Health and Safety Plan

Operation and Maintenance Services

Greenwood Chemical Site
Operable Unit 2 (OU2)
Newtown, Albemarle County, Virginia

Work Assignment No. 035-RARA-03P5

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Prepared for:

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Acronyms and Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
ACP	access control point
ANSI	American National Standards Institute
CAS	Chemical Abstracts Service
CFR	Code of Federal Regulations
CGI	Combustible Gas Indicator
COC	chemicals of concern
CPR	cardiopulmonary resuscitation
CRC	contamination reduction corridor
db	decibel
DOT	Department of Transportation
EPA	US Environmental Protection Agency
FID	flame ionization detector
FSP	field sampling plan
HASP	Health and Safety Plan
IDLH	immediately dangerous to life or health
LEL	lower explosive limit
mg/kg	milligrams per kilogram
mg/m^3	milligrams per cubic meter
MSDS	material safety data sheet
MSHA	Mine Safety and Health Administration
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Ploychlorinated Biphenyl
PCE	tetrachloroethene
PCP	pentachlorophenol
PEL	permissible exposure limit
PID	photo ionization detector
PPE	personal protective equipment
ppm	parts per million
ppb	parts per billion
PVC	polyvinyl chloride
REL	recommended exposure limits
O&M	Operation and Maintenance
RHSR	Regional Health and Safety Representative
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act

SCBA	self-contained breathing apparatus
SM	site manager
SSC	site safety coordinator
SWP	safe work practice
TCA	1,1,1 trichloroethane
TCE	trichloroethylene
TLV	threshold limit value
TWA	time-weighted average exposure concentration for normal 8-hour (TLV, PEL) or up to a 10-hour (REL) workday and 40-hour work week
Tt	Tetra Tech Inc.
USACE	United States Army Corp of Engineers
VDS	vehicle decontamination station
VOC	Volatile Organic Compound
WP	Work Plan

Site-Specific Health and Safety Plan
Greenwood Chemical Site OU2
Focused Groundwater Investigation and Engineering Support

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ATTACHMENTS

1.0 INTRODUCTION

1.1 Purpose

This site-specific health and safety plan (HASP) establishes the site-specific health and safety guidelines and procedures for activities at the Greenwood Chemical Site Operable Unit 2 (Greenwood OU2) site. The Site HASP is based on existing data and site reconnaissance and is in accordance with Occupational Safety and Health Administration (OSHA) Standards and USEPA Regulations. The HASP must be approved by the Tetra Tech Regional Health and Safety Representative (RHSR) or designee.

1.2 Scope

This site-specific HASP applies to all activities to be conducted by Tetra Tech, Inc. or its subcontractors at the Greenwood site. It has been prepared in accordance with OSHA standards for hazardous waste site activities, other applicable OSHA standards and the Tetra Tech (Tt) Corporate Health and Safety Manual.

1.3 Compliance with Site HASP

Consistent with the contents of this Site HASP, work will be conducted in a safe and environmentally acceptable manner, and Tt and all subcontractors contractually under this HASP are required to comply with the health and safety requirements specified herein. All field personnel under this plan are required to read and familiarize themselves with the contents of this Site HASP. Field personnel will indicate their familiarization with these documents through the entry of a signature and date as specified in Section 11.0, Certification of the Site HASP. Contractors who are not contractually under this Site HASP are responsible for developing and implementing a Site HASP that will interface with this Site HASP.

2.0 SITE BACKGROUND

2.1 Site Background

A complete description of the site background, including history of land use at the site and studies conducted to date is included in Section 2.0 of the Work Plan for the Greenwood Site OU2 O&M Services.

The Greenwood Chemical site is located in Albemarle County, Virginia, between the cities of Waynesboro and Charlottesville, approximately four miles east of Rockfish Gap at the foot of Bear Den Mountain and the Blue Ridge Mountain Range.

The area of the Greenwood Chemical site was associated with chemical manufacturing and waste disposal activities, and covers approximately 34 acres. The site is bounded by Route 690 and an east/west residential road to the north; a wire fence and hedgerow to the east; a wire fence and stream to the south; and the Mt. Zion Baptist Church property and a wire fence to the west. Adjoining lands to the east, west, and south are mixed-use rural, residential and agricultural. The site slopes to the south-southeast. On-site features include a groundwater treatment plant, an access road to the groundwater treatment plant, and several dilapidated and abandoned structures.

The Greenwood Chemical Company manufactured a variety of chemicals used in industrial, agricultural, photographic and pharmaceutical processes. Chemical manufacturing operations began in approximately 1947. Throughout its history of operation, the Greenwood Chemical Company was plagued by numerous accidents. In July 1987 the GCS was placed on the NPL. The interim remedy selected was extraction and treatment of groundwater in an on-site water treatment plant. As an interim remedy, a groundwater treatment plant (GWTP) was constructed at the site in late 2000 and started operation in early 2001.

2.2 Nature and Extent of Contamination

The groundwater in the overburden-bedrock aquifer system at the site is contaminated with a variety of volatile organic contaminants, including trichloroethene, chloroform, tetrachloroethene, benzene, toluene, and chlorobenzene. Semivolatile organics primarily consisting of naphthalene, bis-2-chloroethyl ether (BCEE) and TICs have also been detected. Inorganic contamination is less widespread, consisting of scattered occurrences of cyanide and elevated concentrations of aluminum. The type of contaminants and their maximum concentrations that have been identified at the Greenwood Chemical site in the groundwater are included in Attachment 2. Having been detected in all site media, pentachlorphenol is the primary site contaminant. The volume of contaminated groundwater within the fractured bedrock is unknown.

3.0 HAZARD ASSESSMENT

Chemicals of concern (COC) that have been identified at the site are listed in Attachment 2. The table lists the allowable exposure levels for the chemicals, signs and symptoms of exposure, dermal absorption hazards, carcinogenicity, immediately dangerous to life or health (IDLH) values, health hazards, physical hazards, Chemical Abstracts Service (CAS) registry numbers, and physical characteristics.

3.1 Task Hazards and Levels of Risk

A hazard assessment, including physical, biological and chemical hazards, for each task to be performed during the Greenwood OU2 O&M Services follows:

TASKS TO BE PERFORMED		*HAZARD TYPE (✓)*			*RISK LEVEL*
Task #		Physical	Biological	Chemical	High, Moderate, Low
3.1	New Well Survey (If Required)	✓	✓	✓	low
3.2	New Well Installation and Packer Testing (If Required)	✓	✓	✓	moderate
3.3	Groundwater Sampling	✓	✓	✓	moderate
3.4	Surface Water Sampling	✓	✓	✓	moderate
3.5	Investigation-Derived Waste Mangement (If Required)	✓	✓	✓	moderate

high risk = likelihood of injury or exposure greater than normally encountered on a hazardous waste site - requires special monitoring or PPE (e.g., probable explosion hazards, chemical absorption hazards, IDLH conditions likely, etc.)
moderate risk = monitoring and PPE are likely to control hazards sufficiently.
low risk = little chance of injury or exposure - limited or no monitoring or PPE required.

3.2 Physical and Biological Hazards

TASK 3.1: New Well Survey (If Required)		
(✓)	PHYSICAL HAZARD	CONTROL METHOD
✓	trip/slip/fall	awareness, follow General Safe Work Practices per Tt SWP 6-1
✓	heat stress	monitoring per SWP 6-15
✓	cold exposure	monitoring per SWP 6-16
	machinery	
	noise	
	vehicles/traffic	
✓	other: sun exposure	proper clothing & sunblock applied to exposed areas of skin
	BIOLOGICAL HAZARD	CONTROL METHOD
✓	poison ivy, nettles, thorny vegetation	awareness, avoidance
✓	ticks/spiders/insects	awareness, avoidance
✓	reptiles/mammals (snakes)	awareness, avoidance
✓	other: heavy brush	awareness, avoidance

TASK 3.2: New Well Installation and Packer Testing (If Required)		
(✓)	PHYSICAL HAZARD	CONTROL METHOD
✓	trip/slip/fall	awareness, follow General Safe Work Practices per Tt SWP 6-1
✓	heat stress	monitoring per SWP 6-15
✓	cold exposure	monitoring per SWP 6-16
✓	machinery	awareness, follow SWP 6-26 (heavy equpiment), SWP 6-3 (safe drilling practices) or 6-4 (safe excavation practices)
✓	noise	hearing protection while machinery is operating
✓	vehicles/traffic	awareness; safety vests in traffic areas
✓	other: sun exposure	proper clothing & sunblock applied to exposed areas of skin
✓	other: water hazards	follow Tt SWP 6-5 and 6-22.
	BIOLOGICAL HAZARD	CONTROL METHOD
✓	poison ivy, nettles, thorny vegetation	awareness, clothing, avoidance
✓	ticks/spiders/insects	awareness, avoidance
✓	reptiles/mammals-snakes	awareness, avoidance
✓	other: heavy brush	awareness, avoidance

TASK 3.3: Groundwater Sampling		
(✓)	PHYSICAL HAZARD	CONTROL METHOD
✓	trip/slip/fall	awareness, follow General Safe Work Practices.
✓	heat stress	monitoring per SWP 6-15
✓	cold exposure	monitoring per SWP 6-16
	machinery	
	noise	
	vehicles/traffic	
✓	other: water hazards	follow Tt SWP 6-5 and 6-22
	BIOLOGICAL HAZARD	CONTROL METHOD
✓	poison ivy, nettles, thorny vegetation	awareness, avoidance
✓	ticks/spiders/insects	awareness, avoidance
✓	reptiles/mammals (snakes)	awareness, avoidance
✓	other: heavy brush	awareness, avoidance

TASK 3.4: Surface Water Sampling		
(✓)	PHYSICAL HAZARD	CONTROL METHOD
✓	trip/slip/fall	awareness, follow General Safe Work Practices
✓	heat stress	monitoring per SWP 6-15
✓	cold exposure	monitoring per SWP 6-16
	machinery	
	noise	
	vehicles/traffic	
✓	other: water hazards	follow Tt SWP 6-5 and 6-22
	BIOLOGICAL HAZARD	CONTROL METHOD
✓	poison ivy, nettles, thorny vegetation	awareness, avoidance
✓	ticks/spiders/insects	awareness, avoidance
✓	reptiles/mammals (snakes)	awareness, avoidance
✓	other : heavy brush, thickets	awareness, avoidance

TASK 3.6: Investigation-Derived Waste Characterization and Management (If Required)		
(✓)	PHYSICAL HAZARD	CONTROL METHOD
✓	trip/slip/fall	awareness, follow General Safe Work Practices
✓	heat stress	monitoring per SWP 6-15
✓	cold exposure	monitoring per SWP 6-16
✓	machinery	awareness, follow SWP 6-26 (heavy equipment) and SWP 6-4 (safe excavation practices)
	noise	
	vehicles/traffic	
✓	other: drum spill or discharge	follow Tt SWP 6-14
	BIOLOGICAL HAZARD	CONTROL METHOD
✓	poison ivy, nettles, thorny vegetation	awareness, avoidance
✓	ticks/spiders/insects	awareness, avoidance
✓	reptiles/mammals (snakes)	awareness, avoidance
	other:	

3.3 Chemical Hazards

TASK(S): All Tasks					
CHEMICAL NAME	POTENTIALLY CONTAMINATED MEDIA				CONTROL METHOD
	soil	water	air	waste	
volatile organic compounds	✓	✓	✓	✓	monitoring; ventilation; PPE
semi-volatile organic compounds	✓	✓	✓	✓	monitoring; ventilation; PPE
metals	✓	✓	✓	✓	monitoring; PPE

Information regarding Chemicals of Concern (COC) that have been identified at the Greenwood Chemical site are listed in Attachment 2 of the Site HASP. Tables list the maximum concentrations detected for each medium, and the allowable exposure levels for the chemicals, signs and symptoms of exposure, dermal absorption hazards, carcinogenicity, immediately dangerous to life or health (IDLH) values, health hazards, physical hazards, Chemical Abstracts Service (CAS) registry numbers, and physical characteristics.

4.0 PERSONNEL QUALIFICATIONS

4.1 Training Requirements

4.1.1 Personnel Certification

All personnel who will be engaged in hazardous waste operations must present to the site safety coordinator (SSC) a certificate of completion for an initial 40-hour hazardous waste operations training course and the most recent certificate of completion for an 8-hour refresher course. The refresher course must have been completed within 12 months prior to the individual being on site performing hazardous waste operations. The training must comply with OSHA regulations found at 29 Code of Federal Regulations (CFR) 1910.120(e). The certification must be presented to the SSC before site activities begin.

All personnel must complete a minimum of three (3) days on-the-job training under the direct supervision of a qualified SSC or site supervisor before they are qualified to work unsupervised at a hazardous waste site.

Consistent with OSHA 29 CFR 1910.120 paragraph (e)(4), individuals serving in a supervisory role, such as the field team leader or SSC, require an additional eight (8) hours of training.

At least one person trained in first aid and adult cardiopulmonary resuscitation (CPR) will be on site.

Personnel who will potentially use respirators on the site must have received training by a competent person in the proper use, inspection, emergency use, and limitations of the equipment. The initial or refresher training must be current within 12 months prior to the use of the equipment.

Personnel who participate in permitted confined space entry, radiation work, asbestos work, or work involving lockout/tagout of energy sources must have been trained in accordance with the applicable OSHA regulations before performing such work.

Personnel who use health and safety monitoring equipment must have been trained by a competent person in the use, maintenance, calibration, and operation of the equipment before using the equipment.

4.1.2 Safety Meetings

Safety meetings with all team members will be conducted prior to initiating any site activity. In addition, periodic briefings will be held throughout the project, especially when unsafe practices are noted or a change in site conditions requires modifications of the HASP. Periodic meetings will be held weekly, at a minimum. Similar meetings will be held with individuals who later become a part of the field team before those individuals take part in site activities.

The Safety Meeting Checklist in Attachment 5 provides a guide of topics to be covered during the initial briefing and possibly during periodic meetings. The field logbook will be used to document the safety meeting topics discussed and attendance.

The SSC is responsible for conducting and documenting the pre-activity and periodic safety meetings.

4.2 Medical Surveillance Program

All personnel who participate in hazardous waste site investigations will be enrolled in a medical monitoring program prior to initiating site activities. The medical monitoring program will consist of an initial baseline examination, periodic monitoring examinations, and an exit examination.

All personnel who will be engaged in hazardous waste operations must present to the SSC a certificate of completion of a comprehensive medical monitoring examination. The medical examination must have been completed within 12 months prior to the beginning of site activities.

Site-specific medical monitoring examinations or tests may be required to augment the standard examinations.

Personnel who will potentially wear respirators must present to the SSC written documentation that a physician has determined that they are physically able to perform the work and use the respirator.

Medical monitoring records for Tetra Tech personnel working on the Greenwood Chemical Site are on file at the Tetra Tech Christiana, Delaware office.

5.0 PERSONAL PROTECTIVE EQUIPMENT

5.1 General

The following PPE will be provided, used, and maintained in a sanitary and reliable condition whenever it is necessary because hazards of processes or environment, chemical hazards, radiological hazards, or mechanical irritants are encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation, or physical contact.

- Suitable eye protectors.
- Head protection.
- Extremities protection.
- Protective clothing.
- Shields and barriers.
- Face protection.
- Respiratory protection.
- Hearing protection.

5.2 Chemical Protective Equipment

5.2.1 Levels of Protection

Personnel will wear chemical protective equipment when activities involve known or suspected atmospheric contamination; when airborne vapors, gases, or particulates may be generated by site activities; or when direct contact with skin-affecting substances may occur.

Levels of protection are detailed in the Tetra Tech Health & Safety Manual.

5.3 Hazards and Protection Level

The types of hazards for which Levels A, B, C, and D protection are appropriate are described in the Tt Health and Safety Program. The minimum level of protection required for each task is presented below:

Specific protective clothing required for each field task to be performed during the Greenwood OU2 O&M Services is listed by task:

TASK 3.1: New Well Survey (If Required)
INITIAL PROTECTION LEVEL: Modified D
UPGRADE/DOWNGRADE PROTECTION LEVEL: upgrade not expected; no downgrade permitted

✓	PPE	TYPE
✓	work boots	steel-toe/shank
	chemical-resistant boots/covers	
✓	eye protection	safety glasses with side shields where any potential hazard to eyes exists (e.g., in wooded areas, when using hammers to drive wood stakes, etc.)
✓	work gloves	leather gloves optional
	chemical-resistant gloves	
	chemical resistant coveralls	
	chemical resistant hooded suit	
	hearing protection	
	respirator	
	respirator cartridge	
✓	other: safety vests in traffic areas	reflective safety vests

TASK 3.2: New Monitoring Well Installation and Packer Testing (If Required)
INITIAL PROTECTION LEVEL: Modified Level D
UPGRADE/DOWNGRADE PROTECTION LEVEL: upgrade not expected; downgrade not permitted

✓	PPE	TYPE
✓	work boots	steel-toe/shank
	chemical-resistant boots/covers	
✓	eye protection	safety glasses with side shields
✓	work gloves	
✓	chemical-resistant gloves	Nitrile inner and outer gloves
✓	chemical resistant coveralls	poly-coated Tyvek when contact with contaminated ground water or sediment is possible
	chemical resistant hooded suit	
✓	hearing protection and hard hat	
	respirator	
	respirator cartridge	
	other:	

TASK 3.3: Groundwater Sampling **INITIAL PROTECTION LEVEL:** Modified Level D. **UPGRADE/DOWNGRADE PROTECTION LEVEL:** Upgrade not expected; no downgrade permitted.		
✓	**PPE**	**TYPE**
✓	work boots	steel-toe/shank
	chemical-resistant boots/covers	
✓	eye protection	Upgrade: safety glasses with side shields
✓	work gloves	leather gloves optional
✓	chemical-resistant gloves	Nitrile inner and outer gloves
	chemical resistant coveralls	
✓	chemical resistant hooded suit	Upgrade: Saranex or poly-coated Tyvek apron with sleeves
✓	hearing protection	ear plugs while machinery is operating
	respirator	
	respirator cartridge	
	other:	

Task 3.3.1 Well Specific PPE

A PID will be used to check for the presence of volatile organic compounds (VOCs) upon opening each well for the first time. Should VOCs be detected in the well in concentrations greater than 100 ppm, allow the well time to vent. If VOC concentrations are sustained above 100 ppm after ventilation, upgrade PPE.

The following wells are to be sampled with upgraded PPE (Saranex or poly-coated Tyvek apron with sleeves; safety glasses with side shields):

MW-23, OB-5, BR-7, OB-2, MW18S/D, OB-7, MW-7D, BR-6, and MW-21D.

TASK 3.4: Surface Water Sampling
INITIAL PROTECTION LEVEL: Modified Level D
UPGRADE/DOWNGRADE PROTECTION LEVEL: Upgrade not expected; no downgrade permitted

✓	PPE	TYPE
✓	work boots	steel-toe/shank
✓	chemical-resistant boots/covers	water resistant boots or boot covers
✓	eye protection	Safety glasses with side shields
✓	work gloves	leather gloves optional
✓	chemical-resistant gloves	nitrile inner and outer gloves
	chemical resistant coveralls	
	chemical resistant hooded suit	
	hearing protection	
	respirator	
	respirator cartridge	
	other:	

TASK 3.5: Investigation Derived Waste Characterization
INITIAL PROTECTION LEVEL: Modified Level D
UPGRADE/DOWNGRADE PROTECTION LEVEL: Upgrade not expected; downgrade not permitted.

✓	PPE	TYPE
✓	work boots	steel-toe/shank
	chemical-resistant boots/covers	
✓	eye protection	safety glasses with side shields
✓	work gloves	leather gloves optional
✓	chemical-resistant gloves	Nitrile inner and outer gloves
	chemical resistant coveralls	
	chemical resistant hooded suit	
	hearing protection and hard hat	
	respirator	
	respirator cartridge	
	other:	

TASK 3.6: Residential Well Sampling
INITIAL PROTECTION LEVEL: Modified Level D
UPGRADE/DOWNGRADE PROTECTION LEVEL: Upgrade not expected; downgrade not permitted.

✓	PPE	TYPE
	work boots	
	chemical-resistant boots/covers	
	eye protection	
	work gloves	
✓	chemical-resistant gloves	Nitrile inner and outer gloves
	chemical resistant coveralls	
	chemical resistant hooded suit	
	hearing protection and hard hat	
	respirator	
	respirator cartridge	
	other:	

5.4 Reassessment of Protection Level

The level of protection provided by PPE will be upgraded or downgraded at the Greenwood site based upon a change in site conditions or findings of investigations. When a significant change occurs, the hazards will be reassessed by the SSC. The following are some indicators of the need for reassessment:

- Airborne concentrations of chemicals or physical hazards exceed action levels.
- Commencement of a new work phase, such as the start of drum sampling or work that begins on a different portion of the site.
- Change in job tasks during a work phase.
- Change of weather.
- When temperature extremes or individual medical considerations limit the effectiveness of PPE.
- Contaminants other than those previously identified are encountered.
- Change in ambient levels of contaminants.
- Change in work scope affects the degree of contact with contaminants.
- Detection of contamination by instrument, odor, or sight.

5.5 Inspection of PPE

The user of the PPE is responsible for inspecting the equipment prior to immediate use. If the user is not familiar with the equipment's limitations, that user will be denied access to the equipment and work zone. A personal protective equipment checklist is included in Attachment 4.

The user's buddy is responsible for periodically checking on the proper use of the protective equipment while in use, as discussed in Section 7.3.

5.6 Respiratory Protection

Personnel will not be assigned to tasks requiring the use of respirators unless they are physically able to perform the work and use the respirator equipment. These criteria will be documented in writing and provided to the SSC in accordance with Section 4.2.

Personnel who will potentially wear a respirator on site must be trained in the proper use of the respirators and their limitations. The training will allow users to handle their respirator to become familiar with all components, select the proper size for a comfortable fit, wear the respirator in normal air to become used to the breathing resistance, visibly conduct a critical component inspection, and administer a positive and negative pressure fit check.

Respirators are not to be worn when conditions prevent a good full seal. Such conditions may be a growth of beard, sideburns, bangs, a skull cap or other clothing that projects under the facepiece, or temple pieces on glasses. To ensure proper protection, the respirator will be thoroughly inspected before each use, and a positive and negative fit check will be performed each time the respirator is donned.

Respirators will be assigned to individuals for their exclusive use during the project. Air purifying respirators will be regularly cleaned and disinfected in accordance with the Tt Corporate Health and Safety Program SWP 6-27. As a minimum, respirators will be cleaned after each day's use or more often if necessary. Upon completion of the work task, the respirators will be disassembled, inspected, and thoroughly cleaned and disinfected. Worn or deteriorated parts will be replaced, and the respirators will be stored in a clean and sanitary location in individual plastic bags.

Selection of the respirator is the responsibility of a person qualified by appropriate training or experience. Selection will be based on the physical, chemical, and physiological properties of the air contaminants and the concentration likely to be encountered. The quality of fit and the nature of the work being performed will also affect the choice of respirators. The capability of the respirators chosen is determined from appropriate governmental approvals, the manufacturer's test, and the qualified person's experience with respirators.

All workers entering the Exclusion Zone or Contamination Reduction Zone at a site where use of a respirator is necessary or anticipated must have passed at least a qualitative fit test in accordance with the guidelines established in the appendix of 29 CFR 1910.1025. Personnel must have been fit tested for the model and size of respirator issued to them. The fit test record must be current within the previous 12 months.

6.0 MONITORING PROGRAM

6.1 Real-Time Monitoring

Direct reading instruments are used as real-time air monitors. The results of the direct reading instruments are compared with the Monitoring Equipment Action Levels (Table 1) that describe the protective action to be taken to control exposure. The action levels describe the location of the real time monitoring activity and the action to be taken if predefined values are met or exceeded. Site-specific operations or tasks may have other action levels established.

The frequency and location of all real time monitoring activity is based upon the nature of the site activity. Periodic real-time monitoring at the Greenwood site will be performed, at a minimum, whenever the following activities occur:

- Beginning of site activity.
- Operations change.
- Work begins on a different portion of the site.
- Beginning of invasive site activity.
- Contaminants other than those previously identified are being handled.
- Personnel begin to handle obviously contaminated materials.
- Personnel are handling leaking drums or containers.
- Personnel are performing tasks that are likely to expose them to peak levels of contaminants.
- Instrumental or sensible detection of the presence of a chemical contaminant.
- Change in the weather.

6.2 Air Monitoring Result Logging

Before any field activities commence, the background levels of the site must be read and recorded. Daily background readings must be conducted away from areas of potential contamination to obtain accurate results.

All monitoring results must be recorded in the field log. The monitoring results should indicate the following information:

- Range of readings.
- Mode of readings.
- Time.
- Location of reading.
- Activity during reading.
- Weather conditions.
- Wind direction.
- Action taken.

6.3 Personnel Monitoring

Personnel monitoring will not be conducted on the Greenwood Chemical Site.

Specifics of the monitoring required at the Greenwood Chemical Site are described below.

Air Monitoring required for each task? yes ☐ no ■

Air monitoring is not required for those non-intrusive tasks for which there is no potential contact with ground water, surface water, or soil (e.g., survey activities, site walk-through, site mobilization etc.).

Instrument(s) to be Used:

■ PID ☐ CGI/O_2 meter ☐ miniRAM

☐ FID (may be used in place of PID or for detection of methane if suspected.)

☐ radiation meter (specify type): miniRad radiation contamination monitor or equivalent

■ sound level meter while machinery if operating

☐ thermometer ☐ detector tubes (specify): ☐ specific gas detector (specify):

Frequency/Duration of Monitoring:

☐ continuous ☐ periodic (every ____ minutes)

■ At the start of each task and whenever conditions change (wind direction, intrusive activity, etc.)

■ When activity begins at a new sample location ☐ other:

Heat Stress Monitoring to be performed: ■ yes, if temperatures exceed 70°F ☐ no

Monitoring for each task will be conducted in accordance with the Site HASP Section 6.0. Action levels for the site are consistent with Site HASP Table 1, and are listed below. Any upgrade in level of protection will be conducted in accordance with Section 5.4 of the Site HASP. Respiratory protection, if necessary, will be used in accordance with Section 5.6 of the Site HASP.

TABLE 1
HAZARDOUS CONDITION MONITORING EQUIPMENT AND ACTION SUMMARY

Hazardous Condition	Monitoring Equipment	Level or Concentration	Action
Organic vapors and gases	Organic vapor analyzer: PID or FID	Any reading above background	Allow time to ventilate; Upgrade to Level B
Radiation	Radiation survey meter	< 0.25 millirem per hour or less than 3 times gamma background level	Continue investigation
		> 0.25 millirem per hour or more than 3 times gamma background level	Possible radiation sources present; more thorough monitoring necessary; consult health physicist
Oxygen deficient or enriched atmosphere	Oxygen meter	< 19.5% oxygen	Ventilate; monitor wearing SCBA *Note:* Combustible gas readings are not valid in atmospheres with less than 19.5% oxygen
		19.5% to 23.5% oxygen	Continue investigation with caution; SCBA not needed based on oxygen content only
		> 23.5% oxygen	Discontinue inspection; fire hazard potential; consult health and safety specialist
Combustible gases	Explosimeter or combustible gas indicator	<5% LEL	Continue investigation
		> 5 to 10% LEL	Continue on-site monitoring with extreme caution as higher levels are encountered
		> 10% LEL	Explosion hazard; withdraw from area immediately; investigate source

Notes:

FID Flame ionization detector
LEL Lower explosive limit
PID Photoionization detector
SCBA Self-contained breathing apparatus
> Greater than
< Less than

6.4 Operation, Maintenance, and Calibration

The SSC is responsible for the proper operation, maintenance, and calibration of each instrument to be used in accordance with applicable Tt SOPs.

6.5 Initial Survey

Prior to any site activities, the SSC will conduct perimeter and general site monitoring, upwind and downwind, to establish background levels. If information from the site characterization indicates a potential for ionizing radiation or IDLH condition on site or if insufficient information is available to demonstrate otherwise, then monitoring will include monitoring with direct reading ionizing radiation or IDLH conditions, including oxygen, explosive, and toxic atmospheres, and visual observations for actual or potential IDLH conditions on site.

Upon initial entry to an area, representative air monitoring will be conducted using direct reading instruments to identify IDLH conditions and exposures above OSHA PELs or other allowable exposure levels, including exposure to radiation, flammable atmospheres, or oxygen deficient atmospheres.

6.6 Periodic Survey

Periodic monitoring will be conducted when the possibility of an IDLH condition or flammable atmosphere has developed or when there is an indication that exposure may have risen above OSHA PELs or published exposure levels for hazardous substances. After site activities have commenced, the selective monitoring of high-risk workers, i.e., those who are closest to the source of contaminant generation, is essential. Those employees working closest to the source have the highest likelihood of being exposed to concentrations that exceed established exposure limits or action levels. Monitoring efforts will focus on personnel most likely to receive the highest exposures and on all personnel likely to be exposed to any substance above the action level or OSHA PEL. High-risk workers will be monitored at least every 30 minutes when the potential for exposure exists. Monitoring will be performed whenever new work begins on a different position of the site, any time that new contaminants are encountered that differ from those initially encountered, every time a different operation is initiated, whenever employees are working in areas of obvious liquid contamination, or when employees are handling leaking containers.

6.7 Perimeter Monitoring

The SSC is responsible for determining if site activities could negatively impact zones outside the contamination reduction zone. If action levels for airborne contaminants listed in the Action Level Table (Table 1) are exceeded, the SSC will perform monitoring at the perimeter of the Contamination Reduction Zone to determine if the contaminants are getting out of the controlled zones. If action levels are exceeded at these locations, the SSC must advise the site manager (SM) and the Tt RHSR. If necessary, the control zones will be expanded to compensate for the presence of the contaminants.

If the release of contaminants could negatively impact the health and safety of the surrounding areas, the SSC will contact the local emergency response organization responsible for protecting public health from chemical exposures. This agency will be identified prior to the beginning of site activities as part of the emergency preplanning procedures. The SSC will then notify the site representative, SM, and Tt RHSR. The SM will notify the client of the chemical release and the actions taken by the SSC. Notification will be made in accordance with Section 9.6, Spills or Leaks.

7.0 SITE CONTROL

The objective of site control is to control the activities and movement of people and equipment at hazardous waste sites in order to minimize the potential for worker or public exposure to hazardous substances, the spread of hazardous substance in the environment, or vandalism.

7.1 Site Mapping

Maps of the site will be kept in the Support Zone during field activities to assist site personnel in planning and organizing response activities. In addition, the Field Sampling Plan (FSP) contains site maps that are specific to the area where specific tasks will take place.

7.2 Work Zones

Work zones will be established to:

- Reduce the accidental spread of hazardous substances by workers or equipment from the contaminated areas to the clean areas.
- Confine work activities to the appropriate areas, thereby minimizing the likelihood of accidental exposure.
- Facilitate the location and evacuation of personnel in case of an emergency.

To accomplish this, the site will be divided into as many zones as necessary to ensure minimal employee exposure to hazardous substances. As a minimum, three zones will be identified: the Exclusion Zone, the Contamination Reduction Zone, and the Support Zone. Movement of personnel and equipment between these zones will be minimized and restricted to specific access control points (ACP) to prevent cross-contamination from contaminated areas to clean areas.

The work site will be divided into these three zones so field personnel can identify where the site hazards exist, so nonessential personnel will not be affected by the hazards, and so the hazards do not leave the zones. Details of the work site control zones will be established by the SSC prior to starting site activities and will be established so that the Support Zone is upwind of the Exclusion Zone or at a distance far enough away that it is not affected by the dispersion of contaminants from the Exclusion Zone.

Each work zone and the factors to be considered when establishing each zone are described in detail in the Tetra Tech Corporate Health & Safety Manual.

7.3 Buddy System

The implementation of a buddy system is mandatory for entry into the Contamination Reduction Zones or the Exclusion Zone. The prime objective of the buddy system is to ensure rapid assistance in the event of an emergency.

Each member of the field team will be designated by the SSC to observe at least one other field team member. The SSC will implement the system at the ACP for personnel entering the Exclusion Zone.

As part of the buddy system, workers will remain close together and maintain visual contact with each other to provide assistance in the event of an emergency. If an emergency situation arises, workers will

use the communication signals established and agreed upon prior to entering the contaminated area. The communication signals are discussed in Subsection 8.7.3.

The responsibilities of workers utilizing the buddy system include:

- Providing their buddy with assistance.
- Observing their buddy for signs of chemical exposure.
- Observing their buddy for signs of stress due to temperature extremes.
- Observing their buddy for signs of stress or anxiety while wearing chemical protective clothing.
- Periodically checking the integrity of their buddy's PPE.
- Notifying the SSC or other site supervisory personnel if emergency assistance is needed.

Workers should not rely entirely on the buddy system to ensure that help will be provided in the event of an emergency. To augment this system, workers in contaminated areas should, whenever possible, remain in line-of-sight or communication contact with the SSC or other personnel in the Support Zone.

7.4 Audits

Inspection and audits of the work area in accordance with the Tt Corporate Health and Safety Program will be conducted by the SSC or the RHSR as necessary to determine the effectiveness of the HASP. The HASP will be periodically reviewed by the SSC to keep it current with respect to site conditions. The SSC or RHSR will report the findings to the site manager. Correcting deficiencies in the effectiveness and application of the HASP is the responsibility of the project manager. Changes to the HASP to address any deficiencies will be made to the HASP in accordance with Section 12.0 of the Site HASP.

7.5 Visitors

Tt recognizes that all visitors' employers are ultimately responsible for their compliance with all applicable OSHA regulations while on a hazardous waste site. Tt personnel will be courteous to all visitors and adhere to the following procedures for the safety sake of the visitors.

- Visitors are expected to have the permission of the site owner to be on the site.
- The SSC will advise all visitors of the nature, level, and degree of exposure likely as a result of Tt related activities and the emergency response procedures that pertain to visitors at the site.
- The SSC will advise all subcontractors coming onto the site of the hazardous chemicals present, effect of exposure, location of the MSDSs, location of the emergency equipment, and emergency plan and evacuation procedures.
- Visitors entering the Contamination Reduction Zone and the Exclusion Zone at the site will be offered an opportunity to read the applicable provisions of this HASP.
- Visitors will be expected to comply with OSHA requirements such as medical monitoring, training, and respiratory protection.
- Visitors will be expected to provide their own PPE.
- In the event that a visitor does not adhere to the provisions of the HASP, the SSC will request the visitor to leave the work area.
- If a visitor interferes with the work activity or poses a safety hazard to anyone on site, the SSC will terminate work activities and will immediately contact the Tt SM and RHSR.
- All nonconformance incidents will be recorded in the field logbook by the SSC.

- The client and governmental authorities may choose to adopt this plan or develop their own to protect their on-site employees; however, Tt will not take responsibility for compliance of on-site personnel employed by these parties.

While Tt is working on private properties, the property owners will be informed of the site hazards. The Tt SSC will discourage property owners and residents from being in the exclusion zone while intrusive activities are being conducted. If work cannot be conducted in a safe manner while a property owner is present, the SSC will stop work and will contact the Tt RHSR.

8.0 SAFETY AND EMERGENCY PROCEDURES

8.1 Standing Safety Orders

Standing safety orders to be used on the Greenwood site are included in Attachment 3, Tt General Safey Work Practices, SWP 6-1 .

8.2 Medical Emergencies

At least one Tt team member conducting hazardous waste operations at the site will have successfully completed a Red Cross or equivalent sponsored course in adult first aid and cardiopulmonary resuscitation (CPR). Prior to the start of work, the SSC will make arrangements for medical facilities, ambulance service, and medical personnel to be available for prompt attention to the injured. On-site activities will require a first-aid station, which will be located within the Support Zone. First-aid kits will be, as a minimum, 16-unit first-aid kits and will be provided in the ratio of one for each 10 persons. Portable 15-minute emergency eyewash stations will be provided within the Support Zone. Identification markers will be provided to readily denote locations of the eyewash stations. Emergency telephone numbers and reporting instructions for ambulance, local physician, hospitals, poison control center, fire, and police will be conspicuously posted in the Support Zone.

The SSC will act as the emergency coordinator for all medical emergencies. If a person is injured or becomes ill, personnel identified as trained in first aid and CPR will be notified immediately. First aid and CPR will be administered immediately. In all cases, treatment for shock should be considered. After the victim has been attended to, the SSC will be notified. Depending on the severity of the injury or illness, the SSC may notify medical emergency response organizations. If the victim is transferred off-site, the SSC will assign a field team member to accompany the victim.

8.2.1 Chemical Exposure Emergency

If personnel experience any adverse effects or symptoms during field activity, those individuals will notify the SSC. The SSC will assess the situation and make a determination on the extent of medical attention needed. If it is determined that the problem was due to chemical exposure, first aid for chemical exposure will be administered as soon as possible. If the exposed individual needs to go to the hospital, that person will be transported by an individual who has not been exposed. The Site HASP and available MSDSs will accompany the group to the hospital. The SSC will report the incident to the RHSR immediately and submit a written report of the incident to the SM and the RHSR within 24 hours.

The following first aid for chemical exposures will be administered as soon as possible:

- Eye Exposure—If contaminated solid or liquid gets into the eyes, they will be washed immediately at the 15-minute emergency eyewash station using large amounts of water and lifting the lower and upper lids occasionally. Medical attention will be obtained immediately. Use of contact lenses is not permitted in the designated Exclusion Zones.

- Skin Exposure—If contaminated solid or liquid gets on the skin, the affected individual will promptly flush the skin for at least 15 minutes, then wash with soap or mild detergent and water. If contaminated solids or liquids penetrate through the clothing, the clothing will be immediately removed, and the skin will be treated for exposure. Medical attention will be obtained if symptoms warrant.

- Inhalation—If a person breathes in a large volume of potentially toxic contaminants, that person will be moved to fresh air at once. If breathing has stopped, rescue breathing will be performed. If there is no pulse, CPR will be performed. The affected person will be kept warm and at rest. Medical attention will be obtained immediately.

- Ingestion—If contaminated solid or liquid is swallowed, medical attention will be obtained immediately.

8.2.2 Accident Reporting

Injuries or illnesses that require attention beyond simple first aid or attention by a physician or involve exposure to blood or other potentially infectious materials will be reported to the Worker's Compensation Administrator and the Tt RHSR as soon as possible, but no later than 24 hours after the accident. In the event of a fatality or more than one hospitalization, the SSC will immediately notify the Tt RHSR. In turn, the Tt RHSR will notify the local OSHA area office within 8 hours. The SSC will complete the appropriate accident report forms and the required State Workers Compensation form. The SSC is responsible for contacting the State Worker's Compensation Office to obtain the necessary report form. The SSC is also responsible for completing the forms, submitting the originals to the Tt RHSR, and sending copies to the Workers Compensation Administrator and the SM. Copies will be filed in the project file.

Accidents that must be reported include the following:

- Injury or illness that requires attention beyond simple first aid.
- Injury or illness that requires attention by medical professionals.
- Injury or illness that results in time away from work.
- Injury or illness that restricts the ability of the injured to work.
- Unconsciousness, explained or unexplained.
- Exposure of personnel to blood or other potentially infectious agents.
- Exposure to chemical or physical agents that result in adverse signs or symptoms.

The SSC will summarize all incidents that are near-miss injury or illness accidents or physical accidents on a hazardous waste site investigation activity report form and submit it to the SM and Tt RHSR as soon as possible.

The SSC is responsible for investigating the cause of all accidents and reporting the findings and corrective actions taken as described above. The SSC may request the assistance of the Tt RHSR or other personnel to investigate the accident. The final report on the accident is the responsibility of the SSC.

8.2.3 Hospital Routes

The route to the hospital is shown and described in Attachment 1. An alternate route to the same hospital is also described. The route to the hospital will be conspicuously posted in the Support Zone. The SSC and key field personnel will drive the routes to the hospital emergency room doors prior to the start of site activities in order to become familiar with the routes. The routes will be driven at least weekly to confirm that they are unobstructed. A designated vehicle will be available anytime anyone is in the exclusion zone for use in an emergency. In the event of an emergency, the SSC will decide which hospital is most convenient.

8.3 Temperature Extremes

8.3.1 Heat Stress Monitoring

Heat stress monitoring will be performed in accordance with Tt SWP 6-15 in Attachment 3, SWP for Heat Stress.

8.3.2 Cold Stress Monitoring

When ambient temperature reaches 45°F (4.4°C) or below, steps should be taken to prevent cold stress. If necessary Cold Stress Safe Work Practices in accordance with the Tt Health and Safety Program will be utilized.

8.5 Decontamination Procedures

8.5.1 General

All personnel and equipment will be properly decontaminated prior to leaving a site. Decontamination methods could involve physically removing contaminants, neutralizing contaminants by chemical detoxification or disinfection, or removing contaminants through a combination of both physical and chemical means. The types, locations, physical states, and concentrations of contaminants present will determine the degree of decontamination necessary.

To prevent physical transfers of contaminants by people or equipment from on-site to off-site areas, site-specific procedures will be instituted for decontaminating all items leaving the Exclusion Zone and the Contamination Reduction Zone. These procedures will include the decontamination of PPE, vehicles, and all field equipment and the use of correct methods of removing PPE to avoid transfer of contaminants from the clothing to the body and decontamination or disposal. In addition to the decontamination procedures, specific entry and exit routes through the Contamination Reduction Zone will be established for personnel, equipment, and vehicles to minimize the possibilities of additional spread of contaminants. These site-specific decontamination procedures are described below:

Decontamination Equipment:

☐ plastic buckets ■ stainless-steel buckets ■ brushes ■ hand sprayers

■ high-pressure sprayer ☐ steam-cleaner ■ tap water ■ distilled water

☐ deionized water ☐ high-purity water ■ methanol ☐ isopropanol

■ nitric acid ☐ other solvent: ☐ other:

Personal Decontamination Procedure:

■ Remove and dispose contaminated gloves/protective clothing
☐ Wash contaminated clothing with detergent/water solution
☐ Decontamination shower
☐ No decontamination necessary
☐ Other procedure (specify):

Equipment Decontamination Procedure:

- ■ Detergent and water wash, distilled water rinse, solvent rinse, distilled water rinse (small equipment).
- ☐ Detergent and water wash, distilled water, solvent & acid rinse, distilled water rinse
- ☐ Disposal of contaminated equipment
- ■ High pressure water rinse; detergent and water wash; high pressure water rinse (heavy equipment).

Disposal of Decontamination Rinsate:

- ■ Collection and carbon treatment prior to discharge to the ground in the exclusion zone, if not visibly contaminated.
- ■ If decontamination rinseate contains NAPL or other observable contamination, drum and treat as regulated waste; dispose properly after characterization
- ☐ Other (specify):

Disposal of Clothing and Equipment:

- ■ Dispose as municipal waste if not visible contaminated.
- ■ If grossly soiled with NAPL or other observable contamination, bag, drum and treat as regulated waste; dispose properly after characterization
- ☐ Other (specify):

Equipment that is not decontaminated or not completely decontaminated will be disposed of on site or transferred in a controlled manner for subsequent decontamination in a controlled situation. This equipment will be bagged or wrapped in plastic for transferring to the decontamination location. The outside container of the equipment must be labeled as contaminated and list the potential contaminants and associated hazards. To minimize the need to decontaminate equipment, equipment may be packaged or wrapped in a material that will protect it from contamination, but does not interfere with its proper operation.

The initial decontamination plan is based upon a nominal case situation. This initial decontamination plan will be modified, adding necessary stations or otherwise adapting it to site conditions when a worst-case situation occurs. Changes in the decontamination plan will be made and noted in the HASP by the SSC. If, on visual examination, chemical protective clothing appears grossly contaminated, a thorough decontamination will be required.

The SSC is responsible for selecting and monitoring the decontamination procedures to verify their effectiveness. When the decontamination procedures are found to be ineffective, appropriate steps will be taken to correct the deficiencies.

8.5.2 Emergency Decontamination

In a medical emergency, the primary concern is to prevent the loss of life or severe injury to site personnel. Any person who becomes ill or injured in the Exclusion Zone must be decontaminated to the maximum extent possible before providing the necessary first aid or before permitting the person to enter the Support Zone.

If the injury or illness is serious, at least partial decontamination will be completed. This may be accomplished by the following:

- Complete derobing of the victim and redressing in clean coveralls.
- Wrapping the victim in a blanket or plastic.
- Spot decontamination.

If the injury or illness is minor, full decontamination will be completed and first aid administered prior to transport. The SSC will select the degree of needed decontamination in proportion to the potential hazards posed by the contaminants. When a person who is not fully decontaminated requires transportation to the hospital, the interior surfaces of the vehicle will be covered with plastic to prevent spreading of the contamination.

First aid will be administered while awaiting an ambulance or paramedics.

8.5.3 PPE

Personnel leaving the Exclusion Zone must remove potential contaminants in an orderly and controlled manner to avoid contamination of the person. Primary means of avoiding contamination of the person is to minimize contact with contaminants during site activities. Secondary means is to assume contamination and systematically reduce the contamination prior to doffing PPE.

Personal decontamination involves the sequential doffing of PPE, starting with the most heavily contaminated and working to the least contaminated. This progression, in combination with separating each step of the decontamination procedure by a minimum of 3 feet, ensures contamination decreases as the person moves from one station to another further along the line. Wash and rinse steps may be needed to reduce the contamination to a level that is safe to handle. Since it is virtually impossible to prevent the transfer of contaminants on protective clothing to the wearer, thorough decontamination of the chemical protective clothing is necessary. When done effectively, the amount of substance remaining on the chemical protective clothing is greatly reduced and the possibility of transfer is proportionately reduced. Therefore, heavily contaminated disposable chemical protective clothing should be washed and rinsed to minimize the spread of the contaminants during doffing. Unsoiled disposable chemical protective clothing may not require the wash and rinse steps.

Polyethylene plastic sheeting will be placed on the ground in the CRC, and the decontamination stations will be arranged on top of the plastic. The first station will be located within the Exclusion Zone and will be the station where gross contamination is removed.

As a minimum, the level of protection required for the personnel assisting with personnel decontamination will be the most protective of either Level D or one level less than the level worn in the Exclusion Zone.

The SSC is responsible for monitoring the effectiveness of the decontamination procedures.

8.5.4 Instruments

Instrument decontamination requires, as a minimum, that all external surfaces and surfaces that come in contact with contaminants be wiped with a cloth dampened with a trisodium phosphate detergent and wiped dry. Contamination should be prevented by packaging or wrapping the instrument in a material that will protect it from contamination but does not interfere with its proper operation.

Instruments that are internally contaminated or not completely decontaminated will be transferred in a controlled manner for subsequent decontamination. These instruments will be bagged or wrapped in

plastic for transfer to the decontamination location. The outside container of the instrument must be labeled as contaminated and list the potential contaminants and associated hazards.

8.5.5 Equipment

Equipment that comes in direct contact with a contaminant will be decontaminated and shown to be clean before it is returned to the owner or equipment center.

8.5.6 Decontamination Solutions

The standard decontamination solutions will be a solution of Alconox or equivalent detergent. Generally, a solution of trisodium phosphate detergent is sufficient for most site applications. The decontamination solution will be prepared in accordance with the manufacturer's instructions. In general, potable water is a sufficient rinse; however, for specific equipment, deionized or distilled water may be required for decontamination.

8.5.7 Vehicle Decontamination Station

When drill rigs or other vehicles are used for on-site activities, it may be necessary to construct a vehicle decontamination station (VDS) to prevent the spread of contaminants to off-site locations. Typically, the VDS is a sloping area lined with plastic sheeting and gravel so that decontamination solutions can flow into a lined collection pit, sump, or trench. The pit contents can then be pumped into Department of Transportation (DOT) approved 55-gallon drums or containers for later disposal. Other VDS configurations include plastic sheeting with wood runways to accommodate vehicles. It is imperative that all vehicles used on site be thoroughly decontaminated before being allowed to leave the site. Special attention should be paid to the treads or tracks and interior surfaces. Decontamination can be expedited if vehicle interiors are lined with plastic sheeting prior to commencing on-site activities. When using a central vehicular decontamination station, gross dirt must be removed from the vehicle before it leaves the Contamination Reduction Zone.

8.7 Communications

Communication systems will be established at the site for both internal and external communication for both routine and emergency operations.

8.7.1 Internal Communication

Internal communication refers to communication between workers operating in the Exclusion Zone or the Contamination Reduction Zone or to communication from the Support Zone to these workers. Internal communication will be used for the following:

- Alert team members to emergency situations.
- Convey safety information (e.g., air time remaining in SCBA, heat stress check, hazards detected).
- Communicate changes in the work to be accomplished.
- Maintain site control.

The internal communication system may include standard communication devices such as radio, audible signals from noise makers, or visual signals from hand or body movements.

Identification of individual workers is necessary to ensure commands are addressed to the right worker. This may be accomplished by one of several methods, depending on the specifics of the site activities.

- Marking the suit with the worker's name.
- Color coding, numbering, or symbols for long-distance identification.
- Use of names for short distance, small work force tasks
- Standard audible and visual communication signals are listed in Subsection 8.7.3.

8.7.2 External Communications

External communications refers to communication between on-site and off-site personnel. An external communication system must be maintained for the following:

- Coordinate emergency response efforts with off-site responders.
- Report progress or problems to management.
- Maintain contact with essential off-site personnel.

The primary means of external communication will be cellular.

If access to external communications takes longer than 5 minutes to reach, the field team will be equipped to have immediate access to emergency response organizations.

8.7.3 Communication Signals

The purpose of communication signals is to alert members of emergencies, convey safety information, communicate changes in the work to be accomplished, and maintain site control.
Communication signals to be used on the Greenwood O&M Services site are detailed below: Primary method of communication: *voice communication*

Two-way radios required:
- ■ yes, in any areas where field team members cannot been seen by personnel in the support zone
- ☐ no, visual contact between buddies will be maintained.

Secondary form of communication: *hand signals*

Signal	Definition
Hands clutching throat	Out of air/cannot breathe
Hands on top of head	Need assistance
Thumbs up	OK/I understand
Thumbs down	No/negative
Arms waving upright	Send backup support
Grip partners wrist	Exit area immediately
Fist raised above head	Stop immediately

In addition, a portable telephone will be available on-site for off-site communication and emergencies.

8.7.4 Hazard Communication

The following apply to all chemicals where the chemical concentration exceeds 1 percent or 0.1 percent for a carcinogen. This section is applicable to all chemicals brought on site, used on site, or present as contaminants on site.

All chemicals will be accompanied by a MSDS. All MSDSs will be kept on site in the support zone and made available to all personnel. All containers of chemicals will be properly labeled with the chemical name and appropriate hazard warning statement.

All team members will be trained in the following at the initial safety briefing or wherever the presence of chemicals is identified.

- Methods and observations that may be used to detect the presence or release of a hazardous chemical in the work area.
- Physical and health hazards of the chemical in the work area.
- Measures employees can take to protect themselves from these hazards.
- Location of the MSDSs.
- Explanation of the labeling system.

8.8 Confined Space Entry Procedures

Tt team members are not authorized to enter confined spaces without written authorization from the Tt RHSR or designee. Confined spaces are defined as spaces that meet the following criteria.

- Large enough for a person to bodily enter.
- Limited or restricted means of entry or exit.
- Not designed for continuous employee occupancy.

Entry into a confined space must comply with the Tt standard operating procedure for entry into confined spaces.

Confined Space Entry is not anticipated on this site. If necessary, the HASP will be modified before confined space entry procedures are used on site.

9.0 EMERGENCY ACTION PLAN

In the event of an emergency, the SSC will act as the emergency coordinator. The SSC will assess the emergency and determine if on-site resources are capable of responding to the emergency without exceeding the level of training and resources available. Otherwise, emergency response by Tt field team members will be to immediately evacuate the site in the event of a non-medical emergency.

9.1 Preplanning

Arrangements will be made with the local response community (i.e., fire department or local response services) for them to respond to emergencies that may occur during site operations. The local response community will be provided information regarding site activities, including the types of operations being conducted at the site, the type and degree of contamination at the site, the location of the work zone, and any other relevant information that may be necessary for an appropriate response. Such information will be provided to a supervisory level representative of the emergency response organization prior to the commencement of site operations.

9.2 Reporting Emergencies

Emergencies of all types must be immediately reported to the SSC through established communication means. If the SSC is not available, the emergency must be reported to the nearest Tt supervisory representative.

The SSC will assess the emergency and determine if on-site resources are capable of responding to the emergency without exceeding the level of training and resources available. If off-site emergency response organizations are needed, they will be notified in accordance with the preplanning arrangements.

9.3 Notification

In the event of an emergency, personnel will take direction from the SSC. The SSC will notify the appropriate emergency response organization necessary to mitigate the emergency. As soon as possible, the SSC will make contact with the Tt SM and the Tt RHSR. If an emergency response organization is notified to respond, the SSC will dispatch a representative to the site entrance to escort the emergency response organization to the emergency scene. The SSC will act as the liaison with the officer-in-charge of the emergency response organization.

9.4 Emergency Contacts

Attachment 1 lists emergency telephone numbers and reporting instructions for ambulance, physician, hospital, poison control center, fire, police, local hazardous materials response team, emergency rescue team, client contact, and site contact. Attachment 1 will be conspicuously posted in the Support Zone. Where phone numbers are not available for the above-mentioned organizations, the list will so indicate.

9.5 Fire or Explosion

In the event of a fire or explosion, the local fire department will be notified immediately. The SSC or designated alternate will advise the fire commander of the location, nature, and identification of the hazardous materials on site. The SSC will maintain contact with the emergency response organization officer-in-charge.

If it is safe to do so, site personnel may respond as follows:

- Use fire fighting equipment available on site to control or extinguish incipient fires.
- Remove or isolate flammable or other hazardous materials that may contribute to the fire.
- Inform the site supervisor immediately.
- Inform the client immediately.

9.6 Spills or Leaks

Spill and discharge control practices included in Attachment 3 will be employed at the Greenwood Chemical site.

9.7 Evacuation Procedures

At each work site, an evacuation route and rally point will be identified. The evacuation route will be selected to direct field personnel away from the Exclusion Zone to the nearest exit. During evacuation, field personnel will make every effort to evacuate with their assigned buddy. The evacuation route will avoid high hazard areas and efficiently move personnel away from the emergency site.

The evacuation route will be toward a rally point. The rally point is a common area where all field team members are to meet following an evacuation. The purpose of the rally point is to remove personnel to a safe location away from the emergency and away from high hazard areas, and to where they can be accounted for by the SSC. In the event of missing personnel, the SSC will immediately notify the emergency response organizations. The SSC will provide whatever assistance is requested by the emergency response organizations if search and rescue is necessary. If the designated rally point is proximate to the hazard, the SSC will authorize the evacuees to move to a safer rally point. All personnel will remain at the rally point until authorized to leave by the SSC.

9.8 Critique of Response and Follow-up

A follow-up meeting will be held after any emergency situation to assess the actions taken. The meeting will be attended by the SSC and other individuals as appropriate. A record of the meeting will be kept by the SSC. Recommendations from the meeting will be incorporated into the future responses to emergency situations.

10.0 TEAM MEMBER RESPONSIBILITIES

10.1 Managerial Responsibility

10.1.1 Regional Health and Safety or designee

The RHSR or designee is responsible for providing the SM with assistance and support with regard to all regulatory and safety aspects of site activity.

10.1.2 Site Manager

The Tt SM is responsible for technical direction and overall project administration. As a part of that function, the SM will ensure that, at a minimum, Tt's project plans meet OSHA requirements and that the health and safety of all site personnel are a primary concern. The SM is responsible for implementing health and safety procedures in accordance with the HASP. The SM appoints a SSC to ensure the provisions of the HASP are implemented in the field.

10.2 Team Organization/Responsibility

The following personnel organization is critical to the planned activities at the site. The organizational structure is assigned and will be reviewed and updated periodically by the SM.

10.2.1 Project Field Team Leader

The Tt project field team leader is responsible for leading the team in the planned field activities, including paying close attention to site conditions as they may affect the health and safety of all team members during their on-site activities. The SSC will assist the field team leader in the site activities.

10.2.2 Site Safety Coordinator

The SSC has the responsibility of ensuring that the provisions of this HASP are adequate and implemented in the field. Changing field conditions may require decisions to be made concerning adequate protection programs. Therefore, it is vital that personnel assigned as SSC be experienced and meet the additional training requirements specified by OSHA in 29 CFR 1910.120 and the Tt Safety and Health Program. The SSC is also responsible for conducting site inspections on a regular basis to ensure the effectiveness of the HASP.

10.2.3 Field Team

The field team is the Tt team personnel responsible for performing the activities described in the HASP under the site manager's oversight. Each member is expected to handle the assigned duties with attention to the inherent hazards involved. All field team members agree to adhere to the provisions in the HASP. Personnel responsibilities at the Greenwood Site are listed below:

Key Tetra Tech Personnel	Responsibilities On-Site
Site Manager (SM): Shiva Kumar, P.E.	As specified in Section 10.1.2
Field Team Leader: Dennis Anderson Or Dave Neidigh,	As specified in Section 10.2.1
RHSR designee: Cheryl Scanlon RHSR	As specified in Section 10.1.1
Site Safety Coordinator (SSC): Dennis Anderson	As specified in Section 10.2.2
Other Field Personnel:	
Jeff Ernst	Field Team Member; Alternate SSC
Kyle Swartzwelder	Field Team Member; Alternate SSC
Vadim Petrov	Field Team Member, Alternate SSC
Shiva Kumar, P.E.	Field Team Member
Jason Daliessio	Field Team Member
Jeff Lee	Field Team Member

11.0 CERTIFICATION

All field team members are required to read and familiarize themselves with the contents of this HASP and acknowledge their agreement to comply with the provisions of the plan through the entry of a signature and date on the section below. Any changes to the HASP will be made in accordance with Section 12.0, Record of Changes.

By my signature, I certify that:

- I have read,
- I understand, and
- I will comply with the Site Health and Safety Plan, including the Task HASP, for the Greenwood Site OU2 O&M Services.

Printed Name	Signature	Date	Affiliation

12.0 RECORD OF CHANGES

Changes to this HASP must be made on the following form and submitted to the Tt SM and RHSR or designee for approval. Field activities that have the potential for exposure to contaminants will be halted until the HASP has been modified to reflect changed conditions and the Tt RHSR or designee has reviewed and approved the changes. All field team members who are affected by the changes must initial that they have been apprised of those changes.

Revision Number	Subject	Section/Page	Initials/Date

Attachment 1
Emergency Information
Greenwood Chemical Site OU2 O&M Services

Greenwood Chemical Site
O&M Services
Hospital Emergency Routes

Route to: **Martha Jefferson Hospital**
459 Locust Drive
Charlottesville, VA 22902
434/982-7000

The Martha Jefferson Hospital is located approximately 20 miles (½ hour drive) from the site. Following are the directions.

1. Exit the site and go down Newtown Rd.

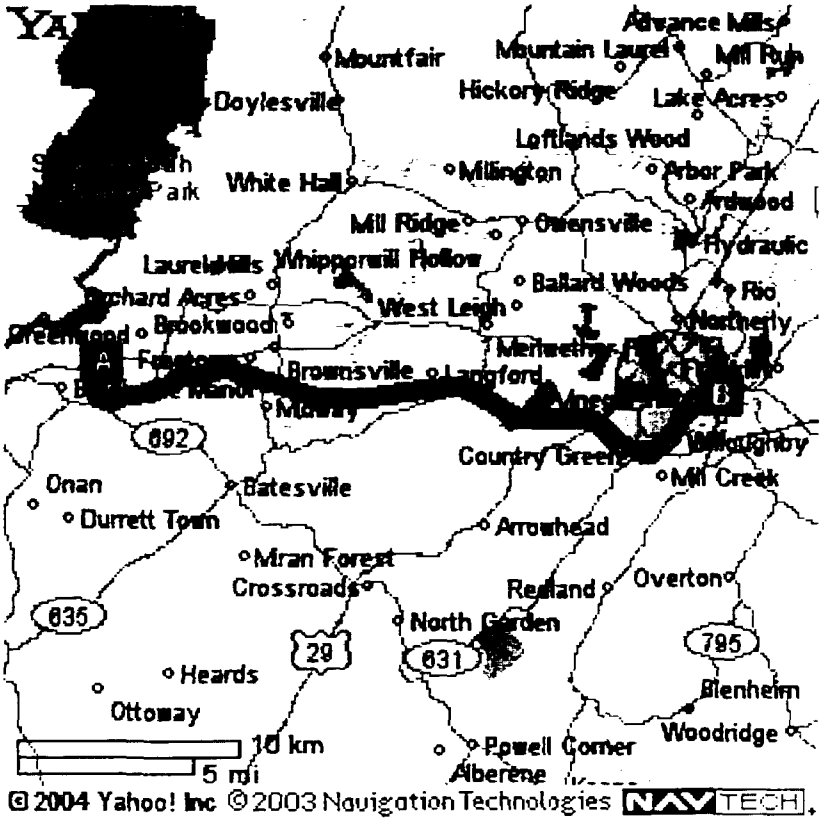
2. Take Eastbound Rt. 250

3. Exit on Locust Avenue and turn right

4. The Hospital is located about half a mile down Locust Avenue, on the right.

Hospital Map

Figure A1-1



Emergency Contacts

Organization	Name	Position	Phone Number
Fire	Greenwood Fire Department		911
Local Medical	N/A		
Hospital	Martha Jefferson Hospital	closest hospital	434/982-7000
Police/Sheriff			911
Tt/B&V	*Shiva Kumar, P.E.*	Site Manager	(302) 738-7551
	Cheryl Scanlon, RHSC	Regional Health and Safety and designee	(302)738-7551 (302)529-7718 (h)
	Christine McClain, CIH	Corporate H&S manager	(626)351-4664
Work Care, Inc.	Peter P. Greaney, MD Peter H. Wald, MD	Consulting Physicians	(800)455-6155
USEPA	Eric Newman	Work Assignment Manager	(215) 814-3237
Subcontractor		*Supervisor*	
Poison Information Center			(800) 722-7112
EPA Region III Office	24-hour phone		(215) 597-9899
National Response Center	Environmental Emergencies Only		800-424-8802

Attachment 2
Chemicals of Concern and
Applicable Regulatory Standards
Greenwood Chemical Site OU2 O&M Services

Concentrations Range Detected in the Groundwater at the Greenwood Site

Contaminants of Concern	Range Detected at the GCS (ug/l)
Volatile Organic Compounds (VOCs)	
Methylene chloride	0.21-190
Tetrachloroethylene (PCE)	0.32-58
Toluene	0.2-2,1000
Trichloroethylene (TCE)	0.31-2,300
Vinyl chloride	0.68-50
1,2-dichlorobenzene	0.88-250
1,2-dichloroethane	0.78-1,000
Benzene	0.27-320
Bromomethane	1.8
Carbon tetrachloride	0.35-3,800
Cis-1,2-dichloroethylene	0.31-340
Chloroform	0.2-260
Semi-Volatile Organic Compounds (SVOCs)	
2-chlorophenol	1.2-13
4-chloroaniline	1.5-120
Acetophenone	0.79-85
Bis (2-chloroethyl) ether (BCEE)	1.2-140
Bis(2-ethylhexyl) phthalate,	0.94-160
Naphthalene	0.9-570
Inorganics	
Aluminum	234-119,000
Arsenic	12.7-66.1
Cyanide	10-546

CHEMICALS OF CONCERN AND APPLICABLE REGULATORY STANDARDS
Greenwood Chemical Site OU2 O&M Services
ABBREVIATIONS KEY

ca -	potential carcinogen
ppm. -	parts per million
mg/m^3 -	milligrams per cubic meter
$\mu g/m^3$ -	micrograms per cubic meter
MW -	molecular weight
BP -	boiling point at 1 atm, °F
Sol -	solubility in water at 68°F, % by weight
Fl.P. -	flash point, closed cup, °F
IP -	ionization potential, eV
MP -	melting point, °F
UEL -	upper explosive limit in air, % by volume
LEL -	lower explosive limit in air, % by volume
N/A -	not applicable
? -	unknown
abs -	skin absorption
ing -	ingestion
inh -	inhalation
con -	skin and/or eye contact
abdom - abdominal	
anor -	anorexia
card -	cardiac
CNS -	central nervous system
conf -	confusion
conj -	conjunctivitis
consti -	constipation
convuls -	convulsions
corn -	cornea
cyan -	cyanosis
depress - depressant/depression	
derm -	dermatitis
dizz -	dizziness
drow -	drowsiness
dysp -	dyspnea
enl -	enlargement
eryt -	erythema
extrem - extremities	
fail -	failure
ftg -	fatigue
GI -	gastrointestinal
giddy -	giddiness
halu -	hallucinations
head -	headache
hyperpig -	hyper pigmentation
inco -	incoordination
insom -	insomnia
irreg -	irregular
irrit -	irritation
jaun -	jaundice
lac -	lacrimation
lass -	lassitude
low-wgt -	weight loss
malnut - malnutrition	
monocy -	monocytosis
muc mem -	mucous membrane
narco -	narcosis
nas -	nose/nasal
pal -	pallor
para -	paralysis
pares -	paresthesia
peri neur -	peripheral neuropathy
resp -	respiratory
som -	somnolence
sweat -	sweating
sys -	system
tend -	tenderness
vis dist - visual disturbance	
vomit -	vomiting
weak -	weakness

NIOSH Pocket Guide to Chemical Hazards

Hydrogen cyanide

CAS 74-90-8

HCN

RTECS MW6825000

Synonyms & Trade Names
Formonitrile, Hydrocyanic acid, Prussic acid

DOT ID & Guide
1051 117 (>20% solution)
1051 117 (anhydrous)
1613 154 (</=20% solution)

Exposure Limits

NIOSH REL: ST 4.7 ppm (5 mg/m^3) [skin]

OSHA PEL†: TWA 10 ppm (11 mg/m^3) [skin]

IDLH 50 ppm See: 74908

Conversion 1 ppm = 1.10 mg/m^3

Physical Description
Colorless or pale-blue liquid or gas (above 78°F) with a bitter, almond-like odor. [Note: Often used as a 96% solution in water.]

MW: 27.0	BP: 78°F (96%)	FRZ: 7°F (96%)	Sol: Miscible
VP: 630 mmHg	IP: 13.60 eV		Sp.Gr: 0.69
Fl.P: 0°F (96%)	UEL: 40.0%	LEL: 5.6%	

Class IA Flammable Liquid Flammable Gas

Incompatibilities & Reactivities
Amines, oxidizers, acids, sodium hydroxide, calcium hydroxide, sodium carbonate, caustics, ammonia [Note: Can polymerize at 122-140°F.]

Measurement Methods
NIOSH 6010
See: NMAM or OSHA Methods

Personal Protection & Sanitation
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contaminated
Remove: When wet (flammable)
Change: No recommendation
Provide: Eyewash, Quick drench

First Aid (See procedures)
Eye: Irrigate immediately
Skin: Water flush immediately
Breathing: Respiratory support
Swallow: Medical attention immediately

Important additional information about respirator selection
Respirator Recommendations NIOSH
Up to 47 ppm: (APF = 10) Any supplied-air respirator
Up to 50 ppm: (APF = 25) Any supplied-air respirator operated in a continuous-flow mode/(APF = 50) Any self-contained breathing apparatus with a full facepiece/(APF = 50) Any supplied-air respirator with a full facepiece
Emergency or planned entry into unknown concentrations or IDLH conditions: (APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode/(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus
Escape: (APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against the compound of concern/Any appropriate escape-type, self-contained breathing apparatus

Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact

Symptoms Asphyxia; lassitude (weakness, exhaustion), headache, confusion; nausea, vomiting; increased rate and depth of respiration or respiration slow and gasping; thyroid, blood changes

Target Organs central nervous system, cardiovascular system, thyroid, blood

See also: INTRODUCTION See ICSC CARD: 0492 See MEDICAL TESTS: 0117

NIOSH Pocket Guide to Chemical Hazards

Aluminum	CAS 7429-90-5
Al	RTECS BD0330000
Synonyms & Trade Names Aluminium, Aluminum metal, Aluminum powder, Elemental aluminum	**DOT ID & Guide** 1309 170 (powder, coated) 1396 138 (powder, uncoated) 9260 169 (molten)

Exposure Limits	
	NIOSH REL: TWA 10 mg/m^3 (total) TWA 5 mg/m^3 (resp)
	OSHA PEL: TWA 15 mg/m^3 (total) TWA 5 mg/m^3 (resp)

IDLH N.D. See: IDLH INDEX	Conversion

Physical Description
Silvery-white, malleable, ductile, odorless metal.

MW: 27.0	BP: 4221°F	MLT: 1220°F	Sol: Insoluble
VP: 0 mmHg (approx)	IP: NA		Sp.Gr: 2.70
Fl.P: NA	UEL: NA	LEL: NA	

Combustible Solid, finely divided dust is easily ignited; may cause explosions.

Incompatibilities & Reactivities
Strong oxidizers & acids, halogenated hydrocarbons [Note: Corrodes in contact with acids & other metals. Ignition may occur if powders are mixed with halogens, carbon disulfide, or methyl chloride.]

Measurement Methods
NIOSH 7013, 7300; OSHA ID121
See: NMAM or OSHA Methods

Personal Protection & Sanitation	**First Aid** (See procedures)
Skin: No recommendation Eyes: No recommendation Wash skin: No recommendation Remove: No recommendation Change: No recommendation	Eye: Irrigate immediately Breathing: Fresh air

Important additional information about respirator selection
Respirator Recommendations To be added later

Exposure Routes inhalation, skin and/or eye contact

Symptoms Irritation eyes, skin, respiratory system

Target Organs Eyes, skin, respiratory system

See also: INTRODUCTION See ICSC CARD: 0988 See MEDICAL TESTS: 0011

NIOSH Pocket Guide to Chemical Hazards

Tetrachloroethylene

CAS 127-18-4

$Cl_2C=CCl_2$

RTECS KX3850000

Synonyms & Trade Names
Perchlorethylene, Perchloroethylene, Perk, Tetrachlorethylene

DOT ID & Guide
1897 160

Exposure Limits

NIOSH REL: Ca Minimize workplace exposure concentrations. See Appendix A

OSHA PEL†: TWA 100 ppm C 200 ppm 300 ppm (5-minute maximum peak in any 3-hours)

IDLH Ca [150 ppm] See: 127184

Conversion 1 ppm = 6.78 mg/m^3

Physical Description
Colorless liquid with a mild, chloroform-like odor.

MW: 165.8	BP: 250°F	FRZ: -2°F	Sol: 0.02%
VP: 14 mmHg	IP: 9.32 eV		Sp.Gr: 1.62
Fl.P: NA	UEL: NA	LEL: NA	

Noncombustible Liquid, but decomposes in a fire to hydrogen chloride and phosgene.

Incompatibilities & Reactivities
Strong oxidizers; chemically-active metals such as lithium, beryllium & barium; caustic soda; sodium hydroxide; potash

Measurement Methods
NIOSH 1003; OSHA 1001
See: NMAM or OSHA Methods

Personal Protection & Sanitation
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contaminated
Remove: When wet or contaminated
Change: No recommendation
Provide: Eyewash, Quick drench

First Aid (See procedures)
Eye: Irrigate immediately
Skin: Soap wash promptly
Breathing: Respiratory support
Swallow: Medical attention immediately

Important additional information about respirator selection
Respirator Recommendations NIOSH
At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration: (APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode/(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus
Escape: (APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister/Any appropriate escape-type, self-contained breathing apparatus

Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact

Symptoms Irritation eyes, skin, nose, throat, respiratory system; nausea; flush face, neck; dizziness, incoordination; headache, drowsiness; skin erythema (skin redness); liver damage; [potential occupational carcinogen]

Target Organs Eyes, skin, respiratory system, liver, kidneys, central nervous system

Cancer Site [in animals: liver tumors]

See also: INTRODUCTION See ICSC CARD: 0076 See MEDICAL TESTS: 0179

NIOSH Pocket Guide to Chemical Hazards

Toluene	CAS 108-88-3
$C_6H_5CH_3$	RTECS XS5250000
Synonyms & Trade Names Methyl benzene, Methyl benzol, Phenyl methane, Toluol	**DOT ID & Guide** 1294 130

Exposure Limits	NIOSH REL: TWA 100 ppm (375 mg/m^3) ST 150 ppm (560 mg/m^3)
	OSHA PEL†: TWA 200 ppm C 300 ppm 500 ppm (10-minute maximum peak)

IDLH 500 ppm See: 108883	**Conversion** 1 ppm = 3.77 mg/m^3

Physical Description
Colorless liquid with a sweet, pungent, benzene-like odor.

MW: 92.1	BP: 232°F	FRZ: -139°F	Sol(74°F): 0.07%
VP: 21 mmHg	IP: 8.82 eV		Sp.Gr: 0.87
Fl.P: 40°F	UEL: 7.1%	LEL: 1.1%	

Class IB Flammable Liquid: Fl.P. below 73°F and BP at or above 100°F.

Incompatibilities & Reactivities
Strong oxidizers

Measurement Methods
NIOSH 1500, 1501, 3800, 4000; OSHA 111
See: NMAM or OSHA Methods

Personal Protection & Sanitation Skin: Prevent skin contact Eyes: Prevent eye contact Wash skin: When contaminated Remove: When wet (flammable) Change: No recommendation	**First Aid** (See procedures) Eye: Irrigate immediately Skin: Soap wash promptly Breathing: Respiratory support Swallow: Medical attention immediately

Important additional information about respirator selection
Respirator Recommendations NIOSH
Up to 500 ppm: (APF = 10) Any chemical cartridge respirator with organic vapor cartridge(s)*/(APF = 25) Any powered, air-purifying respirator with organic vapor cartridge(s)*/(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister/(APF = 10) Any supplied-air respirator*/(APF = 50) Any self-contained breathing apparatus with a full facepiece
Emergency or planned entry into unknown concentrations or IDLH conditions: (APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode/(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus
Escape: (APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister/Any appropriate escape-type, self-contained breathing apparatus

Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact

Symptoms Irritation eyes, nose; lassitude (weakness, exhaustion), confusion, euphoria, dizziness, headache; dilated pupils, lacrimation (discharge of tears); anxiety, muscle fatigue, insomnia; paresthesia; dermatitis; liver, kidney damage

Target Organs Eyes, skin, respiratory system, central nervous system, liver, kidneys

See also: INTRODUCTION See ICSC CARD: 0078 See MEDICAL TESTS: 0232

NIOSH Pocket Guide to Chemical Hazards

Trichloroethylene

CAS 79-01-6

$ClCH=CCl_2$

RTECS KX4550000

Synonyms & Trade Names
Ethylene trichloride, TCE, Trichloroethene, Trilene

DOT ID & Guide
1710 160

Exposure Limits

NIOSH REL: Ca See Appendix A See Appendix C

OSHA PEL†: TWA 100 ppm C 200 ppm 300 ppm (5-minute maximum peak in any 2 hours)

IDLH Ca [1000 ppm] See: 79016

Conversion 1 ppm = 5.37 mg/m^3

Physical Description
Colorless liquid (unless dyed blue) with a chloroform-like odor.

MW: 131.4	BP: 189°F	FRZ: -99°F	Sol(77°F): 0.1%
VP: 58 mmHg	IP: 9.45 eV		Sp.Gr: 1.46
Fl.P: ?	UEL(77°F): 10.5%	LEL(77°F): 8%	

Combustible Liquid, but burns with difficulty.

Incompatibilities & Reactivities
Strong caustics & alkalis; chemically-active metals (such as barium, lithium, sodium, magnesium, titanium & beryllium)

Measurement Methods
NIOSH 1022, 3800; OSHA 1001
See: NMAM or OSHA Methods

Personal Protection & Sanitation
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contaminated
Remove: When wet or contaminated
Change: No recommendation
Provide: Eyewash, Quick drench

First Aid (See procedures)
Eye: Irrigate immediately
Skin: Soap wash promptly
Breathing: Respiratory support
Swallow: Medical attention immediately

Important additional information about respirator selection
Respirator Recommendations NIOSH
At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration: (APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode/(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus
Escape: (APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister/Any appropriate escape-type, self-contained breathing apparatus

Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact

Symptoms Irritation eyes, skin; headache, visual disturbance, lassitude (weakness, exhaustion), dizziness, tremor, drowsiness, nausea, vomiting; dermatitis; cardiac arrhythmias, paresthesia; liver injury; [potential occupational carcinogen]

Target Organs Eyes, skin, respiratory system, heart, liver, kidneys, central nervous system

Cancer Site [in animals: liver & kidney cancer]

See also: INTRODUCTION See ICSC CARD: 0081 See MEDICAL TESTS: 0236

NIOSH Pocket Guide to Chemical Hazards

Naphthalene	CAS 91-20-3
$C_{10}H_8$	RTECS QJ0525000
Synonyms & Trade Names Naphthalin, Tar camphor, White tar	**DOT ID & Guide** 1334 133 (crude or refined) 2304 133 (molten)

Exposure Limits	NIOSH REL: TWA 10 ppm (50 mg/m^3) ST 15 ppm (75 mg/m^3)
	OSHA PEL†: TWA 10 ppm (50 mg/m^3)

IDLH 250 ppm See: 91203	**Conversion** 1 ppm = 5.24 mg/m^3

Physical Description
Colorless to brown solid with an odor of mothballs. [Note: Shipped as a molten solid.]

MW: 128.2	BP: 424°F	MLT: 176°F	Sol: 0.003%
VP: 0.08 mmHg	IP: 8.12 eV		Sp.Gr: 1.15
Fl.P: 174°F	UEL: 5.9%	LEL: 0.9%	

Combustible Solid, but will take some effort to ignite.

Incompatibilities & Reactivities
Strong oxidizers, chromic anhydride

Measurement Methods
NIOSH 1501; OSHA 35
See: NMAM or OSHA Methods

Personal Protection & Sanitation Skin: Prevent skin contact Eyes: Prevent eye contact Wash skin: When contaminated Remove: When wet or contaminated Change: Daily	**First Aid** (See procedures) Eye: Irrigate immediately Skin: Molten flush immediately/solid-liquid soap wash promptly Breathing: Respiratory support Swallow: Medical attention immediately

Important additional information about respirator selection
Respirator Recommendations NIOSH/OSHA
Up to 100 ppm: (APF = 10) Any chemical cartridge respirator with organic vapor cartridge(s) in combination with a dust and mist filter*/(APF = 10) Any supplied-air respirator*
Up to 250 ppm: (APF = 25) Any supplied-air respirator operated in a continuous-flow mode*/(APF = 50) Any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s) in combination with a high-efficiency particulate filter/(APF = 25) Any powered, air-purifying respirator with organic vapor cartridge(s) in combination with a dust and mist filter*/(APF = 50) Any self-contained breathing apparatus with a full facepiece/(APF = 50) Any supplied-air respirator with a full facepiece
Emergency or planned entry into unknown concentrations or IDLH conditions: (APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode/(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus
Escape: (APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having a high-efficiency particulate filter/Any appropriate escape-type, self-contained breathing apparatus

Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact

Symptoms Irritation eyes; headache, confusion, excitement, malaise (vague feeling of discomfort); nausea, vomiting, abdominal pain; irritation bladder; profuse sweating; jaundice; hematuria (blood in the urine), renal shutdown; dermatitis, optical neuritis, corneal damage

Target Organs Eyes, skin, blood, liver, kidneys, central nervous system

See also: INTRODUCTION See ICSC CARD: 0667 See MEDICAL TESTS: 0152

International Chemical Safety Cards

BIS(2-CHLOROETHYL) ETHER

ICSC: 0417

Dichloroethyl ether
2,2'-Dichloroethyl ether
1,1'-Oxybis(2-chloro)ethane
sym-Dichloroethyl ether
Diethylene glycol dichloride
$C_4H_8Cl_2O$ / $(ClCH_2CH_2)_2O$
Molecular mass: 143.02

ICSC # 0417
CAS # 111-44-4
RTECS # KN0875000
UN # 1916
EC # 603-029-00-2

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Flammable. Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames, NO sparks, and NO smoking.	Powder, water spray, foam, carbon dioxide.
EXPLOSION	Above 55°C explosive vapour/air mixtures may be formed.	Above 55°C use a closed system, ventilation.	In case of fire: cool cylinder by spraying with water but avoid contact of the substance with water.
EXPOSURE		PREVENT GENERATION OF MISTS!	
•INHALATION	Cough. Sore throat. Nausea. Vomiting. Burning sensation. Laboured breathing. Symptoms may be delayed (see Notes).	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Half-upright position. Refer for medical attention.
•SKIN	MAY BE ABSORBED!	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap. Refer for medical attention.
•EYES	Redness. Pain.	Face shield, or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION	Abdominal pain. Nausea. Vomiting. Burning sensation.	Do not eat, drink, or smoke during work. Wash hands before eating.	Rinse mouth. Induce vomiting (ONLY IN CONSCIOUS PERSONS!). Rest. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Ventilation. Remove all ignition sources. Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place. (Extra personal protection: chemical protection suit).	Fireproof. Separated from food and feedstuffs . See Chemical Dangers. Keep in the dark. Well closed.	Do not transport with food and feedstuffs. Marine pollutant. T+ symbol R: 10-26/27/28-40 S: 1/2-7/9-27-38-45 UN Hazard Class: 6.1 UN Subsidiary Risks: 3 UN Packing Group: II

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0417

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 2000. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

BIS(2-CHLOROETHYL) ETHER

ICSC: 0417

IMPORTANT DATA		
	PHYSICAL STATE; APPEARANCE: CLEAR, COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR. **PHYSICAL DANGERS:** The vapour is heavier than air. **CHEMICAL DANGERS:** The substance can form explosive peroxides on exposure to air and light. The substance decomposes on burning or on contact with water, producing toxic fumes including hydrogen chloride. Reacts with strong oxidants. Reacts violently with chlorosulfonic acid and oleum. **OCCUPATIONAL EXPOSURE LIMITS:** TLV (as TWA): 5 ppm; A4 (skin); RET(as STEL): 10 ppm; A4 (skin) (ACGIH 1999). OSHA PEL: TWA 15 ppm (90 mg/m^3) skin NIOSH REL: Ca TWA 5 ppm (30 mg/m^3) ST 10 ppm (60 mg/m^3) skin See Appendix A NIOSH IDLH: Potential occupational carcinogen 100 ppm	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation of its vapour, through the skin and by ingestion. **INHALATION RISK:** A harmful contamination of the air can be reached rather quickly on evaporation of this substance at 20°C. **EFFECTS OF SHORT-TERM EXPOSURE:** The substance irritates the eyes and the respiratory tract. Inhalation of vapour may cause lung oedema (see Notes). Exposure far above the OEL may result in death. The effects may be delayed. Medical observation is indicated. **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** Repeated or prolonged contact with skin may cause dermatitis.
PHYSICAL PROPERTIES	Boiling point: 178°C Melting point: -50°C Relative density (water = 1): 1.22 Vapour pressure, kPa at 25°C: 0.206 Relative vapour density (air = 1): 4.9	Flash point: 55°C c.c. Auto-ignition temperature: 369°C Explosive limits, vol% in air: 2.7-? Octanol/water partition coefficient as log Pow: 1.29
ENVIRONMENTAL DATA		

NOTES

The symptoms of lung oedema often do not become manifest until a few hours have passed and they are aggravated by physical effort. Rest and medical observation is therefore essential. Immediate administration of an appropriate spray, by a doctor or a person authorized by him/her, should be considered. An added stabilizer or inhibitor can influence the toxicological properties of this substance, consult an expert. Check for peroxides prior to distillation; eliminate if found. DCEE, Chlorex are trade names.

Transport Emergency Card: TEC (R)-61G61b
NFPA Code: H3; F2; R1;

ADDITIONAL INFORMATION

NIOSH Pocket Guide to Chemical Hazards

Benzene

CAS 71-43-2

C_6H_6

RTECS CY1400000

Synonyms & Trade Names
Benzol, Phenyl hydride

DOT ID & Guide
1114 130

Exposure Limits

NIOSH REL: Ca TWA 0.1 ppm ST 1 ppm See Appendix A

OSHA PEL: [1910.1028] TWA 1 ppm ST 5 ppm See Appendix F

IDLH Ca [500 ppm] See: 71432

Conversion 1 ppm = 3.19 mg/m^3

Physical Description
Colorless to light-yellow liquid with an aromatic odor. [Note: A solid below 42°F.]

MW: 78.1	BP: 176°F	FRZ: 42°F	Sol: 0.07%
VP: 75 mmHg	IP: 9.24 eV		Sp.Gr: 0.88
Fl.P: 12°F	UEL: 7.8%	LEL: 1.2%	

Class IB Flammable Liquid: Fl.P. below 73°F and BP at or above 100°F.

Incompatibilities & Reactivities
Strong oxidizers, many fluorides & perchlorates, nitric acid

Measurement Methods
NIOSH 1500, 1501, 3700, 3800; OSHA 12, 1005
See: NMAM or OSHA Methods

Personal Protection & Sanitation
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contaminated
Remove: When wet (flammable)
Change: No recommendation
Provide: Eyewash, Quick drench

First Aid (See procedures)
Eye: Irrigate immediately
Skin: Soap wash immediately
Breathing: Respiratory support
Swallow: Medical attention immediately

Important additional information about respirator selection
Respirator Recommendations NIOSH
At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration: (APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode/(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus
Escape: (APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister/Any appropriate escape-type, self-contained breathing apparatus

Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact

Symptoms Irritation eyes, skin, nose, respiratory system; dizziness; headache, nausea, staggered gait; anorexia, lassitude (weakness, exhaustion); dermatitis; bone marrow depression; [potential occupational carcinogen]

Target Organs Eyes, skin, respiratory system, blood, central nervous system, bone marrow

Cancer Site [leukemia]

See also: INTRODUCTION See ICSC CARD: 0015 See MEDICAL TESTS: 0022

NIOSH Pocket Guide to Chemical Hazards

Chloroform

CAS 67-66-3

$CHCl_3$

RTECS FS9100000

Synonyms & Trade Names
Methane trichloride, Trichloromethane

DOT ID & Guide
1888 151

Exposure Limits

NIOSH REL: Ca ST 2 ppm (9.78 mg/m^3) [60-minute] See Appendix A

OSHA PEL†: C 50 ppm (240 mg/m^3)

IDLH Ca [500 ppm] See: 67663

Conversion 1 ppm = 4.88 mg/m^3

Physical Description
Colorless liquid with a pleasant odor.

MW: 119.4	BP: 143°F	FRZ: -82°F	Sol(77°F): 0.5%
VP: 160 mmHg	IP: 11.42 eV		Sp.Gr: 1.48
Fl.P: NA	UEL: NA	LEL: NA	

Noncombustible Liquid

Incompatibilities & Reactivities
Strong caustics; chemically-active metals such as aluminum or magnesium powder, sodium & potassium; strong oxidizers [Note: When heated to decomposition, forms phosgene gas.]

Measurement Methods
NIOSH 1003
See: NMAM or OSHA Methods

Personal Protection & Sanitation
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contaminated
Remove: When wet or contaminated
Change: No recommendation
Provide: Eyewash, Quick drench

First Aid (See procedures)
Eye: Irrigate immediately
Skin: Soap wash promptly
Breathing: Respiratory support
Swallow: Medical attention immediately

Important additional information about respirator selection
Respirator Recommendations NIOSH
At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration: (APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode/(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus
Escape: (APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister/Any appropriate escape-type, self-contained breathing apparatus

Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact

Symptoms Irritation eyes, skin; dizziness, mental dullness, nausea, confusion; headache, lassitude (weakness, exhaustion); anesthesia; enlarged liver; [potential occupational carcinogen]

Target Organs Liver, kidneys, heart, eyes, skin, central nervous system

Cancer Site [in animals: liver & kidney cancer]

See also: INTRODUCTION See ICSC CARD: 0027 See MEDICAL TESTS: 0047

NIOSH Pocket Guide to Chemical Hazards

Chlorobenzene

CAS 108-90-7

C_6H_5Cl

RTECS CZ0175000

Synonyms & Trade Names
Benzene chloride, Chlorobenzol, MCB, Monochlorobenzene, Phenyl chloride

DOT ID & Guide
1134 130

Exposure Limits

NIOSH REL: See Appendix D

OSHA PEL: TWA 75 ppm (350 mg/m^3)

IDLH 1000 ppm **See:** 108907

Conversion 1 ppm = 4.61 mg/m^3

Physical Description
Colorless liquid with an almond-like odor.

MW: 112.6	BP: 270°F	FRZ: -50°F	Sol: 0.05%
VP: 9 mmHg	IP: 9.07 eV		Sp.Gr: 1.11
Fl.P: 82°F	UEL: 9.6%	LEL: 1.3%	

Class IC Flammable Liquid: Fl.P. at or above 73°F and below 100°F.

Incompatibilities & Reactivities
Strong oxidizers

Measurement Methods
NIOSH 1003; OSHA 7
See: NMAM or OSHA Methods

Personal Protection & Sanitation
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contaminated
Remove: When wet (flammable)
Change: No recommendation

First Aid (See procedures)
Eye: Irrigate immediately
Skin: Soap wash promptly
Breathing: Respiratory support
Swallow: Medical attention immediately

Important additional information about respirator selection
Respirator Recommendations OSHA

Up to 1000 ppm: (APF = 25) Any supplied-air respirator operated in a continuous-flow mode[£]/(APF = 25) Any powered, air-purifying respirator with organic vapor cartridge(s)[£]/(APF = 50) Any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s)/(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister/(APF = 50) Any self-contained breathing apparatus with a full facepiece/(APF = 50) Any supplied-air respirator with a full facepiece

Emergency or planned entry into unknown concentrations or IDLH conditions: (APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure- demand or other positive-pressure mode/(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape: (APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister/Any appropriate escape-type, self-contained breathing apparatus

Exposure Routes inhalation, ingestion, skin and/or eye contact

Symptoms Irritation eyes, skin, nose; drowsiness, incoordination; central nervous system depression; in animals: liver, lung, kidney injury

Target Organs Eyes, skin, respiratory system, central nervous system, liver

See also: INTRODUCTION See ICSC CARD: 0642

Attachment 3
Tetra Tech Safe Work Practices
Greenwood Chemical Site O&M Services

TETRA TECH, INC.
HEALTH AND SAFETY MANUAL
VOLUME III

SAFE WORK PRACTICES (SWP)

GENERAL SAFE WORK PRACTICES

SWP NO.: 6-1

ISSUE DATE: JULY 1998

REVISION NO.: 1

general Safe Work Practices

To prevent injuries and adverse health effects, the following general safe work practices (SWP) are to be followed when conducting work involving known and unknown site hazards. These SWPs establish a pattern of general precautions and measures for reducing risks associated with hazardous site operations. This list is not inclusive and may be amended as necessary.

- Do not eat, drink, chew gum or tobacco, take medication, or smoke in contaminated or potentially contaminated areas or where the possibility for the transfer of contamination exists.
- Wash hands and face thoroughly upon leaving a contaminated or suspected contaminated area. A thorough shower and washing must be conducted as soon as possible if excessive skin contamination occurs.
- Avoid contact with potentially contaminated substances. Do not walk through puddles, pools, mud, or other such areas. Avoid, whenever possible, kneeling on the ground or leaning or sitting on drums, equipment, or the ground. Do not place monitoring equipment on potentially contaminated surfaces.
- Remove beards or facial hair that interfere with a satisfactory qualitative respirator fit test or routine pre-entry positive and negative pressure checks.
- Be familiar with and knowledgeable of and adhere to all instructions in the site-specific health and safety plan (HASP). At a minimum, a safety meeting will be held at the start of each project to discuss the HASP. Additional meetings will be held, as necessary, to address new or continuing safety and health concerns.
- Be aware of the location of the nearest telephone and all emergency telephone numbers.
- Attend a briefing on the anticipated hazards, equipment requirements, SWPs, emergency procedures, and communication methods before going on site.
- Plan and delineate entrance, exit, and emergency escape routes.
- Rehearse unfamiliar operations prior to implementation.
- Use the "buddy system" whenever respiratory protection equipment is in use. Buddies should establish hand signals or other means of emergency communication in case radios break down or are unavailable.
- Buddies should maintain visual contact with each other and with other on-site team members by remaining in close proximity in order to assist each other in case of emergency.
- Minimize the number of personnel and equipment in contaminated areas (such as the exclusion zone). Nonessential vehicles and equipment should remain within the support zone.

- Establish appropriate support, contamination reduction, and exclusion zones.
- Establish appropriate decontamination procedures for leaving the site.
- Immediately report all injuries, illnesses, and unsafe conditions, practices, and equipment to the site safety coordinator (SSC).
- Maintain a portion of the site field logbook as a project safety log. The project safety log will be used to record the names, entry and exit dates, and times on site of all Tetra Tech, subcontractor, and project site visitor personnel; air quality and personal exposure monitoring data; and other information related to safety matters. Form SSC-1, Daily Site Log, may be used to record names of on-site personnel.
- A portable eyewash station should be located in the support zone if chemical splashes to eyes are possible.
- Do not bring matches and lighters in the exclusion zone or contamination reduction zone.
- Observe coworkers for signs of toxic exposure and heat or cold stress.
- Inform coworkers of nonvisual effects of illness if you experience them, such as headaches, dizziness, nausea, or blurred vision.

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HEALTH AND SAFETY MANUAL

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SAFE WORK PRACTICES (SWP)

SAFE DRILLING PRACTICES

SWP NO.: 6-3

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Safe Drilling Practices

This document establishes safe work practices (SWP) to follow during drilling operations. These SWPs are based on suggested safety procedures provided in the National Drilling Association's "Drilling Safety Guide." Procedures to follow before, during, and after drilling are listed below.

Before beginning any drill operation, each employee must be aware of the following:

- Wear a hard hat, safety glasses or goggles, steel-toed work boots, a shirt and full-length pants when working with or near the drill rig. Shirts must be tucked in at the belt.
- Do not wear loose or frayed clothing, loose long hair, or loose jewelry while working with rotating equipment.
- Do not eat, drink, or smoke near the drill rig.
- Identify all underground utility and buried structure locations before drilling.
- Ensure that the drill rig and any other machinery used is inspected daily by competent, qualified individuals. The site safety coordinator (SSC) will ensure compliance with this precaution.
- Drill rig operators will be instructed to report any abnormalities, such as equipment failure, oozing liquids, and unusual odors, to their supervisors or the SSC.
- Establish hand-signal communications for use when verbal communication is difficult. One person per work team will be designated to give hand signals to equipment operators.

While the drill rig is operating, employees should be aware of the following:

- Wear appropriate respiratory and personal protective equipment (PPE) when conditions warrant their use.
- Avoid direct contact with known or suspected contaminated surfaces.
- Move tools, materials, cords, hoses, and debris to prevent tripping hazards and contact with moving drill rig parts.
- Adequately secure tools, materials, and equipment subject to displacement or falling.
- Store flammable materials away from ignition sources and in approved containers.
- Maintain adequate clearance of the drill rig and mast from overhead transmission lines. The minimum clearance is 25 feet unless special permission is granted by the utility

company. Call the local utility company for proper clearance.

- Only qualified and licensed personnel should operate drill rigs.
- Workers should not assume that the drill rig operator is keeping track of their exact location. Workers should never walk directly behind or beside heavy equipment without the operator's knowledge.
- Workers should maintain visual contact with drill rig operators at all times.
- When an operator must maneuver equipment in tight quarters, the presence of a second person is required to ensure adequate clearance. If much backing is required, two ground guides will be used: one in the direction the equipment is moving, and the other in the operator's normal field of vision to relay signals.
- Auger sections and other equipment are extremely heavy. All lifting precautions should be taken before moving heavy equipment. Appropriate equipment, such as chains, hoists, straps, and other equipment, should be used to safely transport heavy equipment too heavy to safely lift.
- Proper personal lifting techniques will be used. Workers should lift using their legs, not their backs.
- Workers will not use equipment they are not familiar with. This precaution applies to heavy as well as light equipment.
- All personnel not essential to work activities will be kept out of the work area.
- Workers will be aware of their footing at all times.
- Workers will remain alert at all times.

After drilling operations are completed, employees should do the following:

- Shut down machinery before repairing or lubricating parts (except parts that must be in motion for lubrication).
- Shut down mechanical equipment prior to and during fueling operations. When refueling or transferring fuel, containers and equipment must be bonded to prevent the buildup of static electricity.
- Keep drill rigs in the exclusion zone until work has been completed. Such equipment should then be decontaminated within the designated decontamination area.
- Engage parking brakes when equipment is not in use.
- Implement an ongoing maintenance program for all tools and equipment. All tools and moving equipment should be inspected regularly to ensure that parts are secured, are intact, and

have no cracks or areas of weakness. The equipment must turn smoothly without wobbling and must operate in accordance with manufacturer specifications. Defective items should be promptly repaired or replaced. Maintenance and repair logs will be kept.

- Store tools in clean, secure areas to prevent damage, loss, or theft.

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SAFE WORK PRACTICES (SWP)

Excavation Practices

SWP NO.: 6-4

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EXCAVATION PRACTICES

This safe work practice (SWP) outlines minimum requirements to protect employees who may be exposed to hazards during trenching and excavation activities and to provide general guidance for compliance with Title 29 of the *Code of Federal Regulations* (CFR), Part 1926, Subpart P, "Excavations."

Project managers shall ensure that all excavation, shoring, and trenching activities are conducted in accordance with the requirements outlined in this document and Subpart P of 29 CFR 1926. Project managers must also ensure that projects involving trenching and excavation are staffed by an individual capable of performing "competent person" duties as described in this procedure.

The site safety coordinator (SSC) is responsible for on-site enforcement of this SWP.

Definitions and procedures used for excavations are discussed below.

1.0 DEFINITIONS

The following definitions apply to this SWP:

Benching: Forming one or a series of horizontal levels or steps in the sides of an excavation to protect employees from cave-ins

Competent Person: One capable of identifying existing or predictable hazards in the work environment that are unsanitary or dangerous to employees and who has authorization to take prompt corrective measures to eliminate the hazards

Excavation: Any manmade cut, cavity, trench, or depression in an earth surface formed by earth removal

Shoring: Metal, hydraulic, mechanical, or timber system that supports the sides of an excavation and that is designed to prevent cave-ins

Sloping: Sloping the sides of an excavation at an incline away from the excavation to protect employees from cave-ins

Trench: A narrow excavation (in relation to its length) that is usually deeper than it is wide but less than 15 feet wide

2.0 PROCEDURES

Described below are the general safety requirements and protective system requirements for trenching and excavation activities.

2.1 General Safety Requirements

General safety requirements that must be in place before work begins are as follows:

- Utility companies or a utilities locating service in the area must be notified **before excavation or trenching activities begin** to arrange for locating and protecting underground utilities.
- Access to trenching areas must be controlled and limited to authorized personnel. Prior to entering a trench or excavation, workers must notify the project manager, SSC, and nearby equipment operators whose activities could affect the trench or excavation.
- No person may enter a trench or work at the foot of the face of an excavation until a qualified, competent person has inspected the excavation and determined whether sloping or shoring is required to protect against cave-in or subsidence and the appropriate protection has subsequently been installed.
- Trenches and excavations must be assessed by a qualified, competent person, even in the absence of working personnel, whenever heavy equipment will be operating nearby in order to ensure that the trench or excavation will support the weight of the equipment without subsistence or causing the accidental overturning of machinery.
- Trenches and excavations must be inspected regularly (daily at a minimum) to ensure that changes in temperature, precipitation, shallow groundwater, overburden, nearby building weight, vibration, or nearby equipment operation have not caused weakening of the sides, faces, and floors and to ensure that personnel protection is being maintained.
- When subsidence or tension cracks are apparent anywhere in an excavation, all work should be stopped until the problem is corrected.
- The competent person must inspect trenches or excavations after any precipitation event to ensure integrity has been maintained.

- Sufficient ramps or ladders must be provided in excavations 4 or more feet deep to allow quick egress. Ramps or ladders may be placed no more than 25 feet apart, must be secured from shifting, and must extend at least 3 feet above the top of the trench or excavation. Structural ramps must be designed by a competent person.

- Material removed from an excavation or trench must be placed far enough from the edge (at least 2 feet) to prevent it from sliding into the excavation or trench or from stressing the trench or excavation walls. Worker protection must also be provided from loose rock or soil on the excavation faces.

- If trenches or excavations are near walkways or roadways, guards or warning barriers must be placed to alert pedestrians and drivers of the presence of the trench or excavation.

- If possible, trenches or excavations should be covered or filled in when unattended. Otherwise, strong barriers must be placed around the trench or excavation and lighting must be provided at night if the trench or excavation is near a walkway or roadway.

- When a hazardous atmosphere could exist, the excavation must be tested for appropriate hazardous substances and oxygen level before personnel entry. Excavation where hazardous atmospheres exist must be treated as a confined space. Entry must follow procedures outlined in "Confined Spaced Entry Program," Document Control No. 2-5.

- Entry is not allowed into excavations where water has accumulated.

2.2 PROTECTIVE SYSTEM Requirements

Protective systems protect employees from cave-ins, material that could fall in or roll off the face of the excavation, and collapse of adjacent structures. Protective systems include shoring, shielding, sloping and benching, and other systems. Sloping and benching and shoring system requirements are described below.

2.2.1 Sloping and Benching Requirements

Sloping and benching system construction must follow the guidelines established in Appendix B to Subpart P of 29 CFR 1926. Maximum allowable slopes for excavations are summarized below. All slopes indicated are expressed as the ratio of horizontal distance (H) to vertical rise (V).

Soil or Rock Type	Maximum Allowable Slope (H:V) for Excavations Less than 20 Feet Deep
Stable Rock	Vertical (90°)
Type A	0.75:1 (53°)
Type B	1:1 (45°)
Type C	1.5:1 (34°)

Soil types are defined in Appendix A to Subpart P of 29 CFR 1926 and are summarized below.

Type A: Cohesive soils with an unconfined compression strength of 1.5 tons per square foot (ton/ft^2) or greater (such as clay, silty clay, sandy clay, or clay loam)

Type B: Cohesive soils with an unconfined compression strength of greater than 0.5 but less than 1.5 ton/ft^2 (such as angular gravel, silt, silt loam, or sandy loam)

Type C: Cohesive soils with an unconfined compression strength of less than 0.5 ton/ft^2 (such as gravel, sand, loamy sand, submerged soil, or unstable submerged rock)

Sloping and benching for excavations greater than 20 feet deep must be designed by a registered professional engineer.

Soil types must be determined by the competent person using at least one visual and one manual test. Manual tests include plasticity, dry strength, thumb penetration, and drying tests.

2.2.2 Shoring System Requirements

Appendixes C, D, and E to Subpart P of 29 CFR 1926 outline requirements for timber shoring for trenches, aluminum hydraulic shoring for trenches, and alternatives to timber shoring, respectively. Guidelines for shoring systems are listed below.

- If it is not economically feasible or there are space restrictions to prevent cutting the trench or excavation walls back to a safe angle of repose, all trenches or excavations 5 feet deep or more must be shored.
- Shoring should be erected as trenching or excavation progresses and as closely as possible to the excavation floor.
- Shoring timber dimensions must meet the minimum timber requirements specified in Tables C1.1 through C1.3 of Appendix C to Subpart P 29 CFR 1926. Aluminum hydraulic shoring must be constructed using the guidelines and dimension requirements specified in Appendix D of the same standard.
- Trench shields may be used instead of shoring or bracing. Shields must be constructed of steel flat sides welded to a heavy framework of structural pipe. Shields should be moved along by the excavator as trenching or excavation proceeds.

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SAFE WORK PRACTICES (SWP)

WORKING OVER OR NEAR WATER

SWP NO.: 6-5

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WORKING OVER OR NEAR WATER

This safe work practice (SWP) provides guidelines for working over or near bodies of water 3 or more feet deep or swiftly moving water. Workers will observe the requirements of the Occupational Safety and Health Administration (OSHA) specified in Title 29 of the *Code of Federal Regulations* (CFR), Part 1926.106, "Working Over or Near Water." The following sections discuss general procedures, underwater work, and cold water procedures.

1.0 GENERAL PROCEDURES

When working over or near water, the following precautions will be taken:

- All staff and team members must wear a personal flotation device (PFD) within 15 feet of a water body. Personnel will be provided with U.S. Coast Guard (USCG)-approved life jackets or work vests. The PFD should be Class III, which will support the head of an unconscious person above water.
- Life jackets and work vests will be inspected before each use.
- A USCG-approved life-saving skiff will be available.
- Under no circumstances will team members enter water bodies without protective clothing such as rubber boots or waders.
- At least one person will remain on shore as a look-out.

If a team member falls into the water, under no circumstances should another team member enter the water to rescue the person in the water. If possible, a branch, paddle, pole, or similar object should be extended to the person in the water. When the person in the water grabs the extended item, they should be pulled toward the shore or boat. If the person is unconscious, the PFD, clothing, or hair should be hooked to pull the person toward the shore or boat. Once the person has been safely retrieved, necessary emergency medical procedures should be performed by qualified personnel. If none are necessary, the retrieved team member should change into dry clothing as soon as possible after any necessary personal decontamination.

2.0 UNDERWATER WORK

Underwater work should be performed in accordance with the procedures and guidelines of the Diving

Safety Program (Document Control No. 2-15 in Volume I).

3.0 COLD WATER PROCEDURES

When the water temperature is below 45 °F, hypothermia is a serious risk. A person can loose feeling in the extremities within 5 minutes. All field staff members should be familiar with cold water survival techniques or should receive training from an American Red Cross-certified swimming instructor in cold water survival techniques when site conditions warrant such knowledge.

After a person has been rescued from cold water, he or she should change into dry clothes as soon as possible. If the person who has fallen into the water displays hypothermia symptoms, he or she should be treated immediately and taken to a medical facility. Under no circumstances should the hypothermia victim be given hot liquids because this could accelerate shock. Drinks no warmer than normal body temperature are acceptable. If symptoms are severe and evacuation to a medical facility cannot be quickly conducted, any wet clothing should be removed, the victim should be placed in blankets or sleeping bags in a sheltered location, and the rescuer should climb into the blankets or sleeping bag with victim to provide additional warmth. The victim should also be treated continuously for shock, elevating feet and monitoring the victim's pulse and breathing rate.

If a team member falls into cold water, he or she should not remove any clothing while in the water because clothing provides additional insulation. Although clothing creates an added drag while swimming, the insulation outweighs the disadvantage of the additional drag. Each team member should carry a wool hat to place on his or her head in case he or she falls into the water. A wool hat, even when wet, provides good insulation for the head, where a large amount of body heat is lost.

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SAFE WORK PRACTICES (SWP)

Spill and Discharge Control Practices

SWP NO.: 6-14

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Spill and Discharge Control practices

This safe work practice (SWP) provides contingency measures for spills and unintentional discharges from handling and transporting hazardous materials. Spill and discharge control practices should follow specific procedures to ensure the safety of responders and bystanders and to limit environmental impacts.

1.0 General Procedures

Immediate action should be taken to control and contain any spill following the general guidelines below:

- Unnecessary people should be kept away from the spill or discharge.
- The hazardous area should be isolated.
- If the spill or discharge creates a hazardous situation or results in injury or an environmental release, the emergency procedures of the HASP should be implemented. Emergency response telephone numbers, designated contacts, and special reporting procedures are presented in the HASP.
- Personnel should stay on the upwind side of the spill or discharge.
- Entry into a confined space or low area where liquids or vapors may accumulate should be avoided.
- Sources of ignition should be eliminated if the spill or discharge involves combustible materials.
- Drains, manholes, waterways, sewers, and the like should be identified and covered or protected.
- The spill should be controlled or absorbed using appropriate media or devices.
- When the spill or discharge is fully contained and under control, spill or discharge material should be collected.
- Following cleanup, the spill area should be evaluated by collecting soil samples and screening the area with air monitoring instruments.

2.0 Solids

If the spill or discharge material is solid and nonreactive, the material should be scooped up and placed in a suitable and compatible container until the disposal method has been determined.

3.0 Liquids

If liquid is discharged, the following general procedures apply:

- The point of discharge should be immediately identified and measures taken to eliminate further discharges by uprighting or patching containers, transferring contents, or other appropriate methods.
- Any discharged liquids or sludge should be removed or retrieved.
- Discharged materials should be cleaned up with absorbent materials or devices.
- Spent absorbent material should be placed into storage or disposal containers.

4.0 reporting

In some instances, a release may require reporting to government agencies. If a reportable quantity is released (this quantity is stated on the Material Safety Data Sheet) or human health or the environment is threatened, appropriate national, state, and local administering agency personnel should be notified. The timeframe for notification may vary from agency to agency. Notification may be required immediately or within 24 hours, depending on the type, location, and amount of released material. The appropriate agency to report spills to should be determined during HASP development.

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SAFE WORK PRACTICES (SWP)

Heat Stress

SWP NO.: 6-15

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Heat Stress

This safe work practice (SWP) describes situations where heat stress is likely to occur and provides procedures for the prevention and treatment of heat-related injuries and illnesses. Wearing personal protective equipment (PPE), especially during warm weather, puts employees at considerable risk of developing heat-related illness. Health effects from heat stress may range from transient heat fatigue or rashes to serious illness or death.

Many factors contribute to heat stress, including PPE, ambient temperature and humidity, workload, and the physical condition of the employee, as well as predisposing medical conditions. However, the primary factors are elevated ambient temperatures in combination with fluid loss. Because heat stress is one of the more common health concerns that may be encountered during field activities, employees must be familiar with the signs, symptoms, and various treatment methods of each form of heat stress. Heat stroke is the most serious heat-related illness—it is a threat to life and has a 20 percent mortality rate. Direct exposure to sun, poor air circulation, poor physical condition, and advanced age directly affect the tendency to heat stroke. Table 1 lists the most serious heat conditions, their causes, signs and symptoms, and treatment.

Training is an important component of heat stress prevention. Employees are instructed to recognize and treat heat-related illnesses during 8-hour health and safety refresher and first aid training courses. When working in hot environments, specific steps should be taken to lessen the chances of heat-related illnesses. These include the following:

- Ensuring that all employees drink plenty of fluids (Gatorade® or its equivalent)
- Ensuring that frequent breaks are scheduled so overheating does not occur
- Revising work schedules, when necessary, to take advantage of the cooler parts of the day (such as working from 5:00 a.m. to 11:00 a.m. and 6:00 p.m. to nightfall).

When PPE must be worn (especially Levels A and B), suggested guidelines relating to ambient temperature and maximum wearing time per excursion are as shown in Table 2.

TABLE 1

hEAT sTRESS CONDITIONS

Condition	Causes	Signs and Symptoms	Treatment
Heat cramps	Fluid loss and electrolyte imbalance from dehydration	• Painful muscle cramps, especially in legs and abdomen • Faintness • Profuse perspiration	• Move affected worker to cool location • Provide sips of liquid such as Gatorade® • Stretch cramped muscles • Transport affected worker to hospital if condition worsens
Heat Exhaustion	Blood transport to skin to dissipate excessive body heat, resulting in blood pooling in the skin with inadequate return to the heart	• Weak pulse • Rapid and shallow breathing • General weakness • Pale, clammy skin • Profuse perspiration • Dizziness • Unconsciousness	• Move affected worker to cool a • Remove as much clothing as possible • Provide sips of cool liquid or Gatorade® (only if conscious) • Fan the person but do not overcool or chill • Treat for shock • Transport to hospital if conditio worsens
Heat Stroke	Life threatening condition from profound disturbance of body's heat-regulating mechanism	• Dry, hot, and flushed skin • Constricted pupils • Early loss of consciousness • Rapid pulse • Deep breathing at first, and then shallow breathing • Muscle twitching leading to convulsions • Body temperature reaching 105 or 106 °F or higher	• Immediately transport victim to medical facility • Move victim to cool area • Remove as much clothing as possible • Reduce body heat promptly by dousing with water or wrapping in wet cloth • Place ice packs under arms, around neck, at ankles, and wherever blood vessels are close to skin surface • Protect patient during convulsio

TABLE 2

SUGGESTED GUIDELINES WHEN WEARING PPE

Ambient Temperature	Maximum PPE Wearing Time per Excursion
Above 90 °F	15 minutes
85 to 90 °F	30 minutes
80 to 85 °F	60 minutes
70 to 80 °F	90 minutes
60 to 70 °F	120 minutes
50 to 60 °F	180 minutes

Source: National Institute for Occupational Safety and Health (NIOSH). 1985. Memorandum Regarding Recommended Personal Protective Equipment Wearing Times at Different Temperatures. From Austin Henschel. To Sheldon Rabinovitz. June 20.

To monitor the level of an employee's heat stress, the following should be measured:

- Heart Rate: Count the radial (wrist) pulse during a 30-second period as early as possible in the rest period; if heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same.

  If the heart rate still exceeds 110 beats per minute at the next period, shorten the following work cycle by one-third.

- Oral Temperature: Use a clinical thermometer (3 minutes under the tongue) to measure the oral temperature at the end of the work period. If oral temperature exceeds 99.6 °F (37.6 °C), shorten the next work cycle by one-third without changing the rest period. If oral temperature still exceeds 99.6 °F at the beginning of the next rest period, shorten the following work cycle by one-third. Do not permit a worker to wear impermeable PPE when his or her oral temperature exceeds 100.6 °F (38.1 °C).

TETRA TECH, INC.

HEALTH AND SAFETY MANUAL

VOLUME III

SAFE WORK PRACTICES (SWP)

Cold Stress

SWP NO.: 6-16

ISSUE DATE: July 1998

REVISION No.: 1

Cold Stress

This safe work practices (SWP) describes situations where cold stress is likely to occur and discusses procedures for the prevention and treatment of cold-related injuries and illnesses. Cold conditions may present health risks to employees during field activities. The two primary factors that influence the risk potential for cold stress are temperature and wind velocity. Wetness can also contribute to cold stress. Other factors that increase susceptibility to cold stress include age (very young or old), smoking, alcohol consumption, fatigue, and wet clothing. Hypothermia can occur at temperatures above freezing if the individual has on wet or damp clothing or is immersed in cold water. The combined effect of temperature and wind can be evaluated using a wind chill index as shown in Table 1.

Bare flesh and body extremities that have high surface area-to-volume ratios such as fingers, toes, and ears are most susceptible to wind chill or extremely low ambient temperatures. Because cold stress can create the potential for serious injury or death, employees must be familiar with the signs and symptoms and various treatments for each form of cold stress. Table 2 provides information on frostbite and hypothermia, the two most common forms of cold-related injuries.

Training is an essential component of cold stress prevention. Employees are instructed to recognize and treat cold-related injuries during 8-hour health and safety refresher and first aid training courses. When working in cold environments, specific steps should be taken to lessen the chances of cold-related injuries. These include the following:

- Protecting of exposed skin surfaces with appropriate clothing (such as face masks, handwear, and footwear) that insulates, stays dry, and blocks wind
- Shielding the work area with windbreaks to reduce the cooling effects of wind
- Providing equipment for keeping workers' hands warm by including warm air jets and radiant heaters in addition to insulated gloves
- Using adequate insulating clothing to maintain a body core temperature of above 36 °C
- Providing extra insulating clothing on site

TABLE 1

Cooling Power of Wind on Exposed Flesh Expressed as Equivalent Temperature

Estimated Wind Speed (in miles per hour - mph)	Actual Temperature Reading (°F)											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent Chill Temperature (°F)											
CALM	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148

(Wind speeds greater than 40 mph have little additional effect.)	*LITTLE DANGER* in less than 1 hour with dry skin; maximum danger from false sense of security	*INCREASING DANGER* from freezing of exposed flesh within 1 minute	*GREAT DANGER* that flesh may freeze within 30 seconds

Trench foot may occur at any point on this chart.

Source: Modified from American Conference of Governmental Industrial Hygienists. 1997. "Threshold Limit Values for Chemical Substances and Physical Agents."

TABLE 2

Cold Stress CONDITIONS

Condition	Causes	Signs and Symptoms	Treatment
Frostbite	Freezing of body tissue, usually the nose, ears, chin, cheeks, fingers, or toes	• Pain in affected area that later goes away • Area feels cold and numb • Incipient frostbite (frostnip) - skin is blanched or whitened and feels hard on the surface • Moderate frostbite - large blisters • Deep frostbite - tissues are cold, pale, and hard	• Move affected worker to a warm area • Immerse affected body part warm (100 to 105 °F) water—not hot! • Handle affected area gently do not rub • After warming, bandage loosely and seek immediate medical treatment
Hypothermia	Exposure to freezing or rapidly dropping temperatures	• Shivering, dizziness, numbness, weakness, impaired judgment, and impaired vision • Apathy, listlessness, or sleepiness • Loss of consciousness • Decreased pulse and breathing rates • Death	• Immediately move affected person to warm area • Remove all wet clothing and redress with loose, dry clothes • Provide warm, sweet drink or soup (only if conscious) • Seek immediate medical treatment

- Reducing the duration of exposure to cold
- Changing wet or damp clothing as soon as possible

During periods of extreme cold (10 °F or less) workers should use the buddy system to ensure constant protective observation.

Specific monitoring criteria are not established for cold stress. However, employees should be thoroughly cognizant of the signs and symptoms of frostbite and hypothermia (see Table 1) in themselves as well as in coworkers. All instances of cold stress should be reported to the site safety coordinator. Work schedules may be adjusted and warm-up regimes imposed as needed to deal with temperature and wind conditions.

TETRA TECH, INC.

HEALTH AND SAFETY MANUAL

VOLUME III

SAFE WORK PRACTICES (SWP)

Use of Heavy Equipment

SWP NO.: 6-26

ISSUE DATE: July 1998

REVISION: 1

Use of Heavy Equipment

Truck-mounted heavy equipment and field trucks are among the types of equipment that may be used during field work. Heavy equipment can present a substantial hazard to workers. General requirements for motor vehicles and material-handling equipment are provided in the Occupational Safety and Health Administration (OSHA) Construction Industry Standards, 29 CFR 1926, Subpart O. The following precautions will be followed when heavy equipment (such as drill rigs, front-end loaders, and backhoes) is in use:

- Heavy equipment will be inspected by the operator before each work shift. The site safety coordinator (SSC) will ensure compliance with these precautions
- Equipment operators will be instructed to report any abnormalities, such as equipment failure, oozing liquids, and unusual odors, to their supervisors or the SSC
- Only qualified and licensed personnel will operate heavy equipment
- Hard hats, steel-toed boots, and safety glasses or goggles will be worn at all times around heavy equipment. Other personal protective equipment (PPE) specified in the site health and safety plan (HASP) will also be required
- Workers will not assume that the equipment operator is keeping track of their exact location. Workers will never walk directly behind or to the side of heavy equipment without the operator's knowledge
- Workers in close proximity to heavy equipment will maintain visual contact with equipment operators at all times
- When an operator must maneuver equipment in tight quarters, the presence of a second person will be required to ensure adequate clearance. If backing is required, two ground guides will be used: one in the direction the equipment is moving, and the other in the operators's normal field of vision to relay signals
- All heavy equipment used at a contaminated work site will be kept in the exclusion zone until the work has been completed. Such equipment will then be decontaminated within the designated decontamination area
- Hand-signal communications will be established when verbal communication is difficult. One person per work team will be designated to give hand signals to equipment operators
- Equipment with an obstructed rear view must have an audible alarm that sounds when the equipment is moving in reverse (unless a spotter guides the operator)
- Parking brakes will be kept engaged when equipment is not in use

- Blades, buckets, dump bodies, and other hydraulic systems will be kept fully lowered when equipment is not in use
- Equipment cabs will be kept free of all nonessential and loose items
- Seat belts must be present in all vehicles having a rollover protective structure (ROPS)
- With certain exceptions, all material-handling equipment must be equipped with ROPS
- Material-handling equipment that lacks a ROPS will not be operated on a grade unless the grade can safely accommodate the equipment involved
- Drilling auger sections and other equipment are extremely heavy. All precautions must be taken before moving heavy equipment. Appropriate equipment must be used to transport heavy equipment
- Only chains, hoists, straps, and other equipment that safely aids transport of heavy materials will be used
- Proper personal lifting techniques will be used. Workers will lift using their legs, not their backs
- A safety barrier will be used to protect workers when tires are inflated, removed, or installed on split rims
- An ongoing maintenance program for all tools and equipment must be in place. All tools and moving equipment will be inspected regularly to ensure that parts are secured, are intact, and have no cracks or areas of weakness. The equipment must turn smoothly without wobbling and must operate according to manufacturer specifications. Defective items will be promptly repaired or replaced. Maintenance and repair logs will be kept
- Tools will be stored in clean, secure areas to prevent damage, loss, or theft
- Workers will not use equipment with which they are not familiar. This precaution applies to heavy as well as light equipment
- Loose-fitting clothing and loose, long hair will be prohibited around moving machinery
- Workers will make sure that no underground or overhead power lines, sewer lines, gas lines, or telephone lines present a hazard in the work area
- All personnel who are not essential to work activities will be kept out of the work area
- Workers will be aware of their footing at all times
- Workers will remain alert at all times

Attachment 4
Tetra Tech Forms
Greenwood Chemical Site O&M Services

tetra tech, inc.

FIELD AUDIT checklist

Project Name: Project No.:

Field Location: Completed by:

Project Manager: Site Safety Coordinator:

	General Items	In Compliance?		
Health and Safety Plan Requirements		Yes	No	NA
1	Approved health and safety plan (HASP) on site or available			
2	Names of on-site personnel recorded in field logbook or daily log			
3	HASP compliance agreement form signed by all on-site personnel			
4	Material Safety Data Sheets on site or available			
5	Designated site safety coordinator present			
6	Daily tailgate safety meetings conducted and documented			
7	On-site personnel meet HASP requirements for medical examinations, fit testing, and training (including subcontractors)			
8	Compliance with specified safe work practices			
9	Documentation of training, medical examinations, and fit tests available from employer			
10	Exclusion, decontamination, and support zones delineated and enforced			
11	Windsock or ribbons in place to indicate wind direction			
12	Illness and injury prevention program reports completed (California only)			
Emergency Planning				
13	Emergency telephone numbers posted			
14	Emergency route to hospital posted			
15	Local emergency providers notified of site activities			
16	Adequate safety equipment inventory available			
17	First aid provider and supplies available			
18	Eyewash stations in place			
Air Monitoring				
19	Monitoring equipment specified in HASP available and in working order			
20	Monitoring equipment calibrated and calibration records available			
21	Personnel know how to operate monitoring equipment and equipment manuals available on site			
23	Environmental and personnel monitoring performed as specified in HASP			

	Safety Items	In Compliance?		
Personal Protection		Yes	No	NA
1	Splash suit			
2	Chemical protective clothing			
3	Safety glasses or goggles			

4	Gloves			
5	Overboots			
6	Hard hat			
7	Dust mask			
8	Hearing protection			
9	Respirator			
Instrumentation				
10	Combustible gas meter			
11	Oxygen meter			
12	Organic vapor analyzer			
Supplies				
13	Decontamination equipment and supplies			
14	Fire extinguishers			
15	Spill cleanup supplies			
Corrective Action Taken During Audit:				
Corrective Action Still Needed:				

Note: NA = Not applicable

Auditor's Signature

Site Safety Coordinator's Signature

Date

tetra tech, inc.

SUBCONTRACTOR TRAINING CERTIFICATION

Project No.: _____

Occupational Safety and Health Administration (OSHA) Title 29 of the *Code of Federal Regulations* (CFR), Part 1910.120, "Hazardous Waste Operations and Emergency Response," contains training, supervised experience, medical surveillance, and respirator fit testing requirements for individuals working at hazardous sites. To ensure compliance with this and other applicable regulations, Tetra Tech, Inc. (Tetra Tech), and its subsidiary companies require documentation of this training from subcontractors working under Tetra Tech or subsidiary supervision.

(To be checked by Tetra Tech)

Copies of course completion certificates, medical clearance documents, fit-test records, and evidence of supervised field experience for subcontractor employees assigned to this project must be available to Tetra Tech within 24 hours after Tetra Tech has requested such documents.

Copies of course completion certificates, medical clearance documents, fit test records, and evidence of supervised field experience for subcontractor employees assigned to this project are necessary and should be submitted prior to commencement of site work.

Additionally, a site-specific health and safety plan (HASP) has been developed for this project. A copy of the HASP will be provided to subcontractors, and a separate copy will be maintained on site. A prework safety meeting will be held to discuss the HASP and general site activities. The subcontractor is responsible for ensuring that all subcontractor employees are aware of and have read the HASP and will attend the prework safety meeting and all other site safety meetings.

Any questions regarding the HASP should be directed to the Tetra Tech project manager.

Subcontractor Representative Acceptance	Tetra Tech, Inc., Representative Approval
Name:	
Signature:	
Title:	
Date:	

tetra tech, inc.

CERTIFICATION OF health and safety REQUIREMENTS FOR SUBCONTRACTORS

Note: Sign and return to the site safety coordinator.

The SUBCONTRACTOR hereby certifies that all SUBCONTRACTOR employees have been trained in accordance with Title 29 of the *Code of Federal Regulations*, Part 1910.120, "Hazardous Waste Operations and Emergency Response," and that all of the employees who will be engaged in work on

Project Name

shall comply with the provisions of this and other applicable regulations and the provisions of the site-specific health and safety plan.

Name and Title of Officer of the Firm:

Name of Firm:

Signature of Officer of the Firm:

Date Received by Tetra Tech, Inc.:

Printed Name of Site Safety Coordinator:

Signature of Site Safety Coordinator:

tetra tech, inc.

DAILY TAILGATE SAFETY MEETING FORM

Date: Time: Project No.:

Client: Site Location:

Site Activities Planned for Today:

Safety Topics Discussed
Protective clothing and equipment:
Chemical hazards:
Physical hazards:
Environmental and biohazards:
Equipment hazards:
Decontamination procedures:
Other:
Review of emergency procedures:
Employee Questions or Comments:

Attendees	
Printed Name	**Signature**

DAILY TAILGATE SAFETY MEETING Form (Continued)

Meeting Conducted by:

Name Title

Signature

tetra tech, inc.

Daily SITe log

Site Name: Date:

Name (print)	Company	Time	
		In	Out

Comments:

Attachment 5
Safety Meeting Checklist
Greenwood Chemical Site Greenwood

Greenwood Chemical Sit
Safety Meeting Checklist

_____
Site Safety Coordinator/Date

Attendee Initials:_____

_____
SSC Initials

_____Review Immediate and Pertinent Work Plans
_____Collect Current Medical Monitoring Certificates
_____Collect Current Respirator Fit Test Record
Collect Current Training Certificates:
_____Hazardous Waste Operations 40 hr (OSHA 1910.120)
_____Hazardous Waste Operations Refresher (OSHA 1910.120)
_____Hazardous Waste Operations Supervisor (OSHA 1910.120)
_____Confined Space Entry
_____Air Supplied Respirators
_____Monitoring Equipment (other than Tt/B&V supplied)
_____First Aid/CPR
_____Other
_____Review Standing Safety Orders
_____Review Personal Protective Equipment Requirements
Review Emergency Action Plan:
_____Anticipated Emergency Response Discussed
_____Identify First Aid/CPR Trained Personnel to Team Members
_____Personnel Trained to Respond Identified to Team
_____*Review Evacuation and Rally Procedures with Team Members*
Conduct Chemical Hazard Training for Team Members
_____Detection Methods
_____Protective Measures
_____Location of MSDS
_____Labeling System Used On Site
_____Signs/Symptoms of Overexposure
Review Communication Systems with Team Members
_____Internal System
_____External System
_____Review Changes to HASP
_____Point Out Postings:
_____Emergency Phone List
_____Hospital Emergency Route/Map
_____OSHA Poster
_____HASP
Subcontractor Safety
_____MSDS Submitted to Tt/B&V SSC
_____Emergency Equipment
_____Reference Materials

_____
Note: If an item is not applicable, insert "N/A."

Safety briefings are to be held prior to initiating any site activity and at such times as necessary to ensure that employees are apprised of the site safety plan and that the plan is being followed.

AR302693

Attachment 6
Decontamination Methods
Greenwood Chemical Site
O&M Services

Table A6-1
Personnel Decontamination

Method *	Surface	Action	Technique	Advantages	Disadvantages
Soap and water	Skin and hands	Emulsifies and dissolves contaminate	Wash 2-3 minutes and monitor. Do not wash more than 3-4 times.	Readily available and effective for most contamination.	Continued washing will defat the skin. Indiscriminate washing of other than affected parts may spread contamination.
Lava soap, soft brush, and water	Skin and hands	Emulsifies, dissolves, and erodes	Use light pressure with heavy lather. Wash for 2 minutes, 3 times. Rinse and monitor. Use care not to scratch or erode the skin. Apply lanolin or hand cream to prevent chapping	Readily available and effective for most contamination.	Continued washing will abrade the skin.
Tide or other detergent (plain)	Skin and hands	Emulsifies, dissolves, and erodes	Make into a paste. Use with additional water with a mild scrubbing action. Use care not to erode the skin.	Slightly more effective than washing with soap.	Will defat and abrade skin and must be used with care.
Mixture of 50% Tide and 50% cornmeal	Skin and hands	Emulsifies, dissolves, and erodes	Make into a paste. Use with additional water with a mild scrubbing action. Use care not to erode the skin.	Slightly more effective than washing with soap.	Will defat and abrade skin and must be used with care.

Table A6-2 (*page 1 of 3*)
Area and Material Decontamination

Method *	Surface	Action	Technique	Advantages	Disadvantages
Vacuum cleaning	Dry surfaces	Removes contaminated dust by suction	Use conventional vacuum technique with efficient filter.	Good on dry, porous surfaces. Avoids water reactions.	All dust must be filtered out of exhaust. Machine is contaminated.
Water	All nonporous surfaces (metal, painted, plastic, etc.)	Dissolves and erodes	For large surfaces. Hose with high pressure water at an optimum distance of 15 to 20 feet. Spray vertical surfaces at an angle of incidence of 30° to 40°; work from top to bottom to avoid recontamination. Work upwind to avoid spray. Determine cleaning rate experimentally, if possible; otherwise, use a rate of 4 square feet per minute.	All water equipment may be utilized. Allows operation to be carried out from a distance. Contamination may be reduced by 50%. Water equipment may be used for solutions of other decontaminating agents.	Drainage must be controlled. Not suitable for porous materials. Oiled surfaces cannot be decontaminated. Not applicable on dry contaminated surfaces (use vacuum); not applicable on porous surfaces such as wood, concrete, canvas, etc. Spray will be contaminated.
	All surfaces	Dissolve and erodes	For small surfaces Blot up liquid and handwipe with water and appropriate commercial detergent.	Extremely effective if done immediately after spill and on non-porous surfaces.	Of little value in the decontamination of large areas, longstanding contaminants, and porous surfaces.
Steam	Nonporous surfaces (especially painted or oiled surfaces)	Dissolves and erodes	Work from top to bottom and from upwind. Clean surface at a rate of 4 square feet per minute. The cleaning efficiency of stream will be greatly increased by using detergent.	Contamination may be reduced approximately 90% on painted surfaces.	Stream subject to same limitations as water. Spray hazard makes the wearing of waterproof outfits necessary.
Detergents	Nonporous surfaces (metal, painted, glass, plastic, etc.)	Emulsifies contaminant and increases wetting power of water and cleaning efficiency of steam	Rub surface 1 minute with a rag moistened with detergent solution then wipe with dry rag; use clean surface of the rag for each application. Use a power rotary brush with pressure feed for more efficient cleaning. Apply solution from a distance with a pressure proportioned. Do not allow solution to drip onto other surface. Mist application is all that is necessary.	Dissolve industrial film and other materials which hold contamination. Contamination may be reduced by 90%.	May require personal contact with surface. May not be efficient on longstanding contamination.

Table A6-2 (*page 2 of 3*)
Area and Material Decontamination

Method *	*Surface*	*Action*	*Technique*	*Advantages*	*Disadvantages*
Complexing agents	Nonporous surfaces (especially unweathered surfaces, i.e., no rust or calcareous growth)	Forms soluble complexes with contaminated material	Complexing agent solution should contain 3% (by weight) or agent. Spray surface with solution. Keep surface moist 30 minutes by spraying with solution periodically. After 30 minutes, flush material off with water. Complexing agents may be used on vertical and overhead surfaces by adding chemical foam (sodium carbonate or aluminum sulfate).	Holds contamination in solution. Contamination may be reduced by 75% in 4 minutes on unweathered surfaces. Easily stored; carbonates and citrates are nontoxic, noncorrosive.	Requires application for 5 to 30 minutes. Little penetrating power; of small value on weathered surfaces.
Organic solvents	Nonporous surfaces (greasy or waxed surfaces, paint or plastic finishes, etc.)	Dissolves organic materials (oil, paint, etc.)	Immerse entire unit in solvent or apply by wiping procedure (see Detergents).	Quick dissolving action. Recovery of solvent possible by distillation.	Requires good ventilation and fire precautions. Toxic to personnel. Material bulky.
Inorganic acids	Metal surfaces (especially with porous deposits, i.e., rust or calcareous growth); circulatory pipe systems	Dissolve porous deposits	Use dip-bath procedure for movable items. Acid should be kept at a concentration of 1 to 2 normal (9 to 18% hydrochloric, 3 to 6% sulfuric acid). Leave on weathered surfaces for 1 hour. Flush surface with water, scrub with a water-detergent solution, and rinse. Leave in pipe circulatory system 2 to 4 hours; flush with plain water, a water-detergent solution, then again with plain water.	Corrosive action on metal and porous deposits. Corrosive action may be moderated by addition of corrosion inhibitors to solution.	Personal hazard. Wear goggles, rubber boots, gloves, and aprons. Good ventilation required because of toxicity and explosive gases. Acid mixtures should not be heated. Possibility of excessive corrosion if used without inhibitors. Sulfuric acid not effective on calcareous deposits.
Acid mixtures: Hydrochloric, sulfuric, acetic, citric acids, acetates, citrates	Nonporous surfaces (especially with porous deposits); circulatory pipe systems	Dissolves porous deposits	Same as for inorganic acids. A typical mixture consist of 0.1 gal hydrochloric acid, 0.2 lb sodium acetate, and 1 gal water	Contamination may reduced by 90% in 1 hour (unweathered surfaces). More easily handled than inorganic acid solution.	Weathered surfaces may require prolonged treatment. Same safety precautions as required for inorganic acids.

Table A6-2 (*page 3 of 3*)
Area and Material Decontamination

Method *	Surface	Action	Technique	Advantages	Disadvantages
Caustics: lye (solidum hydroxide) calcium hydroxide potassium hydroxide	Painted surfaces (horizontal)	Softens paint (harsh method)	Allow paint-remover solution to remain on surface until paint is softened to the point where it may be washed off with water. Remove remaining paint with long-handled scrapers. Typical paint remover solution: 10 gal water, 4 lb lye, 6 lb boiler compound, 0.75 lb cornstarch.	Minimum contact with contaminated surfaces. Easily stored.	Personal hazard (will cause burns). Reaction slow; thus, it is not efficient on vertical or overhead surfaces. Should not be used on aluminum or magnesium.
Trisodium phosphate	Painted surfaces (vertical, overhead)	Softens paint (mild method)	Apply about 10% solution by rubbing and wiping procedure (see Detergent)	Contamination may be reduced to tolerance in one or two applications.	Destructive effective on paint. Should not be used on aluminum or magnesium.
Abrasion	Nonporous surfaces	Removes surfaces	Use conventional procedures, such as sanding, filing, and chipping; keep surface damp to avoid dust hazard.	Contamination may be reduced to as low a level as desired.	Impracticable for porous surfaces because of penetration by moisture.
Sandblasting	Nonporous	Removes surfaces	Keep sand wet to lessen	Practical for large surface areas	Contamination spread over area must be removed.
Vacuum blasting	Porous and non-porous surfaces	Removes surface; traps and controls contaminated waste.	Hold tool flush to surface to prevent escape of contamination.	Contaminated waste ready for disposal. Safety abrasion method.	Contamination of Equipment.

* Begin with the first listed method and then proceed step by step to the more severe methods, as necessary