USACE CONTRACT NO. DACW33-94-D-0002
TASK ORDER NO. 020
TOTAL ENVIRONMENTAL RESTORATION CONTRACT

FINAL
WORK PLAN
NON-TIME CRITICAL REMOVAL ACTION FOR CHROMIUM AND VOC GROUNDWATER OPERABLE UNIT (OU) 2 EE/CA
STRATFORD ARMY ENGINE PLANT
Stratford, Connecticut

August 1999

Prepared for

U.S. Army Corps of Engineers
New England District
Concord, Massachusetts

Prepared by

Foster Wheeler Environmental Corporation
Boston, MA

and

Harding Lawson Associates
Portland, Maine

Revision Affected	Date	Prepared By	Approved By	Pages
0	6/25/99	N. Walter R. Pendleton G. Rustad	J. Borkland P. Vernon	All
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1.0 INTRODUCTION

Foster Wheeler Environmental Corporation (Foster Wheeler) and Harding Lawson Associates (HLA) have been contracted through the U.S. Army Corps of Engineers – New England District (USACE) to complete a Non-time Critical Removal Action (NCRA) for chromium and volatile organic compound (VOC) groundwater contamination (Operable Unit [OU] 2) at the Stratford Army Engine Plant (SAEP) under Task Order No. 020 of Contract No. DACW33-94-D-0002. The objectives of this Task Order are to 1) complete additional field activities necessary to provide further characterization of subsurface conditions at SAEP, 2) summarize the results of previous field activities in a report, 3) conduct bench-scale testing to determine the effectiveness of particular in-situ technologies at reducing contamination in groundwater at the site, and 4) document the decision process for selection of a removal action for OU 2 in an Engineering Evaluation/Cost Analysis (EE/CA). A pilot-scale test of an in-situ groundwater treatment technology is also planned during this time period; however, a separate plan will be developed for the pilot-scale test after bench-scale testing is completed.

1.1 PROJECT INTRODUCTION

SAEP is located on approximately 124 acres in Stratford, Connecticut, on the Stratford Point peninsula in the southeast corner of Fairfield County (Figure 1) (see Attachment). About 76 acres of the land are improved and 48 acres are riparian (water) rights (see Figure 1).

SAEP was formerly a government-owned, contractor-operated facility. The land and buildings are owned by the U.S. Army, and former plant equipment (removed in early 1998) was owned by both the U.S. Army and it's contractor AlliedSignal Engines. The U.S. Army-owned land, buildings, and equipment were formerly provided to AlliedSignal under a facilities contract for executing government contracts, including the manufacture and testing of turbine engines for the U.S Army. The SAEP property consists of 49 buildings, paved roadways and grounds, and five paved parking lots (Figure 2).

Responsibility for the jurisdiction, control, and accountability of SAEP was transferred from the U.S. Army Aviation and Troop command to the U.S. Army Tank-Automotive and Armament Command (TACOM) in September 1995. In October 1995, SAEP was placed on the Base Closure and Realignment (BRAC) list, known as BRAC 95. Pursuant to the Defense Base Closure and Realignment Act of 1990, the BRAC Environmental Restoration Program mandates that environmental contamination on BRAC properties be investigated and remediated, as necessary, prior to disposal and reuse. In August 1998, SAEP was transitioned from an active production facility to caretaker status.

1.2 AUTHORITY

For BRAC 95 facilities, the Environmental Restoration Program begins with an Environmental Baseline Survey (EBS) to describe the environmental condition of the property. ABB Environmental Services (subsequently HLA) published the Final EBS in December 1996. A Remedial Investigation (RI) is currently being conducted by URS Greiner-Woodward Clyde Federal Services (URSGWCFS) under a contract to the USACE to characterize the type and extent of contamination at SAEP and evaluate potential risks to human health and the environment.

In June 1998, chromium contamination was identified in subsurface soil beneath the concrete floor of the former Chromium Plating Facility in Building B-2. SAEP contracted HLA, through a subcontract to AlliedSignal, to perform additional site characterization to develop a removal action recommendation for the site. HLA's sampling indicated concentrations of hexavalent chromium in soil and groundwater beneath the former Chromium Plating Facility that exceeded Connecticut Department of Environmental Protection (CTDEP) Remediation Standard Regulation (RSR) criteria. HLAs sampling also identified high concentrations of chromium in dust samples within the building. Based on the concentrations of total chromium in the dust samples, a Time-Critical Removal Action Memorandum was written, proposing decontamination of the former Chromium Plating Facility and further investigation of site soil and groundwater followed by in-situ hexavalent chromium reduction of soil.

The facility decontamination was completed in December 1998. Decontamination procedures included sweeping, the removal of debris and dust from the concrete floor, and pressurized steam washing of the ceiling, overhead beams, walls, and floor. Wipe sampling conducted following the decontamination procedures indicated that relatively high concentrations of hexavalent chromium were still present on the floor and in limited areas on overhead beams and walls.

Further soil and groundwater investigations revealed concentrations of hexavalent chromium in groundwater at 100 times previously detected levels (concentrations of up to 950 milligrams per liter [mg/L]), and in an area much larger than expected (Figure 3). In addition, high concentrations of VOCs were unexpectedly detected during the groundwater chromium investigations (concentrations above 100 mg/L). Investigations conducted through May 1999, indicated significant concentrations of VOCs emanating from several potential source areas around SAEP facility (Figure 4). As a result of these investigations, a NCRA was recommended by the U.S. Army for groundwater hot-spots at SAEP (OU 2).

1.3 PURPOSE AND SCOPE OF WORK PLAN

Data from HLA's groundwater and soil investigations from August 1998 through March 1999 were evaluated and summarized in the Draft Data Package for the Chromium Plating Facility Investigation (HLA, 1999). In order to provide a removal action recommendation for OU 2, additional data is required to more fully characterize and evaluate groundwater contamination at identified VOC source area hot spots. Using this data, an EE/CA can be written presenting the recommended OU 2 removal action alternative.

The purpose of this Work Plan is to describe the activities proposed for completion under the OU 2 NCRA. Because a detailed Work Plan has been completed for SAEP by URSGWCFS in support of RI activities, this Work Plan will reference applicable sections of that Work Plan (URSGWCFS, 1998) rather than duplicate that information, when appropriate.

1.4 ORGANIZATION OF WORK PLAN

This Work Plan consists of eight sections, attachments, and appendices. Section 1 contains an introduction to the SAEP site and the purpose and scope of the Work Plan; Section 2 provides information on the history of SAEP; Section 3 summarizes previous investigations completed at the site; Section 4 outlines the project objectives; Section 5 lists the data gaps identified during data review, and the subsequent data quality objectives that have been developed; Section 6 details the work approach for the OU 2 NCRA; Section 7 introduces the OU 2 Waste Management Plan; and Section 8 outlines the management structure for the NCRA.

Attachment A contains figures referenced in this Work Plan and Attachment B contains a copy of Section 2.0 of the URSGWC RI Work Plan. Attachment C contains the CTDEP RSR criteria and Attachment D contains the Work Scope Outline/Cost Estimate Assumptions for the OU2 NCRA. Appendix A is the Sampling and Analysis Plan (SAP), Appendix B is the Quality Assurance Project Plan (QAPjP), and Appendix C is the Site Safety and Health Plan (SSHP).

2.0 SITE DESCRIPTION AND HISTORY

Section Two of the URSGWCFS RI Work Plan (URSGWCFS, 1998) provides a description of SAEP, including a land use assessment, a physical setting description, an ecological setting description, and a site history. Attachment 2 of this Work Plan contains a copy of Section Two of the URSGWCFS RI Work Plan.

3.0 PREVIOUS INVESTIGATIONS

Several previous investigations have been completed at SAEP, including:

- Preliminary Assessment Screening
- Resource Conservation and Recovery Act (RCRA) Facility Assessment
- Phase I Investigation
- Phase II Investigation
- Environmental Baseline Survey
- Remedial Investigation
- Chromium Plating Facility Investigations
- VOC Groundwater Investigations

The first five investigations are summarized in Section Three of the URSGWCFS RI Work Plan (URSGWCFS, 1998). Brief summaries of the three remaining investigations are presented in the following subsections.

3.1 REMEDIAL INVESTIGATION

The RI, currently being conducted by URSGWCFS, has consisted of site-wide sediment and surface water sampling and analysis (from the tidal flats of the Housatonic River), subsurface soil and groundwater sampling and analysis, and monitoring well installation and sampling. These activities were designed to determine the type and extent of contamination in these media at SAEP. These field investigations were initiated in November 1998 and are anticipated to be complete in late summer 1999. Following completion of the RI, human health and ecological risk assessments will be performed to determine the risks posed to human and ecological receptors from site contamination. The results of the RI will be presented in an RI Report scheduled to be issued as a Draft in the fall of 1999.

3.2 CHROMIUM PLATING FACILITY INVESTIGATIONS

In June 1998, SAEP hired AJS Environmental Services, Inc. (AJS), through a subcontract to AlliedSignal, to perform soil sampling beneath the floor of the Chromium Plating Facility. AJS collected over 60 subsurface soil samples from 30 borings, and analyzed the samples for total chromium. Analytical results indicated total chromium concentrations in soil would exceed the CTDEP RSR for hexavalent chromium (if all the total chromium was the hexavalent species); however, no chromium speciation was performed as part of this initial sampling event.

As a result of the detected chromium contamination, SAEP contracted HLA, through a subcontract to AlliedSignal, to perform additional site characterization and develop removal action alternatives to address the contamination. On August 20, 1998, HLA collected 12 additional subsurface soil samples and two groundwater samples from six locations beneath the former Chromium Plating Facility. Sampling results indicated concentrations of total chromium (analyzed by the Synthetic Precipitate Leaching Procedure [SPLP]) exceeded the CTDEP RSR Pollutant Mobility Criteria in soil. In addition, hexavalent chromium concentrations in groundwater exceeded the CTDEP RSR Surface Water Protection Criteria by two orders of magnitude (10.4 mg/L). Figure 5 identifies HLA's previous soil boring locations in the area of the former Chromium Plating Facility at SAEP.

GeoProbe investigations were initiated in January 1999 to further define the extent of chromium contamination in subsurface soil and groundwater in the area around the former Chromium Plating Facility. Figure 5 identifies HLA's previous soil boring locations and Figure 6 identifies HLA's hexavalent chromium groundwater sampling locations. The following bullets summarize activities conducted during the GeoProbe investigation:

- Collection of 41 subsurface soil samples from 21 boring locations (0-7 feet below ground surface [bgs]).
- Off-site analysis of these samples for hexavalent chromium, total chromium, cyanide, and pH.
- One sample from each boring was also analyzed off-site for manganese and total chromium using the SPLP method.
- Collection of 7 groundwater samples from 7 sampling locations that received on-site analysis for ferrous iron and off-site analysis for hexavalent chromium, inorganic compounds, cyanide, sulfate, and alkalinity.
- Collection of 182 groundwater samples from 32 sampling locations (WP-99-01 through WP-99-32) that received on-site Hach™ kit testing for hexavalent chromium and ferrous iron.
- Collection of field readings of pH, temperature, dissolved oxygen, specific conductivity, turbidity, and oxidation-reduction (REDOX) potential for each sample.
- Four of these samples were sent off-site for analysis for VOCs and semi-volatile organic compounds (SVOCs).
- Collection of 30 groundwater samples for confirmation analysis at an off-site laboratory for hexavalent chromium, inorganic compounds, cyanide, sulfate, and alkalinity.

Sampling results from the Chromium Plating Facility investigation indicated hexavalent chromium concentrations in groundwater as high as 950 mg/L, and detectable chromium at depths ranging from the groundwater surface to approximately 50 feet bgs. Figure 3 identifies the location of hexavalent chromium contamination exceeding the CTDEP RSR criteria in groundwater. In addition, concentrations of VOCs in the four samples sent for off-site analysis were in exceedance of the CTDEP RSR criteria, with one sample containing trichloroethylene (TCE) at a concentration above 100 mg/L. Results from the Chromium Plating Facility Investigation are contained in the Draft Data Package for the Chromium Plating Facility Investigation submitted to TACOM and AlliedSignal Engines in April 1999 (HLA, 1999).

3.3 VOC GROUNDWATER INVESTIGATIONS

Based on the VOC concentrations from the four samples collected and analyzed for VOCs during the Chromium Plating Facility Investigations, SAEP directed HLA to begin a VOC groundwater investigation in March 1999. Once again the GeoProbe equipment was used to collect groundwater samples from around the SAEP site. Sample locations are identified on Figure 4. The GeoProbe VOC groundwater investigation consisted of:

- Collection of 126 groundwater samples from 40 sampling locations (WP-99-33 through WP-99-72) that received on-site analysis for select VOCs using a gas chromatograph (GC).

- Collection of field readings of pH, temperature, dissolved oxygen, specific conductivity, turbidity, and REDOX potential for each sample.
- Split sample collection of 10 groundwater samples for VOC confirmation analysis at an off-site laboratory.

Results of the GeoProbe VOC investigation indicated concentrations of several VOCs exceeding CTDEP Surface Water Protection RSR criteria, including TCE, tetrachloroethylene (PCE), 1,1,1-trichloroethane (1,1,1-TCA), and 1,1-dichlroethylene (1,1-DCE). The Draft Data Package for the Chromium Plating Facility Investigation contains data results from the GeoProbe VOC investigation (HLA, 1999).

HLA conducted additional VOC groundwater investigations in April and May 1999 using a cone penetrometer to access depths not attainable by the GeoProbe equipment. Sample locations are identified on Figure 4) (CP-99-01 through CP 99-18). The cone penetrometer VOC groundwater investigation consisted of:

- Eighteen total cone penetrometer explorations were completed for stratigraphic data acquisition and collection of groundwater samples.
- A total of 87 groundwater samples from the water table to a maximum depth of 158 feet bgs, were sent to an off-site laboratory for VOC analyses.
- Stratigraphic logs of 17 explorations were recorded to better define in-situ subsurface geologic conditions beneath SAEP.
- Thirty-eight dissipation tests were conducted to obtain estimates of in-situ horizontal hydraulic conductivity.

Results of the cone penetrometer investigation provided deeper groundwater information and additional horizontal groundwater characterization to supplement the results obtained during the GeoProbe investigation. Analytical results provided better delineation to the extent of VOC contamination.

4.0 PROJECT OBJECTIVES

This section summarizes the project objectives for the OU 2 NCRA at SAEP. Three general categories are discussed to address project objectives, including regulatory framework, project goals, and Applicable or Relevant and Appropriate Requirements (ARARs).

4.1 REGULATORY FRAMEWORK

The NCRA for OU 2 at SAEP is being performed under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). In October 1995, SAEP was placed on the BRAC 95 list. The BRAC Environmental Restoration Program mandates that environmental contamination on U.S. Army BRAC properties be investigated and remediated, as necessary, prior to disposal and reuse.

Regulatory oversight is being provided by the CTDEP and the U.S. Environmental Protection Agency (USEPA). This Work Plan was prepared in accordance with CTDEP, CERCLA, and BRAC requirements.

4.2 PROJECT GOALS

The goal of the OU 2 NCRA is to more fully characterize site conditions and provide a recommended removal action to address groundwater contamination. Project activities will address the following goals:

- Establish the presence or absence, and the concentration of VOC vapors beneath SAEP buildings through a soil vapor survey.
- Determine the location and elevation of previous sampling locations with an elevation and location survey.
- Establish the presence or absence of dense non-aqueous phase liquid (DNAPL) contamination at selected locations through field testing.
- Determine the hydraulic properties of the aquifer in the vicinity of the former Chromium Plating Facility with an aquifer-pumping test.
- Use the results of the aquifer test and the cone penetrometer statigraphic data, to estimate the hydraulic properties of the aquifer in selected other areas of the site.
- Test the effectiveness of selected in-situ technologies at reducing hexavalent chromium and VOC contamination in groundwater using bench-scale testing.
- Determine through a geophysical seismic survey the features of the bedrock surface (optional task).
- Develop additional information on the extent of VOC groundwater contamination at the SAEP site through additional sampling, if necessary (optional task).
- Document the process used to determine the recommended removal action in an EE/CA.

4.3 REGULATORY COMPLIANCE PLAN (ARARS)

Federal, state, and local laws and statutes have been reviewed for two purposes: 1) to determine if permits are required for the proposed field activities, and 2) to evaluate the environmental criteria against which analytical results will be compared. CTDEP RSR criteria (see Attachment C) will be followed as one of the driving considerations in the selection and implementation of any removal action(s).

4.3.1 Permit Requirements

Disposal of investigation-derived waste (IDW) water is covered under an Emergency Discharge Authorization, which was issued by the CTDEP on March 18, 1999. This authorization covers discharge of wastewater from the SAEP Chemical Waste Treatment Plant (CWTP) generated during additional investigation and remediation activities conducted on-site. The expiration date for this authorization is March 18, 2000.

4.3.2 Criteria for Comparison to Sample Data

CTDEP has established RSR criteria for various media including target concentrations for indoor air and criteria for soil, groundwater, and surface water. The OU 2 NCRA will compare contaminant concentrations against RSR criteria to determine if removal actions are required for a specific media. The criteria to be considered include:

- Soil gas analytical data will be compared to CTDEP RSRs (industrial/commercial);
- Soil analytical data will be compared to Direct Exposure Criteria for Soil (industrial/commercial) and the GB Pollutant Mobility Criteria;
- Shallow groundwater analytical data will be compared to Volatilization Criteria for groundwater (industrial/commercial); and
- Groundwater analytical data will be compared to CTDEP's Surface water Protection Criteria for substances in groundwater.

5.0 DATA GAPS AND DATA QUALITY OBJECTIVES

In order to ensure adequate data has been collected to provide the information necessary to complete the EE/CA, data gaps must be identified and data quality objectives (DQOs) must be developed. This process is summarized in the following subsections.

5.1 DATA GAPS

As part of Work Plan development, a review of existing data related to groundwater contamination at SAEP was completed. The review encompassed previous data collected by HLA and URSGWCFS at the site and identified the following data gaps:

- Information on subsurface soil vapor concentrations is not currently available;
- Information on the horizontal location and elevation of previous sampling points is not complete;
- Confirmation is needed regarding the presence or absence of DNAPL for pilot-scale testing and full-scale design;
- The hydraulic properties of the aquifer in the areas of concern are not well known; and
- Information is required concerning the effectiveness of potential in-situ removal action technologies on groundwater contaminants.

In addition to the above-mentioned data, results of the URSGWCFS RI analytical data will need to be reviewed, when available, to determine if the data are adequate to provide a full characterization of groundwater contaminant conditions at the site. If additional data gaps are identified as a result of this review, four optional field tasks have been identified to fulfill the NCRA requirements (Section 6.0).

5.3 DATA QUALITY OBJECTIVES

DQOs have been developed to focus the OU 2 NCRA investigations and ensure the necessary data are collected to support recommendation of a removal action alternative. The DQOs can be qualitative or quantitative, and identify the type and/or quality of data required to characterize a site, support an action, and satisfy ARARs.

The following list presents the DQOs for the OU 2 NCRA investigations, and is the basis for the field activities identified in Section 6.0.

- Do concentrations of vadoze zone VOC soil vapors exceed CTDEP RSR criteria for soil vapor?
- What are the horizontal locations and elevations of previous sampling locations?
- Is DNAPL present in the areas proposed for future pilot-scale testing at the SAEP facility?
- What are the hydraulic properties of the aquifer in the vicinity of the former Chromium Plating Facility?

- What are the probable ranges of hydraulic properties of the aquifer in other areas of the site?
- What will be the most effective in-situ treatment method for contaminant concentrations and site conditions?

If it is determined that data from past field investigations do not provide a complete characterization of groundwater contamination at the SAEP site, additional DQOs will need to be addressed, including:

- What are the limits of groundwater contamination exceeding CTDEP RSR criteria at the site?
- What is the distribution of contaminant concentrations around the hot-spot areas?
- What are the changes in contaminant concentrations with time (i.e., are natural attenuation processes active in the groundwater system)?
- Could the features of the bedrock surface control the location and movement of potential DNAPL contamination?

Quantitative DQOs such as detection limits are discussed in Section 3.0 of the QAPjP presented in Appendix B of this Work Plan.

6.0 WORK APPROACH AND TASK PLAN

This section provides a brief summary of the OU 2 NCRA approach. There are six tasks and four options associated with the OU 2 NCRA, including:

- Task 1 Planning (Work Plan, SAP, QAPjP, SSHP)
- Task 2 BCT/RAB Support and Data Management
- Task 3 Initial Field Activities
  - Subtask 3.1 Soil Vapor Survey
  - Subtask 3.2 Location and Elevation Survey
- Task 4 Pre-Design Investigation Report
- Task 5 EE/CA Process
  - Subtask 5.1 EE/CA Planning
  - Subtask 5.2 Additional Field Activities
    - Additional subsurface investigations (completion of 2 soil borings)
    - Aquifer testing (includes installation of 1 pumping well, 8 monitoring wells)
    - Bench scale testing of removal technologies
  - Subtask 5.3 EE/CA Report Preparation
  - Subtask 5.4 Preparation of the Action Memorandum
- Task 6 Project Management

- Option 1 Geophysical Survey
- Option 2 Cone Penetrometer Explorations
- Option 3 Soil Borings
- Option 4 Monitoring Wells

Details on the field activities (scoped and optional) are presented in the SAP in Appendix A and the Standard Operating Procedures (SOPs) for specific field tasks are contained in Attachment A of the QAPjP. Table 1 of the SAP contains a summary of the analytical sampling proposed for the field investigation.

The following subsections provide a brief summary of the OU 2 NCRA tasks. Attachment D of this Work Plan contains the assumptions used to generate the cost estimate for completion of each of the tasks.

6.1 PLANNING (TASK 1)

Task 1 consists of the writing of the NCRA Work Plan, the SAP, the QAPjP, and the SSHP. Included in this task is a review of existing URSGWCFS plans to ensure coordination between the NCRA and the RI.

6.2 BCT/RAB SUPPORT AND DATA MANAGEMENT (TASK 2)

This task includes Foster Wheeler's/HLAs participation in Restoration Advisory Board (RAB) and BRAC Cleanup Team (BCT) meetings. It is anticipated that Foster Wheeler/HLA will be responsible for development and presentation of technical briefings regarding the status of the NCRA at these meetings.

In addition, this task includes the input and management of all HLA data produced at SAEP since March 1999 and all Foster Wheeler/HLA data produced from June 1, 1999 through February 2000. Primarily this covers the input of data into the Geographic Information System (GIS) and the creation of data tables, as necessary.

6.3 INITIAL FIELD ACTIVITIES (TASK 3)

Field activities associated with Task 3 of the OU 2 NCRA include:

- Soil vapor survey
- Location and elevation survey

6.3.1 Soil Vapor Survey (Subtask 3.1)

The soil vapor survey is scheduled to be completed in August 1999 to determine if concentrations of VOC vapors in the subsurface exceed the CTDEP RSR criteria for soil vapor, and therefore pose a risk to indoor air quality in SAEP buildings. The survey will consist of the collection of soil vapor samples from depths ranging from 1 to 3 feet bgs using a GeoProbe or equivalent hand boring equipment. Samples will be collected at a minimum depth of at least 1 foot below the top of the soil beneath building floors. Samples will be analyzed on-site using a Photovac10S50 portable GC, or equivalent apparatus. Ten percent of samples will be collected as duplicates and sent to an off-site laboratory for analysis to determine the reliability of on-site data. Section 4.0 of the SAP (Appendix A) details the field procedures associated with the soil vapor survey.

6.3.2 Location and Elevation Survey (Subtask 3.2)

A subcontracted, registered land surveyor will perform a horizontal and elevation survey of previous HLA sampling locations, including GeoProbe sampling points, cone penetrometer explorations, and installed piezometers and monitoring wells. Horizontal and vertical control points used during previous surveys by URSGWCFS at SAEP will be used during this survey for consistency. Vertical elevation accuracy will be 0.01-foot and horizontal location accuracy will be 0.1-foot. Section 4.0 of the SAP (Appendix A) details the procedures associated with the location and elevation survey.

6.4 PRE-DESIGN INVESTIGATION REPORT (TASK 4)

Task 4 involves the development of the Pre-design Investigation Report. This report will summarize the results of all previous Foster Wheeler/HLA investigations conducted in support of the recommendation of a removal action for OU 2, including data collected between August 1998 and May 1999, and new data produced from investigations proposed in this NCRA Work Plan.

The Pre-design Investigation Report will summarize the field investigations identified in Subsection 6.3 and the additional field activities identified in Subsection 6.5.2. Optional tasks, if performed, will be summarized in an Addendum to the Pre-design Investigation Report.

6.5 EE/CA PROCESS (TASK 5)

Task 5 consists of activities conducted in support of development of the EE/CA, including:

- EE/CA Planning
- Additional Field Activities
- EE/CA Report Preparation
- Removal Action Memorandum

The following subsections provide a brief summary of the activities planned under each subtask.

6.5.1 EE/CA Planning (Subtask 5.1)

After review of existing data and bench-scale test results, and evaluation of potential removal technologies, a Treatability Work Plan Letter documenting the process proposed for pilot-scale testing at the former Chromium Plating Facility will be written.

6.5.2 Additional Field Activities (Subtask 5.2)

Three additional field activities have been proposed to provide information required to effectively evaluate potential removal action alternatives.

Additional Subsurface Investigations. Proposed under this activity are two soil borings, each to a depth of 50 feet bgs with soil sampling at 5-foot intervals. Three soil samples from each boring will be sent to an off-site laboratory for VOC, SVOC, and Target Analyte List (TAL) inorganic analyses. The soil borings will be located in the areas proposed for pilot testing, including the VOC hot-spot area in the former Chromium Plating Facility (near groundwater sampling location WP-99-33 [see Figure 4]) and the hexavalent chromium hot-spot area just outside the northernmost corner of the former Chromium Plating Facility (near groundwater sampling location WP-99-15 [see Figure 6]).

Additional field testing for DNAPL and bench-scale testing will be completed on soil samples collected during completion of the soil borings. The compound SUDAN-IV will be added to soil samples collected from the soil borings to determine if DNAPL is present in the proposed pilot-testing areas. The SUDAN-IV dye will discolor any free product that may be present in the soil samples upon contact. Further information on the SUDAN-IV dye process is presented in SOP No. 9 in Attachment A to the QAPjP (Appendix B). The details of bench-scale testing are summarized later in this subsection and presented in Subsection 4.4.2 of the SAP (Appendix A).

Aquifer Testing. An aquifer pumping test will be conducted to determine the aquifer's hydraulic properties in the vicinity of the former Chromium Plating Facility. Results of the pumping test will also be used in conjunction with cone penetrometer stratigraphic data to estimate the aquifer's hydraulic properties in other areas of the SAEP site.

Activities under this subtask include the installation and development of one 4-inch pumping well and eight 1-inch monitoring/observation wells by a drilling subcontractor. One 48-hour pumping test is estimated to provide the data necessary to characterize hydraulic conditions. Extracted groundwater will be treated with activated carbon prior to discharge to the SAEP CWTP. Results of the aquifer testing will be presented in the Pre-design Investigation Report.

Section 4.0 of the SAP (Appendix A) details the procedures associated with aquifer testing.

Bench-scale Testing of Removal Technologies. Bench-scale testing will be conducted under this subtask to determine the effectiveness of potential removal technologies on subsurface contamination given SAEP site conditions.

Bench-scale testing will consist of the addition of chemical to extracted site groundwater and excavated soil, to determine the optimum dose for conversion of contaminants and minimum residual solutions during the pilot test. The tests will be based on an estimated dosage determined from stoichiometric calculations of the mass of contaminants in aquifer soil and groundwater. The tests will determine the actual optimum dosages, which is likely to vary from the stoichiometric dosage due to consumption of the chemicals in unrelated reactions associated with other compounds in site soil and groundwater.

Two sets of bench-scale tests will be conducted, the first in the VOC hot-spot area (near groundwater sampling location WP-99-33) in the former Chromium Plating Facility and the second for the hexavalent chromium and VOC hot-spot area (near groundwater sampling location WP-99-15). The tests will be run as jar tests using varying amounts of the chemicals required for the potential removal technologies. Prior to conducting the tests, a technical memorandum will be prepared evaluating different chemical oxidation and reduction agents available for use to treat groundwater. Currently, ferrous sulfate and hydrogen peroxide are being considered, along with other chemicals.

6.5.3 EE/CA Report Preparation (Subtask 5.3)

Four documents will be prepared for the administrative record, an EE/CA, a fact sheet, a response to significant comments, and a Removal Action Memorandum (RAM).

An EE/CA Report will be written to provide the rationale behind the development of removal actions alternatives and document the decision process for selection of a recommended alternative. The EE/CA will be developed in accordance with the USEPA "Guidance on Conducting Non-time Critical Removal Actions Under CERCLA" (USEPA, 1993). Prior to initiation of the required 30-day public comment period, a fact-sheet providing a brief summary of the EE/CA will be prepared for the public. Following the public comment period, a response to significant comments will be prepared for inclusion in the RAM (see Subsection 6.5.4).

6.5.4 Preparation of the Action Memorandum (Subtask 5.4)

A RAM will be written to provide documentation of the selection of a removal action for a site. The RAM will contain a summary of the EE/CA, the recommended removal action, a copy of the transcript from the public hearing, and a response to significant comments received during the 30-day public comment period.

6.6 PROJECT MANAGEMENT (TASK 6)

Activities included under Task 6 include preparation of monthly performance, schedule, and cost reports to include total labor hours, miscellaneous direct costs, and indirect costs expended by Task. Task 6 also includes Level of Effort (LOE) associated with communications between the Foster Wheeler/HLA/USACE/SAEP project team, and HLA Technical Manager. In addition, this task includes project controls to include LOE for development of periodic project estimates to complete and estimates at completions.

6.7 OPTIONAL ACTIVITIES

Four optional activities have been proposed for the OU 2 NCRA, including: 1) a seismic geophysical survey, 2) completion of cone penetrometer explorations, 3) completion of additional soil borings, and 4) installation of additional monitoring wells.

Completion of the seismic geophysical survey is dependent upon the results of field testing for DNAPL and review of the existing depth to bedrock data. The need for additional subsurface investigations is dependent upon the results of the URSGWCFS RI field activities. If review of the RI results indicates data gaps exist, these subsurface investigations will be used to answer the DQOs identified in Section 5.0.

Optional tasks will be performed when it decided that additional information is necessary to more fully characterize groundwater conditions and contaminant distributions at SAEP. The following steps will be used to invoke the optional tasks:

- A review of existing data identifies a data gap;
- A technical review meeting with USACE and SAEP verifies the need for additional investigations;
- The USACE and SAEP decide to invoke the optional tasks;
- The USACE contract department sends notice to proceed and funds the Task Order through a modification; and
- Upon receipt of the signed modification, Foster Wheeler/HLA proceeds with the optional tasks.

Section 4.0 of the SAP (Appendix A) details the procedures associated with each of the optional tasks. The following paragraphs summarize those procedures.

Geophysical Survey. A Foster Wheeler/HLA geophysicist will oversee a geophysical seismic refraction survey, which will be conducted in order to define the depth and features of the bedrock surface. The data collection and initial interpretation for the survey will be performed by a subcontractor.

It is estimated that four traverse areas of the site (approximately 6600 linear feet of survey) will be used to evaluate bedrock surface conditions, including two northwest to southeast along the length of Building B-2 and at the berm and two northeast to southwest from Main Street to the berm. A Foster Wheeler/HLA geophysicists will interpret raw seismic data, and present an interpretation as part of the Pre-design Investigation Report.

Cone Penetrometer Explorations. This option includes cone penetrometer sampling of 5 locations each to a depth of 150 feet bgs. Explorations will be profiled for stratigraphy, and up to five groundwater samples will be collected from each exploration for off-site VOC analysis. No permanent monitoring wells will be installed; groundwater samples will be collected through the cone penetrometer rods.

Soil Borings. This option includes the completion of three soil borings, each to a depth of 50 feet bgs, with soil sampling at 5-foot intervals. Three samples from each boring will be sent to an off-site laboratory for VOC, SVOC, and TAL inorganic analyses. Details as to the parameters to be sampled for, the methods to be used, and the data reporting will be contained in the SAP (Appendix A).

Monitoring Wells. This option includes the installation of five monitoring wells. Each well will be 50 feet in depth, constructed of 2-inch inside diameter schedule 40 polyvinyl chloride piping with a 10-foot screen length.

7.0 WASTE MANAGEMENT PLAN

This waste management section covers the disposition of IDW that is anticipated to be generated at SAEP during investigations for the OU 2 NCRA. IDW will potentially include drill cuttings generated during soil boring and monitoring well installation, groundwater generated during well development and purging, extracted groundwater from the aquifer pumping test, decontamination water generated during field decontamination of equipment, and waste soil and groundwater used during bench-scale testing. IDW will be separated (liquid and solid) and stored separately in appropriate drums inside the former Chromium Plating Facility or the locked gate surrounding the Building 63 Chemical Waste Treatment Plant (CWTP) sump. The final disposition of IDW will be determined based upon waste contents and analytical results, if necessary.

Drums containing soil generated during soil boring completion, monitoring well installation, and bench-scale testing will be stored briefly on-site (a maximum of 90 days) in accordance with regulatory requirements, and then sent off-site for disposal based on analytical findings of the contents. Personal protective equipment and disposable sampling equipment will also be drummed for off-site disposal.

Groundwater generated during well development and purging, and that extracted during the aquifer pumping test will be treated for VOCs by use of a granular activated carbon system prior to discharge to the SAEP CWTP sump at Building 63. Groundwater used during bench-scale testing will be temporarily drummed until it is determined if the contents can be discharged to the CWTP sump. If this water cannot be discharged, due to contaminant concentrations, the water will be sent off-site for disposal. Decontamination water (containing surfactants) will be stored briefly on-site (a maximum of 90 days) and will be sent off-site for disposal based on analytical results of the contaminant concentrations.

8.0 MANAGEMENT PLAN

Foster Wheeler/HLA will manage Delivery Order No. 20.00 in accordance with established procedures and contractual requirements for progress measurement, contract administration, and quality control.

8.1 PROJECT ORGANIZATION AND KEY PERSONNEL

As established under the Total Environmental Restoration Contract (TERC), Mr. Rick Gleason (Foster Wheeler) will be acting as the Program Manager. Mr. Jay Borkland (Foster Wheeler) will be acting as the Project Manager for the OU 2 NCRA at SAEP, and will be responsible for implementing the Task Order in accordance with the established TERC guidelines and procedures. Mr. Nelson Walter (HLA) will assume the role of the Technical Manager for the OU2 work.

8.1.1 Technical Manager

The Technical Manager has primary responsibility for the implementation, and completion of Scope of Work. The Technical Manager is responsible to the Project Manager, and the USACE for day-to-day implementation of the project. The Technical Manager also supervises the timely development and delivery of the technical reports, and other project documents. The Technical Manager assigns and monitors all project personnel in planning, coordinating, and controlling all technical aspects of the tasks, and is responsible for maintaining the quality of the work product, schedule and budget control. In addition, the Technical Manager is responsible for communications with the Foster Wheeler Project Manager and USACE Project Manager, and other key staff personnel.

All personnel assigned to the project, including subcontractors, will be qualified for the task(s) to which they have been retained. Appraisal of the qualification of technical personnel assigned to the project will be made by the Technical Manager and the Project Manager. The appraisal will include comparison of the requirements of the task assignment with the relevant experience and training of the prospective personnel.

8.1.2 Project QA/QC Coordinator

The Project Quality Assurance/Quality Control; (QA/QC) Coordinator, Mr. Christian Ricardi (HLA), works directly with the Technical Manager and other project personnel. The overall responsibility of the Project QA/QC Coordinator is to implement the quality assurance program, and monitor and verify that the work is done in accordance with the SAP, and the QAPjP includes the SOPs for field activities planned for the OU2 NCRA. The Project QA/QC Coordinator also has the following responsibilities: to assess the effectiveness of the QA/QC program; to recommend modifications to the program when applicable; to verify that personnel assigned to the project are trained and indoctrinated relative to the requirements of the QA/QC program; to review and verify the disposition of nonconformance and corrective action reports; and for periodic quality assurance. The

Project QA/QC Coordinator is responsible for the coordination of QA sample collection, and the delivery.

8.1.3 Health and Safety Manager

The Health and Safety Manager (HSM), Ms. Cindy Sundquist, CIH (HLA), reports to the Technical Manager, and works with the other project personnel. The HSM has the responsibility to monitor and verify site conditions, conduct periodic audits and reports from the Site Safety and Health Officer (SSHO), and verify that the field activities are conducted in accordance with the SSHP. The HSM will advise the Technical Manager regarding health and safety issues, but will function independently of the Technical Manager. The HSM will also designate and oversee the activities of the SSHO.

8.1.4 Site Safety and Health Officer

The SSHO will monitor site activities and will be responsible for the implementation of the site-specific SSHP. The SSHO reports directly to the HSM, and works with the Technical Manager and Task Leaders to ensure overall compliance with the SSHP.

8.1.5 Technical Task Leaders

Technical Task Leaders will be chosen by the Technical Manager and the Project Manager, and will be assigned to work on various tasks as deemed necessary by the Technical Manager. Each Task Leader will be responsible to the Technical Manager for planning, scheduling, cost control, and completion of assigned project tasks. The Task Leader is responsible for implementing the QA/QC program as it relates to assigned tasks for the project.

8.1.6 Field Operations Lead

The Field Operations Lead (FOL) will be appointed by the Technical Manager and will be responsible for coordinating all field activities. The FOL will work with the Technical Task Leaders, and will schedule field activities with the project staff assigned by the Technical Manager. The FOL will also work with the SSHO and the QA/QC Coordinator to accomplish the objectives of all aspects of the work plan, including the QAPjP, as they pertain to field activities.

8.1.7 Project Staff

Project staff members are chosen by the Technical Manager. Each member of the project staff is responsible to the FOL or Technical Manager for completion of assigned project activities. Members of the project staff are responsible for understanding and implementing the QA/QC program as it applies to their project activities.

8.1.8 Data Reviewers

Data Reviewers are chosen by the Technical Manager and the Project QA/QC Coordinator. Responsibilities of the Data Reviewers include, but are not necessarily limited to:

- Verifying measurement system calibration;

- Auditing quality control activities;
- Screening data sets for outliers;
- Auditing field sample data records and chain-of-custody forms; and
- Checking calculations.

The primary task of the Data Reviewers is to quantitatively and qualitatively assess chemical data reported by the laboratory.

The quality review of non-laboratory data will be accomplished by a professional individual who is qualified for the specific task. For example, a geologist will review geologic data, and the FOL will review field calibration logs while the field activities are being performed. The appropriate Data Reviewer will review the data results and data collection procedures for compliance with established quality control criteria. Data Reviewers will report to the Technical Manager.

8.2 SUBCONTRACTORS

Implementation of the OU2 NCRA Work Plan and associated activities will require subcontractors for providing additional project support for services such as:

- Soil Vapor Survey: GeoProbe Subcontractor
- Location and Elevation Survey: Surveyor Subcontractor
- Aquifer Test: Drilling Subcontractor
- Bench-Scale Testing: Off-site Laboratory Subcontractor and Data Validation Subcontractor
- Optional Tasks:
    - Geophysical Survey: Geophysical Subcontractors
    - Cone Penetrometer Explorations: cone penetrometer, Off-site Laboratory, and data validation
    - Soil Borings: Drilling, Off-site Laboratory, and Data Validation Subcontractors
    - Monitoring Wells: Drilling and Off-site Laboratory and Data Validation Subcontractors

Training and qualifications of subcontractor personnel will be confirmed via certifications and licenses, which are issued by regulatory agencies. All equipment, including health and safety related items, required for field activities performed by subcontractors, will be supplied by the subcontractors. Subcontractors will be identified during the field planning activities in July 1999.

The QA/QC Coordinator and FOL will be responsible to confirm that the field subcontractors are in compliance with the OU2 NCRA Work Plan, the QAPjP, and all QA/QC requirements. Laboratory personnel, which have primary responsibility of ensuring adherence to the QA/QC of the project and the laboratory QA/QC program, will be identified in the laboratory QA/QC Manual.

Although, the Subcontractors have not been confirmed at this time, bids from prospective firms will be accepted, with the lowest, best-qualified bid to be preferred by Foster Wheeler/HLA.

8.3 MANAGEMENT INFORMATION SYSTEMS FOR REPORTING

Costs will be tracked by Foster Wheeler/HLA at the activity level. A monthly report will be submitted to the USACE with current period and job-to-date committed cost information at the task and subtask levels. This report will include a summary of technical activities and costs, a schedule report (TACOM has requested that schedules be provided in Microsoft Project format), a cost and schedule variance analysis, and a detailed breakout of major subcontract costs.

8.4 ACQUISITION STRATEGY

A number of material, supplies, and services will need to be performed or acquired for different aspects of the OU 2 NCRA field investigations and remedial design. The acquisition strategy will include a make/buy analysis on what investigation components are best self-performed by Foster Wheeler/HLA and those components best performed by outside subcontractors, the appropriate contractual terms for subcontracted work (i.e., cost reimbursable vs. fixed priced contracts), and plans to optimize use of SB/SDBs. Key to this analysis is what provides best value to the government. It is important at his state of the project to develop plans required to maximize the opportunities for SB/SDBs, historically Black Colleges and Universities/Minority Institutions (HBCU/MIs), and local businesses. The following sections provide a discussion concerning Foster Wheeler/HLAs approach for make/buy decisions and plans for maximizing opportunities for SBD/SDBs, HBCU/MIs, and local businesses.

8.4.1 Make/Buy Analysis

A key aspect of the make/buy analysis is what is the most cost effective way of performing the work. In general, Foster Wheeler/HLA opts to “buy” (subcontract the work) when:

- The project requirements are sufficiently well defined and measured, and there is minimal uncertainty or likelihood of change;
- When there is specialized training or skill beyond the capability of the Foster Wheeler Team; or
- Where specialized expertise translates into a clear advantage in terms of cost, schedule, or quality.

In these situations, the work would be performed under a fixed price or fixed unit rate arrangement with the subcontractor: the level of detail would be appropriate for the subcontractor to perform the work and Foster Wheeler/HLA to manage the work as a fixed price contract.

Conversely, Foster Wheeler/HLA prefers to self-perform (“make”) the work when:

- Work requirements are highly uncertain or subject to change;
- Uniquely complex or highly hazardous work conditions exist; the task could potentially affect or significantly interfere with other project activities; or
- The task is on the critical path of the project.

In these instances, self-performance of the work allows Foster Wheeler/HLA to directly control the safety, technical quality, cost, and schedule of the work to be performed. Foster Wheeler/HLA can be more responsive and flexible when we self-perform in these situations, ultimately resulting in overall efficiency benefits for the project. It also means that the design plan and specifications can be prepared as detailed work packages that allow the Foster Wheeler Team to proceed directly to construction, as opposed to developing detailed specifications tailored for procurement and management of a subcontractor.

8.4.2 SB/SDB, HBCU/MI, and Local Business Utilization

The NE TERC has specific goals for utilization of SB/SDBs and HBCU/MIs as a percentage of total subcontracted dollar amount awarded in the contract. Meeting the established goals for the contract will require creative and innovative contracting strategies to provide opportunities for these type of businesses to participate in the project while maintaining overall project efficiency. In addition to SB/SDBs and HBCU/MIs, Foster Wheeler/HLA recognizes that USACE has a commitment to involve local businesses within the project activities. The purpose of this section is to describe the potential strategies to maximize the utilization of SB/SDBs, HBCU/MIs, and local businesses.

SB/SDBs

In order to maximize SB/SDB utilization on the project, prospective source lists for procurements will be developed using the following criteria:

- If it can be demonstrated that adequate competition (i.e., three or more SDB vendors) can be obtained on a particular procurement through the solicitation of only qualified SDB vendors, then the procurement will only include those vendors on the bidders list.
- If there is not adequate competition for a solicitation using only qualified SDB vendors, a determination will be made if adequate competition can be obtained through the solicitation of only SB vendors. In this case, the bidders list for that procurement will consist of qualified SB vendors, as many as possible of which will be SDB vendors.
- If adequate competition cannot be demonstrated through the use of SDB and/or SB vendors, then the bidders list will include a selection of the qualified vendors, as many as possible of which will be SDB or SB vendors.

Careful development of bidders lists, in accordance with this approach, will provide SB/SDBs greater opportunity to bid and win work on the project.

HBCU/MIs

The utilization of HBCU/MIs provides a separate challenge from SB/.SDB subcontractors in that there is more planning and scheduling involved in obtaining services in order to conform to university schedules. Unlike SB/SDBs, it is generally not possible to subcontract an HBCU/MI student or faculty with short notice. On other NE TERC Task Orders, Foster Wheeler has been successful in obtaining and scheduling student interns on a semester-long basis, and we will continue to follow this practice for the SAEP project through the diligent scheduling of opportunities for students and faculty members.

Local Businesses

Foster Wheeler/HLA recognizes USEPA's commitment to involve local businesses and the local labor force in NE TERC projects. Foster Wheeler/HLA will make every effort to involve local businesses in subcontracted work.

GLOSSARY OF ACRONYMS AND ABBREVIATIONS

1,1-DCE	1,1-dichloroethylene
1,1,1-TCA	1,1,1-trichloroethane
%R	percent recovery
AJS	AJS Environmental Services, Inc.
ARAR	Applicable or Relevant and Appropriate Requirements
ASTM	American Society for Testing and Materials
bgs	below ground surface
BCT	BRAC Cleanup Team
BRAC	Base Closure and Realignment
CERCLA	Comprehensive Response, Compensation, and Liability Act
C.G.	Certified Geologist
CPT	cone penetrometer test
CTDEP	Connecticut Department of Environmental Protection
CWTP	Chemical Waste Treatment Plant
DNAPL	dense non-aqueous phase liquid
DQO	data quality objective
EBS	Environmental Baseline Survey
EE/CA	Engineering Evaluation/Cost Analysis
FOL	Field Operations Lead
Foster Wheeler	Foster Wheeler Environmental Corporation
GC	gas chromatograph
GIS	Geographic Information System
HLA	Harding Lawson Associates
HSA	hollow-stem augers
HSM	Health and Safety Manager
IDL	instrument detection limit
IDW	investigation-derived waste
LOE	Level of Effort
MDL	method detection limit
mg/L	milligrams per liter
MS	matrix spike
MSD	matrix spike duplicate

GLOSSARY OF ACRONYMS AND ABBREVIATIONS

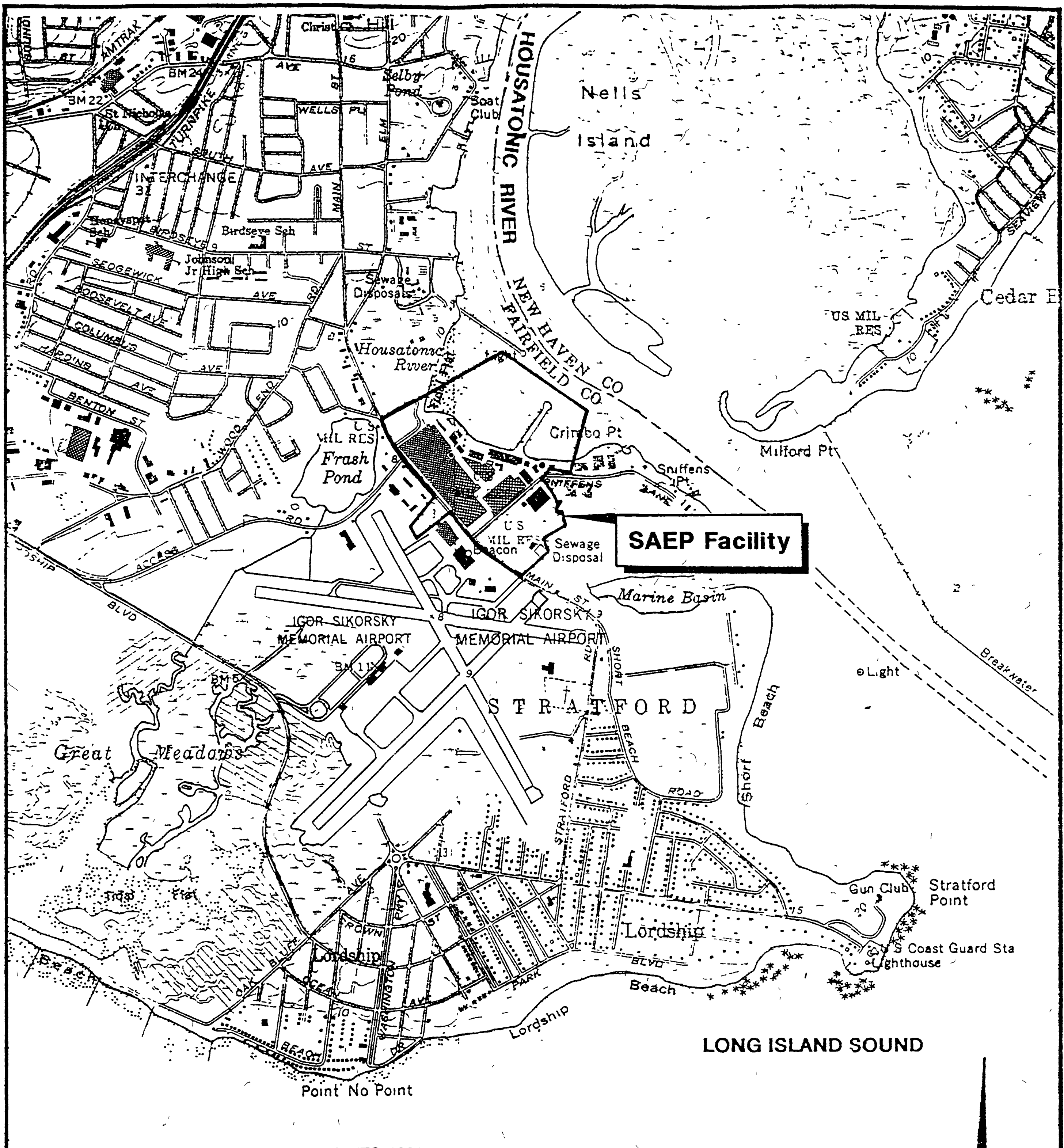
NCRA	Non-time Critical Removal Action
NGVD	National Geodetic Vertical Datum
OU	Operable Unit
PCE	tetrachloroethylene
P.E.	Professional Engineer
QA/QC	Quality Assurance/Quality Control
QAPjP	Quality Assurance Project Plan
RAB	Restoration Advisory Board
RAM	Removal Action Memorandum
RCRA	Resource Conservation and Recovery Act
REDOX	oxidation-reduction
RI	Remedial Investigation
RL	reporting limit
RPD	Relative Percent Difference
RSR	Remediation Standard Regulation
SAEP	Stratford Army Engine Plant
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure
SPLP	Synthetic Precipitate Leaching Procedure
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
SVOC	semi-volatile organic compound
TACOM	U.S. Army Tank-Automotive and Armament Command
TAL	Target Analyte List
TERC	Total Environmental Restoration Contract
TCE	trichloroethylene
URSGWCFG	URS Greiner-Woodward Clyde Federal Services
USACE	U.S. Army Corps of Engineers – New England District
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound

Harding Lawson Associates (HLA), 1999. Draft Data Package for the Chromium Plating Facility Investigation. Prepared for TACOM and AlliedSignal, April 9, 1999.

URS Greiner-Woodward Clyde Federal Services (URSGWCFS), 1998. Remedial Investigation Work Plan for the Stratford Army Engine Plant. Prepared for the U.S. Department of the Army, October 26, 1998.

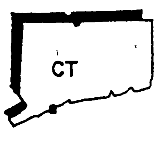
U.S. Environmental Protection Agency (USEPA), 1993. Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA. Office of Emergency and Remedial Response. USEPA/540-R-93-057, Washington DC, August 1993.

ATTACHMENT A
FIGURES



SOURCE: WOODWARD-CLYDE CONSULTANTS, 1991.
FINAL PAS

0 1000 2000 FT
SCALE



Harding Lawson Associates
HLA
Engineering and
Environmental Services

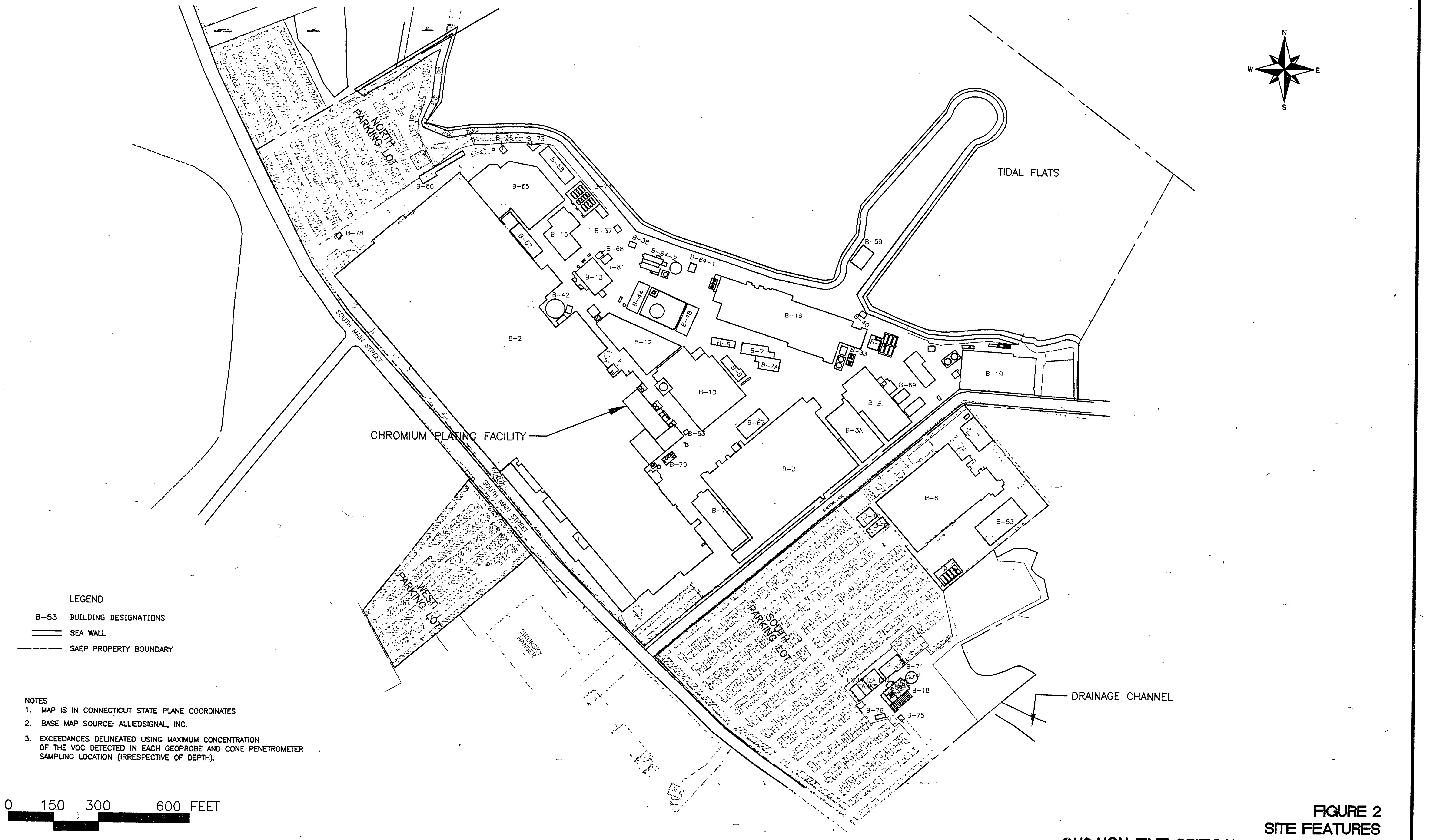
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

SITE LOCATION MAP

OU2 Non-Time Critical Removal Action

47235

FIGURE 1

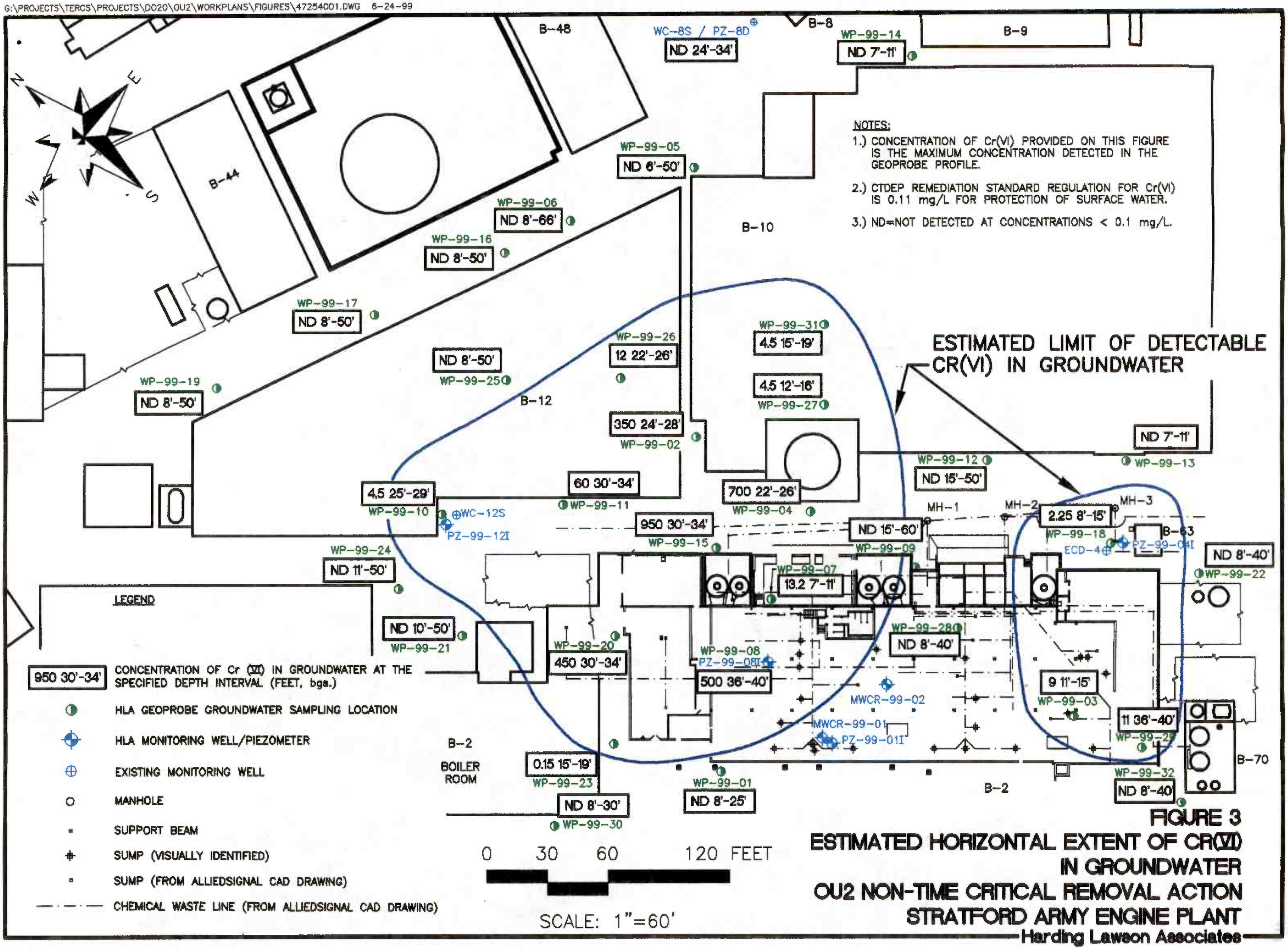


NOTES
1. MAP IS IN CONNECTICUT STATE PLANE COORDINATES
2. BASE MAP SOURCE: ALLIEDSIGNAL, INC.
3. EXCEEDANCES DELINEATED USING MAXIMUM CONCENTRATION OF THE VOC DETECTED IN EACH GEOPROBE AND CONE PENETROMETER SAMPLING LOCATION (IRRESPECTIVE OF DEPTH).

FIGURE 2
SITE FEATURES
OU2 NON-TIME CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
Harding Lawson Associates

G:\PROJECTS\TERCS\PROJECTS\D020\OU2\WORKPLANS\FIGURES\47254006.DWG 6-25-99

G:\PROJECTS\TERCS\PROJECTS\D020\OU2\WORKPLANS\FIGURES\47254001.DWG 6-24-99



NOTES:

1.) CONCENTRATION OF Cr(VI) PROVIDED ON THIS FIGURE IS THE MAXIMUM CONCENTRATION DETECTED IN THE GEOPROBE PROFILE.

2.) CTDEP REMEDIATION STANDARD REGULATION FOR Cr(VI) IS 0.11 mg/L FOR PROTECTION OF SURFACE WATER.

3.) ND=NOT DETECTED AT CONCENTRATIONS < 0.1 mg/L.

LEGEND

950 30'-34'	CONCENTRATION OF Cr (VI) IN GROUNDWATER AT THE SPECIFIED DEPTH INTERVAL (FEET, bgs.)
◑	HLA GEOPROBE GROUNDWATER SAMPLING LOCATION
⊕	HLA MONITORING WELL/PIEZOMETER
⊕	EXISTING MONITORING WELL
○	MANHOLE
▪	SUPPORT BEAM
+	SUMP (VISUALLY IDENTIFIED)
▫	SUMP (FROM ALLIEDSIGNAL CAD DRAWING)
— · — · —	CHEMICAL WASTE LINE (FROM ALLIEDSIGNAL CAD DRAWING)

FIGURE 3
ESTIMATED HORIZONTAL EXTENT OF CR(VI)
IN GROUNDWATER
OU2 NON-TIME CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
Harding Lawson Associates

LEGEND

CP-99-03 ●	EXISTING HLA CONE PENETROMETER LOCATIONS
⊕	PROPOSED U.R.S.–GRENIER / WOODWARD–CLYDE MONITORING WELLS (LOCATIONS ARE APPROXIMATE)
◐	EXISTING HLA GEOPROBE GROUNDWATER SAMPLING LOCATION
⊕	EXISTING PIEZOMETER LOCATION
⊕	EXISTING WOODWARD–CLYDE MONITORING WELL
●	C.A. RICH CONSULTANTS MONITORING WELL
B-53	BUILDING DESIGNATIONS
	FENCE
═	SEA WALL
— — —	SAEP PROPERTY BOUNDARY
—	11–DCE RSR EXCEEDANCES IN GROUNDWATER
—	PCE RSR EXCEEDANCES IN GROUNDWATER
—	TCE RSR EXCEEDANCES IN GROUNDWATER
—	1,1,1–TCA RSR EXCEEDANCES IN GROUNDWATER

NOTES:
1. MAP IS IN CONNECTICUT STATE PLANE COORDINATES.
2. BASE MAP SOURCE: ALLIEDSIGNAL, INC.
3. EXCEEDANCES DELINEATED USING MAXIMUM CONCENTRATION OF THE VOC DETECTED IN EACH GEOPROBE AND CONE PENETROMETER SAMPLING LOCATION (IRRESPECTIVE OF DEPTH).

0 60 120 240 FEET

SCALE: 1"=120'

G:\PROJECTS\TERCS\PROJECTS\D020\OU2\WORKPLANS\FIGURES\47254002.DWG 7–12–99

FIGURE 4
ESTIMATED HORIZONTAL EXTENT OF SELECT VOCs IN GROUNDWATER
OU2 NON-TIME CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT

Harding Lawson Associates

G:\PROJECTS\TERCS\PROJECTS\D020\OU2\WORKPLANS\FIGURES\47254003.DWG 6-24-99

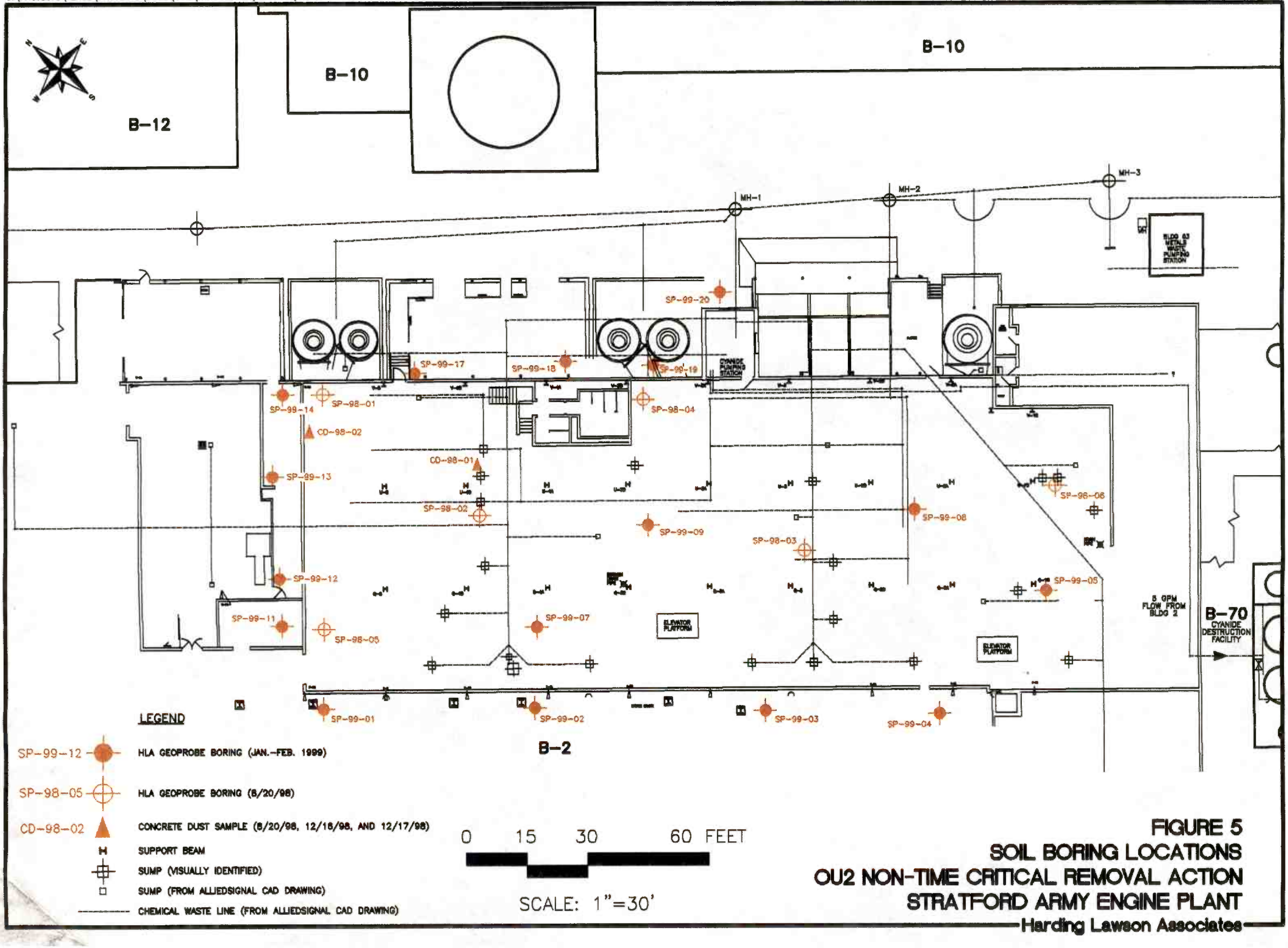


FIGURE 5
SOIL BORING LOCATIONS
OU2 NON-TIME CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
Harding Lawson Associates

G:\PROJECTS\TERCS\PROJECTS\D020\OU2\WORKPLANS\FIGURES\47254004.DWG 6-24-99

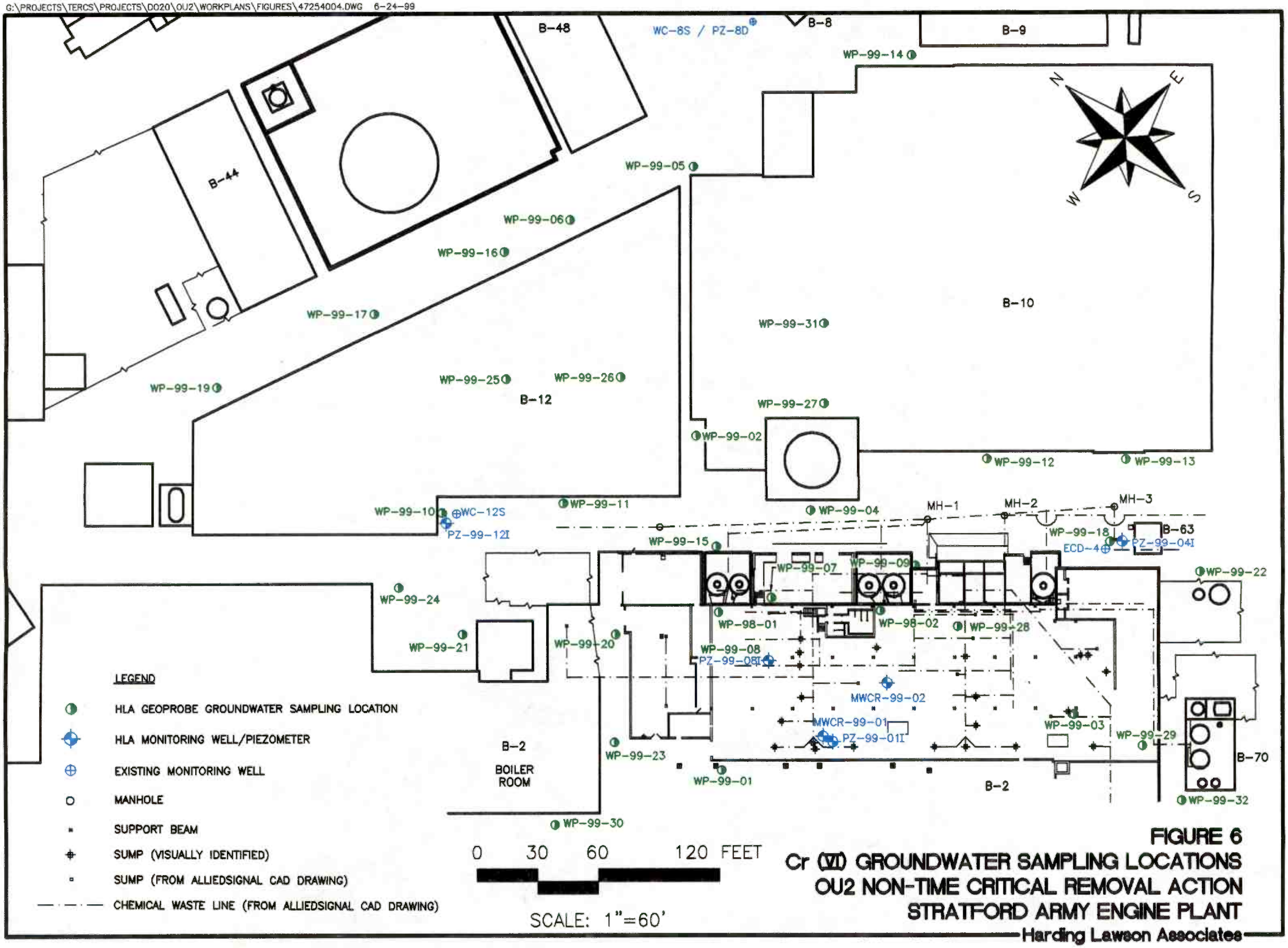


FIGURE 6
Cr (VI) GROUNDWATER SAMPLING LOCATIONS
OU2 NON-TIME CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
Harding Lawson Associates

ATTACHMENT B
SECTION 2 OF THE URSGWCFS RI WORK PLAN

The description and history of the SAEP site has been divided into four categories: land use assessment; physical setting; ecological setting; and, site history. Each of these categories is described below.

2.1 LAND USE ASSESSMENT

2.1.1 SAEP Facility

SAEP is located in Stratford, Connecticut, on the Stratford Point peninsula in the southeast corner of Fairfield County (Figure 1). The plant lies on the borderline of the Bridgeport and Milford Quadrangles. Latitudinal and longitudinal coordinates of SAEP are approximately 41'-10' North and 73'-07' West.

SAEP consists of approximately 124 acres, of which about 76 acres are improved land and 48 acres are riparian rights. (A riparian right is a right of access to, or use of, the shore, bed, or water of land on the bank of a natural watercourse.) The 76 acres of improved land consist of 49 buildings, paved roadway and grounds, and five paved parking lots. Included in the improved land are an estimated 10 acres along the Housatonic River where fill was placed over tidal flats during the early development of SAEP. The 48 acres of riparian rights property consist of intertidal flats of the Housatonic River. An estimated 2 acres of this property comprise a causeway constructed in the 1930s to provide access to the river channel. A site map is provided in Figure 2.

The SAEP property is zoned light industrial. Since 1929, the SAEP site has been used for the development, manufacture, and assembly of aircraft or engines. A discussion of historical operations at SAEP is provided in Section 2.4. Access to SAEP is restricted with a perimeter fence and security guards. Boaters, fishermen, and shell fishers could potentially access unrestricted intertidal flats within SAEP property.

Future land use at the Site has been the subject of intensive study by the SAEP Local Redevelopment Authority (LRA). As reported in "SAEP Redevelopment Plan and Implementation Strategy and Homeless Assistance Submission," the preferred land use plan developed by the LRA includes the development of approximately 800,000 square feet of building space for office, research and development, and "flex space." In addition, 100,000 square feet of museum space and almost 16 acres of park land along the Housatonic River waterfront are proposed (SAEP LRA, 1997). A final decision regarding future use of the Site has not yet been attained.

2.1.2 Adjacent Land

SAEP is bounded by a paved parking lot and wetlands to the north; the Housatonic River to the east; an open field, a drainage channel, and small commercial businesses to the south; and hangar buildings, the Sikorsky Memorial Airport, several small businesses, and Frash Pond to the west.

Historically, land in the SAEP vicinity was used for agricultural and residential purposes. At present, local agricultural activities are minimal. The primary agricultural (aquaculture) activity in the area involves growing oysters in shallow waters of the Housatonic River. Oysters are seeded in areas of the Housatonic River in the spring, collected in the fall, and placed in Long Island Sound to mature. The seed oyster beds are carefully managed by the State of Connecticut Department of Agriculture because of concerns regarding bioaccumulation of contaminants from the Housatonic River.

Land in the vicinity of SAEP is zoned light industrial, business, commercial, or residential. There are several businesses located west of Main Street, across from SAEP, including a small strip mall, several gas stations, and a restaurant.

SAEP is located about 3/4-mile southeast of Johnson Junior High School and Birdseye School.

Recreational facilities in the area include Short Beach Park and nearby public wildlife areas, including Nells Island and the Great Meadow Salt Marsh. SAEP is located about 1/2-mile northwest of Short Beach Park, which had over 80,000 users reported for the year 1991.

2.1.3 Local Demographics

The Greater Bridgeport Regional Planning Agency's population census of Stratford was 49,389 people in 1990. Slow population growth has been a trend in Stratford for nearly two decades, and the Connecticut Office of Policy and Management anticipates a continued slow or declining growth rate for Stratford through the end of the century, with a population projection of 48,650 for the year 2000, and 45,800 for the year 2010 (W-C, 1991).

The age of the population in Stratford is older than the state average. The town's median age in 1980 was 38.2, compared to 32 for the State of Connecticut. The Connecticut Office of Policy and Management anticipates the median age of Stratford to be 45.7 by the year 2010. Nearly 23 percent of Stratford's population had reached age 60 by 1980, compared to the state average of 17 percent.

The population of Stratford represents various races and nationalities. More than 8 percent of the 1980 population in Stratford was non-white. This compares closely to a non-white population of 9,9 percent for the State of Connecticut (W-C, 1991).

2.2 PHYSICAL SETTING

2.2.1 Topography

SAEP is located in the Western Highlands of Connecticut part of the New England Physiographic Province. The local area is part of a coastal belt of dissected hilly country that extends along the coast of Connecticut. The coastal belt is characterized by uplands that range from mean sea level (MSL) to 650 feet above MSL, with an irregular, rocky coastline. Within the coastal belt, hilltops slope southward at a rate of about 50 feet per mile. Topographic features in the area mostly trend in the north-south or northeast-southwest direction, reflecting the structural trends of the local bedrock (Flint, 1968).

SAEP is situated on the Stratford Point peninsula that extends into Long Island Sound. The peninsula is relatively flat with a slight slope toward the sound. Almost all the land at SAEP is less than 10 feet above MSL. The exception to this is a dike that was constructed along the

Housatonic River in 1951 for flood protection. SAEP is within the 100-year flood plain of the Housatonic River; wetland areas surround the plant.

2.2.2 Local Climate and Rainfall

The climate of the SAEP area is strongly influenced by a land-sea breeze, which is most pronounced from spring to early autumn. The sea breeze promotes air mixing that results in slightly higher amounts of precipitation and slightly cooler temperatures at SAEP than inland. The prevailing wind is from the southwest at an average speed of about 11 miles per hour.

Precipitation averages about 44 inches per year, with about 16 inches per year of snowfall. Average monthly temperatures range from a low of about 28 degrees Fahrenheit (°F) in January to a high of about 73°F in July. Detailed information on the monthly and annual climatic averages at SAEP is listed in Table 3-8 of the EBS (ABB-ES, 1996).

2.2.3 Surface Water Drainage

Surface water bodies in the site vicinity include: Long Island Sound, the Housatonic River, Frash Pond, and the Marine Basin and drainage channel (Figure 1). The coastal and marine surface waters have been classified by CDEP Water Quality Standard regulations as SC/SB (NUS, 1990). The SC indicates that the CDEP recognizes existing water quality problems in the coastal waters; however, the SB classification indicates CDEP's goal of improving the water quality conditions. Frash Pond is not currently classified. According to CDEP, unclassified surface waters default to an A classification, which designates the following water uses: potential drinking, agricultural, or industrial water supply; fish and wildlife habitat; and recreational.

Long Island Sound receives all of the region's drainage, in large part via the Housatonic River. Water discharges from the Housatonic River range from 40 to over 100,000 cubic feet per second (cfs) and average 3,000 cfs (USGS, 1989). Reported tidal levels for the Housatonic River at Stratford are:

Low tide level	0.8 feet MSL
Mean tide level	2.9 feet MSL
High tide level	5.5 feet MSL

Most of the SAEP surface is paved or covered with buildings. Typical coefficients of runoff for paved surfaces range from 0.8 to 0.9 (i.e., 80 or 90 percent runoff), and runoff from building rooftops is expected to be equal, if not higher. Thus, runoff during storm events is heavy. Most of the precipitation that falls on SAEP is treated and drained to the Housatonic River; two exceptions are small roof areas of B-2 that drain to either Frash Pond or to the airport.

Runoff at SAEP is currently collected by one of a network of six storm drainage systems. Each of the storm drain systems is equipped with a pumping station because of the low elevation of the plant and proximity of the Housatonic River and Long Island Sound. Effluent from the storm drainage system is pumped through the Oil Abatement Treatment Plant (OATP), except in times of heavy precipitation, when some runoff is pumped directly to the Housatonic through individual outfalls.

Based on historical site photographs and plans, the Site once had a low-lying area at the head of the drainage channel that is connected to the Marine Basin (in the vicinity of B-3 and B-6). The drainage channel abuts a portion of the plant's property line (Figure 2).

SAEP is located within the 100-year flood plain of the Housatonic River (CDEP, 1979). The Site is partially protected from flooding by a dike that runs the entire length of the property abutting the Housatonic River; however, the dike is not tied into high ground, which would prevent floodwaters from going around the dike. The Site was flooded in 1951 when the Housatonic River flooded, and again in 1968.

2.2.4 Geology and Hydrogeology

2.2.4.1 Regional Geology and Hydrogeology

The bedrock geology underlying SAEP is reported to consist of lower Ordovician age metamorphic schists, phyllites, and paragneisses of the Oronoque Member of the Derby Hill Schist (Fritts, 1965). Flint (1968) identifies these rocks as the Orange Formation. Exposures of bedrock do not occur in the SAEP vicinity. Borings made along the Housatonic River (Flint, 1968) and borings completed on-site (ESE, 1991) reportedly encountered bedrock at depths ranging from about 100 to 150 feet below the land surface.

Recent deposition of alluvium, estuarine, tidal marsh, beach sediments, and man-placed artificial fill occur along the Housatonic River. The surficial unconsolidated sediments reported near SAEP are Stratford Outwash, tidal marsh peat, and artificial fill (Flint, 1968; U.S. Department of Agriculture, 1981). Lordship Outwash sediments are found south of the SAEP (Flint, 1968).

Stratified drift, consisting of sorted sediments deposited in streams formed by the meltwater of glaciers, is the main water-bearing hydrogeologic unit in the site area. The stratified drift forms two depositional facies, known as ice-contact stratified drift and outwash (Flint, 1968). Ice-contact stratified drift is defined as "sediments deposited in streams and other bodies of water against, upon, beneath, or otherwise in immediate contact with melting glacier ice", and is characteristically poorly sorted, and contains irregular beds with large and abrupt changes in grain sizes ranging from clay to boulders. Conversely, outwash is defined as "sediments deposited by streams beyond the glacier, and free of any influence of buried ice", and is generally well sorted sand to fine gravel with lenticular beds.

Borings completed near the mouth of the Housatonic River encountered post-glacial estuarine mud unconformably overlying stratified drift at depths as great as 60 feet below MSL (Flint, 1968). The estuarine sediment is described as a gray mud consisting of silt and clay with organic matter. It has a maximum reported thickness of about 60 feet.

The tidal marsh and swamp deposits in the area consist of decayed plant matter, peat, and mixtures of silt and clay with high amounts of peat. These deposits may be as thick as 15 feet. The SAEP area is influenced by tidal marsh sediments deposited at and upstream from the mouths of tidal inlets (due to rise in sea level since the last glaciation and daily tides) that discharge to the ocean (Flint, 1968). Tidal marsh sediments consist of peat and very organic silt or clay that form wedge-shaped deposits, which become thicker towards the ocean or mouth of the streams.

Stratford Outwash is found along the fringes of the Housatonic River and consists of well sorted sand with small amounts of gravel. Borings completed for the Washington Bridge (Highway 1, about 2 miles north of SAEP) encountered outwash sand underlying more recent alluvium, tidal marsh and swamp peat, and estuarine sediments to an elevation of about 115 feet below MSL (Flint, 1968). This indicates that the outwash had filled the entire valley of the Housatonic, but after extensive erosion by the river and rise in sea level, only remnants of the deposit remain. In some exposures along the Housatonic River north of the Site, the Stratford Outwash is found overlying ice-contact stratified drift (Flint, 1968).

2.2.4.2 Site Geology and Hydrogeology

The following assessment of the geology and hydrogeology at the SAEP is summarized from the Phase II Report (W-C, 1996) in which generalized geologic cross-sections were developed from previous engineering reports as well as from boring logs prepared as part of Phase I and Phase II Investigations conducted by W-C and presented in the Phase II Report (W-C, 1996). The cross-sections show that the shallow geology is characterized by four distinct units: fill material, estuarine silt, peat, and glacial deposits. These unconsolidated deposits overlie the bedrock unconformably. A description of these units and their distribution across the SAEP follows.

Fill

Fill material is found throughout most of the SAEP. Fill was used for road construction, site grading, and as foundation material for buildings. Fill material consists of fragments of concrete, brick, asphalt, wood, cinders, copper wire, and rebar. Fill in areas along the shoreline is reported to consist of materials hydraulically dredged from the Housatonic River. The composition of the fill is variable, but most of it is described as a granular material that was placed to promote drainage.

Fill also consists of glacial material deposited on the surface from cut-and-fill operations made during facility development between 1940 and 1960. The glacial fill material generally consists of brown medium to fine sand and gravelly sand.

The thickness of the fill is generally about 5 ft, although it may reach a thickness of up to 19 ft. The fill appears to thin somewhat with distance away from the river. This may be a result of more extensive historical filling operations along the river in order to bring the shoreline up to grade with the rest of the Site.

Estuarine Silt

A thick silt deposit underlies the fill at the northern edge of the facility along the Housatonic River. This deposit consists of black organic silt containing occasional shell and sand layers. This material is an estuarine sediment deposited by the Housatonic River and subsequently topped with fill (both artificial and glacial fill) during enlargement of the facility property.

This silt stretches from piezometer PZ-7D (northeastern corner of building B-2) eastward to monitoring well MW-4 (just south of the Causeway) at a depth of approximately 1 to 9 ft below sea level (8 to 15 feet below ground surface). The thickness of the estuarine silt layer ranges from 2 ft to 30 ft and it extends landward 150 to 250 ft. The silt layer is thickest at location piezometer PZ-5D (30 ft deep at Building B-37) and pinches out at the edges near piezometer PZ-7D (northeast corner of Building B-2) and monitoring well MW-4 (just south of the Causeway).

Peat

A deposit of brown and black peat with some organic silt was encountered in the eastern portion of the SAEP in the vicinity of the former lagoons (impoundment area). It's extent is roughly circular which indicates that it was probably formed by a marsh or swamp. Older USGS quadrangle maps show that this area was formerly a tidal marsh that was subsequently filled. In the former lagoon area, the peat forms a continuous concave layer, approximately 7 ft thick which deepens to the west - northwest. The peat lies directly beneath fill material in this area at depths ranging from 3 to 20 ft bgs. Portions of the upper peat layer may have been excavated prior to fill placement.

Peat material was also encountered at the location of monitoring well WC-8S (at Building B-8) and monitoring well WC-2D (just south of the Causeway) at depths of 5 ft bgs and 30 ft bgs and thicknesses of 2 ft and 5 ft respectively. These two peat deposits are apparently small, isolated pockets and are not a part of the continuous deposit in the lagoon area.

Glacial Sediments

A thick deposit of glacial sediments underlies the fill, estuarine silt, and peat deposits at the Site, and unconformably overlies the bedrock. The total thickness of the glacial sediments is between 148 ft and 156 ft thick, based on boring logs from monitoring wells WC-9D2, WC-20D2 and WC-21D2 (generally off-site to the west of the SAEP) installed during Phase II. The glacial deposits consist of sands, silty sands, and gravelly sands with occasional boulders and varved silt. The glacial deposits can be generally grouped into three layers: 1) a layer of gray to brown, medium to coarse sand with varying amounts of gravel, underlain by 2) light to medium-brown, medium to fine sand and silty sand with occasional clay stringers, followed by 3) another layer of brown to gray sand and gravel immediately above the bedrock.

There are variations in this general sequence, however. For example, in the eastern portion of the Site, a silty sand layer overlies the first layer of sand and gravel and a distinct gravel deposit, approximately 2 to 5 ft thick, is locally extensive in the vicinity of piezometer PZ-13D (near Building B-4), and monitoring wells WC-2D and WC-3S (both near the Causeway).

A glacial varved silt unit had been reported to occur only locally in the vicinity of Building B-65 (Haley and Aldrich, 1987). Varved silt layers were encountered at a depth of 60 ft bgs in monitoring well WC-9D2 and are described as 2 millimeter bands of red clay interlayered with orange sand layers. At other depths in monitoring well WC-9D2 (northwest corner of Building B-2) and in monitoring well WC-20D2 (off-site to the west of Building B-2) red clay stringers were observed. It is unclear as to whether the red clay stringers represent a portion of a larger varved sequence.

Bedrock

A competent amphibole-mica schist bedrock was reported at monitoring well locations LW-5D, LW-9D and LW-10D (in the vicinity of the former lagoons south of the main Plan) at depths of 163 ft, 151.5 ft, and 103 ft below grade, respectively. Bedrock was encountered at three locations during the drilling of Phase II monitoring wells WC-9D2, WC-20D2 and WC-21D2 (generally off-site the west of SAEP); at respective depths of 156 ft, 150 ft and 148 ft below grade. The bedrock is described as a black schist with greenstone.

A nineteenth century report of massive serpentinite consisting of antigorite with accessory magnetite and carbonate was reported at the SAEP (Crowley, 1968). No contemporary confirmation of this report exists.

If the locally N35oE trending trace of the Mixville Fault (Flint, 1968) is extrapolated to the southwest (Rodgers, 1985), across the Housatonic River, it would pass directly under the SAEP. However, there is no confirmation of the existence of this fault southwest of its mapped terminus.

Hydrogeology

During Phase I and Phase II investigations, shallow and intermediate wells were installed at the water table and 30 to 50 ft below the ground surface in the overburden aquifer, respectively. Deep overburden wells were screened just above the bedrock. Data from these monitoring wells, as well as from monitoring wells previously installed at SAEP, established an easterly groundwater flow direction towards the Housatonic River, a northwesterly flow towards Frash Pond, and flow toward the drainage channel in the southern portion of SAEP. There may be a groundwater divide and buried tidal inlets on SAEP, and other buried outlets from Frash Pond may pass under SAEP (Envirosphere, 1984). These types of features appear to be a factor controlling groundwater movement patterns and fate of potential contaminants. Very little flow reversal, as related to tidal influences, were measured. Groundwater contour maps are presented in the Phase II Report (W-C, 1996).

Groundwater flow at the SAEP facility is influenced by three surface water features. The primary influence is that of the intertidal flats. Groundwater flow in the northern half of the facility is in the direction of the intertidal flats at low tide. An average low tide hydraulic gradient was calculated to be 0.0012 for both the shallow and intermediate portions of the aquifer. Because the incoming tide exerts pressure on the water table aquifer, the hydraulic gradients at high tide will be lower than those at low tide.

A second surface water body influencing the groundwater flow at the facility is Frash Pond, located approximately 300 feet from the northwest corner of the facility. Frash Pond appears to be located downgradient of the northwest portion of the SAEP facility. The airport, as well as other off-site properties, are also located upgradient of Frash Pond. Water elevations measured in monitoring wells suggest that groundwater from off-site locations south and west of the SAEP are flowing toward the SAEP. Average groundwater hydraulic gradients in the direction of Frash Pond were calculated to be 0.0012 for the shallow wells and 0.0018 for the intermediate wells in the vicinity of the pond.

The third surface water body influencing the groundwater flow at the facility is the drainage channel located in the southern portion of the SAEP. The presence of groundwater mounds in the shallow portion of the aquifer in this area of the facility is due to the existence of a peat layer that causes a perched water condition above the peat. An average hydraulic gradient in the direction of the drainage channel was calculated to be 0.0073 for the shallow portion of the aquifer above the peat and 0.0018 for the intermediate portion of the aquifer below the peat layer. The area of the facility influenced by groundwater flow to the drainage channel is limited to the lagoon area in the vicinity of the channel.

Hydraulic conductivities calculated from slug tests performed in Phase II investigation monitoring wells indicate that hydraulic conductivities are generally from 12 to 15 feet per day (ft/day) for shallow wells, 0.01 to 2.7 ft/day for intermediate wells and 2.5 to 6.0 ft/day for deep wells.

2.3 ECOLOGICAL SETTING

This section of the RIWP describes the ecological resources on and in the vicinity of SAEP. For the purposes of the RI, ecological habitats are present at the following three areas:

- Intertidal Mudflats;
- Marine Basin/Outfall 008 area; and,
- Causeway.

Information on critical habitats and wetland areas in the vicinity is also summarized. Much of the information in this section is summarized from Section 2.0 of the Phase II investigation Work Plan (W-C, 1994) and the Draft Baseline Ecological Risk Assessment for the SAEP (W-C, 1996). These documents should be consulted for more detailed information and discussion of the area.

2.3.1 Surface Water Bodies

The SAEP is located on the tidal portion of the Housatonic River less than one mile upstream from the Long Island Sound (Figure 1). As such, the habitats and biota which occur in the site vicinity are largely dictated by diurnal fluctuations in water level, salinity and surface water chemistry, and are influenced by the Sound. The Housatonic River is approximately one quarter mile wide in the site vicinity and conveys most of the region's drainage to the Long Island Sound. Currents in the river proper are variable in this area due to the fluctuating tides.

In the tidal mudflat area adjacent to the Site, local currents flow toward land into the sheltered cove on a flooding tide. In the absence of current on a slack tide, suspended fine sediments settle out of the water column and contribute to the sediment accumulation in the mudflat area. The mudflat is exposed twice daily at low tide when all water recedes from the area except for flow in several rivulets near the outfalls.

Marine Basin is located about 1,000 feet southeast of SAEP on the Housatonic River (Figure 1). It is a shallow, permanently inundated, tidal embayment which receives some drainage from the drainage into which Outfall 008 feeds, but mostly from the Housatonic River.

2.3.2 Surface Water Chemistry

Characterization of surface water chemistry in the vicinity of the SAEP site is based on data collected as part of the previous investigations at the Site (W-C, 1993). Generally, surface water pH ranged from 7.4 to 8.5, and was typically approximately 8.1. Similarly, salinity ranged from 11.8 parts per thousand (ppt) to 27 ppt, typical of estuarine waters. Conductivity ranged from 14,500 umhos to 33,000 umhos.

Surface water temperatures at the time of sampling ranged from 10.5 degrees Celsius to 25.0 degrees C. Most values were in the low 20s degrees C. Temperatures were approximately five to ten degrees lower at the tidal flat and intertidal background locations than at the tidal flat outfall locations and at Outfall 008.

2.3.3 Intertidal Mudflats

The intertidal mudflats adjacent to the SAEP are a generally level to gently sloping area that is subject to alternating periods of tidal inundation and exposure. Sediments in the mudflats are primarily fine silt and mud transported from the Housatonic River and deposited here. The mudflats are nutrient enriched and support populations of macroinvertebrates which are important food sources for fish and shorebirds. The northwest portion of the mudflats support some emergent vegetation. The following paragraphs describe biota which utilize the Intertidal Mudflat for habitat and feeding.

2.3.3.1 Benthos

The intertidal mudflats adjacent to the SAEP provide a nutrient rich habitat for a variety of invertebrate forms. Information on indigenous benthic fauna in the vicinity of the SAEP site is based on extensive data collected in December 1994 as part of the Phase II effort and a field reconnaissance performed in May 1995 (W-C, 1996).

A total of 49 different macroinvertebrate taxa occur in the site vicinity. The taxa present are common to estuarine systems, with polychaetes (especially Streblospio benedicti, which was present at all stations) and oligochaetes predominating. As a group, deposit-feeding oligochaetes, and polychaetes were by far the dominant component of all samples. Individually, oligochaete densities ranged from 2 to 67 percent, and polychaetes from 26 to 97 percent of the total number of individuals at all stations sampled.

At most stations, Streblospio benedicti was the dominant polychaete. Its presence alone accounted for 12 to 89 percent of all individuals at the ten mud flat stations. At five locations, the capitellid, Mediomastus ambiseta, exceeded or equaled the Streblospio densities. Amphipods were recovered from most stations. The most common species were Leptocheirus plumulosus and Gammarus palustris. Similarly, molluscs, usually Littorina sp. juveniles (a gastropod), or Gemma gemma (a bivalve), were present in most samples.

In addition to the infaunal invertebrates described above, the site vicinity supports dense beds of oysters. Although Crassostrea virginica, the Eastern oyster, is the primary species of shellfish harvested from the area, other shellfish that are fished for include the hard clam (quahog), bay scallop, soft-shelled clam, blue mussel, and razor clam. Observations were made of benthic macroinvertebrates inhabiting the rocky intertidal zone around the mudflats which has formed as a result of rip-rap placement. The following species were observed on the rocky intertidal zone: Ovalipes ocellatus (calico crab), Mytilus edulis (blue mussel), Modiolus demissus (ribbed mussel), Mercenaria mercenaria (hard clam), and Squilla empusa (mantis shrimp).

2.3.3.2 Fish

A number of fish species are common to the Long Island Sound and Housatonic River in the vicinity of the SAEP. The principal species include: Atlantic herring (Clupeas harengus), American shad (Alosa sapidissima), Atlantic silverside (Menidia menidia), mummichog (Fundulus heteroclitus), American eel (Anguilla rostrata), winter flounder (Pseudopleuronectes americanus), bluefish (Potamus saltatrix), and tautog (Tautoga onitis).

The mudflats adjacent to the SAEP site do not represent an important fish habitat owing largely to the hydrology in this area. At low tide, virtually all of the surface water recedes out of the area for several hours. Hence, at best, this area represents an intermittent feeding habitat for fish such as silversides and other omnivorous species feeding on small crustaceans, worms, and insects.

2.3.3.3 Avifauna

There have been approximately 220 bird species observed in the site area (W-C, 1991). Shore birds and waterfowl constitute the majority of bird life in the SAEP vicinity. The wetlands near SAEP are known breeding grounds for transitory birds such as the great egret (Casmerodius albus), snowy egret (Nyctanassa vidacea), black-crowned night heron (Nycticorax nycticorax), glossy ibis (Plegadis falcinellus), and fish crow (Corvus ossifragus).

Two bird species that nest in the general vicinity of the Site are the least tern (Sterna antillarum) and piping plover (Charadrius melodus). Both species would use tidal marshes as feeding areas during the breeding season.

During the field reconnaissance of the Site performed in May 1995 (W-C, 1996), a variety of species were observed from the Site including: great blue heron (Ardea herodias), American black ducks (Anas rubripes), sandpipers or "peeps" (Calidris sp.), herring gull (Larus argentatus), and mute swans (Cygnus olor).

The United States Fish and Wildlife Service (USF&WS) conducted bird surveys in the vicinity of the Site in 1997. Results of these recent surveys will be included in the RI report.

2.3.4 Marine Basin/Outfall 008 Area

SAEP Outfall 008 discharges into a drainageway which travels several hundred feet to its confluence with the Marine Basin. The channel of the "008 drainageway" is approximately 10 to 12 feet wide and generally less than 2 feet deep. The downstream portion is tidally influenced. The adjacent land area is generally disturbed and vegetated primarily with Phragmites. While documentation is somewhat limited, the drainageway is generally low quality habitat based on visual observation and sediment chemical and benthic community data.

Marine Basin is a tidal, permanently inundated shallow embayment surrounded primarily by stands of Phragmites. Little, if any, emergent vegetation exists. Benthic macroinvertebrates which colonize the Basin likely represent typical estuarine communities observed in the Intertidal Mudflat.

2.3.5 The Causeway

Due to the industrial nature of the SAEP site, there is no terrestrial habitat on the Site with the exception of the limited area on top of the Causeway. Where vegetated, the surface of the Causeway is primarily covered with herbaceous species, limited scrubby vegetation and several trees. Species observed include: clover, ragweed (Ambrosia sp.), jewelweed (Impatiens sp.), smartweed (Polygonum sp.), several tree of heaven (Ailanthus altissima), and willow (Salix sp.). This area is small, one to two acres in size, and does not represent valuable habitat. Since it is isolated from other nondeveloped areas and generally disturbed, it provides limited habitat, at best, to biota. Terrestrial species which may use the Causeway from time to time are likely to include some birds and small rodents which inhabit other disturbed lots in this portion of Stratford.

2.3.6 Critical Habitats and Species

Critical habitats in the vicinity of the Site include extensive tracts of salt marshes, saltwater intertidal flats and shores, and coastal sand dunes which provide habitat for a variety of biota. The intertidal mudflats in the vicinity of SAEP are located in a band along the shoreline of the Housatonic River and Long Island Sound. SAEP's riparian rights encompass the intertidal mudflats area. Plant life in the vicinity of SAEP is limited to the tidal marshes.

The tidal marsh plant life consists primarily of soft-stemmed plants such as sedges, rushes, and grasses. Cordgrass (Spartina patens) and common reed (Phragmites) are the dominant species in the marshes. A number of southeastern Piedmont and Coastal Plain plant species reach their northern native range limits in this region.

Tidal marshes provide habitat for mammals such as rodents and insectivores. The primary mammal species include muskrats (Ondatra zibethica), cottontail (Sylvilagus sp.), and raccoons (Procyon lotor). Cordgrass provides an ideal forage and building material for muskrats. Raccoons feed on crustaceans and small rodents.

A detailed description of the federal- and state-listed threatened, endangered, or special concern species that have the potential to occur in the vicinity of SAEP and the status of each is provided in the Preliminary Assessment Screening (W-C, 1991). A list of these species is provided in Table 3-3 of the Preliminary Assessment Screening (additional information from the field reconnaissance and recent U.S. Fish and Wildlife Service survey will be included in the RI report).

No federally listed threatened or endangered plant species have been reported to occur in the vicinity of the SAEP with the exception of the New England Blazing Star (Liatris borealis), which is a candidate for the list. Two federally-listed and an additional 14 state-listed threatened, endangered or special concern birds have the potential to occur in the vicinity of the SAEP. The two federally-listed species include the piping plover and the Roseate tern.

The piping plover nests in the vicinity of the SAEP; nesting habitat is located on Short Beach, Long Beach, and Milford Point. These areas are extremely important to the continued survival of the piping plover and select areas of these beaches are closed to public activity during the nesting and rearing period. These beach areas utilized as nesting habitat by the piping plover are probably used by the least tern also, which is a state-listed threatened species.

2.4 SITE HISTORY

2.4.1 Operational History

The SAEP site has been used for development, manufacture, and assembly of aircraft or engines since 1929. The plant history has been categorized into the following periods:

1929 to 1939: Sikorsky Aero Engineering Corporation developed and manufactured sea planes at the Stratford plant.

1939 to 1948: Chance Vought Aircraft located its operations at the Stratford plant in 1939, and the company became known as Vought-Sikorsky Aircraft Division. Sikorsky developed the helicopter and left the plant in 1943 because of overcrowding. Chance Vought developed the "Corsair" for the U.S. Navy, and mass produced Corsairs during World War II. Chance Vought vacated the Stratford plant in 1948.

1948 to 1951: The Stratford plant was idle.

1951 to 1976: The U.S. Air Force procured the Stratford plant in 1951 and named it Air Force Plant No. 43. The Avco Corporation (AVCO) was contracted by the Air Force to operate the plant. AVCO manufactured radial engines for aircraft in the 1950s, and developed and manufactured turbine engines, primarily for aircraft, in the 1960s and 1970s.

1976 to Present: The plant was transferred from the U.S. Air Force to the U.S. Army in 1976. At that time, the plant was re-named the Stratford Army Engine Plant, although it continued under AVCO operations. AVCO was contracted by the Army to develop the AGT-1500 engine to power the Abrams tank. AVCO also developed and manufactured marine and industrial engines. AVCO merged with Textron in December 1985, and subsequently formed the Textron Lycoming Stratford Division. The contract for operation of SAEP was transferred from Textron Lycoming to Allied-Signal in 1994. Allied-Signal continued to develop, manufactured and test turbine engines at SAEP for both military and commercial aircraft and land vehicles until 1997. Since the cessation of Allied-Signal operations, the focus of activities at SAEP has been completion of an environmental assessment of the Site and the potential for re-development.

1986 or 1987: Historical state order issued to AVCO Lycoming regarding RCRA groundwater monitoring in the lagoon area.

2.4.2 Waste Disposal

The primary types of industrial waste generated at SAEP prior to the 1950s are reported to have been waste oils, fuels, solvents, and paints (W-C, 1991). Since 1951, most of the wastes generated at SAEP have resulted from engine production operations such as plating, metal working, and finishing, as well as cleaning operations. Wastes were also generated as a result of engine and engine component testing, research and development, raw materials testing, vehicle and other maintenance, and on-site waste treatment.

2.4.3 Environmental Regulatory Compliance

The EBS (ABB-ES, 1996) contains a review of SAEP's environmental compliance history and permit status, its current compliance status, and future compliance issues. Specifically, the EBS assesses SAEP in relation to: Resource Conservation and Recovery Act (RCRA); CERCLA; Emergency Planning and Community Right-to-Know (SARA Title III); Clean Water Act; Clean Air Act (CAA); Toxic Substances Control Act (TSCA); Safe Drinking Water Act; Federal Insecticide, Fungicide and Rodenticide Act; endangered species; radioactive materials; and, National Environmental Policy Act (NEPA). The EBS noted that SAEP has experienced some violations in the past, but, as of December 1996, was in compliance with environmental regulations (ABB-ES, 1996).

The EBS identified the following recorded deficiencies in hazardous waste management practices at SAEP.

- Manifest warning letters for deficiencies in completion of hazardous waste manifests. Deficiencies included missing analytical results, transporter name or identification (ID) number, manifest document numbers, waste ID numbers, and waste quantities; un-specified container type; incorrect USEPA generator ID number; point of departure from the United States not specified for international shipments; failure to sign and date manifest; illegible manifest; and failure to respond to manifest warning letter. To the best of SAEP's knowledge, all prior warning letters were resolved.
- Warning letters issued by CDEP for failure to submit hazardous waste biennial reports on a timely basis or submission of an unacceptable report. SAEP subsequently submitted acceptable reports.
- Several orders issued by CDEP to bring SAEP into compliance with RCRA hazardous waste management regulations. For example, updating the site contingency plan, waste analysis plan, and preparedness and prevention plan.
- Order issued by CDEP to make modifications to OATP in order to bring Outfall 007 into compliance with the National Pollutant Discharge Elimination System (NPDES) permit by "proper treatment of oily wastewaters." SAEP reportedly complied with this order.
- Records indicate that frequent and severe violations of NPDES permit limitations (i.e., effluent concentrations more than five times the permit limit) occurred prior to the mid-1980s. In a Consent Decree dated April 10, 1984, SAEP agreed to use "best reasonable efforts" to achieve compliance with the permit and to complete upgrading

of the Chemical Wastewater Treatment Plant (CWTP). Violations have occurred since that time less frequently and with less severity. Since November 1994, the only violation has been associated with the failure to meet aquatic toxicity criteria. Upon retesting of the sample, the parameter in question was found to be in compliance.

- Inspection reports indicate occasional violations of CAA requirements such as: fumes escaping from vapor degreasers; failure to notify CDEP of modifications to or additions of processes that could increase emissions; and, excess emissions of chromic acid.
- In response to findings that SAEP failed to maintain adequate inspection and maintenance records for 20 polychlorinated biphenyls (PCBs) transformers in accordance with TSCA, SAEP agreed to subsequently ensure that transformers would be inspected and that records of inspections and maintenance history of the transformers would be maintained.
- SAEP does not appear to be in compliance with the requirement of NEPA that environmental evaluations be conducted prior to beginning construction projects since 1970.

The EBS also identified several spills of hazardous materials that resulted in discharges to surface water in the SAEP site vicinity.

October 29, 1981: Approximately 20 gallons of fluorescent metal penetrant, a dye used for nondestructive inspection of metal parts, was spilled into a storm drain and discharge from Outfall 007.

July 29, 1979: Approximately 75 gallons of oil sludge from the OATP bypassed clogged skimmers and discharged from Outfall 007. SAEP was notified of the problem by the U.S. Coast Guard, which was searching for the source of an oil slick on the Housatonic River. (SAEP was apparently the sole source.)

May 8, 1978: Twenty-five to 30 pounds of chromic acid was spilled, and most flushed into a storm drain. About 50,000 gallons of diluted acid was intercepted in the drain and pumped into a holding tank. Remaining pools of the diluted acid were pumped to the CWTP. Acid that was not intercepted or contained was discharged to the Housatonic River from Outfall 007. Chromium concentrations of effluent from Outfall 007 were measured at 30 milligrams per liter (mg/l) on May 8, 1978, 2.5 mg/l on May 10, 1978, and were not detectable by May 11, 1978.

August 1978: CDEP was advised by SAEP that a yellow plume with a pH of 2.9 and 64 parts per million (ppm) of hexavalent chromium was extending approximately 200 yards from Outfall 007 into the Housatonic River (CDM, 1992).

No records of enforcement actions or fines relating to these releases were found or reported in the EBS.

ATTACHMENT C
CT DEP REMEDIAL STANDARD REGULATIONS

STATE OF CONNECTICUT

REGULATION

OF

DEPARTMENT OF ENVIRONMENTAL PROTECTION

concerning

REMEDIATION STANDARD

Section 1. The Regulations of Connecticut State Agencies are amended by adding a new section 22a-133k-1 as follows

Section 22a-133k-1

(a) Definitions

For the purposes of sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies, the following definitions apply

(1) "Analytical detection limit" means the minimum concentration of a substance that can be quantified consistently and reliably using methods approved by EPA and which concentration shall be (A) for a substance in ground water, equal to or less than the ground-water protection criterion for such substance determined (i) for a sample of ground water in a GA area using analytical methods specified in subpart C of 40 CFR part 141 or (ii) for a sample of ground water in a GB area using methods established pursuant to "Test Methods for Evaluating Solid Waste Physical/Chemical Methods", SW-846, U.S. Environmental Protection Agency, Office of Solid Waste, Washington D C 20460, or (B) for a substance in soil, equal to or less than the residential direct exposure criteria or the applicable pollutant mobility criteria, whichever is lower using methods established pursuant to "Test Methods for Evaluating Solid Waste Physical/Chemical Methods", SW-846, U S Environmental Protection Agency, Office of Solid Waste, Washington D C. 20460

(2) "Aquifer protection area" means an aquifer protection area as defined in section 22a-354h of the General Statutes

(3) "Area of influence" means as "area of influence" as defined in section 22a-354b-1(a) of the Regulations of Connecticut State Agencies

(4) "Areal extent of a ground-water plume" means the surface area beneath which ground water has been or may be polluted by a release and in which ground water one or more substances from such release is or may be present at a concentration above the analytical detection limit

(5) "Background concentration for ground water" with respect to a particular release means the concentration of a substance in ground water (A) at the nearest location upgradient of and unaffected by the release, or (B) if such release occurred at or created a ground-water divide, at the nearest location representative of ground water quality unaffected by any release

(6) "Background concentration for soil" means the representative concentration of a substance in soil of similar texture and composition outside the subject release area and in the general geographic vicinity of such release area, but not within any other release area

(7) "Carcinogenic substance" means a substance defined as a "carcinogen" by federal or state agencies and for which a quantitative health risk extrapolation is available

(8) "CFR" means the Code of Federal Regulations

(9) "Commissioner" means the Commissioner of Environmental Protection or his designee

(10) "Dense non-aqueous phase liquid" means a non-aqueous phase liquid that has a density greater than water at 20 degrees Celsius

(11) "Direct Exposure Criteria" means the concentrations identified in Appendix A to sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies or any alternative direct exposure criteria approved by the Commissioner pursuant to section 22a-133k-2(d) of the Regulations of Connecticut State Agencies

(12) "Downgradient" means in the direction of the maximum rate of decrease of hydraulic head

(13) "Downgradient area" with respect to a release of a substance means the area bounded by (A) the width of the release area of such substance perpendicular to the direction of ground-water flow, (B) two side boundary lines parallel to the downgradient direction of ground water flow extending from the two endpoints of said width to the downgradient parcel boundary, and (C) the downgradient parcel boundary extending between the two side boundary lines, excluding any portion of such downgradient area that is (i) affected by any other release of such substance or (ii) beneath an existing permanent structure

(14) "Environmental land use restriction" means an environmental land use restriction as defined in section 22a-133q-1 of the Regulations of Connecticut State Agencies

(15) "Environmentally isolated soil" means polluted soil which is (A)(i) beneath an existing building or (ii) beneath another existing and permanent structure which the Commissioner has determined in writing would prevent the migration of pollutants, (B) not a continuing source of pollution, (C) not polluted with volatile organic substances or, if it is polluted with such substances, the concentration of such substances has been reduced in concentration to the maximum extent prudent, and (D) above the seasonal high water table

(16) "EPA" means the United States Environmental Protection Agency

(17) "Excess lifetime cancer risk" means the estimated probability that an individual's exposure to a substance could result in cancer

(18) "GA area" means an area where the ground-water classification is GA or GAA, respectively

(19) "GB area" means an area where the ground-water classification is GB

(20) "Ground water" means that portion of waters as defined in section 22a-423 of the General Statutes which portion is at or below the water table

(21) "Ground-water classification" means the ground-water classification goal or the ground-water classification, whichever is more stringent, established in the Water Quality Standards

(22) "Ground-water divide" means a line on the water table from which the water table slopes downward in both directions away from such line

(23) "Ground-water protection criteria" means the concentrations identified in Appendix C to sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies

(24) "Ground-water plume" means ground water which has been polluted by a release and in which ground water one or more substances from such release is present at a concentration above the analytical detection limit

(25) "Hazard index" means the calculation of the potential for non-cancer health effects as a result of exposure to one or more substances with the same or similar modes of toxic action or toxic endpoints

(26) "Hydraulic gradient" means the change in hydraulic head per unit distance

(27) "Hydraulic head" means the elevation to which water rises in a piezometer or a well

(28) "Inaccessible soil" means polluted soil which is: (A) more than four feet below the ground surface, (B) more than two feet below a paved surface comprised of a minimum of three inches of bituminous concrete or concrete, which two feet may include the depth of any material used as sub-base for the pavement, or (C)(i) beneath an existing building or (ii) beneath another existing permanent structure provided written notice that such structure will be used to prevent human contact with such soil has been provided to the Commissioner.

(29) "Industrial or commercial activity" means any activity related to the commercial production, distribution, manufacture or sale of goods or services, or any other activity which is not a residential activity as defined in subdivision (53) of this subsection

(30) "Industrial/commercial direct exposure criteria" means the concentrations identified as industrial/commercial direct exposure criteria in Appendix A to sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies

(31) "Industrial/commercial volatilization criteria" means the concentrations identified as industrial/commercial volatilization criteria in Appendices E and F to sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies

(32) "Intermittent watercourse" means "intermittent watercourse" as defined in section 22a-38 of the General Statutes

(33) "Light non-aqueous phase liquid" means a non-aqueous phase liquid that has a density equal to or less than water at 20 degrees Celsius

(34) "Matrix interference effect" means the inability to measure the concentration of a substance in a sample at the analytical detection limit due to chemical interferences within the sample which interferences cannot be compensated for using methods approved by EPA

(35) "Natural attenuation" means a decrease in concentration of a substance in ground water through operation of natural physical or chemical processes, including but not limited to adsorption, absorption, dilution, phase transfer, oxidation, organic complexation, biodegradation, dispersion and diffusion.

(36) "Non-aqueous phase liquid" means a liquid that is not dissolved in water

(37) "Organoleptic" means the capability to produce a detectable sensory stimulus such as odor or taste

(38) "Parcel" means a piece, tract or lot of land, together with the buildings and other improvements situated thereon, a legal description of which piece, parcel, tract or lot is contained in a deed or other instrument of conveyance

(39) "PCB" means polychlorinated biphenyls

(40) "PPB" means parts per billion

(41) "PPM" means parts per million

(42) "Person" means person as defined in section 22a-2(c) of the General Statutes

(43) "Pollutant mobility criteria" means the concentrations identified in Appendix B to sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies or any alternative pollutant mobility criteria approved by the Commissioner pursuant to subsection 22a-133k-2(d) of the Regulations of Connecticut State Agencies

(44) "Polluted fill" means soil or sediment which contained polluting substances at the time such soil or sediment was deposited as fill material

(45) "Polluted soil" means soil affected by a release of a substance at a concentration above the analytical detection limit for such substance

(46) "Pollution" means pollution as defined in section 22a-423 of the General Statutes

(47) "Potable water" means potable water as defined in section 22a-423 of the General Statutes

(48) "Potential public water supply resource" means (A) any "potential well field" as defined in section 22a-354a of the General Statutes, or (B) any area identified by the Commissioner pursuant to section 22a-354c(b) of the General Statutes.

(49) "Prudent" means reasonable, after taking into consideration cost, in light of the social and environmental benefits

(50) "Release" means any discharge, spillage, uncontrolled loss, seepage, filtration, leakage, injection, escape, dumping, pumping, pouring, emitting, emptying, or disposal of a substance.

(51) "Release area" means the land area at and beneath which polluted soil is located as a result of a release

(52) "Remediation" means the containment, removal, mitigation, or abatement of pollution, a potential source of pollution, or a substance which poses a risk to human health or the environment, and includes but is not limited to the reduction of pollution by natural attenuation

(53) "Residential activity" means any activity related to a (A) residence or dwelling, including but not limited to a house, apartment, or condominium, or (B) school, hospital, day care center, playground, or outdoor recreational area

(54) "Residential direct exposure criteria" means the concentrations identified as residential direct exposure criteria in Appendix A to sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies

(55) "Residential volatilization criteria" means the concentrations identified as residential volatilization criteria in Appendices E and F to sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies

(56) "Seasonal high water table" means, on an annual basis, the highest plane in the ground at which plane all pore spaces are filled with water atmospheric pressure

(57) "Seasonal low water table" means, on an annual basis, the lowest plane in the ground at which plane all pore spaces are filled with water atmospheric pressure

(58) "Sediment" means unconsolidated material occurring in a stream channel, estuarine waters, or marine waters

(59) "Seven day, ten year low flow" or "7Q10" means the lowest seven consecutive day mean stream discharge rate with a recurrence interval of ten (10) years

(60) "Soil" means unconsolidated geologic material overlying bedrock, but not including sediment

(61) "Soil water" means that portion of waters as defined in section 22a-423 of the General Statutes which portion is above the water table

(62) "SPLP" means Synthetic Precipitation Leaching Procedure EPA Method 1312 as set forth in "Test Methods for Evaluating Solid Waste Physical/Chemical Methods", SW-846, U S Environmental Protection Agency, Office of Solid Waste, Washington D C 20460

(63) "Substance" means an element, compound or material which, when added to air, water, soil or sediment, may alter the physical, chemical, biological or other characteristic of such air, water, soil or sediment

(64) "Surface-water protection criteria" means the concentrations identified in Appendix D to sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies or any alternative surface-water protection criteria calculated or approved by the Commissioner in accordance with subdivision 22a-133k-3(b)(3) of the Regulations of Connecticut State Agencies.

(65) "TCLP" means Toxicity Characteristic Leaching Procedure EPA Method 1311 as set forth in "Test Methods for Evaluating Solid Waste Physical/Chemical Methods", SW-846, U.S Environmental Protection Agency, Office of Solid Waste, Washington D C. 20460

(66) "Technically practicable" means, with respect to remediation, the greatest degree of remediation that can be achieved using sound engineering and hydrogeologic practices

(67) "Upgradient" means in the direction of maximum rate of increase of hydraulic head

(68) "Upgradient area" with respect to a release area of a substance means the area bounded by (A) the width of the release area of such substance perpendicular to the direction of ground-water flow, (B) two side boundary lines parallel to the upgradient direction of ground-water flow extending from the two endpoints of said width to the upgradient parcel boundary, and (C) the upgradient parcel boundary extending between the two side boundary lines, excluding any portion of such upgradient area that is (i) affected by any other release of such substance or (ii) beneath an existing permanent structure

(69) "Volatilization criteria" means the concentrations identified in Appendix E and Appendix F to sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies or alternative criteria approved by the Commissioner pursuant to subdivision 22a-133k-3(c)(4) of the Regulations of Connecticut State Agencies

(70) "Volatilization criteria for ground water" means the concentrations identified in Appendix E to sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies

(71) "Volatilization criteria for soil vapor" means the concentrations identified in Appendix F to sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies

(72) "Water table" means the plane in the ground at which plane all pore spaces are filled with water at atmospheric pressure

(73) "Water Quality Standards" means the latest adopted Connecticut Water Quality Standards and Criteria adopted by the Commissioner pursuant to section 22a-426 of the General Statutes

(74) "Wetland" means 'wetlands' as defined in sections 22a-38(15) and section 22a-29(2) of the General Statutes

(75) "Zone of influence" means zone of influence as defined in section 22a-430-3(a) of the Regulations of Connecticut State Agencies

(b) Applicability

Sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies apply to any action taken to remediate polluted soil, surface water or a ground-water plume at or emanating from a release area which action is:

(1) required pursuant to Chapter 445 or 446k of the General Statutes, or

(2) taken pursuant to Public Act 95-183 or Public Act 95-190 including but not limited to any such action required to be taken or verified by a licensed environmental professional pursuant to such Public Acts.

Sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies do not apply within the zone of influence of a ground-water discharge permitted by the Commissioner under section 22a-430 of the General Statutes Any person conducting a remediation in accordance with said sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies shall obtain all permits and other authorizations required by state, federal and local law and shall comply with all applicable state, federal and local laws, including without limitation the requirements of 40 CFR Part 761 In the event that any provision of sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies conflicts with any provision of any other statute or regulation, the more stringent provision shall prevail. Nothing in this subsection shall be construed as requiring any further remediation of any release which has been remediated and which remediation has been approved in writing by the Commissioner, unless the Commissioner takes action to require such remediation pursuant to any section of Chapter 446k of the General Statutes

(c) Time frames for Issuance of Approvals by the Commissioner.

The Commissioner shall, no later than thirty days after the date of receipt of a request for his approval of any variance from or alternative criteria pursuant to sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies, provide to the requester in writing estimated time frames for the Commissioner to (1) determine whether additional information is needed for him to evaluate the request; and (2) approve or deny a complete request In addition, no later than one hundred and eighty days following adoption of said sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies, the Commissioner shall make available general estimated written time frames for the Commissioner to approve any variance or alternative criterion pursuant to these regulations, including estimated time frames for the Commissioner to (1) determine whether additional information is needed to evaluate the request, and (2) approve or deny a complete request. In establishing estimated time frames pursuant to this subsection, the Commissioner shall take into account the complexity of the request, and the environmental and economic significance of the remediation, and shall expedite any request associated with any voluntary remediation pursuant to Public Acts 95-183 or 95-190

(d) Public Participation

(1) Public Hearing on Remediation If the Commissioner determines that there is substantial public interest in any remediation proposed pursuant to section 2 of P A 95-190 or section 2 or 3 of P A 95-183, he may hold a public hearing on such proposed remediation, and he shall hold a hearing upon receipt of a petition signed by twenty-five or more persons Notice of any such hearing shall be published in a newspaper of substantial circulation in the area of the proposed remediation at least thirty days prior to such hearing Such hearing need not be conducted pursuant to the provisions of Chapter 54 of the General Statutes

(2) Comment Procedures Any public notice published or mailed pursuant to section 2 of P A 95-190 or section 2 or 3 of P A 95-183 shall provide that comments on the proposed remediation may be submitted to the Commissioner within forty-five days of the publication or mailing of such notice The Commissioner shall forward a copy of all comments received by the date specified in the public notice and all comments made at a public hearing to the owner of the subject parcel and, if different, the person undertaking remediation at such parcel The person undertaking remediation at the subject parcel shall, within sixty days of receiving such comments, submit to the Commissioner a written summary of all such comments and a written response to each such comment. The Commissioner shall review such summary and responses and shall adopt it as his own, adopt it with modifications, or reject it and prepare a response to each such comment The Commissioner shall send a copy of the initial summary and responses and of his action with respect thereto to each person who submitted comments on the

remediation proposal

(e) Periodic review.

The Commissioner shall periodically review sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies to determine whether the implementation of such regulations is successfully protecting public health and the environment from the hazards of pollution. The Commissioner shall also evaluate whether the implementation of the regulations streamlines the process of conducting remediation projects in Connecticut, based upon, among other things, his review of the number of remediation projects completed in accordance with said sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies, the number of such projects reviewed by the Commissioner pursuant to sections 2 or 3 of P.A 95-183, the length of time required for the Commissioner's review of complete requests for approval of alternative criteria or variances, and the number of remediation projects conducted pursuant to P.A 95-190 or sections 2 or 3 of P.A. 95-183 which projects were verified by a licensed environmental professional Such reviews shall be conducted at intervals of no more than five years, provided that nothing in this subsection shall preclude the Commissioner, at his discretion, from conducting such a review at any time and further provided that the first such review shall be conducted no later than eighteen months after the effective date of sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies As a result of such a periodic review, the Commissioner may conclude that the goals of this subsection and section 22a-133k of the General Statute are being met, or he may conclude that revisions to such regulations are necessary to ensure that the implementation of said sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies achieves such goals, in which case he may revise such Regulations as he deems necessary to achieve those goals

Section 2 The Regulations of Connecticut State Agencies are amended by adding a new section 22a-133k-2 as follows

22a-133k-2 Standards for Soil Remediation

(a) General

Unless otherwise specified in sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies, polluted soil at a release area shall be remediated to a concentration which meets (1) (A) the direct exposure criteria set forth in subsection (b) of this section or alternative direct exposure criteria established in accordance with subdivision (2) or subdivision (7) of subsection (d) of this section, and (B) the pollutant mobility criteria set forth in subsection (c) of this section or alternative pollutant mobility criteria established in accordance with subdivision (3) or (5) of subsection (d) of this section, or (2) the background concentration for soil provided notice has been submitted to the Commissioner which notice shall be submitted on a form furnished by the Commissioner and shall include a brief description of the subject release area and of the general characteristics of soils in the vicinity of such release area, a map showing the location of such release area, and based on reasonable inquiry of other release areas in the vicinity thereof, and of all soil samples taken for the purpose of characterizing background concentration for soil, and the results of all laboratory analyses of such samples

(b) Direct Exposure Criteria

(1) Except as otherwise provided in this paragraph, polluted soil at a release area shall be remediated to at least that concentration at which the residential direct exposure criteria for each substance is met

(2) (A) Polluted soil at a release area may be remediated to a concentration at which the industrial/commercial direct exposure criteria for each substance except PCB is met if (i) access to the parcel containing such release area is limited to individuals working at or people temporarily visiting the subject parcel, and (ii) an environmental land use restriction is in effect with respect to such parcel, or to the portion of such parcel containing such release area, which environmental land use restriction ensures that the parcel or restricted portion thereof is not used for any residential activity in the future and that any future use of such parcel or restricted portion thereof is limited to an industrial or commercial activity

(B) Soil polluted with PCB at a release area may be remediated to a concentration at which the industrial/commercial direct exposure criteria for PCB is met if the parcel upon which such release area is located is (i) an outdoor electrical substation as defined in 40 CFR 761.123, or (ii) an other restricted access location as defined in said section 40 CFR 761 123 and an environmental land use restriction is in effect with respect to such parcel, or to the portion of such parcel containing such release area, which environmental land use restriction ensures that the parcel or restricted portion thereof is not used for any residential activity in the future and that any future use of such parcel or restricted portion thereof is limited to an industrial or commercial activity

(3) The direct exposure criteria for substances other than PCB do not apply to inaccessible soil at a release area provided that if such inaccessible soil is less than 15 feet below the ground surface an environmental land use restriction is in effect with respect to the subject parcel or to the portion of such parcel containing such release area, which environmental land use restriction ensures that such soils will not be exposed as a result of excavation, demolition or other activities and that any pavement which is necessary to render such soil inaccessible is maintained in good condition unless and until such restriction is released in accordance with said section 22a-133q-1 Unless an alternative criterion has been approved in accordance with subsection 22a-133k-2(d)(7), inaccessible soil polluted with PCB may be remediated to a concentration of 10 ppm PCB by weight provided that (A) if such inaccessible soil is located on a parcel which is an other restricted access location as defined in said section 40 CFR 761 123, such soil may be remediated to a concentration of 25 ppm PCB by weight, or (B) if such inaccessible soil is located on a parcel which is an outdoor electrical substation as defined in 40 CFR 761 123, such soil may be remediated to a concentration of 25 ppm PCB by weight, or if a label or notice is visibly placed in the area in accordance with 40 CFR Part 761, to a concentration of 50 ppm PCB by weight

(4) Additional Polluting Substances

(A) With respect to a substance at a release area for which a direct exposure criterion is not specified in sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies, the Commissioner may, after consultation with the Commissioner of Public Health, approve in writing a direct exposure criterion to apply to such substance at a particular release area Any person requesting approval of a direct exposure criterion for such substance shall submit to the commissioner (i) a proposed risk-based direct exposure concentration for such substance calculated in accordance with subparagraph (B) or (C) of this subdivision as applicable, and (ii) the analytical detection limit for such substance. Before approving a direct exposure criterion the Commissioner shall consider the proposed risk-based direct exposure concentration for such substance, the analytical detection limit for such substance, any information about the health effects such substance may cause due to exposure pathways not accounted for in the proposed risk-based direct exposure, and any other information that the Commissioner reasonably deems necessary

(B) The proposed residential risk-based direct exposure concentration shall be calculated using the following equations

(i) For carcinogenic substances

$$DEC_{RB} = \left[\frac{Risk}{CSF}\right] x \left[\frac{BW_C \text{ x } AT}{IR_C \text{ x } ED_C \text{ x } EF \text{ x } CF} + \frac{BW_A \text{ x } AT}{IR_A \text{ x } ED_A \text{ x } EF \text{ x } CF}\right]$$

(ii) For non-carcinogenic substances:

$$DEC_{RB} = \left[RFD \times HI\right] \times \left[\frac{BW_C \times AT_C}{IR_C \times ED_C \times EF \times CF} + \frac{BW_A \times AT}{IR_A \times ED_A \times EF \times CF}\right]$$

(iii) The abbreviations used in subparagraphs (i) and (ii) shall be interpreted in accordance with the following table and shall be assigned the values specified therein

Term	Description	Units	Value
DEC_{RB}	Risk-based Direct Exposure Criterion	mg/kg	calculated
Risk	Target Cancer Risk Level	unitless	1.0E-06
HI	Hazard Index	unitless	1.0
CSF	Cancer slope Factor	$(mg/kg\text{-}day)^{-1}$	substance-specific
RFD	Reference Dose	mg/kg-day	substance-specific
IR_C	Ingestion Rate, Child	mg/day	200
IR_A	Ingestion Rate, Adult	mg/day	100
EF	Exposure Frequency	days/year	365
ED_C	Exposure Duration, Child	years	6
ED_A	Exposure Duration, Adult	years	24
CF	Conversion Factor	kg/mg	0 000001
BW_C	Body Weight, Child	kg	15
BW_A	Body Weight, Adult	kg	70
AT	Averaging Time, for carcinogens	days	25550
AT_C	Averaging Time, Child for non-carcinogens	days	2190
AT_A	Averaging Time, Adult for non-carcinogens	days	8760

(C) The proposed industrial/commercial risk-based direct exposure concentration shall be calculated using the following equations

(i) For carcinogenic substances

$$DEC_{RB} = \left[\frac{Risk}{CSF}\right] \times \left[\frac{BW \times AT}{IR \times ED \times EF \times CF}\right]$$

(ii) For non-carcinogenic substances

$$DEC_{RB} = \left[RFD \times HI\right] \left[\times \frac{BW \times AT}{IR \times EF \times ED \times CF}\right]$$

(iii) The abbreviations used in subparagraphs (i) and (ii) shall be interpreted in accordance with the following table and shall be assigned the values specified therein

Term	Description	Units	Value
DEC_{RB}	Risk-based Direct Exposure Criterion	mg/kg	calculated
Risk	Target Cancer Risk Level	unitless	1.0E-06
HI	Hazard Index	unitless	1.0
CSF	Cancer slope Factor	$(mg/kg\text{-}day)^{-1}$	substance-specific
RFD	Reference Dose	mg/kg-day	substance-specific
IR	Ingestion Rate	mg/day	50
~~EF~~	~~Exposure Frequency~~	~~days/year~~	~~250~~
ED	Exposure Duration	years	25
CF	Conversion Factor	kg/mg	0.000001
BW	Body Weight	kg	70
AT	Averaging Time, for carcinogens	days	25550
AT_A	Averaging Time, Adult for non-carcinogens	days	9125

(c) Pollutant Mobility Criteria

(1) General

(A) A substance, other than an inorganic substance or PCB, in soil above the seasonal low water table, or above the seasonal high water table if (i) remediation to the seasonal low water table is not technically practicable or would not result in the permanent elimination of a source of pollution or (ii) the subject soil is located in a GB area, shall be remediated to at least that concentration at which the results of a mass analysis of such soil for such substance does not exceed the pollutant mobility criterion applicable to the ground-water classification of the area at which such soil is located, except that in the circumstances identified in subdivision (2) of this subsection, remediation to achieve compliance with the pollutant mobility criteria may be conducted in accordance with the requirements established in said subdivision (2)

(B) An inorganic substance or PCB in soil above the seasonal low water table, or above the seasonal high water table if (i) remediation to the seasonal low water table is not technically practicable or would not result in the permanent elimination of a source of pollution or (ii) the subject soil is located in a GB area, shall be remediated to at least that concentration at which the results of a TCLP or SPLP analysis of such soil for such substance does not exceed the pollutant mobility criterion applicable to the ground-water classification of the area at which such soil is located, except that in the circumstances identified in subdivision (2) of this subsection, remediation to achieve compliance with the pollutant mobility criteria may be conducted in accordance with the requirements established in said subdivision (2)

(2) Specific Circumstances

(A) Polluted Soils in a GA Area

A soil in a GA area and polluted with a substance, other than 1,2 dichlorobenzene, ethyl benzene, toluene, xylenes or total petroleum hydrocarbons, which soil is at or above the seasonal low water table, or at or above the seasonal high water table if remediation to the seasonal low water table is not technically practicable or would not result in the permanent elimination of a source of pollution, may be remediated to at least that concentration at which the results of a TCLP or SPLP analysis of such soil for such substance do not exceed the ground-water protection criterion for such substance.

(B) Soils Polluted with Volatile Organic Substances in a GA area

A soil in a GA area polluted with a volatile organic substance, other than 1,2 dichlorobenzene, ethyl benzene, toluene, or xylenes which soil is at or above the seasonal low water table, or at or above the seasonal high water table if remediation to the seasonal low water table is not technically practicable or would not result in the permanent elimination of a source of pollution, may be remediated to at least that concentration at which the results of a TCLP or SPLP analysis of such soil for such substance do not exceed the ground-water protection criterion for such substance multiplied by ten or the results of a mass analysis of such soil for such substance do not exceed the pollutant mobility criterion for such substance multiplied by ten or by an alternative dilution or dilution and attenuation factor approved by the Commissioner in accordance with subdivision (4) of subsection (d) of this section, provided no non-aqueous phase liquids are present in the subject release area as determined in accordance with subdivision (3) of this subsection, the water table is at least fifteen feet above the surface of the bedrock and the downward vertical flow velocity is not greater than the horizontal flow velocity, and

(i) (aa) a public water supply distribution system is available within 200 feet of the subject parcel, all adjacent parcels, and any parcel within the areal extent of the ground-water plume caused by the subject release area, (bb) the ground water within the areal extent of such ground-water plume is not used for drinking water, (cc) no public or private water supply wells exist within 500 feet of the subject release area, and (dd) the ground water affected by the subject release area is not a potential public water supply resource, or

(ii) (aa) the concentration of any volatile organic substance in a ground-water plume and within seventy-five feet of the nearest downgradient parcel boundary does not exceed the ground-water protection criterion, (bb) except for seasonal variation, the areal extent of volatile organic substances in the ground-water plume is not increasing over time and the concentration of any volatile organic substance in the ground-water plume is not increasing, except as a result of natural attenuation, at any point over time and (cc) notice of such condition is provided to the Commissioner on a form furnished by the Commissioner, which notice shall include a brief description of the release area, a brief description of the distribution and concentration of volatile organic substances in soil and ground water, a map showing the location of the release area, and based on reasonable inquiry all other volatile organic substance release areas in the vicinity of the subject release area, all ground-water and soil monitoring points, and the areal extent of the volatile organic substance ground-water plume, and the results of all laboratory analyses conducted to determine whether the requirements of this subparagraph have been met, or

(iii) (aa) the concentration of any volatile organic substance within such ground-water plume does not exceed the ground-water protection criterion for such substance at a location downgradient of the release area, on the subject parcel, and within 25 feet of such release area, and (bb) notice of such condition is provided to the Commissioner on a form furnished by the Commissioner, which notice shall include a brief description of the release area, a brief description of the distribution and concentration of volatile organic substances in soil and ground water, a map showing the location of the release area, and based on reasonable inquiry all other volatile organic substance release areas in the vicinity of the subject release area, and all ground-water and soil monitoring points, and the results of all laboratory analyses conducted to determine whether the requirements of this subparagraph have been met

(C) Inorganic, semi-volatile, PCB or pesticide contamination in a GA area

A soil in a GA area and polluted with inorganic substances, semi-volatile substances, PCB or pesticides, which soil is at or above the seasonal low water table, or at or above the seasonal high water table if remediation to the seasonal low water table is not technically practicable or would not result in the permanent elimination of a source of pollution, may be remediated to a level at which (i)(aa) the results of a TCLP or SPLP analysis of such soil for such substance do not exceed the ground-water protection criterion for such substance multiplied by ten or by an alternative dilution or dilution and attenuation factor approved by the Commissioner in accordance with subdivision (4) of subsection (d) of this section or (bb) the results of a mass analysis of such soil for a substance do not exceed the pollutant mobility criterion for such substance multiplied by ten or by an alternative dilution or dilution and attenuation factor approved by the Commissioner in accordance with subdivision (4) of subsection (d) of this section; provided (ii) (aa) the release area and any portion thereof is located at least twenty-five feet from the nearest legal boundary of the parcel in the downgradient direction, (bb) no non-aqueous phase liquids are present in the release area as determined in accordance with subdivision (3) of this subsection, and (cc) the water table is at least fifteen feet above the surface of the bedrock

(D) Polluted Soils in a GB area

A substance other than total petroleum hydrocarbons in soil above the seasonal high water table in a GB area may be remediated to a level at which the results of a TCLP or SPLP analysis of such soil does not exceed the ground-water protection criterion for any such substance (i) (aa) multiplied by 10, (bb) multiplied by the ratio of the summation of the areas downgradient and upgradient of the release area to the release area, provided that such ratio does not exceed 500, or (cc) or multiplied by an alternative dilution or dilution and attenuation factor approved by the Commissioner in accordance with subdivision (5) of subsection (d) of this section; (ii) provided non-aqueous phase liquids are not present in such soil as determined in accordance with subdivision (3) of this subsection

(E) Site specific dilution in a GB area

(i) A substance, other than total petroleum hydrocarbons, in a soil at or above the seasonal high water table in a GB area where the background concentration for ground water for such substance is less than the applicable ground-water protection criterion, may be remediated to a level at which the results of a mass analysis of such soil for a substance do not exceed the pollutant mobility criterion applicable to such substance in a GA area multiplied by a site-specific dilution factor calculated in accordance with clause (ii) of this subparagraph, or the results of a TCLP or SPLP analysis of such soil for a substance do not exceed the ground-water protection criterion for such substance multiplied by a site-specific dilution factor calculated in accordance with clause (ii) of this subparagraph, provided (aa) no non-aqueous phase liquids are present in such soil as determined in accordance with subdivision (3) of this subsection, (bb) notice has been submitted to the Commissioner in accordance with clause (iii) of this subparagraph, and (cc) the water table in the release area is at least fifteen feet above the surface of the bedrock and the downward ground water vertical flow velocity is not greater than the ground water horizontal flow velocity

(ii) For the purpose of clause (i) of this subparagraph, the site-specific dilution factor shall be calculated using the following formula $DF = (1 + (Kid/IL))(1-F_{adj})$, where

DF = site-specific dilution factor
K = hydraulic conductivity, in feet per year, of the unconsolidated aquifer

underlying the release area
i = horizontal hydraulic gradient in feet per feet
d = 15 feet
I = infiltration rate in feet per year as specified in subparagraph (iv) of this subparagraph
L = length in feet of the release area parallel to the direction of ground-water flow
F_{adj} = background concentration for ground water divided by the ground-water protection criterion for the subject substance, or, where the background concentration for ground water can not be quantified, ½ the minimum detection limit for the subject substance divided by the ground-water protection criterion for the subject substance.

(iii) A notice submitted pursuant to clause (i) of this subparagraph shall be submitted on a form prescribed and provided by the Commissioner and shall include: a brief description of the release area and the general characteristics of soils in the vicinity of the release area, a map showing the location of the release area, and based on reasonable inquiry other release areas in the vicinity containing the substance for which the site-specific dilution factor is calculated, and all monitoring points; if applicable, justification for use of a till infiltration rate other than 0.5 feet per year, and the results of all the laboratory analyses and field analyses used to determine the (aa) parameters of the equation in clause (ii) of this subparagraph and (bb) identification of geologic material for the purposes of choosing an infiltration rate in accordance with clause (iv) of this subparagraph

(iv)

Geologic Material	Infiltration Rate (feet/year)
Stratified Drift	2.0
Till	0.5 - 1.0
Lacustrine Deposits	0.4

(3) Determining the Presence of Non-aqueous Phase Liquids in Soil For the purpose of this subsection, the presence of non-aqueous phase liquids in soil shall be determined using the following equation $C_{nap} = (S/2\rho_b)(K_d\,\rho_b + \theta_w + H'\theta_a)$, where

C_{nap} = the concentration of an organic substance at which or above which such substance may be present in a non-aqueous phase
S = the effective solubility
ρ_b = dry soil bulk density
K_d = soil-water partition coefficient, which may be approximated by $K_{OC} \cdot f_{OC}$
K_{OC} = soil organic carbon-water partition coefficient
f_{OC} = fraction organic carbon of soil
θ_w = water-filled soil porosity (L_{water}/L_{soil})
θ_a = air-filled soil porosity (L_{air}/L_{soil})
H' = Henry's law constant (dimensionless)
H = Henry's law constant (atm-m^3/mol)

The terms defined above shall be assigned the following values

Term	Units	Value
C_{NAP}	mg/kg	calculated
S	mg/L	chemical-specific

ρ_b	kg/L	1.5 or the lowest value measured at the subject release area
K_d	L/kg	calculated
K_{oc}	L/kg	chemical-specific
f_{oc}	g/g	0.006 or the lowest value measured at the subject release area
θ_w	L_{water}/L_{soil}	0.15
θ_a	L_{air}/L_{soil}	0.28
H'	unitless	H x 41 where 41 is a conversion factor
H	atm-m^3/mol	chemical-specific

(4) Exceptions

(A) If at a release area (i) the ground-water classification is GB and (ii) the elevation of the water table is below the elevation of the top of bedrock, such release area shall be remediated to a concentration which meets the pollutant mobility criteria applicable to any location at which the ground-water classification is GA or GAA

(B) The pollutant mobility criteria do not apply to environmentally isolated soil provided an environmental land use restriction is in effect with respect to the parcel, or portion thereof, containing such soil which environmental land use restriction ensures that such soil will not be exposed to infiltration of soil water due to, among other things, demolition of the building

(C) The pollutant mobility criteria do not apply to polluted fill on a parcel if (aa) such fill is polluted only with coal ash, wood ash, coal fragments, asphalt paving fragments, or any combination thereof, (bb) such fill is not polluted with any volatile organic substance, (cc) the concentration of each substance in any such fill is consistent with the requirements established in subsection (b) of this section; (dd) such substance is not affecting and will not affect the quality of an existing or potential public water supply resource or an existing private drinking water supply; (ee) a public water supply distribution system is available within 200 feet of such parcel and all parcels adjacent thereto; and (ff) the placement of the fill was not prohibited by law at the time of placement

(5) Additional Polluting Substances

With respect to a substance for which a pollutant mobility criterion is not specified in sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies, the Commissioner may approve a pollutant mobility criterion, a dilution or dilution and attenuation factor, and a method for determining compliance with such criterion to apply to such substance at a particular release area, provided he finds that such criterion will ensure that soil water at such release area does not exceed, in a GA area, the ground-water protection criterion, or in a GB area the ground-water protection criterion multiplied by a dilution factor of 10

(d) Alternative Soil Criteria.

(1) Requests for Approval of Alternative Soil Criteria.

(A) Any person requesting that the Commissioner approve an alternative criterion applicable to a particular release area shall submit the name and address of the owner of the parcel at which such release area is located, the address of such release area and a brief description of its location, a detailed description of such release area; and a map at a scale of not less than 1:1200 showing the location of all release areas on such parcel, the subject release area, and describing the concentration and distribution of all substances in the soil of the subject release area, including but not limited to the substance for which an alternative criterion is sought, a detailed written report describing the justification for the proposed alternative criterion, and any other information the Commissioner reasonably deems necessary to evaluate such request

(B) Any person requesting that the Commissioner approve an alternative pollutant mobility criterion or an alternative dilution or dilution attenuation factor shall submit, in addition to the information required by subparagraph (A) of this subdivision, a detailed description of any other release area located on the same parcel as the subject release area and which other release area (i) is affected or potentially affected by the subject release area or (ii) is affecting or potentially may affect the subject release area,

(C) Any person requesting that the Commissioner approve an alternative direct exposure criterion shall submit, in addition to the information required by subparagraph (A) of this subdivision, a detailed description of any other release area located on the same parcel as the subject release area

(2) Alternative Direct Exposure Criteria

With respect to a substance except PCB for which a direct exposure criterion is specified in sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies, the Commissioner may approve an alternative direct exposure criterion and an alternative method for determining compliance with such criterion provided it is demonstrated to the satisfaction of the Commissioner, after consultation with the Commissioner of Public Health that the application of such alternative criterion at the subject release area will protect human health and the environment from the risks associated with direct exposure to polluted soil by ensuring that (A) the concentration of each carcinogenic substance in such soil does not exceed a 1 X 10^{-6} excess lifetime cancer risk level and the concentration of each non-carcinogenic substance in such soil does not exceed a hazard index of 1, or (B) for a release area polluted with multiple substances, the cumulative excess lifetime cancer risk for all carcinogenic substances in such soil does not exceed 1 X 10^{-5} and the cumulative hazard index does not exceed 1 for non-carcinogenic substances in such soil with the same target organ Any person requesting approval of an alternative direct exposure criterion shall submit to the Commissioner and the Commissioner of Public Health a risk assessment prepared in accordance with the most recent EPA Risk Assessment Guidance for Superfund or other risk assessment method approved by the Commissioner in consultation with the Commissioner of Public Health, and shall submit any additional information specified by the Commissioner or the Commissioner of Public Health

(3) Alternative Pollutant Mobility Criteria for GA Areas

With respect to a substance occurring at a release area located in a GA area, and for which substance a pollutant mobility criterion is specified in sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies, the Commissioner may approve an alternative pollutant mobility criterion and an alternative method for determining compliance with such criterion, provided it is demonstrated to the Commissioner's satisfaction that the application of such alternative criterion at the subject release area will ensure that soil water at such release area will not exceed the ground-water protection criterion for such substance

(4) Alternative Dilution or Dilution Attenuation Factor for GA Areas.

With respect to a substance occurring at a release area located in a GA area, and for which substance a pollutant mobility criterion is specified in sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies, the Commissioner may approve an alternative dilution or dilution attenuation factor, provided that it is demonstrated to the Commissioner's satisfaction that application of such dilution factor will ensure that such release area will not degrade ground-water quality and thereby prevent the achievement of the applicable ground-water remediation standards

(5) Alternative Pollutant Mobility Criteria for GB Areas

With respect to a substance occurring at a release area located in a GB area, and for which substance a pollutant mobility criterion is specified in sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies, the Commissioner may approve an alternative pollutant mobility criterion and an alternative method for determining compliance with such criterion at such release area, provided it is demonstrated to the Commissioner's satisfaction that the application of such criterion will ensure that soil water at the release area, after dilution with ground water derived from infiltration on the parcel, will not exceed the ground-water protection criterion for such substance

(6) Alternative Dilution or Dilution Attenuation Factor for GB Areas

With respect to a substance occurring at a release area located in a GB area, and for which substance a pollutant mobility criterion is specified in sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies, the Commissioner may approve an alternative dilution or dilution attenuation factor, provided that it is demonstrated to the Commissioner's satisfaction that application of such alternative dilution or dilution attenuation factor will ensure that the soil water at such release area will not cause the ground water at the nearest downgradient property boundary to exceed the ground-water protection criterion for such substance

(7) Alternative Direct Exposure Criterion for PCB

The Commissioner may approve an alternative direct exposure criterion for PCB including an alternative direct exposure criterion for an inaccessible soil polluted with PCB, and an alternative method for determing compliance with such criterion, provided it is demonstrated to the satisfaction of the Commissioner after consultation with the Commissioner of Public Health that the application of such alternative criterion at the subject release area will protect human health and the environment from the risks associated with direct exposure to soil polluted with PCB and is consistent with 40 CFR Part 761 and with the "Guide on Remedial Actions at Superfund Sites with PCB Contamination" (EPA Directive 9355 4-01, August 1990)

(e) Applying the Direct Exposure and Pollutant Mobility Criteria

(1) Unless an alternative method for determining compliance with a direct exposure criterion has been approved by the Commissioner in writing, compliance with a direct exposure criterion is achieved when (A) the ninety-five percent upper confidence level of the arithmetic mean of all sample results of

laboratory analyses of soil from the subject release area is equal to or less than such criterion, provided that the results of no single sample exceeds two times the applicable direct exposure criterion or (B) the results of all laboratory analyses of samples from the subject release area are equal to or less than the applicable direct exposure criterion

(2) Unless an alternative method for determining compliance with a pollutant mobility criterion for a particular substance has been approved by the Commissioner in writing, compliance with a pollutant mobility criterion for such substance is achieved when

> (A) (i) a representative sampling program consisting of not less than twenty samples of soil located above the water table has been used to characterize the distribution and concentration of such substance at the subject release area or remaining at the subject release area following remediation, (ii) the release area has not been remediated by means of excavation and removal of polluted soil, (iii) the ninety-five percent upper confidence level of the arithmetic mean of all the sample results of laboratory analyses of soil from the subject release area for such substance is equal to or less than the applicable pollutant mobility criterion or the results of all laboratory analyses of samples from the subject release area are equal to or less than the applicable direct exposure criterion, and (iv) no single sample result exceeds two times the applicable pollutant mobility criterion;
>
> (B) (i) a representative sampling program consisting of less than twenty samples of soil located above the water table has been used to characterize the distribution and concentration of substances remaining at the subject release area following remediation, (ii) the release area has not been remediated by means of excavation and removal of polluted soil, and (iii) the results of all laboratory analysis of samples from the subject release area for such substances are equal to or less than such pollutant mobility criterion, or
>
> (C) (i) the subject release area has been remediated by means of excavation and removal of polluted soil, (ii) a representative sampling program consisting of samples of soil located above the water table has been used to characterize the distribution and concentration of substances remaining at the subject release area following excavation and removal, and (iii) the results of all laboratory analyses of samples from the subject release area for such substances are equal to or less than such pollutant mobility criterion

(3) Matrix interference effects

If any applicable criterion for a substance in soil is less than the concentration for such substance that can be consistently and accurately quantified in a specific sample due to matrix interference effects, the following actions shall be taken

> (A) (i) "Test Methods for Evaluating Solid Waste Physical/Chemical Methods," SW-846, U S Environmental Protection Agency, Office of Solid Waste, Washington D C 20460 shall be consulted to determine if an analytical method sufficiently sensitive to achieve the applicable analytical detection limit was used to conduct the analysis of the subject substance If there is available an alternative analytical method which is sufficient to achieve the required analytical detection limit, appropriate for the sample matrix, and has been approved by EPA or approved in writing by the Commissioner, the subject soil shall be re-analyzed for the subject substance using such alternative method
> (ii)If a sample has been analyzed by one or more analytical methods in accordance with subparagraph (A)(i) of this subdivision and the applicable analytical detection limit has not been achieved due to matrix interference effects, such method(s) shall be modified in order to compensate for such interferences, in accordance with analytical procedures specified by EPA within the scope of the analytical method
>
> (B) If, after re-analyzing the subject soil and attempting to compensate for matrix interference effects in accordance with to subparagraph (A) of this subdivision, any applicable criterion for a substance in soil is less than the concentration for such substance that can be consistently and accurately quantified in a specific sample due to matrix interference effects, compliance with

such criterion shall be achieved when such soil has been remediated to the lowest concentration for such substance which can be consistently and accurately quantified without matrix interference effects.

(C) A detailed summary of all measures taken to overcome matrix interference effects and a determination of the lowest alternative quantification level applicable to the analysis of such substance shall be prepared and, if requested by the Commissioner in writing, shall be submitted to the Commissioner for his review and approval.

(f) Variances

(1) Widespread Polluted Fill

The Commissioner may grant a variance from any of the requirements of subsection (c) of this section upon the written request of the owner of the subject parcel if the Commissioner determines that (A) geographically extensive polluted fill is present at such parcel and at other parcels in the vicinity of the subject parcel; (B) such fill is not polluted with volatile organic substances; (C) such fill is not affecting and will not affect the quality of an existing or potential public water supply resource or an existing private drinking water supply; (D) the concentration of each substance in such fill is consistent with subsection (b) of this section; (E) the placement of such fill was not prohibited by law at the time of placement; and (F) the person requesting the variance did not place the fill on the subject parcel. In determining whether to grant or deny such a variance, the Commissioner may consider the relative cost of compliance with subsection (c) of this section, how extensive the polluted fill is, what relative proportion of such fill occurs on the subject parcel, and whether the person requesting the variance is affiliated with any person responsible for such placement through any direct or indirect familial relationship or any contractual, corporate or financial relationship other than that by which such person's interest in such parcel is to be conveyed or financed

(2) Engineered Control of Polluted Soils

(A) Provided that an engineered control of polluted soils is implemented pursuant to subparagraphs (B) and (C) of this subsection, the requirements of subsections (a) through (e) of this section do not apply if

(i) the Commissioner authorized the disposal of solid waste or polluted soil at the subject release area,

(ii) the soil at such release area is polluted with a substance for which remediation is not technically practicable,

(iii) the Commissioner, in consultation with the Commissioner of Public Health, has determined that the removal of such substance or substances from such release area would create an unacceptable risk to human health; or

(iv) the Commissioner has determined, after providing notice and an opportunity for a public hearing, that a proposal by the owner of the subject parcel to use an engineered control is acceptable because (aa) the cost of remediating the polluted soil at such release area is significantly greater than the cost of installing and maintaining an engineered control for such soil and conducting ground-water monitoring at such release area in accordance with subsection (g) of section 22a-133k-3, and (bb) that the significantly greater cost outweighs the risk to the environment and human health if the engineered control fails to prevent the mobilization of a substance in the soil or human exposure to such substance The Commissioner may hold a public hearing pursuant to this section if in his discretion the public interest will be best served thereby, and he shall hold a hearing upon receipt of a petition signed by at least twenty-five persons Notice of the subject proposal shall be provided by the owner of the subject parcel in two of the three following manners: (i) by publication in a newspaper of substantial circulation in the affected area; (ii) by placing and maintaining on the subject parcel, for at least thirty days, in a legible condition a sign which shall be not less than six feet by four feet which sign shall be clearly visible from the public highway; or (iii) by mailing notice to the owner of record of each property abutting the subject parcel at his address on the most recent grand tax list of the municipality or municipalities in which such properties are located When notice is published or mailed, it shall include the name and address of owner of the subject parcel; the location address and/or a description of the location such parcel, a brief description of the nature of the pollution on the subject parcel, a brief description of the proposed engineered control, and a brief description of the procedures for requesting a hearing When notice is provided by posting a sign, the sign shall include the words "Environmental remediation is proposed for this site For further information contact. " and shall include the name and telephone number of an individual from whom any interested person may obtain information about the remediation The owner of the subject parcel shall verify to the Commissioner in writing on a form furnished by him that notice has been given in accordance with this subsection

(B) A request to use an engineered control shall be submitted to the Commissioner in writing and shall be accompanied by a detailed written report and plan which demonstrates that

(i) (aa) the proposed engineered control is designed and will be constructed to physically isolate polluted soil and to minimize migration of liquids through soil, to function with minimum maintenance, to promote drainage and minimize erosion of or other damage to such control, and to accommodate settling and subsidence of the underlying soil so as to maintain the control's structural integrity and permeability, and (bb) with respect to an engineered cap, such cap has been designed and constructed to have a permeability of less than 10^{-6} cm/sec or, unless otherwise specified by the Commissioner in writing, to have the permeability specified in a closure plan implemented under sections 22a-209-1 et seq of the Regulations of Connecticut State Agencies for a release area which is a lawfully authorized solid waste disposal area,
(ii) plans for ground-water monitoring at the subject release area are adequate to ensure that any substance migrating therefrom will be detected,
(iii) plans for maintenance of the subject release area are adequate to ensure that the structural integrity, design permeability, and effectiveness of the engineered control will be maintained, such plans shall include without limitation measures to prevent run-on and run-off of storm water from eroding or otherwise damaging the engineered control and measures to repair such control to correct the effects of any settling, subsidence, erosion or other damaging events or conditions,
(iv) an environmental land use restriction is or will be in effect with respect to the parcel at which the subject release area is located, which restriction ensures that such parcel will not be used in a manner that could disturb the engineered control or the polluted soil,
(v) any other information that the Commissioner reasonably deems necessary, and
(vi) with respect to any release area subject to any of the requirements of section 22a-

209-4(i) or section 22a-449(c)-100 through 110 of the Regulations of Connecticut State Agencies, all such requirements are or will be satisfied With respect to a release area which is not subject to any such regulations, the owner of the subject parcel shall demonstrate that he has posted or will post a surety in a form and amount approved in writing by the Commissioner, which surety during the first year after installation of the engineered control shall be equal to the cost of one year's maintenance and monitoring of the engineered control, and which in each subsequent year shall be increased in amount by adding an amount equal to the cost of one year's maintenance and monitoring, until the total amount of such surety is equal to the cost of five year's of maintenance and monitoring, which amount shall be maintained in effect for the next twenty-five years or for such other period as may be required by the Commissioner

(C) When the Commissioner approves a request pursuant to this subsection to use an engineered control he may require that such control incorporate any measures which he deems necessary to protect human health and the environment. Any person implementing an engineered control under this subsection shall perform all actions specified in the approved engineered control proposal including the recordation of the environmental land use restriction and posting of the surety, and any additional measures specified by the Commissioner in his approval of such plan Nothing in this subdivision shall preclude the Commissioner from taking any action he deems necessary to protect human health or the environment if an approved engineered control fails to prevent the migration of pollutants from the release area or human exposure to such pollutants

(g) Removal of Non-aqueous Phase Liquids

Removal of light non-aqueous phase liquids from soil and ground water shall be conducted in accordance with section 22a-449(d)-106(f) of the Regulations of Connecticut State Agencies Any other non-aqueous phase liquid shall be contained or removed from soil and ground water to the maximum extent prudent

(h) Use of Polluted Soil and Reuse of Treated Soil

Any soil excavated from and/or treated at a release area during remediation shall be managed as follows

(1) Hazardous Waste

Treatment, storage, disposal and transportation of soil which is hazardous waste as defined pursuant to section 22a-449(c) of the General Statutes shall be carried out in conformance with the provisions of sections 22a-449(c)-101 through 110 of the Regulations of Connecticut State Agencies, and any other applicable law,

(2) Special Wastes

In accordance with section 22a-209-8 of the Regulations of Connecticut State Agencies, the Commissioner may authorize polluted soil, which is not hazardous waste as defined pursuant to subsection 22a-449(c) of the General Statutes, to be disposed of as special wastes as defined in said section 22a-209-1

(3) Polluted soil

Polluted soil from a release area may be treated to achieve concentrations of substances that do not exceed either the applicable direct exposure criteria or pollutant mobility criteria After such treatment, such soil may be reused on the parcel from which it was excavated or on another parcel approved by the Commissioner, provided that such reuse is consistent with all other provisions of sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies and

(A) Prior to reuse, a map showing the location and depth of proposed placement of such soil is submitted to the Commissioner,
(B) Such soil is not placed below the water table,

(C) Such soil is not placed in an area subject to erosion; and
(D) Any such soil in which the concentration of any substance exceeds the pollutant mobility criteria applicable to a GA area is not placed over soil and ground water which have not been affected by a release at the parcel at which placement is proposed, and
(E) For soils polluted with PCB, the Commissioner has issued a written approval in accordance with by section 22a-467 of the General Statutes.

(4) Natural Soil

Polluted soil may be used at any parcel of land if after treatment of such soil to reduce or remove substances. (A) any naturally-occurring substance is present therein in concentrations not exceeding background concentration for soil of such substance at the release area from which such soil is removed, and (B) no other substance is detectable in such soil at a concentration greater than its analytical detection limit.

(i) Additional remediation of soil

Nothing in sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies shall preclude the Commissioner from taking any action necessary to prevent or abate pollution or to prevent or abate any threat to human health or the environment, including without limitation:

(1) at any location at which, despite remediation in accordance with sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies, the Commissioner determines that there is a potential ecological risk he may require that an ecological risk assessment be conducted in accordance with EPA/630/R-92/001, February 1992, "Framework For Ecological Risk Assessment" and that additional remediation be conducted to mitigate any risks identified in such assessment,
(2) at any location at which polluted soil has eroded into a surface-water body, the Commissioner may require that the effect of such polluted soil on aquatic life be assessed and that remediation to protect or restore aquatic life and surface water quality from the effects of such polluted soils be undertaken, or
(3) at any release area or parcel at which there is polluted soil containing multiple polluting substances, the Commissioner may require additional remediation to ensure that the risk posed by such substances does not exceed (A) a cumulative excess lifetime cancer risk of 10^{-5} for carcinogenic substances and (B) a cumulative hazard index of 1 for non-carcinogenic substances with the same target organ

Section 3. The Regulations of Connecticut State Agencies are amended by adding a new section 22a-133k-3 as follows:

22a-133k-3 Ground-water Remediation Standards

(a) General

(1) Remediation of a ground-water plume shall result in the attainment of (A) the requirements concerning surface water protection set forth in subsection (b) of this section and the requirements concerning volatilization set forth in subsection (c) of this section; or (B) the background concentration for ground water for each substance in such plume

(2) Remediation of a ground-water plume in a GA area shall also result in the reduction of each substance therein to a concentration equal to or less than the background concentration for ground water of such substance, except as provided in subsection (d) of this section

(3) Remediation of a ground-water plume in a GB area shall also result in the reduction of each substance therein to a concentration such that such ground-water plume does not interfere with any existing use of the ground water.

(b) Surface-water protection criteria

(1) Except as provided in subdivision (2) of this subsection, remediation of a ground-water plume which discharges to a surface water body shall result in the reduction of each substance therein to a concentration which is consistent with subdivision (2) of subsection (f) of this section and which is equal to or less than the surface-water protection criterion or an alternative surface-water protection criterion established in accordance with subdivision (3) of this subsection

(2) If a ground-water plume (A) discharges to a wetland or an intermittent stream, or (B) the areal extent of such ground-water plume occupies more than 0 5%, or other percentage which is approved in writing by the Commissioner, of the upstream drainage basin of the stream to which such plume discharges measured from the intersection of stream and such ground-water plume, each substance therein shall be remediated to a concentration equal to or less than the applicable aquatic life criteria contained in Appendix D to the most recent Water Quality Standards, or equal to or less than an alternative water quality criterion adopted by the Commissioner in accordance with section 22a-426 of the General Statutes and paragraph 12b of the Water Quality Standards effective May 15, 1992

(3) Alternative surface-water protection criteria

Alternative surface-water criteria may be calculated in accordance with subparagraph (A) of this subdivision or may be approved in writing by the Commissioner in accordance with subparagraph (B) of this subdivision

(A) An alternative surface-water protection criterion may be calculated for a substance in Appendix D of the most recent Water Quality Standards by multiplying the lower of the human health or aquatic life criterion for such substance in said Appendix D by $[(0\ 25 \times 7Q10)/Q_{plume}]$ where Q_{plume} is equal to the average daily discharge of polluted ground water from the subject ground-water plume

(B) The Commissioner may approve an alternative surface-water protection criterion to be applied to a particular substance at a particular release area Any person requesting such approval shall submit to the Commissioner (i) a report on the flow rate, under seven day ten year low flow conditions, of the surface water body into which the subject ground water plume discharges (ii) a report on other surface water or ground water discharges to the surface water body within one-half mile upstream of the areal extent of the ground-water plume, (iii) a report on the instream water quality, (iv) a report on the flow rate of the ground-water discharge from such release area to the surface water body and the extent and degree of mixing of such discharge in such surface water, and (v) and any other information the Commissioner reasonably deems necessary to evaluate such request. The Commissioner shall not approve an alternative surface-water protection criterion under this subparagraph unless the requester demonstrates that such criterion will protect all existing and proposed uses of such surface water

(c) Volatilization criteria

(1) Except as specified in subdivisions (2), (3), (4) and (5) of this subsection, all ground water polluted with a volatile organic substance within 15 feet of the ground surface or a building, shall be remediated such that the concentration of each such substance is equal to or less than the applicable residential volatilization criterion for ground water.

(2) If ground water polluted with a volatile organic substance is below a building used solely for industrial or commercial activity, such ground water shall be remediated such that the concentration of such substance is equal to or less than the applicable industrial/commercial volatilization criterion for ground water, provided that an environmental land use restriction is in effect with respect to the parcel or portion thereof upon which such building is located, which restriction ensures that the parcel or portion thereof will not be used for any residential purpose in the future and that any future use of the parcel or portion thereof is limited to industrial or commercial activity,

(3) (A) Remediation of a volatile organic substance to the volatilization criterion for ground water shall not be required if the concentration of such substance in soil vapors below a building is equal to or less than (i) the residential volatilization criterion for soil vapor or (ii) the industrial/commercial volatilization criterion for soil vapor, if such building is solely used for industrial or commercial activity and, an environmental land use restriction is in effect with respect to the parcel or portion thereof upon which such building is located, which restriction ensures that the parcel or portion thereof will not be used for any residential purpose in the future and that any future use of the parcel or portion thereof is limited to industrial or commercial activity

(B) The requirements of subdivision (1), (2), and (3) of this subsection do not apply if (i) measures acceptable to the Commissioner have been taken to prevent the migration of such substance into any overlying building, (ii) a program is implemented to maintain and monitor all such measures, and (iii) notice of such measures has been submitted to the Commissioner on a form furnished by him which notice includes (aa) a brief description of the areal extent of the ground-water plume and of the area which exceeds any such volatilization or soil vapor criterion, (bb) a brief description of the method of controlling the migration of such substance into any overlying building, (cc) a plan for the monitoring and maintenance of such control method, and (dd) a map showing all existing buildings, the areal extent of the ground-water plume, and the location of such control method

(4) Site-specific and alternative volatilization criteria

(A) Site-specific residential volatilization criteria for ground water or soil vapor may be calculated using the equations in Appendix G to sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies

(B) The Commissioner may approve an alternative volatilization criterion for ground water or for soil vapor to be applied to a substance at a particular release area The Commissioner shall not approve any alternative criterion under this subparagraph unless it has been demonstrated that such criterion will ensure that volatile organic substances from such ground water or soil do not accumulate in the air of any structure used for residential activities at a concentration which, (i) for any carcinogenic substance creates a risk to human health in excess of a 10^{-6} excess lifetime cancer risk level, and for any non-carcinogenic substance does not exceed a hazard index of 1, or (ii) for a ground-water plume polluted with multiple volatile organic substances does not exceed a cumulative excess cancer risk level of 10^{-5} for carcinogenic substances, and for non-carcinogenic substances with the same target organ, the cumulative hazard index does not exceed 1

(5) Exemption from volatilization criteria.

(A) The volatilization criteria do not apply to ground water polluted with volatile organic substances, where the water table is less than fifteen feet below the ground surface, if no building exists over the ground water polluted with volatile organic substances at a concentration above the applicable volatilization criteria, and (i) it has been documented that best efforts have been made to ensure that each owner of any parcel of land or portion thereof overlying such polluted ground water records an environmental land use restriction which ensures that no building is constructed over such polluted ground water; or (ii) the Commissioner has approved in writing a request demonstrating that no building can reasonably be expected to be constructed over the subject ground water or that natural attenuation or other methods of remediation will, within five years, reduce the concentration of volatile organic substances in such ground water to a concentration equal to or less than the applicable volatilization criteria

(B) The volatilization criteria for ground water underlying an existing building do not apply to ground water polluted with volatile organic substances where the Commissioner has approved in writing and there have been implemented an indoor air monitoring program and measures to control the level of any such volatile organic substances in the air of the subject building

(i) Any person seeking the Commissioner's approval of an indoor air monitoring program shall submit to him a detailed written plan describing the proposed indoor air monitoring program, including but not limited to a description of the distribution and concentration of volatile organic compounds beneath the building, the location of proposed monitoring points, the proposed frequency of monitoring, the parameters to be monitored, and a description of proposed actions to be taken in the event such monitoring indicates that the monitored parameters exceed proposed specified concentrations and a proposed schedule for reporting to the Commissioner on the results of such monitoring for as long as monitoring is conducted at the site.

(ii) In approving any indoor air monitoring program pursuant to this subdivision, the Commissioner may impose any additional conditions he deems necessary to ensure that the program adequately protects human health In the event that the Commissioner approves an indoor air monitoring program pursuant to this subparagraph, any person implementing such program shall perform all actions specified in the approved plan, and any additional measures specified by the Commissioner in his approval of such plan

(d) Applicability of Ground-water Protection Criteria

(1) Ground water in a GA area may be remediated to a concentration for each substance therein equal to or less than the ground-water protection criterion for each such substance if, with respect to the subject ground-water plume (A) the background concentration for ground water is equal to or less than such ground-water protection criterion, (B) a public water supply distribution system is available within 200 feet of the subject parcel, parcels adjacent thereto, and any parcel within the areal extent of such plume, (C) such ground-water plume is not located in an aquifer protection area, and (D) such ground-water plume is not located within the area of influence of any public water supply well

(2) If prior to any ground-water remediation the maximum concentration of a substance in a ground-water plume in a GA area is equal to or less than the ground-water protection criteria, remediation of ground water to achieve background ground-water concentration is not required, provided that the extent of the ground-water plume is not increasing over time and, except for seasonal variations, the concentration of the subject substance in such ground-water plume is not increasing at any point over time

(3) Any ground water in a GB area and which is used for drinking or other domestic purposes shall be remediated to reduce the concentration of each substance therein to a concentration equal to or less than the applicable ground-water protection criterion until such time as the use of such ground water for

drinking or other domestic purposes is permanently discontinued.

(e) Technical Impracticability of Ground-water Remediation

(1) Exemption from Background Due to Technical Impracticability

If remediation of a ground-water plume in a GA area to achieve compliance with subdivision (2) of subsection (a) of this section has reduced the concentration of a polluting substance to less than the ground-water protection criterion, and if further reduction of such concentration is technically impracticable, no further remediation of such ground-water plume for such substance shall be required

(2) Variance Due to Technical Impracticability of Ground-water Remediation

The Commissioner may grant a variance from any of the requirements of this section if he finds that non-aqueous phase liquids that cannot be contained or removed in accordance with R C.S A. section 22a-133k-2(g) are present, remediation to the extent technically practicable has reduced the concentration of pollutants in ground water to steady-state concentrations that exceed any applicable criteria, or achieving compliance with the applicable criteria is technically impracticable as determined using Directive No. 9234.2-25 issued September 1993 by the U.S. Environmental Protection Agency's Office of Solid Waste and Emergency Response

(A) Any person requesting a variance pursuant to this subsection from any ground-water protection criterion shall submit· (i) information concerning the concentration of each substance in the ground-water plume with respect to which a variance is sought, (ii) information demonstrating that (aa) the extent of the ground-water plume which exceeds such ground-water protection criterion has been reduced to the extent technically practicable, or (bb) it is not technically practicable to reduce the extent of the ground-water plume, (iii) the results of a study conducted to determine the risks to human health posed by the polluted ground water remaining after such reduction, (iv) if such study shows a risk or a potential risk to human health, a plan to eliminate such risk or potential risk, (v) an application to change the ground-water classification of such polluted ground water to GB in accordance with section 22a-426 of the General Statutes, and (vi) any other information the Commissioner reasonably deems necessary to evaluate such request

(B) Any person requesting a variance pursuant to this subsection from the requirement to remediate ground water to a concentration which does not exceed the applicable surface-water protection criteria shall submit information concerning the concentration of each substance in the ground-water plume with respect to which a variance is sought If such information demonstrates that any such concentration exceeds any applicable surface-water protection criterion, such person shall also submit (i) a map showing the areal extent of the ground-water plume that exceeds such surface-water protection criterion, and (ii) a plan for controlling the migration of such substance to the receiving surface water body

(C) If the Commissioner grants a variance pursuant to this subsection from any ground-water protection criterion, the person receiving the variance shall, no later than thirty days after the date of granting of such variance, submit to the Commissioner on a form prescribed and provided by him (i) certification that written notice of the extent and degree of such pollution has been provided to each owner of property overlying the subject ground-water plume at which it is not technically practicable to remediate a substance to a concentration equal to or less than the ground-water protection criterion, (ii) certification that written notice of the presence of pollution on each such parcel and a description of the extent and degree of such pollution has been sent to the Director of Health of the municipality or municipalities in which the ground-water plume is located, and (iii) certification that best efforts have been made to ensure that each owner of property overlying the subject ground-water plume records an environmental land use restriction which ensures that the subject ground-water plume is not used for drinking or other domestic purposes,

(D) If the Commissioner grants a variance pursuant to this subsection from the requirement to remediate ground water to a concentration which does not exceed the applicable surface-water protection criteria, the person receiving the variance shall perform all actions specified in the plan submitted with the request for such variance, and any additional actions required by the Commissioner in his approval of such plan or granting of such variance.

(f) Applying the Criteria for Ground Water

(1) Compliance with the ground-water protection criterion for a substance in ground water or background concentration for ground water for such substance is achieved when the sampling locations are representative of the subject ground-water plume and (A) the analytical results for such substance at such all sampling locations are equal to or less than either the ground-water protection criterion for such substance or the background concentration for ground water therefor, whichever is applicable, for at least four consecutive quarterly sampling periods, or (B) a representative sampling program consisting of not less than twelve consecutive monthly samples from each such sampling location has been used to characterize the ground-water plume and the ninety-five percent upper confidence level of the arithmetic mean of all results of laboratory analyses of such samples for such substance are equal to or less than the criterion for such substance and that no single sample exceeds two times the applicable criterion for such substance

(2) Compliance with a surface-water protection criterion for a substance in ground water is achieved when the sampling locations are representative of the subject ground-water plume and(A) the average concentration of such substance in such plume is equal to or less than the applicable surface-water protection criterion for at least four consecutive quarterly sampling periods, or (B) the concentration of such substance in that portion of such plume which is immediately upgradient of the point at which such ground-water discharges to the receiving surface-water body is equal to or less than the applicable surface-water protection criterion, provided that the areal extent of such ground-water plume is not increasing over time and that, except for seasonal variations, the concentration of the subject substance in such ground-water plume is not increasing, except as a result of natural attenuation, at any point over time

(3) Compliance with a volatilization criterion for a substance in ground water or soil vapor is achieved when the sampling locations are representative of the subject ground-water plume or soil vapor and (A) the ninety-five percent upper confidence level of the arithmetic mean of all sample results from such locations is equal to or less than the applicable volatilization criterion for at least four consecutive quarterly sampling periods and that the result of no single sample exceeds two times the applicable volatilization criterion, or (B) the results of all laboratory analyses of samples for such substance are equal to or less than the volatilization criterion therefor

(4) Matrix interference effects

If any applicable criterion for a substance in ground water is less than the concentration for such substance that can be consistently and accurately quantified in a specific sample due to matrix interference effects, the following action shall be taken

(A) (i) "Test Methods for Evaluating Solid Waste Physical/Chemical Methods," SW-846, U S Environmental Protection Agency, Office of Solid Waste, Washington D C 20460 shall be consulted to determine if an analytical method sufficiently sensitive to achieve the applicable analytical detection limit was used to conduct the analysis of the subject substance If there is available an alternative analytical method which is sufficient to achieve the required analytical detection limit, appropriate for the sample matrix, and has been approved by EPA or approved in writing by the Commissioner, the subject ground water shall be re-analyzed for the subject substance using such alternative method

(ii) If a sample has been analyzed by one or more analytical methods in accordance with subparagraph (A)(i) of this subdivision and the applicable analytical detection limit has not been achieved due to matrix interference effects, such method(s) shall be modified in order to compensate for such interferences, in accordance with analytical procedures specified by EPA within the scope of the analytical method

(B) If, after re-analyzing the subject ground water and attempting to compensate for matrix interference effects in accordance with subparagraph (A) of this subdivision, any applicable criterion for a substance in ground water is less than the concentration for such substance that can be consistently and accurately quantified in a specific sample due to matrix interference effects, compliance with such criterion shall be achieved when such ground water has been remediated to the lowest concentration for such substance which can be consistently and accurately quantified without matrix interference effects

(C) A detailed summary of all measures taken to overcome matrix interference effects and a determination of the lowest alternative quantification level applicable to the analysis of such substance shall be prepared and, if requested by the Commissioner in writing, shall be submitted to the Commissioner for his review and approval.

(g) Ground-water Monitoring

For any remediation which is conducted to achieve compliance with sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies, ground-water monitoring shall be conducted in accordance with this subsection

(1) Ground-water Monitoring at GA Areas

With respect to remediation of a release area or a ground-water plume in a GA area, a ground-water monitoring plan shall be prepared and implemented Ground-water monitoring under such plan shall be designed to determine
(A) the effectiveness of soil remediation in preventing the pollution of ground water by substances from the release area,
(B) the effectiveness of any remediation taken to eliminate or minimize health or safety risks identified in any risk assessment conducted in accordance with subdivision (2) of subsection (e) of this section or otherwise identified, and
(C) whether applicable requirements identified in subsection (a) of this section have been met

(2) Ground-water Monitoring at GB Areas

With respect to remediation of a release area or a ground-water plume in a GB area, a ground-water monitoring plan shall be prepared and implemented Ground-water monitoring under such plan shall be designed to determine
(A) the effectiveness of soil remediation in preventing further pollution of ground water by substances from the release area,
(B) the effectiveness of any remediation taken to eliminate or minimize identified health or safety risks associated with such release,
(C) whether applicable ground-water protection criteria, surface-water protection criteria, and volatilization criteria have been met, and
(D) whether the ground-water plume interferes with any existing use of the ground water for a drinking water supply or with any other existing use of the ground water, including but not limited to industrial, agricultural or commercial purposes

(3) Discontinuation of Ground-water Monitoring

(A) Unless otherwise specified in writing by the Commissioner, ground-water monitoring in a GA area may be discontinued in accordance with the following

(i) a minimum of one year after compliance with the background concentration for ground water has been achieved in accordance with subsection (f) of this section if the background concentration for ground water of all substances in the subject ground-water plume has been maintained in all sampling events and ground-water monitoring data demonstrate that the soil remediation was effective in preventing the pollution of ground water by any substance from the subject release area; or

(ii) a minimum of three years after compliance with the ground-water protection criteria has been achieved in accordance with subsection (f) of this section if (aa) all applicable ground-water protection criteria for all subject substances or the background concentration for ground water for all substances in the subject ground-water plume, which ever is higher, is maintained in all sampling events, (bb) ground-water monitoring data demonstrate that the soil remediation was effective in preventing the pollution of ground water by substances from the subject release area, and (cc) the volatilization and surface-water protection criteria have been met in accordance with subsection (f) of this section.

(B) Unless otherwise specified in writing by the Commissioner, ground-water monitoring in a GB area may be discontinued two years after the cessation of all remediation of such ground water or soil if the applicable surface-water protection and volatilization criteria have been met in accordance with subsection (f) of this section, and such ground water is suitable for all existing uses

(h) Additional Polluting Substances

(1) With respect to a substance in ground water for which a ground- water protection criterion is not specified in sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies, the Commissioner may approve in writing a ground-water protection criterion to apply to such substance   Any person requesting approval of a ground-water protection criterion for such substance shall submit to the commissioner (A) a risk-based ground-water protection criterion for such substance calculated in accordance with subdivision (2) of this subsection, (B) the analytical detection limit for such substance, (C) a description of the organoleptic properties of such substance. Before approving a ground-water protection criterion the Commissioner shall consider the proposed risk-based ground-water protection criterion for such substance, the analytical detection limit for such substance, the organoleptic effects of such substance, any information about the health effects such substance may cause due to exposure pathways not accounted for in the proposed risk-based ground-water protection criterion, and any other information that the Commissioner reasonably deems necessary

(2) The risk-based ground-water protection criterion shall be calculated using the following equations

(A) For carcinogenic substances,

$$\mathrm{GWPC} = \left[\frac{\mathrm{Risk}}{\mathrm{CSF}}\right] \times \left[\frac{\mathrm{BW} \times \mathrm{AT}}{\mathrm{IR} \times \mathrm{EF} \times \mathrm{ED} \times \mathrm{CF}}\right]$$

(B) For non-carcinogenic substances

$$GWPC = \left[Rfd \times HI \right] \times \left[\frac{BW \times AT}{IR \times EF \times ED \times CF \times SA} \right]$$

(C) The abbreviations used in subparagraphs (A) and (B) of this subdivision shall be interpreted in accordance with the following table and shall be assigned the values specified therein

Term	**Description**	**Units**	**Value**
$GWPC_{RB}$	Risk-based Ground-water protection Criterion	ug/l	calculated
Risk	Target Cancer Risk Level	unitless	1 0E-06
HI	Hazard Index	unitless	1 0
CSF	Cancer slope Factor	$(mg/kg\text{-}day)^{-1}$	substance-specific
RFD	Reference Dose	mg/kg-day	substance-specific
IR	Ingestion Rate	l/day	2
EF	Exposure Frequency	days/year	365
ED	Exposure Duration	years	70
CF	Conversion Factor	unitless	1000
BW	Body Weight	kg	70
AT	Averaging Time,	days	25550
SA	Source Allocation	unitless	0 2

(i) Additional Remediation of Ground Water

Nothing in sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies shall preclude the Commissioner from taking any action necessary to prevent or abate pollution, or to prevent or abate any threat to human health or the environment If the presence of any substance impairs the aesthetic quality of any ground water which is or can reasonably be expected to be a source of water for drinking or other domestic use, additional remediation shall be conducted in order to reduce the concentration of such substance to a concentration appropriate for such use

Appendix A to
Sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies
Direct Exposure Criteria for Soil

Substance	**Residential Criteria in mg/kg (ppm)**	**Industrial/ Commercial Criteria in mg/kg (ppm)**
Volatile Organic Substances		
Acetone	500	1000
Acrylonitrile	1.1	11
Benzene	21	200
Bromoform	78	720
2-Butanone(MEK)	500	1000
Carbon tetrachloride	4.7	44
Chlorobenzene	500	1000
Chloroform	100	940
Dibromochloromethane	7.3	68
1,2-Dichlorobenzene	500	1000
1,3-Dichlorobenzene	500	1000
1,4-Dichlorobenzene	26	240
1,1-Dichloroethane	500	1000
1,2-Dichloroethane	6.7	63
1,1-Dichloroethylene	1	9.5
cis-1,2-Dichloroethylene	500	1000
trans-1,2-Dichloroethylene	500	1000
1,2-Dichloropropane	9	84
1,3-Dichloropropene	3.4	32
Ethylbenzene	500	1000

Substance	**Residential Criteria in mg/kg (ppm)**	**Industrial/ Commercial Criteria in mg/kg (ppm)**
Ethylene dibromide (EDB)	0.007	0.067
Methyl-tert-butyl-ether	500	1000
Methyl isobutyl ketone	500	1000
Methylene chloride	82	760
Styrene	500	1000
1,1,1,2-Tetrachloroethane	24	220
1,1,2,2-Tetrachloroethane	3.1	29
Tetrachloroethylene	12	110
Toluene	500	1000
1,1,1-Trichloroethane	500	1000
1,1,2-Trichloroethane	11	100
Trichloroethylene	56	520
Vinyl chloride	0.32	3
Xylenes	500	1000
Semivolatile Substances		
Acenaphthylene	1000	2500
Anthracene	1000	2500
Benzo(a)anthracene	1	7.8
Benzo(b)fluoranthene	1	7.8
Benzo(k)fluoranthene	8.4	78
Benzo(a)pyrene	1	1

Substance	Residential Criteria in mg/kg (ppm)	Industrial/ Commercial Criteria in mg/kg (ppm)
Bis(2-chloroethyl)ether	1	5.2
Bis(2-chloroisopropyl) ether	8.8	82
Bis(2-ethyl hexyl) phthalate	44	410
Butyl benzl phthalate	1000	2500
2-chlorophenol	340	2500
Di-n-butyl phthalate	1000	2500
Di-n-octyl phthalate	1000	2500
2,4-Dichlorophenol	200	2500
Fluoranthene	1000	2500
Fluorene	1000	2500
Hexachloroethane	44	410
Hexachlorobenzene	1	3.6
Naphthalene	1000	2500
Pentachlorophenol	5.1	48
Phenanthrene	1000	2500
Phenol	1000	2500
Pyrene	1000	2500
Inorganic Substances		
Antimony	27	8200
Arsenic	10	10
Barium	4700	140000

Substance	Residential Criteria in mg/kg (ppm)	Industrial/ Commercial in mg/kg (ppm)
Beryllium	2	2
Cadmium	34	1000
Chromium, trivalent	3900	51000
Chromium, hexavalent	100	100
Copper	2500	76000
Cyanide	1400	41000
Lead	500	1000
Mercury	20	610
Nickel	1400	7500
Selenium	340	10000
Silver	340	10000
Thallium	5.4	160
Vanadium	470	14000
Zinc	20000	610000
Pesticides, PCB's, and Total Petroleum Hydrocarbons (TPH)		
Alachlor	7.7	72
Aldicarb	14	410
Atrazine	2.8	26
Chlordane	0.49	2.2
Dieldrin	0.038	0.36
Endrin	20	610
2-4 D	680	20000

Substance	**Residential Criteria in mg/kg (ppm)**	**Industrial/ Commercial in mg/kg (ppm)**
Heptachlor epoxide	0.067	0.63
Heptachlor	0.14	1.3
Lindane	20	610
Methoxychlor	340	10000
Toxaphene	0.56	5.2
PCB's	1	10
TPH	500	2500

Appendix B to
Sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies
Pollutant Mobility Criteria for Soil

Substance	**GA, GAA Mobility Criteria in mg/kg (ppm)**	**GB Mobility Criteria in mg/kg (ppm)**
Volatile Organic Substances		
Acetone	14	140
Acrylonitrile	0.01	0.1
Benzene	0.02	0.2
Bromoform	0.08	0.8
2-Butanone(MEK)	8	80
Carbon tetrachloride	0.1	1
Chlorobenzene	2	20
Chloroform	0.12	1.2
Dibromochloromethane	0.01	0.1
1,2-Dichlorobenzene	3.1	3.1
1,3-Dichlorobenzene	12	120
1,4-Dichlorobenzene	1.5	15
1,1-Dichloroethane	1.4	14
1,2-Dichloroethane	0.02	0.2
1,1-Dichloroethylene	0.14	1.4
cis-1,2-Dichloroethylene	1.4	14
trans-1,2-Dichloroethylene	2	20
1,2-Dichloropropane	0.1	1.0
1,3-Dichloropropene	0.01	0.1
Ethyl benzene	10.1	10.1
Ethylene dibromide (EDB)	0.01	0.1
Methyl-tert-butyl-ether	2	20
Methyl isobutyl ketone	7	14
Methylene chloride	0.1	1.0
Styrene	2	20
1,1,1,2-Tetrachloroethane	0.02	0.2

Substance	**GA, GAA Mobility Criteria in mg/kg (ppm)**	**GB Mobility Criteria in mg/kg (ppm)**
1,1,2,2-Tetrachloroethane	0.01	0.1
Tetrachloroethylene	0.1	1
Toluene	20	67
1,1,1-Trichloroethane	4	40
1,1,2-Trichloroethane	0.1	1
Trichloroethylene	0.1	1.0
Vinyl chloride	0.04	0.40
Xylenes	19.5	19.5
Semivolatile Substances		
Acenaphthylene	8.4	84
Anthracene	40	400
Benzo(a)anthracene	1	1
Benzo(b)fluoranthene	1	1
Benzo(k)fluoranthene	1	1
Benzo(a)pyrene	1	1
Bis(2-chloroethyl)ether	1	2.4
Bis(2-chloroisopropyl)ether	1	2.4
Bis(2-ethyl hexyl)phthalate	1	11
Butyl benzl phthalate	20	200
2-chlorophenol	1	7.2
Di-n-butyl phthalate	14	140
Di-n-octyl phthalate	2	20
2,4-Dichlorophenol	1	4
Fluoranthene	5.6	56
Fluorene	5.6	56
Hexachloroethane	1	1
Hexachlorobenzene	1	1
Naphthalene	5.6	56
Pentachlorophenol	1	1
Phenanthrene	4	40
Phenol	80	800
Pyrene	4	40

Substance	**GA, GAA Mobility Criteria in mg/kg (ppm)**	**GB Mobility Criteria in mg/kg (ppm)**
Pesticides and TPH		
Alachlor	0.230	0.4
Aldicarb	1	1
Atrazine	0.2	0.2
Chlordane	0.066	0.066
Dieldrin	0.007	0.007
2-4 D	1.4	14
Heptachlor epoxide	0.02	0.02
Heptachlor	0.013	0.013
Lindane	0.02	0.04
Methoxychlor	0.8	8
Simazine	0.8	8
Toxaphene	0.33	0.6
Total Petroleum Hydrocarbon By EPA Method 418.1 or another EPA-approved method acceptable to the Commissioner	500	2500

Inorganic Substances and PCB	**GA, GAA Mobility Criteria By TCLP or by SPLP in mg/l (ppm)**	**GB Mobility Criteria By TCLP or by SPLP in mg/l (ppm)**
Antimony	0.006	0.06
Arsenic	0.05	0.5
Barium	1	10.0
Beryllium	0.004	0.04
Cadmium	0.005	0.05
Chromium, total	0.05	0.5
Copper	1.3	13
Cyanide (by SPLP only)	0.2	2
Lead	0.015	0.15
Mercury	0.002	0.02
Nickel	0.1	1.0
Selenium	0.05	0.5

Substance	GA, GAA Mobility Criteria By TCLP or by SPLP in mg/l (ppm)	GB Mobility Criteria By TCLP or by SPLP in mg/l (ppm)
Silver	0.036	0.36
Thallium	0.005	0.05
Vanadium	0.05	0.50
Zinc	5	50
PCB	0.0005	0.005

Appendix C to
Sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies
Ground-Water Protection Criteria for GA and GAA Areas

Substance	**Ground-water Protection Criteria in ug/l (ppb)**
Volatile Organic Substances	
Acetone	700
Acrylonitrile	0.5
Benzene	1
Bromoform	4
2-Butanone(MEK)	400
Carbon tetrachloride	5
Chlorobenzene	100
Chloroform	6
Dibromochloromethane	0.5
1,2-Dichlorobenzene	600
1,3-Dichlorobenzene	600
1,4-Dichlorobenzene	75
1,1-Dichloroethane	70
1,2-Dichloroethane	1
1,1-Dichloroethylene	7
cis-1,2-Dichloroethylene	70
trans-1,2-Dichloroethylene	100
1,2-Dichloropropane	5
1,3-Dichloropropene	0.5
Ethyl benzene	700
Ethylene dibromide (EDB)	0.05
Methyl-tert-butyl-ether	100
Methyl isobutyl ketone	350
Methylene chloride	5
Styrene	100
1,1,1,2-Tetrachloroethane	1
1,1,2,2-Tetrachloroethane	0.5
Tetrachloroethylene	5

Substance	**Ground-water Protection Criteria in ug/l (ppb)**
Toluene	1000
1,1,1-Trichloroethane	200
1,1,2-Trichloroethane	5
Trichloroethylene	5
Vinyl chloride	2
Xylenes	530
Semivolatile Substances	
Acenaphthylene	420
Anthracene	2000
Benzo(a)anthracene	0.06
Benzo(b)fluoranthene	0.08
Benzo(k)fluoranthene	0.5
Benzo(a)pyrene	0.2
Bis(2-chloroethyl)ether	12
Bis(2-chloroisopropyl)ether	12
Bis(2-ethyl hexyl)phthalate	2
Butyl benzl phthalate	1000
2-chlorophenol	36
Di-n-butyl phthalate	700
Di-n-octyl phthalate	100
2 4-Dichlorophenol	20
Fluoranthene	280
Fluorene	280
Hexachloroethane	3
Hexachlorobenzene	1
Naphthalene	280
Pentachlorophenol	1
Phenanthrene	200
Phenol	4000
Pyrene	200

Substance	Ground-water Protection Criteria in ug/l (ppb)
Inorganic Substances	
Antimony	6
Arsenic	50
Asbestos in mfl	7 (mfl)
Barium	1000
Beryllium	4
Cadmium	5
Chromium (total)	50
Copper	1300
Cyanide	200
Lead	15
Mercury	2
Nickel	100
Selenium	50
Silver	36
Thallium	5
Vanadium	50
Zinc	5000
Pesticides, PCB and Total Petroleum Hydrocarbons	
Alachlor	2
Aldicarb	3
Atrazine	3
Chlordane	0.3
Dieldrin	0.002
2-4 D	70
Heptachlor epoxide	0.2
Heptachlor	0.4
Lindane	0.2
Methoxychlor	40
Simazine	4
Toxaphene	3

Substance	**Ground-water Protection Criteria in ug/l (ppb)**
PCB's	0.5
Total Petroleum Hydrocarbon By EPA Method 418.1 or another EPA-approved method acceptable to the Commissioner	500

Appendix D to
Sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies
Surface-water Protection Criteria
for Substances in Ground Water

Substance	**Surface-Water Protection Criteria in ug/l (ppb)**
Volatile Organic Substances	
Acrylonitrile	20
Benzene	710
Bromoform	10800
Carbon tetrachloride	132
Chlorobenzene	420000
Chloroform	14100
Dibromochloromethane	1020
1,2-Dichlorobenzene	170000
1,3-Dichlorobenzene	26000
1,4-Dichlorobenzene	26000
1,2-Dichloroethane	2970
1,1-Dichloroethylene	96
1,3-Dichloropropene	34000
Ethylbenzene	580000
Methylene chloride	48000
1,1,2,2-Tetrachloroethane	110
Tetrachloroethylene	88
Toluene	4000000
1,1,1-Trichloroethane	62000
1,1,2-Trichloroethane	1260
Trichloroethylene	2340
Vinyl chloride	15750
Semivolatile Substances	
Acenaphthylene	0.3
Anthracene	1100000
Benzo(a)anthracene	0.3
Benzo(b)fluoranthene	0.3
Benzo(k)fluoranthene	0.3

Substance	Surface-Water Protection Criteria in ug/l (ppb)
Benzo(a)pyrene	0 3
Bis(2-chloroethyl) ether	42
Bis(2-chloroisopropyl) ether	3400000
Bis(2-ethyl hexyl)phthalate	59
Di-n-butyl phthalate	120000
2,4-Dichlorophenol	15800
Fluoranthene	3700
Fluorene	140000
Hexachloroethane	89
Hexachlorobenzene	0 077
Phenanthrene	0 077
Phenol	92000000
Pyrene	110000
Inorganic Substances	
Antimony	86000
Arsenic	4
Asbestos (in mfl)	7 mfl
Beryllium	4
Cadmium	6
Chromium, trivalent	1200
Chromium, hexavalent	110
Copper	48
Cyanide	52
Lead	13
Mercury	0 4
Nickel	880
Selenium	50
Silver	12
Thallium	63
Zinc	123

Substance	**Surface-Water Protection Criteria in ug/l (ppb)**
Pesticides and PCB	
Chlordane	0.3
Dieldrin	0.1
Endrin	0.1
Heptachlor epoxide	0.05
Heptachlor	0.05
Toxaphene	1
PCB's	0.5

Appendix E to
Sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies
Volatilization Criteria for Ground Water

Volatile Substance	**Residential Volatilization Criteria for Ground water in parts per billion**	**Industrial/Commercial Volatilization Criteria for Ground water in parts per billion**
Acetone	50000	50000
Benzene	215	530
Bromoform	920	3800
2-Butanone (MEK)	50000	50000
Carbon Tetrachloride	16	40
Chlorobenzene	1800	6150
Chloroform	287	710
1,2-Dichlorobenzene	30500	50000
1,3-Dichlorobenzene	24200	50000
1,4-Dichlorobenzene	50000	50000
1,1-Dichloroethane	34600	50000
1,2-Dichloroethane	21	90
1,1-Dichloroethylene	1	6
1,2-Dichloropropane	14	60
1,3-Dichloropropene	6	25
Ethyl benzene	50000	50000
Ethylene dibromide (EDB)	4	16
Methyl-tert-butyl-ether	50000	50000
Methyl isobutyl ketone	50000	50000
Methylene chloride	50000	50000
Styrene	580	2065
1,1,1,2-Tetrachloroethane	12	50
1,1,2,2-Tetrachloroethane	23	100
Tetrachloroethylene	1500	3820
Toluene	23500	50000
1,1,1-Trichloroethane	20400	50000
1,1,2-Trichloroethane	8000	19600
Trichloroethylene	219	540

Volatile Substance	**Residential Volatilization Criteria for Ground water in parts per billion**	**Industrial/Commercial Volatilization Criteria for Ground water in parts per billion**
Vinyl chloride	2	2
Xylenes	21300	50000

Appendix F to
Sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies
Volatilization Criteria for Soil Vapor

Volatile Substance	**Residential Volatilization Criteria for Soil Vapor in parts per million**	**Industrial/Commercial Volatilization Criteria for Soil Vapor in parts per million**
Acetone	2400	8250
Benzene	1	113
Bromoform	1 5	6
2-Butanone (MEK)	2400	8285
Carbon Tetrachloride	1	2 7
Chlorobenzene	31	106
Chloroform	4 5	10 4
1,2-Dichlorobenzene	240	818
1,3-Dichlorobenzene	240	818
1,4-Dichlorobenzene	950	3270
1,1-Dichloroethane	850	3037
1,2-Dichloroethane	1	1
1,1-Dichloroethylene	1	1
1,2-Dichloropropane	1	1
1,3-Dichloropropene	1	1
Ethyl benzene	1650	5672
Ethylene dibromide (EDB)	1	1
Methyl-tert-butyl-ether	1000	3415
Methyl isobutyl ketone	140	480
Methylene chloride	1200	2907
Styrene	8	28
1,1,1,2-Tetrachloroethane	1	1 5
1,1,2,2- Tetrachloroethane	1	1
Tetrachloroethylene	11	27
Toluene	760	2615

Volatile Substance	**Residential Volatilization Criteria for Soil Vapor in parts per million**	**Industrial/Commercial Volatilization Criteria for Soil Vapor in parts per million**
1,1,1-Trichloroethane	1310	4520
1,1,2-Trichloroethane	40	93
Trichloroethylene	7	16
Vinyl chloride	1	1
Xylenes	500	1702

Appendix G to
Sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies
Equations, Terms and Values for Calculating Site-specific Volatilization Criteria
for Ground Water and Soil Vapor

Volatilization Criteria for Ground Water

Site-Specific Volatilization Criteria for Ground Water may be calculated using the following equations

$$GWC = TAC / (1000 \cdot VF_{GW})$$

$$VF_{GW} = \frac{H\,[(D_{EFF\ WS}/L_{GW})/(ER \cdot L_B)] \cdot 1000}{1+[(D_{EFF\text{-}WS}/L_{GW})/(ER \cdot L_B)] + [(D_{EFF\text{-}WS}/L_{GW})/((D_{EFF\text{-}CRACK}/L_{CRACK}) \cdot \eta)]}$$

$$D_{EFF\ WS} = (h_{cap} + h_v) / [(h_{cap} / D_{EFF\text{-}CAP}) + (h_v / D_{EFF\text{-}S})]$$

$$D_{EFF\text{-}CAP} = D_{AIR} \cdot (\bullet_{ACAP}{}^{3\ 33}/\theta_T{}^2) + D_{WATER}/H \cdot (\theta_{WCAP}{}^{3\ 33}/\theta_T{}^2)$$

$$D_{EFF\text{-}S} = D_{AIR} \cdot (\theta_{AS}{}^{3\ 33}/\theta_T{}^2) + D_{WATER}/H \cdot (\theta_{WS}{}^{3\ 33}/\theta_T{}^2)$$

$$D_{EFF\text{-}CRACK} = D_{AIR} \cdot (\theta_{ACRACK}{}^{3\ 33}/\theta_T{}^2) + D_{WATER}/H \cdot (\theta_{WCRACK}{}^{3\ 33}/\theta_T{}^2)$$

Where

Term	Description	Units	Value
GWC	Ground Water Volatilization Criteria	ug/kg	calculated
TAC	Target Indoor Air Concentration	ug/m^3	**
VF_{GW}	Ground Water Volatilization Factor	mg/m^3	calculated
H	Henry's Law Constant	unitless	substance-specific
$D_{EFF\ WS}$	Effective Diffusion-Ground Water to Soil Surface	cm^2/s	calculated
L_{GW}	Depth to Ground Water (= $h_{CAP} + h_V$)	cm	site-specific
h_{CAP}	Thickness of Capillary Fringe	cm	site-specific
h_v	Thickness of Vadose Zone	cm	site-specific
ER_R	Residential Enclosed Space Air Exchange Rate	1/s	00014
ER_I	Industrial Enclosed Space Air Exchange Rate	1/s	00023

Term	Description	Units	Value
$L_{B R}$	Residential Enclosed Space Volume/Infiltration Area Ratio	cm	site-specific
$L_{B I}$	Industrial Enclosed Space Volume/Infiltration Area Ratio	cm	site-specific
$D_{EFF\text{-}CRACK}$	Effective Diffusion through Foundation Cracks	cm^2/s	calculated
L_{CRACK}	Enclosed Space Foundation or Wall Thickness	cm	site-specific
η	Areal Fraction of Cracks in Foundations / Walls	unitless	01
$D_{EFF\text{-}CAP}$	Effective Diffusion through Capillary Fringe	cm^2/s	calculated
$D_{EFF\text{-}S}$	Effective Diffusion through Soil (In Vapor Phase)	cm^2/s	calculated
D_{AIR}	Diffusion Coefficient in Air	cm^2/s	8 40E-02 or chemical specific
D_{WATER}	Diffusion Coefficient in Water	cm^2/s	1.00E-05 or chemical specific
θ_{ACAP}	Volumetric Air Content in Capillary Fringe	unitless	site-specific
θ_{AS}	Volumetric Air Content in Vadose Zone	unitless	site-specific
θ_{ACRACK}	Volumetric Air Content in Foundation/Wall Cracks	unitless	site-specific
θ_{WCAP}	Volumetric Water Content in Capillary Fringe	unitless	site-specific
θ_{WS}	Volumetric Water Content in Vadose Zone	unitless	site-specific
θ_{WCRACK}	Volumetric Water Content in Foundation/Wall Cracks	unitless	site-specific
θ_{T}	Total Soil Porosity	unitless	site-specific

**See attached "Table of Target Air Concentrations"

Volatilization Criteria for Soil Vapor

Site-Specific Volatilization Criteria for Soil Vapor may be calculated using the following equations

$$SSVC = TAC / (1000 \cdot VF_{SSV})$$

$$VF_{SSV} = \frac{[(D_{EFF\text{-}S}/L_S)/(ER \cdot L_B)]}{1+[(D_{EFF\text{-}S}/L_S)/(ER \cdot L_B)]+[(D_{EFF\text{-}S}/L_S)/(D_{EFF\text{-}CRACK}/L_{CRACK})\cdot\eta]}$$

$$D_{EFF\text{-}S} = D_{AIR} \cdot (\theta_{AS}{}^{3\,33}/\theta_T{}^2) + D_{WATER}/H \cdot (\theta_{WS}{}^{3\,33}/\theta_T{}^2)$$

$$D_{EFF\text{-}CRACK} = D_{AIR} \cdot (\theta_{ACRACK}{}^{3\,33}/\theta_T{}^2) + D_{WATER}/H \cdot (\theta_{WCRACK}{}^{3\,33}/\theta_T{}^2)$$

Where:

Terms	Description	Units	Value
SSVC	Volatilization Criteria for Soil Vapor	mg/m^3-air	calculated
TAC	Target Indoor Air Concentration	ug/m^3-air	**
VF_{SSV}	Volatilization Factor for Subsurface Vapors	unitless	calculated
H	Henry's Law Constant	unitless	substance-specific
$D_{EFF\,S}$	Effective Diffusion through Soil (in Vapor Phase)	cm^2/s	calculated
L_S	Depth to Soil Vapor Sample	cm	site-specific
ER_R	Residential Enclosed Space Air Exchange Rate	1/s	00014
ER_I	Industrial Enclosed Space Air Exchange Rate	1/s	00023
$L_{B\,R}$	Residential Enclosed Space Volume/Infiltration Area Ratio	cm	site-specific
$L_{B\,I}$	Industrial Enclosed Space Volume/Infiltration Area Ratio	cm	site-specific
$D_{EFF\text{-}CRACK}$	Effective Diffusion through Foundation Cracks	cm^2/s	calculated
L_{CRACK}	Enclosed Space Foundation or Wall Thickness	cm	site-specific
η	Areal Fraction of Cracks in Foundations / Walls	unitless	calculated
θ_{AS}	Volumetric Air Content in Vadose Zone	unitless	site-specific
θ_{ACRACK}	Volumetric Air Content in Foundation/Wall Cracks	unitless	site-specific
θ_{WS}	Volumetric Water Content in Vadose Zone	unitless	site-specific
θ_{WCRACK}	Volumetric Water Content in Foundation/Wall Cracks	unitless	site-specific
θ_T	Total Soil Porosity	unitless	site-specific

** See attached "Table of Target Air Concentrations"

Table of Target Air Concentrations

Volatile Substance	**Residential Target Indoor Air Concentration in micrograms per cubic meter**	**Industrial/Commercial Target Indoor Air Concentration in micrograms per cubic meter**
Acetone	8 34 E02	1 17 E03
Benzene	3 25 E00	2 15 E01
Bromoform	2.21 E00	3 72 E00
2-Butanone (MEK)	1 04 E03	1 46 E03
Carbon Tetrachloride	1 00 E00	1 00 E00
Chlorobenzene	2.09 E01	2 92 E01
Chloroform	3 00 E00	3 00 E00
1,2-Dichlorobenzene	2.09 E02	2 92 E02
1,3-Dichlorobenzene	2 09 E02	2 92 E02
1,4-Dichlorobenzene	8 34 E02	1 17 E03
1,1-Dichloroethane	5 21 E02	7 30 E02
1,2-Dichloroethane	9 36 E-02	1 57 E-01
1,1-Dichloroethylene	4 87 E-02	8 18 E-02
1,2-Dichloropropane	1 28 E-01	2 15 E-01
1,3-Dichloropropene	6 58 E-02	1 10 E-01
Ethyl benzene	1 04 E03	1 46 E03
Ethylene dibromide (EDB)	1 11 E-02	1 86 E-02
Methyl-tert-butyl-ether	5 21 E02	7 30 E02
Methyl isobutyl ketone	8 34 E01	1 17 E02
Methylene chloride	6 00 E02	6 00 E02
Styrene	5 00 E00	7 17 E00
1,1,1,2-Tetrachloroethane	3 29 E-01	5 52 E-01
1,1,2,2-Tetrachloroethane	4 20 E-02	7 05 E-02
Tetrachloroethylene	1 10 E01	1 10 E01
Toluene	4 17 E02	5 84 E02

Volatile Substance	Residential Target Indoor Air Concentration in micrograms per cubic meter	Industrial/Commercial Target Indoor Air Concentration in micrograms per cubic meter
1,1,1-Trichloroethane	1.04 E03	1.46 E03
1,1,2-Trichloroethane	3.00 E01	3.00 E01
Trichloroethylene	5.00 E00	5.00 E00
Vinyl chloride	2.90 E-02	4.87 E-02
Xylenes	3.13 E02	4.38 E02

Section 4. The Regulations of Connecticut State Agencies are amended by adding a new section 22a-133q-1 as follows

22a-133q-1 Environmental land use restrictions

(a) Definitions

For the purpose of this section, the definitions of the terms shall be the same as the definitions of terms in section 22a-133k-1 of the Regulations of Connecticut State Agencies In addition, the following definitions shall apply

"Class A-2 survey" means a first survey or independent re-survey which conforms to the "Recommended Standards for Surveys and Maps in the State of Connecticut Adopted on September 24, 1992, effective January 1, 1993 by the Connecticut Association of Land Surveyors, Inc " and which has been prepared by a land surveyor licensed in the State of Connecticut, complies with the minimum detail requirements for urban land title surveys adopted by the American Land Title Association and American Congress on Surveying and Maps (such requirements shall include all optional items on Table A thereof, exclusive of Items #1 (Monumentation), #5 (Contours in Elevation), #7b-2 (Other Data), and #12, and specifically shows (1) the boundaries of the Property by course and distance, together with the metes and bounds description corresponding to such survey, (2) the location of all improvements, (3) the location and width of all easements, utility lines, rights of way and building setback lines, with references to the book and page numbers for the instruments granting the same, (4) the location of all encroachments and restrictions, if any affecting the property, (5) the location of the portion of the parcel which is the subject of the proposed environmental land use restriction and (6) the latitude and longitude of the center of the subject property

"Environmental land use restriction" means (1) a declaration of environmental land use restriction in the form set forth in Appendix 1 to section 22a-133q-1 of the Regulations of Connecticut State Agencies, or, in the case of an environmental land use restriction approved by a licensed environmental professional pursuant to P A 95-190, a declaration of environmental land use restriction in the form set forth in Appendix 2 to section 22a-133q-1 of the Regulations of Connecticut State Agencies, (2) a class A-2 survey of the subject parcel or portion thereof, (3) a certificate of title demonstrating that the subordination agreement(s) required under section 22a-133o of the General Statutes as amended by P A 95-190 has been recorded, and (4) a copy of the decision document prepared in accordance with subsection (f) of this section

"Licensed environmental professional" means an environmental professional licensed in accordance with section 4 of P A 95-183

(b) Applicability

This section shall govern the execution and recording of environmental land use restrictions in accordance with section 22a-133n to 22a-133s, inclusive, of the General Statutes Except as otherwise provided by section 22a-133o of the General Statutes, no environmental land use restriction shall be effective unless and until it has (1) been submitted to the Commissioner for his review and approved by him as evidenced by his signature on the original of the instrument setting forth such restriction, and (2) been recorded on the land records in the municipality in which the subject parcel is located

(c) Publishing Notice of an Environmental Land Use Restriction

(1) The owner of the parcel which is the subject of a proposed environmental land use restriction shall, except as specified in subdivision (1) of this subsection, publish in at least one newspaper of general circulation in the area affected by the proposed environmental land use restriction, notice of intent to record an environmental land use restriction Such notice shall include the name and address of such owner, the address of the parcel or a brief description of its location, a brief description of the purpose of the proposed environmental land use restriction, the name and address of an individual from whom interested persons may obtain a copy of the proposed use restriction, and a statement that public comments on the proposed environmental land use restriction may be submitted in writing to the Commissioner of Environmental

Protection, 79 Elm Street, Hartford, CT 06106 for thirty days after the date of publication of the notice

(2) Notice of a proposed environmental land use restriction need not be published if (A) such restriction provides solely that the use of the subject parcel or portion thereof is restricted to industrial or commercial activities, and (B) the municipal zoning of such parcel limits the parcel to such use.

(d) Proposing an Environmental Land Use Restriction

When submitting a proposed environmental land use restriction to the Commissioner for his review and approval, the owner of the affected parcel of land shall simultaneously submit.

(1) a draft declaration of environmental land use restriction in the form set forth in Appendix 1 or 2 to section 22a-133q-1 of the Regulations of Connecticut State Agencies, as applicable;
(2) a Class A-2 survey of the parcel or portion thereof which is the subject of the proposed environmental land use restriction,
(3) a proposed decision document in accordance with subsection (f) of this section; and
(4) a certified copy of the notice required by subsection (c) of this section, as such notice appeared in the newspaper or newspapers

(e) Approval of an Environmental Land Use Restriction by the Commissioner.

After the close of the public comment period, the Commissioner shall decide whether to approve an environmental land use restriction When making such decision the Commissioner shall consider (1) all comments submitted, (2) whether such restriction will adequately protect human health and the environment from pollution at or emanating from the subject release area; and (3) whether such restriction conforms in all respects to the requirements of this section and sections 22a-133n through 22a-133s of the General Statutes

(f) Decision Document

Any environmental land use restriction approved pursuant to this section shall include a decision document prepared in accordance with this section The decision document shall contain a detailed written description of

(1) the type and location of pollutants present in soil or ground water on or underlying the parcel or portion thereof which is the subject of the environmental land use restriction,
(2) the provisions of the environmental land use restriction, including any limitations on the use of such parcel or portion thereof, and
(3) description of the reason for the environmental land use restriction, including an explanation why such restriction is consistent with sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies

The decision document shall also contain a summary of all comments on the proposed environmental land use restriction received following the publication of notice in accordance with subsection (c) of this section and a brief response to each comment. The decision document shall be signed by the Commissioner or, in the case of a restriction approved pursuant to P.A 95-190, a licensed environmental professional to indicate approval of the decision document

(g) Approval of an Environmental Land Use Restriction by a Licensed Environmental Professional

When an environmental land use restriction is to be approved by a licensed environmental professional in accordance with P A 95-190, the licensed environmental professional shall review the documents listed in subsection (e), shall prepare a written approval of such restriction, and shall retain documentation of all documents reviewed by him A licensed environmental professional shall not approve any environmental land use restriction unless it is consistent with sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies

(h) Subordination Agreements

Whether the Commissioner or a licensed environmental professional approves an environmental land use restriction, prior to recording such environmental land use restriction on the municipal land records, the owner of the subject parcel shall submit to the Commissioner for his review and written approval (1) copies of each subordination agreement, properly executed, required under section 22a-133o of the General Statutes, or (2) a certificate of title indicating that each person holding an interest in such parcel or any part thereof, including without limitation each mortgagee, lessee, lienor and encumbrancer, has irrevocably subordinated such interest to the environmental land use restriction

(i) Recording an Environmental Land Use Restriction

After the Commissioner or a licensed environmental professional, as applicable, has approved an environmental land use restriction in accordance with this section, the owner of the subject parcel shall record such restriction in accordance with this section and all other applicable law

(j) Mailing Notice of an Environmental Land Use Restriction

After an environmental land use restriction has been recorded, the owner of the subject parcel shall send, by certified mail, return receipt requested, a copy of such environmental land use restriction to (1) the chief administrative officer in the town where the parcel is located; (2) the chairman of the municipal planning, zoning or planning and zoning commission, (3) the local director of health, and (4) any person who submitted comments on such environmental use restriction

(k) Release

The owner of any parcel which is subject to an environmental land use restriction recorded in accordance with this section may request that the Commissioner release such parcel, in whole or in part, from the limitations of such restriction If the Commissioner grants such request, the owner of such parcel shall, in accordance with law, record such release on the land records in the municipality where such parcel is located No release of an environmental land use restriction shall be effective unless and until it has been submitted to the Commissioner for his review and approved by him as evidenced by his signature on the original of the instrument setting forth such release, and has been recorded on the land records of the municipality in which such parcel is located

(l) Effect of Court Ruling on Environmental Land Use Restriction

In the event that a court of competent jurisdiction rules that any portion of an environmental land use restriction recorded pursuant to this section is invalid, the owner of the subject parcel shall submit a copy of such restriction and such ruling to the Commissioner The Commissioner shall review such restriction, and if he determines that such restriction would not have been approved without the invalid portion, he shall give notice that the environmental land use restriction is terminated as evidenced by his signature on in instrument setting forth such termination, and shall record such instrument on the land records of the municipality where such parcel is located Promptly thereafter, the owner of the subject parcel shall take actions consistent with sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies to remediate the subject parcel or portion thereof If the Commissioner determines in writing that the environmental land use restriction would have been approved without the invalid portion, the valid portion of the environmental land use restriction shall remain in full force and effect

Appendix 1 to
Section 22a-133q-1 of the Regulations of Connecticut State Agencies
Form of Environmental Land Use Restriction for Commissioner's Approval

Instructions Any environmental land use restriction pursuant to R.C S.A. section 22a-133q-1 shall be in the following form The appropriate information shall be inserted in the blanks shown, and the appropriate language shall be selected from the choices shown in brackets, or if none of the choices addresses the specific circumstance, substitute language shall be inserted

DECLARATION OF ENVIRONMENTAL LAND USE RESTRICTION AND GRANT OF EASEMENT

~~This Declaration of environmental land use restriction and Grant of Easement is made this~~ day of , 1995 , between ("the Grantor") and the Commissioner of Environmental Protection of the State of Connecticut ("the Grantee")

WITNESSETH

WHEREAS, Grantor is the owner in fee simple of certain real property (the "Property") known as [Address/Location located in the Town of in County] [designated as Lot , Block on the tax map of the Town of in County], more particularly described on Exhibit A which is attached hereto and made a part hereof, and

WHEREAS, the Grantee has determined that the environmental land use restriction set forth below is consistent with regulations adopted by him pursuant to Section 22a-133k of the Connecticut General Statutes, and

WHEREAS, the Grantee has determined that this environmental land use restriction will effectively protect public health and the environment from the hazards of pollution, and

WHEREAS, the Grantee's written approval of this Environmental land use restriction is contained in the document attached hereto as Exhibit B (the "Decision Document") which is made a part hereof, and

WHEREAS, the property or portion thereof identified in the class A-2 survey ("the Subject Area") which survey is attached hereto as Exhibit C which is made a part hereof, contains pollutants and

WHEREAS, to prevent exposure to or migration of such pollutants and to abate hazards to human health and the environment, and in accordance with the Decision Document, the Grantor desires to impose certain restrictions upon the use, occupancy, and activities of and at the Subject Area, and to grant this environmental land use restriction to the Grantee on the terms and conditions set forth below; and

WHEREAS, Grantor intends that such restrictions shall run with the land and be binding upon and enforceable against Grantor and Grantor's successors and assigns,

NOW, THEREFORE, Grantor agrees as follows

1 Purpose In accordance with the Decision Document, the purpose of this Environmental land use restriction is to assure [that the Subject Area is not used for residential activities], [that ground water at the Subject Area is not utilized for drinking purposes], [that humans are not exposed to soils at the Subject Area polluted with substances in concentrations exceeding the direct exposure criteria established in R C S A sections 22a-133k-1 through 22a-133k-3, inclusive], [that water does not infiltrate soils at the Subject Area polluted with substances in concentrations exceeding the pollutant mobility criteria established in R C S A sections 22a-133k-1 through 22a-133k-3, inclusive] [that buildings are not constructed over soils or ground water at the Subject Area polluted with substances in concentrations exceeding the volatilization criteria established in R C S A sections 22a-133k-1 through 22a-133k-3, inclusive], [that the engineered control described in Exhibit D attached hereto is not disturbed and is properly maintained to prevent human exposure to soils at the Subject Area polluted with substances in concentrations exceeding the direct exposure criteria

established in R C S A sections 22a-133k-1 through 22a-133k-3, inclusive, and/or that water does not infiltrate soils at the Subject Area polluted with substances in concentrations exceeding the pollutant mobility criteria established in R C.S A. sections 22a-133k-1 through 22a-133k-3, inclusive.]

2 Restrictions Applicable to the Subject Area In furtherance of the purposes of this environmental land use restriction, Grantor shall assure that use, occupancy, and activity of and at the Subject Area are restricted as follows:

[A Use No residential use of the Subject Area shall be permitted
B Ground water Ground water at the Subject Area shall not be used for drinking or other domestic purposes
C Disturbances Soil at the Subject Area shall not be disturbed in any manner, including without limitation,
D. Construction. No building shall be constructed on the Subject Area]

3 Except as provided in Paragraph 4 below, no action shall be taken, allowed, suffered, or omitted if such action or omission is reasonably likely to

i Create a risk of migration of pollutants or a potential hazard to human health or the environment, or

ii Result in a disturbance of the structural integrity of any engineering controls designed or utilized at the Property to contain pollutants or limit human exposure to pollutants

4 Emergencies In the event of an emergency which presents a significant risk to human health or the environment, the application of Paragraph 3 above may be suspended, provided such risk cannot be abated without suspending such Paragraph <u>and</u> the Grantor

i Immediately notifies the Grantee of the emergency,

ii Limits both the extent and duration of the suspension to the minimum reasonably necessary to adequately respond to the emergency,

iii Implements all measures necessary to limit actual and potential present and future risk to human health and the environment resulting from such suspension, and

iv Implements a plan approved in writing by the Grantee, on a schedule approved by the Grantee, to ensure that the Subject Area is remediated in accordance with R C S A sections 22a-133k-1 through 22a-133k-3, inclusive, or restored to its condition prior to such emergency

5 Release of Restriction, Alterations of Subject Area Grantor shall not make, or allow or suffer to be made, any alteration of any kind in, to, or about any portion of any of the Subject Area inconsistent with this Environmental land use restriction unless the Grantor has first recorded the Grantee's written approval of such alteration upon the land records of [name of municipality where Subject Area is located] The Grantee shall not approve any such alteration and shall not release the Property from the provisions of this environmental land use restriction unless the Grantor demonstrates to the Grantee's satisfaction that Grantor has remediated the Subject Area in accordance with R C S A sections 22a-133k-1 through 22a-133k-3, inclusive

6 Grant of Easement to the Grantee Grantor hereby grants and conveys to the Grantee, his agents, contractors, and employees, and to any person performing pollution remediation activities under the direction thereof, a non-exclusive easement (the "Easement") over the Subject Area and over such other parts of the Property as are necessary for access to the Subject Area or for carrying out any actions to abate a threat to human health or the environment associated with the Subject Area Pursuant to this Easement, the Grantee, his agents, contractors, and employees, and any person performing pollution remediation activities under the direction thereof, may enter upon and inspect the Property and perform such investigations and actions as the Grantee deems necessary for any one or more of the following purposes

i Ensuring that use, occupancy, and activities of and at the Property are consistent with this environmental land use restriction,

ii Ensuring that any remediation implemented complies with R C S A sections 22a-133k-1 through 22a-133k-3, inclusive,

iii Performing any additional investigations or remediation necessary to protect human health and the environment,

[iv Ensuring the structural integrity of any engineering controls described in this Environmental land use restriction and Grant of Easement and their continuing effectiveness in containing pollutants and limiting human exposure to pollutants]

7. Notice and Time of Entry onto Property Entry onto the Property by the Grantee pursuant to this Easement shall be upon reasonable notice and at reasonable times, provided that entry shall not be subject to these limitations if the Grantee determines that immediate entry is necessary to protect human health or the environment.

8 Notice to Lessees and Other Holders of Interests in the Property. Grantor, or any future holder of any interest in the property, shall cause any lease, grant, or other transfer of any interest in the Property to include a provision expressly requiring the lessee, grantee, or transferee to comply with this environmental land use restriction and Grant of Easement. The failure to include such provision shall not affect the validity or applicability to the Property of this environmental land use restriction and Grant of Easement.

9 Persons Entitled to Enforce Restrictions The restrictions in this environmental land use restriction on use, occupancy, and activity of and at the Property shall be enforceable in accordance with section 22a-133p of the General Statutes

10 Severability and Termination If any court of competent jurisdiction determines that any provision of this environmental land use restriction or Grant of Easement is invalid or unenforceable, such provision shall be deemed to have been modified automatically to conform to the requirements for validity and enforceability as determined by such court In the event that the provision invalidated is of such nature that it cannot be so modified, the provision shall be deemed deleted from this instrument as though it had never been included herein In either case, the remaining provisions of this instrument shall remain in full force and effect Further, in either case, the Grantor shall submit a copy of this restriction and of the judgement of the Court to the Grantee in accordance with R C S A section 22a-133q-1(1). This environmental land use restriction shall be terminated if the Grantee provides notification pursuant to R C S A section 22a-133q-1(l)

11 Binding Effect All of the terms, covenants and conditions of this environmental land use restriction and grant of easement shall run with the land and shall be binding on the Grantor, the Grantor's successors and assigns, and each owner and any other party entitled to possession or use of the Property during such period of ownership or possession

12 Terms Used Herein The definitions of terms used herein shall be the same as the definitions contained in sections 22a-133k-1 and 22a-133o-1 of the Regulations of Connecticut State Agencies as such sections existed on the date of execution of this environmental land use restriction

Appendix 2 to
Section 22a-133q-1 of the Regulations of Connecticut State Agencies
Form of Environmental Land Use Restriction for Licensed Environmental Professional's Approval

> Instructions Any environmental land use restriction pursuant to R.C.S.A section 22a-133q-1 shall be in the following form The appropriate information shall be inserted in the blanks shown, and the appropriate language shall be selected from the choices shown in brackets, or if none of the choices addresses the specific circumstance, substitute language shall be inserted.

DECLARATION OF ENVIRONMENTAL LAND USE RESTRICTION AND GRANT OF EASEMENT

This Declaration of environmental land use restriction and Grant of Easement is made this day of , 1995 , between ("the Grantor") and the Commissioner of Environmental Protection of the State of Connecticut ("the Grantee")

WITNESSETH

WHEREAS, Grantor is the owner in fee simple of certain real property (the "Property") known as [Address/Location located in the Town of in County] [designated as Lot , Block on the tax map of the Town of in County], more particularly described on Exhibit A which is attached hereto and made a part hereof, and

WHEREAS, remediation of the Property has been conducted in accordance with Public Act 95-190, and

WHEREAS, the Licensed Environmental Professional whose signature appears below has determined that the environmental land use restriction set forth below is consistent with regulations adopted by the Commissioner of Environmental Protection pursuant to Section 22a-133k of the Connecticut General Statutes, and

WHEREAS, the Licensed Environmental Professional whose signature appears below has determined that this environmental land use restriction will effectively protect public health and the environment from the hazards of pollution, and

WHEREAS, the written approval of this Environmental land use restriction by the Licensed Environmental Professional whose signature appears below is contained in the document attached hereto as Exhibit B (the "Decision Document") which is made a part hereof, and

WHEREAS, the property or portion thereof identified in the class A-2 survey ("the Subject Area") which survey is attached hereto as Exhibit C which is made a part hereof, contains pollutants, and

WHEREAS, to prevent exposure to or migration of such pollutants and to abate hazards to human health and the environment, and in accordance with the Decision Document, the Grantor desires to impose certain restrictions upon the use, occupancy, and activities of and at the Subject Area, and to grant this environmental land use restriction to the Grantee on the terms and conditions set forth below, and

WHEREAS, Grantor intends that such restrictions shall run with the land and be binding upon and enforceable against Grantor and Grantor's successors and assigns,

NOW, THEREFORE, Grantor agrees as follows

1 Purpose In accordance with the Decision Document, the purpose of this Environmental land use restriction is to assure [that the Subject Area is not used for residential activities], [that ground water at the Subject Area is not utilized for drinking purposes], [that humans are not exposed to soils at the Subject

Area polluted with substances in concentrations exceeding the direct exposure criteria established in R.C S.A sections 22a-133k-1 through 22a-133k-3, inclusive], [that water does not infiltrate soils at the Subject Area polluted with substances in concentrations exceeding the pollutant mobility criteria established in R.C.S A sections 22a-133k-1 through 22a-133k-3, inclusive] [that buildings are not constructed over soils or ground water at the Subject Area polluted with substances in concentrations exceeding the volatilization criteria established in R C S A sections 22a-133k-1 through 22a-133k-3, inclusive], [that the engineered control described in Exhibit D attached hereto is not disturbed and is properly maintained to prevent human exposure to soils at the Subject Area polluted with substances in concentrations exceeding the direct exposure criteria established in R.C.S.A. sections 22a-133k-1 through 22a-133k-3, inclusive, and/or that water does not infiltrate soils at the Subject Area polluted with substances in concentrations exceeding the pollutant mobility criteria established in R C.S.A sections 22a-133k-1 through 22a-133k-3, inclusive]

2 Restrictions Applicable to the Subject Area In furtherance of the purposes of this environmental land use restriction, Grantor shall assure that use, occupancy, and activity of and at the Subject Area are restricted as follows

[A Use No residential use of the Subject Area shall be permitted
B Ground water Ground water at the Subject Area shall not be used for drinking or other domestic purposes
C Disturbances Soil at the Subject Area shall not be disturbed in any manner, including without limitation,
D Construction No building shall be constructed on the Subject Area]

3 Except as provided in Paragraph 4 below, no action shall be taken, allowed, suffered, or omitted if such action or omission is reasonably likely to

i Cause migration of pollutants or create a potential hazard to human health or the environment, or

ii Result in a disturbance of the structural integrity of any engineering controls or other structures designed or utilized at the Property to contain pollutants or limit human exposure to pollutants

4 Emergencies In the event of an emergency which presents a significant risk to human health or the environment, the application of Paragraph 3 above may be suspended, provided such risk cannot be abated without suspending such Paragraph <u>and</u> the Grantor

i Immediately notifies the Grantee of the emergency,

ii Limits both the extent and duration of the suspension to the minimum reasonably necessary to adequately respond to the emergency,

iii Implements all measures necessary to limit actual and potential present and future risk to human health and the environment resulting from such suspension, and

iv Implements a plan approved in writing by the Grantee, on a schedule approved by the Grantee, to ensure that the Subject Area is remediated in accordance with R C S A sections 22a-133k-1 through 22a-133k-3, inclusive, or restored to its condition prior to such emergency

5 Release of Restriction, Alterations of Subject Area Grantor shall not make, or allow or suffer to be made, any alteration of any kind in, to, or about any portion of any of the Subject Area inconsistent with this Environmental land use restriction unless the Grantor has first recorded the Grantee's written approval of such alteration upon the land records of [name of municipality where Subject Area is located] The Grantee shall not approve any such alteration and shall not release the Property from the provisions of this environmental land use restriction unless the Grantor demonstrates to the Grantee's satisfaction that Grantor has remediated the Subject Area in accordance with R C S A sections 22a-133k-1 through 22a-133k-3, inclusive

6 Grant of Easement to the Grantee Grantor hereby grants and conveys to the Grantee, his agents, contractors, and employees, and to any person performing pollution remediation activities under the direction thereof, a non-exclusive easement (the "Easement") over the Subject Area and over such other parts of the Property as are necessary for access to the Subject Area or for carrying out any actions to abate a threat to human health or the environment associated with the Subject Area Pursuant to this Easement, the Grantee, his agents, contractors, and employees, and any person performing pollution remediation activities

under the direction thereof, may enter upon and inspect the Property and perform such investigations and actions as the Grantee deems necessary for any one or more of the following purposes

i Ensuring that use, occupancy, and activities of and at the Property are consistent with this environmental land use restriction,

ii Ensuring that any remediation implemented complies with R.C.S A. sections 22a-133k-1 through 22a-133k-3, inclusive,

iii. Performing any additional investigations or remediation necessary to protect human health and the environment,

[iv Ensuring the structural integrity of any engineering controls described in this Environmental land use restriction and Grant of Easement and their continuing effectiveness in containing pollutants and limiting human exposure to pollutants]

7 Notice and Time of Entry onto Property. Entry onto the Property by the Grantee pursuant to this Easement shall be upon reasonable notice and at reasonable times, provided that entry shall not be subject to these limitations if the Grantee determines that immediate entry is necessary to protect human health or the environment.

8 Notice to Lessees and Other Holders of Interests in the Property. Grantor, or any future holder of any interest in the property, shall cause any lease, grant, or other transfer of any interest in the Property to include a provision expressly requiring the lessee, grantee, or transferee to comply with this environmental land use restriction and Grant of Easement The failure to include such provision shall not affect the validity or applicability to the Property of this environmental land use restriction and Grant of Easement

9 Persons Entitled to Enforce Restrictions The restrictions in this environmental land use restriction on use, occupancy, and activity of and at the Property shall be enforceable in accordance with section 22a-133p of the General Statutes

10 Severability and Termination If any court of competent jurisdiction determines that any provision of this environmental land use restriction or Grant of Easement is invalid or unenforceable, such provision shall be deemed to have been modified automatically to conform to the requirements for validity and enforceability as determined by such court In the event that the provision invalidated is of such nature that it cannot be so modified, the provision shall be deemed deleted from this instrument as though it had never been included herein In either case, the remaining provisions of this instrument shall remain in full force and effect Further, in either case, the Grantor shall submit a copy of this restriction and of the judgement of the Court to the Grantee in accordance with R C S A section 22a-133q-1(1) This environmental land use restriction shall be terminated if the Grantee provides notification pursuant to R C S A section 22a-133q-1(l)

11 Binding Effect All of the terms, covenants and conditions of this environmental land use restriction and grant of easement shall run with the land and shall be binding on the Grantor, the Grantor's successors and assigns, and each owner and any other party entitled to possession or use of the Property during such period of ownership or possession

12 Terms Used Herein The definitions of terms used herein shall be the same as the definitions contained in sections 22a-133k-1 and 22a-133o-1 of the Regulations of Connecticut State Agencies as such sections existed on the date of execution of this environmental land use restriction

Section 5. Section 22a-209-1 of the Regulations of Connecticut State Agencies is repealed and the following is substituted in lieu thereof

Sec. 22a-209-1. Definitions

"AASHTO specification" means a standard of performance for buried structures set forth in "Standard Specifications for Transportation Materials," published by the American Association of State Highway and Transportation Officials in 1989, 14TH edition

"All weather access" means that affected roads or land surface can support operation of vehicles for the transportation of solid waste and vehicles for the maintenance of solid waste facilities under all normal climatic conditions, provided that snow is removed and flooding is precluded

"Alter" (1) when referring to a solid waste facility which has no permit, means to change the existing configuration or method of operation of the facility in any manner, including but not limited to adding to the volume of solid waste deposited at the facility; (2) when referring to a solid waste facility which holds a permit, means to change the approved configuration or method of operation of the facility in any manner, including but not limited to adding to the approved volume of solid waste deposited at the facility

"Asbestos" means actinolite, amosite, antnophyllite, chrysotile, crocidolite, tremolite, or any material which contains the above, all or part of which is in a friable state

"ASTM specification" means a standard for pipes or other construction materials set forth in "Annual Book of ASTM Standards," published by the American Society of Testing Materials in 1989.

"Base flood" means a flood that has a one percent or greater chance of recurring in any year or a flood of a magnitude equaled or exceeded once in 100 years on the average over a significantly long period If the Commissioner deems it necessary for a particular location, the base flood shall represent a less common occurrence as specified by him or her

"Bird hazard" means an increase in the likelihood of bird/aircraft collisions that may cause damage to the aircraft or injury to its occupants

"Bulky waste" means landclearing debris and waste resulting directly from demolition activities other than clean fill

"Cell construction method" means the spreading, compacting and daily covering of solid wastes through use of the area, ramp, or trench methods of landfilling

"Certified operator" means the solid waste facility operator or an employee of the such operator who is present on site and oversees or carries out the daily operation of the facility, and whose qualifications are approved in accordance with Section 22a-209-6 of the Regulations of Connecticut State Agencies

"Certified soil scientist" means a person who has been certified as a soil scientist by the Board of Directors of the Society of Soil Scientists of Southern New England

"Clean fill" means (1) natural soil (2) rock, brick, ceramics, concrete, and asphalt paving fragments which are virtually inert and pose neither a pollution threat to ground or surface waters nor a fire hazard AND (3) POLLUTED SOIL AS DEFINED IN SUBDIVISION (45) OF SUBSECTION (a) OF SECTION 22a-133k-1 OF THE REGULATIONS OF CONNECTICUT STATE AGENCIES WHICH SOIL HAS BEEN TREATED TO REDUCE THE CONCENTRATION OF POLLUTANTS TO LEVELS WHICH DO NOT EXCEED THE APPLICABLE POLLUTANT MOBILITY CRITERIA AND DIRECT EXPOSURE CRITERIA ESTABLISHED IN SECTIONS 22a-133k-1 THROUGH 22a-133k-3 OF THE REGULATIONS OF CONNECTICUT STATE AGENCIES AND WHICH SOIL IS REUSED IN ACCORDANCE WITH R C S A SUBDIVISION (3) OF SUBSECTION (h) OF SECTION 22a-133k-2 OF SUCH REGULATIONS

"Cover material" means soil, or other suitable material as approved by the Commissioner, which is used to cover compacted solid waste in a solid or special waste disposal area Any soils used shall be classified as GM, silty gravels, poorly graded gravel-sand-silt mixtures, GC, clayey gravels, poorly graded gravel-sand-clay mixtures, SM, silty sands, poorly graded sand-silt mixtures, SC, clayey sands, poorly graded sand-clay mixtures, ML, inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity in accordance with the unified soil classification system

"Dewater" means to subject material to a process that removes water

"Dioxin sampling well" means a stainless steel ground water monitoring well installed within the area of predicted leachate plume from any portion of a solid waste facility at which residue is disposed

"Facility plan" means the engineering studies and proposals to build, establish, alter, operate, monitor and close a solid waste facility, required by Section 22a-209-4(b)(2) of the Regulations of Connecticut State Agencies

"Floodplain" means the lowland and relatively flat areas adjoining inland and coastal waters, including flood-prone areas of offshore islands, which are inundated by the base flood

"Friable" means readily crumbled, pulverized or reduced to powder, when dry, by hand pressure

"Geotextile" means a woven or nonwoven fabric or film which is utilized for the engineering management of soil and water.

"Groundwater" means water present in the zone of saturation

"Groundwater monitoring well" means a dug, driven or drilled well used to determine groundwater elevation, direction of groundwater flow, or the quality of groundwater.

"Hazardous Waste" means any waste material which may pose a present or potential hazard to human health or the environment when improperly treated, stored, transported or disposed of or otherwise managed, including hazardous waste identified in accordance with Section 3001 of the Resource Conservation and Recovery Act of 1976 (42 USC 6901 et seq) as amended

"Leachate" means that liquid which results from ground or surface water which has been in contact with solid waste and has extracted material, either dissolved or suspended, from the solid waste

"Lift" means a horizontal layer of cells within a solid waste disposal area at which the cell construction method is utilized

"Lower explosive limit" means the lowest percent by volume of gas which will propagate a flame in air at 25° C and atmospheric pressure.

"Maximum high water table" means the highest elevation reached by the upper level of the ground water as determined by an engineering evaluation conducted in accordance with test methods approved by the Commissioner

"Monocell" means a variation of the cell construction method whereby only a single type of solid waste is disposed of in any individual cell

"Mottling indicator" means a residual trace of reduced or oxidized iron left on soil strata as the result of fluctuations in groundwater elevation

"Mulch" means a protective cover of organic material placed over soil to preserve soil moisture, prevent erosion, or promote the growth of plants

"Municipal solid waste" means solid waste from residential, commercial, industrial and institutional sources, excluding solid waste consisting of significant quantities of hazardous waste as defined in Section 22a-115 of the General Statutes, landclearing debris, biomedical waste, sewage sludge and scrap metal

"NATURAL SOIL" MEANS SOIL IN WHICH ALL SUBSTANCES NATURALLY OCCURRING THEREIN ARE PRESENT IN CONCENTRATIONS NOT EXCEEDING THE CONCENTRATIONS OF SUCH SUBSTANCE OCCURRING NATURALLY IN THE ENVIRONMENT AND IN WHICH SOIL NO OTHER SUBSTANCE IS ANALYTICALLY DETECTABLE FOR THE PURPOSE OF THIS DEFINITION, SUBSTANCE SHALL HAVE THE SAME MEANING AS IN SECTION 22a-133k-1 OF THE REGULATIONS OF CONNECTICUT STATE AGENCIES

"New municipal solid waste disposal area" means a solid waste facility or expansion thereof, other than a vertical expansion, for the disposal of municipal solid waste, for which facility or expansion a completed application under Sections 22a-430 and 22a-208a of the General Statutes is received by the Commissioner after the effective date of Section 22a-209-14 of the Regulations of Connecticut State Agencies

"Open dump" means a site at which solid waste is disposed of in a manner which does not comply with Subtitle D of the Resource Conservation and Recovery Act of 1976, (42 USC 6901 et seq), as amended, and regulations promulgated thereunder

"Operator" means a person who is ultimately responsible for maintaining the solid waste facility in conformance with applicable statutes and regulations and the facility permits

"Pan lysimeter" means a leachate collection device for sampling leachate from monocells within a solid waste disposal area

"Person" means any individual, firm, partnership, association, syndicate, company, trust, corporation, municipality, agency or political or administrative subdivision of the state, or other legal entity of any kind

"Public airport" means an airport open to the public without prior permission and without restrictions within the physical capacities of available facilities.

"Recharge" means water which enters a geologic formation

"Regional solid waste disposal area" means a solid waste disposal area used for the disposal of solid waste generated in more than one municipality

"Residue" means bottom ash, air pollution control residue, and other residues from the combustion process at resource recovery facilities, municipal solid waste incinerators, and biomedical waste incinerators

"Resources recovery facility" means a volume reduction plant, as defined by Section 22a-207 of the General Statutes as amended, utilizing processes aimed at reclaiming the material or energy values from solid wastes

"Rip-rap" means a loose assemblage of broken or whole stones utilized to dissipate the velocity and energy of moving water

"Scarification" means the process of raking, harrowing or otherwise disturbing a soil surface to allow infiltration of water or other material

"Solid waste boundary" means the outermost perimeter of the solid or special waste (projected in the horizontal plane) as it would exist at completion of the permitted disposal activity at a solid waste or special waste disposal area

"Special waste disposal area" means a solid waste disposal area at which special wastes, as defined in this section, are disposed of

"Special wastes" means the following wastes, so long as they are not hazardous waste pursuant to section 22a-115 of the General Statutes or radioactive material subject to section 22a-148 of the General Statutes (1) water treatment, sewage treatment or industrial sludges, liquid, solids and contained gases; fly-ash and casting sands or slag, and contaminated dredge spoils; (2) scrap tires, (3) bulky waste, as defined in this section, (4) asbestos, (5) residue, and (6) biomedical waste

"Standard proctor density" means the maximum weight per unit volume of earthen material which has been compacted by a specific weight and procedure, at an optimum soil moisture, according to a laboratory engineering test developed by Proctor

"State Solid Waste Management Plan" means the State plan adopted pursuant to Section 22a-211 of the Connecticut General Statutes, as amended

"Stormwater" means precipitation runoff

"Transfer station" means a volume reduction plant, as defined by Section 22a-207 of the General Statutes, as amended, that is a central collection point for the solid waste generated within a municipality or group of municipalities, where solid wastes received are transferred to a vehicle for removal to another solid waste facility

"Underdrainage" means a system of pipes, structures, stone, pumps, wells, or other devices utilized to lower or divert groundwater

"Vector" means as insect or rodent or other animal (not human) which can transmit infectious diseases from one person or animal to another person or animal

"Vertical expansion" means an expansion of an existing solid waste disposal area such that future disposal of municipal solid waste will take place only where solid waste has previously been disposed of and is still present

"Washout" means the carrying away of solid waste by waters of the base flood

"Water Quality Standards" means the water quality standards and water quality Classifications Map published by the Connecticut Department of Environmental Protection, February, 1987

"Water table" means that surface of a body of unconfined groundwater at which the pressure is equal to that of the atmosphere

"Working face" means that portion of a solid waste or special waste disposal area where the waste is deposited, spread and compacted prior to the placement of cover material

"Zone of influence" means the area in which, assuming the absence of any means at a solid waste facility to collect or treat leachate, groundwater may be altered in quality due to discharge of leachate from any portion of such facility

Handout from 30 Apr 99 RSR Seminar

QUESTIONS AND RESPONSE SUMMARY - DEP LIAISON MEETINGS
Environmental Professionals Organization of Connecticut
APRIL 1999

The following is a summary of questions asked at the DEP Liaison committee meetings along with DEP's response. Some of these questions have been previously distributed, and several issues raised at liaison meetings are now outdated and are not included in this summary. Questions are divided into five categories, General, Groundwater, Soil, Surface Water, and Volatilization.

A. GENERAL

1. *What is the status of DEP's research into an alternative for TPH analysis by 418.1?*

   An ad hoc committee composed of personnel from DEP-UST, DPH, DPH lab, and the ERI lab researched new methods for TPH analysis. DEP will be approving an analytical method using methylene chloride extraction with gas chromatograph-flame ionization detection for TPH analysis. This method, which is one of the options available using Method 8015 GC FID will quantify the TPH with carbon numbers equivalent to diesel fuel and higher and will greatly reduce the occurrence of false positives associated with organic matter. The numerical criteria for TPH in soils will be not be changed based on the new method. However, the ground-water protection criteria will be lowered from 500 ppb to 100 ppb. Final work on the new method is being completed at the DPH lab, and DPH approval is expected by mid-May. When the DPH laboratory has approved the method a copy will be provided to EPOC for posting on the web page.

2. *Under what circumstances would remediation of an historical release from an UST be subject to the remediation standard regulations?*

   The RSRs apply to the remediation of UST releases whenever that remediation is required by statute, regulation, or order from the Commissioner. However, the DEP recommends that the RSRs be used to remediate any commercial or industrial UST release. It is simply not cost-effective or efficient to partially remediate an UST release at one time, and then at a later date - perhaps in the context of a property transfer or compliance with an order - have to reassess compliance with the RSRs. DEP also recommends that, for releases of fuel oil from small residential underground storage tanks, the numeric soil criteria should be used as a guide in any excavation project.

3. *Can TPH generally be used as a surrogate for semi-volatile organic compounds when one is evaluating releases and extent of contaminants at areas where petroleum products were handled?*

   With respect to SVOCs, the DEP recommends that the investigator should generally follow the guidance provided by the DEP's "Sampling and Analytical Methods for UST Closure" memo dated 5/28/96. For example, at fuel oil and diesel releases TPH analyses should be performed on all samples, but the sample with the highest TPH concentration should also be analyzed for aromatic VOCs, MTBE, and SVOCs. For most other area where petroleum products were handled it is appropriate to analyze all samples for TPH, and VOCs including MTBE with the sample having the highest level of pollution also being tested for SVOCs. Of course, the investigator should consider the nature and composition of the petroleum products used at the site and design the analytical program accordingly.

4. *If TPH is the only contaminant detected at an establishment, is a Form III filing required? Prior to passage of P.A. 95-183, such a filing would not have been required because TPH was considered a Connecticut Regulated Waste, not a hazardous waste. Please clarify DEP's position on this issue.*

   Pursuant to Section 22a-134 of the Connecticut General Statutes, a Form III filing is required if hazardous wastes have been released. If only TPH has been released at a site and no hazardous wastes have otherwise been released, the filing of a form III is not required. However, the TPH release may still require remediation because of a statute, order or regulation other than the Property Transfer Act.

5. *What are the LEP's obligations for determining standards for contaminants of concern for which criteria have not been tabulated in the RSRs?*

   The RSRs apply to any substance released at a site even if a numeric criteria for soil or ground water has not been established. If criteria have not been adopted, then the Commissioner must approve criteria for such additional polluting substances. The RSRs Sections 22a-133k-2(b)(4), -(2)(c)(5), and -(3)(h) describe the information that must be submitted when requesting an approval of criteria for additional substances. The DEP will share new criteria developed through this process with the public so that there is no duplication of effort.

6. *How many requests for alternative criteria have been received by the Department? How many have been reviewed, or are undergoing review by the DEP and the Department of Public Health (DPH)? How many, if any, have been approved or disapproved? How long has it taken to complete the review process from the date of receipt? Can the Department provide a list of the requests for approval of alternative*

criteria? Is the Department tracking these requests separately? How would one obtain information on these requests and how would one obtain copies of the applications for alternative criteria and the respective decision?

- Fifteen requests for alternative criterial or for additional polluting substance criteria as of March 1999.
- Seven requests have been fully reviewed and final decisions have been made.
- Two requests require additional information to be submitted.
- Six requests are currently under review by the DPH.
- On average, it has taken two to three months to complete a review and send a final determination letter. Complex requests have taken considerably longer, but the average has been about three months.
- The DEP has approved additional criteria for about sixty compounds.
- The DEP not approved alternative criteria that would apply broadly to other sites with the exception of the Massachusetts VPH/EPH method of evaluating direct exposure risk from petroleum hydrocarbons. That analytical method and the appropriate Massachesetts criteria can be used in place of the TPH direct exposure criteria, with the approval of the Commissioner.
- Information can be obtained regarding specific submittals and their respective decisions by calling Ruth Lepley at 424-3923.

B. GROUNDWATER

1. *What is DEP's position on the use of small diameter monitoring wells (less than 2-inch diameter such as those which can be installed by direct push methods) for long term monitoring, i.e.; compliance monitoring after remediation of a release?*

   The DEP considers small diameter wells acceptable for investigative or compliance monitoring purposes, so long as they yield samples that are representative and provide data that meets the objectives of the project. In particular, small-diameter wells are most compatible with low-flow sampling techniques.

2. *What is DEP's position on the use of peristaltic pumps for obtaining samples for VOC analysis?*

   DEP acknowledges that using peristaltic pumps can result in concentrations that are less than the actual concentration in ground water and does not encourage its use, particularly for compliance monitoring. However, factors such as the data objectives, the availability of alternative techniques and the overall body of data that will be generated in the course of an investigation, must be taken into consideration when designing a sampling protocol. There are circumstances for which the use of peristaltic pumps is an acceptable sampling method provided the data generated by such sampling is interpreted appropriately.

3. *Are the GWPC for metals based on filtered or unfiltered sample analysis? What is DEP's experience and position regarding filtering for metals analysis in high silt content formations? Would the Department consider alternative filtering technologies such as the use of a 10 micron filter to remove silt, yet leave colloidal particles?*

The GWPC should be compared to results from unfiltered samples. DEP believes that unfiltered sample results is a better representation of the quality of water that might be used for drinking water purposes. Unfiltered samples are also necessary for evaluation of compliance with the SWPC and for any evaluation of ground water quality in bedrock. Low flow sampling techniques should be routinely employed and monitoring wells should be thoroughly developed prior to sampling in order to reduce the concentration of metals due to suspended solids. The DEP recognizes, however, that there may be monitoring wells installed in formations that yield samples with high turbidity despite thorough efforts to properly develop the well and despite using low flow sampling techniques. In such a circumstance, filtered samples may be more appropriate. DEP recommends contacting the Department in the event that suitable unfiltered samples cannot be obtained to discuss alternative methods, including 10 micron filtration.

4. *If a release to the soil is remediated to below direct exposure and pollutant mobility criteria in a "GB" area, and results of initial groundwater sampling indicated that no impact to groundwater is evident, is a continued groundwater monitoring program required? Is the response different for a "GA" area?*

The RSR monitoring requirements define the objectives of ground water monitoring for both GA and GB areas - Section 22a-133k-3(g)(1)and (2) - and define the circumstances under which monitoring may be discontinued - Section 22a-133k-3(g)(3). However, there are situations for which the defined objectives can be met with less data than that specified by the regulations. In that case, the Commissioner can approve a different compliance or post remediation monitoring program. Any request for such approval should document the ground water data that exists and describe why that body of data meets the objectives for monitoring.

C. <u>SOIL</u>

1. *What is DEP's policy on defining a polluted soil and what are the acceptable procedures for management of those soils?*

   DEP's policy on defining a polluted soil is the same as the definition in the regulations. A polluted soil means soil affected by a release of a substance at a concentration above the analytical detection limit for such substance. There is a provision in the RSRs for the re-use of polluted soil on a site once it has been demonstrated to contain concentrations that do not exceed the Direct Exposure or Pollutant Mobility Criteria. Among other requirements, a map showing where these soils were placed must be submitted to DEP. In general, no prior DEP approval is needed. However, reuse of *What is DEP's experience and position regarding filtering for metals analysis in high silt content formations? Would the Department consider alternative filtering technologies such as the use of a 10 micron filter to remove silt, yet leave colloidal particles?* PCB contaminated soil or reuse of contaminated soil on another site does require DEP approval.

2. *Should weathered bedrock be considered as soil or bedrock? Should the degree of weathering be a factor in the decision?*

   The definition of soil in the RSRs is that if it is unconsolidated it is considered a soil. Highly weathered bedrock is, by definition in the RSRs, a soil. In general, the RSRs use the "engineering" approach to defining soils as opposed to a geologist's or soil scientist's definition. In other words, it is the material's properties that are important rather than the processes by which it formed. Basically, if the material can be moved using standard construction equipment, such as backhoe or even a shovel, it is considered soil.

3. *The definition of inaccessible soil includes those soils beneath an "existing building." Is this also intended to include a future building to be constructed as part of site development?*

   A remedial action plan which proposes to ensure that polluted soil is inaccessible after the construction of a new building and the recording of an ELUR is perfectly acceptable to the DEP. The use of the term "existing" was intended to make clear that, until the new building is constructed, the final remedial action report could not be approved by DEP and the remedial actions could not be verified by an LEP. DEP encourages LEPs to consider rendering polluted soil inaccessible or environmentally isolated when evaluating remedial options.

4. *In a GA area where you have a NAPL-impacted zone between seasonal high and seasonal low water tables, it is understood that you must remediate NAPL to the maximum extent practicable (LNAPL) or maximum extent prudent (DNAPL). When do the direct exposure criteria (DEC) and pollutant mobility criteria (PMC) apply to this zone?*

   The DEC apply to this zone if it is within 15 feet of land surface. The PMC do not apply to the zone between the high and low seasonal water table if NAPL is present because water level fluctuations will result in periodic re-contamination of the soils.

5. *DEP has indicated that the VPH/EPH method is an acceptable alternative to 418.1 for DEC. Does the use of this method still require DEP approval, or can an LEP verify based on this method?*

   DEP approval of this alternative DEC is still required; however, it is anticipated that this will become a self-implementing alternative following RSR revisions.

6. *Are there any proposed RSR exemptions for DEC failures resulting from asphalt fragments in soils?*

   No simple exemptions for DEC exceedances resulting from asphalt fragments in soils are at present contemplated. The Department is considerering a an expanded range of options for managing soil which exceeds the DEC because of asphalt. The Department remains open to considering any suggestions for dealing with this issue in a manner that is protective of human health.

7. *Does DEP have any plans to revisit any of the RSR soil criteria as a result of most laboratories difficulty in achieving the required detection limits? Some of the pesticide detection requirements are particularly troublesome for many labs.*

   The Department has not received any complaints regarding the ability to achieve the required detection limits for any soil criteria specified in the regulations including the pesticides. Achieving some of the risk-based numbers for pesticides developed for the Naval Submarine Base (which are not currently RSR criteria) is acknowledged and will be evaluated when standards are derived during the RSR revision process. The Department has in the past and will continue to take the ability to analytically quantify a compound into consideration when adopting new criteria for additional polluting substances.

8. *Is it appropriate to collect "background" TPH data similar to what would be done for background metals at a site? How many samples does DEP consider to be an adequate number to characterize background conditions at a site?*

Since DEP does not consider TPH to be a naturally occurring substance, a background determination would typically not be appropriate. However, DEP recognizes that 418.1 is subject to false positives resulting from organic matter and may be a consideration on a site-specific basis. The revised TPH method is expected to minimize this problem.

9. *Can contaminated soil be relocated within a contiguous property to an area where an engineered control is planned?*

Relocation of contaminated soil in an area with an engineered control is possible, but may be meet the threshold for creating a solid waste disposal area. In that case, the activity would be subject to the siting and permitting requirements of the Solid Waste or Hazardous Waste Statutes and the discharge permitting requirements.

D. SURFACE WATER

1. *The Surface Water Protection Criteria of phenanthrene is stated as 0.077 ug/L. However, previous versions of the regulations referenced the value as 0.3 ug/L. DEP staff have verbally indicated that 0.3 ug/L is the correct value. Please confirm the correct value.*

The Surface Water Protection Criterion of phenanthrene is 0.3 ug/L. The 0.077 was a typographical error.

2. *Page 26 - Section (f)(2)(B) states "the concentration of such substance in that portion of such plume which is immediately upgradient of the point at which such groundwater discharges to the receiving surface water body... ". Is this meant to be a single point exceedance or an average of the plume concentration at the point of discharge?*

The quoted section refers to a single point exceedance. Section (f)(2)(A) refers to an "average" exceedance.

E. VOLATILIZATION

1. *When evaluating the Volatilization Criteria for Soil Vapor in Appendix F, the referenced criteria are reported in parts per million. Please confirm that the standard is actually ppmv, and not mg/m^3 (as utilized in Appendix G).*

The standard is ppmv. Note that when developing any alternative criterion using Appendix G, the value must be converted from mg/m^3 to ppmv so it can be compared to a default criterion.

2. *Please confirm that on a site where there is residual product in fractured bedrock above the water table within 15 feet of the ground surface, the volatilization criteria do not apply.*

The volatilization criteria apply to ground water. The presence of residual product in the unsaturated zone alone does not trigger the volatilization requirements. However, the situation described above was not envisioned during drafting of the RSRs. Clearly, if the residual product resulted in volatile organic compounds migrating into an overlying building at concentrations that would be a risk to human health, the Commissioner could require additional remediation. In addition, residual product must be remediated in accordance with the provisions of Section 22a-133k-2(g).

3. *Can the soil vapor volatilization criteria be applied in areas where no building exists?*

In accordance with the RSRs, the soil vapor volatilization criteria can only be used to show compliance with samples obtained from beneath a building.

Approved Criteria for Additional Polluting Substances

Pursuant to Sections 22a-133k(1) through (3) of the Regulations of Connecticut State Agencies

Pollutant	Soil (mg/kg)				Groundwater (µg/l)			
	RES DEC	I/C DEC	GAA/ GA PMC	GB PMC	GWPC	SWPC	RES VC	I/C VC
acenaphthene	1000	2500	8.4	84	420	NE	NE	NE
aldrin	0.036	0.34	In Review	In Review	In Review	NE	NE	NE
benzo(g,h,i)perylene [8]	1000	2500	4.2	42	210	NE	NE	NE
benzoic acid	1000	2500	1000	10000	50000	NE	NE	NE
BHC(alpha-)	0.097	0.91	In Review	In Review	In Review	NE	NE	NE
BHC(beta-)	0.34	3.2	In Review	In Review	In Review	NE	NE	NE
BHC(delta) [1]	0.097	0.91	In Review	In Review	In Review	NE	NE	NE
bromodichloromethane	9.9	92	0.011	0.11	0.56	NE	NE	NE
bromomethane	95	1000	0.2	2	9.8	NE	NE	NE
4-bromophenyl-phenylether	500	1000	8.2	82	410	NE	NE	NE
n-butylbenzene	500	1000	1.4	14	61[13]	NE	NE	NE
sec-butylbenzene	500	1000	1.4	14	61[13]	NE	NE	NE
tert-butylbenzene	500	1000	1.4	14	61[13]	NE	NE	NE
carbazole	31	290	1 #	1 #	10 #	NE	NE	NE

Approved Criteria for Additional Polluting Substances

Pursuant to Sections 22a-133k(1) through (3) of the Regulations of Connecticut State Agencies

Pollutant	Soil (mg/kg)				Groundwater (µg/l)			
	RES DEC	I/C DEC	GAA/ GA PMC	GB PMC	GWPC	SWPC	RES VC	I/C VC
carbon disulfide	500	1000	14	140	700	NE	NE	NE
4-chloroaniline	270	2500	1 #	5.6	28	NE	NE	NE
chloromethane	47	440	0.054	0.54	2.7	NE	NE	NE
2-chloronaphthalene	1000	2500	11	110	560	NE	NE	NE
4-chlorophenyl-phenyl ether [2]	500	1000	8.2	82	410	NE	NE	NE
chrysene	84	780	1 #	1 #	4.8	NE	NE	NE
m-cresol	1000	2500	7	70	350	NE	NE	NE
p-cresol	340	2500	0.7	7	35	NE	NE	NE
4,4'-DDD	2.6	24	In Review	In Review	0.15	NE	NE	NE
4,4'-DDE	1.8	17	In Review	In Review	0.1	NE	NE	NE
4,4'-DDT	1.8	17	In Review	In Review	0.1	NE	NE	NE
dibenzofuran	270	2500	1 #	5.6	28	NE	NE	NE
dibenz(a,h)anthracene	1 #	1 #	1 #	1 #	0.5 #	NE	NE	NE

Approved Criteria for Additional Polluting Substances

Pursuant to Sections 22a-133k(1) through (3) of the Regulations of Connecticut State Agencies

Pollutant	Soil (mg/kg)				Groundwater (µg/l)			
	RES DEC	I/C DEC	GAA/ GA PMC	GB PMC	GWPC	SWPC	RES VC	I/C VC
1,2-dibromo-3-chloropropane	0.44	4 1	In Review	In Review	In Review	NE	NE	NE
1,2-dibromoethane	0.0072	0 067	In Review	In Review	In Review	NE	NE	NE
3,3'-dichlorobenzidene	1.4	13	0.33 #	0.33 #	10 #	NE	NE	NE
1,4-dichlorobutene	0.07	0.62	In Review	In Review	In Review	NE	NE	NE
diethyl phthalate	1000	2500	110	1100	5600	NE	NE	NE
2,4-dimethylphenol	1000	2500	2.8	28	140	NE	NE	NE
dimethyl phthalate [10]	1000	2500	110	1100	5600	NE	NE	NE
2,4-dinitrophenol	140	2500	1.65 #	2.8	50 #	NE	NE	NE
2,4-dinitrotoluene	140	2500	1 #	2.8	14	NE	NE	NE
2,6-dinitrotoluene	68	2000	1 #	1.4	10 #	NE	NE	NE
endosulfan I	410	1200	0.84	8.4	42	NE	NE	NE
endosulfan II	410	1200	0.84	8.4	42	NE	NE	NE
endosulfan sulfate [3]	410	1200	0.84	8.4	42	NE	NE	NE
endrin aldehyde [4]	20	610	NE	NE	NE	NE	NE	NE

Approved Criteria for Additional Polluting Substances

Pursuant to Sections 22a-133k(1) through (3) of the Regulations of Connecticut State Agencies

Pollutant	Soil (mg/kg)				Groundwater (µg/l)			
	RES DEC	I/C DEC	GAA/ GA PMC	GB PMC	GWPC	SWPC	RES VC	I/C VC
endrin ketone [5]	20	610	NE	NE	NE	NE	NE	NE
hexachlorobutadiene	7.9	73	1 #	1 #	0.45	NE	NE	NE
hexachlorocyclopentadiene	470	2500	1 #	9.8	49	NE	NE	NE
indeno(1,2,3-cd)pyrene	1 #	7.8	1 #	1 #	0.5 #	NE	NE	NE
isophorone	640	2500	1 #	7.4	37	NE	NE	NE
isopropylbenzene (cumene)	500	1000	0.6	132 [14]	30 [15]	NE	NE	NE
4-isopropyltoluene (p-cymene)	500	1000	0.6	41.8	30 [15]	NE	NE	NE
p-isopropyltoluene [9]	NE	NE	1.4	14	70	NE	NE	NE
2-methylnaphthalene [7]	474	2500	0.98	9.8	49	NE	NE	NE
2-methylphenol	1000	2500	7	70	350	NE	NE	NE
4-methylphenol	340	2500	1 #	7	35	NE	NE	NE
2-nitroaniline	4.1	1200	1.65 #	1.65 #	50 #	NE	NE	NE
3-nitroaniline	200	2500	1.65 #	4.2	50 #	NE	NE	NE

Approved Criteria for Additional Polluting Substances

Pursuant to Sections 22a-133k(1) through (3) of the Regulations of Connecticut State Agencies

Pollutant	Soil (mg/kg)				Groundwater (µg/l)			
	RES DEC	I/C DEC	GAA/ GA PMC	GB PMC	GWPC	SWPC	RES VC	I/C VC
4-nitroaniline	200	2500	1 #	4.2	21	NE	NE	NE
nitrobenzene	34	1000	1 #	1 #	10 #	NE	NE	NE
2-nitrophenol	540	2500	1.1	11	56	NE	NE	NE
N-nitrosodiphenylamine	130	1200	1 #	1.4	10 #	NE	NE	NE
N-nitrosodi-n-propylamine	1 #	1 #	1 #	1 #	10 #	NE	NE	NE
n-propylbenzene	500	1000	1.4	14	61 [13]	NE	NE	NE
1,2,4-trichlorobenzene	680	2500	1.4	14	70	NE	NE	NE
trichloroflouroethane [11]	NE	NE	NE	NE	20000	NE	NE	NE
trichloroflouromethane	500	1000	26	260	1300	NE	NE	NE
2,4,5-trichlorophenol	1000	2500	14	140	700	NE	NE	NE
2,4,6-trichlorophenol	56	520	1 #	1 #	10 #	NE	NE	NE
1,2,4-trimethylbenzene	500	1000	7	70	350	NE	NE	NE
1,3,5-trimethylbenzene	500	1000	7	70	350	NE	NE	NE

Approved Criteria for Additional Polluting Substances

Pursuant to Sections 22a-133k(1) through (3) of the Regulations of Connecticut State Agencies

NE	Not Established
#	Criteria based on detection limits.

Notes: [1] BCH(alpha) used as surrogate for BCH (delta).

[2] 4-bromophenyl-phenyl ether used as surrogate for 4-chlorophenyl-phenyl ether.

[3] Endosulfan used as surrogate for endosulfan sulfate.

[4] Endrin used as surrogate for endrin aldehyde.

[5] Endrin used as surrogate for endrin ketone.

[7] Based on an interim acceptable exposure level of 0.007 mg/kg developed by DPH. Criteria to be used for screening purposes.

[8] Pyrene used as surrogate for benzo(g,h,i)perylene.

[9] Screening level for p-isopropyltoluene is based on isopropylbenzene as a surrogate. Also known as methylisopropylbenzene.

[10] Diethyl phthalate used as surrogate for dimethyl phthalate.

[11] Based on odor threshold. Also known as Freon 113 and 1,1,2-trichloro-1,2,2-triflouroethane.

[12] Based on health based GWPC of 209 μg/l; toxicity is estimated to be three fold greater than cumene.

[13] GWPC from Region III table which incorporates inhalation and drinking exposure routes.

[14] Based on health based GWPC of 660 μg/l.

[15] GWPC based on odor detection from volatilization during showering.

ATTACHMENT D

WORK SCOPE OUTLINE/COST ESTIMATE ASSUMPTIONS FOR THE NON-TIME CRITICAL REMOVAL ACTION FOR CHROMIUM AND VOC GROUNDWATER EE/CA

USACE CONTRACT NO. DACW33-94-D-0002
TASK ORDER NO. 020
TOTAL ENVIRONMENTAL RESTORATION CONTRACT

WORK SCOPE OUTLINE/ COST ESTIMATE ASSUMPTIONS FOR THE NON-TIME CRITICAL REMOVAL ACTION FOR CHROMIUM AND VOC GROUNDWATER EE/CA STRATFORD ARMY ENGINE PLANT

Stratford, Connecticut

June 1999

Prepared for

U.S. Army Corps of Engineers
New England District
Concord, Massachusetts

Prepared by

Foster Wheeler Environmental Corporation
Boston, MA

and

Harding Lawson Associates
Portland, Maine

Revision	Date	Prepared By	Approved By	Pages Affected
0	6/4/99	J. Borkland	R. Gleason	All

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LIST OF ACRONYMS AND ABBREVIATIONS

BCT	BRAC Cleanup Team
bgs	below ground surface
BRAC	Base Realignment and Closure
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CRP	Community Relations Plan
CTDEP	Connecticut Department of Environmental Protection
EAC	Estimate at Completion
EE/CA	Engineering Evaluation/Cost Analysis
ETC	Estimate to Complete
FAR	Federal Acquisitions Regulations
GC	Gas Chromatograph
GIS	Geographic Information System
HLA	Harding Lawson Associates
IDW	Investigation-Derived Waste
LOE	Level of Effort
QA/QC	Quality Control/Quality Assurance
QAPjP	Quality Assurance Project Plan
ODC	Other Direct Cost
P.E.	Professional Engineer
P.G.	Professional Geologist
RAB	Restoration Advisory Board
RAM	Removal Action Memorandum
RFP	Request for Proposal
RI	Remedial Investigation
RSRs	Remediation Standard Regulations
SAEP	Stratford Army Engine Plant
SI	Site Investigation
SSHP	Site-Specific Safety and Health Plan
TACOM	Tank-Automotive and Armaments Command
TERC	Total Environmental Restoration Contract
URSGWC	URS Greiner-Woodward Clyde
USACE	U.S. Army Corps of Engineers - New England District
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound
WBS	Work Breakdown Structure

1.0 INTRODUCTION

This Work Scope Outline/Cost Estimate Assumptions document has been prepared for the U.S. Army Corps of Engineers - New England District (USACE) by Foster Wheeler Environmental Corporation (Foster Wheeler) and Harding Lawson Associates (HLA) in response to the USACE Request for Proposal (RFP) under Task Order No. 020 of Contract No. DACW33-94-D-0002. This Task Order is for completion of a Non-time Critical Removal Action for chromium and VOC groundwater contamination at the Stratford Army Engine Plant (SAEP) in southern Connecticut. The objectives of this Task Order are to complete additional field activities necessary to fully characterize subsurface conditions at SAEP, summarize the results of all previous field activities in a report, conduct bench-scale testing to determine the effectiveness of particular remedial technologies at reducing contamination in groundwater at the site, and document the decision process for selection of a removal action at the site in an Engineering Evaluation/Cost Analysis (EE/CA). The scope involves the following additional field activities:

- A soil vapor survey to determine the potential for migration of subsurface volatile organic compound (VOC) contamination into SAEP buildings.
- A location and elevation survey on previous sampling locations and new monitoring wells.
- An optional geophysical (seismic) survey to document the depth and features of the bedrock surface.
- An aquifer test to determine the hydraulic properties of the aquifer in the vicinity of the Former Chromium Plating Facility.
- Optional field activities to support selection of a removal action, such as cone penetrometer investigations, completion of soil borings, and installation of monitoring wells.
- Bench-scale testing to determine the compatibility of particular treatment technologies with site contaminants and conditions.

In support of these field activities, a Work Plan, a Sampling and Analysis Plan (SAP) including a Quality Assurance Project Plan (QAPjP), and a Site-Specific Safety and Health Plan (SSHP) will be developed. Project staff will attend necessary meetings and briefings, and will provide data management services including developing data tables and providing data in a database format which can be read by the USACE Geographic Information System (GIS). A Pre-design Investigation Report documenting the results of all previous field activities will be developed and a Treatability Work Plan Letter documenting proposed field activities to support selection of a removal action will be written. An EE/CA will document the process involved in recommendation of a removal action for the site

Preparation of this proposal is based on the Task Order Statement of Work dated April 27, 1999, discussions held with USACE and SAEP Project Managers held at the site during a Scoping Meeting on May 11, 1999, and negotiations with USACE-NAE on June 2, 1999 in Concord, Massachusetts. Budget estimates and project schedules are based upon the Task Order Scope of Work and the Scoping Meeting discussions

2.0 TASK PLAN

2.1 General Approach

The work breakdown structure (WBS) for the Task Order contains the following elements:

Task	Activity		WBS Identifier
Task 1	Planning (Work Plan, Sampling and Analysis Plan, SSHP)		01
Task 2	BCT/RAB Support and Data Management		02
	Subtask 2.1	BCT/RAB Support (Attend BRAC Meetings)	02.01
	Subtask 2.2	Data Management	02.02
Task 3	Field Activities		03
	Subtask 3.1	Soil Vapor Survey	03.01
	Subtask 3.2	Location and Elevation Survey (Land Survey of Exploration Locations)	03.02
Task 4	Pre-Design Investigation Report		04
	Subtask 4.1	Pre-Design Investigation Report	04.01
Task 5	EE/CA Process		05
	Subtask 5.1	EE/CA Planning	05.01
	Subtask 5.2	Additional Field Activities • Installation of additional borings and wells for aquifer testing • Bench scale testing of remedial technologies • Aquifer testing	05.02
	Subtask 5.3	EE/CA Report Preparation	05.03
	Subtask 5.4	Preparation of the Action Memorandum	05.04
Task 6	Project Management		06
	Subtask 6.1	Project Management	06.01
Option 1	Geophysical Survey		
Option 2	Cone Penetrometer Explorations		
Option 3	Soil Borings		
Option 4	Monitoring Wells		

2.2 General Work Assumptions

This work plan outline and accompanying cost proposal are based upon the information contained in the request for proposal for Task Order No. 020 (April 27, 1999), discussions held with USACE and SAEP Project Managers during a Scoping Meeting on May 11, 1999, and negotiations with USACE-NAE on June 2, 1999 in Concord, Massachusetts Interpretation of the Statement of Work presented in Task Order No 020 requires important assumptions regarding field investigations, data analysis, and report preparation that affect both cost estimates and project schedule. The duration of the project, as defined by the work scope discussed here, is anticipated to extend for 8 months.

General Assumptions:

- The State of Connecticut Department of Environmental Protection (CTDEP) is the lead regulatory agency for SAEP. CTDEP regulations are the basis for any remedial actions to be conducted at SAEP.

- IDW will be handled as follows:
  - IDW waste and investigation derived soil will be drummed for analysis, stored briefly on-site in accordance with regulatory requirements, and sent off-site for disposal;
  - personal protective equipment will be drummed for off-site disposal; and
  - water will be treated for VOCs with activated carbon prior to discharge to SAEP's Chemical Waste Treatment Plant.

- Access to SAEP is assumed to be free and open to project personnel. SAEP personnel will provide utility clearance for subsurface explorations.

- Foster Wheeler/HLA have assumed there will be no delays to the proposed schedule of activities as a result of third party activities (not to include Foster Wheeler/HLA subcontractors).

- All fieldwork will be conducted at modified Level D health and safety protection.

- TACOM and USACE review of document (plans and reports) will be concurrent. A single set of comments will be provided to Foster Wheeler/HLA for incorporation into the plans.

- Foster Wheeler will provide only cursory review of HLA work products, with the focus of the reviews being on the major engineering and remediation issues.

Assumptions are outlined below for the following specific project components: (1) Planning (work plans); (2) Task Management (Project Management, Data Management, Site Visits/Meetings/Briefings); (3) Field Activities; (4) Pre-design Investigation Report; and (5) EE/CA Process: bench-scale testing, additional field investigations, EE/CA Report preparation, and Removal Action Memorandum (RAM).

2.3 Task 1: Planning (WBS Element 01)

2.3.1 Subtask 1.2: Technical Plans (WBS Element 01.02)

- Includes review of existing (Woodward Clyde) Work Plan, Health and Safety Plan, QA Plan, and chemical data contained in the existing USACE GIS system.

- Work Plan letter will be issued as internal Army Draft, Draft Final for regulatory review, and Final A SAP will also be prepared (QAPjP will be issued as a component of SAP), and an SSHP will be issued as Draft and Final.

- The SAP is assumed to be a maximum length of 100 pages, with references to the Remedial Investigation Work Plan (URS Greiner-Woodward Clyde [URSGWC, 1998]) for most Quality Assurance/Quality Control (QA/QC) issues.

- The Work Plan letter is estimated not to exceed 20 pages of text in length (not including appendices), and should not to exceed 100 pages in length total, including field procedures. The Work Plan will include sections on regulatory compliance and waste management.

- All project plans will require regulatory review, which will be conducted concurrently for each plan. Foster Wheeler/HLA has assumed a 4-week period to develop the initial plans including Foster Wheeler/HLA internal review; 1 week for Army review of the Draft Plans, 1 week to revise the Plans; 2 weeks for regulatory review of the Draft Final Plans; 1 week for Foster Wheeler/HLA to finalize the Plans.

2.4 Task 2: RAB/BCT Support and Data Management (WBS Element 02)

2.4.1 Subtask 2.1: RAB/BCT Support (WBS Element 02.01)

- One combination Restoration Advisory Board (RAB)/BRAC Cleanup Team (BCT) meeting every other month over a period of 8 months to be held at SAEP (4 meetings total), each assumed to be one day in length and requiring 3 Foster Wheeler/HLA personnel.

- It is assumed 20 hours of preparation time will be required to prepare and review necessary meeting materials for each type of meeting.

- One public information meeting budgeted with 3 Foster Wheeler/HLA personnel.

2.4.2 Subtask 2.2: Data Management (WBS Element 02.02)

- Includes LOE for input and management of all HLA data produced at SAEP since March 1999, and all Foster Wheeler/HLA data produced from June 1, 1999 through February 7, 1999.

- As requested by SAEP, includes LOE for formatting and transmission of URSGWC RI data produced at SAEP since March 1999 (monitoring well and GeoProbe exploration analytical data) to USACE for input into the GIS.

- All drawings will be produced by the Foster Wheeler/HLA team in AutoCad release 14.

- GIS system to be used by USACE will be ArcView. The project team will submit a database (Access) of the data collected under this Work Scope in ArcView-compatible format. It is assumed that the USACE will manage the GIS system.

- Includes LOE and subcontractor costs for data validation of data collected under WBS 20.03 and 20.05.

- Two visits to USACE with two people, for coordination of data entry into GIS, and development of associated data views.

2.5 Task 3: Field Activities (WBS Element 03)

2.5.1 Subtask 3 1 Soil Vapor Survey (WBS Element 03.01)

- It is assumed that conditions and SAEP personnel available during previous investigations will be available during the soil vapor survey, including security and location clearance.

- Sixty soil vapor samples will be collected using subcontracted GeoProbe equipment.

- GeoProbe will include truck-mounted rig with operator and helper.

- One geologist and one chemist will be on-site full-time to support the soil vapor survey effort.

- Each sample will be screened for up to six target VOCs using an HP5890 (or equivalent) on-site field gas chromatograph .

- Ten percent of samples, (six estimated), will be sent off-site for confirmatory analysis by U.S. Environmental Protection Agency (USEPA) Method 8260B.

- It is estimated that 6 working days will be required to complete the soil vapor survey, plus one day for mobilization/set-up, for a total of 7 field days.

- Soil vapor survey work is anticipated to be conducted during August 1999.

- Results of the soil vapor survey will be summarized in the Pre-design Investigation Report.

2.5.2 Subtask 3.2: Location and Elevation Survey (WBS Element 03.02)

- It is estimated that 150 soil boring, soil gas cone penetrometer explorations (horizontal) and 25 monitoring wells (horizontal and vertical) will require survey.

- A subcontracted registered land surveyor will perform the survey and will provide a report documenting the results to Foster Wheeler/HLA.

- Previous sampling locations will be marked or staked prior to survey.

- Horizontal and vertical control points used for the previous surveys by URSGWC at SAEP will be used during this survey. Sampling locations will require both horizontal and vertical location using standard field survey techniques. Vertical elevation accuracy will be 0.01-foot and horizontal location accuracy will be 0.1-foot.

- Results of the location and elevation survey will be summarized in the Pre-design Investigations Report, including a site investigation plan and a table of coordinates and elevations.

2.6 Task 4: Pre-design Investigation Report (WBS Element 04)

2.6.1 Subtask 4.1: Report Preparation (WBS Element 04.01)

- The Pre-design Investigation Report will be issued as a Draft, Draft Final, and Final.

- The report will summarize results of previous historical HLA investigations, including:

    - data from HLA investigations conducted between August 1998 and May 1999; and
    - new data produced from investigations proposed in this cost proposal (to be collected between June 1, 1999 and May 31, 2000.

- It is assumed the report will require the same duration for preparation, review, and revision as the Technical Plans (20.01).

- The report is estimated to be approximately 50 pages of text, not including appendices/ attachments (entire document not to exceed 300 pages total in length).

- The Pre-design Investigation Report will not present an assessment of natural attenuation of contaminants in groundwater.

- The Pre-design Investigation Report will not present the results of USACE groundwater modeling.

2.7 Task 5: EE/CA Process (WBS Element 05)

2.7.1 Subtask 5.1: EE/CA Planning (WBS Element 05.01)

- At the inception of the EE/CA process, Foster Wheeler/HLA will prepare a Work Plan Letter detailing the proposed actions to be conducted for treatability testing (includes only pilot-scale testing activities).

- It is assumed that the Work Plan Letter will require the same duration for preparation, review, and revision as the Technical Plans (WBS 20.01).

2.7.2 Subtask 5.2: Additional Field Activities (WBS Element 05.02)

2.7.2.1 Additional Subsurface Investigations

- Additional investigations will be completed, as necessary, to provide information required for design parameters.

- Includes 2 soil borings, each to a depth of 50 feet bgs, with soil sampling at 5-foot intervals. Three samples from each boring will be sent to an off-site laboratory for VOC, semivolatile organic compounds, and inorganics. Details as to the parameters to be sampled for, the methods to be used, and the data reporting will be contained in the SAP. Soil borings are estimated to take a maximum of 2 field days.

- Subcontractors, and one Foster Wheeler/HLA geologist for oversight, will be necessary to complete investigations.

- Results of the additional investigations will be summarized in the EE/CA.

2.7.2.2 Bench-scale Testing

- To complete bench-scale testing, soil and groundwater samples will be collected from the proposed pilot test areas

- Bench-scale testing will be conducted on-site to assess the effectiveness of the proposed treatment technology. Up to four different conditions will be tested for up to 3 different treatment technologies This activity is expected to take up to five days to complete.

- Up to 6 samples will be sent to an off-site laboratory for analysis to confirm on-site testing.

- Results of the bench-scale testing will be summarized in the EE/CA Report (WBS 20.05.3.

2.7.2.3 Aquifer Testing

- One 4-inch pumping well will be installed by a subcontractor to Foster Wheeler/HLA for use during the pumping tests.
- Eight 1-inch monitoring wells will be installed by a subcontractor to Foster Wheeler/HLA for use during the pumping tests.
- To the extent possible, existing monitoring wells will also be used to monitor water levels during the pumping tests.
- It is assumed that up to 10 days will be required to install the pumping and monitoring wells.
- One 48-hour pumping test will be conducted to characterize the hydraulic conditions in the aquifer in the area of the Chromium Plating Facility.
- Extracted groundwater will be treated with activated carbon prior to discharge to the SAEP Chemical Waste Treatment Plant.
- It is estimated to require 5 field days to complete the pumping test.
- Results from the pumping tests will be summarized in the Pre-design Investigation Report.

2.7.3 Subtask 5.3: EE/CA Report Preparation (WBS Element 05.03)

- Four documents will be prepared for the administrative record: the EE/CA, a fact sheet summarizing the EE/CA for the public comment period, a response to significant comments, and a RAM.
- USACE will perform any necessary groundwater modeling to support the EE/CA.
- Assumes use of Connecticut RSRs for cleanup goals (i.e., no risk assessment is needed.)
- The EE/CA will be completed in accordance with the USEPA "Guidance on Conducting Non-time Critical Removal Actions Under Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)", August 1993.
- The EE/CA will be issued as a Draft, Draft Final, and Final document. Foster Wheeler/HLA have assumed a 6-week period to develop the initial document for review; 2 weeks for Army review of the Draft EE/CA, 2 weeks to revise the document; 4 weeks for regulatory review of the Draft Final EE/CA; and 3 weeks for Foster Wheeler/HLA to finalize the EE/CA.
- The EE/CA text is estimated to be a maximum of 150 pages of text in length, with appendices/attachments comprising an additional 100 pages (for a maximum total length of 250 pages).
- A fact sheet will be prepared, and will provide a brief summary of the EE/CA for the public and interested parties during the public comment period. The fact sheet format will be similar to that of the community relations newsletter.

- The fact sheet will be issued as a Draft and a Final document.

- A written response to significant comments will be completed to respond to comments received during the public hearing and the 30-day public comment period. The responses will be included as part of the administrative record.

- The response to comments letter will be issued to USACE/SAEP as a Draft. A Final will then be prepared incorporating any comments.

2.7.4 Subtask 5.4: Action Memorandum (WBS Element 05.04)

- An Action Memorandum will be written to provide documentation of the selection of a removal action.

- The Action Memorandum will be issued as a Draft to USACE/SAEP, then revised and reissued as a Final document.

- The Action Memorandum text is estimated to be a maximum of 30 pages in length, with appendices/attachments/figures comprising an additional 30 pages (for a maximum total length of 60 pages).

2.8 Task 6: Project Management (WBS Element 06)

2.8.1 Subtask 6.1: General Project Management (WBS Element 06.01)

(includes site visits/monthly reports/day-to-day management)

- Preparation of monthly performance, schedule, and cost reports to include the total labor hours and other direct costs (ODCs) and indirect costs expended by WBS with back-up, containing photocopied detail of labor hours by labor category or individual on a monthly basis, by Foster Wheeler/HLA project team.

- Includes level of effort (LOE) associated with communications with Foster Wheeler/HLA, USACE, SAEP, project team, and HLA program and contract manager.

- Includes administration of the major team subcontract (HLA), including monthly internal progress review for percent complete of the various tasks for fixed price subcontract administration and billing

- Project controls to includes LOE for development of periodic project estimates to complete (ETCs) and estimates at completion (EACs).

- One post-award kick-off meeting to be conducted at SAEP that will involve 3 Foster Wheeler/HLA personnel and last one day.

2.9 Optional Tasks

The following subsections present optional tasks to be conducted at SAEP under authorization of the USACE. Costs for these optional activities are presented in Section 5.0, but are not rolled into the total proposal price.

2.9.1 Option 1: Geophysical Survey

- A Foster Wheeler/HLA geophysicist will oversee a geophysical seismic refraction survey, which will be conducted in order to define the depth and features of the bedrock surface. The data collection and initial interpretation for the survey will be performed by a subcontractor.

- It is estimated that four traverse areas of the site (approximately 6600 linear feet of survey) will be used to evaluate bedrock surface conditions, including two northwest to southeast along the length of Building B-2 and at the berm and two northeast to southwest from Main Street to the berm.

- Foster Wheeler/HLA geophysicists will interpret raw seismic data, and present an interpretation as part of the Pre-design Investigation Report (WBS 20.04)

2.9.2 Option 2: Cone Penetrometer Explorations

- Includes cone penetrometer sampling of 5 locations each to a depth of 150 feet below ground surface (bgs). Explorations will be profiled for stratigraphy, and 5 groundwater samples collected from each exploration for off-site VOC analysis. Cone penetrometer sampling is estimated to take a maximum of 5 field days. No permanent monitoring well will be installed; groundwater samples will be collected through the cone Penetrometer rods.

2.9.3 Option 3: Soil Borings

- Includes 3 soil borings, each to a depth of 50 feet bgs, with soil sampling at 5-foot intervals. Three samples from each boring will be sent to an off-site laboratory for VOC, semivolatile organic compounds, and inorganic analyses. Details as to the parameters to be sampled for, the methods to be used, and the data reporting will be contained in the SAP. Soil borings are estimated to take a maximum of 3 field days

2.9.4 Option 4· Monitoring Wells

- Includes 5 monitoring wells, each 50 feet in depth, constructed of 2-inch inside diameter schedule 40 polyvinyl chloride piping with a 10-foot screen length. Monitoring well installation is estimated to require a maximum of 5 field days.

3.0 PROJECT ORGANIZATION

Foster Wheeler and HLA have extensive teaming experience on the current TERC contract and historical REM III contract. Foster Wheeler and HLA have shared resources as teaming partners to meet site- and client-specific objectives for approximately 20 REM III and TERC projects throughout New England. The following paragraphs indicate the principal team personnel proposed for the project.

Jay Borkland will be the Foster Wheeler Project Manager for the SAEP Chromium and VOC Groundwater EE/CA. Mr. Borkland has over 17 years of experience, and is a Senior Scientist and Project Manager with Foster Wheeler.

Nelson Walter, P.E. will be the HLA Chief Technical Lead for the SAEP Chromium and VOC Groundwater EE/CA. Mr. Walter has over 15 years of experience as a Principal Project Manager with HLA.

Rod Pendleton, P.G. will be the Investigation Lead for the SAEP Chromium and VOC Groundwater EE/CA. Mr. Pendleton will be responsible for overseeing all technical activities of the project including interfacing with the field activities and report team. Mr. Pendleton has an extensive knowledge of SAEP site contamination, and has prior experience working with CTDEP and the USEPA, Region I at SAEP.

Gina Rustad, P.E., has been assigned the role of EE/CA Lead. As EE/CA Lead, she will be responsible for all aspects of the EE/CA as well as coordinating the EE/CA documents and activities with those of the Site Investigation.

Other key personnel for the EE/CA include: Dirk Brunner, providing technical review, and Christian Ricardi, Quality Control Lead. Additional key project personnel will be identified in an expanded organization chart that will be developed during preparation of the Technical Plans.

The Foster Wheeler/HLA team will implement a manpower organization that will effectively manage the field operations effort at SAEP. Field operations (drilling and sampling) will be managed by the Field Operations Leader, who will be designated during preparation of Technical Plans. This person is necessary to ensure that the field tasks are coordinated and completed in the appropriate time frames and is very critical since most of the tasks involved in this investigation are contingent on each other. The time frame and schedule of tasks does not allow for the delay critical field tasks.

4.0 SCHEDULE/LEVEL OF EFFORT

The schedule for the EE/CA Project for SAEP is shown in Figure 4-1. Overall project completion is anticipated to be 8 months in accordance with the Task Order Request. The field tasks are scheduled to be completed in 5-day work shifts. The cost basis for the field effort assumes that field activities will start one week following regulatory approval of the draft final Project Plans.

The contract pricing proposal provides a summary of LOE by work element. Travel, subsistence, nonlabor costs and subcontractor costs are tabulated in the accompanying Cost Proposal.

The schedule, manpower, and management that will be implemented by Foster Wheeler/HLA will provide the necessary means to complete the field activities and EE/CA in the anticipated time frame. A high degree of coordination of activities, subcontractor oversight, data management, and communication with SAEP and regulatory agencies will be necessary throughout the program to ensure that the needs of the program are fulfilled.

5.0 COST PROPOSAL

The Cost Proposal for this work accompanies this Work Scope Outline, and includes the required SF 1411 form, the Contract Pricing Proposal Cover Sheet, and supporting schedules listed below:

Exhibit A - The Basis of Estimate
Exhibit B - Travel Details
Exhibit C - Miscellaneous Reimbursables, Team Subcontractor Backup, Other Subcontractor Backup, and the Fee Calculation

6.0 REFERENCES

URSGWC, 1998. "Quality Assurance Project Plan". Remedial Investigation Workplan, SAEP, Prepared for USACE-NED, October 1998.

URSGWC, 1998. "Sampling and Analysis Plan". Remedial Investigation Workplan, SAEP, Prepared for USACE-NED, October 1998.

USEPA, 1993. "Guidance on Conducting Non-Critical Removal Actions Order CERCLA", August, 1993.

USACE CONTRACT NO. DACW33-94-D-0002
TASK ORDER NO. 020
TOTAL ENVIRONMENTAL RESTORATION CONTRACT

APPENDIX A

DRAFT
SAMPLING AND ANALYSIS PLAN FOR THE NON-TIME CRITICAL REMOVAL ACTION FOR THE CHROMIUM AND VOC GROUNDWATER OPERABLE UNIT (OU) 2 EE/CA STRATFORD ARMY ENGINE PLANT

Stratford, Connecticut

July 12, 1999

Prepared for

U.S. Army Corps of Engineers
New England District
Concord, Massachusetts

DRAFT
SAMPLING AND ANALYSIS PLAN
FOR THE
NON-TIME CRITICAL REMOVAL ACTION FOR
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1.0 INTRODUCTION

1.1 SITE DESCRIPTION AND HISTORY

A description of the Stratford Army Engine Plant (SAEP) site history is provided in Section Two of the URS Greiner-Woodward Clyde Federal Services (URSGWCFS) Remedial Investigation (RI) Work Plan, and includes a land use assessment, the physical setting, the ecological setting, and the site history.

A summary of previous investigations at SAEP is contained in Section 3 of the Non-time Critical Removal Action (NCRA) Work Plan.

The analytical results of selected previous Harding Lawson Associates (HLA) investigations at SAEP are presented in the Draft Data Package for the Chromium Plating Facility (HLA, 1999), including the Chromium Plating Facility Investigation and portions of the volatile organic compound (VOC) investigation.

1.2 PROJECT DESCRIPTION

Foster Wheeler Environmental Corporation (Foster Wheeler) and HLA have been contracted through the U.S. Army Corps of Engineer – New England District (USACE) to complete a NCRA for chromium and VOC groundwater contamination (Operable Unit [OU] 2) at the SAEP under Task Order No. 020 of Contract No. DACW33-94-D-0002. As stated in Section 3.0 of the NCRA Work Plan, subsurface soil and groundwater samples collected by Geoprobe and cone penetrometer, and groundwater samples collected from monitoring wells from August 1998 until March 1999 revealed contaminant concentrations that exceed the Connecticut Department of Environmental Protection (CTDEP) Remediation Standard Regulations (RSRs) for total chromium, hexavalent chromium, and VOCs. In addition, significant concentrations (90,000 mg/kg) of total chromium were detected in floor dust samples collected in the former Chromium Plating Facility. As a result, of these findings the present NCRA for OU 2 groundwater contamination has been requested by the U.S. Army Tank-Automotive and Armament Command (TACOM).

1.3 FIELD ACTIVITIES

This task involves completing a NCRA for OU 2 chromium and VOC groundwater contamination and will involve the following field activities:

- A Soil Vapor Survey to determine the potential for migration of subsurface VOC contamination in groundwater to site buildings
- A Location and Elevation Survey for previous sampling locations and the new monitoring wells
- An Aquifer Test to determine the hydraulic properties of the aquifer in the vicinity of the former Chromium Plating facility
- Bench-Scale Testing to determine the effectiveness of potential removal actions
- Optional tasks intended to more fully characterize subsurface conditions at SAEP, if necessary, including:
    - a geophysical survey,

- cone penetrometer sampling,
- soil boring completion, and
- monitoring well installation

1.4 DOCUMENTATION

Documentation to be provided for the OU 2 NCRA is referenced in Section 6.0 of the OU 2 NCRA Work Plan, and includes:

- A Bench-scale Testing Work Plan Letter to detail the processes to be used during completion of bench-scale testing;
- A Pre-design Investigation Report to summarize the results of previous and recent field investigations;
- A Treatability Work Plan Letter to describe the actions to be taken during pilot-testing activities;
- An Engineering Evaluation/Cost Analysis (EE/CA) Report to document the decision process used to select a recommended removal action alternative;
- A Fact Sheet intended to provide a brief summary of the OU 2 NCRA process for the public; and
- A Removal Action Memorandum (RAM) to document the selection of a removal action alternative.

If optional tasks are determined to be necessary following review of previous investigation data, the results of the optional tasks will be presented in an addendum to the Pre-design Investigation Report.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The project organization identifies the responsibilities of individuals involved in this Remedial Investigation (RI) project. The project organizational structure and personnel responsibilities are designed to provide adequate project coordination, control and proper quality assurance for the RI activities at SAEP. The responsibilities of key personnel are described below. The organizational structure is shown on Figure 1. Individual personnel assignments to the project organization may be changed at the discretion of the Foster Wheeler/HLA Program Manager and Foster Wheeler/HLA Project Manager. Upon request, resumes of key personnel will be submitted to the USACE for review and approval. The analytical laboratory internal organizational structure is presented in the laboratory Quality Assurance/Quality Control (QA/QC) Manual, which will be provided upon selection of a subcontractor laboratory.

As established under the Total Environmental Restoration Contract (TERC), Mr. Rick Gleason will be acting as the Foster Wheeler Program Manager and Mr. Jay Borkland will be acting as the Foster Wheeler Chief Project Manager for the OU 2 NCRA at SAEP.

2.1 RESPONSIBILITIES OF KEY PERSONNEL

Responsibilities of key personnel are described in Section 8.1 of the OU 2 NCRA Work Plan

2.2 SUBCONTRACTORS

Project subcontractors are described in Section 8.2 of the OU 2 NCRA Work Plan.

Approximately 10% of all samples submitted to the off-site laboratory will be collected as split samples. The splits will be submitted to a quality assurance (QA) laboratory designated by the USACE to provide data on the comparability of data generated at an independent laboratory. Samples will be shipped directly to the QA Laboratory from the HLA field office. The QA Laboratory, shipping address, and project identification code, and laboratory contact is provided below:

This information will be included in the final revision

3.0 SCOPE AND OBJECTIVES

The Delivery Order includes the completion of a NCRA at the SAEP site for chromium and VOC groundwater contamination (OU 2).

3.1 PROJECT OBJECTIVES

The objectives will involve field activities to fully characterize subsurface conditions at SAEP, with a summary of investigation results, and documentation of the process used to select a recommended removal action. Section 4.0 of the NCRA Work Plan contains the project objectives.

3.2 DATA GAPS / DATA QUALITY OBJECTIVE STATEMENTS

Specific information regarding the identification of data gaps and the development of data quality objectives (DQOs) is located in Section 5.0 of the OU 2 NCRA Work Plan.

4.0 FIELD ACTIVITIES

The field activities to be conducted as part of the OU2 NCRA are included in the following five subsections, with accompanying rationale, field procedures and analyses or results anticipated for each specific category. Table 1 contains a summary of the analytical sampling proposed for the field investigations.

The progress of field activities will be updated on a weekly basis via telephone conferences between SAEP, USACE, and Foster Wheeler/HLA, if necessary.

4.1 SOIL VAPOR SURVEY

4.1.1 Rationale

A soil vapor survey will determine the potential for migration of subsurface VOC contamination into the SAEP buildings. It is important to evaluate the impact of shallow groundwater VOCs on indoor air quality for the protection of human health.

4.1.2 Field Procedures

Figure 2 identifies the proposed locations of 60 soil vapor samples scheduled to be collected using subcontracted GeoProbe equipment, or comparable hand probe equipment, as necessary. The GeoProbe collects subsurface samples by driving a sampling assembly into the subsurface using a hydraulic hammer. Soil vapor samples are collected using a low flow-volume pump to purge to entire probe assembly. The pump inlet is then sealed off from the atmosphere at the required depth in the probe and an in-situ soil vapor sample is drawn into a glass bulb using the pump. The soil vapor sample is then analyzed on-site (see Subsection 4.1.3). The soil vapor sampling procedure, including the equipment to be used and calibration procedures, is described in SOP No. 10 in Attachment A of the QAPjP (Appendix B).

The GeoProbe will include a truck-mounted rig with an operator and helper. A geologist and a chemist will be on-site full-time to support the soil vapor effort. It is estimated that six working days will be required to complete the soil vapor survey, plus one day for mobilization and set-up, for a total of seven field days. The soil vapor survey work is anticipated to be conducted in August 1999, and the results will be summarized in the Pre-design Investigation Report.

4.1.3 Analyses

Each soil vapor sample will be screened for up to six target VOCs using an on-site field gas chromatograph, such as a Photovac 10S50 Portable Gas Chromatograph (GC). Ten percent of the samples, six estimated, will be collected in Tedlar bags and sent off-site for confirmatory analysis by U.S. Environmental Protection Agency (USEPA) Method 8260B for VOCs. Samples analyzed in an off-site laboratory will receive validation by an independent, qualified data validation subcontractor.

4.2 LOCATION AND ELEVATION SURVEY

4.2.1 Rationale

A location and elevation survey will be performed on previous sampling locations and new explorations. This survey is necessary to provide accurate coordinates and elevations of sampling locations to assist in horizontal and vertical definition of subsurface contamination, geology, and groundwater flow direction.

4.2.2 Field Procedures

Approximately, 150 soil borings, and 25 monitoring wells, as well as soil gas and cone penetrometer explorations will be surveyed. A registered land surveying subcontractor will perform the survey and submit a report documenting the results to Foster Wheeler/HLA.

The previous sampling locations will be identified and marked prior to the survey. All locations will be clearly marked and will be surveyed in with a horizontal location accuracy of 0.1-foot. All monitoring well and piezometer locations will be horizontally located and will also be vertically surveyed with an elevation above mean sea level to the nearest 0.01-foot to a consistent National Geodetic Vertical Datum (NGVD) for comparison to previous and subsequent surveys. Additionally, horizontal and vertical control points will be used from the previous surveys conducted by URSGWCFS at SAEP to provide consistent results between the RI program and the OU 2 NCRA program.

4.2.3 Results

The survey subcontractor will be responsible for providing the results of the survey in a report, as well as electronically to Foster Wheeler/HLA. The results of the location and elevation survey will summarized in the Pre-design Investigations Report, including a site investigation plan and a table of coordinates and elevations.

4.3 ADDITIONAL SUBSURFACE INVESTIGATIONS

4.3.1 Rationale

Two soil borings, each to a depth of 50 feet bgs with soil sampling at 5-foot intervals are planned under this activity. Three soil samples from each boring will be sent to an off-site laboratory for VOC, SVOC, and inorganic analysis. Additionally, soil collection for bench-scale testing and field testing for dense non-aqueous phase liquid (DNAPL) using the compound SUDAN-IV will be conducted during soil boring completion. One soil boring will be completed near the location of groundwater sampling point WP-99-15 (see Figure 6 of the Work Plan), the second will be completed near the location of groundwater sampling point WP-99-33 (see Figure 4 of the Work Plan).

4.3.2 Field Procedures

Procedures for obtaining soil samples using split spoon samplers and hollow-stem augers (HSAs) to advance the boreholes are described in SOP No. 1 (Soil Sampling Using Split-Spoon Samplers) also provided in Attachment A. All soil samples will be preserved in methanol at the time of sample collection as described in SOP No. 13 in Attachment A of the QAPjP (Appendix B). Floor slabs in borehole locations in buildings will first be cored or jack-hammered to provide access to the sub-slab soil. Decontamination between borings will be performed as described in SOP No. 7 contained in Attachment A of the QAPjP (Appendix B).

Careful notes will be kept regarding visual, olfactory, and field screening instrument observations to provide the basis for selection of a sample for submittal to the analytical laboratory. Any floating product at the water table or free product in the soil samples will be noted. If material is encountered that, based upon field observations, appears to be potential source material, selected samples may be selected for analysis using the Synthetic Precipitation Leaching Procedure (SPLP) for comparison with CTDEP pollutant mobility criteria.

All boring locations will be clearly marked and will be surveyed in elevation above mean sea level to the nearest 0.01 foot to a consistent NGVD for comparison to previous and subsequent surveys (see Subsection 4.2).

4.3.3 Analyses

Analytical parameters may include VOC, SVOC, and Target Analyte List (TAL) metals, hexavalent chromium, cyanide, grain size, TPH, and cation exchange capacity analyses at an off-site laboratory. Soil samples may also be analyzed for metals using the SPLP method. Additionally, samples may be analyzed on site for the presence or absence of DNAPL using SUDAN-IV. Selected soil samples will also be used during completion of the bench-scale testing to determine the optimum concentrations of reagents for the pilot tests. Attachment B of the QAPjP (Appendix B) contains the method numbers for the laboratory analyses.

4.4 AQUIFER PUMPING TESTS

4.4.1 Rationale

Aquifer pumping tests are necessary to determine the hydraulic properties of the aquifer in the vicinity of the former Chromium Plating Facility. Determination of hydraulic properties is critical to the selection and implementation of a removal action(s).

4.4.2 Field Procedures

A subcontractor to Foster Wheeler/HLA will install one 4-inch extraction/pumping well and eight 1-inch monitoring wells for use in characterizing the hydraulic conditions during the pumping tests. Multiple 1-inch piezometers at different depths may be installed inside the same borehole. To the extent possible, pre-existing monitoring wells will also be used to monitor water levels during the pumping test procedures.

The pumping tests will be monitored by computerized data logging instruments and pressure transducers. Portable field printers and a laptop computer will facilitate data collection and analysis during the aquifer tests. The specific details of the aquifer testing program will be included in the Pre-Design Investigation Report. The following is a general overview of the aquifer pumping tests to be conducted.

A step-drawdown test will be conducted at the extraction/pumping well to establish well efficiency, specific capacity, and short-term well yields. Data from extraction well development will be used to assist in selection of three extraction rates to be conducted for successive 2-hour durations. Following the step-drawdown test, a constant-discharge test will be conducted at the extraction well to calculate transmissivity, storage coefficients, aquifer parameters, and estimates of long-term extraction/pumping rates. The extraction/pumping rate for the constant-discharge test will be determined from data produced during the step-drawdown test. Extraction rates will be monitored with an instantaneous flow meter, as well as with a totalizing flow meter.

The constant-discharge test will be conducted for a maximum of 48 hours. At least one monitoring well/piezometer outside the anticipated extraction well's zone of influence will also be monitored as a reference well, for the purposes of evaluating background water level trends. The water levels in each instrumented monitoring well/piezometer (up to eight total) will be measured until the water table has recovered to 90% of the static water level. Extraction rates will be monitored with an instantaneous flow meter, as well as with a totalizing flow meter.

The extracted contaminated groundwater will be collected into a storage tank and treated with an activated carbon system prior to discharge to the SAEP Chemical Waste Treatment Plant (CWTP); see Section 7.0 of the Work Plan for investigation-derived waste (IDW) procedures.

4.4.3 Results

Results from the aquifer testing will be summarized in the Pre-design Investigation Report and will include an interpretation of hydraulic conditions in the vicinity of the former Chromium Plating Facility to be used in selection of potential removal actions.

4.5 BENCH-SCALE TESTING

4.5.1 Rationale

Bench-scale testing will be conducted to determine the compatibility of particular treatment technologies with the contaminants and conditions at the SAEP site. The testing is necessary for implementation of the best available removal action.

4.5.2 Field Procedures

Bench-scale testing, consisting of the addition of ferrous sulfate and/or hydrogen peroxide solution to extracted site groundwater and excavated soil, will be conducted to determine the optimum dose for conversion of contaminants and minimum residual solutions. The tests will be based on an estimated dosage determined from stoichiometric calculations of the mass of contaminants in aquifer soil and groundwater. The tests will determine the actual optimum dosages, which is likely to vary from the stoichiometric dosage due to consumption of the chemicals in unrelated reactions associated with other compounds in site soil and groundwater.

Two sets of bench-scale tests will be conducted, the first in the VOC hot-spot area (near groundwater sampling location WP-99-33) in the former Chromium Plating Facility and the second for the hexavalent chromium and VOC hot-spot area (near groundwater sampling location WP-99-15). The tests will be run as jar tests using varying amounts of the chemicals required for the potential removal technologies (i.e., ferrous sulfate solution and hydrogen peroxide solution). Results of the testing will be analyzed on-site using field monitoring probes and test kits such as those manufactured by HACH™. The following is a list of information that may be recorded for each jar:

- initial pH
- initial observation of floc or turbidity (qualitative)

- initial observation of settled solids (qualitative)
- initial chemical and contaminant concentrations (HACH™ kit testing for chromium, off-site laboratory for VOCs)
- pH of solution added
- mixing time
- final pH
- final observation of floc or turbidity (qualitative)
- final observation of settled solids (qualitative)
- final chemical and contaminant concentrations (HACH™ kit testing for chromium, off-site laboratory for VOCs)

The most favorable results from the tests will be sent to an off-site laboratory for analysis. The details of the proposed bench-scale testing will be included in a Work Plan Letter following evaluation of existing site data.

4.6 OPTIONAL TASKS

4.6.1 Rationale

Optional field activities to support the selection of a removal action will be conducted at SAEP under the authorization of the USACE. The four optional tasks include: a geophysical survey, cone penetrometer explorations, soil borings and monitoring wells. The need for these optional field activities will depend upon the identification of data gaps following completion of the URSGWCFS RI field activities.

4.6.2 Field Procedures

Option 1: Geophysical Survey. A seismic geophysical survey would be used to determine the location and features of the bedrock surface. Evaluation of the data would be used to determine if the bedrock surface influenced the location and movement of potential DNAPL at SAEP.

A Foster Wheeler/HLA geophysicist will oversee a geophysical seismic refraction survey, which will be conducted in order to define the depth and features of the bedrock surface. The data collection and initial interpretation for the survey will be performed by a subcontractor.

It is estimated that four traverse lines, approximately 6600 linear feet of survey, will be used to evaluate the bedrock surface conditions. The geophysical survey will include two northwest to southeast traverses along the length of Building B-2 and at the dike, and two northeast to southwest traverses from Main Street to the dike.

Seismic refraction measures the velocity of sound waves in subsurface materials that can be equated to depth. It is likely that a marked velocity difference exists between the unconsolidated material and the bedrock surface, which is anticipated to range from approximately 60 to 160 feet bgs across the survey area. A blast charge will be used as an energy source and geophones placed along the length of the traverse will record the refracted sound waves.

Information obtained from the seismic survey will be used to identify potential troughs or low points on the bedrock surface that could influence the location and/or movement of potential DNAPL at the site.

Option 2: Cone Penetrometer Explorations. Cone penetrometer explorations will be used to more fully define the boundary (horizontal and vertical) of VOC contamination in SAEP groundwater, if necessary. Additionally, the explorations can provide information on subsurface geology and, to a limited extent, hydraulic conditions.

The cone penetrometer explorations will include the sampling of up to five locations each to a maximum depth of 150 feet bgs. These locations have not yet been selected. Cone penetrometer tests (CPTs) in the explorations will produce information on stratigraphy, based upon resistivity and friction measurements. Five groundwater samples will be collected through the cone penetrometer rods at each exploration location. The cone penetrometer fieldwork is anticipated to take a maximum of five days. This exploration will not result in the installation of permanent monitoring wells.

The CPT consists of smoothly and continuously pushing a small diameter, instrumented probe (a penetrometer) deep into the ground while a computer system displays and records the soil response to penetration. Completion of CPTs at several locations allows data to be used to develop continuous, high resolution profiles of in-situ soil conditions. The procedure is specified by the American Society for Testing and Materials (ASTM) Standard D3441.

A pressure transducer can be added to the penetrometer to acquire hydrogeologic data and a soil electrical conductivity sensor can provide data regarding the moisture in vadose zone soil and general groundwater quality. Soil, groundwater, and soil gas samplers can be used for direct sampling which reduces site disturbance and the generation of borehole cuttings and drilling fluids.

Option 3: Soil Borings. As for the cone penetrometer locations, the optional soil borings will be used to better define the extent of VOC contamination in SAEP groundwater, if necessary. Three soil borings, each to a depth of 50 feet bgs, with soil sampling at 5-foot intervals will be collected for this option. Three samples from each boring will be sent to an off-site laboratory for VOC, SVOCs, and inorganic analyses. Soil borings are estimated to take a maximum of 3 days. Soil samples will be obtained using the HSAs and 3-inch inside diameter split-spoons.

Procedures for obtaining soil samples using split spoon samplers and HSAs to advance the boreholes are described in SOP No. 1 (Soil Sampling Using Split-Spoon Samplers) also provided in Attachment A of the QAPjP (Appendix B). Floor slabs in borehole locations in buildings will first be cored or jack-hammered to provide access to the sub-slab soil. Decontamination between borings will be performed as described in SOP No. 7.

All boreholes will be sampled continuously. One soil sample will be submitted for analytical laboratory analysis from the zero- to six-inch interval below grade or any paved surface (i.e., first split spoon). A second sample will be submitted from the interval immediately above the water table. Additional samples may be collected based upon visual, olfactory, or field screening evidence of contamination. Provisions will be made to provide samples to other government contractors on-site, subject to available sample volumes.

Careful notes will be kept regarding visual, olfactory, and field screening instrument observations because, in addition to providing the basis for biasing a sample for submittal to the analytical laboratory, this will provide important information needed to define potential source areas. Any floating product at the water table or free product in the soil samples will be noted. If material is encountered that, based upon field observations, appears to be potential source material, selected samples may be selected for analysis using the Synthetic Precipitation Leaching Procedure (SPLP) for comparison with CTDEP pollutant mobility criteria.

Option 4: Monitoring Wells. Up to five monitoring wells will be installed, each to a depth of 50 feet bgs to provide permanent groundwater sampling points, if necessary. The wells will be constructed of 2-inch inside diameter schedule 40 polyvinyl chloride piping with a 10-foot screen length. The monitoring well installation is estimated to require a maximum of five field days.

Groundwater samples will be collected from the wells using low-flow rate purging and sampling techniques. The general procedures to be used for the groundwater investigation are provided in Attachment A, including:

- SOP No. 2 – Monitoring Well Installation
- SOP No. 3 – Groundwater Sampling Using Low Flow Rate Purging and Sampling Technique
- SOP No. 5 – Water Level Measurement

4.6.3 Analysis

Option 1: Geophysical Survey. A Foster Wheeler/HLA geophysicist will interpret the raw seismic data, and provide the interpretation as part of the Pre-design Investigation Report.

Option 2: Cone Penetrometer Explorations. A Foster Wheeler/HLA geologist will interpret the resistivity and friction data from the cone penetrometer explorations to conceptualize the stratigraphy of the core with regard to the previously known adjacent geological interpretations. The groundwater samples collected from each exploration will be sent off-site for VOC analysis. Up to a total of three samples will be anlayzed for SVOCs, TAL Metals, CN, and Water Quality Parameters. These three samples will be collected from locations where it is more likely than an in-situ treatment may occur. Attachment B of the QAPjP (Appendix B) contains the method numbers for these analyses. Field parameter readings for each groundwater sample will also be collected, including pH, temperature, dissolved oxygen content, oxidation-reduction potential, and specific conductance.

Option 3: Soil Borings. Analytical parameters will include VOC, SVOC, and TAL metal analyses at an off-site laboratory. Soil samples may also be analyzed for metals using the SPLP method. Attachment B of the QAPjP (Appendix B) contains the method numbers for these analyses.

Option 4: Monitoring Wells. Groundwater samples collected from the monitoring wells will be analyzed for VOCs, SVOCs and TAL metals. Water quality parameters and field parameters for each sample will also be collected. Attachment B of the QAPjP (Appendix B) contains the method numbers for these analyses.

5.0 SAMPLE HANDLING

Sections 5.0 and 6.0 of the URSGWCFS RI Field Sampling Plan detail the documentation, packaging, and shipping procedures to be used during field activities and sample collection (URSGWCFS, 1998).

As stated in these sections, each sample will receive a unique sample identification number, which will be recorded on the sample label, the laboratory Chain of Custody, and the field logbook. Field data sheets will be used to record observations and details regarding field activities, including boring logs, monitoring well installation information, water levels, field water quality parameters, and general observations. Sample handling requirements, including holding times are presented in Table 2 (Attachment B).

Samples to be sent off-site for analysis will be appropriately packaged to prevent damage to the sample containers, and maintain required temperatures and adequate custody. Standard Operating Procedure No.6, contained in Attachment A of the QAPjP (Appendix B) contains information on sample handling.

Approximately 10% of all samples submitted to the off-site laboratory will be collected as split samples. The splits will be submitted to a quality assurance (QA) laboratory designated by the USACE to provide data on the comparability of data generated at an independent laboratory. Samples will be shipped directly to the QA Laboratory from the HLA field office. The QA laboratory name , shipping address, and laboratory contact is provided below:

Severn Trent Laboratory, Inc.
Mr. Brian Blair
55 South Park Drive
Colchester, VT 05446
(802) 655-1203

6.0 INVESTIGATION-DERIVED WASTES

Section 7.0 of the OU 2 NCRA Work Plan identifies handling and disposal of IDW anticipated to be generated during field investigations.

7.0 CONTRACTOR QUALITY CONTROL

It is the responsibility of Foster Wheeler/HLA to manage, control, and document compliance with the requirements of the contract, the Work Plan, the SAP, the QAPjP, and the SSHP. This responsibility extends to subcontractors, equipment, and supplies that may be used to complete the OU2 NCRA.

As stated in Section 8.0 of the URSGWCFS RI Field Sampling Plan (URSGWCFS, 1998), components of the Technical Plans intended to facilitate quality control include:

- The establishment of DQOs (Section 5.0 of the OU 2 NCRA Work Plan)
- The use of Standard Operating Procedures (SOPs) for planned field activities (Attachment A to the OU 2 NCRA QAPjP)
- Designation of a FOL
- Collection and analysis of QA/QC samples
- Independent validation of laboratory data using established guidelines
- Technical document review

8.0 CORRECTIVE ACTIONS

Section 10.0 of the URSGWCFS RI Field Sampling Plan details the actions that will be taken in the event an unauthorized deviation from the procedures outlined in this SAP occurs (URSGWCFS, 1998). Unauthorized deviations may include, but are not limited to:

- Failure of field equipment or instrumentation;
- Improper equipment calibration;
- Improper sample collection method;
- Improper sample preservation and shipping (e.g., samples arrive at laboratory broken or at an unacceptable temperature); and
- Incorrect sample documentation.

Unauthorized deviations will be controlled and corrected using the following actions:

- The FOL is responsible for ensuring procedures are correctly implemented in the field;
- The Technical Manager will periodically review field procedures and documentation to identify deviations;
- Deviations will be documented and reported, if identified;
- Deviations will be assessed and corrective actions defined by the Technical Manager and the Project QA/QC Coordinator and documented, as appropriate;
- The Technical Manager will provide the Project QA/QC Coordinator with a written memorandum documenting appropriate field procedures upon implementation of a corrective action; and
- A memorandum will be written to the project file documenting the corrective action field implementation.

9.0 PROJECT SCHEDULE

Figure 3 presents an estimated project schedule for OU 2 NCRA activities at SAEP.

10.0 FIELD EQUIPMENT AND INSTRUMENTATION

This section is intended to summarize the procedures to be followed to ensure proper calibration and operation of required field equipment and instrumentation. The procedures outlined in Section 12.0 of the URSGWCFS RI Field Sampling Plan will be followed for the OU 2 NCRA; however, field equipment calibration readings will be documented on a daily basis on calibration log sheets in addition to documentation in individual field logbooks. The following field equipment is anticipated to be used for investigations; however, similar equipment may also be used:

- Photovac 10S50 Portable Gas Chromatograph to analyze soil vapor samples on-site;
- OVM TE 580B Photoionization Detector to monitor concentrations of VOCs in the atmosphere during intrusive explorations;
- Oxygen/Lower Explosive Limit Meter to monitor oxygen content in the work zone;
- Horiba U-10 Water Quality Meter to measure field water quality parameters (temperature, pH, dissolved oxygen content, and specific conductivity) in groundwater samples;
- Oxidation/Reduction Probe to measure the oxidation reduction potential of groundwater samples; and
- Field sampling kits, such as Hach™ Test Kits, to determine the concentrations of chromium and VOCs in bench-scale test samples.

ATTACHMENT A
FIGURES

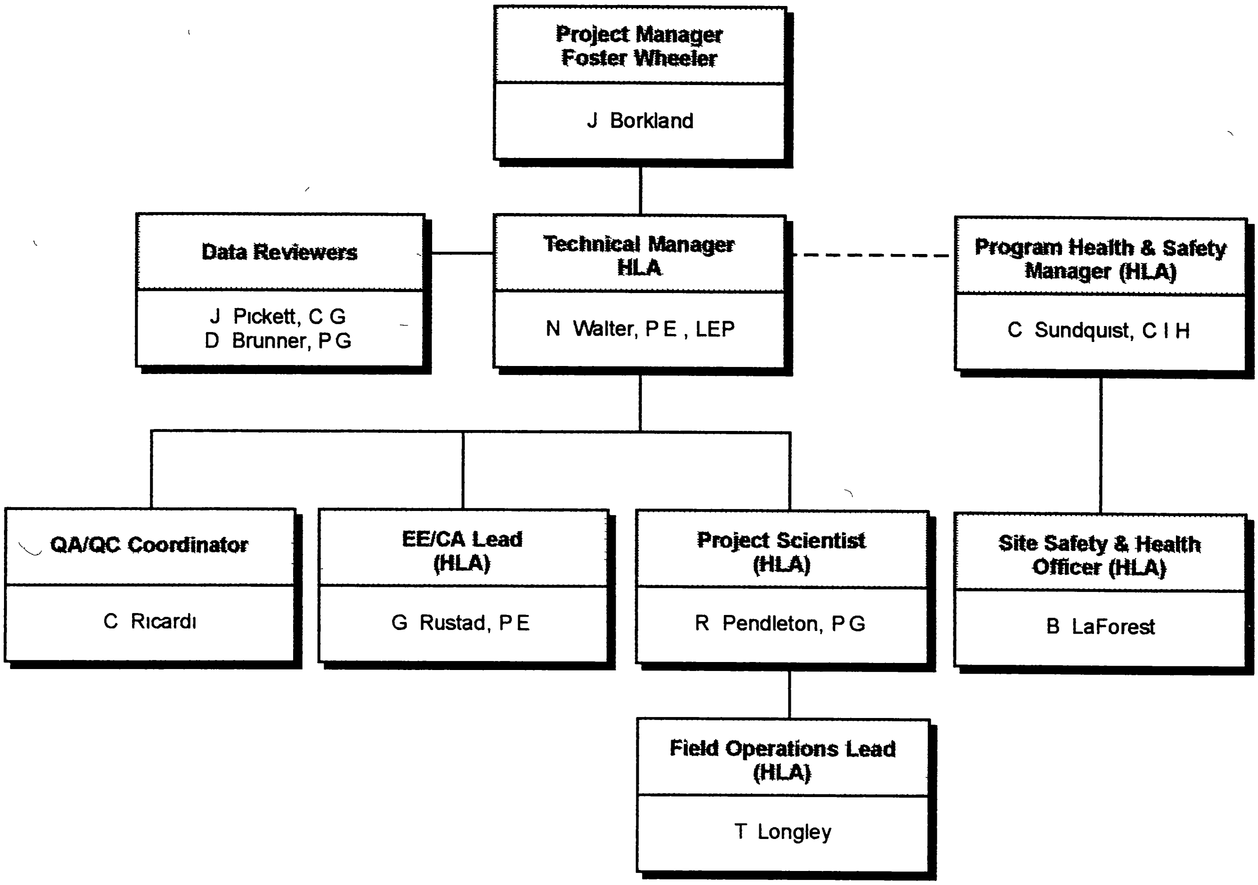

Figure 1: Project Organization Chart.

LEGEND

●	PROPOSED HLA SOIL VAPOR EXPLORATIONS
●	EXISTING HLA CONE PENETROMETER LOCATIONS
⊕	PROPOSED U.R.S.-GRENIER / WOODWARD-CLYDE MONITORING WELLS (LOCATIONS ARE APPROXIMATE)
◐	HLA GEOPROBE GROUNDWATER SAMPLING LOCATION
⊕	EXISTING PIEZOMETER LOCATION
⊕	EXISTING WOODWARD-CLYDE MONITORING WELL
◕	C.A. RICH CONSULTANTS MONITORING WELL
B-53	BUILDING DESIGNATIONS
	FENCE
═	SEA WALL
— — —	SAEP PROPERTY BOUNDARY
—	11-DCE RSR EXCEEDANCES IN GROUNDWATER
—	PCE RSR EXCEEDANCES IN GROUNDWATER
—	TCE RSR EXCEEDANCES IN GROUNDWATER
—	1,1,1-TCA RSR EXCEEDANCES IN GROUNDWATER

NOTES:
1. MAP IS IN CONNECTICUT STATE PLANE COORDINATES.
2. BASE MAP SOURCE: ALLIEDSIGNAL, INC.
3. EXCEEDANCES DELINEATED USING MAXIMUM CONCENTRATION OF THE VOC DETECTED IN EACH GEOPROBE AND CONE PENETROMETER SAMPLING LOCATION (IRRESPECTIVE OF DEPTH).

0 60 120 240 FEET

SCALE: 1"=120'

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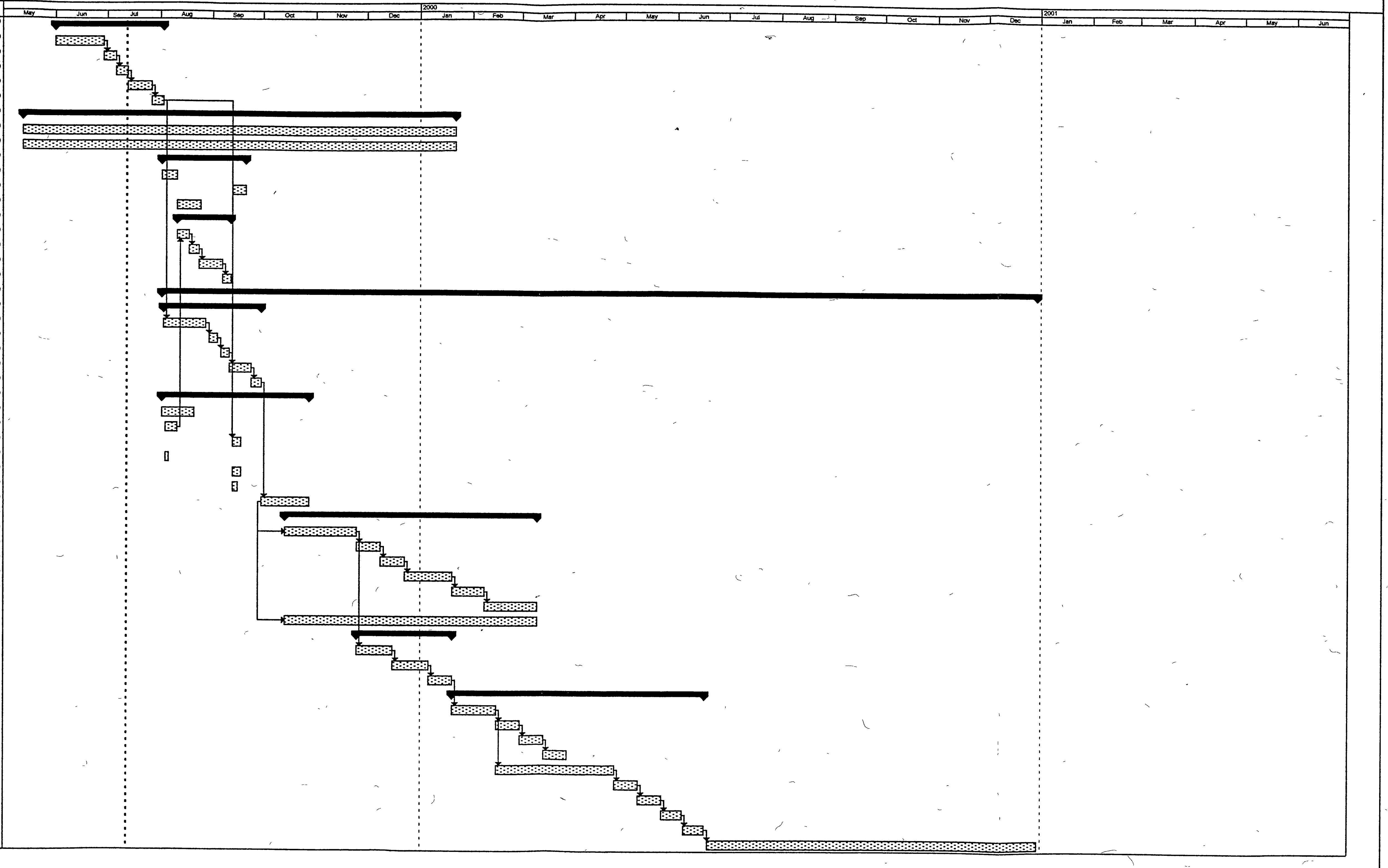
FIGURE 2
PROPOSED SOIL VAPOR INVESTIGATION LOCATIONS
OU2 NON-TIME CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
Harding Lawson Associates

FIGURE 3
PROPOSED SCHEDULE
OU2 NON-TIME CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT

ID	Task Name	Duration	Start	Finish
1	**WBS 20 01 Planning**	**45 days**	**Tue 6/1/99**	**Mon 8/2/99**
2	Write Plans	20 days	Tue 6/1/99	Mon 6/28/99
3	Army Review of Plans	5 days	Tue 6/29/99	Mon 7/5/99
4	Revise Plans	5 days	Tue 7/6/99	Mon 7/12/99
5	Reg Review of Plans	10 days	Tue 7/13/99	Mon 7/26/99
6	Finalize Plans	5 days	Tue 7/27/99	Mon 8/2/99
7	**WBS 20 02 Task Management**	**185 days**	**Thu 5/13/99**	**Fri 1/21/00**
8	Project Mangement and Meetings	185 days	Thu 5/13/99	Fri 1/21/00
9	Data Management	185 days	Thu 5/13/99	Fri 1/21/00
10	**WBS 20 03 Field Activities**	**38 days**	**Mon 8/2/99**	**Mon 9/20/99**
11	Soil Vapor Survey	7 days	Mon 8/2/99	Tue 8/10/99
12	Geophysics (optional)*	6 days	Mon 9/13/99	Mon 9/20/99
13	Location and Elevation Survey	11 days	Wed 8/11/99	Tue 8/24/99
14	**WBS 20 04 Pre-Design Report**	**25 days**	**Wed 8/11/99**	**Sat 9/11/99**
15	Army Review of Report	5 days	Wed 8/11/99	Tue 8/17/99
16	Revise Report	5 days	Wed 8/18/99	Mon 8/23/99
17	Reg Review of Report	10 days	Tue 8/24/99	Mon 9/6/99
18	Finalize Report	5 days	Tue 9/7/99	Sat 9/11/99
19	**WBS 20 05 EECA Process**	**376 days**	**Mon 8/2/99**	**Fri 12/29/00**
20	**EE/CA Treatability Work Plan**	**45 days**	**Tue 8/3/99**	**Wed 9/29/99**
21	Write Work Plan	20 days	Tue 8/3/99	Fri 8/27/99
22	Army Review of Work Plan	5 days	Mon 8/30/99	Fri 9/3/99
23	Revise Work Plan	5 days	Mon 9/6/99	Fri 9/10/99
24	Reg Review of Work Plan	10 days	Sat 9/11/99	Thu 9/23/99
25	Revise Work Plan	5 days	Fri 9/24/99	Wed 9/29/99
26	**Additional Field Activities**	**66 days**	**Mon 8/2/99**	**Wed 10/27/99**
27	Aquifer Test (Well installation and test)	15 days	Mon 8/2/99	Fri 8/20/99
28	Bench Scale Test	5 days	Wed 8/4/99	Tue 8/10/99
29	Cone Penetrometer (Optional)*	5 days	Mon 9/13/99	Fri 9/17/99
30	Soil Borings	2 days	Wed 8/4/99	Thu 8/5/99
31	Monitoring Wells (optional)*	5 days	Mon 9/13/99	Fri 9/17/99
32	Soil Borings (optional)*	3 days	Mon 9/13/99	Wed 9/15/99
33	Pilot Test	20 days	Thu 9/30/99	Wed 10/27/99
34	**EE/CA Report Preparation**	**108 days**	**Thu 10/14/99**	**Thu 3/9/00**
35	Write	30 days	Thu 10/14/99	Wed 11/24/99
36	Army Review	10 days	Thu 11/25/99	Wed 12/8/99
37	Revise	10 days	Thu 12/9/99	Wed 12/22/99
38	EPA Review	20 days	Thu 12/23/99	Wed 1/19/00
39	Revise	15 days	Thu 1/20/00	Mon 2/7/00
40	Public Comment Period	23 days	Tue 2/8/00	Thu 3/9/00
41	EE/CA Action Memorandum (WBS 5 3)	108 days	Thu 10/14/99	Thu 3/9/00
42	**Design Construct Procurement**	**40 days**	**Thu 11/25/99**	**Wed 1/19/00**
43	USACE SOW	15 days	Thu 11/25/99	Wed 12/15/99
44	FW/HLA Proposal	15 days	Thu 12/16/99	Wed 1/5/00
45	Negotiation/Award	10 days	Thu 1/6/00	Wed 1/19/00
46	**Design**	**110 days**	**Thu 1/20/00**	**Fri 6/16/00**
47	30 Percent Design	20 days	Thu 1/20/00	Mon 2/14/00
48	Army Review	10 days	Tue 2/15/00	Mon 2/28/00
49	Revise	10 days	Tue 2/29/00	Mon 3/13/00
50	Regulatory Review	10 days	Tue 3/14/00	Mon 3/27/00
51	90 Percent Design	50 days	Tue 2/15/00	Mon 4/24/00
52	Army Review 90 Percent Design	10 days	Tue 4/25/00	Mon 5/8/00
53	Revise 90 Percent Design	10 days	Tue 5/9/00	Mon 5/22/00
54	Regulatory Review 90 Percent Design	10 days	Tue 5/23/00	Sat 6/3/00
55	Finalize Design	10 days	Mon 6/5/00	Fri 6/16/00
56	Construction	140 days	Mon 6/19/00	Fri 12/29/00



Project saep3
Date Mon 7/12/99

Task ▨ Split …….. Progress ▬ Milestone ◆ Summary ▬ Rolled Up Task ▨ Rolled Up Split …….. Rolled Up Milestone ◇ Rolled Up Progress ▬ External Tasks ▨ Project Summary ▬

ATTACHMENT B
TABLES

TABLE 1
SUMMARY OF PROPOSED OFF-SITE ANALYTICAL SAMPLING

SAMPLING AND ANALYSIS PLAN
OU 2 NON-TIME-CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

				Number of QC Samples					
Exploration Type	**Media**	**Analytical Parameter & Method(1)**	**Number of Off-Site Anlaytical Samples**	**Trip Blanks**	**Rinsate Blanks (water samples)**	**Duplicates**	**Matrix Spike**	**Matrix Spike Duplicate**	**Total Off-Site Analytical Samples**
Soil Vapor Samples	Vapor	VOCs by 8260B	6	0	0	1	0	0	7
Soil Borings (3 borings total)	Soil	VOCs by 8260B	7	1	1	1	1	1	12
		TCL SVOCs by 8270C	7	0	1	1	1	1	11
		TAL Metals by 6010/7000A	7	0	1	1	1	1	11
		Cr^{+6} by 3060A/7196	7	0	1	1	1	1	11
		CN by 9010B/9012A	7	0	1	1	1	1	11
		SPLP for Metals by 1312	3	0	0	0	0	0	3
		Remediation Parameters(2)	7	0	1	1	1	1	11
Aquifer Test	Water	VOCs by 8260B	8	1	0	1	1	1	12
		Vinyl Chloride by Modified 8021	8	1	0	1	1	1	12
		TCL SVOCs by 8270C	2	0	0	1	1	1	5
		TAL Metals by 6010/7000A	2	0	0	1	1	1	5
		CN by 9010B/9012A	2	0	0	1	1	1	5
		Water Quality Parameters(3)	2	0	0	1	1	1	5
Groundwater Samples (bench-scale testing)	Water	VOCs by 8260B	26	3	0	0	0	0	29
		CN by 9010B/9012A	6	0	0	0	0	0	6
		Water Quality Parameters(4)	6	0	0	0	0	0	6

TABLE 1
SUMMARY OF PROPOSED OFF-SITE ANALYTICAL SAMPLING

SAMPLING AND ANALYSIS PLAN
OU 2 NON-TIME-CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

				Number of QC Samples					
Exploration Type	**Media**	**Analytical Parameter & Method[1]**	**Number of Off-Site Anlaytical Samples**	**Trip Blanks**	**Rinsate Blanks (water samples)**	**Duplicates**	**Matrix Spike**	**Matrix Spike Duplicate**	**Total Off-Site Analytical Samples**
Option 2 - Cone Penetrometer Groundwater Samples	Water	VOCs by 8260B	25	4	2	2	2	2	37
		Vinyl Chloride by Modified 8021	25	4	2	2	2	2	37
		TCL SVOCs by 8270C	3	1	1	1	1	1	8
		TAL Metals by 6010/7000A	3	1	1	1	1	1	8
		CN by 9010B/9012A	3	1	1	1	1	1	8
		Water Quality Parameters[3]	3	1	1	1	1	1	8
Option 3 - Soil Borings (3 total)	Soil	VOCs by 8260B	9	2	1	1	1	1	15
		TCL SVOCs by 8270C	9	0	1	1	1	1	13
		TAL Metals by 6010/7000A	9	0	1	1	1	1	13
		Cr^{+6} by 3060A/7196	9	0	1	1	1	1	13
		CN by 9010B/9012A	9	0	1	1	1	1	13
		SPLP for Metals by 1312	3	0	0	0	0	0	3
		Remediation Parameters[2]	9	0	1	1	1	1	13

TABLE 1
SUMMARY OF PROPOSED OFF-SITE ANALYTICAL SAMPLING

SAMPLING AND ANALYSIS PLAN
OU 2 NON-TIME-CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

				Number of QC Samples					
Exploration Type	**Media**	**Analytical Parameter & Method[1]**	**Number of Off-Site Anlaytical Samples**	**Trip Blanks**	**Rinsate Blanks (water samples)**	**Duplicates**	**Matrix Spike**	**Matrix Spike Duplicate**	**Total Off-Site Analytical Samples**
Option 4 - Monitoring Wells (5 total)	Water	VOCs by 8260B	5	1	1	1	1	1	10
		Vinyl Chloride by Modified 8021	5	1	1	1	1	1	10
		TCL SVOCs by 8270C	5	0	1	1	1	1	9
		TAL Metals by 6010/7000A	5	0	1	1	1	1	9
		CN by 9010B/9012A	5	0	1	1	1	1	9
		Water Quality Parameters[3]	5	0	1	1	1	1	9

ABBREVIATIONS

ASTM = American Society for Testing and Materials
BOD = biological oxygen demand
CEC = Cation Exchange Capacity
CN = Total Cyanides
COD = chemical oxygen demand
MS = matrix spike
MSD = matrix spike duplicate
PAHs = Polynuclear Aromatic Hydrocarbons
SPLP = Synthetic Precipitation Leaching Procedure
SVOCs = Semi-Volatile Organic Compounds
TAL = Target Analyte List
TCL = Target Compound List
TOC = Total Organic Carbon
TPH = Total Petroleum Hydrocarbons
USEPA = United States Environmental Protection Agency
VOCs = Volatile Organic Compounds

NOTES:

[1] Analytical methods are from USEPA SW-846, "Test Methods for Evaluating Solid Waste, Chemical/Physical Methods SW-846, Final Update III, revised 1993 or more recent edition unless otherwise indicated

[2] Remediation Parameters = grain size (ASTM D 422), TOC (9060), TPH (USEPA 418.1) and and CEC (9080/9081) MS and duplicates cololected for TOC and TPH only. Rinse blanks collected for TPH only

[3] Water Quality Parameters List 1 = TOC, TPH, BOD, COD, dissolved iron and manganese (field filtered), chloride, phosphate, sulfate, sulfide, nitrate/nitrite, ammonia, methane, alkalinity, and hardness

[4] Water Quality Parameters List 2 = Chloride, sulfide, alkalinity, hardness, and dissolved calcium, magnesium, and manganese (field filtered).

TABLE 2
SAMPLE HANDLING REQUIREMENTS

SAMPLING AND ANALYSIS PLAN
OU 2 NON-TIME-CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

Matrix	Analytical Parameter	Container Type and Size	Holding Time	Special Handling	Preservation/Storage
Soil Vapor	VOCs	Tedlar Bag	72 hours	Store in cooler out of light at all times	4° C
Soil	VOCs	Pre-weighed, septum-sealed, screw cap 40 ml glass vial	14 days	Need additional jars for each QC (dup, MS, MSD)	Methanol; 4° C
	SVOCs[1]	One 8 oz. wide-mouth glass will be used for SVOCs, metals and cyanide.	14 days to extraction 40 days to analysis	Need additional jars for each QC (dup, MS, MSD)	4° C
	Metals[1]		6 months, Hg 28 days	Need additional jars for each QC (dup, MS, MSD)	4° C
	Cyanide[1]		14 days	Need additional jars for each QC (dup, MS, MSD)	4° C
	Cr^{6+}	4 oz. wide-mouth glass	7 days	Need additional jars for each QC (dup, MS, MSD)	4° C
	SPLP(metals)	4 oz. wide-mouth glass	6 months, Hg 28 days	No MS/MSD or duplicate	4° C
	TPH	4 oz. wide-mouth glass	28 days	Need additional jars for each QC (dup, MS, MSD)	4° C
	TOC	4 oz. wide-mouth glass	28 days	Need additional jars for each QC (dup, MS, MSD)	4° C
	CEC	4 oz. wide-mouth glass	NA	Need additional jars for duplicate, No MS or MSD	4° C
	Grain Size	4 oz. wide-mouth glass	NA	NA	4° C

TABLE 2
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SAMPLING AND ANALYSIS PLAN
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STRATFORD, CONNECTICUT

Matrix	Analytical Parameter	Container Type and Size	Holding Time	Special Handling	Preservation/Storage
Water	VOCs	2 x 40 ml glass vials, teflon-lined septum	14 days	No head space	HCl to pH < 2; 4° C
	Low Concentration Vinyl Chloride	2 x 40 ml glass vials, teflon-lined septum	14 days	No head space	HCl to pH < 2; 4° C
	SVOCs	2 x 1-L organics-cleaned, amber glass	7 days to extraction 40 days to analysis	Need additional jars for each QC (dup, MS, MSD)	4° C
	Total Metals	250 ml pre-cleaned teflon jar	Hg 28 days; all others 6 months	Need additional jars for each QC (dup, MS, MSD)	Nitric acid to pH < 2; 4° C
	Cyanide	1-L poly/glass	14 days	pH > 12	4° C
	Cr^{6+}	1-L poly/glass	24 hours	Need additional jars for each QC (dup, MS, MSD)	4° C
	TPH	1-L glass	28 days	Need additional jars for each QC (dup, MS, MSD)	Hydrochloric acid to pH < 2; 4°C
	TOC	250 mL glass bottle	28 days	Need additional jars for each QC (dup, MS, MSD)	H2SO4 or HCL pH<2
	BOD	1 L poly or glass bottle	48 hrs	No MS/MSD	4°C
	Dissolved Iron/Manganese	250 mL poly bottle	6 months	Filter prior to preservation; Need additional jars for each QC (dup, MS, MSD)	HNO3 pH<2
	Phosphate	125 mL poly bottle	48 hrs	Filter in field; Need additional jars for each QC (dup, MS, MSD)	4°C
	Sulfide	500 mL poly or glass	7 days	Need additional jars for each QC (dup, MS, MSD)	2 mL zinc acetate plus NaOH to pH<2
	Nitrate/Nitrite, Ammonia, COD	1 L poly or glass bottle	28 days	Need additional jars for each QC (dup, MS, MSD); No MS/MSD for COD	H2SO4 pH<2
	Hardness	125 mL poly	6 months	Need additional jars for each QC (dup, MS, MSD)	HNO3 pH<2
	Alkalinity	500 mL poly bottle	14 days	Need additional jars for each QC (dup, MS, MSD)	4°C

TABLE 2
SAMPLE HANDLING REQUIREMENTS

SAMPLING AND ANALYSIS PLAN
OU 2 NON-TIME-CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

Matrix	Analytical Parameter	Container Type and Size	Holding Time	Special Handling	Preservation/Storage
Water (cont.)	Chloride/Sulfate	500 mL poly bottle	28 days	Need additional jars for each QC (dup, MS, MSD)	4°C
	Methane	2x40 mL glass vial, teflon lined septum	14 days	Need additional jars for each QC (dup, MS, MSD)	4°C

ABBREVIATIONS:

ASTM = American Society for Testing and Materials
BOD = Biological oxygen demand
CEC = Cation Exchange Capacity
COD = Chemical oxygen demand
Hg = mercury
mL = milliliters

[1] A single 8 ounce jar can be collected for SVOC, metals, and cyanide

MS = matrix spike
MSD = matrix spike duplicates
SPLP = Synthetic Precipitation Leaching Procedure
SVOCs = Semi-volatile Organic Compounds
TOC = Total Organic Compounds
TPH = Total Petroleum Hydrocarbons
VOCs = Volatile Organic Compounds

USACE CONTRACT NO. DACW33-94-D-0002
TASK ORDER NO. 020
TOTAL ENVIRONMENTAL RESTORATION CONTRACT

APPENDIX B

DRAFT
QUALITY ASSURANCE PROJECT PLAN FOR THE NON-TIME CRITICAL REMOVAL ACTIONS FOR THE STRATFORD ARMY ENGINE PLANT

Stratford, Connecticut

August 26, 1999

Prepared for

U.S. Army Corps of Engineers
New England District
Concord, Massachusetts

DRAFT
QUALITY ASSURANCE PROJECT PLAN
FOR THE
NON-TIME CRITICAL REMOVAL ACTIONS FOR THE
STRATFORD ARMY ENGINE PLANT

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DRAFT
QUALITY ASSURANCE PROJECT PLAN
FOR THE
NON-TIME CRITICAL REMOVAL ACTIONS FOR THE
STRATFORD ARMY ENGINE PLANT

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1.0 INTRODUCTION AND PROJECT DESCRIPTION

This Quality Assurance Project Plan (QAPjP) has been developed to detail quality control procedures referenced in the Sampling and Analysis Plans (SAPs) for the Non-time Critical Removal Actions (NCRAs) to be performed for Operable Unit (OU) 2 and the Causeway and Dike at Stratford Army Engine Plant (SAEP). The URS Greiner-Woodward Clyde Federal Services (URSGWCFS) Remedial Investigation (RI) QAPjP was used to develop this QAPjP (URSGWCFS, 1998).

A description of the SAEP site and the purpose of this investigation are provided in Section 1.0 of the SAPs.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

A description of the project and responsibilities for this investigation are provided in Section 8.0 of the Work Plan.

3.0 DATA QUALITY OBJECTIVES

3.1 BACKGROUND

The data quality objectives of this investigation are to obtain the information needed to make decisions on remedial actions or answer the relevant questions leading up to such decisions. The data gaps/DQO process was completed for all future work at the site; from field investigations, to interim removal actions, to selection, design and implementation of final removal actions.

As part of the Work Plan process, an assessment of data gaps in the existing site data was performed. This assessment was based on a conceptual understanding of site conditions, which are summarized in Section 2.0 (Site Description and History) and Section 3.0 (Previous Investigations) of the Work Plan. These data gaps, translated into "data requirements", are needed to fulfill the objectives of the NCRAs.

During the Work Plan planning process, DQO Statements (typically in the form of questions) are developed that, in turn, guide the development of a site-specific data collection and analysis program. DQO Statements can be either qualitative or quantitative. The DQO Statements identify the type and/or quality of data required to characterize a site to the extent needed to: 1) select the most appropriate remedial action that will be protective of human health and the environment; and, 2) satisfy all applicable regulatory requirements.

Qualitative DQOs are presented in Section 5.0 of the respective Work Plans. These DQOs are the basis for the data collection program contained in Section 6.0 of the Work Plan, the field sampling program contained in the SAP, and the quality assurance/quality control program and Standard Operating Procedures (SOPs) presented in Attachment A of this Quality Assurance Project Plan (QAPjP).

3.2 QUALITY ASSURANCE OBJECTIVES FOR DATA

The overall quality assurance objective for the NCRAs at SAEP is to develop and implement procedures for sampling, laboratory analyses, field measurements, and reporting that provide data to a degree of quality consistent with their intended use. The sample set, chemical analysis results, and interpretations must be based on data that meet or exceed quality assurance objectives established for the project.

Quality assurance objectives are usually expressed in terms of accuracy, precision, completeness, representativeness, and comparability. Target ranges for these objectives are discussed below.

Accuracy - The estimated ranges of accuracy for each analytical parameter are defined within the analytical test methods and Table 2. Accuracy will be evaluated using results of Laboratory

Control Samples (LCS), Matrix Spikes and Matrix Spike Duplicates (MS/MSD), and surrogates. Accuracy criteria (percent recovery) for the spiked parameters will be provided by the subcontract laboratory in accordance with analytical procedures listed in Table 1.

Precision - Measured as Relative Percent Difference (RPD), precision in laboratory and field duplicate pairs will be compared against the limits stated in the USEPA Region 1 data validation guidelines through the independent data validation process described in Section 11.3.

Completeness - The goal for all measurement systems is 100 percent completeness, that is, all the data should be valid. The acceptability of less than 100 percent complete data will be reviewed on a case-by-case basis.

Representativeness - Representativeness is a qualitative parameter satisfied by making certain sampling locations are selected properly and that a sufficient number of samples are collected.

An evaluation of laboratory method blank and field QC blank (i.e., trip blanks, rinse blanks, and field blanks) data will be completed to determine the potential for laboratory introduced contamination. Blank data will be reviewed during the data validation process described in Section 11.3. Results will be qualified in accordance with the validation guidelines and assessments of the potential for laboratory or field contamination that may not be representative of the sample conditions will be included in the investigation report.

Comparability - Comparability is a qualitative parameter satisfied by making certain that siting considerations, collections techniques, and measurement procedures, methods, and reporting are equivalent for the samples with a sample set. Data comparability for results provided during the analytical laboratory analyses will be assessed using split samples submitted to a QA laboratory designated by the USACE. The USACE chemist will evaluate results.

Variances from the quality assurance objectives will result in implementation of appropriate corrective measures and as assessment of the impact of corrective measures on the usability of the data in the decision-making process.

4.0 SAMPLING LOCATIONS AND PROCEDURES

A description of the sampling locations and procedures for the OU2 NCRA are provided in Section 4.0 of the OU 2 SAP. A description of the sampling locations and procedures for the Causeway and Dike NCRA are provided in Section 4.0 of the Causeway and Dike SAP.

5.0 SAMPLE CUSTODY AND HOLDING TIMES

A description of the sample custody procedures for the NCRAs are provided in Section 5.0 of the respective SAPs. Holding time requirements for environmental samples are presented in the media-specific subsections of Section 5.0 and Table 2 of the SAPs.

All soil samples collected for VOC analysis will be preserved in methanol at the time of sample collection. Procedures for the preservation of samples are presented in Attachment A, SOP No. 13.

6.0 ANALYTICAL PROCEDURES

On site testing includes a soil vapor survey described in Appendix A, Section 4.1, and field kit testing of water samples for hexavalent chromium, ferrous iron, and hydrogen peroxide. Procedures for the soil vapor analysis are described in Attachment A, SOP No. 10. Procedures for the hexavalent chromium, ferrous iron, and hydrogen peroxide field kit analyses are provided by HACH Inc., and are contained in SOP No. 14.

Analytical data will be collected using a combination of on-site screening tests and off-site laboratory chemical analyses. The laboratory analytical procedures anticipated for the NCRAs are summarized in Table 1 (see Attachment B). The designated analyses for sampling locations are defined in the media-specific subsections of Section 4.0 of the SAPs. Specific laboratory practices for the methods listed in Table 1, including sample preparation and analysis, are defined in the referenced methods. Brief descriptions of the analytical procedures are provided below. Listings of target analytes and reporting limits for VOCs, SVOCs, inorganics, and water quality parameters are presented in Table 3 of Attachment B.

Volatile Organics

Soil and water samples will be analyzed using USEPA Method 8260B (USEPA, 1996). Soil samples will be preserved in methanol at the time of sample collection to prevent loss of VOCs during shipment, storage, and analysis at the laboratory. The analytical procedure uses purge and trap sample concentration followed by gas chromatography (GC) mass spectrometry (MS) analysis.

Low Concentration Vinyl Chloride

A subset of groundwater samples will be analyzed for vinyl chloride using modified USEPA Method 8021 procedure designed to obtain reporting limits less than the CTDEP RSR criterion of 2 ug/L. The method will be modified to include only the reporting of vinyl chloride with a specified quantitation limit of 1 ug/L. The instrument will be calibrated using a low point standard at 1 ug/L to define the quantitation limit for the procedure.

Semivolatile Organics

Soil and water samples will be analyzed using USEPA Method 8270C. The analytical procedure includes solvent extraction of samples using methylene chloride, and analysis of extracts using GC/MS.

Polychlorinated Biphenyls

Soil and water samples will be analyzed using USEPA Method 8082. This analytical procedure includes solvent extraction of samples using methylene chloride, and analysis of extracts using GC/MS.

Metals

Soil and water samples will be analyzed for targeted elements using several procedures described in USEPA SW846 methodologies (USEPA, 1996). For all elements except mercury, analyses will be completed using an acid digestion followed by analysis by inductively coupled plasma atomic adsorption spectrometry (ICP), graphite furnace atomic adsorption (GFAA), or ICP-MS. The exact procedures will be based on the subcontracted laboratory and instrument procedures that are chosen to meet the reporting limit goals listed in Table 3. Mercury will be analyzed using cold vapor atomic adsorption procedures in USEPA Method 7470A and 7571A.

Water samples will be analyzed in the field for ferrous iron using test kit procedures provided by HACH, Inc. Test kit procedures are outline in Attachment A, SOP No. 14.

Cyanide

Soil and water samples will be analyzed for total cyanide using either Method 9010B or 9012a (manual vs. automated procedure) depending on availability at the subcontracted laboratory. This procedure involves the use of the transformation of cyanide to hydrocyanic acid followed by distillation and analysis by titration and spectophotometric detection.

Synthetic Precipitation Leaching Procedure (SPLP)

This method is designed to determine the mobility of analytes in the sample matrix. The sample is extracted with a pH-controlled procedure and the extract is analyzed for specified target analytes using USEPA analytical procedures.

Hexavalent Chromium

Soil samples will be analyzed for hexavalent chromium using USEPA Method 3060A/7196A. This method includes colorimetric titration of samples with diphenylcarbizide. Water samples will be analyzed for hexavalent chromium in the field using colorimetric test kits provided by HACH, Inc. Test kit procedures are outlined in Attachment A, SOP No. 14.

Asbestos

Soil samples will be analyzed for asbestos using Polarized Light Microscopy (PLM). Samples collected for asbestos are evaluated under a microscope to determine the percentage of asbestos present in the sample.

Total Petroleum Hydrocarbons

Soil and water samples will be analyzed for total petroleum hydrocarbons using USEPA Method 418.1 infrared spectophotometry. Soil samples will be prepared using procedures described in USEPA Method 9071A prior to analysis using procedures described in Method 418.1. Samples are extracted with Freon-113, and the extract is analyzed using an infrared detector. This method identifies the presence of a wide class of organic compounds including fuel hydrocarbons and a variety of semivolatile organic compounds.

Water Quality Parameters

Water quality parameters include a list of water chemistry indicators that may include chloride; phosphate; chemical oxygen demand (COD); biochemical oxygen demand (BOD); sulfate; sulfide; nitrate/nitrite; ammonia; alkalinity; total organic carbon (TOC); TPH; dissolved calcium, magnesium, iron, and manganese; and hardness. Analytical procedures for these parameters are defined in USEPA methods for waters and wastes (USEPA, 1983).

Hydrogen Peroxide

Water samples will be analyzed for hydrogen peroxide in the field using test kits provided by HACH, Inc. Test kit procedures are outlined in Attachment A, SOP No. 14.

7.0 CALIBRATION PROCEDURES AND FREQUENCY

This section describes calibration protocols for laboratory and field instruments that will be used during the OU2 investigation.

7.1 FIELD INSTRUMENTS

SOP No. 12, Draft Calibration of Field Instruments U.S. Environmental Protection Agency (USEPA) Region 1, in Attachment A of this QAPjP details the calibrations procedures and frequency for field instruments. Calibration procedures for the soil vapor analysis are described in SOP No. 10.

7.2 OFF-SITE LABORATORY

The off-site laboratory will maintain records that include detailed information regarding calibration of analytical instruments and associated support equipment. Calibration procedures are described in the analytical procedures listed on Table 1.

7.3 ANALYTICAL SUPPORT AREAS

Reference standards and standard solutions will be obtained from the National Institute of Standards and Technology or other reliable commercial source. Preparation and maintenance of standards and reagents will be performed in accordance with the specified methods and documented.

Analytical balances will be calibrated by the manufacture annually and have a calibration check performed at least daily. Balance calibrations will be documented.

All refrigerators and freezers will be monitored for proper temperature by measuring and recording internal temperatures on a daily basis. Thermometers will be calibrated at least annually.

A water supply system capable of furnishing American Society for Testing and Materials (ASTM) Type II 'polished" water will be utilized. The quality of the water will be documented on a regular basis.

8.0 INTERNAL QUALITY CONTROL CHECKS

This section identifies specific internal quality control (QC) methods to be used by the laboratory performing the analytical tests. Internal QC checks are used to determine if analytical operations are in control, as well as to determine the effect sample matrix may have on data being generated. These two aspects are described as batch QC and matrix-specific QC procedures.

8.1 BATCH QC

Samples will be extracted and analyzed in batches, not to exceed 20 samples, that are uniquely identified. Batch Quality Control (Batch QC) includes:

Method Blanks - A method blank consists of analyte-free deionized reagent water or equivalent neutral reference material. The method blank is carried through each step of the analytical method and the results are used to evaluate the possible influence of analytical methods on sample analytical results. At least one method blank will be analyzed with every batch of samples processed.

Laboratory Control Samples - A laboratory control sample (LCS) will be prepared and analyzed with each analytical batch. The LCS will consist of target analytes spiked into a clean soil or water matrix that is carried through the same preparation and analytical procedures as actual samples. Percent recovery of target analytes is determined and compared to control limits generated at the laboratory. LCS results are used to evaluate the analytical accuracy of the laboratory data without the influence of site-specific sample matrices.

LCS limits will be included in the table when the lab is contracted and information becomes available

8.2 MATRIX-SPECIFIC QC

Matrix-specific QC is based on the use of actual environmental samples for precision and accuracy determinations. Results of these samples, supplemented with field blank results, are used to assess the effect of sample matrix and field conditions on analytical data. Matrix-specific QC samples include:

Matrix Duplicates - A matrix duplicate (or field duplicate) sample is prepared by field personnel by dividing an individual environmental sample into two separate aliquots, placing each aliquot into identical but separate sample containers, and submitting the samples to the laboratory without indicating that they are duplicates, i.e., "blind." Duplicates are analyzed for the same parameters as the samples which they duplicate.

Matrix Spikes- A matrix spike (MS) sample and matrix spike duplicate (MSD) is an environmental sample to which known concentrations of analytes have been added. The MS sample is taken through the entire analytical procedure and the percentage of recovery of the analytes is calculated. Results are expressed as percent recover of the known amount spiked. The matrix spike is used to evaluate the effect of the sample matrix on the accuracy of the analysis. A matrix spike duplicate (MSD) is the same environmental sample as the MS which is spiked with the same known concentrations of analytes. The two spiked aliquots are processed separately and the results compared to evaluate the effects of the matrix on the precision and accuracy of the analysis. Results are expressed as RPD between the duplicate samples analyzed and as percent recovery. Control limits for MS/MSD are included in Table 2. Limits for VOC and SVOC analyses were obtained from the USEPA CLP SOW OLM03.0 and represent minimum requirements for the project. Additional limits that are generated by the subcontract laboratory in accordance with the SW-846 methods (USEPA, 1996) will also be obtained and used during the data validation process. Control limits for Inorganics were obtained from the USEPA Region I data validation guidelines (USEPA, 1989).

Surrogate Spike Samples - A surrogate spike sample is a blank sample that is spiked with a known quantity of surrogate prior to purging or extracting according to the appropriate analytical methods. Surrogate spike recoveries must fall within control limits generated by the laboratory (in accordance with the analytical method) for undiluted samples. Surrogate spikes are compounds added to every blank, sample, matrix spike, matrix spike duplicate and standard when specified in the analytical methodology. Surrogate spike compounds are generally brominated, fluorinated, or isotopically labeled compounds not expected to be present in environmental media. Results are expressed as a percent recovery (%R) and are utilized to evaluate the accuracy of an analytical measurement on a sample-specific basis. Surrogate spike samples will be applied to organic analyses only.

8.3 QUALITY ASSURANCE SPLIT SAMPLES

Approximately 10% of all samples submitted to the off-site laboratory will be collected as split samples. The splits will be submitted to a quality assurance (QA) laboratory designated by the USACE to provide data on the comparability of data generated at an independent laboratory. Results from the primary laboratory will be submitted to the USACE for comparison to the QA laboratory data.

9.0 CALCULATION OF DATA QUALITY INDICATORS

This section discusses how precision, accuracy and completeness goals are to be calculated from the project data.

9.1 PRECISION

Precision is the measure of variability between individual sample measurements under prescribed conditions. Precision will be expressed as relative percent difference (RPD) as follows:

$\text{RPD} (\%) = (| S-D | / [(S+D)/2]) \times 100$

where,

S = measured value of first sample (original)

D = measured value of second sample (duplicate)

Precision will be compared against the limits in the laboratory's QA/QC Manual and through the independent data validation process described in Section 11.3.

9.2 ACCURACY

Accuracy is the degree of agreement of a measurement to an accepted reference or true value. Accuracy will be expressed as percent recovery as follows:

$\text{Percent Recovery} = ([X - S]/K) \times 100$

where,

X = measured value of spiked sample

S = measured value of unspiked sample

K = known amount of spike in the sample

Acceptable accuracy measures are also dependent on the sample matrix. Accuracy criteria (percent recovery) for the parameters to be analyzed by the analytical laboratory will be provided in the laboratory's QA/QC Manual.

9.3 COMPLETENESS

Completeness is a measure of the amount of data from a given measurement system that is considered valid based on the prescribed data quality objectives. The completeness goal is to generate a sufficient amount of valid data to support the NCRA objectives. Completeness may be calculated as follows:

$\% \text{ Completeness} = V/T \times 100$

where,

V = number of valid analytical results (accepted and estimated)

T = total number of analytical results requested

The goal for all measurement systems is 100 percent completeness, that is, all the data should be valid. The acceptability of less than 100 percent complete data will be reviewed on a case-by-case basis.

9.4 METHOD DETECTION LIMIT

Method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. The laboratory reporting limit (RL) will be verified by MDL study data provided by the subcontractor laboratory. RL goals are to be a minimum of three to five times greater than the MDL. The laboratory will report all values above the MDL. However, those values above the MDL and below the RL will be flagged to indicate an estimated value. A complete list of target analytes, estimated MDLs, RLs is presented in Attachment B of the SAP. Actual MDL results will be obtained from the subcontract laboratory prior to submitting samples for analysis. A review of MDLs will be completed to verify that reporting limit goals are obtainable for this project.

10.0 CORRECTIVE ACTIONS

When errors, deficiencies, or out-of-control situations exist, the laboratory's QA/QC Manual will provide systematic procedures, called corrective actions, which will be implemented to resolve problems and restore proper functioning to the analytical system. This typically includes corrective actions for the following:

Problems noted during receipt of incoming samples;

- Failure to meet sample extraction/digestion/analysis holding times;
- Failure to achieve appropriate initial and continuing instrument calibration;
- Difficulty in performing appropriate sample cleanup procedures to achieve practical quantitation limits;
- Failure to meet method QC requirements (including blanks, matrix duplicates, matrix spikes, matrix spike duplicates, and surrogate recoveries) as specified in the analytical method; and,
- Calculation or reporting errors.

Corrective action procedures are often handled at the bench level by the analyst, who can review the preparation procedure for possible errors, check the instrument calibration, spike, surrogate, calibration solutions, instrument sensitivity, etc. If the problem persist or cannot be identified, the matter is referred to the laboratory supervisor, manager, and/or quality assurance (QA) department for through investigation. Once resolved, full documentation of the corrective action procedure is filed with the project records.

Details on the laboratory's corrective action procedures will be available in the laboratory's QA/QC Manual.

11.0 DATA REDUCTION, VALIDATION AND REPORTING

All analytical data generated by the laboratory will be reviewed prior to report generation to assure the validity of the reported data. This review process consists of data reduction, data review, data validation, and data reporting as discussed below. The anticipated laboratory turnaround time is also provided in this section.

11.1 DATA REDUCTION

Laboratory personnel will perform the in-house analytical data reduction in accordance with the data reduction procedures specified in the laboratory's QA/QC Manual and the analytical methodology utilized.

11.2 DATA REVIEW

Details on the laboratory's data review procedures will be available in the laboratory's QA/QC Manual. A general description of data review procedures are provided below.

The laboratory analyst who generates the analytical data has the prime responsibility for the correctness and completeness of that data. Analysts review the quality of their work to ensure that:

- Sample preparation information is correct and complete;
- Analysis information is correct and complete;
- Appropriate SOPs have been followed;
- Analytical results are correct and complete;
- QC samples are within established control limits;
- Blanks and laboratory control samples are within appropriate QC limits;
- Special sample preparation and analytical requirements have been met; and,
- Documentation is complete.

The analytical data reviewer evaluates the quality of the work based on established laboratory guidelines. The analytical data reviewer checks a percentage of the data to ensure that:

- All appropriate laboratory SOPs have been followed;
- Calibration data are complete and correct;
- QC samples are within established guidelines;
- Qualitative identification of sample components is correct;
- Quantitative results are correct;
- Documentation is complete;
- Data are ready for incorporation into the final report; and,
- The data package is compete and ready for data archive.

The laboratory QA officer/director performs a review similar to that of the data analytical reviewer except that he/she conducts a total overview of the data package from an administrative perspective to ensure its consistency and compliance with laboratory procedures and documentation.

A signed and dated statement is included in the laboratory analytical report certifying the adherence to the appropriate QA/QC procedures.

11.3 DATA VALIDATION

An independent validation of the analytical data will be performed by Foster Wheeler/HLA to assure the validity of the data. This review is intended to verify that:

- QC samples are within established guidelines;
- Qualitative identification of sample components is correct;
- Quantitative results are correct;
- Documentation is complete and correct;
- The data is ready for incorporation into the final report; and,
- The data package is complete.

Analytical data will undergo review in accordance with the analytical methodology utilized. Criteria for review of data are obtained from Region 1, EPA-New England Data Validation Functional Guidelines for Evaluating Environmental Analyses, July 1996 revised December 1996, or their updated versions. Data obtained from the VOA, SVOA, PCB, and inorganics analysis will be reviewed and validated in accordance with USEPA Region I Tier II specifications. Data obtained for the remaining methods listed in Table 1 will have a validation process that includes the following items:

- Sample documentation and holding time checks
- QC blank data evaluations
- LCS accuracy review
- MS/MSD precision and accuracy reviews
- Laboratory and/or field duplicate reviews
- Surrogate recovery data reviews

Through this independent review of laboratory results, the data will be qualified, as necessary. For example, sample data may be qualified as "J" (estimated), "UJ" (not detected-estimated) or it may be rejected (indicated by "R"). The qualifier "U" is normally used for analytes not detected by the laboratory.

The data validator will identify any out-of-control data points and data omissions and interact with the laboratory to correct data deficiencies. Revised pages will be inserted into the laboratory report as necessary. Based on the extent of the deficiencies and their importance in the overall context of the project, the Project Manager may decide to repeat sample collection and analysis.

The independent data review will be documented in a data validation report that will be signed and dated by the data validator.

11.4 DATA REPORTING

The laboratory will report the data as a group of 20 samples or less, along with supporting QC data, as appropriate for the analytical methodology utilized. The general contents of the hard copy of a laboratory data report are listed below:

- Chain-of-custody forms;
- Cover sheets listing the samples included in the report;
- Narrative comments describing problems encountered in analysis and corrective actions taken;
- Analytical data including field sample identification number, laboratory sample number, date of sample collection, date of sample receipt at laboratory, date(s) of sample extraction/digestion/analysis, batch numbers, calibration information, dilution factors, all analytes tested for and their associated reporting limits, any data qualifiers assigned, matrix, units, percent solids for solid samples, and sample description; and,
- Analytical results for QC samples including blanks, spikes, duplicates, and surrogate recoveries.

To facilitate the transfer and evaluation of analytical data, electronic data deliverables (diskettes) will be requested from the laboratory. (Electronic deliverables contain Data Summary Tables only and do not provide the complete backup information contained in the hard copy described above.) To ensure accurate transfer of laboratory data, the accuracy of electronic copies of analytical data provided by the laboratory will be verified by manually checking a minimum of ten percent of the sample data to the hard copy laboratory data package(s). If inaccuracies are detected, additional data will be checked and appropriate corrective actions taken.

11.5 LABORATORY TURNAROUND TIME

Turnaround time for samples submitted for analysis at the off-site laboratory will be for standard delivery (14 calendar days) from the time of sample receipt.

12.0 PREVENTATIVE MAINTENANCE

Maintenance programs will be followed by the on-site and off-site laboratories to prevent the failure of laboratory equipment or instrumentation during use. Preventive maintenance and careful calibration help to assure accurate measurements from laboratory instruments.

Preventive maintenance procedures such as detector cleaning, and the frequency of such maintenance, will be performed according to the procedures delineated in the manufacturer's instrument manual. Chromatographic carrier gas purification traps, injector liners, and injector septa are cleaned or replaced on a regular basis. Maintenance must be performed when the instrument begins to degrade as evidenced by the degradation of peak resolution, shift in calibration curves, decreased sensitivity, or failure to meet one or another of the QC criteria.

Instrument logbooks are maintained in the laboratories. They contain records of usage, calibration, maintenance, and electronic parts are maintained in the laboratories so that they are available when needed. Information regarding the instruments used, including manufacturer, model number, and accessories can be obtained from the laboratory on request.

13.0 PERFORMANCE AND SYSTEM AUDITS

Performance and system audits will be performed as appropriate throughout the duration of the NCRA. The objectives of the performance and system audits are:

- to ensure that the quality assurance program described herein is being implemented;
- to assess the effectiveness of the quality assurance program;
- to identify nonconformances; and,
- to verify correction of identified deficiencies or nonconformances.

It is anticipated that the laboratory selected to provide analytical services for this project will undergo a validation/certification audit procedure by the United States Army Corps of Engineers (USACE) including performance evaluation sample analysis and a laboratory facility inspection. This validation is implemented at the discretion of USACE.

13.1 PERFORMANCE AUDITS

Laboratory performance audits are conduct on a routine basis and include items such as:

- verification of written procedures and analysts' understanding;
- verification and documentation of procedures;
- verification of documents;
- periodic, unannounced inspection of the analytical process record keeping; and,
- review of a portion of all analytical data and calculations.

In addition, external performance audit check samples may be submitted by external regulatory agencies to assess whether a laboratory is generating data within acceptable control limits. If external performance audit check samples are provided by USACE, the laboratory will analyze these samples and provide analytical results along with results of the investigation samples. Requirements for the performance audit check samples may be fulfilled as part of the contract laboratory validation procedures for USACE.

In addition, USACE, may request that QA samples, usually in the form of splits or replicates of field samples, be submitted to the USACE QA laboratory.

13.2 SYSTEM AUDITS

Systems audits are conducted during the NCRA activities in order to verify that quality control measures/procedures specified in this QAPP are being used, that documentation and project records are being completed and maintained, and that reviews of documents and reports are being conducted.

A laboratory systems audit may be conducted by the QA/QC Officer (or qualified designee) during analysis of initial sample shipments sent to the laboratory. If a laboratory systems audit is conducted, the QA/QC Officer (or designee), in conjunction with the project manager (or designee) representing the laboratory, will review documentation used to verify that instrumentation required by the analytical program is being operated and that the instruments are functioning properly. This initial audit will also include a review of the analytical methods proposed for use and the laboratory SOPs prepared from these methods. The laboratory project manager (or designee) will make changes as necessary following the initial laboratory systems audits and confirm orally within five working days and in writing within ten working days to the QA/QC Officer (or designee) that the laboratory meets all requirements of the measurement system.

13.3 FIELD AUDITS

Field audits will be performed as necessary by the Foster Wheeler/HLA Site Manager.

14.0 QUALITY CONTROL REPORTS TO MANAGEMENT

QC reports are prepared by the laboratory and will be submitted to Foster Wheeler/HLA. These reports typically include:

- An assessment of accuracy, precision, and completeness;
- Performance and system audit results; and,
- Significant QA problems encountered and their resolution.

ATTACHMENT A
STANDARD OPERATING PROCEDURES

ATTACHMENT A
STANDARD OPERATING PROCEDURES (SOPs)

SOP No.	TITLE
SOP No. 1	SOIL SAMPLING USING SPLIT-SPOON SAMPLERS*
SOP No. 2	MONITORING WELL INSTALLATION*
SOP No. 3	GROUNDWATER SAMPLING PROCEDURE LOW FLOW RATE PURGING AND SAMPLING (USEPA REGION 1)*
SOP No. 4	SLUG TESTING*
SOP No. 5	WATER LEVEL MEASUREMENT*
SOP No. 6	SAMPLE IDENTIFICATION, HANDLING, AND DOCUMENTATION*
SOP No. 7	DECONTAMINATION*
SOP No. 8	GEOPHYSICAL SURVEY (FOSTER WHEELER/HLA)
SOP No. 9	SUDAN IV DYE TESTING (HLA)
SOP No. 10	SOIL GAS SAMPLING*
SOP No. 11	TEST PITS (HLA)
SOP No. 12	DRAFT CALIBRATION OF FIELD INSTRUMENTS (USEPA REGION 1)*
SOP No. 13	FIELD PRESERVATION OF SOIL SAMPLES FOR VOLATILE ORGANIC ANALYSIS
SOP No. 14	HACH KIT FIELD ANALYTICAL PROCEDURES FOR HEXAVALENT CHROMIUM, FERROUS IRON, AND HYDROGEN PEROXIDE ANALYSES

* These SOPs are taken directly from URSGWC's Final Remedial Investigation Work Plan for the Stratford Army Engine Plant (October 26, 1998)

SOP No. 1 SOIL SAMPLING USING SPLIT-SPOON SAMPLERS

Please refer to attached URSGWC SOP No. 1. Foster Wheeler/HLA will use forms equivalent to those provided in the URSGWCFS SOP.

STANDARD OPERATING PROCEDURE NUMBER 1

SOIL SAMPLING USING SPLIT-SPOON SAMPLERS

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LIST OF FIGURES

1.0

PURPOSE AND SCOPE

This document defines the standard procedure for collecting soil samples. This Standard Operating Procedure (SOP) serves as a supplement to the Field Sampling Plan (FSP). This procedure gives descriptions of equipment, field procedures, and QA/QC procedures necessary to collect soil samples. The sample locations and frequency of collection are specified in the FSP.

This SOP is intended to be used together with the FSP and several other SOPs. Sample identification, handling, and documentation procedures are described in SOP No. 6. SOP No. 7 describes decontamination procedures which are also applicable to this SOP. Health and safety procedures and equipment that will be required during the investigation are detailed in the Site-Specific Safety and Health Plan (SSHP).

2.0
PROCEDURES FOR SOIL SAMPLING

Subsurface soil samples for chemical analysis will be collected using stainless steel 2-inch O.D. split-spoon samplers. Subsurface samples for geotechnical analysis will be collected using non-stainless steel 2-inch O.D. split-spoon samplers or Shelby tubes.

2.1 EQUIPMENT LIST

The following list of equipment will be needed to collect subsurface soil samples

- Drill rig with appropriate drilling and stainless steel 2-inch O.D. split spoon sampler (for chemical analytical sampling)
- Drill rig with appropriate drilling tools, 3-inch-diameter Shelby tubes, and non-stainless steel 2-inch O.D. split spoon sampler (for geotechnical sampling)
- Measuring tape - 150 feet
- Aluminum foil
- Field books/field sheets
- Stainless steel spoons
- EnCore™ sampler or disposable plastic syringes
- Portable balance and balance weights
- Sample bottles provided by the laboratory
- Sample bottle labels
- Label tape (clear)
- Paper towels
- Camera and film
- Waterproof and permanent marking pens
- Plastic sheeting
- Plastic bags
- Appropriate health and safety equipment, as specified in the SSHP
- Appropriate decontamination supplies

2.2 DECONTAMINATION

Before drilling or sampling begins, the drilling and sampling equipment will be decontaminated according to the procedures contained in SOP No. 7. Drilling and sampling equipment will be decontaminated between boring and sampling locations. Sampling equipment will also be decontaminated between collection of samples from different depths at the same location.

2.3 ANALYTICAL SOIL SAMPLING

The procedures for collecting subsurface analytical soil samples are provided in the following sections.

2.3.1 Subsurface Soil Sampling For Chemical Analysis

Subsurface soil sampling for chemical analysis will occur in borings. Borings will be advanced by auger drilling a boring, using machine driven hollow-stem augers (HSA) with a 4-1/4 inch minimum inside diameter to accommodate a 2-inch outside diameter stainless steel split-spoon sampler. Auger borings will be performed in accordance with ASTM D1452 and standard penetration tests will be made according to ASTM D1586-84. A HSA steel finger plug installed in the bit will be used to prevent soil material coming into the interior of the hollow stem augers.

The coupling head for the split-spoon sampler will contain a ball check valve and will have open vents. Where necessary for sample recovery, the sampler will also be equipped with a spring-type sample retainer or an equivalent retainer.

If refusal is encountered before reaching the required depth, the boring will be relocated approximately 2 feet from the original boring. A second attempt will be made to obtain the remaining sample(s) before drilling operations are stopped at that location.

The procedure for collecting, labeling, storing, and transporting subsurface soil samples is described below:

- Decontaminate the drilling and sampling equipment according to SOP No. 7.
- Record the boring location on a site map and in the field log book.
- Select the appropriate sampler for boring and collect the soil samples using the drilling rig at the intervals stated in the FSP.
- Don a clean pair of latex surgical gloves.
- Open the split-spoon and measure the recovery and scrape off any soil smear zone from the recovered sample with a stainless steel spoon. Determine and identify the use of the recovered sample. This will always be for visual soil classification and stratigraphic logging and may be for chemical or geotechnical analysis.
- Samples to be collected for volatile organic compound (VOC) analysis should be collected prior to homogenizing the retained sample. The sample for VOC analysis should be collected using an EnCore™ sampler or disposable plastic syringe with syringe end of barrel cut off in accordance with USEPA Method 5035 (field preservation/extraction with methanol/ sodium bisulfate).
- Homogenize the remaining sample. Then, fill the remaining bottles in the following order:
    - Semi-volatile organic compounds (SVOCs)
    - Polychlorinated biphenyls (PCBs)
    - Remediation parameters
    - Metals (including cyanide)

- Label, store, transport and document the samples (depending on the use of the sample) according to SOP No. 6.

- Record applicable information on the sample collection Field Sheet (Figure 1) and Chain-of-Custody (COC).

- Complete the lithologic description of the recovered sample according to the Unified Soil Classification System.

- Identify the location for future reference.

2.3.2 Soil Geotechnical Sampling

Soil samples for geotechnical analysis will be collected either with a split-spoon sampler or with a 3-inch O.D. thin-walled samplers (galvanized Shelby tubes) as described in ASTM D1587-83. The field inspector/geologist will utilize ASTM-2488 to classify soils in the field using a group symbol and group name with 10% range for each soil component. Field logs will be corrected after seive analysis of samples have been completed to show actual designation and percentages.

Sampling equipment will be decontaminated according to SOP No. 7.

2.4 FIELD QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

Field Quality Assurance/Quality Control (QA/QC) samples are designed to help identify and minimize potential sources of sample contamination due to field procedures and to evaluate potential error introduced by sample collection and handling. All field QA/QC samples are labeled with QA/QC identification numbers and sent to the laboratory with the other samples for analyses. The frequency of QA/QC samples is specified in the FSP.

2.4.1. Field Blank Samples

A field blank sample of sampling equipment is intended to check if decontamination procedures have been effective. A field blank will be collected from the decontaminated sampling equipment before it is used to obtain a sample. Organic-free deionized water will be rinsed over the decontaminated sampling apparatus and transferred to the sample bottles. The same parameters that are being analyzed in the field samples will be analyzed in the field blank. The field blank is assigned a QA/QC sample identification number, stored in an iced cooler, and shipped to the laboratory along with the soil samples collected that day.

2.4.2 Duplicate Samples

Duplicate samples are samples collected as close as possible to each other in time and space to check for the natural sample variance and the consistency of field techniques and laboratory analysis. The duplicate samples will be collected at the same time as the primary samples. For example, primary sample bottles for the volatile analysis will be filled first, then the duplicate sample bottles for volatiles, and so on until all necessary sample bottles for both the primary sample and the duplicate sample have been filled. The duplicate sample will be handled in the same manner as the primary sample. The duplicate sample will be assigned a QA/QC identification number, stored in an iced cooler, and shipped to the laboratory along with the primary sample it duplicates.

2.4.3 Matrix Spikes and Matrix Spike Duplicates

Matrix spikes are used to determine the long-term precision and accuracy of the laboratory analytical method on various matrices. For this procedure duplicate samples are collected with the field samples and spiking is done by the laboratory. Samples are labeled as matrix spikes for the laboratory. It is useful to collect enough additional sample for both the matrix spike and duplicate samples from the same location.

2.4.4 Blind Spikes and/or Blanks

The USACE may provide blind spikes and/or blanks for laboratory analysis to determine the accuracy of the laboratory analytical method. The samples will be assigned a QA/QC identification number, stored in an iced cooler, and shipped to the laboratory on the day received.

2.5 SAMPLE IDENTIFICATION, HANDLING, AND DOCUMENTATION

Samples will be identified, handled and recorded as described in this SOP and SOP No. 6. The parameters for analysis and preservation are specified in the FSP.

2.6 DOCUMENTATION

Each field activity must be properly documented to facilitate a timely and accurate reconstruction of events in the field (see SOP No. 6). Sample collection field sheets will be completed for all soil samples submitted for chemical analysis (Figure 1).

2.6.1 Field Logbook

The most important aspect of documentation is thorough, organized, and accurate record keeping. All information pertinent to the investigation and not documented on the boring log will be recorded in a bound logbook with consecutively numbered pages. All entries in logbooks will be made in waterproof ink and corrections will consist of line-out deletions that are initialed and dated. Entries in the logbook will include the following, as applicable:

- Project name and number
- Sampler's name
- Date and time of sample collection
- Sample number, location, and depth
- Sampling method

- Sampling media
- Sample type (grab or composite)
- Sample preservation
- Observations at the sampling site
- Unusual conditions
- Information concerning drilling decisions
- Decontamination observations
- Weather conditions
- Names and addresses of field contacts
- Names and responsibilities of field crew members
- Names and titles of any site visitors
- Location, description, and log of photographs (if taken)
- References for all maps and photographs
- Information concerning sampling changes, scheduling modifications, and change orders
- Summary of daily tasks and documentation on any cost or scope of work changes required by field conditions
- Signature and date by personnel responsible for observations

Field investigation situations vary widely. No general rules can include each type of information that must be entered in a logbook for a particular site. A site-specific logging procedure will be developed to include sufficient information so that the sampling activity can be reconstructed without relying on the memory of field personnel. The logbooks will be kept in the field team member's possession or in a secure place during the investigation. Following the investigation, the logbooks will become part of the final project file.

2.6.2 Boring Logs

Boring logs will be completed for each boring by qualified personnel (geologist, geological engineer, or geotechnical engineer). The boring log form is shown on Figure 2.

SAMPLE COLLECTION FIELD SHEET
REMEDIAL INVESTIGATION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

SAMPLE NUMBER:____________________

DATE and TIME OF COLLECTION:____________________________

COLLECTED BY:___________________________________

SAMPLE MEDIA: Soil Water Sediment

SAMPLE DEPTH:______________

SAMPLING EQUIPMENT:____________________________________

SAMPLING METHOD:__________________________________

SAMPLE SPLIT? NO YES SPLIT SAMPLE NUMBER:_____________________________

QA/QC SAMPLES? NO YES QA/QC SAMPLE NUMBERS:_____________________________

Sample Container	Preservative	Analysis Requested

SAMPLE DESCRIPTION:____

INSTRUMENT SCREENING:____

COMMENTS:____

Figure 1
Sample Collection Field Sheet

BORING LOG

HOLE No 0

COMPANY NAME

2. DRILLING SUBCONTRACTOR

SHEET 1
OF 0 SHEETS

3 PROJECT

4 LOCATION

DRILLER

6 MANUFACTURER'S DESIGNATION OF DRILL

7 SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT

8 HOLE LOCATION

9 SURFACE ELEVATION
feet

10. DATE STARTED

11. DATE COMPLETED

12 OVERBURDEN THICKNESS

15. DEPTH GROUNDWATER ENCOUNTERED

13 DEPTH DRILLED INTO ROCK

16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED

14 TOTAL DEPTH OF HOLE

17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)

18 GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19 TOTAL NUMBER OF CORE BOXES

20 SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	21 TOTAL CORE RECOVERY %

22 DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23 SIGNATURE OF INSPECTOR

ELEV a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No f	BLOW COUNTS g	REMARKS h

Project

Hole No.

Figure 2
Boring Log Form

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SOP No. 2 MONITORING WELL INSTALLATION

Please refer to attached URSGWC SOP No. 2. Foster Wheeler/HLA will use forms equivalent to those provided in the URSGWCFS SOP.

One additional type of installation not described in URSGWCFS SOP No. 2 is the installation of piezometers. It is anticipated that 1-inch ID piezometers will be installed to measure water levels at SAEP. The primary discrepancies from SOP No.2 are as follows:

- The inside diameter of the PVC riser will be 1-inch
- Multiple piezometers at different depths may be installed inside the same borehole
- Development of the piezometers will be considered complete when turbidity readings of less than 100 NTUs are achieved

STANDARD OPERATING PROCEDURE NUMBER 2

MONITORING WELL INSTALLATION

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LIST OF FIGURES

1.0
PURPOSE AND SCOPE

The purpose of this document is to define the standard operation procedures (SOP) for installation and development of groundwater wells. The procedures are sufficiently detailed to allow field personnel to properly install and develop wells.

This SOP serves as a supplement to the Field Sampling Plan (FSP) and is intended to be used together with the FSP and several other SOPs. SOP No. 7 describes the decontamination procedures applicable to well installation and development.

2.0
PROCEDURES FOR DRILLING AND MONITORING WELL INSTALLATION

2.1 DRILLING AND WELL INSTALLATION PROCEDURES

This section will describe the standard operating procedures for the installation of both shallow wells (total depth less than 20 ft), intermediate wells (total depth 50 to 60 ft) and deep wells (total depth over 100 feet), the data recorded during the drilling of the well and the well installation procedures. These procedures are defined in keeping with the requirements of the USACE and the standard operating procedures of W-C.

2.1.1 Shallow Wells

The borings for shallow wells, i.e. wells screened from approximately 5 to 15 feet below ground surface (bgs), will be advanced using a truck-mounted hollow stem auger (HSA) drill rig. The drill rig, augers and other drilling tools that will be used down the hole will be steam cleaned before beginning a new boring and before leaving the site. Borings which cannot be completed by the end of a working day will be covered to prevent contaminated material from entering the borehole and will be secured using available equipment.

During the advancement of the well boring, soil samples will be collected using a 2-inch outer diameter (OD) split spoon sampler advanced 24 inches using a 140 lb hammer dropped approximately 30 inches (ASTM D1586-84). The split spoons will be decontaminated according to methods outlined in Section 2.2.2 of SOP 7. Blow counts will be recorded by the W-C drilling inspector.

2.1.1.1 Variable Site Conditions

In areas where the subsurface stratigraphy is principally sand, with some to trace silt, it is not uncommon to encounter "running" sands during the advancing of the well boring below the water table. Running sands are sands that advance up the annulus of the auger when the big plug is removed so that a split spoon sample can be collected. In the event running sands are encountered, potable water will be added to the boring. The weight of the water may stabilize the running sands, thus allowing the sampling and/or installation to continue. In the event the introduction of a head of potable water does not stabilize the well boring, the USACE will be consulted regarding the use of alternative methods of stabilizing or, if necessary, advancing the well boring.

2.1.2 Intermediate and Deep Well Borings

Deep well borings will be advanced using a truck-mounted HSA drill rig. The drill rig, augers and other drilling tools that will be used down the hole will be steam cleaned before beginning a new boring and before leaving the site. Borings which cannot be completed by the end of a working day will be covered to prevent contaminated material from entering the borehole and will be secured using available equipment.

During the advancement of the well boring, soil samples will be collected using a 2-inch outer diameter (OD) split spoon sampler advanced 24 inches using a 140 lb hammer dropped approximately 30 inches (ASTM D1586-84). The split spoons will be decontaminated according to methods outlined in Section 2.2.2 of the SOP 7. Blow counts will be recorded by the person inspecting the boring.

Deep well borings will be advanced to the depth of the shallow water table or to a maximum of 10 feet below ground surface. At that point, the augers will be removed and a 6-inch inner diameter (ID) steel casing, a "working casing," will be driven to the maximum advancement depth of the augers. The augers will then be steam cleaned or replaced by clean augers in order to prevent the augers from carrying potentially contaminated soil from above the water table to the screened interval of the deep wells. The working casing will be removed during the installation of the well (Section 2.3).

2.1.2.1 Variable Site Conditions

- In the event of "running sands" W-C reserves the right to use standard industry techniques such as those described in Section 2.1.1.1.
- Where the shallow saturated zone contains contamination, the working casing will be set below the contaminated zone in order to minimize the potential for cross-contamination between various depths.

2.2 STRATIGRAPHIC LOGGING

Soil samples will be collected using 2-inch OD split spoon samplers. Samples for lithologic logging will be collected every 2.5 feet for the first 10 feet, and every 5 feet for the remaining depth of each boring.

Soil descriptions will be based on visual/manual observations of the soil in the split spoon samples, augmented by observations of soil cuttings from the auger flights. The typical sequence of describing a soil sample is as follows:

- Unified Soil Classification Symbol;
- consistency of cohesive materials or apparent density of non-cohesive materials;.
- moisture content assessment;
- color;
- other descriptive features;
- depositional type.

A legible, concise record of all significant information pertaining to drilling and sampling operations for each boring will be maintained concurrent with the advancement of the hole. This information will be recorded by the W-C drilling inspector on a boring log (Figure 1).

2.3 WELL INSTALLATION PROCEDURES

All materials used for the construction of the wells will be inert with respect to the contaminants of concern. The well screen and riser will be 2-inch OD, flush joint, schedule 40 PVC. Both the well screen and riser will be steam cleaned before installation to insure that remnant machine oils and greases have been removed. Typical well construction is as follows (Figure 2):

- Ten feet of 2-inch OD factory slotted PVC installed in a 6-inch nominal borehole. Based on our current understanding of the site, it is anticipated that 0.010 inch (No. 10) slot will be used. A bottom cap will be installed at the base of the screen. If conditions warrant the use of a different size screen, USACE will be consulted for approval.
- A filter pack of graded sand will be tremied down the annulus of the borehole to an elevation of approximately 3 feet above the top of the screened interval.
- A 3-foot thick bentonite seal will be placed above the sand pack using bentonite pellets.
- The remaining annular space will be tremie grouted with a cement-bentonite grout to within 3 feet of the ground surface. The grout will be composed of approximately 7 gallons of water per 94 lb bag of cement with 3 to 5 percent bentonite (by weight).
- A steel protective casing will be cemented into place in the remaining annular space and the well will be finished with a 4-inch thick, 3-foot square, sloping concrete apron.

The finished well will be fitted with an internal expandable locking cap and bolted flushmount cover.

2.3.1 Variations on Standard Well Installation Procedures

W-C recognizes that field conditions and/or slight differences between shallow and deep well construction methods may cause variations on the well construction procedures outlined above. For example, it is anticipated that the deep wells will have the working casings removed before the well is tremie grouted to within 3 feet of ground surface. However, if the shallow portion of the well boring is unstable, W-C reserves the right to leave the working casing in place.

W-C reserves the right to install wells without using centralizers on the well screen and riser. Centralizers are not compatible with well installation using HSAs and/or in areas where borehole stability is in question. If the HSAs were removed before well installation, the borehole may collapse at any elevation, thereby not allowing the well to be installed at the appropriate depth. To avoid this situation, the wells will be installed through the annular space of the augers, removing the augers in a stepped fashion. If this method is used, centralizers cannot be used because they will not fit down the annular space of the augers.

W-C will consult with the USACE and obtain USACE approval on any variations from the procedures described in this SOP.

2.4 WELL INSTALLATION DOCUMENTATION

A well installation form will be completed for every completed well (Figure 3). The information included on the well installation form is:

- Well designation;
- Date and time well started;
- Date and time well completed;
- Surface elevation (to the nearest 0.1 ft);
- Casing elevation (to the nearest 0.01 ft);
- Elevation of top of grout in annular space;
- Elevation of top of bentonite seal;
- Elevation of top of sand/gravel pack;
- Elevation of top of screen;
- Elevation of bottom of screen; and,
- Elevation of bottom of borehole.

A summary of the well installation procedures including the volume of each material used will be included in the "Remarks" section of the well installation summary form.

3.0
WELL DEVELOPMENT PROCEDURE

Wells will be developed to improve the hydraulic communication between the formation and monitoring wells and to help assure that representative ground water samples will be collected. During the drilling process, the sides of the borehole may become smeared (commonly referred to as the "skin effect") which substantially retards the movement of water into the well. In addition, soil may enter the filter pack, or temporarily clog the well screen slots during the installation of the well materials.

Well development is the process of flushing the interface between the aquifer and the well. In addition, the filter pack and screen slots are cleaned, allowing ground water to flow into the well with a minimum of retardation. Development is required to: 1) restore the natural permeability of the formation immediately adjacent to the borehole; 2) remove clay, silt and other fines from the filter pack and well screen; and, 3) remove remnant drilling fluids and contaminants potentially introduced during drilling activities.

3.1 PROCEDURES

The development of a newly installed monitoring well will proceed only after the grout has been allowed to set for a minimum of 48 hours, but not more than one week after construction. Before development begins, the development equipment will be decontaminated according to the procedures defined in SOP 7.

Initial development of each well will be accomplished using a surge block or by bailing. A surge block is a round plunger with pliable edges that will not catch on the well screen. The surge block is moved forcefully up and down inside the well screen, causing the water to surge in and out of the well screen. The surge procedure or bailing will continue for a minimum of 2 hours.

Following surging, water will be evacuated by pumping. The choice of pumping method is dependent on the well depth and/or recharge rate. Temperature, pH, and specific conductivity and turbidity will be measured once per well volume pumped. The pumping will continue until turbidity is less than 5 NTU and four consecutive sets of readings are within 10 percent for the other parameters. If these parameters have not stabilized after 4 hours of pumping, the USACE will be contacted for further direction.

Development water will be containerized and appropriately disposed of in accordance with federal, state and local requirements. Disposal may consist of one or a combination of the following: 1) shipment to a treatment facility offsite; 2) treatment at the wastewater treatment plant onsite; and/or, 3) discharge to the sanitary sewer after the proper permits have been obtained.

3.2 DOCUMENTATION

The documentation of the observation and data acquired in the field will be recorded in a bound weatherproof field book. As part of the development process the following information will be recorded on well development forms (Figure 4):

- name of project, name of site, and well designation;
- date and time of static water level from top of casing and depth of well before, immediately after and 24 hours after development;
- development method and equipment identification;
- development times and rates;
- volume of water removed and physical character of water before, during and after development;
- volume and source of water added;
- volume and physical character of sediment removed;
- field measurements of pH, specific conductance, temperature and turbidity taken before, during and after development;
- name(s) and job title(s) of developer(s);
- disposition of water removed from wells.

BORING LOG

HOLE No 0

COMPANY NAME

2 DRILLING SUBCONTRACTOR

SHEET 1
OF 0 SHEETS

PROJECT

4 LOCATION

[illegible]RILLER

6 MANUFACTURER'S DESIGNATION OF DRILL

S[illegible] TYPES OF DRILLING AND SAMPLING EQUIPMENT

8 HOLE LOCATION

9. SURFACE ELEVATION
feet

10 DATE STARTED

11. DATE COMPLETED

OVERBURDEN THICKNESS

15 DEPTH GROUNDWATER ENCOUNTERED

DEPTH DRILLED INTO ROCK

16 DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED

TOTAL DEPTH OF HOLE

17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)

GEOTECHNICAL SAMPLES | DISTURBED | UNDISTURBED

19 TOTAL NUMBER OF CORE BOXES

SAMPLES FOR CHEMICAL ANALYSIS | VOC | METALS | OTHER (SPECIFY) | OTHER (SPECIFY)

21. TOTAL CORE RECOVERY
%

DISPOSITION OF HOLE | BACKFILLED | MONITORING WELL | OTHER (SPECIFY)

23. SIGNATURE OF INSPECTOR

ELEV a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No e	ANALYTICAL SAMPLE No f	BLOW COUNTS g	REMARKS h

Project

Hole No.

Figure 1
Boring Log Form

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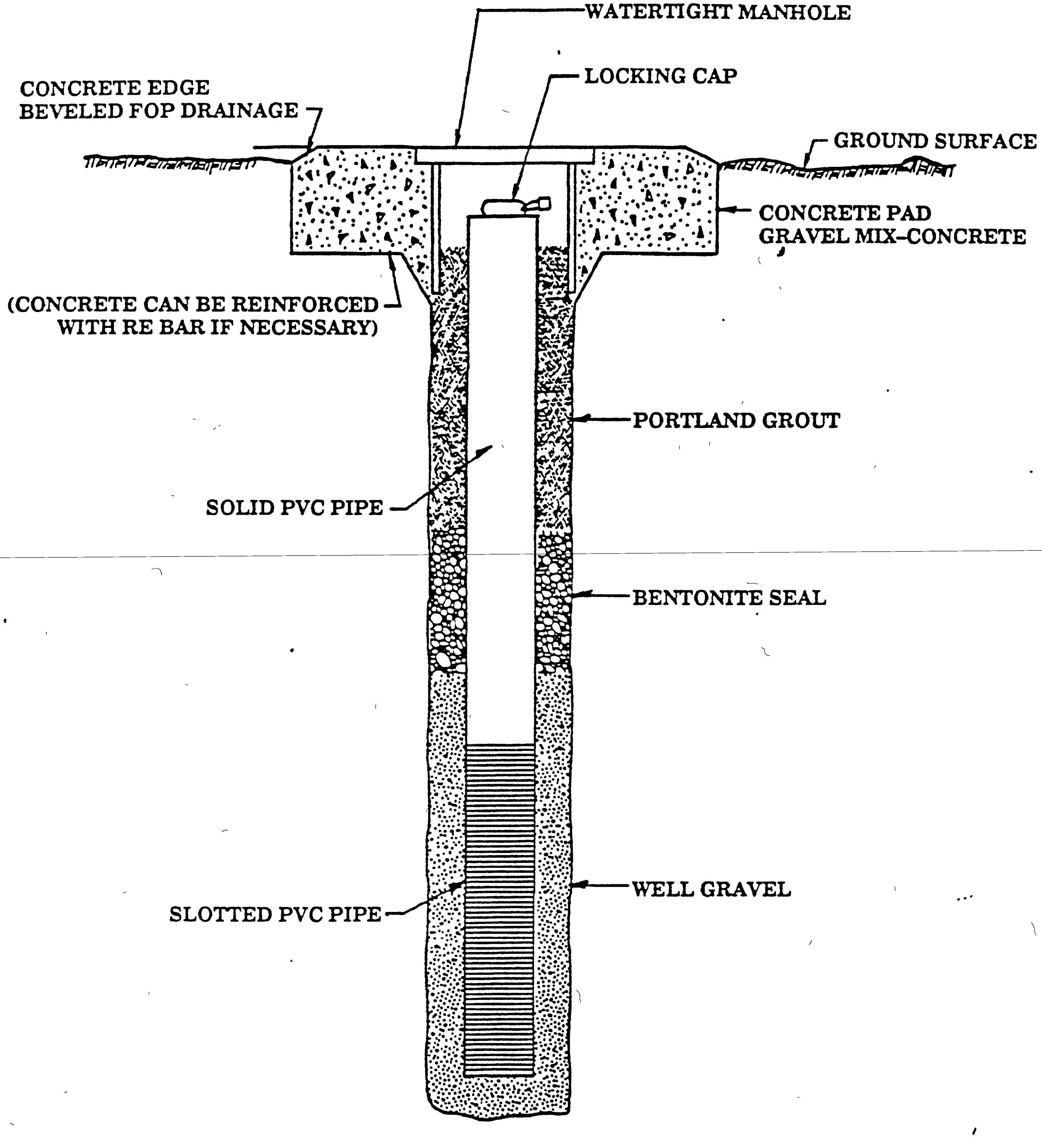


TYPICAL FLUSH MOUNT MONITORING WELL
CONSTRUCTION
REMEDIAL INVESTIGATION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

WOODWARD-CLYDE CONSULTANTS
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
WAYNE, NEW JERSEY

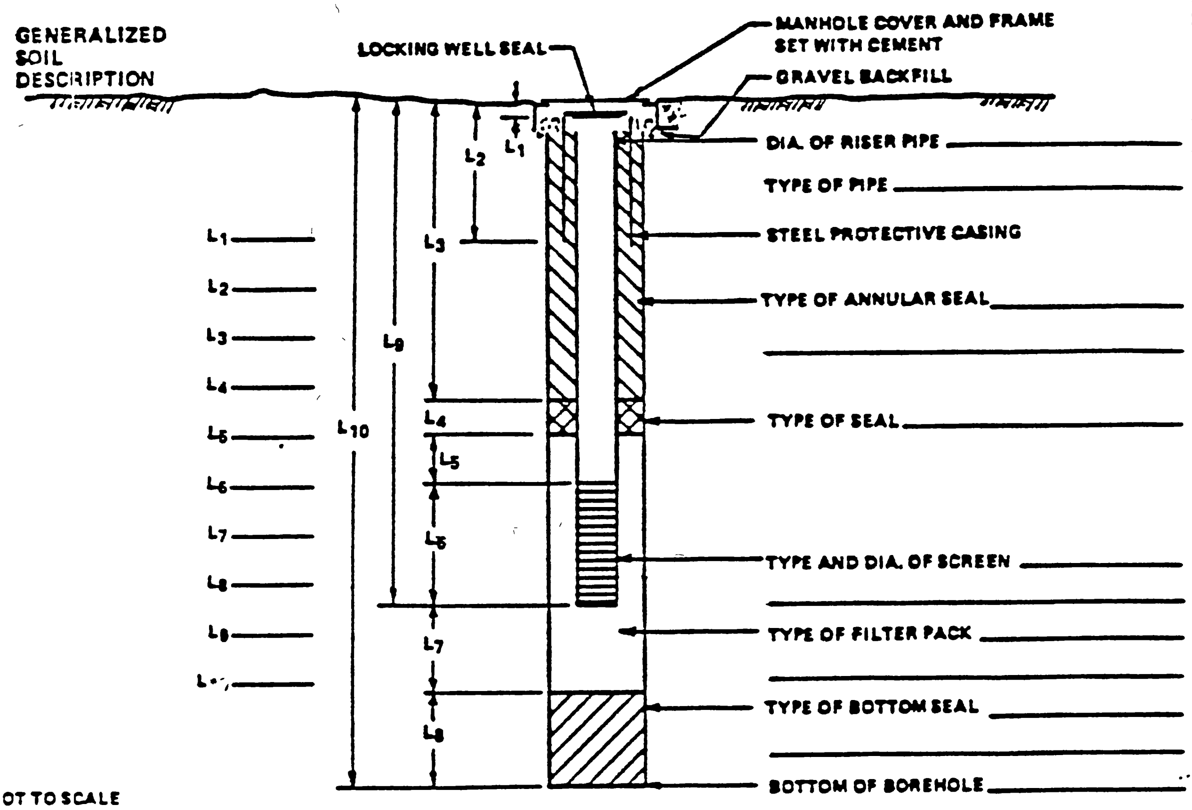
DR. BY: BAS	SCALE: AS SHOWN	PROJ. NO.: C3MILL
CK'D. BY: MEC	DATE: 22 NOV 1994	FIG. NO: 2

WOODWARD–CLYDE CONSULTANTS

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

CONSTRUCTION OF FLUSHMOUNT MONITORING WELL NO. ________

PROJECT AND LOCATION	GROUND ELEV. AND DATUM	PROJECT NO.
DRILLING AGENCY	TOP OF RISER ELEV.	DATE FINISHED
METHOD OF DRILLING ________	TOP OF PROTECTIVE CASING ELEV.	INSPECTOR:
DIA. OF BOREHOLE ________ DEPTH OF BOREHOLE ________	GROUND WATER ELEV.	CHECKED BY:



L1 ________

L2 ________

L3 ________

L4 ________

L5 ________

L6 ________

L7 ________

L8 ________

L9 ________

L10 ________

DIA. OF RISER PIPE ________

TYPE OF PIPE ________

STEEL PROTECTIVE CASING

TYPE OF ANNULAR SEAL ________

____

TYPE OF SEAL ________

TYPE AND DIA. OF SCREEN ________

____

TYPE OF FILTER PACK ________

____

TYPE OF BOTTOM SEAL ________

____

BOTTOM OF BOREHOLE ________

NOT TO SCALE
(VALUES REPORTED IN FT)

REMARKS ________

____

____

____

____

____

FIGURE–3
FLUSHMOUNT MONITORING WELL CONSTRUCTION LOG
REMEDIAL INVESTIGATION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

MONITORING WELL DEVELOPMENT LOG

Well Number: ____________

Date Installed: ____________
Depth of Well (ft): ____________
Screened Interval: ____________
Casing Diameter: ____________

SURGE DATA

Pre-Surge Sample

Depth (ft): ____________

Date and Time: ____________
DTW(ft):* ____________
DTB(ft):** ____________
Surge Date and Time: ____________
Conductivity: ____________
Temperature: ____________
Turbidity (NTUs): ____________
pH: ____________
Surge Method: ____________

Post-Surge Sample

Depth (ft): ____________

Date and Time: ____________
Comments: ____________
Conductivity: ____________
Temperature: ____________
Turbidity (NTU's): ____________
pH:

PURGE DATA

Date and Time: ____________
DTW(ft): ____________
Height of Water Column (ft): ____________
Volume of Water in Casing (g): ____________
5 Casing Volumes (g): ____________
Purge Method: ____________

Time	Temperature	Conductivity	Turbidity (NTUs)	pH	Gallons Purged	Comments

DTW after purge: ____________
Total gallons purged: ____________
Inspector: ____________

*DTW: depth to water
**DTB: depth to bottom

Figure 4
Well Development Log

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i:\projects\k9716\saplan\sops\SOP2FIG4.XLS

SOP No. 3 GROUNDWATER SAMPLING PROCEDURE LOW FLOW RATE PURGING AND SAMPLING (USEPA REGION 1)

Please refer to attached URSGWC SOP No. 3. Foster Wheeler/HLA will use forms equivalent to those provided in the URSGWCFS SOP.

STANDARD OPERATING PROCEDURE NUMBER 3

GROUNDWATER SAMPLING PROCEDURE
LOW FLOW RATE PURGING AND SAMPLING
(USEPA REGION 1)

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION I

GROUND WATER SAMPLING PROCEDURE
LOW FLOW PURGE AND SAMPLING

DRAFT FINAL

I. SCOPE & APPLICATION

The purpose of this standard operating procedure (SOP) is to provide information on collecting ground water samples using a pump. The procedure will in most situations provide for the collection of ground water samples with minimum turbidity. This procedure is designed to be used in conjunction with the analyses for the most common types of ground water contaminants (volatile and semi-volatile organic compounds, pesticides, PCBs, metals and inorganic compounds).

II. EQUIPMENT

- Adjustable rate, positive displacement pumps (e.g., centrifugal or bladder pumps constructed of stainless steel or Teflon). Peristaltic pumps may be used only for inorganic sample collection.
- Clear plastic bottom filling bailer may be used to obtain samples of light or dense non-aqueous liquids (LNAPL, DNAPL).
- Tubing – Teflon or Teflon lined polyethylene must be used to collect samples for organic analysis. For samples collected for inorganic analysis, Teflon or Teflon lined polyethylene, PVC, Tygon or polyethylene tubing may be used.
- Water level measuring device, 0.01 foot accuracy, (electronic preferred for tracking water level drawdown during all pumping operations).
- Flow measurement supplies (e.g., graduated cylinder and stop watch).
- Interface probe, if needed.
- Power source (generator, nitrogen tank, etc.).
- Indicator parameter monitoring instruments – pH, turbidity, specific conductance, and temperature. Optional Indicators – eH and dissolved oxygen.
- Decontamination supplies.
- Logbook(s)

- Sample Bottles.
- Sample preservation supplies (as required by the analytical methods).
- Sample tags or labels.
- Well construction data, location map, field data from last sampling event.
- Field Sampling Plan.

Use of trademarked names does not imply endorsement by U.S. EPA but is intended only to assist in identification of a specific product.

III. PRELIMINARY SITE ACTIVITIES

- Check well for damage or evidence of tampering, record pertinent observations.
- Lay out sheet of polyethylene for monitoring and sampling equipment.
- Remove well cap.
- Measure VOCs (volatile organic compounds) at the rim of the well with a PID or FID instrument and record the reading in the field logbook.
- If the well casing does not have a reference point (usually a V-cut or indelible mark in the well casing), make one.
- Measure and record the depth to water (to 0.01 ft) in all wells to be sampled before any purging begins. Care should be taken to minimize disturbance of any particulate attached to the sides or at the bottom of the well.
- Measure and record (as appropriate) the depth of any DNAPL's or LNAPL's with an interface probe. Care should be given to minimize disturbance of any sediment which has accumulated at the bottom of the well. If LNAPL's or DNAPL's are present, a decision needs to be made on whether to collect samples of the free phase liquid(s) and/or the dissolved phase.

I. SAMPLING PROCEDURE

A positive displacement type pump will be used to purge and sample monitoring wells which have a 2.0 inch I.E. or greater well casing.

Pump, safety cable, tubing and electrical lines will be lowered slowly into the well to a depth corresponding to the center of the saturated screen section of the well. It is also advisable to keep the pump intake at least two feet above the bottom of the well, to prevent mobilization of any sediment present in the bottom of the well.

Measure the water level again with the pump in well before starting the pump. Start pumping the well at 0.2 to 0.5 liters per minute. Ideally, the pump rate should cause little or no water level drawdown in the well (less than 0.3 ft. and the water level should stabilize). The water level should be monitored every three to five minutes (or as appropriate) during pumping. Care should be taken not to cause pump suction to be broken, or entrainment of air in the sample. Record pumping rate adjustments and depths to water. Pumping rates should, if needed, be reduced to the minimum capabilities of the pump (e.g., 0.1 – 0.2 1/min) to avoid pumping the well dry and/or to ensure stabilization of indicator parameters. If the recharge rate of the well is very low and the well is purged dry, then sampling shall commence as soon as the well has recharged to a sufficient level to collect the appropriate volume of samples with the pump.

During purging of the well, monitor the field indicator parameters (turbidity, temperature, specific conductance, pH, etc.) every three to five minutes (or as appropriate). The well is considered stabilized and ready for sample collection once all the field indicator parameter values remain within 10% for three consecutive readings. If the parameters have stabilized, but the turbidity is not in the range of the 5 NTU goal the pump flow rate should be decreased, and measurement of the parameters should continue every three to five minutes. Measurements should be obtained using a flow through cell (preferred method) or taken in a clean container (a glass beaker is ideal).

VOCs samples will be collected first and directly into pre-preserved sample containers. All sample containers should be filled by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.

Samples requiring pH adjustment will have their pH checked to assure that the proper pH has been obtained. For VOC samples, this will require that a test sample be collected to determine the amount of preservative that needs to be added.

If filtered metal samples are to be collected, the use an in-line filter is preferred. A high pressure, in-line 0.45 um particulate filter will be pre-rinsed with approximately 400 ml of deionized water and attached to the discharge end of the pump's tubing. After the sample is filtered, it must be preserved immediately.

As each sample is collected, the sample will be labeled. Those samples (volatile organics, cyanide, etc.) requiring cooling will be placed into an ice cooler for delivery to the laboratory. Metal samples after acidification to a pH less than 2 do not need to be cooled.

After collection of the samples, the pump's tubing may either be dedicated to the well for resampling (by hanging the tubing inside the well), decontaminated or properly discarded.

Measure and record well depth.

Secure the well.

I. DECONTAMINATION

Sampling equipment will be decontaminated prior to use and following sampling of each well. Pumps will not be removed between purging and sampling operations. The pump and tubing (including support cable and electrical wires which are in contact with the sample) will be decontaminated by one of the procedures listed below. Alternative procedures must be approved by the Quality Assurance Office prior to sampling event.

Procedure 1

- Steam clean the outside of the submersible pump.
- Pump hot water from the steam cleaner through the inside of the pump. This can be accomplished by placing the pump inside a three or four inch diameter PVC pipe with end cap. Hot water from the steam cleaner jet will be directed inside the PVC pipe and the pump exterior will be cleaned. The hot water from the steam cleaner will then be pumped from the PVC pipe through the pump and collected into another container. Note: additives or solutions should not be added to the steam cleaner.
- Pump five gallons of non-phosphate detergent solution through the inside of the pump.

- Pump tap water through the inside of the pump to remove all of the detergent solution.

- Pump distilled/deionized water through the pump.

Procedure 2

- The decontaminating solutions can either be pumped from buckets through the pump or the pump can be disassembled and flushed with the decontaminating solutions. It is recommended that detergent and isopropyl alcohol used in the decontamination process be used sparingly and water flushing steps be extended to ensure that any sediment trapped in the pump is flushed out. The outside of the pump and the electrical wires must be rinsed with the decontaminating solutions, as well. The procedure is as follows:

- Flush the equipment/pump with potable water.

- Flush with non-phosphate detergent solution (five gallons).

- Flush with tap water to remove all of the detergent solution.

- Flush with distilled/deionized water.

- Flush with isopropyl alcohol.

- Flush with distilled/deionized water.

I. FIELD QUALITY CONTROL

Quality control samples are required to verify that the sample collection and handling process has not affected the quality of the ground water samples. All field quality control samples must be prepared exactly as regular investigation samples with regard to sample volume, containers, and preservation. The following quality control samples will be collected for each batch of samples (a batch may not exceed 20 samples). Trip blanks are required for the VOC samples at frequency of one per sample cooler.

- Field duplicate.

- Matrix spike.

- Matrix spike duplicate.

- Equipment blank.

- Trip blank (VOCs)

I. FIELD LOGBOOK

A field log must be kept each time ground water monitoring activities are conducted in the field. The field logbook should document the following:

- Well identification.
- Well depth, and measurement technique.
- Static water level depth, date, time and measurement technique.
- Presence and thickness of immiscible liquid layers and detection method.
- Collection method for immiscible liquid layers.
- Pumping rate, drawdown, indicator parameters values, and clock time, at three to five minute intervals; calculate or measure total volume pumped.
- Well sampling sequence and time of sample collection.
- Types of sample bottles used and sample identification numbers.
- Preservatives used.
- Parameters requested for analysis.
- Field observations of sampling event.
- Name of sample collector(s).
- Weather conditions.
- QA/QC data for field instruments.

SAMPLE COLLECTION FIELD SHEET
REMEDIAL INVESTIGATION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

MPLE NUMBER: ____________________

DATE and TIME OF COLLECTION: ____________________

COLLECTED BY: ____________________

SAMPLE MEDIA: Soil Water Sediment

SAMPLE DEPTH: ____________

SAMPLING EQUIPMENT: ____________________

SAMPLING METHOD: ____________________

SAMPLE SPLIT? NO YES SPLIT SAMPLE NUMBER: ____________

QA/QC SAMPLES? NO YES QA/QC SAMPLE NUMBERS: ____________

Sample Container	Preservative	Analysis Requested

SAMPLE DESCRIPTION: ____________________

INSTRUMENT SCREENING: ____________________

COMMENTS: ____________________

Figure 1
Sample Collection Field Sheet

FIGURE 2
LOW FLOW RATE PURGING AND SAMPLING DATA SHEET

Sheet _____ of _____

SITE: ______________________________

DATE: ______________________________

WEATHER: ______________________________

MONITORING WELL NO.: __________ **WELL PERMIT NUMBER:** __________

ENVIRONMENTAL CONSULTING FIRM: ______________________________

FIELD PERSONNEL: ______________________________

TIME	Purging	Sampling	pH (pH units)		Temperature (degrees C)		Specific Conductivity (mS/cm)		Redox Potential (mv)		Dissolved Oxygen (mg/L)		Turbidity (NTU)		Volume Water Removed (ml)	Pumping Rate (ml/min)	Water Elevation (ft BGS)
			Reading	%*	Reading	%*	Reading	%*	Reading	%*	Reading	%*	Reading	< 10 ?*			
				NA		NA		NA		NA		NA		NA	NA	NA	

*** Calculate percent by dividing current reading by previous reading and multiplying by 100. When 3 consecutive readings are between 90 and 110 percent and the turbidity reading is less than 10 NTUs, the monitoring well is stabilized and ready for sampling.**

SOP No. 4 SLUG TESTING

Please refer to attached URSGWC SOP No. 4.

STANDARD OPERATING PROCEDURE NUMBER 4

SLUG TESTING

TABLE OF CONTENTS

1.0
PURPOSE AND SCOPE

This document defines the standard procedure for slug testing monitoring wells. This Standard Operating Procedure (SOP) serves as a supplement to the Field Sampling Plan (FSP). This SOP gives descriptions of equipment and field procedures used to estimate the hydraulic conductivity of the aquifer. Hydraulic conductivity will be determined by a positive displacement test and/or a negative displacement test.

2.0
SLUG TESTING PROCEDURES

2.1 EQUIPMENT LIST

Field equipment to be used for the slug testing activities includes:

- Electronic water level indicator
- Field books
- Slug of known volume for 2-inch diameter wells
- Pressure transducer (10-50 psig)
- Data logger (Hermit) and Operation Manual (Hermit)
- Weighted Measuring tape (100 feet)
- Nylon rope
- Keys to well locks
- Paper towels (organic and lint free)
- Stainless steel knife
- Camera and film
- Waterproof and permanent marking pens
- Clock
- Appropriate health and safety equipment

2.2 PRE-TEST DATA RECORDING

Pre-test data will be collected in accordance with the following procedures:

A. The well casing will be approached from upwind.

B. The well cap will be unlocked and removed.

C. Before beginning the slug test, the following information will be recorded:

- Monitoring well identification number or letter

- Location and elevation of the reference point from which water depth measurements are made (top of PVC well casing)
- Elevation of groundwater with respect to the reference point
- Date and time of test
- Well depth, screen length, riser pipe radius, well screen radius, and radius of gravel pack plus the well screen depth and radius (from the installation record)
- Aquifer or ground water zone (lithology) being tested (from the installation record)
- Volume of solid cylinder (slug)
- Type of measuring device used
- Names of personnel conducting test

2.3 TESTING PROCEDURES

Slug testing will be conducted in accordance with the following procedures.

A. The static water level in the well and total depth of the well will be determined to the nearest 0.01 foot. The appropriate pressure transducer will be inserted and the Hermit Data Logger activated. The water level recording interval will be programmed on the data logger to the logarithmic mode.

B. The slug of known volume will be instantaneously introduced to (or removed from) the well, taking care to fully submerge (or withdraw) the slug. It is important to remove or add the volume as quickly as possible because the analysis assumes an "instantaneous" change in volume in the well. Falling head tests are not valid for wells where the water level is below the top of the screen. Only rising head test data should be recorded from such wells.

C. With the moment (time) of volume addition or removal assigned time zero, the depth of water will be measured and recorded. The pressure transducer will monitor water level change. Care must be taken to ensure that the transducer is submerged throughout the test. Once the test has started, the transducer elevation must not be changed.

D. The test will continue until the water level has stabilized or 90 percent of the excess head has dissipated.

E. The slug testing equipment will be removed and wrapped for decontamination.

F. The well will be locked upon completion.

G. Gloves, aluminum foil/visquene will be disposed of as appropriate.

H. The slug will be decontaminated before the next slug test, in accordance with the procedures discussed in Section 3.0 and SOP No. 7 - Decontamination.

I. The slug test data will be downloaded from the data logger to a field printer to confirm the successful completion of the test prior to departing the site.

3.0
DECONTAMINATION

All slug testing equipment will be decontaminated prior to use. The slug will be decontaminated with:

- Soap (Liquinox) and potable water wash with scrub brush
- Potable water rinse
- Distilled water rinse
- Air drying of the equipment

All decontaminated equipment will be stored on clean aluminum foil sheeting or visquene, and the equipment will not be allowed to touch the ground adjacent to the well.

4.0
SLUG TEST DATA ANALYSIS

Slug test data will be evaluated using the method of Bouwer and Rice (1976) and Bouwer (1989). The Bouwer and Rice method is applicable to unconfined and confined aquifers and considers the effect of partial penetration, the radius of the filter pack, and the effective radius of influence of the test.

SOP No. 5 WATER LEVEL MEASUREMENT

Please refer to attached URSGWC SOP No. 5. Foster Wheeler/HLA will use forms equivalent to those provided in the URSGWCFS SOP.

STANDARD OPERATING PROCEDURE NUMBER 5

WATER LEVEL MEASUREMENT

TABLE OF CONTENTS

Section Page

FIGURES

1.0
PURPOSE AND SCOPE

This document defines the standard procedure for measuring water levels in wells. This Standard Operating Procedure (SOP) serves as a supplement to the Field Sampling Plan (FSP). This procedure describes equipment and field procedures necessary to collect water level measurements. This procedure is intended to be used together with the FSP and other SOPs. SOP No. 7 describes decontamination procedures which are applicable to this SOP.

2.0

WATER LEVEL MEASUREMENT PROCEDURE

2.1 EQUIPMENT LIST

The equipment necessary to measure water levels includes:

- Solinst Model 101 water level meter or equivalent
- Keck Oil/Water Interface probe or equivalent
- Two 5-gal buckets (with lids) or equivalent for decontamination
- Decontamination brushes
- Alconox soap
- Deionized or distilled water
- Potable water
- Spray bottle
- Field data sheets
- Field notebook
- Appropriate health and safety equipment

2.2 MEASUREMENT PROCEDURE

This section gives the sequence of events to follow when measuring water levels. Appropriate health and safety equipment, as described in the Site-Specific Safety and Health Plan (SSHP) should be worn during well opening, well measurement, and decontamination.

- The water level probe and/or oil/water interface probe shall be decontaminated prior to use in each monitoring well. Decontamination procedures are discussed in SOP No. 7.

- The well will be approached from upwind, the well cap unlocked and removed.

- Observations concerning the well pad, surface or protective casing and other well conditions will be documented in the field notebook.

- The depth of the static water level and the total depth of the well will be measured using an electric water level meter. Alternatively, an oil/water interface probe may be used to measure the static level of water and free floating product, if present. The measuring point for all the wells will be the top of the steel monitoring well casing. If a reference mark is not found, then all well readings will be referenced to the north rim of the monitoring well riser pipe for standardization.

- The static water level and the total depth of the well shall be measured with the probe, with an accuracy of 0.01 foot recorded on the water level data sheet, and then immediately rechecked before the probe is removed from the well.

- After measuring water level in the well, the probe of a salinity-conductivity-temperature meter will be lowered into the well. Once submerged, readings will be made of salinity, specific conductance, and temperature, which will be recorded onto the remarks section of the water level data sheet. The probe will be decontaminated between each well as described in Section 2.3 and in SOP No. 7.

- All columns of field data sheets shall be completed, including time of measurement. Water level measurements that will be used to construct water level contour maps should be performed as close as possible in time, preferably on the same day. An example water level data sheet is shown as Figure 1. If measurements are taken over a several-day period, the date of each measurement should be clearly indicated on the form. Section 2.4 describes the documentation required.

- Care shall be taken to verify the readings during each water level measurement period. Any significant changes in water level will be noted by comparing the most recent measurement with past measurements.

- After any measurement is taken, the water level probe shall be decontaminated as described in Section 2.3.

2.3 DECONTAMINATION

The water level indicator and the salinity-conductivity-temperature meter must be decontaminated before use, and at the conclusion of measurements. The probes will be decontaminated according to the procedure for decontamination of sampling equipment described in SOP No. 7.

Probe decontamination will be completed at the wells, and wash and rinse water will be containerized and appropriately disposed of in accordance with federal, state and local requirements. Disposal may consist of one or a combination of the following: 1) shipment to a treatment facility offsite; 2) treatment at the wastewater treatment plant onsite; and/or, 3) discharge to the sanitary sewer after the proper permits have been obtained.

2.4 DOCUMENTATION

This section describes the documentation necessary for water level measurement.

The water level data sheet, shown as Figure 1, shall be completed during each measuring event. Field data sheets will include date, time, well number, total well depth, water level, static water elevation, salinity, specific conductance, temperature, and comments. A field notebook will also be kept during water level measurement activities describing decontamination procedures, calibration procedures, monitoring procedures, and other observations during water level measurement. Both the data sheets and notebook shall be neat and legible, and shall be signed and dated by the person completing the page.

The depth to water, in feet below the measuring point, will be subtracted from the measuring point elevation to determine the elevation of the static water level. The resulting elevation shall be checked in the field to see that it is reasonable and that the subtraction was performed correctly. If there is a discrepancy, the well shall be measured again.

3.0
CALIBRATION

The length of the water level measurement probe cord should be calibrated at least once per month or more often as needed to ensure the desired accuracy. The calibration check consists of laying out 100 feet of steel tape next to 100 feet of the probe cord. Note any measurement discrepancies between the two at 2-foot intervals. The probe cord shall be rechecked if there is a possibility it could have been stretched or damaged during water level measurements.

The procedures followed during any calibration and verification of equipment shall be documented in the field notebook along with any calculations. If a correction is required, the probe will be tagged to indicate the correction.

Project Name/Number:
Project Location
Inspector:
Instrument:

Well/Piezo. Number	Well Depth	Depth to Water	Water Elevation	Date	Time	Salinity	Specific Conduct.	Temp.	Remarks

Figure 1
Water Level Data Form

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SOP No. 6 SAMPLE IDENTIFICATION, HANDLING, AND DOCUMENTATION

Please refer to attached URSGWC SOP No. 6. Foster Wheeler/HLA will use forms equivalent to those provided in the URSGWCFS SOP.

The only significant discrepancy between the URSGWCFS SOP and Foster Wheeler/HLA proposed operating procedure regards the sample identification procedure (Section 2.1 of URSGWC SOP No. 6), which is summarized below.

SAMPLE IDENTIFICATION

Samples collected during site activities will be assigned unique sample identification numbers. These numbers are necessary to identify and track each of the samples collected for analysis during the duration of the project. In addition, the sample identification numbers will be used in documentation to identify and retrieve the analytical results received from the laboratory, as well as other data.

Each sample will be identified by a unique alpha-numeric code. The sample identification code developed for this investigation is based on an identifier for the sample type, followed by a set of characters identifying the sampling location, followed by a set of characters designating the depth of the sample, or other pertinent information. The sample identification coding system is described below.

Soil Samples from Soil Borings

SBYY##&&&XX

where

SB = soil boring
YY = last two digits of the year collected (e.g., "99" = 1999)
= boring number
&&& = bottom depth of sample (feet below ground surface)
XX = place holders to define sample type as described below:
    XX = standard sample
    XD = duplicate sample
    MS = matrix spike sample
    MD = matrix spike duplicate sample

Soil Samples from Direct-Push (i.e., GeoProbe) Explorations

SPYY##&&&XX

where

SP = soil probe
YY = last two digits of the year collected (e.g., "99" = 1999)
= boring number
&&& = bottom depth of sample (feet below ground surface)
XX = place holders to define sample type as described below:
  XX = standard sample
  XD = duplicate sample
  MS = matrix spike sample
  MD = matrix spike duplicate sample

Soil Gas Samples

SGYY##&&&XX

where

SG = soil gas
YY = last two digits of the year collected (e.g., "99" = 1999)
= exploration number
&&& = bottom depth of sample (feet below ground surface)
XX = place holders to define sample type as described below:
  XX = standard sample
  XD = duplicate sample
  MS = matrix spike sample
  MD = matrix spike duplicate sample

Cone Penetrometer Groundwater Samples

CPYY##&&&XX

where

CP = cone penetrometer
YY = last two digits of the year collected (e.g., "99" = 1999)
= exploration number
&&& = bottom depth of sample (feet below ground surface)
XX = place holders to define sample type as described below:
  XX = standard sample
  XD = duplicate sample
  MS = matrix spike sample
  MD = matrix spike duplicate sample

Monitoring Well/ Groundwater Samples

Groundwater samples from monitoring wells will be identified by the monitoring well identification, followed by a 6-digit character set for the month (MM), day (DD), and year (YY) of the sampling. For example, a groundwater sample collected from MW-2S on July 31, 1999 would be identified as "MW-2S073199XX", where)

XX = place holders to define sample type as described below:
  XX = standard sample
  XD = duplicate sample
  MS = matrix spike sample
  MD = matrix spike duplicate sample

Trip Blanks

Trip blanks will be identified with the prefix "TB" followed by a six-digit character designation for the month (MM), day (DD), and year (YY) of the sampling. For example, a trip blank associated with samples collected on July 31, 1999 would be identified as "TB073199".

Field Blanks

Field blanks will be identified with the prefix "FB" followed by a six-digit character designation for the month (MM), day (DD), and year (YY) of the sampling. For example, a field blank associated with samples collected on July 31, 1999 would be identified as "FB073199".

STANDARD OPERATING PROCEDURE NUMBER 6

SAMPLE IDENTIFICATION, HANDLING, AND DOCUMENTATION

TABLE OF CONTENTS

LIST OF FIGURES

1.0
PURPOSE AND SCOPE

This document defines the standard protocols for sample identification, handling, and documentation. This Standard Operating Procedure (SOP) serves as a supplement to the Field Sampling Plan (FSP). This procedure is intended to be used in conjunction with the FSP and other SOPs.

2.0

PROCEDURES FOR SAMPLE IDENTIFICATION, HANDLING, AND DOCUMENTATION

2.1 SAMPLE IDENTIFICATION

Samples collected during site activities will be assigned unique sample identification numbers. These numbers are necessary to identify and track each of the samples collected for analysis during the duration of this project. In addition, the sample identification numbers will be used in documentation to identify and retrieve the analytical results received from the laboratory as well as other data.

Each sample will be identified by a unique alpha-numeric code. The sample identification code developed for this remedial investigation is based on an identifier for the sample type, followed by a set of characters identifying the sampling location, followed by a set of characters designating the depth of the sample or other pertinent information. The sample identification coding system is described below.

2.1.1 Soil Samples - Hollow Stem Auger/Split-Spoon Samplers

The following coding system has been developed for soil samples collected from soil borings advanced using hollow stem augers/split-spoon samplers:

SBXXP##D

where

SB = Soil boring
XX = Parcel number (i.e., 01, 02, 03, ... 33)
P = Subparcel identifier (e.g., A, B, C, etc.)
= Boring number within parcel/subparcel (e.g., 01, 02, 03, etc.)
D = Sampling interval depth identifier (e.g., A, B, C, etc.)

If a particular soil boring location does not have an associated subparcel identifier, the subparcel identifier space (fifth character) will be completed with a hyphen ("-"). Sampling interval depth identifiers (eighth character) begin with "A" as the closest to ground surface sampling interval and proceed alphabetically with increasing sampling depth. The sampling interval depth associated with each sampling interval depth identifier must be recorded in the field log book or on the boring log at the time of sample collection.

2.1.2 Soil Samples - Direct Push Sampling Methods

The following coding system has been developed for soil samples collected from direct push borings:

PBXXS##D

where

PB = Pushed boring
XX = Parcel number (i.e., 01, 02, 03, ... 33)
S = Subparcel identifier (e.g., A, B, C, etc.)
= Boring number within parcel/subparcel (e.g., 01, 02, 03, etc.)
D = Sampling interval depth identifier (e.g., A, B, C, etc.)

If a particular pushed boring location does not have an associated subparcel identifier, the subparcel identifier space (fifth character) will be completed with a hyphen ("-"). Sampling interval depth identifiers (eighth character) begin with "A" as the closest to ground surface sampling interval and proceed alphabetically with increasing sampling depth. The sampling interval depth associated with each sampling interval depth identifier must be recorded in the field log book or on the boring log at the time of sample collection.

2.1.3 Soil Gas Samples

The following coding system has been developed for soil gas samples:

SGYYYB##

where

SG = Soil gas
YYY = Building number (i.e., 01*, 02*, 03*, 03A, ... 63*, 641, 642, 65*,... 82*)
B = Area within building (e.g., A, B, C, etc.)
= soil gas sampling location number within building/area within building (e.g., 01, 02, 03, etc.)

If a particular soil gas sampling location does not have an associated area within building identifier, the area within building identifier space (sixth character) will be completed with a hyphen ("-").

2.1.4 Sediment Samples

The following coding system has been developed for sediment samples:

SDZZ###D

where

SD = Sediment sample
ZZ = Sampling location (one of the 2-character designations below)
  TA = intertidal zone transect A
  TB = intertidal zone transect B
  TC = intertidal zone transect C
  TD = intertidal zone transect D
  TE = intertidal zone transect E

TF = intertidal zone transect F
US = upstream sampling location
DS = downstream sampling location
MB = Marine Basin sampling location
08 = outfall 008 drainage sampling location

= Sediment sampling location number (e.g., 001, 002, 003, etc.)
D = Sampling interval depth identifier (e.g., A, B, C, etc.)

Sampling interval depth identifiers (eighth character) begin with "A" as the closest to sediment surface sampling interval and proceed alphabetically with increasing sampling depth. The sampling interval depth associated with each sampling interval depth identifier must be recorded in the field log book at the time of sample collection.

2.1.5 Surface Water

The following coding system has been developed for surface water samples:

SWZZ###D

where

SW = Surface water sample
ZZ = Sampling location (one of the 2-character designations below)

TA = intertidal zone transect A
TB = intertidal zone transect B
TC = intertidal zone transect C
TD = intertidal zone transect D
TE = intertidal zone transect E
TF = intertidal zone transect F
US = upstream sampling location
DS = downstream sampling location
MB = Marine Basin sampling location
08 = outfall 008 drainage sampling location

= Surface water sampling location number (e.g., 001, 002, 003, etc.)
D = Sampling interval depth identifier (e.g., A, B, C, etc.)

Sampling interval depth identifiers (eighth character) begin with "A" as the closest to surface water surface sampling interval and proceed alphabetically with increasing sampling depth. The sampling interval depth associated with each sampling interval depth identifier must be recorded in the field log book at the time of sample collection.

2.1.6 Fish/Shellfish

The following coding system has been developed for fish/shellfish samples:

BBTZZ##

where

BB = Biota sample type (one of the 2-character designations below)
    FF = Fin fish
    SF = Shellfish
T = Sample type (one of the 2-character designations below)
    1 = Whole body
    2 = Fillet
ZZ = Sampling location (one of the 2-character designations below)
    TA = intertidal zone transect A
    TB = intertidal zone transect B
    TC = intertidal zone transect C
    TD = intertidal zone transect D
    TE = intertidal zone transect E
    TF = intertidal zone transect F
    US = upstream sampling location
    DS = downstream sampling location
    MB = Marine Basin sampling location
    08 = outfall 008 drainage sampling location

= Sample replicate number (e.g., 01, 02, 03, etc.)

2.1.7 Monitoring Well/Groundwater Samples

Groundwater samples collected from monitoring wells will be numbered with the corresponding well number. Existing monitoring well numbers are maintained as originally assigned in previous investigations. Wells in the lagoon area have the "MW" code changed to "LW" to avoid confusion for existing wells with identical numbers but in different locations. Similarly, the existing well in Area 4 has the "MW" code changed to "ECD".

The following codes are designated for groundwater sample types:

WC, MW, LW, ECD = Monitoring Well
S = Shallow monitoring well screened interval
D1 = approximately 30 to 50 foot monitoring well screened interval
D2 = approximately 90 to 110 foot monitoring well screened interval

Each of the monitoring well codes are followed by the sequential number of that type. For example, the first shallow WC monitoring well is identified as WC-1S, the second WC monitoring well as WC-2S, etc.

Groundwater samples will be identified by the monitoring well identification followed by a 4-digit character set for the month (MM) and year (YY) of the sampling. For example, a groundwater sample collected from MW-2D1 collected in May 13, 1999 would be identified as "MW-2D10599".

2.1.8 Field Duplicates

Field duplicates will be submitted to the analytical laboratory as "blind duplicates" i.e., there will be no indication to laboratory personnel that they are field duplicates nor will laboratory personnel be able to determine which environmental samples they duplicate.

Field duplicates will be identified within the alpha-numeric sample code by creating a fictional sampling location. For example, a duplicate soil sample may be identified as being from parcel 50 (there are only 33 parcels), or a duplicate sediment sample may be identified as being from sampling location "CR" (a meaningless designation). **It is imperative that the <u>duplicate</u>**

<u>sample identification number</u> and <u>which environmental sample it duplicates</u> be recorded in the field log book or boring log for future data assessment.

2.1.9 Trip Blanks

Trip blanks will be identified with the prefix "TB" followed by a six-character designation for the month (MM), day (DD), and year (YY). For example, a trip blank associated with samples collected on October 27, 1998 would be identified as "TB102798".

2.1.10 Field Blanks

Field blanks will be identified with the prefix "FB" followed by a six-character designation for the month (MM), day (DD), and year (YY). For example, a field blank associated with samples collected on March 11, 1999 would be identified as "FB031199".

2.2 SAMPLE LABELING

Sample labels will be filled out completely by a designated member of the sampling team. All sample labels shall be filled out using waterproof ink. If needed for protection, labels will also be covered with transparent tape. At a minimum, each label shall contain the following information (see Figure 1):

- site name
- sample identification code
- date and time of sample collection
- analyses requested
- sample preservation
- sample matrix

2.3 SAMPLE HANDLING

This section discusses proper sample containers, preservatives, and packaging and shipping procedures. The FSP summarizes the information contained in this section and also includes the sample holding times for each analyte.

2.3.1 Sample Containers

Certified, commercially clean (to EPA standards) sample containers shall be obtained from the contract analytical laboratory. The bottles shall be labeled by the lab to indicate the type of analyte to be collected in the container.

The FSP lists appropriate sample containers for the specific analyses required for this project.

2.3.2 Sample Preservation

Sample preservation efforts shall commence with container preparation at the laboratory and will continue until analyses are performed. Required preservatives shall be prepared and placed in the bottles at the laboratory prior to shipment to the site. Samples will be stored with ice or cold packs in coolers immediately following collection to maintain sample temperature of approximately 4°C. Additional sample preservation requirements based on analytical methodology are presented in the FSP. Freezing samples to extend holding times will not be permitted.

2.3.3 Sample Packaging and Shipping

After collection, lids for each sample container will be secured, the sample label attached, and samples stored with ice in an insulated cooler to maintain sample temperature of approximately 4°C.

All sediment, water, and soil samples are expected to contain low concentrations of contaminants and will be shipped as environmental samples according to applicable guidance documents and DOT regulations. Sample packaging and shipping procedures are described below:

- Secure sample bottle lids. Check that sample label is securely attached.
- Place sample bottles in recloseable clear plastic bags and wrap them with protective packing material.

- Tape the drain shut on the inside and outside of a waterproof metal (or equivalent strength plastic) cooler.

- Line the sides and bottom of the cooler with protective packing material.

- Line the cooler with a large plastic bag.

- Place vermiculite or other absorbent material in the bottom of the cooler in case of leakage or bottle breakage.

- Place containers upright in the cooler in such a way that they do not touch.

- Pack samples with ice (either chemical ice packs or ice cubes sealed in plastic bags).

- Fill the cooler with cushioning material.

- Close large plastic bag in cooler and tape or secure shut.

- Place chain-of-custody form and other paperwork in a clear plastic bag and tape the bag to the inside lid of the cooler.

- Place address label on inside lid of the cooler.

- Wrap the cooler completely around with strapping tape at two locations. Do not cover any labels.

- Place address label on top of cooler.

- Attach "THIS SIDE UP" labels on all four sides and "FRAGILE" labels on at least two sides and the top of the cooler. ("FRAGILE" labels are optional for coolers not containing glass bottles).

- Affix signed custody seals on the cooler. Cover the seals with wide, clear tape.

- Make a copy of the airbill for the project file and place the original in a clear envelope secured to the cooler lid.

2.4 HOLDING TIMES AND ANALYSES

The holding time is specified as the maximum allowable time between sample collection and analysis and/or extraction, based on the analyte of interest and stability factors, and preservative (if any) used. Holding times are listed in the FSP. Samples should be sent to the laboratory as soon as possible after collection by overnight express courier service.

Chemical constituents which will be analyzed during the field investigation have been identified in the Sampling and Analysis Plan. These constituents and other parameters to be measured are listed in the FSP.

2.5 SAMPLE DOCUMENTATION AND TRACKING

This section describes documentation required in the field notes and on the sample Chain-of-Custody forms. Additional information concerning documentation is presented in the FSP.

2.5.1 Field Notes

Documentation of observations and data acquired in the field will provide information on the acquisition of samples and also provide a permanent record of field activities. The observations and data will be recorded using pens with permanent waterproof ink in a permanently bound weatherproof field log book. The log book pages will be consecutively numbered.

The information in the field book or on the data sheets will include the following as a minimum. Additional information is included in the specific SOPs regarding the data sheets.

- Project name
- Location of sample

- Sampler's printed name and signature
- Date and time of sample collection
- Sample identification code
- Duplicate samples (if any)
- Description of samples (matrix sampled)
- Sample type (grab or composite)
- Sample depth (if applicable)
- Analysis to be performed
- Number and volume of samples
- Sampling methods or reference to the appropriate SOP
- Sample handling, including filtration and preservation, as appropriate for separate sample aliquots
- Analytes of interest
- Field observations
- Results of any field measurements, such as depth to water, pH, temperature, and conductivity
- Personnel present
- Level of PPE used during sampling

Changes or deletions in the field book should be lined out with a single strike mark and initialed and dated by the person making the change or deletion. Sufficient information should be recorded to allow the sampling event to be reconstructed without relying on the sampler's memory.

Each page in the field books will be signed by any persons making entries on that page. Anyone making entries in another person's field book will sign and date those entries.

2.5.2 Sample Chain-Of-Custody

During field sampling activities, traceability of the sample must be maintained from the time the samples are collected until laboratory data are issued. Initial information concerning collection of the samples will be recorded in the field log book. Information on the custody, transfer, handling, and shipping of all samples will be recorded on a Chain-of-Custody (COC) form. An example COC form is shown on Figure 2.

The sampler will be responsible for initiating and filling out the Chain-of-Custody form. The field team members are responsible for the care and custody of the samples collected until the samples are transferred to another individual or shipped to the laboratory. The field team, under the direction of the Field Manager, is responsible for enforcing COC procedures during fieldwork. The COC will be signed, with date and time, by the sampler and when the sampler relinquishes the samples to anyone else. Chain-of-Custody forms will accompany the samples at all times. All individuals who subsequently take possession of the samples will also sign, with date and time, the COC. Each cooler containing samples sent to the analytical laboratory will be accompanied by a chain-of-custody (COC) record. The COC will contain the following information:

- Sampler's signature and company affiliation
- Project number
- Date and time of collection
- Sample identification number
- Sample type
- Sample media
- Preservative used
- Analyses requested
- Number of containers
- Signature of persons relinquishing custody, dates, and times
- Signature of persons accepting custody, dates, and times
- Method of shipment
- Shipping air bill number (if appropriate)

The chain-of-custody procedures are provided below.

- At the time of sample collection, the chain-of-custody form is completed for the sample collected. The sample identification number, date, type of sample (i.e., grab or composite), sample media, type and size of sample container, analysis requested, and preservation is recorded on the form.

- When the form is full or when all samples have been collected that will fit in a single cooler, the field team members will cross-check the form for possible errors and sign the chain-of-custody record. Corrections are made to the record with a single strike mark and dated and initialed. All entries will be made in blue or black ink.

- A shipping bill is completed and the shipping bill number recorded in the COC record prior to enclosing the COC record, placing inside a clear plastic bag and attaching it to the inside of the cooler lid.

When transferring custody of the samples, the individual relinquishing custody of the samples will verify sample numbers and condition and will document the sample acquisition and transfer by signing, with date and time, the COC. Samples are packaged for shipment and dispatched to the analytical laboratory with a separate COC form accompanying each cooler.

A copy of each chain-of-custody form is retained by the sampling team for the project file and the original is sent with the samples. Bills of lading will also be retained as part of the documentation for the chain-of-custody records.

In conjunction with data reporting, the analytical laboratory will return the original or a photocopy of the original COC to the Project Manager for inclusion into the central project file.

Project/Site Name: Stratford - SAEP

Project No. K9716 ____________________

Sampler______________________________

Sample No. __________________________

____

Collection Date/Time ________________

____

Sample Type/Depth/Description _______

____

Preservative_________________________

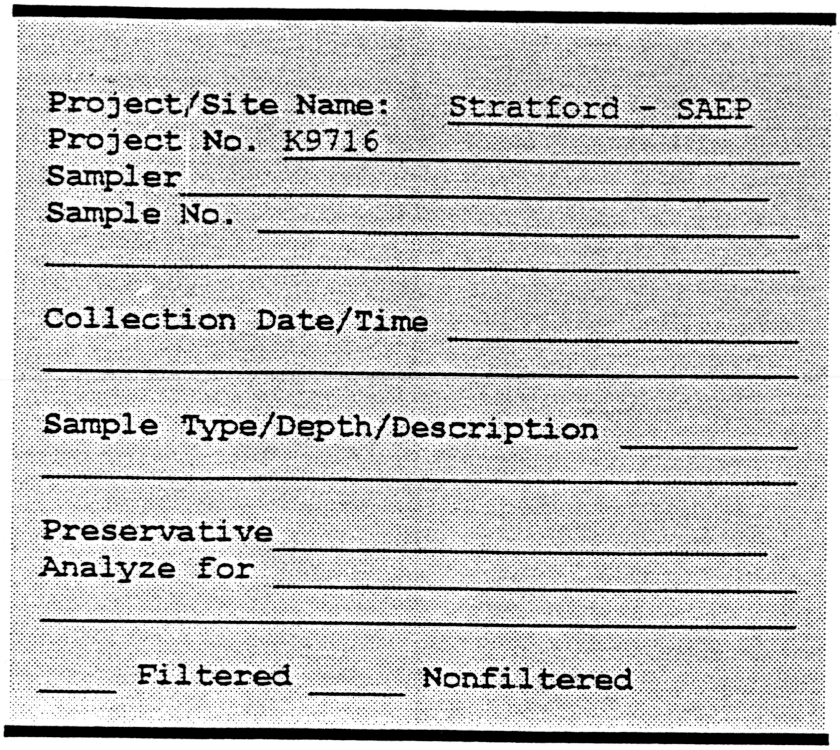
Analyze for _________________________

____

_____ Filtered _____ Nonfiltered

FIGURE 1

Typical Sample Label



Project/Site Name: Stratford - SAEP
Project No. K9716
Sampler ____
Sample No. ____
____

Collection Date/Time ____
____

Sample Type/Depth/Description ____
____

Preservative ____
Analyze for ____
____

____ Filtered ____ Nonfiltered

FIGURE 1

Typical Sample Label

CHAIN-OF-CUSTODY FORM

PROJECT NUMBER:	PROJECT / SITE NAME:	PROJECT / SITE LOCATION:	TEAM LEADER: ____________ SAMPLERS: (SIGNATURES): ____________

Sample I.D. Number	Sample Location	Sample Collection		Sample Matrix	Container Description (Size / Type)	Quantity	Requested Analysis	Comments
		Date	Time					

CHAIN - OF - CUSTODY CHRONICLE

Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received at Laboratory by:	Date	Time
Method of Shipment:			Airbill (Shipping Number):		

FIGURE – 2
CHAIN OF CUSTODY FORM
REMEDIAL INV IGATION
STRATFORD ARM IGINE PLANT

SOP No. 7 DECONTAMINATION

Please refer to attached URSGWC SOP No. 7.

STANDARD OPERATING PROCEDURE NUMBER 7

DECONTAMINATION

TABLE OF CONTENTS

1.0
INTRODUCTION AND TYPES OF CONTAMINATION

This document defines the standard procedure for decontamination. This Standard Operating Procedure (SOP) serves as a supplement to the Field Sampling Plan (FSP) and the Site-Specific Safety and Health Plan (SSHP). The procedure is intended to be used together with the FSP and the other SOPs.

Site and/or Sample Cross-Contamination

The overall objective of multimedia sampling programs is to obtain samples which accurately depict the chemical, physical, and/or biological conditions at the sampling site. Extraneous contaminant materials can be brought onto the sampling location and/or introduced into the medium of interest during the sampling program (e.g., by bailing or pumping of ground water with equipment previously contaminated at another sampling site). Trace quantities of these contaminant materials can consequently be captured in a sample and lead to false positive analytical results and, ultimately, to an incorrect assessment of the contaminant conditions associated with the site. Decontamination of sampling equipment (e.g., bailers, pumps, tubing, soil and sediment sampling equipment) and field support equipment (e.g., drill rigs, vehicles) is therefore required prior to, during and after use at SAEP to ensure that sampling cross-contamination is prevented, and that on-site contaminants are not carried off-site.

If contaminants detected in field blanks are reported above the method detection limit for any analytical procedure, the possible source of contamination will be investigated. If a problem is found, it will be corrected and samples rerun, if necessary. If no analytical problems are identified, the data will be flagged accordingly. Decontamination techniques will also be adjusted in the field prior to collection of additional samples.

2.0
PROCEDURE

2.1 EQUIPMENT LIST

The following is a list of equipment that may be needed to perform decontamination:

- Brushes
- Wash tubs
- Buckets
- Scrapers, flat bladed
- Hot water - high-pressure sprayer
- Disposal drums (55-gallon with secure lids)
- Sponges or paper towels
- Liquinox detergent or equivalent
- Nitric acid
- Potable tap water
- Organic free deionized water
- Garden-type water sprayers

2.2 DECONTAMINATION

Sampling order will be selected to minimize cross contamination. The first locations sampled at each site will be those expected to have the lower concentrations of contaminants and the sampling order will proceed to the expected higher contaminated areas. Present chemical data, visual site inspection, and logical contamination movement will be used to select sampling order.

If PPE is upgraded to Level C, then work zones will be required. Three work zones will be established: the exclusion zone, the contamination reduction zone, and the support zone. An exclusion zone is an area where contamination could or does occur. The exclusion zone will be demarcated using orange cones and/or flagging. All W-C or subcontractor personnel who enter the exclusion zone must be cleared by the SSO, have signed a safety compliance agreement form, and wear the level of protective equipment specified in the Site-Specific Safety and Health Plan.

The contamination reduction zones are located immediately outside the exclusion zone. This zone is designed to limit the migration of contaminants from potentially contaminated areas to non-contaminated areas. Personnel decontamination facilities will be located in this area.

The support zone is an uncontaminated area. Supporting equipment and facilities will be located in this area.

2.2.1 Personnel

Personnel decontamination will be limited to removal of disposable gloves and boot covers for work performed while in Level D personnel protection equipment. Disposable gloves and boot covers will be drummed and stored on site or placed in plastic bags and disposed of in trash dumpsters onsite. However, all field personnel will be required to wash their hands and face with water and soap prior to eating or drinking. If an upgrade to Level C is required, personnel decontamination will be required as follows:

1. Wash boots and outer gloves using Liquinox/potable water wash and potable water rinse.

2. Remove outer gloves and disposable coveralls and place in plastic bags.

3. Remove respirator (if used) and wash and store according to manufacturer's instructions.

4. Remove disposable inner gloves and place in plastic bag.

5. Wash hands and face with water and soap prior to eating or drinking.

All decontamination water will be containerized and appropriately disposed of in accordance with federal, state and local requirements. Disposal may consist of one or a combination of the following: 1) shipment to a treatment facility offsite; 2) treatment at the wastewater treatment plant onsite; and/or, 3) discharge to the sanitary sewer after the proper permits have been obtained. Decontamination refuse and used protective gear for Level C work will be disposed in trash dumpsters on site.

2.2.2 Sampling Equipment

The following steps will be used to decontaminate sampling equipment in the field:

- Personnel will dress in suitable safety equipment to reduce personal exposure as required by the Site-Specific Safety and Health Plan.

- Gross contamination on equipment will be scraped off at the sampling or construction site.

- Equipment that will not be damaged by water will be placed in a wash tub containing Liquinox (or equivalent) and potable water and scrubbed with a bristle brush or similar utensil. Equipment will be rinsed with tap water in a second wash tub. The equipment will then be rinsed with deionized water.

  If visual contamination persists or gross contamination is suspected, additional decontamination procedures will be followed. Equipment used for metals sampling will be rinsed with a 10 percent nitric acid solution followed by a deionized water rinse. Equipment used for organics sampling will be rinsed with a deionized water rinse. If visual contamination persists, that particular piece of sampling equipment will be retired from service and appropriately tagged.

- Equipment that may be damaged by water will be carefully wiped clean using a sponge and detergent water and rinsed with deionized water. Care will be taken to prevent any equipment damage.

- Rinse and detergent water will be replaced with new solutions between borings or sample locations.

Following decontamination, equipment will be placed in a clean area on clean plastic sheeting to prevent contact with contaminated soil. If the equipment is not used immediately, the equipment will be wrapped in foil (shiny side out) to minimize potential contact with airborne contamination.

2.2.3 Electronic Water Level Indicator Probe/Oil-Water Interface Probe

After ground water elevations are measured, the electronic water level indicator probe will be decontaminated using the following procedures:

- Wash probe with Liquinox detergent (or equivalent) and potable water.
- Allow to air dry, if possible. (If air drying is not possible due to cold weather, rinse with additional distilled water in next step.)
- Rinse with distilled water.

After ascertaining the presence, if any, of supernatant product, the oil/water interface probe will be decontaminated as follows.

If product is encountered:

- Spray probe with Liquinox detergent (or equivalent) and potable water.
- Rinse with deionized water.
- Allow to air dry.
- Rinse with deionized water.

If product is not encountered, the oil-water interface probe will be decontaminated using the four-step decontamination procedure described for the electronic water level indicator probe.

2.2.4 Submersible Pumps

If well purging is performed with a submersible pump, the pump will be cleaned after purging the well as follows:

- Wash outside and rinse the inside of submersible pump with Liquinox detergent (or equivalent) and potable water.
- Rinse with potable water.
- Flush pump with at least 30 gallons of potable water to rinse inside of pump.

2.2.5 Drilling and Heavy Equipment

Drilling rigs will be decontaminated on a decontamination pad. The decontamination pad will be designed to capture any water generated by the decontamination process. The following steps may be used to decontaminate drilling and heavy equipment:

- Personnel will dress in suitable safety equipment to reduce personal exposure as required by the Site-Specific Safety and Health Plan.
- Equipment showing gross contamination or having caked-on drill cuttings will be scraped with a flat-bladed scraper at the sampling or construction site.
- Equipment that will not be damaged by water, such as drill rigs, augers, drill bits, and shovels, will be sprayed with a hot water, high-pressure washer. Care will be taken to adequately clean the insides of the hollow-stem augers.

Following decontamination, drilling equipment will be placed back on the clean drill rig. If the equipment is not used immediately, it should be stored in a designated clean area.

2.2.6 Equipment Leaving the Site

Vehicles used for non-contamination activities will be cleaned on an as-needed basis, as determined by the Site Safety Officer, using soap and water on the outside and vacuuming the inside. On-site cleaning will be required for very dirty vehicles which will be leaving the area. On-site construction equipment such as trucks, drilling rigs, backhoes, trailers, etc., will be pressure washed on-site before the equipment is removed from the site to limit exposure of off-site personnel to potential contaminants.

2.2.7 Wastewater

Wash and rinse solutions obtained from decontamination operations will be containerized and appropriately disposed of in accordance with federal, state and local requirements. Disposal may consist of one or a combination of the following: 1) shipment to a treatment facility offsite; 2) treatment at the wastewater treatment plant onsite; and/or, 3) discharge to the sanitary sewer after the proper permits have been obtained.

2.2.8 Other Wastes

Solid wastes such as used personal protective equipment will be placed in plastic bags and disposed in trash dumpsters on site.

2.3 DOCUMENTATION

Sampling personnel will be responsible for documenting the decontamination of sampling and drilling equipment. The documentation will be recorded with waterproof ink in the sampler's field notebook with consecutively numbered pages. The information entered in the field book concerning decontamination should include the following:

- Decontamination personnel
- Date and start and end times
- Decontamination observations
- Weather conditions

3.0
QUALITY ASSURANCE REQUIREMENTS

Field blank samples will be taken using decontaminated sampling equipment to verify the effectiveness of the decontamination procedures. The procedure will include rinsing organic free deionized water through or over a decontaminated sampling tool (such as a split spoon sampler or bailer) and collecting the rinsate water into the sample bottles, which will be sent to the laboratory for analysis. The procedure, including the sample number, will be recorded in the field notebook. Water used to make field blanks will be supplied by the analytical laboratory.

If contaminants detected in field blanks are reported above the method detection limit for any analytical procedure, the possible source of contamination will be investigated. If a problem is found, it will be corrected and samples rerun, if necessary. If no analytical problems are identified, the data will be flagged accordingly. Decontamination techniques will also be adjusted in the field prior to collection of additional samples.

SOP No. 8 GEOPHYSICAL SURVEY

1.0 PURPOSE

This SOP provides guidance for conducting a geophysical survey that includes an electromagnetic induction (EMI) and a ground-penetrating radar (GPR) survey. The geophysical survey will be conducted to determine the location and type of subsurface features that may limit subsurface investigations.

2.0 RESPONSIBILITIES

The personnel who perform the geophysical survey are responsible for:

- Proper operation and calibration of instrumentation in accordance with equipment manuals and the site-specific Work Plan;
- Complete and accurate documentation of field activities including instrument calibrations and survey methods; and
- Preparation of preliminary survey results.

3.0 EQUIPMENT

EMI

The Geonics EM-61 Buried Metal Detector is a time-domain instrument that is currently considered state-of-the-art. The EM-61 is particularly well suited for this project, because signals due to above ground utilities and power lines can be identified and suppressed, which will avoid masking subsurface items. Because of its two receiver coils, the EM-61 can detect burial depth and relative mass of the metallic object, and can differentiate between moderately conductive rock and metallic objects. By transmitting over 150 pulses per second, the EM-61 will generate a large quantity of subsurface data that will be collected and plotted on a daily basis. Trained and experienced geophysicists will screen the collected data and make preliminary anomaly identifications. Daily maintenance will be performed on the EM-61 including recharging batteries, drying sensitive electrical areas, and performing daily adjustment and calibration as required.

GPR

The GPR system consists of a signal recording device, such as a graphic recorder and/or tape recorder, an antenna, and associated electronics and system cables. The antenna(s) selected for a particular investigation depend upon the material properties of the anticipated targets, their depth, and the presence of cultural features at the site.

A GSSI SIR-2 System (or equivalent) will be used to acquire GPR data at the Stratford site. At a minimum, the GPR system will be portable, have digital data storage capability, and have the ability to acquire data along the ground surface at intervals of approximately 0.1 feet. The SIR-2 System meets these criteria and allows data to be color coded and visually displayed in real-time on a color monitor, digitally recorded on an internal hard drive, and printed on a high-resolution printer for detailed analysis. As necessary, the digital data will be processed to enhance subtle features that may not be evident in the raw data.

GPS

Global positioning system (GPS) equipment will be used to determine the location coordinates for the geophysical data collected. The geophysical teams will simultaneously collect GPS and EM-61 data to identify the GPR data collection line end points. The GPS equipment consists of a base station and rover unit(s) for the geophysical acquisition team. The GPS rover unit will be mounted on the EM-61 backpack when configured without wheels or directly over the EM-61 coils when it is configured with wheels. Daily maintenance will be performed on each GPS rover including recharging batteries, drying sensitive electrical areas, and performing daily adjustment and calibration as required.

4.0 CALIBRATION

In order to satisfy quality assurance procedures, each piece of geophysical equipment used during the Stratford geophysical survey will be listed according to make, model, and serial number on field data sheets. Checklists of equipment tests and calibrations will be filled out and retained in the project files. Instrument-specific calibration and testing procedures are described below.

EMI Equipment

The Geonics EMI equipment will be tested daily prior to operation. Results of tests performed will be recorded in field logbooks or in a digital polycorder file. Manufacturer recommended testing procedures are outlined in the operating manual, and will be adhered to during the field program.

No calibration will be made to the instrument, if possible, since it is calibrated prior to leaving the factory. However, measurements will be recorded at regular time-intervals over a portion of an existing data acquisition line or at a designated location to provide information on the precision and repeatability of the measurement process.

Caution will be exercised to avoid excessive noise from electrical static or "spherics" caused by electromagnetic radiation from local or distant thunderstorms. Surveying may cease until severe events are over.

GPR Equipment

No calibration will be made to the instrument electronics or antenna since they are calibrated at the factory. Functional checks will be to ensure the computer hardware is functioning properly, including correctly identifying the reflection from the surface.

Measurements will be recorded at least two times per day over a portion of an existing data acquisition line or at a designated location to provide information on the precision and repeatability of the measurement process.

5.0 INITIAL SURVEY

At the inception of the geophysical survey, an initial survey line will be run with each of the instruments being used for the program (EM-61 and GPR). The line will be a minimum of 25 feet long, and the purpose of this initial line will be three-fold:

- To ensure that the equipment is operating as expected under the specific site conditions;
- To ensure that the anticipated equipment response (meeting the project data quality objectives - see below) is being achieved under the specific site conditions; and
- To provide initial information on the general subsurface geophysical conditions at the specific site location so that the field geophysicists can obtain a preliminary idea of what the geophysical data will look like prior to conducting the survey.

The initial survey line will be collected over a feature with a generally known response on both field instruments. The feature used for this pre-survey check-line will be selected by the field geophysicists at the inception of the survey in a given area. The test feature may be an object that already exists at the survey site, or may be an object brought by the geophysicists for the purpose. Examples of acceptable features include: a visible surface feature such as a steel plate on the ground of sufficient size to result in an anomaly on both field instruments; a visible buried object such as a sewer or drain pipe where the pipe exits the subsurface into a drainage ditch, pond, or the harbor; or a non-visible subsurface object for which excellent location documentation exists (such as a buried pipe or electric line). The test feature may also be an object brought to the site by the geophysicists, such as a piece of steel pipe or a steel plate.

For each of the survey areas, the initial pre-survey test-line will be processed, interpreted, and evaluated in the field for adequacy prior to commencing the full geophysical survey in that area. The field geophysicists will review the test-line results in the field and make a decision as to whether the results of the survey are likely to reasonably meet the project data quality objectives and data quality needs. If the data collected from the initial portion of the survey program does not meet the data quality needs, then the following actions will be taken:

- Modifications to the program may be recommended that will allow the data quality objectives to be met, or
- The field program may be terminated, depending on the nature of the difficulty.

If information from one or both instruments fails to achieve objectives, the field geophysicists shall notify the Foster Wheeler/HLA Field Operations Lead, who in turn will notify the Foster Wheeler/HLA Project Manager and Technical Manager.

6.0 SURVEY METHOD

Electromagnetic Induction (EMI)

The EMI investigation will encompass the area along the top of the dike and the area of the causeway. EMI data will be acquired along lines spaced 5 feet apart depending upon the specific conditions at each area under investigation.

The EM-61 system will be configured to record data continuously at 0.17-second intervals along each data acquisition line, which translates into a sampling interval on the ground of approximately 0.5 foot. Specific data acquisition lines will be repeated during the survey to quantitatively assess the repeatability and locational accuracy of the instrument. A digital polycorder will be used to record the data.

Ground Penetrating Radar (GPR)

The GPR system will primarily be used to validate specific targets and features detected with the EM-61. GPR data will be digitally collected along profile lines spaced 2-3 feet apart depending on the specific objectives at each target under investigation.

The GPR system will be configured to record data with 200 and/or 500 megahertz (Mhz) antennas at no less than 32 scans per second along each data acquisition line, which translates into a sampling interval on the ground of approximately 0.1 feet. Specific data acquisition lines will be repeated during the survey to assess the repeatability and locational accuracy of the instrument. The data will be recorded digitally on a computer, printed out in real time, and fiducial identifiers input into the recording system at each grid node via a remote button.

The GPR antenna will be pulled at a constant rate along the surface and grid location coordinates transferred to the digital data with fiducial marks at regular spatial intervals. The location of anomalies will then be described with respect to the fiducial marks visible on the GPR data. To the extent possible, the survey will be conducted at a constant antenna speed between fiducial marks such that anomalies are neither compressed (sudden increase in speed), nor stretched (decrease in speed) so the true character of an anomaly is not distorted.

7.0 DATA PROCESSING

Subcontract geophysicists, assisted by Foster Wheeler/HLA geophysicists will perform data processing, preliminary data analysis, and interpretation at the on-site processing center as the data are acquired. The geophysical data will require computer reduction prior to interpretation. The basic processes for reduction of the digitally recorded EMI (EM-61) data are summarized as follows:

Electromagnetic Induction (EMI)

- Data files for each survey grid will be checked for proper geometry and recording interval with internally developed software. Coordinate transformations, if necessary, will be performed, as well as minor instrument positioning corrections.
- The data are input into software that allows the merging of EM data with GPS positional data. The software assigns an X-Y coordinate location to each digital EMI data value.
- Data are formatted for input into the Geosoft software package for analysis and interpretation.

Ground Penetrating Radar (GPR)

GPR data are stored digitally on the computer during the acquisition phase in a format that allows the location of each data acquisition line and station to be accurately determined. If it is necessary to analyze the GPR data in detail, the data will be transferred to manufacturer software (RADAN or GRADIX) created specifically for that purpose.

The geophysical survey database will be stored during the project on a field laptop computer. Data will be backed-up on tape/disk (Iomega ZIP or JAZZ drive) daily. At the end of the project, these digital data will be transferred to the client. The data that may be recorded and stored are:

- Facility name
- Site ID (file name and data survey coordinates)
- Survey area conditions/weather
- Geophysical survey personnel
- Geophysical Equipment Serial Numbers
- EMI and GPR digital data
- Survey date
- Coordinate system

This information will be entered from field notes and digital data files acquired by the geophysical survey personnel. Simplistic site feature maps will be completed for each grid surveyed to achieve a more complete understanding of the relationships between the site characteristics and the geophysical data.

Interpretation Techniques

Preliminary analysis and interpretation of the geophysical survey information will be completed each day in the on-site processing center to aid in planning remaining work or modifying the survey program in specific areas. The objective of the data analysis and interpretation phase will be to characterize the responses from the geophysical data. Targets and features detected by EMI and GPR methods will be collectively interpreted in terms of their most probable sources (i.e., pipeline, debris trench or pit, etc.). The EMI and GPR data will also be analyzed and interpreted using other historic data from the Site, including any lithologic and otherr sampling data available at present.

Using both commercial (Oasis Montage) and Foster Wheeler developed software, experienced geophysicists will identify target and feature responses within the data and generate color–coded maps and target anomaly lists depicting geophysical anomalies. If it is necessary to improve target and feature recognition capabilities, the geophysical data may be intensively analyzed with mathematical processes to include simplistic filtering and data enhancement operations. Digital processing/interpretation portfolios will be maintained for each grid surveyed so that each processing/interpretation sequence can be reproduced at a future date. The format of the digital geophysical data, as well as the graphics produced, will be compatible with the existing project database protocols.

GPR data will be interpreted from the graphic images produced in the field, and representative symbols translated onto a plan map of the site to indicate potential targets and features of interest. If it is necessary to improve target and feature recognition capabilities, the GPR data will be intensively analyzed with simplistic filtering operations to improve target recognition capabilities.

8.0 DELIVERABLES

Upon completion of the tasks described above, a brief data report will be generated to document the results of activities that were conducted. This data report will become part of the BDDA for the project's remedial design. Specifically, the most probable sources of the targets and features detected with the geophysical methods will be transcribed onto a master plan map of the site that will be used by the remediation team to locate potential buried objects of concern. This process will ensure that remediation activities are performed in a safe and cost-effective manner.

SOP No. 9 SUDAN IV DYE TESTING

Sudan IV is a nonvolatile, hydrophobic dye manufactured by Aldrich Chemical Company. It is a reddish-brown powder that dyes organic fluids red upon contact, and has shown great promise in identifying the presence or absence of NAPL in laboratory-prepared samples (Cohen and Mercer, 1993). Sudan IV is an irritant and possible mutagen. Skin and eye contact will be avoided through the use of personal protective equipment. Latex glove usage will be required at all times during handling of Sudan IV.

The following procedure is adapted from the practices of Cohen and Mercer, 1993.

1. Prepare clear, 250 mL jar with Teflon®-lined cap by adding approximately 4 milligrams (twice the amount that would rest on the edge of a toothpick) of Sudan IV dye to the jar. This can be done in advance of sample collection in a controlled environment to avoid adverse conditions in the field.
2. Add sample (soil and/or groundwater) to the prepared 250 mL jar and tighten cap.
3. Shake sample for 10 to 30 seconds and examine it for NAPL, which should be stained a bright red through contact with the Sudan IV.
4. Rate the presence of NAPL using the following categories:
    "A" if NAPL was identified as present based on visual evidence;
    "B" if NAPL presence was suspected based on visual evidence; or
    "C" if there was no visual evidence of DNAPL.
5. Record results in field notebook.

SOP No. 10 SOIL GAS SAMPLING

Please refer to attached URSGWC SOP No. 10. HLA provides the following exceptions to the URSGWC SOP.

Introduction:

This procedure describes analytical procedures for analysis of soil gas samples by USEPA Region I method "Ambient Air Grab Sample Analysis For Volatile Organic Compounds". Samples will be collected by pumping known volumes of soil gas through glass, gas sample bulbs. Soil gas will be obtained using GeoProbe™ sample rods from depths outlined in the project Work Plan. Modifications made to the analytical method are discussed below.

Target Compounds and Reporting Limits:

Table 1 lists the target compounds and their reporting limits.

TABLE 1

Target Compound	Reporting Limit (ppb$_v$)
Vinyl chloride	76
1,1-Dichloroethylene	118
Trichloroethylene	142
Tetrachloroethylene	201

Sample Collection:

1. The GeoProbe™ rods will be advanced to within three feet bgs of the water table (vadose zone). The expendable point will be released and the rods backed out of the ground approximately four to six inches. This will provide a void volume to draw soil gas into the probe rods.

2. Inert tubing is threaded through the rods to a fitting located at the rod's end. The fitting is engaged with the tubing and a seal is formed. A glass, soil gas sample bulb will be connected in line of the probe rods to a vacuum pump.

3. Three liters of soil vapor will be purged, measured by an attached flow meter. The exit stopcock for the gas sample bulb will be closed. The vacuum gauge will be allowed to equilibrate to zero, at this point the entrance stopcock will be closed. The bulb will then be submitted to the field lab for analysis.

Calibration:

A single point calibration as per the EPA method. After analysis of the initial calibration point a second calibration point is run. The results of the second point are compared to the first. The recoveries of the second point must agree within 80% of the first for all compounds. The instrument will be recalibrated in the same way after every ten samples.

Documentation:

A FTDS included as Attachment 1 will be completed for each soil gas sample. The sample tube ID, HLA Field sample number, date of collection, purging information, sampling times, flow rates, and observations will be recorded in the spaces provided.

STANDARD OPERATING PROCEDURE 10

SOIL GAS SURVEYS

1.0 PURPOSE AND APPLICABILITY

This SOP provides guidance for conducting a soil gas survey. A soil gas survey is conducted to determine whether concentrations of certain vapors are present in subsurface soils.

A soil gas survey can be conducted by analyzing soil gas samples either in the field or in the laboratory. Parameters to be analyzed for using field analysis techniques are usually limited to volatile organic compounds. Collection procedures for obtaining soil gas samples for laboratory analyses are provided in Attachment 1.

Specific project requirements as described in an approved, site-specific Work Plan, Quality Assurance Project Plan (QAPP), or Health and Safety Plan (HASP) will take precedence over the procedures described in this document. Additionally, deviation from this SOP regarding materials and techniques is acceptable providing: 1) the impact of the deviation on data quality has been evaluated by the Project Manager and has been deemed to be acceptable; and 2) the deviation has been clearly documented in an approved site-specific Work Plan or Work Plan Addendum.

2.0 RESPONSIBILITIES

The Field Operator/Technician who performs the soil gas survey is responsible for:

- Proper operation and calibration of instrumentation in accordance with equipment manuals and the site-specific Work Plan or Work Plan Addendum;
- Complete and accurate documentation of field activities including sampling methods and, if field analysis conducted, instrument calibrations and analysis results; and,
- Preparation of a report of survey results.

3.0 MATERIALS/EQUIPMENT

A soil gas survey performed in the field is conducted using a portable gas chromatograph (GC) [e.g., photovac] and a soil vapor probe attached to the GC inlet port. Alternately, evacuated Tedlar bags may be coupled with a vacuum pump/soil probe assembly for sample collection; however, the volume of soil gas must be measured.

Portable GCs can be configured in a variety of ways regarding the column enclosure. Some instruments operate columns under ambient conditions. Other instruments are equipped with column ovens which operate in iso-thermal or temperature program modes. Iso-thermal refers to a single oven temperature; temperature programming refers to a pre-programmed oven temperature regime which gradually increases oven temperature over time. Temperature programs allow for a faster separation of complex gas mixtures. [NOTE: Changes in column oven temperatures can have profound effects on the elution times of the target compounds. These retention times are the principal means of compound identification.] Heated GC units require additional power for operation which makes mobility a factor to be considered.

A variety of detectors are currently available on portable GCs. For the purposes of soil gas surveys, two detectors are commonly used: the photoionization detector (PID) and the flame ionization detector (FID). Both detectors sense the presence of organic compounds by "ionizing" the compound and measuring the change in voltage across the detector.

The typical PID employed in the field uses a 10.2 or 11.7 eV ultraviolet lamp to ionize organic compounds. Therefore, compounds with an ionization potential of less than the rated lamp value can be "seen" with this detector. PIDs are generally more selective for aromatic hydrocarbons than FIDs but cannot detect simple aliphatic hydrocarbons such as methane. Ambient moisture can render a PID useless due to the signal quenching effects of water on the unit. UV lamps must be checked for intensity and cleanliness for successful operation.

The typical FID uses a hydrogen/air mixture to ionize organic compounds. This detector has been referred to as a "carbon counter" due to its direct response to the number of carbon atoms in an organic compound. The FID is generally unaffected by ambient moisture. However, it is not as selective for most of the aromatic hydrocarbons as the PID. Compound concentrations are measured as relative responses to a calibration standard such as methane (see page 217 of the FSPM). FIDs that are exposed to high concentrations of contaminants must be cleaned of combustion deposits to remain operable. [NOTE: Due to the hydrogen/air flame present, care must be taken to ensure that only FIDs which have been approved as intrinsically safe can be used where flammable substances are present.]

The equipment list below is, at best, a cursory example of what should be included with a basic portable GC which uses an analytical column operated at ambient temperatures (20 to 30 degrees Celsius) and is equipped with a PID. The Field Operator/Technician should check to see that all of the following equipment is in good operating condition and is transported to the site.

- Portable GC with appropriate column and recharging adapter;
- Ultra zero-air (hydrocarbon free air) compressed carrier gas with appropriate regulator to deliver 20 psi;
- Fully charged supplemental battery pack for the GC and recharging adapter;
- Teflon® sample line/carrier line including one with a quick connect fitting;
- Soil vapor probes;
- Calibration standard(s) for compound(s)/mixture(s) of interest;
- Dual flowmeter;
- Fittings;
- Spare parts kit including GC column, sample line, soil vapor probes, photovac paper, pens, and UV lamp;
- Tedlar bags;
- Decontamination supplies;
- Sampler's logbook/logsheets;
- Gloves;
- Hammer and steel rod, hand auger, or other devices for creating a hole of appropriate depth to accommodate the soil probe;
- High pressure air reservoir tank filling manifold;
- Site map;
- Tool box; and,
- Thermometer.

4.0 METHOD

The selection of GC and associated equipment, the GC laboratory environment, and the composition and application of calibration standards are topics which need to be considered and addressed during development of a soil gas survey program. Each item depends on site logistics, site-specific chemistry, the nature of the contaminated media to be studied, and the objectives of the study. Field Operators/Technicians must be properly trained in the chromatographic principles employed, sample handling procedures, project objectives, and health and safety considerations.

4.1 Field Preparation

The example below applies to the conditions listed above (ambient operation/PID). The contractor or subcontractor responsible for the soil gas survey must provide a procedure for column/instrument conditioning/preparation prior to the start of work.

Prior to making field measurements, the GC analytical column will be conditioned overnight by flowing ultra zero air through the column. Appropriate tools will be ready and the GC battery pack will be fully charged. The ultra zero air cylinder will be filled. Before initiating field work, the field blank and field calibration standards will be ready for collection.

4.2 Sampling Procedures

Where possible, sampling locations should be selected in advance in area(s) of concern and shown on a site map outlining the area(s) of concern and significant site features above and below the ground surface. Actual sampling locations must be accurately recorded on chromatogram standard log sheets.

4.3 Sample Probe Placement/Analysis

Before placing the soil vapor probe into the ground and after each sample collection, the probe will be cleaned with distilled water. If the probe shows evidence of coal tar residues, the probe will be decontaminated with methanol and distilled water as outlined in the FSPM. The GC field equipment may require recalibration if the detection limits were effected by a contaminated probe. The probes will be purged with ultra zero air gas after each measurement.

To collect a sample, the soil vapor probe is inserted into the ground through a hole created by a hammer or auger so that the tip is placed to the desired depth into the soil. The operator must make sure that there is not a direct air path between ambient surface air and the probe sampling tip. **Avoid placing the probe into a water-saturated area.** If the sampling analysis is required to be aborted in mid-run, allow sufficient time before the next injection for potentially eluting compounds to clear the GC column. The GC column will be purged overnight if the survey is to be continued the next day.

5.0 QUALITY CONTROL

A Quality Control (QC) Program must be prepared for each specific project and included in the site-specific Work Plan. General guidelines for a QC Program are discussed below.

The soil gas survey is dependent on site logistics, the nature of the contaminated material, the chemical parameters to be analyzed, and the type of gas chromatograph. Standard laboratory safety practices will be followed when handling chemicals and using equipment (e.g., syringes, compressed gas cylinders). If a mobile laboratory is used, the laboratory will be adequately ventilated and properly equipped (e.g., fire extinguisher, eye wash, spill kit).

Field control samples will be collected at the beginning and end of each day of field activities and after every twentieth soil gas sample. Quality Assurance/Quality Control samples will be obtained by filtering ambient air through a dust and organic vapor filter cartridge and encapsulating it. To document analytical repeatability, a duplicate analysis will be performed on every tenth field sample. Laboratory blanks of nitrogen gas will also be analyzed after every tenth field sample. Analytical equipment will be calibrated using a 3-point instrument-response curve and via injection of known concentrations of the target analytes. Retention times of the standards will be used to identify peaks in the chromatograms of the field samples, and their response factors are to be used to calculate the analyte concentrations.

6.0 DOCUMENTATION

Each sampling event will be documented on the field log sheet. The following information will be recorded for each event:

- Sample number;
- Project name and number;
- Sample location and depth;
- Date and time;
- Ambient temperature;
- Sampler's name;
- Site location;
- Instrument gain;
- Observations;
- Column used;
- Flow rate during sampling; and,
- Program used.

Other documentation for each day's analyses will be recorded in the bound field notebook and will include:

- Calibration results;
- Blank measurement results;
- Sequence program used; and,
- Library File (if used).

The original field records will be placed in the project files immediately upon completion of field work. All records will be completed using indelible ink whenever possible. When this is not possible, records will be photocopied promptly after completion, and the photocopies signed and dated.

SOP No. 11 TEST PITS

1.0 PURPOSE

This SOP provides guidance for completing test pits. Test pits are designed to allow exploration of subsurface soil when traditional drilling techniques are not capable of accessing areas with significant amounts of debris.

2.0 EQUIPMENT

Test pits will be excavated using a backhoe or equivalent heavy construction equipment. The equipment should be capable of excavating to required depths specific to the project. The following additional equipment will generally be required to complete a test pit:

- shovels or other hand tools
- tape measure
- six-foot rule
- PID/FID
- plastic sheeting
- soil sampling equipment
- stakes and flagging
- site plans and test-pit forms
- camera and film

3.0 EXCAVATION AND SAMPLING PROCEDURE

The locations of test pits may coincide with exploration locations where sample borings were unsuccessful in obtaining subsurface soil for sampling. Test pitting will be conducted at the levels of personal protection specified in the site-specific SSHP.

The following steps will be followed to complete test pit excavation and sampling:

1. Excavate to the dimensions required by the field geologist.

2. Test pit excavation may be terminated due to groundwater seepage into the excavation or encountering obstructions, utility lines, or waste containers. Depending on the conditions encountered, it may be possible to continue excavating more slowly and carefully, rather than to terminate the exploration.

3. The backhoe operator will remove the material from the test pit, under the direction of the field geologist, and deposit excavated soil on plastic sheets in order to minimize contamination of surface soils.

4. When the bucket is brought to the surface, the contents will be screened for VOCs with a PID and examined for visible signs of contamination.

5. Samples will be obtained from the middle of the bucket and placed in the appropriate jars using a clean stainless steel trowel or spatula. Samples may also be collected from the test pit walls by using an extendable hand tool.

6. Excavated soils will be back-filled into the excavation and tamped down into place with the backhoe bucket.

This procedure will not require the field geologist to enter the excavation to collect samples. Sample containers will be checked for complete and accurate labeling and COC procedures will be followed.

The test-pitting subcontractor will decontaminate his backhoe bucket between excavations following the procedures described in SOP No. 7.

4.0 DOCUMENTATION

The field geologist will record the following information on a Test Pit Record and in the field logbook:

- site name and location;
- names of contractor, backhoe operator, and sampler;
- date and time of excavation;
- depth, width, length, and orientation of pit;
- sample number, depth, and type for all samples;
- approximate water level, after stabilization and/or relative soil moisture;
- soil description and stratigraphic changes
- results of any field screening;
- list of any photographs taken;
- date and type of backfill; and
- any other pertinent observations (staining, odor, etc.).

SOP No. 12 DRAFT CALIBRATION OF FIELD INSTRUMENTS (USEPA REGION 1)

Please refer to attached URSGWC SOP No. 12.

STANDARD OPERATING PROCEDURE NUMBER 12

DRAFT CALIBRATION OF FIELD INSTRUMENTS
(USEPA REGION 1)

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 1

DRAFT CALIBRATION OF FIELD INSTRUMENTS
(temperature, pH, dissolved oxygen, conductivity/specific conductance, oxidation/reduction potential [ORP], and turbidity)

I. SCOPE & APPLICATION

The purpose of this standard operating procedure (SOP) is to provide a framework for calibrating field instruments used to measure water quality parameters for ground water and surface water. Water quality parameters include temperature, pH, dissolved oxygen, conductivity/specific conductance, oxidation/reduction potential [ORP], and turbidity. This SOP supplements, but does not replace, EPA analytical methods listed in 40 CFR 136 and 40 CFR 141 for temperature, dissolved oxygen, conductivity/specific conductance, pH and turbidity.

This SOP is written for instruments that utilize multiple probes (temperature, pH, dissolved oxygen, conductivity/specific conductance, and/or oxidation/reduction potential [ORP]) and the probe readings for pH, dissolved oxygen, and specific conductance are automatically corrected for temperature. Communications to the instrument (programming and displaying the measurement values) are performed using a display/logger or a computer. Information sent to the instrument is entered through the keypad on the display/logger or computer. It is desirable that the display/logger or computer have data storage capabilities. If the instrument does not have a keypad, follow the manufacturer's instructions for entering information into the instrument.

For ground water monitoring, the instrument must be equipped with a flow-through-cell, and the display/logger or computer display screen needs to be large enough to simultaneously contain the readouts of each probe in the instrument. Turbidity is measured using a separate instrument because turbidity cannot be measured in a flow-through-cell. This procedure is applicable for use with the EPA Region 1 Low Stress (low flow) Purging and Sampling Procedure for the Collection of Ground Water Samples from Monitoring Wells.

II. GENERAL

All monitoring instruments must be calibrated before they are used to measure environmental samples. Part of the calibration is performed prior to the field event. For instrument probes that rely on the temperature sensor (pH, dissolved oxygen, conductivity/specific conductance, and at least once per year and the accuracy check date/information is kept with the instrument. If the accuracy check date/information is not included with the instrument or the last check was over a year, the temperature sensor accuracy needs to be checked at the beginning of the sampling event. If the instrument contains multiple temperature sensors, each sensor must be checked.

Verification Procedure

1. Allow a container filled with water to come to room temperature.

2. Place a thermometer that is traceable to the National Institute of Standards and Technology (NIST), and the instrument's temperature sensor into the water and wait for both temperature readings to stabilize.

3. Compare the two measurements. The instrument's temperature sensor must agree with the reference thermometer measurement within the accuracy of the sensor (usually ±0.15°C). If the measurements do not agree, the instrument may not be working properly and the manufacturer needs to be consulted.

pH (electrometric)

The pH of a sample is determined electrometrically using a glass electrode.

Choose the appropriate buffered standards that will bracket the expected values at the sampling locations. For ground water, the pH will usually be close to seven. Three standards are needed for the calibration: one close to seven, one at least two pH units below seven and the other at least two pH units above seven. For those instruments that will not accept three standards, the instrument will need to be re-calibrated if the water sample's pH is outside the initial calibration range described by the two standards.

Calibration Procedure

1. Allow the buffered standards to equilibrate to the ambient temperature.

2. Fill calibration containers with the buffered standards so each standard will cover the pH probe and temperature sensor.

Calibration Procedure

1. Gently dry the temperature sensor according to manufacturer's instructions.

2. Place a wet sponge or a wet paper towel on the bottom of the DO calibration container.

3. Place the DO probe into the container without the probe coming in contact with the wet sponge or paper towel. The probe must fit tightly into the container to prevent the escape of moisture evaporating from the sponge or towel.

4. Allow the confined air to become saturated with water vapor (saturation occurs in approximately 10 to 15 minutes). During this time, turn-on the instrument to allow the DO probe to warm-up. Select monitoring/run mode. Check temperature readings. Readings must stabilize before continuing to the next step

5. Select calibration mode; then select "DO %".

6. Enter the local barometric pressure (usually in mm of mercury) for the sampling location into the instrument. This measurement must be determined from an on-site barometer. Do not use barometric pressure obtained from the local weather services unless the pressure is corrected for the elevation of the sampling location. [Note: inches of mercury times 25.4 mm/inch equals mm of mercury or consult Oxygen Solubility at Indicated Pressure chart attached to the SOP for conversion at selected pressures].

7. The instrument should indicate that the calibration is in progress. The instrument will take approximately one minute to calibrate. After calibration, the instrument should display percent saturated DO.

8. Select monitoring/run mode. Compare the DO mg/l reading to the Oxygen Solubility at Indicated Pressure chart attached to the SOP. The numbers should agree. If they do not agree to the accuracy of the instrument (usually ± 0.2 mg/L), repeat calibration. If this does not work, change the membrane and electrolyte solution.

9. Remove the probe from the container and place it into a 0.0 mg/L DO standard (see note). The standard must be filled to the top of its container and the DO probe must fit tightly into the standard's container (no head space). Check temperature readings. They must stabilize before continuing.

4. Look up the conductivity value at this temperature from the conductivity versus temperature correction table usually found on the standard bottle or on the standard instruction sheet. You may need to interpolate the conductivity value between temperatures. Select calibration mode, then conductivity. Enter the temperature corrected conductivity value into the instrument.

5. Select monitoring/run mode. The reading should remain within manufacturer's specifications. If it does not, re-calibrate. If readings continue to change after re-calibration, consult manufacturer.

6. Read the specific conductance on the instrument and compare the value to the specific conductance value on the standard. The instrument value should agree with the standard within the manufacturer's specifications. If not, re-calibrate. If the re-calibration does not correct the problem, the probe may need to be cleaned or serviced by the instrument manufacturer.

7. Remove probe from the standard, rinse the probe with a small amount of the second conductivity/specific conductance standard (discard the rinsate), and place the probe into the second conductivity/specific conductance standard. The second standard will serve to verify the linearity of the instrument. Read the specific conductance value from the instrument and compare the value to the specific conductance on the standard. The two values should agree within the specifications of the instrument. If they do not agree, re-calibrate. If readings do not compare, then the second standard may be outside the linear range of the instrument. Use a standard that is closer, but above the first standard and repeat the verification. If values still do not compare, try cleaning the probe or consult the manufacturer.

8. When monitoring ground water or surface water, use the specific conductance readings.

OXIDATION/REDUCTION POTENTIAL (ORP)

The oxidation/reduction potential is the electrometric difference measured in a solution between an inert indicator electrode and a suitable reference electrode. The electrometric difference is measured in millivolts and is temperature dependent.

Calibration Procedures

1. Allow the calibration standards to equilibrate at the ambient temperature. The use of commercially available polymer primary standards (AMCO-AEPA-1) is preferred, however, the standards can be prepared using Formazin according to the EPA analytical Method 180.1.

2. If the standard cuvette is not sealed, rinse a cuvette with deionized water. Shake the cuvette to remove as much water as possible. Do not wipe dry the inside of the cuvette because lint from the wipe may remain in the cuvette. Add the standard to the cuvette.

3. Before performing the calibration procedure, make sure the cuvettes are not scratched and the outside surfaces are dry, free from fingerprints and dust. If the cuvette is scratched or dirty, discard or clean the cuvette respectively.

4. Zero the instrument by using either a zero or 0.02 NTU standard. A zero standard (approximately 0 NTU) can be prepared by passing distilled water through a 0.45 micron pore size membrane filter.

5. Using a standard in the range of 5 - 20 NTUs, calibrate according to manufacturer's instructions or verify calibration if instrument will not accept a second standard. If verifying, the instrument should read standard value to within the specifications of the instrument. If the instrument has range of scales, check each range that will be used during the sampling event with a standard that falls within that range.

7. Using a standard between 20 and 100 NTUs, calibrate according to manufacturer's instructions or verify calibration if instrument does not accept a third standard. If verifying, the instrument should read standard value to within the specifications of the instrument. If the instrument has range of scales, check each range that will be used with the proper standard for that scale.

IV. DATA MANAGEMENT AND RECORDS MANAGEMENT

All calibration records must be documented in the project's log book. At a minimum, include the instrument manufacturer, model number, instrument identification number, standards used to calibrate the instruments (including source), calibration date, and the instrument readings.

Oxygen Solubility at Indicated Pressure

Temp.	Pressure (Hg)							
	760	755	750	745	740	735	730	mm
°C	29.92	29.72	29.53	29.33	29.13	28.94	28.74	in
0	14.57	14.47	14.38	14.28	14.18	14.09	13.99	mg/l
1	14.17	14.08	13.98	13.89	13.79	13.70	13.61	
2	13.79	13.70	13.61	13.52	13.42	13.33	13.24	
3	13.43	13.34	13.25	13.16	13.07	12-98	12.90	
4	13.08	12.99	12.91	12.82	12.73	12.65	12.56	
5	12.74	12.66	12.57	12.49	12.40	12.32	12.23	
6	12.42	12.34	12.26	12.17	12.09	12.01	11.93	
7	12.11	12.03	11.95	11.87	11.79	11.71	11.63	
8	11.81	11.73	11.65	11.57	11.50	11.42	11.34	
9	11.53	11.45	11.38	11.30	11.22	11.15	11.07	
10	11.28	11.19	11.11	11.04	10.96	10.89	10.81	
11	10.99	10.92	10.84	10.77	10.70	10.62	10.55	
12	10.74	10.67	10.60	10.53	10.45	10.38	10.31	
13	10.50	10.43	10.36	10.29	10.22	10.15	10.08	
14	10.27	10.20	10.13	10.06	10.00	9.93	9.86	
15	10.05	9.98	9.92	9.85	9.78	9.71	9.65	
16	9.83	9.76	9.70	9.63	9.57	9.50	9.43	
17	9.63	9.57	9.50	9.44	9.37	9.31	9.24	
18	9.43	9.37	9.30	9.24	9.18	9.11	9.05	
19	9.24	9.18	9.12	9.05	8.99	8.93	8.87	
20	9.06	9.00	8.94	8.88	8.82	8.75	8.69	
21	8.88	8.82	8.76	8.70	8.64	8.58	8.52	
22	8.71	8.65	8.59	8.53	8.47	8.42	8.36	
23	8.55	8.49	8.43	8.38	8.32	8.26	8.20	
24	8.39	8.33	8.28	8.22	8.16	8.11	8.05	
25	8.24	8.18	8.13	8.07	8.02	7.96	7.90	
26	8.09	8.03	7.98	7.92	7.87	7.81	7.76	
27	7.95	7.90	7.84	7.79	7.73	7.68	7.62	
28	7.81	7.76	7.70	7.65	7.60	7.54	7.49	
29	7.68	7.63	7.57	7.52	7.47	7.42	7.36	
30	7.55	7.50	7.45	7.39	7.34	7.29	7.24	
31	7.42	7.37	7.32	7.27	7.22	7.16	7.11	
32	7.30	7.25	7.20	7.15	7.10	7.05	7.00	
33	7.08	7.13	7.08	7.03	6.98	6.93	6.88	
34	7.07	7.02	6.97	6.92	6.87	6.82	6.78	
35	6.95	6.90	6.85	6.80	6.76	6.71	6.66	
36	6.84	6.79	6.76	6.70	6.65	6.60	6.55	
37	6.73	6.68	6.64	6.59	6.54	6.49	6.45	
38	6.63	6.58	6.54	6.49	6.44	6.40	6.35	
39	6.52	6.47	6.43	6.38	6.35	6.29	6.24	
40	6.42	6.37	6.33	6.28	6.24	6.19	6.15	
41	6.32	6.27	6.23	6.18	6.14	6.09	6.05	
42	6.22	6.18	6.13	6.09	6.04	6.00	5.95	
43	6.13	6.09	6.04	6.00	5.95	5.91	5.87	
44	6.03	5.99	5.94	5.90	5.86	5.81	5.77	
45	5.94	5.90	5.85	5.81	5.77	5.72	5.68	

(Continued)

Source: Draft EPA Handbook of Methods for Acid Deposition Studies, Field Operations for Surface Water Chemistry, EPA/600/4-89/020, August 1989.

FIELD PRESERVATION OF SOIL SAMPLES FOR VOLATILE ORGANIC ANALYSIS

STRATFORD ARMY ENGINE PLANT (SAEP)
OU2 INVESTIGATION

Prepared by:

Harding Lawson Associates
Portland, Maine

July 12, 1999

1.0 INTRODUCTION

This purpose of this standard operating procedure is to outline the steps associated with field preservation of soil samples collected during the SAEP OU2 Investigation for volatile organic analysis (VOA). Specific steps and details are outlined for the primary tasks of sample container preparation, soil sample collection, sample container management, sample analysis, and target compound quantitation.

2.0 SAMPLE CONTAINER PREPARATION

Soil samples collected for off-site laboratory analysis for volatile organic compounds (VOCs) will be preserved in methanol at the time of sample collection. Sample vials used for off-site analyses will be prepared by the subcontract laboratory prior to delivery to the field office. Sample containers will be stored separately from field samples in a dedicated refrigerator until they are obtained for sample collection.

Container preparation by the off-site laboratory will include attaching labels, adding methanol and surrogate(s), weighing sample containers, and recording all information necessary to document container preparation. Developing and implementing the exact procedures for container preparation will be the responsibility of the contract laboratory. The laboratory will maintain a vial preparation logbook that is used to record all information necessary to document the preparation of vials, and calculate soil sample weights upon receipt of field samples.

If a VOA sample is the only sample being collected at a given location, a second vial will be collected for use in percent moisture determination. These vials can be standard VOA vials, and the laboratory will not need to record information on these vials in the vial preparation logbook.

The following requirements are provided to the contract laboratory for incorporation into the methanol preserved vial preparation procedures:

1. A single container with methanol will be prepared for each VOA sample.

2. The sample container will consist of a glass vial appropriate for VOA soil samples. The container must contain a Teflon lined cap with an air tight silicone or phenolic septa.

3. A water resistant sample label will be attached to each container. Each methanol preserved sample container will be assigned a unique sample container identification number that is marked on the container label with permanent waterproof ink. The label will have room for field samplers to record sample ID, date sampled, time sampled, and initials.

4. VOA sample containers will be filled with 10 mL of purge and trap grade methanol. The lot number of the methanol must be recorded in the vial preparation logbook. If

possible, the laboratory will use a single methanol lot for the preparation of all VOA containers, or the laboratory should use as few lots as necessary for the program. Each container will be spiked with a surrogate standard concentration that will result in the appropriate concentration of surrogate standard that is appropriate for the final analysis. This will be based on the addition of 10 grams of soil to the container, and the analysis of 100 µL of methanol during the purge and trap procedure.

5. Sample container caps will be firmly secured to create an air-tight seal. Containers will be weighed and container weights will be recorded in the vial preparation logbook to the nearest 0.1 gram. A line will be drawn with a waterproof permanent marker on the container at the meniscus of the methanol to document the volume of the methanol. No other tape or packaging material will be added to the containers. Containers will be stored at 4±2°C in a cooler or designated location that does not contain other environmental samples or standards until shipment to the field. Containers will be shipped on ice to the field office or picked up at location by the HLA field sampler.

6. The laboratory will maintain container preparation records. Records must contain all information necessary to document container preparation steps and calculate soil weights for each sample. Copies of the vial preparation logs will be submitted with the data deliverable packages. At a minimum the following information must be recorded:

- preparation dates
- container tracking number for each container
- manufacturer and lot number of the containers
- methanol supplier and lot number
- volume of surrogate added and reference to surrogate working standard mix used (to establish traceability of the standard)
- pre-sampling weight of container and methanol (with cap on) recorded to the nearest 0.1 gram
- signature or initials of the individual preparing the containers
- additional fields for entering the post-sampling weight of container, and the calculated weight of soil added to the container during sampling, and the signature or initials of individual recording and calculating final weights

7. Containers will be stored at the field office in a dedicated refrigerator or cooler until sample is collected. Samples will be shipped to the laboratory in coolers at 4±2°C.

8. At the time of sample receipt at the laboratory, sample collection containers will be re-weighed by the laboratory sample manager and the weights will be entered into the container preparation records for use in calculating the actual soil weights for each sample. At the time of sample collection, the field sampler will add a second line to the vial to mark the level of methanol in the vial after soil is added. The sample

manager will check each vial to verify no significant loss of methanol occurred during shipment to the laboratory.

9. A separate sample vial filled with soil will be submitted for percent moisture determination.

10. Samples will be analyzed in accordance with the high level purge and trap procedures specified in USEPA SW-846 methods. Samples will not be shaken prior to shipment to the laboratory. **The laboratory must shake the samples as outlined in the method prior to introduction to the purge and trap sparger.** Samples analyzed as matrix spikes will be spiked with the appropriate spike mix prior to shaking the sample.

3.0 COLLECTION OF FIELD SAMPLES

Materials and Supplies

- 40 mL or 60 mL. glass sample container with Teflon lined silicone septa lids.
- disposable plastic sampling syringe
- utility knife
- stainless steel spatula
- dedicated vial storage refrigerator or cooler
- permanent waterproof marker
- sample coolers

Sample collection will be performed with a disposable plastic syringe to reduce soil exposure to air when transferring soil to sample vials. A stainless steel spatula will be used to transfer soil to the vials, if necessary, due to compacted soil media. The volume of soil in the syringe will be an estimated ten (10) grams of soil. Field personnel will check methanol fluid level marks on the sample containers to ensure no significant loss of methanol occurred during shipment to the field. Field personnel are responsible for ensuring that sample containers remain on ice at all times. The specific steps and details for soil sample collection are outlined below:

1. Using a clean utility knife or other sharp knife carefully cut of the tapered end of the plastic sampling syringes. Take care to remove all of the tapered portion without removing significant portions of the body or tube of the syringe. Sampling syringes are disposable and are not to be reused after collecting a sample.

2. Obtain sample containers from the sample cooler. Make sure the methanol is at, or slightly below, the marked fluid level (the methanol level may be slightly below the line due to cooling of the methanol during vial shipment and storage). If methanol is below the marked fluid level line by greater than 10% of the marked volume, discard the sample container, make note in the field logbook, and select another one.

3. Open split spoon sampler and push/advance the sampling syringe into the soil filling the soil sampling syringe to the target level volume. If the proper volume of soil is not present, repeat the procedure until the proper volume of soil has been collected. If necessary, use a stainless steel spatula to fill the vial with the needed soil volume.

4. Carefully extrude the soil sample from the syringe into the sample container. This task should be done slowly and carefully to insure that the methanol does not splash from the sample container. Syringes should be discarded immediately after extruding sample from syringe; do not reuse. If duplicate samples are collected, care must be taken to make them equally representative (i.e., collected from the same part of the soil core).

5. Replace container cap as soon as possible. The sample container should be open for the shortest time possible to prevent evaporation of methanol and the surrogates.

6. Mark the new fluid level in the container by placing the container on a level surface and marking a line with a permanent marker on the label at the fluid level meniscus.

7. With permanent waterproof ink fill out the sample container label with the following information: date, time, location or sample identification code, and sampler initials. **Do not tape over the sample container label or add any additional weight to the vials.** A second vial should be filled with soil and submitted for percent moisture determination if no other sample jars are collected for additional analyses. The label of this vial should be filled out with the same information as the associated field sample and marked "percent moisture".

8. Make sure the sample container lid is screwed down tightly. If necessary wipe excess soil from the mouth of the container to get an air-tight seal. Keep samples on ice until they are submitted to the laboratory.

9. A trip blank will accompany each shipment of samples to the off-site laboratory. The trip blank will consist of a sample container with methanol prepared by the off-site laboratory.

4.0 TARGET COMPOUND QUANTITATION

Estimated reporting limits (RLs) for the majority of target VOCs will be 250 µg/kg. RLs are based on a 10 gram sample and 0.100 mL methanol extract volume which will result in a calculation factor of 50. Actual sample quantitation limits (SQLs) may vary based on the actual weight of soil collected, the amount of methanol extract analyzed, and percent solids.

5.0 QUALITY CONTROL

Several quality control checks have been incorporated into the methanol preservation process for the off-site analytical program. Samples will be analyzed at the off-site laboratory following QC requirements outlined for the USEPA 8260B methodology.

- Method blanks will be analyzed daily using methanol from the same lots used to prepare the samples.
- Trip blanks will be analyzed in association with each sample cooler shipment.
- Matrix spikes and laboratory control samples will be prepared as required for SW-846 methodologies. Spike mix for matrix spikes will be added prior to shaking the sample container during the soil extraction procedure.

REFERENCES:

U.S. Environmental Protection Agency (USEPA), 1995. "Test Methods for Evaluating Solid Waste"; Laboratory Manual Physical/Chemical Methods; Office of Solid Waste and Remedial Response; Washington, DC; SW-846; November 1986; Revised January 1995.

ATTACHMENT A
STANDARD OPERATING PROCEDURE No. 14

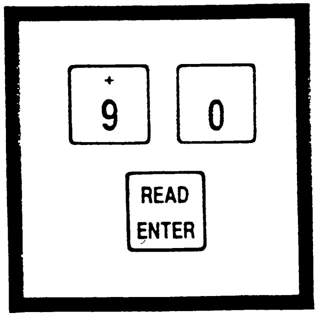
HACH KIT FIELD ANALYTICAL PROCEDURES FOR HEXAVALENT CHROIMUM AND FERROUS IRON ANALYSIS

STRATFORD ARMY ENGINE PLANT (SAEP) OU2 INVESTIGATION

CHROMIUM, HEXAVALENT (0 to 0.60 mg/L Cr^{6+}) For water and wastewater

1,5-Diphenylcarbohydrazide Method* (Powder Pillows or AccuVac Ampuls), EPA Approved

USING POWDER PILLOWS



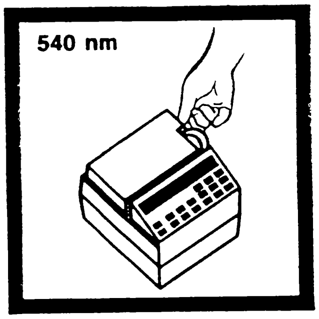
1. Enter the stored program number for hexavalent chromium (Cr^{6+})

Press. **9 0 READ/ENTER**

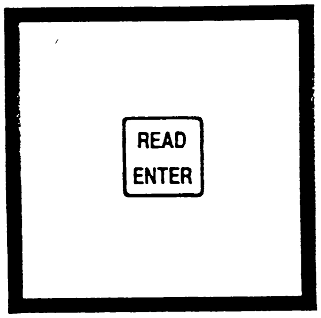
The display will show
DIAL nm TO 540

Note: DR/2000s with software versions 3.0 and greater will display "P" and the program number.

Note: Instruments with software versions 3.0 and greater will not display "DIAL nm TO" message if the wavelength is already set correctly. The display will show the message in Step 3. Proceed with Step 4.

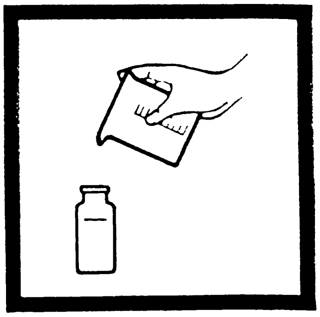


2. Rotate the wavelength dial until the small display shows·
540 nm



3. Press: **READ/ENTER**

The display will show:
mg/l Cr^{6+}



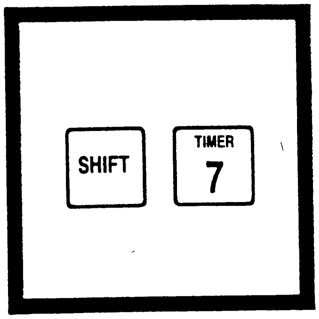
4. Fill a sample cell with 25 mL of sample

Note: For proof of accuracy, use a 0.25 mg/L hexavalent chromium standard solution (preparation given in the Accuracy Check) in place of the sample.

5. Add the contents of one ChromaVer 3 Reagent Powder Pillow to the cell (the prepared sample). Swirl to mix.

Note: A purple color will form if hexavalent chromium is present.

Note: At high chromium levels a precipitate will form. Dilute sample according to Sample Dilution Techniques (Section I).

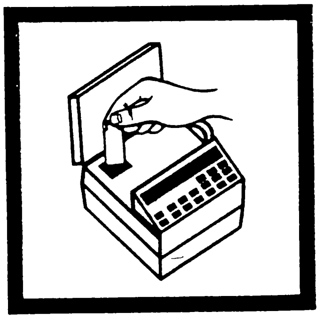


6. Press **SHIFT TIMER**

A five-minute reaction period will begin.

7. Fill another sample cell with 25 mL of sample (the blank).

Note: For turbid samples, treat the blank with the contents of one Acid Reagent Powder Pillow. This will ensure any turbidity dissolved by the acid in the ChromaVer 3 Chromium Reagent also will be dissolved in the blank.



8. When the timer beeps, the display will show:
mg/l Cr^{6+}
Place the blank into the cell holder. Close the light shield.

Note: The Pour-Thru Cell can be used with this procedure.

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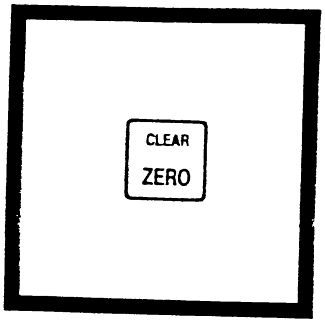
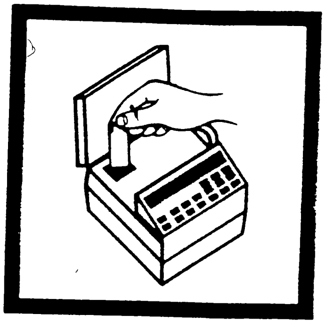
*Adapted from *Standard Methods for the Examination of Water and Wastewater*

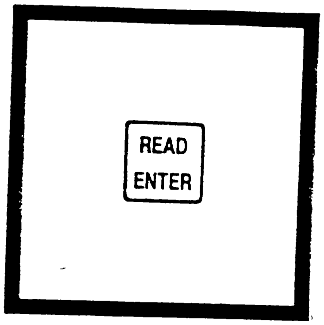


9. Press: **ZERO**

The display will show:
WAIT
then:
0.00 mg/l Cr^{6+}



10. Place the prepared sample into the cell holder. Close the light shield.



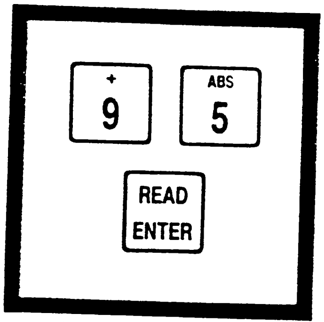
11. Press: **READ/ENTER**

The display will show
WAIT
then the results, in mg/L hexavalent chromium will be displayed

Note: The results can be expressed as mg/L chromate (CrO_4^{2-}) or mg/L sodium chromate (Na_2CrO_4) by multiplying the mg/L hexavalent chromium by 2.23 or 3.12, respectively

Note: In the constant-on mode, pressing READ/ENTER is not required. WAIT will not appear. When the display stabilizes, read the result

USING ACCUVAC AMPULS



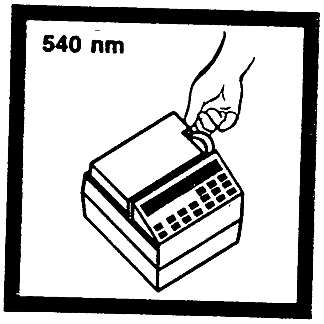
1. Enter the stored program number for hexavalent chromium.

Press: **9 5 READ/ENTER**

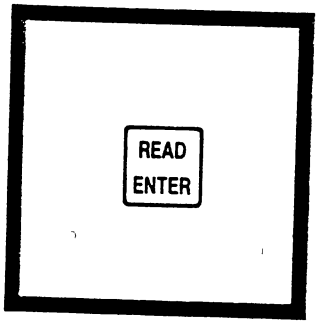
The display will show:
DIAL nm TO 540

Note: DR/2000s with software versions 3.0 and greater will display "P" and the program number

Note: Instruments with software versions 3.0 and greater will not display "DIAL nm TO" message if the wavelength is already set correctly. The display will show the message in Step 3. Proceed with Step 4

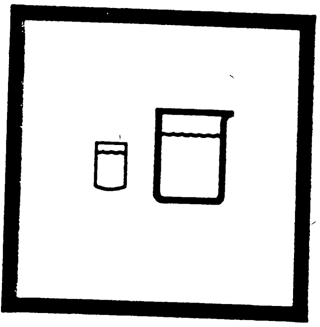


2. Rotate the wavelength dial until the small display shows:
540 nm



3. Press: **READ/ENTER**

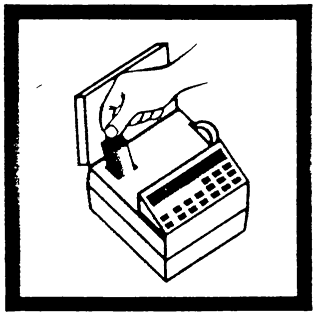
The display will show:
mg/l Cr^{6+} AV



4. Fill a zeroing vial with at least 10 mL of sample (the blank). Collect at least 40 mL of sample in a 50-mL beaker.

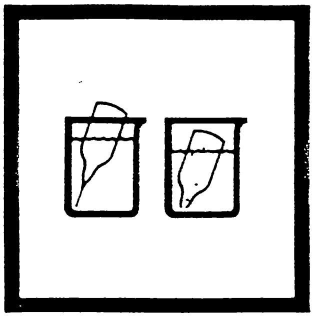
Note: For turbid samples, treat 25 mL of the blank with the contents of one Acid Reagent Powder Pillow This will ensure any turbidity dissolved by the acid in the ChromaVer 3 Chromium Reagent also will be dissolved in the blank

Note: For proof of accuracy, use a 0.25 mg/L hexavalent chromium standard solution (preparation given in the Accuracy Check) in place of the sample



5. Place the AccuVac Vial Adapter into the cell holder.

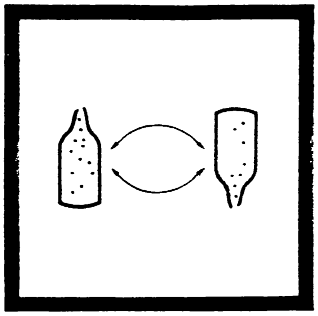
Note: Place the grip tab at the rear of the cell holder



6. Fill a ChromaVer 3 Reagent AccuVac Ampul (the prepared sample) with sample

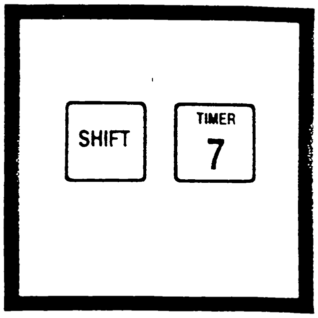
Note: Keep the tip immersed while the ampul fills completely

Note: ChromaVer 3 should be white to tan in color Replace if it is brown or green.



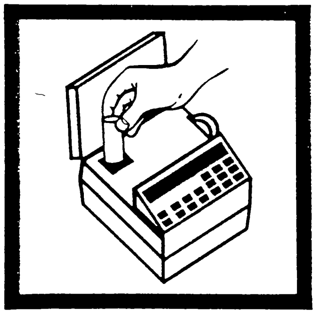
7. Quickly invert the ampul several times to mix. Wipe off any liquid or fingerprints

Note: A purple color will form if hexavalent chromium is present



8. Press: **SHIFT TIMER**

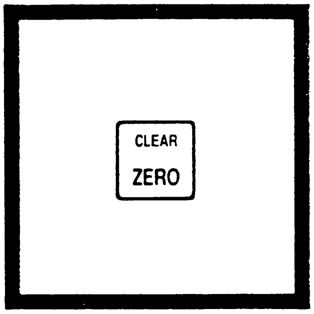
A five-minute reaction period will begin.



9. When the timer beeps, the display will show:

mg/l Cr^{6+} AV

Place the blank into the cell holder. Close the light shield.



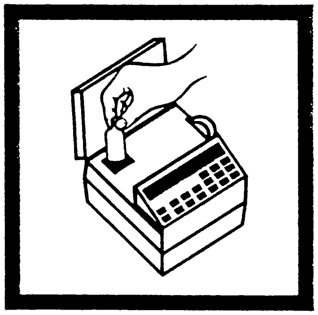
10. Press: **ZERO**

The display will show:

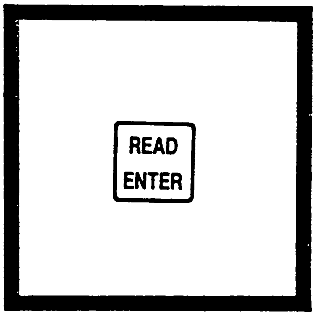
WAIT

then.

0.00 mg/l Cr^{6+} AV



11. Place the prepared sample into the cell holder. Close the light shield.



12. Press: **READ/ENTER**

The display will show:

WAIT

then the result in mg/L hexavalent chromium will be displayed.

Note: The results can be expressed as mg/L chromate (CrO_4^{2-}) *or mg/L sodium chromate* (Na_2CrO_4) *by multiplying the mg/L hexavalent chromium* (Cr^{6+}) *by 2.23 or 3.12, respectively*

Note: In the constant-on mode, pressing READ/ENTER is not required. WAIT will not appear. When the display stabilizes, read the result

26672 88

Iron, Ferrous, Test Kit

0.0 – 10.0 mg/L
Mod. IR-18C
(1,10 Phenanthroline Iron Reagent Method)
26672-00

- To ensure accurate results, read carefully before proceeding
- Pour obtenir des résultats exacts, lire attentivement le mode d emploi avant d utiliser la trousse
- Um genaue Ergebnisse zu gewährleisten, lesen Sie das Folgende bitte aufmerksam durch bevor Sie fortfahren
- Para obtener resultados precisos lea detenidamente las instrucciones antes de proceder al analisis

WARNING

Handling chemical samples, standards, and reagents can be dangerous. Review the Material Safety Data Sheets before handling any chemicals.

ATTENTION

La manipulation des échantillons chimiques, étalons et réactifs peut être dangereuse. Lire les fiches de données de sécurité des produits avant de manipuler tout produit chimique

WARNUNG

Die Handhabung chemischer Proben, Standards und Reagenzien kann gefährlich sein Bitte gehen Sie die Materialsicherheitsdatenblätter durch, bevor Sie Chemikalien handhaben.

ADVERTENCIA

El manejo de sustancias químicas, patrones y reactivos, puede resultar peligroso. Lea las Fichas de Informaciones de Seguridad de Materiales antes de manipular cualquier producto químico

HACH

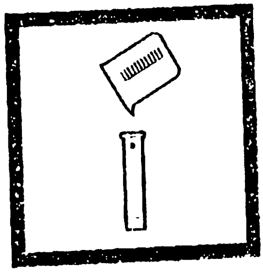
troduction

- The 1,10 phenanthroline indicator in the Ferrous Iron Reagent reacts with ferrous iron in the sample to form an orange color in proportion to the iron concentration. Ferric iron does not react. The ferric iron (Fe3$^+$) concentration can be determined by subtracting the ferrous iron concentration from the results of a total iron test.

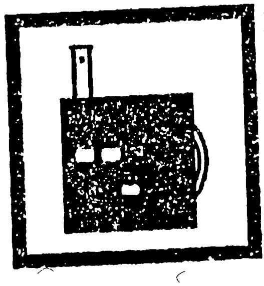
leasuring Hints and General Test Information

- Wash all labware between tests. Contamination may alter test results. Clean with a non-abrasive detergent or a solvent such as rubbing alcohol. Use a soft cloth for wiping or drying. Do not use paper towels or tissue on plastic tubes as this may scratch them. Rinse with clean water (preferably demineralized water).
- Rinse all viewing tubes thoroughly with the sample water before testing.
- Use clippers to open plastic powder pillows.
- Hach strongly recommends that, for optimum test results, reagent accuracy be checked with each new lot of reagents. Prepare a ferrous iron stock solution (100 mg/L Fe) by dissolving 0.7022 grams of ferrous ammonium sulfate, hexahydrate in deionized water. Dilute 5.00 mL of this solution to 100 mL with demineralized water to make a 5.0 mg/L standard solution. Prepare this immediately before use. Follow the ferrous iron test instructions using this solution instead of a water sample.

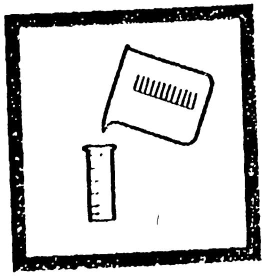
Procedure



1. Fill a viewing tube to the first (5-mL) line with sample water. This is the blank.



2. Place this tube in the top left opening of the color comparator.

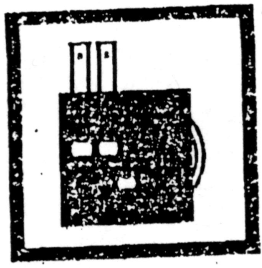


3. Fill the measuring vial to the 25-mL mark with sample water.

4. Add the contents of one Ferrous Iron Reagent Powder Pillow to the measuring vial.

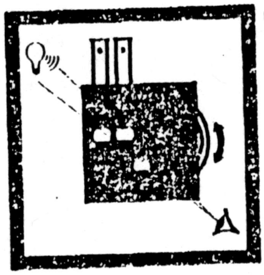
5. Swirl to mix. An orange color will develop if ferrous iron is present. Allow three minutes for full color development.

6. Fill another viewing tube to the first (5-mL) mark with the prepared sample.

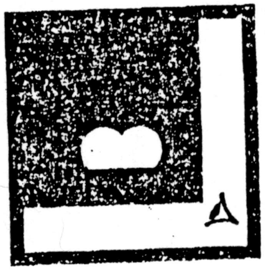


7. Place the second tube in the top right opening of the color comparator.

8. Hold comparator up to a light source such as the sky, a window or a lamp. Look through the openings in front.



9. Rotate the color disc until the color matches in the two openings.



10. Read the mg/L ferrous iron in the scale window.

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Hydrogen Peroxide Test Kit

Model HYP-1

Cat. No. 22917-00

Sample Preparation for Both Ranges

1. Fill the glass sample cell to the mark with the water to be tested. Use care to fill exactly to the mark.
2. Add 1 mL of Ammonium Molybdate solution to the sample cell.
3. Tear open one Sulfite 1 Reagent Powder Pillow as shown in Figure 1. Add the contents of the pillow to the sample cell.
4. Cap the sample cell and invert repeatedly to mix. Not all of the powder must dissolve. If hydrogen peroxide is present, a blue color will develop. Wait for five minutes before proceeding to Step 5. This is the prepared sample.

WARNING: The chemicals in this kit may be hazardous to the health and safety of the user if inappropriately handled. Please read all warnings before performing the tests and use appropriate safety equipment.

HACH COMPANY, P O. BOX 389 LOVELAND, COLORADO 80539
TELEPHONE: WITHIN U.S. 800-227-4224, OUTSIDE U.S. 303-669-3050, TELEX: 160840

High Range Test Instructions

1 drop = 1 mg/L Hydrogen Peroxide

5. Fill the plastic measuring tube level full with the prepared sample. Pour the sample from the plastic measuring tube into the flask.
6. Add Sodium Thiosulfate Titrant drop by drop to the flask. Do not pause during the titration for anything other than to refill the dropper as this will cause low results. Hold the dropper vertically above the flask to add drops. Swirl the sample in the flask constantly while adding drops and count each drop as it is added. Continue to add Sodium Thiosulfate Titrant until the sample loses all blue color or is very faintly yellow.
7. Each drop used to bring about the color change is Step 6 is equal to 1 mg/L hydrogen peroxide (H_2O_2).
8. As soon as possible, rinse the glass sample cell and cap, the plastic measuring tube and the flask with clean water.

Low Range Test Instructions

1 drop = 0.2 mg/L Hydrogen Peroxide

If the result from Step 6 of the high range test is low (2 mg/L or less), it is advisable to test a larger sample to obtain a more sensitive test.

5. Follow the sample preparation instructions (Steps 1 to 4 above) with a fresh sample of water to be tested and pour the entire prepared sample from the glass sample cell into the flask.
6. Add Sodium Thiosulfate Titrant drop by drop to the flask. Do not pause during the titration for anything other than to refill the dropper as this will cause low results. Hold the dropper vertically above the flask to add drops. Swirl the sample in the flask constantly while adding drops and count each drop as it is added. Continue to add Sodium Thiosulfate Titrant until the sample loses all blue color or is very faintly yellow.

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7. To calculate the mg/L of hydrogen peroxide (H_2O_2) present in the sample, multiply the number of drops used to bring about the color change in Step 6 by 0.2.

8. As soon as possible, rinse the glass sample cell and cap, the plastic measuring tube and the flask with clean water.

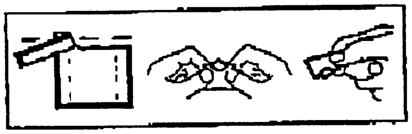

Figure 1

REPLACEMENTS

Cat. No.	Description	Unit
24491-00	Hydrogen Peroxide Reagent Set contains one each:	100 tests
2203-99	Sulfite 1 Reagent Powder Pillows*	pkg/50x2
24087-37	Sodium Thiosulfate Titrant, Stablizer	118 mL MDB**
1933-37	Ammonium Molybdate Reagent	118 mL MDB**
505-41	Flask, erlenmeyer, 50 mL	each
20849-00	Sample Cell, marked	pkg/6
21665-06	Cap, white, foam liner	pkg/6
438-00	Tube, plastic measuring	each

*Sulfite 1 Reagent is a proprietary name for a specially formulated starch-iodide reagent used in both the sulfite and hydrogen peroxide tests.

**marked dropping bottle

[redacted]

Note: When Cat. No. 20849-00 is ordered as a replacement for the glass sample cell it will be supplied with a black cap. Do not use this black cap in the hydrogen peroxide test as it will be decomposed. Always use Cat. No 21665-06 as the replacement cap for this test.

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MADE IN U.S.A.

ATTACHMENT B
TABLES

TABLE 1A
SUMMARY OF METHODS FOR SAMPLE ANALYSIS

QUALITY ASSURANCE PROJECT PLAN
OU 2 NON-TIME-CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

Media	Analytical Parameter & Method(1)
Soil Vapor	VOCs by 8260B
Soil	VOCs by 8260B TCL SVOCs by 8270C TAL Metals by 6010 CN by 9010B/9012A SPLP for Metals by 1312 Remediation Parameters(2)
Groundwater	VOCs by 8260B TCL SVOCs by 8270C TAL Metals by 6010 CN by 9010B/9012A Water Quality Parameters

ABBREVIATIONS:
ASTM = American Society for Testing and Materials
CEC = Cation Exchange Capacity
CN = Total Cyanides
PAHs = Polynuclear Aromatic Hydrocarbons
SPLP = Synthetic Precipitation Leaching Procedure
SVOCs = Semi-Volatile Organic Compounds
TAL = Target Analyte List
TCL = Target Compound List
TOC = Total Organic Carbon
TPH = Total Petroleum Hydrocarbons
USEPA = United States Environmental Protection Agency
VOCs = Volatile Organic Compounds

NOTES
1 Analytical methods are from USEPA SW-846, "Test Methods for Evaluating Solid Waste, Chemical/Physical Methods SW-846, Final Update III, revised 1993 or more recent edition unless otherwise indicated.
2. Remediation Parameters = grain size (ASTM D 422), TOC (9060), TPH (USEPA 418.1) and and CEC (9080/9081)
3 Soil, sediment, and biological tissue samples will also be analyzed for percent moisture.

ATTACHMENT B
TABLES

TABLE 1
ANALYTICAL METHODOLOGIES

QUALITY ASSURANCE PROJECT PLAN
OU 2 NON-TIME CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

Parameter	Method Reference	Preparation Method Water	Preparation Method Soil
Volatile Organic Compounds	SW-846 Method 8260B	5030B	5035
Low Conc. Vinyl Chloride	Modified 8021	-	NA
Semi-Volatile Organic Compounds	SW-846 Method 8270C	3520C	3550B
Polychlorinated Biphenyls	SW-846 Method 8082	3520C	3550B
Metals	SW-846 Method 6010/7000	3010B	3050B
SPLP Extraction*(see note)*	Various SW-846 Methods	NA	1312/State of Conn.
Cyanide	SW-846 Methods 9010b/9012a	-	-
TOC	SW-846 Method 415.1 or 9060	-	-
TPH	EPA Method 418.1	-	9071A
BOD	EPA Method 405.1	-	NA
COD	EPA Method 410.1	-	NA
$Cr^{(6+)}$	EPA Method 3060A/7196	-	NA
Diss. Fe	SW-846 Method 6010	6010B	NA
Diss. Mn	SW-846 Method 6010	6010B	NA
Chloride	EPA Method 300.0	-	NA
Phosphate	EPA Method 300.0	-	NA
Sulfate	EPA Method 300.0	-	NA
Sulfide	EPA Method 376.1	-	NA
Nitrate/Nitrite	EPA Method 353.2	-	NA
Ammonia	EPA Method 350.1	-	NA
Methane	RSK Method 175	-	NA
Alkalinity as Bicarbonate	EPA Method 310.1	-	NA
Hardness	EPA Method 130.1	-	NA
TCLP	Extraction 1312	-	NA

Notes:

Some samples will be further analyzed following SPLP extraction procedures and analysis as required by the State of Connecticut Department of Environmental Protection.

Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846 Final Update III, June 1996.

Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, March 1983.

"-" indicates that preparation procedures are included in the original referenced method.

TABLE 2
ACCURACY AND PRECISION CRITERIA FOR VOLATILE ORGANIC COMPOUNDS BY METHOD 8260B

QUALITY ASSURANCE PROJECT PLAN
OU 2 NON-TIME-CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

	Water		Soil Methanol		
Analyte	**MS/MSD**	**RPD**	**LCS**	**MS/MSD**	**RPD**
Acetone	-	-		-	-
Benzene	76-127	11		76-127	2
Bromodichloromethane	-	-		-	-
Bromoform	-	-		-	-
Bromomethane	-	-		-	-
2-Butanone	-	-		-	-
Carbon Disulfide	-	-		-	-
Carbon Tetrachloride	-	-		-	-
Chlorobenzene	75-130	13		75-130	2
Chloroethane	-	-		-	-
Chloroform	-	-		-	-
Chloromethane	-	-		-	-
Dibromochloromethane	-	-		-	-
1,1-Dichloroethane	-	-		-	-
1,2-Dichloroethane	-	-		-	-
1,1-Dichloroethene	61-145	14		61-145	2
1,2-Dichloroethene (total)	-	-		-	-
1,2-Dichloropropane	-	-		-	-
cis-1,3-Dichloropropene	-	-		-	-
trans-1,3-Dichloropropene	-	-		-	-
Ethyl Benzene	-	-		-	-
2-Hexanone	-	-		-	-
Methylene Chloride	-	-		-	-
4-Methyl-2-pentanone	-	-		-	-
Styrene	-	-		-	-
1,1,2,2-Tetrachloroethane	-	-		-	-
Tetrachloroethene	-	-		-	-
Toluene	76-125	13		76-125	2
1,1,1-Trichloroethane	-	-		-	-
1,1,2-Trichloroethane	-	-		-	-
Trichloroethene	71-120	14		71-120	2
Vinyl Chloride	-	-		-	-
Xylenes (total)	-	-		-	-

NOTES:

[1]Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846 Final Update III, June,

LCS - laboratory control sample (recovery limits will be provided in final document)

MS/MSD - matrix spike/matrix spike duplicate recovery and RPD goals obtained from CLP SOW OLM .

RPD - relative percent difference

TABLE 2
ACCURACY AND PRECISION CRITERIA FOR SEMI-VOLATILE ORGANIC COMPOUNDS

QUALITY ASSURANCE PROJECT PLAN
OU 2 NON-TIME-CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

		Water		Soil		
Analyte	**Method[1]**	**MS/MSD**	**RPD**	**LCS**	**MS/MSD**	**RPD**
1,2,4-Trichlorobenzene	8270B	39-98	28		38-107	23
1,2-Dichlorobenzene	8270B					
1,3-Dichlorobenzene	8270B					
1,4-Dichlorobenzene	8270B	36-97	28		28-104	27
2,4,5-Trichlorophenol	8270B					
2,4,6-Trichlorophenol	8270B					
2,4-Dichlorophenol	8270B					
2,4-Dimethylphenol	8270B					
2,4-Dinitrophenol	8270B					
2,4-Dinitrotoluene	8270B	24-96	38		28-89	47
2,6-Dinitrotoluene	8270B					
2-Chloronaphthalene	8270B					
2-Chlorophenol	8270B	27-123	40		25-102	50
2-Methylnaphthalene	8270B					
2-Methylphenol	8270B					
2-Nitroaniline	8270B					
2-Nitrophenol	8270B					
3,3'-Dichlorobenzidine	8270B					
3-Nitroaniline	8270B					
4,6-Dinitro-2-Methylphenol	8270B					
4-Bromophenyl phenyl ether	8270B					
4-Chloro-3-Methylphenol	8270B	23-97	42		26-103	33
4-Chloroaniline	8270B					
4-Chlorophenyl phenyl ether	8270B					
4-Methylphenol	8270B					
4-Nitroaniline	8270B					
4-Nitrophenol	8270B	10-80	50		11-114	50
Acenaphthene	8270B	46-118	31		31-137	19
Acenaphthylene	8270B					
Anthracene	8270B					
Benzo(a)anthracene	8270B					
Benzo(a)pyrene	8270B					
Benzo(b)fluoranthene	8270B					
Benzo(k)fluoranthene	8270B					
Benzo(g,h,i)perylene	8270B					
Benzoic Acid	8270B					
Benzyl alcohol	8270B					
bis(2-Chloroethoxy)methane	8270B					
bis(2-Chloroethyl)ether	8270B					
bis(2-Chloroisopropyl)ether	8270B					

TABLE 2
ACCURACY AND PRECISION CRITERIA FOR SEMI-VOLATILE ORGANIC COMPOUNDS

QUALITY ASSURANCE PROJECT PLAN
OU 2 NON-TIME-CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

		Water		Soil		
Analyte	**Method[1]**	**MS/MSD**	**RPD**	**LCS**	**MS/MSD**	**RPD**
bis(2-Ethylhexyl)phthalate	8270B					
Butylbenzylphthalate	8270B					
Chrysene	8270B					
Di-n-butylphthalate	8270B					
Di-n-octylphthalate	8270B					
Dibenzo(a,h)anthracene	8270B					
Dibenzofuran	8270B					
Diethylphthalate	8270B					
Dimethylphthalate	8270B					
Fluoranthene	8270B					
Fluorene	8270B					
Hexachlorobenzene	8270B					
Hexachlorobutadiene	8270B					
Hexachlorocyclopentadiene	8270B					
Hexachloroethane	8270B					
Indeno(1,2,3-cd)pyrene	8270B					
Isophorone	8270B					
n-Nitrosodiphenylamine	8270B					
n-Nitrosodipropylamine	8270B	41-116	38		41-126	38
Naphthalene	8270B					
Nitrobenzene	8270B					
Pentachlorophenol	8270B	9-103	50		17-109	47
Phenanthrene	8270B					
Phenol	8270B	12-110	42		26-90	35
Pyrene	8270B	26-127	31		35-142	36

NOTES:

[1] Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846 Final Update III, June, 1996

LCS - laboratory control sample *(recovery limits will be provided in final revision)*

MS/MSD - matrix spike/matrix spike duplicate limits from CLP SOW OLM 3.0.

RPD - relative percent difference

TABLE 2
ACCURACY AND PRECISION CRITERIA FOR METALS ANALYSIS

QUALITY ASSURANCE PROJECT PLAN
OU 2 NON-TIME-CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

	Water			Soil		
Analyte	**LCS**	**MS/MSD**	**RPD**	**LCS**	**MS/MSD**	**RPD**
Aluminum	80-120	75-125	20	80-120	75-125	35
Antimony	80-120	75-125	20	80-120	75-125	35
Arsenic	80-120	75-125	20	80-120	75-125	35
Arsenic $^{(3+, 5+)}$	65-135	75-125	20	-	75-125	35
Barium	80-120	75-125	20	80-120	75-125	35
Beryllium	80-120	75-125	20	80-120	75-125	35
Cadmium	80-120	75-125	20	80-120	75-125	35
Calcium	80-120	75-125	20	80-120	75-125	35
Chromium	80-120	75-125	20	80-120	75-125	35
Chromium $^{(6+)}$				-	75-125	35
Cobalt	80-120	75-125	20	80-120	75-125	35
Copper	80-120	75-125	20	80-120	75-125	35
Iron	80-120	75-125	20	80-120	75-125	35
Lead	80-120	75-125	20	80-120	75-125	35
Magnesium	80-120	75-125	20	80-120	75-125	35
Manganese	80-120	75-125	20	80-120	75-125	35
Nickel	80-120	75-125	20	80-120	75-125	35
Potassium	80-120	75-125	20	80-120	75-125	35
Selenium	80-120	75-125	20	80-120	75-125	35
Silver	80-120	75-125	20	80-120	75-125	35
Sodium	80-120	75-125	20	80-120	75-125	35
Thallium	80-120	75-125	20	80-120	75-125	35
Vanadium	80-120	75-125	20	80-120	75-125	35
Zinc	80-120	75-125	20	80-120	75-125	35

NOTES.

Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846 Final Update III, June, 1996

LCS - laboratory control sample criteria from USEPA Regional Validation Guidelines.

MS/MSD - matrix spike/matrix spike duplicate criteria from USEPA Region 1 Validation Guidelines.

RPD - relative percent difference for lab duplicate criteria from USEPA Region 1 Guidelines.

TABLE 2
ACCURACY AND PRECISION CRITERIA FOR WATER QUALITY PARAMETERS

QUALITY ASSURANCE PROJECT PLAN
OU 2 NON-TIME-CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

Analyte	Water			Soil		
	LCS	MS/MSD	RPD	LCS	MS/MSD	RPD
Alkalinity as Bicarbonate[2]	85-115	85-115	20	-	-	-
Ammonia[2]	85-115	75-125	20	-	-	-
BOD[2]	60-140	60-140	20	-	-	-
Chloride[2]	75-125	75-125	20	-	-	-
COD[2]	75-125	75-125	20	-	-	-
Cyanide[1]	75-125	75-125	20	-	-	-
Methane[3]	60-130	60-130	30	-	-	-
Nitrate[2]	75-125	75-125	20	-	-	-
Nitrite[2]	75-125	75-125	20	-	-	-
Phosphate[2]	75-125	75-125	20	-	-	-
Sulfate[2]	75-125	75-125	20	-	-	-
Sulfide[2]	85-115	85-115	20	-	-	-
TOC[1]	75-125	75-125	20	-	-	-
TRPH[2]	75-125	70-130	30	75-125	65-135	50

NOTES:

[1] Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846 Final Update III, June, 1996

[2] Methods for Chemical Analysis of Water and Waste, EPA-600/4-79-020, March 1983

[3] Robert S. Kerr Laboratory Method Reference

BOD - biochemical oxygen demand
COD - chemical oxygen demand
LCS - laboratory control sample
MS/MSD - matrix spike/matrix spike duplicate
RL - reporting limit
RPD - relative percent difference
TOC - total organic carbon
TRPH - total recoverable petroleum hydrocarbons

TABLE 3
METHOD DETECTION LIMITS AND REPORTING LIMITS FOR VOLATILE ORGANIC COMPOUNDS BY METHOD 8260B

QUALITY ASSURANCE PROJECT PLAN
OU 2 NON-TIME-CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

	CTDEP RSR Criteria		Waters		CTDEP RSR Criteria		Soils Methanol[1]	
Analyte	**SWP (ug/L)**	**I/C Vol. (ug/L)**	**RL (ug/L)**	**Preparation Method**	**I/C DE (mg/kg)**	**GB PM (mg/kg)**	**RL (ug/kg)**	**Preparation Method**
Acetone	NE	50000	10	5030B	1000	140	500	5035
Benzene	710	530	5	5030B	200	0.2	250	5035
Bromodichloromethane	NE	NE	5	5030B	92	0.11	250	5035
Bromoform	10800	3800	5	5030B	720	0.8	250	5035
Bromomethane	NE	NE	10	5030B	1000	2	500	5035
2-Butanone	NE	50000	10	5030B	1000	80	500	5035
Carbon Disulfide	NE	NE	5	5030B	1000	140	250	5035
Carbon Tetrachloride	132	40	5	5030B	44	1	250	5035
Chlorobenzene	420000	6150	5	5030B	1000	20	250	5035
Chloroethane	NE	NE	10	5030B	NE	NE	500	5035
Chloroform	14100	710	5	5030B	940	1.2	250	5035
Chloromethane	NE	NE	10	5030B	440	0.54	500	5035
Dibromochloromethane	1020	NE	5	5030B	68	0.1	250	5035
1,1-Dichloroethane	NE	50000	5	5030B	1000	14	250	5035
1,2-Dichloroethane	2970	90	5	5030B	63	0.2	250	5035
1,1-Dichloroethene	96	6	5	5030B	9.5	1.4	250	5035
cis-1,2-Dichloroethene	NE	NE	5	5030B	1000	14	250	5035
trans-1,2-Dichloroethene	NE	NE	5	5030B	1000	20	250	5035
1,2-Dichloropropane	NE	60	5	5030B	84	1	250	5035
cis-1,3-Dichloropropene	NE	NE	5	5030B	NE	NE	250	5035
trans-1,3-Dichloropropene	NE	NE	5	5030B	NE	NE	250	5035
Ethylbenzene	580000	50000	5	5030B	1000	10.1	250	5035
2-Hexanone	NE	NE	10	5030B	NE	NE	500	5035
Methylene Chloride	48000	50000	5	5030B	760	1	250	5035
4-Methyl-2-pentanone	NE	NE	10	5030B	NE	NE	500	5035
Styrene	NE	2065	5	5030B	1000	20	250	5035
1,1,2,2-Tetrachloroethane	NE	50	5	5030B	220	0.2	250	5035
Tetrachloroethene	88	3820	5	5030B	110	1	250	5035
Toluene	4000000	50000	5	5030B	1000	67	250	5035
1,1,1-Trichloroethane	62000	50000	5	5030B	1000	40	250	5035
1,1,2-Trichloroethane	1260	19600	5	5030B	100	1	250	5035
Trichloroethene	2340	540	5	5030B	520	1	250	5035
Vinyl Chloride	15750	2	1	5030B	3	0.4	300	5035
Xylenes (total)	NE	50000	5	5030B	1000	19.5	250	5035

NOTES

[1] Samples will be prepared for analysis using methanol

2 The MDL will be established by the laboratory chosen to complete analyses

3 The MDL is required to be less than or equal to the CTDEP RSR for the given analyte

CTDEP - Connecticut Department of Environmental Protection	RSR - Remediation Standard Regulation
I/C Vol - Industrial/Commercial Volatilization Criteria	SWP - Surface Water Protection Criteria
MDL - Method Detection Limit	ug/L - micrograms per liter
NE - not established	ug/kg - micrograms per kilogram
RL - Reporting Limit	

TABLE 3
METHOD DETECTION LIMITS AND REPORTING LIMITS FOR SEMIVOLATILE ORGANIC COMPOUNDS BY METHOD 8270C

QUALITY ASSURANCE PROJECT PLAN
OU 2 NON-TIME-CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

	CTDEP RSR Criteria		Water	
Analyte	SWP (ug/L)	I/C Vol. (ug/L)	RL (ug/L)	Preparation Method
1,2,4-Trichlorobenzene	NE	NE	10	3520C
1,2-Dichlorobenzene	170000	50000	10	3520C
1,3-Dichlorobenzene	26000	50000	10	3520C
1,4-Dichlorobenzene	26000	50000	10	3520C
2,2'-oxybis(1-Chloropropane)	NE	NE	10	3520C
2,4,5-Trichlorophenol	NE	NE	25	3520C
2,4,6-Trichlorophenol	NE	NE	10	3520C
2,4-Dichlorophenol	15800	NE	10	3520C
2,4-Dimethylphenol	NE	NE	10	3520C
2,4-Dinitrophenol	NE	NE	25	3520C
2,4-Dinitrotoluene	NE	NE	10	3520C
2,6-Dinitrotoluene	NE	NE	10	3520C
2-Chloronaphthalene	NE	NE	10	3520C
2-Chlorophenol	NE	NE	10	3520C
2-Methylnaphthalene	NE	NE	10	3520C
2-Methylphenol	NE	NE	10	3520C
2-Nitroaniline	NE	NE	25	3520C
2-Nitrophenol	NE	NE	10	3520C
3,3'-Dichlorobenzidine	NE	NE	10	3520C
3-Nitroaniline	NE	NE	25	3520C
4,6-Dinitro-2-methylphenol	NE	NE	25	3520C
4-Bromophenyl-phenylether	NE	NE	10	3520C
4-Chloro-3-methylphenol	NE	NE	10	3520C
4-Chloroaniline	NE	NE	25	3520C
4-Chlorophenyl-phenylether	NE	NE	10	3520C
4-Methylphenol	NE	NE	10	3520C
4-Nitroaniline	NE	NE	25	3520C
4-Nitrophenol	NE	NE	25	3520C
Acenaphthene	NE	NE	10	3520C
Acenaphthylene	0.3	NE	10	3520C
Anthracene	110000	NE	10	3520C
Benzo(a)anthracene	0.3	NE	10	3520C
Benzo(a)pyrene	0.3	NE	10	3520C
bis(2-chloroethyl)ether	42	NE	10	3520C
bis(2-Chloroisopropyl)ether	3400000	NE	10	3520C
bis(2-Ethylhexyl)phthalate	59	NE	10	3520C
Butylbenzylphthalate	NE	NE	10	3520C

TABLE 3
METHOD DETECTION LIMITS AND REPORTING LIMITS FOR SEMIVOLATILE ORGANIC COMPOUNDS BY METHOD 8270C

QUALITY ASSURANCE PROJECT PLAN
OU 2 NON-TIME-CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

	CTDEP RSR Criteria		Water	
Analyte	**SWP (ug/L)**	**I/C Vol. (ug/L)**	**RL (ug/L)**	**Preparation Method**
Carbazole	NE	NE	10	3520C
Chrysene	NE	NE	10	3520C
Di-n-butylphthalate	120000	NE	10	3520C
Di-n-octylphthalate	NE	NE	10	3520C
Dibenzo(a,h)anthracene	NE	NE	10	3520C
Dibenzofuran	NE	NE	10	3520C
Diethylphthalate	NE	NE	10	3520C
Dimethylphthalate	NE	NE	10	3520C
Fluoranthene	3700	NE	10	3520C
Fluorene	140000	NE	10	3520C
Hexachlorobenzene	0.077	NE	10	3520C
Hexachlorobutadiene	NE	NE	10	3520C
Hexachlorocyclopentadiene	NE	NE	25	3520C
Hexachloroethane	89	NE	10	3520C
Indeno(1,2,3-cd)pyrene	NE	NE	10	3520C
Isophorone	NE	NE	10	3520C
N-Nitroso-di-n-propylamine	NE	NE	10	3520C
N-Nitrosodiphenylamine	NE	NE	10	3520C
Naphthalene	NE	NE	10	3520C
Nitrobenzene	NE	NE	10	3520C
Pentachlorophenol	NE	NE	25	3520C
Phenanthrene	0 077	NE	10	3520C
Phenol	92000000	NE	10	3520C
Pyrene	110000	NE	10	3520C

NOTES.

1 The MDL will be established by the laboratory chosen to complete analyses.

2 The MDL is required to be less than or equal to the CTDEP RSR for the given analyte

CTDEP - Connecticut Department of Environmental Protection
I/C Vol. - Industrial/Commercial Volatilization Criteria
MDL - Method Detection Limit
NE - not established
RL - Reporting Limit
RSR - Remediation Standard Regulation
SWP - Surface Water Protection Criteria
ug/L - micrograms per liter
ug/kg - micrograms per kilogram
- Criteria based on detection limits

TABLE 3
METHOD DETECTION LIMITS AND REPORTING LIMITS FOR SEMIVOLATILE ORGANIC COMPOUNDS BY METHOD 8270C

QUALITY ASSURANCE PROJECT PLAN
OU 2 NON-TIME-CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

	CT DEP RSR Criteria		Soil	
Analyte	**I/C DE (mg/kg)**	**GB PM (mg/kg)**	**RL (ug/kg)**	**Preparation Method**
1,2,4-Trichlorobenzene	2500	14	333	3550B
1,2-Dichlorobenzene	1000	3.1	333	3550B
1,3-Dichlorobenzene	1000	120	333	3550B
1,4-Dichlorobenzene	240	15	333	3550B
2,2'-oxybis(1-Chloropropane)	NE	NE	333	3550B
2,4,5-Trichlorophenol	2500	140	833	3550B
2,4,6-Trichlorophenol	520	1#	333	3550B
2,4-Dichlorophenol	2500	4	333	3550B
2,4-Dimethylphenol	2500	28	333	3550B
2,4-Dinitrophenol	2500	2.8	833	3550B
2,4-Dinitrotoluene	2500	28	333	3550B
2,6-Dinitrotoluene	2000	1.4	333	3550B
2-Chloronaphthalene	2500	110	333	3550B
2-Chlorophenol	2500	7.2	333	3550B
2-Methylnaphthalene	2500	9.8	333	3550B
2-Methylphenol	2500	70	333	3550B
2-Nitroaniline	1200	1.65#	833	3550B
2-Nitrophenol	2500	11	333	3550B
3,3'-Dichlorobenzidine	13	.33#	333	3550B
3-Nitroaniline	2500	4.2	833	3550B
4,6-Dinitro-2-methylphenol	NE	NE	833	3550B
4-Bromophenyl-phenylether	1000	82	333	3550B
4-Chloro-3-methylphenol	NE	NE	333	3550B
4-Chloroaniline	2500	5.6	833	3550B
4-Chlorophenyl-phenylether	1000	82	333	3550B
4-Methylphenol	2500	7	333	3550B
4-Nitroaniline	2500	4.2	833	3550B
4-Nitrophenol	NE	NE	333	3550B
Acenaphthene	2500	84	333	3550B
Acenaphthylene	2500	84	333	3550B
Anthracene	2500	400	333	3550B
Benzo(a)anthracene	7.8	1	333	3550B
Benzo(a)pyrene	1	1	333	3550B
bis(2-chloroethyl)ether	5.2	2.4	333	3550B
bis(2-Chloroisopropyl)ether	82	2.4	333	3550B
bis(2-Ethylhexyl)phthalate	410	11	333	3550B
Butylbenzylphthalate	2500	200	333	3550B

TABLE 3
METHOD DETECTION LIMITS AND REPORTING LIMITS FOR SEMIVOLATILE ORGANIC COMPOUNDS BY METHOD 8270C

QUALITY ASSURANCE PROJECT PLAN
OU 2 NON-TIME-CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

	CT DEP RSR Criteria		Soil	
Analyte	I/C DE (mg/kg)	GB PM (mg/kg)	RL (ug/kg)	Preparation Method
Carbazole	290	1#	333	3550B
Chrysene	780	1#	333	3550B
Di-n-butylphthalate	2500	140	333	3550B
Di-n-octylphthalate	2500	20	333	3550B
Dibenzo(a,h)anthracene	1#	1#	333	3550B
Dibenzofuran	2500	5.6	333	3550B
Diethylphthalate	2500	1100	333	3550B
Dimethylphthalate	2500	1100	333	3550B
Fluoranthene	2500	56	333	3550B
Fluorene	2500	56	333	3550B
Hexachlorobenzene	410	1	333	3550B
Hexachlorobutadiene	73	1#	333	3550B
Hexachlorocyclopentadiene	2500	9.8	667	3550B
Hexachloroethane	410	1	333	3550B
Indeno(1,2,3-cd)pyrene	7.8	1#	333	3550B
Isophorone	2500	7.4	333	3550B
N-Nitroso-di-n-propylamine	1#	1#	333	3550B
N-Nitrosodiphenylamine	1200	1.4	333	3550B
Naphthalene	2500	56	333	3550B
Nitrobenzene	1000	1#	333	3550B
Pentachlorophenol	48	1	833	3550B
Phenanthrene	2500	40	333	3550B
Phenol	2500	800	333	3550B
Pyrene	2500	40	333	3550B

NOTES:

1 The MDL will be established by the laboratory chosen to complete analyses

2 The MDL is required to be less than or equal to the CTDEP RSR for the given analyte.

CTDEP - Connecticut Department of Environmental Protection
I/C Vol. - Industrial/Commercial Volatilization Criteria
MDL - Method Detection Limit
NE - not established
RL - Reporting Limit
RSR - Remediation Standard Regulation
SWP - Surface Water Protection Criteria
ug/L - micrograms per liter
ug/kg - micrograms per kilogram
- Criteria based on detection limits

TABLE 3
METHOD DETECTION LIMITS AND REPORTING LIMITS FOR METALS ANALYSES

QUALITY ASSURANCE PROJECT PLAN
OU 2 NON-TIME-CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

	CTDEP RSR Criteria		**Water**		
Analyte	**SWP (ug/L)**	**I/C Vol. (ug/L)**	**RL (ug/L)**	**Preparation Method[1]**	**Analytical Method[1]**
Aluminum	NE	NE	200	3010B	6010B
Antimony	86000	NE	100	3010B	6010B
Barium	NE	NE	10	3010B	6010B
Beryllium	4	NE	10	3010B	6010B
Boron	NE	NE	100	3010B	6010B
Cadmium	6	NE	10	3010B	6010B
Calcium	NE	NE	1000	3010B	6010B
Chromium - total	NE	NE	10	3010B	6010B
Chromium $^{(6+)}$	110	NE	0.01	7196	7196
Cobalt	NE	NE	20	3010B	6010B
Copper	52	NE	20	3010B	6010B
Iron	NE	NE	200	3010B	6010B
Lead	13	NE	10	3010B	6010B
Magnesium	NE	NE	1000	3010B	6010B
Manganese	NE	NE	10	3010B	6010B
Nickel	880	NE	50	3010B	6010B
Potassium	NE	NE	5000	3010B	6010B
Selenium	50	NE	10	3010B	6010B
Silver	12	NE	20	3010B	6010B
Sodium	NE	NE	1000	3010B	6010B
Thallium	63	NE	10	3010B	6010B
Vanadium	NE	NE	10	3010B	6010B
Zinc	123	NE	20	3010B	6010B

NOTES:

[1] Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846 Final Update III, June, 1996.

The MDL will be established by the laboratory chosen to complete analyses.

The MDL is required to be less than or equal to the CTDEP RSR for the given analyte.

CTDEP - Connecticut Department of Environmental Protection
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TABLE 3
METHOD DETECTION LIMITS AND REPORTING LIMITS FOR METALS ANALYSES

QUALITY ASSURANCE PROJECT PLAN
OU 2 NON-TIME-CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

	CTDEP RSR Criteria		**Soil**		
Analyte	**I/C DE (mg/kg)**	**GB PM (mg/kg)**	**RL (ug/kg)**	**Preparation Method[1]**	**Analytical Method[1]**
Aluminum	NE	NE	20	3050B	6010B
Antimony	8200	0.06	10	3050B	6010B
Barium	140000	10	1	3050B	6010B
Beryllium	2	0.04	1	3050B	6010B
Boron	NE	NE	10	3050B	6010B
Cadmium	1000	0.05	1	3050B	6010B
Calcium	NE	NE	100	3050B	6010B
Chromium - total	NE	0.5	1	3050B	6010B
Chromium $^{(6+)}$	100	NE	-	-	-
Cobalt	NE	NE	2	3010B	6010B
Copper	76000	13	2	3010B	6010B
Iron	NE	NE	20	3010B	6010B
Lead	1000	0.15	1	3010B	6010B
Magnesium	NE	NE	100	3010B	6010B
Manganese	NE	NE	1	3010B	6010B
Nickel	7500	1	5	3010B	6010B
Potassium	NE	NE	500	3010B	6010B
Selenium	10000	0.5	1	3010B	6010B
Silver	10000	0.36	2	3010B	6010B
Sodium	NE	NE	100	3010B	6010B
Thallium	160	0.05	1	3010B	6010B
Vanadium	14000	0.5	1	3010B	6010B
Zinc	610000	50	2	3010B	6010B

NOTES:

[1] Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846 Final Update III, June, 1996.

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RSR - Remediation Standard Regulation

SWP - Surface Water Protection Criteria

ug/L - micrograms per liter

ug/kg - micrograms per kilogram

TABLE 3
METHOD DETECTION LIMITS AND REPORTING LIMITS FOR WATER QUALITY PARAMETERS

QUALITY ASSURANCE PROJECT PLAN
OU 2 NON-TIME-CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

	CTDEP RSR Criteria			Water	
Parameter	**SWP (ug/L)**	**I/C Vol.(ug/L)**	**Method**	**RL**	**Units**
Cyanide[1]	52	NE	9010B	10.00	mg/L
TRPH[2]	NE	NE	418.1	1.000	mg/L
Chloride[2]	NE	NE	300.0	0.200	mg/L
Phosphate[2]	NE	NE	300.0	0.500	mg/L
COD[2]	NE	NE	410.1	1.000	mg/L
BOD[2]	NE	NE	405.1	2.000	mg/L
Sulfate[2]	NE	NE	300.0	0.200	mg/L
Nitrate[2]	NE	NE	300.0	0.100	mg/L
Nitrite[2]	NE	NE	300.0	0.200	mg/L
Sulfide[2]	NE	NE	376.1	1.000	mg/L
Ammonia[2]	NE	NE	350.2	0.040	mg/L
Alkalinity as Bicarbonate[2]	NE	NE	310.1	5.000	mg/L
Methane[3]	NE	NE	175	1.000	**ug/L**
TOC	NE	NE	9060	5.000	mg/L

NOTES:

[1] Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846 Final Update III, June 1996.

[2] Methods for Chemical Analysis of Water and Waste, EPA-600/4-79-020, March 1983.

[3] Robert S. Kerr Laboratory Method Reference

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TABLE 3
METHOD DETECTION LIMITS AND REPORTING LIMITS FOR WATER QUALITY PARAMETERS

QUALITY ASSURANCE PROJECT PLAN
OU 2 NON-TIME-CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

	CT DEP RSR Criteria		**Soil**	
Parameter	**I/C DE (mg/kg)**	**GB PM(mg/kg)**	**RL**	**Units**
Cyanide[1]	41000	NE	-	-
TRPH[2]	2500	2500	20.0	mg/kg
Chloride[2]	NE	NE	-	-
Phosphate[2]	NE	NE	-	-
COD[2]	NE	NE	-	-
BOD[2]	NE	NE	-	-
Sulfate[2]	NE	NE	-	-
Nitrate[2]	NE	NE	-	-
Nitrite[2]	NE	NE	-	-
Sulfide[2]	NE	NE	-	-
Ammonia[2]	NE	NE	-	-
Alkalinity as Bicarbonate[2]	NE	NE	-	-
Methane[3]	NE	NE	-	-
TOC	NE	NE		

NOTES:

[1] Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846 Final Update III, June 1996.

[2] Methods for Chemical Analysis of Water and Waste, EPA-600/4-79-020, March 1983.

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USACE CONTRACT NO. DACW33-94-D-0002
TASK ORDER NO. 020
TOTAL ENVIRONMENTAL RESTORATION CONTRACT

APPENDIX C

DRAFT
SITE SAFETY AND HEALTH PLAN FOR THE NON-TIME CRITICAL REMOVAL ACTION FOR THE CHROMIUM AND VOC GROUNDWATER OPERABLE UNIT (OU) 2 EE/CA
STRATFORD ARMY ENGINE PLANT
Stratford, Connecticut

July 12, 1999

Prepared for

U.S. Army Corps of Engineers
New England District
Concord, Massachusetts

This Site Safety Plan is specifically prepared for:

Project Location: Stratford Army Engine Plant - Stratford, Connecticut

Project / Task Number: 47254/2001

Date: November 10, 1998

Revision Date: June 25, 1999

ALL PERSONNEL PARTICIPATING IN THE FIELD MUST BE TRAINED IN THE GENERAL AND SPECIFIC HAZARDS UNIQUE TO THE JOB AND, IF APPLICABLE, MEET RECOMMENDED MEDICAL EXAMINATION REQUIREMENTS. ALL SITE PERSONNEL AND VISITORS SHALL FOLLOW THE GUIDELINES, RULES, AND PROCEDURES CONTAINED IN THIS SAFETY PLAN. THE PROJECT MANAGER OR SITE SAFETY OFFICER MAY IMPOSE ANY OTHER PROCEDURES OR PROHIBITIONS THAT THEY BELIEVE ARE NECESSARY FOR SAFE OPERATIONS.

THIS PLAN IS PREPARED TO INFORM ALL FIELD PERSONNEL, INCLUDING HLA CONTRACTORS AND HLA SUBCONTRACTORS, OF THE POTENTIAL HAZARDS ON THE SITE HOWEVER, EACH CONTRACTOR OR SUBCONTRACTOR MUST ASSUME DIRECT RESPONSIBILITY FOR HIS OWN EMPLOYEES' HEALTH AND SAFETY.

DRAFT
SITE SAFETY AND HEALTH PLAN
FOR THE NON-TIME CRITICAL REMOVAL ACTION FOR THE CHROMIUM AND VOC GROUNDWATER (OU) 2 EE/CA

TABLE OF CONTENTS

1.0. INTRODUCTION

A. SITE LOCATION: Stratford Army Engine Plant (SAEP) – Stratford, Connecticut

B. PLAN PREPARED:

	Rod Pendleton	11/10/98
	Name	Date

C. PLAN APPROVED:

	Nelson Walter	11/10/98
	Technical Manager	Date
	Cindy Sundquist	11/10/98
	DHSO	Date

D. PLAN REVISED:

	Gina Rustad	06/25/99
	Name	Date

E. REVISION APPROVED:

	Nelson Walter	06/25/99
	Technical Manager	Date
	Cindy Sundquist	06/25/99
	DHSO	Date

F. THE POSSIBLE HAZARDS ON THIS JOB ARE EXPECTED TO BE:

Dust generated during drilling of concrete floor may contain chromium contamination.

Chromium (III and VI) contamination in sampled soil and groundwater.

VOC contamination in sampled soil, groundwater, and soil gas

G. REQUIRED PERSONAL PROTECTIVE ITEMS AND EQUIPMENT FOR THIS PROJECT:

Level C dermal and respiratory protection during concrete drilling inside the Chromium Plating Facility, and Modified Level D protection during soil, groundwater, and soil gas sampling. Air monitoring equipment (PID) during soil, groundwater, and soil gas sampling.

H. Only personnel that are current in their HAZWOPER (29CFR 1910.120) training, enrolled in HLA's Medical Monitoring Program, and are medically authorized to work on hazardous waste projects will be allowed within the Chromium Plating Facility.

2.0 PERSONS RESPONSIBLE AND INVOLVED

A. TECHNICAL MANAGER - Nelson Walter, P.E.

Health and Safety Responsibilities: Follow health and safety practices when on site and ensure all potential personnel are aware of and understand the provisions of the health and safety plan.

B. SITE SUPERVISOR – D. Roderick Pendleton

Health and Safety Responsibilities: Follow health and safety practices and safe work practices when on-site. Perform frequent inspections for safe work practices and conditions. Take appropriate action to maintain safe work environment.

C. SITE SAFETY OFFICER – Ann Hewes

Health and Safety Responsibilities: Follow health and safety practices when on-site and inspect for compliance with health and safety practices and safe work conditions during on-site activities

Take appropriate action when necessary to maintain a safe work environment.

D. OTHERS - Wolfgang Calicchio, Amy E Bates, Stephen Mitchell, Gina Rustad, Patrick Craine, Tom Longley, Brad LaForest

Health and Safety Responsibilities: Follow health and safety safe work practices when on-site and report observed unsafe work conditions and practices.

E. SUBCONTRACTORS - Clean Harbors Environmental Services (for dust decontamination and investigation-derived waste disposal), Stratigraphics, Inc (for cone penetrometer investigation); drilling subcontractor and geoprobe subcontractor (to be determined)

Health and Safety Responsibilities: Follow health and safety safe work practices when on-site and report observed unsafe work conditions and practices

3.0 FACILITY BACKGROUND

A. FACILITY BACKGROUND AND DESCRIPTION: The SAEP facility began operations in 1929, manufacturing seaplanes. The facility continued to develop and manufacture aviation equipment and engines until 1995. The site consists of 124 acres and 77 buildings.

B. SITE HISTORY (USE OF SITE, ORIGIN OF CONTAMINATION): A portion of the SAEP, located in the southeast corner of Building B-2, was used as an electroplating shop. Chromium, nickel, and copper plating activities were conducted in this area. The remaining buildings were used to support manufacturing operations, including waste storage and handling.

C. HAZARDOUS INCIDENCE HISTORY (HISTORY OF INJURIES, EXPOSURE, CHEMICAL SPILLS, COMPLAINTS, ETC.):

Unknown.

D. PURPOSE OF ACTIVITY/OBJECTIVE OF HLA's WORK (CHARACTERIZATION, REMEDIAL ACTIONS, EXCAVATION, TRENCHING; INCLUDE LOCATION WITH RESPECT TO AREAS OF KNOWN OR SUSPECTED CONTAMINATION):

Further characterization of subsurface soil, groundwater, and soil gas in order to evaluate implementation of potential removal actions. Site activities will include drilling, cone penetrometer exploration, geophysics, bench-scale testing, survey, and soil gas samples.

E. SITE STATUS (ACTIVE, INACTIVE, UNKNOWN): Inactive

F. SURROUNDINGS (LOCATION WITH RESPECT TO CITY, ROADS, RESIDENCES, BUSINESSES, NATURAL FEATURES, GRADIENTS, TANKS, ETC.):

The surrounding area is light industrial use The site is bounded on the east by the Housatonic River, on the south and north by paved parking and open areas, and on the west by Main Street and the Sikorsky Memorial Airport

G SITE MAP (ATTACHED MAP AT END OF THIS PLAN SHOWING SALIENT FEATURES, INCLUDING LOCATION OF HLA'S WORK AND LOCATION OF CONTAMINATED AREAS) (SEE PLATE 1)

H. CLIMATE

AVERAGE WIND SPEED AND DIRECTION: N/A

	July	October	January	April
MEAN HIGH TEMPERATURE	86	64	32	60
MEAN LOW TEMPERATURE	70	45	28	42

4.0 IDENTIFIED CHEMICAL CONTAMINANTS

A. IDENTIFIED CHEMICAL CONTAMINANTS KNOWN TO BE PRESENT

List chemical contaminants that have been identified, their concentration, and the environmental media in which they are present. Hazardous property information for selected chemicals appears in the appendix. Review this information for all chemicals listed below. If chemicals are not listed in the appendix, you must enter the hazardous property information in the appendix in the spaces provided.

Chemical	Environmental Media (Enter Code)	Measured Concentration	
		Minimum	Maximum
Hexavalent chromium	Indoor surfaces	0.1 mg/m^2	176 mg/m^2
Total chromium	Indoor surfaces	0.275 mg/m^2	5,720 mg/m^2
Hexavalent chromium	So	0.534 mg/kg	640 mg/kg
Total chromium	So	3.43 mg/kg	2,460 mg/kg
Cyanide	So	0.416 mg/kg	230 mg/kg
Nickel	So	5.2 mg/kg	223 mg/kg
Lead	So	6.1 mg/kg	19,700 mg/kg
Hexavalent chromium	GW	0.1mg/L	950 mg/L
Total chromium	GW	0 001mg/L	950 mg/L
TCE	GW	1 µg/L	830,000 µg/L
PCE	GW	1 µg/L	1,900 µg/L
1,1-DCA	GW	1 µg/L	15,000 µg/L
1,1-DCE	GW	1 µg/L	8,900 µg/L
1,2-DCE	GW	1 µg/L	29,000 µg/L
1,1,1-TCA	GW	1 µg/L	280,000 µg/L
Vinyl Chloride	GW	1 µg/L	2,600 µg/L
t-1,2-DCE	GW	5 µg/L	1,000 µg/L
c-1,2-DCE	GW	1.3 µg/L	5,500 µg/L

B. CHEMICAL CONTAMINANTS ONSITE

List chemical contaminants that are present.

Chemical	Environmental Media
Chromium (III) and (VI)	So, GW, indoor building surfaces
VOCs	So, GW

Code for environmental media:

Sl	Sludge
GW	Groundwater
SW	Surface water
LW	Liquid waste
So	Soil
A	Air
Other - Specify	

C. CHEMICAL CONTAMINANTS CHARACTERIZATION

Has the site been adequately characterized to the best of your knowledge?

Yes __X____ No ________

If yes, list applicable references or previous reports/studies.
Draft Data Package, HLA 1999

5.0 GENERAL WORK PRACTICES

- No one will be permitted to engage in work operations alone.
- Smoking, eating, drinking, chewing gum or tobacco will not be permitted within the work zones.
- Personnel should keep track of weather conditions and wind direction to the extent they could affect potential exposure.
- Personnel should be alert to any abnormal behavior on the part of other workers that might indicate distress, disorientation, or other ill effects.
- Personnel should never ignore symptoms which could indicate potential exposure to chemical contaminants. These should be immediately reported to their supervisor or the Site Safety Officer.
- Others (specific to tasks, i.e., trenching safety, drill rig safety, site entry, etc.)

6.0 SITE CONTROL/WORK ZONES

A. DESCRIBE LOCATION OF EXCLUSION ZONE, HOT LINE, CONTAMINATION REDUCTION ZONE, AND DECONTAMINATION AREA AND SUPPORT ZONE. SHOW LOCATIONS ON SITE PLAN.

The attached site plan (Plate 1) identifies the proposed work zone (i.e., exclusion zone and decontamination area) and the support zone for the dust decontamination activities. The exclusion zone, contamination reduction zone, and decontamination area will be located within the boundaries of the chromium plating room. Access to this room will be limited during investigation and decontamination/remediation activities. The support zone will be located outside of this area. During site-wide soil, groundwater, soil gas sampling and aquifer testing, a work zone (i.e., exclusion zone and decontamination area) and support zone will be established around the vehicle using caution tape.

B. DEFINE THE SITE CONTROL/SECURITY MEASURES (I.E., FENCING, LOCKED GATES, KEYS, SECURITY GUARDS, FLAGGING, ETC.

Access to the SAEP facility itself is limited by security guards located at the main entrance. Access to the exclusion, contamination reduction, and decontamination zones will be restricted using caution tape. Caution tape will prevent entry to work zones by unauthorized personnel.

C. DESCRIBE SAFETY PLAN LOCATIONS.

Copies of the safety plan will be located in the vehicle used during completion of work and in Room 15 of Building B-1 (i.e., HLA's on-site field office).

7.0 SITE RESOURCES

SITE RESOURCES LOCATIONS

Toilet facilities: In Buildings B-1 and B-12, outside of work zone________________

Drinking water supply: In Buildings B-1 and B-12, outside of work zone ____________

Telephone: In Buildings B-1 and B-12, outside of work zone and cellular phone in support zone

Radio: Contact with security via on-site radios __________________________

Other: N/A____

8.0 HAZARD ANALYSES

Activity Number	Job Task	Mechanical	Electrical	Chemical	Temperature	Acoustical	Radioactive	02 Deficiency-Confined Space	Biohazard
1	Dust Decontamination	Mechanical lift vacuum sprayer	Power for equipment	Chromium dust	Heat stress	Vacuum noise	NE	NE	NE
2	Concrete drilling	Concrete Hammer	Power for equipment	Chromium dust from concrete coring	Heat stress	Hammer noise	NE	NE	NE
3	Subsurface soil sampling	GeoProbe tools	buried electrical lines	Potential contaminants in soil	Heat stress	Rig noise	NE	NE	NE
4	Groundwater sampling	GeoProbe tools	buried electrical lines	Potential contaminants in groundwater	Heat stress	Rig noise	NE	NE	NE
5	Groundwater sampling (conventional)	Pump generator	NE	Potential contaminants in groundwater	Heat stress	Generator and pump noise	NE	NE	NE
6	Cone penetrometer soil and groundwater sampling	GeoProbe tools (including cone penetrometer)	buried electrical lines	Potential contaminants in groundwater	Heat stress	Rig noise	NE	NE	Mosquitoes and ticks
7	Soil gas sampling	GeoProbe tools	buried electrical lines	Potential contaminants in soil gas	Heat stress	Rig noise	NE	NE	Mosquitoes and ticks
8	Monitoring well installation	Drill rig	Buried electrical lines	Potential contaminants in soil/groundwater	Heat stress	Rig noise	NE	NE	Mosquitoes and ticks
9	Soil borings	Drill rig	Buried electrical lines	Potential contaminants in soil/groundwater	Heat stress	Rig noise	NE	NE	Mosquitoes and ticks
10	Aquifer testing	Pump and generator	Power for Pump	Potential contaminants in groundwater	Heat stress	Generator noise	NE	NE	Mosquitoes and ticks
11	Geophysical survey	Equipment weight and bulkiness	Monitoring equipment	Potential contaminants in soil/groundwater	Heat stress	Blasting noise	NE	NE	Mosquitoes and ticks
12	Groundwater discharge to CWTP	Pump	Power for Pump	Potential contaminants in groundwater	Heat stress	Pump noise	NE	NE	NE
13	Bench-scale treatability testing	Pump, mixer	Power for pump, mixer	Potential contaminants in groundwater	Heat stress	Pump noise	NE	NE	NE

NE = Not Expected

9.0 HAZARD MITIGATION

Identify procedures to mitigate all hazards listed in Section VIII by placing the task number next to the appropriate mitigating measure. Listing of standard procedures is not inclusive. A specific procedure must be entered to mitigate each hazard identified in Section VIII.

Activity List Number	A. Mechanical Hazards
NE	Do not stand near backhoe buckets and earthmoving equipment.
1,2,3,4,5,6,7,8,9,10,11,12,13	Verify that all equipment is in good condition.
1	Do not stand or walk under elevated loads or ladders.
NE	Do not stand near unguarded excavation and trenches.
NE	Do not enter excavation or trenches over 5 feet deep that are not properly guarded, shored, or sloped.
NE	Consult DHSO if other mechanical hazards exist.
	B. Electrical Hazards
2,3,4,6,7,8,9	Locate and mark buried utilities before drilling.
2,3,4,6,7,8,9	Utilities located by: SAEP personnel during construction and located on site plans.
NE	Maintain at least 10-foot clearance from overhead power lines.
NE	Contact utility company for minimum clearance from high voltage power lines
NE	If unavoidably close to buried or overhead power lines, have power turned off, with circuit breaker locked and tagged.
1,2,5,7,10,11,12,13	Properly ground all electrical equipment.
1,2,5,7,10,11,12,13	Avoid standing in water when operating electrical equipment.
NE	If equipment must be connected by splicing wires, make sure all connections are properly taped.
1,2,3,4,5,6,7,8,9,10,11,12,13	Be familiar with specific operating instructions for each piece of equipment
	C Chemical Hazards
1,2,3,4,5,6,7,8,9,10,11,12,13	Use personal protective equipment indicated in Section XI.
1,2,3,4,5,6,7,8,9,10,11,12,13	Conduct direct reading air monitoring to evaluate respiratory and explosion hazards (list instrument, action level, monitoring location, and action to be taken in Section X).
NE	Consult DHSO for personal air monitoring.

D. Temperature Hazards

1. Heat Stress

1,2,3,4,5,6,7,8,9,10,11,12,13	When temperature exceeds 70°F, take frequent breaks in shaded area. Unzip or remove coveralls during breaks. Have cool water or electrolyte replenishment solution available. Drink small amounts frequently to avoid dehydration. Count the pulse rate for 30 seconds as early as possible in the rest period. If the pulse rate exceeds 110 beats per minute at the beginning of the rest period, shorten the work cycle by one-third.

2. Cold Stress

3,4,5,6,7,8,9,10,11,12,13	Wear multilayer cold weather outfits. The outer layer should be of wind resistant fabric.
NE	0° to -30°F total work time is 4 hours. Alternate 1 hour in and 1 hour out of the low-temperature area. Below -30°F, consult industrial hygienist.
NE	Drink warm fluid. Provide warm shelter for resting. Use buddy system. Avoid heavy sweating.

E. Acoustical Hazards

1,2,3,4,5,6,7,8,9,10,11,12,13	Use earplugs or earmuffs when noise level prevents conversation in normal voice at distance of 3 feet.

F. O_2 Deficiency - Confined Space Hazards

Confined spaces include trenches, pits, sumps, elevator shafts, tunnels, or any other area where circulation of fresh air is restricted or ability to readily escape from the area is restricted. Consult DHSO and Corporate Health and Safety Policy prior to entering confined space.

NE	Obtain permits for confined space entry
NE	Monitor O_2 and organic vapors before entering. If following values are exceeded, do not enter: - O_2 less than 19.5 percent or greater than 25%. - Total hydrocarbons greater than 5 ppm above background, if all air contaminants have not been identified. - Concentrations of specific contaminants exceeding action level in Section X if all air contaminants are identified.
NE	Monitor O_2 and organic vapors continuously while inside confined space. If values cited in Item 1 are exceeded, evacuate immediately. Record instrument readings.

NE	At least one person must be on standby outside the confined space who is capable of pulling workers from confined space in an emergency.
NE	Use portable fans or blowers to introduce fresh air to confined spaces whenever use of respirator is required.
NE	Work involving the use of flame, arc, spark, or other source of ignition is prohibited within a confined space.

G. Radiation Hazards

NE	If radiation meter indicates 2 mR/hr or more, leave the area and consult DHSO.

H. Biohazards

NE	Poison oak, poison ivy.
NE	Infectious waste.
NE	Rabid animals.
6,7,8,9,10,11	Ticks, mosquitoes, and other insects (disease carriers or poisonous).
NE	Biological or animal laboratories.

NE = Not Expected
Task 1 = Chromium Plating Facility dust decontamination
Task 2 = Concrete drilling inside Chromium Plating Facility
Task 3 = Subsurface soil sampling
Task 4 = Groundwater sampling (using GeoProbe)
Task 5 = Groundwater sampling (conventional)
Task 6 = Cone Penetrometer Sampling
Task 7 = Soil Gas Sampling
Task 8 = Monitoring well installation
Task 9 = Soil borings
Task 10 = Aquifer testing
Task 11 = Geophysical survey
Task 12 = Groundwater discharge to CWTP
Task 13 = Bench-scale treatability testing

10.0 AIR MONITORING

Air monitoring should be conducted with instruments selected to measure contaminants that employees may be exposed to. Measurements should be taken within the breathing zones of workers. If action levels are reached for a 1-minute reading, appropriate action must occur.

A. GASES AND VAPORS

Instrument (and Calibration Frequency)	Calibration Gas Standard	Frequency/ Duration of Air Monitoring	Action Level (a)(b) Above Background (Breathing Zone)	Action
Photoionization Detector (Daily)	Isobutylene	Continuous	Any detection above background	Introduce engineering controls (i.e., blower fans) (Level D). Monitor to ensure effectiveness
Vinyl Chloride 0.5/a Draeger tube	N/A	Whenever PID is greater than Background and Periodic	≥ 0.5 ppm	
Handheld CO meter (Daily)	CO	Continuous	Any detection above background	
Photoionization Detection (Daily)	Isobutylene	Continuous	≥ 22 ppm	Don respirator (Level C)
Photoionization Detector (Daily)	Isobutylene	Continuous	≥ 296 ppm	Upgrade to Level B
Vinyl Chloride 0.5/a Draeger tube	N/A	Periodic	≥ 0.5 ppm	
Photoionization Detector (Daily)	Isobutylene	Continuous	≥ 445 ppm	Upgrade to Level A. May also backoff and allow situation to stabilize; consult with Project Manager and DHSO.

(a) Action Levels for "known contaminants" should be based upon the contaminants Permissible Exposure Level (PEL) or Threshold Limit Values (TLVs).

(b) Action levels for unknown contaminants are based upon the following:

HNu or OVA Measurements in Breathing Zone
<u>Reading for 1 minute</u>

Background	Level D
>0-5 ppm above background	Level C
5-500 ppm above background	Level B
500-1000 ppm above background	Level A or backoff and allow situation to stabilize; consult with Project Manager and DHSO.

Comments: ______________________________

B. EXPLOSION HAZARD

Instrument & Date of Calibration	Action Level Above Background (Ambient Air)	Frequency/Duration of Air Monitoring	Action
Combustible gas indicator	Greater than 20% LEL	Continuous	Leave area

C. OXYGEN DEFICIENCY

Instrument & Date of Calibration	Action Level (Ambient Air)	Frequency/Duration of Air Monitoring	Action
O_2 meter	Less than 19.5% O_2 More than 23% O_2	Continuous	Leave work area if meter alarm sounds or reading is low.
CO meter	Less than 25 ppm Greater than 200 ppm	Continuous	Leave work area if meter alarm sensor reading is high

D OTHER INSTRUMENTS

Instrument & Date of Calibration	Action Level (Breathing Zone/ Ambient Air)	Duration/Frequency of Air Monitoring	Action
Draeger pump/tubes Vinyl Chloride 0 5/a	0 5 ppm	Periodic	Introduce

Instrument & Date of Calibration	Action Level (Breathing Zone/ Ambient Air)	Duration/Frequency of Air Monitoring	Action
			engineering controls or upgrade to Level B.
Radiation monitor			
Heat stress meter			
Noise meter			
H_2S meter			
Respirable dust meter	0.5 mg/m^3	Continuous (during dust decontamination)	Upgrade to Level C
pH analyzer			
Others: Personal air sampling for chromium[1]	0.5 mg/m^3	Representative (during dust decontamination, if necessary)	Confer with DSHO

[1] In the event visible dust cannot be controlled with wet or other methods, personal air sampling pumps with collection filters will be used to measure for chromium dust during subsequent chromium analysis

11.0 REQUIRED PERSONAL PROTECTIVE AND RELATED SAFETY EQUIPMENT

Place the activity number from Section VIII next to each item of personal protective equipment anticipated to be required for that task. All personal safety equipment must meet ANSI standards or equivalent.

LEVEL: __________ A __________ B ____1,2__C 3,4,5,6,7,8,9,10,11 Modified D

Comments: ____

Head

1,2,3,4,6,7 ,8,9,10,11	Hardhat

Eye/Face

1,2,3,4,5,6,7,8,9,10,11,12,13	Safety Glasses
	Faceshield
	Chemical Goggles

Hand

1,2,3,4,5,6,7,8,9,10,11,12,13	Neoprene
	Nitrile
	PVC
	Viton
1,2,3,45,6,7,8,9,10,11,12,13	Underglove-Nitrile
	Other = ____________________

Body

	Full Encapsulating Suit: _
	Two Piece Rainsuit, Material = ____________________
	One Piece Splash Suit, Material = ____________________
1,2,3,4,5,6,7,8,9,10,11,12,13	Hooded Tyvek Suit
	Hooded Tyvek/Saranax Suit
	Hooded Tyvek/Polyethylene Suit
	Cloth Coveralls
	High Visibility Vest
	Other __

Lung

	SCBA (open circuit, pressure demand): ___
1,2	Full Face Respirator, cartridge = Particulate/N95 cartridges
3,4,5,6,7,8,9,10,11,12,13	Full Face Respirator, cartridge = MSA GMC or equivalent with N95 pre-filter (only if Level C upgrade is required)
	Supplied Air, Airline
	Half Mask Respirator, cartridge = ____________________

Ear

2,3,4,5,6,7,8,9,10,11,12,13	Earplug, type = ________
__________	Earmuff, type = ________

Foot

1,2,3,4,5,6,7,8,9,10,11,12,13	Steel-toed Boots, type = ANSI Approved
__________	Disposable Overboots, type = ________

Other Safety Equipment

3,4 (when indoors)	Ventilation blower/fan
__________	Traffic cones
__________	Blast alarm
__________	Ground fault circuit interrupter
__________	Lifeline harness
__________	Radiation Dosimeter

Comments: Water spray bottles and/or other appropriate mist spray equipment will be available for dust suppression during Task 2 (concrete drilling inside Chromium Plating or vacuum with HEPA filter Facility). A ventilation blower/fan will be used to circulate air through the work area and prevent the accumulation of fumes from the gas-powered equipment (i.e., GeoProbe) when working indoors, if necessary.

12.0 DECONTAMINATION PROCEDURES

A. EQUIPMENT (SAMPLING, CONSTRUCTION, ETC.) DECONTAMINATION (SOLVENTS USED, EQUIPMENT USED, METHOD OF DISPOSAL). ATTACH SITE DECONTAMINATION MAP AS NECESSARY.

Drilling equipment, soil gas sampling equipment and concrete coring equipment will be decontaminated using potable water and Liquinox, or by using high pressure water or steam cleaning following use. Sampling equipment that comes in contact with the sample media will be decontaminated with a solution of Liquinox and potable water, followed by a deionized water rinse.

B. PERSONNEL DECONTAMINATION (SOLVENTS USED, METHOD OF SOLVENT DISPOSAL; INCLUDE DECONTAMINATION METHOD OF PPE AND DISPOSAL OF PPE). ATTACH DECONTAMINATION MAP AS NECESSARY.
PPE will be placed in 55-gallon DOT-approved drums and disposed off-site. Decontamination water containing surfactants (i.e., Liquinox) will be placed in 55-gallon DOT-approved drums and disposed off-site. Solid and liquid wastes will be drummed separately. Purged groundwater will be containerized in 55-gallon drums and pre-treated using a granular activated carbon unit prior to discharge to the sump at Building 63, where it will then be pumped to the to the Chemical Waste Treatment Plant.

C. INVESTIGATION-DERIVED MATERIAL DISPOSAL

1. Drill cuttings/well water: Soil cuttings will be placed in 55-gallon DOT-approved drums and disposed off-site (by Clean Harbors). Purged groundwater will be containerized in 55-gallon drums and pre-treated using a granular activated carbon unit prior to discharge to the sump at Building 63, where it will then be pumped to the to the Chemical Waste Treatment Plant

2. Decontamination solutions· Decontamination water containing surfactants (i.e., Liquinox) will be placed in 55-gallon DOT-approved drums and disposed off-site (by Clean Harbors)

3 Other Chromium dust and related decontamination equipment and soil cuttings will be containerized in 55-gallon drums and transported to an off-site facility.

13.0. DOCUMENTATION

HLA PERSONNEL TRAINING AND MEDICAL RECORDS ARE LOCATED AT HLA – PORTLAND, MAINE. RECORDS WILL BE MAINTAINED ONSITE AS NECESSARY.

A. PROJECT PERSONNEL LIST AND SAFETY PLAN DISTRIBUTION RECORD

1. HLA Employees

All project staff must sign, indicating they have read and understand the Site Safety Plan. A copy of this Site Safety Plan must be made available for their review and readily available at the job site.

Employee Name/Job Title	Date Distributed	Signature
D. Roderick Pendleton		
Gina L. Rustad		
Wolfgang Calicchio		
Amy E. Bates		
Nelson Walter		
Patrick Craine		
Glenn Daukas		
Tom Longley		
Brad LaForest		
Ann Hewes		

2. Contractors, Subcontractors

A copy of this safety plan shall be provided to contractors and subcontractors who may be affected by activities covered under the scope of this Site Safety Plan. All contractors and subcontractors must comply with applicable OSHA, EPA, and local government rules and regulations

Firm Name	Contact Person	Date Distributed
Clean Harbors Environmental Services	John Mullen, 860-583-8917	
Stratigraphics, Inc	Christine Strutysky, 630-790-4610	
Drilling Subcontractors (TBD)		
GeoProbe Subcontractor (TBD)		

B. HEALTH AND SAFETY MEETING - ALL PERSONNEL PARTICIPATING IN THE PROJECT MUST RECEIVE INITIAL HEALTH AND SAFETY ORIENTATION. THEREAFTER, A BRIEF TAILGATE SAFETY MEETING IS REQUIRED AS DEEMED NECESSARY BY THE SITE SAFETY (DAILY OR MORE OFTEN).

Date	Topics	Name of Attendee	Firm Name	Employee Initials

C. VISITOR - IT IS HLA's POLICY THAT VISITORS MUST FURNISH HIS/HER OWN PERSONAL PROTECTIVE EQUIPMENT. ALL VISITORS ARE REQUIRED TO SIGN THE VISITOR LOG AND COMPLY WITH THE SAFETY PLAN REQUIREMENTS. IF THE VISITOR REPRESENTS A REGULATORY AGENCY CONCERNED WITH SITE HEALTH AND SAFETY ISSUES, THE SITE SAFETY OFFICER SHALL ALSO IMMEDIATELY NOTIFY DHSO.

VISITOR LOG

Name of Visitor	Firm Name	Date of Visit	Signature

14.0. CONTINGENCY/EMERGENCY INFORMATION

A. REQUIRED EMERGENCY EQUIPMENT LOCATION

Safety shower/eyewash: In support zone.
First aid kit: In support zone.
Fire extinguisher: In support zone.

B. EMERGENCY TELEPHONE NUMBERS

Ambulance:	Call security (6653); they will call 911	
Police:	Call security (6653); they will call 911	
Fire department:	Call security (6653); they will call 911	
Hospital:	Bridgeport Hospital (203) 384-3000	
Client contact:	Security Headquaters (6652)	
Poison Control Center:	(800) 233-3360	
CHEMTREC:	(800) 424-9300	
Project Manager	Office (207) 828-3637	Home Redacted - Privacy Act
DHSO	Office (207) 828-3309	Home

C. * STANDARD PROCEDURES FOR REPORTING EMERGENCIES:

When calling for assistance in an emergency situation, the following information should be provided:

1. Name of person making call
2. Telephone number at location of person making call
3. Name of person(s) exposed or injured
4. Nature of emergency
5. Actions already taken

Recipient of call should hang up first-not the caller.

D. EMERGENCY ROUTES. ATTACH MAP SHOWING ROUTE TO NEAREST HOSPITAL. DESCRIBE NARRATIVELY THE ROUTE TO THE HOSPITAL. HAS HOSPITAL BEEN CONTACTED TO DETERMINE IF THEY WILL HANDLE A CHEMICAL EXPOSURE?

Follow Main Street north about ¾ mile to W Broad Street. Left on W. Broad Street about ¼ mile to Barnum Avenue Left on Barnum about ½ mile to Mill Hill Avenue. Right on Mill Hill Avenue to Bridgeport Hospital on left Hospital has been contacted. See Plate 2.

E. CONTINGENCY PLANS AS APPROPRIATE: DESCRIBE CONTINGENCY PLANS FOR EMERGENCIES SUCH AS: FIRES. EMERGENCY CARE, INJURY, PPE, OR OTHER EQUIPMENT FAILURE. INCLUDE EMERGENCY SIGNALS AND EVACUATION ROUTES. IF FORMAL CONTINGENCY PLAN DOCUMENT HAS BEEN PREPARED, ATTACH A COPY.

In the event of a fire, personnel will exit the building through the nearest exterior exit to the West Parking Lot Personnel will have access to a golf cart for rapid transport to a telephone and the main facility entrance. Since personnel will be working in several different buildings, and areas of the facility, evacuation routes and gathering points will be discussed at daily safety meetings.

APPENDIX A

HAZARDOUS PROPERTY INFORMATION

This appendix contains hazardous property information for selected compounds. Place a check mark next to each compound identified in Section IV, and review the hazardous property information for those compounds. If you have identified compounds in Section IV that are not listed in the appendix, you must list the compounds and enter the appropriate information.

MSDSs will be provided in the Draft Final and Final SSHP.

HAZARDOUS PROPERTY INFORMATION

Check if present	Material	Water Solubility^{a}	Specific Gravity	Vapor Density	Flash Point °F	Vapor Pressure^{e}	LEL UEL	LD$_{50}$ mg/kg	TLV/PEL TWA^{g}	IDLH Level	Odor Threshold or Warning Concentration	Hazard^{j} Property	Dermal^{k} Toxicity	Acute^{l} Exposure Symptoms
VOLATILE ORGANIC PRIORITY POLLUTANTS														
	Acrolein	22%	0 8410	1 9	-15	214 mm	2 8% 31%	46	C0 1 ppm, A4, skin	2 ppm	0.1-16 6 (0.21-0 5)	BCED	BJ	ABDFGHIKLMNOPQR
	Acrylonitrile	7 1%	0 8060	1 8	30	83 mm	3% 17%	82	2 ppm, A2, skin	85 ppm	19-100	BCEGO	DIG	FGIKLMNOR
	Benzene	820 ppm	0 8765	2 8	12	75 mm	0 339% 7/1%	3800	0 5 ppm, A1, skin	2,000 ppm	4.68	BCGO	CIG	BCDFHIKLMNOQR
	Bromomethane	0 1 g	1 732	3 3	none	1 88 atm	13 5%^{c} 14 5%		5 ppmh	2,000 ppm	no odor	CD		BCDEIJKLMNOQR
	Bromodichloromethane	Insoluble	1 980	--	none	n/a	non flam	916	none established	none specified		CGO		BIMN
	Bromoform	0 01 g	2 887	--	none	5 mm	non flam	1147	0.5 ppm, A3, skin	n/a	530	CED		BCDKLM
	Carbon Tetrachloride	0 08%	1 5967	5 3	none	91 mm	non flam	2800	5 ppm, A2, skin	300 ppm	21.4-200	CD	JGH	ABCFGHKMO
	Chlorobenzene	0 01 g	1 1058	3 9	84	8 8 mm	1 3% 9 6%	2910	10 ppm, A3 skin	2,400 ppm	0 21-60	BCD	CIF	BCFIKLMNOPQR
	Chloroethane	0 6 g	0 8978	2 2	-58	1 36 atm	3 8% 15 4%		100 ppm, A3, skin	20,000 ppm		BCD		BFHIKMNP
	2-Chloroethylvinyl Ether	Insoluble	1 0475	3 7	80	30 mm	--	250	none established	none specified		BCD		NIM
	Chloroform	0 8 g	1 4832	4 12	none	160 mm	non flam	800	10 ppm, A3	500 ppm	50-307 fatigue (>4096)	CD		BCDGIKLMN
	Chloromethane	0 74%	0 9159	1 8	32	50 atm	7 6% 19%		50 ppm, A4 skin	2,000 ppm	10-100 no odor (500-1000)	BCD	DHF	ABCDEFGIJKLOQR

HAZARDOUS PROPERTY INFORMATION

Check if present	Material	Water Solubility^{d}	Specific Gravity	Vapor Density	Flash Point °F	Vapor Pressure^{e}	LEL UEL	LD_{50} mg/kg	TLV/PEL TWA^{g}	IDLH Level	Odor Threshold or Warning Concentration	Hazard^{j} Property	Dermal^{k} Toxicity	Acute^{l} Exposure Symptoms
	Dibromochloromethane	Insoluble	2 451	--	--	--	--	848	none established	none specified		BCD		BFHIMNPQ
X	1,1-Dichloroethane (DCA)	0 1 g	1 1757	8 4	22	182 mm	6% 16%	725	100 ppm, A4	3,000 ppm	5 ppm	BCD		AGHIMNO
X	1,2-Dichloroethane	0 8%	1 2554	3 4	55	87 mm	6 2% 16%	670	10 ppm, A4	50 ppm	6 ppm	BCDG		BCFGOLMNQ
X	1,1-Dichloroethylene (DCE)	2250 mg/l @ 77°F	--	3 4	3	591 mm	7 3% 16 0%	200	5 ppm, A4	None specified		BCD		BIMN
X	Trans-1,2-Dichloroethylene	Slightly soluble	1 2565	--	36	400 mm	9 7% 12 8%		200 ppm	1,000 ppm	0043 mg/l	BCD		ABFILOQ
	1,2 Dichloropropene	0 26%	1 583	3 9	60	40 mm	3 4% 14 5%	1900	75 ppm, A4	400 ppm	50	BCD		ABGHIKMNO
	Cis-1,3-Dichloropropene	Insoluble	1 2	3 8	83	28 mm	5% 14 5%		1 ppm, A3 skin	None specified		BCD		ABGIKLMNP
	Trans-1,3-Dichloropropane	Insoluble	1 2	3 8	83	28 mm	5% 14 5%		1 ppm, A3 skin	none specified		BCD		ABGIKLMNP
	Ethylbenzene	0 015 g	0 867	3 7	59	7 1 mm	1 0% 6 7%	3500	100 ppm	2,000 ppm		BCD	CIF	ABFHIKLMNPQR
	Methylene Chloride	Slightly soluble	1 335	2 9	none	350 mm	12%^{c} unavailable	167	25 ppm, A3 skin	5,000 ppm	25-320 (200)	CED	CIF	BCIKLMNPR
	1,1,2,2-Tetrachloroethane	0 19%	1 5953	5 8	none	5 mm	non flam		1 ppmh, A3, skin	150 ppm	3-5	CD		ABCFHIKLMNOQ
X	Tetrachloroethylene	0 15 g/ml	1 6227	5 8	none	15 8 mm	non flam	8850	25 ppmh, A3	500 ppm	4.68%-50 (160-690)	CD		ACFHIKLMNP
X	1,1,1-Trichloroethane (TCA)	0 7 g	1 3390	4 6	none	100 mm	8 0%^{c} 10 5%	10300	350 ppm. A4	1,000 ppm	20-400 (500-1000)	BCED		ABEFHIKLNOP

HAZARDOUS PROPERTY INFORMATION

Check if present	Material	Water Solubility[d]	Specific Gravity	Vapor Density	Flash Point °F	Vapor Pressure[e]	LEL UEL	LD_{50} mg/kg	TLV/PEL TWA[g]	IDLH Level	Odor Threshold or Warning Concentration	Hazard[j] Property	Dermal[k] Toxicity	Acute[l] Exposure Symptoms
	1,1,2-Trichloroethane	0 45	1 4397	4 6	none	19 mm	6%[c] 15 5%	1140	10 ppm, A3	500 ppm	-0-	C		DEFGHIKM NOPQ
X	Trichloroethylene (TCE)	0 1%	1 4642	4 5	90[d]	58 mm	12 5% 90%	4920	50 ppmh	1,000 ppm	21.4-400	BC		BFKLNOPQ
	Trichlorofluoromethane	0 11 g	1 494	--	none	0 91 atm	non flam		C1000 ppm, A4	2,000 ppm	135-209	CD		BFHKLQ
X	Toluene	0 05 g	0 866	3 2	40	22 mm	1 3% 7 1%	5000	50 ppm, A4 skin	500 ppm	0 17-40 fatigue (300-400)	BC	BHE	DEFHIKLM NOPQ
X	Vinyl Chloride	negligible	0 9100	2 24	-108	3 31 atm	3 6% 33%	500	1 ppm, A1	none specified	260	BCEG	DJG	ABFHIKLM N
METALS														
	Arsenic	b	5 727	n a	none	n/a	f		0 01 mg/m^3, A1	None specified		CEG	CJG	ACDGJMO QR
	Beryllium	b	1 85	n/a	none	n/a	f		002 mg/m3, A1	4 mg/m3		C		IJMNR
	Cadmium	b	8 642	n/a	none	n/a	f	225	002 mg/m3. A1	9 mg/m^3		C		ABGHIKLM NQR
X	Chromium	b	7 20	n/a	none	n/a	f		0.5 mg/ m^3, A1	25 mg/m3	Not Applicable	C		FMNQ
	Copper	b	8 92	n/a	none	n/a	f		0 1 mg/m^3	100 mg/3		C		FGIJMOQR
X	Lead	b	11 3437	n/a	none	n/a	f		05 mg/m^3, A3	100 mg/m3	Not Applicable	C		ACDFGKOQ R
	Mercury	b	13 5939	7 0	none	0 0012 mm	f		0 025 mg/m^3, A4, skin	10 mg/m^3		C		AGLMNQ

HAZARDOUS PROPERTY INFORMATION

Check if present	Material	Water Solubility[a]	Specific Gravity	Vapor Density	Flash Point °F	Vapor Pressure[e]	LEL UEL	LD_{50} mg/kg	TLV/PEL TWA[g]	IDLH Level	Odor Threshold or Warning Concentration	Hazard[j] Property	Dermal[k] Toxicity	Acute[l] Exposure Symptoms
X	Nickel	b	8 9	n/a	none	n/a	f		0 1 mg/m^3, skin	10 mg/m3		C		DGHLMNQ
	Silver	b	10 5	n/a	none	n/a	f		0 01mg/m^3	10 mg/m3		C		IN
	Thallium	b	11 85	n a	none	n/a	f		0 1mg/m^3, skin	15 mg/m^3		C	BG	ABGLNOQ
	Zinc	b	7 14	n a	none	n a	f		5 mg/m3	500 mg/m3		C		DF
MISCELLANEOUS														
	Asbestos	Insoluble	2 5	n a	none	n/a	non flam		0 1 fibers/cc, A1	None specified		CG		MN
X	Cyanides	58-72%		n a	none	n/a	non flam		C5 mg/m^3, skin	25 mg/m3	Not Applicable	CE		FKLMPQ
	PCB (generic)	slightly	--	n/a	none	n/a	non flam		0 5 mg/m^3, A3	5 mg/m3		CG		CHLPQ
	Phenol	8 4%	1 0576	3 2	175	0 36 mm	1 8% 8 6%	414	5 ppm, A4 skin	250 ppm	0 47-5 (48)	C		ABCDGIKM NOQR
	Xylene	0 00003%	0 8642	3 7	84	9 mm	1 1% 7%	5000	100 ppm, A4	900 ppm	0 5-200 (200)	BCD		ABFHIKLM NPQ
	Acetone	soluble	0 8	2 0	-4	400 mm	2 6% 12 8%	9750	500 ppm A4	2,000 ppm	100	BCD	DI	H
	Chromic Acid	soluble	1 67-2 82	n/a	none	n/a	non flam		0 05 mg/m3, A1	15 mg/m3		ACEG		GIH
	Diesel Fuel	insoluble	0 81-0 90	--	130	--	0 6-1 3 6-7 5		100 ppm	none specified	0.08	BC	ABC	IN
	Gasoline	insoluble	0 72-0 76	3 4	-45	variable	1 4% 7 6%		300 ppm	none specified	0 005-10 x 0.25	CD	AB	IN

HAZARDOUS PROPERTY INFORMATION

Check if present	Material	Water Solubility^{a}	Specific Gravity	Vapor Density	Flash Point °F	Vapor Pressure^{c}	LEL UEL	LD_{50} mg/kg	TLV/PEL TWA^{g}	IDLH Level	Odor Threshold or Warning Concentration	Hazard^{j} Property	Dermal^{k} Toxicity	Acute^{l} Exposure Symptoms
	Kerosene	insoluble	0 83 1 0	--	100-165	5	0 7% 5 0%		100 ppm\	none specified	1 0	BCD	AB	IN

Notes
A1 = Confirmed Human Carcinogen
A2 = Suspected Human Carcinogen
A3 = Confirmed Animal Carcinogen with unknown relevance to humans
A4 - Not classifiable as a human carcinogen
Skin = Danger of Cutaneous Absorption
C - Ceiling limit The concentration cannot be exceeded during any part of the working exposure

HAZARDOUS PROPERTY INFORMATION EXPLANATIONS AND FOOTNOTES

Water solubility is expressed in different terms in different references. Many references use the term "insoluble" for materials that will not readily mix with water, such as gasoline. However, most of these materials are water soluble at the part per million or part per billion level. Gasoline, for example, is insoluble in the gross sense, and will be found as a discrete layer on top of the groundwater. But certain gasoline constituents, such as benzene, toluene, and xylene will also be found in solution in the groundwater at the part per million of part per billion level.

a. Water solubility expressed as 0.2 g means 0.2 grams per 100 grams water at 20°C.

b. Solubility of metals depends on the compound in which they are present.

c. Several chlorinated hydrocarbons exhibit no flash point in conventional sense, but will burn in presence of high energy ignition source or will form explosive mixtures at temperatures above 200°F.

d. Practically non-flammable under standard conditions.

e. Expressed as mm Hg under standard conditions.

f. Explosive concentrations of airborne dust can occur in confined areas.

g. Values for Threshold Limit Value-Time Weighted Average (TLV-TWA) are OSHA Permissible Exposure Limits except where noted in h and i.

h. TLV-TWA adopted by the American Conference of Governmental Industrial Hygienists, which is lower than the OSHA PEL.

i. TLV-TWA recommended by the national Institute for Occupational Safety and Health (NIOSH). A TLV or PEL has not been adopted by ACGIH or OSHA.

j. A - corrosive
B - flammable
C - toxic
D - volatile
E - reactive
F - radioactive
G - carcinogen
H - infectious

k Dermal Toxicity data is summarized in the following three categories:

Skin Penetration

- A - negligible penetration (solid-polar)
+ B - slight penetration (solid-nonpolar)
++ C - moderate penetration (liquid/solid-nonpolar)

+++	D	-	high penetration (gas/liquid-nonpolar)

Systemic Potency

E	-	slight hazard - LD_{50} = 500-15,000 mg/kg lethal dose for 70 kg man = 1 pint-1 quart
F	-	moderate hazard - LD_{50} = 50-500 mg/kg lethal dose for 70 kg man = 1 ounce-1 pint
G	-	extreme hazard - LD_{50} = 10-50 mg/kg lethal dose for 70 kg/man = drops to 20 ml

Local Potency

H	-	slight - reddening of skin
I	-	moderate - irritation/inflammation of skin
J	-	extreme - tissue destruction/necrosis

1. Acute Exposure Symptoms

A	-	abdominal pain
B	-	central nervous system depression
C	-	comatose
D	-	convulsions
E	-	confusion
F	-	dizziness
G	-	diarrhea
H	-	drowsiness
I	-	eye irritation
J	-	fever
K	-	headache
L	-	nausea
M	-	respiratory system irritation
N	-	skin irritation
O	-	tremors
P	-	unconsciousness
Q	-	vomiting
R	-	weakness

Please reduce your browser font size for better viewing and printing.

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: 202-483-7616

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.

MSDS *Material Safety Data Sheet*

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

MALLINCKRODT J.T.Baker

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

FERROUS SULFATE

MSDS Number: F1802 — *Effective Date: 03/05/97*

1. Product Identification

Synonyms: Iron (II) sulfate (1:1), heptahydrate; sulfuric acid, iron (2+) salt (1:1), heptahydrate
CAS No.: 7720-78-7
Molecular Weight: 278
Chemical Formula: $\mathrm{FeSO4\ 7H2O}$
Product Codes: J.T. Baker. 2070, 2074, 2075, 5830 Mallinckrodt: 5055, 5056, 5401, 5572

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Ferrous Sulfate	7720-78-7	99 - 100%	Yes

3. Hazards Identification

Emergency Overview

WARNING! HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS THE LIVER.

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

Health Rating: 1 - Slight
Flammability Rating: 0 - None
Reactivity Rating: 0 - None
Contact Rating: 0 - None
Lab Protective Equip: GOGGLES; LAB COAT
Storage Color Code: Orange (General Storage)

Potential Health Effects

Inhalation:
Causes irritation to the respiratory tract. Symptoms may include coughing, shortness of breath.

Ingestion:
Low toxicity in small quantities but larger dosages may cause nausea, vomiting, diarrhea, and black stool. Pink urine discoloration is a strong indicator of iron poisoning. Liver damage, coma, and death from iron poisoning has been recorded. Smaller doses are much more toxic to children.

Skin Contact:
Causes irritation to skin. Symptoms include redness, itching, and pain.

Eye Contact:
Causes irritation, redness, and pain.

Chronic Exposure:
Severe or chronic ferrous sulfate poisonings may damage blood vessels. Large chronic doses cause rickets in infants Chronic exposure may cause liver effects. Prolonged exposure of the eyes may cause discoloration.

Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems, or impaired liver, kidney or respiratory function 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. Get medical attention.

Ingestion:
Induce vomiting immediately as directed by medical personnel. 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. Remove 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:
Not considered to be a fire hazard.

Explosion:
Not considered to be an explosion hazard.

Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire.

Special Information:
Use protective clothing and breathing equipment appropriate for the surrounding fire.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Spills: Pick up and place in a suitable container for reclamation or disposal, using a method that does not generate dust. 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 Maintain a constant temperature not to exceed 24 degrees centigrade (75 degrees fahrenheit) Fluctuating temperatures causes product oxidation. Do not use this product if coated with brownish-yellow basic ferric sulfate. Isolate from incompatible substances Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
-ACGIH Threshold Limit Value (TLV): 1 mg/m3 (TWA) soluble iron salt as Fe

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, a half-face dust/mist 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 dust/mist 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-facepiece 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 full face shield where dusting or splashing of solutions is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
Blue green crystals

Odor:
Odorless

Solubility:
48.6 g 100 g water @ 50C (122F)

Density:
1.90

pH:
No information found.

% Volatiles by volume @ 21C (70F):
0

Boiling Point:
> 300C (> 572F) Decomposes.

Melting Point:
57C (135F) Loses water

Vapor Density (Air=1):
No information found.

Vapor Pressure (mm Hg):
No information found.

Evaporation Rate (BuAc=1):
No information found.

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10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage. Looses water in dry air and oxidizes upon exposure to moisture, forming a brown coating of extremely corrosive basic ferric sulfate.

Hazardous Decomposition Products:
Burning may produce sulfur oxides.

Hazardous Polymerization:
This substance does not polymerize.

Incompatibilities:
Alkalis, soluble carbonates, and oxidizing materials. Reacts in moist air to form ferric sulfate

Conditions to Avoid:
Moisture

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11. Toxicological Information

Oral rat LD50 319 mg/kg. Investigated as a tumorigen and mutagen.

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

Ingredient	---NTP Carcinogen---		IARC Category
	Known	Anticipated	
Ferrous Sulfate (7720-78-7)	No	No	None

12. Ecological Information

Environmental Fate:
No information found.

Environmental Toxicity:
No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal 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

Not regulated.

15. Regulatory Information

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

Ingredient	TSCA	EC	Japan	Australia
Ferrous Sulfate (7720-78-7)	Yes	Yes	Yes	Yes

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

Ingredient	Korea	--Canada--		Phil.
		DSL	NDSL	
Ferrous Sulfate (7720-78-7)	Yes	Yes	No	Yes

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

Ingredient	-SARA 302-		------SARA 313------	
	RQ	TPQ	List	Chemical Catg.
Ferrous Sulfate (7720-78-7)	No	No	No	No

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

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Ferrous Sulfate (7720-78-7)	1000	No	No

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Chemical Weapons Convention:  No     TSCA 12(b):  No     CDTA:  No
SARA 311/312:  Acute: Yes      Chronic: Yes   Fire: No  Pressure: No
Reactivity: No          (Mixture / Solid)
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Australian Hazchem Code: No information found.
Poison Schedule: No information found.

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: 1 **Flammability:** 0 **Reactivity:** 0

Label Hazard Warning:
WARNING! HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS THE LIVER.

Label Precautions:
Avoid contact with eyes, skin and clothing. Wash thoroughly after handling. Avoid breathing dust. Keep container closed. Use only with adequate ventilation.

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, get medical attention.

Product Use:
Laboratory Reagent Bulk pharmaceutical chemical.

Revision Information:
Mixture New 16 section MSDS format, all sections have been revised.

Disclaimer:

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Prepared by: Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: HYDROCHLORIC ACID
FORMULA: HCL
FORMULA WT: 36.46
CAS NO.: 7647-01-0
NIOSH/RTECS NO.: MW4025000
COMMON SYNONYMS: MURIATIC ACID; CHLOROHYDRIC ACID; HYDROCHLORIDE
PRODUCT CODES: 9543,9539,9535,5367,9534,9544,9529,9542,4800,9549,9530,9548 9540,9547,9546,9537
EFFECTIVE: 08/07/86
REVISION #02

PRECAUTIONARY LABELLING

BAKER SAF-T-DATA(TM) SYSTEM

HEALTH - 3 SEVERE (POISON)
FLAMMABILITY - 0 NONE
REACTIVITY - 2 MODERATE
CONTACT - 3 SEVERE (CORROSIVE)

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES

PRECAUTIONARY LABEL STATEMENTS

POISON DANGER
CAUSES SEVERE BURNS
MAY BE FATAL IF SWALLOWED OR INHALED

DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
DO NOT BREATHE VAPOR. CAUSES DAMAGE TO RESPIRATORY SYSTEM (LUNGS), EYES AND SKIN. KEEP IN TIGHTLY CLOSED CONTAINER. LOOSEN CLOSURE CAUTIOUSLY. USE WITH ADEQUATE VENTILATION. WASH THOROUGHLY AFTER HANDLING. IN CASE OF SPILL NEUTRALIZE WITH SODA ASH OR LIME AND PLACE IN DRY CONTAINER.

SAF-T-DATA(TM) STORAGE COLOR CODE. WHITE (CORROSIVE)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
HYDROCHLORIC ACID (23 BAUME)	35-40	7647-01-0

3 - PHYSICAL DATA

BOILING POINT: 110 C (230 F) VAPOR PRESSURE(MM HG): N/A

MELTING POINT: -25 C (-13 F) VAPOR DENSITY(AIR=1): 1.3

SPECIFIC GRAVITY: 1.19
(H2O=1)
EVAPORATION RATE: N/A
(BUTYL ACETATE=1)

SOLUBILITY(H2O): COMPLETE (IN ALL PROPORTIONS) % VOLATILES BY VOLUME: 100

APPEARANCE & ODOR: CLEAR, COLORLESS OR SLIGHTLY YELLOW, PUNGENT, FUMING LIQUID.

4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP N/A NFPA 704M RATING: 3-0-0

FLAMMABLE LIMITS: UPPER - N/A % LOWER - N/A %

FIRE EXTINGUISHING MEDIA
USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

SPECIAL FIRE-FIGHTING PROCEDURES
FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE. MOVE CONTAINERS FROM FIRE AREA IF IT CAN BE DONE WITHOUT RISK. USE WATER TO KEEP FIRE-EXPOSED CONTAINERS COOL.
DO NOT GET WATER INSIDE CONTAINERS.

UNUSUAL FIRE & EXPLOSION HAZARDS
MAY EMIT HYDROGEN GAS UPON CONTACT WITH METAL.

TOXIC GASES PRODUCED
HYDROGEN CHLORIDE, HYDROGEN GAS

5 - HEALTH HAZARD DATA

PEL AND TLV LISTED DENOTE CEILING LIMIT.

THRESHOLD LIMIT VALUE (TLV/TWA): 7 MG/M3 (5 PPM)

PERMISSIBLE EXPOSURE LIMIT (PEL): 7 MG/M3 (5 PPM)

TOXICITY. LD50 (ORAL-RABBIT)(MG/KG) - 900
LD50 (IPR-MOUSE)(MG/KG) - 40
LC50 (INHL-RAT-1H) (PPM) - 3124

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE
INHALATION OF VAPORS MAY CAUSE PULMONARY EDEMA, CIRCULATORY SYSTEM COLLAPSE, DAMAGE TO UPPER RESPIRATORY SYSTEM, COLLAPSE.
INHALATION OF VAPORS MAY CAUSE COUGHING AND DIFFICULT BREATHING.
LIQUID MAY CAUSE SEVERE BURNS TO SKIN AND EYES.
INGESTION IS HARMFUL AND MAY BE FATAL.

INGESTION MAY CAUSE SEVERE BURNING OF MOUTH AND STOMACH.
INGESTION MAY CAUSE NAUSEA AND VOMITING.

TARGET ORGANS
RESPIRATORY SYSTEM, EYES, SKIN

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE
NONE IDENTIFIED

ROUTES OF ENTRY
INGESTION, INHALATION, SKIN CONTACT, EYE CONTACT

EMERGENCY AND FIRST AID PROCEDURES
CALL A PHYSICIAN.
IF SWALLOWED, DO NOT INDUCE VOMITING; IF CONSCIOUS, GIVE WATER, MILK, OR MILK OF MAGNESIA.
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 RE-USE.

6 - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: HEAT, MOISTURE

INCOMPATIBLES: MOST COMMON METALS, WATER, AMINES, METAL OXIDES, ACETIC ANHYDRIDE, PROPIOLACTONE, VINYL ACETATE, MERCURIC SULFATE, CALCIUM PHOSPHIDE, FORMALDEHYDE, ALKALIES, CARBONATES, STRONG BASES, SULFURIC ACID, CHLOROSULFONIC ACID

DECOMPOSITION PRODUCTS: HYDROGEN CHLORIDE, HYDROGEN, CHLORINE

7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE
WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING. STOP LEAK IF YOU CAN DO SO WITHOUT RISK. VENTILATE AREA. NEUTRALIZE SPILL WITH SODA ASH OR LIME. WITH CLEAN SHOVEL, CAREFULLY PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND COVER; REMOVE FROM AREA. FLUSH SPILL AREA WITH WATER.

J T BAKER NEUTRASORB(R) OR NEUTRASOL(R) "LOW NA+" ACID NEUTRALIZERS ARE RECOMMENDED FOR SPILLS OF THIS PRODUCT.

DISPOSAL PROCEDURE
DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: D002 (CORROSIVE WASTE)

8 - PROTECTIVE EQUIPMENT

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.

RESPIRATORY PROTECTION:	RESPIRATORY PROTECTION REQUIRED IF AIRBORNE CONCENTRATION EXCEEDS TLV. AT CONCENTRATIONS UP TO 100 PPM, A CHEMICAL CARTRIDGE RESPIRATOR WITH ACID CARTRIDGE IS RECOMMENDED. ABOVE THIS LEVEL, A SELF-CONTAINED BREATHING APPARATUS IS ADVISED.
EYE/SKIN PROTECTION:	SAFETY GOGGLES AND FACE SHIELD, UNIFORM, PROTECTIVE SUIT, ACID-RESISTANT GLOVES ARE RECOMMENDED.

9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: WHITE (CORROSIVE)

SPECIAL PRECAUTIONS
KEEP CONTAINER TIGHTLY CLOSED. STORE IN CORROSION-PROOF AREA.
ISOLATE FROM INCOMPATIBLE MATERIALS.
DO NOT STORE NEAR OXIDIZING MATERIALS.

10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME	HYDROCHLORIC ACID
HAZARD CLASS	CORROSIVE MATERIAL (LIQUID)
UN/NA	UN1789
LABELS	CORROSIVE
REPORTABLE QUANTITY	5000 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME	HYDROCHLORIC ACID, SOLUTION
HAZARD CLASS	8
UN/NA	UN1789
LABELS	CORROSIVE

Please reduce your browser font size for better viewing and printing.

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: 202-483-7616

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.

MSDS Material Safety Data Sheet

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

J.T.Baker

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

Hydrogen Peroxide,10%

MSDS Number: H4068 — ***Effective Date: 03/01/97***

1. Product Identification

Synonyms: Hydrogen Peroxide Solution
CAS No.: 7722-84-1
Molecular Weight: 34.01
Chemical Formula: H_2O_2
Product Codes: 2194

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Water	7732-18-5	89 - 91%	No
Hydrogen Peroxide	7722-84-1	9 - 11%	Yes

3. Hazards Identification

Emergency Overview

DANGER! STRONG OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE. CORROSIVE. CAUSES BURNS TO SKIN, EYES, AND RESPIRATORY TRACT. HARMFUL IF SWALLOWED OR INHALED.

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

Health Rating: 2 - Moderate
Flammability Rating: 0 - None
Reactivity Rating: 3 - Severe (Oxidizer)
Contact Rating: 4 - Extreme (Corrosive)
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: Yellow (Reactive)

Potential Health Effects

Inhalation:
Vapors are corrosive and irritating to the respiratory tract. Inhalation of mist may burn the mucous membrane of the nose and throat. In severe cases, exposures may result in pulmonary edema and death.

Ingestion:
Corrosive and irritating to the mouth, throat, and abdomen. Large doses may cause symptoms of abdominal pain, vomiting, and diarrhea as well as blistering or tissue destruction. Stomach distention (due to rapid liberation of oxygen), and risk of stomach perforation, convulsions, pulmonary edema, coma, possible cerebral edema (fluid on the brain), and death are possible.

Skin Contact:
Corrosive. Symptoms of redness, pain, and severe burn can occur.

Eye Contact:
Vapors are very corrosive and irritating to the eyes. Symptoms include pain, redness and blurred vision. Splashes can cause permanent tissue destruction.

Chronic Exposure:
No information found

Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired respiratory function 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. Get medical attention immediately.

Ingestion:
If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never

give anything by mouth to an unconscious person. Get medical attention immediately.

Skin Contact:
Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention immediately. Wash clothing before reuse. Thoroughly clean shoes before reuse. If allowed to dry on clothing, evaporation leads to concentration and increasedpossibility of ignition.

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:
Pulmonary edema may be delayed for 24 to 72 hours;keep under observation. Gastric lavage may be necessary if swallowed. Analysis of body fluids (particularly gastric aspirates) using the titanium chloride reaction, if done immediately, will reveal peroxides.

---

5. Fire Fighting Measures

Fire:
Not combustible, but substance is a strong oxidizer and its heat of reaction with reducing agents or combustibles may cause ignition. Increases the flammability of combustible, organic and readily oxidizable materials.

Explosion:
Strong oxidizer. Contact with combustible materials, flammable materials, or powdered metals can cause fire or explosion. Drying of concentrated hydrogen peroxide on clothing or other combustible materials may cause fire or explosion. Sealed containers may rupture when heated.

Fire Extinguishing Media:
Water spray may be used to extinguish surrounding fire and cool exposed containers. Water spray will also reduce fume and irritant gases.

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

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6. Accidental Release Measures

CAUTION! Caustic material Causes fires with organic material. Ventilate area of leak or spill Wear appropriate personal protective equipment as specified in Section 8. Contain and recover liquid when possible. Do not return spilled material to original container Larger Spills: Dilute with a large amount of water and hold in a pond or dyked area until the peroxide decomposes followed by discharge into a suitable treatment system. May be neutralized with sodium metabisulfite or sodium sulfite after diluting to 5-10% peroxide. Do not flush undiluted material to sewer. This oxidizing material can increase the flammability of adjacent combustible materials. Empty containers should be rinsed with water before discarding.

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7. Handling and Storage

Store in a cool(<35C), well-ventilated dark area separated from combustible substances, reducing agents, strong bases, organics.Do not store on wooden shelves or floors. Suggest rotation of stock. Containers must be vented, but check periodically for bulging containers which can burst from pressure. Protect containers from physical damage, contamination, heat and incompatibles.. Contamination from any source (dust, metals) may cause rapid decomposition with generation of large quantities of oxygen gas and high pressures. Rinse empty containers thoroughly with clean water. Glass, polyethylene, stainless steel and aluminum are recommended materials for storage containers. 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.

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8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
-OSHA Permissible Exposure Limit (PEL): 1 ppm (TWA). -ACGIH Threshold Limit Value (TLV): 1 ppm (TWA), A3: Animal 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, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus. This substance has unknown warning properties

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:
Pungent odor.

Solubility:
Complete (100%)

Specific Gravity:
1.05

pH:
4.4 (10% solution)

% Volatiles by volume @ 21C (70F):
100

Boiling Point:
100C (212F)

Melting Point:
No information found.

Vapor Density (Air=1):
Not applicable.

Vapor Pressure (mm Hg):
23.0 @ 20C (68F)

Evaporation Rate (BuAc=1):
>1

10. Stability and Reactivity

Stability:
Normally stable if uncontaminated, but slowly decomposes to release oxygen. Unstable with heat, may result in dangerous pressures. A strong oxidizer, reacts violently upon contact with many organic substances, particularly textile and paper. Avoid light and keep in a closed but vented container to prevent evaporation (concentration) and contamination.

Hazardous Decomposition Products:

Decomposes to water and oxygen with rapid heat release. Use vented containers. The solution can decompose violently upon heating.

Hazardous Polymerization:
Will not occur.

Incompatibilities:
Heat, reducing agents, organic materials, dirt, alkalis, rust, and many metals. Spontaneous combustion may occur on standing in contact with readily flammable materials.

Conditions to Avoid:
Light and incompatibles. Avoid excess heat and contact with combustible or organic materials.

11. Toxicological Information

Investigated as a tumorigen and mutagen. No LD50/LC50 information found relating to normal routes of occupational exposure.

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

	---NTP Carcinogen---		
Ingredient	Known	Anticipated	IARC Category
Hydrogen Peroxide (7722-84-1)	No	No	3
Water (7732-18-5)	No	No	None

12. Ecological Information

Environmental Fate:
No information found.

Environmental Toxicity:
No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to 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: HYDROGEN PEROXIDE, AQUEOUS SOLUTION (WITH 9-11% HYDROGEN PEROXIDE)
Hazard Class: 5.1
UN/NA: UN2984
Packing Group: III
Information reported for product/size: 8PT

International (Water, I.M.O.)

Proper Shipping Name: HYDROGEN PEROXIDE, AQUEOUS SOLUTION (WITH 9-11% HYDROGEN PEROXIDE)
Hazard Class: 5.1
UN/NA: UN2984
Packing Group: III
Information reported for product/size: 8PT

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

Proper Shipping Name: HYDROGEN PEROXIDE, AQUEOUS SOLUTION (WITH 9-11% HYDROGEN PEROXIDE)
Hazard Class: 5.1
UN/NA: UN2984
Packing Group: III
Information reported for product/size: 8PT

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15. Regulatory Information

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

Ingredient	TSCA	EC	Japan	Australia
Hydrogen Peroxide (7722-84-1)	Yes	Yes	Yes	Yes
Water (7732-18-5)	Yes	Yes	Yes	Yes

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

		--Canada--		
Ingredient	Korea	DSL	NDSL	Phil.
Hydrogen Peroxide (7722-84-1)	Yes	Yes	No	Yes
Water (7732-18-5)	Yes	Yes	No	Yes

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

	-SARA 302-		------SARA 313------	
Ingredient	RQ	TPQ	List	Chemical Catg.
Hydrogen Peroxide (7722-84-1)	1000	1000	No	No
Water (7732-18-5)	No	No	No	No

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

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Hydrogen Peroxide (7722-84-1)	1	No	No
Water (7732-18-5)	No	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: 2P
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: 3 **Flammability:** 0 **Reactivity:** 1 **Other:** Oxidizer

Label Hazard Warning:
DANGER! STRONG OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE. CORROSIVE. CAUSES BURNS TO SKIN, EYES, AND RESPIRATORY TRACT. HARMFUL IF SWALLOWED OR INHALED.

Label Precautions:
Keep from contact with clothing and other combustible materials. Do not get in eyes, on skin, or on clothing. Do not breathe vapor or mist. Store in a tightly closed container. Use only with adequate ventilation Wash thoroughly after handling. Remove and wash contaminated clothing promptly Avoid contamination from any source, metals, dust, and organic materials that may cause rapid decomposition, generation of large quantities of oxygen gas and high pressure Drying of product on clothing or combustible materials may cause fire

Label First Aid:
If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. 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 while removing contaminated clothing and shoes. Wash clothing before reuse. In all cases get medical attention immediately.

Product Use:
Laboratory Reagent

Revision Information:
Mixture. New 16 section MSDS format, all sections have been revised.

Disclaimer:
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Prepared by: Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

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MSDS *Material Safety Data Sheet*

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: 202-483-7616

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.

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

MALLINCKRODT J.T.Baker

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

METHYL ALCOHOL

MSDS Number: M2015 — *Effective Date: 12/08/96*

1. Product Identification

Synonyms: Wood alcohol; methanol; carbinol
CAS No.: 67-56-1
Molecular Weight: 32.04
Chemical Formula: CH_3OH
Product Codes:
J T. Baker. 5217, 5370, 5794, 5807, 5811, 5842, 5869, 9049, 9063, 9067, 9069, 9070, 9071, 9073, 9075, 9076, 9077, 9091, 9093, 9096, 9097, 9098, 9263, 9893
Mallinckrodt. 3004, 3006, 3016, 3017, 3018, 3024, 3041, 3701, 4295, 5160, 8814, H080, H488, H603, V079, V571

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Methyl Alcohol	67-56-1	100%	Yes

3. Hazards Identification

Emergency Overview

POISON! DANGER! VAPOR HARMFUL. MAY BE FATAL OR CAUSE BLINDNESS IF SWALLOWED. HARMFUL IF INHALED OR ABSORBED THROUGH SKIN. CANNOT BE MADE NONPOISONOUS. FLAMMABLE

LIQUID AND VAPOR. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS THE LIVER.

J.T. Baker SAF-T-DATA$^{\text{(tm)}}$ Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)
Flammability Rating: 4 - Extreme (Flammable)
Reactivity Rating: 1 - Slight
Contact Rating: 1 - Slight
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

Potential Health Effects

Inhalation:
A slight irritant to the mucous membranes. Toxic effects exerted upon nervous system, particularly the optic nerve. Once absorbed into the body, it is very slowly eliminated. Symptoms of overexposure may include headache, drowsiness, nausea, vomiting, blurred vision, blindness, coma, and death. A person may get better but then worse again up to 30 hours later.

Ingestion:
Toxic. Symptoms parallel inhalation. Can intoxicate and cause blindness. Usual fatal dose: 100-125 milliliters.

Skin Contact:
Methyl alcohol is a defatting agent and may cause skin to become dry and cracked. Skin absorption can occur; symptoms may parallel inhalation exposure.

Eye Contact:
Irritant Continued exposure may cause eye lesions

Chronic Exposure:
Marked impairment of vision and enlargement of the liver has been reported. Repeated or prolonged exposure may cause skin irritation

Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired liver or kidney 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.

Ingestion:
Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person.

Skin Contact:

Remove any contaminated clothing. Wash skin with soap or mild detergent and water for at least 15 minutes. Get medical attention if irritation develops or persists.
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: 12C (54F) CC
Autoignition temperature: 464C (867F)
Flammable limits in air % by volume:
lel: 7.3; uel: 36
Flammable.
Explosion:
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Moderate explosion hazard and dangerous fire hazard when exposed to heat, sparks or flames. Sensitive to static discharge.
Fire Extinguishing Media:
Water spray, dry chemical, alcohol foam, or carbon dioxide.
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. Use water spray to blanket fire, cool fire exposed containers, and to flush non-ignited spills or vapors away from fire. 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!

J T Baker SOLUSORB(tm) solvent adsorbent is recommended for spills of this product

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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.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
For Methyl Alcohol:
- OSHA Permissible Exposure Limit (PEL):
200 ppm (TWA)
- ACGIH Threshold Limit Value (TLV):
200 ppm (TWA), 250 ppm (STEL) skin

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, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus.

Skin Protection:
Rubber or neoprene gloves and additional protection including impervious boots, apron, or coveralls, as needed in areas of unusual exposure.

Eye Protection:
Use chemical safety goggles. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid

Odor:
Characteristic odor

Solubility:
Miscible in water

Specific Gravity:
0.8

pH:
No information found

% Volatiles by volume @ 21C (70F):
100

Boiling Point:
64.5C (147F)

Melting Point:
-98C (-144F)
Vapor Density (Air=1):
1.1
Vapor Pressure (mm Hg):
97 @ 20C (68F)
Evaporation Rate (BuAc=1):
5.9

---

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
May form carbon dioxide, carbon monoxide, and formaldehyde when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Strong oxidizing agents such as nitrates, perchlorates or sulfuric acid. Will attack some forms of plastics, rubber, and coatings May react with metallic aluminum and generate hydrogen gas.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles

---

11. Toxicological Information

Methyl Alcohol (Methanol) Oral rat LD50 5628 mg/kg, inhalation rat LC50: 64000 ppm/4H, skin rabbit LD50 15800 mg/kg, Irritation data-standard Draize test: skin, rabbit 20mg/24 hr Moderate, eye, rabbit 100 mg/24 hr Moderate; Investigated as a mutagen, reproductive effector

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--------\Cancer Lists\------------------------------------------------------
                                      ---NTP Carcinogen---
Ingredient                            Known    Anticipated    IARC Category
------------------------------------  -----    -----------    -------------
Methyl Alcohol (67-56-1)               No          No             None
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12. Ecological Information

Environmental Fate:
When released into the soil, this material is expected to readily biodegrade. When released into the soil, this material is expected to leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into the water,

this material is expected to have a half-life between 1 and 10 days. When released into water, this material is expected to readily biodegrade. When released into the air, this material is expected to exist in the aerosol phase with a short half-life. When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into air, this material is expected to have a half-life between 10 and 30 days. When released into the air, this material is expected to be readily removed from the atmosphere by wet deposition.
Environmental Toxicity:
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: METHANOL
Hazard Class: 3
UN/NA: UN1230
Packing Group. II
Information reported for product/size: 350LB

International (Water, I.M.O.)

Proper Shipping Name: METHANOL
Hazard Class: 3.2, 6.1
UN/NA: UN1230
Packing Group II
Information reported for product/size: 350LB

15. Regulatory Information

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--------\Chemical Inventory Status - Part 1\---------------------------------
Ingredient                                       TSCA  EC   Japan  Australia
-----------------------------------------------  ----  ---  -----  ---------
Methyl Alcohol (67-56-1)                         Yes   Yes  Yes     Yes

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

Ingredient	Korea	--Canada-- DSL	 NDSL	Phil.
Methyl Alcohol (67-56-1)	Yes	Yes	No	Yes

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

Ingredient	-SARA 302- RQ	 TPQ	------SARA 313------ List	 Chemical Catg.
Methyl Alcohol (67-56-1)	No	No	Yes	No

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

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Methyl Alcohol (67-56-1)	5000	U154	No

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

Australian Hazchem Code: 2PE
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: **1** Flammability **3** Reactivity: **0**
Label Hazard Warning:
POISON! DANGER! VAPOR HARMFUL. MAY BE FATAL OR CAUSE BLINDNESS IF SWALLOWED HARMFUL IF INHALED OR ABSORBED THROUGH SKIN CANNOT BE MADE NONPOISONOUS. FLAMMABLE LIQUID AND VAPOR CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT AFFECTS THE LIVER.
Label Precautions:
Keep away from heat, sparks and flame
Keep container closed
Use only with adequate ventilation.
Wash thoroughly after handling
Avoid breathing vapor.
Avoid contact with eyes, skin and clothing.
Label First Aid:
If swallowed, induce vomiting immediately as directed by medical personnel. 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 while removing contaminated clothing and shoes Wash clothing before reuse. If inhaled, remove to fresh air. If not breathing give artificial respiration. If breathing is difficult, give oxygen. In all cases get

medical attention immediately.

Product Use:

Laboratory Reagent.

Revision Information:

New 16 section MSDS format, all sections have been revised.

Disclaimer:

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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.

****

Prepared by: Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

Please reduce your browser font size for better viewing and printing

MSDS *Material Safety Data Sheet*

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CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

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Chemtrec: 202-483-7615

From: Mallinckrodt Baker, Inc.
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MALLINCKRODT J.T.Baker

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

POTASSIUM PERMANGANATE

MSDS Number: P6005 — *Effective Date: 12/08/96*

1. Product Identification

Synonyms: Permanganic acid, potassium salt; Condy's crystals
CAS No.: 7722-64-7
Molecular Weight: 158.03
Chemical Formula: KMnO4
Product Codes: J.T. Baker: 3227, 3228, 3232 Mallinckrodt: 7056, 7068

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Potassium Permanganate	7722-64-7	90 - 100%	Yes

3. Hazards Identification

Emergency Overview

DANGER! STRONG OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE. CORROSIVE. CAUSES BURNS TO ANY AREA OF CONTACT. HARMFUL IF SWALLOWED OR INHALED.

J T Baker SAF-T-DATA$^{(tm)}$ Ratings (Provided here for your convenience)

Health Rating: 2 - Moderate
Flammability Rating: 0 - None
Reactivity Rating: 3 - Severe (Oxidizer)
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES
Storage Color Code: Yellow (Reactive)

Potential Health Effects

Inhalation:
Causes irritation to the respiratory tract. Symptoms may include coughing, shortness of breath. High concentrations can cause pulmonary edema.

Ingestion:
Ingestion of solid or high concentrations causes severe distress of gastro-intestinal system with possible burns and edema; slow pulse; shock with fall of blood pressure. May be fatal. Ingestion of concentrations up to 1% causes burning of the throat, nausea, vomiting, and abdominal pain; 2-3% causes anemia and swelling of the throat with possible suffocation; 4-5% may cause kidney damage.

Skin Contact:
Dry crystals and concentrated solutions are caustic causing redness, pain, severe burns, brown stains in the contact area and possible hardening of outer skin layer. Diluted solutions are only mildly irritating to the skin.

Eye Contact:
Eye contact with crystals (dusts) and concentrated solutions causes severe irritation, redness, blurred vision and can cause severe damage, possibly permanent.

Chronic Exposure:
Prolonged skin contact may cause irritation, defatting, and dermatitis Chronic manganese poisoning can result from excessive inhalation exposure to manganese dust and involves impairment of the central nervous system Early symptoms include sluggishness, sleepiness, and weakness in the legs Advanced cases have shown symptoms of fixed facial expression, emotional disturbances, spastic gait, and falling

Aggravation of Pre-existing Conditions:
No information found

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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. Get medical attention immediately.

Ingestion:
If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Skin Contact:
Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention immediately. 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:
Not combustible, but substance is a strong oxidizer and its heat of reaction with reducing agents or combustibles may cause ignition. Contact with oxidizable substances may cause extremely violent combustion.

Explosion:
Strong oxidants may explode when shocked, or if exposed to heat, flame, or friction. Also may act as initiation source for dust or vapor explosions. Contact with oxidizable substances may cause extremely violent combustion. Sealed containers may rupture when heated. Sensitive to mechanical impact.

Fire Extinguishing Media:
Use water spray to blanket fire, cool fire exposed containers, and to flush non-ignited spills or vapors away from fire Suffocating type extinguishers are not as effective as water Do not allow water runoff to enter sewers or waterways.

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

6. Accidental Release Measures

Remove all sources of ignition Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Spills: Clean up spills in a manner that does not disperse dust into the air Use non-sparking tools and equipment. Reduce airborne dust and prevent scattering by moistening with water. Pick up spill for recovery or disposal and place in a closed container. 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 and moisture. Isolate from any source of heat or ignition. Avoid storage on wood floors. Separate from incompatibles, combustibles, organic or other readily oxidizable materials. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
- OSHA Permissible Exposure Limit (PEL): 5 mg/m3 Ceiling for manganese compounds as Mn - ACGIH Threshold Limit Value (TLV): 0.2 mg/m3 (TWA) for manganese, elemental and inorganic compounds as Mn

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, a half-face dust/mist 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 dust/mist 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-facepiece 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 full face shield where dusting or splashing of solutions is possible. Maintain eye wash fountain and quick-drench facilities in work area

9. Physical and Chemical Properties

Appearance:
Purple-bronze crystals.

Odor:
Odorless.

Solubility:
7 g in 100 g of water.

Density:
2.7

pH:
No information found.

% Volatiles by volume @ 21C (70F):
0

Boiling Point:
Not applicable.

Melting Point:
ca. 240C (ca. 464F)

Vapor Density (Air=1):
5 40

Vapor Pressure (mm Hg):
No information found.

Evaporation Rate (BuAc=1):
No information found.

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10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.

Hazardous Decomposition Products:
Toxic metal fumes may form when heated to decomposition.

Hazardous Polymerization:
Will not occur

Incompatibilities:
Powdered metals, alcohol, arsenites, bromides, iodides, phosphorous, sulfuric acid, organic compounds, sulfur, activated carbon, hydrides, strong hydrogen peroxide, ferrous or mercurous salts, hypophosphites, hyposulfites, sulfites, peroxides, and oxalates.

Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

11. Toxicological Information

Investigated as a mutagen, reproductive effector. Oral rat LD50: 1090 mg/kg.

\Cancer Lists\

	---NTP Carcinogen---		
Ingredient	Known	Anticipated	IARC Category
Potassium Permanganate (7722-64-7)	No	No	None

12. Ecological Information

Environmental Fate:
No information found.

Environmental Toxicity:
This material may be 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 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, POTASSIUM PERMANGANATE
Hazard Class: 5.1
UN/NA: UN1490
Packing Group: II

Information reported for product/size: 110LB

International (Water, I.M.O.)

Proper Shipping Name: POTASSIUM PERMANGANATE
Hazard Class: 5.1
UN/NA: UN1490
Packing Group: II
Information reported for product/size: 110LB

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

Proper Shipping Name: POTASSIUM PERMANGANATE
Hazard Class: 5.1
UN/NA: UN1490
Packing Group: II
Information reported for product/size: 110LB

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15. Regulatory Information

\Chemical Inventory Status - Part 1\

Ingredient	TSCA	EC	Japan	Australia
Potassium Permanganate (7722-64-7)	Yes	Yes	Yes	Yes

\Chemical Inventory Status - Part 2\

Ingredient	Korea	--Canada-- DSL	--Canada-- NDSL	Phil.
Potassium Permanganate (7722-64-7)	Yes	Yes	No	Yes

\Federal, State & International Regulations - Part 1\

Ingredient	-SARA 302- RQ	-SARA 302- TPQ	------SARA 313------ List	------SARA 313------ Chemical Catg.
Potassium Permanganate (7722-64-7)	No	No	No	Manganese co

\Federal, State & International Regulations - Part 2\

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Potassium Permanganate (7722-64-7)	100	No	No

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

Australian Hazchem Code: 2Y
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.

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16. Other Information

NFPA Ratings: Health: 1 **Flammability:** 0 **Reactivity:** 0 **Other:** Oxidizer

Label Hazard Warning:
DANGER! STRONG OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE. CORROSIVE. CAUSES BURNS TO ANY AREA OF CONTACT. HARMFUL IF SWALLOWED OR INHALED.

Label Precautions:
Keep from contact with clothing and other combustible materials. Store in a tightly closed container. Do not store near combustible materials. Remove and wash contaminated clothing promptly. Do not get in eyes, on skin, or on clothing. Do not breathe dust. Keep container closed. Use only with adequate ventilation. Wash thoroughly after handling.

Label First Aid:
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. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. In all cases get medical attention immediately.

Product Use:
Laboratory Reagent.

Revision Information:
Pure New 16 section MSDS format, all sections have been revised.

Disclaimer:
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Prepared by: Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

Please reduce your browser font size for better viewing and printing

MSDS *Material Safety Data Sheet*

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

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: 202-483-7616

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

SODIUM HYDROXIDE

MSDS Number: S4034 --- *Effective Date: 03/05/97*

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1. Product Identification

Synonyms: Caustic soda; lye, sodium hydroxide solid; sodium hydrate
CAS No.: 1310-73-2
Molecular Weight: 40.00
Chemical Formula: NaOH
Product Codes: J.T. Baker: 3718, 3721, 3722, 3723, 3728, 3729, 3734, 3736, 5045, 5565 Mallinckrodt: 7001, 7680, 7708, 7712, 7772, 7798

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2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Sodium Hydroxide	1310-73-2	99 - 100%	Yes

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3. Hazards Identification

Emergency Overview

POISON! DANGER! CORROSIVE. MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED. CAUSES BURNS TO ANY AREA OF CONTACT. REACTS WITH WATER, ACIDS AND OTHER MATERIALS.

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

Health Rating: 3 - Severe (Poison)
Flammability Rating: 0 - None
Reactivity Rating: 2 - Moderate
Contact Rating: 4 - Extreme (Corrosive)
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES
Storage Color Code: White Stripe (Store Separately)

Potential Health Effects

Inhalation:
Severe irritant. Effects from inhalation of dust or mist vary from mild irritation to serious damage of the upper respiratory tract, depending on severity of exposure. Symptoms may include sneezing, sore throat or runny nose. Severe pneumonitis may occur.

Ingestion:
Corrosive! Swallowing may cause severe burns of mouth, throat, and stomach. Severe scarring of tissue and death may result. Symptoms may include bleeding, vomiting, diarrhea, fall in blood pressure. Damage may appears days after exposure.

Skin Contact:
Corrosive! Contact with skin can cause irritation or severe burns and scarring with greater exposures.

Eye Contact:
Corrosive! Causes irritation of eyes, and with greater exposures it can cause burns that may result in permanent impairment of vision, even blindness.

Chronic Exposure:
Prolonged contact with dilute solutions or dust has a destructive effect upon tissue.

Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired 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

Ingestion:
DO NOT INDUCE VOMITING! Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. Get medical attention

immediately.

Skin Contact:
Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Call a physician, immediately. Wash clothing 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:
Perform endoscopy in all cases of suspected sodium hydroxide ingestion. In cases of severe esophageal corrosion, the use of therapeutic doses of steroids should be considered. General supportive measures with continual monitoring of gas exchange, acid-base balance, electrolytes, and fluid intake are also required.

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5. Fire Fighting Measures

Fire:
Not considered to be a fire hazard. Hot or molten material can react violently with water. Can react with certain metals, such as aluminum, to generate flammable hydrogen gas.

Explosion:
Not considered to be an explosion hazard.

Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire. Adding water to caustic solution generates large amounts of heat

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

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6. Accidental Release Measures

Ventilate area of leak or spill Keep unnecessary and unprotected people away from area of spill Wear appropriate personal protective equipment as specified in Section 8. Spills: Pick up and place in a suitable container for reclamation or disposal, using a method that does not generate dust Do not flush caustic residues to the sewer. Residues from spills can be diluted with water, neutralized with dilute acid such as acetic, hydrochloric or sulfuric. Absorb neutralized caustic residue on clay, vermiculite or other inert substance and package in a suitable container for disposal. 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. Protect from physical damage. Store in a cool, dry, ventilated area away from sources of heat, moisture and incompatibilities. Always add the caustic to water while stirring; never the reverse. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product. Do not store with aluminum or magnesium. Do not mix with acids or organic materials.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
- OSHA Permissible Exposure Limit (PEL): 2 mg/m3 Ceiling - ACGIH Threshold Limit Value (TLV): 2 mg/m3 Ceiling

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, a half-face dust/mist 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 dust/mist 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-facepiece 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:
White, deliquescent pellets.

Odor:
Odorless.

Solubility:
111 g/100 g of water.

Specific Gravity:
2.13

pH:
13 - 14 (0.5% soln.)

% Volatiles by volume @ 21C (70F):
0

Boiling Point:
1390C (2534F)

Melting Point:
318C (604F)

Vapor Density (Air=1):
> 1.0

Vapor Pressure (mm Hg):
Negligible

Evaporation Rate (BuAc=1):
No information found

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10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage. Very hygroscopic. Can slowly pick up moisture from air and react with carbon dioxide from air to form sodium carbonate.

Hazardous Decomposition Products:
Sodium oxide. Decomposition by reaction with certain metals releases flammable and explosive hydrogen gas

Hazardous Polymerization:
Will not occur

Incompatibilities:
Contact with water, acids, flammable liquids, and organic halogen compounds, especially trichloroethylene, may cause fire or explosion. Contact with nitromethane and other similar nitro compounds causes formation of shock-sensitive salts. Contact with metals such as aluminum, tin, and zinc causes formation of flammable hydrogen gas.

Conditions to Avoid:
Moisture, dusting and incompatibles.

11. Toxicological Information

Irritation data: skin, rabbit: 500 mg/24H severe; eye rabbit: 50 ug/24H severe; investigated as a mutagen.

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

	---NTP Carcinogen---		
Ingredient	Known	Anticipated	IARC Category
Sodium Hydroxide (1310-73-2)	No	No	None

12. Ecological Information

Environmental Fate:
No information found.

Environmental Toxicity:
No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to 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. SODIUM HYDROXIDE, SOLID
Hazard Class: 8

UN/NA: UN1823
Packing Group: II
Information reported for product/size: 300LB

International (Water, I.M.O.)

Proper Shipping Name: SODIUM HYDROXIDE, SOLID
Hazard Class: 8
UN/NA: UN1823
Packing Group: II
Information reported for product/size: 300LB

15. Regulatory Information

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

Ingredient	TSCA	EC	Japan	Australia
Sodium Hydroxide (1310-73-2)	Yes	Yes	Yes	Yes

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

		--Canada--		
Ingredient	Korea	DSL	NDSL	Phil.
Sodium Hydroxide (1310-73-2)	Yes	Yes	No	Yes

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

	-SARA 302-		------SARA 313------	
Ingredient	RQ	TPQ	List	Chemical Catg.
Sodium Hydroxide (1310-73-2)	No	No	Yes	No

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

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Sodium Hydroxide (1310-73-2)	1000	No	No

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

Australian Hazchem Code: 2R
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: 3 **Flammability:** 0 **Reactivity:** 1

Label Hazard Warning:
POISON! DANGER! CORROSIVE. MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED. CAUSES BURNS TO ANY AREA OF CONTACT. REACTS WITH WATER, ACIDS AND OTHER MATERIALS.

Label Precautions:
Do not get in eyes, on skin, or on clothing. Do not breathe dust. Keep container closed. Use only with adequate ventilation. Wash thoroughly after handling.

Label First Aid:
If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. 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 while removing contaminated clothing and shoes. Wash clothing before reuse. If inhaled, remove to fresh air. If not breathing give artificial respiration. If breathing is difficult, give oxygen. In all cases get medical attention immediately.

Product Use:
Laboratory Reagent.

Revision Information:
Pure. New 16 section MSDS format, all sections have been revised.

Disclaimer:

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Prepared by: Strategic Services Division
Phone Number. (314) 539-1600 (U.S.A.)

1 - PRODUCT IDENTIFICATION

PRODUCT NAME:	SODIUM META-BISULFITE, GRANULAR
FORMULA:	NA2S2O5
FORMULA WT:	190.10
CAS NO.:	07681-57-4
NIOSH/RTECS NO.:	UX8225000
COMMON SYNONYMS:	PYROSULFUROUS ACID, DISODIUM SALT
PRODUCT CODES:	3552

EFFECTIVE: 08/18/86
REVISION #02

PRECAUTIONARY LABELLING

BAKER SAF-T-DATA(TM) SYSTEM

HEALTH	1	SLIGHT
FLAMMABILITY	0	NONE
REACTIVITY	1	SLIGHT
CONTACT	1	SLIGHT

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

SAFETY GLASSES; LAB COAT

PRECAUTIONARY LABEL STATEMENTS

CAUTION
MAY CAUSE IRRITATION
MAY BE HARMFUL IF SWALLOWED
MAY CAUSE ALLERGIC REACTION.

DURING USE AVOID CONTACT WITH EYES, SKIN, CLOTHING. WASH THOROUGHLY AFTER HANDLING WHEN NOT IN USE KEEP IN TIGHTLY CLOSED CONTAINER.

SAF-T-DATA(TM) STORAGE COLOR CODE: ORANGE (GENERAL STORAGE)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
NOT APPLICABLE		

3 - PHYSICAL DATA

BOILING POINT	N/A	VAPOR PRESSURE(MM HG):	N/A
MELTING POINT	N/A	VAPOR DENSITY(AIR=1):	N/A
SPECIFIC GRAVITY	N/A	EVAPORATION RATE:	N/A

(H2O=1) (BUTYL ACETATE=1)

SOLUBILITY(H2O): APPRECIABLE (MORE THAN 10 %) % VOLATILES BY VOLUME: 0

APPEARANCE & ODOR: WHITE CRYSTALS WITH SMELL OF SULFUR DIOXIDE.

4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP N/A

FLAMMABLE LIMITS: UPPER - N/A % LOWER - N/A %

FIRE EXTINGUISHING MEDIA
USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

SPECIAL FIRE-FIGHTING PROCEDURES
FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE.

TOXIC GASES PRODUCED
SULFUR DIOXIDE

5 - HEALTH HAZARD DATA

TOXICITY: LD50 (IV-RAT) (MG/KG) - 115

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE
DUST MAY IRRITATE SKIN OR EYES.
ALLERGIC REACTION MAY DEVELOP. EXPOSURES TO SMALL AMOUNTS OF SULFITES HAVE BEEN REPORTED TO CAUSE HYPERSENSITIVITY REACTIONS IN CERTAIN INDIVIDUALS, ESPECIALLY ASTHMATICS. A SEVERE ALLERGIC REATION MAY BE FATAL.

TARGET ORGANS
BRAIN, GI TRACT, RESPIRATORY SYSTEM, SKIN

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE
ASTHMA

ROUTES OF ENTRY
INHALATION, SKIN CONTACT

EMERGENCY AND FIRST AID PROCEDURES

INGESTION	IF SWALLOWED AND THE PERSON IS CONSCIOUS, IMMEDIATELY GIVE LARGE AMOUNTS OF WATER GET MEDICAL ATTENTION.
INHALATION	IF A PERSON BREATHES IN LARGE AMOUNTS, MOVE THE EXPOSED PERSON TO FRESH AIR. GET MEDICAL ATTENTION.
EYE CONTACT	IMMEDIATELY FLUSH WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES GET MEDICAL ATTENTION.

SKIN CONTACT.	IMMEDIATELY WASH WITH PLENTY OF SOAP AND WATER FOR AT LEAST 15 MINUTES.

6 - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: NONE DOCUMENTED

INCOMPATIBLES: STRONG OXIDIZING AGENTS, STRONG ACIDS

DECOMPOSITION PRODUCTS: OXIDES OF SULFUR

7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE
WEAR SUITABLE PROTECTIVE CLOTHING. CAREFULLY SWEEP UP AND REMOVE.

DISPOSAL PROCEDURE
DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

8 - PROTECTIVE EQUIPMENT

VENTILATION: USE ADEQUATE GENERAL OR LOCAL EXHAUST VENTILATION TO KEEP FUME OR DUST LEVELS AS LOW AS POSSIBLE.

RESPIRATORY PROTECTION: NONE REQUIRED WHERE ADEQUATE VENTILATION CONDITIONS EXIST. IF AIRBORNE CONCENTRATION IS HIGH, USE AN APPROPRIATE RESPIRATOR OR DUST MASK.

EYE/SKIN PROTECTION: SAFETY GLASSES WITH SIDESHIELDS, PROPER GLOVES ARE RECOMMENDED.

9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: ORANGE (GENERAL STORAGE)

SPECIAL PRECAUTIONS
KEEP CONTAINER TIGHTLY CLOSED SUITABLE FOR ANY GENERAL CHEMICAL STORAGE AREA

10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O T)

PROPER SHIPPING NAME CHEMICALS, N.O.S. (NON-REGULATED)

INTERNATIONAL (I M O)

PROPER SHIPPING NAME CHEMICALS, N.O.S. (NON-REGULATED)

Please reduce your browser font size for better viewing and printing

MSDS *Material Safety Data Sheet*

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

MALLINCKRODT 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: 202-483-7616

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

SULFURIC ACID, 52 - 100 %

MSDS Number: S8234 — *Effective Date: 09/24/97*

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1. Product Identification

Synonyms: Oil of vitriol; Babcock acid; sulphuric acid
CAS No.: 7664-93-9
Molecular Weight: 98.07
Chemical Formula: H_2SO_4 in H_2O
Product Codes:
J.T Baker: 5030, 5137, 5374, 5802, 5815, 5889, 6902, 9673, 9674, 9675, 9676, 9679, 9680, 9681, 9682, 9684, 9687, 9691, 9693, 9694
Mallinckrodt 2468, 2876, 2878, 2900, 2904, 3780, 4222, 5524, 5557, V344

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2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Sulfuric Acid	7664-93-9	52 - 100%	Yes
Water	7732-18-5	0 - 48%	No

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3. Hazards Identification

Emergency Overview

POISON! DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR CONTACTED WITH SKIN. HARMFUL IF INHALED. AFFECTS TEETH.

WATER REACTIVE. CANCER HAZARD. STRONG INORGANIC ACID MISTS CONTAINING SULFURIC ACID CAN CAUSE CANCER. Risk of cancer depends on duration and level of exposure.

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

Health Rating: 3 - Severe (Poison)
Flammability Rating: 0 - None
Reactivity Rating: 3 - Severe (Water Reactive)
Contact Rating: 4 - Extreme (Corrosive)
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: White (Corrosive)

Potential Health Effects

Inhalation:
Inhalation produces damaging effects on the mucous membranes and upper respiratory tract. Symptoms may include irritation of the nose and throat, and labored breathing. May cause lung edema, a medical emergency.

Ingestion:
Corrosive. Swallowing can cause severe burns of the mouth, throat, and stomach, leading to death. Can cause sore throat, vomiting, diarrhea. Circulatory collapse with clammy skin, weak and rapid pulse, shallow respirations, and scanty urine may follow ingestion or skin contact. Circulatory shock is often the immediate cause of death.

Skin Contact:
Corrosive. Symptoms of redness, pain, and severe burn can occur. Circulatory collapse with clammy skin, weak and rapid pulse, shallow respirations, and scanty urine may follow skin contact or ingestion Circulatory shock is often the immediate cause of death.

Eye Contact:
Corrosive Contact can cause blurred vision, redness, pain and severe tissue burns. Can cause blindness

Chronic Exposure:
Long-term exposure to mist or vapors may cause damage to teeth. Chronic exposure to mists containing sulfuric acid is a cancer hazard

Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired 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:
DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Call a physician immediately.
Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Excess acid on skin can be neutralized with a 2% solution of bicarbonate of soda. Call a physician immediately.
Eye Contact:
Immediately flush eyes with gentle but large stream of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Call a physician immediately.

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5. Fire Fighting Measures

Fire:
Concentrated material is a strong dehydrating agent. Reacts with organic materials and may cause ignition of finely divided materials on contact.
Explosion:
Contact with most metals causes formation of flammable and explosive hydrogen gas.
Fire Extinguishing Media:
Dry chemical, foam or carbon dioxide. Do not use water on material. However, water spray may be used to keep fire exposed containers cool.
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. Structural firefighter's protective clothing is ineffective for fires involving this material. Stay away from sealed containers.

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6. Accidental Release Measures

Ventilate area of leak or spill 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. Neutralize with alkaline material (soda ash, lime), then 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.

J T Baker NEUTRASORB(tm) or TEAM(tm) 'Low Na+' acid neutralizers are recommended for spills of this product.

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7. Handling and Storage

Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage. Protect from physical damage. Keep out of direct sunlight and away from heat, water, and incompatible materials. Do not wash out container and use it for other purposes. When diluting, always add the acid to water; never add water to the acid. When opening metal containers, use non-sparking tools because of the possibility of hydrogen gas being present. 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:
For Sulfuric Acid:
-OSHA Permissible Exposure Limit (PEL):
1 mg/m3 (TWA).
-ACGIH Threshold Limit Value (TLV):
1 mg/m3 (TWA), 3 mg/m3 (STEL)

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, a full facepiece respirator with an acid gas cartridge and dust/mist filter 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-facepiece 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 oily liquid

Odor:
Odorless

Solubility:

Miscible with water, liberates much heat.
Specific Gravity:
1.84 (98%), 1.40 (50%), 1.07 (10%)
pH:
1 N solution (ca. 5% w/w) = 0.3; 0.1 N solution (ca. 0.5% w/w) = 1.2; 0.01 N solution (ca. 0.05% w/w) = 2.1.
% Volatiles by volume @ 21C (70F):
No information found.
Boiling Point:
ca. 290C (ca. 554F) (decomposes at 340C)
Melting Point:
3C (100%), -32C (93%), -38C (78%), -64C (65%).
Vapor Density (Air=1):
3.4
Vapor Pressure (mm Hg):
1 @ 145.8C (295F)
Evaporation Rate (BuAc=1):
No information found.

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage. Concentrated solutions react violently with water, spattering and liberating heat.
Hazardous Decomposition Products:
Toxic fumes of oxides of sulfur when heated to decomposition. Will react with water or steam to produce toxic and corrosive fumes. Reacts with carbonates to generate carbon dioxide gas, and with cyanides and sulfides to form poisonous hydrogen cyanide and hydrogen sulfide respectively
Hazardous Polymerization:
Will not occur
Incompatibilities:
Water, potassium chlorate, potassium perchlorate, potassium permanganate, sodium, lithium, bases, organic material, halogens, metal acetylides, oxides and hydrides, metals (yields hydrogen gas), strong oxidizing and reducing agents and many other reactive substances
Conditions to Avoid:
Heat, moisture, incompatibles

11. Toxicological Information

Toxicological Data:
Oral rat LD50 2140 mg/kg, inhalation rat LC50: 510 mg/m3/2H; standard Draize, eye rabbit, 250 ug (severe), investigated as a tumorigen, mutagen, reproductive effector.
Carcinogenicity:
Cancer Status The International Agency for Research on Cancer (IARC) has classified

"strong inorganic acid mists containing sulfuric acid" as a known human carcinogen, (IARC category 1). This classification applies only to mists containing sulfuric acid and not to sulfuric acid or sulfuric acid solutions.

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--------\Cancer Lists\------------------------------------------------------
                                          ---NTP Carcinogen---
Ingredient                                Known    Anticipated    IARC Category
------------------------------------      -----    -----------    -------------
Sulfuric Acid (7664-93-9)                  No          No            None
Water (7732-18-5)                          No          No            None
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12. Ecological Information

Environmental Fate:
When released into the soil, this material may leach into groundwater. When released into the air, this material may be removed from the atmosphere to a moderate extent by wet deposition. When released into the air, this material may be removed from the atmosphere to a moderate extent by dry deposition.

Environmental Toxicity:
LC50 Flounder 100 to 330 mg/l/48 hr aerated water/Conditions of bioassay not specified;
LC50 Shrimp 80 to 90 mg/l/48 hr aerated water /Conditions of bioassay not specified;
LC50 Prawn 42.5 ppm/48 hr salt water /Conditions of bioassay not specified.
This material may be 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: SULFURIC ACID (WITH MORE THAN 51% ACID)
Hazard Class: 8
UN/NA: UN1830
Packing Group: II
Information reported for product/size: 440LB

International (Water, I.M.O.)

Proper Shipping Name: SULPHURIC ACID (WITH MORE THAN 51% ACID)
Hazard Class: 8
UN/NA: UN1830
Packing Group: II
Information reported for product/size: 440LB

15. Regulatory Information

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--------\Chemical Inventory Status - Part 1\---------------------------------
Ingredient                                       TSCA  EC   Japan  Australia
-----------------------------------------------  ----  ---  -----  ---------
Sulfuric Acid (7664-93-9)                         Yes  Yes   Yes       Yes
Water (7732-18-5)                                 Yes  Yes   Yes       Yes

--------\Chemical Inventory Status - Part 2\---------------------------------
                                                         --Canada--
Ingredient                                       Korea  DSL   NDSL  Phil.
-----------------------------------------------  -----  ---   ----  -----
Sulfuric Acid (7664-93-9)                         Yes   Yes   No     Yes
Water (7732-18-5)                                 Yes   Yes   No     Yes

--------\Federal, State & International Regulations - Part 1\----------------
                                           -SARA 302-    ------SARA 313------
Ingredient                                 RQ    TPQ     List  Chemical Catg.
-----------------------------------------  ---   -----   ----  --------------
Sulfuric Acid (7664-93-9)                  1000  1000    Yes          No
Water (7732-18-5)                          No    No      No           No

--------\Federal, State & International Regulations - Part 2\----------------
                                                      -RCRA-    -TSCA-
Ingredient                                 CERCLA     261.33     8(d)
-----------------------------------------  ------     ------    ------
Sulfuric Acid (7664-93-9)                  1000       No         No
Water (7732-18-5)                          No         No         No


Chemical Weapons Convention: No     TSCA 12(b): No     CDTA: Yes
SARA 311/312: Acute: Yes     Chronic: Yes  Fire: No  Pressure: No
Reactivity: Yes        (Pure / Liquid)
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Australian Hazchem Code: 2P
Poison Schedule: No information found
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: **3** Flammability: **0** Reactivity: **2** Other: **Water reactive**
Label Hazard Warning:
POISON! DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS

TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR CONTACTED WITH SKIN. HARMFUL IF INHALED. AFFECTS TEETH. WATER REACTIVE. CANCER HAZARD. STRONG INORGANIC ACID MISTS CONTAINING SULFURIC ACID CAN CAUSE CANCER. Risk of cancer depends on duration and level of exposure.

Label Precautions:

Do not get in eyes, on skin, or on clothing.
Do not breathe mist.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Do not contact with water.

Label First Aid:

In all cases call a physician immediately. 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 re-use. Excess acid on skin can be neutralized with a 2% bicarbonate of soda solution. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. 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.

Product Use:

Laboratory Reagent.

Revision Information:

Disclaimer:

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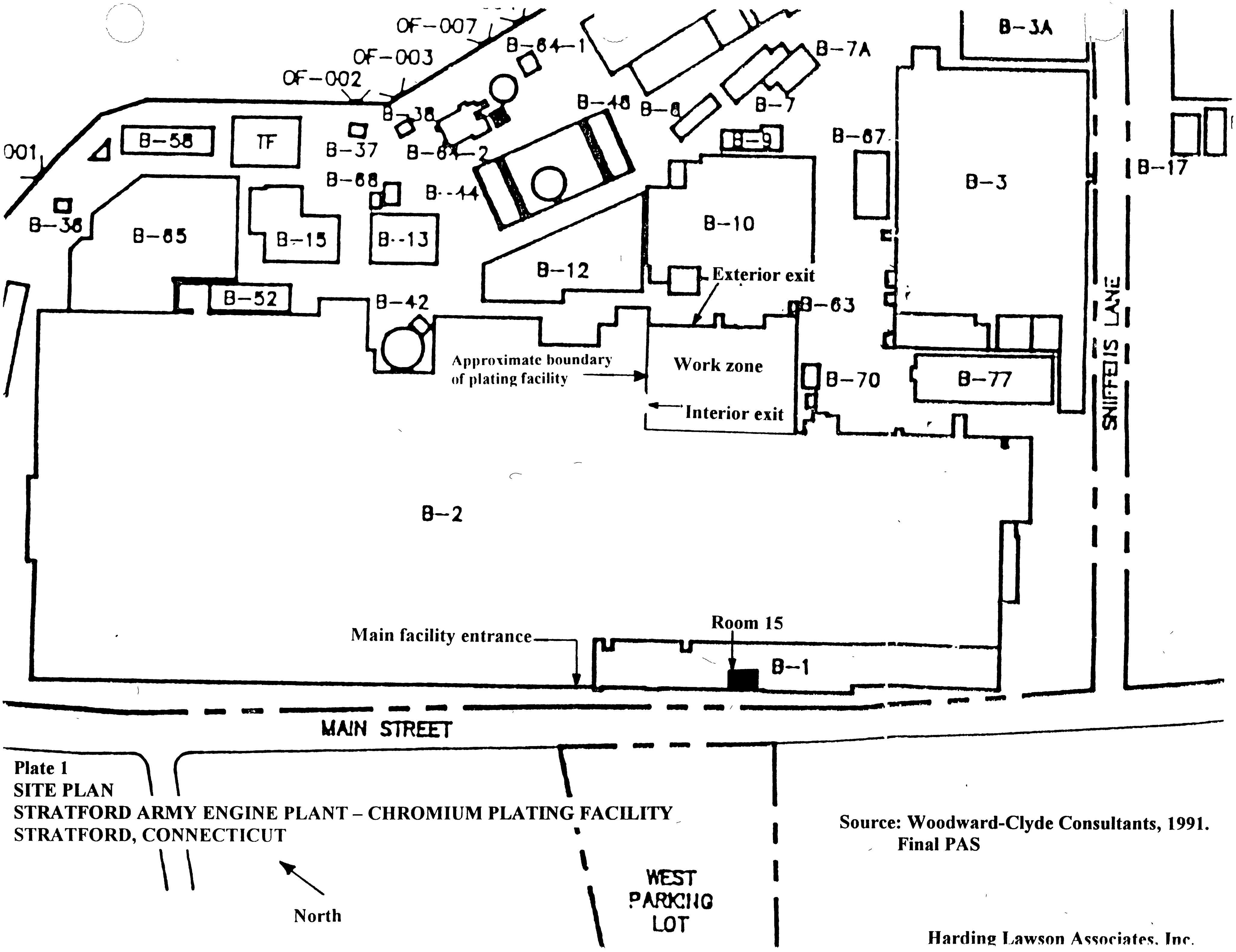

Plate 1
SITE PLAN
STRATFORD ARMY ENGINE PLANT – CHROMIUM PLATING FACILITY
STRATFORD, CONNECTICUT

Source: Woodward-Clyde Consultants, 1991.
Final PAS

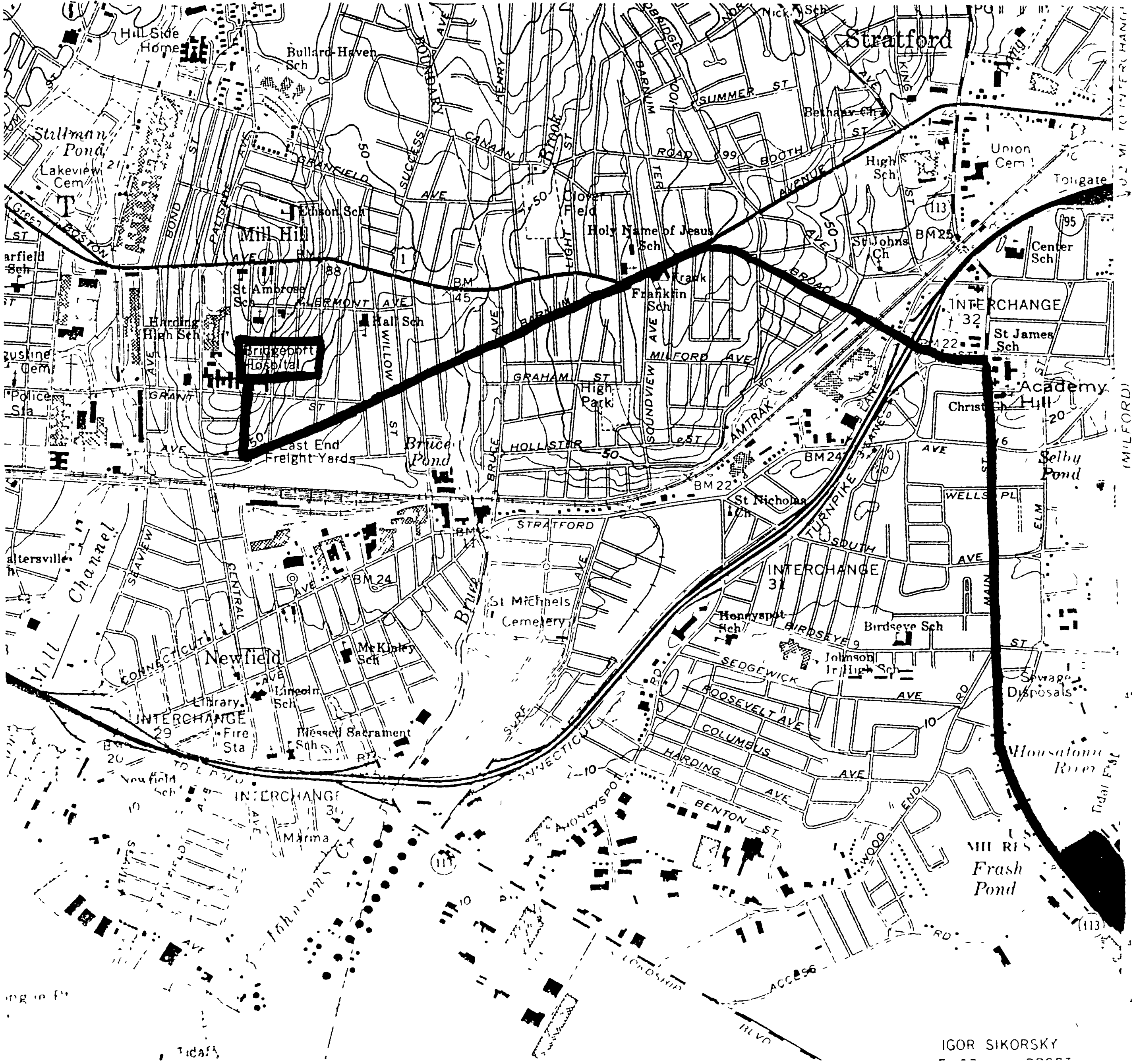

PLATE 2
LOCATION AND ROUTE TO NEAREST HOSPITAL
STRATFORD ARMY ENGINE PLANT – CHROMIUM PLATING FACILITY
STRATFORD, CONNECTICUT

Harding Lawson Associates, Inc