1-30-003A-02

Final

DRAFT WORK PLAN
FOR
PRE-DESIGN INVESTIGATION TASKS
GM-38 AREA GROUNDWATER REMEDIATION
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BETHPAGE, NEW YORK

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1.0 INTRODUCTION

Tetra Tech FW, Inc. (TtFW) has been contracted by the United States Department of the Navy, Engineering Field Activity, Northeast to perform pre-design tasks for the upcoming GM-38 Area groundwater remediation at the Naval Weapons Industrial Reserve Plant (NWIRP) Bethpage, in Bethpage, New York. This Work Plan has been prepared to satisfy the requirements of Remedial Action Contract No. N62472-99-D-0032, Contract Task Order No. 96.

1.1 Site Description

NWIRP Bethpage is located in east central Nassau County, Long Island, New York, approximately 30 miles east of New York City. The Navy's property totaled approximately 109.5 acres and was formerly a Government Owned Contractor Operated (GOCO) facility that was operated by the Northrop Grumman Corporation (NGC) until September 1998. NWIRP Bethpage is bordered on the north, west, and south by property owned, or formerly owned, by NGC that covered approximately 605 acres, and, on the east, by a residential neighborhood.

NWIRP Bethpage is currently listed by New York State Department of Environmental Conservation (NYSDEC) as an "inactive hazardous waste site" (#1-30-003B), as is NGC (#1-30-003A) and the Hooker/RUCO site (#1-30-004) located less than 1/2 mile west of NWIRP Bethpage.

NWIRP Bethpage was established in 1933. Since inception, the primary mission of the facility has been the research, prototyping, testing, design engineering, fabrication, and primary assembly of military aircraft. The facilities at NWIRP Bethpage include four plants (Nos. 3, 5, and 20, used for assembly and prototype testing; and No. 10, which contains a group of quality control laboratories), two warehouse complexes, a salvage storage area, water recharge basins, an industrial wastewater treatment plant, and several smaller support buildings.

Historical operations that resulted in hazardous material generation at the facility included metal finishing processes, maintenance operations, painting of aircraft and components, and other activities that involve aircraft manufacturing. Wastes generated by plant operations were disposed directly into either drainage sumps, dry wells, and/or on the ground surface, resulting in the disposal of a number of hazardous wastes, including the volatile organic compounds (VOCs) perchloroethene (PCE) and trichloroethene (TCE), the semivolatile organic compounds (SVOCs) polychlorinated biphenyls (PCBs), and the inorganics chromium and cadmium at the site. Some of these contaminants have migrated from the points of disposal to surrounding areas, including the soils of these sites and the groundwater beneath and downgradient of the NWIRP Bethpage property.

The GM-38 Area refers to a cluster of monitoring wells that were installed in the 1990s by NGC and that first identified an isolated groundwater contaminant plume in this area. Chlorinated VOCs were identified in moderately deep groundwater (220 to 470 feet below ground surface [bgs]) at concentrations greater than 500 micrograms per liter (ug/L). The contaminated groundwater in the area represents a relatively large mass of chlorinated VOCs that would remain for extended periods and could adversely affect public water supplies in the area, as well

as other downgradient water supplies. Two public water supply systems are present in the general area and extract groundwater at depths ranging from 540 to 740 feet bgs. Navy and contractor funded systems are in place at the public water supply wells to remove VOCs from the water prior to distribution.

The GM-38 Area is approximately 8,500 feet south southeast and hydraulically downgradient of NWIRP Bethpage, as shown on Figure 1. Specifically, the center of the project area is a utility easement that is located east of Broadway Avenue, west of the Seaford – Oyster Bay Expressway, and between the north and south dead ends of Windhorst and Herman Streets. The site layout is shown on Figure 2.

1.2 Geology and Hydrogeology

The sites are underlain by five geologic/hydrogeologic formations (descending from ground surface):

- Pleistocene deposits (Upper Glacial Aquifer) consisting of various sands and gravels intermixed with discontinuous low permeability clay lenses, approximately 100 feet thick
- Magothy Formation (Magothy Aquifer) consisting of various sands and gravels varying in thickness interlaced with low permeability confining layers
- Raritan Clay Formation
- Lloyd Sand Formation (Lloyd Aquifer)
- Bedrock

The Upper Glacial Formation (commonly referred to as glacial deposits) forms the surface deposits across the entire NWIRP facility. The glacial deposits beneath the site consist of coarse sands and gravels. These deposits are generally about 30 to 45 feet thick; local variations in thickness are common due to the irregular and undulating interface of the glacial deposits with the underlying Magothy Formation. The interface between the two formations was defined in the field as the horizon where gravel becomes very rare to absent, and finer sands, silts, and clays predominate. The generally coarse nature of both formations near their interface, however, may make this differentiation either difficult or rather subjective.

The Upper Glacial Formation and the Magothy Formation comprise the aquifer of concern at NWIRP. Regionally, these formations are generally considered to form a common, interconnected aquifer as the coarse nature of each unit near their interface and the lack of any regionally confining clay unit allow for the unrestricted flow of groundwater between these two formations.

Although the water table beneath NWIRP occurs below the glacial deposits, these deposits are hydrogeologically important because their high permeability allows for the rapid recharge of precipitation to the underlying Magothy Formation. In addition, the large quantity of groundwater withdrawn daily from the Magothy passes back through part of the glacial deposits via the recharge basins to the Magothy Formation.

The Magothy aquifer is the major source of public water in Nassau County. The most productive water-bearing zones are the discontinuous lenses of sand and gravel that occur within the generally siltier matrix. The major water-bearing zone is the base gravel.

The Magothy aquifer is commonly regarded to function as an unconfined aquifer at shallow depths and a confined aquifer at deeper depths. Previous drilling at Bethpage has revealed that clay zones beneath the facility are common but laterally discontinuous. No confining clay units of facility-wide extent were encountered.

The groundwater beneath NWIRP dominantly flows to the southwest and, to a lesser extent, to the south. The flow is greatly influenced by groundwater mounding that occurs at the recharge basins, and by the withdrawal of water at numerous facility wells. The wells have the potential to significantly change the local flow pattern. These wells were operated on an irregular basis and in various combinations. Consequently, their influence on the local flow at any time is difficult to predict.

The horizontal hydraulic gradient varies throughout the facility due to the recharge basins and the facility wells. The average gradient calculated across the facility is 5.3 feet/mile, which is significantly lower than the published regional gradient of 10 feet/mile. The average linear velocity of the groundwater at the water table is estimated to range from 0.2 feet/day to 0.9 feet/day, which is significantly less than the previous estimate of 50 to 70 feet/day. The facility occupies an area of recharge. Vertical hydraulic gradients are downward, but are very low, and this agrees with previously published regional data.

1.3 Nature and Extent of Groundwater Contamination

The groundwater contaminants are chlorinated VOCs that were either used or disposed of at the sites or are breakdown products of these chemicals. These compounds are:

- Perchloroethene (PCE)
- Trichloroethene (TCE)
- Dichloroethenes (DCE)
- Vinyl chloride
- 1,1,1-trichloroethane (1,1,1-TCA)

The contaminated groundwater plumes emanating from the Navy and NGC sites is estimated to total more than 2,000 acres in area and extend more than 700 feet deep in some locations. Recent groundwater data from the Navy's vertical profile borings indicate that the contaminated groundwater plume has migrated south beyond the Hempstead Turnpike.

To date, the off-site groundwater plume(s) have impacted or threatened three public water supply wellfields operated by the Bethpage Water District (BWD). There are treatment systems in place at each of the three impacted or threatened wellfields. The water that is distributed to the community is tested on a monthly basis to ensure that the drinking water standards promulgated by the New York State Department of Health (NYSDOH) are met. In addition, the BWD has a policy of providing its consumers with drinking water that contains no detectable concentrations

of site-related contaminants. Given the proximity of the contaminants to the BWD wellfields, nine (9) outpost or sentry wells were installed upgradient of the water supplies. These wells have been sampled on a quarterly basis since March 1995. The purpose of this quarterly sampling is to provide the BWD with the data necessary to ensure that the existing treatment systems are adequate to treat the level of contaminants that may impact their public supply wells. The data are also used to make decisions about the need for groundwater remediation.

Based upon a review of the sentry well data, there is an area surrounding monitoring well cluster GM-38 that contains high concentrations, in excess of 1,000 parts per billion (ppb), of site-related contamination. The outpost wells will continue to be monitored to determine the groundwater concentrations of these site-related contaminants.

1.4 Summary of the Record of Decision

Remediation of the GM-38 Area groundwater is identified in the NYSDEC Record of Decision (ROD) for Operable Unit (OU) 2 Groundwater for Site Numbers 1-30-003A & B, dated March 2001, and the Navy's ROD for OU 2 - Groundwater for Site Number 1-30-003B, dated April 2003 (Rev. 1).

The remedial action selected in the ROD addresses on-site contaminated groundwater beneath the Navy's 105-acre parcel, as well as contaminated groundwater that has migrated off-site beyond the boundaries of NWIRP Bethpage.

The Navy's selected remedy for on-site groundwater includes an institutional control consisting of the placement of a restriction in the deed of transfer to the County of Nassau, New York prohibiting extraction of groundwater from within the boundaries of the 105-acre or Plant 20 parcels located at the Navy's former NWIRP Bethpage facility. This remedy is based on the recognition that an existing groundwater extraction and treatment system, known as the Onsite Containment (ONCT) System, is containing and remediating VOC-contaminated groundwater emanating from the Navy's property. The system was constructed and is operated by NGC as part of the March 2001 ROD for Regional Groundwater issued by NYSDEC. If the system fails to continue to operate for any reason, the Navy will re-evaluate the remedy for on-site groundwater and implement necessary measures to ensure that the remedy is still protective of human health and the environment.

The Navy's selected remedy for off-site groundwater includes the following:

Groundwater Remedial Program:

- Contaminant removal through groundwater extraction and treatment at an off-site area near the GM-38 monitoring well cluster
- Pre-design investigation to determine the optimal groundwater extraction locations in the GM-38 Area
- Operation and maintenance of the GM-38 Area remedy
- Additional investigation in the vicinity of well GM-75D2, or any other area identified as requiring additional groundwater investigation, to determine if a contaminant removal program similar to the GM-38 program is necessary

- Continued participation in the Technical Advisory Committee (TAC) established by NYSDEC

Public Water Supply Protection Program:

- Installation of Vertical Profile Borings (VPBs) to gather water quality and lithologic data to aid in the placement of outpost monitoring wells
- Development of a Public Water Supply Well Contingency Plan
- Installation of outpost monitoring wells in areas upgradient of potentially affected water supply wellfields as outlined in the Public Water Supply Well Contingency Plan
- Public water supply wellhead treatment or comparable alternative measures, if necessary, for wellfields that become affected in the future by site-related contaminants
- Provision of public water to residential or commercial users that have private drinking water wells determined to be affected or potentially affected by site-related contaminants

This work plan addresses the pre-design tasks that will be performed for the GM-38 Area groundwater extraction and treatment system.

2.0 SCOPE OF WORK

The following pre-design tasks are included in the scope of work:

- Geotechnical investigation to develop design parameters for the groundwater treatment system building foundation and slab;
- Pre-design groundwater investigation, to determine extraction and reinjection rates and verify the influent groundwater quality to the treatment system;
- Treatability study to gather additional information for the detailed design of the groundwater treatment process.

The tasks are described in more detail in the following sections. The Site-Specific Health and Safety Plan (SHSP) is presented as Appendix A. Standard Operating Procedures (SOPs) for investigation activities are presented in Appendix B. During intrusive activities (drilling, opening monitoring well casings, etc), air monitoring will be performed as stipulated in the SHSP (Appendix A) and SOP 31 (Appendix B).

2.1 Mobilization

The Navy will obtain access agreements, if needed, and will provide copies to TtFW, prior to the start of field activities. TtFW will mobilize all necessary personnel, equipment, and materials to the site. All subcontractor personnel and equipment will be mobilized to the site. Mobilization activities will be conducted in accordance with SOP 1 (Appendix B).

Underground utility mark-out will be performed. TtFW will contact the New York State One-Call System. In addition, each drilling location will be screened for utilities using geophysical methods (i.e., ground penetrating radar or magnetometer).

2.2 Geotechnical Investigation

TtFW will perform a geotechnical investigation at the planned location of the treatment system building to develop design parameters for the building foundation and slab.

Four geotechnical soil borings will be drilled to a maximum depth of 60 feet each at the building location (see Figure 3). The borings will be advanced using mud rotary drilling techniques. The borings will be reamed to approximately five inches in diameter. If sloughing of the upper borehole occurs, 4-inch diameter Schedule 40 PVC temporary surface casing will be installed to the depth of the sloughing. Drilling mud will consist of potable water and polymer-free sodium bentonite. All drilling mud will be contained and re-circulated in a baffled, high capacity mud pan.

Split-spoon samples will be collected at intervals of 5 feet at each boring location in accordance with SOP 13 (Appendix B). In addition, up to eight Shelby Tube samples will be collected (2 per boring). The borehole will be advanced to the top of the interval to be sampled. A decontaminated 2 foot long by 2 inch diameter carbon steel split spoon will be driven into the overburden, using a 140 pound hammer falling 30 inches, until either approximately 2 feet has

been penetrated or 100 blows within a 6 inch interval have been applied. The number of blows required for each 6 inches of penetration or fraction thereof will be recorded. The split spoon samples will be visually classified in accordance with the Unified Soil Classification System (USCS) Method. Following completion of a split spoon sample, the borehole will be advanced to the top of the next interval to be sampled and the process will be repeated.

Up to eight (8) soil samples will be will be tested as follows:

- Particle size analysis by ASTM D-422
- Natural moisture content by ASTM D-2216
- Atterberg limits by ASTM D-4318
- Specific gravity by ASTM D-854

If necessary, up to eight (8) additional samples will be analyzed for the following parameters:

- Consolidation by ASTM D-2435
- Unconfined compressive strength by ASTM D-2166
- Total organic carbon

Once split spoon sampling of the borehole is complete, the temporary PVC casing will be removed (if present) and all drill cuttings will be containerized and eventually disposed off-site. The boreholes will be grouted.

2.3 Pre-Design Groundwater Investigation

TtFW will perform a pre-design groundwater investigation to determine site-specific parameters for design of the extraction and re-injection systems (e.g., groundwater flow direction and gradient, required number of wells, well locations and depths, extraction/re-injection rates, and capture zones) and to verify the expected influent groundwater quality for the treatment system.

2.3.1 Installation and Sampling of Monitoring Wells

Six (6) 4-inch Schedule 80 PVC monitoring wells will be installed at the locations depicted on Figure 3. Two (2) monitoring wells will be installed in the shallow zone (355 to 435 feet bgs) and three (3) will be installed in the deep zone (440 to 510 feet bgs). These wells will be installed either side gradient or up gradient of the extraction wells in order to verify the capture zone of the extraction wells. One (1) monitoring well will be installed to a depth of 150 feet bgs and within 25 feet of the injection well in order to determine the effects of groundwater re-injection.

Installation

The monitoring wells will be drilled following the mud rotary procedure described for the geotechnical borings and in accordance with SOP 22 (Appendix B).

For each monitoring well, the borehole will be drilled to the specified depth. Borehole geophysical logs will be recorded for each of the boreholes. Downhole geophysical logging will be conducted in accordance with SOP 5 (Appendix B). Following advancement to the total depth of the boring, the drilling tools will be withdrawn from the borehole. A geophysical probe will then be run down the borehole and back up. The geophysical data will be recorded using a Mount Sopris MGX II digital logger, or equivalent. The probe will be multi-function and will record a gamma ray log, as well as single point resistivity and spontaneous potential logs. Once logging of the borehole is complete, the well will then be constructed.

The monitoring wells associated with the extraction wells will be constructed using approximately forty feet of 4-inch diameter Schedule 80 PVC screen, with 0.010-inch slot openings and flush joint threads. The length of the screen may be modified based on geophysical log results and the slot openings maybe modified based on grain-size analysis. The monitoring well associated with the injection well will be constructed using approximately 130 feet of four-inch diameter Schedule 80 PVC screen, with 0.010-inch slot openings and flush joint threads. Four-inch diameter Schedule 80 PVC riser pipe with locking security cap will be installed from the top of the screen to ground surface for flush-mount, or two feet above grade for stick-up completion.

Morie #1 sand-pack will be installed via tremie pipe in the annulus around the well screen and riser pipe to 3 feet above the screened interval. The annulus above the sand pack will be sealed to near ground surface using a bentonite-cement grout via tremie pipe.

Monitoring wells will be completed in accordance with SOP 26 (Appendix B). A protective steel stick-up casing or flush mount cover will be installed over the top of the riser pipe at each monitoring well. For flush mount installations, a locking cap will be installed on top of the riser pipe and a manhole cover will be bolted to secure the well. For stick-up installations, the protective steel stick-up casing will be secured with a padlock. All locks will be keyed alike. The monitoring well identification number will be stamped on the inside of the protective casing with a steel die.

A concrete pad will be constructed around each flush mount casing to direct surface water runoff away from the casing. The pad will meet the criteria defined in SOP 26 (Appendix B).

Development

The monitoring wells will be developed according to the following procedures and in accordance with SOP 27 (Appendix B). The grout will be allowed to cure for at least 48 hours prior to well development. The wells will be developed by pumping and surging. The surge blocks will be cylinders with a slightly smaller diameter than the inner diameter of the well. Rubber rings or flaps will be attached to surround the block at two or more points along its length. The outside diameter of these rings will be equal to or greater than the inside diameter of the well. The surge block will be repeatedly raised and lowered throughout the entire length of the well screen in order to develop the well filter pack.

Development will continue until there is less than a 10% variance between successive measurements of pH, temperature, conductivity, and dissolved oxygen, and/or until the turbidity is observed to be less than 50 nephelometric turbidity units (NTUs). Development will continue for a minimum of two (2) hours and a maximum of eight (8) hours. The minimum volume to be removed is three times the amount of water introduced into the hole during drilling. Well development water will be containerized and sampled for off-site laboratory analysis under expedited turn around to verify the suitability of the water for either pre-treatment and then discharge or direct discharge into local sewer manhole.

Groundwater Sampling

A minimum of 72 hours after monitoring well development, one round of groundwater samples will be collected from the newly installed monitoring wells. Prior to sampling, water level measurements will be collected from GM-38 Area wells (see SOP 44; Appendix B). Low flow methods will be used in the collection of groundwater samples in accordance with SOP 46 and SOP 47 (Appendix B). The pump intake will be set at the mid point of the screened interval. During purging, prior to groundwater sample collection, field quality parameters of pH, specific conductance, temperature, dissolved oxygen, turbidity, and oxygen reduction potential (ORP) will be monitored. Groundwater samples will be collected for analysis of VOCs, metals, total suspended solids (TSS), total dissolved solids (TDS), and chemical oxygen demand (COD). Well purging water will be containerized and sampled for off-site laboratory analysis under expedited turn around to verify the suitability of the water for either pre-treatment and then discharge or direct discharge into local sewer manhole.

Constant Head Test

At the conclusion of sampling a constant head test will be performed at each monitoring well. The test will involve pumping water into the monitoring well at five different rates. The equilibrium water level in the well at each injection rate is measured. The information of injection rate versus water level are analyzed to determine the hydraulic conductivity of the formation in the immediate vicinity of the monitoring well.

2.3.2 Installation and Testing of Extraction Wells

Installation

Two (2) 12-inch extraction wells will be installed. One extraction well will be installed to a depth of approximately 435 feet with an estimated screen interval from 355 to 435 feet. The second extraction well will be installed to a depth of approximately 510 feet with an estimated screen interval from 440 to 510 feet. A one-inch stainless steel observation piezometer will be strapped to the exterior of the well. The piezometer will have a screen with 0.010-inch slot openings and screen length that matches the screen length of the well it is attached to. The locations of the extraction wells are depicted on Figure 3.

The extraction wells will be drilled using standard mud rotary method with organic drilling mud. The borehole will be 18-inch diameter. Split spoon samples will be taken every 10 feet within

the proposed screen interval of each well. Samples will be collected from each split spoon for grain size analysis. The grain size analysis information will be used to design the filter pack and to choose the optimal slot size of the screen. Borehole geophysical logs will be recorded for each of the boreholes. Downhole geophysical logging will be conducted in accordance with SOP 5 (Appendix B). Following advancement to the total depth of the boring, the drilling tools will be withdrawn from the borehole. A geophysical probe will then be run down the borehole and back up. The geophysical data will be recorded using a Mount Sopris MGX II digital logger, or equivalent. The probe will be multi-function and will record a gamma ray log, as well as single point resistivity and spontaneous potential logs.

Once logging of the borehole is complete, the well will then be constructed. The extraction wells will be constructed of Schedule 80 stainless steel wire wrap screen and carbon steel riser. The sand pack and bentonite-cement grout mixture will be installed by tremie pipe.

A variable frequency drive (VFD) well pump will be used so that the pumping rate can be modified based on hydraulic loading. The hydraulic loading of the new extraction wells is unknown. The VFD will be controlled via a variable speed drive controller mounted near the well vault in a weather-tight enclosure. The VFD is a constant volt-per-hertz type with a pulse width modulated inverter designed for use with standard induction motors. The VFD will allow the motor speed to be reduced down to 50% of its rated speed, thereby reducing the capacity of the pump. The motor speed is adjusted manually via the controller located within the weather-tight enclosure near the well vault. No automatic adjustments of the pump motor will be provided. The controller will be suitable to operate a pump motor up to a size of 3 horsepower, 460 volt, 3-phase power.

Development

The extraction wells will be developed following the same procedure used for the monitoring wells. The development will take place a minimum of 72 hours after installation. Development will continue until there is less than a 10% variance between successive measurements of pH, temperature, conductivity, and dissolved oxygen, and/or until the turbidity is observed to be less than 50 NTUs. Development will continue for a minimum of two (8) hours and a maximum of twenty four (24) hours. Well development water will be containerized and sampled for off-site laboratory analysis under expedited turn around to verify the suitability of the water for either pre-treatment and then discharge or direct discharge into local sewer manhole.

Variable Rate Step Testing

Following installation and development, a variable rate step drawdown test (see SOP 49; Appendix B) will be performed on each extraction well to estimate the maximum long-term pumping rates of the wells. Each well will be pumped at several successively higher pumping rates, and the drawdown for each step will be recorded with a pressure transducer. The rates will be increased without recovery periods between each step. Each step will have approximately the same duration, Three to five steps are anticipated at each extraction well, each lasting 1 to 2 hours. Flow rates will be monitored by a totalizing flow meter and hand measurements to confirm the flow meter rate.

2.3.3 Installation and Testing of Injection Well

Installation

One (1) 12-inch injection well will be installed to a depth of 150 feet with an estimated screen interval of 20 – 150 feet. The proposed location of the injection well is presented on Figure 3. The injection well will be drilled and installed following the same procedure used for the extraction wells as described previously.

Development

The injection well will be developed following the same procedure used for the monitoring wells. Well development water will be containerized and sampled for off-site laboratory analysis under expedited turn around to verify the suitability of the water for possible injection during injection testing at the proposed injection well.

Injection Testing

A one-day re-injection test will be performed on the injection well. Following installation and development a variable rate step injection test will be performed on the well. Water will be injected at successively higher pumping rates for periods of up to 4 hours for each step. The water level in the injection well and a nearby monitoring well will be measured using pressure transducers. The information obtained will be analyzed to determine the viable long term injection rate of the well and the hydraulic conductivity of the formation in the area of the injection well.

The water for the injection testing will either be containerized development and purge water from the monitoring and extraction wells that is pre-treated or potable water from a nearby fire hydrant that is purchased from the local water authority. The application for and receipt of State Pollutant Discharge Elimination System (SPDES) permit will be necessary for the re-injection test. Anticipated contaminant concentrations will be compared to the SPDES permit effluent limits to predict whether pre-treatment of containerized development and purge water will be necessary prior to injection. The pre-treatment requirements will then be compared to the ability to purchase and use potable water in order to determine which water source to use for the re-injection test.

2.4 Decontamination

Drilling equipment, field instrumentation (probes, water quality meters, air meters, etc), non disposable chemical sampling equipment and low-flow groundwater sampling equipment will be decontaminated in accordance with SOP 52, SOP 53, SOP 55 and SOP 56 (Appendix B). Decontamination of drilling equipment will be conducted at the decontamination pad. Decontamination of other equipment will be conducted at the sampling location or as necessary. All decontamination fluids will be containerized, and handled as described in Section 3.

2.5 Survey

A New York state licensed surveyor will conduct a topographic survey of the site as shown on Figure 4. The survey will also include the locations of the geotechnical borings, monitoring wells, extraction wells, and injection well. Field survey data will be reduced to horizontal coordinates based upon the New York State Plane Coordinate System and vertical elevations will be referenced to the North American Vertical Datum of 1988.

2.6 Treatability Study

Based on the results of the pre-design groundwater sampling and analysis, TtFW will perform a bench-scale groundwater treatability study to address data gaps associated with the conceptual process design. Preliminary data gaps identified include the need for metals removal in the treatment system, inclusion of appropriate treatment to remove vinyl chloride from the groundwater, and development of site-specific carbon usage rates.

Groundwater will be collected from the monitoring wells for use during the treatability study. Bench-scale treatability studies for metals removal and carbon adsorption will be performed. Specific adsorbents for removal of vinyl chloride will be evaluated if vinyl chloride is determined to be a significant contaminant in the extracted groundwater.

2.7 Demobilization

Upon completion and approval of the project, all potentially contaminated equipment and facilities will be pressure washed prior to demobilization. All equipment and supplies will be removed from the site in accordance with SOP 1 (Appendix B).

3.0 WASTE MANAGEMENT

Waste materials that are determined to be non-hazardous will be managed in compliance with applicable New York solid waste regulations.

Waste generation activities will be conducted under the worker protection provisions of regulations promulgated by the Occupational Safety and Health Administration (OSHA) in 29 CFR Parts 1910 and 1926.

3.1 Waste Types

Wastes generated from the site activities are expected to be non-hazardous and may include:

- Well purging and development water
- Decontamination water
- Excess cuttings and drilling mud
- Personal protective equipment and disposable sampling equipment

3.1.1 Well Purging and Development Water

Any remaining water from well purging and development will be discharged to the Publically Operated Treatment Works (POTW). It is not anticipated that this water will need to be pre-treated.

3.1.2 Decontamination Water

All decontamination liquids will be containerized in 55-gallon United States Department of Transportation (USDOT)-approved drums for proper off-site disposal.

3.1.3 Excess Cuttings and Drilling Mud

Excess cuttings and drilling mud will be initially drummed and then consolidated into roll-off containers for eventual disposal as non-hazardous waste at an approved off-site facility.

3.1.4 Personal Protective Equipment and Disposable Sampling Equipment

Used personal protective equipment (PPE) and disposable sampling equipment will be stored in USDOT-approved containers prior to off-site disposal. These wastes will be regulated as non-hazardous wastes by NYSDEC and will be transported by a non-hazardous solid waste transporter to a permitted Resource Conservation and Recovery Act (RCRA) Subtitle D solid waste landfill. Wastes will be shipped using a Bill of Lading or non-hazardous waste manifest.

3.2 Procedures for Handling Contaminated Solids and Liquids

Procedures for handling contaminated solids and liquids include, but are not limited to, the following:

A. The contaminated area will remain isolated, and site access will be restricted to authorized TtFW employees, subcontractors, and authorized Navy employees. The Exclusion Zone will be barricaded with signs and caution tape. Entry to the Exclusion Zone will be restricted to one passageway and signage will be displayed.

B. A majority of decontamination activities will be conducted within the NWIRP Bethpage property. During decontamination activities, contaminated solids and liquids will be collected in a manner intended to prevent contact with personnel. This will include the use of appropriate PPE. All on-site personnel will be informed of the known hazards and will be properly trained in safe handling procedures contained herein and in the Site-Specific Health and Safety Plan.

C. During collection of the contaminated solids, proper equipment and work procedures will be utilized to control the flow of material and to eliminate the potential for any of the material to reach an uncontaminated surface.

D. Contaminated solid material will be collected in the appropriate sized containers (USDOT approved drums or roll-off boxes with liners) and immediately covered. Polyethylene sheeting will be used when necessary for spill protection while containers are being filled. Spill control materials will be on-site during all waste handling activities. All containers will be inspected prior to use. Containers will be placed in the waste staging area to await off-site disposal at an approved facility. Waste container exteriors will be inspected and any waste material adhering to the exterior of the waste container will be removed prior to off-site transportation. Containers will be labeled with non-hazardous waste labels. All waste containers will also be labeled with the waste description, the generation date and location, and a unique container identifier number. All waste containers will be securely closed or tarped while being stored prior to off-site disposal.

E. Solid wastes will be securely containerized to prevent release to the environment. They will be stored on-site for no more than ninety (90) days and will be inspected weekly to ensure that containers are sound and not leaking.

F. Solid waste and liquids will be disposed according to the following procedures.

1. Manifests - TtFW will organize and maintain the material shipment records/manifests required by RCRA (Public Law 94-580), New York State, and the disposal facility. All manifests will be signed by the designated NWIRP representative. Copies of all final completed manifests, including final waste quantities and disposition, will be submitted during the project to

the NWIRP representative, retained in the TtFW project file, and will be included in TtFW's Final Report submitted to the Navy.

2. TtFW will coordinate the schedule for truck arrival and material deliveries at the disposal site to meet the approved schedule. The schedule will be compatible with the availability of equipment and personnel for material handling operations.

G. Roll-off Containers (if required) - Lined and tarped, USDOT-approved roll-off containers will be provided by the selected transport or disposal facility and will be located in the laydown area. Necessary steps for spill prevention and control of spills will be implemented and containers will be labeled. Roll-offs will be labeled with non-hazardous waste labels.

H. Drums - Solid waste that should be containerized will be placed in USDOT-specified, lA2 55-gallon drums or similar USDOT-approved container. At least 6 to 12 inches of empty space will be allowed in each drum to facilitate the addition of absorbent, if necessary. Spill prevention and control steps will be taken and the containers will be labeled.

Once filled, drums will be stored on pallets under a shelter. The drums will be arranged in rows of two pallets with adequate space between rows. This arrangement allows access to any drum without rearranging drums. Drums will be arranged so the numbers on the sides are facing outward and are visible after staging. Drums will not be stacked on top of each other unless the contents are known to be non-explosive and non-flammable. If stacked, drum layers must be separated using pallets. Under no circumstances will drums be stacked more than two high.

3.3 Transportation

TtFW is responsible for all transportation of waste. TtFW will prepare all waste manifests and other shipping documents for the NWIRP Representative's signature as generator. TtFW will not sign any waste manifests/shipping document or assume generator status for transportation purposes.

All waste materials destined for off-site disposal are expected to be non-hazardous and not meet the definition of a USDOT hazardous material; however, in the event hazardous materials are encountered, TtFW will follow the following requirements for waste and sample shipments. Hazardous materials will be assigned the proper hazard class, described, packaged, marked, labeled, and in condition for shipment as required by 49 CFR 171.

Waste that does not exhibit one of the nine USDOT hazard class characteristics (i.e., explosive, flammable, poison, combustible, etc.) is not regulated under USDOT rules for the transportation of hazardous material. If waste is suspected to be hazardous, then it will be shipped under the

suspected hazard class. If a particular hazard class is unable to be determined, then the soil or water may be shipped under either of the following:

Shipping Name	Hazard Class	ID Number	Packing Group	Label
Environmentally hazardous substances, liquid, n.o.s.	9	UN3082	III	CLASS 9
Environmentally hazardous substances, solid, n.o.s.	9	UN3077	III	CLASS 9

When using either one of these "n.o.s." (not otherwise specified) shipping names, at least two technical names must follow (i.e., "Environmentally hazardous substances, liquid, n.o.s. [Benzene and Acetone]").

The shipping name, identification number, packing group, instructions, cautions, weights, United States Environmental Protection Agency (USEPA) waste code numbers and consignee/consignor designations will be marked on packages for shipment. Labeling provides information regarding the USDOT hazard class.

The label to be placed on the material will depend upon the results of sampling. Once the waste is characterized, reference should be made to the Hazardous Materials Table in 49 CFR 172.101 to determine the appropriate label. The package (or drum) will be marked and labeled as specified in 49 CFR 172.301.

The person offering hazardous material for shipment will offer placards, if the amount of hazardous material meets placarding threshold requirements (49 CFR 172.506). Any quantity of material listed in Table 1 of the regulations will be placarded. However, if there is less than 1,000 lb. of a Table 2 material, no placard is required. A Class 9 placard is not required for domestic shipments. If a placard is required, the label referenced above will be affixed on each side and each end of the vehicle(s).

Hazardous material shipping papers will have the following description of the hazardous material, in the following order:

- Proper shipping name;
- Hazard class or division;
- Identification number;
- Packaging group;
- Total quantity (must appear either before or after the above information); and
- Technical and chemical group names may be entered in parentheses between the proper shipping name and hazard class or following the basic description (e.g., "Flammable liquids, n.o.s. [contains xylene and benzene], 3 UN1993, PG II").

Other required information includes:

- USEPA identification number (on manifests);
- Emergency Response Guidebook numbers;

- Twenty-four hour emergency response number, supplied by the generator and answered by a knowledgeable person;
- Signatures; and
- Shipper's certification.

All TtFW and subcontractor personnel involved in USDOT Hazardous Material Shipment activities will have been trained in accordance with USDOT Hazardous Material Regulations. All waste transporters and disposal/recycling facilities will be reviewed and approved by TtFW prior to disposal in accordance with TtFW Corporate Procedure EHS 1-4 Subcontractor Selection and Management.

Additional procedures for transportation include, but are not limited to, the following:

A. TtFW will utilize fully licensed, permitted, appropriate vehicles and operating practices to prevent spillage or leakage of contaminated material from occurring en-route.

B. TtFW will not deliver waste to any facility other than the disposal facility(s) listed on the shipping manifest/bill of lading.

C. TtFW will coordinate vehicle inspection, manifest review, and recording of quantities leaving the site with the Navy. These quantities will be verified with recorded quantities at the disposal facility(s). If any deviation between the two weight records occurs, the matter will be reported in a timely manner to the Resident Officer in Charge of Construction (ROICC) and Navy Technical Representative (NTR).

D. TtFW will use an approved designated transport route to haul waste off-site. This route will be determined based on facility requirements.

E. TtFW will ensure that trucks are protected against contamination by properly covering and lining them with compatible material or by decontaminating them prior to any use other than hauling contaminated materials.

F. Liquid-containing drums will be sealed by TtFW or its subcontractor in a manner such that tampering with the contents cannot occur without breaking the seal.

G. The designated NWIRP representative will sign the manifest as the generator. Copies of all final completed manifests will be submitted to the NWIRP representative within one week after removal of waste from the site. The Navy will review waste profiles before wastes are shipped off-site.

3.4 Off-site Disposal

Procedures for off-site disposal include, but are not limited to, the following:

A. TtFW will use only approved treatment, disposal, and/or recycling facilities. All facilities and transporters will be approved prior to use in accordance with TtFW EHS Procedure 1-4 Subcontractor Selection and Management. Substitutions or additions will not be permitted without prior written approval from the Navy.

B. TtFW will ensure that the facility is properly permitted to accept the stated material, that the facility provides the stated treatment and/or disposal services, and that the facility is approved to accept wastes under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Off-Site Rule.

3.5 Recordkeeping

TtFW will obtain manifest forms and complete the shipment manifest records as required by the appropriate regulatory agencies for verifying the material type (Code No.) and quantity of each load in unit of volume and weight. Copies of each manifest will be submitted to the Navy within one week following shipment, and as soon as possible after notification of receipt of the disposal facility. Copies of the manifests and all waste documentation will be retained in the TtFW project file and will be returned to the client with the project close-out report. Any manifest discrepancies will be reported immediately to the Navy ROICC and NTR, and will be resolved by TtFW.

TtFW will maintain a Drum/Container Log for all wastes generated. The log will contain the date and location where the waste was generated, the waste name, the waste classification, the sampling date, shipment date, and manifest/bill of lading number. A Daily Shipment Log will be maintained documenting each day's off-site waste shipments. Both logs will be retained in the project file.

Waste drum/container storage areas will be inspected weekly, and will be documented either in the project notebooks or on a TtFW Drum/Container Inspection Sheet. Deficiencies will be corrected immediately.

4.0 SAMPLING AND ANALYSIS PLAN

This section presents the geotechnical boring and monitoring well sampling and analysis procedures to be implemented during the project.

4.1 Sampling Procedures

4.1.1 Sample Identification

Each sample will be designated by an alphanumeric code that identifies the site, sample type, and a sequential sample number. The site code will be the initials for the site name, in this case: Naval Weapons Industrial Reserve Plant (NWIRP). Sample type will be identified by a two-letter code, while each sample number will be identified by the monitoring well number or geotechnical boring number.

Site/Location	Sample Type	Sample Number
NWIRP	AA	NN

Symbol Definition:
A = Alphabetic
N = Numeric

Sample Type Options:
MW = Monitoring Well
GB = Geotechnical Boring

Sample Number Options:
00 - 99

For example, the sample collected from Monitoring Well 01 would be designated NWIRP-MW-01.

Field QC samples will be designated as follows:

FB	Field blank
D	Field duplicate
TB	Trip Blank

4.1.2 Analytical Requirements

Table 1 presents the analytical requirements for the geotechnical boring samples. Table 2 presents the analytical requirements for the monitoring well samples.

4.2 Quality Assurance/Quality Control (QA/QC)

The procedures that will be used to ensure that data are of known quality and will be acceptable for project objectives are described in this section.

All sampling procedure and quality assurance/quality control (QA/QC) requirements will be consistent with those described in the *Navy Installation Restoration Chemical Data Quality Manual*, Naval Facilities Engineering Service Center, September, 1999.

4.2.1 Quality Control Sample Requirements

QA/QC samples are analyzed for the purpose of assessing the quality of the sampling effort and of the analytical data. QA/QC samples to be collected include field duplicates, equipment rinsate blanks, trip blanks, and temperature blanks. The descriptions below include sampling methodologies, sample frequencies, and the purpose of the samples.

4.2.1.1 Field Duplicate Samples

Field duplicate samples are two samples of the same matrix which are collected, to the extent possible, at the same time, from the same location, using the same techniques, and are analyzed at the same laboratory. Field duplicates will be handled, containerized, preserved, stored, and transported in the same manner. Field duplicates will be collected at a frequency of 5 percent per sample matrix or one per day, whichever is more frequent. The off-site laboratory will analyze samples as "blind" duplicates to provide a measure of sampling variability.

4.2.1.2 Equipment Rinsate Blanks

Equipment rinsates (field blanks) are samples consisting of a reagent (analyte-free) water collected daily during a sampling event from a final rinse of sampling equipment after the decontamination procedure has been performed. The purpose of equipment rinsates is to determine whether the sampling equipment is causing cross-contamination of samples. Where equipment is decontaminated and reused, equipment rinsates will be collected at a frequency of 1 in 20 samples. Where equipment is disposable and not decontaminated, a single rinsate blank, serving to document that disposable equipment and sample containers are not contributing to sample contamination, will be collected for each analysis.

4.2.1.3 Trip Blanks

Trip blanks will be collected for VOC analyses. They consist of laboratory-grade distilled and/or deionized water and are used to detect contamination that may be introduced during sample handling and transport. These samples are prepared prior to field operations, brought out into the field, and returned to the laboratory unopened. A trip blank will be included with every sample shipment cooler sent to the laboratory for VOC analyses.

4.2.1.4 Temperature Blanks

A temperature blank consisting of potable water will be included in each cooler to document cooler temperature upon receipt at the laboratory.

4.2.2 Sample Shipping and Packaging

Chain-of-Custody (COC) forms, sample labels, custody seals, and other sample documents will be completed as specified in the above-referenced manual. All entries will be made in permanent ink. If errors are made when completing any of these forms, the error will be crossed out with a single line, initialed, and dated by the sampler.

Each sample will be labeled with the following information:

1. Site Name
2. Field identification or sample station number
3. Date and time of sample collection
4. Designation as a grab or composite sample
5. Sample type (matrix)
6. Signature of the sampler
7. Sample preservation
8. Analyses to be performed

Each environmental sample will be properly identified and sealed in a polyethylene (PE) bag. The bag will be placed in a fiberboard cooler, which has also been lined with a large PE bag. The samples will be packed with sufficient ice (sealed in PE bags) to cool the samples to 4° C. Non-combustible absorbent cushioning material will be added to minimize the possibility of container breakage. The large PE bag in the cooler will be sealed and the container closed. Custody seals and nylon strapping tape will be affixed to the cooler. All samples will be shipped within 24 hours of collection via a common carrier. All sample coolers and samples will be shipped in accordance with New York DOT requirement and regulations.

A COC record will be used to record the custody of samples, and will accompany the samples at all times. The following information will be included on the COC record:

1. Project name
2. Signature of samplers
3. Sampling station number, date and time of collection, grab or composite designation
4. Signatures of individuals involved in the transfer (i.e., relinquishing and accepting the samples)
5. Sample matrix
6. Analyses to be performed
7. Sample preservation

4.2.3 Laboratory Data Reporting

As a minimum, laboratory reports presenting data will contain the following:

- Title of project
- Date report was prepared
- Name, address, and telephone number of laboratory
- Sample identification numbers
- Type of sample
- Date on which analysis was performed
- Any special observations, circumstances, or comments which may be relevant for interpretation of the data
- Signature of the laboratory manager
- All analyte concentrations determined for each parameter tested

Each parameter tested shall include: name of parameter, USEPA or New York State approved testing procedure references, detection limits, results of analysis, and the unit of the reported results. Quality control results including surrogate and internal standard recoveries, spike recoveries, and blank data shall be reported for each sample.

4.2.4 Records

4.2.4.1 Sampling and Monitoring Records

An on-site individual will maintain a site logbook that summarizes the daily sampling and monitoring activities. The logbook will be bound with numbered pages. The records will be dated and signed or otherwise authenticated on the day of entry. The logbook will document vital information, such as sample source, sampling methods, sample conditions, and field measurements. Any problems encountered and corrective actions taken will also be documented in the logbook.

4.2.4.2 Laboratory Records

In addition to the data set deliverables, the laboratory will maintain records that contain, at a minimum, the following information:

- Copies of relevant analyst notebook pages
- Copies of relevant instrument logs
- Raw instrument outputs (chromatograms, ion spectra, absorbance value, etc.)
- QC charts
- Documentation of corrective actions
- Chain-of-custody information
- Automated data processing system output and/or calculations
- Calibration data
- Blank, spike, and spike duplicate results

4.3 Equipment Decontamination Procedures

All non-disposable equipment involved in field sampling activities will be decontaminated prior to sampling, between each sample, and before removal from the site. The general decontamination procedure for sampling equipment will include:

1. A liquinox detergent and potable water scrub;
2. Potable water rinse;
3. Distilled/deionized water rinse;
4. Rinse with approved solvent; and
5. Air dry.

Fluids generated by decontamination of non-disposable sampling equipment will be collected in 55-gallon USDOT-approved drums and sampled for characterization purposes. Appropriate disposal will be determined following receipt of the sampling results.

5.0 HEALTH AND SAFETY

The SHSP is presented as Appendix A. The SHSP includes organizational information, an activity hazard analysis, protective equipment requirements, air monitoring, site controls and protective zones, medical surveillance procedures, emergency response and spill control measures, and training requirements.

6.0 REGULATORY COMPLIANCE

6.1 Purpose

This section presents methods, procedures, and guidance for the proper use of equipment and handling of materials to protect all on-site personnel, the general public, the on-site, as well as the off-site environment from spills, discharges or contact with established site contaminants. TtFW has prepared these plans to be in compliance with all applicable federal, state, and local regulations.

6.2 Spill Prevention and Control

The implementation of these plans will put in place an integrated system of active as well as passive safeguards to:

- Prevent/minimize spills and discharges of solids or liquids that contain established site or other contaminants.
- Establish procedures and methods to contain and mitigate spills or discharges in order to minimize and then eliminate their impact.

6.2.1 Equipment and Personnel Training

Equipment

- All equipment will be inspected prior to or upon arrival at the site to assure good working condition and acceptability for use. This activity will be documented as part of the Daily Quality Control Report (DQCR).
- All equipment will be subject to decontamination procedures as outlined in the SHSP prior to being demobilized from the site or being used in the support zone after being in the exclusion zone.
- All equipment decontamination activities will be documented in the DQCR as well as a "Decontamination Log" which will list the equipment name, a unique equipment identifier (e.g., equipment number or serial number), decontamination date, the name/title of the person who witnessed the activity, along with results of any sample analysis required.

Personnel Training

All site personnel will be trained in the requirements of this plan prior to beginning their work assignment. This training can be part of and documented with the site health and safety orientation. This training is to be repeated and updated, as appropriate, based on changes in the Work Plan, working conditions, or personnel changes.

6.2.2 Definition

A spill is defined as an uncontrolled release of a solid, liquid or sludge material that contains established site contaminants; Polychlorinated Biphenyl (PCBs), oils, lubricants, solvents, or other fluids from site equipment; or other products used on-site by site personnel or equipment

outside of the exclusion zone or within the exclusion zone onto a non-contaminated area. A release of potable water or a spill or release of contaminated material back into a contaminated area does not fall under the requirements of this plan.

6.2.3 Spill Prevention

TtFW's standard operating procedures and practices for spill prevention during the handling of materials include the following:

- Heavy equipment, portable pumps, compressors, generators, and power washers will be maintained in good operating condition as to be free of leaks of fuel, lubricants, and hydraulic oils.
- Refueling and addition of lubricant or hydraulic oils will be performed carefully with absorbent pads and/or absorbent booms to capture and contain any minor spillage.
- Heavy equipment such as excavators or off road dump trucks will be operated in such a manner that movement or transportation of contaminated materials will not be spilled or leaked onto clean areas.
- All unloading, staging, or stockpiling facilities will be constructed to contain the designated contaminated materials in the quantities required. These facilities will also be constructed to be able to contain and accumulate all liquids generated from or running off this material.
- Portable pumps, hoses, valves, and accessories will be inspected before and after use with particular attention to gaskets and hose fitting connections. Defective items will be repaired or discarded as appropriate.
- Portable pumps, hoses, valves, and accessories will be drained and flushed with clean water or vacuumed clean or drained into a container after use, and caps or plugs applied to openings. Each hose will be coiled with ends joined if not capped or plugged.
- Quick connect fittings will have their cam levers tied or taped to prevent accidental disconnection when in use as part of a pumping system.
- All pumping operations will be constantly observed and monitored to prevent overflow, splashing, or equipment failure.
- Prior to disconnection of hoses and pumps, the system must be depressurized, and the supply turned off or disconnected.
- Residual pressure in air supply hose to air powered pumps will be relieved before any disconnection.
- All valves will be opened slowly to prevent surges.
- All quick connect fittings, caps, and plugs will be opened slowly, one side at a time to verify depressurization.
- In non-contaminated areas, drip pans, tubs, or buckets will be in place under hose connections, valves, pipelines and pump connections prior to opening or disconnection.

- All liquids will be transferred only into approved, inspected containers in good condition.
- Two layers of 6-mil polyethylene sheeting will be placed under pumps, equipment or personnel during cleaning/decontamination procedures involving liquids to capture any leakage, overspray or runoff when not in established personnel decontamination areas or on site equipment decontamination pads.
- During work activities on the project site, minimization efforts for dust dispersion and odor control will be conducted. Clean water spray will be applied as needed to control the dispersion of contaminated dust.

6.2.4 Delineation of Spill Boundaries in the Absence of Visible Traces

For spills where there are insufficient visible traces, yet there is evidence of a leak or spill, the boundaries of the spill are to be determined by using a statistically based sampling scheme, such as the USEPA guidance document "Verification of PCB Spill Cleanup by Sampling and Analysis."

6.2.5 Spill Equipment

The following equipment will be kept on-site at all times during site work activities to provide for any unexpected spill or discharges:

- Sand, clean fill, or other non-combustible absorbent
- Drums (55 gallon, USDOT 1A1 or 1A2)
- Shovels
- PPE (overgarments, gloves, respirators, etc.)
- Spill pads, absorbent booms

6.2.6 Reporting Requirements

In addition to the immediate notification of the Navy, and reporting under the applicable requirements of the Clean Water Act or the CERCLA of 1980, TtFW will adhere to the following reporting procedures:

A. If a spill directly contaminates surface water, sewers, or drinking water supplies, TtFW will notify the Navy, who will then immediately notify the appropriate USEPA Regional Office (the Office of Pesticides and Toxic Substances Branch), the New York State Emergency Management Office, and obtain guidance for appropriate cleanup measures.

B. If a spill directly contaminates grazing lands or vegetable gardens, TtFW will notify the Navy, who will then immediately notify the appropriate USEPA Regional Office and NYSDEC, and will proceed with the applicable requirements in the shortest possible time after discovery, but in no case later than 24 hours after discovery.

C. Where a spill exceeds 1.0 pound of PCBs or other CERCLA hazardous substance and is not addressed in A or B above, TtFW will notify the Navy, who will then notify the appropriate USEPA Regional Office, the National Response Center, and NYSDEC. TtFW will proceed to decontaminate the spill in the shortest possible time after discovery, but in no case later 24 hours after discovery. For the purposes of the notification requirement, the 1.0 pound is measured by weight of the material containing the absorbed contaminant spilled.

D. Spills of 1.0 pound or less, which are not addressed in A or B above, will be cleaned in accordance with the general procedures, but the USEPA will not be notified.

E. Spill Reporting Numbers are as follows: 1) National Response Center - 800-424-8802; 2) NYSDEC - 800-457-7362; 3) New York State Emergency Management Office - 518-457-2200.

6.2.7 Recordkeeping

At the completion of cleanup, TtFW will document the cleanup with records and certification of decontamination. The record and certification will consist of the following:

A. Identification of the source of the spill;

B. Estimated or actual date and time of the spill occurrence;

C. The date and time cleanup was completed or terminated;

D. A brief description of the spill location;

E. Sampling data taken prior to the cleanup boundaries and a brief description of the methodology used to establish the spill boundaries;

F. A brief description of the solid surface cleaned and the double wash/rinse method used.

G. Approximate depth of soil excavation and the amount of soil removed.

H. A certification statement signed by TtFW stating that the cleanup requirements have been met and that the information contained in the record is true to the best of our knowledge.

6.3 Wastewater Discharge Requirements

A permit to discharge water from well purging and development into the local sewer will be obtained from the Cedar Creek Water Pollution Control Plant ("WPCP") of Nassau County – Department of Public Works. TtFW will comply with the discharge permit requirements

regarding volume limits and maximum contaminant concentrations. Total VOC's will not exceed 1 milligram per liter (mg/L) with the maximum concentration of tetrachloroethene not to exceed 0.1 mg/L.

All water will initially be containerized into 21,000- gallon storage tanks for temporary storage. Containerized water will be sampled for total VOC's only. Samples will be submitted to the laboratory for rush turnaround of results. Results will be immediately forwarded to the Cedar Creek WPCP for review and permission to discharge. Pre-treatment will be necessary if results exceed the maximum concentration limits.

The approved sewer manhole discharge locations are located within the utility easement. Manhole No. 129 is located in the utility easement near S. Herman Ave and Manhole No. 133 is located in the utility easement near Windhorst Avenue. The sewer line size at both locations is 8" diameter. The permitted discharge rate is 200 gallons per minute. A minimum of 24 hours notice will be provided to the Cedar Creek WPCP prior to discharge.

6.4 Stormwater Discharge Requirements

This project is not required to meet National Pollutant Discharge Elimination system (NPDES) Stormwater Discharge Permit Regulations for construction activities (40 CFR 122.26), since the total area of disturbance is expected to be less than 1 acre.

6.5 Air Pollution Control

There are no air pollutants that are anticipated to be generated during pre-design investigation activities other than local dust generation due to the operation of drilling equipment. Air monitoring will be performed during drilling activities in accordance with the SHSP.

7.0 REFERENCES

Tetra Tech NUS, Inc., 2000. *Vertical Profile Borings VPB-38, -76, and –77 Summary Report, Naval Weapons Industrial Reserve Plant, Bethpage, New York.* November 2000.

New York State Department of Environmental Conservation, 2001. *Record of Decision, Operable Unit 2 Groundwater, Northrop Grumman and Naval Weapons Industrial Reserve Plant Sites, Nassau County, Site Numbers 1-30-003A & B.* March 2001.

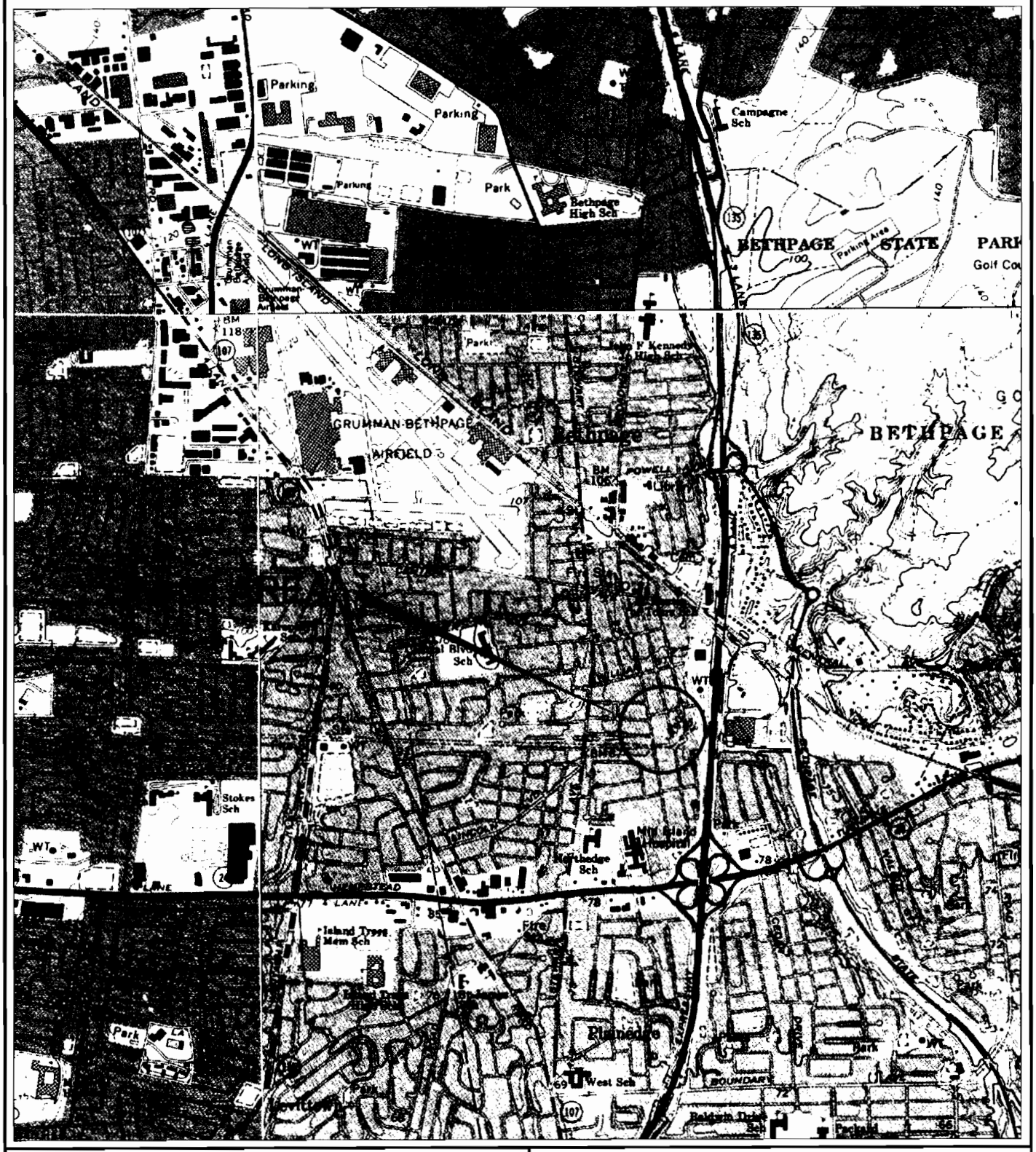
New York State Department of Environmental Conservation – Division of Environmental Remediation, 2002. *Draft DER-10 Technical Guidance for Site Investigation and Remediation.* December 2002.

Tetra Tech NUS, Inc., 2003. *GM-38 Area Groundwater Remedy Analysis Report, Naval Weapons Industrial Reserve Plant, Bethpage, New York.* February 2003.

Engineering Field Activity, Northeast, Naval Facilities Engineering Command, 2003. *Record of Decision for Naval Weapons Industrial Reserve Plant, Bethpage, New York, Operable Unit 2 – Groundwater, NYS Registry: 1-30-003B.* April 2003 (Revision 1).

New York State Department of Environmental Conservation. *Division of Water Technical and Operational Guidance Series (1.2.1) – Industrial Permit Writing.*

FIGURES



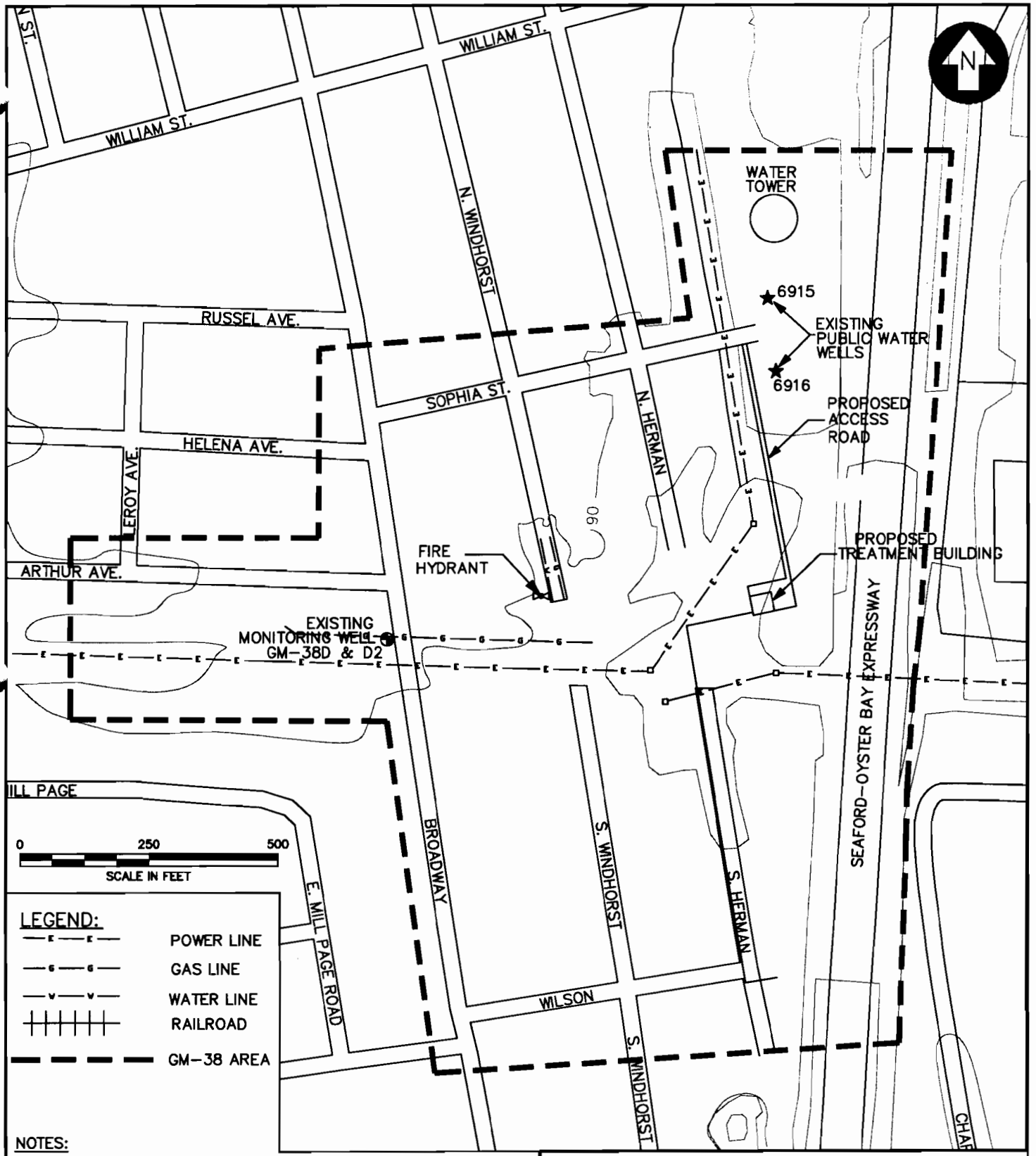
Source: U.S.G.S. Topographic Maps (7.5 Minute)
Amityville, Freeport, Hicksville, Huntington, NY Quadrangles

U.S. Navy RAC
Engineering Field Activity, Northeast

GM-38 Area (Offsite)
NWIRP Bethpage
Bethpage, NY

Figure 1
Site Location Map

TETRA TECH FW, INC.



NOTES:

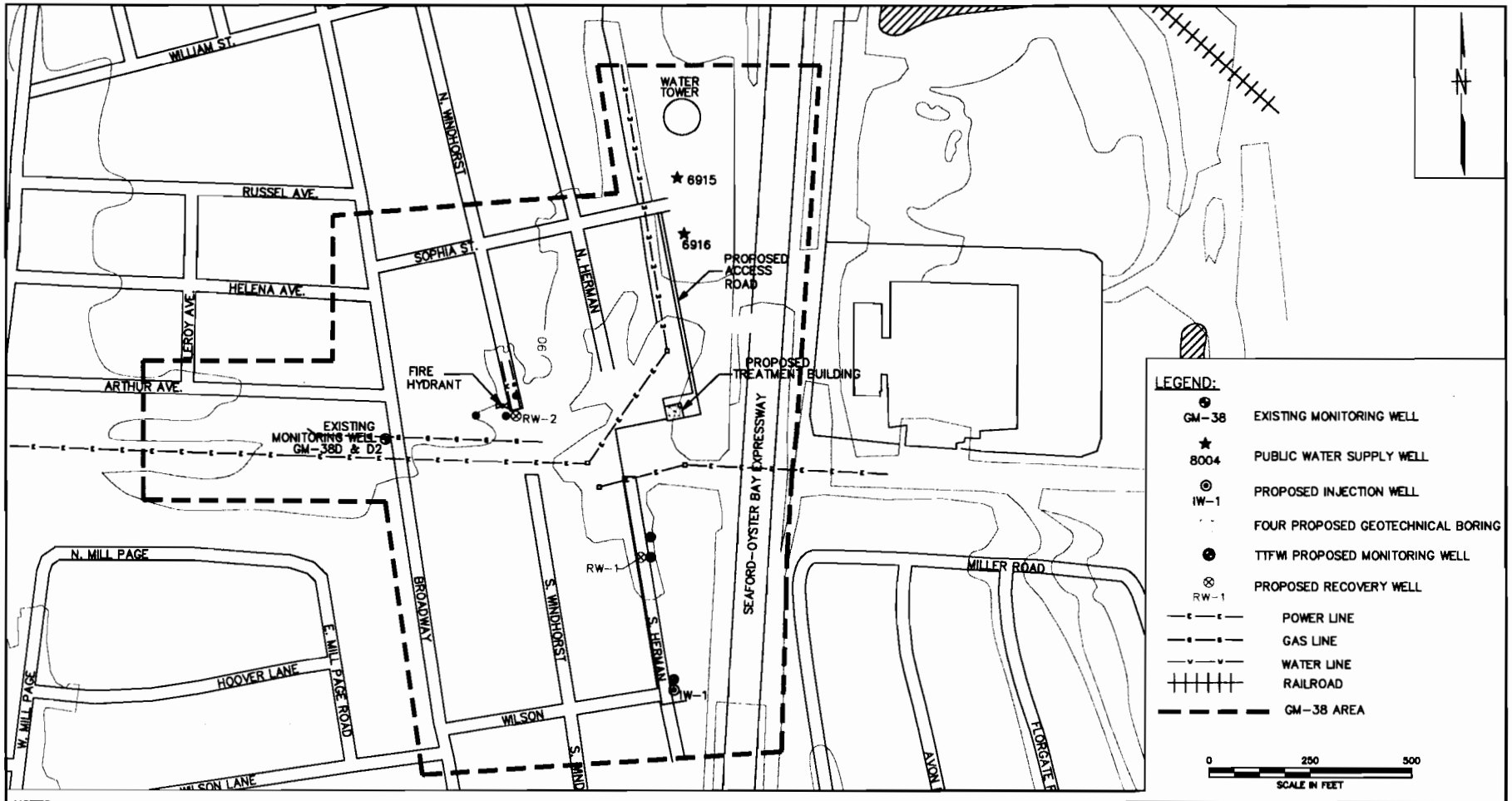
1. SITE MAP IS BASED ON TETRA TECH NUS, INC. GM-38 AREA GROUNDWATER REMEDY ANALYSIS REPORT, DATED FEB. 2003, DRAWING C-1. ROADS AND OTHER FEATURES WERE DIGITIZED FROM THE U.S.G.S. TOPOGRAPHIC MAP, AMITYVILLE, NY QUADRANGLE. FEATURES WHICH COULD NOT BE LOCATED ON THE TOPOGRAPHIC QUADRANGLE WERE BASED ON OBSERVATION ONLY, INCLUDING UTILITY LOCATIONS.
2. ALL FEATURES ARE APPROXIMATE OR PROPOSED.

U.S. Navy RAC
Engineering Field Activity, Northeast

GM-38 Area (Offsite)
NWIRP Bethpage
Bethpage, NY

Figure 2
Site Layout

TETRA TECH FW, INC.



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2. ALL FEATURES ARE APPROXIMATE OR PROPOSED.
3. THE RW-1 LOCATION MAY MOVE APPROXIMATELY 200 FEET EASTWARD TO BE WITHIN RIGHT OF WAY OF THE SEAFORD-OYSTER BAY EXPRESSWAY.
4. GEOTECHNICAL SOIL BORINGS WILL BE WITHIN THE LIMITS OF THE TREATMENT BUILDING.

U.S. Navy RAC
Engineering Field Activity, Northeast
GM-38 Area (Offsite)
NWIRP Bethpage
Bethpage, NY
Figure 3
Proposed Predesign Investigation Locations
TETRA TECH FW, INC.

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NOTES:

1. SITE MAP IS BASED ON TETRA TECH NUS, INC. GM-38 AREA GROUNDWATER REMEDY ANALYSIS REPORT, DATED FEBRUARY 2003, DRAWING C-1. ROADS AND OTHER FEATURES WERE DIGITIZED FROM THE U.S.G.S. TOPOGRAPHIC MAP AMITYVILLE, NY QUADRANGLE. FEATURES WHICH COULD NOT BE LOCATED ON THE TOPOGRAPHIC QUADRANGLE WERE BASED ON OBSERVATION ONLY, INCLUDING UTILITY LOCATIONS.
2. ALL FEATURES ARE APPROXIMATE OR PROPOSED.

U.S. Navy RAC
Engineering Field Activity, Northeast
GM-38 Area (Offsite)
NWIRP Bethpage
Bethpage, NY
Figure 4
Area of Survey
TETRA TECH FW, INC.

TABLES

Table 1
Analytical Requirements for Geotechnical Boring Samples

Medium	*Analysis*	*Estimated Number of Samples*	*Preservation*	*Hold Time*	*Sample Container*
Soil	- Particle size analysis (ASTM D-422) - Natural moisture content (ASTM D-2216) - Atterberg limits (ASTM D-4318) - Specific gravity (ASTM D-854)	8	None	None	1 – 5 gallon pail
	- Consolidation (ASTM D-2435) - Unconfined compressive strength (ASTM D-2166)	4 - 8 (if necessary)	None	None	Shelby tube & 1 – 5 gallon pail
	- Total organic carbon (TOC)	4 - 8 (if necessary)	Sulfuric Acid	28 days	500 ml. glass jar

Table 2
Analytical Requirements for Monitoring Well Samples

Medium	*Analysis*	*Estimated Number of Samples*	*Preservation*	*Holding Time*	*Sample Container*
Aqueous	VOCs - SW-846 8260B	6 - 8	Ice to 4° C; Hydrochloric Acid	Analyze within 14 days	Three 40-mL glass vials with Teflon septa
Aqueous	Inorganics - SW-846 6010B	6 - 8	Ice to 4° C; Nitric acid	Analyze Mercury within 28 days; analyze all other metals within 6 months	One 500-mL HDPE bottle
Aqueous	Total Dissolved Solids - USEPA 160.1	6 - 8	Ice to 4° C	Analyze within 7 days	One 250-mL glass or HDPE bottle
Aqueous	Total Suspended Solids - USEPA 160.2	6 - 8	Ice to 4° C	Analyze within 7 days	One 250-mL glass or HDPE bottle
Aqueous	Chemical Oxygen Demand – USEPA 410.4	6 - 8	Ice to 4° C; Sulfuric acid	Analyze within 28 days	Glass bottle
Aqueous – Duplicate	VOCs, Inorganics, TDS, TSS, and COD	1 / 20 / matrix or 1/day	See above	See above	See above
Aqueous – Field Blank	VOCs, Inorganics, TDS, TSS, and COD	1 per 20	See above	See above	See above
Aqueous – Trip Blank	VOCs - SW-846 8260B	1 per cooler of VOC samples	Ice to 4° C; Hydrochloric acid	Analyze within 14 days	Three 40-mL glass vials with Teflon septa

APPENDIX A

SITE-SPECIFIC HEALTH AND SAFETY PLAN

DEPARTMENT OF THE NAVY
ENGINEERING FIELD ACTIVITY, NORTHEAST
REMEDIAL ACTION CONTRACT (RAC)
CONTRACT NO. N62472-99-D-0032
CONTRACT TASK ORDER NO. 0096

DRAFT
SITE-SPECIFIC HEALTH AND SAFETY PLAN
FOR
PRE-DESIGN INVESTIGATION TASKS GM-38 AREA GROUNDWATER REMEDIATION
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BETHPAGE, NEW YORK

June 18, 2004

Prepared for:

Engineering Field Activity, Northeast
Naval Facilities Engineering Command
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Prepared by:

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Revision	Date	Prepared by	Approved by	Pages Affected
0	May 21, 2004	M. Lavin	S. Patselas	All
1	June 18, 2004	M. Lavin	S. Patselas	All

APPROVALS

By their signature, the undersigned hereby certify that this Site-Specific Health and Safety Plan (SHSP) has been reviewed and approved for use during the remedial actions involving the pre-design tasks for the upcoming GM-38 Area Groundwater Remediation at the Bethpage Site.

PROJECT MANAGER	DATE
PROJECT SUPERINTENDENT	DATE
PROJECT ENVIRONMENTAL AND SAFETY MANAGER	DATE
SITE HEALTH AND SAFETY OFFICER	DATE

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ACRONYMS

ACGIH	American Conference of Industrial Hygienists
AHA	Activity Hazard Analysis
BWD	Bethpage Water District
CGI	Combustible Gas Indicator
COD	Chemical Oxygen Demand
CNS	Central Nervous System
CRZ	Contamination Reduction Zone
EZ	Exclusion Zone
FID	Flame-Ionization Detector
GOCO	Government Owned Contractor-Operated
GPR	Ground Penetrating Radar
IP	Ionization Potential
LEL	Lower Explosive Limit
LOP	Level of Protection
MSDS	Material Safety Data Sheet
NGC	Northrop Grumman Corporation
NIOSH	National Institute for Occupational Safety and Health
NWIRP	Naval Weapons Industrial Reserve Plant
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
ONCT	On-site Containment
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
PCBs	Polychlorinated Biphenyls
PCE	Tetrachloroethene
PEL	Permissible Exposure Limit
PESM	Project Environmental and Safety Manager
PID	Photo-Ionization Detector
PM	Project Manager
PPE	Personal Protective Equipment
ppm	Parts Per Million
PS	Project Superintendent
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
RW	Recovery Well
SHSO	Site Hazardous Safety Officer
SHSP	Site-Specific Health and Safety Plan
Sp. Gr.	Specific Gravity
SVOC	Semi-Volatile Organic Compounds
SZ	Support Zone
TAC	Technical Advisory Committee
TCE	Trichloroethene
T&D	Transportation and Disposal
TSS/TDS	Total Suspended Solids/Total Dissolved Solids
TtFW	Tetra Tech FW, Inc.
TLV	Threshold Limit Value
TWA	Time Weighted Average
UEL	Upper Explosive Limit
USEPA	United States Environmental Protection Agency
VOCs	Volatile Organic Compounds
VPBs	Vertical Profile Borings

1.0 INTRODUCTION

Tetra Tech FW, Inc. (TtFW), formerly Foster Wheeler Environmental Corporation (Foster Wheeler), has been contracted by the Engineering Field Activity, Northeast with the Pre-design Tasks for the upcoming GM-38 Area Groundwater Remediation located at Naval Weapons Industrial Reserve Plant (NWIRP), Bethpage, NY. This Site-Specific Health and Safety Plan (SHSP) addresses the health and safety practices that will be employed by all site workers participating in field operations. This SHSP takes into account the specific hazards inherent to the site work and presents procedures to be followed by TtFW, its subcontractors and all other on-site personnel in order to avoid and, if necessary, protect against health and/or safety hazards. Activities performed on this Contract Task Order (CTO) will comply with this SHSP, OSHA Regulations 29 CFR Parts 1910 and 1926, USACE EM 385-1-1, as well as the Tetra Tech FW, Inc. Health and Safety Program. A copy of this SHSP will be on-site during site activities. Modifications to this SHSP may be made with the approval of the PESM and the Navy using the Change Request Form in Appendix A.

1.1 Scope of Work

The work shall include, but not be limited to the following:

- Mobilization and site preparation;
- Geotechnical Investigation;
- Pre-Design Groundwater Investigation;
- Survey;
- Treatability Study; and
- Demobilization.

1.1.1 Mobilization

The Navy will obtain access agreements, if needed, and will provide copies to TtFW, prior to the start of field activities. TtFW will mobilize all necessary personnel, equipment, and materials to the site. All subcontractor personnel and equipment will be mobilized to the site.

Underground utility mark-out will be performed. TtFW will contact the New York State One-Call System, and screen drilling locations using geophysical techniques, such as ground penetrating radar (GPR) or magnetometer.

1.1.2 Geotechnical Investigation

TtFW will perform a geotechnical investigation at the planned location of the treatment system building to develop design parameters for the building foundation and slab. Four geotechnical borings will be advanced to a maximum depth of 60 feet at the building location. The borings will be advanced using mud rotary drilling techniques. The borings will be reamed to eight inches in diameter. If sloughing of the upper borehole occurs, 6-inch diameter Schedule 40 PVC temporary surface casing will be installed to the depth of the sloughing.

Following advancement to the total depth of the boring, the drilling tools will be withdrawn from the borehole. A geophysical probe will then be run down the borehole and back up. The geophysical data will be recorded using a Mount Sopris MGX II digital logger, or equivalent. The probe will be multi-function and will record a gamma ray log, as well as single point resistivity and spontaneous potential

logs. Once gamma logging of the borehole is complete, the temporary PVC casing will be removed (if present) and drill cuttings will be placed back into the boreholes. The boreholes will not be grouted. Excess drill cuttings will be disposed of off-site.

1.1.3 Pre-Design Groundwater Investigation

TtFW will perform a pre-design groundwater investigation to determine site-specific parameters for design of the extraction and re-injection systems (e.g., groundwater flow direction and gradient, required number of wells, well locations and depths, extraction/re-injection rates, and capture zones) and to verify the expected influent groundwater quality for the treatment system.

Six 4-inch PVC monitoring wells will be installed. Three will be installed in the shallow zone (355 to 435 feet bgs) and three will be installed in the deep zone (440 to 510 feet bgs). The monitoring wells will be drilled following the mud rotary procedure described for the geotechnical borings. One round of water levels and groundwater sample collection and analysis for volatile organic compounds (VOCs), metals, total suspended solids/total dissolved solids (TSS/TDS), and chemical oxygen demand (COD) will be performed at each monitoring well.

Two 12-inch extraction wells will be installed to depths up to 435 and 510 feet. The extraction wells will be installed with pre-cast concrete well vaults. A step drawdown test will be performed after the extraction wells have been developed to determine the maximum long-term pumping rates of the wells.

One 12-inch injection well will be installed to a depth of 150 feet. A 1-day re-injection test will be performed on the injection well. The containerized development and purging water from the monitoring and extraction wells will be used for the re-injection test.

1.1.4 Survey

A topographic survey of the site will be performed. The survey will include the locations of the geotechnical borings, monitoring wells, extraction wells, and injection well.

1.1.5 Treatability Study

Based on the results of the pre-design groundwater sampling and analysis, a bench-scale groundwater treatability study will be performed to address data gaps associated with the conceptual process design. Preliminary data gaps identified include the need for metals removal in the treatment system, inclusion of appropriate treatment to remove vinyl chloride from the groundwater, and development of site-specific carbon usage rates.

TtFW will collect groundwater from the monitoring wells for use during the treatability study. An off-site subcontracted laboratory will perform bench-scale treatability studies for metals removal and carbon adsorption. Specific adsorbents for removal of vinyl chloride will be evaluated if vinyl chloride is determined to be a significant contaminant in the extracted groundwater.

2.3 Project Superintendent (PS)

The PS is John Imhoff. His responsibilities are:

- Ensures that the SHSP is implemented in conjunction with the designated PESM and SHSO
- Ensures that field work is scheduled with adequate personnel and equipment resources to complete the job safely
- Ensures that adequate communication between field crews and emergency response personnel is maintained
- Ensures that field site personnel are adequately trained and qualified to work at the site;
- Enforces site health and safety rules
- Investigates all incidents
- Conducts daily safety briefings
- Conducts weekly site inspections
- Acts as Emergency Coordinator

2.4 Site Health and Safety Officer (SHSO)

The SHSO is Tony Barroquiero. The SHSO is responsible for the following:

- Works as a member of the project team to ensure implementation of the SHSP
- Ensures that all health and safety activities identified in the SHSP are conducted and/or implemented
- Identifies operational changes which require modifications to health and safety procedures and the SHSP, and ensures that the procedure modifications are implemented and documented through changes to the SIHSP
- Directs and coordinates health and safety monitoring activities
- Ensures that proper personal protective equipment is utilized by field teams
- Assists in conducting and documenting daily safety briefings
- Monitors compliance with this SHSP
- Notifies PESM of all accidents/incidents
- Coordinates with PM in any accident/incident investigation
- Maintains Accident/Incident Report Forms
- Determines upgrades or downgrades of personal protective equipment (PPE) based on site conditions and/or real-time monitoring results
- Ensures that monitoring instruments are calibrated
- Reports to PESM to provide summaries of field operations and progress
- Maintains health and safety field log books
- Displays and maintains postings such as:
  - OSHA Job Safety and Health Poster
  - OSHA Noise Regulation
  - Department of Labor Postings (Minimum wage, fair labor standards)
  - Hazard Warning Signs
  - Noise Hazard Warning Sign
  - Do It Right Poster
  - Client Service Quality (CSQ) Poster
  - TtFW Shared Vision

  - TtFW Mission Statement
  - TtFW Hot Line Poster
  - TtFW Work Rules
  - TtFW ESQ Policy Poster
  - ZIP Bulletins
  - Flash reports
  - Emergency telephone numbers
  - Diagrams showing the location of fire extinguishers and emergency equipment
  - Emergency exit, evacuation routes and staging area

2.5 Site Personnel

Site Personnel responsibilities are:

- Report any unsafe or potentially hazardous conditions to the SHSO
- Maintain knowledge of the information, instructions and emergency response actions contained in the SHSP
- Comply with rules, regulations and procedures as set forth in this SHSP and any revisions
- Prevent admittance to work sites by unauthorized personnel
- Inspect all tools and equipment, including PPE, daily prior to use

3.0 SITE LOCATION AND DESCRIPTION

3.1 Site Location

NWIRP Bethpage is located in east central Nassau County, Long Island, New York, approximately 30 miles east of New York City. The Navy's property totaled approximately 109.5 acres and was formerly a Government Owned Contractor-Operated (GOCO) facility that was operated by the Northrop Grumman Corporation (NGC) until September 1998. NWIRP Bethpage is bordered on the north, west, and south by property owned, or formerly owned, by NGC that covered approximately 605 acres, and, on the east, by a residential neighborhood.

The facilities at NWIRP Bethpage include four plants (Nos. 3, 5, and 20, used for assembly and prototype testing; and No. 10, which contains a group of quality control laboratories), two warehouse complexes, a salvage storage area, water recharge basins, an industrial wastewater treatment plant, and several smaller support buildings.

The GM-38 Area is approximately 8,500 feet south-southeast and hydraulically downgradient of NWIRP Bethpage.

3.2 Site Background and Description

NWIRP Bethpage was established in 1933. Since inception, the primary mission of the facility has been the research, prototyping, testing, design engineering, fabrication, and primary assembly of military aircraft. Historical operations that resulted in hazardous material generation at the facility included metal finishing processes, maintenance operations, painting of aircraft and components, and other activities that involved aircraft manufacturing. Wastes generated by plant operations were disposed of directly into either drainage sumps, dry wells, and/or on the ground surface, resulting in the disposal of a number of hazardous wastes, including the Volatile Organic Compounds (VOCs) tetrachloroethene (PCE) and

trichloroethene (TCE), the semi-volatile organic compounds (SVOCs) polychlorinated biphenyls (PCBs), and the inorganics chromium and cadmium at the site. Some of these contaminants have migrated from the points of disposal to surrounding areas, including the soils of these sites and the groundwater beneath and downgradient of the NWIRP Bethpage property.

The GM-38 Area refers to a cluster of monitoring wells that were installed in the 1990s by NGC and that first identified an isolated groundwater contaminant plume in this area. Chlorinated VOCs were identified in moderately deep groundwater (220 to 470 feet below ground surface [bgs]) at concentrations greater than 500 micrograms per liter (µg/L). The contaminated groundwater in the area represents a relatively large mass of chlorinated VOCs that would remain for extended periods and could adversely affect public water supplies in the area, as well as other downgradient water supplies. Two public water supply systems are present in the general area and extract groundwater at depths ranging from 540 to 740 feet bgs.

The contaminated groundwater plumes emanating from the Navy and NGC sites is estimated to total more than 2,000 acres in area and extend more than 700 feet deep in some locations. Recent groundwater data from the Navy's vertical profile borings indicate that the contaminated groundwater plume has migrated south beyond the Hempstead Turnpike.

To date, the off-site groundwater plume(s) have impacted or threatened three public water supply wellfields operated by the Bethpage Water District (BWD). There are treatment systems in place at each of the three impacted or threatened wellfields. The water that is distributed to the community is tested on a monthly basis to ensure that the drinking water standards promulgated by the New York State Department of Health (NYSDOH) are met. In addition, the BWD has a policy of providing its consumers with drinking water that contains no detectable concentrations of site-related contaminants. Given the proximity of the contaminants to the BWD well fields, nine outpost or sentry wells were installed upgradient of the water supplies. These wells have been sampled on a quarterly basis since March 1995. The purpose of this quarterly sampling is to provide the BWD with the data necessary to ensure that the existing treatment systems are adequate to treat the level of contaminants that may impact their public supply wells. The data are also used to make decisions about the need for groundwater remediation.

Based upon a review of the sentry well data, there is an area surrounding monitoring well cluster GM-38 that contains high concentrations, in excess of 1,000 parts per billion (ppb), of site-related contamination. The outpost wells will continue to be monitored to determine the groundwater concentrations of these site-related contaminants.

Remediation of the GM-38 Area groundwater is identified in the New York State Department of Environmental Conservation (NYSDEC) Record of Decision (ROD) for Operable Unit (OU) 2 Groundwater for Site Numbers 1-30-003A & B, dated March 2001, and the Navy's ROD for OU 2 – Groundwater for Site Number 1-30-003B, dated April 2003 (Rev. 1).

The remedial action selected in the ROD addresses on-site contaminated groundwater beneath the Navy's 105-acre parcel, as well as contaminated groundwater that has migrated off-site beyond the boundaries of NWIRP Bethpage.

The Navy's selected remedy for on-site groundwater includes an institutional control consisting of the placement of a restriction in the deed of transfer to the County of Nassau, New York prohibiting extraction of groundwater from within the boundaries of the 105-acre or Plant 20 parcels located at the Navy's former NWIRP Bethpage facility. This remedy is based on the recognition that an existing

groundwater extraction and treatment system, known as the On-site Containment (ONCT) System, is containing and remediating VOC-contaminated groundwater emanating from the Navy's property. The system was constructed and is operated by NGC as part of the March 2001 ROD for Regional Groundwater issued by NYSDEC. If the system fails to continue to operate for any reason, the Navy will re-evaluate the remedy for on-site groundwater and implement necessary measures to ensure that the remedy is still protective of human health and the environment.

The Navy's selected remedy for off-site groundwater includes the following:

Groundwater Remedial Program:

- Contaminant removal through groundwater extraction and treatment at an off-site area near the GM-38 monitoring well cluster
- Pre-design investigation to determine the optimal groundwater extraction locations in the GM-38 Area
- Operation and maintenance of the GM-38 Area remedy
- Additional investigation in the vicinity of well GM-75D2, or any other area identified as requiring additional groundwater investigation, to determine if a contaminant removal program similar to the GM-38 program is necessary
- Continued participation in the Technical Advisory Committee (TAC) established by NYSDEC

Public Water Supply Protection Program:

- Installation of Vertical Profile Borings (VPBs) to gather water quality and lithologic data to aid in the placement of outpost monitoring wells
- Development of a Public Water Supply Well Contingency Plan
- Installation of outpost monitoring wells in areas upgradient of potentially affected water supply wellfields as outlined in the Public Water Supply Well Contingency Plan
- Public water supply wellhead treatment or comparable alternative measures, if necessary, for wellfields that become affected in the future by site-related contaminants
- Provision of public water to residential or commercial users that have private drinking water wells determined to be affected or potentially affected by site-related contaminants

4.0 POTENTIAL HAZARDS

This section presents an assessment of the chemical, biological, and physical hazards that may be encountered during the tasks specified under SHSP Section 1.1. Additional information can be found in Appendix B- Material Safety Data Sheets or in Appendix C-Activity Hazard Analyses.

4.1 Chemical Hazards

The contaminants previously revealed in groundwater are listed below in Table 4-1:

Table 4-1
Contaminants of Concern Groundwater Concentrations

Contaminant	Average Concentration (µg/L)	
	RW-1	RW-2
1,1,1-Trichloroethane	4.1	0
1,1-Dichloroethene	2.0	0.6
1,2-Dichloroethene	41.8	3.5
Trichloroethene	461.1	277.3
Tetrachloroethene	45.8	1.3
Vinyl Chloride	6.5	0.1

The contaminants of concern for the site are tetrachloroethene (PCE), trichloroethene (TCE), 1,2-dichloroethene (DCE), 1,1,1-trichloroethane (1,1,1-TCA), vinyl chloride, and other related chlorinated solvents.

Exposure to these compounds, listed in Table 4-1, may occur through inhalation of contaminated dust particles, inhalation of volatile contaminants, dermal absorption, skin contamination, or accidental ingestion of the contaminant.

The action levels for the contaminants of concern were based upon the known concentration of contaminants, physical and chemical properties, toxicity, and distribution of these compounds at the site. Due to the vapor pressures of these chemicals, inhalation is the primary route of exposure. Skin absorption is also a possible route of exposure, leading to the same symptoms as inhalation overexposure. Symptoms of exposure to these potential site contaminants, especially if they are encountered in their pure form, can range from irritation of skin, mucous membranes and other sensitive tissues such as the eyes, to nausea and vomiting, fatigue, lightheadedness/dizziness and headache. Potential damage of major organ systems (e.g., liver, kidneys, central nervous system, blood forming organs, reproductive systems) could result from chronic exposure or acute exposure to high concentrations of the materials. VOCs are potent narcotics and may cause central nervous system (CNS) and lung damage. Some of the site contaminants that may potentially be encountered are suspected carcinogens.

Due to the nature of the work being performed, the anticipated levels of exposure to potential site contaminants are expected to be moderate. Table 4-2 contains a summary of the toxicological and chemical properties of the compounds that may be encountered during field activities.

4.2 Biological Hazards

During the course of the project, there is a potential for workers to encounter biological hazards such as animals, insects and plants.

4.2.1 Animals

During site operations, animals such as dogs, cats, raccoons, skunks, mice, and snakes may be encountered. Workers will use discretion and avoid all contact with animals. If these animals present a problem, efforts will be made to remove these animals from the site by contacting a licensed pest control technician.

Table 4-2
Chemical Data

COMPOUNDS	ACGIH TLV	OSHA PEL	NIOSH IDLH	ROUTES OF EXPOSURE	SYMPTOMS OF EXPOSURE	TARGET ORGANS	PHYSICAL DATA
1,1,1-Trichloroethane	350 ppm	350 ppm		Inhalation, Ingestion, Contact	Headache, dizziness, weakness, nausea, vomiting, eye irritation, dermatitis, potential carcinogen	Skin, eyes, respiratory system; liver, kidneys, CNS	MW: 133.40; IP: 11.25 ev; Sp. Gr.: 1.34; LEL: 7%; UEL: 16%; VP: 100 mmHg
1,1,2-Trichloroethane	10 ppm	10 ppm	100 ppm	Inhalation, Ingestion, Contact	Drunkenness, eye and skin irritation, vomiting, headache	CNS, liver	MW: 133.4; IP: 11 ev; Sp. Gr.: 1.4416; LEL: N/A; UEL: N/A; VP: 17 mmHg
1,1-Dichloroethene	5 ppm	1 ppm	1000 ppm	Inhalation, Ingestion, Contact	Drunkenness, severe eye and skin irritation	CNS, liver	MW: 96.64; IP: 10 ev; Sp. Gr.: 1.213; LEL: 5.6%; UEL: 11.4%; VP: 400 mmHg
1,1-Dichloroethane	100 ppm	100 ppm	3000 ppm	Inhalation, Ingestion, Contact, Absorption	Nausea, headache, dizziness, vomiting, weakness, skin irritation	Skin, liver, kidneys, lungs, CNS	MW: 98.97; IP: 11.06 ev; Sp. Gr.: 1.174; LEL: 5.6%; UEL: N/A; VP: 230 mmHg
1,2-Dichloroethene	200 ppm	200 ppm	1000 ppm	Inhalation, Ingestion, Contact	Eye and skin irritation, nausea, vomiting, drowsiness, drunkenness	CNS	MW: 96.94; IP: 9.66 ev; Sp. Gr.: 1.2837; LEL: 9.7%; UEL: 12.8%; VP: 400 mmHg

Table 4-2
Chemical Data

COMPOUNDS	ACGIH TLV	OSHA PEL	NIOSH IDLH	ROUTES OF EXPOSURE	SYMPTOMS OF EXPOSURE	TARGET ORGANS	PHYSICAL DATA
1,2-Dichloroethane	10 ppm	50 ppm	50 ppm	Inhalation, Ingestion, Contact, Absorption	Headache, weakness, nausea, vomiting, diarrhea, skin and eye irritation, possible carcinogen	Eyes, skin, kidneys, liver, CNS, cardiovascular system	MW: 98.96; IP: 11.04 ev; Sp. Gr.: 1.24; LEL: 6.2%; UEL: 15.9%; VP: 87 mmHg
Benzene	0.5 ppm	1 ppm	500 ppm	Inhalation, Ingestion, Contact	Eye and skin irritation, drying or defatting of skin, headache, dizziness, nausea, vomiting, weakness, loss of coordination, blurred vision, drowsiness, confusion, or disorientation, potential carcinogen	Blood forming organs, CNS, bone marrow	MW: 147.01; IP: 9.25 ev; Sp. Gr.: 0.88; LEL: 1.3%; UEL: 7.9%; VP: 75 mmHg
Carbon Tetrachloride	5 ppm	10 ppm	200 ppm	Inhalation, Ingestion, Contact	Irritation, digestive disorders, headache, drunkenness, suspect carcinogen	CNS, liver, kidneys	MW: 153.84; IP: 11.28 ev; Sp. Gr.: 1.58; LEL: N/A; UEL: N/A; VP: 91.3 mmHg
Chlorobenzene	10 ppm	75 ppm	1000 ppm	Inhalation, Ingestion, Contact	Coughing, shortness of breath, dizziness, nausea, vomiting, diarrhea, skin and eye irritation	Liver, kidneys	MW: 112.56; IP: 9.07 ev; Sp. Gr.: 1.11; LEL: 1.3%; UEL: 9.6%; VP: 11.8 mmHg

Table 4-2
Chemical Data

COMPOUNDS	ACGIH TLV	OSHA PEL	NIOSH IDLH	ROUTES OF EXPOSURE	SYMPTOMS OF EXPOSURE	TARGET ORGANS	PHYSICAL DATA
Chloroform	10 ppm	50 ppm	500 ppm	Inhalation, Ingestion, Contact, Absorption	Headache, drowsiness, dizziness, burning in mouth and throat, pain in chest, vomiting, eye and skin irritation, drying or defatting of skin, suspect carcinogen	CNS, liver, kidneys	MW: 119.38; IP: 11.37 ev; Sp. Gr.: 1.48; LEL: %; UEL: %; VP: 160 mmHg
Methyl Tert Butyl Ether	50 ppm			Inhalation, Ingestion, Contact, Absorption	Light-headedness, dizziness, weaknes, nausea, vomiting, headache, skin and eye irritation	CNS, blood forming organs, kidneys	MW: 88.15; IP: 9.41 ev; Sp. Gr.: 0.74; LEL: 1.6%; UEL: 8.4%; VP: 245 mmHg
Tetrachloroethene	25 ppm	100 ppm	150 ppm	Inhalation, Ingestion, Contact, Absorption	Irritable eyes, nose, throat; nausea; flush face, neck; vertigo, dizziness, giddiness, incoordination, headache, skin erythema (skin redness), suspect carcinogen	Eyes, skin, respiratory system, liver, kidneys, CNS	MW: 165.83; IP: 9.32ev; Sp. Gr.: 1.62; VP: 14 mmHg
Toluene	50 ppm	200 ppm	500 ppm	Inhalation, Ingestion, Contact	Eye and skin irritation, drying or defatting of skin, headache, dizziness, nausea, vomiting, weakness, loss of coordination, blurred vision, drowsiness, confusion, or disorientation, possible carcinogen	Skin, eyes, respiratory system, liver, kidneys	MW: 92.13; IP: 8.76ev; Sp. Gr.: 0.86; LEL: 3.3%; UEL: 19%; VP: 22 mmHg

Table 4-2
Chemical Data

COMPOUNDS	ACGIH TLV	OSHA PEL	NIOSH IDLH	ROUTES OF EXPOSURE	SYMPTOMS OF EXPOSURE	TARGET ORGANS	PHYSICAL DATA
Trichloroethene	50 ppm	100 ppm	1000 ppm	Inhalation, Ingestion, Contact	Headache, vertigo, visual disturbance, tremors, vomiting, eye irritation, dermatitis, fatigue, giddiness, potential carcinogen	Eyes, skin, respiratory system, heart, liver, CNS	MW: 131.39; IP: 9.4ev; Sp. Gr.: 1.46; LEL: 10.5%; UEL: NA; VP: 58 mmHg
Vinyl Chloride	1 ppm	1 ppm		Inhalation, Ingestion, Contract	Eye and skin irritation, nausea, difficulty breathing, headache, drowsiness, dizziness, known carcinogen	CNS	MW: 62.5; IP: 10.0 ev; Sp. Gr.: 0.9106; LEL:3.6 %; UEL: 33%; VP: 2515.6 mmHg
Xylenes	100 ppm	100 ppm	900 ppm	Inhalation, Ingestion, Contact, Absorption	Eye, skin, and respiratory irritant, nausea, vomiting, headache, ringing in the ears, and severe breathing difficulties, characteristic dermatitis	Blood, kidneys, CNS, liver, lungs, eyes, skin, mucous membranes	MW: 106.17; IP: ~8.5ev; Sp. Gr.: 0.864; LEL: 1.1%; UEL: 7%; VP: 6.72 mmHg

Abbreviations:
ACGIH = American Conference of Industrial Hygienists
CNS = Central Nervous System
IDLH = Immediately Dangerous to Life and Health
IP = Ionization Potential
LEL = Lower Explosive Limit
MW = Molecular Weight
NA = Not Applicable
OSHA = Occupational Safety & Health Administration
PEL = Permissible Exposure Limit
ppm = Parts Per Million
Sp. Gr. = Specific Gravity
TLV = Threshold Limit Value
UEL = Upper Explosive Limit
VP = Vapor Pressure

4.2.2 Insects

Insects, such as mosquitoes, ticks, bees and wasps may be present during certain times of the year. Workers will be encouraged to wear repellents (DEET for Ticks) when working in areas where insects are expected to be present. If insects are prevalent, efforts will be made to remove them from the site by contacting a licensed pest control technician.

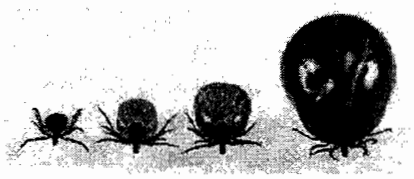
Rocky Mountain Ticks

Left to Right: female, male

4.2.2.1 Lyme Disease

Since the site is located in the mid-Atlantic region, the potential for coming into contact with deer ticks exists. Lyme disease is caused by an infection from a deer tick that is about the size of the head of a pin. After a blood feeding, the tick becomes engorged and may vomit its stomach contents into the host, a microorganism (spirochete) may be transmitted into the bloodstream that may lead to Lyme disease. The feeding time is 24 to 48 hours. The effects of the disease vary from person to person, which often makes it difficult to diagnose. Typically, the incubation period ranges from two days to two weeks. In most cases, the infected area will resemble a red bull's eye with concentric rings. Within the same period, flu-like symptoms may develop. If left untreated, the red ringed area will eventually fade and Lyme disease may further develop into an arthritis-like condition.

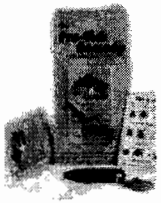
Deer tick - Black Legged tick

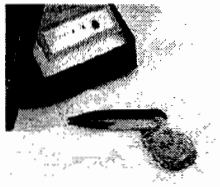


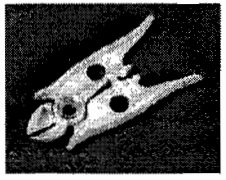
The changing face as the deer tick engorges
Left to Right: unengorged female, 1/4 engorged, 1/2 engorged and fully engorged

The best method for stopping insect borne disease is to avoid the bite. Control measures to prevent Lyme Disease include the following:

- Avoid dense or high brush, when possible
- Wear light colored clothing
- Spray DEET on your skin and Permethrin on clothing and work boots
- Tuck pant legs into socks and shirts into gloves, if possible
- Self/Buddy check of neck, hairline, groin and body after working in areas that may contain deer ticks
- Wear light colored tyvek or clothing
- Wear booties over work boots
- Look for ticks upon returning from field work
- Shower as soon as possible
- If a tick is found, suffocate it with baby oil applied to the tick, then remove it by pulling gently at the head with tweezers or better, the Pro-Tick removal system (see below)
- Report any of the above symptoms and all tick bites to the SHSO for evaluation. Employees bitten by deer ticks during the course of employment or one who finds an engorged tick on their body, will be given a medical examination
- Analysis of the tick for Spirochete may be warranted. Administration of antibiotic therapy may be warranted. Either action may be taken with the concurrence of the Corporate Medical Consultant.







A source for Pro-Tick removal systems as well as Deet and Permethrin based lotions and sprays as well as sun screen can be found on-line at http://www.scs-mall.com/store/

The following is from the "Pro-Tick Remover" ad on the above web site: Pro-Tick Remedy (now includes a 5X magnifier) makes this sometimes difficult and distasteful task easier than any other tool.

The Pro-Tick has consistently tested superior when tested against other tick removers and tweezers. Here's a quote from a research paper published in 1995. ***"... while others (tick removers and tweezers) broke the tip of the hypostrome and chelicerae (mouthparts) in at least one tick. The Pro-Tick remedy succeeded in removing all fifty-one ticks without damaging any mouthparts ... results indicate that the Pro-Tick Remedy removed the most tick cement while causing the least damage ..."*** More recent tests against nymph ticks (the dangerous immature ones) showed that the Pro-Tick Remedy removes nymph ticks better than any other instrument.

4.2.3 Snakes

Snakes are a hazard in the forests and wetlands, if you see a snake, avoid it! If you are bitten, try to identify the snake and seek emergency medical help immediately. Venomous snakes native to this area include:

- **Northern Copperhead:** This snake grows to 24" to 36" in length. The Northern Copperhead Snake has a stocky body that may be copper, orange or pinkish in color. Dark, chestnut-colored bands cross the body, breaking the color pattern into alternating bands of darker and lighter color. Young copperheads are lighter in color than the adults, and they have a yellow-tipped tail that they often flick.

- **Timber Rattlesnake:** It often lives on rocky hillsides and in wooded areas. The Timber Rattlesnake has a head and body that are pinkish-gray to yellowish-brown with a pattern of dark bands on the back and a grayish-white belly. The tail is black with a rattle. Size of average adult is 3 - 4.5 feet long.

4.2.4 Plants

Plants such as poison ivy and poison oak may be prevalent at the site during certain times of the year. Workers will be trained to recognize these plants and to minimize contact with them. Employees may wear PPE to reduce the potential for exposure. Pre-exposure topical lotions such as Tecuu may be applied prophylactically. "Ivy Block" is an easy to use non-prescription, pre-exposure lotion. You apply it like sunscreen to all exposed skin. It dries quickly and the active ingredient, bentoquatam, guards you against the harmful oil in poison ivy, oak and sumac. Remove lotion with running water and soap after risk of exposure has ended. Toll FREE ORDER LINE (800) 421-1223.

The use of Clorox wipes to decontaminate reusable clothing to preclude exposure to poison ivy may prove valuable. Gloves should be worn during decontamination and removal of PPE.

4.3 Physical Hazards

Most safety hazards are discussed in the Activity Hazard Analyses (AHA) in Appendix C for the different phases of the project. In addition to the AHAs, general work rules and other safety procedures are described in Section 10 of this SHSP.

4.3.1 Heat Stress

Heat stress is a significant potential hazard, which is greatly exacerbated with the use of PPE in hot environments. A heat stress prevention program will be implemented when ambient temperatures exceed 70°F for personnel wearing impermeable clothing and for other personnel when the WBGT index exceeds the ACGIH TLVs. The following are the main elements of the TtFW Health and Safety Program (EHS 4-6) related to temperature extremes, which can be found in Appendix D.

- Selection of PPE to reduce the risk of heat related illness
- Hydration
- Cool rest areas
- Engineering Controls (i.e., air conditioned cabs, drenching)
- Administrative Controls (work schedules, acclimatization, work/rest regimens)
- PPE (i.e., ice vests, vortex tubes)
- Monitoring (body core temperature, pulse rate)
- Identification of heat related illnesses (heat cramps, heat exhaustion, and heat stroke)
- Employee training

4.3.2 Cold Stress

At certain times of the year, workers may be exposed to the hazards of working in cold environments. Potential hazards in cold environments include frostbite, trench foot or immersion foot, hypothermia as well as slippery surfaces, brittle equipment, poor judgment and unauthorized procedural changes. The following are the main elements of the TtFW Health and Safety Program (EHS 4-6) related to temperature extremes, which can be found in Appendix D.

- PPE (i.e. hard hat liners, boot and glove liners, insulated coveralls)
- Engineering controls (i.e. heaters, wind shields, covered metal handles)
- Administrative controls (i.e. work/warm up schedule, acclimatization)
- Recognition of Cold Stress Related Injury (frostbite and hypothermia)
- Warm rest area
- Employee training

4.3.3 Noise

Noise is a potential hazard associated with the operation of heavy equipment, power tools, pumps and generators. All employees routinely working within 10 feet of these operations will wear hearing protection. All employees receive a pre-employment audiogram as part of their physical examination. High noise areas shall be so designated.

4.3.4 Underground Utilities

When intrusive work activities are conducted on-site the threat of contact with underground utilities exists. Underground utilities include lines such as electrical, gas, and sewer. An assessment of the presence of underground utilities will be made before conducting any intrusive activities. In preparing the Activity Hazard Analysis, TtFW's EHS Procedure 3-15 was considered.

Striking underground utilities is a possible hazard whenever excavation is conducted. All steps will be taken to locate underground utilities as per EHS 3-15. This will include white lining the area of excavation, calling the New York State One-Call System, having utilities located and when on private property, use of a private locating service to perform a geophysical survey.

4.3.5 Other Physical Hazards

Other physical hazards at the site include:

- Drill rig;
- Possible explosive atmosphere during drilling; and
- Other heavy equipment.

5.0 ACTIVITY HAZARD ANALYSIS (AHA)

An Activity Hazard Analysis (AHA) has been developed for each task. The AHA considers the hazards discussed in Section 4.0.

An additional or expanded AHA will be developed by the SHSO, or subcontractors, for all unanticipated work and/or prior to working on a new task.

The AHAs will be used to instruct workers on the hazards of the associated activities during a safety meeting.

AHAs are included in Appendix C for the following phases of work:

- Mobilization and Site Preparation
- Geotechnical Investigation
- Pre-Design Groundwater Investigation
- Survey
- Treatability Study
- Demobilization

Subcontracted work will be evaluated for hazards in a manner consistent with self-performed work. The PS or SHSO is responsible to obtain and review AHA from subcontractors or will develop accurate AHA for subcontracted work.

6.0 PERSONAL PROTECTIVE EQUIPMENT

For the purposes of PPE selection, the PESM and SHSO are considered competent persons. The signatures on the front of this SHSP constitute certification of the hazard assessment. As established in this SHSP, the initial level of personal protective equipment (PPE) will be modified Level D for all activities. Sampling data and past experience indicate a relatively low hazard for exposure.

For activities not covered by an AHA, the SHSO will conduct the hazard assessment and select the PPE using the form provided in Appendix E and will certify the assessment by signing the form. PPE selection will be made in consultation with the PESM. Modifications for initial PPE selection may also be made by the SHSO in consultation with the PESM. A written justification for downgrades will be provided to the PESM for approval by the Navy as a field change request.

Table 6-1 describes PPE for site tasks.

6.1 Hazard Assessment for Selection of Personal Protective Equipment

The initial levels of protection were selected by performing a hazard assessment taking into consideration the following:

- Potential chemical and physical hazards present or suspected;
- Work operations to be performed;
- Potential routes of exposure;
- Characteristics, capabilities and limitations of PPE,
- Hazards that the PPE presents or magnifies.

The primary routes of exposure for the contaminants are skin contact and inhalation, ingestion is a secondary route of exposure. During well installation and development activities there is a potential for skin contact with chemical contaminants; the SHSO will need to exercise judgment in determining an upgrade in level of PPE. Additionally, the type of respiratory protection will be dependent on real-time air monitoring results. The air monitoring program, along with use of respirators equipped with organic vapor cartridges, if necessary, will provide adequate respiratory protection to minimize potential exposure via inhalation. Strict adherence to decontamination and personal hygiene procedures will effectively eliminate ingestion as a potential route of exposure.

6.2 Respirator Cartridge Change-out Schedule

A respirator cartridge change-out schedule has been developed in order to comply with 29 CFR 1910.134. The respirator cartridge change-out schedule for this project is as follows:

- Cartridges will be removed and disposed of after four hours of use, when cartridges become wet or wearer experiences breakthrough, whichever occurs first.
- If the humidity exceeds 85%, then cartridges will be removed and disposed of after two hours of use.

Respirators will not be stored at the end of the shift with contaminated cartridges left on. Cartridges will not be reused on another shift, regardless of use time on a previous shift.

Table 6-1
Personal Protective Equipment Selection

TASK	HEAD	EYES/FACE	FEET	HANDS	BODY	HEARING	RESPIRATORY
Geotechnical Investigation	HH	SG	STB	Nit	WC	EP as needed	Initial LOP: D Upgrades based on real time readings and conditions
Pre-Design Groundwater Investigation	HH	SG	STB	Nit	WC	EP as needed	Initial LOP: D Upgrades based on real time readings and conditions

Legend:
EP = Ear Plugs
HH = Hard Hat
Nit = Nitrile Gloves
SG = Safety Glasses
STB= Steel Toe Boots
WC = Work Clothes

The schedule was developed based on the following scientific information and assumptions:

- Analytical data that is available regarding site contaminants;
- Using the Rules of Thumb provided by the AIHA;
- All of the chemicals have boiling points greater than 70° C;
- Total airborne concentration of contaminants is anticipated to be less than 200 ppm
- The humidity is expected to be less than 85%; and
- Desorption of contaminants (including those with poor warning properties) after partial use of the chemical cartridge can occur after a short period (hours) without use (i.e. overnight) and result in a non-use exposure.

The following is a partial list of factors that may affect the usable cartridge service life and/or the degree of respiratory protection attainable under actual workplace conditions. These factors have been considered when developing the cartridge change-out schedule.

- Type of contaminant(s)
- Contaminant concentration
- Relative humidity
- Breathing rate
- Temperature
- Changes in contaminant concentration, humidity, breathing rate and temperature
- Mixtures of contaminants
- Accuracy in the determination of the conditions
- The contaminant concentration in the workplace can vary greatly. Consideration must be given to the quality of the estimate of the workplace concentration
- Storage conditions between multiple uses of the same respirator cartridges. It is recommended that the chemical cartridges be replaced after each work shift. Contaminants adsorbed on a cartridge can migrate through the carbon bed without airflow.
- Age of the cartridge
- Condition of the cartridge and respirator
- Respirator and cartridge selection
- Respirator fit
- Respirator assembly, operation, and maintenance
- User training, experience and medical fitness
- Warning properties of the contaminant
- The quality of the warning properties should be considered when establishing the chemical cartridge change schedule. Good warning properties may provide a secondary or back-up indication for cartridge change-out.

MSA Cartridge Life Expectancy Results

Final Breakthrough Time Calculation

When using a UltraTwin Facepiece with a Comfo GMC Cartridge under the following conditions:

Chem 1 at Conc:	Tetrachloroethylene	at	50 ppm
Chem 2 at Conc:	Trichloroethylene	at	50 ppm
Chem 3 at Conc:	1,2-Dichloroethylene	at	50 ppm
Breakthrough Chemical PEL (ppm):	200 OSHA PEL		
Temperature:	75 F		
Relative Humidity:	75 %		
Pressure:	760 Torr		
Breathing Rate:	60 LPM		
Breakthrough Concentration:	10 % OSHA PEL		

Based on 1,2-Dichloroethylene,
the estimated Breakthrough Time at which cartridges need to be replaced is:
247 **minutes**

"NaN" = Not A Number
For example, a result cannot be calculated if Use Concentration is less than Breakthrough Concentration.

Back to the Calculator

Response
Respirator Selector

Combination cartridges should be replaced prior to the estimated breakthrough time if, the breathing resistance becomes too high, the cartridge has been damaged or become dirty.

! WARNING

- Do not use the results from this calculator as the sole source of information when determining a cartridge change-out schedule. An appropriate change-out schedule must be developed by a qualified professional and take into account all factors that may influence respiratory protection including specific work practices and other conditions unique to the workers environment.

- Over exposure can occur without user awareness. If using the respirator against substances having poor warning properties the user must rely solely on the change-out schedule to determine when to replace the cartridges. Take appropriate precautions to prevent overexposure, which may include selecting a low Breakthrough Concentration percentage or using an air-supplied respirator or SCBA.

- Replace cartridges every shift, or sooner if calculated service time exceeds 480 minutes. Use beyond one shift could result in shorter than expected service time and over exposure due to contaminant desorption and migration through the cartridge when not in use.

Failure to follow the above warnings can result in serious personal injury or death.

Thank you for using the MSA Cartridge Life Expectancy Calculator.
This concludes the report.

Version 2.0 May 2000

7.0 AIR MONITORING

The following sections contain information describing the type, frequency and location of real time air monitoring.

7.1 Real Time Air Monitoring

This section addresses the real time air monitoring that will be conducted, including instrumentation selection, frequency and location of air sampling. At a minimum, real-time air monitoring will be conducted during well installation and development. Air monitoring will continue in this manner until sufficient data is developed to consider a frequency reduction or cessation for a particular activity. Table 7-1 lists the Real Time Air Monitoring Action Levels to be used in all work areas. Table 7-2 presents a breakdown of each main activity and provides the instrumentation, frequency and location of real-time air monitoring for the site. All air monitoring readings will be recorded, regardless of concentrations.

The following instruments will be used for real-time air monitoring:

- Photo-Ionization Detector (PID) with an 11.7 eV lamp
- Combustible Gas Indicator/Oxygen (CGI/O_2)
- Detector tube for vinyl chloride, low range tube, able to detect < 1 ppm

Organic vapor concentrations will be measured using the PID and vinyl chloride detector tubes. Measurements will be recorded during the above activities, at a minimum. The monitoring for organic vapors will consist of measurements recorded at the breathing zone (BZ) height in the area of highest employee exposure risk. Readings will be taken in accordance with Table 7-2.

Monitoring for combustible gases will be conducted during well installation and development activities and any other activities that may generate combustible gas or vapors.

Based on real time air monitoring readings and site conditions, the SHSO or designee may increase/decrease the frequency at which the readings are taken, using professional judgment. Table 7-1 provides the real-time air monitoring action levels. Real-time air monitoring will be conducted in order to confirm the "no exposure scenario."

Real-time air monitoring results for on-site activities will be reviewed with craft labor periodically by the SHSO in site daily health and safety briefings.

Table 7-1
Real Time Air Monitoring Action Levels

Air Monitoring Instrument	Monitoring Location	Action Level	Site Action	Reason
PID w/11.7 lamp	Breathing Zone	>0.5 ppm	Use detector tube for vinyl chloride	Conservative action level based on the potential exposure to vinyl chloride
	Breathing Zone	0 – 2.5 ppm, no vinyl chloride	Level D	Conservative action level based on the potential exposure to carbon tetrachloride.
	Breathing Zone	2.5 – 25 ppm, no vinyl chloride	Level C	Based on increasing potential for exposure to VOCs
	Breathing Zone	>25 ppm	Level B	Assume conservative protection factor for respirators
Vinyl Chloride Detector Tube	Breathing Zone	<1 ppm	Level D	PEL for vinyl chloride is 1 ppm
	Breathing Zone	>1 ppm	Cease activities, contact PM and PESM for further instruction	There are currently no approved cartridges for vinyl chloride
CGI/O_2	Breathing Zone, borehole	1% LEL< conc.< 10% LEL	Investigate possible cause, use caution	Increasing potential for ignition of vapors
	Breathing Zone, borehole	Conc. > 10% LEL	Cease activities, contact PM and PESM for further instruction	Potential for ignition of vapors

7.2 Frequency and Location of Real Time Air Monitoring

Table 7-2 provides the frequency and location of real time air monitoring.

Table 7-2
Frequency and Location of Air Monitoring

Activity	Air Monitoring Instrument	Frequency And Location
Well installation and development	PID, CGI/O_2, and VC tubes	BZ: every 15-30 minutes

7.3 Integrated Air Monitoring

Integrated air monitoring will not be performed due to the nature of the work and the contaminants.

7.4 Data Quality Assurance

7.4.1 Calibration

Instrument calibration will be documented and included in a dedicated Health and Safety Logbook or on separate calibration pages. All instruments will be calibrated before and after each shift. Calibration checks may be used during the day to confirm instrument accuracy. Duplicate readings may be taken to confirm individual instrument response.

7.4.2 Operations

All instruments will be operated in accordance with the manufacturer's specifications. Manufacturers' literature, including an operations manual for each piece of air monitoring equipment will be maintained on-site by the SHSO for reference.

7.4.3 Data Review

The SHSO will interpret all monitoring data based on Table 7-1 and his professional judgment. The SHSO will review the monitoring and sampling data with the PESM to evaluate the potential for worker exposure and upgrades/downgrades in LOP.

7.5 Noise Monitoring

Noise monitoring will not be conducted. Hearing protection will be worn by workers in proximity to heavy equipment, fans, blowers and pumps. When equipment requires the wearing of ear muffs the equipment will be labeled as hazardous to hearing, and the hazard radius noted on the warning.

8.0 ZONES, PROTECTION AND COMMUNICATION

8.1 Site Control

Site zones are intended to control the potential spread of contamination throughout the site and to assure that only authorized individuals are permitted into potentially hazardous areas. A three-zone approach will be utilized. It will include an Exclusion Zone (EZ), Contamination Reduction Zone (CRZ) and a Support Zone (SZ). Specific zones will be established on the work site when operations begin. A map showing these zones will be developed on site and posted in the field office. All maps will be posted at the site and used during initial site-specific training.

This project is a hazardous waste remediation project, and any person working in an area where the potential for exposure to site contaminants exists, will only be allowed access after providing the SHSO with evidence of proper training and medical documentation.

The zones are based upon current knowledge of proposed site activities. It is possible that the zone configurations may be altered due to work plan revisions. Should this occur, the Site Zones will be adjusted accordingly.

The following will be used for guidance in revising these preliminary zone designations, if necessary.

Support Zone - The SZ is an uncontaminated area (trailers, offices, etc.) that will be the field support area for most operations. The SZ provides for field team communications and staging for emergency response. Appropriate sanitary facilities and safety equipment will be located in this zone. Potentially contaminated personnel/materials are not allowed in this zone. The only exception will be appropriately packaged/decontaminated and labeled samples.

Contamination Reduction Zone - The CRZ is established between the EZ and the SZ. The CRZ contains the contamination reduction corridor and provides for an area for decontamination of personnel and portable hand-held equipment, tools and heavy equipment. A personnel decontamination area will be prepared at each exclusion zone. The CRZ will be used for Exclusion Zone entry and egress in addition to access for heavy equipment and emergency support services.

Exclusion Zone - All activities that may involve exposure to site contaminants, hazardous materials and/or conditions should be considered an exclusion zone (EZ). This zone will be clearly delineated by cones, tapes or other means. The SHSO may establish more than one EZ where different levels of protection may be employed or different hazards exist. The size of the EZ will be determined by the SHSO allowing adequate space for the activity to be completed, field members and emergency equipment.

Site personnel and visitors must log in and out of the EZ and CRZ daily.

8.2 Contamination Control

Decontamination areas will be established for the following activities.

8.2.1 Personnel Decontamination Station

Personnel hygiene, coupled with diligent decontamination, will significantly reduce the potential for exposure of off-site areas to contaminants from the site. When participating in potentially dust-raising activities, such as excavating soil, it will be crucial for field personnel to adhere to the following personal hygiene guidelines:

- Wash hands and face after leaving the contamination reduction zone.
- Every effort will be made to reduce dust production through engineering controls (i.e., watering, if deemed necessary based on weather conditions).

8.2.2 Minimization of Contact With Contaminants

During completion of all site activities, personnel should attempt to minimize contact with contaminated materials. This involves a conscientious effort to keep "clean" during site activities. This may ultimately minimize the degree of decontamination required and the generation of waste materials from site operations.

8.2.3 Personnel Dry Decontamination Sequence

When decontamination is needed, a dry decon will be used whenever possible.

1. Perform dry decon if contact with contaminants occurred
2. Remove exterior protective clothing carefully and dispose of same
3. Remove and clean respirator, if applicable
4. Remove gloves without touching outside surface of gloves and dispose of same
5. Wash hands and face thoroughly

8.2.4 Heavy Equipment Decontamination

Heavy equipment and hand held equipment that has come into contact with contaminated material will be decontaminated upon completion of the required project operations and after traveling from the exclusion zones into other work zones from the site. Decontaminate rinsate will then be containerized in approved 55-gallon drums before being disposed off-site.

Heavy equipment will not be permitted to leave the EZ unless it has been thoroughly decontaminated and visually inspected by the SHSO or his designee.

8.3 Communication

The following communications equipment shall be specified as appropriate:

- Hand-held two-way radios are utilized as appropriate by field teams for communication with the site office trailer.
- Telephones - A telephone will be located in the site office trailer in the SZ for communication with emergency support services/facilities.
- Air Horns - Air horns will be carried by field teams or be strategically located within the EZ and will be maintained as the means for announcing emergency evacuation procedures and backup for other forms of communication.
- Hand Signals - Hand signals will be used by field teams along with the buddy system. They will be known by the entire field team before operations commence and their use covered during site-specific training. Typical hand signals are the following:

SIGNAL	MEANING
Hand gripping throat	Out of air, can't breathe
Grip on a partner's wrist or placement of both hands around a partner's waist.	Leave the area immediately, no debate.
Hands on top of head	Need general assistance
Hands raised above head	Need immediate assistance
Thumbs up	Okay, I'm all right, I understand.
Thumbs down	No, negative.

9.0 MEDICAL SURVEILLANCE PROCEDURES

All contractor and subcontractor personnel performing field work where potential exposure to contamination exists are required to have passed a medical surveillance examination in accordance with 29 CFR 1910.120(f).

The TtFW Medical Surveillance Program is described in detail in EHS 4-5 of the Health and Safety Program. The Corporate Medical Consultant is WorkCare, located in Orange, California. Dr. Peter Greaney, the Director, is Board certified in occupational medicine.

9.1 Medical Surveillance Requirements

A physician's medical release for work will be confirmed by the SHSO before an employee can work in the exclusion zone. The examination will be taken annually at a minimum and upon termination of hazardous waste site work if the last examination was not taken within the previous six months. Additional medical testing may be required by the PESM in consultation with the Corporate Medical Consultant and the SHSO if an over-exposure or accident occurs, if an employee exhibits symptoms of exposure, or if other site conditions warrant further medical surveillance.

9.2 Medical Data Sheet

A medical data sheet is provided in Appendix F. This medical data sheet is voluntary and should be completed by all on-site personnel and will be maintained at the site. Where possible, this medical data sheet will accompany the personnel needing medical assistance. The medical data sheet will be maintained in a secure location, treated as confidential, and used only on a need-to-know basis.

10.0 SAFETY CONSIDERATIONS

10.1 General Health and Safety Work Rules

A list of work rules and general safe work practices has been included from the TtFW Health and Safety Program, EHS 3-6. These rules have been incorporated into the SHSP as Appendix G. The work rules will be posted in a conspicuous location at the site.

10.2 General Construction Hazards

The following is a list of applicable safety considerations for the major tasks. Further information is provided in the specific Activity Hazard Analysis and the specific TtFW Health and Safety Program.

- Slips/Trips/Falls
- Punctures/Cuts
- Lifting/Materials Handling

10.3 High Loss Potential Hazards

Activities that have the potential for a serious injury to occur, include the following:

- Excavation/Intrusive activities

- Exposure to energized electric lines / underground utility lines
- Heavy Equipment

10.3.1 Underground Utilities

Striking Underground Utilities is a possible hazard whenever excavation is conducted. All steps will be taken to locate underground utilities as per EHS 3-15 (see Appendix H, Underground Utilities). This includes white lining the area of excavation, calling the "One-Call" number and having underground utilities located and marked. On private property, a locating service and/or a geophysical survey will be needed.

Underground utility avoidance requires a "competent person" be designated. "Competent person" means one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

The Competent Person will be responsible for:

- Obtaining a copy of, and understanding the applicable regulations for the State of NY
- Contacting the appropriate One-Call agency or private locating service, as applicable
- Recording One-Call locate numbers
- If necessary, renewing One-Call locate numbers before expiration
- Ensuring that white-lining of the area to be excavated is performed
- Ensuring that a "positive response" has been received from every utility owner/operator identified by the One-Call agency and that they have located their underground utilities and have appropriately marked any potential conflicts with the areas of planned intrusive activities
- Completion of the *Underground Utilities Locating and Marking Checklist* and the *Underground Utilities Management Checklist*
- Reviewing applicable AHAs with all project members before work begins
- Conducting training on communication protocols to be used by the excavation observer and equipment operator
- Ensuring Implementation of appropriate work practices during intrusive activities
- Conducting daily inspections of the excavation area to make sure that all markings are intact
- Maintaining required records
- Providing the Site Health and Safety Officer (SHSO) with all required documentation on a daily basis

11.0 WASTE DISPOSAL PROCEDURES

All discarded materials, waste materials or other objects will be handled in such a way as to preclude the potential for spreading contamination, creating a sanitary hazard or causing litter to be left on site. To the extent possible, cuttings will be placed back into boreholes. Water from well purging and well development can be discharged to the Publicly-Owned Treatment Works (POTW) without prior treatment. All potentially contaminated materials, e.g., clothing, gloves, etc., will be bagged or drummed as necessary, labeled and segregated for disposal. All non-contaminated materials will be collected and bagged for appropriate disposal as non-hazardous solid waste. Additional waste disposal procedures may be developed with the ESQ department regulatory specialist as applicable.

12.0 EMERGENCY RESPONSE PLAN

This section establishes procedures and provides information for use during a project emergency. Emergencies happen unexpectedly and quickly, and require an immediate response; therefore, contingency planning and advanced training of staff is essential. Specific elements of emergency support procedures which are addressed in the following subsections include communications, local emergency support units, preparation for medical emergencies, first aid for injuries incurred on site, record keeping, and emergency site evacuation procedures.

12.1 Responsibilities

12.1.1 Project Environmental and Safety Manager (PESM)

The PESM is Grey Coppi, CIH, CSP.

The PESM oversees and approves the Emergency Response/Contingency Plan and performs audits to determine that the plan is in effect and that all pre-emergency requirements are met. The PESM acts as a liaison to applicable regulatory agencies and notifies OSHA of reportable accidents.

12.1.2 Site Health and Safety Officer (SHSO)

The SHSO is Tony Barroquiero.

The SHSO is responsible for ensuring that all personnel are evacuated safely and that machinery and processes are shut down or stabilized in the event of a stop work order or evacuation. The SHSO is required to immediately notify the PESM of any fatalities or catastrophes (three or more workers injured and hospitalized) so that the PESM can notify OSHA within the required time frame. The PESM will be notified of all OSHA recordable injuries, fires, spills, releases or equipment damage in excess of $500 within 24 hours. The SHSO also serves as the Alternate Emergency Coordinator.

12.1.3 Emergency Coordinator (EC)

The Emergency Coordinator is John Imhoff.

The emergency coordinator will make contact with Local Emergency Response personnel prior to beginning work on site. In these contacts the emergency coordinator will inform interested parties about the nature and duration of work expected on the site and the type of contaminants and possible health or safety effects of emergencies involving these contaminants. The emergency coordinator will locate emergency phone numbers and identify hospital routes prior to beginning work on site. The emergency coordinator will make necessary arrangements to be prepared for any emergencies that could occur.

The Emergency Coordinator will implement the Emergency Response/Contingency Plan whenever conditions at the site warrant such action.

12.1.4 Site Personnel

Site personnel are responsible for knowing the Emergency Response/Contingency Plan and the procedures contained herein. Personnel are expected to notify the Emergency Coordinator of situations that could constitute a site emergency.

12.2 Communication

A variety of communication systems may be utilized during emergency situations. These are discussed in the following sections.

12.2.1 Radio Communication

The primary form of communication during an emergency between field groups in the exclusion zone and the Emergency Coordinator will be radio communications. Each field team within the exclusion zone will have a radio. During an emergency situation, the lines will be kept clear so that all field teams can receive instructions.

12.2.2 Telephone Communication

A telephone will be maintained in the office trailer.

12.2.3 Air Horns

Air horns will be used to alert site personnel of emergencies. The following signals will be used:

- Two short blasts - shut down equipment, clear radio channels, await instructions.
- Three short blasts - injured employee, first-aid providers respond.
- One continuous blast - site evacuation.

Air horns can be found in the office trailer and site vehicles. The procedure to activate the air horns consists of depressing the air horn button or switch while pointing it in the direction of the area to be signaled. Air horns should be tested at least monthly to ensure that they are working properly.

12.2.4 Hand Signals

Field teams will employ hand signals (Section 8.3) where necessary for communication during an emergency.

12.3 Local Emergency Support Units

In order to be able to deal with any emergency that might occur during remedial activities at the site, Table 12-1 will be posted prominently in the field office and in all places where telephone service is available.

A route map from the site to the nearest hospital is located in Appendix I. This map will be posted adjacent to the above emergency telephone numbers in the field office and in all places where telephone service is available. It should also be placed in all on site vehicles.

Table 12-1
Emergency Telephone Numbers

Contact	Firm or Agency	Telephone Number
Police	Nassau County Police Department	516-573-6800
Fire	Bethpage Fire Department	516-931-2660
Hospital	New Island Hospital	516-579-6000
Ambulance	Bethpage EMS	516-931-0666
Environmental Coordinator, Dave Barney	Base	617-753-4656
PM, Stavros Patselas	TtFW	Work – 215-702-4099 267-688-9967
PS, John Imhoff	TtFW	315-678-2879
SHSO – Tony Barroquiero	TtFW	973-630-8177
PESM, Grey Coppi	TtFW	Work – 973-630-8101
Facility Contact, Al Taormina	J.A. Jones Management Services NWIRP Bethpage	516-346-0344 516-702-5861
NAVY ROICC- James Colter	EFANE	610-595-0567
Poison Control Center		1-800-222-1222
National Response Center		800-424-8802

12.4 Pre-Emergency Planning

TtFW will communicate directly with administrative personnel from the emergency room at the hospital in order to determine whether the hospital has the facilities and personnel needed to treat cases of trauma resulting from exposure to any of the contaminants expected to be found on the site. Instructions for finding the hospital will be posted conspicuously in the site office and in each site vehicle.

Before the field activities begin, the local emergency response personnel will be notified of the schedule for field activities and about the materials that are thought to exist on the site so that they will be able to respond quickly and effectively in the event of a fire, explosion, or other emergency.

12.5 Emergency Medical Treatment

The procedures and rules in this SHSP are designed to prevent employee injury. However, should an injury occur, no matter how slight, it will be reported to the SHSO immediately. First-aid equipment will be available on site at the following locations:

- First Aid Kit: Field Office and Site Vehicles
- Emergency Eye Wash (Meets ANSI Z.358.1-1998 for a 15 minute flush): Field Office and CRZ

During the site safety briefing, project personnel will be informed of the location of the first aid station(s). Unless they are in immediate danger, severely injured persons will not be moved until paramedics can attend to them. Some injuries, such as severe cuts and lacerations or burns, may require immediate treatment. Any first aid instructions that can be obtained from doctors or paramedics, before an emergency-response squad arrives at the site or before the injured person can be transported to the hospital, will be followed closely.

TtFW will provide at least two personnel with current First Aid and CPR certification on each active work shift. When personnel are transported to the hospital, the SHSO will provide a copy of the Medical Data Sheet to the paramedics and treating physician.

Only in **non-emergency** situations will an injured person be transported to the hospital by means other than an ambulance. For minor injuries, contact WorkCare, at 800-455-6155 for the location of the nearest clinic.

12.6 Emergency Site Evacuation Routes and Procedures

In order to mobilize the manpower resources and equipment necessary to cope with a fire or other emergency, a clear chain of authority will be established. The EC will take charge of all emergency response activities and dictate the procedures that will be followed for the duration of the emergency. The EC will report immediately to the scene of the emergency, assess the seriousness of the situation, and direct whatever efforts are necessary until the emergency response units arrive. At his discretion, the EC also may order the closure of the site for an indefinite period.

All project personnel will be instructed on proper emergency response procedures and locations of emergency telephone numbers during the initial site safety meeting. If an emergency occurs, including but not limited to fire, explosion or significant release of toxic gas into the atmosphere, an air horn will be sounded on the site. The horn will sound continuously for one blast, signaling that immediate evacuation of all personnel is necessary due to an immediate or impending danger. All heavy equipment will be shut down and all personnel will evacuate the work areas and assemble at the assigned locations.

The EC will give directions for implementing whatever actions are necessary. Any project team member may be assigned to be in charge of emergency communications during an emergency.

The project team member will attend the site telephone specified by the EC from the time the alarm sounds until the emergency has ended.

After sounding the alarm and initiating emergency response procedures, the EC will check and verify that access roads are not obstructed. If traffic control is necessary, as in the event of a fire or explosion, a project team member, who has been trained in these procedures and designated at the site safety meeting, will take over these duties until local police and fire fighters arrive.

The EC will remain at the site to provide any assistance requested by emergency-response squads as they arrive to deal with the situation. A map showing evacuation routes, meeting places, and location of emergency equipment will be developed on site and will be posted in all field offices and vehicles and used during site-specific training.

12.6.1 Evacuation Drills

An evacuation drill will be conducted within two weeks of mobilization to test the emergency notification and response system.

The drill will simulate situations that may be likely to occur onsite. The SHSO will critique the drill according to TtFW Health and Safety Program, EHS 2-1.

12.7 Fire Prevention and Protection

In the event of a fire or explosion, procedures will include immediately evacuating the site (air horn will sound for a single continuous blast), and notification of local fire and police departments. No personnel will fight a fire beyond the stage where it can be put out with a portable extinguisher (incipient stage).

12.7.1 Fire Prevention

The major workplace fire hazards are flammable liquids and fuels, motorized vehicles and equipment.

Fires will be prevented by adhering to the following precautions:

- Good housekeeping and storage of materials
- Storage of flammable liquids and gases away from oxidizers
- No smoking in the exclusion zone or any work area.
- No hot work without a properly executed hot work permit
- Shutting off engines to refuel
- Grounding and bonding metal containers during transfer of flammable liquids
- Use of UL approved flammable storage cans
- Fire extinguishers rated at least 5 pounds ABC located on all heavy equipment, in all trailers and near all hot work activities
- Monthly inspections of all fire extinguishers

12.7.2 Fire Protection

A map of all fire extinguisher locations will be developed on site and posted in the field office.

The person responsible for the maintenance of fire prevention and/or control equipment is the SHSO.

The person responsible for the control of fuel source hazards is the SHSO.

12.8 Overt Chemical Exposure

The following are standard procedures to treat chemical exposures. Other, specific procedures detailed on the Material Safety Data Sheet or recommended by the Corporate Medical Consultant will be followed, when necessary. He may be reached at (800) 455-6155.

SKIN AND EYE CONTACT: Use copious amounts of water. Rinse affected areas thoroughly, then provide appropriate medical attention. Eyes and skin should be rinsed for 15 minutes upon chemical contamination.

INHALATION:Move to fresh air. Decontaminate and transport to hospital or local medical provider.

INGESTION: Decontaminate and transport to emergency medical facility.

PUNCTURE WOUND OR LACERATION: Decontaminate and transport to emergency medical facility.

12.9 Decontamination During Medical Emergencies

If emergency life-saving first aid and/or medical treatment is required, normal decontamination procedures may need to be abbreviated or postponed. The SHSO or designee will accompany contaminated victims to the medical facility to advise on matters involving decontamination, when necessary. The outer garments can be removed if they do not cause delays, interfere with treatment or aggravate the problem. Respiratory equipment must always be removed. Protective clothing can be cut away. If the outer contaminated garments cannot be safely removed on-site, a plastic barrier placed between the injured individual and clean surfaces should be used to help prevent contamination of the inside of ambulances and/or medical personnel. Outer garments may then be removed at the medical facility. No attempt will be made to wash or rinse the victim if their injuries are life threatening, unless it is known that the individual has been contaminated with an extremely toxic or corrosive material which could also cause severe injury or loss of life to emergency response personnel. For minor medical problems or injuries, the normal decontamination procedures will be followed.

12.10 Accident/Incident Reporting

As soon as first aid and/or emergency response needs have been met, the following parties are to be contacted by telephone:

- Project Environmental and Safety Manager - Grey Coppi, CIH, CSP, (973) 630-8101
- Project Manager – Stavros Patselas (215) 702-4099, cell (267) 688-9967
- The employer of any injured worker who is <u>not</u> a TtFW employee

Written confirmation of verbal reports are to be submitted within 24 hours. The accident/incident report is found in the TtFW Health and Safety Program EHS 1-7. If the employee involved is not a TtFW employee, their employer will receive a copy of the report.

12.11 Adverse Weather Conditions

In the event of adverse weather conditions, the SHSO or designee will determine if work can continue without potentially risking the safety of all field workers. Some of the items to be considered prior to determining if work should continue are:

- Potential for heat/cold stress injuries
- Treacherous weather-related working conditions (hail, rain, snow, ice, high winds)
- Limited visibility (fog)
- Potential for electrical storms
- Other major incidents

Site activities will be limited to daylight hours, or when suitable artificial light is provided, and acceptable weather conditions prevail. The SHSO will determine the need to cease field operations or observe daily weather reports and evacuate, if necessary, in case of severe inclement weather conditions.

12.12 Spill Control and Response

All small hazardous spills/environmental releases will be contained as close to the source as possible. Whenever possible, the MSDS will be consulted to assist in determining the best means of containment and cleanup. For small spills, sorbent materials such as sand, sawdust or commercial sorbents should be placed directly on the substance to contain the spill and aid recovery. Any acid spills should be diluted or neutralized carefully prior to attempting recovery. Berms of earthen or sorbent materials can be used to contain the leading edge of the spills. Drains or drainage areas should be blocked. All spill containment materials will be properly disposed. An exclusion zone of 50-100 feet around the spill area should be established depending on the size of the spill.

The following procedures, in order, should be taken by the Emergency Coordinator:

- Determine the nature, identity and amounts of major spill components
- Make sure all unnecessary persons are removed from the spill area
- Notify appropriate response teams and authorities and PM as well as PESM
- Use proper PPE
- If a flammable liquid, gas or vapor is involved, remove all ignition sources and use non-sparking and/or explosive proof equipment to contain or clean up the spill (diesel only vehicles, air operated pumps, etc)
- If possible, try to stop the leak with appropriate material
- Remove all surrounding materials that can react or compound with the spill
- Contact Tom Teeling @ (215) 702-4078 for spill reporting information and assistance

12.13 Emergency Equipment

The following minimum emergency equipment will be kept and maintained on-site:

- Industrial first aid kit
- Burn kit
- Portable eye washes (one per field team) (Meets ANSI Z.358.1-1998 for 15 minute flush.)
- Air horns (one per field team)
- Fire extinguishers (one per trailer/vehicle, trailers and located at hot work stations)
- Two-way radios
- Absorbent material

12.14 Postings

The following information will be posted at various, conspicuous locations throughout the site

- Emergency telephone numbers
- Diagrams showing the location of fire extinguishers and emergency equipment
- Emergency exit, evacuation routes and staging area
- Hospital route map

12.15 Restoration and Salvage

After an emergency, prompt restoration of utilities, fire protection equipment, medical supplies and other equipment will reduce the possibility of further losses. Some of the items that may need to be addressed are:

- Refilling fire extinguishers
- Refilling medical supplies
- Recharging eyewashes and/or showers
- Replenishing spill control supplies
- Replacing used air horns

13.0 TRAINING

13.1 General Health and Safety Training

In accordance with TtFW policy, and pursuant to 29 CFR 1910.120, hazardous waste site workers will, at the time of job assignment, have received a minimum of 40 hours of initial health and safety training for hazardous waste site operations unless otherwise noted in the above reference. At a minimum, the training will have consisted of instruction in the topics outlined in the standard. Personnel who have not met the requirements for initial training will not be allowed to work in any site activity in which they may be exposed to hazards (chemical or physical).

13.1.1 Three Day Supervised On the Job Training

In addition to the required initial hazardous waste operations training, each employee will have received three days of directly supervised on-the-job training. This training will address the duties the employees are expected to perform.

13.2 Annual Eight-Hour Refresher Training

Annual eight-hour refresher training will be required of all hazardous waste site field personnel in order to maintain their qualifications for fieldwork. The training will cover a review of 1910.120 requirements and related company programs and procedures.

13.3 Supervisory Training

Personnel acting in a supervisory capacity will have received 8 hours of instruction in addition to the initial 40 hours training.

13.4 Site-Specific Training

Prior to commencement of field activities, all field personnel assigned to the project will have completed training that will specifically address the activities, procedures, monitoring, and equipment used in the site operations. It will include site and facility layout, hazards and emergency services at the site and will highlight all provisions contained within this SHSP. This training will also allow field workers to clarify anything they do not understand and to reinforce their responsibilities regarding safety and operations for their particular activity.

13.5 On-Site Safety Briefings

Project personnel and visitors will be given on-site health and safety briefings daily by the SHSO to assist site personnel in safely conducting their work activities. The briefings will include information on new operations to be conducted, changes in work practices or changes in the site's environmental conditions, as well as periodic reinforcement of previously discussed topics. The briefings will also provide a forum to facilitate conformance with safety requirements and to identify performance deficiencies related to safety during daily activities or as a result of safety inspections. The meetings will also be an opportunity for the SHSO to periodically update the workers on air monitoring results. Prior to starting any new activity, a training session using the Activity Hazard Analysis will be held for workers involved in the activity.

13.6 First Aid and CPR

The SHSO will identify those individuals requiring First Aid and CPR training in order to ensure that emergency medical treatment is available during field activities. The training will be consistent with the requirements of the American Red Cross Association and include Bloodborne Pathogens training.

13.7 Hazard Communication

Hazard communication training will be provided in accordance with the requirements contained in the TtFW Health and Safety Program, EHS 4-2.

14.0 LOGS, REPORTS AND RECORD KEEPING

The following is a summary of required health and safety logs, reports and record keeping.

14.1 Change Request Form (CRF)

A CRF is to be completed for initiating a change to the SHSP. The Navy, PESM and Project Manager or designee approval is required. The original will be kept in the project file. Approved changes will be reviewed with affected field personnel at a safety briefing. Copies will be distributed to the Client Representative.

14.2 Medical and Training Records

Copies or verification of training (40 hour, 8 hour, supervisor, site-specific training and documentation of three day OJT) and medical clearance for hazardous waste site work and respirator use will be maintained on-site. Records for all subcontractor employees will also be kept on-site. All employee medical records will be maintained by the Corporate Medical Consultant – Work Care in accordance with TtFW Health and Safety Program, EHS 1-9.

14.3 On-Site Log

A log of personnel on-site each day will be kept by the Project Superintendent or designee.

14.4 Weekly/Monthly Safety Reports

The SHSO will complete and submit weekly and monthly safety reports to the PESM. The reports are provided in Appendix J.

14.5 Exposure Records

All personal air monitoring results, laboratory reports, calculations and air sampling data sheets are part of an employee exposure record. These records will be maintained by the SHSO during site work. At the end of the project they will be maintained according to 29 CFR 1910.1020 and TtFW Health and Safety Program, EHS 1-9.

14.6 Accident/Incident Reports

Completion of all incident and investigation reports will be in accordance with TtFW Health and Safety Program, EHS 1-7.

14.7 OSHA Form 300

An OSHA Form 300 will be kept at the project site. All recordable injuries or illnesses will be recorded on this form. At the end of the project, the original will be sent to the PESM for maintenance. Subcontractor employers must also meet the requirements of maintaining an OSHA 300 form. The incident report form referenced in Section 12.10 meets the requirements of the OSHA Form 301(supplemental record) and must be maintained with the OSHA Form 300 for all recordable injuries or illnesses.

14.8 Health and Safety Logbook

The SHSO will maintain a logbook during site work. The daily site conditions, personnel, air monitoring results and significant events will be recorded. The original logbook will become part of the exposure records file.

14.9 Hazard Communication Program/MSDS

Material Safety Data Sheets (MSDS) will be obtained for applicable substances and included in the site hazard communication file. The hazard communication program will be maintained onsite in accordance with 29 CFR 1910.1200 and TtFW Health and Safety Program EHS 4-2.

14.10 Work Permits

All work permits, including confined space entry, hot work, lockout/tagout, and line breaking permits will be maintained in the project files.

15.0 FIELD PERSONNEL REVIEW

This form serves as documentation that field personnel have read, or have been informed of, and understand the provisions of the SHSP. It is maintained on-site by the SHSO as a project record.

Each field person team will sign this section after site-specific training is completed and before being permitted to work on site.

I have read, or have been informed of, this Site-Specific Health and Safety Plan for GM-38 Area Groundwater Remedy at NWIRP, Bethpage, NY, and understand the information presented. I will comply with the provisions contained therein.

Name (Print and Sign)	Date

16.0 REFERENCES

American Conference of Governmental Industrial Hygienists, Inc., 1992, Documentation of the Threshold Limit Values and Biological Exposure Indices; 6th Ed., ACGIH, Cincinnati, Ohio.

American Conference of Governmental Industrial Hygienists, Inc., 1987, Guidelines For The Selection of Chemical Protective Clothing; Third Edition, ACGIH, Cincinnati, Ohio, February 1987.

American Conference of Governmental Industrial Hygienists, Inc., 2003, Threshold Limit Values For Chemical Substances And Physical Agents In The Work Environment And Biological Exposure Indices; ACGIH, Cincinnati, Ohio.

Federal Acquisition Regulation, F.A.R. Clause 52.236-13: Accident Prevention.

NIOSH/OSHA/USCG/EPA, 1985, Occupational Safety and Health, Guidance Manual For Hazardous Waste Site Activities; October 1985.

NIOSH Pocket Guide to Chemical Hazards, 1997, U.S. Department of Health and Human Services; Public Health Service, Centers for Disease Control and Prevention, June 1997.

Sax, N. Irving, 1992, Dangerous Properties of Industrial Materials, 8th Ed; Van Nostrand Reinhold Co. Inc., New York, NY.

TtFW , TtFW Health and Safety Program.

U.S. Army Corps of Engineers, 1996, Safety and Health Requirements Manual; EM 385-1-1.

U.S. Department of Labor, Occupational Safety and Health Administration, 1989, 29 CFR Part 1910 Hazardous Waste Operations and Emergency Response, draft rule, March 6, 1989; Construction Industry Standards, 29 CFR 1926; and General Industry Standards, 29 CFR 1910.

U.S. Environmental Protection Agency, Standard Operating Safety Guides; July 1988.

U.S. Environmental Protection Agency, no date, Response Safety Decision-Making; Course Manual, Office of Emergency and Remedial Response, Hazardous Response Support Division.

Appendix A

Change Request Form

Tetra Tech FW, Inc.
Change Request Form

Section 1 through 4 to be filled out by Tetra Tech FW, Inc., Section 5 to be filled out by Navy

PROJECT:	OFS No.:	Change Request Form:
Navy RAC CTO 96	**2282-0096**	**CRF-001** **Rev.** **0**

To: _____ Dept.: _____ Location: _____ Date: _____

Re: ☐ Drawing No. _____ Title _____

☐ Spec. No. _____ Title _____

☐ Other _____

1. DESCRIPTION *(Items involved, submit sketch if applicable)* _____

2. REASONS FOR CHANGE *(If from disposition of nonconformance report, list report number)* _____

3. RECOMMENDED DISPOSITION

☐ Technical Clarification [NTR & COTR approval required]
☐ In Scope Adjustment [COTR approval required]
☐ Out of Scope [CO & COTR approval required]
☐ Cost Growth
☐ ROM Estimate (If Applicable) $_____
☐ Schedule Impact (describe below)

TtFW Initiator (Signature/Title):

4. TtFW Project Manager (Signature)	Date	Project Superintendent Concurrence (Signature)	Date

5. NAVY DISPOSITION

☐ Approved per recommended disposition
☐ Not approved (give reason)
☐ Approved with modification(s) [describe below]

NTR Concurrence *(signature)*	Date	ROICC Concurrence *(Signature)*	Date
Contracting Officer Technical Representative Approval *(Signature)*		Contracting Officer Approval *(Signature)*	Date

Engineer signs and transmits to Resident Engineer with copies to:

_____ Project Manager
_____ Project Superintendent
_____ Quality Control
Others as Required _____
File: _____

Appendix B

Material Safety Data Sheets

International Chemical Safety Cards

1,1,1-TRICHLOROETHANE

ICSC: 0079

1,1,1-TRICHLOROETHANE
Methyl chloroform
Methyltrichloromethane
alpha-Trichloroethane
$C_2H_3Cl_3$ / CCl_3CH_3
Molecular mass: 133.4

CAS #71-55-6
RTECS #KJ2975000
ICSC #0079
UN #2831
EC #602-013-00-2

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible under specific conditions. Heating will cause rise in pressure with risk of bursting. See Notes. Gives off irritating or toxic fumes (or gases) in a fire.		In case of fire in the surroundings: all extinguishing agents allowed.
EXPLOSION			In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		PREVENT GENERATION OF MISTS!	
• **INHALATION**	Ataxia. Dizziness. Drowsiness. Headache. Nausea. Unconsciousness.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Artificial respiration if indicated. Refer for medical attention.
• **SKIN**	Dry skin. Redness.	Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
• **EYES**	Redness.	Safety goggles, 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**	Diarrhoea. Nausea. Vomiting (further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Give a slurry of activated charcoal in water to drink. Do NOT induce vomiting. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING

Ventilation. Collect leaking and spilled liquid in sealable, suitable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT let this chemical enter the environment (extra personal protection: self-contained breathing apparatus).	Provision to contain effluent from fire extinguishing. Separated from food and feedstuffs and incompatible materials (see Chemical Dangers). Cool. Dry. Ventilation along the floor.	Do not transport with food and feedstuffs. Xn symbol N symbol R: 20-59 S: (2-)24/25-59-61 Note: F UN Hazard Class: 6.1 UN Packing Group: III Marine pollutant.

SEE IMPORTANT INFORMATION ON BACK

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International Chemical Safety Cards

1,1,1-TRICHLOROETHANE

ICSC: 0079

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR.

PHYSICAL DANGERS:
The vapour is heavier than air.

CHEMICAL DANGERS:
The substance decomposes on heating or on burning producing toxic and corrosive fumes including phosgene and hydrogen chloride. Reacts violently with aluminium, manganese and their alloys, alkalis, strong oxidants, acetone and zinc. Attacks natural rubber. Mixtures of 1,1,1-trichloroethane with potassium or its alloys are shock sensitive. Reacts slowly with water releasing corrosive hydrochloric acid.

OCCUPATIONAL EXPOSURE LIMITS (OELs):
TLV: 350 ppm; 1910 mg/m^3 (as TWA); 450 ppm; 2460 mg/m^3 (as STEL) (ACGIH 1994-1995).

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation of its vapour and by ingestion.

INHALATION RISK:
A harmful contamination of the air can be reached rather quickly on evaporation of this substance at 20℃.

EFFECTS OF SHORT-TERM EXPOSURE:
The substance irritates the eyes, the skin and the respiratory tract. The substance may cause effects on the heart and central nervous system, kidneys and liver , resulting in cardiac disorders and respiratory failure. Exposure at high level may result in death. Medical observation is indicated.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
The liquid defats the skin. The substance may have effects on the liver.

PHYSICAL PROPERTIES

Boiling point: 74℃
Melting point: -30℃
Relative density (water =1): 1.34
Solubility in water: none
Vapour pressure, kPa at 20℃: 13.3
Relative vapour density (air =1): 4.6
Flash point: see Notes℃
Auto-ignition temperature: 537℃
Explosive limits, vol% in air: 8-16
Octanol/water partition coefficient as log

	Pow: 2.49
ENVIRONMENTAL DATA	The substance is harmful to aquatic organisms. This substance may be hazardous to the environment; special attention should be given to air and ground water.

NOTES

Combustible vapour/air mixtures difficult to ignite, may be developed under certain conditions. The substance burns only in excess oxygen or if a strong source of ignition is present. Use of alcoholic beverages enhances the harmful effect. Depending on the degree of exposure, periodic medical examination is indicated. An added stabilizer or inhibitor can influence the toxicological properties of this substance, consult an expert. Do NOT use in the vicinity of a fire or a hot surface, or during welding. Aerothene, Algylen, Trichloran, Chlorylen, Genklene, Chlorothene NU, Chlorothene VG, and Solvent 111 are trade names.

Transport Emergency Card: TEC (R)-721
NFPA Code: H2; F1; R0

ADDITIONAL INFORMATION

ICSC: 0079 **1,1,1-TRICHLOROETHANE**

International Chemical Safety Cards

1,1,2-TRICHLOROETHANE

ICSC: 0080

1,1,2-TRICHLOROETHANE
Vinyl trichloride
Beta-trichloroethane
$C_2H_3Cl_3$ / $CHCl_2CH_2Cl$
Molecular mass: 133.4

CAS #79-00-5
RTECS #KJ3150000
ICSC #0080
UN #1082
EC #602-014-00-8

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible under specific conditions. Heating will cause rise in pressure with risk of bursting. See Notes.	NO open flames. NO contact with hot surfaces.	Powder, water spray, foam, carbon dioxide.
EXPLOSION	See Notes.		In case of fire: cool drums, etc., by spraying with water but avoid contact of the substance with water.
EXPOSURE		PREVENT GENERATION OF MISTS!	
• **INHALATION**	Dizziness. Drowsiness. Headache. Nausea. Shortness of breath. Unconsciousness.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Refer for medical attention.
• **SKIN**	MAY BE ABSORBED! Dry skin.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap. Refer for medical attention.
• **EYES**		Safety spectacles, or face shield.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**	(Further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Induce vomiting (ONLY IN CONSCIOUS PERSONS!). Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Collect leaking and spilled liquid in	Provision to contain effluent from fire	

sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT let this chemical enter the environment (extra personal protection: self-contained breathing apparatus).	extinguishing. Separated from strong oxidants, strong bases, many metals. Well closed. Ventilation along the floor.	Xn symbol R: 20/21/22 S: (2-)9 UN Hazard Class: 9 UN Packing Group: III Marine pollutant.

SEE IMPORTANT INFORMATION ON BACK

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International Chemical Safety Cards

1,1,2-TRICHLOROETHANE

ICSC: 0080

I M P O R T A N T D A T A	**PHYSICAL STATE; APPEARANCE:** COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR. **PHYSICAL DANGERS:** The vapour is heavier than air. **CHEMICAL DANGERS:** On contact with hot surfaces or flames this substance decomposes forming hydrogen chloride (see ICSC #0163), phosgene (see ICSC #0007), and other toxic gases. Reacts with strong oxidizers, strong bases and metals such as sodium, potassium, magnesium and powdered aluminium. Attacks many plastics, rubber, steel and zinc. **OCCUPATIONAL EXPOSURE LIMITS (OELs):** TLV: 10 ppm; 55 mg/m^3 (as TWA) (skin) (ACGIH 1993-1994).	**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 may cause effects on the central nervous system, kidneys, liver , resulting in central nervous depression, liver impairment and kidney impairment. Exposure at high levels may result in unconsciousness. **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** The liquid defats the skin.
PHYSICAL PROPERTIES	Boiling point: 114°C Melting point: -36°C Relative density (water = 1): 1.44 Solubility in water: none Vapour pressure, kPa at 20°C: 2.5	Relative vapour density (air = 1): 4.6 Relative density of the vapour/air-mixture at 20°C (air = 1): 4.6 Explosive limits, vol% in air: 6-15.5 Octanol/water partition coefficient as log Pow: 2.35
ENVIRONMENTAL DATA	The substance is harmful to aquatic organisms.	

NOTES
Flash point unknown in literature. Combustible vapour/air mixtures difficult to ignite, may be developed under certain conditions. Use of alcoholic beverages enhances the harmful effect. The relation between odour and the occupational exposure limit cannot be indicated. Do NOT use in the vicinity of a fire or a hot surface, or during welding. NFPA Code: H 3; F 1; R 0;

ADDITIONAL INFORMATION	

ICSC: 0080 **1,1,2-TRICHLOROETHANE**

IMPORTANT LEGAL NOTICE:	Neither the CEC or the IPCS nor any person acting on behalf of the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use.

International Chemical Safety Cards

VINYLIDENE CHLORIDE

ICSC: 0083

VINYLIDENE CHLORIDE
1,1-Dichloroethene
1,1-Dichloroethylene
VDC
$C_2H_2Cl_2/H_2C{=}CCl_2$
Molecular mass: 97

CAS #75-35-4
RTECS #KV9275000
ICSC #0083
UN #1303 (inhibited)
EC #602-025-00-8

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Extremely 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	Vapour/air mixtures are explosive. Vinyl chloride monomer vapours are uninhibited and may form polymers in vents or flame arresters of storage tanks, resulting in blockage of vents.	Closed system, ventilation, explosion-proof electrical equipment and lighting. Use non-sparking handtools.	In case of fire: keep drums, etc., cool by spraying with water. Combat fire from a sheltered position.
EXPOSURE		STRICT HYGIENE!	
• **INHALATION**	Dizziness. Drowsiness. Unconsciousness.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Artificial respiration if indicated. Refer for medical attention.
• **SKIN**	Redness. Skin burns.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
• **EYES**	Redness. Pain.	Safety goggles, 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. Sore throat (further see Inhalation).	Do not eat, drink, or smoke during work. Wash hands before eating.	Rinse mouth. Do NOT induce vomiting. Give plenty of water to drink. Rest.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Evacuate danger area! Consult an expert! Collect leaking and spilled	Fireproof. Separated from incompatible materials (see Chemical	Airtight. Unbreakable packaging; put breakable packaging into closed

liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place (extra personal protection: complete protective clothing including self-contained breathing apparatus).	Dangers). Cool. Keep in the dark. Store only if stabilized.	unbreakable container. IMO: Marine Pollutant F-symbol Xn symbol R: 12-20-40 S: 7-16-29 Note: D UN Hazard Class: 3 UN Packing Group: I

SEE IMPORTANT INFORMATION ON BACK

ICSC: 008 Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities ©IPCS CEC 1993

International Chemical Safety Cards

VINYLIDENE CHLORIDE

ICSC: 008

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
VOLATILE COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR.

PHYSICAL DANGERS:
The vapour is heavier than air and may travel along the ground; distant ignition possible.

CHEMICAL DANGERS:
The substance can readily form explosive peroxides. The substance will polymerize readily due to heating or under the influence of oxygen, sunlight, copper or aluminium, with fire or explosion hazard. May explode on heating or on contact with flames. The substance decomposes on burning producing toxic and corrosive fumes (hydrogen chloride, phosgene and chlorine). Reacts violently with oxidants.

OCCUPATIONAL EXPOSURE LIMITS (OELs):
TLV: 5 ppm; 20 mg/m^3 (STEL): 20 ppm; 79 mg/m^3 (ACGIH 1992-1993).

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation, through the skin and by ingestion.

INHALATION RISK:
A harmful contamination of the air can be reached very quickly on evaporation of this substance at 20℃.

EFFECTS OF SHORT-TERM EXPOSURE:
The substance irritates the eyes, the skin and the respiratory tract. Swallowing the liquid may cause aspiration into the lungs with the risk of chemical pneumonitis. The substance may cause effects on the central nervous system.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
Repeated or prolonged contact with skin may cause dermatitis. The substance may have effects on the liver and kidneys.

PHYSICAL PROPERTIES

Boiling point: 32℃	Relative density of the vapour/air-mixture at 20℃ (air=1): 2.5
Melting point: -122℃	Flash point: 5.6℃
Relative density (water=1): 1.2	Auto-ignition temperature: 570℃
Solubility in water, g/100 ml at 25℃: 0.25	Explosive limits, vol% in air: 5.6-16
Vapour pressure, kPa at 20℃: 66.5	Octanol/water partition coefficient as log Pow: 1.32
Relative vapour density (air=1): 3.3	

ENVIRONMENTAL DATA

This substance may be hazardous to the environment; special attention should be given to water organisms. In the food chain important to humans, bioaccumulation takes place, specifically in plants.

NOTES

Contains inhibitors (e.g. methoxyphenol). Depending on the degree of exposure, periodic medical examination is indicated. The odour warning when the exposure limit value is exceeded is insufficient. Do NOT use in the vicinity of a fire or a hot surface, or during welding.

Transport Emergency Card: TEC (R)-641
NFPA Code: H2; F4; R2;

ADDITIONAL INFORMATION

ICSC: 008 **VINYLIDENE CHLORIDE**
©IPCS, CEC, 1993

International Chemical Safety Cards

1,1-DICHLOROETHANE

ICSC: 0249

1,1-DICHLOROETHANE
Ethane, 1,1-dichloro-
Ethylidene chloride
CH_3CHCl_2
Molecular mass: 99.0

CAS #75-34-3
RTECS #KI0175000
ICSC #0249
UN #2362
EC #602-011-00-1

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Highly 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	Vapour/air mixtures are explosive.	Closed system, ventilation, explosion-proof electrical equipment and lighting. Do NOT use compressed air for filling, discharging, or handling.	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		PREVENT GENERATION OF MISTS!	
• INHALATION	Dizziness. Drowsiness. Dullness. Nausea. Unconsciousness.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Refer for medical attention.
• SKIN	Dry skin. Roughness.	Protective gloves.	Remove contaminated clothes. Rinse skin with plenty of water or shower.
• EYES	Redness. Pain.	Safety spectacles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• INGESTION	Burning sensation (further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Collect leaking liquid in sealable containers. Absorb remaining liquid in sand or inert absorbent and remove to	Fireproof. Separated from: see Chemical Dangers. Cool.	F symbol Xn symbol

safe place. Do NOT wash away into sewer (extra personal protection: self-contained breathing apparatus).		R: 11-22-36/37 S: 16-23 UN Hazard Class: 3 UN Packing Group: II Marine pollutant.

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0249 Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities ©IPCS CEC 1993

International Chemical Safety Cards

1,1-DICHLOROETHANE

ICSC: 0249

I M P O R T A N T D A T A	**PHYSICAL STATE; APPEARANCE:** COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR. **PHYSICAL DANGERS:** The vapour is heavier than air and may travel along the ground; distant ignition possible. **CHEMICAL DANGERS:** The substance decomposes on heating and on burning producing toxic and corrosive fumes including phosgene (see ICSC 0007) and hydrogen chloride (see ICSC 0162). Reacts violently with strong oxidants, alkali metals and earth-alkali metals, powdered metals, causing fire and explosion hazard. Attacks aluminium, iron and polyethylene. Contact with strong caustic will cause formation of flammable and toxic acetaldehyde gas. **OCCUPATIONAL EXPOSURE LIMITS (OELs):** TLV: 100 ppm; 405 mg/m^3 (ACGIH 1992-1993).	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation 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 may cause effects on the central nervous system. Exposure at high levels may result in unconsciousness. **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** The liquid defats the skin. The substance may have effects on the kidneys and liver.
PHYSICAL PROPERTIES	Boiling point: 57°C Melting point: -98°C Relative density (water = 1): 1.2 Solubility in water, g/100 ml at 20°C: 0.6 Vapour pressure, kPa at 20°C: 24	Relative vapour density (air = 1): 3.4 Flash point: -6°C c.c. Auto-ignition temperature: 458°C Explosive limits, vol% in air: 5.6-11.4 Octanol/water partition coefficient as log Pow: 1.8
ENVIRONMENTAL DATA		

NOTES

Do NOT use in the vicinity of a fire or a hot surface, or during welding.

Transport Emergency Card: TEC (R)-30G34
NFPA Code: H 2; F 3; R 0;

ADDITIONAL INFORMATION

ICSC: 0[illegible] **1,1-DICHLOROETHANE**

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CHEM SERVICE INC -- 0-659 CIS 1,2-DICHLOROETHENE -- 6550-00F037480

========== Product Identification ==========

Product ID:0-659 CIS 1,2-DICHLOROETHENE
MSDS Date:06/02/1992
FSC:6550
NIIN:00F037480
MSDS Number: BWJDT
=== Responsible Party ===
Company Name:CHEM SERVICE INC
Address:660 TOWER LN
Box:3108
City:WEST CHESTER
State:PA
ZIP:19381-3108
Country:US
Info Phone Num:215-692-3026/800-452-9994
Emergency Phone Num:215-692-3026/800-452-9994
CAGE:84898
=== Contractor Identification ===
Company Name:CHEM SERVICE INC
Box:3108
City:WEST CHESTER
State:PA
ZIP:19381
Country:US
Phone:215-692-3026
CAGE:84898
Company Name:CHEM SERVICE, INC
Address:660 TOWER LN
Box:599
City:WEST CHESTER
State:PA
ZIP:19301-9650
Country:US
Phone:610-692-3026
CAGE:8Y898

========== Composition/Information on Ingredients ==========

Ingred Name:DICHLOROETHENE
CAS:156-59-2
RTECS #:KV9420000

========== Hazards Identification ==========

Routes of Entry: Inhalation:YES Skin:YES Ingestion:YES
Reports of Carcinogenicity:NTP:NO IARC:NO OSHA:NO
Health Hazards Acute and Chronic:SKIN: MAY BE HARMFUL IF ABSORBED. CAN CAUSE IRRITATION. INHALATION: MAY BE HARMFUL. DUST &/VAPORS CAN CAUSE RESPIRATORY TRACT IRRITATION. CAN BE IRRITATING TO MUCOUS MEMBRANCES. INGESTION: MAY BE HARM FUL. EYES: IRRITATION. EXPOSURE CAN CAUSE LIVER DAMAGE. NARCOTIC AT HIGH CONCENTRATIONS.
Explanation of Carcinogenicity:NONE

Effects of Overexposure:IRRITATION, NARCOTIC.

========== First Aid Measures ==========

First Aid:EYES: FLUSH CONTINUOUSLY W/WATER FOR 15-20 MINS. SKIN: FLUSH W/WATER FOR 15-20 MINS. IF NOT BURNED, WASH W/SOAP & WATER TO CLEANSE. INHALATION: REMOVE TO FRESH AIR. GIVE CPR/OXYGEN IF NEEDED & CONTINU E LIFE SUPPORT UNTIL MEDICAL ASSISTANCEARRIVES. INGESTION: RINSE MOUTH OUT W/WATER, IF CONSCIOUS. OBTAIN MEDICAL ATTENTION IN ALL CASES.

========== Fire Fighting Measures ==========

Flash Point:42.8F
Extinguishing Media:CO2, DRY CHEMICAL POWDER/SPRAY.
Unusual Fire/Explosion Hazard:FLAMMABLE CHEMICAL. VAPORS MAY TRAVEL CONSIDERABLE DISTANCE TO IGNITION SOURCE & FLASH BACK. DECOMPOSITION PRODUCTS ARE CORROSIVE.

========== Accidental Release Measures ==========

Spill Release Procedures:EVACUATE AREA. WEAR APPRORPRIATE OSHA REGULATED EQUIPMENT. VENTILATE AREA. ABSORB ON VERMICULITE/SIMILAR MATERIAL. SWEEP UP & PLACE IN APPROPRIATE CONTAINER/HOLD FOR DISPOSAL. WASH CONTAMINATED SURFAC ES TO REMOVE ANY RESIDUES.

========== Handling and Storage ==========

Handling and Storage Precautions:STORE IN A COOL DRY PLACE ONLY W/COMPATIBLE CHEMICALS. KEEP TIGHTLY CLOSED. STORE UNDER REFRIGERATION.
Other Precautions:AVOID CONTACT W/SKIN, EYES & CLOTHING. DON'T BREATH VAPORS. CONTACT LENSES SHOULDN'T BE WORN IN THE LABORATORY. ALL CHEMICALS SHOULD BE CONSIDERED HAZARDOUS. AVOID DIRECT PHYSICAL CONTACT.

========== Exposure Controls/Personal Protection ==========

Respiratory Protection:WEAR APPROPRIATE OSHA/MSHA APPROVED SAFETY EQUIPMENT.
Ventilation:CHEMICAL SHOULD BE HANDLED ONLY IN A HOOD.
Eye Protection:EYE SHIELDS
Supplemental Safety and Health

========== Physical/Chemical Properties ==========

Boiling Pt:B.P. Text:140F
Melt/Freeze Pt:M.P/F.P Text:-112F
Solubility in Water:INSOLUBLE
Appearance and Odor:COLORLESS LIQUID

========== Stability and Reactivity Data ==========

Stability Indicator/Materials to Avoid:YES
STRONG OXIDIZING AGENTS, MAGNESIUM, ALUMINUM.

Stability Condition to Avoid:MOISTURE, AIR, LIGHT, HEAT & OTHER IGNITION SOURCES.
Hazardous Decomposition Products:TOXIC FUMES

========== Disposal Considerations ==========

Waste Disposal Methods:BURN IN A CHEMICAL INCINERATOR EQUIPPED W/AN AFTERBURNER & SCRUBBER IAW/FEDERAL, STATE & LOCAL REGULATIONS.

International Chemical Safety Cards

1,2-DICHLOROETHANE ICSC: 0

1,2-DICHLOROETHANE
Ethylene dichloride
1,2-Ethylene dichloride
Ethane dichloride
$ClCH_2CH_2Cl$ / $C_2H_4Cl_2$
Molecular mass: 98.96

CAS #: 107-06-2
RTECS #: KI0525000
ICSC #: 0250
UN #: 1184
EC #: 602-012-00-7

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Highly 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	Vapour/air mixtures are explosive.	Closed system, ventilation, explosion-proof electrical equipment and lighting. Prevent build-up of electrostatic charges (e.g., by grounding). Do NOT use compressed air for filling, discharging, or handling.	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		AVOID ALL CONTACT!	IN ALL CASES CONSULT A DOCTOR!
• INHALATION	Abdominal pain. Cough. Dizziness. Drowsiness. Headache. Nausea. Sore throat. Unconsciousness. Vomiting. Symptoms may be delayed (see Notes).	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Half-upright position. Artificial respiration if indicated. Refer for medical attention.
• SKIN	Redness.	Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap. Refer for medical attention.
• EYES	Redness. Pain. Blurred vision.	Safety goggles, 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 cramps. Diarrhoea (further see Inhalation).	Do not eat, drink, or smoke during work. Wash hands before eating.	Give nothing to drink. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Evacuate danger area! 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. Do NOT wash away into sewer (extra personal protection: self-contained breathing apparatus).	Fireproof. Separated from strong oxidants, food and feedstuffs and other incompatible substances (see Chemical Dangers). Cool. Dry.	Unbreakable packaging; put breakable packaging into closed unbreakable container. Do not transport with food and feedstuffs. F symbol T symbol R: 45-11-22-36/37/38 S: 53-45 Note: E UN Hazard Class: 3 UN Subsidiary Risks: 6.1 UN Packing Group: II Marine pollutant.

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0 — Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities © IPCS CEC 1993

International Chemical Safety Cards

1,2-DICHLOROETHANE ICSC: 0

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
COLOURLESS, VISCOUS LIQUID , WITH CHARACTERISTIC ODOUR. TURNS DARK ON EXPOSURE TO AIR, MOISTURE AND LIGHT.

PHYSICAL DANGERS:
The vapour is heavier than air and may travel along the ground; distant ignition possible. As a result of flow, agitation, etc., electrostatic charges can be generated.

CHEMICAL DANGERS:
The substance decomposes on heating and on burning producing toxic and corrosive fumes including hydrogen chloride (ICSC #0163) and phosgene (ICSC #0 007). Reacts violently with aluminium, alkali metals, alkali amides, ammonia, bases, strong oxidants. Attacks many metals in presence of water. Attacks plastic.

OCCUPATIONAL EXPOSURE LIMITS (OELs):
TLV: 10 ppm; 40 mg/m^3 (as TWA) (ACGIH 1994-1995).

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 very quickly on evaporation of this substance at 20°C.

EFFECTS OF SHORT-TERM EXPOSURE:
The vapour irritates the eyes, the skin and the respiratory tract. Inhalation of the vapour may cause lung oedema (see Notes). The substance may cause effects on the central nervous system, kidneys, liver , resulting in impaired functions.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
Repeated or prolonged contact with skin may cause dermatitis. This substance is probably carcinogenic to humans.

PHYSICAL PROPERTIES	Boiling point: 83.5℃ Melting point: -35.7℃ Relative density (water = 1): 1.235 Solubility in water, g/100 ml: 0.87 Vapour pressure, kPa at 20℃: 8.7 Relative vapour density (air = 1): 3.42	Relative density of the vapour/air-mixture at 20℃ (air = 1): 1.2 Flash point: 13℃ c.c. Auto-ignition temperature: 413℃ Explosive limits, vol% in air: 6.2-16 Octanol/water partition coefficient as log Pow: 1.48
ENVIRONMENTAL DATA		

NOTES

Depending on the degree of exposure, periodic medical examination is indicated. 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 are therefore essential. Immediate administration of an appropriate spray, by a doctor or a person authorized by him/her, should be considered.

Transport Emergency Card: TEC (R)-605
NFPA Code: H 2; F 3; R 0;

ADDITIONAL INFORMATION

ICSC: 0[illegible] **1,2-DICHLOROETHANE**

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MATERIAL SAFETY DATA SHEET

BENZENE (AMOCO/TOTAL)

MSDS No. 11697000 ANSI/ENGLISH

1.0 CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: BENZENE (AMOCO/TOTAL)

MANUFACTURER/SUPPLIER:

Amoco Oil Company
200 East Randolph Drive
Chicago, Illinois 60601 U.S.A.

EMERGENCY HEALTH INFORMATION:
1 (800) 447-8735

EMERGENCY SPILL INFORMATION:
1 (800) 424-9300 CHEMTREC (USA)

OTHER PRODUCT SAFETY INFORMATION:
(312) 856-3907

2.0 COMPOSITION/INFORMATION ON INGREDIENTS

Component	CAS#	Range % by Wt.
Benzene	71-43-2	99.80
Toluene	108-88-3	0.20

(See Section 8.0, Exposure Controls/Perso nal Protection," for exposure guidelines)

3.0 HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: Danger! Extremely flammable. Causes eye and skin irritation. Inhalation causes headaches, dizziness, drowsiness, and nausea, and may lead to unconsciousness. Harmful or fatal if liquid is aspirated into lungs. Danger! Contains Benzene. Cancer hazard. Can cause blood disorders. Harmful when absorbed through the skin.

POTENTIAL HEALTH EFFECTS:

EYE CONTACT: Causes mild eye irritation.

SKIN CONTACT: Causes mild skin irritation. Causes skin irritation on prolonged or repeated contact. Harmful when absorbed through the skin.

INHALATION: Cancer hazard. Can cause blood disorders. Inhalation causes headaches, dizziness, drowsiness, and nausea, and may lead to unconsciousness. See Tox icological Information"section (Section 11.0).

INGESTION: Harmful or fatal if liquid is aspirated into lungs. See Toxicological Information" section (Section 11.0).

HMIS CODE: (Health:2) (Flammability:3) (Reactivity:0)

NFPA CODE: (Health:2) (Flammability:3) (Reactivity:0)

4.0 FIRST AID MEASURES

EYE: Flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation persists.

SKIN: Wash exposed skin with soap and water. Remove contaminated clothing, including shoes, and thoroughly clean and dry before reuse. Get medical attention if irritation develops.

INHALATION: If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. Get immediate medical attention.

INGESTION: If swallowed, drink plenty of water, do NOT induce vomiting. Get immediate medical attention.

5.0 FIRE FIGHTING MEASURES

FLASHPOINT: 12℉(-11℃)

UEL: 8.0%

LEL: 1.5%

AUTOIGNITION TEMPERATURE: 928℉ (498℃)

FLAMMABILITY CLASSIFICATION: Extremely Flammable Liquid.

EXTINGUISHING MEDIA: Agents approved for Class B hazards (e.g., dry chemical, carbon dioxide, foam, steam) or water fog.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Extremely flammable liquid. Vapor may explode

if ignited in enclosed area.

FIRE-FIGHTING EQUIPMENT: Firefighters should wear full bunker gear, including a positive pressure self-contained breathing apparatus.

PRECAUTIONS: Keep away from sources of ignition (e.g., heat and open flames). Keep container closed. Use with adequate ventilation.

HAZARDOUS COMBUSTION PRODUCTS: Incomplete burning can produce carbon monoxide and/or carbon dioxide and other harmful products.

6.0 ACCIDENTAL RELEASE MEASURES

Remove or shut off all sources of ignition. Remove mechanically or contain on an absorbent material such as dry sand or earth. Increase ventilation if possible. Wear respirator and spray with water to disperse vapors. Keep out of sewers and waterways.

7.0 HANDLING AND STORAGE

HANDLING: Use with adequate ventilation. Do not breathe vapors. Keep away from ignition sources (e.g., heat, sparks, or open flames). Ground and bond containers when transferring materials. Wash thoroughly after handling. After this container has been emptied, it may contain flammable vapors; observe all warnings and precautions listed for this product.

STORAGE: Store in flammable liquids storage area. Store away from heat, ignition sources, and open flame in accordance with applicable regulations. Keep container closed. Outside storage is recommended.

8.0 EXPOSURE CONTROLS / PERSONAL PROTECTION

EYE: Do not get in eyes. Wear eye protection.

SKIN: Do not get on skin or clothing. Wear protective clothing and gloves.

INHALATION: Do not breathe mist or vapor. If heated and ventilation is inadequate, use supplied-air respirator approved by NIOSH/MSHA.

ENGINEERING CONTROLS: Control airborne concentrations below the exposure guidelines.

EXPOSURE GUIDELINES:

Component	CAS#	Exposure Limits

Benzene	71-43-2	OSHA PEL: 1 ppm OSHA STEL: 5 ppm ACGIH TLV-TWA: 10 ppm
Toluene	108-88-3	OSHA PEL: 100 ppm (1989); 200 ppm (1971) OSHA STEL: 150 ppm (1989); Not established. (1971) OSHA Ceiling: 300 ppm (1971) ACGIH TLV-TWA: 50 ppm (skin)

9.0 CHEMICAL AND PHYSICAL PROPERTIES

APPEARANCE AND ODOR: Liquid. Colorless. Sweet odor.

pH: Not determined.

VAPOR PRESSURE: 74.6 mm Hg at 20 ℃

VAPOR DENSITY: Not determined.

BOILING POINT: 176℉(80℃)

MELTING POINT: 42℉(6℃)

SOLUBILITY IN WATER: Slight, 0.1 to 1.0%.

SPECIFIC GRAVITY (WATER=1): 0.88

10.0 STABILITY AND REACTIVITY

STABILITY: Stable.

CONDITIONS TO AVOID: Keep away from ignition sources (e.g. heat, sparks, and open flames).

MATERIALS TO AVOID: Avoid chlorine, fluorine, and other strong oxidizers.

HAZARDOUS DECOMPOSITION: None identified.

HAZARDOUS POLYMERIZATION: Will not occur.

11.0 TOXICOLOGICAL INFORMATION

ACUTE TOXICITY DATA:

EYE IRRITATION: Testing not conducted. See Other Toxicity Data.

SKIN IRRITATION: Testing not conducted. See Other Toxicity Data.

DERMAL LD50: Testing not conducted. See Other Toxicity Data.

ORAL LD50: 3.8 g/kg (rat).

INHALATION LC50: 10000 ppm (rat)

OTHER TOXICITY DATA: Acute toxicity of benzene results primarily from depression of the central nervous system (CNS). Inhalation of concentrations over 50 ppm can produce headache, lassitude, weariness, dizziness, drowsiness, or excitation. Exposure to very high levels can result in unconsciousness and death.

Long-term overexposure to benzene has been associated with certain types of leukemia in humans. In addition, the International Agency for Research on Cancer (IARC) and OSHA consider benzene to be a human carcinogen. Chronic exposures to benzene at levels of 100 ppm and below have been reported to cause adverse blood effects including anemia. Benzene exposure can occur by inhalation and absorption through the skin.

Inhalation and forced feeding studies of benzene in laboratory animals have produced a carcinogenic response in a variety of organs, including possibly leukemia, other adverse effects on the blood, chromosomal changes and some effects on the immune system. Exposure to benzene at levels up to 300 ppm did not produce birth defects in animal studies; however, exposure to the higher dosage levels (greater than 100 ppm) resulted in a reduction of body weight of the rat pups (fetotoxicity). Changes in the testes have been observed in mice exposed to benzene at 300 ppm, but reproductive performance was not altered in rats exposed to benzene at the same level.

Aspiration of this product into the lungs can cause chemical pneumonia and can be fatal. Aspiration into the lungs can occur while vomiting after ingestion of this product. Do not siphon by mouth.

12.0 ECOLOGICAL INFORMATION

Ecological testing has not been conducted on this product.

13.0 DISPOSAL INFORMATION

Disposal must be in accordance with applicable federal, state, or local regulations. Enclosed-controlled incineration is recommended unless directed otherwise by applicable ordinances. Residues and spilled material are hazardous waste due to ignitability.

14.0 TRANSPORTATION INFORMATION

U.S. DEPT OF TRANSPORTATION

Shipping Name Benzene
Hazard Class 3
Identification Number UN1114
Packing Group II
RQ RQ

INTERNATIONAL INFORMATION:

Sea (IMO/IMDG)

Shipping Name Not determined.

Air (ICAO/IATA)

Shipping Name Not determined.

European Road/Rail (ADR/RID)

Shipping Name Not determined.

Canadian Transportation of Dangerous Goods

Shipping Name Not determined.

15.0 REGULATORY INFORMATION

CERCLA SECTIONS 102a/103 HAZARDOUS SUBSTANCES (40 CFR Part 302.4): This product is reportable under 40 CFR Part 302.4 because it contains the following substance(s):

Component/CAS Number	Weight %	Component Reportable Quantity (RQ)
Benzene 71-43-2	99.80	10 lbs.

SARA TITLE III SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR Part 355): This product is not regulated under Section 302 of SARA and 40 CFR Part 355.

SARA TITLE III SECTIONS 311/312 HAZARDOUS CATEGORIZATION (40 CFR Part 370): This product is defined as hazardous by OSHA under 29 CFR Part 1910.1200(d).

SARA TITLE III SECTION 313 (40 CFR Part 372): This product contains the following substance (s), which is on the Toxic Chemicals List in 40 CFR Part 372:

Component/CAS Number	Weight Percent
Benzene 71-43-2	99.80

U.S. INVENTORY (TSCA): Listed on inventory.

OSHA HAZARD COMMUNICATION STANDARD: Flammable liquid. Carcinogen. Irritant. CNS Effects. Target organ effects.

EC INVENTORY (EINECS/ELINCS): In compliance.

JAPAN INVENTORY (MITI): Not determined.

AUSTRALIA INVENTORY (AICS): Not determined.

KOREA INVENTORY (ECL): Not determined.

CANADA INVENTORY (DSL): Not determined.

PHILIPPINE INVENTORY (PICCS): Not determined.

16.0 OTHER INFORMATION

Prepared by:

Environment, Health and Safety Department

Issued: November 14, 1995

This material Safety Data Sheet conforms to the requirements of ANSI Z400.1.

This material safety data sheet and the information it contains is offered to you in good faith as accurate. We have reviewed any information contained in this data sheet which we received from sources outside our company. We believe that information to be correct but cannot guarantee its accuracy or completeness. Health and safety precautions in this data sheet may not be adequate for all individuals and/or situations. It is the user's obligation to evaluate and use this product safely and to comply with all applicable laws and regulations. No statement made in this data sheet shall be construed as a permission or recommendation for the use of any product in a manner that might infringe existing patents. No warranty is made, either express or implied.

International Chemical Safety Cards

CARBON TETRACHLORIDE

ICSC: 0024

CARBON TETRACHLORIDE
Tetrachloromethane
Tetrachlorocarbon
Tetra
CCl_4
Molecular mass: 153.8

CAS #56-23-5
RTECS #FG4900000
ICSC #0024
UN #1846
EC #602-008-00-5

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Not combustible. Gives off irritating or toxic fumes (or gases) in a fire.		In case of fire in the surroundings: all extinguishing agents allowed.
EXPLOSION	Risk of fire and explosion (see Chemical Dangers).		In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		AVOID ALL CONTACT!	
• **INHALATION**	Dizziness. Drowsiness. Headache. Nausea.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Artificial respiration if indicated. Refer for medical attention.
• **SKIN**	MAY BE ABSORBED! Redness. Pain.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse skin with plenty of water or shower. 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. Diarrhoea (further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Give plenty of water to drink. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Evacuate danger area! Consult an expert! 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. Do NOT let this chemical	Separated from metals (see Chemical Dangers), fluorine, food and feedstuffs. Ventilation along the floor.	Unbreakable packaging; put breakable packaging into closed unbreakable container. Do not transport with food and feedstuffs. T symbol R: 23/24/25-40-48/23

enter the environment (extra personal protection: complete protective clothing including self-contained breathing apparatus).		S: 23-36/37/44 UN Hazard Class: 6.1 UN Packing Group: II Marine pollutant.

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0024 Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities ©IPCS CEC 1993

International Chemical Safety Cards

CARBON TETRACHLORIDE

ICSC: 0024

IMPORTANT DATA	**PHYSICAL STATE;APPEARANCE:** COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR. **PHYSICAL DANGERS:** The vapour is heavier than air. **CHEMICAL DANGERS:** On contact with hot surfaces or flames this substance decomposes forming toxic and irritating fumes (hydrogen chloride, ICSC # 0163; chlorine, ICSC #0126; phosgene, ICSC #0007). Reacts violently with some metals such as aluminium, barium, magnesium, potassium, sodium, with fluorine and other substances, causing fire and explosion hazard. Attacks copper, lead and zinc. **OCCUPATIONAL EXPOSURE LIMITS (OELs):** TLV (as TWA): 5 ppm; 31 mg/m^3 A2 (skin) (ACGIH 1992-1993). MAK: 10 ppm; 65 mg/m^3; II,1, H, D (1992). MAK: class III B (1992).	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation, through the skin and by ingestion. **INHALATION RISK:** A harmful contamination of the air can be reached very quickly on evaporation of this substance at 20℃. **EFFECTS OF SHORT-TERM EXPOSURE:** The substance irritates the eyes. The substance may cause effects on the liver, kidneys and the central nervous system , resulting in unconsciousness. Medical observation is indicated. **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** Repeated or prolonged contact with skin may cause dermatitis. This substance is possibly carcinogenic to humans.
PHYSICAL PROPERTIES	Boiling point: 76.5℃ Melting point: -23℃ Relative density (water =1): 1.59 Solubility in water, g/100 ml at 20℃: 0.1	Vapour pressure, kPa at 20℃: 12.2 Relative vapour density (air =1): 5.3 Relative density of the vapour/air-mixture at 20℃ (air =1): 1.5 Octanol/water partition coefficient as log Pow: 2.64
ENVIRONMENTAL DATA	This substance may be hazardous to the environment; special attention should be given to water.	

NOTES

Use of alcoholic beverages enhances the harmful effect. Depending on the degree of exposure, periodic medical examination is indicated. The odour warning when the exposure limit value is exceeded is insufficient. Do NOT use in the vicinity of a fire or a hot surface, or during welding. Ascordin, Katarin, Tetracol, Chlorasol are trade names.

Transport Emergency Card: TEC (R)-102
NFPA Code: H 3; F 0; R 0;

ADDITIONAL INFORMATION

ICSC: 0024 **CARBON TETRACHLORIDE**

IMPORTANT LEGAL NOTICE:	Neither the CEC or the IPCS nor any person acting on behalf of the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use.

MSDS Number: **C2475** * * * * * *Effective Date: 02/18/03* * * * * *Supercedes: 04/04/00*

CHLOROBENZENE

1. Product Identification

Synonyms: Monochlorobenzene; Chlorobenzol; Phenyl chloride; Benzene chloride
CAS No.: 108-90-7
Molecular Weight: 112.56
Chemical Formula: C6H5Cl
Product Codes:
J.T. Baker: 5153, 5163, 9179
Mallinckrodt: 4419, 4426

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardo
Chlorobenzene	108-90-7	99 - 100%	Yes

3. Hazards Identification

Emergency Overview

WARNING! FLAMMABLE LIQUID AND VAPOR. HARMFUL IF SWALLOWED

OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM AND LIVER.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 2 - Moderate
Flammability Rating: 3 - Severe (Flammable)
Reactivity Rating: 1 - Slight
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER.
Storage Color Code: Red (Flammable)

Potential Health Effects

Inhalation:
Causes irritation to the respiratory tract. Symptoms may include coughing, shortness of breath. Affects central nervous system causing dizziness, incoordination and unconsciousness.
Ingestion:
Causes irritation to the gastrointestinal tract. Symptoms may include nausea, vomiting and diarrhea. Toxic! May cause systemic poisoning with symptoms paralleling those of inhalation.
Skin Contact:
Causes irritation to skin. Symptoms include redness, itching, and pain. May be slowly absorbed through the skin with possible systemic effects.
Eye Contact:
Vapors cause eye irritation. Splashes cause severe irritation, possible corneal burns and eye damage.
Chronic Exposure:
Prolonged or repeated skin exposure may cause dermatitis or skin burns. Prolonged or repeated exposure may cause liver, kidney, or lung damage.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin, eye or central nervous system disorders, or impaired liver, kidney, or pulmonary function may be more susceptible to the effects of this substance.

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
Ingestion:
Give large amounts of water to drink. Never give anything by mouth to an unconscious person. Get medical attention.

Skin Contact:
Immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

5. Fire Fighting Measures

Fire:
Flash point: 28C (82F) CC
Autoignition temperature: 593C (1099F)
Flammable limits in air % by volume:
lel: 1.3; uel: 9.6
Flammable Liquid
Explosion:
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Reactions with incompatibles may pose an explosion hazard. Vapors can flow along surfaces to distant ignition source and flash back. Sealed containers may rupture when heated. Sensitive to static discharge.
Fire Extinguishing Media:
Dry chemical, foam or carbon dioxide. Water spray may be used to keep fire exposed containers cool, dilute spills to nonflammable mixtures, protect personnel attempting to stop leak and disperse vapors.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. This highly flammable liquid must be kept from sparks, open flame, hot surfaces, and all sources of heat and ignition. Combustion by-products include phosgene and hydrogen chloride gases.

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker SOLUSORB® solvent adsorbent is recommended for spills of this product.

7. Handling and Storage

Protect against physical damage. Outside or detached storage is preferred. Inside storage should be in a standard flammable liquids storage room or cabinet. Separate from oxidizing materials. Storage and use areas should be No Smoking areas. Containers should be bonded and grounded for transfers to avoid static sparks. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
-OSHA Permissible Exposure Limit (PEL):
75 ppm (TWA)

-ACGIH Threshold Limit Value (TLV):
10 ppm (TWA)
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, a half-face organic vapor respirator may be worn for up to ten times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece organic vapor respirator may be worn up to 50 times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-face piece positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.
Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid.
Odor:
Faint, almond like odor.
Solubility:
Insoluble in water.
Specific Gravity:
1.11 @ 20C/4C
pH:
No information found.
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
132C (270F)
Melting Point:
-45C (-49F)
Vapor Density (Air=1):
3.9
Vapor Pressure (mm Hg):
11.8 @ 25C (77F)
Evaporation Rate (BuAc=1):
1.1

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
May produce carbon monoxide, carbon dioxide, hydrogen chloride and phosgene when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Oxidizing agents, dimethyl sulfoxide, silver perchlorate, silver chromate.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

11. Toxicological Information

For Chlorobenzene: Oral rat LD50: 1110 mg/kg; Inhalation rat LC50: 2965 ppm.
Investigated as a tumorigen, mutagen, reproductive effector.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Chlorobenzene (108-90-7)	No	No	None

12. Ecological Information

Environmental Fate:
When released into the soil, this material may evaporate to a moderate extent. When released into the soil, this material is not expected to biodegrade. When released into the soil, this material may leach into groundwater. When released to water, this material is expected to quickly evaporate. When released into the water, this material is expected to have a half-life of less than 1 day. When released into water, this material is not expected to biodegrade. This material is not expected to significantly bioaccumulate. When released into the air, this material may be moderately degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life between 1 and 10 days.
Environmental Toxicity:
The LC50/96-hour values for fish are between 10 and 100 mg/l. This material is expected to be slightly toxic to aquatic life.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: RQ, CHLOROBENZENE
Hazard Class: 3
UN/NA: UN1134
Packing Group: III
Information reported for product/size: 52L

International (Water, I.M.O.)

Proper Shipping Name: CHLOROBENZENE
Hazard Class: 3
UN/NA: UN1134
Packing Group: III
Information reported for product/size: 52L

International (Air, I.C.A.O.)

Proper Shipping Name: CHLOROBENZENE
Hazard Class: 3
UN/NA: UN1134
Packing Group: III
Information reported for product/size: 52L

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\----------

Ingredient	TSCA	EC	Japan	Australia
Chlorobenzene (108-90-7)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\----------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Chlorobenzene (108-90-7)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Chlorobenzene (108-90-7)	No	No	Yes	No

--------\Federal, State & International Regulations - Part 2\----------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Chlorobenzene (108-90-7)	100	U037	Yes

Chemical Weapons Convention: No TSCA 12(b): No CDTA: Yes
SARA 311/312: Acute: Yes Chronic: Yes Fire: Yes Pressure: No
Reactivity: No (Pure / Liquid)

Australian Hazchem Code: 2Y
Poison Schedule: None allocated.

WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

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16. Other Information

NFPA Ratings: Health: **2** Flammability: **3** Reactivity: **0**
Label Hazard Warning:
WARNING! FLAMMABLE LIQUID AND VAPOR. HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM AND LIVER.
Label Precautions:
Keep away from heat, sparks and flame.
Avoid breathing vapor.
Keep container closed.
Wash thoroughly after handling.
Avoid contact with eyes, skin and clothing.
Use only with adequate ventilation.
Label First Aid:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. If swallowed, give large amounts of water to drink. Never give anything by mouth to an unconscious person. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. In all cases, get medical attention.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 8.
Disclaimer:
****

Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.
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Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

International Chemical Safety Cards

CHLOROFORM

ICSC: 0027

CHLOROFORM
Trichloromethane
Methane trichloride
Formyl chloride
$CHCl_3$
Molecular mass: 119.4

CAS # 67-66-3
RTECS # FS9100000
ICSC # 0027
UN # 1888
EC # 602-006-00-4

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Not combustible. See Notes. Gives off irritating or toxic fumes (or gases) in a fire.		In case of fire in the surroundings: all extinguishing agents allowed.
EXPLOSION	Risk of fire and explosion (see Chemical Dangers).		In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		STRICT HYGIENE! AVOID EXPOSURE OF ADOLESCENTS AND CHILDREN!	
• **INHALATION**	Cough. Drowsiness. Headache. Nausea.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Artificial respiration if indicated. Refer for medical attention.
• **SKIN**	MAY BE ABSORBED! Redness. Pain.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse skin with plenty of water or shower. 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. Vomiting (further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Give plenty of water to drink. Rest. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Evacuate danger area! Consult an expert! 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. Do NOT let this chemical enter the environment (extra personal protection: self-contained breathing apparatus).	Separated from strong oxidants, strong bases, metals, acetone, food and feedstuffs. Keep in the dark. Ventilation along the floor.	Unbreakable packaging; put breakable packaging into closed unbreakable container. Do not transport with food and feedstuffs. Xn symbol R: 22-38-40-48/20/22 S: 36/37 UN Hazard Class: 6.1 UN Packing Group: III Marine pollutant.

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0027 Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities © IPCS CEC 1993

International Chemical Safety Cards

CHLOROFORM

ICSC: 0027

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
VOLATILE COLOURLESS LIQUID, WITH CHARACTERISTIC ODOUR.

PHYSICAL DANGERS:
The vapour is heavier than air.

CHEMICAL DANGERS:
On contact with hot surfaces or flames this substance decomposes forming irritating and toxic fumes (hydrogen chloride, ICSC # 0163; phosgene, ICSC # 0007; chlorine, ICSC # 0126). The substance decomposes slowly under influence of air and light. Reacts violently with strong bases, strong oxidants, some metals, such as aluminium, lithium, magnesium, potassium, sodium and acetone, causing fire and explosion hazard. Attacks plastic, rubber and coatings.

OCCUPATIONAL EXPOSURE LIMITS (OELs):
TLV (as TWA): 10 ppm; 50 mg/m^3 (ACGIH 1992-1993).
MAK: 10 ppm; 50 mg/m^3; II,1, B (1992).
MAK: class III B (1992).

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation, through the skin and by ingestion.

INHALATION RISK:
A harmful contamination of the air can be reached very quickly on evaporation of this substance at 20°C.

EFFECTS OF SHORT-TERM EXPOSURE:
The substance irritates the eyes. The substance may cause effects on the heart, liver, kidneys and the central nervous system, resulting in unconsciousness. 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. This substance is possibly carcinogenic to humans.

PHYSICAL PROPERTIES

Boiling point: 62°C
Melting point: -64°C
Relative density (water = 1): 1.48
Solubility in water, g/100 ml at 20°C: 0.8

Vapour pressure, kPa at 20°C: 21.2
Relative vapour density (air = 1): 4.12
Relative density of the vapour/air-mixture at 20°C (air = 1): 1.7
Octanol/water partition coefficient as log Pow: 1.97

ENVIRONMENTAL DATA

This substance may be hazardous to the environment; special attention should be given to

DATA	water.

NOTES

Turns combustible on addition of small amounts of a flammable substance or an increase in the oxygen content of the air. Use of alcoholic beverages enhances the harmful effect. Depending on the degree of exposure, periodic medical examination is indicated. The odour warning when the exposure limit value is exceeded is insufficient. Do NOT use in the vicinity of a fire or a hot surface, or during welding.

Transport Emergency Card: TEC (R)-146
NFPA Code: H 2; F 0; R 0;

ADDITIONAL INFORMATION

ICSC: 0027 **CHLOROFORM**

International Chemical Safety Cards

2-METHOXY-2-METHYL PROPANE

ICSC: 1164

2-METHOXY-2-METHYL PROPANE
tert-Butyl methyl ether
Methyl tert-butyl ether
MTBE
$(CH_3)_3COCH_3$
Molecular mass: 88.2

CAS # 1634-04-4
RTECS # KN5250000
ICSC # 1164
UN # 2398

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Highly flammable.	NO open flames, NO sparks, and NO smoking. NO contact with oxidants.	Water spray. Alcohol-resistant foam. Carbon dioxide.
EXPLOSION	Vapour/air mixtures are explosive. Risk of fire and explosion.	Prevent build-up of electrostatic charges (e.g., by grounding).	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE			
• **INHALATION**	Cough. Dizziness. Unconsciousness. Weakness.	Ventilation.	Fresh air, rest. Artificial respiration if indicated. Refer for medical attention.
• **SKIN**	Dry skin.	Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
• **EYES**	Redness. Pain.	Safety goggles or face shield.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**	Abdominal pain. Dizziness. Nausea. Vomiting.	Do not eat, drink, or smoke during work.	Rinse mouth. Give a slurry of activated charcoal in water to drink. Do NOT induce vomiting. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
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. Do NOT wash away into sewer.	Fireproof. Separated from strong oxidants, strong acids. Keep in a well-ventilated room.	UN Haz Class: 3 UN Pack Group: II

Use self-contained breathing apparatus in the case of large spills.		

SEE IMPORTANT INFORMATION ON BACK

ICSC: 1164	Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities ©IPCS CEC 1993

International Chemical Safety Cards

2-METHOXY-2-METHYL PROPANE

ICSC: 1164

IMPORTANT DATA	**PHYSICAL STATE;APPEARANCE:** COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR. **PHYSICAL DANGERS:** The vapour is heavier than air and may travel along the ground; distant ignition possible. The vapour mixes well with air, explosive mixtures are easily formed. As a result of flow, agitation, etc., electrostatic charges can be generated. **CHEMICAL DANGERS:** Reacts violently with strong oxidants causing fire hazard. **OCCUPATIONAL EXPOSURE LIMITS (OELs):** TLV not established.	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation and by ingestion. **INHALATION RISK:** **EFFECTS OF SHORT-TERM EXPOSURE:** Inhalation of high concentrations of vapour may cause irritation of respiratory tract. Exposure to high concentrations could cause lowering of consciousness. **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:**
PHYSICAL PROPERTIES	Boiling point: 55°C Melting point: -109°C Relative density (water = 1): 0.7 Solubility in water, g/100 ml: 4.8 Solubility in water: 6.9% by volume Vapour pressure, kPa at 25°C: 32.7	Relative vapour density (air = 1): 3.0 Relative density of the vapour/air-mixture at 20°C (air = 1): 1.7 Flash point: -28°C Auto-ignition temperature: 224°C Explosive limits, vol% in air: 1.6-15.1 Octanol/water partition coefficient as log Pow: 1.3
ENVIRONMENTAL DATA		

NOTES

Other explosive limits: 1.6-8.4 volume %. Much less likely to form peroxides than other ethers.

Transport Emergency Card: TEC (R)-30G30

ADDITIONAL INFORMATION

ICSC: 1164 **2-METHOXY-2-METHYL PROPANE**

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International Chemical Safety Cards

TETRACHLOROETHYLENE

ICSC: 0076

TETRACHLOROETHYLENE
1,1,2-Tetrachloroethylene
Perchloroethylene
Tetrachloroethene
C_2Cl_4/$Cl_2C{=}Cl_2$
Molecular mass: 165.8

CAS # 127-18-4
RTECS # KX3850000
ICSC # 0076
UN # 1897
EC # 602-028-00-4

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Not combustible. Gives off irritating or toxic fumes (or gases) in a fire.		In case of fire in the surroundings: all extinguishing agents allowed.
EXPLOSION			
EXPOSURE		STRICT HYGIENE!	
• **INHALATION**	Incoordination. Exhilaration. Dizziness. Drowsiness. Headache. Nausea. Weakness. Unconsciousness.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Artificial respiration if indicated. Refer for medical attention.
• **SKIN**	Dry skin. Redness. Skin burns. Blisters.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
• **EYES**	Redness. Pain.	Safety goggles, face shield.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**	Abdominal pain (further see Inhalation).	Do not eat, drink, or smoke during work. Wash hands before eating.	Rinse mouth. Do NOT induce vomiting. Give plenty of water to drink. Rest.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Ventilation. 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.	Separated from metals (see Chemical Dangers), food and feedstuffs. Keep in the dark. Ventilation along the floor.	Do not transport with food and feedstuffs. IMO: Marine Pollutant Xn symbol R: 40 S: 23-36/37 UN Hazard Class: 6.1 UN Packing Group: III

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0076 Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities © IPCS CEC 1993

International Chemical Safety Cards

TETRACHLOROETHYLENE

ICSC: 0076

IMPORTANT DATA	**PHYSICAL STATE;APPEARANCE:** COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR. **PHYSICAL DANGERS:** The vapour is heavier than air. **CHEMICAL DANGERS:** On contact with hot surfaces or flames this substanee decomposes forming toxic and corrosive fumes (hydrogen chloride, phosgene, chlorine). The substanee decomposes slowly on contact with moisture producing trichloroacetic acid and hydrochloric acid. Reacts with metals such as aluminium, lithium, barium, berrylium. **OCCUPATIONAL EXPOSURE LIMITS (OELs):** TLV: 50 ppm; 339 mg/m^3 (STEL): 200 ppm; 1357 mg/m^3 (ACGIH 1992-1993).	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation, through the skin and by ingestion. **INHALATION RISK:** A harmful contamination of the air will be reached rather slowly on evaporation of this substance at 20°C. **EFFECTS OF SHORT-TERM EXPOSURE:** The substance irritates the eyes, the skin and the respiratory tract. Swallowing the liquid may cause aspiration into the lungs with the risk of chemical pneumonitis. The substance may cause effects on the central nervous system. **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** Repeated or prolonged contact with skin may cause dermatitis. The substance may have effects on the liver and kidney. Tumours have been detected in experimental animals but may not be relevant to humans (see Notes).
PHYSICAL PROPERTIES	Boiling point: 121°C Melting point: -22°C Relative density (water = 1): 1.6 Solubility in water, g/100 ml at 20°C: 0.015	Vapour pressure, kPa at 20°C: 1.9 Relative vapour density (air = 1): 5.8 Relative density of the vapour/air-mixture at 20°C (air = 1): 1.09 Octanol/water partition coefficient as log Pow: 2.6
ENVIRONMENTAL DATA	This substance may be hazardous to the environment; special attention should be given to indoor air and water.	

NOTES

Use of alcoholic beverages enhances the harmful effect. Depending on the degree of exposure, periodic medical examination is indicated. The odour warning when the exposure limit value is exceeded is insufficient. Do NOT use in the vicinity of a fire or a hot surfaee, or during welding. Technieal grades may contain small amounts of carcinogenic stabilizers.

Transport Emergency Card: TEC (R)-722
NFPA Code: H2; F0; R0;

ADDITIONAL INFORMATION

ICSC: 0076	TETRACHLOROETHYLENE
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MATERIAL SAFETY DATA SHEET

TOLUENE (AMOCO/TOTAL)

MSDS No. 11699000 ANSI/ENGLISH

1.0 CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: TOLUENE (AMOCO/TOTAL)

MANUFACTURER/SUPPLIER:

Amoco Chemical Company
200 East Randolph Drive
Chicago, Illinois 60601 U.S.A.

EMERGENCY HEALTH INFORMATION:
1 (800) 447-8735

EMERGENCY SPILL INFORMATION:
1 (800) 424-9300 CHEMTREC (USA)

OTHER PRODUCT SAFETY INFORMATION:
(312) 856-3907

2.0 COMPOSITION/INFORMATION ON INGREDIENTS

Component	CAS#	Range % by Wt.
Toluene	108-88-3	80
C9 Isoparaffins		9
C8 Isoparaffins		5
Benzene	71-43-2	2
Xylenes		2
Ethylbenzene	100-41-4	2

(See Section 8.0, "Exposure Controls/Personal Protection", for exposure guidelines)

3.0 HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: Warning! Flammable. Causes eye irritation. Prolonged or repeated contact can defat the skin and lead to irritation and/or dermatitis. Inhalation causes headaches,

dizziness, drowsiness, nausea, and respiratory irritation. If swallowed, causes headaches, dizziness, drowsiness and nausea, and may lead to unconsciousness. Harmful or fatal if liquid is aspirated into lungs. Danger! Contains Benzene. Cancer hazard. Can cause blood disorders. Harmful when absorbed through the skin.

POTENTIAL HEALTH EFFECTS:

EYE CONTACT: Causes mild eye irritation.

SKIN CONTACT: Prolonged or repeated contact can defat the skin and lead to irritation and/or dermatitis. Harmful when absorbed through the skin. Cancer hazard. Can cause blood disorders.

INHALATION: Inhalation causes headaches, dizziness, drowsiness, nausea, and respiratory irritation. See "Toxicological Information" section (Section 11.0).

INGESTION: If swallowed, causes headaches, dizziness, drowsiness and nausea, and may lead to unconsciousness. Harmful or fatal if liquid is aspirated into lungs.

HMIS CODE: (Health:2) (Flammability:3) (Reactivity:0)

NFPA CODE: (Health:2) (Flammability:3) (Reactivity:0)

4.0 FIRST AID MEASURES

EYE: Immediately flush eyes with plenty of water for at least 15 minutes. Then get immediate medical attention.

SKIN: Wash exposed skin with soap and water. Remove contaminated clothing and thoroughly clean and dry before reuse.

INHALATION: If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. Get immediate medical attention.

INGESTION: If swallowed, drink plenty of water, do NOT induce vomiting. Get immediate medical attention.

5.0 FIRE FIGHTING MEASURES

FLASHPOINT: 40°F(4°C)

UEL: 6.8%

LEL: 1.3%

AUTOIGNITION TEMPERATURE: 997°F (536°C)

FLAMMABILITY CLASSIFICATION: Flammable Liquid.

EXTINGUISHING MEDIA: Agents approved for Class B hazards (e.g., dry chemical, carbon dioxide, foam, steam) or water fog.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Flammable liquid. Vapor may explode if ignited in enclosed area.

FIRE-FIGHTING EQUIPMENT: Firefighters should wear full bunker gear, including a positive pressure self-contained breathing apparatus.

PRECAUTIONS: Keep away from sources of ignition (e.g., heat and open flames). Use with adequate ventilation. Keep container closed.

HAZARDOUS COMBUSTION PRODUCTS: Incomplete burning can produce carbon monoxide and/or carbon dioxide and other harmful products.

6.0 ACCIDENTAL RELEASE MEASURES

Remove or shut off all sources of ignition. Remove mechanically or contain on an absorbent material such as dry sand or earth. Keep out of sewers and waterways.

7.0 HANDLING AND STORAGE

HANDLING: Do not breathe vapors. Do not get in eyes. Do not get on skin or clothing.

STORAGE: Store in flammable liquids storage area. Store away from heat, ignition sources, and open flame in accordance with applicable regulations. Keep container closed.

8.0 EXPOSURE CONTROLS / PERSONAL PROTECTION

EYE: Do not get in eyes. Wear chemical goggles.

SKIN: Avoid skin contact. Wear protective clothing and gloves.

INHALATION: Do not breathe mist or vapor. Use with adequate ventilation. If ventilation is inadequate, use NIOSH certified respirator that will protect against organic vapor and dust/mist.

ENGINEERING CONTROLS: Control airborne concentrations below the exposure guidelines.

EXPOSURE GUIDELINES:

Component	CAS#	Exposure Limits

Toluene	108-88-3	OSHA PEL: 100 ppm (1989); 200 ppm (1971) OSHA STEL: 150 ppm (1989); Not established. (1971) OSHA Ceiling: 300 ppm (1971) ACGIH TLV-TWA: 50 ppm (skin)
C9 Isoparaffins		No exposure limit established
C8 Isoparaffins		No exposure limit established
Benzene	71-43-2	OSHA PEL: 1 ppm OSHA STEL: 5 ppm ACGIH TLV-TWA: 10 ppm
Xylenes		No exposure limit established
Ethylbenzene	100-41-4	OSHA PEL: 100 ppm (1989)(1971) OSHA STEL: 125 ppm(1989); Not established. (1971) ACGIH TLV-TWA: 100 ppm ACGIH TLV-STEL: 125 ppm

9.0 CHEMICAL AND PHYSICAL PROPERTIES

APPEARANCE AND ODOR: Liquid. Clear. Colorless. Aromatic odor.

pH: Not determined.

VAPOR PRESSURE: 26 mm Hg at 25 °C

VAPOR DENSITY: 3.2

BOILING POINT: 231°F(111°C)

MELTING POINT: Not determined.

SOLUBILITY IN WATER: Negligible, below 0.1%.

SPECIFIC GRAVITY (WATER=1): 0.87

EVAPORATION RATE:

10.0 STABILITY AND REACTIVITY

STABILITY: Burning can be started easily.

CONDITIONS TO AVOID: Keep away from ignition sources (e.g. heat, sparks, and open flames).

MATERIALS TO AVOID: None identified.

HAZARDOUS DECOMPOSITION: Burning can produce carbon monoxide and/or carbon dioxide and other harmful products.

HAZARDOUS POLYMERIZATION: Will not occur.

11.0 TOXICOLOGICAL INFORMATION

ACUTE TOXICITY DATA:

EYE IRRITATION: Testing not conducted. See Other Toxicity Data.

SKIN IRRITATION: Testing not conducted. See Other Toxicity Data.

DERMAL LD50: Testing not conducted. See Other Toxicity Data.

ORAL LD50: Testing not conducted. See Other Toxicity Data.

INHALATION LC50: Testing not conducted. See Other Toxicity Data.

OTHER TOXICITY DATA: Specific toxicity tests have not been conducted on this product. Our hazard evaluation is based on information from similar products, the ingredients, technical literature, and/or professional experience.

This stream contains benzene, toluene, xylene and ethylbenzene.

Toluene: Toluene is readily absorbed via inhalation, ingestion, and somewhat through skin contact. In the liquid form, it causes mild skin irritation with a single exposure (PDIS: 4.8/8.0) and dermatitis following repeated exposures. Toluene also produces mild eye irritation (Draise score at 1.0 hour 13.7/110.0) which includes reversible corneal opacity and iritis. It is not a dermal sensitizer. Inhalation in humans has caused mild respiratory irritation (200 ppm), mild eye irritation (400 ppm), and lassitude and slight nausea (600 ppm). Drowsiness occurs at 800 ppm. Very high concentrations may result in paresthesia, dizziness, disturbances of vision, nausea, narcosis, and collapse. It does not induce the hematopoietic effects seen with benzene exposure. Rat oral LD50: 5000 mg/kg; rat inhalation LC50: 4000 ppm (4 hours).

Acute toxicity of benzene results primarily from depression of the central nervous system (CNS). Inhalation of concentrations over 50 ppm can produce headache, lassitude, weariness, dizziness, drowsiness, or excitation. Exposure to very high levels can result in unconsciousness and death.

Long-term overexposure to benzene has been associated with certain types of leukemia in humans. In addition, the International Agency for Research on Cancer (IARC) and OSHA consider benzene to be a human carcinogen. Chronic exposures to benzene at levels of 100 ppm and below have been reported to cause adverse blood effects including anemia. Benzene exposure can occur by inhalation and absorption through the skin.

Inhalation and forced feeding studies of benzene in laboratory animals have produced a carcinogenic response in a variety of organs, including possibly leukemia, other adverse effects on the blood, chromosomal changes and some effects on the immune system. Exposure to benzene at levels up to 300 ppm did not produce birth defects in animal studies; however, exposure to the higher dosage levels (greater than 100 ppm) resulted in a reduction of body weight of the rat pups (fetotoxicity). Changes in the testes have been observed in mice exposed to benzene at 300 ppm, but reproductive performance was not altered in rats exposed to benzene at the same level.

This product contains xylene. Xylene is readily absorbed through the skin. It is also absorbed when inhaled or ingested. Overexposure to xylene can cause eye and respiratory irritation, drowsiness, headache, fatigue, irritability, and gastrointestinal disturbances. Some liver damage and lung inflammation were seen in chronic studies in guinea pigs but not in rats. In rat reproduction studies, xylenes did not produce birth defects but were toxic to the embryo when toxicity to the mother was produced. In a mouse study, xylenes caused birth defects at doses that threatened the life of the mother. The doses which produced these effects were greatly in excess of the TLV. Rat oral LD50: 4300 mg/kg; rat inhalation LC50: 5000 ppm/4 hours.

Aspiration of this product into the lungs can cause chemical pneumonia and can be fatal. Aspiration into the lungs can occur while vomiting after ingestion of this product. Do not siphon by mouth.

12.0 ECOLOGICAL INFORMATION

Ecological testing has not been conducted on this product.

13.0 DISPOSAL INFORMATION

Disposal must be in accordance with applicable federal, state, or local regulations. Residues and spilled material are hazardous waste due to ignitability. Incineration at an EPA-permitted hazardous waste management facility as required by law. Do not landfill.

14.0 TRANSPORTATION INFORMATION

U.S. DEPT OF TRANSPORTATION

Shipping Name	Toluene
Hazard Class	3
Identification Number	UN1294
Packing Group	II
RQ	RQ

INTERNATIONAL INFORMATION:

Sea (IMO/IMDG)

Shipping Name Not determined.

Air (ICAO/IATA)

Shipping Name Not determined.

European Road/Rail (ADR/RID)

Shipping Name Not determined.

Canadian Transportation of Dangerous Goods

Shipping Name Not determined.

15.0 REGULATORY INFORMATION

CERCLA SECTIONS 102a/103 HAZARDOUS SUBSTANCES (40 CFR Part 302.4): This product is reportable under 40 CFR Part 302.4 because it contains the following substance(s):

Component/CAS Number	Weight %	Component Reportable Quantity (RQ)
Benzene 71-43-2	2	10 lbs.
Ethylbenzene 100-41-4	2	1,000 lbs.
Xylenes	2	100 lbs.
Toluene 108-88-3	80	1,000 lbs.

SARA TITLE III SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR Part 355): This product is not regulated under Section 302 of SARA and 40 CFR Part 355.

SARA TITLE III SECTIONS 311/312 HAZARDOUS CATEGORIZATION (40 CFR Part 370): This product is defined as hazardous by OSHA under 29 CFR Part 1910.1200(d).

SARA TITLE III SECTION 313 (40 CFR Part 372): This product contains the following substance (s), which is on the Toxic Chemicals List in 40 CFR Part 372:

Component/CAS Number	Weight Percent
Benzene 71-43-2	2
Ethylbenzene 100-41-4	2
Xylenes	2

Toluene 108-88-3	80

U.S. INVENTORY (TSCA): Listed on inventory.

OSHA HAZARD COMMUNICATION STANDARD: Flammable liquid. CNS Effects.

EC INVENTORY (EINECS/ELINCS): In compliance.

JAPAN INVENTORY (MITI): Not determined.

AUSTRALIA INVENTORY (AICS): Not determined.

KOREA INVENTORY (ECL): Not determined.

CANADA INVENTORY (DSL): Not determined.

PHILIPPINE INVENTORY (PICCS): Not determined.

16.0 OTHER INFORMATION

Prepared by:

Environment, Health and Safety Department

Issued: April 14, 1997

Supersedes: April 10, 1997

This material Safety Data Sheet conforms to the requirements of ANSI Z400.1.

This material safety data sheet and the information it contains is offered to you in good faith as accurate. We have reviewed any information contained in this data sheet which we received from sources outside our company. We believe that information to be correct but cannot guarantee its accuracy or completeness. Health and safety precautions in this data sheet may not be adequate for all individuals and/or situations. It is the user's obligation to evaluate and use this product safely and to comply with all applicable laws and regulations. No statement made in this data sheet shall be construed as a permission or recommendation for the use of any product in a manner that might infringe existing patents. No warranty is made, either express or implied.

MSDS Number: **T4940** * * * * * *Effective Date: 05/08/03* * * * * * *Supercedes: 09/14/00*

TRICHLOROETHYLENE

1. Product Identification

Synonyms: Trichloroethene; TCE; acetylene trichloride; Ethinyl trichloride
CAS No.: 79-01-6
Molecular Weight: 131.39
Chemical Formula: C2HCl3
Product Codes:
J.T. Baker: 5376, 9454, 9458, 9464, 9473, 9474
Mallinckrodt: 8598, 8600, 8633

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardo
Trichloroethylene	79-01-6	100%	Yes

3. Hazards Identification

Emergency Overview

WARNING! HARMFUL IF SWALLOWED OR INHALED. AFFECTS HEART,

CENTRAL NERVOUS SYSTEM, LIVER AND KIDNEYS. CAUSES SEVERE SKIN IRRITATION. CAUSES IRRITATION TO EYES AND RESPIRATORY TRACT. SUSPECT CANCER HAZARD. MAY CAUSE CANCER. Risk of cancer depends on level and duration of exposure.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Cancer Causing)
Flammability Rating: 1 - Slight
Reactivity Rating: 1 - Slight
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: Blue (Health)

Potential Health Effects

Inhalation:
Vapors can irritate the respiratory tract. Causes depression of the central nervous system with symptoms of visual disturbances and mental confusion, incoordination, headache, nausea, euphoria, and dizziness. Inhalation of high concentrations could cause unconsciousness, heart effects, liver effects, kidney effects, and death.
Ingestion:
Cases irritation to gastrointestinal tract. May also cause effects similar to inhalation. May cause coughing, abdominal pain, diarrhea, dizziness, pulmonary edema, unconsciousness. Kidney failure can result in severe cases. Estimated fatal dose is 3-5 ml/kg.
Skin Contact:
Cause irritation, redness and pain. Can cause blistering. Continued skin contact has a defatting action and can produce rough, dry, red skin resulting in secondary infection.
Eye Contact:
Vapors may cause severe irritation with redness and pain. Splashes may cause eye damage.
Chronic Exposure:
Chronic exposures may cause liver, kidney, central nervous system, and peripheral nervous system effects. Workers chronically exposed may exhibit central nervous system depression, intolerance to alcohol, and increased cardiac output. This material is linked to mutagenic effects in humans. This material is also a suspect carcinogen.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders, cardiovascular disorders, impaired liver or kidney or respiratory function, or central or peripheral nervous system disorders may be more susceptible to the effects of the substance.

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4. First Aid Measures

Inhalation:

Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.
Ingestion:
Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. Call a physician.
Skin Contact:
Immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

Note to Physician:
Do not administer adrenaline or epinephrine to a victim of chlorinated solvent poisoning.

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5. Fire Fighting Measures

Fire:
Autoignition temperature: 420C (788F)
Flammable limits in air % by volume:
lel: 8; uel: 12.5
Explosion:
A strong ignition source, e. g., a welding torch, can produce ignition. Sealed containers may rupture when heated.
Fire Extinguishing Media:
Use water spray to keep fire exposed containers cool. If substance does ignite, use CO2, dry chemical or foam.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Combustion by-products include phosgene and hydrogen chloride gases. Structural firefighters' clothing provides only limited protection to the combustion products of this material.

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6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable

quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Isolate from any source of heat or ignition. Isolate from incompatible substances. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
Trichloroethylene:
-OSHA Permissible Exposure Limit (PEL):
100 ppm (TWA), 200 ppm (Ceiling),
300 ppm/5min/2hr (Max)

-ACGIH Threshold Limit Value (TLV):
50 ppm (TWA) 100 ppm (STEL);
listed as A5, not suspected as a human carcinogen.
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus. Breathing air quality must meet the requirements of the OSHA respiratory protection standard (29CFR1910.134). This substance has poor warning properties. Where respirators are required, you must have a written program covering the basic requirements in the OSHA respirator standard. These include training, fit testing, medical approval, cleaning, maintenance, cartridge change schedules, etc. See 29CFR1910.134 for details.
Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact. Neoprene is a recommended material for personal protective equipment.
Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid.
Odor:
Chloroform-like odor.
Solubility:
Practically insoluble in water. Readily miscible in organic solvents.
Specific Gravity:
1.47 @ 20C/4C
pH:
No information found.
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
87C (189F)
Melting Point:
-73C (-99F)
Vapor Density (Air=1):
4.5
Vapor Pressure (mm Hg):
57.8 @ 20C (68F)
Evaporation Rate (BuAc=1):
No information found.

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage. Will slowly decompose to hydrochloric acid when exposed to light and moisture.
Hazardous Decomposition Products:
May produce carbon monoxide, carbon dioxide, hydrogen chloride and phosgene when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Strong caustics and alkalis, strong oxidizers, chemically active metals, such as barium, lithium, sodium, magnesium, titanium and beryllium, liquid oxygen.
Conditions to Avoid:
Heat, flame, ignition sources, light, moisture, incompatibles

11. Toxicological Information

Toxicological Data:
Trichloroethylene: Oral rat LD50: 5650 mg/kg; investigated as a tumorigen, mutagen, reproductive effector.
Reproductive Toxicity:
This material has been linked to mutagenic effects in humans.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Trichloroethylene (79-01-6)	No	Yes	2A

12. Ecological Information

Environmental Fate:
When released into the soil, this material may leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released to water, this material is expected to quickly evaporate. This material has an experimentally-determined bioconcentration factor (BCF) of less than 100. This material is not expected to significantly bioaccumulate. When released into the air, this material may be moderately degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life between 1 and 10 days.
Environmental Toxicity:
The LC50/96-hour values for fish are between 10 and 100 mg/l. This material is expected to be slightly toxic to aquatic life.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: TRICHLOROETHYLENE
Hazard Class: 6.1
UN/NA: UN1710
Packing Group: III
Information reported for product/size: 4L

International (Water, I.M.O.)

Proper Shipping Name: TRICHLOROETHYLENE
Hazard Class: 6.1
UN/NA: UN1710
Packing Group: III
Information reported for product/size: 4L

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\----------

Ingredient	TSCA	EC	Japan	Australia
Trichloroethylene (79-01-6)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\----------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Trichloroethylene (79-01-6)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Trichloroethylene (79-01-6)	No	No	Yes	No

--------\Federal, State & International Regulations - Part 2\----------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Trichloroethylene (79-01-6)	100	U228	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
Reactivity: No (Pure / Liquid)

WARNING:
THIS PRODUCT CONTAINS A CHEMICAL(S) KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER.

Australian Hazchem Code: None allocated.
Poison Schedule: S6
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **2** Flammability: **1** Reactivity: **0**
Label Hazard Warning:
WARNING! HARMFUL IF SWALLOWED OR INHALED. AFFECTS HEART, CENTRAL NERVOUS SYSTEM, LIVER AND KIDNEYS. CAUSES SEVERE SKIN IRRITATION. CAUSES IRRITATION TO EYES AND RESPIRATORY TRACT. SUSPECT CANCER HAZARD. MAY CAUSE CANCER. Risk of cancer depends on level and duration of exposure.
Label Precautions:
Do not get in eyes, on skin, or on clothing.
Do not breathe vapor.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Keep away from heat and flame.
Label First Aid:
If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. In all cases call a physician. Note to physician: Do not administer adrenaline or epinephrine to a victim of chlorinated solvent poisoning.
Product Use:
Laboratory Reagent.
Revision Information:
No Changes.
Disclaimer:
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Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

International Chemical Safety Cards

VINYL CHLORIDE

ICSC: 0082

VINYL CHLORIDE
Chloroethene
Chloroethylene
VCM
(cylinder)
$C_2H_3Cl/H_2C=CHCl$
Molecular mass: 62.5

CAS #75-01-4
RTECS #KU9625000
ICSC #0082
UN #1086 (inhibited)
EC #602-023-00-7

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Extremely flammable. Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames, NO sparks, and NO smoking.	Shut off supply; if not possible and no risk to surroundings, let the fire burn itself out; in other cases extinguish with powder, carbon dioxide.
EXPLOSION	Gas/air mixtures are explosive. Vinyl chloride monomer vapours are uninhibited and may form polymers in vents or flame arresters of storage tanks, resulting in blockage of vents.	Closed system, ventilation, explosion-proof electrical equipment and lighting. Use non-sparking handtools.	In case of fire: keep cylinder cool by spraying with water. Combat fire from a sheltered position.
EXPOSURE		AVOID ALL CONTACT!	
• **INHALATION**	Dizziness. Drowsiness. Headache. Unconsciousness.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Refer for medical attention.
• **SKIN**	ON CONTACT WITH LIQUID: FROSTBITE.	Protective gloves. Cold-insulating gloves. Protective clothing.	ON FROSTBITE: rinse with plenty of water, do NOT remove clothes.
• **EYES**	Redness. Pain.	Safety goggles, 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**		Do not eat, drink, or smoke during work. Wash hands before eating.	

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Evacuate danger area! Consult an	Fireproof. Separated from	

expert! Ventilation (extra personal protection: complete protective clothing including self-contained breathing apparatus).	incompatible materials (see Chemical Danger). Cool.	F symbol T symbol R: 45-13 S: 53-9-16-44 Note: D UN Hazard Class: 2.1

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0082 Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities ©IPCS CEC 1993

International Chemical Safety Cards

VINYL CHLORIDE

ICSC: 0082

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
COLOURLESS COMPRESSED LIQUEFIED GAS , WITH CHARACTERISTIC ODOUR.

PHYSICAL DANGERS:
The gas is heavier than air, and may travel along the ground; distant ignition possible.

CHEMICAL DANGERS:
The substance can under specific circumstances form peroxides, initiating explosive polymerization. The substance will polymerize readily due to heating and under the influence of air, light, and on contact with a catalyst, strong oxidizing agents and metals such as copper and aluminium, with fire or explosion hazard. The substance decomposes on burning producing toxic and corrosive fumes (hydrogen chloride and phosgene).

OCCUPATIONAL EXPOSURE LIMITS (OELs):
TLV: 5 ppm; 13 mg/m^3 (ACGIH 1993-1994).

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation.

INHALATION RISK:
A harmful concentration of this gas in the air will be reached very quickly on loss of containment.

EFFECTS OF SHORT-TERM EXPOSURE:
The substance irritates the eyes. The liquid may cause frostbite. The substance may cause effects on the central nervous system. Exposure could cause lowering of consciousness. Medical observation is indicated.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
The substance may have effects on the liver, blood vessels and connective tissue. This substance is carcinogenic to humans. May cause heritable genetic damage in humans.

PHYSICAL PROPERTIES

Boiling point: -13℃	Flash point: -78℃ c.c.℃
Melting point: -154℃	Auto-ignition temperature: 472℃
Relative density (water = 1): 0.9	Explosive limits, vol% in air: 3.6-33
Solubility in water: none	Octanol/water partition coefficient as log Pow: 0.6
Relative vapour density (air = 1): 2.2	

ENVIRONMENTAL DATA

NOTES

According to ACGIH this substance belongs to Group A1 indicating confirmed human carcinogen. Contains

inhibitors (e.g. phenol). Depending on the degree of exposure, periodic medical examination is indicated. The odour warning when the exposure limit value is exceeded is insufficient. Do NOT use in the vicinity of a fire or a hot surface, or during welding.

Transport Emergency Card: TEC (R)-150
NFPA Code: H 2; F 4; R 2;

ADDITIONAL INFORMATION

ICSC: 0082 **VINYL CHLORIDE**

IMPORTANT LEGAL NOTICE:

MSDS Number: **X2000** * * * * * *Effective Date: **04/01/03** * * * * * Supercedes: **03/15/02***

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS | J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

XYLENES

1. Product Identification

Synonyms: Dimethyl benzene, xylol, methyltoluene
CAS No.: 1330-20-7
Molecular Weight: 106.17
Chemical Formula: C6H4(CH3)2
Product Codes:
J.T. Baker: 5377, 5810, 5813, 9483, 9489, 9490, 9493, 9494, 9499, 9516, X516
Mallinckrodt: 8664, 8668, 8671, 8672, 8685, 8802, V052

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardo
m-Xylene	108-38-3	40 - 65%	Yes
o-Xylene	95-47-6	15 - 20%	Yes
p-Xylene	106-42-3	< 20%	Yes
Ethyl Benzene	100-41-4	15 - 25%	Yes

3. Hazards Identification

Emergency Overview

DANGER! HARMFUL OR FATAL IF SWALLOWED. VAPOR HARMFUL. AFFECTS CENTRAL NERVOUS SYSTEM. CAUSES SEVERE EYE IRRITATION. CAUSES IRRITATION TO SKIN AND RESPIRATORY TRACT. MAY BE HARMFUL IF ABSORBED THROUGH SKIN. CHRONIC EXPOSURE CAN CAUSE ADVERSE LIVER, KIDNEY, AND BLOOD EFFECTS. FLAMMABLE LIQUID AND VAPOR.

SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 2 - Moderate (Life)
Flammability Rating: 2 - Moderate
Reactivity Rating: 1 - Slight
Contact Rating: 3 - Severe
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

Potential Health Effects

Inhalation:
Inhalation of vapors may be irritating to the nose and throat. Inhalation of high concentrations may result in nausea, vomiting, headache, ringing in the ears, and severe breathing difficulties which may be delayed in onset. Substernal pain, cough, and hoarseness are also reported. High vapor concentrations are anesthetic and central nervous system depressants.
Ingestion:
Ingestion causes burning sensation in mouth and stomach, nausea, vomiting and salivation. Minute amounts aspirated into the lungs can produce a severe hemorrhagic pneumonitis with severe pulmonary injury or death.
Skin Contact:
Skin contact results in loss of natural oils and often results in a characteristic dermatitis. May be absorbed through the skin.
Eye Contact:
Vapors cause eye irritation. Splashes cause severe irritation, possible corneal burns and eye damage.
Chronic Exposure:
Chronic inhalation can cause headache, loss of appetite, nervousness and pale skin. Repeated or prolonged skin contact may cause a skin rash. Repeated exposure of the eyes to high concentrations of vapor may cause reversible eye damage. Repeated exposure can damage bone marrow, causing low blood cell count. May damage the liver and kidneys.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems, or impaired liver, kidney, blood, or respiratory function may be more susceptible to the effects of the substance.

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician immediately.
Ingestion:
Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately.
Skin Contact:
Immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

5. Fire Fighting Measures

Fire:
Flash point: 29C (84F) CC
Autoignition temperature: 464C (867F)
Flammable limits in air % by volume:
lel: 1.0; uel: 7.0
Explosion:
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Contact with strong oxidizers may cause fire. Sealed containers may rupture when heated. Sensitive to static discharge.
Fire Extinguishing Media:
Dry chemical, foam or carbon dioxide. Water spray may be used to keep fire exposed containers cool, dilute spills to nonflammable mixtures, protect personnel attempting to stop leak and disperse vapors.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Vapors can flow along surfaces to distant ignition source and flash back.

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-

sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker SOLUSORB® solvent adsorbent is recommended for spills of this product.

7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from incompatibles. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment, including explosion proof ventilation. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product. Do Not attempt to clean empty containers since residue is difficult to remove. Do not pressurize, cut, weld, braze, solder, drill, grind or expose such containers to heat, sparks, flame, static electricity or other sources of ignition: they may explode and cause injury or death.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
-OSHA Permissible Exposure Limit (PEL):
100 ppm (TWA) xylene
100 ppm (TWA) ethylbenzene
-ACGIH Threshold Limit Value (TLV):
xylene: 100 ppm (TWA) 150 ppm (STEL), A4 - Not classifiable as a human carcinogen.
ethyl benzene: 100 ppm (TWA) 125 ppm (STEL), A3 - Confirmed Animal Carcinogen with Unknown Relevance to Humans.
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details. Use explosion-proof equipment.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, a half-face organic vapor respirator may be worn for up to ten times the exposure limit, or the maximum

use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece organic vapor respirator may be worn up to 50 times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-face piece positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres. Where respirators are required, you must have a written program covering the basic requirements in the OSHA respirator standard. These include training, fit testing, medical approval, cleaning, maintenance, cartridge change schedules, etc. See 29CFR1910.134 for details.

Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

The following physical data is for xylene.

Appearance:
Clear, colorless liquid.

Odor:
Characteristic odor.

Solubility:
Insoluble in water.

Specific Gravity:
0.86 @ 20C/4C

pH:
Not applicable.

% Volatiles by volume @ 21C (70F):
100

Boiling Point:
137 - 140C (279 - 284F)

Melting Point:
-25C (-13F)

Vapor Density (Air=1):
3.7

Vapor Pressure (mm Hg):
8 @ 20C (68F)

Evaporation Rate (BuAc=1):
0.7

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.

Hazardous Decomposition Products:
Involvement in a fire causes formation of carbon monoxide and unidentified organic components.

Hazardous Polymerization:
Will not occur.

Incompatibilities:
Strong oxidizing agents and strong acids.

Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

11. Toxicological Information

Toxicological Data:
Xylene: oral rat LD50: 4300 mg/kg; inhalation rat LC50: 5000 ppm/4H; skin rabbit LD50: > 1700 mg/kg; Irritation eye rabbit: 87 mg mild (Std. Draize); irritation skin rabbit 500 mg/24 moderate (Std. Draize); investigated as a tumorigen, mutagen, reproductive effector.
Ethyl benzene: oral rat LD50: 3500 mg/kg; skin rabbit LD50: 17800 uL/kg; investigated as a tumorigen, mutagen, reproductive effector.

Reproductive Toxicity:
May cause teratogenic effects.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
m-Xylene (108-38-3)	No	No	3
o-Xylene (95-47-6)	No	No	3
p-Xylene (106-42-3)	No	No	3
Ethyl Benzene (100-41-4)	No	No	2B

12. Ecological Information

Environmental Fate:
Following data for xylene: When released into the soil, this material may evaporate to a moderate extent. When released into the soil, this material is expected to leach into groundwater. When released into the soil, this material may biodegrade to a moderate extent. When released into water, this material may evaporate to a moderate extent. When released into water, this material may biodegrade to a moderate extent. When released into the air, this material may be moderately degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life of less than 1 day. This material is not expected to significantly bioaccumulate. (mixed xylenes: octanol / water partition coefficient 3.1 - 3.2; bioconcentration factor = 1.3, eels)

Environmental Toxicity:

For xylene: This material is expected to be slightly toxic to aquatic life. The LC50/96-hour values for fish are between 10 and 100 mg/l.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: RQ, XYLENES
Hazard Class: 3
UN/NA: UN1307
Packing Group: III
Information reported for product/size: 398LB

International (Water, I.M.O.)

Proper Shipping Name: XYLENES
Hazard Class: 3
UN/NA: UN1307
Packing Group: III
Information reported for product/size: 398LB

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\--------

Ingredient	TSCA	EC	Japan	Australia
m-Xylene (108-38-3)	Yes	Yes	Yes	Yes
o-Xylene (95-47-6)	Yes	Yes	Yes	Yes
p-Xylene (106-42-3)	Yes	Yes	Yes	Yes
Ethyl Benzene (100-41-4)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\--------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
m-Xylene (108-38-3)	Yes	Yes	No	Yes
o-Xylene (95-47-6)	Yes	Yes	No	Yes
p-Xylene (106-42-3)	Yes	Yes	No	Yes
Ethyl Benzene (100-41-4)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\--------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
m-Xylene (108-38-3)	No	No	Yes	No
o-Xylene (95-47-6)	No	No	Yes	No
p-Xylene (106-42-3)	No	No	Yes	No
Ethyl Benzene (100-41-4)	No	No	Yes	No

--------\Federal, State & International Regulations - Part 2\--------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
m-Xylene (108-38-3)	1000	No	No
o-Xylene (95-47-6)	1000	No	No
p-Xylene (106-42-3)	100	No	Yes
Ethyl Benzene (100-41-4)	1000	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: Yes Pressure: No
Reactivity: No (Mixture / Liquid)

Australian Hazchem Code: 3[Y]
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **2** Flammability: **3** Reactivity: **0**
Label Hazard Warning:
DANGER! HARMFUL OR FATAL IF SWALLOWED. VAPOR HARMFUL. AFFECTS CENTRAL NERVOUS SYSTEM. CAUSES SEVERE EYE IRRITATION. CAUSES IRRITATION TO SKIN AND RESPIRATORY TRACT. MAY BE HARMFUL IF ABSORBED THROUGH SKIN. CHRONIC EXPOSURE CAN CAUSE ADVERSE LIVER, KIDNEY, AND BLOOD EFFECTS. FLAMMABLE LIQUID AND VAPOR.
Label Precautions:
Keep away from heat, sparks and flame.
Avoid contact with eyes, skin and clothing.
Keep container closed.
Use only with adequate ventilation.

Avoid breathing vapor.
Wash thoroughly after handling.

Label First Aid:
Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. In all cases get medical attention immediately.

Product Use:
Laboratory Reagent.

Revision Information:
MSDS Section(s) changed since last revision of document include: 8.

Disclaimer:
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Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

Appendix C

Activity Hazard Analysis

ACTIVITY HAZARD ANALYSIS

Project: NWIRP Bethpage, GM-38 Area
Activity: General Site Hazards
Location: Bethpage, NY

MAJOR STEPS	POTENTIAL HAZARDS	PROTECTIVE MEASURES/CONTROLS
1. General Site Hazards	1. Overexertion/Strain/Back Injuries	a. Site personnel will be instructed on proper lifting techniques; b. Mechanical devices should be used to reduce manual handling of materials c. Team lifting should be utilized if mechanical devices are not available.
	2. Slips/Trips/Falls	a. Maintain work areas safe and orderly; unloading areas should be on even terrain b. Mark and repair tripping hazards if possible.
	3. Struck by Dropped Objects	a. Steel- toe boots meeting ANSI Standard Z41 will be worn.
	4. Temperature Extremes	a. Controls will be implemented to minimize exposure to temperature extremes including work rest regimens, warm or cool rest areas, protective clothing, and minimize exposure time (Temperature Extremes program EHS 4-6). b. Wear sun block when solar exposure is expected to be encountered. Drink plenty of fluids. c. Train personnel of signs/symptoms of heat/cold stress. Monitor air temperatures when extreme weather conditions are present. d. Stay in visual and verbal contact with your buddy.
	5. Struck by Eye Injuries	a. Safety glasses meeting ANSI Standard Z87 will be worn.
	6. Pinch/Cut/Smash	a. Cut resistant kevlar work gloves will be worn when dealing with sharp objects.
	7. Contact with Hand and Power Tools 8. Contact with Electricity 9. Contact with Biological Hazards	a. Daily inspections for hazards will be performed. Remove broken or damaged tools from service. b. Guards will be kept in place while using hand and power tools. c. Use the tool for its intended purpose, and use in accordance with manufacturer's instructions. d. GFCIs with 'no-voltage' release feature will be used. e. Use proper PPE: insect repellent, ivy block lotion, and sunblock. f. Be alert to the presence of biological hazards. Follow procedures for tick bites; g. PS/SHSO will be aware of on-site personnel with known allergic reactions to insect bites and stings
	10. Struck Against Utilities/ Encountering Utilities	a. All overhead utilities will be identified prior to equipment operations; no equipment or personnel closer than 10 feet to energized electrical lines or unprotected/ unshielded circuits or similar structures. b. The New York State One-Call System will be contacted and drilling locations will be screened using geophysical techniques, such as GPR or magnetometer.
	11. Fires	a. Keep fire extinguisher available. b. No smoking on work site.
EQUIPMENT USED	**INSPECTION REQUIREMENTS**	**TRAINING REQUIREMENTS**
1. Appropriate PPE 2. First Aid Kits 3. Portable Eyewash 4. Fire Extinguishers 5. Hand and Power Tools	1. Inspections will be performed on equipment prior to each use. 2. Inspections will be performed on PPE prior to each use. 3. Monthly inspections will be performed on first aid kits. 4. Portable eye wash will be inspected monthly 5. Monthly inspections will be performed on fire extinguishers. 6. Hand and power tools will be inspected before each use.	1. Personnel have read and comply with SHSP 2. Site specific training 3. Qualified operators will be used for equipment operation 4. At least two individuals on-site will have current CPR, First Aid, and BBP training 5. Instruct personnel on proper use of fire extinguishers 6. Workers will be aware of manufacturer's directions for hand and power tools in use.

ACTIVITY HAZARD ANALYSIS

Project: NWIRP Bethpage, GM-38 Area
Activity: Site Preparations
Location: Bethpage, NY

MAJOR STEPS	POTENTIAL HAZARDS	PROTECTIVE MEASURES/CONTROLS
1. Establish site controls, security, and work zones	1. Falls from same level 2. Falls from different level	a. Maintain work areas safe and orderly; unloading areas should be on even terrain; mark and repair if possible tripping hazards. b. Operators mounting and dismounting equipment must maintain 3 point contact.
EQUIPMENT USED	**INSPECTION REQUIREMENTS**	**TRAINING REQUIREMENTS**
1. Appropriate PPE	1. Inspections will be performed on PPE prior to each use.	1. Site specific training 2. At least two individuals on-site will have current CPR, First Aid, and BBP training

ACTIVITY HAZARD ANALYSIS

Project: NWIRP Bethpage, GM-38 Area
Activity: Drilling for Geotechnical Borings and Installation of Extraction Wells
Location: Bethpage, NY

MAJOR STEPS	POTENTIAL HAZARDS	PROTECTIVE MEASURES/CONTROLS
1. Mobilization of Equipment and Supplies (hazards and controls 1,3,4,8,9 apply)	1. Dropped objects, hand injuries, noise, back injuries, falls from elevated work platforms	a. All work must be performed in compliance with OSHA 29 CFR 1910 and 29 CFR 1926 and ACOE EM 385 1-1 (section 9 fire protection). b. Workers will be required to wear a minimum of hard hat (ANSI Z89.1), safety glasses (ANSI Z87), and steel toe boots (ANSI Z41). c. Hearing protection required for activities which may generate greater than 85 dBA (i.e. heavy equipment, drill rigs, pumps). d. Leather palmed work gloves will be used for general material handling. e. Kevlar gloves will be worn when handling sharp objects or using razor knifes. f. Team lifting shall be used for handling loads greater than 50 pounds when mechanical lifting devices are not available. g. Employees performing work or waling/working surface with unprotected side or edge which is 6 feet or more above a lower level shall be protected from falling.
2. Drill to depth for geotechnical borings and well installation (hazards and controls 1,2,3,4,5,6,7, 8,9,10,11 apply)	2. Exposure to site contaminants, hazards arising from lack of training	a. Workers who may be exposed to contaminant material or atmosphere must be enrolled in a Medical Monitoring Program (OSHA 1910.120) have had 40 hours OSHA training (1910.120) and have a current 8-hour refresher. b. SHSO shall conduct air sampling with PID, CGI/O_2, and vinyl chloride detector tubes. Action levels are: >0.5 ppm on PID for vinyl chloride and >2.5 on PID when no vinyl chloride is present; 1% UEL on CGI/O_2; and 1 ppm with vinyl chloride detector tubes. If action levels are exceeded follow procedures in Table 7-2.
	3. Struck by, up overs, falling loads, hazards associated with work around heavy equipment	a. Equipment will not be approached on blind sides; eye contact shall be maintained with equipment operator. b. Equipment will be equipped with back-up alarms and roll over protection devices. c. Equipment shall have seat belts that will be worn by operator at all times when operating equipment. d. Equipment will not be operated on grades which exceed manufacturer's recommendations. e. Non-essential personnel and vehicles will remain 25 feet from work areas.
	4. Striking underground utilities, electrocution	a. All underground utilities will be identified prior to drilling. b. The New York State One-Call System will be contacted and drilling locations will be screened using geophysical techniques, such as GPR or magnetometer.
	5. Struck by pedestrian exposure to work area	a. Delineate work areas by placing caution tape or traffic cones around work area prior to start of work. b. Keep non-essential personnel a minimum of 50 feet from work area. c. Stay in drivers line of sight when vehicle is backing up.

ACTIVITY HAZARD ANALYSIS

Project: NWIRP Bethpage, GM-38 Area
Activity: Drilling for Geotechnical Borings and Installation of Extraction Wells
Location: Bethpage, NY

MAJOR STEPS	POTENTIAL HAZARDS	PROTECTIVE MEASURES/CONTROLS
	6. Temperature extremes	a. Controls will be implemented to minimize exposure to temperature extremes including work rest regimens, warm or cool rest areas, protective clothing, and minimize exposure time (Temperature Extremes program EHS 4-6). b. Wear sunblock when solar exposure is expected to be encountered. Drink plenty of fluids. c. Train personnel of signs/symptoms of heat/cold stress. Monitor air temperatures when extreme weather conditions are present. d. Stay in visual and verbal contact with your buddy.
	7. Dermal exposure to site contaminants	a. Initial level of protection will be Level D. b. Upgrades to LOP shall be determined by the SHSO based on real time air monitoring, site conditions, and professional judgment. c. Follow PPE guidelines in section 6 of this SHSP.
	8. Inhalation exposure to site contaminants	a. Air monitoring will be performed per section 7 of this SHSP. b. Originally Level D PPE will be used with upgrades in respiratory protection based on real time air monitoring results, site conditions, and professional judgment.
	9. Medical emergencies, minor injuries, situations requiring emergency response services	a. Keep first aid kit, fire extinguisher, and ANSI approved eye wash in close proximity to work area. b. Keep phone numbers of emergency services in close proximity and review hospital route during safety briefings prior to work. c. Keep cellular phone charged and in work area for emergency communication. d. Keep MSDS for all materials with other emergency information.
	10. Fire	a. Smoking and open flames are not permitted in exclusion zone. b. All equipment shall be equipped with 10 lb. ABC type fire extinguishers.
	11. Spills	a. Absorbent material will be readily available. b. Drip pans, polyethylene sheeting or other means will be used for secondary containment.

EQUIPMENT USED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
1. Drill Rig 2. Fire extinguishers 3. PID, CGI/O_2, vinyl chloride detector tubes 4. Level D and Level C PPE 5. First Aid Kits 6. Spill Control Materials	1. Initial equipment inspection will be conducted prior to use. 2. Monthly site inspections will be performed. 3. Pre and post calibration/system checks will be performed daily. 4. An initial inspection of each lot of PPE will be performed. Users will inspect prior to donning. 5. Daily safety and weekly inspections will be performed. 6. Weekly safety inspections of spill control materials will be conducted.	1. Qualified operator for drill rig is required. 2. Personnel will be given instructions on proper use of fire extinguishers. 3. Proficiency training for users will be given. 4. Personnel will be given training on proper donning and doffing procedures. 5. Personnel with first aid and CPR training will be identified. 6. Workers will be aware of manufacturer's directions for hand and power tools in use.

Appendix D

Temperature Extremes

EHS 4-6: Temperature Extremes (Previously HS4-6)

Purpose
The purpose of this program is to prevent heat and cold stress related injuries and illnesses at field operations.

Version Date: 03/17/98 - Revised
Original Issue 02/01/95
Date:

Department/Category: Environmental Health & Safety Programs
Document Type: Procedure
Keyword Index: EHS Compliance/Waste Management, Monitoring, Operational Control, Training
Approved by:

Table of Contents

1.0 PURPOSE

The purpose of this program is to prevent heat and cold stress related injuries and illnesses at field operations.

2.0 SCOPE

This program applies to all Tetra Tech FW, Inc. (TtFW) and subcontractor field personnel that may be exposed to heat or cold stress during the performance of their field work assignments.

3.0 MAINTENANCE

The Director, Environmental, Safety and Quality (ESQ) Programs is responsible for updating this procedure. Approval authority rests with TtFW's President and Chief Executive Officer. Suggestions for revision shall be submitted to both the department responsible for updating the procedure and the Executive Director, Administration and Compliance.

4.0 DEFINITIONS

4.1 Adjusted Temperature

The dry bulb temperature adjusted to account for solar radiation, to be used as a heat stress indicator for personnel in impermeable protective clothing.

4.2 Deep Frostbite

The tissue beneath the skin is solid to the touch; it may involve a full thickness freeze to the bone. This is an extreme emergency and can result in permanent tissue loss.

4.3 Frostbite

Freezing of body tissue.

4.4 Frostnip or Incipient Frostbite

A cold related injury that progresses slowly and is painless while developing. The victim is usually unaware that he/she has frost nip. The skin first becomes reddened, then changes to white; no freezing of tissue occurs.

4.5 Heat Cramp

Painful muscle spasms usually occurring on the arms, legs, and abdomen; caused by excessive loss of body electrolytes from profuse sweating.

4.6 Heat Exhaustion

A form of shock that occurs when the body loses large amounts of water and electrolytes from excessive perspiration after exposure to heat and physical activity; also called heat prostration.

4.7 Heat Rash

Profuse tiny raised red vesicles (blister-like) on affected areas of the skin which cause a prickling sensation during heat exposure.

4.8 Heat Stroke

A life-threatening condition caused by rapidly rising body core temperature that occurs when the body's temperature regulating mechanisms are overwhelmed. Sweating stops and the skin is dry and hot.

4.9 Hyperthermia

A rise in body core temperature above 99.6 C.

4.10 Hypothermia

Decreased body core temperature from prolonged exposure to freezing or near-freezing temperatures. This is the most life-threatening cold injury and affects the entire body with possible localized severe cooling.

4.11 Superficial Frostbite

Frostbite which affects the skin and tissue just beneath the skin. The skin is firm and waxy, tissue beneath is soft and numb. The skin turns purple and may tingle and burn during warming.

4.12 Wet-Bulb Globe Temperature (WBGT)

Method used to measure the environmental factors (e.g., temperature, relative humidity) which impacts the body's physiological responses to heat.

4.13 Wind-Chill Factor or Equivalent Chill Temperature (ECT)

An index describing the effect of the cooling power of moving air on exposed flesh. The effect of wind velocity at a certain temperature is expressed as the equivalent cooling effect of a lower temperature with still air.

4.14 Work/Rest Regimen

The ratio of time spent working to time spent resting in an area designed to relieve heat related conditions. This ratio is expressed in one hour periods. Example: A work/rest regimen of 75% work, 25% rest corresponds to 45 minutes work, 15 minutes rest each hour.

5.0 DISCUSSION

5.1 Responsibilities

5.1.1 Field Personnel

All field personnel will be trained in heat and cold stress prevention and treatment. Field personnel will monitor themselves and their workmates for symptoms of heat and cold stress and will inform the Environmental and Safety Supervisor (ESS) or their supervisor immediately should symptoms become apparent.

5.1.2 Line Management

Site Supervisors have the responsibility to:

- Provide resources and facilities necessary to prevent health effects from temperature extremes
- Enforce work rules related to such prevention
- Ensure implementation of the requirements of this program as specified in the Site Environmental, Safety and Health (EHS) plans.

5.1.3 Environmental, Health and Safety Personnel

The Project Environmental and Safety Manager (PESM) will make the initial determination of heat and cold stress prevention requirements as part of the site EHS Plan (see EHS 3-2, EHS Plans) and oversee the implementation of this program on a project basis for all TtFW field programs.

The ESS will assist with implementation of heat and cold stress prevention programs. The ESS will, in most cases, be the person responsible for monitoring heat and cold

stress on the job, determining work/rest and work/warm-up schedules where used, and will implement emergency response or corrective action, if needed. The ESS will train site personnel on the effects of temperature extremes and the site prevention program, and will maintain records related to this program.

5.2 General Program Requirements

Adverse weather conditions must be considered when planning site operations. Excessively hot or cold working environments can produce a number of different injuries. Critical to the ability to care for those injuries is a basic understanding of the way in which the body maintains its temperature and how it physiologically adjusts to extremes of heat and cold. Attachment A provides information on the body's physiological responses to heat and cold stress.

Proper care of victims who are suffering from the effects of heat or cold exposure will help to minimize injuries and speed recovery. On the other hand, improper treatment of these emergencies can result in serious injury, disability, or death.

The most effective first aid for any injury is prevention. When acceptable monitoring and prevention programs are followed, there should be no victims.

5.3 Heat Stress

A heat stress prevention program will be implemented when ambient temperatures exceed 70°F for personnel wearing impermeable clothing and for other personnel when the WBGT index exceeds the ACGIH Threshold Limit Values.

5.3.1 Selection of Chemical Protective Clothing

The PESM will review site data and working conditions and select the personal protective equipment ensemble that best protects the employees from site hazards. The risk of heat related illness will be fully considered in balancing the risks and benefits of the PPE. Where contact with a waste material is unlikely; contact is not expected to result in a serious dermal hazard; and significant absorption of the contaminants is not likely to occur, then impermeable clothing should not be required. In this case, the risk of heat related illness may grossly outweigh the benefits provided by such equipment. Even when chemical protective clothing is needed, the PESM should consider the probable exposure scenarios and select protective equipment accordingly. For example, if dermal exposure is likely to be localized, strong consideration should be given to using gloves, boots, gauntlets, leggings, aprons, bibs, face shields, etc., in lieu of full body coveralls and respirators.

5.3.2 Hydration

TtFW will supply cool (50°–59°F) potable water or other suitable drinks (e.g., sport electrolyte replacements) for fluid replacement. Employees involved in the heat stress prevention program will be trained and encouraged to drink at a rate of approximately 8 oz. every 20 minutes. Individual cups will be used and kept in closed containers or dispensers.

5.3.3 Cool Rest Areas

Shaded rest areas will be provided. On large remediation projects, air conditioned rest areas should be provided for workers exposed to heat stress conditions.

5.3.4 Other Prevention Program Elements

The PESM, ESS and the Project Manager will incorporate other elements into the heat stress prevention program as necessary. The selected elements will be described in the EHS plans. Engineering controls are preferred. Where their use is not feasible, the program must incorporate administrative/work practice controls, personal protective equipment, or a combination. Examples of other prevention program elements include:

- **Engineering Controls**

Engineering controls may include:

— Air conditioned cabs for heavy equipment and vehicles (Such controls may eliminate the need for other program elements);

— Fans or blowers; and

— Cold water for drenching personnel in impermeable clothing. This can be provided through a garden hose, a garden sprayer filled with ice water, a clean drum full of water for "hard hat dipping" or containers of ice water and clean towels in the rest area to hasten cool down.

- **Administrative and Work Practice Controls**

Administrative controls include:

— Adjusting work schedules to do the bulk of the work during the cooler parts of the day;

— Acclimatizing workers; and

— Implementing work/rest regimens (See Attachment B for Work/Rest Regimen Procedures).

- **Personal Protective Equipment**

Personal cooling devices which may be useful include:

— Ice vests;

— Circulating water vests; and

— Vortex tubes.

Where ice vests and circulating water vests are used, rest periods of approximately 15 minutes should be taken when ice packs or batteries need to be changed.

Continuous work over long periods of time with these devices may present an increased musculoskeletal injury risk due to the extra weight. Since the duration of the cooling effectiveness of these devices will vary with heat and work loads, users must be instructed to leave the area to replenish ice or batteries at the first sign of loss of cooling.

- **Monitoring**

A program of environmental and physiological monitoring must be established in order to use work/rest regimens. The monitoring procedures are described in Attachment B.

5.3.5 Training

All site personnel must receive training on the following topics:

- Health effects of hot environments and symptoms of heat related illness;
- Personal risk factors;
- Effect of personal protective equipment on heat stress conditions;
- Preventive measures;
- Fluid replacement;
- Elements of the site Heat Stress Prevention Program; and
- First aid and emergency response.

Records shall be maintained in accordance with EHS 1-9, Recordkeeping.

5.4 Cold Stress

At certain times of the year, workers may be exposed to the hazards of working in cold environments. Potential hazards in cold environments include frostbite, trenchfoot or immersion foot, and hypothermia as well as slippery surfaces, brittle equipment, poor judgement and taking short cuts. The current ACGIH threshold limit values (TLVs) for cold stress will be used as a guideline. TtFW will implement the following cold stress prevention program elements when there is a potential for cold related injuries.

5.4.1 Personal Protective Equipment

The following personal protective equipment will be provided as necessary to TtFW employees when conditions indicate a potential for cold-related injury. Subcontractors will be expected to supply appropriate equipment to their employees.

- Hard hat liners,
- Gloves or glove liners,

- Rain gear or water impermeable coveralls and gloves for potentially wet operations,
- Fleeced boot liners where rubber steel-toe boots are used, and
- Winter coveralls.

5.4.2 Engineering Controls

A variety of engineering controls shall be evaluated to minimize cold stress. These include:

- General or spot heating should be used to increase temperature at the workplace.
- If fine work is to be performed with bare hands in a cold environment, special provisions should be made to keep the worker's hands warm. Warm air jets, radiant heaters, or contact warm plates can be used.
- The work area should be shielded from winds and drafts that may affect the wind chill factor.
- The air velocity in refrigerated rooms should be minimized as much as possible, and should not exceed 1m/sec in the work zone.
- At temperatures below freezing, metal handles of tools and control bars should be covered with thermal insulating material.
- Unprotected metal chair sets should not be used as they conduct heat away from the body.
- When necessary, equipment and processes should be substituted, isolated, relocated, or redesigned to reduce cold stress at the worksite.
- Power tools, hoists, cranes, or lifting aids should be used to reduce metabolic workload.
- Heated warming shelters such as tents and cabins should be made available if work is performed continuously in an equivalent chill temperature of 20°F or below.
- The ESS may implement a work-rest schedule to reduce exposure to cold stress.
- Scheduled rest breaks should be enforced.
- Personnel exposed to the cold should be provided the opportunity for frequent intake of warm, sweet, caffeine-free, nonalcoholic liquids or soup.
- Work should be moved to warmer areas whenever possible.
- Extra workers should be assigned to highly demanding tasks.
- Workers should be allowed to pace themselves, taking breaks when needed.

- Workers shall be trained in the prevention, symptoms, and emergency response to cold stress.
- Utilize the "buddy system" to monitor cold stress symptoms among the workers.
- Allow new employees time to adjust or "acclimate" to cold conditions.
- Minimize the need to sit or stand in one place for long periods of time.
- Minimize the amount of work time spent in a cold environment.
- Allow for the weight and bulkiness of protective clothing when estimating work performance goals and tasks.

5.4.3 Warm Rest Areas

TtFW will make warm rest areas, e.g., heated trailers, available for rest breaks in cold weather. Employees will be permitted and encouraged to use the heated trailers whenever they experience symptoms of cold stress.

5.4.4 Work/Warm-up Schedule

The work/warm-up schedule found in the ACGIH TLVs for cold stress will be followed. In addition, TtFW will make warm-up periods available to employees who need to change into dry clothing to prevent immersion foot or hypothermia.

5.4.5 Training

All TtFW employees and subcontractors will be trained in:

- The effects of cold stress, including frostbite, immersion foot and hypothermia;
- Personal risk factors;
- Recognition of the symptoms;
- Methods employees can use to protect themselves; and
- First aid procedures and recognition of medical emergencies.

Records shall be maintained in accordance with EHS 1-9, Recordkeeping.

6.0 REFERENCES

ACGIH (American Conference of Government Industrial Hygienists)
Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices, 1994-95.
NIOSH (National Institute for Occupational Safety and Health)
Occupational Exposure to Hot Environments, Revised Criteria 1986.

NIOSH/OSHA/EPA/USCG/EPA
Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities. October 1985.
National Safety Council
Fundamentals of Industrial Hygiene. Third Edition, 1988.

Environmental, Health & Safety - Programs Procedure EHS 1-9, Recordkeeping
Environmental, Health & Safety - Programs Procedure EHS 3-2, Environmental, Healty & Safety Plan(s)

7.0 ATTACHMENTS

Attachment A - Heat and Cold Stress Information
Attachment B - Work/Rest Regimens and Monitoring

ATTACHMENT A (Page 1 of 6)
HEAT AND COLD STRESS INFORMATION

Tetra Tech FW, Inc.

HEAT AND COLD STRESS INFORMATION

HEAT STRESS

Hot weather can cause physical discomfort, loss of efficiency, and personal injury. The human body strives to maintain a constant core temperature of 98.6o. If this temperature is to be maintained, heat loss must equal heat production. This balance is maintained by variations in the blood flow to the outer part of the body. When the core temperature rises, blood vessels beneath the skin dilate, and the blood brings increased heat to the skin, where it is dissipated by radiation and convection. This works only as long as the skin temperature is lower than the temperature of the outside environment. Heat loss by radiation convection is impossible when the temperature of the outside air approaches or exceeds the temperature of the skin. The body will now rely on dissipation through evaporation of sweat. But the sweat mechanism also has limits. The normal adult can sweat only about one liter per hour and can sweat at that rate for only a few hours at a time. In addition, sweating only works if the relative air humidity is low. Sweat evaporation ceases entirely when the relative humidity reaches 75 percent.

Of particular concern in heat stress monitoring is the use of personal protective clothing which decreases natural body ventilation and greatly increases the temperature and humidity to the skin. If precautions are not taken, heat stress will progress into a heat-related injury. Heat-related injuries fall into three major categories: heat cramps, heat exhaustion, and heat stroke.

Heat Cramps

Symptoms

Heat cramps are the least common and least severe of heat injuries. Heat cramps occur when the electrolytic balance in the blood between water, calcium, and sodium (salt) is altered. Low blood salt level, from profuse sweating and inadequate salt consumption, is the usual cause.

Symptoms of heat cramps include:

- Severe muscle cramps and pain, especially of the upper legs, calves, and abdomen, and occasionally in the arms
- Faintness and dizziness
- Possible nausea and vomiting

Treatment

Emergency care will include:

- Remove victim from the hot environment

ATTACHMENT A (Page 2 of 6)
HEAT AND COLD STRESS INFORMATION

- Dilute one level tablespoon of salt in fifteen quarts of water or use a commercial product with a low glucose content; allow victim to sip this solution at the rate of one-half glassful every 15 minutes
- To relieve pain, gently stretch the involved muscle group; gently message cramps as long as it does not increase the pain or discomfort

The victim should avoid exertion of any kind for 12 hours. A victim of heat cramps is prone to recurrence.

Heat Exhaustion

Symptoms

Heat exhaustion is the most common heat injury and usually occurs in an individual who is involved with heavy physical exertion in a hot, humid environment, and is wearing protective clothing. Heat exhaustion is a mild state of physical shock caused by the pooling of blood in the vessels just below the skin, causing blood to flow away from the major organs of the body. Due to prolonged and profuse sweating, the body also loses large amounts of salt and water.

The symptoms of heat exhaustion include:

- Profuse sweating
- Pale, cool, sweaty skin
- Headache and extreme weakness, fatigue
- Nausea and possible vomiting
- Dizziness and faintness
- Collapse and possible brief unconsciousness
- Body core temperature normal, may even be slightly below normal

Treatment

Emergency care will include:

- Remove victim from the hot environment and out of the exclusion zone
- Lie victim down with feet slightly raised
- Remove as much clothing as reasonable (especially personal protective clothing); loosen what cannot be removed
- Apply cold, wet compresses to the skin; fanning will also aid in cooling
- If the victim is fully alert, allow him/her to drink water or the same solution, at the same rate, that was used for the emergency care of heat cramps
- If the victim vomits, do not give fluids by mouth, transport him/her to a hospital immediately (dehydration is the most critical problem in heat exhaustion victim; intravenous fluids will have to be given)
- Take oral temperature every 10 minutes, if the victim's temperature is above 101° or shows a steady increase, transport to a hospital immediately and start sponging him/her off with cool water

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HEAT AND COLD STRESS INFORMATION

Heat Stroke

Heat stroke is a true life-threatening emergency having a mortality rate of 20 to 70 percent. This condition results when the heat regulating mechanisms of the body break down and fail to cool the body sufficiently. The body temperature rises to between 105 and 110 F; no sweating occurs in about 50 percent of the victims. Because no cooling takes place, the body stores increasingly more heat, and eventually brain cells are damaged, causing permanent disability or death. About 4,000 Americans die of heat stroke annually.

There are two basic kinds of heat stroke: classic heat stroke and exertional heat stroke. Classic heat stroke, in which people lose the ability to sweat, generally effects the elderly or chronically ill. Exertional heat stroke, in which victims retain the ability to sweat, is accompanied by physical exertion and muscle stress. Exertional heat stroke is the type that will be most commonly encountered on a field operation requiring strenuous physical activity.

The symptoms of heat stroke include:

- Oral temperature of 105 F or higher
- Hot, reddish skin, skin is usually dry
- Headache
- Dry mouth
- Shortness of breath
- Nausea or vomiting
- Increasing dizziness and weakness
- Mental confusion and anxiety; victims may show unusual irritability, aggression, combative agitation, or hysterical behavior
- Convulsions, sudden collapse and possible unconsciousness; all heat stroke victims having varying levels of consciousness, ranging from disorientation to coma

Treatment

Emergency care will include:

- Remove the victim from the hot environment and from the exclusion zone
- Call for trained emergency medical personnel immediately
- Remove as much clothing as reasonable (especially personal protective clothing); cut clothing with bandage scissors, if necessary, being careful not to injure victim
- Pour cool water over the victim, avoiding his nose and mouth
- Fan the victim
- Place cold packs under the arms and against neck and ankles
- Wrap victim in a wet blanket
- Continue a combination of these methods until the oral temperature falls below 103 F (take measures to prevent chilling, if necessary, i.e., use slower cooling if the victim starts shivering
- Elevate the head and shoulders slightly during cooling
- Never give the victim anything to drink unless fully conscious and vomiting is unlikely
- Because heat stroke involves the entire body, a number of complications may result:
- Brain swelling, convulsions, coma, kidney failure, liver failure, high blood pressure and heart failure.

Therefore, always transport the victim to a hospital even if the body core temperature has lowered to near normal.

ATTACHMENT A (Page 4 of 6)
HEAT AND COLD STRESS INFORMATION

The two most reliable and distinct differences between heat stroke and heat exhaustion are:

Heat Stroke

- Skin flushed (red); may be dry; hot to touch
- Oral temperature above 105°F.

Heat Exhaustion

- Skin pale; wet or clammy; cool to touch
- Oral temperature usually normal.

Cold Stress

Hypothermia is a drop in the core body temperature below 98.6 F. The first symptoms of hypothermia are uncontrollable shivering and the sensation of cold; this is followed by a slowed and sometimes irregular heart beat, a weakened pulse and a drop in blood pressure. Vague or slow slurred speech, memory lapses, apathy, incoherence and drowsiness can occur. Other symptoms may include cool skin, slow, irregular breathing, apparent exhaustion, and fatigue after rest.

Prevention

Hypothermia is caused by prolonged exposure to a cold environment, whether air, water, or snow and ice. Adequate dry clothing with appropriate insulating capacity must be provided to workers to prevent hypothermia, especially if work is performed in air temperatures below 40 F. Wind chill is a critical factor. Work at a slow but steady pace. The job should be a "no sweat" operation.

Unless there are unusual or extenuating circumstances, cold injury to other than the extremities (hands, feet, and head) is not likely to occur without the development of the initial signs of hypothermia. Older workers or workers with circulatory problems require special precautionary protection against hypothermia. The use of extra insulating clothing and/or a reduction in the duration of the exposure period are among the special precautions which should be considered for these workers. The precautionary actions to be taken will depend upon the physical condition of the worker and should be determined with the advice of a physician with knowledge of the cold stress factors and the medical condition of the worker.

Treatment

First aid for mild hypothermia will be performed as follows:

1. End the exposure - get the victim out of the cold and wet.
2. Replace wet clothing with dry or add insulation to clothing.
3. Offer warm, non-alcoholic fluids.
4. Increase exercise.
5. Seek shelter from wind, wet and cold.

ATTACHMENT A (Page 5 of 6)
HEAT AND COLD STRESS INFORMATION

CAUTION: If the victim remains cold for a number of hours, chemical changes may have taken place which, on rewarming, may cause major medical problems for the victim and which could result in death. Severely hypothermic victims are best warmed in the hospital under controlled conditions. If a severely hypothermic victim cannot be transported to a hospital within a few hours, rewarming should begin in the field.

Symptoms

Frostbite can occur either before or after the onset of hypothermia when body tissue (usually an extremity) is exposed to freezing temperatures. Frostbite occurs when the fluids surrounding tissue cells freezes. The danger of frostbite increases with increased wind chill and/or reduced temperatures below 32 F. Frostbite can also occur if tissues are in prolonged contact with a frozen material or object. Skin contact with frozen metal, for example, can result in frostbite in a short period of time, even in a warm environment.

There are three degrees of frostbite:

- First degree - freezing without blistering or peeling, "frostnip"
- Second degree - freezing with blistering and/or peeling, and
- Third degree - freezing resulting in the death of skin tissue and possibly the death of underlying tissues as well

Symptoms of frostbite include the following:

- The skin changes color to white or grayish-yellow, progresses to reddish-violet, and finally turns black as the tissue dies
- Pain may be felt at first, but subsides
- Blisters may appear, and
- The affected area is cold and numb

Prevention

Frostbite can be prevented by wearing sufficient protection to prevent skin from coming into prolonged contact with a freezing environment. The following steps can be taken:

1. Wear sufficient clothing. Mittens are better than gloves. Face masks and wool stocking caps are better than hats. Wind and waterproof hoods protect the face and neck.
2. Clothing should be loose enough to prevent constriction of blood vessels. Boots must be roomy enough to permit movement of the toes with no feeling of tightness.
3. Do not contact conductive metals or contact gasoline or other solvents with bare skin as rapid evaporation of solvents may quickly lead to frozen tissues in a cold environment.
4. Exercise the toes and fingers to maintain circulation.
5. Observe the condition of your partners' face, hands and ears frequently for signs of frostbite.
6. Avoid smoking and drinking alcoholic beverages.

ATTACHMENT A (Page 6 of 6)
HEAT AND COLD STRESS INFORMATION

Treatment

First aid for superficial (first degree) frostbite is as follows:

1. Place a warm body part next to the frozen area, applying firm, steady pressure.
2. DO NOT RUB THE AREA. Rubbing may cause further damage to already injured skin.
3. Protect the area from further freezing.

First aid for deep frostbite (second and third degree) is as follows:

1. KEEP THE FROZEN PART FROZEN!
2. Prevent further injury: avoid rubbing and further freezing of unaffected tissue.
3. If the part has thawed, the part should NOT be allowed to refreeze or bear weight. A victim with thawed feet should be carried out.
4. Give the victim plenty of fluids and evacuate to medical assistance as soon as possible.

Symptoms

This condition may be caused by long, continuous exposure to cold without freezing, combined with persistent dampness or actual immersion in water. Edema (swelling), tingling, itching, and severe pain occur, and may be followed by blistering, death of skin tissue, and ulceration. When other areas of the body are affected besides the feet, the condition is known as chilblains.

Prevention

Trenchfoot and chilblains can be prevented by keeping the body as dry as possible at all times. Waterproof boots should be worn when required, but provisions must be made for preventing excessive perspiration to accumulate inside the boots. Socks should be changed at least twice daily and the boots wiped dry inside with each change of socks. The feet should also be wiped dry and foot powder applied.

Treatment

Affected body parts should not be rubbed or massaged, but bathed in water using plain white soap. Dry thoroughly and elevate the body part, allowing the body part to be exposed at room temperatures. If the feet are affected, do not walk during treatment.

ATTACHMENT B (Page 1 of 5)

WORK/REST REGIMENS AND MONITORING

Tetra Tech FW, Inc.

HEAT STRESS
WORK/REST REGIMES AND MONITORING

Introduction

Establishing a work/rest regimen that allows work to be completed in a timely manner while providing adequate rest time to prevent heat stress requires involvement of the ESS, FOL, and individuals involved. In many cases, particularly when wearing normal field type clothing (i.e., level D), awareness and communication are the key elements to a successful program. Allowing rest periods on an "as needed" basis while ensuring vigilance for initial symptoms of heat stress, encourages this success.

There are times when this approach is not appropriate. When heat stress contributing protective clothing (e.g., respirators, impermeable coveralls) are worn for extended periods, or when "as needed" work/rest regimens adversely impact either the individuals exposed to the heat source or work completion, a more formal work/rest regimen will be established.

Formal work/rest regimens are based either on 1) monitoring ambient conditions (e.g., with a WBGT), estimating work loads and establishing work/rest times, 2) monitoring physiological conditions and adjusting work/rest periods, or 3) using personnel heat stress monitors.

The WBGT, physiological monitors, and personnel heat stress monitors will be used in accordance with manufacturer's instructions. Personnel heat stress monitors will be approved for use by the PESM.

II. WBGT Based Work/Rest Regimens

A. Work/Rest Regimens

When required, the WBGT will be used in conjunction with the work load to determine the appropriate work/rest regimen for personnel wearing regular work clothing or semipermeable disposal coveralls (uncoated Tyvek). Light work examples include sitting or standing or performing light hand or arm work. Moderate work includes walking about with moderate lifting and pushing. Heavy work corresponds to pick and shovel-type work.

The work/rest regimen using the WBGT procedure will be used as a guideline. Table B-1 outlines the work/rest regimen guidelines based upon WBGT temperature and work load. Table B-2 identifies the correction factors. The WBGT temperature will be determined in accordance with Section B of this attachment.

ATTACHMENT B (Page 2 of 5)

WORK/REST REGIMENS AND MONITORING

Table B-1 . Examples of Permissible Heat Exposure Threshold Limit Values. Values are given in °F (WBGT)[1]

Work - Rest Regimen	Work Load		
	Light	Moderate	Heavy
Continuous work	86	80	77
75% Work - 25% Rest, each hour	87	82	78
50% Work - 50% Rest, each hour	89	85	82
25% Work - 75% Rest, each hour	90	88	86

Notes on Table B-1

1. These values are for fully acclimatized workers wearing light weight pants and shirts. For conditions other than this use this table with the correction factors from Table B-2

2. These values assume that workers drink frequently and have properly increased salting of food prior to exposure.

3. These values are guidelines. Actual levels may be modified based on individual physiological response and actual work and rest conditions.

4. These values assume that the rest location is cool enough to alleviate heat load conditions.

ATTACHMENT B (Page 3 of 5)

WORK/REST REGIMENS AND MONITORING

Table B-2 Correction Factors for Table B-1 in °F

Clothing Type	WBGT Correction
Summer work uniform	0
Cotton overalls	-3
Winter work uniform	-7
Water barrier, permeable	-1
Condition	**WBGT Correction**
Unacclimatized worker, moderate work load	-5

To use this table, identify the most restrictive applicable clothing type and whether unacclimatized workers are involved. Add the two. Modify Table B-1 temperatures by this amount. For example, the Table B-1 TLV for continuous work, light workload is 86°F If cotton overalls (-3) are work and acclimatized workers are acclimatized (no additional change) the modified limit is 83°F

B. WBGT Determination

If the Wet Bulb Globe Temperature (WBGT) is used to determine if field conditions are conducive to heat stress illnesses, the WBGT is determined through the following equations:

- Outdoors with solar load: [1]

  WBGT=0.7 NWB+0.2GT+0.1DB

- Indoors or outdoors with no solar load: [2]

  WBGT=0.7 NWB+0.3GT

Where:
WGBT = Wet Bulb Globe Temperature Index
NWB = Natural Wet-Bulb Temperature
DB = Dry-Bulb Temperature
GT = Globe Thermometer Temperature

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WORK/REST REGIMENS AND MONITORING

The factors involved in the above equations can be measured in the following manner:

- Through the use of a direct-reading heat stress monitor capable of measuring all of the individual factors associated with the WBGT equation. For example, the Reuter-Strokes Wibet No. RSS-214 heat stress monitor.

- By measuring the individual factors manually using the following type of equipment

  Natural Wet-Bulb Temperature Thermometer
  Dry-Bulb Temperature Thermometer
  Globe Temperature Thermometer
  Stand

III. Adjusted Temperature Based Work/Rest Regimens

When wearing impermeable protective clothing, the use of work/rest regimens based on WBGT is not recommended. The WBGT index is designed to account for the effects of evaporative cooling. Vapor barrier clothing impedes the evaporation of sweat and renders the WBGT an inappropriate physiological model. The most important environmental conditions related to heat stress for workers wearing impermeable protective clothing have been suggested to be the ambient dry bulb temperature and the radiant solar heat. These factors are combined into an index called the adjusted temperature using the following formula:

T° adjusted = ambient dry bulb temperature + (13 x % sunshine)

where % sunshine is an estimate of the amount of time the sun is covered by clouds thick enough to produce a shadow. The thermometer bulb should be shielded from radiant heat when taking measurements.

The adjusted temperature values are then used to determine the initial work/rest regimen and physiological monitoring frequency. Table B-3 gives the work period and monitoring frequency. Initially, rest periods will be at least 15 minutes. Physiological monitoring that is normally recommended is pulse rate and body temperature. Procedures for each are described below. Initially, both should be done. Pulse rate monitoring may be discontinued with the approval of the PESM if temperature monitoring proves to be effective.

ATTACHMENT B (Page 5 of 5)

WORK/REST REGIMENS AND MONITORING

A. Pulse Rate Monitoring

Take the pulse immediately at the start of the rest period (P1). Take the pulse again 2 1/2 to 3 minutes into the rest period (P2). If any of the following conditions exist, shorten the next work period by a third:

P1 > 110 beats per minute(bpm)

P2 > 90 bpm

P1 - P2 < 10 bpm.

Pulse rates can be taken with an electronic pulse meter, or manually with a stopwatch for 30 seconds.

B. Oral Temperature

Take the oral temperature immediately at the start of the rest period. If the oral temperature exceeds 99.5o shorten the next work period by a third. Do not return the worker to hot work in semipermeable or impermeable clothing until the oral temperature is less than 99.5oF.

Oral temperatures may be taken with disposable oral thermometers or infrared ear drum scanners, such as the Thermoscan. Note: If a Thermoscan unit is purchased, the Pro Model should be selected. The home model available through drugstores cannot be recalibrated.

C. Removal from Exposure

If an individual requires a shortening of the work period on more than two consecutive monitoring periods, or repeatedly over a few days, they should be removed from exposure to hot environments wearing semipermeable impermeable protective clothing until examined and cleared for such work by the consulting physician.

Table B-3. Initial Work Period and Physiological Monitoring Frequency [1]

ADJUSTED TEMPERATURES	SCHEDULE
0 for above	minutes
5 - 0 F	minutes
5 - 5 F	minutes
5 5 F	minutes
0 5 F	minutes

[1] Schedule is for fit and acclimatied workers in impermeable protective clothing.

Appendix E

Personal Protective Equipment Selection Form

TABLE 6 - PERSONAL PROTECTI VE EQIPMENT (PPE) SELECTION

ACTIVITY: _____

TASK	HEAD	EYE/FACE	FEET	HANDS	BODY	HEARING	RESPIRATOR

SHSO_

Appendix F

Medical Data Sheet

Tetra Tech FW, Inc.

MEDICAL DATA SHEET

The brief medical data sheet will be completed by all on-site personnel and will be kept in the Support Zone by the SHSO as a project record during the conduct of site operations. It accompanies any personnel when medical assistance is needed or if transport to a hospital is required.

Project: _____

Name: _____ Home Telephone: _____

Address: _____

Age: _____ Height: _____ Weight: _____ Blood Type: _____

Name and Telephone Number of Emergency Contact: _____

_____

Drug or Other Allergies: _____

Particular Sensitivities: _____

Do You Wear Contacts? _____

Provide A Check List Of Previous Illnesses: _____

What Medications Are You Presently Using? _____

Do You Have Any Medical Restrictions? _____

Name, Address, And Phone Number Of Personal Physician: _____

_____

_____

_____

Appendix G

Work Rules

TETRA TECH FW,INC.

GENERAL HEALTH AND SAFETY RULES

(Page 1 of 2)

1. All site personnel must attend each day's Daily Briefing.
2. Any individual taking prescribed drugs will inform the Site Health and Safety Officer (SHSO) of the type of medication. The SHSO will review the matter with the Project Environmental and Safety Manager (PESM) and the Corporate Medical Consultant (CMC), who will decide if the employee can safely work on-site while taking the medication.
3. The personal protective equipment specified by the SHSO and in the SHSP will be worn by all site personnel. This includes hard hats and safety glasses which must be worn at all times in active work areas.
4. Facial hair (beards, long sideburns or mustaches) which may interfere with a satisfactory fit of a respirator mask is not allowed on any person who may be required to wear a respirator.
5. All personnel must sign the site log and the exclusion zone log when used at the site.
6. Personnel must follow proper decontamination procedures and shower at the end of the work shift.
7. Eating, drinking, chewing tobacco or gum, smoking and any other practice that may increase the possibility of hand-to-mouth contact is prohibited in the exclusion zone or the contamination reduction zone.
8. All lighters, matches, cigarettes and other forms of tobacco are prohibited in the Exclusion Zone.
9. All signs and demarcations will be followed. Such signs and demarcation will not be removed except as authorized by the SHSO.
10. No one will enter a permit-required confined space without a permit. Confined space entry permits will be implemented as issued.
11. All personnel must follow Hot Work Permits as issued.
12. All personnel must use the Buddy System in the Exclusion Zone.
13. All personnel must follow the work-rest regimens and other practices required by the heat stress program.
14. All personnel must follow lockout/tagout procedures when working on equipment involving moving parts or hazardous energy sources.
15. No person will operate equipment unless trained and authorized. No one may enter an excavation greater than four feet deep unless authorized by the Competent Person. Excavations must be sloped or shored properly. Safe means of access and egress from excavations must be maintained.
16. Ladders and scaffolds will be solidly constructed, in good working condition and inspected prior to use. No one may use defective ladders or scaffolds.
17. Fall protection or fall arrest systems must be in place when working at elevations greater than six feet for temporary working surfaces and four feet for fixed platforms.
18. Safety belts, harnesses and lanyards must be selected by the Supervisor. The user must inspect the equipment prior to use. No defective personal fall protection equipment will be used. Personal fall protection that has been shock loaded must be discarded.

TETRA TECH FW,INC.

GENERAL HEALTH AND SAFETY RULES

(Page 2 of 2)

19. Hand and portable power tools must be inspected prior to use. Defective tools and equipment will not be used.
20. Ground fault interrupters will be used for cord and plug equipment used outdoors or in damp locations. Electrical cords will be kept out of walkways and puddles unless protected and rated for the service.
21. Improper use, mishandling or tampering with health and safety equipment and samples is prohibited.
22. Horseplay of any kind is prohibited.
23. Possession or use of alcoholic beverages, controlled substances or firearms on any site is forbidden.
24. All incidents, no matter how minor must be reported immediately to the Supervisor.
25. All personnel will be familiar with the Site Emergency Response Plan.

The abov Health and Safety Rules are not all incl usiv and it is your responsibility to comply ith all regulations set forth by OSHA, the TtFW En ironmental, Health and Safety Programs, the SHSP,the client,TtFW Superisors and the SHSO.

Appendix H

Underground Utilities

EHS 3-15: Underground Utilities

Purpose
This program provides requirements and recommendations relative to identification, location, avoidance, and management of underground utilities, appurtanances, and structures during intrusive activities.

Version Date: 05/16/2002 - Revised
Original Issue Date: 02/20/2002
Department/Category: Environmental Health & Safety Programs
Document Type: Procedure
Keyword Index: EHS Compliance/Waste Management, Field Activities/Science, Operational Control, Training, Monitoring
Approved by:

Table of Contents

1.0 PURPOSE

This program provides requirements for identification, location, and avoidance of underground utilities, appurtenances, and structures during intrusive activities, as defined in Section 4.0. The program also addresses actions to be taken in response to encountering or contacting underground utilities.

2.0 SCOPE

These requirements are applicable to all Tetra Tech FW, Inc. (TtFW) operations. The procedures address the requirements and recommendations for identifying and locating, working around, and encountering or contacting underground utilities.

3.0 MAINTENANCE

The Director, Environmental, Safety and Quality (ESQ) Programs, is responsible for updating this procedure. Approval authority rests with TtFW's President and Chief Executive Officer. Suggestions for revision shall be submitted to both the department responsible for updating the procedure and the Executive Director, Administration and Compliance.

4.0 DEFINITIONS

4.1 Aggressive Methods

The use of mechanized equipment such as excavators, backhoes, drill rigs, directional drilling, road saws, etc. Non-Aggressive methods involve the use of manual or non-mechanized methods such as hand-digging with shovels and air/hydro/vacuum methods.

4.2 Buffer Zone

As defined in this procedure, the area around a utility where only non-aggressive excavation methods may be utilized, unless specific conditions are met.

The definition cited above, and the excavation requirements and restrictions associated with it, will vary depending on the particular state regulations. TtFW requires the imposition of a four-foot Buffer Zone on all sides of the utility as measured from the outside edges of the utility, both horizontally and vertically. Since most jurisdictions recognize Buffer Zones which vary somewhere in the range of 18 to 36 inches, this distance must be verified by consulting the applicable state regulations before excavating so that adjustments to surface markings can be

made to achieve the TtFW-required four-foot buffer zone.

Referred to as the "Tolerance Zone", "Safety Zone", or "Approximate Location of Underground Utilities" in some jurisdictions.

Information relative to excavation within the buffer zone is contained in Section 5.2.2.4.

4.3 Competent Person

A Competent Person has the ability to recognize hazards associated with underground utilities and the authority to stop or direct operations to ensure the safety of personnel and conformance with this procedure. The Competent Person has an understanding of this procedure, and the "One-Call" system requirements for the jurisdiction where excavation is occurring. The Competent Person must be capable of notifying One-Call agencies and maintaining and tracking One-Call Locate Numbers. Additionally, they must have knowledge of methods and work practices for utility identification, avoidance, and protection.

4.4 De-Energize

As applicable to a utility, to physically eliminate and/or prevent the presence, transmission, flow, or release of energy or materials which may cause harm to personnel or property.

4.5 Excavation

An operation for the purpose of movement or removal of earth, rock, or the materials in the ground, including but not limited to: digging, blasting, augering, backfilling, test boring, drilling, pile driving, directional drilling, grading, plowing-in, hammering, pulling-in, jacking-in, trenching, tunneling, structural demolition, milling, scraping, tree and root removal (grubbing), fence or sign post installation. TtFW requires that the designated One-Call agency for the applicable jurisdiction be contacted any time an intrusive activity is planned.

4.6 Jurisdiction

The authority having legal jurisdiction relative to regulations and requirements for notification of excavation activities and associated identification and marking. In the United States, the states have jurisdiction, and most consider the regulations applicable when excavation is to be performed in any location, including any public or private way, any company right-of-way or easement, or any public or privately owned land or way.

4.7 Locate

To indicate the existence of a utility by establishing a mark through the use of flags, pins, stakes, paint, or some other customary manner, that approximately determines the location of a line or facility.

4.8 Locate Request

A communication between an entity performing intrusive activities and a utility marking agency (One-Call, etc).

4.9 Observer

The person assigned to visually monitor and, as needed, signal the operator during mechanized intrusive activity when the activity is occurring within four feet of the outside edge of the buffer zone. This person remains in close communication with the equipment operator(s) and will stop the activity if needed.

4.10 One-Call Agency

An entity that administers a system through which a person can notify owners/operators of underground lines or utilities of the intent to perform intrusive activities in proposed public areas.

4.11 Positive Response

Communication with the entity performing intrusive activities, prior to the activity, to ensure that all contacted (typically via the One-Call agency) owner/operators have located and marked the underground utilities.

4.12 Potholing

The practice of exposing an underground facility by safe, non-aggressive excavation methods in order to ascertain the precise horizontal and vertical position and orientation of underground lines or utilities.

4.13 Underground Utility

An underground or submerged conductor, pipe, or structure used in providing electric or

communications service (including but not limited to, traffic control loops and similar underground or submerged devices), or an underground or submerged pipe used in carrying, providing, or gathering gas, oil or oil product, sewage, storm drainage, water or other liquid service (including, but not limited to, irrigation systems), and appurtenances thereto. As used in this procedure, utility includes all underground appurtenances and structures.

The following are examples of the types of underground utilities that may be present in a given location:

- Natural gas pipelines
- High voltage electric cables
- Water pipelines
- Fiber optic telecommunications lines
- Steam pipelines
- Gasoline, oil, or other fuels
- Sewer pipelines
- Hazardous Materials
- Underground Storage Tanks (USTs)
- Abandoned underground structures containing hazardous materials, hazardous wastes, and radioactive materials

Note: Electrical and pressurized mechanical underground utilities that are not energized shall be considered as applicable to the requirements of this procedure until they are disconnected and removed or protected by a lockout/tagout system approved by TtFW (see Section 5.2.2.6)

4.14 Underground Utility Owner

Any person, utility, municipality, authority, political subdivision or other person or entity who owns, operates, or controls the operation of an underground line/facility.

4.15 White Lining

The practice whereby the entity which intends to perform intrusive activities pre-marks the site with an outline of the area where intrusive activities will occur. This involves the use of white paint, flags, stakes, or a combination thereof to mark the extent of where work is to be performed. The marking may vary depending on what intrusive activities are to be conducted. For example, for general excavation, an areal outline of the excavation shall be marked, while for drilling, the individual boreholes shall be marked. Studies have shown that pre-marking is a practice that does prevent utility contact incidents.

5.0 DISCUSSION

5.1 Responsibilities

5.1.1 Competent Person

The Competent Person shall be responsible for:

- Obtaining a copy of, and understanding the applicable regulations for the state of jurisdiction where the excavation activities are to be performed.
- Contacting the appropriate One-Call agency or private locating service, as applicable.
- Recording One-Call locate numbers.
- If necessary, renewing One-Call locate numbers before expiration.
- Ensuring that white-lining of the area to be excavated is performed.
- Ensuring that a "positive response" has been received from every utility owner/operator identified by the One-Call agency and that they have located their underground utilities and have appropriately marked any potential conflicts with the areas of planned intrusive activities.
- Completion of the *Underground Utilities Locating and Marking Checklist* (Attachment A) and the *Underground Utilities Management Checklist* (Attachment B).
- Reviewing applicable AHAs with all project members before work begins.
- Conducting training on communication protocols to be used by the excavation observer and equipment operator.
- Ensuring Implementation of appropriate work practices during intrusive activities (including maintaining the prescribed buffer zone for use of aggressive methods).
- Conducting daily inspections of the excavation area to make sure that all markings are intact.
- Maintaining required records.
- Providing the Environmental and Safety Supervisor (ESS) with all required documentation on a daily basis.

5.1.2 Observer

Whenever intrusive operations with mechanized equipment are being conducted within four feet of the outside edge of the buffer zone, horizontally and vertically, an observer must be assigned to monitor the activities. The observer is responsible for:

- Observing the operation to ensure that the operator stops operations if utilities are observed.
- Reviewing hand signals and other forms of communication with the operator.
- Properly signaling the operator.
- Stopping the operation immediately if the observer's attention must be diverted even momentarily.
- Stopping the operation immediately if a hand signal or other directive is not followed. Operations will not resume until the observer and operator mutually agree that the reason(s) for not complying with the directive(s) are/is identified and fully corrected.
- Maintaining required records, such as logbook entries, or other, as requested by line management.

5.1.3 Line Management

The Project Manager (PM) shall be responsible for:

- Ensuring compliance with this procedure.
- Providing the necessary resources for compliance with this procedure.
- Designating Competent Personnel in consultation with the Project Environmental, Health

and Safety Manager (PESM) prior to the start of work.

5.1.4 Environmental, Health and Safety Personnel

The Environmental and Safety Supervisor (ESS) shall be responsible for:

- Providing oversight on the implementation of the requirements contained in this procedure.
- Consulting with the PM and Competent Person on underground utility issues.

5.2 Procedure

The following sections provide the requirements and recommendations of this procedure, which are intended to prevent injury to personnel, damage to infrastructure, and associated indirect effects associated with encountering or contacting underground utilities during the execution of intrusive work. Underground utilities present multiple potential hazards that must be recognized before and during work which occurs near them, therefore, this procedure is divided into sections addressing underground utility identification and location, working around or near underground utilities, and actions to be taken in the event that underground utilities are encountered or contacted. Hazards that may be presented by underground utilities include explosion and fire, electrocution, toxic exposures, pathogens, and drowning.

5.2.1 Identifying and Locating Underground Utilities

The possibility of the existence of underground utilities must be evaluated as early as possible in the planning phase for any project which involves intrusive activities, as defined in Section 4.2. The Task Initiation Procedure (TIP) form should be used for documentation of the identification of this potential hazard and the procedures to be followed to address them. The following sections describe various methods for identifying and locating utilities on a site. Plans should be verified during the readiness review. The *Underground Utilities Locating and Marking Checklist* (Attachment A) and the *Underground Utilities Management Checklist* (Attachment B) must be completed before any activities meeting the definition of excavation in Section 4.2 are conducted. Attachment A is intended to be used as a guide during the process of locating and marking utilities in the area to be excavated. Attachment B is intended to be used as a guide in the overall process of underground utilities management during the course of the project.

All underground utilities on a site involving excavation as defined in Section 4.4, must be located and identified before intrusive activities commence, by one or more of the following entities:

- The Utility Owner
- A Private or Public Utility Locating Service
- An Approved TtFW Competent Person

These options are described in greater detail in the following Sub-Sections:

5.2.1.1 Pre-Planning and the Site EHSP

- The Site-Specific Environmental Health and Safety Plan (EHSP) developed for the

project must:

- Identify the location and types of underground utilities that are believed to be present on the site.
- Reference this procedure (EHS 3-15), and describe how it will be implemented on the project.
- Contain an Activity Hazard Analysis in which the hazards associated with underground utilities are identified, as well as the measures used to control them.
- Contain, as an appendix, a copy of the applicable regulations from the state of jurisdiction where excavation activities are to be performed. These can usually be obtained via the Internet.
- Contain clear and concise procedures to be followed in the event that contact with underground utilities occurs.
- Address underground utilities and potential associated scenarios in the emergency response section of the EHSP.

5.2.1.2 "One-Call" Locating and Marking Services

Every state has utility marking service programs having various names such as "One-Call", "Dig-Safe", "Call-Before-You-Dig", "Dig-Safely", and many others. These services will identify the types and locations of any utility that may exist in an area to be excavated, as long as the property is in the public domain.

- The appropriate One-Call service for the jurisdiction where the project is located must be contacted prior to beginning excavation work. The One-Call agency should be given as detailed a description of the property as possible; address, cross street, utility pole numbers, physical description, etc.
- Notification to the One-Call service shall allow sufficient lead time for the agency to mark the utilities before excavation begins. The lead times vary, but range from two to ten days, depending on the state of jurisdiction.
- A complete listing of One-Call agencies and telephone numbers for all states is available in the *"Call-Before-You-Dig Call Center Directory"* , which can be accessed on the Internet at the WebPage (http://underspace.com/index.htm) sponsored by *"Underground Focus"* magazine.
- Once notified, the One-Call agency will provide the contractor with a unique "locate number" or "reference number". This reference number must be kept in the project files by the Competent Person or designee. Additionally, the reference numbers have expiration dates, which may vary depending on the particular One-Call agency. The valid period of the locate number and required renew notification date shall be requested from the One-Call agency.
- On a project with multiple contractors, each contractor must request a separate locate number. Under no circumstances will any other contractor or entity be allowed to "work under our locate number". Subcontractors to TtFW may excavate under the locate number secured by TtFW, provided that they are excavating within the area which was previously white-lined by TtFW and subsequently marked. **However, the One-Call agency must be contacted and notified of this arrangement so that the subcontractor can be recorded as working under the existing locate number.** If a TtFW subcontractor will be excavating in an area not white-lined by TtFW, then the TtFW subcontractor must request a new locate.
- The area where work is to be performed shall be white-lined by TtFW personnel before the locating service goes to the site.
- It is good practice to arrange a pre-excavation meeting at the project site with the personnel performing the utility location and marking. This meeting will facilitate communications, coordinate the marking with actual excavation, and assure identification of high-priority utilities.

- The One-Call agency should provide the identities of the utility owners that will be notified of the locate request. This information shall be recorded on the Underground Utility Locating and Marking Checklist (Appendix A) and maintained in the project files. The contact person and phone number for each utility owner shall also be recorded.
- The utility owners should provide a "positive response" relative to the locate request, which can consist of two types of action by the utility owner. The facility owner or operator is required to 1) mark it's underground utilities with stakes, paint, or flags, or 2) notify the excavator that the utility owner/operator has no underground utilities in the area of the excavation.
- The positive responses shall be recorded on the Underground Utility Locating and Marking Checklist (Appendix A) and cross-checked with the list of utility owners that the One-Call agency stated that they would notify. If it is discovered that a utility owner has not provided a positive response, then the One-Call agency must be notified.
- Excavation shall not be conducted until positive responses have been received from all utility owners identified by the One-Call agency as having underground utilities on the property.
- Before beginning excavation, the excavator must verify that the location marked was correct, and the distinct, color-coded markings of all utility owners are present.
- Examine the site to check for any visible signs of underground utilities that have not been located and marked such as pedestals, risers, meters, warning signs, manholes, pull boxes, valve boxes, patched asphalt or concrete pavement, areas of subsidence, fresh sod or grass, lack of grass or vegetation, and new trench lines.
- The markings placed by the utility owners must be documented by TtFW using a still, digital, or video camera. The photo-documentation shall be maintained with the project files indefinitely.
- The markings placed by the utility owners or marking services shall follow the American Public Works Association Uniform Color Code as described in ANSI Standard Z 535.1. This code appears below.

American Public Works Association Uniform Color Code

Red		Electric Power Lines, Cables, Conduit
Orange		Communications, Telephone, Cable TV
Yellow		Gas, Oil, Steam, Petroleum or Gaseous Materials
Green		Sewers and Drains
Blue		Potable Water Systems
Purple		Reclaimed Water, Irrigation, Slurry Lines
Pink		Temporary Survey Markings
White		Proposed Excavation

5.2.1.3 Private Utility Locating and Marking Services

- As discussed in Section 5.2.1.1, One-Call agencies arrange for the identification and marking of underground utilities only on public property, up to the point of contact with private property. In the event that excavation activities are to be conducted on non-public properties, the presence, location, depth, and orientation of all underground utilities within the white-lined area shall be ascertained through records review, including any site plot plans, utility layout plans, and as-built drawings available from the property owner, as well as through interviews with knowledgable personnel associated with the property. Additionally, the information gathered from these sources shall be verified by physical detection methods (non-aggressive), performance of a geophysical survey, or by procuring the services of a private utility locating and marking service. If any detection

methods are to be self-performed, the requirements of 5.2.1.4. must be followed.

The above requirements are also intended to address the potential presence of unknown or undocumented underground utilities, therefore, the area to be excavated must also be evaluated by the PM to determine if the potential for unknown or undocumented underground utilities exist. If the determination is made that the presence of these unknown or undocumented underground utilities is unlikely, then a variance should be requested to eliminate the requirement to identify them.

A list of vendors providing locating and marking services can be found in the *"Network of Underground Damage Prevention Professionals"* which can be accessed on the Internet at the *"Underspace"* WebPage (http://underspace.com/index.htm).

- Variance to this requirement above must be approved by the PM and PESM.

5.2.1.4 Self-Performance of Utility Locating and Marking

The techniques and instruments used to locate and characterize underground utilities can be extremely complicated and difficult to use effectively. Additionally, interpretation of the data generated by this instrumentation can be difficult. The utility marking services described in 5.2.1.1 and 5.2.1.2 are staffed by well-trained, experienced professionals who perform locating activities on a regular basis. For these reasons, it is most desirable that these professional services are used for utility location and marking on projects.

- In some instances, such as long-term projects where excavation is a primary task, and the presence of underground utilities is extensive, it may be prudent to self-perform locating and marking activities.
- If locating and marking is to be self-performed, all personnel using instrumentation will be trained on the use of the equipment that will be used, and the interpretation of the data.
- There are variety of locating methods which may be utilized for self-performance of utility locating as categorized below:
- Magnetic field-based locators or path tracers
- Buried electronic marker systems (EMS)
- Ground penetration radar-based buried –structure detectors
- Acoustics-based plastic pipe locators
- Active probes, beacons, or sondes for non-metallic pipes
- Magnetic polyethylene pipe
- Before self-performing any underground utility locating on a project, approval must be obtained from the TtFW Director, EHS Services.

5.2.2 Working Near or Around Underground Utilities

After the site has been properly evaluated for the presence of underground utilities, intrusive activities may begin. Since there is no perfect way of eliminating the hazards presented by underground utilities, an effort must be made to perform the tasks following the direction and guidance as described by the following best practices that should be implemented during the execution of the project.

5.2.2.1 Work Site Review

Before beginning intrusive activities, a meeting shall be held between all members of the project team. This shall consist of a review of the marked utility locations with the equipment operators, observers, laborers, etc.

5.2.2.2 Preservation of Marks

During excavation, efforts must be made to preserve the markings placed by the utility owners until they are no longer required. If any markings are obliterated, the One-Call agency must be contacted for re-marking. No intrusive activities are to take place if markings are not visible.

5.2.2.3 Excavation Observer

Whenever intrusive operations are being conducted within four feet of the edge of the buffer zone, an observer must be assigned to monitor the activities. The observer will be designated each day, and a review of hand signals and other forms of communication between the observer and operator will be conducted. The directives of the observer will be followed precisely and immediately by those operating equipment.

5.2.2.4 Excavation Within The Buffer Zone

Performing intrusive activities within the buffer zone requires careful adherence to proper guidelines and procedures to minimize the risk of contact with underground utilities.

The purpose of the buffer zone is to designate and define an area where careful, prudent, and reasonable excavation practices are to be used to prevent contact with underground utilities. However, there may be occasions where it is necessary to perform aggressive excavation methods in this designated area.

The boundaries of the buffer zone as defined in Section 4.1 will be observed at all times during intrusive activities. Aggressive excavation methods (excavators, backhoes, drill rigs) must be restricted to areas outside of the 4-foot buffer zone unless a special exemption to this requirement is obtained.

Consider whether the objective of the project can be completed without performing intrusive activities in the buffer zone at all. This will greatly reduce the risks presented by performing work in close proximity to underground utilities. If after consideration, the determination is made that intrusive activities in the buffer zone are necessary, then a formal exemption request shall be made to the PESM according to the guidelines below.

A request to utilize aggressive excavation methods in the buffer zone may be made if:

- There is no other appropriate and reasonable alternative to using aggressive methods in the buffer zone; and
- The utility has been de-energized (and purged if necessary), verified as de-energized, and locked-out (per Section 5.2.2.6); or

- the depth and orientation of the utility has been adequately and visually determined through the use of non-aggressive methods such as air/hydro/vacuum excavation, potholing, probing, hand-digging, or a combination thereof; and

- for utilities containing electrical energy, the depth of the existing water table is below the location of the utility; and
- application for the exemption has been submitted to the PESM via a Field Change Notification (FCN); and
- the exemption has been granted and approved in writing by the PESM on the FCN form.

The following conditions will apply to this request:

- Aggressive methods may be used in the buffer zone only to the extent allowed by the applicable state or other jurisdictional regulations.
- Appropriate physical protection measures for exposed utilities as described in Section 5.2.2.5 shall be implemented to eliminate the potential for equipment contact with utilities.
- The extent of the project excavation area to be covered by the exemption request must be specified in the FCN.
- When evaluating the use of aggressive excavation methods in the buffer zone, the PESM will consider the type of utility involved and the associated risk potential.

Based on this evaluation, the PESM may impose further conditions and requirements, which will be detailed in the FCN.

Even if the above exemption conditions are met, the PESM has authority to deny the request, the reasons for which will be described in the FCN.

Unless exempted according to the above provisions of this procedure, only non-aggressive methods may be used within the buffer zone. Non-aggressive, or non-mechanized equipment is used in order to prevent mechanical contact with underground utilities which could result in damage to the utility and create the potential for personal injury and property damage. Following are examples of non-aggressive excavation methods:

- Hand-digging
- Non-conductive hand tools must be used when digging within the buffer zone surrounding underground electrical utilities.
- If conductive hand tools must be used near electrical lines, then the PESM shall be consulted to determine additional requirements relative to safe electrical practices, procedures, and equipment.
- Hydro-excavation (water pressure).
- Air excavation (air pressure).
- Vacuum extraction (soil excavation/removal).
- Air excavation/vacuum extraction combination.
- Aggressive methods may be used for the removal of pavement over a utility, if allowed by the state regulations.

5.2.2.5 Protection of Underground Utilities

It is very important that consideration be given to the protection of underground utilities when performing adjacent intrusive activities. This is necessary not only to prevent physical damage and associated indirect effects, but also to prevent the potential for injury to employees and the

public.

- When using aggressive excavation methods within the buffer zone around exposed underground utilities, physical protection may be appropriate. Basically, this involves creation of a physical barrier between the mechanized operation and the utility. The following are some possible types of physical protective measures:
- Heavy timbers, similar to swamp mats.
- Sheets of plywood.
- Blasting mats.
- Once exposed, underground utilities no longer have the support provided by surrounding soil and may need to be physically supported to prevent shifting, bending, separation, or collapse, which could result in damage to the utility, and possibly personnel. Following are suggested support methods:
- Timber shoring underneath the utility.
- Timbers or girders over the top of the excavation fitted with hangers that support the utility.
- Design by a PE for complicated or large applications.
- Utilities must also be protected from objects that may fall into the excavation such as rocks and equipment. This can be accomplished by following these guidelines:
- Cast spoils as far away from the excavation as possible. Excavated and loose materials shall be kept two feet from the edge of excavations, as required by OSHA.
- Relocate large rocks, cobbles, and boulders away from the excavation and sloped spoils piles.
- When vehicles and machinery are operating adjacent to excavations, warning systems such as soil berms, stop logs or barricades shall be utilized to prevent vehicles from entering the excavation or trench.
- Scaling or barricades shall be used to prevent rock and soils from falling into the excavation.
- Barriers shall be provided to prevent personnel from inadvertently falling into an excavation.

5.2.2.6 De-Energizing Utilities

Utilities can carry many types of potential energy, including electricity, flowing liquids, liquids under pressure, gasses under pressure, etc. A release, such as may happen if a utility conveyance is compromised, could result in personal injury, property damage, and other indirect effects. If the white lines of the proposed excavation area overlaps or extends into the buffer zone of a known underground utility, then if at all possible, that utility shall be de-energized to physically prevent the transmission, flow, or release of energy. Conversely, if the buffer zone of the known utility lies outside of the white-lined, proposed excavation area, then de-energization is not required.

- The owner of the utility shall be contacted to determine the feasibility and methodology of de-energizing the utility. Plenty of lead-time should be provided for this since it may take utility companies weeks to de-energize some utilities.
- Depending on the utility and the material being conveyed, isolation points which may be suitable for de-energizing include but are not limited to the following:
- Electrical circuit breakers
- Slide gate
- Disconnect switches
- Piping flanges
- Other similar devices
- When utilities are de-energized, it must be verified by demonstration. This can be

accomplished by testing equipment, switching on a machine or lighting, opening a valve, etc. For any current-carrying electrical equipment, such as cables, electrical panels, etc., successful de-energization must be certified through the use of appropriate electrical testing equipment.
- Whenever a utility is de-energized, a means of ensuring that the energy isolation device and equipment cannot be operated until the device is removed must be provided. Typically, this is achieved by utilizing a lockout device, accompanied by a written tag, that physically controls the configuration of the energy isolation point. Lockout devices include but are not limited to the following:
- Locks
- Chains
- Valve covers
- Circuit breaker hasps
- Blind flanges
- Slip blinds, and
- Multiple lock hasps
- When de-energizing and locking out of utilities is practiced, the provisions of EHS 6-4 Lockout/Tagout, shall be followed, as applicable.
- In the event that a utility is de-energized, but there is no means of adequately providing a physical locking-out of the utility, then a spotter must be posted at the point of isolation to ensure that the utility is not re-energized. The spotter must be supplied with a communication device such as a site radio.

5.2.2.7 Damage Discovery

During excavation, utility damage may be discovered which is pre-existing or otherwise not related to a known contact. Disclosure to the utility owner is very important because the possibility of utility failure or endangerment of the surrounding population increases when damage has occurred. The utility may not immediately fail as a result of damage, but the utility owner or operator must be afforded the opportunity to inspect the utility and make a damage assessment and effect repairs if necessary. The following guidance applies:

- Observe and photograph the utility from a safe distance and determine in there is damage. Damage would be all breaks, leaks, nicks, dents, gouges, grooves, or other damages to utility lines, conduits, coatings, or cathodic protection systems.
- The One-Call agency or private location service must be contacted immediately.

5.2.3 Encountering or Contacting Underground Utilities

In the event that encountering or contacting an underground utility occurs, it is imperative that the appropriate actions are taken to minimize damage to the utility, prevent personal injury, and minimize indirect effects.

5.2.3.1 Encountering Underground Utilities

It is possible that underground utilities will be encountered in locations that have previously been "cleared" of having underground utilities by the locating service, or are found outside of the area which has been marked as having underground utilities. In either case, if this occurs, the following applies:

- Intrusive activities must be curtailed

- The One-Call agency or private location service must be contacted immediately
- The PM and PESM must be notified
- No further intrusive activities may be conducted until:
- The One-Call agency/private location service and/or the subject utility owner visit the site;
- Identification of the utility owner and the type of material/energy being conveyed by the utility has been made; and
- The orientation and depth of the subject utility has been determined and suitably marked.
- A TtFW Incident Report and Investigation form must be completed per EHS 1-7. The report should be accompanied by photographs clearly showing the marking(s), and the actual location, with a distance gauge to document how far off the mark the utility was encountered.

5.2.3.2 Contacting Underground Utilities

If excavation or other equipment being used for intrusive activities makes contact with an underground utility, the following guidelines apply:

- Intrusive activities must be stopped immediately.
- Observe the utility from a safe distance and determine if there is damage. Damage would be all breaks, leaks, nicks, dents, gouges, grooves, scratched coatings, cathodic protection compromise, material leakage, obvious electrical energy.
- Move all personnel to the evacuation meeting point as described in the SSHP.

EXCEPTION: If an electrical line has been contacted and it is your belief that equipment (such as an excavator) is electrically energized, do not approach the equipment. Order the operator to remain in the equipment until emergency personnel can de-energize the source (unless the equipment is on fire, at which time the operator should jump off of the vehicle and shuffle along the ground to a safe area). Shuffling is required because current flows outward through the soil in a ripple pattern called a power gradient, creating a pattern of high and low potential. Shuffling decreases the chance that these gradients could be bridged, causing current to flow through the body, resulting in electrocution.

- Secure the area to prevent the public from entering.
- Contact emergency responders as specified in the SSHP.
- The One-Call agency or if known, the utility owner must be contacted immediately.
- The PM and PESM must be notified.
- No further intrusive activities may be conducted until:
- The utility owner inspects the scene and after repairs, verifies that all danger has passed.
- The orientation and depth of the subject utility has been determined and suitably marked.
- Permission from the emergency responders to resume work has been given.
- A TtFW Incident Report and Investigation form must be completed per EHS 1-7. The report should be accompanied by photographs clearly showing the marking(s), and the actual location, with a distance gauge to document how far off the mark the utility was encountered.
- State and Local regulations must be reviewed to determine if reporting to any additional agencies is required.

5.3 Training

Competent Persons shall have adequate experience and/or training to carry out the requirements

of this procedure.

6.0 SOURCES OF INFORMATION

6.1 Organizations

- Common Ground Alliance
  http://www.commongroundalliance.com/wc.dll?cga~toppage
- Center for Subsurface Strategic Action (CSSA)
  http://underspace.com/cs/index.htm
- DigSafely
  http://www.digsafely.com/digsafely/default.asp
- National Utility Contractors Association (NUCA)
  http://www.nuca.com/
- National Utility Locating Contractors Association (NULCA)
  http://underspace.com/nu/index.htm
- Underground Focus Magazine
  http://underspace.com/uf/index.htm
- NUCA State Listing of One-Call centers
  http://www.nuca.com/
- Utility Safety Magazine
  http://www.utilitysafety.com/

6.2 Vendors and Commercial Sites

- RadioDetection, Inc. (Detection Instruments)
  http://www.radiodee.com/
- Heath Consultants (Detection Instruments)
  http://www.heathus.com/
- Ben Meadows Company (Detection Instruments)
  http://www.benmeadows.com/cgi-bin/SoftCart.exe/index.html?E+scstore
- So-Deep, Inc. (Complete Utilities Services)
  http://www.sodeep.com/
- Concept Engineering Group, Inc. (Air Excavation Equipment)
  http://www.air-spade.com/index.html
- Rycom Instruments, Inc. (Detection Instruments)
  http://www.rycominstruments.com/

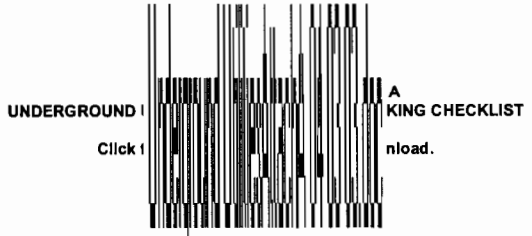
- Schonstedt Instrument Company (Detection Instruments)
  http://www.schonstedt.com/
- Forestry Suppliers, Inc. (Fiberglass Probe – "Fiberglass Tile Probe", Part #77543, Approx. $20.00, Telephone 800-647-5368)
  http://www.forestry-suppliers.com/

7.0 REFERENCES

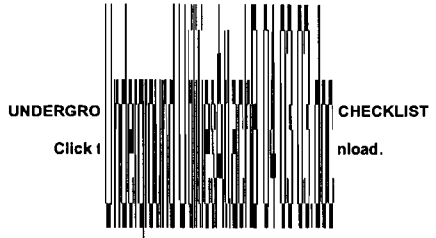
- Common Ground Study of One-Call Systems and Damage Prevention Best Practices, August, 1999, Sponsored by US DOT.

8.0 ATTACHMENTS

Attachment A – Underground Utilities Locating and Marking Checklist
Attachment B – Underground Utilities Management Checklist



Select the "Detach" button in the pop-up window to save a copy to a disk or hard drive.



UNDERGRO CHECKLIST

Click t nload.

Select the "Detach" button in the pop-up window to save a copy to a disk or hard drive.

EHS 3-15 ATTACHMENT A
UNDERGROUND UTILITY LOCATING AND MARKING CHECKLIST

TETRA TECH FW, INC.

To b Completed by PM and/or Competent Person"
Complete Form as Location/Marking Progesses and Maintain in Site Files

PROJECT INFORMATION:	Location:
Project Name:	Task/Activity:
Tetra Tech FW Competent Person:	Start Date of Work:
Tetra Tech FW Subcontractor: ☐ No ☐ Yes:	Private Locating Service Required: ☐ Yes ☐ No
Property Owner:	If Not, Explain:
NOTIFICATION:	
Locating Service Name:	Locating Service Tel. Number:
Date Locating Service Notified:	Locate Ticket Number:
Address of Property to be Marked:	Locate Ticket Expiration Date:
Nearest Intersecting Street:	
Are There Any Utilities on the Properties That the Locating Service Will Not Contact? ☐ Yes ☐ No	
Specify:	
Enter Utility Information in Table 1 Below. In Addition to Utility Locating Services, Consult Client, Utility Owners, Drawings, Facility Personnel, Maintenance Personnel, Municipalities, etc.	

TABLE 1
ON-SITE UTILITY INFORMATION

NAME OF UTILITY COMPANY	TYPE OF UTILITY	COLOR CODE	UTILITY PRESENT ON-SITE?	EMERGENCY PHONE NUMBER	DATE MARKS COMPLETED
	Electric	RED			
	Communications, Phone, CATV	ORANGE			
	Gas, Oil, Steam, Petroleum	YELLOW			
	Sewers, Drains	GREEN			
	Potable Water	BLUE			
	Reclaimed Water, Irrigation	PURPLE			
	Temporary Survey Markings	PINK			
To be performed by excavator prior to utility mark-out.	Proposed Excavation	WHITE			

White-Lining Completed? ☐ No Explain: _____ ☐ Yes: Date: _____ By Whom? _____

LOCATING AND MARKING:

Have All Utilities Identified in Table 1 Been Marked? ☐ Yes ☐ No (If Not, Contact Locating Service for Resolution)
Problem(s) With Markings?
☐ Yes ☐ No ☐ No Marks ☐ Incorrect Location ☐ Too Wide
☐ Other: _____ ☐ Not All Utilities Marked Per Table 1 (notify marking service)
Measurements Taken: ☐ Yes ☐ No
Documentation of Marks: ☐ Photos ☐ Video ☐ Other: _____

EXCAVATION:

Utilities Accurately Marked? ☐ Yes ☐ No
If no, describe: _____
Were Unmarked or Mis-Marked Utilities Encountered? ☐ Yes ☐ No
If Yes, Specify: _____
Locating Service Notified? ☐ Yes ☐ No
Will Excavation Continue Past Locate Number Expiration? ☐ Yes ☐ No
If Yes, Locate Number Renewed? ☐ Yes ☐ No New Expiration Date: _____
Any Other Problems/Concerns? Specify: _____

Form Completed By:	Signature:	Date:

EHS 3-15 - ATTACHMENT B

UNDERGROUND UTILITIES MANAGEMENT CHECKLIST

TETRA TECH FW, INC.

To be Completed by PM and/or "Competent Person"
Complete Form as Project Progresses and Maintain in Site Files.

PHASE		TASK	YES	NO	NA	COMMENTS Required if Response is No or NA. (Reference Item Number)
Pre-Planning	1.	Excavation in Work Scope? (As defined in EHS 3-15, Section 4.4)				
	2.	Underground Utilities Identified in TIP?				
	3.	Competent Person Assigned?				
	4.	Has a Copy of the Applicable State Regulations Been Obtained, Read, Understood?				
	5.	EHS Plan Addresses Underground Utilities? (AHAs, Contingency Plan, State Regulations Appendix)				
Identifying, Locating and Marking	6.	Locating and Marking Checklist Initiated? (Attachment A)				
	7.	Identification and Address of Property Determined, Including Nearest Intersection?				
	8.	One-Call Agency Contacted?				
	9.	Additional Locating and Marking Required on Property? (One-Call agency marks to public property line only)				
	10.	Additional Marker/Locator Identified?				
	11.	Additional Marker/Locator Qualified?				
	12.	TtFW Self-Performing Location and Marking?				
	13.	If Yes to 12 Above, Approval From TtFW Director EHS Services?				
	14.	Area of Excavation "White-Lined" by TtFW?				
	15.	TtFW Present When Markings Completed?				
	16.	All Utilities Marked? (Refer to Attachment A, Table 1)				
	17.	All Markings Photo/Video Documented?				
	18.	Area Checked for Signs of Previous Excavation? (subsidence, new grass, patching, etc)				
	19.	All Applicable Information Recorded on Attachment A?				
	20.	Multiple Contractors Excavating On-Site?				
	21.	Separate Locate Requests for All Contractors?				
	22.	TtFW Subcontractors Excavating in TtFW White-Lined Area(s)?				
	23.	If Yes to 22 Above, One-Call Agency Contacted to Determine if TtFW Subcontractor Can be Added to Existing Locate Ticket?				
Excavation Activities	24.	Meeting and Site Walk-Over Conducted with Project Personnel? (Managers, Equipment Operators, Laborers, Competent Person, Excavation Observer, etc)				
	25.	AHA and EHSP Review Conducted With Personnel?				
	26.	Do Site Activities Have Potential to Obliterate Utility Markings?				
Excavation Activities – Cont'd	27.	If Yes to 26 Above, Have Provisions Been Made to Preserve Markings?				

EHS 3-15 - ATTACHMENT B

UNDERGROUND UTILITIES MANAGEMENT CHECKLIST

PHASE		TASK	YES	NO	NA	COMMENTS Required if Response is No or NA. (Reference Item Number)
	28.	Has an Excavation Observer Been Designated to Monitor Excavation When Occurring within 4 Feet of the Buffer Zone?				
	29.	Have Operator and Observer Reviewed Commands and Signals?				
	30.	Has TtFW-Required 4-Foot Buffer Zone Been Marked on Either Side of Markings Placed by Locator?				
Excavation Within Buffer Zone	31.	Is Excavation Within The Buffer Zone Absolutely Necessary?				
	32.	If Yes to 31 Above, Can Non-Aggressive Methods Be Used For Excavation In The Buffer Zone? If Yes, Identify Appropriate Non-Aggressive Methods.				
	33.	If No to 32 Above, Has a Buffer Zone Exemption Request (FCN) Been Approved by The PESM? If No, then Aggressive Methods May Not Be Used in The Buffer Zone.				
	34.	If Yes to 33 Above, Has the Utility Been De-Energized, Purged, Verified/Tested, and Locked-Out? Or, Has The Depth and Orientation of the Utility Been Adequately and Visually Determined Through The Use of Non-Aggressive Methods?				
	35.	If Yes to 34 Above, Have All of The Following Conditions Been Met? For Utilities Containing Electrical Energy, Is The Depth of The Water Table Below The Depth of The Utility? Have Regulations Been Consulted to Determine Specific State Requirements Relative to Excavating in The Buffer Zone? Have Appropriate Physical Protection Measures Been Implemented to Prevent Equipment Contact With Utilities and to Prevent Damage to Utilities? Has The FCN Requesting The Buffer Zone Exemption Been Signed by The PESM? If No to Any of The Above Conditions, Then Only Non-Aggressive Excavation Methods May Conducted in The Buffer Zone, Since The Conditions of The Exemption Have Not Been Satisfied.				
Working Around Exposed Utilities	36.	If Necessary, Have Provisions Been Made to Support the Utility During Work Activities?				
	37.	Have Spoils Been Placed as far Away From the Excavation as Feasible?				
	38.	Has the Utility Been De-Energized? (If Any Portion of the 4-Foot Buffer Zone around a Utility is Inside of the White-Lined Area)				
	39.	Has the Isolation Point for the De-Energized Utility Been Physically Locked-Out?				
Working Around Exposed Utilities –Cont'd	40.	If No to 39 Above, Has a Spotter Been Assigned to Monitor Isolation Point?				
	41.	If Yes to 40 Above, Does the Spotter Have Adequate Communications? (Radio, Telephone, etc)				
	42.	Has the Isolation Point Been Tagged?				
Damage Discovery	43.	Has Pre-Existing Damage to a Utility Been Discovered During Excavation?				
	44.	If Yes to 43 Above, Has the One-Call Agency and/or Utility Owner Been Notified?				
	45.	If Yes to 43 Above, Have Photographs Been taken?				

EHS 3-15 - ATTACHMENT B

UNDERGROUND UTILITIES MANAGEMENT CHECKLIST

PHASE		TASK	YES	NO	NA	COMMENTS Required if Response is No or NA. (Reference Item Number)
Encountering or Contacting Underground Utilities	46.	Have Utilities Been Encountered in Locations That Have Not Been Marked?				
	47.	If Yes to 46 Above, Has the One-Call Agency or Other Locating Service Been Contacted?				
	48.	If Yes to 46 Above, Has the PM and PESM Been Notified?				
	49.	If Yes to 46 Above, Has a TtFW Incident Report per EHS 1-7 Been Completed? (Include Photographs)				
	50.	Has Excavation Equipment Come In Contact With Underground utilities?				
	51.	If Yes to 50 Above, Were Intrusive Activities Immediately Curtailed?				
	52.	If Yes to 50 Above, Has a Damage Determination Been Made From a Safe Distance?				
	53.	If Yes to 50 Above, Has the Area Been Secured?				
	54.	If Yes to 50 Above, Have Emergency Responders Been Notified?				
	55.	If Yes to 50 Above, Has the Locating Agency and/or Utility Owner Been Notified?				
	56.	If Yes to 50 Above, Have State and Local Reporting Requirements Been Met?				
	57.	If Yes to 50 Above, Were Intrusive Activities Curtailed Until; Inspection From Utility Owner, Orientation and Depth of Utility Was Determined and Marked, Permission From Emergency Responders Given?				
	58.	If Yes to 50 Above, Has a TtFW Incident Report per EHS 1-7 Been Completed? (Include Photographs)				

CHECKLIST COMPLETED BY:

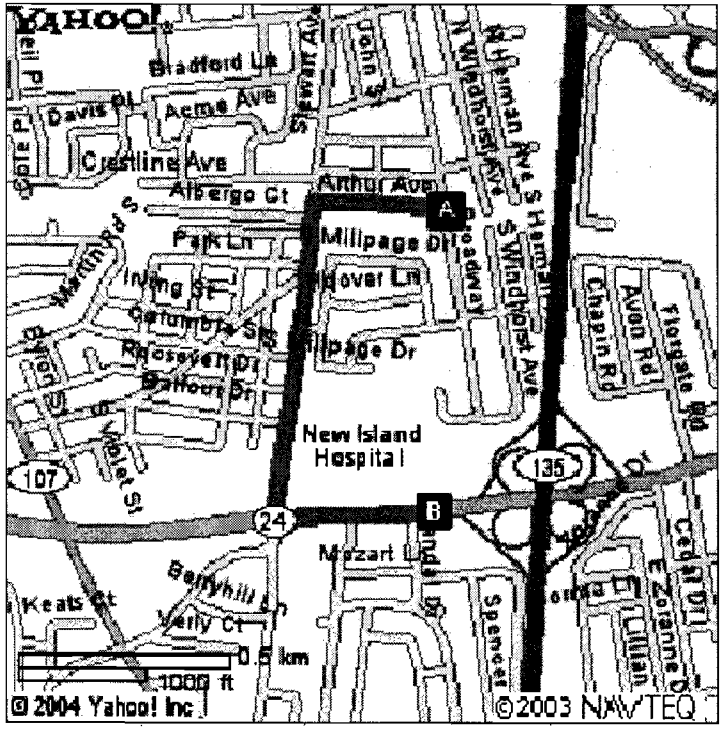
NAME	SIGNATURE	DATE
NAME	SIGNATURE	DATE

Appendix I

Hospital Route Map

Driving directions from located at Broadway at Arthur Avenue, Bethpage, NY to New Island Hospital, 4295 Hempstead Turnpike, Oyster Bay, NY

1: Start out on ARTHUR AVE (at BROADWAY) going towards LEROY AVE.
2: Turn LEFT onto STEWART AVE.
3: Turn LEFT onto BETHPAGE TURNPIKE / HEMPSTEAD TURNPIKE.
4: End at New Island Hospital



	U.S. Navy RAC Engineering Field Activity, Northeast
	GM-38 Area (Offsite) NWIRP Bethpage Bethpage, NY
	Figure 12.1 Hospital Route Map
	TETRA TECH FW, INC.

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Appendix J

Weekly/Monthly Safety Reports

TETRA TECH FW INC.
EFANE EEKLY HEALTH AND SAFETY REPORT

Proiect Name: _
Location: _

SITE INFORMATION
Week Ending _

Hours
Worked: Craft: _PS: _Subs: _

Check Level of Protection
For the week: B _ C _ D _

INIURIES AND ILLNESSES
ás_ No_
Describe:
_
_
_

MAOR ACTIVITIES CONDUCTED THIS EEK:
(drum handling, sampling, excavation, abatement/TR, etc.)
_
_
_

SIGNIFICANT EVENTS THIS EEK:
(regulatory visits, equipment malfunctions, process start-up or shutdown):
_
_
_

FUTURE ISSUES:
(schedule, manpower allocation, monitoring equipment, other resources needed)
_
_
_
_

SITE AUDIT/INSPECTIONS CONDUCTED ás _No _
(describe outstanding findings and attach results)
_
_
_
_
_

HIPO ACTIVITIES

Hot Work	ás	_No _	Dates: _
Lockout/Tagout	ás	_No _	Dates: _
Confined Space Entry	ás _	No _	Dates: _
Soils Analysis Classification	ás	_No _	Dates: _
Excavation Daily Check List	ás	_No _	Dates: _
Crane On-Site	ás	_No _	Dates: _
Critical Lift Plan Performed	ás	_No _	Dates: _

TETRA TECH FW INC.
EFANE EEKLY HEALTH AND SAFETY REPORT

REAL TIME AIR MONITORING

Major Activity	Location(s)	Worker Occupation Monitored	FID/PID Range and Readings	CGI/02 Range and Readings	PDM Range and Readings	Other

PERSONAL AIR MONITORING

Activity Monitored	Location	Occupation	Type of Sample	Analyte	Result

SUBCONTRACTORS ON SITE

Company Name	Task or Function	Return to Site Next Week (Y/N)	Performed Subcontractor Review (Y/N)

_ Site Health and Safety Officer - Signature _ Date

Monthly Statistical Report

PROJECT: ____ MONTH: ____ PROJECT START DATE: __/__/__	TRW MANUAL			TRW NON-MANUAL			SUBCONTRACTOR TOTALS			PROJECT TOTALS		
	Month	YTD	PTD	Month	YTD	PTD	Month	YTD	PTD	Month	YTD	PTD
1. First Aid Cases												
2. Total OSHA Recordables												
3. Restricted Duty Cases												
4. Restricted Duty Workdays												
5. Lost Time Cases												
6. Lost Time Workdays												
7. Hours Worked - Estimated												
8. Property Losses >$500												
9. High Loss Potential Incidents												
10. Total Incidents Investigated												

Project Incident Rates	YTD	PTD	Nat'l Avg.
Total OSHA Recordable Rate			10.6
Lost Workday Rate			4.9
Lost Workday Severity Rate			39

OSHA Recordable Rate = # Recordables x 200,000 / # of hours worked

Lost Work Day Rate = Total # of lost time cases and restricted duty cases x 200,0 / # of hours worked

Lost Work Day Severity Rate = Total # of days lost and days restricted x 200,000 / # of hours worked

Revised 5/14/2004

Monthly Health and Safety Report

PROJECT: ______________________ **MONTH:** ______________________

I. Descriptive Summary of Accidents/Incidents

II. Summary of Site Safety Inspections and Audits

III. Other Issues

1. Recognition and awards program:
2. Site specific training:
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4. H&S program administration/implementation:
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6. Unique exposure hazards:
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APPENDIX B

STANDARD OPERATING PROCEDURES (SOPS)

APPENDIX B

STANDARD OPERATING PROCEDURES (SOPS)

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Mobilization and Demobilization (SOP 1)

This field investigation activity consists of field personnel orientation, equipment mobilization, the determination of monitoring well, extraction well and injection well locations, and demobilization. Each field team member will attend an on-site orientation meeting to become familiar with the history of the site, health and safety requirements, and field investigation procedures.

Equipment mobilization will entail the ordering, purchase, and if necessary, fabrication of all sampling supplies and equipment needed for the field investigation. An inventory of available TtFW supplies/equipment will be conducted prior to initiating field activities, and all additional equipment required will be secured. A field office trailer will be set up and necessary utility hookups will be made as part of the mobilization effort.

During mobilization, locations for the geotechnical borings, monitoring wells, extraction wells and injection well will be staked.

Phase II Investigation mobilization will consist of staking all additional locations (as applicable), prior to sampling. The types and locations of samples to be collected during this phase will be determined from Reconnaissance Phase and Phase I Investigation data.

Equipment and personnel will be demobilized at the completion of each phase of field activities as necessary. Equipment demobilization may include (but will not be limited to) sampling equipment, drilling subcontractor equipment, and field office trailer and utility hookups. Demobilization will also consist of site-area clean-up, staging and inventory of investigation-derived wastes, and organization of investigation records.

Downhole Geophysics (SOP 5)

Downhole gamma-ray geophysical logging will be conducted by a subcontractor on the four geotechnical soil borings as they are completed. Gamma-ray logging may be conducted in cased as well as uncased boreholes, and, because clays typically contain a higher percentage of gamma emitting minerals, can be useful for identification and correlation of claycy zones. The gamma-ray log tends to provide an indication of stratigraphic change from the glacial deposits to the underlying formation whether or not there is an intervening clay unit. Downhole geophysical logging will be conducted in accordance with the following procedure:

1. Be certain that the well has ample clearance for the gamma probe to pass without obstruction or binding. A dummy cylinder with the same diameter as the gamma log tool may be lowered downhole as a test for obstructions. Downhole may be performed if significant uncertainty exists. Wear appropriate health and safety equipment.

2. Set the tripod over the wellhead and park the mobile unit at a convenient location.

3. Slowly and carefully lower the probe to the bottom of the well with the logger recording the counts per second (cps) of gamma radiation. The descent is a "dry" run until the well bottom is attained.

4. Set the plotter so the gamma-ray logging is recorded on a graph. Set the upward speed at a constant rate. Bring the probe to the surface.

5. If the graph is successfully plotted, perform appropriate decontamination on the probe and the line and proceed to the next logging location.

Deep Subsurface Soil Boring Sampling [Split-Spoon] (SOP 13)

1. Drill a borehole to the desired sampling depth. Drive a split-spoon sampler into the undisturbed soil to be sampled.

2. Drive a decontaminated carbon steel 2-inch outer diameter split-spoon sampler using 140 pound hammer falling 30 inches until either approximately 2 feet has been penetrated or 100 blows within a 6-inch interval have been applied (modified from ASTM Method D-1586-84).

3. Record the number of blows required for each 6 inches of penetration or fraction thereof. The first 6 inches is considered to be a seating drive. The sum of the number of blows required for the second and third 6 inches of penetration is termed the penetration resistance. If the sampler is driven less than 2 feet, the penetration resistance is for the last 1 foot of penetration. (If less than 1 foot is penetrated, the logs shall state the number of blows and the fraction of 1 foot penetrated.)

4. Bring the sampler to the surface and remove both ends and one half of the split-spoon so that the recovered soil rests in the remaining half of the barrel. Place the split-spoon on clean polyethylene sheeting. Visually classify the sample in accordance with the Unified Soil Classification System. Describe thoroughly the approximate recovery (length), composition, color, moisture, etc. of the recovered soil.

5. Complete sample logs, labels, custody seals, and chain of custody forms. Record sample information in the field notebook.

6. Prepare samples for shipment or delivery to the geotechnical laboratory.

Monitoring Well Installation [Overburden Well] (SOP 22)

Overburden monitoring wells will be constructed and installed in accordance with the following procedure:

1. Wear appropriate health and safety equipment as outlined in the Site-Specific Health and Safety Plan.

2. The borehole will be advanced using a hollow-stem auger or mud rotary drill rig (or other appropriate method) to the desired screening depth, as determined by the water table surface levels.

3. Borehole advancement will be conducted using 8-inch mud rotary drilling.

4. Construct all deep **([Magothy Formation])** monitoring wells using 10 feet of 4-inch diameter Schedule 80 PVC screen (or Schedule 5 stainless steel) (0.010-inch slot) and 4-inch diameter Schedule 80 PVC riser pipe. For non-flush mounted wells, at least 2 feet of riser pipe must extend above the ground surface.

5. Backfill the annular space to approximately 2 feet above the well screen with Morie No. 1 sand. The remaining annular space will be filled with bentonite/cement slurry up to the surface. The ratio of cement to bentonite for grouting will be approximately 94 pounds of cement to every 5 pounds of bentonite with up to 6 gallons of water.

6. Complete the monitoring well as described in **[SOP 26 (Monitoring Well Completion)]**.

Monitoring Well Completion (SOP 26)

Each monitoring well installed during pre-design investigation activites at the site will be completed in accordance with the following procedure:

1. Install a locking steel cap over the top of the carbon steel casing. The cap will be locked to ensure that well access will only be provided during well development, sampling or water level measurement events. All locks will be keyed alike. The monitoring well ID number will be stamped on the protective casing with a steel die, and the well casing coated with a protective paint. A protective casing will be used for overburden wells.

2. Construct a concrete pad around the security casing mounded in such a way as to direct surface runoff from the casing. Concrete will be used to fill the space above the bentonite-cement slurry (at approximately 3-feet below grade) to grade, including a 2-foot by 2-foot by 8-inch pad. Drill a hole in the protective casing (stick up) above the concrete pad to provide a drain for water accumulated within the casing annulus.

Monitoring Well Development (SOP 27)

Each monitoring well installed at the Site as part of the field investigation will be developed in accordance with the following procedure:

1. Wait at least 48 hours for the grout to cure subsequent to monitoring well completion before beginning well development. Each new well will be developed by pumping and surging. The surge blocks will be cylinders that have a diameter slightly smaller than the borehole of the well. Rubber flaps of a slightly larger diameter will be attached to the surge blocks and will come into contact with the sides of the borehole The surge blocks will be raised and lowered across the length of the screen to remove fine particles and deposits which may be clogging the screen. During the surging procedure the well will be pumped using a centrifugal pump to remove suspended particles and induce flow into the well to prevent clogging of the sand pack.

2. Continue development until there is less than a 10 percent variance between successive measurements of pH, temperature, turbidity, and conductivity and/or turbidity is less than 5 NTUs. Development will be continued for a minimum of two hours, but for no longer than eight hours without client permission.

Development (and purge water) will be containerized in drums for proper disposal.

Air Monitoring [Real Time] (SOP 31)

Real-time air monitoring will be conducted during all intrusive site program activities to ensure the safety of all field personnel. Air monitoring will be conducted by a trained SHSO utilizing a PID or FID, as outlined in the Site-Specific Health and Safety Plan. The procedure for conducting air monitoring is described below.

1. Wear appropriate health and safety equipment as outlined in the Site-Specific Health and Safety Plan.

2. Ensure that the selected air monitoring equipment has been fully charged in accordance with the Site-Specific Health and Safety Plan, and the manufacturer's instructions.

3. At the start of each day's activities, and as appropriate during the day, calibrate all air-monitoring instruments in accordance with the Site-Specific Health and Safety Plan, and the manufacturer's instructions.

4. During drilling activities, air monitoring readings should be measured at the borehole and in the breathing zone of field personnel at regular intervals, as described in the Site-Specific Health and Safety Plan. In addition, air monitoring readings will be collected from each split-spoon sampler as they are opened. Readings will be measured during all other intrusive activities (e.g., opening monitoring wells). Readings should be recorded in field logbooks and on log sheets as described in the Site-Specific Health and Safety Plan.

5. Should readings exceed action levels, appropriate action will be taken, as described in the Health and Safety Plan.

Water Level Measurement (SOP 44)

Water level measurements will be conducted in accordance with the following procedure:

1. Groundwater level measurements will be collected from all monitoring wells primarily using an electronic water level indicator. An interface probe will also be used during the initial measurement round and periodically through the program to check for the presence of free product. Water levels will be measured, relative to surveyed datum (i.e., top of well riser), at a specific mark on the casing, to the nearest 0.01 foot.

2. Electronic water level indicators will preferably be the type with water level markings on the cable at increments of 0.01 foot or less.

3. All electronic water level measurements will be recorded in the appropriate field logbook or data sheet.

4. The electronics of the water level indicator will be checked prior to the commencement of measurements with a jar of water and the depths calibrated on the ground against a steel tape.

5. The water level indicator cable, tape and probe will be decontaminated between wells by rinsing with deionized water (**[see SPO 53]**).

Groundwater Sampling [Field Parameter Measurement] (SOP 46)

Field parameters (**[temperature, pH, turbidity, specific conductance, and/or dissolved oxygen]**) will be monitored during purging of the monitoring wells and prior to surface water sampling, utilizing a Horiba® water quality meter or equivalent. Measurements will be conducted in accordance with the manufacturer's instructions and the following procedure:

1. Calibrate the water quality meter as per manufacturer's instructions.
2. For low flow purging of the monitoring wells:
   - Attach a flow-through cell to the Teflon-lined polyethylene tubing. Position the water quality meter probe in the flow-through cell. Begin purging the monitoring well, following **SOP 47 (Low Flow Purge)**.
   - After the cell has been "flushed" at least twice, begin monitoring the field parameters, and continue approximately every 3 to 5 minutes during purging. All water quality measurements will be recorded in the appropriate field logbook or on a well purge data sheet.
   - When the indicator parameters have stabilized for three consecutive readings (see **[Step 11 of Procedure 47 (Low Flow Purge)]**), the well is considered stabilized and ready for sample collection. Remove the flow-through cell from the tubing.
3. All water quality measurements will be recorded in the appropriate field logbook.
4. The probe of the water quality meter will be decontaminated between wells by rinsing with deionized water (see **[SOP 53]**).

Groundwater Sampling [Low Flow Purge Procedure] (SOP 47)

Groundwater samples will be obtained starting at the least contaminated well and proceeding systematically to the well likely to be most contaminated. All monitoring well samples will be analyzed for the parameters identified in the Work Plan (VOCs, inorganics, total dissolved solids, total suspended solids and chemical oxygen demand) in accordance with the following procedures:

1. Check and record the condition of the well for any damage or evidence of tampering.
2. Remove the well cap.
3. Measure well headspace with a PID or FID and record the reading in the field logbook.
4. Measure and record the depth to water as stated in **[Procedure 44 (Water Level Measurement),]** and record the measurement in the field logbook. Do not measure the depth to the bottom of the well at this time (to avoid disturbing any sediment that may have accumulated). Obtain depth to bottom information from installation information in the field logbook or drilling logs. Calculate volume of the water column.
5. Lay out plastic sheeting and place the monitoring, purging and sampling equipment on the sheeting. To avoid cross-contamination, do not let any downhole equipment touch the ground.
6. Re-check and record the depth to water after approximately 5 minutes at the well location. If the measurement has changed more than 0.01 foot, check and record the measurement again, then begin well purging.
7. Attach and secure the Teflon-lined polyethylene tubing to the low-flow submersible pump. As the pump is slowly lowered into the well, secure the safety drop cable, tubing, and electrical lines to each other using nylon stay-ties placed approximately 5 feet apart.
8. Set the pump at approximately the middle of the screen and/or the best depth based on the stratigraphy of the well. Be careful not to place the pump intake less than 2 feet above the bottom of the well as this may cause mobilization of any sediment present in the bottom of the well. Start pumping the well at 0.2 to 0.5 liters per minute.
9. Monitor the water level in the well periodically during pumping, and ideally the pump rate should equal the well recharge rate with little or no water level drawdown in the well (drawdown shall be 0.3 foot or less). There should be at least 1 foot of water over the pump intake so there is no risk of the pump suction being broken, or entrapment of air in the sample. Record the pumping rate adjustments and depth(s) to water in the logbook. Pumping rates should, if needed, be reduced to the minimum capabilities of the pump (0.1 to 0.2 liters per minute) to avoid purging the well dry. However, if the recharge rate of the well is very low and the well is purged dry, then wait until the well has recharged to a sufficient level and collect the appropriate volume of sample with the submersible pump.
10. Purge the well at a low-flow rate (from 0.2 to 0.5 liters per minute). During purging, monitor the field parameters (temperature, pH, turbidity, Eh, specific conductance, and dissolved

oxygen) approximately every 3 to 5 minutes. A flow-through cell will be used to monitor the field parameters. Begin measuring field parameters after the flow-through eell has been "flushed" with groundwater twice.

11. The well is considered stabilized and ready for sample collection when the indicator parameters have stabilized for three consecutive readings, as follows:

    - 0.1 for pH
    - 3 percent for specific conductance
    - 10 percent for dissolved oxygen
    - 10 percent for turbidity
    - I0 mV for Eh

    Dissolved oxygen and turbidity usually require the longest time to aehieve stabilization. The pump must not be removed from the well between purging and sampling.

12. Once the field parameters have stabilized, collect the samples directly from the end of the tubing. Volatiles and analyses that degrade by aeration must be collected first. The bottles should be preserved and filled according to the procedures specified in the Work Plan.

13. Fill all sample bottles by allowing the pump discharge to flow gently down the inside of the bottle with minimal turbulence. Cap each bottle as it is filled.

14. Preserve and label the samples, and record them on the chain of custody. Place immediately into a cooler for shipment and maintain at 4°C.

15. The filling and preservation procedures will be:

    - VOCs – Fill each sample vial to just overflowing so that no air bubbles are entrapped inside. If effervescence occurs, submit the sample without preservative and note on the chain of custody.

    - Other Parameters – Fill each container and preserve immediately as required. To test for pH, pour a minimal portion of the sample onto a broad range pH paper to verify that the appropriate pH level has been attained.

16. Carefully remove the pump assembly from the well. The Teflon-lined polyethylene tubing will be dedicated to each well. The tubing should be placed in a large plastie garbage bag, sealed, and labeled with the appropriate well identification number.

17. After sampling is complete, measure the total depth of the well.

18. Close and lock the well.

Aquifer Testing [Step Tests] (SOP 49)

Short term step tests of the selected pumping wells (extraction wells) will be performed to estimate the hydraulic properties of the aquifer(s) and to establish long term pumping/extraction rates.

The well will be pumped at several successively higher pumping rates, and the drawdown for each step will be recorded. The rates may be increased without recovery periods, or the water level may be allowed to recover to the static level between each step. Each step test will have the same duration. Four to five steps are expected to be performed, each lasting 1 to 2 hours.

Water levels will be measured in all seleeted observation wells prior to start of pumping to establish the pre-pumping trend (i.e., fluetuations in groundwater levels unrelated to the pump test). The period of monitoring will be approximately one week. The trend in all observation wells should be similar. A well with an unusual trend may reflect effects of local disturbance in the hydrologic system.

Decontamination [Drilling Equipment] (SOP 52)

All drilling equipment involved in field sampling activities will be decontaminated prior to and subsequent to sampling. Equipment leaving the Site will also be decontaminated.

All drilling equipment will be steam cleaned prior to use. Pressurized steam will be used to remove all visible excess material from augers, rods, drill bits, the back of the drilling rig, and other parts of the rig which contact augers, rods, and split-spoons.

Steam cleaning will be conducted on a decontamination pad, which will be constructed on-site for the field investigation.

Any decontamination fluids that result from steam cleaning operations will be stored in U.S. Department of Transportation (USDOT)-approved 55-gallon drums until disposal. Personnel directly involved in equipment decontamination will wear appropriate protective clothing, as stated in the Site-Specific Health and Safety Plan (Appendix A).

Decontamination [Field Instrumentation - Probes, Water Quality Meters, etc.] (SOP 53)

Field instrumentation (such as interface probes, water quality meters, etc.) will be decontaminated between sample locations by rinsing with deionized water. If visible contamination still exists on the equipment after the rinse, an Alconox detergent scrub will be added, and the probe thoroughly rinsed again.

Decontamination of sampling equipment will be kept to a minimum in the field and wherever possible, dedicated disposable sampling equipment will be used. Any decontamination fluids generated will be stored in U.S. Department of Transportation (USDOT)-approved 55-gallon drums or in an on-site storage tank (liquids only) until disposal. Personnel directly involved in equipment decontamination will wear appropriate protective clothing, as stated in the Site-Specific Health and Safety Plan (Appendix A).

Decontamination [Non-disposable Chemical Sampling Equipment] (SOP 55)

Decontamination of non-disposable sampling equipment used to collect samples for chemical analyses (i.e., scoops, trowels, bowls, split-spoons, etc.) will be conducted as described below:

1. Alconox detergent and potable water scrub
2. Potable water rinse.
3. 10 percent nitric acid rinse (ultra pure grade) when sampling for inorganics. Carbon steel split spoons will be rinsed with a 1 percent acid solution to prevent stripping of metals.
4. Deionized water rinse.
3. Methanol rinse followed by a hexane rinse (solvents are pesticide grade or better) for equipment involved in the sampling of organics.
4. Deionized water rinse (volume at least five times amount of solvent used in rinse step above).
5. Air dry.
6. Wrap or cover exposed ends of equipment with aluminum foil for transport and handling.

Decontamination of sampling equipment will be kept to a minimum in the field and wherever possible, dedicated disposable sampling equipment will be used. Decontamination fluids will be stored in U.S. Department of Transportation (USDOT)-approved 55-gallon drums or in an on-site storage tank (liquids only) until disposal. Personnel directly involved in equipment decontamination will wear appropriate protective clothing, as stated in the Site-Specific Health and Safety Plan (Appendix A).

Decontamination [Low Flow Groundwater Sampling Equipment] (SOP 56)

The following decontamination procedures will be performed for the low flow purge and sampling procedure.

Non-disposable sampling equipment, including the pump, support cable and electrical wires in contact with the sample, must be decontaminated thoroughly each day before use ("daily decon") and after each well is sampled ("between-well decon"). For pumps, it is strongly recommended that non-disposable sampling equipment, including the pump, support cable and electrical wires in contact with the sample, be decontaminated thoroughly each day before use ("daily decon"). USEPA's field experience indicates that the life of pumps may be extended by removing entrained grit. All non-dedicated sampling equipment (pumps, tubing, etc.) must be decontaminated after each well is sampled ("between-well decon," see below).

Daily Decon

1. Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.
2. Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Alconox, for 5 minutes and flush other equipment with fresh detergent solution for 5 minutes. Use the detergent sparingly.
3. Rinse: Operate pump in a deep basin of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.
4. Disassemble pump.
5. Wash pump parts: Place the disassembled parts of the pump into a deep basin containing 8 to 10 gallons of non-phosphate detergent solution. Scrub all pump parts with a test tube brush.
6. Rinse pump parts with potable water.
7. Rinse the following pump parts with distilled/deionized water: inlet screen, shaft, suction interconnector, motor lead assembly, and stator housing.
8. Place impeller assembly in a large glass beaker and rinse with 1 percent nitric acid (HNO_3).
9. Rinse impeller assembly with potable water.
10. Place impeller assembly in a large glass beaker and rinse with isopropanol.
11. Rinse impeller assembly with distilled/deionized water.

Decontamination [Low Flow Groundwater Sampling Equipment] (SOP 56) (Cont'd)

Between-Well Decon

1. Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

2. Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Alconox, for 5 minutes and flush other equipment with fresh detergent solution for 5 minutes. Use the detergent sparingly.

3. Rinse: Operate pump in a deep basin of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

4. Final Rinse: Operate pump in a deep basin containing 1 to 2 gallons of distilled/deionized water, as final rinse.

Decontamination of sampling equipment will be kept to a minimum in the field and wherever possible, dedicated disposable sampling equipment will be used. Decontamination fluids will be stored in U.S. Department of Transportation (USDOT)-approved 55-gallon drums or in an on-site storage tank (liquids only) until disposal. Personnel directly involved in equipment decontamination will wear appropriate protective clothing, as stated in the Site-Specifie Health and Safety Plan (Appendix A).