checked="" type="checkbox"/> Other Equipment

Table B-3. Anticipated Field Equipment for Expanded SI

Equipment	Purpose and description
<p>Personal Protective Equipment Nitrile disposable gloves Tyvek® coveralls or equivalent</p> <p>Respirators and cartridges</p> <p>Steel-toed boots or shoes and a hard hat Gloves – leather or nitrile depending on conditions</p>	<p>Prevents exposure to potentially contaminated soil or groundwater. Prevents exposure to potentially contaminated soil or groundwater. To be used if conditions are required.</p> <p>If necessary, half face or full face respirator will be used if the level of PPE is upgraded during work. Respiratory equipment must be in working condition and fit-tested for that person. A combination organic vapor/acid gas P100 particulate cartridge should be adequate protection for the contaminants expected at this site. The end of service for cartridge will be 12 hours based on toluene/chlorobenzene/trichloroethane and the respiratory manufacturers recommendations. If upgrade to Level C for unexpected chemicals is required, the Health and Safety Director will be contacted to determine End of Service Life change out schedule for cartridges based on exposure conditions. All personnel wearing respiratory protection will be in compliance with fit-testing requirements as specified in the FA/BC Health and Safety Program Manual Section 302.</p> <p>Required PPE for Modified Level D. Required PPE for Modified Level D.</p>
<p>Environmental Monitoring Equipment Organic vapor monitor or equivalent</p> <p>Benzene detector tubes (0.125-60 ppm) Vinyl Chloride detector tubes (0.25-70 ppm)</p>	<p>A PID or equivalent is required to monitor air quality in and around the work zone. The PID must be calibrated before and after each workday. A calibration data sheet will be maintained. A periodic response check will be performed during the workday to determine that it is responding to contaminants. Detector tubes, benzene and vinyl chloride, are required to monitor air quality in the work zone as specified in Table B-5.</p>
<p>Site Control Measures Traffic Cones, barricades and safety tape</p>	<p>All work areas will be delineated with traffic cones and/or safety tape to prevent people from entering the work zone. Barricades may also be used in higher traffic areas.</p>
<p>Decontamination Equipment Wash buckets and soap, plastic drop cloth, disposable towels, disposal containers.</p>	<p>Necessary for proper decontamination of small equipment and non-disposable PPE (i.e., work boots).</p>
<p>Other Equipment Water level probe</p> <p>Interface probe</p> <p>pH/electrical conductance (EC) meter</p> <p>Sampling containers (soil and water) Sample labels, COC forms, zip-lock bags, cooler, ice (if necessary), custody seals</p>	<p>There is a possibility during drilling that groundwater may be encountered. All equipment will be checked prior to use to determine if it is working properly.</p> <p>There is a possibility during drilling that free-phase petroleum hydrocarbons in groundwater may be encountered. All equipment will be checked prior to use to determine if it is working properly. If groundwater is encountered, physical properties (such as pH, EC, color, odor, and relative clarity) will be noted in the field logbook. This equipment will be calibrated before use and calibration notes will be logged in the field logbook.</p> <p>If necessary, appropriate containers for soil and groundwater samples will be required. Necessary for any soil or groundwater sampling. Proper COC forms, labels, and custody seals will be completed for proper QC. Samples will be stored in a clean cooler (with ice, if necessary for specified analysis) for delivery to an analytical laboratory. If ice is used, all samples will be sealed around the end caps, lids, or caps to prevent water from invading the sample. Then the samples will be double-bagged and sealed for an additional protective barrier from melt water.</p>

Table B-3. Anticipated Field Equipment for Expanded SI (continued)

Equipment	Purpose and description
Other Equipment (continued)	
Hand auger or post hole digger	Prior to using power drilling equipment, a hand auger or hand operated post hole digger will be used to explore the upper 3 to 5 feet for underground utilities and other obstructions. In addition, the hand auger may be used for the collection of shallow subsurface soil samples.
Thermometer	Monitor air temperature when ambient temperature is above 70 degrees F. Thermometer should be placed in a shady area.
Illumination	All work activities will be conducted in daylight hours to provide adequate lighting for outside activities. Work activities will not be conducted indoors.
Potable water and sanitation	Drinking water and toilets are located at the site for use by all workers.

The End of Service Life (ESL) for organic vapor/acid gas/ P-100 cartridge change out was calculated for Octane and TCE based on the respirator manufacturer's recommendation for TCE (Table B-4) (Attachment F).

**Table B-4. End of Service Life (ESL)
Vapor/Acid Gas/P-100 Cartridge Change Out**

Contaminant	Use Concentration	Hours
Octane	100 ppm	11
Trichloroethylene	100 ppm	10

There is a slight possibility that Benzene may be found during the Expanded SI. If Benzene is detected during SI activities, the ESL for cartridge change out should be at the end of each work shift not to exceed 8-hours (29 CFR 1910.1028).

6.0 ENVIRONMENTAL MONITORING PLAN

The following is the anticipated environmental monitoring plan necessary for the Expanded SI field activities. Equipment anticipated for environmental monitoring is listed on Table B-3. Environmental monitoring will be in accordance with the Organic Vapor Response criteria outlined in Table B-5. Generally, only drilling activities will include monitoring of air quality in and around the work area and heat or cold stress.

7.0 MEDICAL SURVEILLANCE REQUIREMENTS

There are no special medical surveillance requirements anticipated for the Expanded SI field activities. The General SSHP describes the general medical surveillance requirements.

8.0 SITE CONTROL MEASURES

The work area around the drill rig, including accessory equipment and materials will be designated as the Exclusion Zone. The exclusion zone for drill rig activities will be set at 30 feet, taken into account the height of the drill rig mast.

The exclusion zone for CPT rig activities will differ from drill rig activities due to the CPT rig being a self contained unit. All drilling takes place beneath the rig and personnel are contained at all times during drilling and sampling within the rig. The exclusion zone for CPT activities will be the CPT rig itself.

Only workers with the proper PPE will be allowed access to the Exclusion Zone. Figure B-1 identifies the various drilling locations.

Table B-5. Organic Vapor Response Criteria for Petroleum Hydrocarbons that may Include Gasoline, Diesel and Fuel Oil

Organic vapor concentrations in breathing zone	Sampling frequency	Action taken
0 less than 1 ppm	At a minimum of every 15 minutes, whenever active excavation or drilling is being conducted, upon initial approach to surface water and sediment sampling sites where contamination is anticipated.	Continue work with required minimum PPE for the field activity
1 ppm to 10 ppm for more than 2 minutes	Every 15 minutes until organic vapor concentration levels decrease less than 1 ppm.	Collect benzene and vinyl chloride detector tubes (DTs) at borehole: <ul style="list-style-type: none"> • If DTs reveal no detectable concentrations then, continue work with required minimum PPE for the field activity • If DTs reveal detectable concentrations greater than 1 ppm upgrade to Level C PPE • If DTs for benzene reveal detectable concentrations greater than 10 ppm, then stop work
10 to 100 ppm for more than 2 minutes	Every 15 minutes	Level C PPE required
100 ppm for more than 2 minutes with ½-face respirator (500 ppm with full-face respirator)	Every 10 minutes	<ul style="list-style-type: none"> • Stop work • Work crews position themselves upwind of site • Re-evaluate in 15 minutes • Contact Health and Safety Director and Project Manager • Evacuate

Equipment necessary for site control measures is listed on Table B-3. Further details regarding site control measures can be found in the FA/BC Health and Safety Program Manual (406; p.25-28).

8.1 Site Communication

Communication between field team members will consist of verbal and telephone (standard or cellular) communication. The Valero refinery is located within the Former Arsenal boundaries. There is a potential that work will take place on properties adjacent or near the refinery. Brown and Caldwell contacted the current Safety Manager, Al Middleton, to confirm Valero's hazard communication policy. Al Middleton can be contacted at 1-707-745-7764. The refinery has a specific hazard communication plan for its workers. In the event field personnel hear horns, Table B-6 summarizes the purpose of the sound and action to be taken by field personnel.

Table B-6. Valero Refinery Emergency Horn Signals

Horn Signal	Reason	Action by Field Personnel
4 to 5 second blasts of horn	Fire in refinery	STOP WORK. Turn off all motorized equipment. Evacuate area – move upwind of the site of emergency. Call Site Safety Officer and Project Manager.
1 second blast of horn	Toxic Gas Release	STOP WORK. Turn off all motorized equipment. Evacuate area – move upwind of the site of emergency. Call Site Safety Officer and Project Manager.
1 long blast	"All Clear"	Return to work

Note: The Toxic Gas alarm will continue until the emergency condition is under control or the Valero Incident Commander orders that the horns be silenced.

Always evaluate the wind direction and travel crosswind until clear of the hazard and then travel upwind to a safe area.

9.0 DECONTAMINATION

Decontamination will take place within the various drilling areas are identified on Figure B-1. A sample decontamination set-up can be found in the FA/BC Health and Safety Program Manual (405; p.23) (FA/BC, 1998). There are no special emergency decontamination procedures anticipated for this project. General decontamination equipment necessary for this project is listed on Table B-3.

10.0 EMERGENCY PROCEDURES

There are two medical assistance centers near the Benicia Arsenal, **Kaiser Permanente Hospital in Vallejo, CA** and **Contra Costa Regional Medical Center in Martinez, CA**. The closest medical assistance center should be chosen dependant upon location within the Former Arsenal. See descriptions below of each medical facility.

10.1 Kaiser Permanente Hospital

Kaiser Permanente should be the primary medical center if located in the north or northwest areas of the Arsenal. The hospital is located at **975 Sereno Dr., Vallejo, CA.**, telephone number: **(707) 651-1000**. Directions from I-780 are presented below and shown on the route to hospital map included in this document as Figure B-2.

Directions from I-780 to Kaiser Permanente Hospital:

- Travel on **I-780 West** for approximately 5.4 miles.
- Take **I-80 East** towards Sacramento for \approx 2 miles (heading north).
- Take Redwood Street exit.
- Travel west on **Redwood Street** for \approx 1 mile.
- Right onto **Broadway** heading north for \approx 0.4 miles.
- Right onto **Sereno Drive** heading east for \approx 0.2 miles.
- **Hospital** is located on the right at **975 Sereno Drive**.

Total travel time from the project area to Kaiser Permanente hospital is approximately 20 minutes, and the total distance is approximately 10 miles.

The nearest telephone is located in the work zone. If a cell phone is to be used for emergency purposes, it must be checked upon arrival to the site to verify that reception to the area is available. The emergency telephone numbers to be used to call for assistance are listed in the section on Key Personnel and Responsibilities in the FA/BC Health and Safety Program Manual (Forward; p. F-5).

In the event of a medical emergency cell phones must dial **(707) 745-3411** or **3412** for the **Benicia Police Department**. BC will post the number in the work zone area.

10.2 Contra Costa Regional Medical Center

Contra Costa Regional Medical Center should be the primary medical center if located in the south or southeast areas of the Former Arsenal. The hospital is located at **2500 Alhambra Street, Martinez, CA**, telephone number: **(925) 370-5000**. Directions from I-680 are presented below and shown on the route to hospital map included in this document as Figure B-2.

Directions from I-680 to Contra Costa Regional Medical Center:

- Travel on **I-680 South** towards Martinez/San Jose for approximately 2.47 miles.
- Take the **Marina Vista Avenue** exit and turn left.
- Travel on **Marina Vista Avenue** for approximately 1.6 miles.
- Left onto **Berrellesa Street** for approximately 0.9 miles.
- **Berrellesa Street** will merge into **Alhambra Street**.
- The **Medical Center** will be on the right side.

11.0 DOCUMENTATION

Proper completion of standard Attachments A through E is required health and safety documentation for this site. Attachments A through E are located at the end of this SSHP. The procedures and frequency in which each Attachment must be completed is described in Table B-7.

Table B-7. Attachments A – E for Expanded SI Activities

Attachment	Procedures	Frequency
Attachment A – Site Safety & Health Plan Acknowledgement Form	Attachment A will be completed and signed by all contractors and subcontractors involved with the field effort. An emergency contact for each contractor and subcontractor will also be required on Attachment A.	Once, prior to the start of the field project
Attachment B – Site Safety & Health Plan Site Activity and Safety Briefing	A safety briefing will be held every day prior to start of work. Attachment B will be included with all other daily sheets (i.e., field notes, boring logs) submitted by the contractor at the end of the day.	Daily
Attachment C – Site Safety & Health Plan Safety Plan Implementation Checklist	Attachment C will be completed prior to the start of each field project and all items listed and their respective status will be reviewed every day of the field effort.	Once, prior to the start of the field project
Attachment D – Unsafe Conditions	Attachment D will be completed, if necessary, for every occurrence of an unsafe condition. If an Attachment D is completed for an unsafe condition, the Project Manager and the Health and Safety Director will be notified immediately and all work at the job site will stop until the unsafe condition is corrected.	When necessary
Attachment E – Site Safety & Health Plan Safety Plan Environmental Monitoring Documentation	Attachment E can be used as a sheet to record daily air monitoring data. If Attachment E is not used, the information must be kept elsewhere.	Daily during invasive activities

12.0 REFERENCES

Brown and Caldwell. 1999. Benicia Arsenal General SSHP. Prepared for U.S. Army Corps of Engineers, Sacramento, California. January.

Forsgren Associates/Brown and Caldwell. 1998. Health and Safety Program Manual. Prepared for U.S. Army Corps of Engineers, Sacramento, California. August.

DIRECTIONS FROM I-780 TO KAISER PERMANENTE HOSPITAL:
 TRAVEL ON I-780 WEST FOR APPROXIMATELY 5.4 MILES.
 TAKE I-80 EAST TOWARDS SACRAMENTO FOR 2 MILES (HEADING NORTH).
 TAKE REDWOOD STREET EXIT.
 TRAVEL WEST ON REDWOOD STREET FOR 1 MILE.
 RIGHT ONTO BROADWAY HEADING NORTH FOR 0.4 MILES.
 RIGHT ONTO SERENO DRIVE HEADING EAST FOR 0.2 MILES.
 HOSPITAL IS LOCATED ON THE RIGHT AT 975 SERENO DRIVE.

DIRECTIONS FROM I-680 TO CONTRA COSTA REGIONAL MEDICAL CENTER:
 TRAVEL ON I-680 SOUTH TOWARD MARTINEZ FOR ABOUT 2.8 MILES.
 TAKE MARINA VISTA AVE EXIT TOWARD MARINA VISTA/MARTINEZ.
 TURN LEFT ONTO MARINA VISTA AVE AND TRAVEL FOR 1.7 MILES.
 TURN LEFT ONTO BERRELLESA STREET HEADING SOUTH FOR 0.8 MILES.
 BERRELLESA STREET MERGES INTO ALHAMBRA AVE FOR 0.1 MILES.
 HOSPITAL IS LOCATED ON THE RIGHT AT 2500 ALHAMBRA AVE.



Figure B-2
Route to Hospital
 Expanded SI SSHP
 Benicia Arsenal

**BROWN
AND
CALDWELL**

Attachment A—Site Safety and Health Plan Employee Acknowledgment

Employee Name

Project Name

Project Location

Project Number

Employee Statement of Acknowledgment

I hereby certify that I have read and that I understand the safety and health guidelines contained in Brown and Caldwell's Site Safety and Health Plan for the above-named project.

Employee Signature

Date

In the Case of an Emergency, contact:

Name

Relationship

Phone Number

1. _____

2. _____

Name of Site Safety Officer Receiving This Form

Signature of Site Safety Officer

Date

NOTE: Send completed form to Health and Safety Director.

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Attachment B—Site Safety and Health Plan Site Activity and Safety Briefing

Name of Site Safety Officer	Signature of Site Safety Officer	Date
Project Name	Project Location	Project Number

Who attended the briefing?

Names of Brown and Caldwell Employees

Names of Subcontractor(s) Employees

What items were discussed?

- | | |
|--|--|
| <input type="checkbox"/> Site Safety and Health Plan | <input type="checkbox"/> Hazardous Site Conditions/Activities |
| <input type="checkbox"/> Specific Accident/Incident | <input type="checkbox"/> Changes/Solutions to Specific Accident(s) |
| <input type="checkbox"/> Protective Equipment to be Used | <input type="checkbox"/> Location of Emergency Telephone Number |
| <input type="checkbox"/> Emergency Hospital Route | <input type="checkbox"/> Work Schedule |
| <input type="checkbox"/> Other _____ | |

Do any items require assistance from BC Health and Safety staff? (If yes, describe the item and type of assistance required and contact the Health and Safety staff directly.)

YES NO

NOTE: Place a copy of the completed form in the project file.

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Attachment C—Site Safety and Health Plan Safety Plan Implementation Checklist

Project Name		Project Location (city and state)	Date
Name of Site Safety Coordinator		Weather Conditions	Project Number
BC Staff Present	Name	Office	
	_____	_____	
	_____	_____	
	_____	_____	

Indicate the status of each of the following:

1. Is a copy of the Site Safety and Health Plan (SSHP) on site? YES NO N/A
 2. Is the personal protective equipment required by the SSHP available and being used correctly? YES NO N/A
 3. Have the work zones been delineated? YES NO N/A
 4. Has a decontamination station been set up as required by the SSHP? YES NO N/A
 5. Are the decontamination procedures being followed? YES NO N/A
 6. Is access to the exclusion zone being controlled? YES NO N/A
 7. Has the site activities briefing and tailgate safety meeting been provided? YES NO N/A
 8. Is the list of emergency telephone numbers posted at the support zone? YES NO N/A
 9. Are directions to nearest emergency medical assistance posted at support zone? YES NO N/A
 10. Is emergency equipment available and functional, as required by the SSHP? YES NO N/A
 11. Has the nearest toilet facility been identified or a portable facility been set up? YES NO N/A
 12. Has an adequate supply of drinking water been provided? YES NO N/A
 13. Has water for decontamination been provided? YES NO N/A
 14. Have the instruments for environmental and exposure monitoring been calibrated and set up as required by the SSHP? YES NO N/A
 15. Are the instruments being used properly and periodically checked during the shift for battery charge status? YES NO N/A
 16. Have the trenches and excavations been clearly marked? YES NO N/A
 17. Have trenches and excavations been shored or sloped as required by soil type and work activities? YES NO N/A
 18. Are dust suppression measures being used? YES NO N/A
 19. Is food and tobacco consumption being restricted to the support zone? YES NO N/A
 20. Has a confined space been identified as part of this project? YES NO N/A
 21. Are the confined space entry procedures being correctly implemented? YES NO N/A
 22. Has the work/rest cycle for the shift been established? YES NO N/A
- TIME ON (minutes): _____ TIME OFF (minutes): _____
23. Has a shaded rest area been set up in the support zone? YES NO N/A

NOTE: Place completed form in project file.

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**BROWN
AND
CALDWELL**

**Attachment D
Notice of Unsafe Conditions**

Contractor

Date

Project Name

Project Number

THIS NOTICE . . .

This notice is to advise you, the Prime Contractor on the above-named Contract, that this Representative of the Owner of the above-mentioned Project has observed (on the date shown above) an unsafe condition on the Project.

These conditions are listed as follows:

ITEM

CONDITION

ITEM	CONDITION
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

By this Notice, the Owner or its Representatives shall not assume any responsibility under the GENERAL CONDITIONS or assume any liability for the existence or correction thereof, for the unsafe conditions, or any others that may have been unnoticed.

These conditions shall be remedied as soon as possible within a safe working period. If these corrections are not made, the Owner will be forced to remove all field staff from the job. No payment shall be made for any work installed after this date without first examination of work in accordance with the GENERAL CONDITIONS.

Signature of Owner's Representative

Title

Date

Received by (Signature of Contractor's Representative)

Title

Date

NOTE: Place a copy of completed form in project file.

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Attachment E—Site Safety and Health Plan Environmental Monitoring Documentation

Project Name	Project Number	Date
Employee Name	Project Location	

Equipment Used (check as appropriate)

	Calibrated	Date	Used	Dates(s)
OVA (Organic Vapor Analyzer)/FID	<input type="checkbox"/>	_____	<input type="checkbox"/>	_____
OVM (Organic Vapor Monitor)/PID	<input type="checkbox"/>	_____	<input type="checkbox"/>	_____
HNU	<input type="checkbox"/>	_____	<input type="checkbox"/>	_____
PTLV Sniffer	<input type="checkbox"/>	_____	<input type="checkbox"/>	_____
Photovac TIP	<input type="checkbox"/>	_____	<input type="checkbox"/>	_____
Combustible Gas Meter/Explosimeter	<input type="checkbox"/>	_____	<input type="checkbox"/>	_____
Other _____	<input type="checkbox"/>	_____	<input type="checkbox"/>	_____

Instrument	Date	Time	Readout Value	Area Monitored	Changes in PPE			User's Initials
					YES	NO	Type of PPE	

Attachment F – End of Service Life

MSA**Cartridge Life Expectancy Calculator****MSA Cartridge Life Expectancy Results****Final Breakthrough Time Calculation**

When using a Facepiece with a Cartridge under the following conditions:

Chemical Name:

Chemical PEL (ppm):

Temperature:

Relative Humidity:

Pressure:

Breathing Rate:

Use Concentration:

Breakthrough Concentration:

The estimated
Breakthrough Time
at which cartridges
need to be replaced is:

minutes

MSA Cartridge Life Expectancy Calculator



MSA Cartridge Life Expectancy Results

Final Breakthrough Time Calculation

When using a Facepiece with a Cartridge under the following conditions:

- Chemical Name:
- Chemical PEL (ppm):
- Temperature:
- Relative Humidity:
- Pressure:
- Breathing Rate:
- Use Concentration:
- Breakthrough Concentration:

The estimated Breakthrough Time at which cartridges need to be replaced is: minutes

APPENDIX C

QAPP Addendum

**Table 2-1 Additions
Sample Containers, Preservation Methods, and Analytical Holding Times**

Parameter	Matrix	Container	Lid	Preservation	Maximum Holding Times	
					Preparation ^a	Analysis ^b
Volatiles, including Purgeable Hydrocarbons	Water	40 ml glass vials X 3	Cap with Teflon® septum	Ice to 4°C	-	7 days
	Water Soil	40 ml glass vials X 3 EnCore sampler X 4 (separate samples must be submitted for moisture analysis)	Cap with Teflon® septum o-ring cap	HCl to pH<2; Ice to 4°C Ice to 4°C; 48 hours to analyze or preserve with methanol or sodium bisulfate ^d	-	14 days 14 days
Soil gas	Soil	Stainless steel sleeve	Teflon®-lined plastic end-caps	Ice to 4°C	-	48 hours
	Soil gas	Tedlar bag	None	none	-	3 days
	Soil gas	Gas-tight Syringe	None	none	-	3 days
	Soil gas	Summa Canister	None	none	-	14 days
Nitrosamines	Water	1 liter glass amber jar X 2	Teflon®-lined	Ice to 4°C	7 days	40 days

**Table 2-2 Additions
Summary of Common Environmental Analytical Methods**

Parameter	Analytical		Extraction/Preparation Procedure
	Matrix	Method	
Volatile Organic Compounds, including Purgeable Hydrocarbons	Water, Soil	SW8260B	Gas Chromatography/Mass Spectrometry Purge and Trap
	Soil	SW8260B	
		SW5035	Closed System Purge and Trap

2.4.4. Analytical Methods for Organic Compounds Addition

2.4.4.9a SW8260B – Field Analysis of Soil Gas for Volatile Organic Compounds by GC/MS

Soil gas or air samples will be collected in Tedlar bags, gas-tight syringes, glass bulbs or other equivalent vessels. The aliquot of sample for analysis is obtained using a Luer-lok type syringe equipped with a stopcock and removable needle. The needle is inserted into the sample container and the syringe filled with the air sample. The stopcock is immediately closed and the needle removed. The syringe is then locked onto the purge and trap unit, the stopcock is opened and the sample transferred into a sparge tube containing 5 ml of lab pure water spiked with the appropriate internal standards and surrogate compounds.

Appendix A - PQL Tables

Method Quantitation Limits for Volatile Organic Compounds
by GC/MS (EPA Method 8260B) for the Expanded SI

Parameter	Method	Analyte	Water* ($\mu\text{g/L}$)	Soil ($\mu\text{g/kg}$)	Air (mg/m^3)
Volatile Organic Compounds	SW8260B	Total Petroleum Hydrocarbons as Gasoline	2.0	100	NA
		Benzene	1.0	5.0	100
		Bromobenzene	1.0	5.0	100
		Bromochloromethane	1.0	5.0	100
		Bromodichloromethane	1.0	5.0	100
		Bromoform	1.0	5.0	100
		Bromomethane	1.0	5.0	100
		n-Butylbenzene	1.0	5.0	100
		sec-Butylbenzene	1.0	5.0	100
		tert-Butylbenzene	1.0	5.0	100
		Carbon tetrachloride	1.0	5.0	100
		Chlorobenzene	1.0	5.0	100
		Chlorodibromomethane	1.0	5.0	100
		Chloroethane	1.0	5.0	100
		Chloroform	1.0	5.0	100
		Chloromethane	1.0	5.0	100
		2-Chlorotoluene	1.0	5.0	100
		4-Chlorotoluene	1.0	5.0	100
		1,2-Dibromo-3-chloropropane	1.0	5.0	100
		1,2-Dibromoethane	1.0	5.0	100
		Dibromomethane	1.0	5.0	100
1,2-Dichlorobenzene	1.0	5.0	100		
1,3-Dichlorobenzene	1.0	5.0	100		
1,4-Dichlorobenzene	1.0	5.0	100		
Dichlorodifluoromethane	1.0	5.0	100		

**Method Quantitation Limits for Volatile Organic Compounds
by GC/MS (EPA Method 8260B) for the Expanded SI**

Parameter	Method	Analyte	Water* (µg/L)	Soil (ug/kg)	Air (mg/m ³)
		(Freon® 12)			
		1,1-Dichloroethane	1.0	5.0	100
		1,2-Dichloroethane	1.0	5.0	100
		1,1-Dichloroethene	1.0	5.0	100
		cis-1,2-Dichloroethene	1.0	5.0	100
		trans-1,2-Dichloroethene	1.0	5.0	100
		1,2-Dichloropropane	1.0	5.0	100
		1,3-Dichloropropane	1.0	5.0	100
		2,2-Dichloropropane	1.0	5.0	100
		Ethylbenzene	1.0	5.0	100
		Hexachlorobutadiene	1.0	5.0	100
		Isopropylbenzene	1.0	5.0	100
		p-Isopropyltoluene	1.0	5.0	100
		Methylene Chloride	1.0	5.0	100
		Naphthalene	1.0	5.0	100
		n-Propylbenzene	1.0	5.0	100
		Styrene	1.0	5.0	100
		1,1,1,2-Tetrachloroethane	1.0	5.0	100
		1,1,1,2-Tetrachloroethane	1.0	5.0	100
		Tetrachloroethene(PCE)	1.0	5.0	100
		Toluene	1.0	5.0	100
		1,2,3-Trichlorobenzene	1.0	5.0	100
		1,2,4-Trichlorobenzene	1.0	5.0	100
		1,1,1-Trichloroethane	1.0	5.0	100
		1,1,2-Trichloroethane	1.0	5.0	100
		Trichloroethene	1.0	5.0	100
		Trichlorofluoromethane(Freon ® 11)	1.0	5.0	100
		1,2,3-Trichloropropane	1.0	5.0	100
		1,2,4-Trimethylbenzene	1.0	5.0	100
		1,3,5-Trimethylbenzene	1.0	5.0	100
		Vinyl chloride	1.0	5.0	100
		o-Xylene	1.0	5.0	100
		m, p-Xylenes	1.0	5.0	100
		Methyl tertiary butyl ether (MTBE)	1.0	5.0	100

Table A-15. Method Quantitation Limits for Semivolatile Organic Compounds by GC/MS (EPA Method 8270C)

Parameter	Method	Analyte	Water (µg/L)	Soil (mg/kg)	
Semivolatile Organic Compounds	SW8270C	<u>Base/Neutral Extractables</u>			
		Aniline	10	0.7	
		Benzyl alcohol	10	0.7	
		Bis(2-chlorethyl)ether	10	0.7	
		Bis(2-chloroisopropyl)ether	20	0.7	
		Bis(2-chlorethoxy)methane	10	0.7	
		Bis(2-ethylhexyl)phthalate	10	0.7	
		4-Bromophenyl phenyl ether	10	0.7	
		Butyl benzyl phthalate	10	0.7	
		4-Chloroaniline	10	0.7	
		2-Chloronaphthalene	10	0.7	
		4-Chlorophenyl phenyl ether	10	0.7	
		Dibenzofuran	10	0.7	
		Di-n-butylphthalate	10	0.7	
		1,2-Dichlorobenzene	10	0.7	
		1,3-Dichlorobenzene	10	0.7	
		1,4-Dichlorobenzene	10	0.7	
		3,3'-Dichlorobenzidine	20	0.7	
		Diethyl phthalate	10	0.7	
		Dimethyl phthalate	10	0.7	
		2,4-Dinitrotoluene	10	0.7	
		2,6-Dinitrotoluene	10	0.7	
		Di-n-octyl phthalate	10	0.7	
		Hexachlorobenzene	10	0.7	
		Hexachlorobutadiene	10	0.7	
		Hexachlorocyclopentadiene	40	0.7	
		Hexachloroethane	10	0.7	
		Isophorone	10	0.7	
		2-Methylnaphthalene	10	0.7	
		2-Nitroaniline	50	1.7	
		3-Nitroaniline	50	1.7	
		4-Nitroaniline	50	1.7	
		Nitrobenzene	10	0.7	
		N-nitrosodimethylamine	5	0.7	
		N-nitrosodiphenylamine	5	0.7	
		N-nitrosodipropylamine	5	0.7	
		1,2,4-Trichlorobenzene	10	0.7	
		<u>Acid Extractables</u>			
		Benzoic Acid	50	1.7	
		4-Chloro-3-methylphenol	10	0.7	
		2-Chlorophenol	10	0.7	

Table A-15. Method Quantitation Limits for Semivolatile Organic Compounds by GC/MS (EPA Method 8270C)

Parameter	Method	Analyte	Water ($\mu\text{g/L}$)	Soil (mg/kg)		
Semivolatile Organic Compounds	SW8270C	2,4-Dichlorophenol	10	0.7		
		2,4-Dimethylphenol	10	0.7		
		4,6-Dinitro-2-methylphenol	50	1.7		
		2,4-Dinitrophenol	50	1.7		
		2-Methylphenol	10	0.7		
		4-Methylphenol	10	0.7		
		2-Nitrophenol	10	0.7		
		4-Nitrophenol	50	1.7		
		Pentachlorophenol	50	1.7		
		Phenol	10	0.7		
		2,4,5-Trichlorophenol	50	1.7		
		2,4,6-Trichlorophenol	10	0.7		
		<u>PAHs in SIM Mode</u>				
				Acenaphthalene	5.0	1.0
				Acenaphthene	5.0	1.0
		Anthracene	5.0	1.0		
		Benzo(a)anthracene	0.25	0.05		
		Benzo(b)fluoranthene	0.25	0.05		
		Benzo(k)fluoranthene	0.50	0.10		
		Benzo(g,h,i)perylene	0.5	0.1		
		Benzo(a)pyrene	0.25	0.05		
		Chrysene	0.5	0.1		
		Dibenzo(a,h)anthracene	0.5	0.1		
		Fluoranthrene	0.5	0.1		
		Fluorene	0.5	0.1		
		Indeno(1,2,3-cd)pyrene	0.25	0.05		
		Naphthalene	2.5	0.5		
		Phenanthrene	1.0	0.2		
		Pyrene	1.0	0.2		

Appendix C - LCS/LCSD and MS/MSD Control Limits

Table C-12. Control Limits for Laboratory Control Samples and Surrogate Spikes for Volatile Organic Compounds by GC/MS (EPA Method 8260B)

Analytical Method	Spiking Compounds	Benicia Arsenal Control Limits			
		Percent Recovery (%)			Relative Percent Difference (%)
		LCS/LCSD		LCS/LCSD	
		Water	Soil	Air	Water, Soil, & Air
SW8260B	Total Petroleum Hydrocarbons as Gasoline (TPPH-Gasoline)	NA	NA	NA	NA
	Benzene	75-125	75-125	70-130	25
	Bromobenzene	75-125	75-125	70-130	25
	Bromochloromethane	75-125	75-125	70-130	25
	Bromodichloromethane	75-125	75-125	70-130	25
	Bromoform	75-125	75-125	70-130	25
	Bromomethane	75-125	75-125	70-130	25
	n-Butylbenzene	75-125	75-125	70-130	25
	sec-Butylbenzene	75-125	75-125	70-130	25
	tert-Butylbenzene	75-125	75-125	70-130	25
	Carbon tetrachloride	75-125	75-125	70-130	25
	Chlorobenzene	75-125	75-125	70-130	25
	Chlorodibromomethane	75-125	75-125	70-130	25
	Chloroethane	75-125	75-125	70-130	25
	Chloroform	75-125	75-125	70-130	25
	Chloromethane	75-125	75-125	70-130	25
	2-Chlorotoluene	75-125	75-125	70-130	25
	4-Chlorotoluene	75-125	75-125	70-130	25
	1,2-Dibromo-3-chloropropane	75-125	75-125	70-130	25
	1,2-Dibromoethane	75-125	75-125	70-130	25
	Dibromomethane	75-125	75-125	70-130	25
	1,2-Dichlorobenzene	75-125	75-125	70-130	25
	1,3-Dichlorobenzene	75-125	75-125	70-130	25
	1,4-Dichlorobenzene	75-125	75-125	70-130	25
	Dichlorodifluoromethane(Freon® 12)	75-125	75-125	70-130	25
	1,1-Dichloroethane	75-125	75-125	70-130	25
	1,2-Dichloroethane	75-125	75-125	70-130	25
	1,1-Dichloroethene	75-125	75-125	70-130	25
	cis-1,2-Dichloroethene	75-125	75-125	70-130	25
	trans-1,2-Dichloroethene	75-125	75-125	70-130	25
	1,2-Dichloropropane	75-125	75-125	70-130	25
	1,3-Dichloropropane	75-125	75-125	70-130	25
	2,2-Dichloropropane	75-125	75-125	70-130	25
	Ethylbenzene	75-125	75-125	70-130	25
	Ethyl methacrylate	75-125	75-125	70-130	30
	Hexachlorobutadiene	75-125	75-125	70-130	25
	Isopropylbenzene	75-125	75-125	70-130	25

		Benicia Arsenal Control Limits			
		Percent Recovery (%)			Relative Percent Difference (%)
		LCS/LCSD			LCS/LCSD
Analytical Method	Spiking Compounds	Water	Soil	Air	Water, Soil, & Air
	p-Isopropyltoluene	75-125	75-125	70-130	25
	Methylene Chloride	75-125	75-125	70-130	30
	Naphthalene	75-125	75-125	70-130	25
	n-Propylbenzene	75-125	75-125	70-130	25
	Styrene	75-125	75-125	70-130	25
	1,1,1,2-Tetrachloroethane	75-125	75-125	70-130	25
	1,1,2,2-Tetrachloroethane	75-125	75-125	70-130	25
	Tetrachloroethene	75-125	75-125	70-130	25
	Toluene	75-125	75-125	70-130	25
	1,2,3-Trichlorobenzene	75-125	75-125	70-130	25
	1,2,4-Trichlorobenzene	75-125	75-125	70-130	25
	1,1,1-Trichloroethane	75-125	75-125	70-130	25
	1,1,2-Trichloroethane	75-125	75-125	70-130	25
	Trichloroethene	75-125	75-125	70-130	25
	Trichlorofluoromethane(Freon® 11)	75-125	75-125	70-130	25
	1,2,3-Trichloropropane	75-125	75-125	70-130	25
	1,2,4-Trimethylbenzene	75-125	75-125	70-130	25
	1,3,5-Trimethylbenzene	75-125	75-125	70-130	25
	Vinyl chloride	75-125	75-125	70-130	30
	o-Xylene	75-125	75-125	70-130	25
	m, p-Xylenes	75-125	75-125	70-130	25
	Methyl tertiary butyl ether (MTBE)	75-125	75-125	70-130	30
	Surrogates:				
	4-Bromofluorobenzene	86-115	74-121	70-130	N/A
	1,2-Dichloroethane-d4	80-120	80-120	70-130	N/A
	Toluene-d8	88-110	81-117	70-130	N/A
	Dibromofluoromethane	86-118	80-120	70-130	N/A

Table C-22. Control Limits for Matrix Spikes, Matrix Spike Duplicates, and Surrogate Spikes for Volatile Organic Compounds by GC/MS (EPA Method 8260B)

		Benicia Arsenal Control Limits					
		Percent Recovery (%)			Relative Percent Difference (%)		
		MS/MSD			MS/MSD		
Analytical Method	Spiking Compounds	Water	Soil	Air	Water	Soil	Air
SW8260B	1,1-Dichloroethene	61-145	59-172	65-135	14	22	40
	Trichloroethene	71-120	62-137	65-135	14	24	40
	Chlorobenzene	75-130	60-133	65-135	13	21	40
	Toluene	76-125	59-139	65-135	13	21	40
	Benzene	76-127	66-142	65-135	11	21	40

		Benicia Arsenal Control Limits					
		Percent Recovery (%)			Relative Percent Difference (%)		
		MS/MSD			MS/MSD		
Analytical Method	Spiking Compounds	Water	Soil	Air	Water	Soil	Air
	Surrogates:						
	4-Bromofluorobenzene	86-115	74-121	70-130	N/A	N/A	N/A
	1,2-Dichloroethane-d4	80-120	80-120	70-130	N/A	N/A	N/A
	Toluene-d8	88-110	81-117	70-130	N/A	N/A	N/A
	Dibromofluoromethane	86-118	80-120	70-130	N/A	N/A	N/A

**TEG NORTHERN CALIFORNIA
STANDARD OPERATING PROCEDURES (SOP)**

**GC/MS
EPA Method 8260B**

Revision 7
January 2004

1.0 Scope and Applications

This SOP has been prepared for TEG Laboratories to help insure consistent analytical protocol and applies to the performance of the EPA Method 8260B. The scope of topics discussed in this SOP include the following:

- * Method Summary
- * Instrumentation and Equipment
- * Detection Limits
- * Precision, Bias and Working range
- * Sample Collection, Preservation and Holding Times
- * Reagents and Standards
- * Procedure (Sample Preparation, Instrument Operation, Calibration and Analysis)
- * QA/QC Requirements
- * Run Logs
- * Reporting
- * Safety Precautions

2.0 Summary of Method

TEG Laboratories uses EPA Method 8260B to identify sixty-eight volatile organic compounds. Samples are introduced into the chromatograph by Purge and Trap by EPA Method 5030, and EPA Method 5035 either as a direct purge of soil or water or as an extraction followed by purge and trap of an aliquot of the extract. Soil vapor samples are treated in an identical manner to that of water samples with the exception that the internal standards and surrogates are added to water in the purge apparatus prior to the introduction of the vapor sample. The analysis is performed on a gas chromatograph (GC) with a quadrupole mass spectrometer (MS).

3.0 Instrumentation and Equipment

TEG has Agilent Technologies 6850 GCs with a 5973N Mass Selective Detectors (MSD) system for performing EPA Method 8260B. The purge and trap is a Tekmar Dohrman 3100 with an Archon purge & Trap autosampler with fifty-one sample capacity autosampler. The column is a J&W-624, 20m X 0.32 X 1.0u film thickness. The carrier gas is ultra high purity (UHP) Helium. A detailed description of the analytical method parameters are to be found in the initial demonstration of proficiency data package which is kept as part of TEGs initial lab certification.

Soil samples are weighed on top loading balances such as the Ohaus CT600 digital balance. Water samples are transferred by the Archon sampler to the purge and trap or measured in gas tight syringes from 5mL down to 10 uL. Purge and Trap grade methanol is used as the solvent for soil extractions. Ten ul and 25 uL syringes are used during dilution preparations. Sample preparation is performed with ventilation directed to the outside of the lab. Soil vapor samples are taken in gas-tight 5, 10 and 25 mL syringes and immediately transferred to the autosampler sparge tube.

Agilent Technologies Chemstation software version G1701CA with Enviroquant software running on Windows NT/Pentium personal computers are used for data acquisition and instrument control. Chromatograms are printed out on HP Laserjet printers.

The above-mentioned equipment requires 110 VAC as a power source to operate.

Sources of further information can be found in the Agilent Technologies GC, MS and Tekmar Purge and Trap hardware and software manuals, which are kept with each instrument. Each instrument also comes with Agilent Technologies maintenance information on CD, which can be viewed on the computer.

4.0 Reporting Limits

The normal reporting limits (RLs) are nominally 5-10 ng of compound on column. This corresponds to 5-10 ug/kg for a one-gram soil sample or 1 ug/L for 5 mL water or vapor samples. These limits should be compared annually to the MDL's to make certain that they are appropriate. Depending upon client data quality objectives (DQO's) TEG may report lower than these values. The reporting limits, however, should be no lower than twice the MDL calculated at initial instrument checkout and updated yearly or at major instrument overhaul. Results reported that are between the MDL and RL should be flagged with the "J" flag as a quantitative estimate. Reporting limits will be based on the low standard of the calibration curve.

5.0 Working Range

The applicable working range of the analyses for the EPA Method 8260B is dependent upon the concentrations of the calibration standards used while developing the calibration curve for the instrument. This calibration curve is discussed in Section 7.0, Calibration. Generally, the working range of the instrument is between the detection limit for the analyte and the concentration of the high standard used for system calibration (normally 500 ng). In the event that the analytical results are greater than the highest standard value, the sample must be diluted and reanalyzed. If for some reason the sample cannot be reanalyzed the "E" flag (estimated value) will be used to qualify the data. In the case of the LARWQCB protocol for soil vapor samples, the "E" flag will be used if the sample is greater than 150% of the high standard.

6.0 Sample Collection, Preservation and Holding Times

It is the responsibility of the field scientist (geologist, consultant, etc.), to collect all soil and water samples in manners which are consistent with protocol as set forth by federal, state and local regulatory agencies. The lab operator should assist in any manner possible but the ultimate responsibility lies with the sampler to assure that samples are taken in proper containers with preservatives if required. Care should be taken by the lab operator to insure that samples are not inadvertently contaminated in the lab.

6.1 Soil Samples

All soil samples should be collected in clean brass sample tubes (usually during drilling) or clean, laboratory approved, glass sample jars with Teflon liners. When brass sample tubes are used, the tube ends should be sealed with an impermeable material such as aluminum foil or Teflon tape. Next, the sample tubes should be capped with plastic caps and final-sealed with adhesive tape such as duct tape. It is important not to let the adhesive portion of the tape come in contact with the soil, as this adhesive material often contains toluene or other contaminants. Care should be taken to insure that the sample tubes are full and no headspace is present.

When using glass sample jars, they too must be completely filled to alleviate headspace. After filling, the jars should be securely capped with screw-on caps.

Once soil samples have been obtained, they should be placed in an ice chest or appropriate cooler by TEG. Care must be taken to insure the soil samples are kept at, or below, 4 degrees C +/- 2 degrees. The holding time for soil samples should not exceed 14 days from the time of collection.

6.2 Water Samples

As is the case with soil samples, it is the responsibility of the field scientist to insure that all water samples are collected in accordance with regulatory protocol. Water samples should be collected in glass vials designed to prevent the loss of volatile compounds. The vials should be completely filled, then securely capped with screw-on caps. No headspace should be present within the vials. To check for headspace, invert the capped vial and look for air bubbles.

Once water samples have been collected, they should immediately be placed in an ice chest or other appropriate cooler and maintained at a temperature of 4 degrees C +/- 2 degrees. Care must be taken to insure that the samples do not freeze, thus bursting the sample container. The holding time for water samples should not exceed 14 days from the time of collection.

6.3 Soil Vapor Samples

As is the case with soil and water samples, it is the responsibility of the field scientist to insure that all vapor samples are collected in accordance with regulatory protocol. Samples should be collected in gas tight syringes; Tedlar bags or other vessels designed to prevent the loss of volatile compounds. Holding times for the various sample vessels should be observed. TEG will observe maximum holding times of 72 hours for Tedlar bags, 2 hours for syringe samples.

Once vapor samples have been collected, they should immediately be placed on the purge and trap autosampler or in an appropriate container away from sunlight.

6.4 Chains-of-Custody

The laboratory operator or sample custodian accepts samples from the field. Samples should be delivered with the appropriate chain-of custody (COC) form. The lab operator or sample custodian should immediately open the cooler and inspect the contents of the cooler. The contents are removed and inspected against the COC. The custodian should note that the following are in place. The COC must contain:

- Unique sample identifier for all samples
- Date and time of sampling
- Source of sample including name, location and sample type
- Designation of MS/MSD
- Preservatives used
- Analyses required
- Name of collector
- Pertinent field data
- Serial numbers of custody seals and transport cases (if used)
- Custody transfer signatures and dates and times of sample transfer from the field to transporter and the lab
- Bill of lading or transporter tracking numbers (if applicable)

The sample custodian will check the COC for the above criteria in reference to the applicable methods. If any discrepancies are found, the custodian should document those on the COC or in the daily analysis logs. The custodian should also immediately inform the field personnel of the problem. No samples whose name or other information is in question should be analyzed. Once sampling personnel have solved the problem analysis can begin. Samples awaiting analysis are stored in refrigerators or freezers separate from those containing analytical standards.

6.5 Sample Storage

Samples for VOCs are stored in the lab refrigerator at 4 degrees +/- 2 degrees. The refrigerators are monitored for temperature 7 days per week and records maintained in the excursion log.

6.6 Sample Handling

6.6.1 High Level Samples

For the purposes of this SOP, high level samples will be defined as those samples exhibiting a noticeable odor, are wet with nonaqueous material or those which have been prescreened by another technique and shown to be high level or those designated by the field as high level.

The following precautions may be taken by the lab operator in order to protect their health and safety. Because all lab operators have been OSHA 40 hour trained, and are considered personnel of supervisory level, it will be left to the lab operator to determine the level of precaution required on an individual and project basis. The following protections are available to the operator.

- a) Preparation using eye protection and gloves
- b) Use of the well ventilated preparation room with doors open
- c) Use of the laboratory hood
- d) Store sample until more protection can be arranged.

If at any time the lab operator feels ill, especially after handling samples which may be high level, the operator should inform supervisory and/or medical personnel at the site and discontinue sample contact.

7.0 Calibration

7.1 Reagents and Standards

Purge and Trap grade methanol is used for all extractions and dilutions of standards. Stock standards for analytes, surrogates and internal standards are normally purchased and are diluted for use. All purchased and prepared solutions are recorded in Laboratory Standards notebooks. Each mobile lab and the fixed based lab have notebooks to log standards. Refer to TEG's SOP manual or the individual notebook for nomenclature of standards.

In addition to the stock standards, medium and/or low secondary standards are also necessary for GC/MS calibration. Normally a solution is diluted to a convenient volume such as 10 to 1. To prepare a medium dilution from a standard, measure 1 ml from the stock (high) standard with a 2500 ul syringe and transfer it to a 10-ml volumetric flask. Add methanol to the flask until a volume of 10 ml has been achieved. Calculate the concentration of the medium standard by dividing the concentration of the high standard by 10.

To prepare the low secondary standard, transfer 100 ul of the high standard to a 10-ml volumetric flask and add methanol until 10 ml has been achieved. Calculate the concentration of the low standard by dividing the concentration of the high standard by 100.

All standards should be transferred to glass vials, securely capped and labeled. The standards should then be refrigerated to at least 4 degrees c. All standards should be logged into the standards logs located within the vans or the house standards log. All standards should be stored in the standards refrigerators located within the vans and stored separately from samples.

7.2 Standard Expiration

Standards for VOC analysis will be prepared and given expiration dates shown below. Care must be taken that these dates do not exceed the manufacturer's date of expiration.

Internal Standards and surrogates	- 6 months
Non gas VOCs	- 3 months
Gaseous VOCs	- 1 month

Because internal standards and surrogate absolute amounts are non-critical, they will last longer in the absence of degradation. Volatile, non-gas standards such as 1,1 DCE have been found to decrease in the EPA 8260 solution matrix

spike solution over the course of 3 months. Gaseous VOC standards should be prepared from stock solutions every two weeks but may not remain over 1 month.

The lab operator should monitor response factors to determine whether standards are degrading. In general, response factors will vary with tuning characteristics. However, comparison to response factors from fresh standard is suggested.

8.0 Procedures

8.1 System Start-Up

The mass spectrometer is maintained heated and under vacuum through the use of the generator, or shore power. Helium is always supplied to the gas chromatograph but is automatically shut off when the GC is off through the electronic pressure control.

Upon arriving on site:

- 1) Connect to shore power (if available) and wait for the delay period to ensure that the system is running on AC. Fill out excursion log.
- 2) Start air conditioners if needed.
- 3) Supply power to the GC, purge and trap and autosamplers. Make sure computer and printer also have power. Load method 8260 on the GC and make sure system is "ready".
- 4) Start computer. Go to windows and load "ENV TOP", Purge and Trap will beep to indicate power had failed. Follow directions to click OK.
- 5) Select "MS Tuning", Diagnostics, Vacuum Status to view vacuum status. diff. pump should be hot, MS should be around 145-165 degrees, 150 degrees for the analyzer and foreline pressure around 35-45 mm.

8.1.1 Initial System Calibration

Prior to performing analyses, the GC-MS must be tuned and calibrated to insure system precision and accurate results.

Tuning of the GC-MS is accomplished using the Agilent Target Tune function in the BFB tune mode. The instrument automatically performs the tuning in an attempt to adjust parameters such that the spectrum of the compound 1,4-Bromofluorobenzene will meet the following specifications:

- Mass 50 15 percent to 40 percent of mass 95
- Mass 75 30 percent to 60 percent of mass 95
- Mass 95 base peak, 100 percent relative abundance
- Mass 96 5 percent to 9 percent of mass 95
- Mass 173 less than 2 percent of mass 174

- Mass 174 greater than 50 percent of mass 95
- Mass 175 5 percent to 9 percent of mass 174
- Mass 176 greater than 95 percent, but less than 101 percent of mass 174
- Mass 177 5 percent to 9 percent of mass 176

Following tuning, BFB must immediately be evaluated in the next blank or standard to determine the validity of the tune. Once the tune has passed, samples can be analyzed for a 12 hour period. After 12 hours the calibration midpoint and BFB must be re-evaluated before analyzing additional samples. If the above criteria are not met, the instrument must be retuned or the problem found prior to proceeding.

Prior to performing analyses, the GC-MS must be calibrated to insure system precision and accurate results. To calibrate the GC-MS, standards of the analytes, along with internal standards and surrogates are injected into reagent water, and measured by the method. (For convenience in standard preparation four standards are used, internal standards, surrogate standards, the 8260B compounds and the 8260B permanent gases. A minimum of five concentration levels should be used during calibration for EPA Method 8260B. Each standard solution is analyzed under the identical parameters as samples will be analyzed. The end result is a calibration curve for each analyte. (Note: Certain regulatory protocols i.e. LARWQCB and specific client Data Quality Objectives (DQOs) may require fewer than five initial calibration standards)

To prepare a calibration curve:

- 1) Turn on the system. Refer to Section 7.1.
- 2) Load a Method (e.g.M18260.mth) into the software. Schedule the autosampler for the correct sample que.
- 3) Inject 20ng of the 8260B compounds, 20ng of the 8260B gases, 20 ng of the surrogates and 50ng of the internal standards into 5 mL of reagent water in a five-mL syringe. Connect the syringe to the purge apparatus and load the purge tube with the standard/water mix. Initiate the run by clicking start in the P&T windows.
- 4) Repeat for 50ng, 100ng, 150ng, and 200ng of target and surrogate keeping the internal standards constant at 50 ng. Other levels may be used to extend the calibration curve to higher concentrations.
- 5) After completing the standards, quantitate and load the five standards as the initial calibration. Evaluate the initial curve for linearity and response factors per the current version of EPA Method 8260B (or project specific DQO's).
 - a) The SPCC compounds must have RF's greater than

Chloromethane	0.1
1,1-Dichloroethane	0.1
Bromoform	0.1
Chlorobenzene	0.3
1,1,2,2-Tetrachloroethane	0.3
 - b) The CCC compounds must have %RSD less than 30%.

The CCC's are vinyl chloride, 1,1-Dichloroethene, chloroform, 1,2-Dichloropropane, toluene, ethylbenzene.

- c) Target compounds that have a %RSD less than 15% are considered to be linear within the calibration curve. For these compounds the average response factor is chosen as the calibration curve type.
- d) Targets with %RSD greater than 15% may be treated in the following manner.
 - 1. The analyst may run an additional calibration point and drop either the high or low point of the curve thus achieving an abbreviated or narrower linear range for the curve. In this instance, this compound will have a lower high point for the curve. If the low point is dropped, the reporting limit must be raised proportionately.

OR

- 2. A minimum of a six-point curve may be prepared and a quadratic fit of the points used for calibration.

The calibration curve is checked for validity using a calibration standard from a second source. The second source is introduced into the system in the same manner as the curve. In order for validity to be achieved the second source must pass the requirements of a daily calibration i.e., SPCC's and CCC's must pass per method

The calibration curve must be verified each working day by injecting standards. SPCCs must have RF's at least equal to the levels specified above. CCC compounds must be less than 20% for the system to be considered still within calibration.

If all the above CCC compounds do not meet the 20% criteria several options are available.

- a. The analyst may reanalyze the calibration standard, reprepare the calibration standard and reanalyze and/or perform instrument troubleshooting and reanalyze.
- b. The average of the %drifts for all calibrated target compounds may be calculated. If this is less than 20% the system may be assumed to be calibrated. However, calibration data should accompany the report so that the user may know which compounds did not meet the criteria. In this case, however, no compound may have a %RSD greater than 40%.
- c. Target compounds may be individually screened to see if they meet the 20% criteria. If the target analytes meet the 20% criteria, analysis may continue.
- d. Data from those compounds which do not pass the 20% criteria may be flagged as estimated.

8.2 Laboratory Blank Preparation

Place a clean purge tube in the purge tube holder or autosampler position.

- 1) Add 5 ml blank water (nitrogen purged bottled drinking water, e.g. Alhambra, Arrowhead) to a 5 mL syringe. Using a 5 or 10 ul syringe add 50ng internal standard (I.S.) and 50ng of surrogate solution. The I.S. and Surrogate solutions may be combined for daily calibration, sample and blank analysis although they must be separate for initial calibration.

Sample Receipt

Samples are received by the laboratory (either mobile or fixed base) and documented by a chain-of-custody (if receiving in the field, the lab operator may record the chain-of-custody if needed) Samples which are not ready for immediate preparation and analysis should be stored in the mobile lab refrigerators or in the freezers in the fixed based lab.

8.3 Low Level Soil Sample Preparation/analysis

Soil samples should be prepared using the following steps:

- 1) Check the balance with the calibration weight of ASTM class 3. Record the weight and expected weight on the daily extraction log. The balance should be checked daily when samples are extracted or when the balance is moved.
- 2) Tare (zero) the balance with a clean VOA vial, containing a stir bar, on the balance tray. Add 5.0 grams of soil to a VOA vial with a clean scoop or 5.0 gram subcore as outlined in EPA method 5035. Add 5.0 ml of reagent grade water. Place the VOA vial on the autosampler.
- 3) The autosampler adds an additional 5 ml of reagent water and 50 ng of I.S./surrogate to the sample vial. The sample is purged through the sealed VOA vial.
- 4) The sample is analyzed on the GC/MS.

8.4 Medium/High Level Soil Sample Preparation/Analysis

Soil samples should be prepared using the following steps:

- 1) Check the balance with the calibration weight of ASTM class 3. Record the weight and expected weight on the daily extraction log. The balance should be checked daily when samples are extracted or when the balance is moved.
- 2) Tare (zero) the balance with a 40-mL VOA bottle on the balance tray. Add 5.0 grams of soil to the tube with a clean object such as a scoop. Add 5.0 mL of Purge and Trap grade Methanol to the VOA. Shake.
- 3) Add 5.0 ml reagent water to the 5.0 ml syringe and add 50 ng I.S./surrogate solution. Then add an aliquot of the MeOH extract to the syringe and add to the

purge tube on the autosampler. Depending upon the expected concentration of analytes in the sample aliquots of 25ul, 10ul, 2ul may be chosen. The respective dilution factors associate with these are 40, 100 and 500 respectively.

4) The sample is analyzed on the GC/MS.

8.5 Water Samples Extraction Preparation

Prepare water samples using the following steps:

- 1) Insert VOA vial containing the water sample into the autosampler.
- 2) The autosampler transfers a 5.0 ml aliquot of sample to the purge & trap unit as 50 ng of I.S./surrogate is added to the sample.
- 3) The sample is purged in the purge & trap unit.
- 4) The sample is analyzed on the GC/MS.

8.5.1 Soil Vapor Samples Preparation

Prepare soil vapor samples using the following steps:

- 1) Transfer 5 ml of reagent water to a syringe
- 2) Add the required amount of internal standard and surrogates (2.5ul)
- 3) Inject the water into the purge tube.
- 4) Inject the soil vapor into the purge tube, through the water.

8.6 Analysis

Once the system has been turned on, the daily calibration checked and a blank analyzed, samples may be analyzed. After preparing the sample extractions as directed above, the procedures outlined below should be followed for sample analysis.

8.6.1 STANDARD OPERATING PROCEDURE FOR 8260B ANALYSIS

8.6.1.1 Turn on GC-MS, Purge and Trap, Autosampler, and computer. Load method files on P&T and GC-MS. Use sequencing for multiple GC-MS analyses. Use scheduling to run multiple P&T samples.

8.6.1.2 Analysis of blank water

- a. Add 5 mL blank water to syringe.
- b. Add 50 ng each of surrogates and internal standards solutions to water
- c. Introduce into purge tube. Start run.

8.6.1.3 Standard Analysis

- a. Add 50 ng targets and 50ng surrogates and 50 ng internal standards to 5 mL reagent in the syringe.
- b. b. Introduce into purge tube and analyze.

8.6.1.4. Remove and clean purge vessel.

8.6.2 Data Analysis

8.6.2.1. Blank must have all targets < R.L.

8.6.2.2 Daily Calibration standard must have all SPCC and CCC compounds within method specifications otherwise corrective must be taken.

All SPCCs must be within specifications of the method. A second calibration can be analyzed. If all SPCC compounds do not meet criteria instrument troubleshooting should be performed.

If all CCC compounds are within 20% drift then all analytes are assumed to be within calibration. If any one CCC compound has a response factor that differs from its average by more than 20%, then each compound must be examined to determine whether it fits the 20% drift criteria. (Exception: If vinyl chloride is the only CCC out of calibration all compounds except the gases may be assumed to be calibrated.) Otherwise compound "hits" out of calibration must be flagged as estimated. Data quality objectives may be revised on a project by project basis to relax this requirement.

8.7 Detection Limits/ Reporting Limits

When samples are diluted for 8260B, the R.L.s are raised proportionately. All multipliers must also be applied to the R.L.s as well. Dilutions are recorded on the daily extraction/run logs and are entered into the HP chemstation software for the particular analysis.

8.8 Data Processing

8.8.1 Peak Integration

The GC/MS data system will perform peak integration of the target ion chromatograms. If parameters for thresholding and peak width are correctly set (see HP manuals), the algorithm used by the Hewlett-Packard instruments should correctly integrate 90% or greater of the ion chromatograms correctly. It is recommended that the operator allow this to occur and to simply view or monitor the result.

Sometimes manual integration is necessary. The following are some common examples in Method 8260 where manual integration may be necessary.

- 1 Gaseous VOCs at low levels

Owing to noise at the top of the peak the program may only choose one half of the peak to integrate.

- 2 Peak tailing
Excessive peak tailing can add significant area to a peak. The peak should be cut off such that the peak is as symmetrical as possible.
- 3 Unresolved peaks
The program may pick the wrong peak to quantitate. eg. the internal standard chlorobenzene-d5 is not always completely resolved from chlorobenzene and the latter is chosen. This may be manually integrated using a drop to baseline method.
- 4 Interference
Interference with the target ion may require manual integration. eg. the surrogate 1,4 bromofluorobenzene is often interfered by fuel hydrocarbons.
- 5 Noise in the baseline
Noise in the baseline may add area to compounds which may incorrectly increase the amount detected. This is more often a problem at the lower levels. A noisy baseline can be witnessed by several small "bumps" in the ion chromatogram preceding or following the peak of interest. If noise is evident it shall be acceptable to manually integrate from the top of the noise line instead of the "zero" baseline level.

When manual integration is necessary, it must be documented. The operator should follow the following guidelines.

Check to see how the particular compound integration is performed on the standards (ICAL, CCAL). Is it baseline, valley to valley, etc?

Manually integrate the compound in the new data file in a manner as consistent with (a) as possible.

Print copies of the computer integrated and manually integrated ion chromatogram showing the integration.

Document the reason for the manual integration (see 1-4 above) sign and initial the hardcopies.

8.8.2 Reporting and Review

8.8.2.1 The Data Package

The analyst will prepare a data package for Reporting and Review. For EPA Method 8260B the package will be produced on a daily basis corresponding to the 12-hour window of operations. The package will consist of the following in the order listed or as near as possible to that order

The Original COCs for the samples analyzed during that day

The daily run logs

The BFB tuning report

Edited Quantitation reports from the daily initial Calibration (ICAL) or the passing Continuing Calibration Verification (CCV)

The Response factor summary (if ICAL) or the Evaluation of CCV (if daily CCV)

Edited quantitation report from a blank analysis

Edited quantitation reports for all analyses.

Edited quantitation for LCS/LCSD and MS/MSD if applicable.

LCS/LCSD and MS/MSD summaries with control limits.

In addition to the above daily package, other data pertinent to the project should be supplied to the data entry person(s) and the reviewer. Such project specific information as out of control events and associated recommendations for qualifier flags, corrective actions, MDL studies should be added to the above package if required by project DQOs.

The analyst will assure that the data is in the proper format above before passing it on for data entry or review.

8.8.2.2 Report Review

Data Review will consist of a second party review of the data generated during this project. The data reviewer will check:

- 1) Folder
 - Project Number
 - Project Name (site)
 - Project date
- 2) Accounting Information
 - Lab confirmation form
 - Report to information
 - Billing to information
- 3) Print report on plain paper
- 4) From Chain of Custody Record confirm:
 - a. Project information (client, project No. etc.)
 - b. Correct dates

Special instructions or out of control items
Does the COC sample names match the report.
e. Check the COC for the following items:

Unique sample identifier for all samples

Date and time of sampling

Source of sample including name, location and sample type

Designation of MS/MSD

Preservatives used

Analyses required

Name of collector

Pertinent field data

Serial numbers of custody seals and transport cases (if used)

Custody transfer signatures and dates and times of sample transfer from the field to transporter and the lab

Bill of lading or transporter tracking number (if applicable)

5) From Raw Data:

Organize raw data in order of date

Go through the raw data page by page

Date - is the correct date analyzed listed

BFB tuning - does it pass?

Blank - is it clean

ICAL - does it meet project QC requirements (if applicable)

ICV - does it meet project QC requirements?

CCAL - is it acceptable under project QC

LCS - within specifications

Sample - identify each individual set of data

6) Using the final report forms, check that the raw data from above is correctly entered in the proper places on the forms. Apply data qualifier flags to the data as necessary according to project requirements.

7) Edits

In spreadsheet, with edited copy of rough draft

Page by page make all changed marked in red

Print out on letterhead

Compare final to rough draft

8) Mail

Prepare the report; spreadsheet pages, and COC.

Make a complete copy for our file

9.0 Quality Assurance and Quality Control

Quality Assurance (QA) and Quality Control (QC) are a set of procedures and conditions designed to maximize the precision and accuracy of the analytical process. QA/QC is a continuous process requiring verification by inspection and, if necessary, appropriate corrective action. Listed below are key items used to insure proper QA/QC. A brief description of each term is included, along with TEG and regulatory requirements.

- Initial Calibration
- Continuing Calibration
- Chain-of-custody
- Detection Limit
- Minimum detection limit (MDL)
- Reporting Limit
- Matrix Spiking
- Blanks
- Percent Recovery Calculation
- Relative Percent Difference (RPD)
- Laboratory control Limits
- Sample Run Logs

9.1 Initial Calibration (ICAL)

Prior to performing sample analysis, the GC must be initially calibrated. Following a clean blank analysis, a minimum of five levels of target compounds along with surrogates and internal standards are introduced into the GC/MS system and the total area under each peak determined. These values are entered into the software. The computer will construct the calibration curve according to one of several methods. Among these are (a) average response factors, (b) straight line through origin, (c) straight line using origin, (d) quadratic. Hardcopy output of the five chromatograms should be saved and kept with the instrument throughout the lifetime of the ICAL. The hardcopy output should list the method used to generate the ICAL curve. The ICAL is considered valid until the continuing calibration fails or a major change in the instrument operating condition occurs.

9.2 Continuing Calibration (CCAL)

The calibration of the instrument is checked prior to running samples. The continuing calibration (CCAL) or continuing calibration verification (CCV) uses a second source of the standard to check the validity of the ICAL. Normally a standard corresponding to the midpoint of the curve is chosen. Response of the compounds of interest must be within that specified by the method for the continuing calibration check compounds (CCCs) for the curve to be valid. If not all compounds are of interest only those being analyzed need to be checked.

9.3 Chain of Custody Record

A Chain of Custody Record serves to note the disposition of the samples, from the time of collection to laboratory receipt. This form should be filled out at the

time of collection and signed by all persons collecting, relinquishing and receiving samples. All samples must be documented on an appropriate Chain of Custody form.

9.4 Detection Limits

9.4.1 Minimum Detection Limit (MDL)

The method detection limit (MDL) is the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. The laboratory shall establish MDLs for each method, matrix, and analyte for each instrument the laboratory plans to use for the project. The laboratory shall revalidate these MDLs at least once per twelve-month period. The laboratory shall maintain proof of the MDL demonstrations (i.e., before project samples are analyzed) and upon request in the format specified in Section 8. Results less than or equal to the MDL shall be reported as the MDL value and flagged with a "U" (see Section 8).

Laboratories participating in this work effort shall demonstrate the MDLs for each instrument, including confirmatory columns, method of analysis, analyte, and matrix (i.e., water and soil) using the following instructions:

- (1) Estimate the MDL using one of the following:
 - a) The concentration value that corresponds to an instrument signal/noise ratio in the range of 2.5 to 5, or
 - b) The concentration equivalent of 3 times the standard deviation of replicate measurement of the analyte in reagent water, or
 - c) The region of the standard curve where there is a significant change in sensitivity (i.e., a break in the slope of the standard curve).
- (2) Prepare (i.e., extract, digest, etc.) and analyze seven samples of a matrix spike (ASTM Type II water for aqueous methods, Ottawa sand for soil methods, glass beads of 1 mm diameter or smaller for metals) containing the analyte of interest at a concentration three to five times the estimated MDL.
- (3) Determine the variance (S^2) for each analyte as follows:

$$S^2 = \frac{1}{n-1} \left[\sum_{i=1}^n (x_i - \bar{x})^2 \right]$$

where x_i = the i th measurement of the variable x and \bar{x} = the average value of x

$$\bar{x} = \frac{1}{n} \sum_{i=1}^n x_i$$

- (4) Determine the standard deviation (s) for each analyte as follows:

$$s = (S^2)^{1/2}$$

- (5) Determine the MDL for each analyte as follows:

$$\text{MDL} = 3.14(s)$$

(note: 3.14 is the one-sided t-statistic at the 99 percent confidence level appropriate for determining the MDL using 7 samples)

(6) If the spike level used in step 2 is more than 5 times the calculated MDL, repeat the process using a smaller spiking level.

Where multiple instruments are used, the MDL used for reporting purposes shall represent the least sensitive instrument.

9.4.2 Reporting Limit

The Reporting Limit (RL), also referred as the Practical Quantitation Limit (PQL), is equal to the lowest level of the calibration curve which should be 2 to 5 times greater than the MDL. Results between the MDL and the RL will be reported as estimated.

9.5 Laboratory Control Samples and duplicates (LCS/LCSD)

Laboratory control standards and duplicates, prepared at the midpoint concentration, are to be analyzed once per analytical batch of up to 20 samples. The RPD between the LCS and the LCSD should be less than 30%.

9.6 Matrix Spike and Matrix Spike Duplicate

The Matrix Spike (MS) and Matrix Spike Duplicate (MSD) are two aliquots of the same sample, which have been spiked with a known concentration of a target analyte. Together, the results of these two sample spikes are used to indicate method precision and accuracy, and to characterize the effects, if any, of matrix interference. TEG uses a minimum of 5 percent of all samples for these spikes.

9.7 Blanks

A Method Blank is an analyte free matrix sample, run through the sample preparation and analysis procedures of those used for samples. These blanks check the levels of contamination for the method.

9.8 Percent Recovery Calculation

The values for the MS and MSD are used to calculate the Percent Recovery (PR), an estimate of the accuracy of the analytical process. The Average PR can be calculated using the following general equation:

$$\text{Average PR}_{\text{SA}} = \frac{(\text{MS} + \text{MSD})}{2} \times 100$$

where: PR = Percent Recovery
 MS = Matrix Spike Result
 MSD= Matrix Duplicate Spike Result
 SA = Spiked amount

TEG calculates the PR for each set of spikes (MS and MSD) and the resultant value is included in the QA/QC section of the report. TEG will report the individual percent recoveries for the MS and MSD for this project.

9.9 Relative Percent Difference

The Relative Percent Difference (RPD) is calculated from MS and MSD data and is used to estimate overall method precision. The RPD can be calculated using the following general equation:

$$RPD = \frac{MS - MSD}{(MS + MSD)/2} \times 100$$

This RPD data is calculated for each set of spikes (MS and MSD) and is included in the QA/QC section of the report.

9.10 Laboratory Control Limits

Each certified laboratory establishes their own set of Laboratory Control Limits (LCL's). These limits include criteria such as recovery ranges and maximum allowable RPD's. TEG has established the following preliminary list of control limits for EPA Method 8260B from the method:

MS/MSD or LCS/LCSD:	Average percent recovery	RPD
1,1-Dichloroethene	60-130	<30
Trichloroethene	60-130	<30
Chlorobenzene	60-130	<30
Benzene	60-130	<30
Toluene	60-130	<30

Surrogate recovery:

4-Bromofluorobenzene	60-140
dibromofluoromethane	60-140
toluene -d8	60-140

Spiked matrix/duplicate pairs which exceed this limit are either reanalyzed or a matrix blank is spiked (Lab Control Spike) to check method performance.

Samples whose surrogate exceeds the limits are reanalyzed one time.

9.11 Sample Run Logs

TEG maintains a Sample Run Log for all samples analyzed. These logs are kept within a logbook, one of which is located in each lab. A new log is prepared for each work day. The following information is included on the run logs:

- Date of operation
- TEG job number
- Operator name
- Instrument No.
- Analysis type
- Solvent type
- Extraction method
- Matrix Spike, Matrix Spike Duplicate information
- Sample extraction data (sample amount, solvent amount, dilution factor, etc.)
- Calibration Standard identification
- Sample Analysis data

Also located in each van are instrument and excursion logs. The instrument log is used to document problems and subsequent corrective action for the instrumentation (excessive column bleed, baseline irregularities, interference, etc.). The excursion log documents where and when the particular job takes place, the type of analysis, and operating conditions (weather, temperature, etc.). The excursion log should be filled out for each new job.

10.0 Reporting

The following information should be included in each TEG report:

- Client
- Client job number
- Site location
- Dates samples received
- Dates samples analyzed
- Analyst
- Sample results in table form
- Sample number
- Amount found and units
- Detection limit for each sample
- QA/QC report for each method used
- Chain of custody

Cover letter

- A brief description of the method

Narrative

- A description of any unusual or notable events or conclusions

10.1 Data Retention

TEG maintains hardcopy data for a period not less than five years. Electronic data is currently maintained 10 years old which is the age of the company.

11.0 Preventive Maintenance

Preventive Maintenance (PM_) is that set of procedures taken in an effort to assure that sample throughput is continued and that data quality is not degraded by system malfunctions. Although failure to perform preventive maintenance does not of itself produce poor quality data, the lack of such procedures may lead to earlier degradation of data and slower processing of samples.

This section treats PM in two sections: preparation and instrument PM.

11.1 Preparation PM

The primary area where preventable errors can enter throughout the preparation steps is the introduction of contamination. Preventive maintenance in the preparation steps primarily consists of thorough washing of glassware and other apparatus.

11.1.1 Purge tubes are cleaned by washing with tap water, rinsing with reagent water and baked prior to reuse. The GC oven is used to bake the purge tubes before reuse.

Purge tubes which had high level samples in them should receive a methanol rinses prior to aqueous washing.

At washing inspect the purge tubes for cracking at the top of the tube.

11.2 Instrument PM

There are five pieces of instrumentation involved in the analysis of volatile organics by GC/MS. These are:

- (1) Mass Spectrometer
- (2) Gas Chromatograph
- (3) Purge and Trap concentrator
- (4) Purge and Trap Autosampler
- (5) computer system

1) TEG Labs follows the manufacturer's recommendations on mass spectrometer PM. Monitoring and changing rough and diffusion pump oil, cleaning of source are performed at regular intervals. A full stock of parts are kept in the lab including but not limited to source filaments and cleaning apparatus.

2) Gas Chromatograph PM consists primarily of maintaining a full stock of consumable parts. Swagelok nuts, ferrules, septa, extra columns etc. allow the operator to repair, change worn parts quickly and to continue operation without loss of time. Tubing should be periodically inspected for

cracks and possible leaks. Monitoring of the gas levels and rate of pressure loss may help discover problems.

3) The purge and trap concentrator can be monitored for leaks by observing the pressure of purging. In general the purge operates at a purge pressure of 4-5 psi. A pressure less than this may indicate a leak in the purge vessel.

4) Autosampler(AS) PM is mainly concerned with cleanliness of the purging system and the checking of leaks. Following high level samples and standards it is desirable to run blank water and purge gas through the AS.

5) The Computer system PM consists of keeping dust and dirt out of the components and backing up the data and methods as often as possible.

12.0 Safety

TEG employs conservative safety practices at all times. Eye protection is to be worn by all laboratory operators while sample preparation; extraction and analysis are taking place. The laboratory operator is not to enter the exclusion zone (nor any other areas designated as exclusive by the field safety officer) at any time. Sample handling will be carried out beneath the "hood" when possible. Smoking is not permitted in the van and eating is not permitted in the analysis area of the van. Fire extinguishers, first aid kits and Material Safety Data Sheets are located in each van.

Modified EPA 8015 Analysis
Diesel, Motor Oil/ Extended Range Hydrocarbons
Using EPA method 3550 Solvent Extraction
Standard Operating Procedures (SOP)

TEG Northern California

December 2003, revision 1

11350 Monier Park Place
Rancho Cordova, California 95742
916-853-8010

Analytical Methodology

The following protocol presents procedures, necessary information, and guidelines for analyzing water and or soil for non-volatile hydrocarbon products. This protocol, along with our highly experienced analysts combine to give the client the highest quality analytical results available.

Operating Conditions and Instrumentation

Diesel, Motor Oil/ Extended Range Hydrocarbons by EPA Modified 8015

Instruments: Shimadzu GC-14A Gas Chromatograph or equivalent

Column: 15 meter DB-5, megabore capillary.

Detectors: Flame Ionization Detector (FID).

GC 1 8015 settings:

Oven Temperature	
Initial Temp	80°
Hold	2 min
Ramp	15°/min
Final Temp	250°
Injector Temp	250°
Carrier Flow	10 ml/min
Detector Temp	250°
Output	Rec 1 output FID 1 Rec 2 output FID 2
Range	FID 1 - 1 FID 2 - 1
Attenuation	Rec 1 - 4 Rec 2 - 4
Autozero	FID 1 - A/Z OFF FID 2 - A/Z OFF
Events	None

Standard Preparation

Primary (stock) standards: Neat concentrations of diesel fuel #2 for diesel range organics and SAE 10W30 motor oil for motor oil/extended range organics.

Secondary (working) Standards: Made by diluting primary standard. Typical concentrations are 20-50ug/ml, 200-500 ug/ml, and 2000-5000 ug/ml.

Laboratory Check Samples are prepared at the midpoint concentration from a standard purchased from a source different than the primary standards.

Lot numbers and preparations of all standards are recorded on a log sheet and kept on file.

Initial Multi-Point Calibration Curve

An initial calibration curve of a minimum of 5 points is performed:

- When the GC column or operating conditions have changed;
- When the daily mid-point calibration check cannot meet the requirements as specified below.

Calibration curves for Diesel, Motor Oil / Extended Range Hydrocarbons are prepared by analyzing low, mid, and high calibration standards covering the expected concentration range (e.g. 50ppm, 500ppm and 5000ppm for diesel). The lowest standard concentration will not exceed five times the detection limit for each compound.

A linearity check of the calibration curve for each compound is performed by computing a correlation coefficient and an average response factor. If a correlation coefficient of 0.990 or a percent relative standard deviation (%RSD) of $\pm 20\%$ is obtained, an average response factor (RF) is used over the entire calibration range. If the linearity criteria are not obtained, quantitation for that analyte can be performed using a calibration curve.

After each initial multi-point calibration, the validity of the curve is further verified with a laboratory control standards (LCS) prepared at the mid-point of the calibration range. The LCS includes all target compounds and the response factor (RF) must fall within $\pm 20\%$ of the factor from the initial calibration curve.

Compound Identification and Quantification

All analyses are performed with megabore capillary columns following EPA Method 8000 protocols. All compounds detected in the samples are identified by chromatographic retention times established using C10, C20, and C24 and quantified using the average response factor from the active calibration curve. The carbon range for diesel is C10 to C24. The carbon range for identifying motor oil (residual organics) is beyond C24 to the end of the chromatogram.

Detection Limits / Reporting Limits

Detection limits are determined by a method detection limit study (MDL). The Reporting Limit (RL), also referred as the Practical Quantitation Limit (PQL), is equal to the lowest level of the calibration curve which should be 2 to 5 times greater than the MDL. Results between the MDL and the RL will be reported as estimated.

Analytical Quality Control

Method Blanks

Method blanks are performed at the start of each day by analyzing reagent grade water with appropriate surrogates. These blanks verify all components of the analytical system are free of contamination. Additional blanks are performed as appropriate depending upon the measured concentrations, at a minimum 1 every 20 samples. The results of all blank analyses are recorded in the data tables. If a blank shows a measurable amount of any target compound, the on-site chemist will investigate and determine the source, and resolve the contamination problem prior to analyzing any samples.

Duplicate Samples

Duplicate analysis of a sample is performed at least once every 20 samples, or once a day, or when inconsistent data are observed.

Continuing Calibration (Daily Mid-point Calibration Check)

Continuing calibration standards prepared from a traceable source are analyzed at the beginning of each day. Acceptable continuing calibration agreement is set at $\pm 15\%$ to the average response factor from the calibration curve. When calibration checks fall outside this acceptable range for analytes detected on the site, corrective action, consisting of verification of the standard and/or a new calibration curve for the analytes out of specifications, is performed by the on-site chemist.

The continuing calibration includes all compounds expected or detected at the site and any specific compounds designated in the project work plan.

A continuing calibration shall be analyzed once a day and after every 20 samples run.

Laboratory Control Standards (LCS) and LCS Duplicates (LCSD)

Laboratory control standards and duplicates, prepared at the midpoint concentration, are to be analyzed once every 20 samples or once per analytical batch. The RPD between the LCS and the LCSD should be less than 30%.

Soil Samples

All soil samples should be collected in clean brass, or plastic sample tubes (usually during drilling) or clean, laboratory approved glass sample jars with Teflon liners. Care should be taken to insure that the sample tubes are full and no headspace is present and sample jar lids are securely capped with screw-on caps.

Once soil samples have been obtained, they should be placed in an ice chest or an appropriate cooler by TEG. Care must be taken to insure the soil samples are kept at, or below, 4 degrees C + or - 2 degrees. The holding time for soil samples should not exceed 14 days from the time of collection.

Water Samples

As is the case with soil samples, it is the responsibility of the field scientist to insure that all water samples are collected in accordance with regulatory protocol.

Once water samples have been collected, they should immediately be placed in an ice chest or other appropriate cooler and maintained at a temperature of 4 degrees C + or - 2 degrees. Care must be taken that the samples do not freeze, thus bursting the sample container. Dry ice must never be used with water samples. The holding time for unpreserved water samples is 7 days and 14 days for preserved samples from the time of collection.

Water Sample Preparation

Low Concentration Samples:

For aqueous samples, a 100 ml aliquot is measured into a flask and spiked with 10ul of Bromofluorobenzene (BFB) surrogate and 1 ml of solvent. The flask is then capped and agitated for 5 min and then allowed to settle. 3ul of solvent are withdrawn and directly injected into the GC.

High Concentration Samples:

For aqueous samples, a 30 ml aliquot is measured into a VOA vial and spiked with 10ul of Bromofluorobenzene (BFB) surrogate 1 ml of solvent. The flask is then capped and agitated for 5 min and then allowed to settle. 3ul of solvent are withdrawn and directly injected into the GC.

Soil Sample Preparation

a 5 g aliquot of soil is taken from the sample tube and 1-3g of sodium sulfate is placed into a 40ml VOA with 10ul BFB surrogate added and 5ml of high purity Hexanes solvent. The vial is then capped and agitated for 5 minutes and placed in a sonicator bath for 10 minutes. Using a 10ul syringe, 3ul are withdrawn and directly injected into the GC.

Identification of peaks

Samples are confirmed by comparing their retention range with that of the daily standard and the surrogate. If the surrogate retention time is out of compliance, the on-site chemist must determine the cause (leaking septa, carrier gas flow change) fix and recalibrate if necessary.

Surrogate

Surrogate compound is added to all calibration and daily mid-point check standards, blanks and site samples. The surrogate recovery must not exceed $\pm 40\%$ from the true concentration.

Dilution of Samples

If the concentration of the sample falls outside the calibrated range a dilution of the sample is necessary. A 10:1 dilution is made by taking 100ul of the solvent extract and mixing it with 900ul of solvent in a vial. A 100:1 dilution is made by taking 10ul of the solvent extract and mixing it with 900ul of solvent in a vial.

Laboratory Data Logs

The field chemist maintains sample analysis records including date and time of analysis, chemist's name, sample ID number, concentrations of compounds detected, calibration data, and any unusual conditions.

Analytical Procedures

Daily Start-up Procedure

- CG carrier gas flow rate is set to proper value.
- CG oven, injector, and detector temperatures at proper values.
- FID is on.
- Computers are on and integration software booted up.
- Proper signals from detectors confirmed on computer.
- Confirm that RF of midpoint falls within the appropriate RPD.

Analytical Procedure

- Sample is received from the field and checked for proper labeling and logged on to the chain of custody.
- A visual inspection of the sample is done to check the integrity of the sample.
- The sample is extracted; 3uL of extract is direct injected into the GC.
- Computer data system identifies peaks and integrates the compounds.
- Lab analyst checks to confirm correct peak identification, retention time, surrogate response, and that compound concentration is within calibration range.
- Date, time, dilution and analysis results are recorded on analysis log sheet and entered into a spreadsheet.

Quality Control Procedures

Staff Responsibilities

Staff responsibilities regarding operating and quality assurance procedures are assigned as follows:

Field Supervisor/Chemist:

- daily maintenance, startup and calibration of analytical equipment
- daily performance of quality control protocol
- sample and QA/QC sample analysis
- preparation of standards for linearity checks
- documentation of analyses, problems, QA, maintenance of project files
- preparation of preliminary analytical report

Laboratory Director Responsibility:

- preparation of SOPs and QA/QC protocol
- implementation of QA program and technical training of personnel
- document control, security and confidentiality
- technical application and development
- verification of project data completeness
- verification of QA/QC compliance
- verification of client requirements
- preparation of QA report to include: technical difficulties, QA/QC results and conclusions



California Regional Water Quality Control Board

San Francisco Bay Region



Terry Tamminen
Secretary for
Environmental
Protection

1515 Clay Street, Suite 1400, Oakland, California 94612
(510) 622-2300 • Fax (510) 622-2460
<http://www.swrcb.ca.gov/rwqcb2>

Arnold Schwarzenegger
Governor

Date: JUN 29 2004
File No. 2129.2078 (GJR)

Department of the Army
U.S. Army Engineer District
Sacramento District, Corps of Engineers
Attn: Ms. Meegan Nagy
1325 J Street (CESPK-PM-H)
Sacramento, California 95814-2922

Subject: Staff Comments on Final Expanded Site Inspection Field Site Investigation Plan for the Former Benicia Arsenal, Solano County (April 2004)

Dear Ms. Nagy:

Staff of the Regional Water Quality Control Board has reviewed the above-referenced Field Site Investigation Plan (FSIP). In general, the document presents a well-designed, dynamic sampling approach that is appropriate for characterization of this large site on an expedited basis. Specific comments are as follows:

General: Water Board staff requested inclusion of additional sites in the FSIP in comments on the *Draft Preliminary Assessment* and in further comments on the *Final Preliminary Assessment*. As described in a June 1, 2004 letter, staff believes the following sites require further investigation: DOD Sites 177, 195, 48, 49, 70, 92, 98, 99 118(B), 179, and Nike Missile Sites 1 and 2. Please see Water Board comments on the *Preliminary Assessment* for a complete listing of sites where further action is necessary under the Porter-Cologne Water Quality Control Act and State Water Resources Control Board Resolution No. 92-49.

General: The Executive Officer requested a Source Evaluation Report on Emergent Chemicals for the former Benicia Arsenal in a June 13, 2003 letter to Mr. Michael Mitchener of the Army Corps of Engineers. The Army has not submitted the requested response to this letter. Water board staff comments on both the *Draft Preliminary Assessment* and the *Final Preliminary Assessment* directed sampling for emergent chemicals at a number of sites. The Army has deferred a response awaiting DOD policy guidance. The lack of a detailed response and sampling for emergent chemicals leaves a

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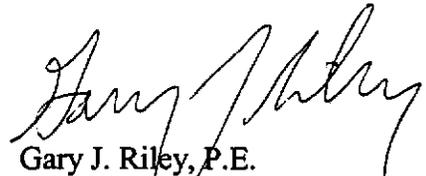
continuing data gap in the Arsenal-wide investigation that must be addressed prior to final Water Board concurrence on investigation and remedial decision documents.

Section 2.4.2: This section correctly states that the Geofon UST removal report (2002) recommended additional soil and groundwater investigation at a number of Area I UST sites. Water board staff concurred with this recommendation in written correspondence to the Army. Staff note that no soil investigation is proposed in the FSIP to delineate the soil contamination observed at the former UST locations. The downgradient groundwater sampling proposed in the subject FSIP may address some groundwater concerns, but source area soils remain incompletely characterized and will require future investigation.

Diagram 5-1: This figure shows the flowchart for the FSIP sampling process and step-out sampling criteria. In cases where no groundwater is encountered in borings, a soil gas sample will be collected only if an existing building is nearby. This sampling approach does not address potential indoor air impacts from contaminated soils at locations where buildings may be constructed in the future. Areas of VOC soil contamination will need to be addressed in a future remedial investigation to assess future risks to site users, including those risks attributable to vapor intrusion.

If you have any questions please contact me at (510) 622-2462 or via email to gjr@rb2.swrcb.ca.gov.

Sincerely,



Gary J. Riley, P.E.
Water Resource Control Engineer
Remedial Project Manager

Distribution:

Ms. Christine Parent - DTSC
Ms. Wendy Linck - FA/BC