412-97-0063
7/10

Site: SAVAGE WELL
Break: 3.7.4
Other: ______

PROJECT OPERATIONS PLAN
SAVAGE WELL SITE RI/FS
MILFORD, NEW HAMPSHIRE

5478

October, 1988

VOLUME I

Prepared by:

HMM ASSOCIATES, INC.
336 Baker Avenue
Concord, MA 01742

SITE: SAVAGE W
BREAK: 3.1.4
OTHER:

PROJECT OPERATIONS PLAN
SAVAGE WELL SITE RI/FS
MILFORD, NEW HAMPSHIRE

October, 1988
Addended November 23, 1988

HMM Project Manager ______________________
Richard Cote

HMM QA Officer Barbara Buckley
Barbara Buckley

EPA Project Manager ______________________
Diana Lettro

EPA QA Officer Charles Porfert
Charles Porfert

2176/HAZ/1028

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Section

VOLUME I

VOLUME II

3.0 APPENDIX A

1.0 INTRODUCTION

1.0 INTRODUCTION

The Project Operations Plan (POP) is the consolidation of four Savage Well RI/FS Site Specific plans. The four Site Specific Plans that HMM has developed for the Savage Well RI/FS are the Site Management Plan (SMP), the Sampling and Analysis Plan (SAP), the Quality Assurance Project Plan (QAPP), and the Health and Safety Plan (HSP). The Appendices of the POP contain individual work plans for the required subtasks to complete Task 2, the Multi-Media Field Investigation, of the Savage Well RI/FS. As the RI/FS progresses, HMM may modify sections of the POP. Any modifications will be implemented only with prior approval from the PRPs and the EPA.

The overall objective of the SMP is to provide the EPA and the PRPs with a written document on how HMM will manage various aspects of the RI/FS.

The SMP has been prepared by the Project Manager, John R. Moebes, in accordance with the Request for Proposal. Prior to implementation, the plan will be reviewed by the PRPs and the EPA. All requested revisions will be made by HMM and implemented prior to commencement of the field activities.

The Sampling and Analysis Plan addresses EPA approved procedures on sampling and analysis that HMM will use throughout the Savage Well Remedial Investigation (RI). The plan will ensure that the proposed sampling and analysis activities are necessary and will provide sufficient data for use during the Feasibility Study (FS). It also provides a common point of reference for all parties to ensure comparability and compatibility between all sampling and analysis activities.

The QAPP's primary objective is to ensure complete, accurate, and quality data for all areas of the Savage Well RI/FS project. The plan was prepared by HMM's QA/QC Manager, Paula S. Cappello, in accordance with "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans," EPA-600/4-83-004, February, 1983. The QAPP addresses the 16 basic elements of a QA/QC Plan in detail with specific objectives, policies, functional activities, and organization designed to achieve the established Data Quality Objectives (DQOs), which may be found in the Sampling and Analysis Plan.

The Savage Well site specific Health and Safety Plan (HSP) has been developed to establish and communicate the procedures, personnel responsibilities and training necessary to meet the requirements for protecting the health and safety of all on-site personnel during the RI/FS.

The requirements and procedures of the HSP will be updated and implemented with prior approval from the EPA, by the Health and Safety Officer, based on an ongoing assessment of site conditions. All updates will include the most current information available for each media.

The HSP has been developed in accordance with the following documents:

- U.S. Environmental Protection Agency, Standard Operating Safety Guides, U.S. EPA, November, 1984.
- U.S. Environmental Protection Agency, Superfund Public Health Evaluation Manual, EPA/540/1-86/060, January, 1986.
- 29 CFR 1910 Hazardous Waste Operations and Emergency Response, August 10, 1987.
- NIOSH, Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, DHHS/NIOSH-85-115, October, 1985.
- HMM Corporate Health and Safety Manual, April, 1987.

Each plan has been prepared to work as a stand alone document. Cross references between the plans have been made. Each technical staff member, prior to performing any field activities, will read and understand each element of the Sampling and Analysis Plan, the QAPP, and the HSP. The Project Manager and the Field Operations Manager will implement the SMP.

2.1 SITE MANAGEMENT PLAN

SITE MANAGEMENT PLAN
SAVAGE WELL SITE RI/FS
MILFORD, NEW HAMPSHIRE
VERSION 1.0

HMM Document No. 2176-022/WPPHAZ/340

October, 1988

Prepared by:

HMM ASSOCIATES, INC.
336 Baker Avenue
Concord, MA 01742

TABLE OF CONTENTS

1.0 INTRODUCTION

The objective of the Site Management Plan (SMP) is to provide all parties with a written understanding of how various aspects of the RI/FS will be managed. The SMP consists of the following elements:

- Project Management Responsibilities
- Project Coordination
- Project Planning and Tracking
- Financial Management and Budget Control
- Responsibilities of Approved Subcontractors
- Site Access
- Site Security
- Control and Disposal of Hazardous Waste Generated by RI Activities

2.0 PROJECT MANAGEMENT RESPONSIBILITIES

HMM's Project Manager is responsible for all aspects of the RI/FS, both technical and administrative. He has the authority to apply whatever staff and support resources are necessary to complete the various project tasks.

A number of Task Managers have been given responsibility for technical management of specific tasks as well as responsibility for managing subcontractors required to complete the task. All Task Managers are directly responsible to and report to the Project Manager.

2.1 Project Team and Organization

Exhibit 2-1 is the organization chart for the Savage Well Site Remedial Investigation/Feasibility Study project. Details of the reporting structure, and management and control systems are provided in later sections.

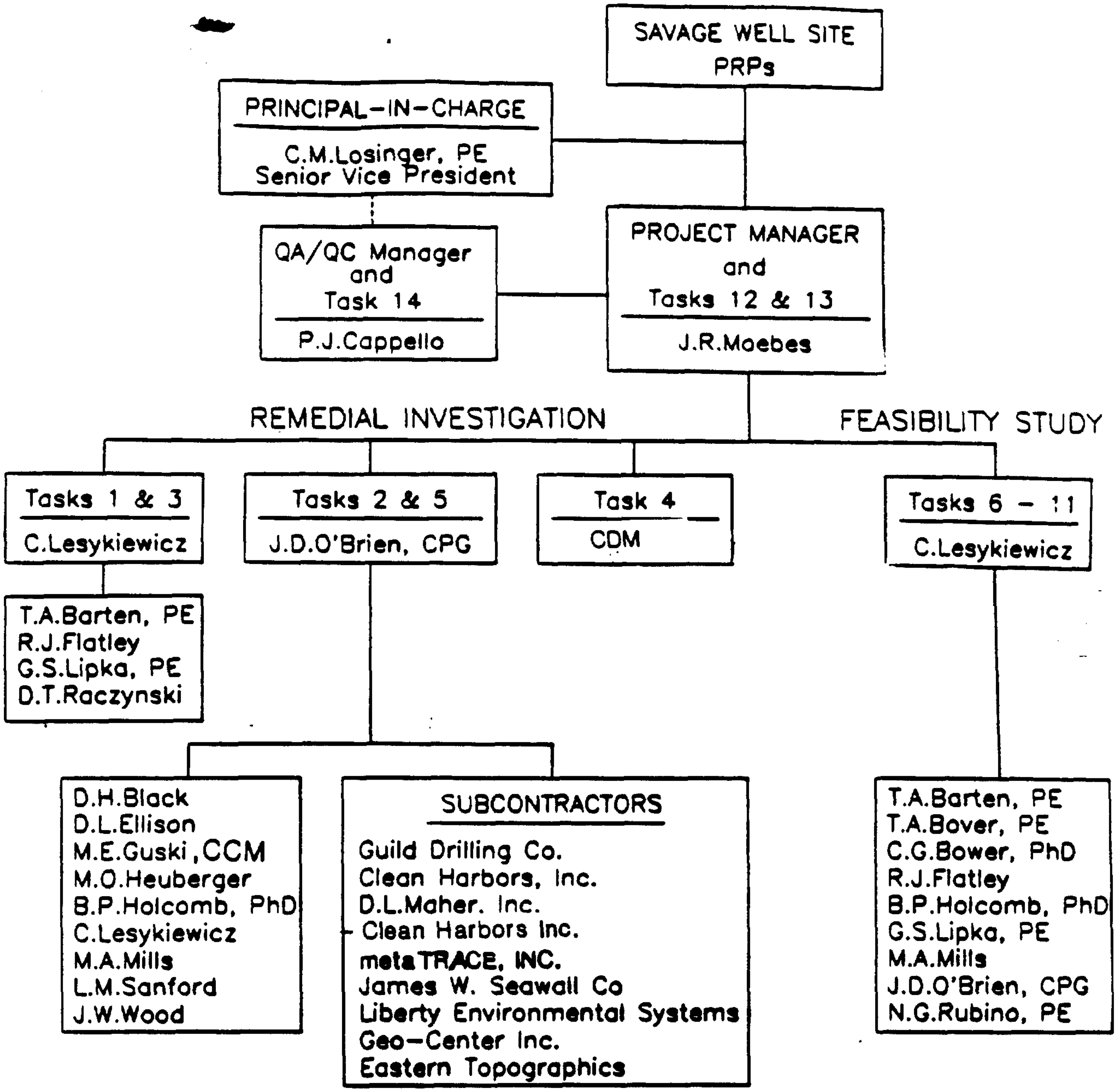
2.2 Responsibilities

Exhibit 2-2 is a matrix illustrating the responsibilities of key personnel per task throughout this project. In addition to the HMM personnel committed to the Savage Well Site project, the matrix lists subcontractors and associated responsibilities per task.

2.3 Key Personnel

The following summarizes the capabilities and experience level of key personnel assigned to this project.

Mr. Charles M. Losinger, P.E. is assigned as Principal-In-Charge. He is a Senior Vice President at HMM who oversees all operations. Mr. Losinger has a broad range of experience in environmental analysis, industrial chemical and waste management, site assessment, health and safety studies, and engineering feasibility projects. He has served as the project manager on a number of hazardous materials assessment and monitoring projects. He has extensive experience in developing hazard communications and hazardous waste handling procedures, contingency plans, and related training programs for a number of facilities, including an electronic components manufacturer, a pulp and paper mill, an oil transfer facility, a cogeneration plant, and a nuclear materials manufacturing facility. He is a registered Professional Engineer in New Hampshire and several other states and provides over 15 years of technical expertise in the field of hazardous materials and wastes management.



KEY:

Task 1: Scoping of Response Actions - I
Task 2: Multi-media Field Investigation
Task 3: Scoping of Response Actions - II
Task 4: Baseline Risk Assessment
Task 5: Remedial Investigation Report
Task 6: Development of Alternatives
Task 7: Initial Screening of Alternatives
Task 8: Detailed Evaluation
Task 9: Draft Feasibility Study Report
Task 10: Conceptual Design
Task 11: Final Feasibility Study Report
Task 12: Management and Coordination
Task 13: Community Relations
Task 14: Quality Assurance

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EXHIBIT 2-1
SAVAGE WELL SITE
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
PROJECT ORGANIZATION

TASK NUMBER		1	2A	2B	2C	2D	2E	2F	2G	2H	2I	3	4	5	6	7	8	9	10	11	12	13	14
HMM Associates	YEARS OF EXPERIENCE	RESPONSE ACTIONS – I	SURVEY	OPERATIONS PLAN	GEOPHYSICAL INVESTIGATION	AIR SAMPLING	WATER / SEDIMENT	WELL INSTALLATION	GROUNDWATER	SOILS / SUBSURFACE	TREATABILITY	RESPONSE ACTION – II	RISK ASSESSMENT	RI REPORT	ALTERNATIVES	INITIAL SCREENING	DETAILED EVALUATION	DRAFT FS REPORT	CONCEPTUAL DESIGN	FINAL FS REPORT	MANAGEMENT	COMMUNITY RELATIONS	QUALITY ASSURANCE
Barten, T.A., PE BS Env. Engineering; MBA	13	S									S	S		S	S	S	S	S	S	S			
Black, D.H. BA Biology	4						S		S					S									
Bover, T.A., PE BS Civil Engineering	15																S	S	S	S			
Bower, C.G., PhD BS Soc Sci; MS/PhD Safety	11			S									S	S			S	S		S			
Brown, D., ScD ScD Toxicology	29												S					S		S			
Cappello, P.J. BS Toxicology	7			S									P	S						S		S	P
Ellison, D.L. MS Hydrogeol/Geomorphology	4		S	S	S		P	S	S	S				S									
Flatley, R.J. BS Environmental Engineering	5	S									P	S		S	S	S	S	S	S	S	S		
Gallinaro, C. BS Chem; MED Nat Sciences	14			S			S						S	S								S	
Guski, M.E., CCM BS/ME Atmospheric Sciences	14					S								S				S	S	S			
Heuberger, M.O. BS Earth Science;MS Geology	5		S				S	S	S	S				S									
Holcomb, B.P., PhD BS Nat Res; MS/PhD Env Sci	11						S		S				S	S		S	S	S	S	S			
Lesykiewicz, C. BS Hydrogeology;MS Civil Eng	12	P										P			P	P	P	P	P	P	S		
Lipka, G.S., PE BS/ME Env Engineering	13	S												S	S	S	S	S	S	S			
Losinger, C.M., PE, V.P. BS/ME Env Engineering; MBA	15			S										S					S	S	**S**		S
Mills, M.A. BA Biology; MS Zoology	16						S		S				S	S									
Moebes, J.R. BS Civil Engineering	17	S		S						S	S	S		S	S	S	S	S	S	S	P	P	S
O'Brien, J.D., CPG BS/MA Geology	14	S	P	P	S	S	S	P	P	P	S	S	S	P	S	S	S	S	S	S	S		
Raczynski, D.T. BS Chemical Engineering	6															S	S	S	S	S			
Rubino, N.G., PE BS Civil Engineering	11														S	S	S	S	S	S			
Sanford, L.M. BS Marine Biology	5			S									S	S									
Schreibman, S.J. BS Toxicology	1			S									S	S									
Wood, J.W. BS Geology; MS Hydrogeology	5			S	P		S	S	S	S	S			S									
Young, J.S. BS/MS Geology	10		S	S	S	S	S	S	S	S	S			S									

P: Primary
S: Support Functions

EXHIBIT 2–2
SAVAGE WELL SITE
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
RESPONSIBILITY MATRIX
PAGE 1 OF 2

	TASK NUMBER	1	2A	2B	2C	2D	2E	2F	2G	2H	2I	3	4	5	6	7	8	9	10	11	12	13	14
Subcontractors	YEARS OF EXPERIENCE	RESPONSE ACTIONS – I	SURVEY	OPERATIONS PLAN	GEOPHYSICAL INVESTIGATION	AIR SAMPLING	WATER / SEDIMENT	WELL INSTALLATION	GROUNDWATER	SOILS / SUBSURFACE	TREATABILITY	RESPONSE ACTION – II	RISK ASSESSMENT	RI REPORT	ALTERNATIVES	INITIAL SCREENING	DETAILED EVALUATION	DRAFT FS REPORT	CONCEPTUAL DESIGN	FINAL FS REPORT	MANAGEMENT	COMMUNITY RELATIONS	QUALITY ASSURANCE
Guild Drilling Company								P		P				S									
Geo – Center Inc.					P									S									
Clean Harbors Inc.										P				S									
D.L. Maher Inc.											P			S									
Liberty Environmental Systems											P			S									
Eastern Topographics			P											S									
Clean Harbors Inc.						P	P		P	P				S									

P: Primary
S: Support Functions

EXHIBIT 2–2
SAVAGE WELL SITE
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
RESPONSIBILITY MATRIX
PAGE 2 OF 2

Mr. John R. Moebes is assigned as Project Manager. He is an Associate and Manager of the Hazardous Materials Division at HMM. He has extensive experience in the management of hazardous waste sites investigation and remediation and the management of wastewater control programs. He managed the U.S. Environmental Protection Agency's Region 1, Boston, Superfund Branch. While managing the Region's Consolidated Permits Branch, he was responsible for implementing the National Pollutant Discharge Elimination System (NPDES), Resource Conservation Recovery Act (RCRA), Ocean Dumping and Section 404 Dredge and Fill Permit Programs.

As Manager of the EPA Region 1 Superfund Branch, he was responsible for the implementation of clean-up activities at 54 sites in New England. Remedial investigations and feasibility studies were implemented at 40 sites, final clean-up remedies were selected at 11 sites and construction started at seven sites. Overall responsibility included management of a $35 million budget, and integrating the services of numerous contractors providing engineering, risk assessments, drilling, hydrogeological investigations and analytical services.

Since joining HMM, he has directed site assessments and remedial action at several sites and provided services at the Union Chemical site in South Hope, ME, Dover Landfill in Dover, NH and Conductor Lab in Groton, MA.

Ms. Paula J. Cappello is assigned as QA/QC Manager and Task Manager. She serves as HMM's lead toxicologist and QA Manager. In this capacity she provides technical support and specific project consultation on matters related to hazardous materials, risk assessments, the use of the Hazardous Ranking System (HRS) for hazardous waste site placement on the National Priorities List (NPL), and site specific health and safety plans. Her background includes environmental chemistry, toxicology, and laboratory supervision. She was responsible for the design and implementation of an onsite laboratory at HMM for the analysis, preparation, and storage of hazardous samples. Ms. Cappello, as the QA Manager, was responsible for the development and implementation of HMM's corporate Technical Quality Assurance Plan. She has managed a project for Personnel Protection and Safety for Hazardous Waste Site Activities Training, the course is 40 hours of instruction to meet the requirements of OSHA's 29 CFR 1910 and SARA section 126(d).

Mr. James D. O'Brien, C.P.G. has responsibility for the remedial investigation. He is a senior hydrogeologist and is experienced in the development, implementation and management of investigations and remediations at hazardous waste sites. He assisted in the technical management of the Commonwealth of Massachusetts Department of Environmental Quality Engineering's Field Investigation Team. He was responsible for overseeing site investigations at over 30 Massachusetts State Superfund sites. As a project geologist in the private sector, he was responsible for the planning and supervision of hundreds of field investigations encompassing the fields of engineering, geology, geotechnical engineering, environmental geology and hydrogeology. He is currently involved in responsible party negotiations for a NPL site in New Hampshire, a hydrogeological assessment of a state-listed hazardous waste site and the evaluation of remedial alternatives for a hazardous waste lagoon. Mr. O'Brien is a Certified Professional Geologist.

Reporting to Mr. O'Brien are eleven scientists and engineers to complete Task 2, Multi-Media Field Investigation.

Mr. Conrad G. Leszkiewicz has primary responsibility for the scoping of response actions and completion of the feasibility study. He has experience as a project engineer in a variety of environmental and geotechnical engineering projects for the U.S. Army as well as serving as an officer (Major) in various positions of responsibility both while on active duty and as a reservist. Projects which Mr. Leszkiewicz has completed include site investigations for explosive ordnance disposal, underground storage tank and other hazardous waste sites. He has experience in design and project management of a 35 acre landfill closure and design of waste water treatment and sewage collection systems. Mr. Leszkiewicz has additional experience in cost estimating, specification writing and interacting with regulatory officials. Currently, Mr. Leszkiewicz is conducting an engineering cost analysis for a superfund site in Maine and the review of a remedial investigation/feasibility study for an NPL site in New Hampshire. For the Savage Well Site RI/FS he will also be involved in the field investigations.

Mr. Robert J. Flatley will support the scoping of response actions and completion of the feasibility study. He has experience in a wide range of hazardous materials activities. He has developed and managed various health and safety plans at a number of sites while reviewing company regulations to ensure that operations were in compliance with EPA and RCRA standards. Mr. Flatley has been responsible for: overseeing hazardous waste site remedial investigations and site restoration projects; maintaining a Right-to-Know program; and for testing and designing an analysis of hazardous waste incineration facilities. He has also been involved with the development of new chemical waste management technology and air emission evaluation and monitoring. Mr. Flatley has completed assignments for the EPA office of Research and Development and the Hazardous Waste Engineering Research Lab to evaluate commercially available and economical treatment technologies to replace land disposal of hazardous and toxic wastes. He performed electromagnification studies at various sites to determine the extent of road salt plumes, petroleum hydrocarbon plumes, and solvent plumes.

3.0 PROJECT COORDINATION

HMM recognizes the need to closely coordinate activities with the project in order to ensure the successful and timely completion of the RI/FS.

All field activities will be scheduled in advance and notice as required by the consent order will be provided to the EPA Regional Project Manager (RPM). It will be the RPM's responsibility to notify the NHDES and EPA contractors performing oversight activities of the scheduled activities.

HMM will work closely and cooperatively with EPA personnel or contractors to ensure the timely completion of any tasks for which EPA has retained responsibility.

The RPM will be provided monthly progress reports as required by the consent order. These reports will provide the RPM with the necessary budget and project tracking information to determine the status of the overall project.

At a minimum, these reports will contain the following:

Monthly Progress Reports and Meetings

Respondent shall provide monthly written progress reports (Progress Reports) to EPA according to the Schedule contained in the RI/FS Work Plan. At a minimum, these Progress Reports shall report on the progress made during the preceding month as follows:

(1) describe the actions which have been taken toward achieving compliance with this Consent Order;

(2) present all results of sampling and tests and all other data received by Respondent; and

(3) describe actions, data, plans, and procedures which are scheduled for the next month.

Progress Reports shall be submitted to the EPA Project Coordinator by the last calendar day of each month following the effective date of this Consent Order. Meetings between the Project

Coordinator and the HMM Project Manager shall be held monthly, as determined by the EPA Project Coordinator, at the EPA office in Boston, unless the EPA Project Coordinator agrees to another meeting site or the parties agree that a monthly meeting is not required for a particular month. HMM will meet with and make formal presentations to EPA technical staff at the completion of major components of the RI/FS, as specified by the EPA Project Coordinator.

4.0 PROJECT PLANNING AND TRACKING

The initial planning for the RI/FS is based on the schedule contained in the EPA Work Plan. Many of the tasks are interdependent and weather or seasonal dependent. HMM's initial planning efforts have been to determine the optimal sequencing of tasks and accelerate those which would be delayed by winter snow cover. These tasks include the aerial survey for the base map preparation, the geophysical investigations and the air sampling walkover. The successful early completion of these tasks will allow the remaining tasks to proceed basically in accordance with the Work Plan schedule.

The Timeline® project management and tracking software system will be used to monitor the progress of the project. The 14 tasks required by the Work Plan will be divided into appropriate subtasks and start and completion dates established for all tasks and subtasks. The Timeline system will generate current status, lag and projection reports as well as critical path determinations. This system is critical for the successful management of the RI/FS and will provide the information necessary to determine slippage or potential schedule problems. Exhibit 4-1 is a current Gantt Chart for the Savage Well project. Exhibits 4-2 through 4-4 are typical project tracking reports from Timeline® which will be supplied on a monthly basis.

The system will be updated on a weekly basis to ensure that the Project Manager and Task Managers have current data. The system will use approved EPA schedules for computing all reports. EPA approved schedule changes or approved start dates will be entered into the system upon receipt.

Schedule Name: MILFORD RI/F[illegible] - SRVP WELL
Project Manager: MOEBES
As of date: 17-Dec-87 3:52pm Schedule File: C:\TLMIL\MILFORD

TWO YEAR DURATION RI/FS ACTIVITIES
RI MANAGER JIM OBRIEN, FS MANAGER CONRAD LESZKIEWICZ

SUBTASK 2A1-SITE BASE MAP	TASK 1 SCOPING RESPONSE ACT'S	SUBTASK 2B1 DRAFT POP'S	SUBTASK 2A1 AERIAL SURVEY	SUBTASK 2B PROJECT OPER.PLANS	STUDY AREA SURVEY SUBTASK 2A	TASK 5: PREP.of RI REPORT	TASK 12: MGT & COOR DINATION

TIME LINE PERT Chart Strip number 1 of 2.

EXHIBIT 4-2

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TWO YE
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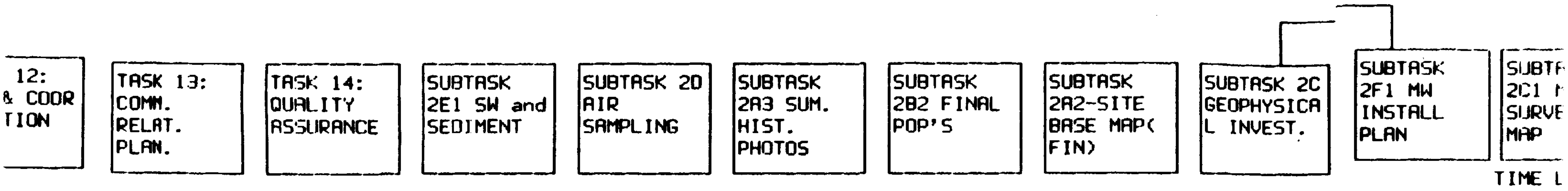

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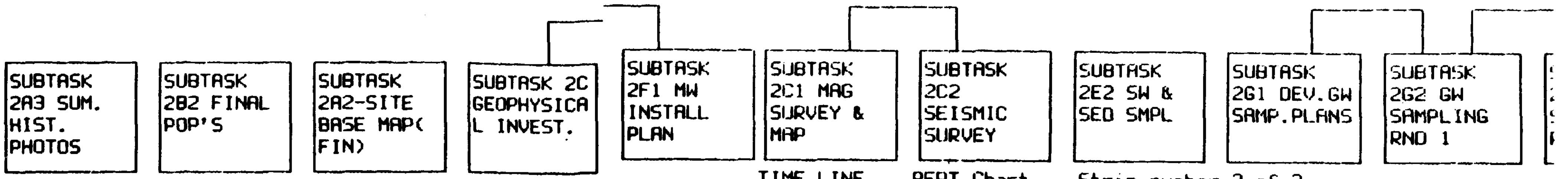
TWO YEAR DURATION RI/FS ACTIVITIES
RI MANAGER JIM OBRIEN, FS MANAGER CONRAD LESZKIEWICZ

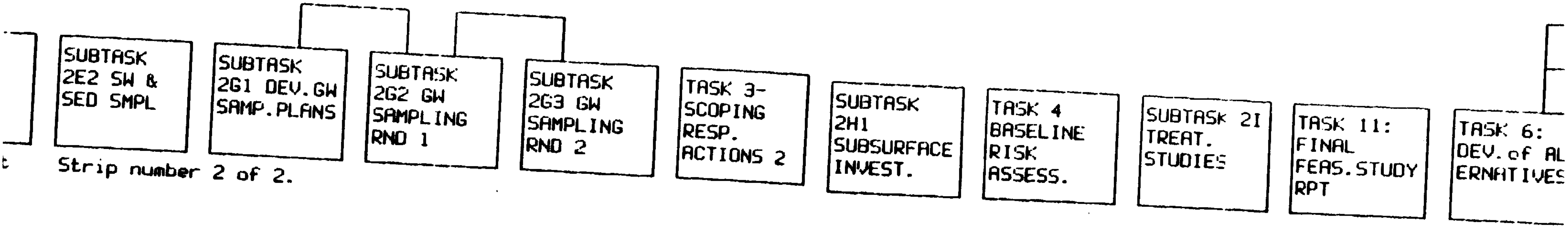


TIME LINE PERT Chart Strip number 2 of 2.

ec-87 3:52pm Schedule File: C:\TLM\ MIL

S ACTIVITIES

FS MANAGER CONRAD LESZKIEWICZ



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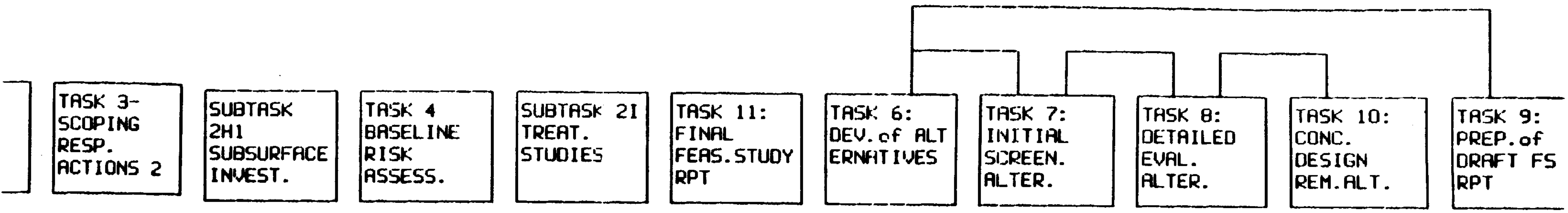
TASK 3-
SCOPING
RESP.
ACTIONS 2
SUBTASK
2H1
SUBSURFACE
INVEST.
TASK 4
BASELINE
RISK
ASSESS.
SUBTASK 2I
TREAT.
STUDIES
TASK 11:
FINAL
FEAS.STUDY
RPT
TASK 6:
DEV.of ALT
ERNATIVES
TASK 7:
INITIAL
SCREEN.
ALTER.
TASK 8:
DETAILED
EVAL.
ALTER.
TASK 10:
CONC.
DESIGN
REM.ALT.
TASK 9:
PREP.of
DRAFT FS
RPT

EXHIBIT 4-1
SAVAGE WELL SITE
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
PROJECT SCHEDULE
PAGE 1 of 3

SCHEDULE OF ACTIVITIES AND DELIVERABLES
Months after effective date of order

RI/FS Schedule of Tasks and Deliverables

TASK 1: Scoping of Response Actions - I

- o Preliminary List of Applicable Technologies
- o Identification of ARAR
- o Identification of Receptors

TASK 2: Multi-Media Field Investigation

Subtask 2A: Study Area Survey

- o Site Base Map (Draft)
- o Site Base Map (Final) with map showing various plots at the site
- o Letter report summarizing historical photo analysis

Subtask 2B: Project Operations Plan

- o Draft Project Operations Plan
- o Project Operations Plan (Final

Subtask 2C: Geophysical Investigation

- o Map showing magnetic contours of the site with interpretation
- o Map showing seismic lines with profiles and interpretations

Subtask 2D: Air Sampling

- o Letter report

Subtask 2E: Surface Water and Sediment Sampling

- o Letter report

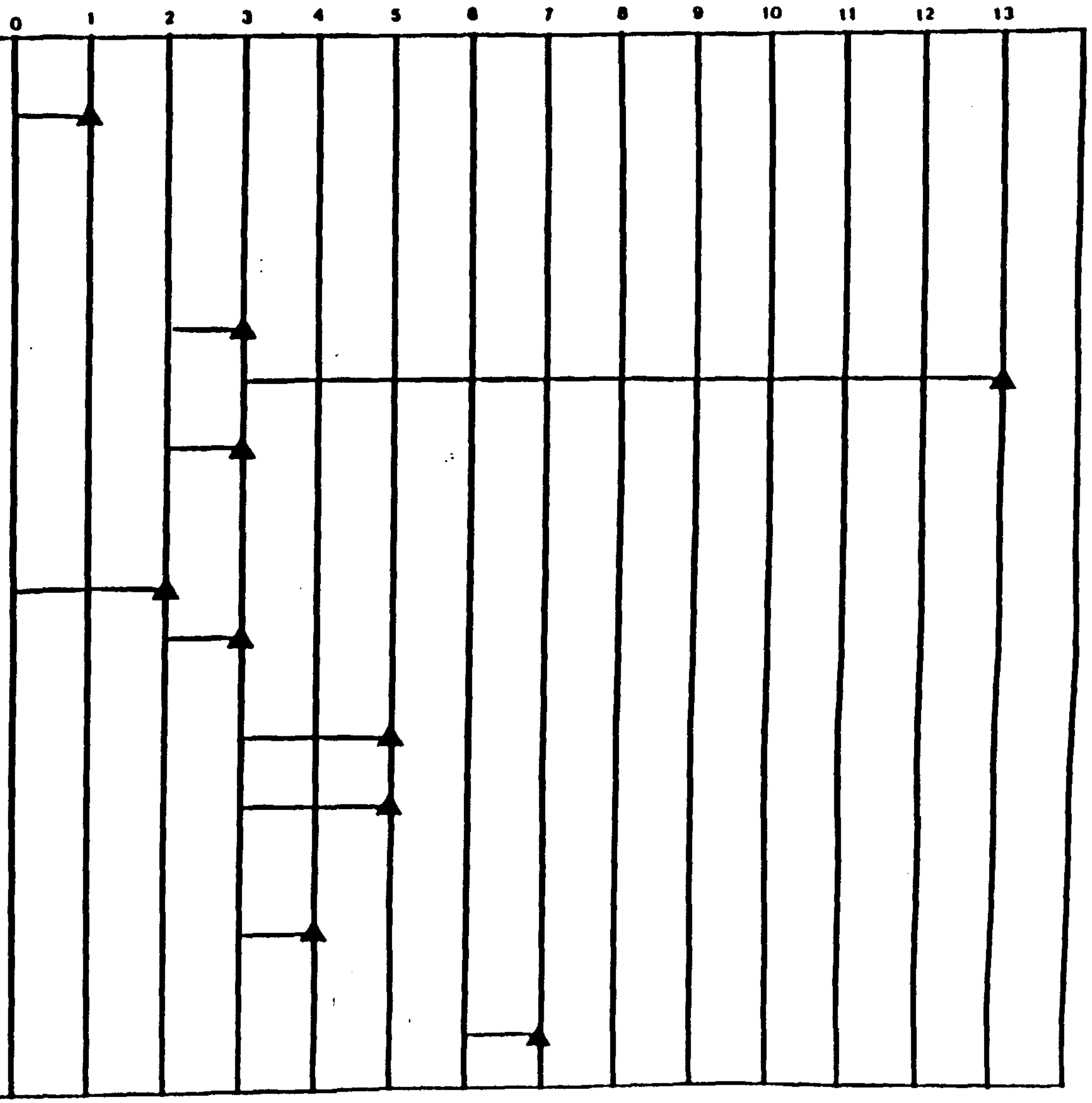

EXHIBIT 4-1
SAVAGE WELL SITE
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
PROJECT SCHEDULE
PAGE 2 of 3

SCHEDULE OF ACTIVITIES AND DELIVERABLES
Months after effective date of order

RI/FS Schedule of Tasks and Deliverables

Subtask 2E: Monitoring Well Installation Program
- o Letter reports containing logs and aquifer parameters

Subtask 2G: Groundwater Sampling
- o Letter reports

Subtask 2H: Soils and Subsurface Investigation
- o Letter report and data on soil gas sampling with interpretation of results - Phase I
- o Letter report and data on soil boring with interpretation - Phase II
- o Letter report and data on further soil borings with interpretation - Phase III

Subtask 2I: Treatability Studies
- o Letter report

TASK 3: Scoping of Response Actions - II
- o Letter report with suggested technologies for consideration, and discussion of ARAR

TASK 4: Baseline Risk Assessment
- o Outline of Baseline Risk Assessment
- o Letter report which summarizes hazard identification
- o Baseline Risk Assessment (Draft)

TASK 5: Preparation of Remedial Investigation Report
- o Draft RI Report
- o Final RI Report

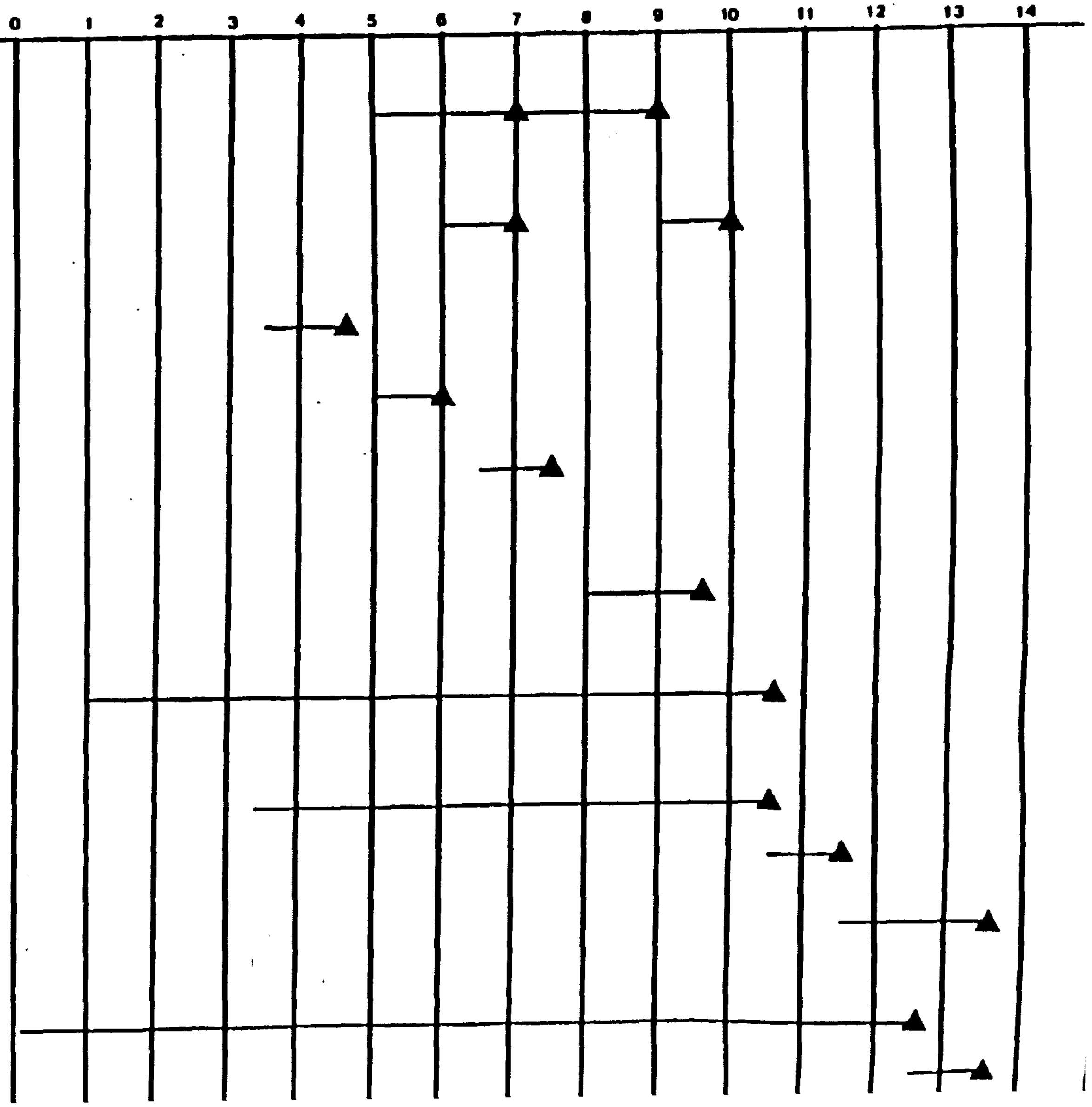

EXHIBIT 4-1
SAVAGE WELL SITE
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
PROJECT SCHEDULE
PAGE 3 of 3

SCHEDULE OF ACTIVITIES AND DELIVERABLES
Months after effective date of order

RI/FS Schedule of Tasks and Deliverables

TASK 6: Development of Alternatives

- o Briefing to present preliminary response objectives and criteria
- o Memo report discussing preliminary response objectives and criteria
- o Memo report outlining remedial alternatives developed

TASK 7: Initial Screening of Alternatives

- o Letter report

TASK 8: Detailed Evaluation of Remaining Alternatives

- o Summary table and narrative description of advantages and disadvantages of each alternative

TASK 9: Preparation of Draft Feasibility Study Report

- o Draft FS Report

TASK 10: Conceptual Design of Selected Remedial Alternatives

- o Conceptual Design Report

TASK 11: Final Feasibility Study Report

- o Final FS Report

TASK 12: Management and Coordination

- o Monthly Progress Reports

TASK 13: Community Relations Planning and Implementation Support

TASK 14: Quality Assurance

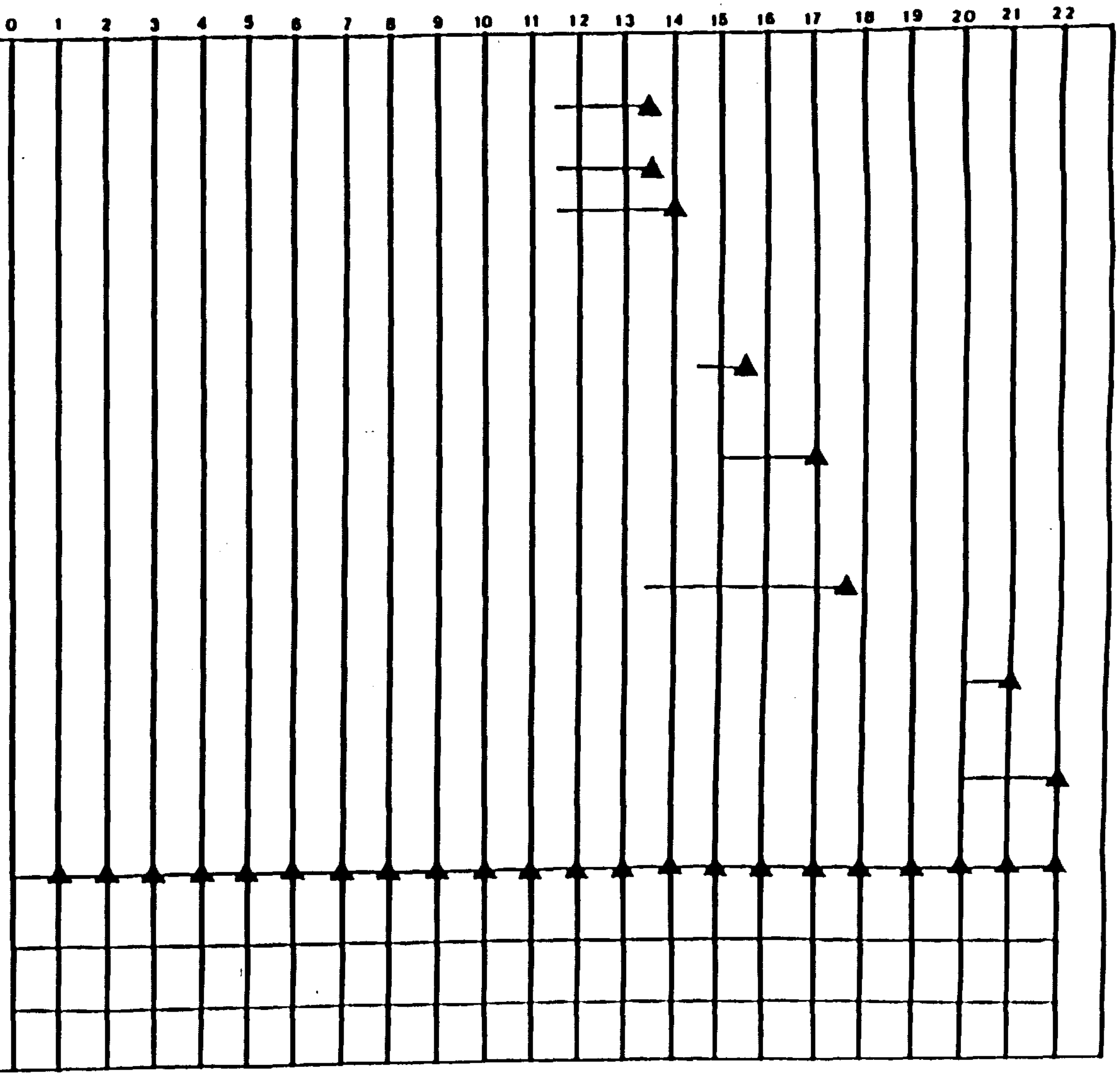

EXHIBIT 4-3

LAG REPORT

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Schedule Name:   MILFORD RI/FS - SAVAGE WELL
Project Manager: MOEBES
   of date:      17-Dec-87  3:08pm   Schedule File: C:\TLMIL\MILFORD

    'EAR DURATION RI/FS ACTIVITIES
    .NAGER JIM OBRIEN, FS MANAGER CONRAD LESZKIEWICZ

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  -------------------------------------------------------------------------
  .e longer than planned:
------------------------------Planned------------Actual-------------------


-------------------------------------------------------------------------
Take less time than planned:
------------------------------Planned------------Actual-------------------

TIME LINE Actual-vs-Planned Report                                 Page 1
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  hedule Name:   MILFORD RI/FS - SAVAGE WELL
Project Manager: MOEBES
As of date:      17-Dec-87  3:08pm   Schedule File: C:\TLMIL\MILFORD

  IO YEAR DURATION RI/FS ACTIVITIES
  : MANAGER JIM OBRIEN, FS MANAGER CONRAD LESZKIEWICZ

Compared against plan, C:\TLMIL\MILFORD.T00, of 17-Dec-87  1:51pm.


  -------------------------------------------------------------------------
Dropped tasks (in plan, but not in actual):
  -------------------------------------------------------------------------


  -------------------------------------------------------------------------
  ew tasks (in actual, but not in the plan)
  -------------------------------------------------------------------------

  IME LINE Actual-vs-Planned Report                                Page 2
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Schedule Name:   MILFORD RI/FS - SAVAGE WELL
Project Manager: MOEBES
 s of date:      17-Dec-87  3:09pm   Schedule File: C:\TLMIL\MILFORD

.WO YEAR DURATION RI/FS ACTIVITIES
RI MANAGER JIM OBRIEN, FS MANAGER CONRAD LESZKIEWICZ

 ompared against plan, C:\TLMIL\MILFORD.T00, of 17-Dec-87  1:51pm.


  -------------------------------------------------------------------------
  ixed-date tasks that start later than planned:
  ----------------------------Planned------------Actual-------------------


  -------------------------------------------------------------------------
Milestones that start later than planned:
------------------------------Planned------------Actual-------------------

TIME LINE Actual-vs-Planned Report                                 Page 3
```

EXAMPLE ONLY

EXHIBIT 4-4

MONTH-BY-MONTH STATUS REPORT

```
Schedule Name:    MILFORD RI/FS - SAVAGE WELL
Project Manager:  MOEBES
As of date:       17-Dec-87   2:00pm    Schedule File: C:\TLMIL\MILFORD

TWO YEAR DURATION RI/FS ACTIVITIES
RI MANAGER JIM OBRIEN, FS MANAGER CONRAD LESZKIEWICZ

(     1)  SUBTASK 2A1-SITE BASE MAP        Summarizes  SUB 2A1     ?? Dates ?

          Fixed        Started       4 weeks, 2 days

          Priority:       7

          FIRST
          SUBTASK OF TASK 2A AERIAL SURVEY

                          Start:                  End:
                          -----------------       -----------------
          Date:           26-Oct-87  8:00am       27-Nov-87  5:00pm

          Resource:                               Amount:        Cost:
          ------------------------------  ------------  ------------
          CONRAD LESZKIEWICZ                        0.10      1,056.00
          JIM O'BRIEN                               0.01         61.60
              Total Cost ..............................      1,117.60

(     2)  TASK 1 SCOPING RESPONSE ACT'S    Summarizes  TASK 1      ?? Dates ?

          Fixed        Done          4 weeks, 2 days

          Priority:       10

                          Start:                  End:
                          -----------------       -----------------
          Date:           26-Oct-87  8:00am       27-Nov-87  5:00pm
```

EXAMPLE ONLY

```
TIME LINE Task Detail Report                                        Page 1
```

5.0 FINANCIAL MANAGEMENT AND BUDGET CONTROL

The Project Manager is responsible for overall budget control and he delegates weekly budget monitoring to the Task Managers.

At the beginning of the project, a man-hour and expense budget is developed for each task. These budgets are incorporated into HMM's computerized project cost accounting system. Within this system each individual task is assigned a number. Labor charges are made weekly to each task number on employee time sheets, entered into the computer and issued in timesheet edit reports to the Project Manager and Task Managers. These reports total the labor charges for each task or subtask. Exhibit 5-1 is an example of the timesheet.

On a monthly basis, the system totals other direct expenses and labor charges. This monthly report is also issued to the Project Manager and the Task Managers. Exhibit 5-2 is an example of the monthly time and materials billing worksheet. The Project Manager compares labor charges with completed tasks to make sure that the percentage of work completed is consistent with the labor charged.

Task Managers are responsible for monitoring subcontractor charges on a weekly basis. All subcontractors will be required to provide weekly telephone progress reports and monthly written progress reports. These reports will include costs and percent completion of tasks. These data will be entered onto the computer tracking system monthly and will appear on the monthly project budget report.

TIMESHEET EDIT REPORT BY ACCOUNT **EXHIBIT 5-1**

PROJ MGR: LESYKIEWICZ

FROM 12/10/87 TO 12/11/87

NUMBER ESCRIPTION	JOB CATEGORY	EMPLOYEE NAME	EMPL ID	T/S DATE	DEPT	PAY TYPE	TRD CD	HOURS
176-120-39 VAGE-MGMT & COORDINATIO	2-3-TECH II/WORD PROC.	DUFFEY, MONICA	DUFFY	12/11/87	10	R	N/A	0.5
				CATEGORY TOTALS				0.5
	4-5-SCIENTIST/ENG. III	CAPPELLO, PAULA J.	CAPPEL	12/11/87	03	R	N/A	2.0
				CATEGORY TOTALS				2.0
	5-6-SCIENTIST/ENG. II	FLATLEY, ROBERT J.	FLATLE	12/11/87	03	R	N/A	4.5
				CATEGORY TOTALS				4.5
	7-9-ASSOC./UNIT MGR.	MOEBES, JOHN R.	MOEBES	12/11/87	03	R	N/A	5.0
				CATEGORY TOTALS				5.0
				ACCOUNT TOTALS				12.0

REPORT DATE: 12/10/87 11:01
LLING #: 1285
ATUS: NOT SELECTED

HMM ASSOCIATES, INC.
TIME & MATERIALS BILLING WORKSHEET
BILLING PERIOD ENDED: 11/27/87

EXHIBIT 5-2

PAGE 355

IENT: MCLANE, GRAF, RAULERSON &
MIDDLETON
P O BOX 326

CONTRACTOR: HMM ASSOCIATES, INC.
P.O. BOX 4133
BOSTON, MA 02211

RIME CONTRACT #:
OTHER CONTRACT #: MOEBES
CONTRACTOR'S ACCT #: 2176-000

TOTAL CONTRACT: 0.00
CONTRACT NAME: SAVAGE WELL SITE-MILFORD

	PREVIOUSLY BILLED	+	CURRENT BILLING	=	CUMULATIVE BILLED	-	CUMULATIVE INCURRED	=	UNBILLED AMOUNTS
ABOR BILLING	0.00		200.00		200.00		N/A		N/A
OTHER DIRECT COST	0.00		144.51		144.51		144.51		0.00
TOTAL NON-LABOR COSTS	0.00		144.51		144.51		N/A		N/A
E AT 0.00%	0.00		0.00		0.00		N/A		N/A
AMT IN EXC OF TOTAL VALUE	0.00		-344.51		-344.51		N/A		N/A
TAL BILLING	0.00		0.00		0.00		0.00		0.00

* INDIRECT COSTS BILLED MAY NOT COMPUTE TO SHOWN PROVISIONAL RATES IF DIFFERENT RATES WERE USED IN PRIOR PERIODS

** CUMULATIVE INCURRED AND UNBILLED AMOUNTS ON T&M CONTRACTS ARE PROVIDED ONLY FOR ODC'S AND FOR THE TOTAL BILLING AMOUNT

REPORT DATE: 12/10/87 10:07
ERIOD ENDING: 11/27/87

HMM ASSOCIATES, INC.

EXHIBIT 5-2

JOB STATUS REPORT
LABOR HOURS BY EMPLOYEE
AS OF 11/27/87

CLIENT: MCLANE, GRAF, RAULERSON
ONTRACT NAME: SAVAGE WELL SITE-MILFORD
RACT NUMBER: 2176-000
SION NUMBER: 1
PROJ MGR: MOEBES

CONTRACT VALUE: 0.0
START DATE: 09/24/8
END DATE: 00/00/0
JOB TYPE: T&M
RATE TYPE: TARGETE

			HOURS		
	JOB CATEGORY	EMPLOYEE NAME	CURRENT PERIOD	YEAR TO DATE	TOTAL CONTRACT
	39 DIRECT LABOR				
2	3-TECH II/WORD PROC.	VANDELINDER, LEANNE	-3.0	0.0	0.0
4	5-SCIENTIST/ENG. III	ARMSTRONG, LIANNE D.	-1.0	0.0	0.0
8	CORPORATE OFFICER	LOSINGER, CHARLES	2.0	2.0	2.0
			-2.0	2.0	2.0
	TOTALS		-2.0	2.0	2.0

EXHIBIT 5-2

PORT DATE: 12/09/87 18:28
RIOD ENDING: 11/27/87

HMM ASSOCIATES, INC.

JOB STATUS REPORT
CURRENT ODC DETAIL
AS OF 11/27/87

CLIENT: MCLANE, GRAF, RAULERSON
RACT NAME: SAVAGE WELL SITE-MILFORD
RACT NUMBER: 2176-000
DIVISION NUMBER: 1
OJ MGR: MOEBES

CONTRACT VALUE: 0.00
START DATE: 09/24/87
END DATE: 00/00/00
JOB TYPE: T&M
RATE TYPE: N/A

JC	DESCRIPTION	PD	SOURCE	REF. NUMBER	VENDOR NAME	TRANSACTION DESCRIPTION	AMOUNT
43	TRAVEL					END OF PRIOR PD BALANCE	91.20
		06	AJ-413			TRANSFER TASKS	-91.20
						TOTAL	0.00
46	OTHER DIRECT COST					END OF PRIOR PD BALANCE	515.87
		06	AJ-413			TRANSFER TASKS	-515.87
			AP-001	006576	FOTOBEAM BROOKSIDE	OTHER DIRECT COST	128.73
			AP-002	006629	LOSINGER, CHARLES	OTHER DIRECT COST	28.40
			AP-003	006746	PHOTO VIDEO DEPOT	OTHER DIRECT COST	15.75
			AP-004	006885	SENTRY OFFICE SUPPLY	OTHER DIRECT COST	36.45
			AP-004	006895	SENTRY OFFICE SUPPLY	OTHER DIRECT COST	-64.82
						TOTAL	144.51

REPORT DATE: 12/10/87 11:01
ILLING #: 1285
STATUS: NOT SELECTED

HMM ASSOCIATES, INC.
TIME & MATERIALS BILLING WORKSHEET
BILLING PERIOD ENDED: 11/27/87

EXHIBIT 5-2

LIENT: MCLANE, GRAF, RAULERSON &
MIDDLETON
P O BOX 326

CONTRACTOR: HMM ASSOCIATES, INC.
P.O. BOX 4133
BOSTON, MA 02211

RIME CONTRACT #:
OTHER CONTRACT #: MOEBES
ONTRACTOR'S ACCT #: 2176-000

TOTAL CONTRACT: 0.00
CONTRACT NAME: SAVAGE WELL SITE-MILFORD

LABOR CATEGORY	CUMULATIVE HOURS INCURRED	CUMULATIVE HOURS PREV BILLED	CURRENT HOURS BILLABLE	CURRENT RATE	CURRENT BILLING	CUMULATIVE HOURS BILLED	CUMULATIVE $$$ BILLED	HOURS UNDER (OVER) BILLED
ORPORATE OFFICER	2.0	0.0	2.0	100.00	200.00	2.0	200.00	0.0
TOTALS	2.0	0.0	2.0		200.00	2.0	200.00	0.0

6.0 RESPONSIBILITIES OF SUBCONTRACTORS

HMM Associates will utilize a number of subcontractors in the conduct of the RI/FS. These subcontractors were chosen based on their demonstrated past performance, expertise in their respective fields and their ability to provide the required quality work product on a timely and cost effective basis. The following is a short description of each subcontractor and their responsibility, followed by a company brochure, if available.

Guild Drilling Company will be utilized to construct all monitoring wells and hazardous waste investigations requiring the installation of cluster wells, including bedrock wells. Several Guild drillers have completed training in Personnel Protection and Safety in compliance with 29 CFR 1910.120. Previous HMM experience with Guild Drilling has included both Level B and Level C site safety requirements. Refer to Subtasks 2F and 2H.

Geo-Centers Inc. will conduct geophysical activities including seismic refraction and Geo-Centers will prepare maps showing the magnetic contours of the site with test interpretations, the seismic lines and profiles of field data and interpretation, and bedrock topography of the site. Refer to Subtask 2C.

D. L. Maher Inc. will drill the large diameter wells for the treatability studies and pump tests. Refer to Subtask 2I.

Liberty Environmental Systems will be responsible for designing and supplying the equipment required for the treatability studies. Refer to Subtask 2I.

Clean Harbors, Inc. will be utilized for disposal of any hazardous fluids, soils, equipment and clothing which may be generated during the RI. Refer to Site Management Plan, Control and Disposal of Hazardous Wastes Generated by RI Activities (page 9-1).

Eastern Topographic Inc. will provide the site base map utilizing aerial photograph and ground surveying. Refer to Subtask 2A Study Area Survey.

Clean Harbors, Inc. will provide sample analysis services. Additional analytical support may be provided by metaTRACE, Inc. metaTRACE will serve as a backup lab and will be utilized at the discretion of the HMM QA officer for quick turn-around samples, special analytical work, quality control samples and overflow capacity. Refer to Sampling and Analysis Plan.

7.0 SITE ACCESS

The site as defined by the work plan encompasses approximately 75 parcels of private and public property. Conduct of the RI will require access to approximately 33 of these parcels. Property owners have been asked to sign access agreements granting permission to HMM, HMM's subcontractors, NHDES, EPA and EPA's contractor to conduct field investigations and oversight activities.

Should any property owners refuse access to property where it is necessary to conduct field activities, assistance will be requested from EPA. Due to the large number of parcels and property owners involved, agreements will be sought only where defined field activities will occur.

Exhibit 7-1 is the Site Access Agreement as prepared by Mr. Gregory Smith, ESQ of McLane, Graf, Raulerson & Middleton PA, Manchester, NH.

EXHIBIT 7-1

SITE ACCESS AGREEMENT

AGREEMENT entered into this ____ day of ______________, 1987, by and between _______________________________________, (referred to as "Owner") owner of the property described in Exhibit A, (referred to as the "Property") and **HITCHINER MANUFACTURING COMPANY, INC.**, a New Hampshire corporation with a principal place of business in Milford, New Hampshire; **THE OK TOOL COMPANY**, a New Hampshire corporation with a principal place of business in Milford, New Hampshire; **NEW ENGLAND STEEL FABRICATORS**, a New Hampshire corporation with a principal place of business in Milford, New Hampshire; and **HENDRIX WIRE AND CABLE**, a division of Conductron Corporation, a Massachusetts corporation with a principal place of business in Milford, New Hampshire (collectively referred to as "the Group").

WITNESSETH:

WHEREAS, the members of the Group have been identified by the United States Environmental Protection Agency ("EPA") as potentially responsible parties for hazardous waste corrective action at the Savage Well site ("Site") in Milford, New Hampshire; and

WHEREAS, the Group, while denying that the activities of its members have caused the alleged contamination of the well, feel that it is in the best interest of the community for an environmental study to be conducted in a prompt and cost effective manner, and, to that end, have agreed to an Administrative Order by Consent (the "Consent Order") with the EPA; and

WHEREAS, the Group desires to have HMM Associates, Inc., a properly qualified engineering expert conduct a Remedial Investigation

EXHIBIT 7-1 (Continued)

and Feasibility Study, (referred to as the "RI/FS") pursuant to the Consent Order; and

WHEREAS, part or all of the Property has been identified as part of the study area for the RI/FS.

NOW, THEREFORE, in consideration of the foregoing and the mutual promises set forth below, the parties agree as follows:

1. Owner agrees to allow HMM Associates, Inc., its officers, employees, agents, subcontractors and authorized representatives access to the Property for the purposes of conducting the RI/FS. The activities to be conducted by HMM Associates, Inc. may include, but shall not be limited to:

a. the taking of such soil, water and air samples as may be determined to be necessary;

b. the sampling of any solids or liquids located or stored or disposed of on the Property;

c. the drilling of holes and installation of monitoring wells for subsurface investigation;

d. any other actions related to the investigation of surface or subsurface contamination.

2. Owner agrees to allow the Group, its officers, employees, agents and authorized representatives access to the Property for the purpose of overseeing the implementation of the RI/FS.

3. Owner agrees to allow the EPA and New Hampshire agencies' employees, agents and authorized representatives access to the Property for the purpose of overseeing and recording field activity of the RI/FS by HMM Associates, Inc.

4. The parties agree that access to the Property shall be as reasonably necessary to carry out the provisions of the Consent Order.

5. The Group agrees to remove all equipment used in the RI/FS on the Property and restore the affected areas of the Property as reasonably practicable after the completion of the RI/FS by HMM Associates, Inc.

6. Owner understands that these actions are taken pursuant to an Administrative Order By Consent issued by the EPA under the Comprehensive Environmental Response, Compensation and Liability Act (Superfund), 42 U.S.C. § 9601 et. seq.

IN WITNESS WHEREOF, the parties have caused this agreement to be executed on the date first written above.

WITNESS	**OWNER**
______________________________	By: ______________________________
WITNESS	**HITCHINER MANUFACTURING COMPANY, INC.**
______________________________	By: ______________________________
WITNESS	**THE OK TOOL COMPANY**
______________________________	By: ______________________________

WITNESS	**NEW ENGLAND STEEL FABRICATORS**
______________________________	**By:** ______________________________
WITNESS	**HENDRIX WIRE AND CABLE**
______________________________	**By:** ______________________________

STATE OF NEW HAMPSHIRE
COUNTY OF ____________

Subscribed and sworn to before me this _____ day of __________, 1987.

____
Notary Public/Justice of the Peace

8.0 SITE SECURITY

The Savage Well Site does not require security in order to prevent exposure to hazardous wastes. Should hazardous wastes be generated during RI activities, access will be controlled as detailed in the Site Safety Plan. The generated wastes will be disposed of as detailed in Section 9.0 of this plan. HMM will be granted the use of a secure area at one or more of the PRP facilities to store and secure private and government property used in the investigation.

9.0 CONTROL AND DISPOSAL OF HAZARDOUS WASTES GENERATED BY RI ACTIVITIES

There is a possibility that existing hazardous materials will be encountered during the RI. HMM will maintain the necessary equipment on-site to handle any such situation. Specifically, empty drums will be on hand should any material encountered require containerization for off-site disposal. Over-pack drums will be on-site should any drums be exhumed during test pit operations. Contaminated protective clothing and gloves will be containerized. All containerized hazardous materials generated by the RI activities will be disposed of by Clean Harbors, Inc. in an acceptable and approved manner.

2.2 SAMPLING AND ANALYSIS PLAN

SAVAGE WELL SITE RI/FS
MILFORD, NEW HAMPSHIRE

PROJECT OPERATIONS
SAMPLING AND ANALYSIS PLAN

HMM Document No. 2176-022/HAZ/345

October, 1988

Prepared by:

HMM ASSOCIATES, INC.
336 Baker Avenue
Concord, MA 01742

TABLE OF CONTENTS

1.0 OBJECTIVE

The purpose of this plan is to define the level of effort and specific field activities for the remedial investigation at the Savage Well Site, Milford, New Hampshire. The objectives of the site Sampling and Analysis Plan are to:

- Provide specific guidance for all field work
- Provide a mechanism for planning and approving site activities
- Provide a basis for estimating costs of field efforts
- Ensure that sampling activities are limited to those that are necessary and sufficient
- Provide a common point of reference for all parties to ensure comparability among all activities performed at the site.

This sampling plan was developed on the basis of existing site information and on the "Work Plan for the Savage Well Site Remedial Investigation/Feasibility Study, Milford, New Hampshire." It may become apparent from technical, environmental and health information needs identified during the feasibility study that revisions to the sampling plan are necessary to increase the detail of information collected or to focus efforts on a particular problem.

2.0 ELEMENTS OF A SAMPLING AND ANALYSIS PLAN

Each subtask involving collection and analysis of samples is described separately in Appendix A. The sampling plan for each subtask includes the following elements:

- Sampling objective for each subtask
- Data quality objectives, including data uses and the rationale for selection of analytical levels
- Site background update, including an evaluation of the validity, sufficiency, and sensitivity of existing data
- Sampling locations and rationale
- Sampling procedures and rationale
- Sampling equipment, containers, minimum sample quantities, sample preservation techniques, maximum holding times, chain of custody procedures, etc.
- Procedures for calibration and use of portable air, soil, or water monitoring instruments for use in the field
- Number of samples and justification
- Sample frequency
- Chemical and physical parameters to be analyzed for in each sample
- Sample types including collection methods and whether field and/or laboratory analysis will be conducted
- Laboratory analytical equipment and detection limits
- Sample media (e.g., groundwater, soil, surface water, sediments, air, buildings, facilities, and structures including surfaces, structural materials, and residues)

- Consistency with QA/QC Plan by identical objectives, procedures, and justification or by cross-reference

- Operational plan or schedule

A sampling and analysis plan for each subtask which involves sampling and analysis is included in Appendix A. Subtasks which are in Appendix A include:

- Air Sampling (subtask 2D)
- Surface Water and Sediment Sampling (subtask 2E)
- Monitoring Well Installation Program (subtask 2F)
- Groundwater Sampling (subtask 2G)
- Soils and Subsurface Investigation (subtask 2H)
- Laboratory Studies (subtask 2I)

There are additional plans in Appendix A not mentioned above. These additional plans are work plans for activities not requiring sampling and analysis. Since a sampling and analysis plan has all of the elements of a work plan, plus additional information, each sampling and analysis plan in Appendix A is also a work plan and they are being referred to as Sampling and Analysis/Work Plans (SA/work plan). Each Sampling and Analysis Plan/Work Plan in Appendix A has a list of references which may be referred to for methods which are EPA standards or ASTM standards. Also, each plan is intended to be used in conjunction with the Site Health and Safety Plan and Quality Assurance/Project Plan. It is required that all field investigators be familiar with the most recent Site Health and Safety Plan and Quality Assurance Project Plan.

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* SA/work plan = sampling and analysis/work plan

3.0 OVERVIEW OF SUBTASK SCHEDULES

Air Sampling, Subtask 2D, will be the first activity performed at the site. It is anticipated to begin in June 1988.

The second activity, Subtasks 2E, 2H and 2F (Surface Water and Sediment Sampling, Soils and Subsurface Investigation and Monitoring Well Installation, respectively), are all contingent on the completion of Subtask 2C, Geophysical Investigation. The geophysical investigation is scheduled to be completed in April, 1988.

Subtask 2F, Monitoring Well Installations (Phase I) will begin in August 1988 and be completed in late September or early October 1988. Both Subtask 2H-Soil and Subsurface Investigation, and Subtask 2E-Surface Water and Sediment Sampling will be performed in late May to June 1989 to avoid the flushing effect of stormwater and snow melt events in early spring.

Subtask 2G-Groundwater Sampling, will begin in late October to early November 1988, and it is anticipated the first round of sampling for laboratory screening analysis for volatile organic compounds (EPA Method SW-846) will be completed in mid to late November 1988.

Both Subtask 2H-Soils and Subsurface Investigations and Subtask 2E-Surface Water and Sediment Investigation will begin early August 1988 and be completed in mid to late September 1988.

Up to 55 monitoring wells (installed during Subtask 2F) will be sampled during yhr Phase I monitoring program. Up to 20 wells selected for this second round of sampling will be included for a more thorough analysis of contaminants. This round of sampling and analysis will begin in mid to late October 1988 and will be completed late November 1988.

The results of the second round of sampling will be used to determine the locations of Phase II Monitoring Wells which may be required to further delineate and define areas of contamination. The Phase II monitoring well installations will begin as early as possible. After the completion of these wells, up to 20 to 25 wells will be sampled and laboratory analysis for volatile organic compounds (EPA Method SW 846) will be performed. To provide seasonal information on variations in water level and quality, fifteen of the Phase I and Phase II monitoring wells will be sampled quarterly for one year starting in January 1989.

Subtask 2I-Laboratory Investigations, might begin in late September 1988; however, the location of the pilot treatability studies may depend on the laboratory results from the Phase II monitoring well installations. If this is the case, the pilot treatability studies will begin in 1989.

4.0 OVERVIEW OF DATA QUALITY OBJECTIVES FOR THE SAVAGE WELL SITE

4.1 Introduction

The U.S. EPA recently issued guidance on Data Quality Objectives for Superfund remedial response activities. The stated purpose of the DQO process is to help ensure that data of sufficient quality are obtained to support remedial response decisions, reduce overall costs of data sampling and analyses activities and accelerate project planning and implementation.

The specification of a DQO for each sampling and analysis activity at a Superfund site will enable both the investigator and data user or decision maker to be in agreement on the types of decisions to be made and on the data expected to support each decision. DQOs permit explicit review of the rationale for and the execution of investigation activities in support of the key decisions to be made at Superfund sites. The DQO process should help ensure that each sample is necessary to the investigation. There are 3 stages to the DQO process which are as follows:

Stage I - The Stage I DQO process will include a conceptual model of the site and specify objectives for the project. This will include the identification of key issues which must be addressed in conducting the Superfund cleanup. The investigation will evaluate the mobility, toxicity and volume (MTV) of the site contamination. Data users should be identified and a path of communications will be established which will allow the data users to become involved in the decision process.

Stage II - The Stage II DQO process involves identifying the data types, quantity and quality needed and selecting sampling and analytical approaches to support the objectives identified in Stage 1. The U.S. EPA's DQO guidance offers the following five analytical levels:

- Level I - field screening or analysis using portable instrumentation such as photoionizers or organic vapor analyzers.

- Level II - field analysis using more sophisticated portable analytical instruments or mobile laboratories.

- Level III - analysis performed by off-site laboratories using U.S. EPA approved procedures.

- Level IV - CLP routine analytical services.

- Level V - nonstandard analysis.

Stage III - The Stage III DQO process involves selection of sampling and analysis options and design of the site investigation plan.

4.2 Savage Well Site DQO

Stage I

Previous investigations at the site detected volatile organic compounds in water from the Milford town well during routine water quality monitoring by the Water Supply Division of the New Hampshire Water Supply and Pollution Control Commission (NHWSPCC). Additional investigations of four industrial facilities have been performed by the NHWSPCC. Also, investigations of both the O.K. Tool Company and the Hitchiner facilities have been completed by their consultants, Normandeau Associates, Inc., and Weston, Inc., respectively.

Suspected sources of contamination which have been identified at the Hitchiner facilities include industrial waste water discharge pipes and discharge streams and the Hitchiner landfill which contains material dredged from the discharge stream.

Suspected sources of contamination at the O.K. Tool facility include: a floor drain inside the building which was formerly located adjacent to a vapor degreasing tank; an area north of the building where oily wastes have been observed; an area also north of the building containing VOCs in the soils and debris consisting of rusted tools, shavings and cuttings; an area northwest of the building that does not contain VOCs but that does contain base/neutral compounds; and an area northeast of the building where OVA readings up to 200 to 300 ppm were recorded.

A suspected source at New England Steel Fabricators is the storage area south of the facility building, which may have been an area where 4,000-6,000 gallons of waste (possibly containing volatile organic compounds) disposal may have occurred.

Suspected sources of contamination at Hendrix Wire and Cable are the industrial waste water discharge pipe, the storage yard east of the building, and the onsite leaching facility.

The present risks, posed by contamination identified at the site, include possible direct contact with contaminated soils, possible air transport of contaminants, groundwater transport of contamination to surface water, ingestion of contaminated soils and surface waters and contact with contaminants during excavating. At least four media exist for which additional investigations are needed to existance or significance of a threat to health and the environment. These include air, groundwater, surface water and subsurface soils.

Both groundwater and surface water analysis have indicated the presence of volatile organic compounds, acid/base/neutral extractable compounds and metals. Presently, there is limited data on air quality; however, air monitoring during certain past site investigations have detected volatile organic compounds.

Stage II and III

Stage II and III consist of identification of data types, quantity and quality needed and selection of analytical approaches to support the objectives identified in Stage I. Table 2.1 presents a summary of data needs. This table gives an overview of the sample media, number of samples, duplicate samples needed, blanks, expected analysis level, and expected analysis. Because the number of samples to be taken in each subtask is contingent on field screening results and results from other subtasks, the exact number of samples for some subtasks will be determined at a later date. The number of duplicates and blanks will be determined as specified in the Quality Assurance Project Plan.

TABLE 2.1

SAVAGE WELL SITE DATA QUALITY OBJECTIVES AND TYPE OF ANALYSIS BY MEDIA

Subtask/ Phase	Media	Number of Samples	Duplicates	Blanks	DQO Level	Analysis
2D/I	Air	Field Screening In Selected Areas	QA/QC	QA/QC	I	Total Volatile Organic/portable G.C.
2D/II	Air	TBD*	--	--	--	--
2H/I	Soil Gas	90**	--	--	I	Total Volatile Organic/portable G.C.
2H/II	Soil Borings	TBD*	--	--	I,III	Total Volatile Organic/portable G.C., and lab VOA
2H/II	Test Pits	TBD*	--	--	I,III	Total Volatile Organic/portable G.C. and lab VOA
2E/I	Surface Water	21**	QA/QC	QA/QC	IV	CLP VOA, EOC & Selected Materials
2E/I	Sediments	17**	QA/QC	QA/QC	IV	CLP VOA, EOC & Selected Materials
2G/I	Groundwater	TBD*	QA/QC	QA/QC	III	Lab VOA
2G/II	Groundwater	TBD*	QA/QC	QA/QC	III, IV	Lab VOA, CLP Analysis
2G/II	Groundwater	TBD*	QA/QC	QA/QC	III	Lab VOA
2I/I	Groundwater	4-12	--	--	III III	Lab VOA 2 Metals
	Soil Gas				I	Total Volatile Organics/portable G.C.

---

* TBD	To be determined at a later date
QA/QC	Listed in the QA Project Plan
---	Not applicable
VOA	Volatile Organic Analysis (EPA Method 624)
HSL	Hazardous Substance List Analysis
EOC	Extractable Organic Compounds
**	Maximum Proposed Number, exact number of samples is contingent upon available information
CLP VOA	Contract Lab Program Volatile Organic Analysis

2.3 QUALITY ASSURANCE PROJECT PLAN

QUALITY ASSURANCE PROJECT PLAN

SAVAGE WELL SITE

HMM Document No. 2176-22/HAZ/310

October, 1988

Prepared by:

HMM ASSOCIATES, INC.
336 Baker Avenue
Concord, Massachusetts 01742

1.0 TITLE PAGE

QUALITY ASSURANCE PROJECT PLAN

SAVAGE WELL SITE

HMM DOCUMENT NO. 2176-22/HAZ/310

2.0 TABLE OF CONTENTS

Section Page

3.0 PROJECT DESCRIPTION

HMM Associates is conducting an RI/FS for the Savage Well site. The Savage Wellfield site encompasses approximately one square mile and is located in southwestern New Hampshire in the Town of Milford in Hillsborough County. The study area includes four major industrial facilities and two high-yield industrial process water supply wells. The Savage Well, a water supply well formerly used by the Town of Milford, is located approximately 2 miles west of the center of Milford. The land use in the area includes agriculture and heavy industry, interspersed with commercial and residential development.

The objective of the Remedial Investigation is to evaluate existing information, identify data gaps, and perform the necessary field work and laboratory analyses to define the extent of contamination and the potential public health risks related to the Savage Well site. Furthermore, it is necessary to distinguish between potential sources and to identify the interrelationships between sources. After defining the nature and extent of contamination, the need for remedial action can be defined. Remedial action alternatives will be evaluated leading to the development of a selected remedial action alternative during the Feasibility Study.

The objectives of the Feasibility Study are to evaluate the need for the remedial actions, establish response criteria and objectives, identify remedial action alternatives, evaluate the alternatives, recommend a cost-effective alternative that provides adequate protection of public health, welfare and the environment and prepare a conceptual design for the selected remedial action. The FS will focus on the development and evaluation of measures to be taken to alleviate all identified contamination problems.

This RI/FS work plan has been developed to address the needs of EPA, the appropriate state agencies, and the public within the surrounding area who may be directly affected by both the contamination problem and any proposed remedial actions.

Period of Performance: Twenty-two month contract commencing 10/27/87 and completion date 8/27/89. Refer to Exhibit 1 for RI/FS Schedule of Activities and Deliverables.

EXHIBIT 1
SAVAGE WELL SITE
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
PROJECT SCHEDULE
PAGE 1 of 3

SCHEDULE OF ACTIVITIES AND DELIVERABLES
Months after effective date of order

RI/FS Schedule of Tasks and Deliverables

TASK 1: Scoping of Response Actions - I

- o Preliminary List of Applicable Technologies
- o Identification of ARAR
- o Identification of Receptors

TASK 2: Multi-Media Field Investigation

Subtask 2A: Study Area Survey

- o Site Base Map (Draft)
- o Site Base Map (Final) with map showing various plots at the site
- o Letter report summarizing historical photo analysis

Subtask 2B: Project Operations Plan

- o Draft Project Operations Plan
- o Project Operations Plan (Final

Subtask 2C: Geophysical Investigation

- o Map showing magnetic contours of the site with interpretation
- o Map showing seismic lines with profiles and interpretations

Subtask 2D: Air Sampling

- o Letter report

Subtask 2E: Surface Water and Sediment Sampling

- o Letter report

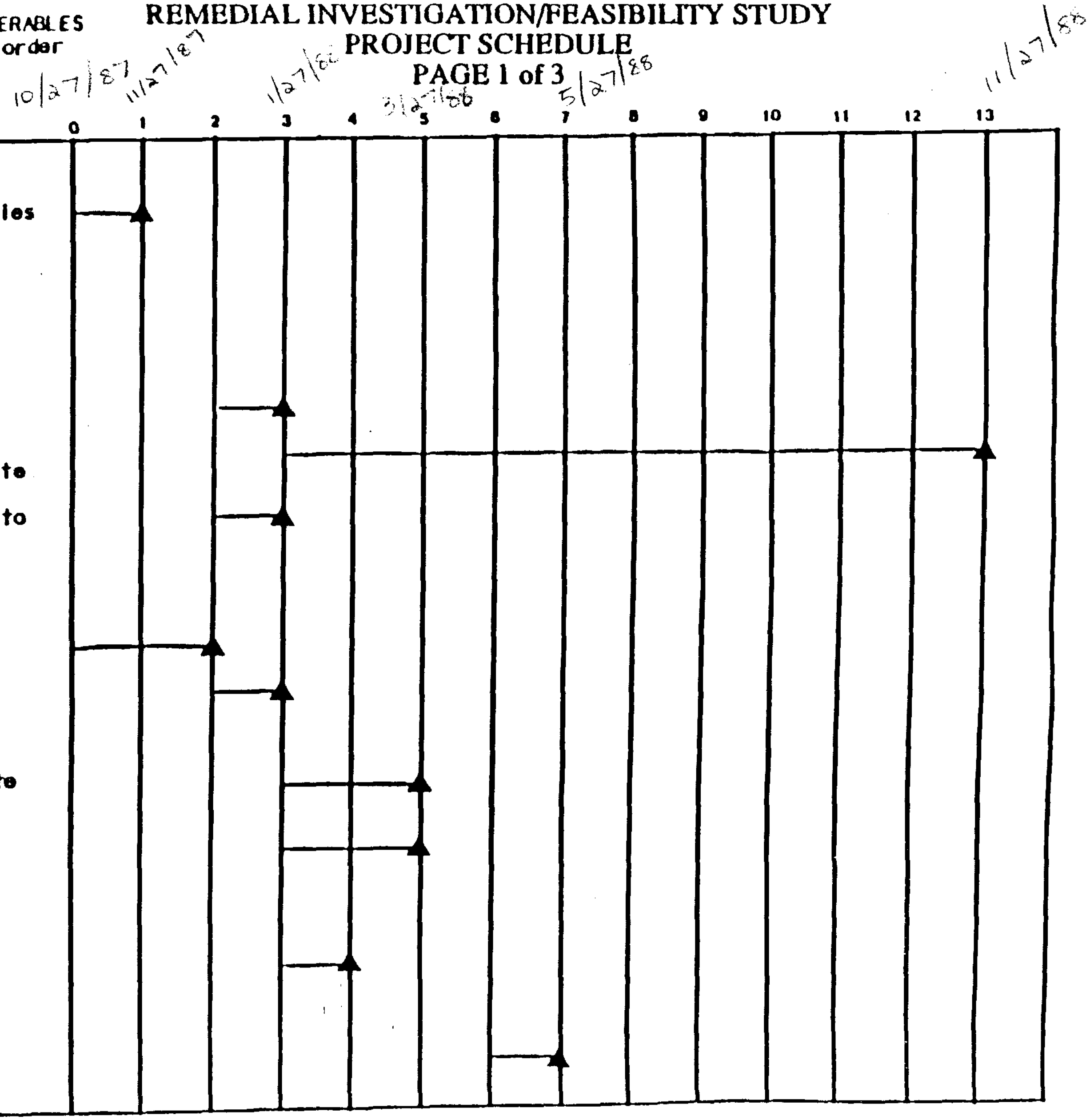


EXHIBIT 1
SAVAGE WELL SITE
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
PROJECT SCHEDULE
PAGE 2 of 3

SCHEDULE OF ACTIVITIES AND DELIVERABLES
Months after effective date of order

RI/FS Schedule of Tasks and Deliverables

Subtask 2E: Monitoring Well Installation Program

- o Letter reports containing logs and aquifer parameters

Subtask 2G: Groundwater Sampling

- o Letter reports

Subtask 2H: Soils and Subsurface Investigation

- o Letter report and data on soil gas sampling with interpretation of results - Phase I
- o Letter report and data on soil boring with interpretation - Phase II
- o Letter report and data on further soil borings with interpretation - Phase III

Subtask 2I: Treatability Studies

- o Letter report

TASK 3: Scoping of Response Actions - II

- o Letter report with suggested technologies for consideration, and discussion of ARAR

TASK 4: Baseline Risk Assessment

- o Outline of Baseline Risk Assessment
- o Letter report which summarizes hazard identification
- o Baseline Risk Assessment (Draft)

TASK 5: Preparation of Remedial Investigation Report

- o Draft RI Report
- o Final RI Report

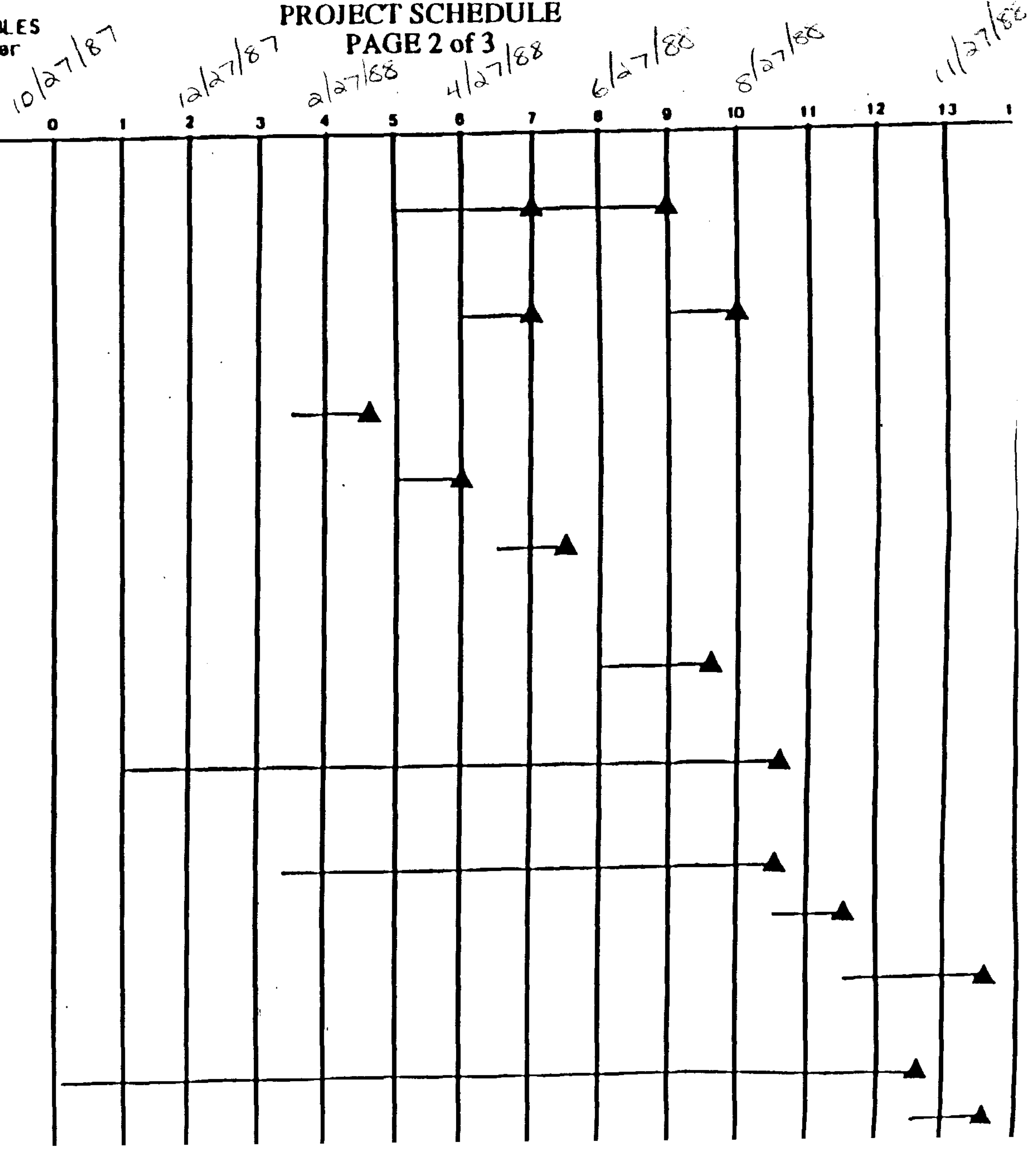


EXHIBIT 1
SAVAGE WELL SITE
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
PROJECT SCHEDULE
PAGE 3 of 3

SCHEDULE OF ACTIVITIES AND DELIVERABLES
Months after effective date of order

RI/FS Schedule of Tasks and Deliverables

TASK 6: Development of Alternatives

- o Briefing to present preliminary response objectives and criteria
- o Memo report discussing preliminary response objectives and criteria
- o Memo report outlining remedial alternatives developed

TASK 7: Initial Screening of Alternatives

- o Letter report

TASK 8: Detailed Evaluation of Remaining Alternatives

- o Summary table and narrative description of advantages and disadvantages of each alternative

TASK 9: Preparation of Draft Feasibility Study Report

- o Draft FS Report

TASK 10: Conceptual Design of Selected Remedial Alternatives

- o Conceptual Design Report

TASK 11: Final Feasibility Study Report

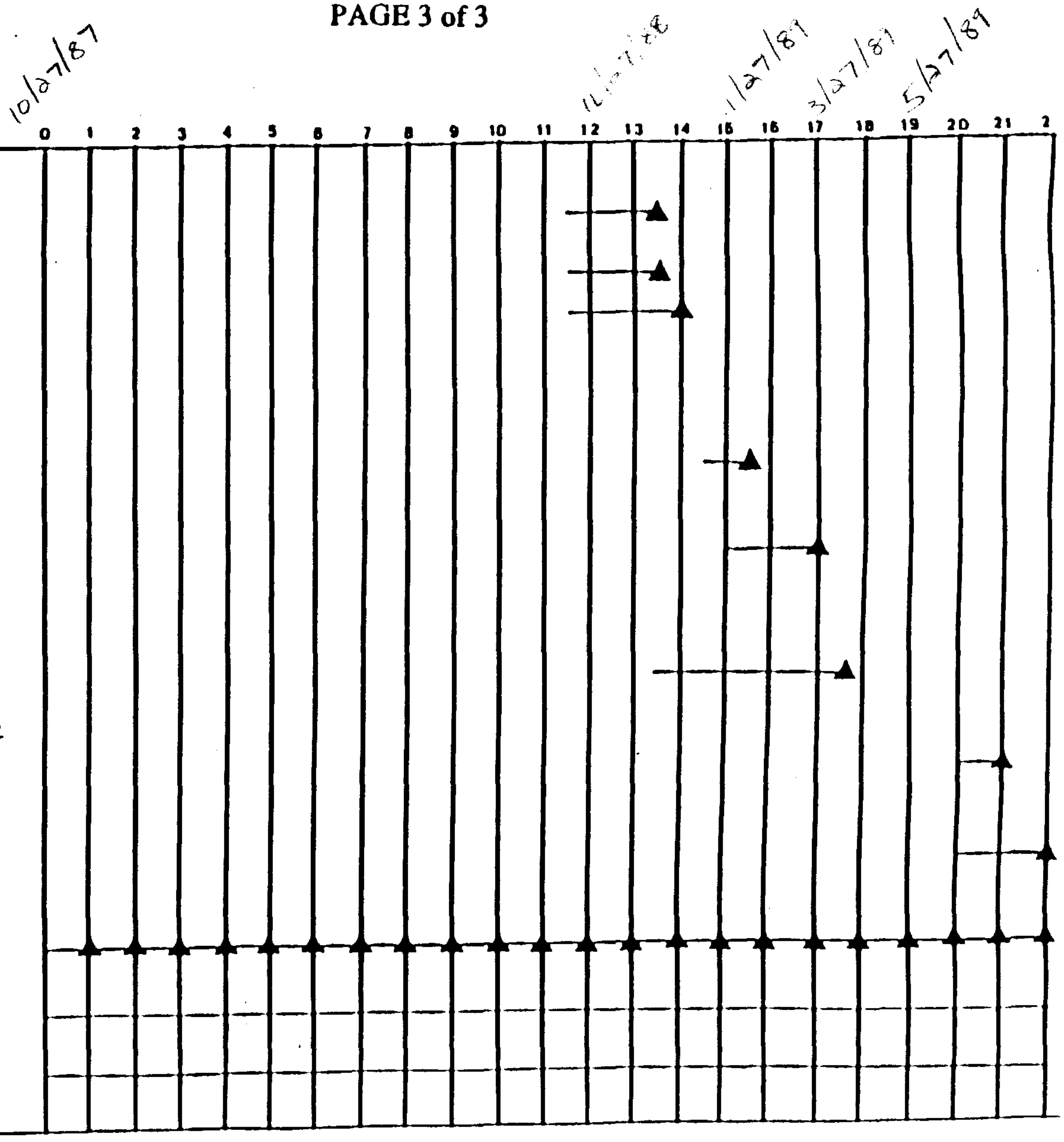
- o Final FS Report

TASK 12: Management and Coordination

- o Monthly Progress Reports

TASK 13: Community Relations Planning and Implementation Support

TASK 14: Quality Assurance



Work Performed by Subcontractors: Aerial surveying, geophysical exploration, test borings, test pits and trenches, monitoring well and pump test wells, laboratory analyses, air monitoring and pilot studies.

Number of Construction Contractors Managed: None at this time.

Extent of Subsurface Exploration: The remedial investigation's subsurface exploration program designed by HMM Associates will employ techniques and procedures that are on the leading edge of available methodologies. The program includes soil gas monitoring in the vadose zone, sophisticated geophysical investigations, state-of-the-art monitoring well and piezometer installations and stream and river gauging.

Extent of Hydrologic Modeling: Solute Transport Modeling has not been identified as a specific work item in EPA's work plan. However, solute transport modeling may be necessary to characterize contaminant transport for evaluating remedial alternatives as part of the feasibility study. If it is apparent that modeling is necessary, HMM will submit the software specifications and objectives of the modeling task to EPA prior to implementation.

Extent of Water Quality Testing: Approximately 60 locations will undergo four rounds of sampling and analysis. Laboratory analyses will include: VOC, metals, acid base neutral extractables, pH and conductivity.

Recommendations for Remediation: Will be provided as part of the FS. It is anticipated that onsite soil venting and groundwater stripping will be implemented.

Emergency Response Activities: None.

Environmental Impact Assessments: As part of the RI/FS, HMM Associates will conduct air quality as required by Subtask 2D and wetlands assessments as required by Subtask 2A, taking into account all pertinent federal, state, and local ARAR's.

Pilot Testing: Two bench scale pilot studies will be conducted at the site. One study is directed to contaminated soil treatability, and the second to groundwater treatability.

Community Relations: HMM will provide community relations support to EPA, as needed. This includes: participation at informational and technical meetings, preparation of fact sheets and updates and assistance in preparation of a responsiveness summary after the public RI/FS comment period.

Health and Safety Plan: A site specific health and safety plan is being prepared and administered prior to any onsite activities. This plan is being developed consistent with the guidance of HMM's Corporate Health and Safety Plan.

Quality Control/Quality Assurance: Specific routine Quality Control (QC) checks are built into each task.

The objective of HMM Associates Quality Assurance (QA) program for the Savage Municipal Well RI/FS is to produce results of the highest quality for all investigations, analyses and studies. The purpose of a QA program is to provide periodic evaluation of Quality Control (QC) procedures and results. QC refers to the continuing routine checks on quality in each area of project activity.

HMM will manage six major QA operations for the Savage Well RI/FS:

(1) QA and Objectives

(2) Sampling, Field Activities and Measurements

(3) Laboratory Analysis

(4) Technical Data Handling

(5) Instrumentation and Equipment QC for HMM and chosen subcontractors

(6) Corrective Action and QA Reports to Management

4.0 PROJECT ORGANIZATION AND RESPONSIBILITY

Exhibit 2 is the organization chart for the Savage Well Site Remedial Investigation/Feasibility Study (RI/FS) project. The following summarizes the capabilities and experience level of key personnel. Each person has been assigned to manage or assist in the management of the tasks within the RI/FS.

Mr. Charles M. Losinger, P.E. is assigned as Principal-In-Charge. He is a Senior Vice President at HMM who oversees all operations. Mr. Losinger has a broad range of experience in environmental analysis, industrial chemical and waste management, site assessment, health and safety studies, and engineering feasibility projects. He has served as the project manager on a number of hazardous materials assessment and monitoring projects. He has extensive experience in developing hazard communications and hazardous waste handling procedures, contingency plans, and related training programs for a number of facilities, including an electronic components manufacturer, a pulp and paper mill, an oil transfer facility, a cogeneration plant, and a nuclear materials manufacturing facility. He is a registered Professional Engineer in New Hampshire and several other states and provides over 15 years of technical expertise in the field of hazardous materials and wastes management.

Mr. John R. Moebes is assigned as Project Manager. He is an Associate and Manager of the Hazardous Materials Division at HMM. He has extensive experience in the management of hazardous waste sites investigation and remediation and the management of wastewater control programs. He managed the U.S. Environmental Protection Agency's Region 1, Boston, Superfund Branch. While managing the Region's Consolidated Permits Branch, he was responsible for implementing the National Pollutant Discharge Elimination System (NPDES), Resource Conservation Recovery Act (RCRA), Ocean Dumping and Section 404 Dredge and Fill Permit Programs.

As Manager of the EPA Region 1 Superfund Branch, he was responsible for the implementation of clean-up activities at 54 sites in New England. Remedial investigations and feasibility studies were implemented at 40 sites, final clean-up remedies were selected at 11 sites and construction started at seven sites. Overall responsibility included management of a $35 million budget, and integrating the services of numerous contractors providing engineering, risk assessments, drilling, hydrogeological investigations and analytical services.

EXHIBIT 2

SAVAGE WELL SITE
REMEDIAL INVESTIGATION/FEASIBILITY STUDY PROJECT ORGANIZATION

Section No. 4.0
Revision No. 2
Date: 08/25/88
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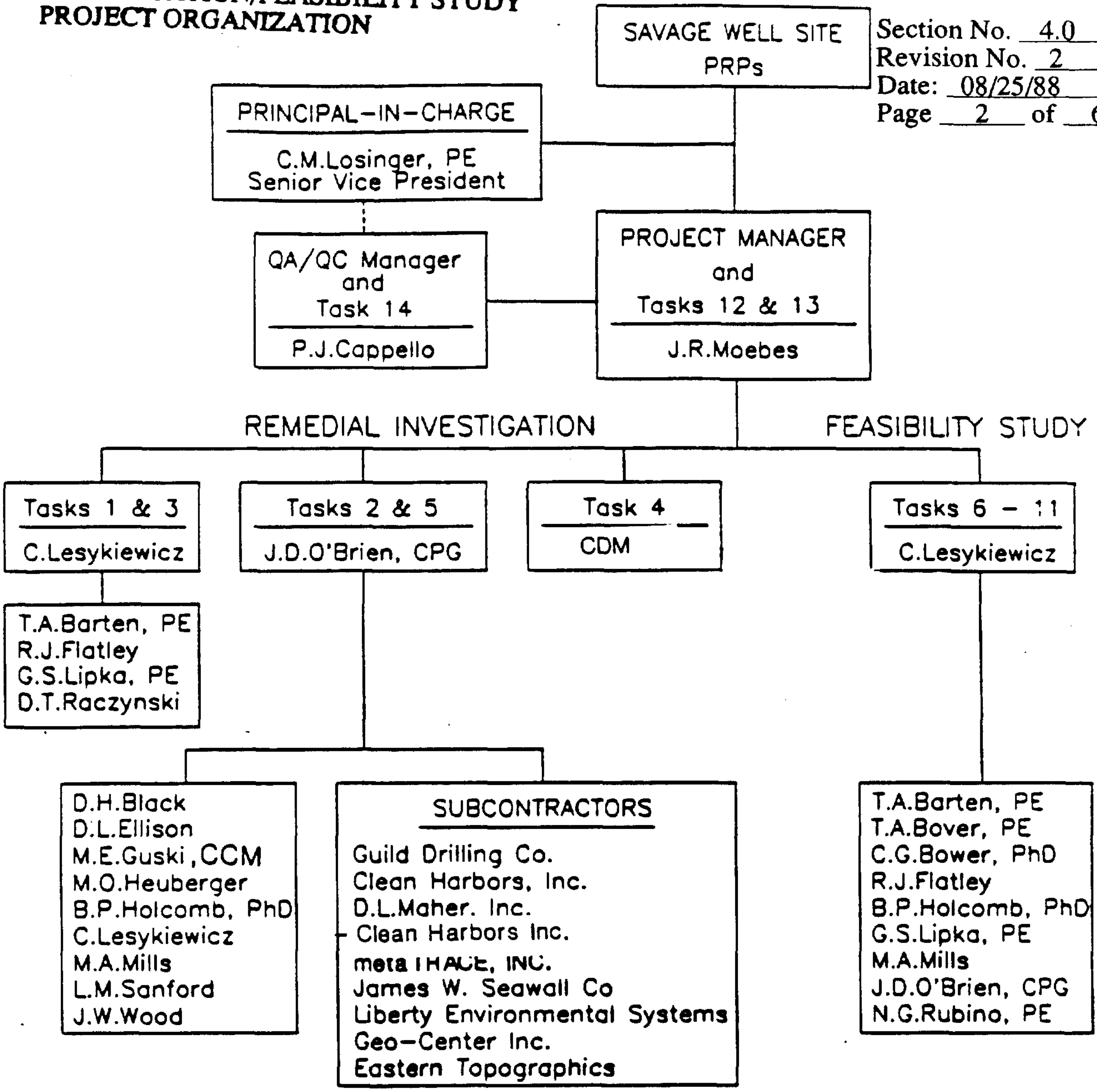


KEY:
Task 1: Scoping of Response Actions - I
Task 2: Multi-media Field Investigation
Task 3: Scoping of Response Actions - II
Task 4: Baseline Risk Assessment
Task 5: Remedial Investigation Report
Task 6: Development of Alternatives
Task 7: Initial Screening of Alternatives
Task 8: Detailed Evaluation
Task 9: Draft Feasibility Study Report
Task 10: Conceptual Design
Task 11: Final Feasibility Study Report
Task 12: Management and Coordination
Task 13: Community Relations
Task 14: Quality Assurance

Since joining HMM, he has directed site assessments and remedial action at several sites and provided services at the Union Chemical site in South Hope, ME, Dover Landfill in Dover, NH and Conductor Lab in Groton, MA.

Ms. Paula J. Cappello is assigned as QA/QC Manager and Task Manager. She serves as HMM's lead toxicologist and QA Manager. In this capacity she provides technical support and specific project consultation on matters related to hazardous materials, risk assessments, the use of the Hazardous Ranking System (HRS) for hazardous waste site placement on the National Priorities List (NPL), and site specific health and safety plans. Her background includes environmental chemistry, toxicology, and laboratory supervision. She was responsible for the design and implementation of an onsite laboratory at HMM for the analysis, preparation, and storage of hazardous samples. Ms. Cappello, as the QA Manager, was responsible for the development and implementation of HMM's corporate Technical Quality Assurance Plan. She has managed a project for Personnel Protection and Safety for Hazardous Waste Site Activities Training, the course is 40 hours of instruction to meet the requirements of OSHA's 29 CFR 1910 and SARA section 126(d).

Mr. James D. O'Brien, C.P.G. has responsibility for the remedial investigation. He is a senior hydrogeologist and is experienced in the development, implementation and management of investigations and remediations at hazardous waste sites. He assisted in the technical management of the Commonwealth of Massachusetts Department of Environmental Quality Engineering's Field Investigation Team. He was responsible for overseeing site investigations at over 30 Massachusetts State Superfund sites. As a project geologist in the private sector, he was responsible for the planning and supervision of hundreds of field investigations encompassing the fields of engineering, geology, geotechnical engineering, environmental geology and hydrogeology. He is currently involved in responsible party negotiations for a NPL site in New Hampshire, a hydrogeological assessment of a state-listed hazardous waste site and the evaluation of remedial alternatives for a hazardous waste lagoon. Mr. O'Brien is a Certified Professional Geologist.

Reporting to Mr. O'Brien are eleven scientists and engineers to complete Task 2, Multi-Media Field Investigation.

Mr. Conrad G. Leszkiewicz has primary responsibility for the scoping of response actions and completion of the feasibility study. He has experience as a project engineer in a variety of environmental and geotechnical engineering projects for the U.S. Army as well as serving as an officer (Major) in various positions of responsibility both while on active duty and as a reservist. Projects which Mr. Leszkiewicz has completed include site investigations for explosive ordnance disposal, underground storage tank and other hazardous waste sites. He has experience in design and project management of a 35 acre landfill closure and design of waste water treatment and sewage collection systems. Mr. Lesykiewicz has additional experience in cost estimating, specification writing and interacting with regulatory officials. Currently, Mr. Lesykiewicz is conducting an engineering cost analysis for a superfund site in Maine and the review of a remedial investigation/feasibility study for an NPL site in New Hampshire. For the Savage Well Site RI/FS he will also be involved in the field investigations.

Mr. Robert J. Flatley will support the scoping of response actions and completion of the feasibility study. He has experience in a wide range of hazardous materials activities. He has developed and managed various health and safety plans at a number of sites while reviewing company regulations to ensure that operations were in compliance with EPA and RCRA standards. Mr. Flatley has been responsible for: overseeing hazardous waste site remedial investigations and site restoration projects; maintaining a Right-to-Know program; and for testing and designing an analysis of hazardous waste incineration facilities. He has also been involved with the development of new chemical waste management technology and air emission evaluation and monitoring. Mr. Flatley has completed assignments for the EPA office of Research and Development and the Hazardous Waste Engineering Research Lab to evaluate commercially available and economical treatment technologies to replace land disposal of hazardous and toxic wastes. He performed electromagnification studies at various sites to determine the extent of road salt plumes, petroleum hydrocarbon plumes, and solvent plumes.

Exhibit 3 is a matrix illustrating the responsibilities of key and support personnel per task throughout the Savage Well Site RI/FS. In addition to the HMM Personnel committed to the Savage Well Site project, the matrix lists subcontractors and associated responsibilities per task.

EXHIBIT 3
SAVAGE MUNICIPAL WELL SITE
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
RESPONSIBILITY MATRIX
PAGE 1 OF 2

TASK NUMBER		1	2A	2B	2C	2D	2E	2F	2G	2H	2I	3	4	5	6	7	8	9	10	11	12	13	14
HMM Associates	YEARS OF EXPERIENCE	RESPONSE ACTIONS - I	SURVEY	OPERATIONS PLAN	GEOPHYSICAL INVESTIGATION	AIR SAMPLING	WATER / SEDIMENT	WELL INSTALLATION	GROUNDWATER	SOILS / SUBSURFACE	TREATABILITY	RESPONSE ACTION - II	RISK ASSESSMENT (CDM)	RI REPORT	ALTERNATIVES	INITIAL SCREENING	DETAILED EVALUATION	DRAFT FS REPORT	CONCEPTUAL DESIGN	FINAL FS REPORT	MANAGEMENT	COMMUNITY RELATIONS	QUALITY ASSURANCE
Barten, T.A., PE BS Env. Engineering; MBA	13	S									S	S		S	S	S	S	S	S	S			
Black, D.H. BA Biology	4						S		S					S									
Bover, T.A., PE BS Civil Engineering	15																S	S	S	S			
Bower, C.G., PhD BS Soc Sci; MS/PhD Safety	11			S										S			S	S		S			
Brown, D., ScD ScD Toxicology	29																	S		S			
Cappello, P.J. BS Toxicology	7			S										S						S		S	P
Ellison, D.L. MS Hydrogeol/Geomorphology	4		S	S	S		P	S	S	S				S									
Flatley, R.J. BS Environmental Engineering	5	S				P					P	S		S	S	S	S	S	S	S	S		
Gallinaro, C. BS Chem; MED Nat Sciences	14			S			S							S								S	
Guski, M.E., CCM BS/ME Atmospheric Sciences	14					S								S				S	S	S			
Heuberger, M.O. BS Earth Science;MS Geology	5		S				S	S	S	S				S									
Holcomb, B.P., PhD BS Nat Res; MS/PhD Env Sci	11						S		S					S		S	S	S	S	S			
Lesykiewicz, C. BS Hydrogeology;MS Civil Eng	12	P										P			P	P	P	P	P	P	S		
Lipka, G.S., PE BS/ME Env Engineering	13	S												S	S	S	S	S	S	S			
Losinger, C.M., PE, V.P. BS/ME Env Engineering; MBA	15			S										S					S	S			S
Mills, M.A. BA Biology; MS Zoology	16						S		S					S									
Moebes, J.R. BS Civil Engineering	17	S		S						S	S	S		S	S	S	S	S	S	S	P	P	S
O'Brien, J.D., CPG BS/MA Geology	14	S	P	P	S	S	S	P	P	P	S	S		P	S	S	S	S	S	S	S		
Raczynski, D.T. BS Chemical Engineering	6															S	S	S	S	S			
Rubino, N.G., PE BS Civil Engineering	11														S	S	S	S	S	S			
Sanford, L.M. BS Marine Biology	5			S										S									
Schreibman, S.J. BS Toxicology	1			S										S									
Wood, J.W. BS Geology; MS Hydrogeology	5			S	P		S	S	S	S	S			S									
Young, J.S. BS/MS Geology	10		S	S	S	S	S	S	S	S	S			S									

P: Primary
S: Support Functions

EXHIBIT 3
SAVAGE MUNICIPAL WELL SITE
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
RESPONSIBILITY MATRIX
PAGE 2 OF 2

	TASK NUMBER	1	2A	2B	2C	2D	2E	2F	2G	2H	2I	3	4	5	6	7	8	9	10	11	12	13	14
Subcontractors	YEARS OF EXPERIENCE	RESPONSE ACTIONS – I	SURVEY	OPERATIONS PLAN	GEOPHYSICAL INVESTIGATION	AIR SAMPLING	WATER / SEDIMENT	WELL INSTALLATION	GROUNDWATER	SOILS / SUBSURFACE	TREATABILITY	RESPONSE ACTION – II	RISK ASSESSMENT	RI REPORT	ALTERNATIVES	INITIAL SCREENING	DETAILED EVALUATION	DRAFT FS REPORT	CONCEPTUAL DESIGN	FINAL FS REPORT	MANAGEMENT	COMMUNITY RELATIONS	QUALITY ASSURANCE
Guild Drilling Company								P		P				S									
Geo – Center Inc.					P									S									
Clean Harbors Inc.										P				S									
D.L. Maher Inc.											P			S									
Liberty Environmental Systems											P			S									
Eastern Topographics			P											S									
Clean Harbors Inc.						P	P		P	P				S									

P: Primary
S: Support Functions

5.0 QA OBJECTIVES FOR MEASUREMENT DATA IN TERMS OF PRECISION, ACCURACY, COMPLETENESS, REPRESENTATIVENESS AND COMPARABILITY

To ensure quality data collection and characterization of the Savage Well Site RI/FS data objectives have been outined.

Field Operation Task	Objective	QA Requirement
Study Area Survey	Establish a detailed topographic map of the site to use as a site base map for the RI/FS.	Conduct Performance and System Audits periodically to review data used to create the Site Base Map.
Geophysical Investigation	Apply two remote sensing techniques in order to aid in the definition of subsurface conditions and to provide input relative to the locational aspects of soil boring and/or drill coring. Because relatively little is known about bedrock conditions beneath the site, the geophysical program outlined below will also attempt to establish bedrock conditions, especially as related to groundwater flow and contaminant transport. The two types of geophysical techniques that will be utilized under this task will be magnetometry and seismic refraction. The previous geophysical data collected at this site wil be reviewed in light of the additional data provided by Subtasks 2C and 2E for its appropriateness in determining the locations of monitoring wells, source areas, and the bedrock/overburden interface. The data collected from Subtask 2C will be used to verify the geophysical data (ground truth).	Conduct Performance and System Audits periodically to review data collected during surveys. Review prepared maps.
Air Sampling	To assess the air quality on and off-site relative to the existing air quality, and to identify any hazards associated from emissions to the air.	Conduct Performance and System Audits for data collected during the site walkover and if phase II is required HMM will implement further QA objectives.
Surface Water and Sediment Sampling	Define the extent and nature of contamination transported by surface waters.	Conduct Performance and System Audits for all field protocols and data collected. Review of Chain of Custody forms and sample storage and shipment. Review of all analytical data generated on Samples and Quality Control Procedures.
Monitoring Well Installation Program	Collect data on the aquifer characteristics and factors affecting groundwater flow and transport. The monitoring well installation will follow the geophysical program, in order to utilize the geophysical information to assist in the location of subsequent wells. In addition, the well installation program results will be used to verify the results of the geophysical program.	Conduct Performance and System Audits of protocols, field data, well materials, and security of all monitoring wells.

Field Operation Task	Objective	QA Requirement
Groundwater Sampling	Determine the nature and extent of pollutant migration in the groundwater.	Conduct Performance and System Audits on sampling protocols, field data, field procedures, sample chain of custody and sample storage and shipment. Review of analytical data on all samples and Quality Control Procedures.
Soils and Subsurface Investigation	Define the lateral and vertical extent of contaminated soils within the source areas.	Conduct Performance and System Audits on Soil Gas Sampling and Analysis protocols. Phase II and III protocols and analytical schedules will be provided upon approval of work by the USEPA.
Treatability Studies	Conduct laboratory studies to obtain necessary information to evaluate the effectiveness of alternative remedial treatment technologies on the various contaminated environmental media at the site.	Conduct Performance and System Audits on protocols for treatability studies and a review of groundwater and soil evaluations. Review of sample chain of custody, storage and shipment. Review of analytical data from samples and Quality Control procedures.

QA objectives for data measurements are summarized in the following table:

Measurement Parameter (Method)	Reference	Experimental Conditions	Precision (Standard Deviation)	Accuracy	Complete-ness-
VOC (Volatile Organic Compounds)	8240 SW-846 3RD EDITION 09/86	Groundwater Soil/Sediment Surface Water	<±10%	±10%	90%
BNA (Base/Neutral and Acid Extractables)	8270 SW-846 3RD EDITION 09/86	Groundwater Soil/Sediment Surface Water	<±10%	±10%	90%
Metals	SW-846 3RD EDITION 09/86	Groundwater Soil/Sediment Surface Water	<±10%	±10%	90%
Cyanide	335.2 Alkaline Extraction EPA, 1988	Groundwater Soil/Sediment	<+10%	+10%	90%
PCBs	8080 SW-846 3RD EDITION 09/86	Groundwater Soil/Sediment Surface Water	<±10%	±10%	90%
Acetophenone and Methyl Styrene	8270 SW-846 3RD EDITION 09/86 with analytical standards for methyl styrene	Groundwater Surface Water	>±10%	±10%	90%
pH		Groundwater Surface Water	>±10%	±10%	90%
Conductivity		Groundwater Surface Water	>±10%	±10%	90%

The objective of the sampling program is to collect samples that are representative of the material or medium under consideration. To ensure representativeness and comparability HMM performs routine quality control checks. The selected methods must be capable of delivering a true representation of the situation under investigation. HMM will have 20% of all samples collected analyzed in duplicate. HMM will monitor all analytical QC data in the form of control charts to ensure that sample data will be comparable throughout the entire Savage Well RI/FS project.

6.0 SAMPLING PROCEDURES

All sampling performed for the Savage Well Site RI/FS project will follow EPA approved methods. These sampling protocols and procedures are located in the Sampling and Analysis Plan for the Savage Well Site RI/FS.

The techniques and guidelines used to select sampling sites are included in each individual work plan, located in the Appendices.

All sampling program operations plans are outlined in the individual work plans, located in the Appendices.

For each measurement parameter Clean Harbors, Inc. will supply the appropriate sample containers and preservatives (if necessary) required for proper collection of the samples.

Decontamination Procedures

Decontamination zones will always be set up upwind of the restricted zone.

Sampling and Analytical Equipment: Each piece of equipment is disassembled as instructed in the manufacturers guidelines. Decontamination cleaning procedures are as follows:

Inorganic Constituents:

1) Wash with a non-phosphate detergent or soap mixture.

2) Rinse with dilute (0.1 N) hydrochloric acid or nitric acid. Dilute hydrochloric acid is preferred over nitric acid when cleaning stainless steel because nitric acid may oxidize the stainless steel.

3) Rinse with tap water.

4) Final rinse is with Type II reagent grade water.

Organic Constitutents:

1) Wash with a non-phosphate detergent

2) Rinse with tap water.

3) Rinse with distilled water.

4) Rinse with Methanol.

5) Final rinse is with pesticide quality hexane.

Containers and Laboratory Glassware: Each sample container and all laboratory glassware must be decontaminated prior to use as follows:

Inorganic Constituents:

1) Wash with a non-phosphate detergent

2) Rinse with (1:1) nitric acid

3) Rinse with tap water

4) Rinse with (1:1) hydrochloric acid

5) Rinse with tap water

6) Final rinse is with Type II water

Organic Constituents:

1) Wash, in hot tap water, with a non-phosphate detergent

2) Rinse with tap water

3) Rinse with distilled water

4) Rinse with Methanol

5) Final rinse is with pesticide quality hexane

Personnel: The major decontamination activities involving personnel are associated with protective clothing, except in the case of chemical exposure where body decontamination shall be required. In order to limit the amount of decontamination required, disposable protective clothing will be used whenever possible. When contact occurs, it is important to remember that no protective material is completely impermeable, therefore, it is important to remove the contamination as quickly as possible. Clean water is available onsite for washing with soap. Decontamination at a minimum will consist of a soap and water wash. Specific cleaning solutions may be used to react with or neutralize specific substances (if known). Please refer to the Site Specific Health and Safety Plan.

Document: If field documents or reports become contaminated due to accidental exposure onsite, the documents must be placed in double plastic bags and clearly marked "contaminated".

Vehicle: All vehicles, i.e. drill rigs, will be steam cleaned at the location of use prior to being moved to the next drilling location.

Personal Equipment: All non-disposable personal equipment used where in contact with contaminated materials shall be considered contaminated and must be decontaminated either onsite or sealed in secure containers and properly decontaminated offsite. Respirator face pieces, viton inner gloves and re-usable overboots shall be washed, dried, and inspected for missing parts and overall condition. They shall then be stored in clean dry areas.

The following two pages of requirements for sample containers, preservation techniques, and holding times were taken from Test Methods for Evaluating Solid Waste - Physical/Chemical Methods, EPA SW-846, 3rd Edition, 1986.

This is to be used as a guideline for field operations. Reference may also be made to the specific analytical method.

REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES (CONTINUED)

Name	Container[1]	Preservation	Maximum holding time
ulfate	P, G	Cool, 4°C	28 days
Sulfide	P, G	Cool, 4°C, add zinc acetate plus sodium hydroxide to pH>9	7 days
ulfite	P, G	None required	Analyze immediately
Surfactants	P, G	Cool, 4°C	48 hours
Temperature	P, G	None required	Analyze
urbidity	P, G	Cool, 4°C	48 hours
Organic Tests:			
Purgeable Halocarbons	G, Teflon-lined septum	Cool, 4°C	7 days
urgeable aromatic hydrocarbons	G, Teflon-lined septum	Cool, 4°C,	7 days
crolein and acrylonitrile	G, Teflon-lined septum	Cool, 4°C, 0.008% $Na_2S_2O_3$, Adjust pH to 4-5	14 days
Phenols	G, Teflon-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$	7 days until extraction, 40 days after extraction
enzidines	G, Teflon-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$	7 days until extraction
Phthalate esters	G, Teflon-lined cap	Cool, 4°C	7 days until extraction 40 days after extraction
itrosamines	G, Teflon-lined cap	Cool, 4°C, store in dark, 0.008% $Na_2S_2O_3$	40 days after extraction
PCBs, acrylonitrile	G, Teflon-lined cap	Cool, 4°C	40 days after extraction
itroaromatics and isophorone	G, Teflon-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$ store in dark	40 days after extraction
Polynuclear aromatic hydrocarbons	G, Teflon-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$ store in dark	40 days after extraction
aloethers	G, Teflon-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$	40 days after extraction
Chlorinated hydrocarbons	G, Teflon-lined cap	Cool, 4°C	40 days after extraction
CDD	G, Teflon-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$	40 days after extraction
otal organic halogens	G, Teflon-lined cap	Cool, 4°C; H_2SO_4 to pH<2	7 days
Pesticides Tests:			
esticides	G, Teflon-lined cap	Cool, 4°C, pH 5-9	40 days after extraction
iological Tests:			
Alpha, beta and radium	P, G	HNO_3 to pH<2	6 months

olyethylene (P) or Glass (G)

REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES

Name	Container[1]	Preservation	Maximum holding time
Bacterial Tests:			
Coliform, fecal and total	P, G	Cool, 4°C, 0.008% $Na_2S_2O_3$	6 hours
Fecal streptococci	P, G	Cool, 4°C, 0.008% $Na_2S_2O_3$	6 hours
Inorganic Tests:			
Acidity	P, G	Cool, 4°C	14 days
Alkalinity	P, G	Cool, 4°C	14 days
Ammonia	P, G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Biochemical oxygen demand	P, G	Cool, 4°C	48 hours
Bromide	P, G	None required	28 days
Biochemical oxygen demand, carbonaceous	P, G	Cool, 4°C	48 hours
Chemical oxygen demand	P, G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Chloride	P, G	None required	28 days
Chlorine, total residual	P, G	None required	Analyze immediately
Color	P, G	Cool, 4°C	48 hours
Cyanide, total and amenable to chlorination	P, G	Cool, 4°C, NaOH to pH>12, 0.6g ascorbic acid	14 days
Fluoride	P	None required	28 days
Hardness	P, G	HNO_3 to pH<2, H_2SO_4 to pH<2	6 months
Hydrogen ion (pH)	P, G	None required	Analyze immediately
Kjeldahl and organic nitrogen	P, G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Metals:			
Chromium VI	P, G	Cool, 4°C	24 hours
Mercury	P, G	HNO_3 to pH<2	28 days
Metals, except chromium VI and mercury	P, G	HNO_3 to pH<2	6 months
Nitrate	P, G	Cool, 4°C	48 hours
Nitrate-nitrite	P, G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Nitrite	P, G	Cool, 4°C	48 hours
Oil and grease	G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Organic carbon	P, G	Cool, 4°C, HCl or H_2SO_4 to pH<2	28 days
Orthophosphate	P, G	Filter immediately, cool, 4°C	48 hours
Oxygen, Dissolved Probe	G Bottle and top	None required	Analyze immediately
Winkler	do	Fix on site and store in dark	8 hours
Phenols	G only	Cool, 4°C, H_2SO_4 to pH<2	28 days
Phosphorus (elemental)	G	Cool, 4°C	48 hours
Phosphorus, total	P, G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Residue, total	P, G	Cool, 4°C	7 days
Residue, Filterable	P, G	Cool, 4°C	7 days
Residue, Nonfilterable (TSS)	P, G	Cool, 4°C	7 days
Residue, Settleable	P, G	Cool, 4°C	48 hours
Residue, volatile	P, G	Cool, 4°C	7 days
Silica	P	Cool, 4°C	28 days
Specific conductance	P, G	Cool, 4°C	28 days

7.0 SAMPLE CUSTODY

HMM strictly follows Chain-of-Custody procedures for the collection of all samples. For each sample collected at the Savage Well Site RI/FS a chain-of-custody form will be filled out by the technical staff member. Exhibit 4 is a sample of HMM's Standard Chain-of-Custody form.

7.0 A FIELD SAMPLING OPERATIONS

- All sample bottles, vials and containers will be prepared and supplied by Clean Harbors, Inc. Subtask 2D - Air Sampling Program requires the services of Alliance Technologies Corporation. All sampling equipment and analytical services will be provided by Alliance.
- Any sample preservation will be recorded in the REMARKS column of the Chain-of-Custody form.
- All samples will be labeled using Clean Harbors, Inc. and Alliance Technologies Corporation, Inc. (Subtask 2D) prepared labels.
- Exhibit 5 represents a Field Tracking Report Form which will be used to track all samples collected prior to delivery to the laboratories.

The following information is pertinent and (at a minimum) will be recorded in the field log book for each sample collected:

- Name of Sampler from HMM Associates
- Sample Description
- Location
- Date
- Time
- Station
- Media
- Sample Type
- Preservation
- Sample ID No.
- Remarks

HMM ASSOCIATES, INC.

CHAIN OF CUSTODY RECORD

PROJ. NO.

PROJECT NAME

SAMPLERS: *(Signature)*

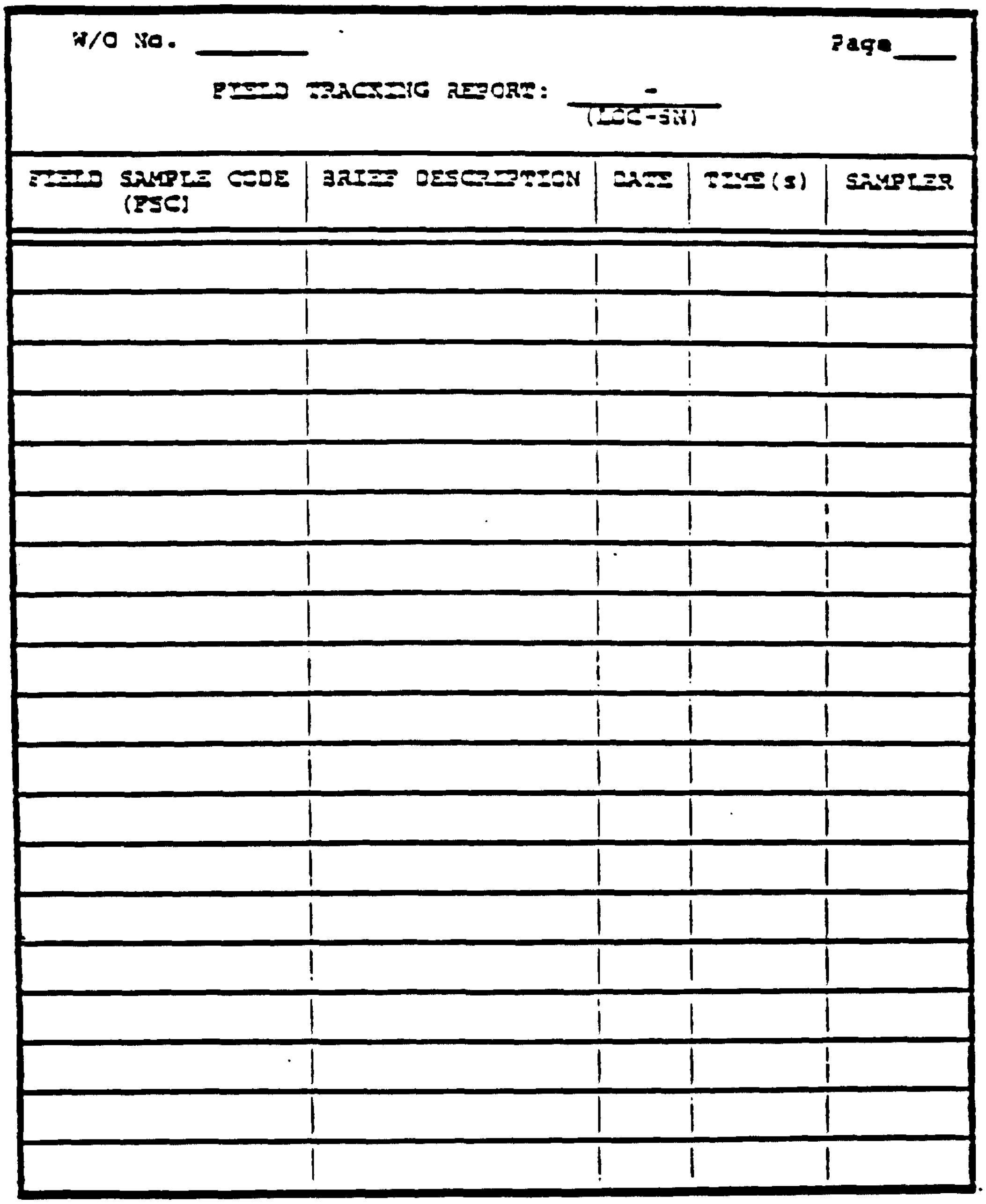
STA. NO.	DATE	TIME	COMP	GRAB	STATION LOCATION	NO OF CON- TAINERS							REMARKS

Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date / Time	Received for Laboratory by: *(Signature)*	Date / Time	Remarks	

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

EXHIBIT 5

SAMPLE OF FIELD TRACKING REPORT FORM



W/O No. ________ Page____

FIELD TRACKING REPORT: ____-____
(LOC-SN)

FIELD SAMPLE CODE (FSC)	BRIEF DESCRIPTION	DATE	TIME(s)	SAMPLER

7.0 B LABORATORY OPERATIONS

Clean Harbors, Inc. (CHI) and Alliance Technologies (Subtask 2D only) will be performing the required analytical work for the Savage Well RI/FS Project. Both laboratories have appointed Project Managers and each will have responsibility for the analytical work submitted to the laboratory. HMM's QA Manager has reviewed CHI's and Alliance's policies and procedures for sample receipt and each has authorized sample bank custodians. The custodians will retain records of sample receipt and verify the data entered onto the sample chain-of-custody records.

- CHI and Alliance utilize internal sample receiving worksheets to log the receipt of all samples. The logs are filled out by the sample bank custodian. An example of the worksheet that they will use to log and track samples is presented in Exhibit 6.

- The sample bank custodians will have ultimate custody of all samples submitted for analysis. They will receive, log in, store and distribute to the appropriate sections of the lab all of the samples.

- Sample Rejection Policy: All Savage Well Site Samples submitted to Clean Harbors and Alliance both of Bedford, MA will be checked for the following:

  1. Proper storage prior to and during transportation
  2. Proper preservation, if appropriate
  3. Proper labeling
  4. Proper information recorded on Chain of Custody forms

  Samples which fail any one of the above checks will immediately be brought to the attention of the Laboratory Project Manager, of Clean Harbors or Alliance. They will also immediately notify HMM's Project Manager and QA Manager. The severity of the problem will be reviewed by the Laboratory and HMM's Project and QA Managers, and a decision of sample rejection and re-collection will be made.

  Clean Harbors and Alliance's Project and QA Managers will bring to the attention of HMM's Project and QA Managers problems that arise with any sample they feel is not acceptable for analysis.

SAMPLE RECEIVING WORKSHEET

Contract ______

Client ______

Date Recd ______ Condition ______

Submittor ______ Container Prep ______

Comments ______

Control No.	Sample ID/Description	Remarks

Date/Initials:

MLB ______ Pgs ______ Lat ______

Check if conti
on next page ______

8.0 CALIBRATION PROCEDURES AND FREQUENCY

Calibration Procedures for each field measurement parameter are as follows:

Procedures:

Organic Vapor Analysis - HMM's technical staff will be performing field screening with the following instruments:

- Century 128 OVA/Gas Chromatograph (OVA)

- HNU: ISPI 101 Analyzer - Intrinsically Safe Photoionizer (HNU)

- OVM 580A Organic Vapor Analyzer - Thermo Election

These instruments will be calibrated as outlined in the procedures on the following pages. Exhibit 7 represents the calibration procedure for the OVA, Exhibit 8 represents the calibration procedure for the HNU, and Exhibit 8A represents the calibration procedure for the OVM 580A, as taken from the manufacturers manuals.

Field measurements of pH and conductivity will be performed on the following instruments:

- Orion SA 230 Digital pH Meter
- YSI 33 Salinity-Conductivity-Temperature Meter

These instruments will be calibrated following the procedures in Exhibits 8B and 8C, respectively.

Frequency:

Initial daily calibration will be performed on each instrument, listed above, when used for screening and pH/conductivity measurements. Additional calibration checks will be performed if the instrument is demonstrating unstable or variable readings.

EXHIBIT 7

CALIBRATION PROCEDURE FOR THE OVA 128

Calibration Procedure - Prior to daily use.

Calibration Gas - Methane in Air 97 ppm

1. Remove instrument components from the instrument shell.

2. Turn on Electronics and Zero Instrument on X10 scale. Gas select dial to 30.

3. Go to Survey Mode. Turn on Pump and Hydrogen. Ignite Flame.

4. Introduce Methane Standard (97 ppm).

5. Adjust R-32 Trimpot to Circuit Board to make meter read to Standard.

6. Turn off Hydrogen flame and adjust meter needle to read 40 ppm (calibrate at X10) using the calibration adjust knob.

7. Switch to X100 scale. The meter should indicate 0.4 on the 1-10 meter markings (0.4 x 100 = 40 ppm). If the reading is off, adjust with R33 Trimpot.

8. Return to X10 scale and adjust meter needle to 40 ppm with calibration adjust knob if necessary.

9. At the X10 scale, adjust meter to read 0.4 on the 1-10 meter markings using the calibration adjust. Switch X1 scale. The meter should read 4 ppm. If the reading is off, adjust using the R-31 Trimpot.

EXHIBIT 8

CALIBRATION PROCEDURE FOR THE HNU ISPI 101

Calibration Procedure - Prior to daily use

Calibration Gas - Isobutylene 68 ppm standard

1. Turn the FUNCTION switch to the battery check position. Check to ensure that the indicator reads within or beyond the green battery arc on the scale plate. If the indicator is below the green arc, or if the red LED comes on, the battery must be charged prior to using.
2. To zero the instrument, turn the FUNCTION switch to the STANDBY position and rotate the ZERO POTENTIOMETER until the meter reads zero. Wait 15-20 seconds to ensure that the zero adjustment is stable. If not, then readjust.
3. Check to see that the SPAN POTENTIOMETER is set at the appropriate setting for the probe being used. (5.0 for 9.5 5 eV probe, 9.8 for 10.2 eV, 5.0 for 11.7 eV).
4. Set the FUNCTION switch to the desired ppm range. A violet-colored glow from the UV lamp source should be observable at the sample inlet of the probe/sensor unit. (Avoid looking directly at the glow since eye damage can result).
5. Listen for the fan operation to verify fan function.
6. Connect a sampling hose to the regulator outlet and the other end to the sampling probe of the HNU.
7. Crack the regulator valve.
8. Take reading after 5-10 seconds.
9. Adjust the calibration screw to produce the concentration listed on the span gas cylinder (68 ppm). The calibration screw is located on the circuit board, just under the zero adjust knob.

EXHIBIT 8A

CALIBRATION PROCEDURE FOR THE OVM 580A

Calibration Procedure - Prior to daily use.

Calibration Gas - Isobutylene 68 ppm standard.

1. Turn the instrument on and allow PID lamp to warm up for several minutes.

2. By pressing the MODE/STORE switch from the RUN mode and then pressing the -/CRSR switch when asked if logging is desired, the OVM will display:

   R/COMM -/PARAM
   +/ACCESS S/CLOCK

3. Press the -/PARAM switch and then the +/INC switch until "RESET" TO CALIBRATE is displayed.

4. The calibration mode may be entered by pressing the RESET switch. The OVM will display:

   ZERO GAS
   RESET WHEN READY

5. Using clean silicon or polyethylene tubing, connect the cylinder of "Zero Air" to the inlet probe of the instrument. Open the regulator valve to introduce the Zero Air gas into the instrument. Once the zero gas has been introduced the RESET switch should be depressed. The OVM 580A will then make internal adjustment to zero the instrument. The OVM 580A will display:

   MODEL 580A
   ZEROING

EXHIBIT 8A (CONT'D)

6. Once the OVM 580A has been zeroed the instrument will display:

SPAN PPM = 0000
(or SPAN PPM = concentration of span gas used for the previous instrument calibration)

The concentration of the span gas may now be entered by pressing the RESET switch and either the +/INC switch to increment the digit above the cursor or the -/CRSR switch to move the cursor. Once the concentration of the span gas has been entered the +/INC switch should be pressed. The OVM 580A will then display:

SPAN GAS
RESET WHEN READY

Using clean silicon or polyethylene tubing connect the cylinder of calibration gas to the inlet probe of the instrument. Open the regulator to introduce the calibration gas into the instrument. Once the calibration gas has been introduced the RESET switch should be pressed. The OVA 580A will make an internal calibration and the instrument will display:

MODEL 580A
CALIBRATING

Once the OVM 580A has been calibrated the instrument will display:

"RESET" TO
CALIBRATE

EXHIBIT 8A (CONT'D)

If during the zeroing or calibrating of the OVM 580A a steady reading was not seen the instrument will display:

CAL ERROR
RESET WHEN READY

Pressing the RESET switch will return the OVM to the zero or calibration mode and the calibration procedures should be repeated.

7. Once the calibration has been completed, pressing the +/INC switch twice will display:

   CONC METER
   "RESET" TO CHG

8. Press the MODE switch to return the instrument to an operating mode where the OVM 5890A can be used to make measurements of total volatile organic vapors.

EXHIBIT 8B

CALIBRATION PROCEDURE FOR THE ORION SA 230 pH METER

Calibration Procedure - Prior to daily use.

Calibration Materials - Buffer solutions with tolerances as referenced by NBS Standards

- pH 4.000 ±0.002
- pH 7.000 ±0.002
- pH 10.000 ±0.005

1. Remove instrument components from the instrument shell.

2. Turn on electronics, allow 15 minutes for warm-up.

3. Sample and buffer temperature must be equal. Set temp/slope control to buffer temperature (°C).

4. Place electrode in pH 7 buffer and stir moderately.

5. Slide mode switch to pH. Allow reading to stabilize, then adjust calibration control so that correct buffer value at that temperature is displayed.

6. Remove electrode from the buffer solution, rinse, and place electrode in second buffer (either pH 4 or pH 10 depending upon expected results). Stir moderately. Allow reading to stabilize.

7. Adjust temp/slope control until correct value of second buffer is displayed. Remove electrode from solution, rinse and place electrode in sample. Stir moderately. Allow reading to stabilize.

8. Record pH value displayed.

EXHIBIT 8C

CALIBRATION PROCEDURE FOR THE YSI MODEL 33 S-C-T METER

Calibration Procedure - Prior to daily use.

Calibration Materials - 0.01 demal KCl solution

1. Remove instrument components from the instrument shell.

2. Turn on electronics, allow 15 minutes for warm-up.

3. Set-up the instrument.

   a) Adjust meter zero (if necessary) by turning the bakelite screw on the meter face so that the meter needle coincides with the zero on the conductivity scale.

   b) Calibrate the meter by turning the MODE control to REDLINE and adjusting the REDLINE control so the meter needle lines up with the redline on the meter face. If this cannot be accomplished, replace the batteries.

   c) Plug the probe into the probe jack on the side of the instrument.

   d) Put the probe in the standard KCl solution to be measured, read the conductivity and relate the temperature to the expected conductivity umohs/cm values. If the meter is out of calibration, return to manufacturer for factory re-calibration.

The YSI 33 Series are calibrated to absolute accuracy of ±1.5% based on a standard solution. A 0.01 demal KCl standard solution method, as determined by the manufacturer, is used to standardize the instrument. Recent ASTM Standards, Part 23-Designation D1125-64, concur with this manufacturer's method. The solution is prepared by diluting 0.745 grams of pure dry KCl with distilled water until the solution is 1 kilogram. The table below shows the values of conductivity this solution would have if the distilled water were nonconductive. However, since even high purity distilled water is slightly conductive, the measured conductivity will be higher by an amount equal to the water's conductivity.

EXHIBIT 8C (CONT'D)

Temperature °C	Conductivity umohs/cm
15	1141.5
16	1167.5
17	1193.6
18	1219.9
19	1246.4
20	1273.0
21	1299.7
22	1326.6
23	1353.6
24	1380.8
25	1408.1
26	1436.5
27	1463.2
28	1490.9
29	1518.7
30	1546.7

9.0 ANALYTICAL PROCEDURES

EPA approved analytical procedures for each measurement parameter are required for the completion of the Savage Well RI/FS along with method are as follows:

Volatile Organic Analysis

Method 8240 (EPA SW-846, 3rd Edition)

For the analysis of Volatile Organic Compounds (VOCs) in water and soil/sediment samples.

Extractables Analysis (Base Neutrals/Acids - BNA)

Method 8270 (EPA SW-846, 3rd Edition)

For the analysis of Semi-Volatile Organic Compounds (SVOCs) in water and soil/sediment samples.

Inorganics Analysis

Metals and Cyanide Analyses Methods are as follows:

Metals Digestion: 3010 (water); 3050 (soil/sediment)
Metals Analysis: 6010 ICAP
Mercury Analysis: Cold vapor methods, 7470 (water);
Cyanide Analysis: Alkaline Extraction of soil, Method 335.2
U.S. EPA Region I Methodology - 1988

PCBs Analysis

Method 8080 (EPA SW-846, 3rd Edition)

For the analysis of PCBs in water and soil samples.

Acetophenone and Methyl Styrene Analysis

Acetophenone -	Method 8270
Methyl Styrene -	Modified Method 8270, by GC/MS with Standardization and Calibration for Methyl Styrene

For the analysis of Acetophenone and Methyl Styrene in water samples.

pH and Conductivity Field Analyses

Methods taken from "A Compendium of Superfund Field Operations Methods"

EPA/540/P-87/001, December 1987. Utilizing the following instruments:

pH Measurement: Orion SA-230 temperature compensating pH meter

Conductivity Measurement: YSI Model 33 salinity conductivity-temperature (SCT) meter

Exhibits 9-1 and 9-2 represent CLP detection limits to be used with the above analytical methods.

EXHIBIT 9-1

Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL)*

Volatiles	CAS Number	Quantitation Limits** Water ug/L	Low Soil/Sediment[a] ug/Kg
1. Chloromethane	74-87-3	10	10
2. Bromomethane	74-83-9	10	10
3. Vinyl Chloride	75-01-4	10	10
4. Chloroethane	75-00-3	10	10
5. Methylene Chloride	75-09-2	5	5
6. Acetone	67-64-1	10	10
7. Carbon Disulfide	75-15-0	5	5
8. 1,1-Dichloroethene	75-35-4	5	5
9. 1,1-Dichloroethane	75-35-3	5	5
10. 1,2-Dichloroethene (total)	540-59-0	5	5
11. Chloroform	67-66-3	5	5
12. 1,2-Dichloroethane	107-06-2	5	5
13. 2-Butanone	78-93-3	10	10
14. 1,1,1-Trichloroethane	71-55-6	5	5
15. Carbon Tetrachloride	56-23-5	5	5
16. Vinyl Acetate	108-05-4	10	10
17. Bromodichloromethane	75-27-4	5	5
18. 1,1,2,2-Tetrachloroethane	79-34-5	5	5
19. 1,2-Dichloropropane	78-87-5	5	5
20. cis-1,3-Dichloropropene	10061-01-5	5	5
21. Trichloroethene	79-01-6	5	5
22. Dibromochloromethane	124-48-1	5	5
23. 1,1,2-Trichloroethane	79-00-5	5	5
24. Benzene	71-43-2	5	5
25. trans-1,3-Dichloropropene	10061-02-6	5	5
26. Bromoform	75-25-2	5	5
27. 2-Hexanone	591-78-6	10	10
28. 4-Methyl-2-pentanone	108-10-1	10	10
29. Tetrachloroethene	127-18-4	5	5
30. Toluene	108-88-3	5	5

EXHIBIT 9-1 (Cont'd)

		Quantitation Limits**	
Volatiles	CAS Number	Water ug/L	Low Soil/Sediment[a] ug/Kg
31. Chlorobenzene	108-90-7	5	5
32. Ethyl Benzene	100-41-4	5	5
33. Styrene	100-42-5	5	5
34. Xylenes (Total)	133-02-7	5	5

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[a] Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Volatile TCL Compounds are 100 times the individual Low Soil/Sediment CRQL.

*Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

**Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

EXHIBIT 9-1 (Cont'd)

Target Compound List (TCL) and
Contract Required Quantitation Limits (CRQL)*

		Quantitation Limits**	
Semivolatiles	CAS Number	Water ug/L	Low Soil/Sediment^b ug/Kg
35. Phenol	108-95-2	10	330
36. bis(2-Chloroethyl) ether	111-44-4	10	330
37. 2-Chlorophenol	95-57-8	10	330
38. 1,3-Dichlorobenzene	541-73-1	10	330
39. 1,4-Dichlorobenzene	106-46-7	10	330
40. Benzyl Alcohol	100-51-6	10	330
41. 1,2-Dichlorobenzene	95-50-1	10	330
42. 2-Methylphenol	95-48-7	10	330
43. bis(2-Chloroisopropyl) ether	39638-32-9	10	330
44. 4-Methylphenol	106-44-5	10	330
45. N-Nitroso-Dipropylamine	621-64-7	10	330
46. Hexachloroethane	67-72-1	10	330
47. Nitrobenzene	98-95-3	10	330
48. Isophorone	78-59-1	10	330
49. 2-Nitrophenol	88-75-5	10	330
50. 2,4-Dimethylphenol	105-67-9	10	330
51. Benzoic Acid	65-85-0	50	1600
52. bis(2-Chloroethoxy) methane	111-91-1	10	330
53 2,4-Dichlorophenol	120-83-2	10	330
54. 1,2,4-Trichlorobenzene	120-82-1	10	330
55. Naphthalene	91-20-3	10	330
56. 4-Chloroaniline	106-47-8	10	330
57. Hexachlorobutadiene	87-68-3	10	330
58. 4-Chloro-3-methylphenol (para-chloro-meta-cresol)	59-50-7	10	330
59. 2-Methylnaphthalene	91-57-6	10	330
60. Hexachlorocyclopentadiene	77-47-4	10	330
61. 2,4,6-Trichlorophenol	88-06-2	10	330
62. 2,4,5-Trichlorophenol	95-95-4	50	1600
63. 2-Chloronaphthalene	91-58-7	10	330
64. 2-Nitroaniline	88-74-4	50	1600

EXHIBIT 9-1 (Cont'd)

Semivolatiles	CAS Number	Quantitation Limits** Water ug/L	Quantitation Limits** Low Soil/Sediment[b] ug/Kg
65. Dimethyl Phthalate	131-11-3	10	330
66. Acenaphthylene	208-96-8	10	330
67. 2,6-Dinitrotoluene	606-20-2	10	330
68. 3-Nitroaniline	99-09-2	50	1600
69. Acenaphthene	83-32-9	10	330
70. 2,4-Dinitrophenol	51-28-5	50	1600
71. 4-Nitrophenol	100-02-7	50	1600
72. Dibenzofuran	132-64-9	10	330
73. 2,4-Dinitrotoluene	121-14-2	10	330
74. Diethylphthalate	84-66-2	10	330
75. 4-Chlorophenyl Phenyl ether	7005-72-3	10	330
76. Fluorene	86-73-7	10	330
77. 4-Nitroaniline	100-01-6	50	1600
78. 4,6-Dinitro-2-methylphenol	534-52-1	50	1600
79. N-nitrosodiphenylamine	86-30-6	10	330
80. 4-Bromophenyl Phenyl ether	101-55-3	10	330
81. Hexachlorobenzene	118-74-1	10	330
82. Pentachlorophenol	87-86-5	50	1600
83. Phenanthrene	85-01-8	10	330
84. Anthracene	120-12-7	10	330
85. Di-n-butylphthalate	84-74-2	10	330
86. Fluoranthene	206-44-0	10	330
87. Pyrene	129-00-0	10	330
88. Butyl Benzyl Phthalate	85-68-7	10	330
89. 3,3'-Dichlorobenzidine	91-94-1	20	660
90. Benzo(a)anthracene	56-55-3	10	330
91. Chrysene	218-01-9	10	330
92. bis(2-ethylhexyl)phthalate	117-81-7	10	330
93. Di-n-octyl Phthalate	117-84-0	10	330
94. Benzo(b)fluoranthene	205-99-2	10	330

EXHIBIT 9-1 (Cont'd)

Semivolatiles	CAS Number	Quantitation Limits** Water ug/L	Quantitation Limits** Low Soil/Sediment[b] ug/Kg
95. Benzo(k)fluoranthene	207-08-9	10	330
96. Benzo(a)pyrene	50-32-8	10	330
97. Indeno(1,2,3-cd)pyrene	193-39-5	10	330
98. Dibenz(a,h)anthracene	53-70-3	10	330
99. Benzo(g,h,i)perylene	191-24-2	10	330

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[b] Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Semi-Volatile TCL Compounds are 60 times the individual Low Soil/Sediment CRQL.

*Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

**Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

Quantitation Limits**:

Acetophenone - water - 10ug/c; low soil/sediment [b] - 330 ug/kg

Methyl Styrene - to be determined by the CHI laboratory prior to sample analysis by a modified method 8270, SW-846 3rd Edition 9/86.

EXHIBIT 9-1 (Cont'd)

Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL)*

		Quantitation Limits**	
Pesticides/PCBs	CAS Number	Water ug/L	Low Soil/Sediment[c] ug/Kg
100. alpha-BHC	319-84-6	0.05	8.0
101. beta-BHC	319-85-7	0.05	8.0
102. delta-BHC	319-86-8	0.05	8.0
103. gamma-BHC (Lindane)	58-89-9	0.05	8.0
104. Heptachlor	76-44-8	0.05	8.0
105. Aldrin	309-00-2	0.05	8.0
106. Heptachlor Epoxide	1024-57-3	0.05	8.0
107. Endosulfan I	959-98-8	0.05	8.0
108. Dieldrin	60-57-1	0.10	16.0
109. 4,4'-DDE	72-55-9	0.10	16.0
110. Endrin	72-20-8	0.10	16.0
111. Endosulfan II	33213-65-9	0.10	16.0
112. 4,4'-DDD	72-54-8	0.10	16.0
113. Endosulfan Sulfate	1031-07-8	0.10	16.0
114. 4,4'-DDT	50-29-3	0.10	16.0
115. Endrin Ketone	53494-70-5	0.10	16.0
116. Methoxychlor	72-43-5	0.5	80.0
117. alpha-chlordane	5103-71-9	0.5	80.0
118. gamma-chlordane	5103-74-2	0.5	80.0
119. Toxaphene	8001-35-2	1.0	160.0
120. Aroclor-1016	12674-11-2	0.5	80.0
121. Aroclor-1221	11104-28-2	0.5	80.0
122. Aroclor-1232	11141-16-5	0.5	80.0
123. Aroclor-1242	53469-21-9	0.5	80.0
124. Aroclor-1248	12672-29-6	0.5	80.0
125. Aroclor-1254	11097-69-1	1.0	160.0
126. Aroclor-1260	11096-82-5	1.0	160.0

---

[c] Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Pesticide/PCB TCL compounds are 15 times the individual Low Soil/Sediment CRQL.

*Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

**Quantitation limits listed for soil/sediment are based on wet weight. The quantitation Limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

NOTE: Exhibit 9-1 was reproduced from the USEPA Contract Laboratory Program, Statement of Work for Organic Analysis; Multi-Media, Multi-Concentration, 10/86.

EXHIBIT 9-2

INORGANIC TARGET ANALYTE LIST

Element	Contract Required Detection Level[1,2] (ug/L)
Aluminum	200
Antimony	60
Arsenic	10
Barium	200
Beryllium	5
Cadmium	5
Calcium	5000
Chromium	10
Cobalt	50
Copper	25
Iron	100
Lead	5
Magnesium	5000
Manganese	15
Mercury	0.2
Nickel	40
Potassium	5000
Selenium	5
Silver	10
Sodium	5000
Thallium	10
Tin	40
Vanadium	50
Zinc	20

NOTE: Exhibit 9-2 was reproduced from USEPA Contract Laboratory Program, <u>Statement of Work for Inorganic Analysis</u>; Multi-Media, Multi-Concentration, 7/87.

10.0 DATA REDUCTION, VALIDATION, AND REPORTING

Final reduction, validation, and reporting of all data collected by HMM will be performed by HMM's QA Manager and Project Manager.

For each individual task that involves the collection of data, the work plan and the Sampling and Analysis Plan will address the exact approach to collecting the required data. Data reduction will be performed by each individual task manager. The process of data review and validation will be performed by HMM's QA Manager and HMM's Project Manager.

Data that is collected by HMM and analytical data that is reported to HMM by CHI and Alliance Technologies Corp. will be reviewed, validated, and reported by HMM's QA Manager and HMM's Project Manager.

Analytical data validation procedure is as follows:

1) A review of all analytical data generated in a report form, including the review of backup data for each sample (i.e. comparison of mass spectra with generated results). The review of calculations used to determine reported levels of contaminants. The equations and formulas used to calculate results are found in the specific analytical procedures, each parameter required will be performed utilizing an EPA approved method.

2) A review of all generated QC data, including duplicate sample analyses, blanks, spikes, matrix spikes, and surrogate recoveries.

3) A comparison of field screening data and analytical lab data, if both are available.

11.0 INTERNAL QUALITY CONTROL CHECKS

HMM routinely performs internal Quality Control Checks. Field blanks (consisting of Equipment & Trip Blanks) will be analyzed for field sampling activities internal QC checks of decontamination procedures are performed by the collection of equipment blanks on all sampling instrumentation. Equipment blanks will be collected on a daily basis prior to the collection of samples. Trip blanks are provided by the lab with the empty sample containers to check sample collection and storage (to monitor cross contamination of the samples in the storage ice chest). HMM requires that the laboratory analyze samples in duplicate and split sample matrices on at least 20% of all samples submitted for analysis. Split sample collection will be performed by HMM and the Split Sample Analysis will be performed by Mr. Richard Pease of the New Hampshire Department of Environmental Services during the sampling and analysis program. Mr. Pease will be informed of the specific analytical method of analysis. The analytical laboratory will be the only variable in the process.

HMM also routinely performs quality control checks on the analytical laboratory. Blind samples are submitted for analysis and labelled as a collected sample. The data serves as a proficiency check for accuracy of the analytical procedures.

HMM records and plots QC data points on control charts. The QC data record is:

QC Data Points	Frequency of Analysis
Replicates	20%
Spiked sample matrices	20%
Field Blanks (trip and equipment)	Daily
Surrogate sample recoveries	on all samples analyzed
Calibration standards	as each method requires*
Method Blanks (Reagent Blanks)	Daily

*SW-846, 3rd Edition 9/86., Please refer to the table on page 5-3 and Section 9.0 for detailed Outlines of Analytical Methods to be used.

12.0 PERFORMANCE AND SYSTEM AUDITS

HMM's QA Manager will carry out Performance and System Audits to ensure that data of known and defensible quality is being produced throughout the Savage RI/FS. HMMs policy on systems audits is to periodically review field and laboratory procedures. The QA Manager will perform regular site visits at various stages of the field activities program. The QA Manager will review field logbooks to assure that all recorded data is complete, legible and signed by the technical staff member who recorded the data. Completed field data sheets are reviewed by the QA Manager for accuracy and completeness. (Copies of HMM's field data sheets are in Exhibit 10.)

Laboratory audits will be performed by the QA Manager. On-site visits to the Analytical Laboraotry will consist of a review of Sample Receipt Logs, Sample Storage Logs and Sample Custody procedures. Also a review of Certification Status with State Certification Programs. Quality control records and analytical procedures used and the data generated on the submitted samples will be reviewed.

HMM follows the EPAs guidelines on the Evaluation of Laboratories from the "Manual for the Certification of Laboratories Analyzing Public Drinking Water (EPA 570/9-82-002, October 1982) and the "Procedure for the Evaluation of Environmental Monitoring Laboratories" (EPA 600/4-78-017 March 1978 EMSL-CI). During the field activities of the Savage Well Site RI/FS there will be monthly performance audits. Therefore if a task or subtask should run for one month, or less, there will be one performance audit conducted unless a specific situation arises requiring more frequent auditing.

See Exhibit 11 for the Schedule of Performance Audits for the Savage Well RI/FS.

HMM will perform quantitative evaluation of the Measurement Systems in the Savage Well RI/FS. In addition to these evaluations, HMM submits for analysis blind spiked samples for internal Quality Control. The spiked samples are normally prepared utilizing analytical standard solutions, preferably EMSL Standards. (EMSL; Environmental Monitoring and Support Laboratory, Cincinnati, OH or Environmental Monitoring Systems Laboratory, Las Vegas, NV).

HMM Associates
Environmental Consultants, Engineers and Planners
336 BAKER AVENUE CONCORD, MASSACHUSETTS 01742

EXHIBIT 10

VARIABLE HEAD PERMEABILITY TEST PIEZOMETER NO.

PROJECT:

CLIENT:

JOB NO:

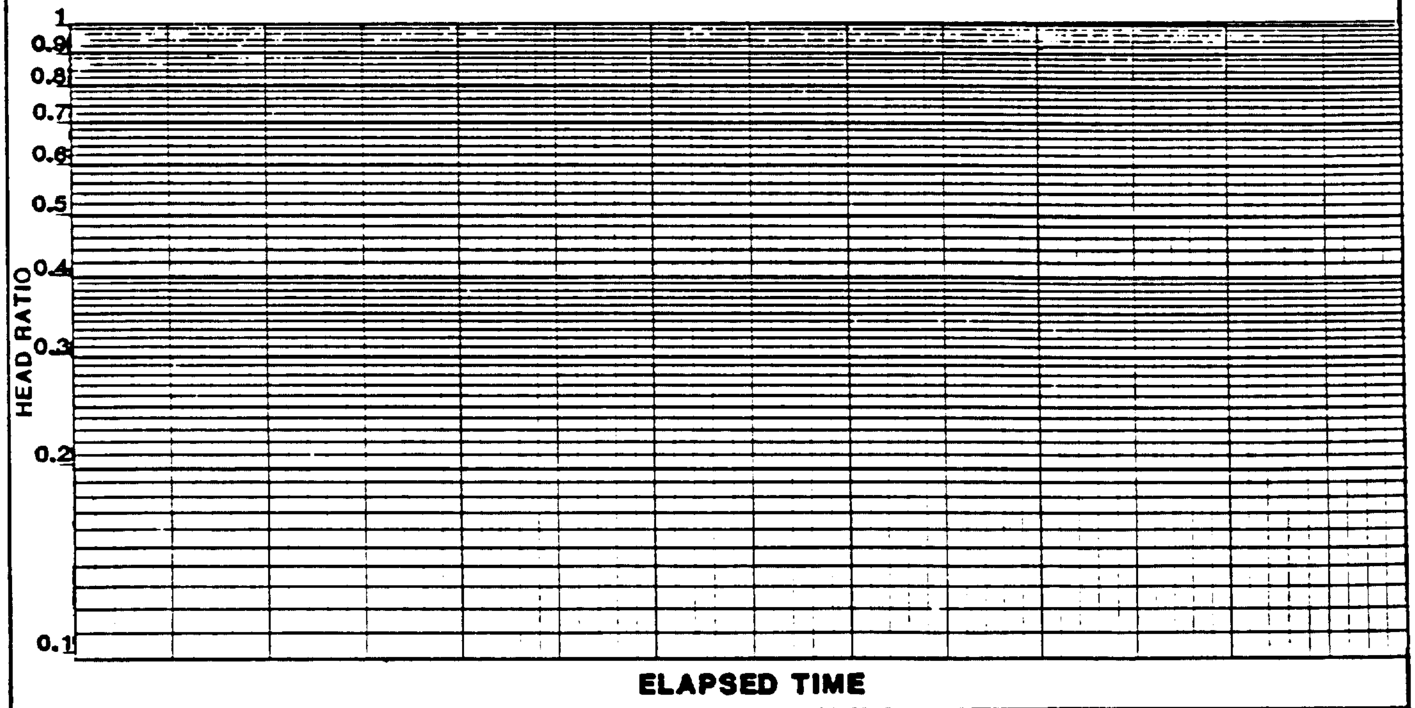
DATE OF TEST:

SCREENED INTERVAL:

METHOD:

TEST DATA

ELAPSED TIME	HEAD RATIO



CALCULATIONS:

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EXHIBIT 10 (CONT'D)

HMM Associates	**WATER PRESSURE TEST**	HOLE NO.	TEST NO.

PROJECT: __________

CLIENT: __________

CONTRACTOR:

JOB NO. __________

SHEET NO. __________

LOCATION: __________

ELEVATION: __________

DATE START: __________

DATE FINISH: __________

DRILLER: __________

INSPECTOR: __________

GEOLOGIST: __________

	PACKER SYSTEM	WATER METER	WATER GAUGE	SURGE CHAMBER
TYPE				
MFG.				
MODEL NO.				

M.G.P. = (0.566 to 1.0) x Ƶ

COMPUTED MAX GAUGE PRESS: (MGP) __________

COMPUTED INTERNAL FRICTION: __________

ROCK TYPE: __________ HOLE SIZE __________

RECOVERY (%) __________

R Q D (%) __________

DEPTHS: (All Distances Measured From Ground Surface In Feet)

TO TOP OF ROCK __________

TO TOP LOWER PACKER __________

TO BOTTOM OF BORING __________

TO BOTTOM UPPER PACKER (Ƶ) __________

TO WATER TABLE __________

LENGTH OF TEST SECTION __________

HEIGHT OF WATER PRESSURE GAUGE ABOVE GROUND SURFACE __________

TIME	ELAPSED TIME (MIN)	PACKER PRESSURE (PSI)	GAUGE PRESSURE (PSI)	METER READING (GALS)	VOLUME OF FLOW (GALS/MIN)	REMARKS

EXHIBIT 10 (CONT'D)

HMM ASSOCIATES

WATER PRESSURE TEST

Page ______ Of ______

Project ______________________ Boring No. ______________ Test No. ______________

TIME	ELAPSED TIME (MIN)	PACKER PRESSURE (PSI)	GAUGE PRESSURE (PSI)	METER READING (GALS)	VOLUME OF FLOW (GALS/MIN)	REMARKS

EXHIBIT 10 (CONT'D)

HMM ASSOCIATES

FIELD SUMMARY OF ROCK CHARACTERISTICS

PROJECT ____ GEOLOGIST ____ DATE ____ FILE NO. ____

BORING NO. ____ RUN NO. ____ DEPTH from ____ to ____ RECOVERY ____ ft. ____ %

RQD ____ ft. ____ % (for entire run) AVERAGE DRILLING RATE ____ (min./ft.)

per foot basis beginning with ____ to ____ ft. (optional)

1 ____ % 2 ____ % 3 ____ % 4 ____ % 5 ____ %

6 ____ % 7 ____ % 8 ____ % 9 ____ % 10 ____ %

NO. OF PIECES ____ NO. OF CHIPS ____ NO. OF SOIL/CLAY LAYERS ____

Size and distribution of pieces in inches SCHMIDT HARDNESS ____

____ ____, ____ ____, ____ ____, ____ ____, ____ ____, ____ ____, ____ ____

ROCK TYPE ____

MINERALS ____

FORMATION ____

REMARKS ____

$$RQD = \frac{\text{Summation of} \geq \text{NX core lengths} \geq 4''}{\text{Length of core run}}$$

1. Compute RQD only on rock core which has been moderately weathered or less
2. RQD adjustments required Yes ____ No ____

SAMPLES REMOVED FOR TESTING: None ____ (Depth, lengths) ____

CORE PHOTOGRAPHED ____ WATER LOSS ____

FIELD HARDNESS (Check one)

Very hard ____ Hard ____ Mod. Hard ____ Medium ____ Soft ____ Very Soft ____

WEATHERING (Check one)

Fresh ____ Very Slight ____ Slight ____ Moderate ____

Moderately Severe ____ Severe ____ Very Severe ____ Complete ____

ROCK CORE FRACTURES (CONTINUITY) (Check applicable and indicate depth)

Very Severe ____ Severe ____ Moderate ____ Slight ____ Very Slight ____

TEXTURE (Check one) COLOR

Amorphous (micro) ____ Fine gr. (macro) ____ Med. gr. ($<\frac{1}{8}''$) ____ Coarse gr. ($\frac{1}{8}''-\frac{1}{4}''$) ____ V. Coarse gr. ($>\frac{1}{4}''$) ____

DISCONTINUITIES (Indicate No.(s) of each type)

Crack ____ Joint ____ Shear ____ Fault ____ Shear or Fault Zones ____

Attitude: Hor. (0°-5°) ____ Shallow (5°-35°) ____ Mod. (35°-55°) ____ Steep (55°-85°) ____ Vert. (85°-90°) ____

Primary ____ Secondary ____ Other ____ (Indicate attitude by corresponding number)

Tightness: Tight ____ Open ____

Surfaces: Altered ____ Unaltered ____

Spacing: V. Close ____ Close ____ Mod. Close ____ Wide ____ V. Wide ____

Degree of Planeness: Plane ____ Curved ____ Irregular ____

Degree of Smoothness: Slick ____ Smooth ____ Rough ____

Fill between Discontinuities: No ____ Yes ____ Type of Fill ____

BEDDING / FOLLATION (Check one)

Strike ____ Dip ____

Thickness: V. Thin ____ Thin ____ Medium ____ Thick ____ V. Thick ____

AREA OUTCROPS (if applicable) Location ____

Veins ____ Type ____ Brecciation ____

Slickensides ____

Gouge ____ Color ____ Type ____

FIELD HARDNESS	
V. Hard	- Knife can't scratch
Hard	- Scratches difficult
Mod. Hard	- Scratches readily
Medium	- Grooves difficult
Soft	- Grooves readily
V. Soft	- Carves

WEATHERING	
Fresh	-Crystals bright
V. Slight	-Joints slightly stained
Slight	- Joints completely stained
Moderate	- Core slightly discolored
Mod. Severe	- Core completely discolored
Severe	- Strength reduced
V. Severe	- Only rock fragments
Complete	- Reduced to soil

BEDDING / JOINT SPACING	
V. Thin / V. Close	< 2"
Thin / Close	2" - 12"
Medium / Mod. Close	12" - 36"
Thick / Wide	36" - 120"
V. Thick / V. Wide	>120"

ROCK CORE FRACTURING		
V. Severe	- Core	< 1"
Severe	- Core	1" - 2"
Moderate	- Core	2" - 4"
Slight	- Core	4" - 8"
V. Slight	- Core	> 8"

EXHIBIT 10 (CONT'D)

VISUAL-MANUAL IDENTIFICATION OF ROCK

FIELD HARDNESS: A measure of resistance to scratching or abrasion.

Very hard - Cannot be scratched with knife or sharp pick. Breaking of hand specimens requires several hard blows of geologist's pick.

Hard - Can be scratched with knife or pick only with difficulty. Hard blow of hammer required to detach hand specimen.

Moderately hard - Can be scratched with knife or pick. Gouges or grooves to 1/4 in. deep can be excavated by hard blow of point of a geologist's pick. Hand specimens can be detached by moderate blow.

Medium - Can be grooved or gouged 1/16 in. deep by firm pressure on knife or pick point. Can be excavated in small chips to pieces about 1 in. maximum size by hard blows of the point of a geologist's pick.

Soft - Can be gouged or grooved readily with knife or pick point. Can be excavated in chips to pieces several inches in size by moderate blows of a pick point. Small thin pieces can be broken by finger pressure.

Very soft - Can be carved with knife. Can be excavated readily with point of pick. Pieces 1 in. or more in thickness can be broken with finger pressure. Can be scratched readily by fingernail.

WEATHERING: The action of the elements in altering the color, texture and composition of the rock.

Fresh - Rock fresh, crystals bright, few joints may show slight staining. Rock rings under hammer if crystalline.

Very slight - Rock generally fresh, joints stained, some joints may show thin clay coatings, crystals in broken face show bright. Rock rings under hammer if crystalline.

Slight - Rock generally fresh, joints stained, and discoloration extends into rock up to 1 in. Joints may contain clay. In granitoid rocks some occasional feldspar crystals are dull and discolored. Crystalline rocks ring under hammer.

Moderate - Significant portions of rock show discoloration and weathering effects. In granitoid rocks, most feldspars are dull and discolored; some show clayey. Rock has dull sound under hammer and shows significant loss of strength as compared with fresh rock.

Moderately severe - All rock except quartz discolored or stained. In granitoid rocks, all feldspars dull and discolored and majority show kaolinization. Rock shows severe loss of strength and can be excavated with geologist's pick. Rock goes "clunk" when struck.

Severe - All rock except quartz discolored or stained. Rock "fabric" clear and evident, but reduced in strength to strong soil. In granitoid rocks, all feldspars kaolinized to some extent. Some fragments of strong rock usually left.

Very severe - All rock except quartz discolored or stained. Rock "fabric" discernible, but mass effectively reduced to "soil" with only fragments of strong rock remaining.

Complete - Rock reduced to "soil". Rock "fabric" not discernible or discernible only in small scattered locations. Quartz may be present as dikes or stringers.

ROCK CONTINUITY: Any break in a rock whether or not it has undergone relative displacement.

Extremely Fractured - Drill core stem less than 1 in.

Moderately Fractured - Drill core stem 1 in. to 4 in.

Slightly Fractured - Drill core stem 4 in. to 8 in.

Sound - Drill core stem greater than 8 in.

TEXTURE: Terminology used to identify size, shape and arrangement of constituent elements.

Amorphous - Too small to be seen with naked eye.

Fine Grained - Barely seen with naked eye.

Medium Grained - Barely seen with naked eye to 1/8 in.

Coarse Grained - 1/8 in. to 1/4 in.

Very Coarse Grained > 1/4 in.

DISCONTINUITIES: Surfaces representing breaks or fractures separating the rock mass into discrete units.

Crack - A partial or incomplete fracture

Joint - A simple fracture along which no shear displacement has occurred. May form joint sets.

Shear - A fracture along which differential movement has taken place parallel to the surface sufficient to produce slickensides, striations or polishing. May be accompanied by a zone of fractured rock up to a few inches wide.

Fault - A major fracture along which there has been appreciable displacement and accompanied by gouge and/or a severely fractured adjacent zone.

Shear or Fault Zone - A band or zone of parallel, closely spaced shears or faults.

FRACTURES, BEDDING AND FOLIATION, SPACING AND ATTITUDE

Fractures	Bedding and Foliation	Spacing (1)	Attitude	Angle
Very close	Very thin	Less than 2 in.	Horizontal	$0^\circ - 5^\circ$
Close	Thin	2 in. - 1 ft.	Shallow or low angle	$5^\circ - 35^\circ$
Moderately close	Medium	1 ft. - 3 ft.	Moderately dipping	$35^\circ - 55^\circ$
Wide	Thick	3 ft. - 10 ft.	Steep or high angle	$55^\circ - 85^\circ$
Very wide	Very thick	More than 10 ft.	Vertical	$85^\circ - 90^\circ$

ROCK QUALITY DESIGNATION (RQD)

$$\text{RQD in \%} = \frac{\text{Length of Core in Pieces 4 in. and Longer}}{\text{Length of Run}} \times 100$$

Additional characteristics to further identify and evaluate the rock include: Type, Color, Cavities and Voids, Secondary Mineralization, Fossils, Swelling and Slaking Properties, etc. Visual-manual rock descriptions consist of the following factors in the order presented. Example: Hard, slightly weathered, moderately fractured, gray, coarse grained CAMBRIDGE ARGILLITE, moderately close, tight, shallow dipping, smooth joints; minor shear parallel to bedding at 40 ft.; very thin, horizontal bedding; with siltstone partings and calcite fillings.

NOTE: 1. Spacing - Refers to perpendicular distance between discontinuities

HMM Associates

TEST PIT REPORT

TEST PIT NO.

EXHIBIT 10 (CONT'D)

PROJECT: ____

CLIENT: ____

CONTRACTOR: ____

EQUIPMENT USED: ____

JOB NO. ____

LOCATION: ____

ELEVATION: ____

EXPLORATION DATE: ____

INSPECTOR: ____

Scale in Feet	Strata Change	Sample Number	Sample Depth Range	DESCRIPTION OF MATERIALS	REMARKS
2					
4					
6					
8					
10					
12					

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GROUNDWATER		
DATE	TIME*	DEPTH/FT.
NOT ENCOUNTERED		* HRS. AFTER COMPL.

____ x ____ x ____ = ____ Cu. Ft.
(L) (W) (D)

BOULDERS

6" to 18" DIAM: No. ____ - Vol. ____ Cu. Ft.
Over 18" DIAM: No. ____ - Vol. ____ Cu. Ft.

SUMMARY

DEPTH ____
JAR SAMPLES ____
BAGSAMPLES ____
GROUNDWATER ____
TEST PIT NO.

EXHIBIT 10 (CONT'D)

HMM ASSOCIATES

BOREHOLE PERMEABILITY TEST REPORT

SITE/LOCATION ____________ BORING/PIEZ. NO. ________

CONTRACTOR ____________ JOB NO. ________ TEST NO. ________

WELLPOINT ☐ STANDPIPE ☐ DATE ____________ TEST DEPTH (A) ________

WATERTABLE DEPTH (D) ________ BORING DEPTH ________ CASING/STANDPIPE DIAM. (2r) ________

BORING DIAM. (2R) ________ WELLPOINT/UNCASED BORING LENGTH (L) ________

TYPE OF TEST: FALLING HEAD ☐ RISING HEAD ☐ CONSTANT FLOW ☐ FLOW METER NO. ________

RIG & CREW TIME ________ GROUND ELEVATION ________ REFERENCE ELEVATION ________

TAPE/RULE NO. ________ INSPECTOR ________ CHEK'D BY ________

SOIL DESCRIPTION ____________

REMARKS:

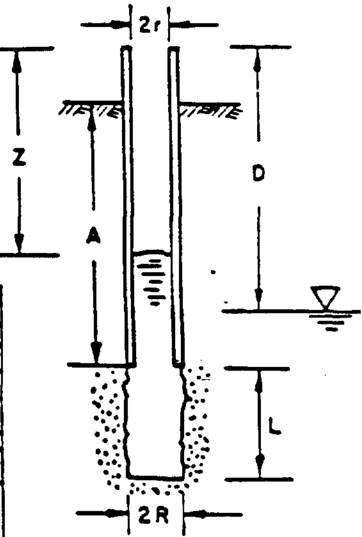
$H = D - Z$ (FALLING HEAD)

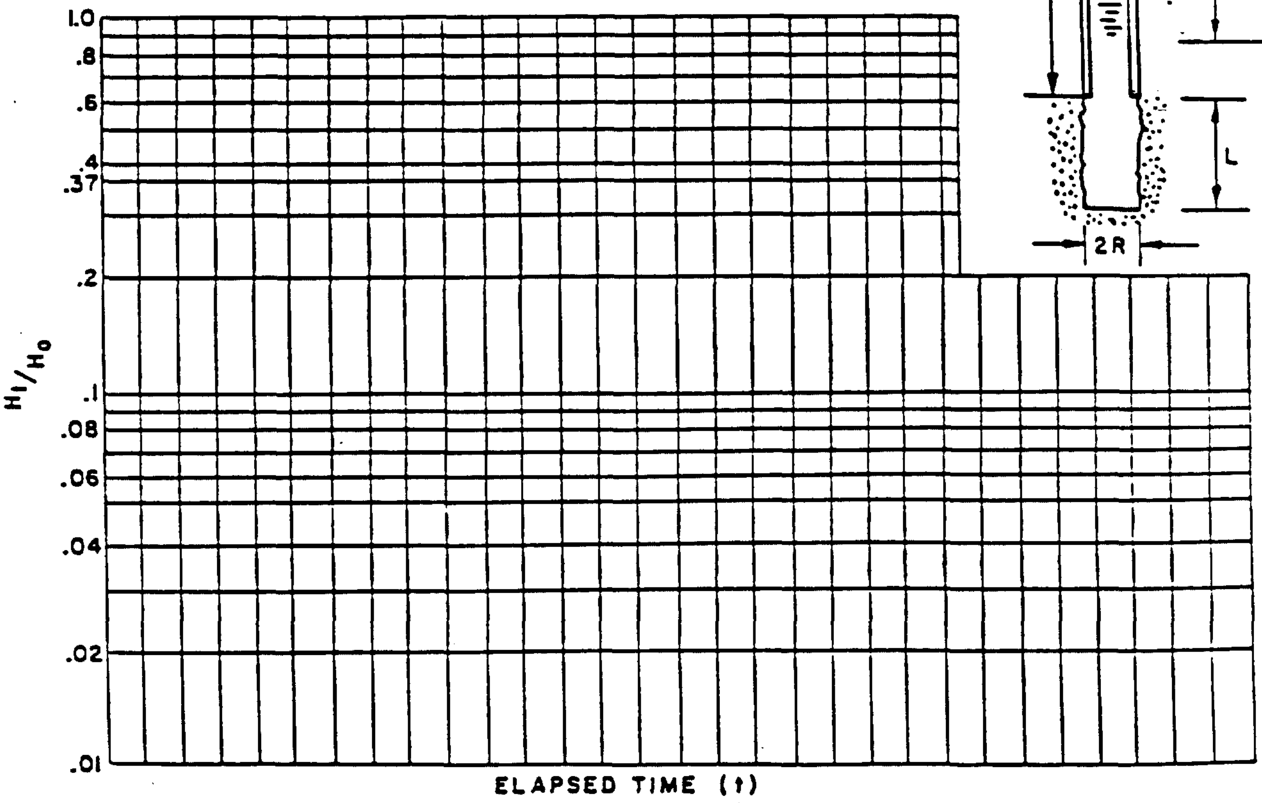
$H = Z - D$ (RISING HEAD)

$H = f(t)$

$H_0 = H$ for $t = 0$

$H_t = H$ for $t > 0$





TIME	ELAPSED TIME	METER READING	WATER DEPTH (Z)	ACTIVE HEAD (H)	H_t/H_0

EXHIBIT 10 (CONT'D)

TIME	ELAPSED TIME	METER READING	WATER DEPTH (Z)	ACTIVE HEAD (H)	H_t/H_o

EXHIBIT 10 (CONT'D)

HMM ASSOCIATES 336 BAKER AVE. CONCORD, MA	PROJECT:	BORING NUMBER ______ SHEET ______ OF ______ DATE ______ FILE ______

BORING COMPANY ______________________
FOREMAN ______________________
HMM GEOLOGIST ______________________
BORING LOCATION ______________________
GROUND ELEVATION ______________________
DATE STARTED ____________ DATE ENDED ____________

CASING
SIZE ____________
HAMMER ____________
FALL ____________

SAMPLER
TYPE ____________
HAMMER ____________
FALL ____________

OTHER:

GROUNDWATER READINGS

DATE	DEPTH	CASING	STABILIZATION TIME

	SAMPLE				SAMPLE DESCRIPTION	STRATA. CHANGE AND GENERAL DESCRIPTION	FIELD TESTING HNU OR OVA	EQUIPMENT OR WELL INSTALLED
	NO.	REC.	DEPTH	BLOWS				
5'								
10'								
15'								
20'								

SAMPLE IDENTIFICATION
S ----- SPLIT SPOON
T ----- THIN WALL TUBE
U ----- UNDISTURBED PISTON
O ----- OPEN END ROD
W ----- WASH SAMPLE
A ----- AUGER SAMPLE

PENETRATION RESISTANCE
140 LB WT FALLING 30" ON 2" O.D. SAMPLER

COHESIONLESS DENSITY		COHESIVE CONSISTENCY	
0-4	VERY LOOSE	0-2	VERY SOFT
5-9	LOOSE	3-4	SOFT
10-29	MED. DENSE	5-8	M/STIFF
30-49	DENSE	9-15	STIFF
50+	VERY DENSE	16-30	V-STIFF
		31+	HARD

PROPORTIONS USED

TRACE	0 TO 10%
LITTLE	10 TO 20%
SOME	20 TO 35%
AND	35 TO 50%

EXHIBIT 10 (CONT'D)

HMM Associates

GROUNDWATER OBSERVATION WELL REPORT

PROJECT: ____________________

LOCATION: ____________________

CLIENT: ____________________

CONTRACTOR: ____________________

DRILLER: ____________ INSPECTOR: ____________

INSTALLATION DATE: ____________________

JOB NO. ________

WELL NO. ________

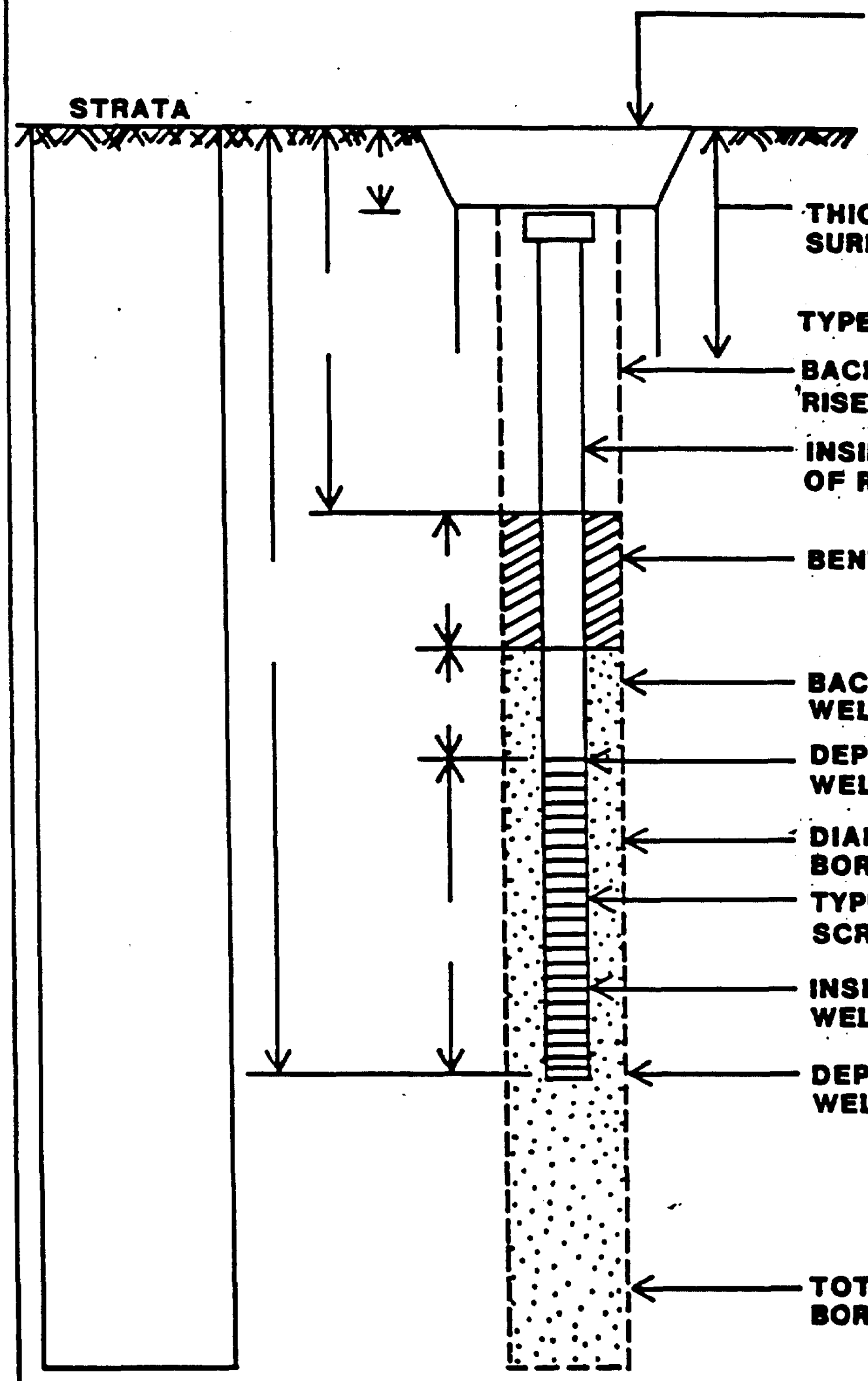
BORING NO. ________

LOCATION ________

____

SHEET ____ OF ____

REMARKS:



GATE BOX/ PROTECTIVE COVER ________

GROUND ELEVATION ________

THICKNESS OF SURFACE SEAL ________

TYPE OF SURFACE SEAL ________

BACKFILL AROUND RISER PIPE ________

INSIDE DIAMETER OF RISER PIPE ________

BENTONITE SEAL(S) ________

BACKFILL AROUND WELLPOINT ________

DEPTH TO TOP OF WELLPOINT BELOW SURFACE ________

DIAMETER OF BOREHOLE ________

TYPE OF WELLPOINT ________

SCREEN SIZE ________

INSIDE DIAMETER OF WELLPOINT ________

DEPTH TO BOTTOM OF WELLPOINT BELOW SURFACE ________

TOTAL DEPTH OF BORING ________

EXHIBIT 10 (CONT'D)

HMM Associates

GROUND WATER MONITORING REPORT

OW/PZ NUMBER: ______________

ELEVATION SUBTRAHEND ______________

JOB NO. ______________

PAGE NO. ______________

DATE	TIME	ELAPSED TIME	DEPTH OF WATER FROM ______	ELEVATION OF WATER	REMARKS	READ BY

CHEMICAL ANALYSIS

____of____pages

Collector: ____________
Julian Date(s) ____________

Analyst: ____________
Date: ____________

Stored by: ____________
Date: ____________

Posted: ________
Logged: ________

Proofed: ________

STORET Codes			00041	00021	00011	00094	00300	00400	00070							
Station	Date	Time	Weather	Air-Temp.	H_2O-Temp.	Cond.	D.O.	pH	Turb.							

REMARKS

EXHIBIT 11

SCHEDULE OF PERFORMANCE AUDITS

Subtask	Details of Performance Audit	Date
2A Study Area Survey	- To review data used to create the draft site base map.	1/22/88
	- Review of Final Site Base Map.	11/22/88
	- Review of report on historical photo analysis.	1/22/88
2B Project Operations Plan	- N/A	
2C Geophysical Investigations	- Review data collected during surveys.	8/31/88
	- Upon completion of all surveys the prepared maps will be reviewed.	8/31/88
2D Air Sampling	- Review of data obtained from initial site walk over. a) Review of HNU & OVA calibration procedures b) Review of field log book(s) c) Review of field data sheets	8/28/88
	- If Phase II is required: a) A review of the OVA/GC mode calibration for specific VOC analysis b) Review of data if it is suggested that airborne contamination has or potentially may migrate off-site. c) Review of analytical data for the samples collected, and review of all QC data from Alliance Technologies Corporation.	*
2E Surface Water and Sediment Sampling	- Review of Sampling protocols	9/1/88
	- Review of field logbooks	
	- Review of field data sheets	
	- Review of Chain of Custody forms 1) sample shipment	
	- Review of Analytical Protocols on-site 1) sample receiving logs and storage 2) analytical data review a - samples b - QC	9/14/88

* A review schedule will be set up if phase II is implemented, with prior approval from the USEPA.

EXHIBIT 11 (CONT'D)

Subtask	Details of Performance Audit	Date
2F Monitoring Well Installation Program	- Review of well construction protocols (ASTM) - inspection of well materials - not on ground - Review of field log books - Review of field screening results - split spoon and return water - Review of aquifer test results - Review of field data sheets (boring logs) - Inspection of installed wells (caps and locks) - Security enforcement of all borings, review of protocols in the case of unattended borings.	10/1/88 and 10/1/88
2G Ground Water Sampling	- Review of sampling protocols - Review of decon procedures - Review of equipment - Review of sample chain-of-custody - Review of sample storage - Review of sample transport - Review of the Analytical Lab 1 - sample receiving logs and storage 2 - analytical data review a - samples b - QC	10/1/88 and 10/1/88
2H Soils and Subsurface Investigation	- Review of soil gas protocols - Review of soil gas results	10/1/88 10/1/88
2I Treatability Study	- Review of protocols of treatability studies - Review of Phase I groundwater evaluations - Review of Phase II groundwater evaluations - Review of soil treatability evaluation	3/1/89

Acceptable data quality limits will be derived from the Data Quality Objectives (DQOs) contained in the Sampling and Analysis plan. When the DQOs are not met the QA Manager will take action in the form of a Corrective Action Report (Section 15.0).

13.0 PREVENTATIVE MAINTENANCE

The three major field instruments that require preventative maintenance are the Foxboro Century 128 OVA (OVA), the HNU Intrinsically Safe Photoionization Analyzer (HNU) and the 580A OVM (OVM).

Exhibit 12 represents the required maintenance procedure for the OVA. The staff are trained to perform all of the required routine maintenance. Following the maintenance procedure, the manufacturer lists a table of Recommended Spare Parts for the OVA.

Exhibit 13 represents the required maintenance procedure for the HNU. The staff has been instructed on the routine maintenance procedures. There are only two parts of the HNU that should be maintained by the staff. The lamp and ion chamber both may be cleaned or replaced. Any further required maintenance must be performed by a service person of HNU Systems, Inc. The major recommended HNU spare part to have is the lamp.

Exhibit 13A represents the required maintenance for the OVM. Any other field instrumentation/equipment requires daily Field Maintenance prior to use. This includes checking power switches, connections, fluid levels, fittings, cleanliness, and overall performance of the field instrumentation/equipment.

EXHIBIT 12

MAINTENANCE PROCEDURE FOR OVA 128

MAINTENANCE

This section describes the routine maintenance schedule and provides procedures for trouble-shooting an instrument malfunction.

CAUTION: Maintenance personnel should be thoroughly familiar with instrument operation before performing maintenance. It is essential that all portions of this manual relating to safety of operation, servicing and maintenance, be thoroughly understood. There should be no potential igniters or flame in the area when filling, emptying or purging the hydrogen system and the instrument should be turned off.

Extreme care should be exercised to ensure that required parts replacement is accomplished with the parts specified by Foxboro. NO MODIFICATIONS ARE PERMITTED. DISASSEMBLE INSTRUMENT ONLY IN A NON-HAZARDOUS ATMOSHPHERE.

Routine Maintenance *(Refer to Figure 5)*

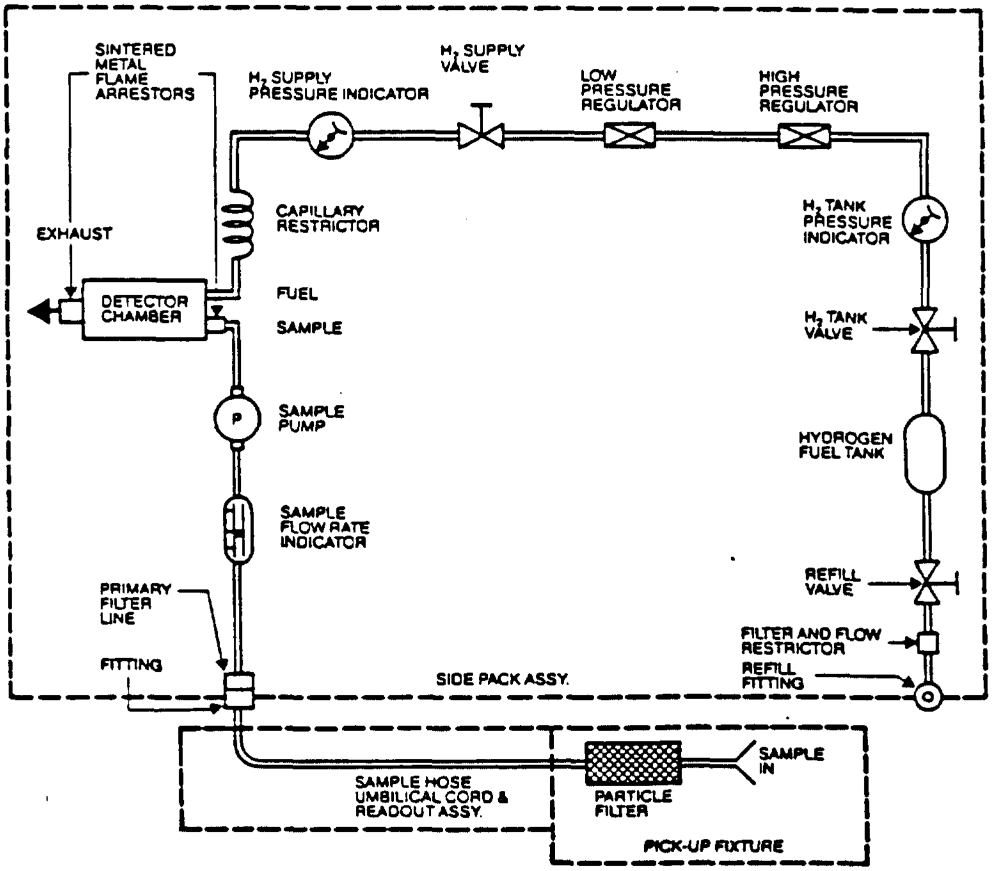


FIGURE 5
BLOCK DIAGRAM - GAS HANDLING SYSTEM

EXHIBIT 12 (CONT'D)

Primary Filter

This filter is located behind the sample inlet connector (Fitting Assembly) on the Side Pack Assembly and is removed for cleaning by using a 7/16 inch thin wall socket to unscrew the Fitting Assembly. The filter cup, "O" ring and loading spring will then come out. The porous stainless filter cup can be cleaned by blowing out or washing in solvent. If a solvent is used, care should be taken to ensure that all solvent is removed by blowing out or heating the filter. Reassemble in reverse order ensuring that the "O" ring seal on the Fitting Assembly is intact.

Secondary Filter

A particle filter is located in each pick-up fixture. One of these filters must be in the sample line whenever the instrument is in use. The OVA 128 uses a porous metal filter which can be replaced or cleaned.

Mixer/Burner Assembly Filter

A porous metal particle filter is incorporated in the Mixer/Burner Assembly which screws into the Preamp Assembly. This filter is used as the sample mixer and inlet flame arrestor in the chamber. The filter should not become contaminated under normal conditions but can be cleaned or the assembly replaced if necessary.

Access to this filter or output surface does not require removing the instrument from the case. For access, remove the safety cover using a hex key wrench (supplied) then unscrew the exhaust port. The Filter Assembly can now be seen on the side of the chamber (Preamp Assembly) and can be cleaned with a small wire brush.

Exhaust Flame Arrestor

A porous metal flame arrestor is located in the exhaust port of the detector chamber (Preamp Assembly). It acts as a particle filter on the chamber output and restricts foreign matter from entering the chamber. This filter may be cleaned by removing the exhaust port. For access, see Mixer/Burner section above. Note that the filter is captive to the exhaust port. Clean the filter with a solvent or detergent and ensure that it is dry and completely baked out at 120°F before reinstalling.

Sampling Fixtures

Sampling fixtures should be periodically cleaned with an air hose and/or detergent water to eliminate foreign particle matter.

If a solvent is used, the fixture should be subsequently cleaned with detergent and baked out at 120°F to eliminate residual hydrocarbons from the solvent.

Hydrogen Tank Supply & Refill Valves

After some time, the Teflon washers under each valve packing nut can "cold flow" (move with pressure) and allow hydrogen to leak. Leakage can be determined by using Leak-Tec, Snoop or a soap solution around the valve stems. This leakage can usually be stopped by tightening the compression nut (adapter) as outlined below.

a) Unscrew the packing nut with a 7/16 inch wrench
b) Unscrew the valve
c) Replace the compression rings

This compression is against soft material and only a small amount of force is necessary to sufficiently compress the Teflon washers. If, after tightening, leakage still occurs, it would be advisable to replace the two Teflon washers, as follows:

a) Drain hydrogen system slowly and to the extent necessary to work on the leaking valve(s). Observe safety precautions. There should be no potential igniters in the area.

b) Remove all three (3) knob screws and knobs.

c) Remove the compression nut on the valve that is not sealing properly. Remove the stem by unscrewing it from the valve body. Observe the sandwich of metal and Teflon washers and note their order.

d) Visually check the Kel-F™ seat on the stem for cracks or foreign material. Wipe clean, if necessary, with a lint free cloth (no solvents or oils) and replace if damaged.

e) Remove the washers and replace the Teflon washers (the factory procedure is a light wipe of HYDROCARBON FREE silicone grease).

f) Replace the stem assembly in the valve body and tighten lightly.

EXHIBIT 12 (CONT'D)

g) Push the washers down into the compression area in the same order as noted upon removal. Replace the compression nut and tighten snuggly.

h) Close the low pressure valve and fill the tank assembly. Check valves for leaks. Tighten again, if necessary, and reassemble the unit.

Air Sampling System Maintenance

A potential problem associated with the OVA instrument is that leaks can develop in the air sample pumping system. These leaks can result in dilution or loss of sample, causing low reading of vapor concentration and slow response.

The OVA is equipped with a flow gauge that provides a method to check for air leaks. Assemble the pickup probe selected for use to the readout assembly and then position the sidepack vertically so the flow gauge may be observed. Cover the end of the pickup probe with your finger and observe that the ball in the flow gauge goes to the bottom, indicating no air flow (if ball has slight chatter while on bottom, this is acceptable). Cover the center of the chamber exhaust port with your thumb and again observe the ball going to the bottom. Another simple check is to expose the pickup probe to cigarette smoke or a light vapor (butane) and observe that the meter responds in approximately 2.0 seconds. It should be noted that slow meter response may also indicate a restriction in the air sampling system.

Failure of the ball to go to the bottom when the inlet is blocked indicates a leak in the system between the probe and the pump inlet or the inlet check valve. To isolate the problem, remove parts, one at a time, and again block off the air inlet. Remove the pickup probe(s) and cover the air inlet at the Readout Assembly. If the ball goes to the bottom, check that the "readout to probe" seal washer is in place and replace the probes, holding them back against this seal while tightening the nut. Recheck, and if leakage is still present, it is probably in the probe (pickup fixture), which should be repaired or replaced.

If leakage is indicated as being past the readout handle when the connection to the sidepack is tight, disconnect the sample line at the fitting on the sidepack and cover this inlet with your finger. If the flow gauge ball goes to the bottom, the problem should be a leak in the umbilical cord/Readout Assembly, which should be investigated and repaired. There is also the possibility of a leaking check valve in the pump which would not show up on this test. If the leakage is not found in the umbilical cord, it is most likely in the pump check valve. The pump should be replaced.

If the ball does not go to the bottom, the leak will be either in the flow gauge or it's connecting tubing. Visually check that the tubing is connected and if so, the flow gauge should be repaired or replaced. Check the "O" ring installation in the sample inlet connector (Fitting Assembly).

As an alternate approach, leaks on the inlet side of the pump can be detected by using alcohol on a "Q" Tip and lightly swabbing the connections one at a time or by directing organic vapor or smoke at the potential leakage points and observing the meter response or audible alarm.

Leaks (beyond the pump) are easier to locate, as any of the commercially available leak detection solutions can be used. Cover the exhaust port, which will place the exhaust system under pressure, and check each connection, one at a time. Replace the Teflon tubing or retape the threaded connections with Teflon joint tape. Check the igniter and Mixer/Burner Assembly where they screw into the detector, the high voltage terminal screw on the side of the Mixer/Burner and exhaust port itself. If after these checks, the flow gauge ball still will not go to the bottom with the exhaust blocked, the problem is likely a leaking exhaust check valve in the pump, which should be repaired or replaced.

Contaminating Control

On occasion, the background reading may be relatively high under normal ambient conditions. Ambient background readings will vary somewhat depending on the geographical location where the instrument is being used. However, the background reading normally should be in the range of 3 to 5 ppm as methane. The acceptable background reading consists of 1 to 1½ ppm of methane which is present in the normal air environment. In addition to the measurement of a normal methane background, there will normally be 2 to 4 ppm of equivalent methane background caused by acceptable levels of contamination in the hydrogen fuel and/or hydrogen fuel handling system resulting in a total equivalent methane reading of 3 to 5 ppm in clean air.

If the background reading goes above 5 ppm to 6 or 7 ppm, this is normally still acceptable since any measurement is additive to that background reading, i.e., 2 ppm on top of 5 or 2 ppm on top of 7 provides the same differential reading, however, the lower background is obviously desirable.

The background reading is zeroed out or nulled - even though in reality the background still exists. The background reading is measured by zeroing the meter with the flame out and noting the meter indication after the flame is on.

The cause for a high background reading is usually associated with contamination in the hydrogen fuel system. This will, of course, cause a background reading since this is the function of the basic detector "to measure contamination entering the detector chamber". In addition, contamination present in the hydrogen will many times leave a small unobservable deposit on the burner face which can continue to generate a background reading when the detector is in operation and the burner assembly is heated.

Another possible cause of contamination is the Mixer/Burner Assembly when the contamination is trapped in the porous bronze sample filter. This is not a common problem and usually only happens when an unusually high level of contaminant is drawn into the assembly. Another possible cause of high background reading is contamination in the air sample line to the detector. This is uncommon but can be the source of the problem.

NOTE: An OVA that has the Chromatograph Option can have high background caused by saturation or contamination of the activated charcoal filter, which is in the line during chromatograph analysis, or of the column which is in the hydrogen line at all times.

Analysis and Correction

Prior to analyzing the problem, the OVA should be checked for proper electronic operation. It should be ensured that the instrument is calibrated to methane as referenced.

If, after checking that the OVA is properly calibrated, the background is still higher than normal for ambient conditions, the following procedure should be followed to isolate the cause of the problem:

a) Let the OVA run for a period of time (15 to 30 minutes) and see if the background level decreases as a function of time. The background could go down as a result of clearing line contamination which is removable simply by the normal flow of air through the sample line.

b) Take a reading in a known, relatively clean air environment. Normally, outside air environment is clean enough to assess by comparison whether the background reading is internal to the instrument or is present in the location where the instrument is being used.

c) If the OVA has the Gas Chromatograph Option, depress the sample inject valve, so that the activated charcoal is in the line, and observe whether the background reading goes down and stays steady after elution of the air peak. The reading should always go down or stay the same but never increase when the sample valve is depressed, since the charcoal filter will remove trace elements of organic vapors in the air sample heavier than C_2. If another activated charcoal filter is available, this may be attached to the end of the probe to scrub the air so that a clean air sample is supplied to the detector. The external activated charcoal filter can be used on any instrument, with or without chromatograph, for providing a clean air sample to assess background level.

d) If the background cannot be reduced by any of the previous steps, remove the safety cover and the exhaust port of the detector chamber (on the bottom of the case) and clean the cavity and the electrode using the small wire brush supplied with the analyzer. This will remove any small quantities of contamination which could be the source of the background vapor. After cleaning, replace the exhaust port and safety cover and reignite the OVA. If detector contamination was the cause, the problem should be immediately resolved and the ambient back ground will drop to an acceptable level.

EXHIBIT 12 (CONT'D)

e) If the high background is still present, the various parts of the sample flow line such as pickup probes, umbilical cord to the instrument, etc., should be investigated by the process of elimination to see if the contamination can be isolated.

Serious contamination in the air sample line is very uncommon, however, if very large doses of low vapor pressure compounds are sampled, there is a possibility of residual contamination. This would eventually clear itself out but may take a considerable period of time. A typical cause for high background from the sample line is a contaminated Mixer/Burner Assembly. If heavy contamination of the Mixer/Burner is indicated, replace the Mixer/Burner Assembly.

f) In the event of contamination in the pump or other internal parts of the sample flow lines which cannot be removed, the sample flow components have to be disassembled and cleaned. This is normally a factory operation, however, components such as the pump can be replaced in the field along with any contaminated tubing.

g) High background readings on OVA's which include the Gas Chromatograph Option can be caused by other sources of contamination. If the charcoal filter mounted on the instrument panel <u>is</u> saturated, contaminated air would be supplied to the detector and raise the ambient level background. To check for this, refill the cartridge with fresh charcoal, Foxboro P/N CSC004. This would determine if the charcoal was the source of the background reading. It is also possible that a high background reading could be due to contamination in the column. This could be caused by compounds slowly eluting from a column which has become contaminated. The easiest way to check for column contamination is to replace the column with a clean column or a short empty piece of column tubing and see if the high background reading drops.

h) If the above steps do not correct the high background, the cause will normally be contamination in the hydrogen fuel system.

Contamination in the hydrogen fuel system is usually the direct result of contaminated hydrogen gas or contamination introduced during the filling operation. Filling hose contamination can be caused by storing the hose in a contaminated area.

To remove contamination, the fuel system should be purged with hydrogen. Effective purging is accomplished by disconnecting the capillary tube fitting to the manifold block which has the low pressure gauge (Hydrogen Supply Pressure Gauge and Hydrogen Supply Valve). This disconnects the capillary tubing from the hydrogen line so that hydrogen may be purged at a reasonable rate from the tank assembly through the regulators, gauges and valves. After disconnecting the capillary, the hydrogen tank can be filled in the normal manner. The tank valve and hydrogen supply valve can then be opened which will bleed the hydrogen from the tank through the hydrogen fuel system, purging contamination which is in vapor form. There is the possibility that contamination has been introduced into the hydrogen fuel system which is not readily purged by the hydrogen gas, but this is unlikely. After purging with clean hydrogen two or three times, the capillary tube should be reconnected and the background again checked. Five or ten minutes should be allowed before assessing the background reading, since contaminated hydrogen can be trapped in the capillary tube.

If another clean instrument is available, the fuel system from the clean instrument can be connected to the contaminated instrument to verify whether the problem is associated with the hydrogen fuel supply system. The interconnection should be made to the capillary tube of the contaminated instrument.

Troubleshooting

Table 1 presents a summary of field troubleshooting procedures. If necessary, the instrument can be easily removed from the case by unlocking the four (4) ¼ turn fasteners on the panel face and removing the refill cap. The battery pack is removed by taking out the four (4) screws on the panel and disconnecting the power connector.

EXHIBIT 12 (CONT'D)

Factory Maintenance

To ensure continuous trouble-free operation, a periodic factory maintenance, overhaul, and recalibration is recommended. The recommended schedule is every six to nine months. This maintenance program includes replacement of plastic seals and parts as required, pump overhaul, motor check, sample line cleaning, hydrogen leak check, recalibration, and detailed examination of the unit for any other required maintenance and repair.

Recommended Spare Parts

Item	Description	Part Number	Recommended Quantity
1	Igniter	510461-1	2
2	Pump Assembly	510223-6	1
3	Cup, Filter (3/8 inch OD, ss)	510318-1 (5/pkg.)	1
4	Mixer/Burner Assembly	510513-1	1
5	Wafer, Teflon, H_2 Valve	510160-1 (10/pkg.)	1
6	Washer, Brass, H_2 Valve	510160-2 (10/pkg.)	1
7	Exhaust Port Assembly	510530-1	1
8	Battery Pack Assembly	510542-1	1
9	Sample Line Assembly	510316-1	1
10	Particle Filters	510116-1	1

EXHIBIT 13

MAINTENANCE PROCEDURE FOR THE HNU ISPI 101

5.1 INTRODUCTION

User maintenance of the analyzer consists of cleaning the lamp and ion chamber, and replacing the lamp or ion chamber. Other component parts or subassemblies may be serviced only by a service person trained and authorized by HNU Systems, Inc. HNU Systems has made this policy to maintain the Intrinsically Safe properties of the ISPI 101.

WARNING: Turn the function switch on the control panel to the OFF position before probe disassembly. Otherwise, high voltage of 1000 V DC will be present in the probe assembly.

WARNING: Do not look at the light source from any closer than 6 inches with unprotected eyes. Observe the source only briefly. Continued exposure to ultraviolet energy generated by the light source can be harmful to eyesight.

CAUTION: Do not interchange lamps of different eV ratings in a probe. Amplifier and other components are selected for a specific eV lamp. A probe with the wrong lamp will not operate properly.

5.2 CLEANING PROCEDURE FOR ISPI-101 LAMPS AND ION CHAMBER

During periods of operation of the analyzer, dust or other foreign matter could be drawn into the probe forming deposits on the surface of the UV lamp or in the ion chamber. This condition is indicated by meter readings that are low, erratic, unstable, non-repeatable, or drifting, or apparently due to moisture sensitivity. These deposits interfere with the ionization process and cause erroneous readings. Check for this condition monthly or more often as required. Cleaning can be accomplished as follows:

a. Lamp Removal

1. Remove 5/32" hex screw (exhaust screw) with Allen wrench provided. Slide the innards out of the probe shell.

2. Remove the probe from the unit. Hold the probe upright, cable down (see Figure 5-2). Remove the two cross-headed screws that hold the black end cap. Carefully remove the end cap. Remove the two screws holding the ion chamber on, and lift the chamber off the probe.

3. Loosen the small set screw in the side of the lamp housing, place your hand over the end of the probe and tilt. The lamp will fall into your hand. Notice the eV number etched on the lamp.

b. Lamp Cleaning: 10.2 and 9.5 eV

1. Put a small drop of HNU Cleaning Compound (Part No. #80-PA 101534-A1) on the lens of the lamp (the small glass circle on the metal end).

2. Using a nonlinting tissue, rub in a circular motion until all residue is removed.

3. Rinse with hot, clean tap water, and dry with nonlinting tissue.

4. If the lens is still not clean, repeat steps 1, 2 and 3.

c. Lamp Cleaning: 11.7 eV

1. Clean the lens only (the small glass circle on the metal end) with Freon (TM) or any chlorinated organic solvent to remove any deposits, using a nonlinting tissue.

2. Do NOT use HNU Cleaning Compound, water, or any water-miscible solvent on these lamps.

d. Ion Chamber Cleaning

1. Remove the "O" ring from the side opposite the wire mesh and save.

2. Agitate the whole asssembly in a beaker of methanol or acetone, or place the beaker and contents in an ultrasonic bath for ten minutes.

3. Remove the beaker and shake out the surplus solvent. Dry overnight at room temperature or bake for two hours in a drying oven at 100 oC. Do not dry at temperatures over 100 oC. Allow chamber to cool completely before reinstalling.

4. In an emergency, careful use of a hairdryer is permissible.

e. Reassembly

1. Hold the probe upright, cable down, and replace the lamp with the lens uppermost. Tighten the set screw in the lamp housing after insertion.

2. Replace the "O" ring in the groove in the ion chamber (side opposite the wire mesh).

3. Place the ion chamber over the lamp with the wire mesh side on top. Make sure all the connection pins, screw holes, and the vent hole in the ion chamber are correctly aligned. (The small vent hole in the ion chamber lines up with the vent hole in the probe, which has a small black "O" ring around it). Secure the chamber with the two screws.

4. Replace the probe cap noting the alignment of the screw holes. Replace the two screws and tighten evenly.

5. Replace the lamp housing in the probe shell, aligning the exhaust ports and the amplifier board connector. Secure with the hex exhaust screw.

6. Reattach the probe to the analyzer and check the analyzer operation.

7. If performance is still not satisfactory replace the lamp. See Section 5.3, below.

The unit is now ready to be used.

5.3 LAMP REPLACEMENT

CAUTION

Do not exchange lamps of different eV ratings in a probe. Amplifier and components are selected for a specific eV lamp. A probe with the wrong lamp will not operate properly.

To replace the lamp, disassemble the probe, remove the old lamp, install a new one of the same eV rating and reassemble.

WARNING

Turn the function switch on the control panel to the OFF position before disassembly. Otherwise, high voltage of 1000 V DC will be present in the probe assembly.

5.4 LAMP eV POWER CHANGE

If different applications for the analyzer would require lamps of different eV power, then separate probes, each with its own eV lamp, must be used. A single readout assembly will serve for any of the probes. A change in probe will require resetting of the ZERO control and the SPAN control. Calibration should be checked to verify proper operation.

5.5 PROBE DISASSEMBLY/ASSEMBLY

WARNING

Turn the function switch on the control panel to the OFF position before probe disassembly. Otherwise high voltage of 1000 V DC will be present in the probe assembly.

Disassemble the probe by first removing the exhaust screw at the base of the probe adjacent to the handle using the 5/32" hex key (Allen wrench) (see Figure 5-1). Disconnect the probe cable connector at the readout assembly. Grasp the end cap in one hand and the probe shell in the other, gently pull to separate the end cap and the lamp housing from the shell.

Hold the lamp housing with the black end cap upright. Loosen the screws on the top of the end cap, separate the end cap from the lamp housing. Remove the two screws on the ion chamber and separate the chamber from the lamp housing. To remove the lamp, locate the lamp retaining screw on the side of the lamp housing and remove.

CAUTION

Care must be taken so that the lamp does not fall out of the lamp housing when the retaining screw is removed.

Place one hand over the top of the lamp housing and tilt slightly. The light source will slide out of the housing.

Reassemble the probe by first sliding the lamp back into the lamp housing and aligning the screw hole in the lamp retaining ring with the aperture on the side of the lamp housing, then install the lamp retaining screw and tighten.

CAUTION

Overtightening this screw may break the lamp. DO NOT OVERTIGHTEN.

Place the ion chamber on top of the lamp housing, making sure that the contacts and the vent hole are properly aligned. The ion chamber fits only one way; secure it with the two screws.

If the ion chamber is to be replaced, always use one identical to the one being removed. Check the aperture (small: 3.0 mm, used with the 10.2 eV eV lamp; large: 6.0 mm, used with the 9.5 and 11.7 eV lamps) at the top of the ion chamber and materials of construction (gold-plated or Teflon(TM)) to ensure proper replacement. See Parts List, Section 7.

Check the ion chamber electrodes (on the side with NO mesh): the collecting electrode (a disk about 1" in diameter) must not touch the polarizing electrode (the central pin). If they do, call HNU Systems, Inc.

Place the end cap on top of the ion chamber and replace the two screws. Tighten the screws only enough to seal the O-ring.

CAUTION

Do not over-tighten these screws.

Line up the pins (pogo contacts) on the base of the lamp housing with the pins inside the probe shell. Gently slide the housing assembly into the probe shell.

The end cap should meet the probe shell evenly after final assembly. If not, the ion chamber may be installed wrongly.

EXHIBIT 13 (CONT'D)

SECTION 5.5, PROBE DISASSEMBLY/ASSEMBLY cont.

CAUTION

DO NOT FORCE the assembly into the shell.
It fits only one way.

If the probe does not reassemble readily, remove it from the shell and check pin alignment. Check to ensure pogo contacts are not bent. Refasten the exhaust screw at the base of the probe.

Align the 12 pin probe connector to the readout assembly and reconnect with a twisting motion until a click occurs. The lamp should light if the function switch is turned to any position except STANDBY.

5.6 READOUT UNIT

WARNING

The Readout Unit should NEVER be opened except by a service person certified and authorized by HNU Systems, Inc. Leave the case on the Readout Unit, which is fitted with a tamperproof seal.

EXHIBIT 13 (CONT'D)

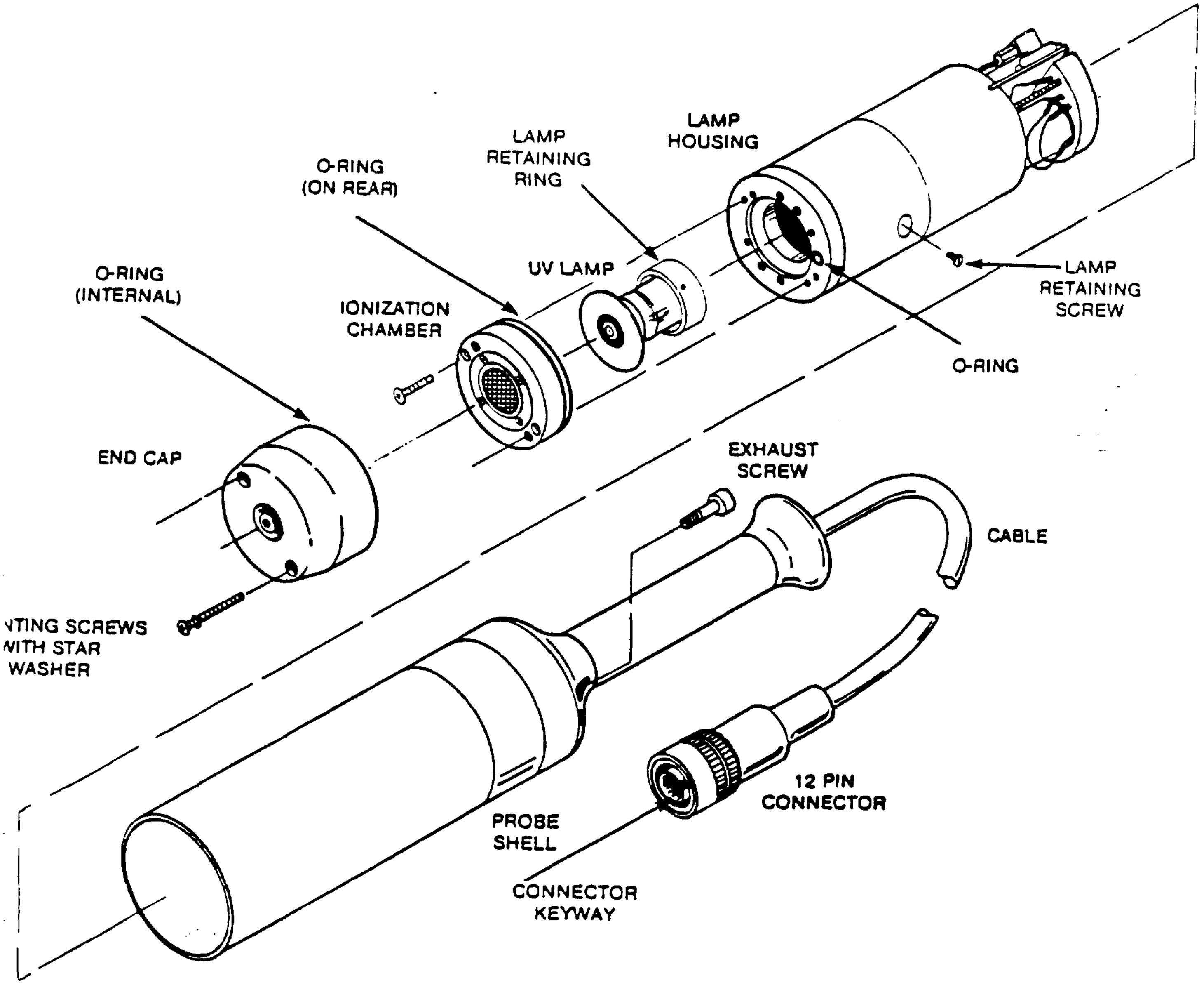


FIGURE 5-1
PROBE ASSEMBLY

EXHIBIT 13A

OVM 580A MAINTENANCE AND SERVICE/HARDWARE PROCEDURES

The routine maintenance of the 580A involves the calibration of the instrument, the cleaning of the lamp window, a the maintaining of charge on the battery. The following pages give instructions for routine maintenace as well as a compl set of technical drawings including electrical circuitry, and system flow.

6.1 LAMP INSERTION AND REMOVAL

6.1.1 REMOVAL

In order to remove the lamp the bolt in the base of the 580A must first be removed. The base should be placed flat a table and the top placed on its side next to the base. The lamp is located inside of the lamp housing. The lamp housi is the cylindrical white teflon structure located behind the detector (see figure 6.1). Pull the lever away from the detector th releasing the lamp housing from the lever. The lamp housing may then be slipped off of the lamp. The lamp may now removed by again pulling the lever away from the detector and then lifting the lamp off of the detector.

6.1.2 INSERTION

The lever should be pulled away from the detector and the lamp placed between the detector and the yolk. The lev may then be released. It is important that the lamp be properly seated. The lamp should be flat against the o-ring thus maki a proper seal. Once the lamp is properly inserted the lamp housing may be placed on. The lamp housing should be slipp over the lamp. The flat edge of the housing oriented towards the bottom of the base. The lever should be pulled slightly f ward and the lamp housing pushed in so that it is secured by the lever.

6.1.3 LAMP CLEANING

On occasion the lamp should be removed for cleaning. Cleaning of the lamp is accomplished by cleaning the lens surfa of the UV lamp. This is accomplished by using the aluminum oxide scouring powder provided with the 580A.

The procedure for cleaning the lamp is as follows. First place a small amount of aluminum oxide scouring powder the lens of the UV lamp. Next gently scour this lens with a soft tissue or cloth. Scour the lens in a rotary type motion. Aft scouring the lens surface gently blow the remaining powder from the lens. Throughly wipe the lamp lens with a clean tiss to remove the last traces of cleaning powder. The lamp is now able to be inserted into the detctor.

14.0 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY AND COMPLETENESS

For each required measurement parameter, an EPA approved method will be used. Each EPA method has built in Quality Control (QC) checks for precision and accuracy. QC check samples are prepared using EPA standards and are analyzed four times by the method. The average recoveries are collected and precision and accuracy are calculated. The laboratory, on an ongoing basis, analyzes spike samples (equivalent to 10% of all samples analyzed) to monitor and evaluate laboratory data quality. The laboratory spikes all samples with surrogate standards to monitor continuing laboratory performance by calculating surrogate recoveries. The laboratory maintains quality control performance records to document the completeness and the quality of the data generated.

Reference can be made to the individual analytical method for the specific Precision and Accuracy methods associated with them.

Exhibit 14 is Chapter 1 from Test Methods for Evaluating Solid Waste - Physical/Chemical Methods, EPA SW-846, 3rd Edition, 1986. This chapter supplies valuable information for assessing the quality of analytical data and will be referred to throughout the Savage Well RI/FS.

EXHIBIT 14

PART I METHODS FOR ANALYTES AND PROPERTIES

Revision 0
Date September 1986

CHAPTER ONE

QUALITY CONTROL

1.1 INTRODUCTION

Appropriate use of data generated under the great range of analytical conditions encountered in RCRA analyses requires reliance on the quality control practices incorporated into the methods and procedures. The Environmental Protection Agency generally requires using approved methods for sampling and analysis operations fulfilling regulatory requirements, but the mere approval of these methods does not guarantee adequate results. Inaccuracies can result from many causes, including unanticipated matrix effects, equipment malfunctions, and operator error. Therefore, the quality control component of each method is indispensable.

The data acquired from quality control procedures are used to estimate and evaluate the information content of analytical data and to determine the necessity or the effect of corrective action procedures. The means used to estimate information content include precision, accuracy, detection limit, and other quantifiable and qualitative indicators.

1.1.1 Purpose of this Chapter

This chapter defines the quality control procedures and components that are mandatory in the performance of analyses, and indicates the quality control information which must be generated with the analytical data. Certain activities in an integrated program to generate quality data can be classified as management (QA) and other as functional (QC). The presentation given here is an overview of such a program.

The following sections discuss some minimum standards for QA/QC programs. The chapter is not a guide to constructing quality assurance project plans, quality control programs, or a quality assurance organization. Generators who are choosing contractors to perform sampling or analytical work, however, should make their choice only after evaluating the contractor's QA/QC program against the procedures presented in these sections. Likewise, laboratories that sample and/or analyze solid wastes should similarily evaluate their QA/QC programs.

Most of the laboratories who will use this manual also carry out testing other than that called for in SW-846. Indeed, many user laboratories have multiple mandates, including analyses of drinking water, wastewater, air and industrial hygiene samples, and process samples. These laboratories will, in most cases, already operate under an organizational structure that includes QA/QC. Regardless of the extent and history of their programs, the users of this manual should consider the development, status, and effectiveness of their QA/QC program in carrying out the testing described here.

1.1.2 Program Design

The initial step for any sampling or analytical work should be strictly to define the program goals. Once the goals have been defined, a program must be designed to meet them. QA and QC measures will be used to monitor the program and to ensure that all data generated are suitable for their intended use. The responsibility of ensuring that the QA/QC measures are properly employed must be assigned to a knowledgeable person who is not directly involved in the sampling or analysis.

One approach that has been found to provide a useful structure for a QA/QC program is the preparation of both general program plans and project-specific QA/QC plans.

The program plan for a laboratory sets up basic laboratory policies, including QA/QC, and may include standard operating procedures for specific tests. The program plan serves as an operational charter for the laboratory, defining its purposes, its organization and its operating principles. Thus, it is an orderly assemblage of management policies, objectives, principles, and general procedures describing how an agency or laboratory intends to produce data of known and accepted quality. The elements of a program plan and its preparation are described in QAMS-004/80.

Project-specific QA/QC plans differ from program plans in that specific details of a particular sampling/analysis program are addressed. For example, a program plan might state that all analyzers will be calibrated according to a specific protocol given in written standard operating procedures for the laboratory (SOP), while a project plan would state that a particular protocol will be used to calibrate the analyzer for a specific set of analyses that have been defined in the plan. The project plan draws on the program plan or its basic structure and applies this management approach to specific determinations. A given agency or laboratory would have only one quality assurance program plan, but would have a quality assurance project plan for each of its projects. The elements of a project plan and its preparation are described in QAMS/005/80 and are listed in Figure 1-1.

Some organizations may find it inconvenient or even unnecessary to prepare a new project plan for each new set of analyses, especially analytical laboratories which receive numerous batches of samples from various customers within and outside their organizations. For these organizations, it is especially important that adequate QA management structures exist and that any procedures used exist as standard operating procedures (SOP), written documents which detail an operation, analysis or action whose mechanisms are thoroughly prescribed and which is commonly accepted as the method for performing certain routine or repetitive tasks. Having copies of SW-846 and all its referenced documents in one's laboratory is not a substitute for having in-house versions of the methods written to conform to specific instrumentation, data needs, and data quality requirements.

EXHIBIT 14 (cont'd)

FIGURE 1-1

ESSENTIAL ELEMENTS OF A QA PROJECT PLAN

1. Title Page
2. Table of Contents
3. Project Description
4. Project Organization and Responsibility
5. QA Objectives
6. Sampling Procedures
7. Sample Custody
8. Calibration Procedures and Frequency
9. Analytical Procedures
10. Data Reduction, Validation, and Reporting
11. Internal Quality Control Checks
12. Performance and System Audits
13. Preventive Maintenance
14. Specific Routine Procedures Used to Assess Data Precision, Accuracy, and Completeness
15. Corrective Action
16. Quality Assurance Reports to Management

1.1.3 Organization and Responsibility

As part of any measurement program, activities for the data generators, data reviewers/approvers, and data users/requestors must be clearly defined. While the specific titles of these individuals will vary among agencies and laboratories, the most basic structure will include at least one representative of each of these three types. The data generator is typically the individual who carries out the analyses at the direction of the data user/requestor or a designate within or outside the laboratory. The data reviewer/approver is responsible for ensuring that the data produced by the data generator meet agreed-upon specifications.

Responsibility for data review is sometimes assigned to a "Quality Assurance Officer" or "QA Manager." This individual has broad authority to approve or disapprove project plans, specific analyses and final reports. The QA Officer is independent from the data generation activities. In general, the QA Officer is responsible for reviewing and advising on all aspects of QA/QC, including:

Assisting the data requestor in specifying the QA/QC procedure to be used during the program;

Making on-site evaluations and submitting audit samples to assist in reviewing QA/QC procedures; and,

if problems are detected, making recommendations to the data requestor and upper corporate/institutional management to ensure that appropriate corrective actions are taken.

In programs where large and complex amounts of data are generated from both field and laboratory activities, it is helpful to designate sampling monitors, analysis monitors, and quality control/data monitors to assist in carrying out the program or project.

The sampling monitor is responsible for field activities. These include:

Determining (with the analysis monitor) appropriate sampling equipment and sample containers to minimize contamination;

Ensuring that samples are collected, preserved, and transported as specified in the workplan; and

Checking that all sample documentation (labels, field notebooks, chain-of-custody records, packing lists) is correct and transmitting that information, along with the samples, to the analytical laboratory.

The analysis monitor is responsible for laboratory activities. These include:

Training and qualifying personnel in specified laboratory QC and analytical procedures, prior to receiving samples;

EXHIBIT 14 (cont'd)

Receiving samples from the field and verifying that incoming samples correspond to the packing list or chain-of-custody sheet; and

Verifying that laboratory QC and analytical procedures are being followed as specified in the workplan, reviewing sample and QC data during the course of analyses, and, if questionable data exist, determining which repeat samples or analyses are needed.

The quality control and data monitor is responsible for QC activities and data management. These include:

Maintaining records of all incoming samples, tracking those samples through subsequent processing and analysis, and, ultimately, appropriately disposing of those samples at the conclusion of the program;

Preparing quality control samples for analysis prior to and during the program;

Preparing QC and sample data for review by the analysis coordinator and the program manager; and

Preparing QC and sample data for transmission and entry into a computer data base, if appropriate.

1.1.4 Performance and Systems Audits

The QA Officer may carry out performance and/or systems audits to ensure that data of known and defensible quality are produced during a program,.

Systems audits are qualitative evaluations of all components of field and laboratory quality control measurement systems. They determine if the measurement systems are being used appropriately. The audits may be carried out before all systems are operational, during the program, or after the completion of the program. Such audits typically involve a comparison of the activities given in the QA/QC plan with those actually scheduled or performed. A special type of systems audit is the data management audit. This audit addresses only data collection and management activities.

The performance audit is a quantitative evaluation of the measurement systems of a program. It requires testing the measurement systems with samples of known composition or behavior to evaluate precision and accuracy. The performance audit is carried out by or under the auspices of the QA Officer without the knowledge of the analysts. Since this is seldom achievable, many variations are used that increase the awareness of the analyst as to the nature of the audit material.

1.1.5 Corrective Action

Corrective action procedures should be addressed in the program plan, project, or SOP. These should include the following elements:

The EPA predetermined limits for data acceptability beyond which corrective action is required;

Procedures for corrective action; and,

For each measurement system, identification of the individual responsible for initiating the corrective action and the individual responsible for approving the corrective action, if necessary.

The need for corrective action may be identified by system or performance audits or by standard QC procedures. The essential steps in the corrective action system are:

Identification and definition of the problem;

Assignment of responsibility for investigating the problem;

Investigation and determination of the cause of the problem;

Determination of a corrective action to eliminate the problem;

Assigning and accepting responsibility for implementing the corrective action;

Implementing the corrective action and evaluating its effectiveness; and

Verifying that the corrective action has eliminated the problem.

The QA Officer should ensure that these steps are taken and that the problem which led to the corrective action has been resolved.

1.1.6 QA/QC Reporting to Management

QA Project Program or Plans should provide a mechanism for periodic reporting to management (or to the data user) on the performance of the measurement system and the data quality. Minimally, these reports should include:

Periodic assessment of measurement quality indicators, i.e., data accuracy, precision and completeness;

Results of performance audits;

Results of system audits; and

Significant QA problems and recommended solutions.

The individual responsible within the organization structure for preparing the periodic reports should be identified in the organizational or management plan. The final report for each project should also include a separate QA section which summarizes data quality information contained in the periodic reports.

Other guidance on quality assurance management and organizations is available from the Agency and professional organizations such as ASTM, AOAC, APHA and FDA.

1.1.7 Quality Control Program for the Analysis of RCRA Samples

An analytical quality control program develops information which can be used to:

Evaluate the accuracy and precision of analytical data in order to establish the quality of the data;

Provide an indication of the need for corrective actions, when comparison with existing regulatory or program criteria or data trends shows that activities must be changed or monitored to a different degree; and

To determine the effect of corrective actions.

1.1.8 Definitions

ACCURACY:	Accuracy means the nearness of a result or the mean ($\bar{X}$) of a set of results to the true value. Accuracy is assessed by means of reference samples and percent recoveries.
ANALYTICAL BATCH:	The basic unit for analytical quality control is the analytical batch. The analytical batch is defined as samples which are analyzed together with the same method sequence and the same lots of reagents and with the manipulations common to each sample within the same time period or in continuous sequential time periods. Samples in each batch should be of similar composition.
BLANK:	A blank is an artificial sample designed to monitor the introduction of artifacts into the process. For aqueous samples, reagent water is used as a blank matrix; however, a universal blank matrix does not exist for solid samples, and therefore, no matrix is used. The blank is taken through the appropriate steps of the process. A reagent blank is an aliquot of analyte-free water or solvent analyzed with the analytical batch. Field blanks are aliquots of analyte-free water or solvents brought to the field in sealed containers and transported back to the

laboratory with the sample containers. Trip blanks and equipment blanks are two specific types of field blanks. Trip blanks are not opened in the field. They are a check on sample contamination originating from sample transport, shipping and from site conditions. Equipment blanks are opened in the field and the contents are poured appropriately over or through the sample collection device, collected in a sample container, and returned to the laboratory as a sample. Equipment blanks are a check on sampling device cleanliness.

CALIBRATION CHECK: Verification of the ratio of instrument response to analyte amount, a calibration check, is done by analyzing for analyte standards in an appropriate solvent. Calibration check solutions are made from a stock solution which is different from the stock used to prepare standards.

CHECK SAMPLE: A blank which has been spiked with the analyte(s) from an independent source in order to monitor the execution of the analytical method is called a check sample. The level of the spike shall be at the regulatory action level when applicable. Otherwise, the spike shall be at 5 times the estimate of the quantification limit. The matrix used shall be phase matched with the samples and well characterized: for an example, reagent grade water is appropriate for an aqueous sample.

ENVIRONMENTAL SAMPLE: An environmental sample or field sample is a representative sample of any material (aqueous, nonaqueous, or multimedia) collected from any source for which determination of composition or contamination is requested or required. For the purposes of this manual, environmental samples shall be classified as follows:

Surface Water and Ground Water;

Drinking Water -- delivered (treated or untreated) water designated as potable water;

Water/Wastewater -- raw source waters for public drinking water supplies, ground waters, municipal influents/effluents, and industrial influents/effluents;

Sludge -- municipal sludges and industrial sludges;

Waste -- aqueous and nonaqueous liquid wastes, chemical solids, contaminated soils, and industrial liquid and solid wastes.

MATRIX/SPIKE-DUPLICATE ANALYSIS:	In matrix/spike duplicate analysis, predetermined quantities of stock solutions of certain analytes are added to a added to a sample matrix prior to sample extraction/digestion and analysis. Samples are split into duplicates, spiked and analyzed. Percent recoveries are calculated for each of the analytes detected. The relative percent difference between the samples is calculated and used to assess analytical precision. The concentration of the spike should be at the regulatory standard level or the estimated or actual method quantification limit. When the concentration of the analyte in the sample is greater than 0.1%, no spike of the analyte is necessary.
MQL:	The method quantification limit (MQL) is the minimum concentration of a substance that can be measured and reported.
PRECISION:	Precision means the measurement of agreement of a set of replicate results among themselves without assumption of any prior information as to the true result. Precision is assessed by means of duplicate/replicate sample analysis.
PQL:	The practical quantitation limit (PQL) is the lowest level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions.
RCRA:	The Resource Conservation and Recovery Act.
REAGENT GRADE:	Analytical reagent (AR) grade, ACS reagent grade, and reagent grade are synonomous terms for reagents which conform to the current specifications of the Committee on Analytical Reagents of the American Chemical Society.
REPLICATE SAMPLE:	A replicate sample is a sample prepared by dividing a sample into two or more separate aliquots. Duplicate samples are considered to be two replicates.
STANDARD CURVE:	A standard curve is a curve which plots concentrations of known analyte standard versus the instrument response to the analyte.
SURROGATE:	Surrogates are organic compounds which are similar to analytes of interest in chemical composition, extraction, and chromatography, but which are not normally found in environmental samples. These compounds are spiked into all blanks, standards, samples and spiked samples prior to analysis. Percent recoveries are calculated for each surrogate.

EXHIBIT 14 (cont'd)

WATER: <u>Reagent</u>, <u>analyte-free</u>, or <u>laboratory</u> <u>pure</u> <u>water</u> means distilled or deionized water or Type II reagent water which is free of contaminants that may interfere with the analytical test in question.

1.2 QUALITY CONTROL

The procedures indicated below are to be performed for all analyses. Specific instructions relevant to particular analyses are given in the pertinent analytical procedures.

1.2.1 <u>Field Quality Control</u>

The sampling component of the Quality Assurance Project Plan (QAPP) shall include:

Reference to or incorporation of accepted sampling techniques in the sampling plan;

Procedures for documenting and justifying any field actions contrary to the QAPP;

Documentation of all pre-field activities such as equipment check-out, calibrations, and container storage and preparation;

Documentation of field measurement quality control data (quality control procedures for such measurements shall be equivalent to corresponding laboratory QC procedures);

Documentation of field activities;

Documentation of post-field activities including sample shipment and receipt, field team de-briefing and equipment check-in;

Generation of quality control samples including duplicate samples, field blanks, equipment blanks, and trip blanks; and

The use of these samples in the context of data evaluation, with details of the methods employed (including statistical methods) and of the criteria upon which the information generated will be judged.

1.2.2 <u>Analytical Quality Control</u>

A quality control operation or component is only useful if it can be measured or documented. The following components of analytical quality control are related to the analytical batch. The procedures described are intended to be applied to chemical analytical procedures; although the principles are applicable to radio-chemical or biological analysis, the procedures may not be directly applicable to such techniques.

EXHIBIT 14 (cont'd)

All quality control data and records required by this section shall be retained by the laboratory and shall be made available to the data requestor as appropriate. The frequencies of these procedures shall be as stated below or at least once with each analytical batch.

1.2.2.1 Spikes, Blanks and Duplicates

General Requirements

These procedures shall be performed at least once with each analytical batch with a minimum of once per twenty samples.

1.2.2.1.1 Duplicate Spike

A split/spiked field sample shall be analyzed with every analytical batch or once in twenty samples, whichever is the greater frequency. Analytes stipulated by the analytical method, by applicable regulations, or by other specific requirements must be spiked into the sample. Selection of the sample to be spiked and/or split depends on the information required and the variety of conditions within a typical matrix. In some situations, requirements of the site being sampled may dictate that the sampling team select a sample to be spiked and split based on a pre-visit evaluation or the on-site inspection. This does not preclude the laboratory's spiking a sample of its own selection as well. In other situations the laboratory may select the appropriate sample. The laboratory's selection should be guided by the objective of spiking, which is to determine the extent of matrix bias or interference on analyte recovery and sample-to-sample precision. For soil/sediment samples, spiking is performed at approximately 3 ppm and, therefore, compounds in excess of this concentration in the sample may cause interferences for the determination of the spiked analytes.

1.2.2.1.2 Blanks

Each batch shall be accompanied by a reagent blank. The reagent blank shall be carried through the entire analytical procedure.

1.2.2.1.3 Field Samples/Surrogate Compounds

Every blank, standard, and environmental sample (including matrix spike/matrix duplicate samples) shall be spiked with surrogate compounds prior to purging or extraction. Surrogates shall be spiked into samples according to the appropriate analytical methods. Surrogate spike recoveries shall fall within the control limits set by the laboratory (in accordance with procedures specified in the method or within ±20%) for samples falling within the quantification limits without dilution. Dilution of samples to bring the analyte concentration into the linear range of calibration may dilute the surrogates below the quantification limit; evaluation of analytical quality then will rely on the quality control embodied in the check, spiked and duplicate spiked samples.

1.2.2.1.4 Check Sample

Each analytical batch shall contain a check sample. The analytes employed shall be a representative subset of the analytes to be determined. The concentrations of these analytes shall approach the estimated quantification limit in the matrix of the check sample. In particular, check samples for metallic analytes shall be matched to field samples in phase and in general matrix composition.

1.2.2.2 Clean-Ups

Quality control procedures described here are intended for adsorbent chromatography and back extractions applied to organic extracts. All batches of adsorbents (Florisil, alumina, silica gel, etc.) prepared for use shall be checked for analyte recovery by running the elution pattern with standards as a column check. The elution pattern shall be optimized for maximum recovery of analytes and maximum rejection of contaminants.

1.2.2.2.1 Column Check Sample

The elution pattern shall be reconfirmed with a column check of standard compounds after activating or deactivating a batch of adsorbent. These compounds shall be representative of each elution fraction. Recovery as specified in the methods is considered an acceptable column check. A result lower than specified indicates that the procedure is not acceptable or has been misapplied.

1.2.2.2.2 Column Check Sample Blank

The check blank shall be run after activating or deactivating a batch of adsorbent.

1.2.2.3 Determinations

1.2.2.3.1 Instrument Adjustment: Tuning, Alignment, etc.

Requirements and procedures are instrument- and method-specific. Analytical instrumentation shall be tuned and aligned in accordance with requirements which are specific to the instrumentation procedures employed. Individual determinative procedures shall be consulted. Criteria for initial conditions and for continuing confirmation conditions for methods within this manual are found in the appropriate procedures.

1.2.2.3.2 Calibration

Analytical instrumentation shall be calibrated in accordance with requirements which are specific to the instrumentation and procedures employed. Introductory Methods 7000 and 8000 and appropriate analytical procedures shall be consulted for criteria for initial and continuing calibration.

EXHIBIT 14 (cont'd)

1.2.2.3.3 Additional QC Requirements for Inorganic Analysis

Standard curves used in the determination of inorganic analytes shall be prepared as follows:

Standard curves derived from data consisting of one reagent blank and four concentrations shall be prepared for each analyte. The response for each prepared standard shall be based upon the average of three replicate readings of each standard. The standard curve shall be used with each subsequent analysis provided that the standard curve is verified by using at least one reagent blank and one standard at a level normally encountered or expected in such samples. The response for each standard shall be based upon the average of three replicate readings of the standard. If the results of the verification are not within ±10% of the original curve, a new standard shall be prepared and analyzed. If the results of the second verification are not within ±10% of the original standard curve, a reference standard should be employed to determine if the discrepancy is with the standard or with the instrument. New standards should also be prepared on a quarterly basis at a minimum. All data used in drawing or describing the curve shall be so indicated on the curve or its description. A record shall be made of the verification.

Standard deviations and relative standard deviations shall be calculated for the percent recovery of analytes from the spiked sample duplicates and from the check samples. These values shall be established for the twenty most recent determinations in each category.

1.2.2.3.4 Additional Quality Control Requirements for Organic Analysis

The following requirements shall be applied to the analysis of samples by gas chromatography, liquid chromatography and gas chromatography/mass spectrometry.

The calibration of each instrument shall be verified at frequencies specified in the methods. A new standard curve must be prepared as specified in the methods.

The tune of each GC/MS system used for the determination of organic analytes shall be checked with 4-bromofluorobenzene (BFB) for determinations of volatiles and with decafluorotriphenylphosphine (DFTPP) for determinations of semi-volatiles. The required ion abundance criteria shall be met before determination of any analytes. If the system does not meet the required specification for one or more of the required ions, the instrument must be retuned and rechecked before proceeding with sample analysis. The tune performance check criteria must be achieved daily or for each 12 hour operating period, whichever is more frequent.

Background subtraction should be straightforward and designed only to eliminate column bleed or instrument background ions. Background subtraction

EXHIBIT 14 (cont'd)

actions resulting in spectral distortions for the sole purpose of meeting special requirements are contrary to the objectives of Quality Assurance and are unacceptable.

For determinations by HPLC or GC, the instrument calibration shall be verified as specified in the methods.

1.2.2.3.5 Identification

Identification of all analytes must be accomplished with an authentic standard of the analyte. When authentic standards are not available, identification is tentative.

For gas chromatographic determinations of specific analytes, the relative retention time of the unknown must be compared with that of an authentic standard. For compound confirmation, a sample and standard shall be re-analyzed on a column of different selectivity to obtain a second characteristic relative retention time. Peaks must elute within daily retention time windows to be declared a tentative or confirmed identification.

For gas chromatographic/mass spectrometric determinations of specific analytes, the spectrum of the analyte should conform to a literature representation of the spectrum or to a spectrum of the authentic standard obtained after satisfactory tuning of the mass spectrometer and within the same twelve-hour working shift as the analytical spectrum. The appropriate analytical methods should be consulted for specific criteria for matching the mass spectra, relative response factors, and relative retention times to those of authentic standards.

1.2.2.3.6 Quantification

The procedures for quantification of analytes are discussed in the appropriate general procedures (7000, 8000) and the specific analytical methods.

In some situations in the course of determining metal analytes, matrix-matched calibration standards may be required. These standards shall be composed of the pure reagent, approximation of the matrix, and reagent addition of major interferents in the samples. This will be stipulated in the procedures.

Estimation of the concentration of an organic compound not contained within the calibration standard may be accomplished by comparing mass spectral response of the compound with that of an internal standard. The procedure is specified in the methods.

1.3 DETECTION LIMIT AND QUANTIFICATION LIMIT

The detection limit and quantification limit of analytes shall be evaluated by determining the noise level of response for each sample in the batch. If analyte is present, the noise level adjacent in retention time to the analyte peak may be used. For wave-length dispersive instrumentation, multiple determinations of digestates with no detectable analyte may be used to establish the noise level. The method of standard additions should then be used to determine the calibration curve using one digestate or extracted sample in which the analyte was not detected. The slope of the calibration curve, m, should be calculated using the following relations:

m = slope of calibration line

S_B = standard deviation of the average noise level

MDL = KS_B/m

For K = 3; MDL = method detection limit.

For K = 5; MQL = method quantitation limit.

1.4 DATA REPORTING

The requirement of reporting analytical results on a wet-weight or a dry-weight basis is dictated by factors such as: sample matrix; program or regulatory requirement; and objectives of the analysis.

Analytical results shall be reported with the percent moisture or percent solid content of the sample.

1.5 QUALITY CONTROL DOCUMENTATION

The following sections list the QC documentation which comprises the complete analytical package. This package should be obtained from the data generator upon request. These forms, or adaptations of these forms, shall be used by the data generator/reportor for inorganics (I), or for organics (O) or both (I/O) types of determinations.

1.5.1 Analytical Results (I/O: Form I)

Analyte concentration.

Sample weight.

Percent water (for non-aqueous samples when specified).

Final volume of extract or diluted sample.

Holding times (I: Form X).

EXHIBIT 14 (cont'd)

1.5.2 Calibration (I: Form II; O: Form V, VI, VII, IX)

Calibration curve or coefficients of the linear equation which describes the calibration curve.

Correlation coefficient of the linear calibration.

Concentration/response data (or relative response data) of the calibration check standards, along with dates on which they were analytically determined.

1.5.3 Column Check (O: Form X)

Results of column chromatography check, with the chromatogram.

1.5.4 Extraction/Digestion (I/O: Form I)

Date of the extraction for each sample.

1.5.5 Surrogates (O: Form II)

Amount of surrogate spiked, and percent recovery of each surrogate.

1.5.6 Matrix/Duplicate Spikes (I: Form V, VI; O: Form III)

Amount spiked, percent recovery, and relative percent difference for each compound in the spiked samples for the analytical batch.

1.5.7 Check Sample (I: Form VII; O: Form VIII)

Amount spiked, and percent recovery of each compound spiked.

1.5.8 Blank (I: Form III; O: Form IV)

Identity and amount of each constituent.

1.5.9 Chromatograms (for organic analysis)

All chromatograms for reported results, properly labeled with:

- Sample identification
- Method identification
- Identification of retention time of analyte on the chromatograms.

EXHIBIT 14 (cont'd)

1.5.10 Quantitative Chromatogram Report (O: Forms VIII, IX, X)

Retention time of analyte.

Amount injected.

Area of appropriate calculation of detection response.

Amount of analyte found.

Date and time of injection.

1.5.11 Mass Spectrum

Spectra of standards generated from authentic standards (one for each report for each compound detected).

Spectra of analytes from actual analyses.

Spectrometer identifier.

1.5.12 Metal Interference Check Sample Results (I: Form IV)

1.5.13 Detection Limit (I: Form VII; O: Form I)

Analyte detection limits with methods of estimation.

1.5.14 Results of Standard Additions (I: Form VIII)

1.5.15 Results of Serial Dilutions (I: Form IX)

1.5.16 Instrument Detection Limits (I: Form XI)

1.5.17 ICP Interelement Correction Factors and ICP Linear Ranges (when applicable) (I: Form XII, Form XIII).

1.6 REFERENCES

1. Guidelines and Specifications for Preparing Quality Assurance Program Plans, September 20, 1980, Office of Monitoring Systems and Quality Assurance, ORD, U.S. EPA, QAMS-004/80, Washington, DC 20460.

2. Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans, December 29, 1980, Office of Monitoring Systems and Quality Assurance, ORD, U.S. EPA, QAMS-005/80, Washington, DC 20460.

EXHIBIT 14 (cont'd)

Date ____________

COVER PAGE
INORGANIC ANALYSES DATA PACKAGE

Lab Name ____________ Case No. ____________

No. ____________ Q.C. Report No. ____________

Sample Numbers

EPA No.	Lab ID No.	EPA No.	Lab ID No.

Comments: ____________

EXHIBIT 14 (cont'd)

Form I

Sample No. ____________

Date ____________

INORGANIC ANALYSIS DATA SHEET

LAB NAME ____________

CASE NO. ____________

Lab Receipt Date ____________

LAB SAMPLE ID. NO. ____________

QC REPORT NO. ____________

Elements Identified and Measured

Matrix: Water ________ Soil ________ Sludge ________ Other ________

ug/L or mg/kg dry weight (Circle One)

1. Aluminum ____________
2. Antimony ____________
3. Arsenic ____________
4. Barium ____________
5. Beryllium ____________
6. Cadmium ____________
7. Calcium ____________
8. Chromium ____________
9. Cobalt ____________
10. Copper ____________
11. Iron ____________
12. Lead ____________

Cyanide ____________

13. Magnesium ____________
14. Manganese ____________
15. Mercury ____________
16. Nickel ____________
17. Potassium ____________
18. Selenium ____________
19. Silver ____________
20. Sodium ____________
21. Thallium ____________
22. Vanadium ____________
23. Zinc ____________

Precent Solids (%) ____________

Comments: ____________

Lab Manager ____________

EXHIBIT 14 (cont'd)

Form II

Q. C. Report No. ________

INITIAL AND CONTINUING CALIBRATION VERIFICATION

LAB NAME ____________________ CASE NO. ____________________

DATE ____________________ UNITS: ug/L

Compound	Initial Calib.[1]			Continuing Calibration[2]					
Metals:	True Value	Found	%R	True Value	Found	%R	Found	%R	Method[4]
1. Aluminum									
2. Antimony									
3. Arsenic									
4. Barium									
5. Beryllium									
6. Cadmium									
7. Calcium									
8. Chromium									
9. Cobalt									
10. Copper									
11. Iron									
12. Lead									
13. Magnesium									
14. Manganese									
15. Mercury									
16. Nickel									
17. Potassium									
18. Selenium									
19. Silver									
20. Sodium									
21. Thallium									
22. Vanadium									
23. Zinc									
Other:									
Cyanide									

[1] Initial Calibration Source [2] Continuing Calibration Source ____________

[4] Indicate Analytical Method Used: P - ICP; A - Flame AA; F - Furnace AA

EXHIBIT 14 (cont'd)

Form III

Q. C. Report No. ______

BLANKS

LAB NAME ____________________ CASE NO. ____________________

DATE ____________________ UNITS ____________________

Compound	Initial Calibration Blank Value	Continuing Calibration Blank Value				Preparation Blank	
		1	2	3	4	Matrix: ______ 1	Matrix: ______ 2
Metals:							
1. Aluminum							
2. Antimony							
3. Arsenic							
4. Barium							
5. Beryllium							
6. Cadmium							
7. Calcium							
8. Chromium							
9. Cobalt							
10. Copper							
11. Iron							
12. Lead							
13. Magnesium							
14. Manganese							
15. Mercury							
16. Nickel							
17. Potassium							
18. Selenium							
19. Silver							
20. Sodium							
21. Thallium							
22. Vanadium							
23. Zinc							
Other: ______							
Cyanide							

[1] Reporting Units: aqueous, ug/L; solid mg/kg

Form IV

Q. C. Report No. ________

ICP INTERFERENCE CHECK SAMPLE

LAB NAME ____________________

CASE NO. ____________________

Check Sample I.D. ____________

DATE ____________________

Check Sample Source ________

Units: ug/L

Compound	Control Limits[1] Mean	Control Limits[1] Std. Dev.	True[2]	Initial Observed	Initial %R	Final Observed	Final %R
Metals:							
1. Aluminum							
2. Antimony							
3. Arsenic							
4. Barium							
5. Beryllium							
6. Cadmium							
7. Calcium							
8. Chromium							
9. Cobalt							
10. Copper							
11. Iron							
12. Lead							
13. Magnesium							
14. Manganese							
15. Mercury							
16. Nickel							
17. Potassium							
18. Selenium							
19. Silver							
20. Sodium							
21. Thallium							
22. Vanadium							
23. Zinc							
Other:							

[1] Mean value based on n = ________.

[2] True value of EPA ICP Interference Check Sample or contractor standard.

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Form V

Q. C. Report No. ______

SPIKE SAMPLE RECOVERY

LAB NAME ______________

DATE ______________

CASE NO. ______________

Sample No. ______________

Lab Sample ID No. ______________

Units ______________

Matrix ______________

Compound	Control Limit %R	Spiked Sample Result (SSR)	Sample Result (SR)	Spiked Added (SA)	%R[1]
Metals:					
1. Aluminum					
2. Antimony					
3. Arsenic					
4. Barium					
5. Beryllium					
6. Cadmium					
7. Calcium					
8. Chromium					
9. Cobalt					
10. Copper					
11. Iron					
12. Lead					
13. Magnesium					
14. Manganese					
15. Mercury					
16. Nickel					
17. Potassium					
18. Selenium					
19. Silver					
20. Sodium					
21. Thallium					
22. Vanadium					
23. Zinc					
Other:					
Cyanide					

[1] %R = [(SSR - SR)/SA] x 100

"N" - out of control

"NR" - Not required

Comments: ______________

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Form VI

Q. C. Report No. ______

DUPLICATES

LAB NAME ______

DATE ______

CASE NO. ______
Sample No. ______
Lab Sample ID No. ______
Units ______

Matrix ______

Compound	Control Limit[1]	Sample(S)	Duplicate(D)	RPD[2]
Metals:				
1. Aluminum				
2. Antimony				
3. Arsenic				
4. Barium				
5. Beryllium				
6. Cadmium				
7. Calcium				
8. Chromium				
9. Cobalt				
10. Copper				
11. Iron				
12. Lead				
13. Magnesium				
14. Manganese				
15. Mercury				
16. Nickel				
17. Potassium				
18. Selenium				
19. Silver				
20. Sodium				
21. Thallium				
22. Vanadium				
23. Zinc				
Other:				
Cyanide				

* Out of Control

[1] To be added at a later date.

[2] RPD = [|S − D|/((S + D)/2)] x 100

NC − Non calculable RPD due to value(s) less than CRDL

Form VII

Q.C. Report No. ________

INSTRUMENT DETECTION LIMITS AND

LABORATORY CONTROL SAMPLE

LAB NAME ______________ CASE NO. ________ DATE ________

LCS NO. ________

Compound	Required Detection Limits (CRDL)-ug/l	Instrument Detection Limits (IDL)-ug/l		Lab Control Sample ug/L mg/kg (circle one)		
		ICP/AA ID#____	Furnace ID#____	True	Found	%R
Metals:						
1. Aluminum						
2. Antimony						
3. Arsenic						
4. Barium						
5. Beryllium						
6. Cadmium						
7. Calcium						
8. Chromium						
9. Cobalt						
10. Copper						
11. Iron						
12. Lead						
13. Magnesium						
14. Manganese						
15. Mercury						
16. Nickel						
17. Potassium						
18. Selenium						
19. Silver						
20. Sodium						
21. Thallium						
22. Vanadium						
23. Zinc						
Other:______						
Cyanide		NR	NR			

NR - Not required

Form VIII

Q.C. Report No. ________

STANDARD ADDITION RESULTS

LAB NAME ______________________ CASE NO. ______________

DATE ______________________ UNITS : ug/L

EPA Sample #	Element	Matrix	0 ADD ABS.	1 ADD		2 ADD		3 ADD		FINAL CON.[3]	r*
				CON.	ABS[2]	CON.	ABS.[2]	CON.	ABS.[2]		

[2] CON is the concentration added, ABS. is the instrument readout in absorbance or concentration.

[3] Concentration as determined by MSA

*"r" is the correlation coefficient.

+ - correlation coefficient is outside of control window of 0.995.

Form IX

Q. C. Report No. ______

ICP SERIAL DILUTIONS

LAB NAME ____________________

CASE NO. ____________

Sample No. ____________

DATE ____________________

Lab Sample ID No. ____________

Units: ug/L

Matrix ____________

Compound	Initial Sample Concentration(I)	Serial Dilution Result(S)[1]	% Difference[2]
Metals:			
1. Aluminum			
2. Antimony			
3. Arsenic			
4. Barium			
5. Beryllium			
6. Cadmium			
7. Calcium			
8. Chromium			
9. Cobalt			
10. Copper			
11. Iron			
12. Lead			
13. Magnesium			
14. Manganese			
15. Nickel			
16. Potassium			
17. Selenium			
18. Silver			
19. Sodium			
20. Thallium			
21. Vanadium			
22. Zinc			
Other:			

[1] Diluted sample concentration corrected for 1:4 dilution (see Exhibit D)

[2] Percent Difference = $\frac{|I - S|}{I} \times 100$

NR - Not Required, initial sample concentration less than 10 times IDL

NA - Not Applicable, analyte not determined by ICP

Form X

QC Report No. ____________

HOLDING TIMES

LAB NAME ______________________________

DATE ______________________________ CASE NO. ____________________

EPA Sample No.	Matrix	Date Received	Mercury Prep Date	Mercury Holding Time[1] (Days)	CN Prep Date	CN Holding Time[1] (Days)

[1] Holding time is defined as number of days between the date received and the sample preparation date.

Form XI

INSTRUMENT DETECTION LIMITS

LAB NAME ______________________ DATE ______________

ICP/Flame AA (Circle One) Model Number __________ Furnace AA Number __________

Element	Wavelength (nm)	IDL (ug/L)	Element	Wavelength (nm)	IDL (ug/L)
1. Aluminum			13. Magnesium		
2. Antimony			14. Manganese		
3. Arsenic			15. Mercury		
4. Barium			16. Nickel		
5. Beryllium			17. Potassium		
6. Cadmium			18. Selenium		
7. Calcium			19. Silver		
8. Chromium			20. Sodium		
9. Cobalt			21. Thallium		
10. Copper			22. Vanadium		
11. Iron			23. Zinc		
12. Lead					

Footnotes:

- Indicate the instrument for which the IDL applies with a "P" (for ICP an "A" (for Flame AA), or an "F" (for Furnace AA) behind the IDL valu
- Indicate elements commonly run with background correction (AA) with a "B" behind the analytical wavelength.
- If more than one ICP/Flame or Furnace AA is used, submit separate Forms XI-XIII for each instrument.

COMMENTS: ______________________________

Lab Manager ______________________

Form XII

ICP Interelement Correction Factors

LABORATORY ____________________ ICP Model Number ____________

DATE ____________

		Interelement Correction Factors for							
Analyte	Analyte Wavelength (nm)	Al	Ca	Fe	Mg				
1. Antimony									
2. Arsenic									
3. Barium									
4. Beryllium									
5. Cadmium									
6. Chromium									
7. Cobalt									
8. Copper									
9. Lead									
10. Manganese									
11. Mercury									
12. Nickel									
13. Potassium									
14. Selenium									
15. Silver									
16. Sodium									
17. Thallium									
18. Vanadium									
19. Zinc									

COMMENTS: ____________________

Lab Manager ____________

Form XII

ICP Interelement Correction Factors

LABORATORY ____________________ ICP Model Number ____________

DATE ______________

		Interelement Correction Factors for							
Analyte	Analyte Wavelength (nm)								
1. Antimony									
2. Arsenic									
3. Barium									
4. Beryllium									
5. Cadmium									
6. Chromium									
7. Cobalt									
8. Copper									
9. Lead									
10. Manganese									
11. Mercury									
12. Nickel									
13. Potassium									
14. Selenium									
15. Silver									
16. Sodium									
17. Thallium									
18. Vanadium									
19. Zinc									

COMMENTS: ______________________________________

____

Lab Manager ______________

Form XIII

ICP Linear Ranges

LAB NAME ______________________ ICP Model Number ______________

DATE ______________________

Analyte	Integration Time (Seconds)	Concentration (ug/L)	Analyte	Integration Time (Seconds)	Concentration (ug/L)
1. Aluminum			13. Magnesium		
2. Antimony			14. Manganese		
3. Arsenic			15. Mercury		
4. Barium			16. Nickel		
5. Beryllium			17. Potassium		
6. Cadmium			18. Selenium		
7. Calcium			19. Silver		
8. Chromium			20. Sodium		
9. Cobalt			21. Thallium		
10. Copper			22. Vanadium		
11. Iron			23. Zinc		
12. Lead					

Footnotes:

- Indicate elements not analyzed by ICP with the notation "NA".

COMMENTS: ____

____

____

____

Lab Manager ______________________

Organics Analysis Data Sheet
(Page 1)

Sample Number

Laboratory Name: ____________________

Case No: ____________________

Lab Sample ID No: ____________________

QC Report No: ____________________

Sample Matrix ____________________

Data Release Authorized By: ____________________

Date Sample Received: ____________________

Volatile Compounds

Date Extracted/Prepared: ____________________

Date Analyzed: ____________________

Conc/Dil Factor: ____________ pH ____________

Percent Moisture: (Not Decanted) ____________

CAS Number		ug/l or ug/Kg (Circle One)
74-87-3	Chloromethane	
74-83-9	Bromomethane	
75-01-4	Vinyl Chloride	
75-00-3	Chloroethane	
75-09-2	Methylene Chloride	
67-64-1	Acetone	
75-15-0	Carbon Disulfide	
75-35-4	1, 1-Dichloroethene	
75-34-3	1, 1-Dichloroethane	
156-60-5	Trans-1, 2-Dichloroethene	
67-66-3	Chloroform	
107-06-2	1, 2-Dichloroethane	
78-93-3	2-Butanone	
71-55-6	1, 1, 1-Trichloroethane	
56-23-5	Carbon Tetrachloride	
108-05-4	Vinyl Acetate	
75-27-4	Bromodichloromethane	

CAS Number		ug/l or ug/Kg (Circle One)
78-87-5	1, 2-Dichloropropane	
10061-02-6	Trans-1, 3-Dichloropropene	
79-01-6	Trichloroethene	
124-48-1	Dibromochloromethane	
79-00-5	1, 1, 2-Trichloroethane	
71-43-2	Benzene	
10061-01-5	cis-1, 3-Dichloropropene	
110-75-8	2-Chloroethylvinylether	
75-25-2	Bromoform	
108-10-1	4-Methyl-2-Pentanone	
591-78-6	2-Hexanone	
127-18-4	Tetrachloroethene	
79-34-5	1, 1, 2, 2-Tetrachloroethane	
108-88-3	Toluene	
108-90-7	Chlorobenzene	
100-41-4	Ethylbenzene	
100-42-5	Styrene	
	Total Xylenes	

Data Reporting Qualifiers

For reporting results to EPA, the following results qualifiers are used. Additional flags or footnotes explaining results are encouraged. However, the definition of each flag must be explicit.

Value	If the result is a value greater than or equal to the detection limit, report the value
U	Indicates compound was analyzed for but not detected. Report the minimum detection limit for the sample with the U (e.g., 10U) based on necessary concentration/dilution action. (This is not necessarily the instrument detection limit.) The footnote should read U-Compound was analyzed for but not detected. The number is the minimum attainable detection limit for the sample
J	Indicates an estimated value. This flag is used either when estimating a concentration for tentatively identified compounds where a 1:1 response is assumed or when the mass spectral data indicated the presence of a compound that meets the identification criteria but the result is less than the specified detection limit but greater than zero (e.g., 10J). If limit of detection is 10 μg/l and a concentration of 3 μg/l is calculated, report as 3J
C	This flag applies to pesticide parameters where the identification has been confirmed by GC/MS. Single component pesticides ≥10 ng/ul in the final extract should be confirmed by GC/MS
B	This flag is used when the analyte is found in the blank as well as a sample. It indicates possible/probable blank contamination and warns the data user to take appropriate action
Other	Other specific flags and footnotes may be required to properly define the results. If used, they must be fully described and such description attached to the data summary report

Form I

EXHIBIT 14 (cont'd)

Laboratory Name ____________________

Case No ____________________

Sample Number

Organics Analysis Data Sheet
(Page 2)

Semivolatile Compounds

GPC Cleanup ☐Yes ☐No

Separatory Funnel Extraction ☐Yes

Continuous Liquid - Liquid Extraction ☐Yes

Date Extracted/Prepared: ____________________

Date Analyzed: ____________________

Conc/Dil Factor: ____________________

Percent Moisture (Decanted) ____________________

CAS Number		ug/l or ug/Kg (Circle One)
108-95-2	Phenol	
111-44-4	bis(-2-Chloroethyl)Ether	
95-57-8	2-Chlorophenol	
541-73-1	1, 3-Dichlorobenzene	
106-46-7	1, 4-Dichlorobenzene	
100-51-6	Benzyl Alcohol	
95-50-1	1, 2-Dichlorobenzene	
95-48-7	2-Methylphenol	
39638-32-9	bis(2-chloroisopropyl)Ether	
106-44-5	4-Methylphenol	
621-64-7	N-Nitroso-Di-n-Propylamine	
67-72-1	Hexachloroethane	
98-95-3	Nitrobenzene	
78-59-1	Isophorone	
88-75-5	2-Nitrophenol	
105-67-9	2, 4-Dimethylphenol	
65-85-0	Benzoic Acid	
111-91-1	bis(-2-Chloroethoxy)Methane	
120-83-2	2, 4-Dichlorophenol	
120-82-1	1, 2, 4-Trichlorobenzene	
91-20-3	Naphthalene	
106-47-8	4-Chloroaniline	
87-68-3	Hexachlorobutadiene	
59-50-7	4-Chloro-3-Methylphenol	
91-57-6	2-Methylnaphthalene	
77-47-4	Hexachlorocyclopentadiene	
88-06-2	2, 4, 6-Trichlorophenol	
95-95-4	2, 4, 5-Trichlorophenol	
91-58-7	2-Chloronaphthalene	
88-74-4	2-Nitroaniline	
131-11-3	Dimethyl Phthalate	
208-96-8	Acenaphthylene	
99-09-2	3-Nitroaniline	

CAS Number		ug/l or ug/Kg (Circle One)
83-32-9	Acenaphthene	
51-28-5	2, 4-Dinitrophenol	
100-02-7	4-Nitrophenol	
132-64-9	Dibenzofuran	
121-14-2	2, 4-Dinitrotoluene	
606-20-2	2, 6-Dinitrotoluene	
84-66-2	Diethylphthalate	
7005-72-3	4-Chlorophenyl-phenylether	
86-73-7	Fluorene	
100-01-6	4-Nitroaniline	
534-52-1	4, 6-Dinitro-2-Methylphenol	
86-30-6	N-Nitrosodiphenylamine (1)	
101-55-3	4-Bromophenyl-phenylether	
118-74-1	Hexachlorobenzene	
87-86-5	Pentachlorophenol	
85-01-8	Phenanthrene	
120-12-7	Anthracene	
84-74-2	Di-n-Butylphthalate	
206-44-0	Fluoranthene	
129-00-0	Pyrene	
85-68-7	Butylbenzylphthalate	
91-94-1	3, 3'-Dichlorobenzidine	
56-55-3	Benzo(a)Anthracene	
117-81-7	bis(2-Ethylhexyl)Phthalate	
218-01-9	Chrysene	
117-84-0	Di-n-Octyl Phthalate	
205-99-2	Benzo(b)Fluoranthene	
207-08-9	Benzo(k)Fluoranthene	
50-32-8	Benzo(a)Pyrene	
193-39-5	Indeno(1, 2, 3-cd)Pyrene	
53-70-3	Dibenz(a, h)Anthracene	
191-24-2	Benzo(g, h, i)Perylene	

(1)-Cannot be separated from diphenylamine

Form I

Laboratory Name: ____________________

Case No ____________________

Sample Number

Organics Analysis Data Sheet
(Page 3)

Pesticide/PCBs

GPC Cleanup ☐Yes ☐No

Date Extracted/Prepared: ____________________

Separatory Funnel Extraction ☐Yes

Date Analyzed: ____________________

Continuous Liquid - Liquid Extraction ☐Yes

Conc/Dil Factor: ____________________

Percent Moisture (decanted) ____________________

CAS Number		ug/l or ug/Kg (Circle One)
319-84-6	Alpha-BHC	
319-85-7	Beta-BHC	
319-86-8	Delta-BHC	
58-89-9	Gamma-BHC (Lindane)	
76-44-8	Heptachlor	
309-00-2	Aldrin	
1024-57-3	Heptachlor Epoxide	
959-98-8	Endosulfan I	
60-57-1	Dieldrin	
72-55-9	4, 4'-DDE	
72-20-8	Endrin	
33213-65-9	Endosulfan II	
72-54-8	4, 4'-DDD	
1031-07-8	Endosulfan Sulfate	
50-29-3	4, 4'-DDT	
72-43-5	Methoxychlor	
53494-70-5	Endrin Ketone	
57-74-9	Chlordane	
8001-35-2	Toxaphene	
12674-11-2	Aroclor-1016	
11104-28-2	Aroclor-1221	
11141-16-5	Aroclor-1232	
53469-21-9	Aroclor-1242	
12672-29-6	Aroclor-1248	
11097-69-1	Aroclor-1254	
11096-82-5	Aroclor-1260	

V_i = Volume of extract injected (ul)

V_s = Volume of water extracted (ml)

W_s = Weight of sample extracted (g)

V_t = Volume of total extract (ul)

V_s ____________ or W_s ____________ V_t ____________ V_i ____________

Form 1

EXHIBIT 14 (cont'd)

Laboratory Name: ____________________

Case No: ____________________

Sample Number

Organics Analysis Data Sheet

CAS Number	Compound Name	Fraction	RT or Scan Number	Estimated Concentration (ug/l or ug/kg)
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				
20.				
21.				
22.				
23.				
24.				
25.				
26.				
27.				
28.				
29.				
30.				

Form 1, Part B

WATER SURROGATE PERCENT RECOVERY SUMMARY

Case No. ____________ Laboratory Name ____________

	VOLATILE			SEMI-VOLATILE								PESTICIDE
SAMPLE NO.	TOLUENE-D8 (88-110)	BFB (86-115)	1,2 DICHLORO-ETHANE-D4 (76-114)	NITRO-BENZENE-D5 (35-114)	2-FLUORO-BIPHENYL (43-116)	TERPHENYL-D14 (33-141)			PHENOL-D5 (10-94)	2-FLUORO-PHENOL (21-100)	2,4,6 TRIBROMO PHENOL (10-123)	DIBUTYL-CHLORENDATE (24-154)

VALUES ARE OUTSIDE OF REQUIRED QC LIMITS

Volatiles: ______ out of ______; outside of QC limits
Semi-Volatiles: ______ out of ______; outside of QC limits
Pesticides: ______ out of ______; outside of QC limits

Comments: ____________

FORM II

SOIL SURROGATE PERCENT RECOVERY SUMMARY

Case No. ____________ **Laboratory Name** ____________

	VOLATILE			SEMI-VOLATILE								PESTICIDE
SAMPLE NO	TOLUENE-D8 (81-117)	BFB (74-121)	1,2 DICHLORO-ETHANE-D4 (70-121)	NITRO-BENZENE-D5 (23-120)	2-FLUORO-BIPHENYL (30-115)	TERPHENYL-D14 (18-137)			PHENOL-D5 (24-113)	2-FLUORO-PHENOL (25-121)	2,4,6 TRIBROMO-PHENOL (19-122)	DIBUTYL-CHLORENDATE (20-150)

VALUES ARE OUTSIDE OF REQUIRED QC LIMITS

Volatiles: ______ out of ______; outside of QC limits
Semi-Volatiles: ______ out of ______; outside of QC limits
Pesticides: ______ out of ______; outside of QC limits

Comments: ____________________

FORM II

WATER MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Case No ______________ Laboratory Name ______________

FRACTION	COMPOUND	CONC. SPIKE ADDED (ug/L)	SAMPLE RESULT	CONC. MS	% REC	CONC. MSD	% REC	RPD	QC LIMITS	
									RPD	RECOVERY
VOA	1,1-Dichloroethene								14	61-145
	Trichloroethene								14	71-120
SAMPLE NO.	Chlorobenzene								13	75-130
	Toluene								13	76-125
______	Benzene								11	76-127
	1,2,4-Trichlorobenzene								28	39-98
B/N	Acenaphthene								31	46-118
	2,4 Dinitrotoluene								38	24-96
SAMPLE NO.	Di-n-Butylphthalate								40	11-117
	Pyrene								31	26-127
	N-Nitroso-Di-n-Propylamine								38	41-116
______	1,4-Dichlorobenzene								28	36-97
ACID	Pentachlorophenol								50	9-103
	Phenol								42	12-89
SAMPLE NO.	2-Chlorophenol								40	27-123
	4-Chloro-3-Methylphenol								42	23-97
______	4-Nitrophenol								50	10-80
PEST	Lindane								15	56-123
	Heptachlor								20	40-131
	Aldrin								22	40-120
SAMPLE NO.	Dieldrin								18	52-126
	Endrin								21	56-121
______	4,4'-DDT								27	38-127

ADVISORY LIMITS

RPD: VOAs ______ out of ______; outside QC limits
B/N ______ out of ______; outside QC limits
ACID ______ out of ______; outside QC limits
PEST ______ out of ______; outside QC limits

RECOVERY: VOAs ______ out of ______; outside QC limits
B/N ______ out of ______; outside QC limits
ACID ______ out of ______; outside QC limits
PEST ______ out of ______; outside QC limits

Comments: ______________

FORM III

EXHIBIT 14 (cont'd)

SOIL MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Case No. ______________ Laboratory Name ______________

FRACTION	COMPOUND	CONC. SPIKE ADDED (ug/Kg)	SAMPLE RESULT	CONC. MS	% REC	CONC. MSD	% REC	RPD	QC LIMITS	
									RPD	RECOVERY
VOA SAMPLE NO. ______	1,1-Dicholorethene								22	59-172
	Trichloroethene								24	62-137
	Chlorobenzene								21	60-133
	Toluene								21	59-139
	Benzene								21	66-142
B/N SAMPLE NO. ______	1,2,4-Trichlorobenzene								23	38-107
	Acenaphthene								19	31-137
	2,4 Dinitrotoluene								47	28-89
	Di-n-Butylphthalate								47	29-135
	Pyrene								36	35-142
	N-Nitrosodi-n-Propylamine								38	41-126
	1,4-Dichlorobenzene								27	28-104
ACID SAMPLE NO. ______	Pentachlorophenol								47	17-109
	Phenol								35	26-90
	2-Chlorophenol								50	25-102
	4-Chloro-3-Methylphenol								33	26-103
	4-Nitrophenol								50	11-114
PEST SAMPLE NO. ______	Lindane								50	46-127
	Heptachlor								31	35-130
	Aldrin								43	34-132
	Dieldrin								38	31-134
	Endrin								45	42-139
	4,4'-DDT								50	23-134

ADVISORY LIMITS

RPD: VOAs ______ out of ______; outside QC limits
B/N ______ out of ______; outside QC limits
ACID ______ out of ______; outside QC limits
PEST ______ out of ______; outside QC limits

RECOVERY: VOAs ______ out of ______; outside QC limits
B/N ______ out of ______; outside QC limits
ACID ______ out of ______; outside QC limits
PEST ______ out of ______; outside QC limits

Comments: ______________

FORM III

METHOD BLANK SUMMARY

Case No. ____________ Laboratory Name ____________

FILE ID	DATE OF ANALYSIS	FRACTION	MATRIX	CONC. LEVEL	INST. ID	CAS NUMBER	COMPOUND (HSL, TIC OR UNKNOWN)	CONC.	UNITS	CRDL

Comments:

FORM IV

GC/MS TUNING AND MASS CALIBRATION

Bromofluorobenzene (BFB)

Case No. ______________ **Laboratory Name** ______________________________

Instrument ID ____________ Date ______________________ Time ______________

Data Release Authorized By: ______________________________

m/e	ION ABUNDANCE CRITERIA	%RELATIVE ABUNDANCE
50	15.0 - 40.0% of the base peak	
75	30.0 - 60.0% of the base peak	
95	Base peak, 100% relative abundance	
96	5.0 - 9.0% of the base peak	
173	Less than 1.0% of the base peak	
174	Greater than 50.0% of the base peak	
175	5.0 - 9.0% of mass 174	( )[1]
176	Greater than 95.0%, but less than 101.0% of mass 174	( )[1]
177	5.0 - 9.0% of mass 176	( )[2]

THIS PERFORMANCE TUNE APPLIES TO THE FOLLOWING SAMPLES, BLANKS AND STANDARDS.

[1] Value in parenthesis is % mass 174.

[2] Value in parenthesis is % mass 176.

SAMPLE ID	LAB ID	DATE OF ANALYSIS	TIME OF ANALYSIS

FORM V

EXHIBIT 14 (cont'd)

GC/MS TUNING AND MASS CALIBRATION
Decafluorotriphenylphosphine (DFTPP)

Case No. ____________ **Laboratory Name** ____________

Instrument ID ____________ Date ____________ Time ____________

Data Release Authorized By: ____________

m/e	ION ABUNDANCE CRITERIA	%RELATIVE ABUNDANCE
51	30.0 - 60.0% of mass 198	
68	less than 2.0% of mass 69	( )[1]
69	mass 69 relative abundance	
70	less than 2.0% of mass 69	( )[1]
127	40.0 - 60.0% of mass 198	
197	less than 1.0% of mass 198	
198	base peak, 100% relative abundance	
199	5.0 - 9.0% of mass 198	
275	10.0 - 30.0% of mass 198	
365	greater than 1.00% of mass 198	
441	present, but less than mass 443	
442	greater than 40.0% of mass 198	
443	17.0 - 23.0% of mass 442	( )[2]

[1] Value in parenthesis is % mass 69.
[2] Value in parenthesis is % mass 442.

THIS PERFORMANCE TUNE APPLIES TO THE FOLLOWING SAMPLES, BLANKS AND STANDARDS.

SAMPLE ID	LAB ID	DATE OF ANALYSIS	TIME OF ANALYSIS

FORM V

EXHIBIT 14 (cont'd)

Initial Calibration Data
Volatile HSL Compounds

Case No: ____________

Laboratory Name ____________

Instrument I.D: ____________

Calibration Date: ____________

Minimum $\overline{RF}$ for SPCC is 0.300 (0.25 for Bromoform)

Maximum % RSD for CCC is 30%

Laboratory ID								
Compound	RF_{20}	RF_{50}	RF_{100}	RF_{150}	RF_{200}	$\overline{RF}$	% RSD	CCC• SPCC••
Chloromethane								••
Bromomethane								
Vinyl Chloride								•
Chloroethane								
Methylene Chloride								
Acetone								
Carbon Disulfide								
1, 1-Dichloroethene								•
1, 1-Dichloroethane								••
Trans-1, 2-Dichloroethene								
Chloroform								•
1, 2-Dichloroethane								
2-Butanone								
1, 1, 1-Trichloroethane								
Carbon Tetrachloride								
Vinyl Acetate								
Bromodichloromethane								
1, 2-Dichloropropane								•
Trans-1, 3-Dichloropropene								
Trichloroethene								
Dibromochloromethane								
1, 1, 2-Trichloroethane								
Benzene								
cis-1, 3-Dichloropropene								
2-Chloroethylvinylether								
Bromoform								••
4-Methyl-2-Pentanone								
2-Hexanone								
Tetrachloroethene								
1, 1, 2, 2-Tetrachloroethane								••
Toluene								•
Chlorobenzene								••
Ethylbenzene								•
Styrene								
Total Xylenes								

RF - Response Factor (subscript is the amount of ug/L)
$\overline{RF}$ - Average Response Factor
%RSD - Percent Relative Standard Deviation

CCC - Calibration Check Compounds (•)
SPCC - System Performance Check Compounds (••)

Form VI

EXHIBIT 14 (cont'd)

Initial Calibration Data
Volatile HSL Compounds

Case No: ______________

Instrument I D: ______________________

Laboratory Name ______________________

Calibration Date: ______________________

Minimum $\overline{RF}$ for SPCC is 0.300
(0.25 for Bromoform)

Maximum % RSD for CCC is 30%

Laboratory ID								
Compound	RF_{20}	RF_{50}	RF_{100}	RF_{150}	RF_{200}	$\overline{RF}$	% RSD	CCC* SPCC**

RF -Response Factor (subscript is the amount of ug/L)
$\overline{RF}$ -Average Response Factor
%RSD -Percent Relative Standard Deviation

CCC -Calibration Check Compounds (*)
SPCC -System Performance Check Compounds (**)

Form VI

Initial Calibration Data
Semivolatile HSL Compounds
(Page 1)

Case No: ____________

Laboratory Name ____________

Instrument ID: ____________

Calibration Date: ____________

Minimum $\overline{RF}$ for SPCC is 0.050   Maximum % RSD for CCC is 30%

Laboratory ID								
Compound	RF_{20}	RF_{50}	RF_{80}	RF_{120}	RF_{160}	$\overline{RF}$	% RSD	CCC• SPCC••
Phenol								•
bis(-2-Chloroethyl)Ether								
2-Chlorophenol								
1, 3-Dichlorobenzene								
1, 4-Dichlorobenzene								•
Benzyl Alcohol								
1, 2-Dichlorobenzene								
2-Methylphenol								
bis(2-chloroisopropyl)Ether								
4-Methylphenol								
N-Nitroso-Di-n-Propylamine								••
Hexachloroethane								
Nitrobenzene								
Isophorone								
2-Nitrophenol								•
2, 4-Dimethylphenol								
Benzoic Acid	†							
bis(-2-Chloroethoxy)Methane								
2, 4-Dichlorophenol								•
1, 2, 4-Trichlorobenzene								
Naphthalene								
4-Chloroaniline								
Hexachlorobutadiene								•
4-Chloro-3-Methylphenol								•
2-Methylnaphthalene								
Hexachlorocyclopentadiene								••
2, 4, 6-Trichlorophenol								•
2, 4, 5-Trichlorophenol	†							
2-Chloronaphthalene								
2-Nitroaniline	†							
Dimethyl Phthalate								
Acenaphthylene								
3-Nitroaniline	†							
Acenaphthene								•
2, 4-Dinitrophenol	†							••
4-Nitrophenol	†							••
Dibenzofuran								

Response Factor (subscript is the amount of nanograms)
$\overline{RF}$ -Average Response Factor
%RSD -Percent Relative Standard Deviation
CCC -Calibration Check Compounds (•)
SPCC -System Performance Check Compounds (••)
† -Not detectable at 20 ng

Form VI

Initial Calibration Data
Semivolatile HSL Compounds
(Page 2)

Case No: ____________ Instrument ID: ____________

Laboratory Name ____________ Calibration Date: ____________

Minimum $\overline{RF}$ for SPCC is 0.050 Maximum % RSD for CCC is 30%

Laboratory ID								
Compound	RF$_{20}$	RF$_{50}$	RF$_{80}$	RF$_{120}$	RF$_{160}$	$\overline{RF}$	% RSD	CCC• SPCC••
2, 4-Dinitrotoluene								
2, 6-Dinitrotoluene								
Diethylphthalate								
4-Chlorophenyl-phenylether								
Fluorene								
4-Nitroaniline	†							
4, 6-Dinitro-2-Methylphenol	†							
N-Nitrosodiphenylamine (1)								•
4-Bromophenyl-phenylether								
Hexachlorobenzene								
Pentachlorophenol	†							•
Phenanthrene								
Anthracene								
Di-N-Butylphthalate								
Fluoranthene								•
Pyrene								
Butylbenzylphthalate								
3, 3'-Dichlorobenzidine								
Benzo(a)Anthracene								
bis(2-Ethylhexyl)Phthalate								
Chrysene								
Di-n-Octyl Phthalate								•
Benzo(b)Fluoranthene								
Benzo(k)Fluoranthene								
Benzo(a)Pyrene								•
Indeno(1, 2, 3-cd)Pyrene								
Dibenz(a, h)Anthracene								
Benzo(g, h, i)Perylene								

Response Factor (subscript is the amount of nanograms)
$\overline{RF}$ -Average Response Factor
%RSD -Percent Relative Standard Deviation
CCC -Calibration Check Compounds (•)

SPCC -System Performance Check Compounds (••)
† - Not detectable at 20 ng
(1) -Cannot be separated from diphenylamine

Form VI

EXHIBIT 14 (cont'd)

Initial Calibration Data
Semivolatile HSL Compounds
(Page 1)

Case No ______________ Instrument ID ______________

Laboratory Name ______________ Calibration Date ______________

Minimum $\overline{RF}$ for SPCC is 0.050 Maximum % RSD for CCC is 30%

Laboratory ID								
Compound	RF_{20}	RF_{50}	RF_{80}	RF_{120}	RF_{160}	$\overline{RF}$	% RSD	CCC• SPCC••

Response Factor (subscript is the amount of nanograms)
$\overline{RF}$ -Average Response Factor
%RSD -Percent Relative Standard Deviation
CCC -Calibration Check Compounds (•)

SPCC -System Performance Check Compounds (••)
† -Not detectable at 20 ng

Form VI

EXHIBIT 14 (cont'd)

Continuing Calibration Check
Volatile HSL Compounds

Case No: ____________

Laboratory Name ____________

Contract No: ____________

Instrument ID: ____________

Calibration Date: ____________

Time: ____________

Laboratory ID: ____________

Initial Calibration Date: ____________

Minimum RF for SPCC is 0.300
(0.25 for Bromoform)

Maximum %D for CCC is 25%

Compound	RF	RF_{50}	%D	CCC	SPCC
Chloromethane					••
Bromomethane					
Vinyl Chloride				•	
Chloroethane					
Methylene Chloride					
Acetone					
Carbon Disulfide					
1, 1-Dichloroethene				•	
1, 1-Dichloroethane					••
Trans-1, 2-Dichloroethene					
Chloroform				•	
1, 2-Dichloroethane					
2-Butanone					
1, 1, 1-Trichloroethane					
Carbon Tetrachloride					
Vinyl Acetate					
Bromodichloromethane					
1, 2-Dichloropropane				•	
Trans-1, 3-Dichloropropene					
Trichloroethene					
Dibromochloromethane					
1, 1, 2-Trichloroethane					
Benzene					
cis-1, 3-Dichloropropene					
2-Chloroethylvinylether					
Bromoform					••
4-Methyl-2-Pentanone					
2-Hexanone					
Tetrachloroethene					
1, 1, 2, 2-Tetrachloroethane					••
Toluene				•	
Chlorobenzene					••
Ethylbenzene				•	
Styrene					
Total Xylenes					

RF_{50} -Response Factor from daily standard file at 50 ug/l
RF -Average Response Factor from initial calibration Form VI

%D -Percent Difference
CCC -Calibration Check Compounds (•)
SPCC -System Performance Check Compounds (••)

Form VII

EXHIBIT 14 (cont'd)

Continuing Calibration Check
Volatile HSL Compounds

Case No: ______________

Laboratory Name ______________

Contract No: ______________

Instrument ID: ______________

Calibration Date ______________

Time ______________

Laboratory ID: ______________

Initial Calibration Date: ______________

Minimum RF for SPCC is 0.300
(0.25 for Bromoform)

Maximum %D for CCC is 25%

Compound	$\overline{RF}$	RF_{50}	% D	CCC	SPCC

RF_{50} -Response Factor from daily standard file at 50 ug/l
$\overline{RF}$ -Average Response Factor from initial calibration Form VI

%D -Percent Difference
CCC -Calibration Check Compounds (•)
SPCC -System Performance Check Compounds (••)

Form VII

Continuing Calibration Check
Semivolatile HSL Compounds
(Page 1)

Case No: ______________ Calibration Date: ______________

Laboratory Name ______________ Time: ______________

Laboratory ID: ______________

Instrument ID: ______________ Initial Calibration Date: ______________

Minimum RF for SPCC is 0.050 Maximum %D for CCC is 25%

Compound	$\overline{RF}$	RF_{50}	% D	CCC	SPCC
Phenol				•	
bis(-2-Chloroethyl)Ether					
2-Chlorophenol					
1, 3-Dichlorobenzene					
1, 4-Dichlorobenzene				•	
Benzyl Alcohol					
1, 2-Dichlorobenzene					
2-Methylphenol					
bis(2-chloroisopropyl)Ether					
4-Methylphenol					
N-Nitroso-Di-n-Propylamine					••
Hexachloroethane					
Nitrobenzene					
Isophorone					
2-Nitrophenol				•	
2, 4-Dimethylphenol					
Benzoic Acid †					
bis(-2-Chloroethoxy)Methane					
2, 4-Dichlorophenol				•	
1, 2, 4-Trichlorobenzene					
Naphthalene					
4-Chloroaniline					
Hexachlorobutadiene				•	
4-Chloro-3-Methylphenol				•	
2-Methylnaphthalene					
Hexachlorocyclopentadiene					••
2, 4, 6-Trichlorophenol				•	
2, 4, 5-Trichlorophenol †					
2-Chloronaphthalene					
2-Nitroaniline †					
Dimethyl Phthalate					
Acenaphthylene					
3-Nitroaniline †					
Acenaphthene				•	
2, 4-Dinitrophenol †					••
4-Nitrophenol †					••
Dibenzofuran					

RF_{50} - Response Factor from daily standard file at concentration indicated (50 total nanograms)

$\overline{RF}$ - Average Response Factor from initial calibration Form VI

† - Due to low response, analyze at 80 total nanograms

%D - Percent Difference

CCC - Calibration Check Compounds (•)

SPCC - System Performance Check Compounds (••)

Form VII

XHIBIT 14 (cont'd)

Continuing Calibration Check
Semivolatile HSL Compounds
(Page 2)

Case No: ____________

Laboratory Name ____________

Instrument ID: ____________

Calibration Date: ____________

Time: ____________

Laboratory ID: ____________

Initial Calibration Date: ____________

Minimum RF for SPCC is 0.050   Maximum %D for CCC is 25%

Compound	$\overline{RF}$	RF_{50}	% D	CCC	SPCC
2, 4-Dinitrotoluene					
2, 6-Dinitrotoluene					
Diethylphthalate					
4-Chlorophenyl-phenylether					
Fluorene					
4-Nitroaniline †					
4, 6-Dinitro-2-Methylphenol †					
N-Nitrosodiphenylamine (1)				•	
4-Bromophenyl-phenylether					
Hexachlorobenzene					
Pentachlorophenol †				•	
Phenanthrene					
Anthracene					
Di-N-Butylphthalate					
Fluoranthene				•	
Pyrene					
Butylbenzylphthalate					
3, 3'-Dichlorobenzidine					
Benzo(a)Anthracene					
bis(2-Ethylhexyl)Phthalate					
Chrysene					
Di-n-Octyl Phthalate				•	
Benzo(b)Fluoranthene					
Benzo(k)Fluoranthene					
Benzo(a)Pyrene				•	
Indeno(1, 2, 3-cd)Pyrene					
Dibenz(a, h)Anthracene					
Benzo(g, h, i)Perylene					

RF_{50} · Response Factor from daily standard file at concentration indicated (50 total nanograms)

$\overline{RF}$ Average Response Factor from initial calibration Form VI

%D Percent Difference

† - Due to low response, analyze at 80 total nanograms

CCC · Calibration Check Compounds (•)

SPCC · System Performance Check Compounds (••)

(1) Cannot be separated from diphenylamine

Form VII

Continuing Calibration Check
Semivolatile HSL Compounds
(Page 1)

Case No: __________

Laboratory Name____________________

Instrument ID: ____________________

Calibration Date: ____________________

Time: ____________________

Laboratory ID: ____________________

Initial Calibration Date: ____________________

Minimum RF for SPCC is 0.050 Maximum %D for CCC is 25%

Compound	$\overline{RF}$	RF_{50}	% D	CCC	SPCC

RF_{50} -Response Factor from daily standard file at concentration indicated (50 total nanograms)

$\overline{RF}$ -Average Response Factor from initial calibration Form VI

† -Due to low response, analyze at 80 total nanograms

%D -Percent Difference

CCC -Calibration Check Compounds (*)

SPCC System Performance Check Compounds (**)

Form VII

XHIBIT 14 (cont'd)

Pesticide Evaluation Standards Summary
(Page 1)

Case No: ________

Laboratory Name: ________

GC Column: ________

Date of Analysis ________

Instrument ID: ________

Evaluation Check for Linearity

Laboratory ID				
Pesticide	Calibration Factor Eval. Mix A	Calibration Factor Eval. Mix B	Calibration Factor Eval. Mix C	% RSD (≤10%)
Aldrin				
Endrin				
4,4'- DDT(1)				
Dibutyl Chlorendate				

Evaluation Check for 4,4'- DDT/Endrin Breakdown
(percent breakdown expressed as total degradation)

	Laboratory I.D.	Time of Analysis	Endrin	4,4'- DDT	Combined(2)
Eval Mix B 72 Hour					
Eval Mix B					
Eval Mix B					
Eval Mix B					
Eval Mix B					
Eval Mix B					
Eval Mix B					
Eval Mix B					
Eval Mix B					
Eval Mix B					
Eval Mix B					
Eval Mix B					

(1) See Exhibit E, Section 7.5.4
(2) See Exhibit E, Section 7.3.1.2.2.1

Form VIII

RCRA
4/86

Pesticide Evaluation Standards Summary
(Page 2)

Evaluation of Retention Time Shift for Dibutyl Chlorendate
Report all standards, blanks and samples

Sample No	Lab I.D.	Time of Analysis	Percent Diff.	SMO Sample No.	Lab I.D.	Time of Analysis	Percent Diff.

Form VIII (Continued)

RCRA
4/86

PESTICIDE/PCB STANDARDS SUMMARY

Case No. ____________ Laboratory Name ____________

GC Column ____________ GC Instrument ID ____________

DATE OF ANALYSIS ____________
TIME OF ANALYSIS ____________
LABORATORY ID ____________

DATE OF ANALYSIS ____________
TIME OF ANALYSIS ____________
LABORATORY ID ____________

COMPOUND	RT	RETENTION TIME WINDOW	CALIBRATION FACTOR	CONF. OR QUANT.	RT	CALIBRATION FACTOR	CONF. OR QUANT.	PERCENT DIFF. **
alpha-BHC								
beta-BHC								
delta-BHC								
gamma-BHC								
Heptachlor								
Aldrin								
Heptachlor Epoxide								
Endosulfan I								
Dieldrin								
4,4'-DDE								
Endrin								
Endosulfan II								
4,4'-DDD								
Endrin Aldehyde								
Endosulfan Sulfate								
4,4'-DDT								
Methoxychlor								
Endrin Ketone								
Tech. Chlordane								
alpha-Chlordane								
gamma-Chlordane								
Toxaphene								
Aroclor - 1016								
Aroclor - 1221								
Aroclor - 1232								
Aroclor - 124								
Aroclor - 1248								
Aroclor - 1254								
Aroclor - 1260								

** CONF. = CONFIRMATION (<20% DIFFERENCE)
QUANT. = QUANTITATION (<15% DIFFERENCE)

FORM IX

EXHIBIT 14 (cont'd)

Pesticide/PCB Identification

Case No. ____________________ Laboratory Name ____________________

SAMPLE ID	PRIMARY COLUMN	PESTICIDE/ PCB	RT OF TENTATIVE ID	RT WINDOW OF APPROPRIATE STANDARD	CONFIRMATION COLUMN	RT ON CONFIRMATORY COLUMN	RT WINDOW OF APPROPRIATE STANDARD	GC/MS CONFIRMED (Y or N)

FORM X

15.0 CORRECTIVE ACTION

HMM's Corrective Action Program

All corrective action reports will be written by the QA Manager and submitted to the Principal-in-Charge for formal action.

Corrective Action reports will be based on the monthly performance and systems audit results in each area outlined in Section 12.0.

All field activities have predetermined limits for data acceptability (outlined in Section 12.0). The recorded data from field activities will be checked by the Project/Field Manager (on-site) and then by the QA Manager. Any deviations from the limits for data acceptability will be noted in a corrective action report.

For laboratory analysis, the Clean Harbors (Bedford) Project Manager will perform a review of all analytical results and submit them to the QA Manager (HMMs) for review. All samples analyzed by Clean Harbors will follow EPA approved methods. Each EPA Method has predetermined limits for data acceptability (as outlined in Section 12.0) these limits will be adhered to by Clean Harbors and reviewed by HMMs QA Manager. The Contract Laboratory Program also has predetermined limits for data acceptability. These also will be adhered to by Clean Harbors and reviewed by HMMs QA Manager. Any deviations from the predetermined limits for data acceptability will warrant a Corrective Action Report written by HMMs QA Manager and will be submitted to the Principal-in-Charge. Clean Harbors may also be required to reanalyze samples which can be proven to have been analyzed improperly or with Quality Control deviations at no additional cost.

Elements Used for Corrective Action

1. Monthly review of Systems Audit of field and laboratory activities.

2. Monthly review of Performance Audits of field and laboratory activities.

3. QA Managers monthly QA report to management.

4. The notation of any deviations from predetermined limits for data acceptability.

Procedures for Corrective Action

1. Identification and definition of the problem.
2. Assignment of responsibility for investigating the problem.
3. Investigation and determination of the cause of the problem.
4. Determination of a corrective action to eliminate the problem.
5. Assigning and accepting responsibility for implementing the corrective action.
6. Implementing the corrective action and evaluating its effectiveness.
7. Verifying that the corrective action has eliminated the problem.

Clean Harbors' Analytical Services - Bedford Division - Corrective Action Program (Revision 1, 7/7/87)

QA/QC deficiency reports will be generated by the QA/QC supervisor. The QA/QC deficiency (Figures 8 & 9, pages 42 & 43) will include data deficiencies and actions, recommended action and dates, and completed action and dates. Copies of the report will be distributed to Technical Managers and Lab Managers. If an individual(s) is responsible for a gross QA/QC deficiency, the individual(s) is given a written QA/QC deficiency warning and the individual(s) signs the warning. The individual, the QA/QC department and the personnel file each receive a copy of the warning. If an individual acquires three QA/QC deficiency warnings during a quarter, the individual will be issued a day off without pay. A gross deficiency is defined as "an "out of control" situation which is caused by the analyst, knowingly, not following Clean Harbors QA/QC protocols", as set forth in this manual.

When an "Out of Control" situation occurs, the supervisor will be notified as soon as possible. Upon notification, the supervisor will recommend the appropriate corrective action. The situation and corrective action will be documented by the supervisor in the appropriate "Out of Control" log. The lab managers or QA/QC Supervisor will initial the documentation of successful corrective action after its completion and must approve resumption of analysis. Repetitive "out of control" situations will be monitored for analyst-specific deficiencies and be reported on the weekly QA/QC (Figure 10, page 44) summary. These analyst-specific problems will be resolved as described above.

CleanHarbors

QA/QC DEFICIENCY

Date

Person(s)

Deficiency:

Investigation:

Corrective action:

nalyst's signature:

Supervisor's signature:

A/QC supervisor's signature:

Figure 8

CleanHarbors

QA/QC DEFICIENCY

Date: ______________
Person: ____________

Violation:

Corrective action:

Violator's signature: ____________________________________

Supervisor's signiture: __________________________________

QA/QC supervisor's signiture: ____________________________

Figure 9

CleanHarbors

CHAS QA/QC WEEKLY SUMMARY
Copies to Arthur Clark, Lou M. and Dave Newton
DATE:

Identify data deficiencies and actions

A1 ____

A2 ____

A3 ____

A4 ____

A5 ____

A6 ____

Recommended action and dates

B1 ____

B2 ____

B3 ____

B4 ____

B5 ____

B6 ____

Completed action and dates

C1 ____

C2 ____

C3 ____

C4 ____

C5 ____

C6 ____

Figure 10

16.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Monthly QA reports will be submitted by the QA Manager to management, specifically to the Principal-in-Charge. These reports will contain information on the monthly Performance and System audit results (as outlined in Section 12.0). Also included will be the periodic assessment of measurement data accuracy, precision and completeness of field activities and laboratory analyses.

The reports will also contain any significant QA problems and their recommended solutions.

The monthly QA report will contain projections of work and audits for the next month. A copy of the monthly report will also be submitted to the EPA at this time.

17.0 REFERENCES

1. Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans. EPA-600/4-83004 February 1983. (QAMS-005180)

2. Test Methods for Evaluating Solid Waste - Physical/Chemical Methods. EPA SW-846, 1986, 3rd Edition.

3. Handbook for Analytical Quality Control in Water and Wastewater Laboratories. EPA-600/4-79-019, March 1979.

4. Procedure for the Evaluation of Environmental Monitoring Laboratories. EPA 600/4-78-017, March 1978.

5. Manual for the Certification of Laboratories Analyzing Public Drinking Water Supplies. EPA-570/9-82-002, October 1982.

6. Contract Laboratory Program - Statement of Work Organic and Inorganic Analyses, October 1986, July 1987. As approved by D. Szaro, DPO.

7. EPA SW-846, 3rd Edition, Volume 1B, Analytical Protocols for the following: Volatile Organic Analysis Method 8240, Base Neutral and Acid Extractables Methods 8270, PCB Analysis Method 8080.

8. 40CFR143, July 19, 1979. National Secondary Drinking Water Regulations Procedure.

9. Instruction Book, Century Model OVA-128, Foxboro Company.

10. User Manual, OVM/Datalogger Model 580A, Thermo Environmental Instruments, Inc.

11. Instruction Manual, HNU ISPI 101 Analyzer, HNU Systems, Inc.

2.4 HEALTH AND SAFETY PLAN

SITE SAFETY PLAN
SAVAGE WELL SITE RI/FS
MILFORD, NEW HAMPSHIRE
VERSION 1.0

HMM Document No. 2176-022/HAZ/316

October, 1988

Prepared by:

HMM ASSOCIATES, INC.
336 Baker Avenue
Concord, MA 01742

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 Brief Site History

In February of 1983, volatile organic compounds were detected in the Savage Well during routine water quality monitoring by the Water Supply Division of the New Hampshire Water Supply and Pollution Control Commission (WSPCC).

In response to the contamination, hydrogeological investigations were initiated at the O.K. Tool Company, and Hitchiner Manufacturing Company, facilities which are located near the Savage Well. The Hydrogeological Investigation Unit of the Water Supply and Pollution Control Commission designed and implemented a study of the Savage Well area in the summer and fall of 1984.

The study revealed that the area is underlain by an unconfined, high yield, overburden aquifer. Volatile organic compounds were detected in the groundwater and surface water.

The Savage Well site is approximately one square mile in area, as defined in the EPA work plan and contains four operating industrial facilities. Site access restrictions have not been established by State or Federal agencies.

1.2 Purpose of The Site Specific Health and Safety Plan

The purpose of this site specific Health and Safety Plan is to provide specific guidelines, and establish procedures, for the protection of personnel conducting a Remedial Investigation of the Savage Well Site located in Milford, NH. The initial version (Version 1.0) of the site specific health and safety plan nas based upon previous studies and information available at that time. The plan and procedures will be updated based upon the on-going investigation of site conditions, including the most current information available for each media.

All personnel conducting activities on-site in which a potential exposure exists shall be in compliance with all applicable Federal/State rules and regulations. All personnel conducting site activities shall also be familiar with the procedures, requirements and provisions of this plan. In the event of conflicting plans/requirements, personnel must implement those safety practices which afford the highest level of protection. Section 6.1 lists the general guidelines for personnel conducting activities on-site. The procedures, requirements, and provisions addressed by this plan include: work environment monitoring (Section 6.1), personal protective equipment levels (Section 6.2), health and safety action levels (Section 6.3), site control (Section 7.0), decontamination (Section 8.0), site emergencies (Section 9.0), and other areas of health and safety.

The project manager is directly responsible for all aspects of the project both technical and administrative. The site safety manager is responsible for all aspects of health and safety for activities conducted during the RI/FS. The site safety officer is responsible for insuring the site safety plan is implemented properly at all times during site operations. Specific personnel responsibilities will vary depending upon the task being conducted.

2.0 LIST OF KEY PROJECT TEAM PERSONNEL

John Moebes - Project Manager	HMM Associates	(617)371-1692
James O'Brien - Task Manager	HMM Associates	(617)371-1692
Conrad Leszkiewicz - Task Manager	HMM Associates	(617)371-1692
John Wood - Hydrogeologist	HMM Associates	(617)371-1692
Donald Ellison - Hydrogeologist	HMM Associates	(617)371-1692
Mark Heuberger - Hydrogeologist	HMM Associates	(617)371-1692
Jim Young - Hydrogeologist	HMM Associates	(617)371-1692
Loretta Sanford - Site Safety Officer	HMM Associates	(617)371-1692
Robert Flatley - Engineer	HMM Associates	(617)371-1692
Paula Cappello - QA/QC Manager	HMM Associates	(617)371-1692
Diana Lettro - EPA Project Manager	U.S. EPA	(617) 573-9612

3.0 SITE AND TASK DESCRIPTION

3.1 Brief Site Description

The Savage Well Site is located in Southwestern New Hampshire in the Town of Milford, which is in Hillsborough County. The study area (approximately one square mile) is characterized by a variety of land uses ranging from agricultural to heavy industrial which is interspersed with commercial and residential developments. The area immediately northwest and east of the well site is utilized for agricultural purposes. Four major industrial facilities, Hendrix Wire and Cable Company Inc., Hitchiner Manufacturing Company, Inc., New England Steel Fabricators, Inc. and O.K. Tool Company, Inc. are located west and southwest of the Savage Well Site at distances ranging from approximately 1,600 feet to 3,400 feet. A mobile home park is located about 1,600 feet west of the Savage Well Site. Several single family residences are located on Old Wilton Road and Perry Road, southwest of the site. Exhibit 1 is a site map depicting the location of the primary industrial features and access roadways on the site.

3.2 Task Description

HMM Associates Inc. is tasked to conduct a Remedial Investigation/Feasibility Study (RI/FS) at the Savage Well Site in Milford NH. This RI/FS is divided into 14 tasks. Below is a brief description of the task and associated potential hazard(s) for each task which involves on-site activities.

3.2.1 Study Area Survey

3.2.1.1 Task Description

The study area survey will provide a detailed topographic map of the site for use as a Site Base Map during future RI/FS activities. Aerial photography and field surveying will be employed to prepare a detailed site map for use in plotting reference locations and data accumulated throughout the individual subtasks of the RI/FS. The ground control for the photogrammetry and base map of the site will be performed by Eastern Topographic of Wolfeboro, NH.

HMM Engineers Inc. will conduct additional field surveys to review and validate the topographic base map once it is completed. HMM Engineers will also conduct additional surveying in the summer months to identify plot property lines, utilities easements, right of way, groundwater monitoring well locations, and other pertinent features which will be incorporated into the final site map. Also included in the site survey will be a study to identify and delineate wetland resources.

3.2.1.2 Exposure Potential

The study area survey will require a site walkover by the ground control crew and site surveyors. During the site walkover, surveyors will shoot spot elevations, locations, and property boundaries. Periodic air monitoring will be conducted during ground control activities and surveying activities in accordance with Section 6.1 to determine if an upgrade in level of protection is required as defined by Section 6.3. The site walkovers have little to no effect on-site conditions and therefore limits the potential for exposure is minimal.

3.2.2 Air Sampling

HMM Associates will conduct an air monitoring program in two phases. Phase I will consist of an initial site walkover utilizing various monitoring equipment such as an HNU photoionization detector (HNU) and/or a Foxboro OVA Century 128 Flame Ionization Detector (OVA). If the site walkover suggests that airborne contamination of volatile organic compounds (VOC's) has migrated off-site or potentially could migrate off-site, Phase II sampling will be initiated.

The data collection in Phase I will be used to aid in the evaluation of potential exposure in other tasks. The Phase II effort, if required, will be directed toward determining the concentration and identification of VOC's off-site. To achieve this, five monitoring locations will be established in the area of the suspected contaminant migration and at the background location. Each monitoring location will be situated to avoid any upwind or downwind obstruction which might alter the local wind currents. The samples will be collected at the breathing zone (5 foot level) and adsorbed in a bed of Tenax or activated carbon resin.

3.2.2.2 Exposure Potential

The air sampling task will require personnel to operate field portable organic vapor detecting instruments to collect air samples at the inhalation level (5 ft.). The potential for exposure is limited to the inhalation of volatile organic vapors. The field portable instruments used in this task are identical to air monitoring equipment. Personal protection levels will be determined from monitoring results, and action levels defined in Section 6.3.

3.2.3 Geophysical Investigations

3.2.3.1 Task Description

The objective of this task is to apply two remote sensing techniques to aid in the definition of subsurface conditions and to assist in the location of soil borings/rock corings and groundwater monitoring wells. The geophysical program is expected to provide information on the depths and configuration of the bedrock surface and characteristics which may control groundwater and contaminant flow in the bedrock. The two types of geophysical techniques that will be utilized under this task will be magnetometry and seismic refraction. HMM Associates will retain Geo-Centers, Inc. to perform the geophysical investigation under the supervision of a HMM hydrogeologist.

3.2.3.2 Exposure Potential

The geophysical investigation will require personnel to place seismic energy sources (shotgun cartridges) approximately one foot below grade. Geophones will be placed into surficial soils. The potential for exposure during the geophysical investigations is through direct contact with contaminated soils and inhalation of volatile organic vapors. Relatively high concentrations of volatile organic contamination have been detected in the soil during previous investigations in the areas of seismic line SL-2 and magnetometry survey area MG-1 and MG-2. (See Exhibit 1). During the placement of geophones and shot points, a modified Level D (as specified in Section 6.2) will be required to reduce the risk of exposure through direct contact. During the ignition of shot points, personnel will be located in a remote area to avoid potential hazards. The work area will be monitored (as specified in Section 6.1) for levels of volatile organic vapors. If concentration of volatile organic vapors exceed action levels as defined in Section 6.3, then an upgrade in level of personnel protection and other appropriate measures is required.

3.2.4 Surface Water and Sediment Sampling

3.2.4.1 Task Description

Surface water samples SW1 through SW21 and sediment samples SW1 through SW17 will be collected using containers, sampling methods and handling methods in accordance with protocols approved by the EPA. An effort will be made to sample the surface waters at low flow conditions. Samples are to be collected after a three to four day period during which no precipitation or snow melt events have occurred.

3.2.4.2 Exposure Potential

Previous investigations have detected surface water contamination in various concentrations and locations. Volatile organic vapors may be present during sampling collection. Potential exposures exist through inhalation of volatile organic vapors and direct contact with contaminated surface water and soils. A modified Level D will be required (as specified in Section 6.2) for all surface water and sediment sampling to reduce risk of direct contact during sampling handling. Air monitoring will be conducted to insure the proper level of protection is provided. An upgrade in level of protection is required if air monitoring exceeds action levels (as specified in Section 6.3). Boating may be required to obtain samples from the Souhegan River. Personnel will be required to use Coast Guard approved personal flotation devices.

3.2.5 Groundwater Monitoring Well Installation

3.2.5.1 Task Description

The hydrogeologic investigation will include the installation of a total of 15 overburden well clusters, 4 bedrock wells, and 5 piezometers which will be installed as part of Phase I to complement the existing array of wells located on-site. A well cluster will consist of two or three individual wells depending on the saturated thickness of the overburden aquifer.

Screen placement will be contingent upon the results of field screening of split spoon samples. All drilling and well installation activities will be conducted by Guild Drilling Co. Guild will mobilize a Mobile B-40 or comparable rig with drive and wash, and rock coring capabilities to install the monitoring wells. The Phase I overburden wells will be cored (10 feet) into rock to confirm depth to rock and the bedrock characteristics.

During drilling operations, HMM Associates will have an experienced geologist present at each rig at all times to make observations, complete boring logs and supervise drilling operations. Samples will be field screened using an OVA 128 Flame Ioninzation Detector (OVA) to identify contaminated zones within the aquifer.

3.2.5.2 Potential Exposure

Groundwater well installation activities create the potential of contaminated groundwater and soil to volatilize into the work environment. The potential exposure of organic vapor inhalation and direct contact with contaminated groundwater and soils exist during groundwater well installation activities. To reduce the risk of direct contact with contaminated soils a modified Level D (See Section 6.2) will be initially required during groundwater well installation. Periodic monitoring will be conducted in accordance with Section 6.1 to determine if an upgrade in level of protection is required.

3.2.6 Groundwater Sampling

3.2.6.1 Task Description

Sampling of all new and existing wells will be performed by an HMM hydrogeologist experienced with required sampling methods, sampling equipment, and decontamination procedures. HMM Associates proposes using a teflon bladder pump to sample wells with sufficent submergence and recharge characteristics. Low yielding wells may either be sampled with a type 316 stainless steel bailer attached to a teflon coated cable or peristaltic pump, fitted with teflon tubing and a teflon sample trap.

3.2.6.2 Potential Exposure

The potential routes of exposure during groundwater sampling activities are through inhalation of volatile organic vapors and direct contact with contaminated groundwater. During all groundwater sampling a modified Level D (Section 6.3) will be required to reduce the risk of exposure through direct contact. Periodic air monitoring of the work environment will be conducted in accordance with Section 6.1 during sampling activities to determine the appropriate level of personnel protection.

3.2.7 Soils and Subsurface Investigations

3.2.7.1 Task Description

The purpose of the Phase I soils investigations is to determine the lateral and vertical variation of contamination within the first two to three feet of the soil horizon. Sampling locations will be selected based on the available historical information, disposal practices at the site and on present knowledge of local geological conditions. This characterization will be based upon an analysis of up to 90 soil gas samples for volatile organics using field portable organic vapor detecting instruments.

Phase II (if deemed necessary) will utilize data from Phase I that identified source areas of contaminated soils. A maximum of 40 borings will be completed to a depth of two feet below the water table. A maximum of six test pit trenches, 2 feet wide by 15 feet long may be excavated to groundwater or the maximum reach of the backhoe. These test pit locations will be determined subsequent to the initial surfical reconnaissance and interpretation of the magnetometry survey. The number of soil samples to be collected is estimated to be 18. Test pits will be located with the intent of transecting suspected areas of disposal, lagoons, and tanks which may have been backfilled in the past. Soil sampling may be required within the PRP's facilities if source areas are suspected.

3.2.7.2 Potential Exposure

Soils and subsurface investigations in Phase I involves excavating and venting of soils. During the soil gas sampling collection, soil gas will be vented to the atmosphere in order to collect the sample. The soil venting in Phase I and excavation in Phase II causes a potential exposure of inhalation of volatile organic vapors. The collection of soil samples in Phase II creates the potential for direct contact with contaminated soils. A modified Level D (see Section 6.3) will be required for sample collection and handling to reduce the risk of direct contact. Periodic air monitoring will be conducted in accordance with Section 6.1 to monitor exposure to respiratory hazards. Level C (Section 6.3) will be required for test pit activities. The potential exposure to high concentrations of volatile organic vapors exists if ruptured drums are detected during test pit activities. (See Section 6.1 on drum/tank restrictions).

3.2.8 Treatability Study

3.2.8.1 Task Description

The treatability study includes conducting evaluations of volatile organic compound removal by air stripping of groundwater and soil venting technologies. The air stripping study will consist of the following: constructing monitoring wells; pumping wells; collecting and analyzing groundwater samples; conducting an aquifer pump test; performing air stripper treatment efficiency on a bench scale system with one day of evaluation; and, conducting a pilot scale air stripping test with an increased flow rate and a thirty day performance evaluation.

3.2.8.2 Potential Exposure

The treatability study involves a number of different activities. Potential exposure from the inhalation of volatile organic vapors exists during monitoring well construction, in the pumping wells, in sample collection, in conducting pump tests, and during air stripping activities. This potential exists due to the chance of open volatilization of groundwater in the work environment. The potential for direct contact with contaminated groundwater exists in sample collection, and pump test activities. During those activities in which direct contact with contaminated groundwater exist a modified Level D is required (see Section 6.3). Periodic air monitoring in accordance with Section 6.1 will be conducted to insure health and safety action levels are met.

4.0 HAZARD EVALUATION

4.1 Volatile Organic Contamination

There is a substantial quantity of hydrogeologic information available from previous investigations of the Savage Well Site area. The purpose and scope of the previous investigations has varied from water supply exploration to contamination investigations at specific locations within the site. Volatile organic contamination of groundwater is distributed throughout the site. Contamination has been found in an area extending from O.K. Tool Company to the west, Hitchiner Manufacturing Company and Hendrix Wire & Cable Company to the south and to approximately 1,100 feet east of Savage Well. Three smaller areas of volatile organic contamination in low concentrations were detected. Two of the areas were detected near New England Steel Fabricators. The third area was located near the Hitchiner sludge disposal site on Perry Road.

A site map (Exhibit 1) featuring the site characteristics (monitoring well locations, industrial facilities, etc.) is located at the end of this plan. This site map should be referred to for monitoring well locations and other site characteristics mentioned in this section.

Previous investigations at the O.K. Tool Company facility indicated that there are several areas containing high levels of volatile organic compounds which may be acting as significant sources of groundwater contamination. The highest levels of volatile organic compounds in the groundwater were detected downgradient from the O.K. Tool Company facility. Samples from the north side of Elm Street have generally contained tetrachloroethylene in the largest concentration with lesser amounts of trichloroethylene, 1,2 trans-dichloroethylene, and 1,1,1-trichloroethane. Samples from the south side of Elm Street have generally contained 1,1,1-trichloroethane in the highest concentration with lower quantities of tetrachloroethylene and 1,1-dichloroethane.

Volatile organic compounds have been detected in the Hendrix-Hitchiner discharge stream. The volatile organic compounds detected include 1,1,1-trichloroethane and methyl isobutyl ketone in the greatest concentrations and relatively low concentrations of tetrachloroethylene, 1,1-dichloroethane and 1,1-dichloroethylene.

The Hitchiner production well has contained similar volatile organic compounds such as 1,1,1-trichloroethane, tetrachloroethylene, and 1,1-dichloroethane. The eastern extent of volatile organic contamination of the groundwater was found to extend at least 1,100 feet east of the Savage Well.

Six groundwater and four surface water samples were obtained in previous investigations and analyzed for acid base/neutral extractable organic analysis. A total of ten compounds were tentatively indentified. Acetophenone was detected in higher concentrations than any other compound at MI-53 (472 ug/l).

4.2 Inorganic Contamination

Four surface water samples and two groundwater samples were analyzed in previous investigations for inorganic parameters. Inorganic contamination varies in concentration and location. MI-42 had higher levels of aluminum (202.4 ug/l), antimony (5.5 ug/l), barium (70.7 ug/l), arsenic (4.4 ug/l), manganese (3080 ug/l), and zinc (57.9 ug/l) as compared to the other samples. The Hendrix-Hitchiner discharge stream samples, MI-52 and MI-53, exhibited high levels of iron (1511 ug/l and 637.5 ug/l respectively) and manganese (371.2 ug/l and 255.5 ug/l respectively). In addition, antimony, barium, and copper were found at higher concenetrations than detected in the Souhegan River samples. Nickel was detected only at MI-30 at a concentration of 70.3 ug/l.

A comparison of data for the Souhegan River samples, MI-49 and MI-51, indicates that levels of aluminum, antimony, barium, iron, and manganese are higher downstream of the Hendrix-Hitchiner stream discharge than in the Souhegan River. The concentration of lead was found to be relatively high (ranging between 261 ug/l to 305 ug/l), in all samples.

4.3 Surface Soil Contamination

Results from OVA headspace-screening performed previously at the O.K. Tool Company facility and surrounding property has shown readings ranging from undetectable to greater than 1000 ppm (See Exhibit 6). Readings above 1000 ppm were recorded at four locations at depths up to 4 feet. Four locations exhibited readings between 1000 ppm and 100 ppm and four locations exhibited readings between 100 ppm and 10 ppm. Most locations exhibited readings at or a few ppm above, background. Elevated readings were generally found at locations north and east of the main O.K. Tool building. Subsequent laboratory soil analyses indicated tetrachloroethylene contamination at concentrations up to 300,000 ppb.

5.0 SPECIFIC HAZARDS

In Section 3, the specific hazards identified for each task are indicated. Other specific on-site hazards include:

- The inhalation of volatile organic vapors during site operations.
- Direct contact with contaminated soil and/or groundwater.
- The inhalation of contaminated dusts during site operations.
- Oxygen deficient and/or explosive conditions upon entering confined or enclosed spaces.
- Physical injuries, such as heat stress, frostbite, abrasions, etc.

Investigations conducted to date have identified a number of chemical substances to be present on-site. A Hazardous Substance Identification Form has been prepared for each chemical substance found to date in significant concentrations. These forms list physical, chemical, and toxicological properties of the substance. Appendix A contains a draft copy of the Hazardous Substance Identification Forms which are arranged in alphabetical order.

6.0 PERSONNEL PROTECTION

6.1 General Guidelines and Monitoring

- All work conducted on-site shall be coordinated through the site safety officer and/or the site manager.

- During any activity conducted on-site in which a potential exists for exposure to hazardous materials or, accident or injury, at least two persons shall be present who are in constant communication with each other.

- Following the procedures, requirements, and provisions of this plan, all personnel who may be potentially exposed to hazardous materials or wastes shall be in compliance with Federal/State regulations including OSHA 29 CFR 1910.120.

- Any drum or tank discovered on-site shall not be sampled or opened until an appropriate plan for unknown drum/tank sampling has been implemented.

- Samples from areas known, or suspected, to be contaminated with hazardous substances shall be handled with appropriate personal protective equipment.

- All equipment used in site operations shall be properly cleaned and maintained in good working order. Equipment shall be inspected for signs of defect and/or contamination before and after use.

- Eating, drinking, chewing gum, and smoking shall be prohibited while performing site activities and in work zones. Personnel shall wash thoroughly before initiating any of the aforementioned activities.

- The discovery of any condition that would suggest the existence of a situation more hazardous than anticipated shall result in the evacuation of site personnel and the reevaluation of the hazard and the level of protection.

Monitoring shall be performed within the work area on-site in order to detect the presence, and the relative levels of toxic substances. Monitoring shall be conducted to identify other dangerous situations such as the presence of flammable or explosive atmospheres and/or oxygen deficient environments. The data collected throughout monitoring shall be used to determine the appropriate levels of personal protective equipment. Monitoring shall be conducted in order to determine baseline data on potential hazards prior to entry in the work area, and periodically while conducting work on-site to evaluate any changes in conditions of the specific work area. Each work area must be screened for ambient levels of contamination prior to initiating work activities.

Periodic monitoring on the site will consist of monitoring initially, during change of site conditions (i.e. opening of a monitoring well, soil excavation, sampling etc.), and at fifteen minute intervals.

Any activity which is to be conducted in a confined or enclosed area must be monitored for physical hazards such as explosion potential and oxygen deficiency, as well as chemical contamination. Air monitoring and field screening equipment will consist of an HNU photoionizer, a Thermo Environmental Instruments (OVM) photoionizer, a Foxboro organic vapor analyzer (OVA), Draeger gas detector, an oxygen meter, and an explosimeter. The HNU, OVM and OVA will be used for the determination of organic vapor activity in samples and in the the work environment. The Draeger gas detector will be used to determine the presence of inorganic gases in the work environment. The HNU and OVM have the ability to detect from 1 ppm to 2000 ppm. The OVA has the ability to detect from 1 ppm to 1000 ppm. The Draeger gas detection limits vary depending on the compound being detected.

6.2 Personal Protective Equipment and Action Levels

The purpose of personal protective clothing and equipment is to shield or isolate individuals from the chemical and physical hazards that may be encountered during work activity. The level of protection required must correspond to the level of hazard known, or suspected, in the specific work area.

There are four basic levels(A,B,C, and D) of personnel protection as established by the U.S. Environmental Protection Agency (EPA). Level A provides the highest level of protection and Level D provides the lowest. Exhibit 2 is a list of various levels of protection and indicates the recommended and required equipment for activities conducted in the work area.

- Level D will be modified to contain; blue tyvek coveralls or field clothes, outer chemical resistant gloves, chemical resistant boots, safety glasses and a hard hat if overhead hazards are present.

- Level C will consist of white tyvek coveralls, full-faced air purifying canister equipped respirator, inner and outer chemical resistant gloves, chemical resistant boots, and a hard hat if overhead hazards are present.

- Level B will consist of the same equipment as listed for Level C with the substitution of a full-faced Self Contained Breathing Apparatus or Supplied Air Line in place of a full-faced air purifying respirator.

Personal protective equipment has been selected with specific considerations to the hazards associated with the RI/FS site activities. The change in the color of tyvek coveralls has been designed so that persons approaching the site who are aware of the designated color schemes will be able to recognize the hazard level. The air purifying respirator cartridges selected for use are the MSA GMC-H, which has the ability to protect against total organic vapors up to 1000 ppm, 10 ppm chlorine, 30 ppm formaldehyde, 50 ppm hydrogen chloride and 50 ppm sulfur dioxide. The cartridges will also protect against dusts, fumes and mists having a TWA less than 0.05 mg/m^3; absestos containing dusts and mists, and radionuclides.

6.3 Health and Safety Action Levels

An action level is a point at which increased protection is required due to the concentration of contaminants in the work area. Each action level is determined by the concentrations above background levels and the ability of the personal protective equipment to protect against that specific contaminant. A clean zone background level will be established at approximately 30 to 50 feet (where practical), from the specific work area.

An upgrade to Level C is required if:

- Concentrations of organic vapors recorded in the work area by air monitoring equipment are 5 ppm above background.

An upgrade to Level B is required if:

- o Concentrations of organic vapors recorded by air monitoring equipment in the work area reach or exceed 250 ppm above background levels.
- o Concentration of oxygen recorded on the oxygen meter is less than 19.5%.
- o Activities are conducted in areas of confined or enclosed spaces.

A cease and desist of operations at the specific work site is required if:

- o Concentration of organic vapors recorded in the work area are greater than 1000 ppm.
- o Concentration of combustible gases recorded on the explosimeter are greater than 20% of the lower explosion limit (LEL).
- o Concentration of organic vapors recorded in an area accessible to the public are greater than 5 ppm above background levels.
- o Concentration of oxygen recorded on the oxygen meter is less than 19.5% in an area accessible to the public.

If ambient levels are measured which exceed the above criteria in areas accessible to the public or unprotected personnel, necessary site control measures must be implemented prior to commencing activities at the specific work site.

Personnel should also be able to upgrade or downgrade their level of protection with the concurrence of the site safety officer and task manager.

<u>Reasons to upgrade</u>:

- o Known or suspected presence of dermal hazards.
- o Occurrence or likely occurrence of gas, vapor or dust emission.

- Change in work task that will increase the exposure or potential exposure with hazardous materials.

- Request of the individual performing the task.

Reasons to downgrade:

- New information indicating that the situation is less hazardous than was orginally suspected.

- Change in site conditions that decreases the potential hazard.

- Change in work task that will reduce exposure with hazardous materials.

7.0 SITE CONTROL

The purpose of site control is to minimize potential contamination of workers, protect the public from the site's hazards, and prevent vandalism. The degree of site control necessary depends on the site characteristics, site size, and the surrounding community. The site map (Exhibit 1) indicates the location of buildings and access roadways.

Site work zones will be established at each work area, and will be established directly prior to the work being conducted. A basic guideline for Level B and C activities will be followed for the establishment of work zones as indicated in Exhibit 3 and below.

Each work area will establish three zones.

- Exclusion Zone - contaminated work area.
- Contamination Reduction Zone - the decontamination area.
- Support Zone - uncontaminated, clean area.

Each zone will be periodically monitored in accordance with Section 6.1 and personal protection levels will be established in accordance with Section 6.3. The Exclusion Zone and the Contamination Reduction Zone are considered work areas. The Support Zone is considered an area which is excessible to the public (See Section 6.3 on requirements for public protection).

The Exclusion Zone is the area where primary activities occur, such as sampling, installation of wells, clean up work, etc. This area must be clearly marked with hazard tape or enclosed by fences or ropes. Only personnel involved in work activities will be allowed in the Exclusion Zone.

The Contamination Reduction Zone is the transition area between the contaminated area and the clean area. Decontamination is the main focus in this area. The decontamination of workers and equipment limits the physical transfer of hazardous substances into the clean area. This area must also be clearly marked with hazard tape and access limited to personnel involved in decontamination. Decontamination is explained in a later section (Section 8.0) of this plan.

The Support Zone is an uncontaminated zone which is the location of adminstrative and other support functions, such as first aid, equipment supply, emergency information, etc. The Support Zone should have negligible potential for exposure to contaminants and is equivalent to that of background.

8.0 DECONTAMINATION

8.1 Personnel Decontamination

Personnel decontamination areas will be established at each sampling location. All personal protective equipment will be disposed of, or decontaminated at the conclusion of each work day. A designated container for tyvek suits and other disposables will be located on the site. Tyvek suits, respirator cartridges, and other disposables (inner gloves) will be doffed at the conclusion of each work day and replaced with new equipment prior to commencing work on the following work day. Respiratory equipment, boots, outer gloves, and foul weather gear will be washed and rinsed, then placed in a designated personal protective equipment storage area. The required decontamination layout for Level B and C protection for site activities is shown in Exhibit 4.

8.2 Equipment Decontamination

The drilling company will decontaminate all drilling equipment with a steam cleaner before drilling at the first hole, between each boring, and at the conclusion of the drilling activities. Drilling rigs will also be decontaminated with steam before leaving the site. Monitoring, and other equipment used in an exclusion zone will be decontaminated in a designated area in the contamination reduction zone.

9.0 EMERGENCY INFORMATION

On-site emergencies can range in intensity from minor to serious conditions. Various procedures for responding to site emergencies are listed in this section. The site safety officer or alternate site safety officer is responsible for contacting local emergency services in emergency situations. An injured person shall be accompanied by another worker at all times.

An emergency information sheet containing the hospital location, directions, phone access, and emergency service phone numbers shall be posted at each work area during site activities. A weather resistant copy of the emergency information sheet will be supplied to site personnel.

9.1 Emergency Procedures for Contaminated Personnel

Whenever possible, personnel should be decontaminated before administering first aid. In the Contamination Reduction Zone there will be a separate decontamination line for emergency use only in order to reduce the risk of exposure.

- o Skin Contact: Remove contaminated clothing, wash immediately with water, use soap if available.

- o Inhalation: Remove from contaminated atmosphere. Initiate artificial respiration if necessary. Transport to hospital.

- o Ingestion: Remove from contaminated atmosphere. Do not induce vomiting if the victum is unconscious. Also, never induce vomiting when acids, alkalines, or petroleum products are suspected.

- o If site personnel have unexplainably collapsed, all personnel must evacuate work area. Rescue personnel must donn Supplied Air Respirators before evacuating victim from work area.

- o In case of fire, all personnel must evacuate work area and contact local fire department.

9.2 Physical Injuries and Temperature Stress

Basic first aid supplies (bandages, gauze, tape) will be located in the the first aid box. The first aid box, along with a first aid manual for chemical accidents, (LeFeure, First Aid Manual for Chemical Accidents) will be located in the Support Zone.

Temperature stress is one of the common illnesses at hazardous waste sites. Acclimatization and frequent rest periods must be established for conducting activites where temperature stress may occur. Below are listed signs and symptoms of heat stress, personnel should follow appropriate guidelines if any personnel exhibit these symptoms.

- Heat Rash - redness of skin. Frequent rest and change of clothing.

- Heat Cramp - painful muscle spasms in hands feet, and/or abdomen. Administer lightly salted water by mouth unless there are medical restrictions.

- Heat Exhaustion - clammy, moist, pale skin; dizziness, nausea rapid pulse, fainting. Remove to cooler area and administer fluids orally or have physician administer saline solution intravenously.

- Heat Stroke - hot dry skin; red, spotted or bluish; high body temperature of 104°F, mental confusion, loss of consciousness, convulsions or coma. Immediately cool victim by immersion in cool water. Wrap in wet sheet while fanning sponge with cool liquid. While fanning, treat for shock. DO NOT DELAY TREATMENT. COOL BODY WHILE AWAITING AMBULANCE.

Ambient air temperatures during site activities may create cold stress for on-site workers. Procedures for recognizing and avoiding cold stress must be followed, cold stress can range from frostbite to hypothermia. Below are listed signs and symptoms of cold stress. Personnel should follow appropriate guidelines if any personnel exhibit these symptoms.

- Frostbite - Pain in the extremities, and loss of manual dexterity. "Frostnip" or reddening of the tissue, accompanied by a tingling or loss of sensation in the extremities. Continuous shivering.

- Hypothermia - Pain in the extremities and loss of manual dexterity. Severe, uncontrollable shivering. Inability to maintain level of activity. Excessive fatigue, drowsiness, irritability, or euphoria. Severe hypothermia: clouded consciousness, low blood pressure, pupil dilation, cease of shivering, and unconsciousness. Severe hypothermia may result in death.

Cold Stress and Frostbite Emergency Care

Remove the patient to a warm, dry place. If clothing is wet, remove and replace with dry clothing. Keep patient warm. Rewarming of the patient should be gradual to avoid stoke symptoms. Dehydration, or the loss of body fluids may result in cold injury due to a significant change in blood flow to the extremities. If patient is conscious and alert, warm sweet drinks should be provided. Coffee and other caffeinated liquids should be avoided because of diuretic and circulatory effects. Extremities affected by frostbite should be gradually warmed up and returned to normal temperature. Moist compresses should be applied; begin with luke warm compresses and slowly increase the temperature as changes in skin temperature are detected. Keep patient warm and calm, remove to a medical facility as soon as possible.

9.3 Safety Equipment

Safety and personal protective equipment will be kept in a designated area in the support zone. The safety equipment availiable on-site is as follows: respiratory equipment, hard hats, tyvek coveralls, safety glasses, gloves, boots, emergency eyewash, fire extinguisher, first aid kit and manual.

9.4 Public Phone Access

There will be a phone for use inside the industrial facilites of Hitchiner Manufacturing, Hendrix Wire and Cable, New England Steel Fabricators, and O.K. Tool Company.

9.5 Emergency Telephone Numbers

LOCAL

Milford Police Department Emergency Number	911
Milford Fire Department Emergency Number	911

Ambulance Service	911
Milford Police Department	(603) 673-3131
Milford Fire Department	(603) 673-1414
Ambulance Service	(603) 673-1414
State Police Department	(603) 472-7333
Milford Medical Center	(603) 673-5623

STATE

NH Water Supply and Pollution Control Commission	(603) 271-3503
NH Bureau of Hazardous Waste Management	(603) 271-4608
NH Fire Marshall Office	(603) 271-3336
NH State Police (24 hour dispatch)	1-800-852-3411
Poison Information Center	1-800-562-8236

FEDERAL

U.S. EPA (24 hour hotline)	1-800-842-3411

9.6 Directions to Milford Medical Center

Milford Medical Center is located on Route 101 in Milford Center. The address is 130 Nashua Road, Milford, N.H.

From the Savage Well Site head east on 101 (Elm Street) toward Milford Center. At the junction of 101 and Route 13, turn right onto Route 13 and then left onto Nashua Street (Route 101 A). The Milford Medical Center is 0.7 miles from Route 13 on the left hand side of Nashua Street. An area map (Exhibit 5) identifies the direction of the Milford Medical Center with respect to the site.

10.0 REFERENCES

1. U.S. Environmental Protection Agency, Standard Operating Safety Guides, U.S. EPA, November 1984.

2. U.S. Environmental Protection Agency, Superfund Public Health Evaluation Manual, EPA/540/1-86/060, January 1986.

3. 29 CFR 1910 Hazardous Waste Operations and Emergency Response, August 10, 1987.

4. NIOSH, Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, DHHS/NIOSH-85-115, October 1985.

5. HMM Corporate Heath and Safety Manual, April, 1987.

EXHIBITS

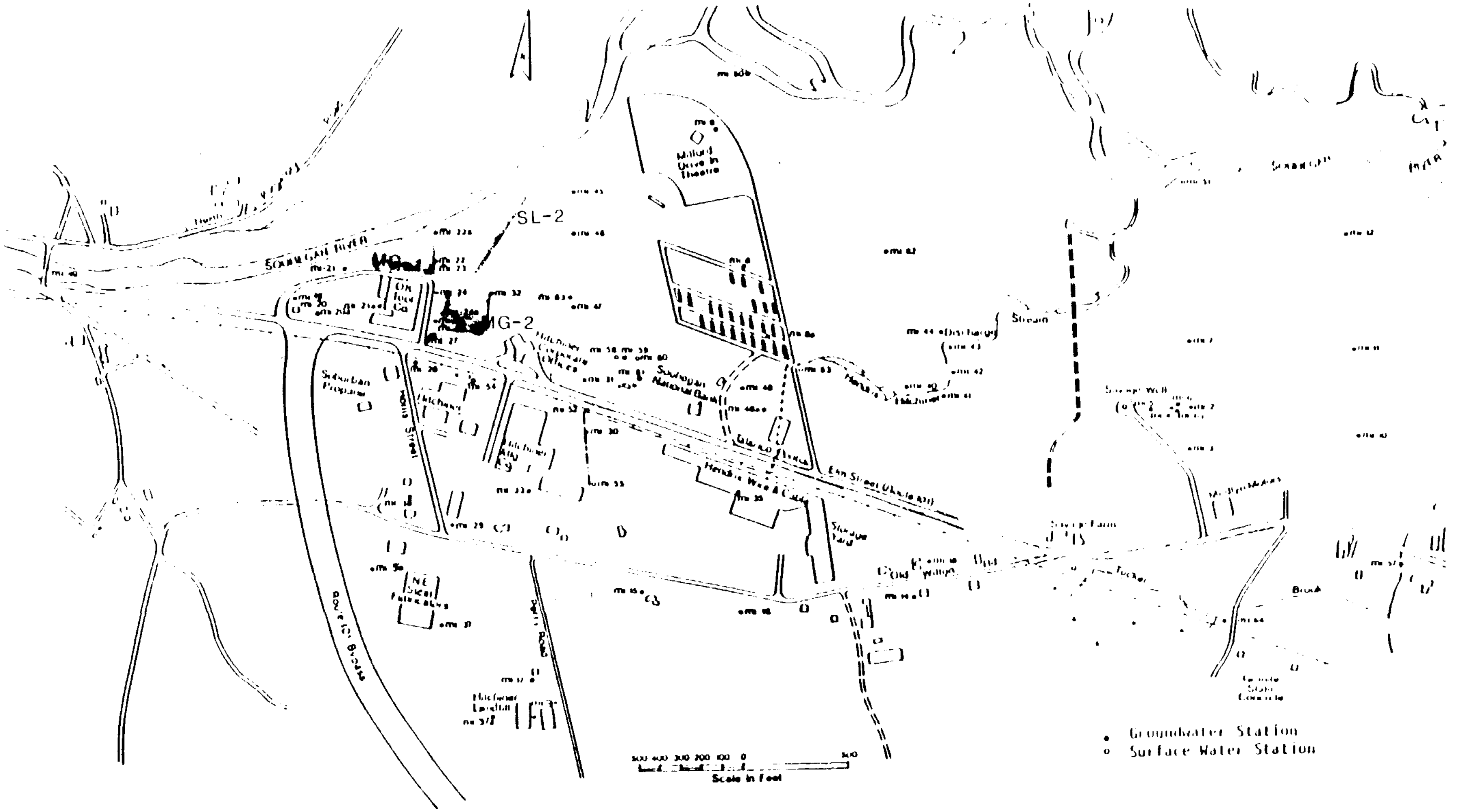


EXHIBIT 1 SITE MAP

HMM ASSOCIATES INC.

TABLE 1

LEVEL OF PROTECTION	EQUIPMENT	PROTECTION PROVIDED	SHOULD BE USED WHEN:	LIMITING CRITERIA
B	RECOMMENDED: • Pressure-demand, full-facepiece SCBA or pressure-demand supplied-air respirator with escape SCBA. • Chemical-resistant clothing (overalls and long-sleeved jacket; hooded, one- or two-piece chemical splash suit; disposable chemical-resistant one-piece suit). • Inner and outer chemical-resistant gloves. • Chemical-resistant safety boots/shoes. • Hard hat. • Two-way radio communications. OPTIONAL: • Coveralls. • Disposable boot covers. • Face shield. • Long cotton underwear.	The same level of respiratory protection but less skin protection than Level A. It is the minimum level recommended for initial site entries until the hazards have been further identified.	• The type and atmospheric concentration of substances have been identified and require a high level of respiratory protection, but less skin protection. This involves atmospheres: – with IDLH concentrations of specific substances that do not represent a severe skin hazard; or – that do not meet the criteria for use of air-purifying respirators. • Atmosphere contains less than 19.5 percent oxygen. • Presence of incompletely identified vapors or gases is indicated by direct-reading organic vapor detection instrument, but vapors and gases are not suspected of containing high levels of chemicals harmful to skin or capable of being absorbed through the intact skin.	• Use only when the vapor or gases present are not suspected of containing high concentrations of chemicals that are harmful to skin or capable of being absorbed through the intact skin. • Use only when it is highly unlikely that the work being done will generate either high concentrations of vapors, gases, or particulates or splashes of material that will affect exposed skin.
C	RECOMMENDED: • Full-facepiece, air-purifying, canister-equipped respirator. • Chemical-resistant clothing (coveralls and long-sleeved jacket; hooded, one- or two-piece chemical splash suit; disposable chemical-resistant one-piece suit). • Inner and outer chemical-resistant gloves. • Chemical-resistant safety boots/shoes. • Hard hat. • Two-way radio communications. OPTIONAL: • Coveralls. • Disposable boot covers. • Face shield. • Escape mask. • Long cotton underwear.	The same level of skin protection as Level B, but a lower level of respiratory protection.	• The atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect any exposed skin. • The types of air contaminants have been identified, concentrations measured, and a canister is available that can remove the contaminant. • All criteria for the use of air-purifying respirators are met.	• Atmospheric concentration of chemicals must not exceed IDLH levels. • The atmosphere must contain at least 19.5 percent oxygen.
D	RECOMMENDED: • Coveralls. • Safety boots/shoes. • Safety glasses or chemical splash goggles. • Hard hat. OPTIONAL: • Gloves. • Escape mask. • Face shield.	No respiratory protection. Minimal skin protection.	• The atmosphere contains no known hazard. • Work functions preclude splashes, immersion, or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals.	• This level should not be worn in the Exclusion Zone. • The atmosphere must contain at least 19.5 percent oxygen.

*Based on EPA protective ensembles.

EXHIBIT 2 LEVELS OF PROTECTION

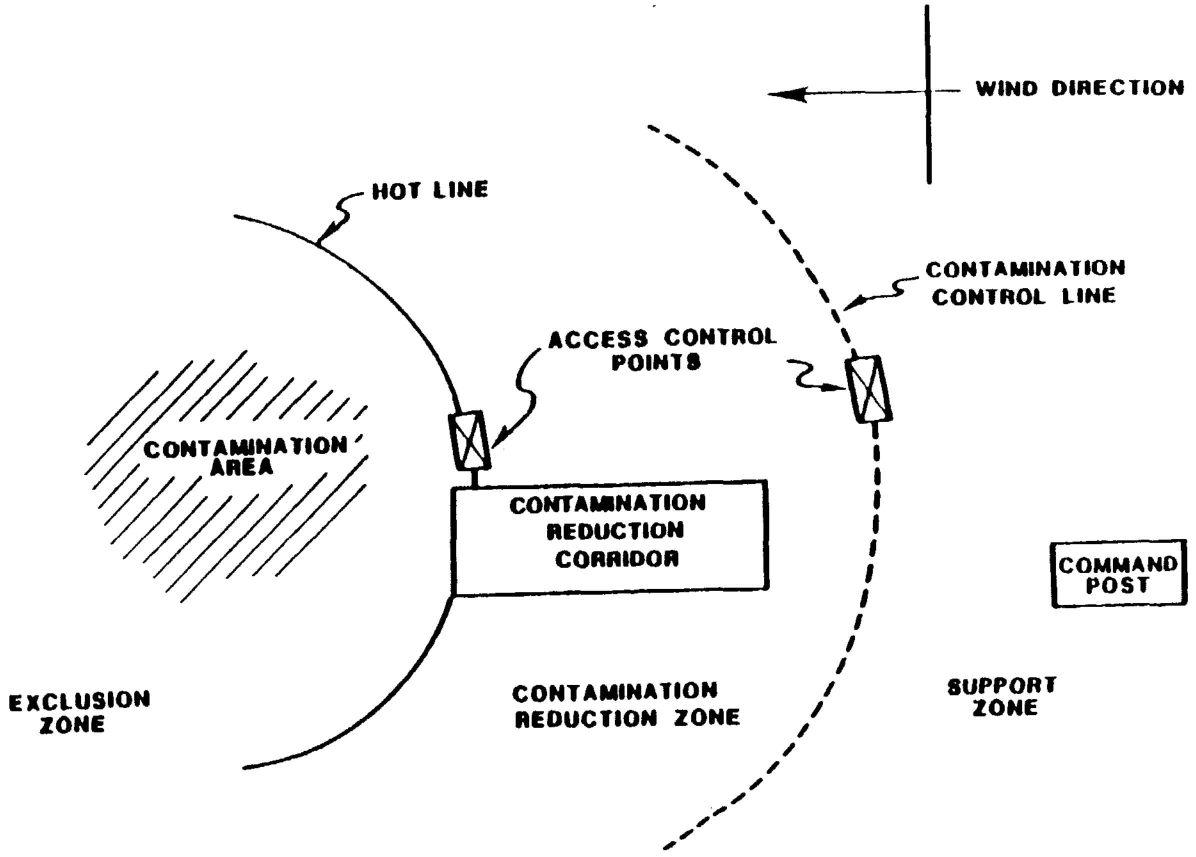
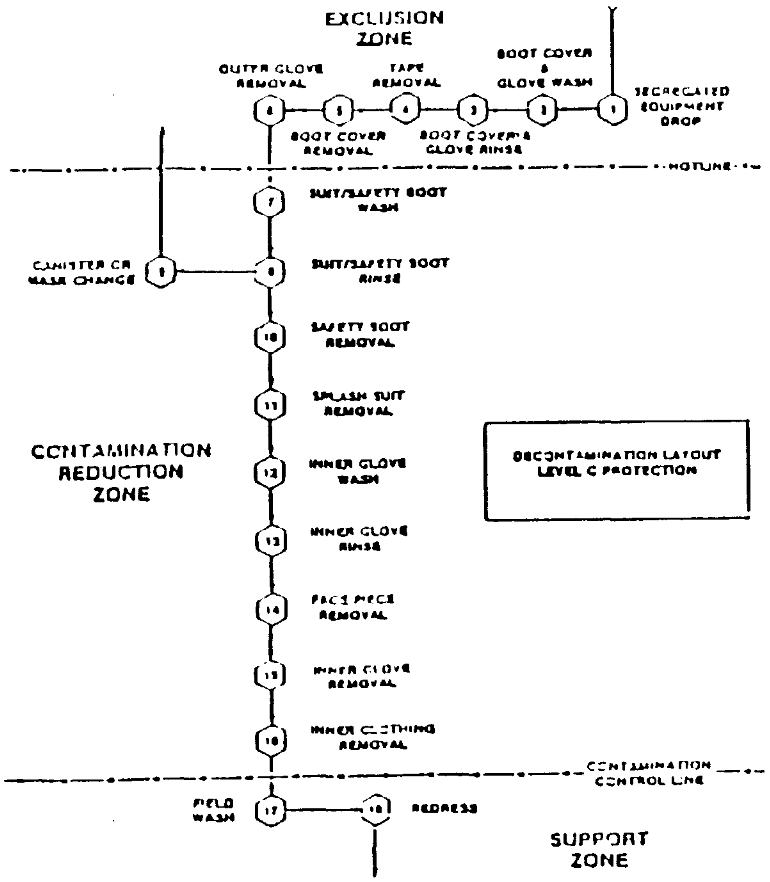


DIAGRAM OF SITE WORK ZONES

EXHIBIT 3 SITE CONTOL



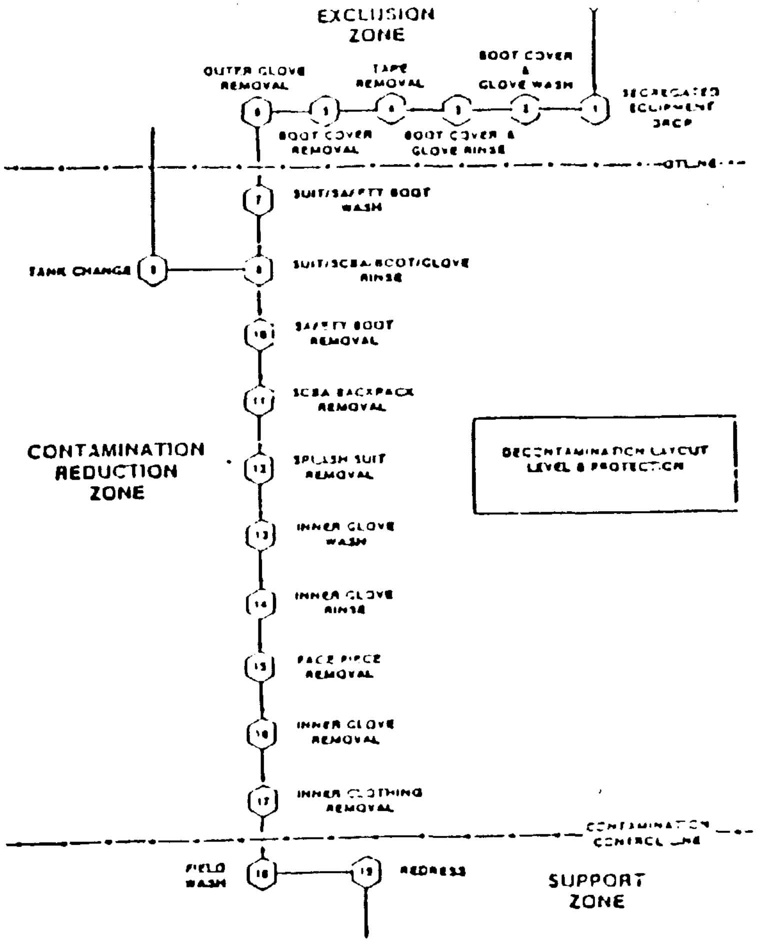
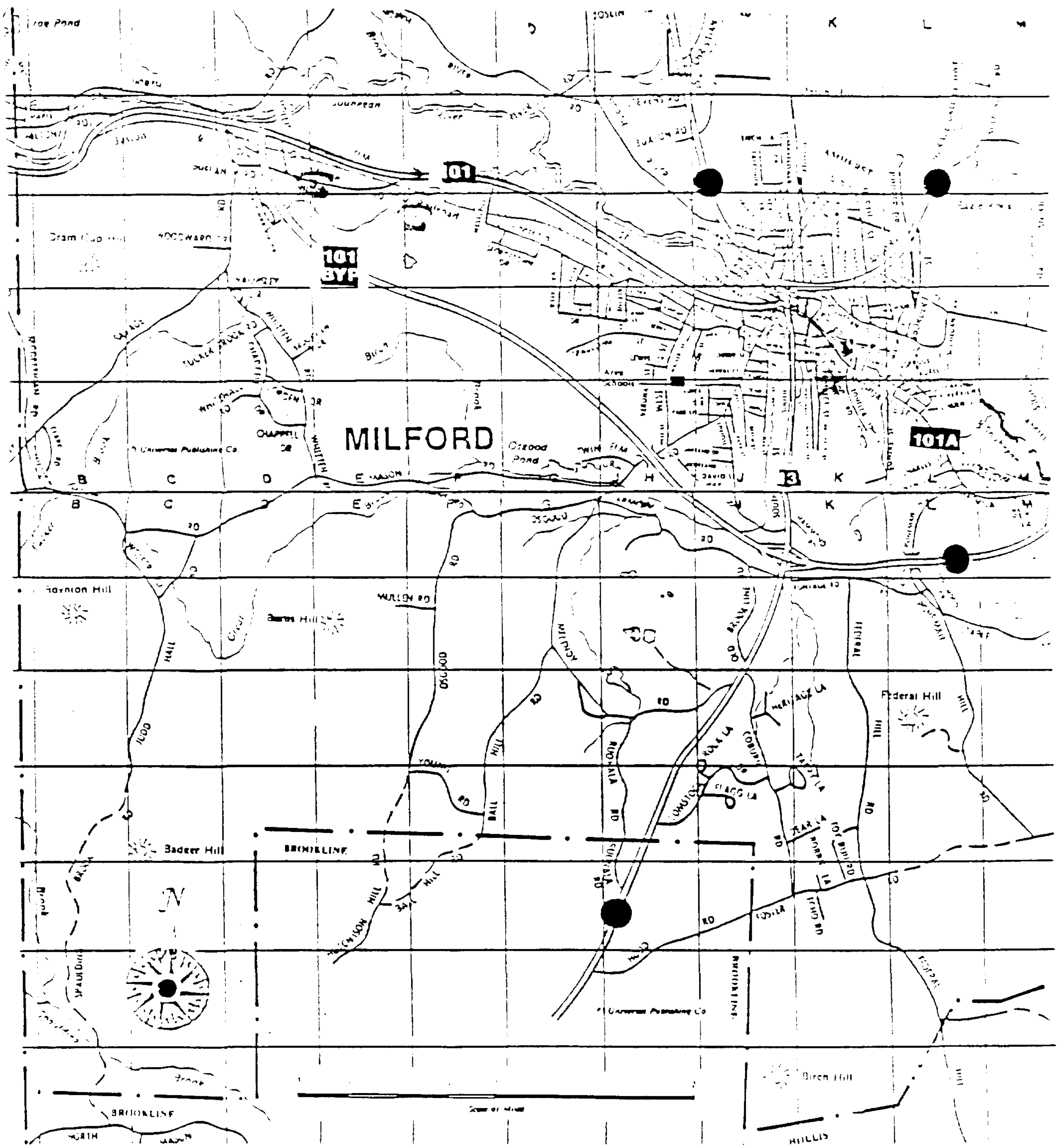


EXHIBIT 4 DECONTMANATION PROCEDURES

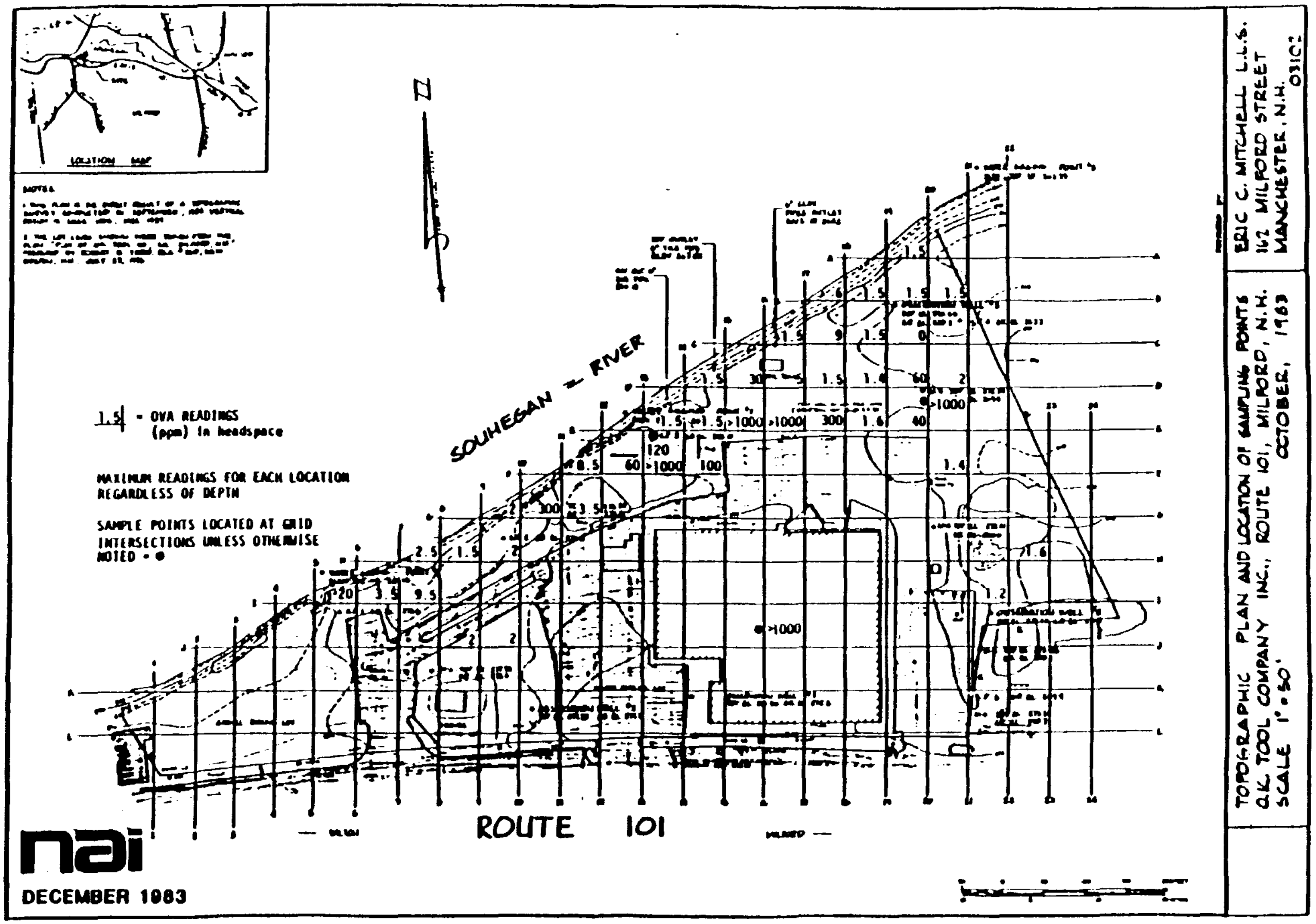


MILFORD MEDICAL CENTER ★

PHONE ACCESS ☎

EXHIBIT 5 EMERGENCY INFORMATION

HMM ASSOCIATES INC.



OVA Readings (ppm) in headspace for soil and waste samples. O.K. Tool Report.

EXHIBIT 6 OVA HEADSPACE READING FOR OK TOOL PROPERTY

APPENDIX A

HAZARDOUS SUBSTANCE INDENTIFICATION FORMS

HAZARDOUS SUBSTANCE INFORMATION FORM

COMMON NAME: BARium CHEMICAL NAME: BARium Ba
SYNONYMS

I. PHYSICAL/CHEMICAL PROPERTIES

SOURCE

Natural physical state: Gas____ Liquid____ Solid____ SAX
(at ambient temps of 20°C-25°C)
~~Molecular weight~~ Atomic Wt for C: 137.36 g/g-mole
Density[a] g/ml
Specific gravity[a] 7= 3.5 ● 20° °F/°C SAX
Solubility: water ● °F/°C
Solubility[b]: ____ ● °F/°C
Boiling point 1640° °F/°C SAX
Melting point 725° °F/°C SAX
Vapor pressure 10mm mmHg ● 1049° °F/°C SAX
Vapor density ● °F/°C
Flash point °F/°C
(open cup____; closed cup____)
Other: IDLH 250mg/m³

II. HAZARDOUS CHARACTERISTICS

A. Exposure limits (TLV, PEL, other)

	CONCENTRATION	SOURCE
ACGIH TLV:	TWA 0.5mg/m³	SAX
DFG MAK:	0.5 mg/m³	

B. TOXICOLOGICAL HAZARD

B. TOXICOLOGICAL HAZARD	HAZARD?	EFFECTS	SOURCE
Inhalation	Yes__ No__		
Ingestion	Yes__ No__		
Skin/eye absorption	Yes__ No__		
Skin/eye contact	Yes__ No__		
Carinogenic	Yes__ No__		
Teratogenic	Yes__ No__		
Mutagenic	Yes__ No__		
Aquatic	Yes__ No__		
Other: ____	Yes__ No__		

C. TOXICOLOGICAL HAZARD

C. TOXICOLOGICAL HAZARD	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes__ No__		
Toxic byproduct(s):	Yes__ No__		
Flammability	Yes__ No__		
LFL			
UFL			
Explosivity	Yes__ No__		
LEL			
UEL			

OH/WPPHAZO/5

Hazardous Substance Information Form

COMMON NAME: Barium

CHEMICAL NAME: Barium Ba

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas___ Liquid___ Solid X (at ambient temps of 20°C-25°C)			
Molecular weight	137.33	g/g-mole	Merck
Density[a]	3.6	g/ml	Merck
Specific gravity[a]	@	°F/°C	
Solubility: water	@	°F/°C	
Solubility[b]: _____	@	°F/°C	
Boiling point	1600	°F/[✓ °C]	Merck
Melting point	710	°F/[✓ °C]	Merck
Vapor pressure	mmHg @	°F/°C	
Vapor density	@	°F/°C	
Flash point (open cup___; closed cup___)		°F/°C	
Other:			

TLV,PEL... 0.5 mg/m^3

II. HAZARDOUS CHARACTERISTICS

A. TOXICOLOGICAL HAZARD	HAZARD?	EFFECTS	SOURCE
Inhalation	[✓ Yes] No	upper respiratory irritation	NIOSH
Ingestion	[✓ Yes] No	GI irritation, muscle spasm,	NIOSH
Skin/eye absorption	[✓ Yes] No	slow pulse, extra systoles	
Skin/eye contact	[✓ Yes] No	eye irritation, skin burns	
Carcinogenic	Yes No		
Teratogenic	Yes No		
Mutagenic	Yes No		
Aquatic	Yes No		
Other:	Yes No		

B. TOXICOLOGICAL HAZARD	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes [✓ No]		Merck
Toxic byproduct(s):	Yes [✓ No]		
Flammability	Yes [✓ No]		Merck
LFL			
UFL			
Explosivity	Yes [✓ No]		Merck
LEL			
UEL			

---

[a] Only one is necessary.

[b] For organic compounds, recovery of spilled material by solvent extraction may require solubility data.

HAZARDOUS SUBSTANCE INFORMATION FORM

COMMON NAME: Benzene CHEMICAL NAME: Benzene

SYNONYMS Benzol; Benzole; Cyclohexatriene; Coal tar naphtha, Phenyl hydride

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas ___ (at ambient temps of 20°C-25°C)	Liquid X Solid ___		
Molecular weight	78.11	g/g-mole	NIOSH
Density[a]		g/ml	
Specific gravity[a]	.02109 @ 70	°F/°C	
Solubility: water	.180 @ 77.02	°F/°C	
Solubility[b]: ___	@	°F/°C	
Boiling point	176°F = 80.1°C = 353.3K	°F/°C	
Melting point	42°F	°F/[illegible]	
Vapor pressure	1.535 mmHg @ 70	°F/[illegible]	
Vapor density	.02109 @ 70	°F/[illegible]	
Flash point (open cup ___; closed cup X)	12°F	°F/[illegible]	
Other: ___			

II. HAZARDOUS CHARACTERISTICS

A. Exposure limits (TLV, PEL, other)

	CONCENTRATION	SOURCE
OSHA PEL	TWA 10ppm	SAX
ACGIH TLV	TWA 10ppm	SAX
CEIL	1ppm · 5 min	NIOSH

B. TOXICOLOGICAL HAZARD

	HAZARD?	EFFECTS	SOURCE
Inhalation	Yes ✓ No ___	Loss of consciousness Dizziness, headache	NIOSH
Ingestion	Yes ___ No ___		
Skin/eye absorption	Yes ___ No ___		
Skin/eye contact	Yes ✓ No ___	IRRITATION OF EYES	
Carinogenic	Yes ✓ No ___		NIOSH
Teratogenic	Yes ___ No ___		
Mutagenic	Yes ___ No ___		
Aquatic	Yes ___ No ___		
Other: ___	Yes ___ No ___		

C. TOXICOLOGICAL HAZARD

	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes ___ No ___		
Toxic byproduct(s):	Yes ___ No ___		
Flammability	Yes ✓ No ___		
LFL		1.3%	NIOSH
UFL		7.9%	NIOSH
Explosivity	Yes ✓ No ___		
LEL		13%	
UEL		7.9%	

OH/WPPHAZO/5

Hazardous Substance Information Form

COMMON NAME: Benzene **CHEMICAL NAME:** Benzene

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas____ Liquid X Solid____ (at ambient temps of 20°C-25°C)			GE MSDS
Molecular weight	78.12	g/g-mole	GE MSDS
Density[a]		g/ml	
Specific gravity[a]	0.879 @ 20	°F/[✓ °C]	GE MSDS
Solubility: water	0.06 @	°F/°C	GE MSDS
Solubility[b]: ____________	@	°F/°C	
Boiling point	80	°F/[✓ °C]	GE MSDS
Melting point	5.5	°F/[✓ °C]	GE MSDS
Vapor pressure	74.6 mmHg @ 20	°F/[✓ °C]	GE MSDS
Vapor density	@	°F/°C	GE MSDS
Flash point (open cup_____; closed cup_____)	12°F (-11°C)	°F/°C	
Other: ____________			

II. HAZARDOUS CHARACTERISTICS

TLV,PEL... 10 ppm/8hr TWA (skin)

A. TOXICOLOGICAL HAZARD

	HAZARD?	EFFECTS	SOURCE
			NIOSH
Inhalation	[✓ Yes] No	blood effects (cell counts) (Lukemia from chroni	
Ingestion	[✓ Yes] No	give edible frats or oils or excessive exposure	
Skin/eye absorption	[✓ Yes] No	headache, weariness, loss of appitite	
Skin/eye contact	[✓ Yes] No	eye=irritation skin = defatting	
Carcinogenic	[✓ Yes] No	potential to man	
Teratogenic	Yes No		
Mutagenic	Yes No		
Aquatic	Yes No		
Other: __________	Yes No		

B. TOXICOLOGICAL HAZARD

	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	[✓ Yes] No		GE MSDS
Toxic byproduct(s):	[✓ Yes] No		
oxidation in air produces			GE MSDS
oxides of carbon and nitrogen			GE MSDS
Flammability	[✓ Yes] No		
LFL		1.3	GE MSDS
UFL		7.1	GE MSDS
Explosivity	[✓ Yes] No		
LEL		can form explosive	GE MSDS
UEL		mixtures at 25°C	GE MSDS

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[a] Only one is necessary.

[b] For organic compounds, recovery of spilled material by solvent extraction may require solubility data.

HAZARDOUS SUBSTANCE INFORMATION FORM

COMMON NAME: BenzyL ButyL Phthalate CHEMICAL NAME: BenzyL ButyL Phtha

SYNONYMS Butyl Benzyl Phthalate; Benzyl n-Butyl Phthalate; Phthalic Acid; Benzyl Butyl Ether.

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas ___ (at ambient temps of 20°C-25°C)	Liquid X Solid ___		
Molecular weight	313	g/g-mole	
Density[a]	1.116 @ 25°/25°	g/ml	
Specific gravity[a]	1.12 ● 20°C	°F/°C	
Solubility: water	86°F ● .0 lbs/lbs H_2O	°F/°C	
Solubility[b]: ___	●	°F/°C	
Boiling point	698°F = 380°C	°F/°C	
Melting point	< -35°	°F/°C	SAX
Vapor pressure	mmHg ●	°F/°C	
Vapor density	10.8 ●	°F/°C	SAX
Flash point (open cup X; closed cup ___)	390°F	°F/°C	SAX
Other:			

II. HAZARDOUS CHARACTERISTICS

A. Exposure limits (TLV, PEL, other)	CONCENTRATION	SOURCE

B. TOXICOLOGICAL HAZARD	HAZARD?	EFFECTS	SOURCE
Inhalation	Yes ___ No ___		
Ingestion	Yes ___ No ___		
Skin/eye absorption	[✓ Yes] No ___	Iritation of Skin	NIOSH
Skin/eye contact	[✓ Yes] No ___	Irritation of eyes	
Carinogenic	Yes ___ No ___		
Teratogenic	Yes ___ No ___		
Mutagenic	Yes ___ No ___		
Aquatic	Yes ___ No ___		
Other: ___	Yes ___ No ___		

C. TOXICOLOGICAL HAZARD	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	[✓ Yes] No ___		NIOSH
Toxic byproduct(s): ___	Yes ___ No ___		
Flammability	Yes ___ No ___		
LFL			
UFL			
Explosivity	Yes ___ No ___		
LEL			
UEL			

OH/WPPHAZ0/5

HAZARDOUS SUBSTANCE INFORMATION FORM

COMMON NAME: Beryllium CHEMICAL NAME: Beryllium

SYNONYMS

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas ___ Liquid ___ Solid X (at ambient temps of 20°C-25°C)			CHRIS DATA SHE
Molecular weight	9.01	g/g-mole	"
Density[a]		g/ml	
Specific gravity[a]	1.85 @ 20°C	°F/°C	
Solubility: water	insoluble[a]	°F/°C	
Solubility[b]: ___	in WATER @	°F/°C	
Boiling point	2970° = bp	°F/°C	SAX
Melting point	1278° = mp	°F/°C	
Vapor pressure	NOT PERTINENT mmHg @	°F/°C	CHRIS DATA SHE
Vapor density	NOT PERTINENT @	°F/°C	"
Flash point (open cup ___; closed cup ___)	NOT PERTINENT	°F/°C	"
Other: IDLH	Ca		NIOSH

II. HAZARDOUS CHARACTERISTICS

A. Exposure limits (TLV, PEL, other)

	CONCENTRATION	SOURCE
OSHA PEL:	TWA 2 ug/m³	SAX
ACGIH TLV:	TWA 0.002 mg/m³	SAX
CEIL:	5.0 ug/m³	NIOSH

B. TOXICOLOGICAL HAZARD

	HAZARD?	EFFECTS	SOURCE
		Lung Disease	
Inhalation	Yes ✓ No ___	Difficult Breathing; Toxic; Coughing	Chris Data Shee
Ingestion	Yes ___ No ___	weight loss, indicates Beryllium Disease	"
Skin/eye absorption	Yes ✓ No ___	Dermatitis	
Skin/eye contact	Yes ✓ No ___	Conjunctival inflammation of eyes.	"
Carinogenic	Yes ✓ No ___	experimental + suspected carcinogen =	SAX
Teratogenic	Yes ___ No ___		
Mutagenic	Yes ___ No ___		
Aquatic	Yes ___ No ___		
Other: ___	Yes ___ No ___		

C. TOXICOLOGICAL HAZARD

	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes ___ No ___		
Toxic byproduct(s):	Yes ___ No ___	when heated to decomposition it emits vy toxic fumes of BeO. =	SAX
Flammability	Yes ___ No ___		
LFL			
UFL			
Explosivity	Yes ___ No ___		
LEL			
UEL			

HAZARDOUS SUBSTANCE INFORMATION FORM

COMMON NAME: n-Butyl Acetate CHEMICAL NAME: n-Butyl Acetate

SYNONYMS acetic Acid; n-butyl ester; Butyl Acetate; Butyl ethanoate.

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas ___ (at ambient temps of 20°C-25°C)	Liquid X	Solid ___	
Molecular weight	116.16	g/g-mole	NIOSH
Density[a]	0.88 at 20/20°C	g/ml	SAX
Specific gravity[a]	0.875 ● 20°C	°F/°C	NIOSH
Solubility: water	68.02°F ● 1 lbs/100 lbs	°F/°C	
Solubility[b]: ___	●	°F/°C	
Boiling point	259°F = 126°C	°F/°C	
Melting point	-101°F	°F/°C	
Vapor pressure	15 mmHg ● 25°C	°F/°C	"
Vapor density	.00420 lbs ● 70°F	°F/°C	"
Flash point (open cup X; closed cup X)	99°F = O.C.; 75°F = C.C.	°F/°C	"
Other: IDLH =	10,000 ppm		

II. HAZARDOUS CHARACTERISTICS

A. Exposure limits (TLV, PEL, other)

	CONCENTRATION	SOURCE
	OSHA PEL = TWA 150 PPM	SAX
	ACGIH TLV = TWA 150 PPM	
	DFG MAK = 200 PPM	

B. TOXICOLOGICAL HAZARD

B. TOXICOLOGICAL HAZARD	HAZARD?	EFFECTS	SOURCE
Inhalation	Yes ✓ No ___	Headache, dizziness	NIOSH
Ingestion	Yes ✓ No ___	Induce Vomiting; call physician	
Skin/eye absorption	Yes ✓ No ___	Drying	
Skin/eye contact	Yes ✓ No ___	Slight Smarting of eyes	
Carinogenic	Yes ___ No ___		
Teratogenic	Yes ___ No ___		
~~Mutagenic~~	Yes ___ No ___		
Aquatic	Yes ✓ No ___	44ppm/48hr/daphnia/TLm	fresh water
Other: B.O.D	Yes ✓ No ___	0.5 to 2.5 lb/lb, 5 days (theo) 52%, 5 days	

C. TOXICOLOGICAL HAZARD

C. TOXICOLOGICAL HAZARD	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes ___ No ___		
Toxic byproduct(s):	Yes ___ No ___		
Flammability	Yes ✓ No ___		
LFL		1.7%	
UFL		7.6%	
Explosivity	Yes ✓ No ___		NIOSH
LEL		1.7%	
UEL		7.6%	

OH/WPPHAZ0/5

Hazardous Substance Information Form

COMMON NAME: Bis-(2-Ethylhexyl) phthalate **CHEMICAL NAME:** Bis (2-Ethylhexyl) Phthalate or di (2-ethylhexyl) Phthalate

I. PHYSICAL/CHEMICAL PROPERTIES

				SOURCE
Natural physical state: Gas___ Liquid X Solid___ (at ambient temps of 20°C-25°C)				GE MSDS
Molecular weight	390.5		g/g-mole	GE MSDS
Density[a]			g/ml	GE MSDS
Specific gravity[a]	0.98	@ 25	°F/°C	GE MSDS
Solubility: water	nearly insolable	@	°F/[✓ °C]	GE MSDS
Solubility[b]: ________		@	°F/°C	GE MSDS
Boiling point	385		°F/[✓ °C]	GE MSDS
Melting point			°F/°C	GE MSDS
Vapor pressure	1.3 mmHg	@ 200	°F/[✓ °C]	GE MSDS
Vapor density	16	@	°F/°C	GE MSDS
Flash point (open cup X ; closed cup___)	420		[✓ °F]/°C	
Other:				

II. HAZARDOUS CHARACTERISTICS

5mg/m³/8hr TWA TLV,PEL...

A. TOXICOLOGICAL HAZARD	HAZARD?	EFFECTS	SOURCE NIOSH
Inhalation	Yes [✓ No]	Only if heated or misted causes nausea, resp. tract irritati	
Ingestion	[✓ Yes] No	abdominal cramps nausea-	
Skin/~~eye~~ absorption	[✓ Yes] No	low levels through skim	
Skin/eye contact	[✓ Yes] No	irratation to eyes and skin	
Carcinogenic	Yes No		
Teratogenic	Yes No		
Mutagenic	Yes No		
Aquatic	Yes No		
Other: ________	Yes No		

B. TOXICOLOGICAL HAZARD	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	[✓ Yes] No	OSHA Class III B	NIOSH
Toxic byproduct(s):	Yes [✓ No]		GE MSDS
			GE MSDS
Flammability	[✓ Yes] No		
LFL		0.28	GE MSDS
UFL			GE MSDS
Explosivity	Yes [✓ No]		GE MSDS
LEL			
UEL			GE MSDS

---

[a] Only one is necessary.

[b] For organic compounds, recovery of spilled material by solvent extraction may require solubility data.

HAZARDOUS SUBSTANCE INFORMATION FORM

COMMON NAME: Cadmium CHEMICAL NAME: Cadmium Cd
SYNONYMS

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas____ Liquid____ Solid____ (at ambient temps of 20°C-25°C)			
Molecular weight	112.40	g/g-mole	SAX
Density[a]	d = 8.642	g/ml	SAX
Specific gravity[a]	@	°F/°C	
Solubility: water	@	°F/°C	
Solubility[b]: ____	@	°F/°C	
Boiling point	767 ± 2 = bp	°F/°C	SAX
Melting point	320.9° = mp	°F/°C	
Vapor pressure	1 mm mmHg @ 394°	°F/°C	SAX
Vapor density	@	°F/°C	
Flash point (open cup____; closed cup____)		°F/°C	
Other: IDLH	carcinogen		NIOSH

II. HAZARDOUS CHARACTERISTICS

A. Exposure limits (TLV, PEL, other)

	CONCENTRATION	SOURCE
OSHA PEL:	TWA 200µg/m³	SAX
ACGIH TLV:	TWA (Dusts and salts) 0.05mg/m³	"
Cd (dust) CEIL:	0.6 mg/m³	NIOSH
Cd (fume) CEIL:	0.3 mg/m³	NIOSH

B. TOXICOLOGICAL HAZARD

	HAZARD?	EFFECTS	SOURCE
Inhalation	Yes ✓ No___	Poison	SAX
Ingestion	Yes ✓ No___	Poison	"
Skin/eye absorption	Yes___ No___		
Skin/eye contact	Yes___ No___		
Carinogenic	Yes___ No___		
Teratogenic	Yes___ No___		
Mutagenic	Yes___ No___		
Aquatic	Yes___ No___		
Other: ____	Yes___ No___		

C. TOXICOLOGICAL HAZARD

	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes___ No___		
Toxic byproduct(s):	Yes___ No___		
		Dust is moderately flammable – explosive when exposed to heat flame or by chemical reaction with oxidizing agents; metals; HN3; Zn; Se; Te.	SAX
Flammability	Yes___ No___		
LFL			
UFL			
Explosivity	Yes___ No___		
LEL			
UEL			

OH/WPPHAZO/3

Hazardous Substance Information Form

COMMON NAME: Cadmium **CHEMICAL NAME:** Cadmium Cd

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas ___ Liquid ___ Solid X (dust) (at ambient temps of 20°C-25°C)			GE MSDS
Molecular weight	112.41	g/g-mole	GE MSDS
Density[a]		g/ml	↓
Specific gravity[a]	8.6 @	°F/°C	
Solubility: water	insoluble @	°F/°C	
Solubility[b]: ______	@	°F/°C	
Boiling point	767	°F/[✓ °C]	
Melting point	320.9	°F/[✓ °C]	
Vapor pressure	1 mmHg @ 394	°F/[✓ °C]	
Vapor density	@	°F/°C	
Flash point (open cup ___; closed cup ___)		°F/°C	
Other:			

II. HAZARDOUS CHARACTERISTICS

fume TWA = 0.1 mg/m^3/8hr
dust TWA = 0.2 mg/m^3/8hr

A. TOXICOLOGICAL HAZARD	HAZARD?	EFFECTS	SOURCE
			NIOSH
Inhalation	[✓ Yes] No	Pulmonary Edema,	cough, tight chest,
Ingestion	[✓ Yes] No	substernal pain, Headache, chills, muscle aches,	
Skin/eye absorption	[✓ Yes] No	nausea, diarrhea, anosmia, emphysema, proteinusi	
Skin/eye contact	[✓ Yes] No	anemia, wash area immediately	
Carcinogenic	[✓ Yes] No	potential human carcinogen	
Teratogenic	Yes No		
Mutagenic	Yes No		
Aquatic	Yes No		
Other: ______	Yes No		

B. TOXICOLOGICAL HAZARD	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes [✓ No]		GE MSDS
Toxic byproduct(s):	Yes No		
Flammability	Yes [✓ No]		
LFL			
UFL			
Explosivity	Yes [✓ No]		
LEL			
UEL			

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[a] Only one is necessary.

[b] For organic compounds, recovery of spilled material by solvent extraction may require solubility data.

HAZARDOUS SUBSTANCE INFORMATION FORM

COMMON NAME: Chlorobenzene CHEMICAL NAME: Chlorobenzene

SYNONYMS monochlorobenzene, Chlorobenzol, Phenyl chloride, MCB

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas ___ Liquid X Solid ___ (at ambient temps of 20°C-25°C)			
Molecular weight	113	g/g-mole	NIOSH
Density[a]		g/ml	
Specific gravity[a]	.00386 @ 70	°F/[illegible]	
Solubility: water	.400 @ 86	°F/[illegible]	
Solubility[b]: ___	@	°F/°C	
Boiling point	270°F	°F/°C	
Melting point	-47°F	°F/°C	
Vapor pressure	.195 mmHg @ 70°	°F/°C	
Vapor density	.00386 @ 70°	°F/°C	
Flash point (open cup X ; closed cup X)	84°F C.C; 97°F O.C.	°F/°C	
Other: ___			

II. HAZARDOUS CHARACTERISTICS

A. Exposure limits (TLV, PEL, other)

	CONCENTRATION	SOURCE

B. TOXICOLOGICAL HAZARD

	HAZARD?	EFFECTS	SOURCE
Inhalation	Yes ✓ No ___	FATIGUE, NARCOSIS coughing; dizziness	NIOSH
Ingestion	Yes ___ No ___		
Skin/eye absorption	Yes ✓ No ___	irritation	
Skin/eye contact	Yes ___ No ___		
Carinogenic	Yes ___ No ___		
Teratogenic	Yes ___ No ___		
Mutagenic	Yes ___ No ___		
Aquatic	Yes ✓ No ___	in very low concentrations	
Other: ___	Yes ___ No ___		

C. TOXICOLOGICAL HAZARD

	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes ___ No ___		
Toxic byproduct(s): ___	Yes ___ No ___		
Flammability	Yes ✓ No ___		NIOSH
LFL		1.3%	
UFL		7.1%	
Explosivity	Yes ___ No ___		
LEL		1.3%	NIOSH
UEL		7.1%	

OH/WPPHAZO/5

HAZARDOUS SUBSTANCE INFORMATION FORM

COMMON NAME: Chromium CHEMICAL NAME: Chromium

I PHYSICAL/CHEMICAL PROPERTIES

Natural physical state: Gas ____ Liquid ____ Solid ____
(at ambient temps of 20°C-25°C)

			SOURCE
Molecular weight Atomic Weight	52.0	g/g-mole	SAX
Density[a]		g/ml	
Specific gravity[a]	@	°F/°C	
Solubility: water	@	°F/°C	
Solubility[b]: ____	@	°F/°C	
Boiling point		°F/°C	
Melting point		°F/°C	
Vapor pressure	mmHg @	°F/°C	
Vapor density	@	°F/°C	
Flash point (open cup ____; closed cup ____)		°F/°C	
Other: ____			

I . HAZARDOUS CHARACTERISTICS

A. Exposure limits (TLV, PEL, other)

	CONCENTRATION	SOURCE
	OSHA PEL: TWA 1mg/m³	= SAX
	ACGIH TLV: TWA 0.5 mg/m³	= SAX

TOXICOLOGICAL HAZARD	HAZARD?	EFFECTS	SOURCE
Inhalation	Yes ___ No ___		
Ingestion	Yes ___ No ___		
Skin/eye absorption	Yes ___ No ___		
Skin/eye contact	Yes ___ No ___		
Carinogenic	Yes ✓ No ___	EXPERIMENTAL CARCINOGEN	= SAX
Teratogenic	Yes ___ No ___		
Mutagenic	Yes ___ No ___		
Aquatic	Yes ___ No ___		
Other: ____	Yes ___ No ___		

C. TOXICOLOGICAL HAZARD	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes ___ No ___		
Toxic byproduct(s):	Yes ___ No ___		
____			
____			
Flammability	Yes ___ No ___		
LFL			
UFL			
Explosivity	Yes ___ No ___		
LEL			
UEL			

HAZARDOUS SUBSTANCE INFORMATION FORM

COMMON NAME: Cobalt CHEMICAL NAME: Cobalt Co

I. PHYSICAL/CHEMICAL PROPOERTIES

			SOURCE
Natural physical state: Gas ___ Liquid ___ Solid X (at ambient temps of 20°C-25°C)			
Molecular weight	58.93	g/g-mole	SAX
Density[a]	d = 8.9	g/ml	
Specific gravity[a]	●	°F/°C	
Solubility: water	●	°F/°C	
Solubility[b]: ______	●	°F/°C	
Boiling point	bp = 2000°	°F/°C	SAX
Melting point	mp = 1495°	°F/°C	SAX
Vapor pressure	mmHg ●	°F/°C	
Vapor density	●	°F/°C	
Flash point (open cup ___; closed cup ___)		°F/°C	
Other: ______			

II. HAZARDOUS CHARACTERISTICS

A. Exposure limits (TLV, PEL, other)

	CONCENTRATION	SOURCE
	ACGIH TLV: TWA (metal, dust, and fume) .05 mg/m3 } ⇒ SAX	
	TRK: 0.5 mg/m3 ⇒	SAX

B. TOXICOLOGICAL HAZARD

	HAZARD?	EFFECTS	SOURCE
Inhalation	Yes ___ No ___		
Ingestion	Yes ___ No ___		
Skin/eye absorption	Yes ___ No ___		
Skin/eye contact	Yes ___ No ___		
Carinogenic	Yes ✓ No ___	Experimental Carcnogen	= SAX
Teratogenic	Yes ___ No ___		
Mutagenic	Yes ___ No ___		
Aquatic	Yes ___ No ___		
Other: ______	Yes ___ No ___		

C. TOXICOLOGICAL HAZARD

	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes ___ No ___		
Toxic byproduct(s):	Yes ___ No ___		
______			
______			
Flammability	Yes ___ No ___		
LFL			
UFL			
Explosivity	Yes ___ No ___		
LEL			
UEL			

HAZARDOUS SUBSTANCE INFORMATION FORM

COMMON NAME: Copper CHEMICAL NAME: Copper Cu

I. PHYSICAL/CHEMICAL PROPOERTIES

			SOURCE
Natural physical state: Gas ___ Liquid ___ Solid X (at ambient temps of 20°C-25°C)			
Molecular weight ATOMIC WEIGHT:	63.54	g/g-mole	SAX
Density[a]		g/ml	
Specific gravity[a]	d = 8.92 ●	°F/°C	SAX
Solubility: water	●	°F/°C	
Solubility[b]: ___	●	°F/°C	
Boiling point	bp = 2324°	°F/°C	SAX
Melting point	mp = 1083°	°F/°C	SAX
Vapor pressure	1mm mmHg ● 1628°	°F/°C	SAX
Vapor density	●	°F/°C	
Flash point (open cup ___; closed cup ___)		°F/°C	
Other: ___			

II. HAZARDOUS CHARACTERISTICS

A. Exposure limits (TLV, PEL, other) CONCENTRATION (FUME) SOURCE

ACGIH TLV: TWA 0.2 mg/m³ = SAX
DFG MAK: (dust) = 1 mg/m³ = SAX
(Fume) = 0.1 mg/m³ = SAX

B. TOXICOLOGICAL HAZARD	HAZARD?	EFFECTS	SOURCE
Inhalation	Yes ___ No ___		
Ingestion	Yes ✓ No ___	POISON	
Skin/eye absorption	Yes ___ No ___		
Skin/eye contact	Yes ___ No ___		
Carinogenic	Yes ___ No ___		
Teratogenic	Yes ___ No ___		
Mutagenic	Yes ___ No ___		
Aquatic	Yes ___ No ___		
Other: ___	Yes ___ No ___		

C. TOXICOLOGICAL HAZARD	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes ___ No ___		
Toxic byproduct(s): ___	Yes ___ No ___		
Flammability	Yes ___ No ___		
LFL			
UFL			
Explosivity	Yes ___ No ___		
LEL			
UEL			

HAZARDOUS SUBSTANCE INFORMATION FORM

COMMON NAME: 1,1, Dichloroethane CHEMICAL NAME: 1,1 Dichloroethane

SYNONYMS Ethylidene chloride; Ethylidene dichloride; Chlorinated hydrochloric ether.

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas ___ (at ambient temps of 20°C-25°C)	Liquid X Solid ___		
Molecular weight	98.97	g/g-mole	NIOSH
Density[a]		g/ml	
Specific gravity[a]	1.174 ● 20°C	[illegible]/°C	
Solubility: water	.500 ● 68°C	°F/°C	
Solubility[b]: ___	●	°F/°C	
Boiling point	135.14°F = 57.3°C = 330.5°K	°F/°C	
Melting point	-142°F	°F/[illegible]	
Vapor pressure	230 mmHg ● 25°	°F/°C	
Vapor density	.11845 ● 60°F	°F/[illegible]	
Flash point (open cup X ; closed cup X)	57°F O.C. = 22F C.C.	°F/°C	
Other: ___			

II. HAZARDOUS CHARACTERISTICS

A. Exposure limits (TLV, PEL, other)	CONCENTRATION	SOURCE
	OSHA PEL: TWA 100PPM =	SAX

B. TOXICOLOGICAL HAZARD	HAZARD?	EFFECTS	SOURCE
Inhalation	Yes ✓ No ___	Irritation of Resp. tract	NIOSH
Ingestion	Yes ✓ No ___	NAUSEA, CYANOSIS	
Skin/eye absorption	Yes ✓ No ___	Slight BURN	
Skin/eye contact	Yes ✓ No ___	Lacrimation; Irritation	
Carinogenic	Yes ___ No ___		
Teratogenic	Yes ___ No ___		
Mutagenic	Yes ___ No ___		
Aquatic	Yes ___ No ___		
Other: ___	Yes ___ No ___		

C. TOXICOLOGICAL HAZARD	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes ___ No ___		
Toxic byproduct(s):	Yes ___ No ___		
Flammability	Yes ✓ No ___		
LFL		5.6%	
UFL		11.4%	
Explosivity	Yes ✓ No ___		
LEL		6%	
UEL		16%	

OH/WPPHAZO/5

Hazardous Substance Information Form

COMMON NAME: 1, 1- dichloroethane **CHEMICAL NAME:** 1,1 - dichloroethane

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas___ Liquid X Solid___ (at ambient temps of 20°C-25°C)			
Molecular weight	99	g/g-mole	Merck
Density[a]	1.174	g/ml	Merck
Specific gravity[a]	@	°F/°C	
Solubility: water	insoluble @	°F/°C	Merck
Solubility[b]: ______	@	°F/°C	
Boiling point	135	[✓ °F]/°C	Merck
Melting point	-142°	[✓ °F]/°C	Merck
Vapor pressure	182 mmHg @ 25	°F/[✓ °C]	Merck
Vapor density	@	°F/°C	
Flash point (open cup____; closed cup____)	170°	[✓ °F]/°C	Merck
Other: ______			

II. HAZARDOUS CHARACTERISTICS

TLV,PEL... 100 ppm/ 8 hr TWA

A. TOXICOLOGICAL HAZARD	HAZARD?	EFFECTS	SOURCE
Inhalation	[✓ Yes] No	CNS depression, unconciousness	NIOSH
Ingestion	[✓ Yes] No	liver & kidney damage	
Skin/eye absorption	[✓ Yes] No	systemic effects	
Skin/eye contact	[✓ Yes] No	skin irritation	
Carcinogenic	Yes No		
Teratogenic	Yes No		
Mutagenic	Yes No		
Aquatic	Yes No		
Other: ______	Yes No		

B. TOXICOLOGICAL HAZARD	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes [✓ No]		
Toxic byproduct(s):	Yes [✓ No]		
Flammability	Yes [✓ No]		
LFL			
UFL			
Explosivity	[✓ Yes] No		
LEL		60%	NIOSH
UEL		16.0%	NIOSH

---

[a] Only one is necessary.

[b] For organic compounds, recovery of spilled material by solvent extraction may require solubility data.

HAZARDOUS SUBSTANCE INFORMATION FORM

COMMON NAME: CIS + TRANS 1,2 Dichloroethylene CHEMICAL NAME: CIS + TRANS 1,2 Dichloroethylene
SYNONYMS Acetylene dichloride, Dioform; cis-1,2dichloroethylene; trans 1,2-dichloroethylene

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas ___ Liquid X Solid ___ (at ambient temps of 20°C-25°C)			NIOSH
Molecular weight	97.0	g/g-mole	
Density[a]		g/ml	
Specific gravity[a]	1.27 @ 25°C	@/°C	
Solubility: water	@	°F/°C	
Solubility[b]: ___	@	°F/°C	
Boiling point	= cis: 140°F = 60°C = 333°K; trans: 118°F = 48°C = 321°K	°F/°C	
Melting point	-56 to -115°F	°F/°C	
Vapor pressure	180 - 265 mmHg @	°F/°C	
Vapor density	.7330 @ 70°F	°F/°C	
Flash point (open cup ___; closed cup X)	37°F	°F/°C	
Other: ___			

II. HAZARDOUS CHARACTERISTICS

A. Exposure limits (TLV, PEL, other)

	CONCENTRATION	SOURCE

B. TOXICOLOGICAL HAZARD

	HAZARD?	EFFECTS	SOURCE
Inhalation	Yes ✓ No ___	nausea, tremor, central nervous depression.	NIOSH
Ingestion	Yes ✓ No ___	Slight depression to deep narcosis.	
Skin/eye absorption	Yes ___ No ___		
Skin/eye contact	Yes ✓ No ___	Irritation	
Carinogenic	Yes ___ No ___		
Teratogenic	Yes ___ No ___		
Mutagenic	Yes ___ No ___		
Aquatic	Yes ___ No ___		
Other: ___	Yes ___ No ___		

C. TOXICOLOGICAL HAZARD

	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes ___ No ___		NIOSH
Toxic byproduct(s): ___	Yes ___ No ___		
Flammability	Yes ✓ No ___		
LFL		9.7%	
UFL		12.8%	
Explosivity	Yes ✓ No ___		
LEL		9.7%	
UEL		12.8%	

OH/WPPHAZO/5

HAZARDOUS SUBSTANCE INFORMATION FORM

COMMON NAME: Iron CHEMICAL NAME: Iron → Fe

I. PHYSICAL/CHEMICAL PROPOERTIES

			SOURCE
Natural physical state: Gas ___ Liquid ___ Solid ___ (at ambient temps of 20°C-25°C)			
Molecular weight Atom = Weight =	55.8	g/g-mole	SAX
Density[a]	d = 7.86	g/ml	SAX
Specific gravity[a]	●	°F/°C	
Solubility: water	●	°F/°C	
Solubility[b]: ___	●	°F/°C	
Boiling point	bp = 3000°	°F/°C	SAX
Melting point	mp = 1535°	°F/°C	SAX
Vapor pressure	1mm mmHg ● 1787°	°F/°C	SAX
Vapor density	●	°F/°C	
Flash point (open cup ___; closed cup ___)		°F/°C	
Other: ___			

II. HAZARDOUS CHARACTERISTICS

A. Exposure limits (TLV, PEL, other)	CONCENTRATION	SOURCE

B. TOXICOLOGICAL HAZARD	HAZARD?	EFFECTS	SOURCE
Inhalation	Yes ___ No ___		
Ingestion	Yes ___ No ___		
Skin/eye absorption	Yes ✓ No ___	Conjunctivitis	SAX
Skin/eye contact	Yes ✓ No ___	Retinitis	SAX
Carinogenic	Yes ✓ No ___	Suspected Ca of lung,	SAX
Teratogenic	Yes ___ No ___	liver; connective	
Mutagenic	Yes ___ No ___	tissue; + reticuloendo-	
Aquatic	Yes ___ No ___	thelial tissue.	
Other: ___	Yes ___ No ___		

C. TOXICOLOGICAL HAZARD	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes ___ No ___	FLAMMABLE	SAX
Toxic byproduct(s):	Yes ___ No ___	in the FORM	
___		of DUST WHEN	
___		EXPOSED TO	
Flammability	Yes ___ No ___	HEAT OR FLAME.	
LFL			
UFL			
Explosivity	Yes ___ No ___		
LEL			
UEL			

OH/WPPHAZO/5

HAZARDOUS SUBSTANCE INFORMATION FORM

COMMON NAME: Lead CHEMICAL NAME: Lead (Pb)
SYN: LEAD FLAKE

I. PHYSICAL/CHEMICAL PROPOERTIES

			SOURCE
Natural physical state: Gas ___ Liquid ___ Solid ___ (at ambient temps of 20°C-25°C)			
Molecular weight Atomic Weight:	207.19	g/g-mole	SAX
Density[a]	d = 11.34	g/ml	
Specific gravity[a]	@	°F/°C	
Solubility: water	@	°F/°C	
Solubility[b]: ___	@	°F/°C	
Boiling point	bp = 1740°	°F/°C	SAX
Melting point	mp = 327.43°	°F/°C	SAX
Vapor pressure	1mm mmHg @ 973°	°F/°C	SAX
Vapor density	11.34 @	°F/°C	SAX
Flash point (open cup ___; closed cup ___)		°F/°C	
Other: ___			

II. HAZARDOUS CHARACTERISTICS

A. Exposure limits (TLV, PEL, other) CONCENTRATION SOURCE

10-HR TWA: < 0.1mg/m^3 = NIOSH
OSHA PEL: TWA 200 µg/m^3 = SAX
ACGIH BEI: Lead n Blood 5 µg/mL = SAX
→ BAT: 70 µg/dl; 45 µg/dl (women) {under 45 years} = SAX

B. TOXICOLOGICAL HAZARD	HAZARD?	EFFECTS	SOURCE
Inhalation	Yes ___ No ___		
Ingestion	Yes ✓ No ___	A poison	SAX
Skin/eye absorption	Yes ___ No ___		
Skin/eye contact	Yes ___ No ___		
Carinogenic	Yes ✓ No ___	Lung + Kidney Carcinoam	SAX
Teratogenic	Yes ✓ No ___	Experimental Teratogen	SAX
Mutagenic	Yes ___ No ___		
Aquatic	Yes ___ No ___		
Other: ___	Yes ___ No ___		

C. TOXICOLOGICAL HAZARD	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes ___ No ___		
Toxic byproduct(s): ___	Yes ___ No ___		
Flammability	Yes ___ No ___	Flammable in the Form of Dust when exposed to heat or flame.	
LFL			
UFL			
Explosivity	Yes ___ No ___		
LEL			
UEL			

Hazardous Substance Information Form

COMMON NAME: Lead Fumes/Dust **CHEMICAL NAME:** Lead Pb

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas____ Liquid____ SolidX &fumes (at ambient temps of 20°C-25°C)			
Molecular weight	207.2	g/g-mole	Merck
Density[a]		g/ml	
Specific gravity[a]	____ @ ____	°F/°C	
Solubility: water	____ @ ____	°F/°C	
Solubility[b]: ____________	____ @ ____	°F/°C	
Boiling point	1740	°F/[✓ °C]	Merck
Melting point	327.4	°F/[✓ °C]	Merck
Vapor pressure	1.77 mmHg @ 1000	°F/[✓ °C]	Merck
Vapor density	____ @ ____	°F/°C	
Flash point (open cup_____; closed cup_____)		°F/°C	
Other: ____________			

II. HAZARDOUS CHARACTERISTICS

TLV,PEL..0.05 mg/m^3

A. TOXICOLOGICAL HAZARD	HAZARD?	EFFECTS	SOURCE
			NIOSH
Inhalation	[✓ Yes] No	Lassitude, insomnia, pallor, anorexia, low weight	
Ingestion	[✓ Yes] No	Malnutrition, constripation, abdomen pain, colic	
Skin/eye absorption	Yes No	Gingvial lead line, tremors, anemia paralysis of wrist	
Skin/eye contact	[✓ Yes] No		
Carcinogenic	Yes No		
Teratogenic	Yes No		
Mutagenic	Yes No		
Aquatic	Yes No		
Other: ________	Yes No		

B. TOXICOLOGICAL HAZARD	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes [✓ No]		Merck
Toxic byproduct(s):	Yes [✓ No]		
____________			Merck
____________			
Flammability	Yes [✓ No]		
LFL			Merck
UFL			
Explosivity	Yes [✓ No]		
LEL			Merck
UEL			

---

[a] Only one is necessary.

[b] For organic compounds, recovery of spilled material by solvent extraction may require solubility data.

HAZARDOUS SUBSTANCE INFORMATION FORM

COMMON NAME: Manganese CHEMICAL NAME: Manganese → MN

SYNONYMS Colloidal manganese

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas____ Liquid____ Solid____ (at ambient temps of 20°C-25°C)			
Molecular weight Atomic weight:	54.94	g/g-mole	SAX
Density[a]		g/ml	
Specific gravity[a]	@	°F/°C	
Solubility: water	@	°F/°C	
Solubility[b]: ____________	@	°F/°C	
Boiling point	bp = 1900°	°F/°C	SAX
Melting point	mp = 1260°	°F/°C	SAX
Vapor pressure	1mm mmHg @ 1292	°F/°C	SAX
Vapor density	d= 7.20 @	°F/°C	SAX
Flash point (open cup____; closed cup____)		°F/°C	
Other: IDLH	10,000 mg/m³		NIOSH

II. HAZARDOUS CHARACTERISTICS

A. Exposure limits (TLV, PEL, other)

	CONCENTRATION	SOURCE
OSHA PEL:	TWA CL 5 mg/m³	SAX
ACGIH TWA:	5 mg/m³ (dust)	SAX
DFG MAK:	5 mg/m³	SAX
ACGIH:	1 mg/m³ (FUME)	NIOSH
CEIL:	5 mg/m³	NIOSH

B. TOXICOLOGICAL HAZARD

	HAZARD?	EFFECTS	SOURCE
Inhalation	Yes ✓ No__	emotional disturbances; spastic gait; languor, sleepiness, weakness; paralysis→S	
Ingestion	Yes__ No__		
Skin/eye absorption	Yes__ No__		
Skin/eye contact	Yes__ No__		
Carinogenic	Yes ✓ No__	Experimental Data	SAX
Teratogenic	Yes__ No__		
Mutagenic	Yes ✓ No__	Mutagenic Data	SAX
Aquatic	Yes__ No__		
Other: ________	Yes__ No__		

C. TOXICOLOGICAL HAZARD

	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes__ No__	Flammable in	SAX
Toxic byproduct(s):	Yes__ No__	the Form of	
____________		Dust or Powder,	
____________		when exposed	
Flammability	Yes__ No__	to Flame.	
LFL			
UFL			
Explosivity	Yes__ No__		
LEL			
UEL			

OH/WPPHAZ0/5

HAZARDOUS SUBSTANCE INFORMATION FORM

COMMON NAME: Mercury CHEMICAL NAME: Mercury → Hg

SYNONYMS Quicksilver; Colloidal mercury

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas ___ (at ambient temps of 20°C-25°C)	Liquid X Solid ___		
Molecular weight	200.59	g/g-mole	Chris Data Shee
Density[a]		g/ml	
Specific gravity[a]	3.55 ● 20°C	°F/°C	"
Solubility: water	Insoluble ●	°F/°C	"
Solubility[b]: ___	●	°F/°C	
Boiling point	675°F = 357°C	°F/°C	"
Melting point	-38.0°F = -38.9°C	°F/°C	"
Vapor pressure	1mm mmHg ● 126.2°	°F/°C	
Vapor density	7. ●	°F/°C	
Flash point (open cup ___; closed cup ___)	NOT FLAMMABLE	°F/°C	
Other: ___			

II. HAZARDOUS CHARACTERISTICS

A. Exposure limits (TLV, PEL, other)

	CONCENTRATION	SOURCE
OSHA PEL:	TWA CL 1mg/10m³	SAX
ACGIH TLV:	TWA 0.05 mg/m³	SAX
DFG MAK:	0.01ppm (0.1mg/m³)	SAX
BAT (INORG+MET):	Blood 5ug/dl urine 200ug/l	SAX
BAT (ORGANIC)	Blood 10ug/dl	SAX

B. TOXICOLOGICAL HAZARD

	HAZARD?	EFFECTS	SOURCE
Inhalation	Yes ✓ No ___	nausea Slight muscular tremor	Chris Data Sh
Ingestion	Yes ✓ No ___	GI tract Effects	
Skin/eye absorption	Yes ___ No ___		
Skin/eye contact	Yes ___ No ___		
Carinogenic	Yes ✓ No ___	An Experimental Carcinogen	= SAX
Teratogenic	Yes ___ No ___		
Mutagenic	Yes ___ No ___		
Aquatic	Yes ✓ No ___	0.5-1ppm/48hr/carassius	CHRIS
Other: ___	Yes ___ No ___	auratus/TLm/Fresh water.	DATA SHE

C. TOXICOLOGICAL HAZARD

	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes ___ No ___		
Toxic byproduct(s): ___	Yes ___ No ___		
Flammability	Yes ___ No ___		
LFL			
UFL			
Explosivity	Yes ___ No ___		
LEL			
UEL			

OH/WPPHAZ0/5

HAZARDOUS SUBSTANCE INFORMATION FORM

COMMON NAME: Methylene Chloride CHEMICAL NAME: Methylene Chloride
SYNONYMS Dichloromethane; Methylene Dichloride

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas ___ Liquid X Solid ___ (at ambient temps of 20°C-25°C)			
Molecular weight	84.93	g/g-mole	NIOSH
Density[a]		g/ml	
Specific gravity[a]	1.322 @ 20°C	°F/°C	"
Solubility: water	1.380 @ 68.02F	°F/°C	"
Solubility[b]: ___	@	°F/°C	
Boiling point	104°F = 39.8°C	°F/°C	"
Melting point	-142°F = -96.7°C	°F/°C	"
Vapor pressure	350 mmHg @	°F/°C	"
Vapor density	1.4244 @ [illegible]	°F/°C	meeck Index
Flash point (open cup X; closed cup X)	O.C. = 200°F; C.C = 237°F	°F/°C	NIOSH
Other:			

II. HAZARDOUS CHARACTERISTICS

A. Exposure limits (TLV, PEL, other)

	CONCENTRATION	SOURCE
ACGIH	- 100ppm	NIOSH
	500 PPM	
	1000 PPM = CEIL	
	2000 PPM	
	5 min / 2-HR PEAK	

B. TOXICOLOGICAL HAZARD

B. TOXICOLOGICAL HAZARD	HAZARD?	EFFECTS	SOURCE
Inhalation	Yes ✓ No ___	Shortness of Breath	
Ingestion	Yes ✓ No ___	Tremors, convulsions,	
Skin/eye absorption	Yes ___ No ___		
Skin/eye contact	Yes ✓ No ___	On Skin - 2nd degree Burns	
Carinogenic	Yes ✓ No ___	Carinogenic - Ca	NIOSH
Teratogenic	Yes ___ No ___		
~~Mutagenic~~ Aquatic	Yes ✓ No ___	5 ppm / 12 hours / bluegills	Killed / [illegible]
Aquatic BIOLOGICAL OXYGEN	Yes ✓ No ___	5 ppm / 3 hours / RAINBOW	trout / Killed, [illegible]
Other: DEMAND = B.O.D. →	Yes ✓ No ___	" 100%, 5 days	

C. TOXICOLOGICAL HAZARD

C. TOXICOLOGICAL HAZARD	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes ✓ No ___		
Toxic byproduct(s):	Yes ___ No ___		
Flammability	Yes ✓ No ___		
LFL		14%	FIRE GUIDE ON
UFL		22%	HAZARDOUS M
Explosivity	Yes ✓ No ___		
LEL		12%	NIOSH
UEL		19°F	"

OH/WPPHAZO/5

Hazardous Substance Information Form

COMMON NAME: Methylene Chloride **CHEMICAL NAME:** Dichloromethane

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas____ (at ambient temps of 20°C-25°C)	Liquid X Solid____		GE MSDS
Molecular weight	84	g/g-mole	GE MSDS
Density[a]	1.336	g/ml	GE MSDS
Specific gravity[a]	1.32 @ 25	°F/[✓ °C]	GE MSDS
Solubility: water	1.6% @ 20	°F/[✓ °C]	GE MSDS
Solubility[b]: ______	@	°F/°C	GE MSDS
Boiling point	40	°F/[✓ °C]	GE MSDS
Melting point		°F/°C	GE MSDS
Vapor pressure	340 mmHg @ 20	°F/[✓ °C]	GE MSDS
Vapor density	2.9 @	°F/°C	GE MSDS
Flash point (open cup____; closed cup____)		°F/°C	
Other:			

II. HAZARDOUS CHARACTERISTICS

TLV,PEL... 100 ppm/8 hr. TWA

A. TOXICOLOGICAL HAZARD	HAZARD?	EFFECTS	SOURCE
Inhalation	[✓ Yes] No	Unconsciousness and death of prolonged at high cc	
Ingestion	[✓ Yes] No	do not vomit - give milk	NIOSH
Skin/eye absorption	[✓ Yes] No	causes irritation	
Skin/eye contact	[✓ Yes] No		
Carcinogenic	Yes No		
Teratogenic	Yes No		
Mutagenic	Yes No		
Aquatic	Yes No		
Other:	Yes No		

B. TOXICOLOGICAL HAZARD	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	[✓ Yes] No	@ high temperatures forms weak combustibles	GE MSDS
Toxic byproduct(s): at high temperatures	[✓ Yes] No		GE MSDS
Flammability	[✓ Yes] No		
LFL		Auto ignition 1033 °F	GE MSDS
UFL			
Explosivity	[✓ Yes] No	In O_2 enriched air	GE MSDS
LEL			
UEL			

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[a] Only one is necessary.

[b] For organic compounds, recovery of spilled material by solvent extraction may require solubility data.

HAZARDOUS SUBSTANCE INFORMATION FORM

COMMON NAME: Methyl Ethyl Ketone CHEMICAL NAME: Methyl Ethyl [illegible]
SYNONYMS Ethyl Methyl Ketone; 2-Butanone; Semicarbazone; Methyl Ethyl Ketone Semicarbazone

I. PHYSICAL/CHEMICAL PROPERTIES

Natural physical state: Gas ___ Liquid X Solid ___ (at ambient temps of 20°C-25°C)			NIOSH
Molecular weight	72.11	g/g-mole	NIOSH
Density[a]		g/ml	
Specific gravity[a]	0.806 @ 20°C	°F/°C	"
Solubility: water	27lbs/lbs @ 68.02°F	°F/°C	NIOSH
Solubility[b]:	@	°F/°C	
Boiling point	175.3°F = 79.6°C	°F/°C	
Melting point	-123.3°F = -86.3°C	°F/°C	NIOSH
Vapor pressure	1.461 mmHg @ 70°F	°F/°C	"
Vapor density	.01853 @ 70°F	°F/°C	"
Flash point (open cup X ; closed cup X)	O.C.=22°F; C.C.=20°F	°F/°C	NIOSH
Other: IDLH (Immediately Dangerous to Life or Death)	: 3000 ppm		

II. HAZARDOUS CHARACTERISTICS

A. Exposure limits (TLV, PEL, other)	CONCENTRATION	SOURCE
	200 ppm (590 mg/m³)	NIOSH
	10-hr TWA (200 ppm)	

B. TOXICOLOGICAL HAZARD	HAZARD?	EFFECTS	SOURCE
Inhalation	Yes ✓ No ___	Loss of consciousness Headache, dizziness	NIOSH
Ingestion	Yes ___ No ___		
Skin/eye absorption	Yes ✓ No ___	EYE BURN	
Skin/eye contact	Yes ___ No ___		
Carinogenic	Yes ___ No ___		
Teratogenic	Yes ___ No ___		
Mutagenic	Yes ___ No ___		
Aquatic	Yes ✓ No ___	5640 mg/l/48hr/bluegill/TLm/	fresh water
Other: B.O.D.	Yes ✓ No ___	2.14%, 5 days	

C. TOXICOLOGICAL HAZARD	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes ___ No ___		
Toxic byproduct(s):	Yes ✓ No ___	When heated to decomposition it emits toxic fumes of NOx.	SAX
Flammability	Yes ✓ No ___		
LFL		1.8%	NIOSH
UFL		11.5%	"
Explosivity	Yes ✓ No ___		
LEL		2%	NIOSH
UEL		10%	

OH/WPPHAZO/5

HAZARDOUS SUBSTANCE INFORMATION FORM

COMMON NAME: METHYL ISOBUTYL KETONE CHEMICAL NAME: METHYL ISOBUTYL KET
SYNONYMS 4-methyl-2-Pentanone; Isobutyl methyl ketone; Hexone; Isopropyl acetone

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas ___ Liquid X Solid ___ (at ambient temps of 20°C-25°C)			
Molecular weight	100.16	g/g-mole	NIOSH
Density[a]		g/ml	
Specific gravity[a]	0.802 @ 20°C	°F/°C	"
Solubility: water	2 lbs/lbs H_2O @ 68.02°F	°F/°C	"
Solubility[b]: ________	@	°F/°C	"
Boiling point	241.2°F = 116.2°C	°F/°C	"
Melting point	-117°F = -84.2°C	°F/°C	"
Vapor pressure	.308 lb/in² mmHg @ 70°F	°F/°C	"
Vapor density	.00542 lb/ft³ @ 70°F	°F/°C	"
Flash point (open cup X ; closed cup X)	O.C. = 75°F; C.C. = 73°F	°F/°C	
Other: IDLH	3000 ppm		NIOSH

II. HAZARDOUS CHARACTERISTICS

A. Exposure limits (TLV, PEL, other)

	CONCENTRATION	SOURCE
	OSHA PEL: TWA 100 PPM →	SAX
	100 PPM (410 mg/m³)	NIOSH
	(NIOSH) 50 PPM (200 mg/m³) = 10 hr TWA	"
	ACGIH = 50 PPM	

B. TOXICOLOGICAL HAZARD

	HAZARD?	EFFECTS	SOURCE
Inhalation	Yes ✓ No ___	HUMAN SYSTEMIC IRRITANT Moderately toxic	SAX
Ingestion Intraperitoneal:	Yes ✓ No ___	A Poison	SAX
Skin/eye absorption	Yes ✓ No ___	Dry skin; dermatitis	NIOSH
Skin/eye contact	Yes ✓ No ___	Irritation to eyes	
Carinogenic	Yes ___ No ___		
Teratogenic	Yes ___ No ___		
Mutagenic	Yes ___ No ___		
Aquatic	Yes ___ No ___		
Other: B.O.D	Yes ✓ No ___	(theor.) 1.8%; 0.5 DAl; (theo.)	12%, 5 days

C. TOXICOLOGICAL HAZARD

	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes ___ No ___		
Toxic byproduct(s): ________	Yes ___ No ___		
Flammability	Yes ✓ No ___		
LFL		1.4%	
UFL		7.5%	
Explosivity	Yes ✓ No ___		NIOSH
LEL		1.4%	
UEL		7.5%	

OH/WPPHAZ0/5

HAZARDOUS SUBSTANCE INFORMATION FORM

COMMON NAME: Nickel CHEMICAL NAME: Nickel → Ni
SYNONYMS Nickel Catalyst; nickel sponge. Pulverized Nickel; Raney Alloy; Raney Nic

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas ___ Liquid ___ Solid ___ (at ambient temps of 20°C-25°C)			
Molecular weight	58.71	g/g-mole	SAX
Density[a]		g/ml	
Specific gravity[a]	@	°F/°C	
Solubility: water	@	°F/°C	
Solubility[b]: ___	@	°F/°C	
Boiling point	bp = 2730°	°F/°C	SAX
Melting point	mp = 1455°	°F/°C	SAX
Vapor pressure	1mm mmHg @ 1810°	°F/°C	SAX
Vapor density	d= 8.90 @ 25°	°F/°C	SAX
Flash point (open cup ___; closed cup ___)		°F/°C	
Other: ___			

II. HAZARDOUS CHARACTERISTICS

A. Exposure limits (TLV, PEL, other)

	CONCENTRATION	SOURCE
OSHA PEL:	TWA 1mg/m^3 (SKIN)	SAX
ACGIH TLV:	TWA (metal) 1mg/m^3; (Soluble compds as Ni) 0.1mg	
→ TRK :	0.5mg/m^3 - (as respirable dust and fume	
TRK :	0.05mg/m^3 - (as respirable droplets).	

B. TOXICOLOGICAL HAZARD

	HAZARD?	EFFECTS	SOURCE
Inhalation	Yes ___ No ___		
Ingestion	Yes ✓ No ___	Nausea, Vomit, Diarrhea	SAX
Skin/eye absorption	Yes ___ No ___		
Skin/eye contact	Yes ✓ No ___	May cause dermatitis	SAX
Carinogenic	Yes ✓ No ___	Experimental Carcinogen	SAX
Teratogenic	Yes ___ No ___		
Mutagenic	Yes ✓ No ___	Mutagenic Data	SAX
Aquatic	Yes ___ No ___		
Other: ___	Yes ___ No ___		

C. TOXICOLOGICAL HAZARD

	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes ___ No ___		
Toxic byproduct(s):	Yes ___ No ___		
Flammability	Yes ___ No ___		
LFL			
UFL			
Explosivity	Yes ___ No ___		
LEL			
UEL			

Hazardous Substance Information Form

COMMON NAME: Quicksilver **CHEMICAL NAME:** Mercury - Hg

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas____ Liquid X Solid____ (at ambient temps of 20°C-25°C)			GE MSDS
Molecular weight	200.61	g/g-mole	GE MSDS
Density[a]		g/ml	↓
Specific gravity[a]	13.5 @	°F/°C	↓
Solubility: water	Nil @	°F/°C	↓
Solubility[b]: ____	@	°F/°C	↓
Boiling point	674	[✓ °F]/°C	↓
Melting point	-38.9	°F/[✓ °C]	↓
Vapor pressure	0.0012 mmHg @ 20	°F/[✓ °C]	↓
Vapor density	@	°F/°C	
Flash point (open cup____; closed cup____)		°F/°C	
Other: ____			

II. HAZARDOUS CHARACTERISTICS

TLV,PEL... ____

TLV = 0.05 mg/M^3/8h TWA

A. TOXICOLOGICAL HAZARD

TOXICOLOGICAL HAZARD	HAZARD?	EFFECTS	SOURCE
			NIOSH
Inhalation	[✓ Yes] No	Cough, bronchitis,	
Ingestion	[✓ Yes] No	Get medical attention immediately for ingestion	
Skin/eye absorption	[✓ Yes] No	pneumonia, tremor, insomnia	
Skin/eye contact	[✓ Yes] No	irritability, indecision, headache, fatigue, sto tit	
Carcinogenic	Yes No		
Teratogenic	Yes No		
Mutagenic	Yes No		
Aquatic	Yes No		
Other: ____	Yes No		

B. TOXICOLOGICAL HAZARD

TOXICOLOGICAL HAZARD	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes [✓ No]		GE MSDS
Toxic byproduct(s): with heat forms toxic fumes, heat=fire	[✓ Yes] No		GE MSDS GE MSDS
Flammability in air	Yes [✓ No]		GE MSDS
LFL			
UFL			GE MSDS
Explosivity in air	Yes [✓ No]		GE MSDS
LEL			
UEL			

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[a] Only one is necessary.

[b] For organic compounds, recovery of spilled material by solvent extraction may require solubility data.

HAZARDOUS SUBSTANCE INFORMATION FORM

COMMON NAME: Selenium CHEMICAL NAME: Selenium Se

SYNONYMS Selenium Alloy; Selenium Base; Selenium Homopolymer; Elemental Selenium Selenium Dust.

I. PHYSICAL/CHEMICAL PROPERTIES

Natural physical state: Gas____ Liquid____ Solid____

(at ambient temps of 20°C-25°C)

			SOURCE
Molecular weight Atomic weight	78.96	g/g-mole	SAX
Density[a]		g/ml	
Specific gravity[a]	@	°F/°C	
Solubility: water	@	°F/°C	
Solubility[b]:	@	°F/°C	
Boiling point	bp = 690°	°F/°C	SAX
Melting point	mp = 170°-217°	°F/°C	SAX
Vapor pressure	1mm mmHg @ 356°	°F/°C	SAX
Vapor density	d = 4.81-4.26 @	°F/°C	SAX
Flash point (open cup____; closed cup____)		°F/°C	
Other: IDLH	100mg/m^3		NIOSH

II. HAZARDOUS CHARACTERISTICS

A. Exposure limits (TLV, PEL, other)

	CONCENTRATION	SOURCE
OSHA PEL:	TWA 200µg(Se)/m^3	SAX
ACGIH TLV:	TWA 0.2 mg/m^3	
DFG MAK:	0.1 mg/m^3	

B. TOXICOLOGICAL HAZARD

	HAZARD?	EFFECTS	SOURCE
Inhalation	Yes___ No___		
Ingestion	Yes___ No___		
Skin/eye absorption	Yes___ No___		
Skin/eye contact	Yes___ No___		
Carinogenic	[✓ Yes] No___	Experimental Carcinogen	SAX
Teratogenic	Yes___ No___		
Mutagenic	Yes___ No___		
Aquatic	Yes___ No___		
Other: ____	Yes___ No___		

C. TOXICOLOGICAL HAZARD

	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes___ No___		
Toxic byproduct(s):	Yes___ No___	When heated to decomposition it emits toxic fumes of Se.	
Flammability	Yes___ No___		
LFL			
UFL			
Explosivity	Yes___ No___		
LEL			
UEL			

HAZARDOUS SUBSTANCE INFORMATION FORM

COMMON NAME: Silver CHEMICAL NAME: Silver - Ag

SYNONYMS Argentium; Shell silver; Silver atom.

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas ___ Liquid ___ Solid ___ (at ambient temps of 20°C-25°C)			
Molecular weight Atomic weight	107.87	g/g-mole	SAX
Density^a		g/ml	
Specific gravity^a	@	°F/°C	
Solubility: water	@	°F/°C	
Solubility^b: ___	@	°F/°C	
Boiling point	bp = 2212°	°F/°C	SAX
Melting point	mp = 961.93	°F/°C	SAX
Vapor pressure	mmHg @	°F/°C	
Vapor density	d = 10.50 @ 20°	°F/°C	SAX
Flash point (open cup ___; closed cup ___)		°F/°C	
Other: ___			

II. HAZARDOUS CHARACTERISTICS

A. Exposure limits (TLV, PEL, other)

	CONCENTRATION	SOURCE
OSHA PEL:	TWA 10 µg/m^3	SAX
ACGIH TLV:	TWA (metal) 0.1 mg/m^3	
	(soluble cmpds as Ag) 0.01 mg/m^3	
DFG MAK:	0.01 mg/m^3	

B. TOXICOLOGICAL HAZARD

	HAZARD?		EFFECTS	SOURCE
Inhalation	Yes ___	No ___		
Ingestion	Yes ___	No ___		
Skin/eye absorption	Yes ✓	No ___	Human systemic skin effects	SAX
Skin/eye contact	Yes ___	No ___	1mg/m^3 of silver dust	SAX
Carinogenic	Yes ___	No ___	causes skin effects.	
Teratogenic	Yes ___	No ___		
Mutagenic	Yes ___	No ___		
Aquatic	Yes ___	No ___		
Other: ✓	Yes ✓	No ___	An experimental Tumorigen	SAX

C. TOXICOLOGICAL HAZARD

	HAZARD?		CONCENTRATIONS	SOURCE
Combustibility	Yes ___	No ___		
Toxic byproduct(s):	Yes ___	No ___		
___				
Flammability	Yes ___	No ___		
LFL				
UFL				
Explosivity	Yes ___	No ___		
LEL				
UEL				

OH/WPPHAZO/5

HAZARDOUS SUBSTANCE INFORMATION FORM

COMMON NAME: STYRENE CHEMICAL NAME: STYRENE

SYNONYMS Styrol; Vinyl Benzene; Phenylethylene; Styrolene; Cinnamene; Cinnamenol; Phenethylene; NCI-C02200; Styrene Monomer;

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas ___ Liquid X Solid ___ (at ambient temps of 20°C-25°C)			
Molecular weight	104.15	g/g-mole	NIOSH
Density[a]		g/ml	
Specific gravity[a]	0.906 @ 20°C	°F/°C	"
Solubility: water	@	°F/°C	
Solubility[b]: ___	@	°F/°C	
Boiling point	293.4°F = 145.2°C	°F/°C	"
Melting point	-23.1°F = -30.6°C	°F/°C	"
Vapor pressure	0.99 lb/in² mmHg @ 70°F	°F/°C	"
Vapor density	.0018 lb/ft³ @ 70°F	°F/°C	"
Flash point (open cup X ; closed cup X)	O.C = 93°F; C.C. = 88°F	°F/°C	"
Other: IDLH	5000 PPM		"

II. HAZARDOUS CHARACTERISTICS

A. Exposure limits (TLV, PEL, other)	CONCENTRATION	SOURCE
OSHA PEL = TWA	1000 PPM	SAX
ACGIH TLV = TWA	50 PPM	"
DFG MAK	= 100 PPM (420 mg/m³)	"
CEIL:	= 200 PPM	NIOSH

B. TOXICOLOGICAL HAZARD	HAZARD?	EFFECTS	SOURCE
Inhalation	Yes ✓ No ___	Dizziness, drunkeness;	NIOSH
Ingestion	Yes ✓ No ___	POISON	SAX
Skin/eye absorption	Yes ✓ No ___	Irritation To Eyes	NIOSH
Skin/eye contact	Yes ✓ No ___	LACHRIMATION	SAX
Carinogenic	Yes ✓ No ___	EXPERIMENTAL CARCINOGEN :	SAX
Teratogenic	Yes ___ No ___		
Mutagenic	Yes ___ No ___		
Aquatic	Yes ✓ No ___	22 PPM/96 HR/BLUEGILL/TLm/FRESH WATER	
Other: B.OD	Yes ✓ No ___	13% (THEOR.), 412 days	

C. TOXICOLOGICAL HAZARD	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes ___ No ___		
Toxic byproduct(s): ___	Yes ___ No ___		
Flammability	Yes ✓ No ___		
LFL		1.1%	NIOSH
UFL		6.1%	"
Explosivity	Yes ✓ No ___		
LEL		1.1%	"
UEL		6.1%	"

OH/WPPHAZO/5

HAZARDOUS SUBSTANCE INFORMATION FORM

COMMON NAME: 1122 Tetrachloroethane CHEMICAL NAME: 1122 Tetrachloroethane
SYNONYMS Tetrachloroethane; Acetylene tetrachloride; Symmetrical tetrachloroethane

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas ___ [✓ Liquid X] Solid ___ (at ambient temps of 20°C-25°C)			
Molecular weight	167.85	g/g-mole	NIOSH
Density[a]		g/ml	
Specific gravity[a]	1.595 ● 20°C	°F/°C	
Solubility: water	2.29% ●	°F/°C	
Solubility[b]: ___	●	°F/°C	
Boiling point	295.3°F = 146.3°C	°F/°C	
Melting point	-46.8°F = -43.8°C	°F/°C	
Vapor pressure	8mm mmHg ●	°F/°C	
Vapor density	.00468 P.S.I ● 80°F	°F/°C	
Flash point (open cup ___; closed cup ___)	NOT FLAMMABLE	°F/°C	
Other: IDLH	150 ppm		

II. HAZARDOUS CHARACTERISTICS

A. Exposure limits (TLV, PEL, other)	CONCENTRATION	SOURCE
	5 ppm (35 mg/m3)	NIOSH
	Lowest detectable limit	(NIOSH)
	(ACGIH) 1 ppm (7 mg/m3)	

B. TOXICOLOGICAL HAZARD	HAZARD?	EFFECTS	SOURCE
Inhalation	[✓ Yes] No ___	Repeated exposure can be fatal	NIOSH
Ingestion	[✓ Yes] No ___	Liver narcosis; cyanosis	
Skin/eye absorption	[✓ Yes] No ___	Lachrymation	
Skin/eye contact	[✓ Yes] No ___	Severe skin lesions	
Carinogenic	[✓ Yes] No ___	CARCINOGENIC	NIOSH
Teratogenic	Yes ___ No ___		
Mutagenic	Yes ___ No ___		
Aquatic	Yes ___ No ___		
Other: ___	Yes ___ No ___		

C. TOXICOLOGICAL HAZARD	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes ___ [✓ No]		NIOSH
Toxic byproduct(s): ___	Yes ___ No ___		
Flammability	Yes ___ [✓ No]	NOT FLAMMABLE	
LFL			
UFL			
Explosivity	Yes ___ No ___		
LEL			
UEL			

OH/WPPHAZ0/5

HAZARDOUS SUBSTANCE INFORMATION FORM

COMMON NAME: *Tetrachloroethylene* CHEMICAL NAME: *Tetrachloroethylene*

SYNONYMS *Tetracap; Perclene; Perchloroethylene; Perk; Carbon Bichloride; Carbon Dichloride*

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas ___ Liquid X Solid ___ (at ambient temps of 20°C-25°C)			NIOSH
Molecular weight	65.83	g/g-mole	NIOSH
Density[a]		g/ml	
Specific gravity[a]	1.63 ● 20°C	°F/°C	
Solubility: water	.016 lb/100 lb H2O ● 68.02°F	°F/°C	
Solubility[b]: ___	●	°F/°C	
Boiling point	250°F = 121°C	°F/°C	"
Melting point	-8.3°F = -22.4°C	°F/°C	"
Vapor pressure	15.8 mmHg ● 22°C	°F/°C	SAX
Vapor density	5.83 ●	°F/°C	SAX
Flash point (open cup ___; closed cup ___)	NOT FLAMMABLE	°F/°C	
Other: ___			

II. HAZARDOUS CHARACTERISTICS

A. Exposure limits (TLV, PEL, other)

	CONCENTRATION	SOURCE
OSHA PEL	TWA 100PPM	SAX
DFG MAK	50 PPM (345mg/m³)	SAX
ACGIH	50 PPM	NIOSH
CEIL	200 PPM	NIOSH

B. TOXICOLOGICAL HAZARD

	HAZARD?	EFFECTS	SOURCE
Inhalation	Yes ✓ No ___	Affects central nervous system	"
Ingestion	Yes ✓ No ___	Anesthesia	
Skin/eye absorption	Yes ✓ No ___	Eye Irritation	
Skin/eye contact	Yes ✓ No ___	Skin Irritation	
Carinogenic	Yes ✓ No ___	Carcinogenic	
Teratogenic	Yes ___ No ___		
Mutagenic	Yes ___ No ___		
Aquatic	Yes ___ No ___		
Other: ___	Yes ___ No ___		

C. TOXICOLOGICAL HAZARD

	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes ___ No ___		
Toxic byproduct(s): ___	Yes ___ No ___		
Flammability	Yes ___ No ✓	NOT FLAMMABLE	
LFL			
UFL			
Explosivity	Yes ___ No ___		
LEL			
UEL			

OH/WPPHAZO/5

Hazardous Substance Information Form

COMMON NAME: tetrachloroethylene CHEMICAL NAME: tetrachloroethylene
perchloroethylene

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas ____ Liquid X Solid ____ (at ambient temps of 20°C-25°C)			
Molecular weight	166	g/g-mole	
Density[a]		g/ml	
Specific gravity[a]	@	°F/°C	
Solubility: water	0.015% @	°F/°C	
Solubility[b]: ________	@	°F/°C	
Boiling point	121	°F/[✓ °C]	
Melting point	-8	[✓ °F]/°C	
Vapor pressure	14 mmHg @ 25	°F/[✓ °C]	
Vapor density	@	°F/°C	
Flash point (open cup ____; closed cup ____)		°F/°C	
Other:			

II. HAZARDOUS CHARACTERISTICS

TLV,PEL... 50 ppm TWA

A. TOXICOLOGICAL HAZARD	HAZARD?	EFFECTS	SOURCE
Inhalation	[✓ Yes] No	irritation eyes nose, throat	
Ingestion	[✓ Yes] No	nausea , flush face & neck, vertigo, dizzy, Headac	
Skin/eye absorption	Yes No		
Skin/eye contact	[✓ Yes] No	irritation	
Carcinogenic	[✓ Yes] No	potential human carcinogen	
Teratogenic	Yes No		
Mutagenic	Yes No		
Aquatic	Yes No		
Other: ________	Yes No		

B. TOXICOLOGICAL HAZARD	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes [✓ No]		
Toxic byproduct(s):	Yes [✓ No]		
Flammability	Yes [✓ No]		
LFL			
UFL			
Explosivity	Yes [✓ No]		
LEL			
UEL			

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[a] Only one is necessary.

[b] For organic compounds, recovery of spilled material by solvent extraction may require solubility data.

HAZARDOUS SUBSTANCE INFORMATION FORM

COMMON NAME: Thallium CHEMICAL NAME: Thallium → Tl

SYNONYMS Ramor

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas___ Liquid___ Solid___ (at ambient temps of 20°C-25°C)			
Molecular weight Atomic weight	204.37	g/g-mole	SAX
Density[a]		g/ml	
Specific gravity[a]	@	°F/°C	
Solubility: water	@	°F/°C	
Solubility[b]: ______	@	°F/°C	
Boiling point	bp = 1457°	°F/°C	SAX
Melting point	mp = 303.5	°F/°C	SAX
Vapor pressure	1mm mmHg @ 825°	°F/°C	SAX
Vapor density	d = 11.85 @ 20°	°F/°C	SAX
Flash point (open cup___; closed cup___)		°F/°C	
Other: IDLH	20mg/m^3		NIOSH

II. HAZARDOUS CHARACTERISTICS

A. Exposure limits (TLV, PEL, other)

	CONCENTRATION	SOURCE
ACGIH TLV:	TWA 0.1mg/m^3 (skin)	SAX
DFG, MAK:	0.1mg/m^3	

B. TOXICOLOGICAL HAZARD

	HAZARD?	EFFECTS	SOURCE
Inhalation	Yes___ No___	Polyneuritis; angina-like pains; insomnia, mental confusion;	SAX
Ingestion	Yes ✓ No___	Swelling of feet + legs;	
Skin/eye absorption	Yes ✓ No___	Optic Neuritis	
Skin/eye contact	Yes ✓ No___	arthralgia	
Carinogenic	Yes___ No___		
Teratogenic	Yes___ No___		
Mutagenic	Yes___ No___		
Aquatic	Yes___ No___		
Other: ______	Yes___ No___		

C. TOXICOLOGICAL HAZARD

	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes___ No___	when heated to	SAX
Toxic byproduct(s):	Yes___ No___	decomposition it	
		emits toxic fumes	
		of Tl.	
Flammability	Yes___ No___		
LFL			
UFL			
Explosivity	Yes___ No___		
LEL			
UEL			

OH/WPPHAZO/5

HAZARDOUS SUBSTANCE INFORMATION FORM

COMMON NAME: TIN CHEMICAL NAME: TIN → Sn

SYNONYMS Silver Matt Powder; Tin (Alpha); Tin Flake; Tin Powder

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas ___ Liquid ___ Solid ___ (at ambient temps of 20°C-25°C)			
Molecular weight Atomic weight:	118.69	g/g-mole	SAX
Density[a]	stabilizes < 18°	g/ml	SAX
Specific gravity[a]	@	°F/°C	
Solubility: water	@	°F/°C	
Solubility[b]: ___	@	°F/°C	
Boiling point	bp = 2507°	°F/°C	SAX
Melting point	mp = 231.9°	°F/°C	SAX
Vapor pressure	1mm mmHg @ 1492°	°F/°C	SAX
Vapor density	d= 7.31 @	°F/°C	SAX
Flash point (open cup ___; closed cup ___)		°F/°C	
Other: IDLH	400mg/m³		NIOSH

II. HAZARDOUS CHARACTERISTICS

A. Exposure limits (TLV, PEL, other) CONCENTRATION SOURCE

ACGIH TLV: TWA metal 2mg/m³, oxide and inorganic cmpds (except SnH4) as Sn: 2mg/m³; Organic cmpds: 0.1 mg/m³ (SKIN). = SAX

DFG MAK: Inorganic 2 mg/m³, Organic 0.1 mg/m³.

B. TOXICOLOGICAL HAZARD

B. TOXICOLOGICAL HAZARD	HAZARD?	EFFECTS	SOURCE
Inhalation	Yes __ No __	Elemental Tin	SAX
Ingestion	Yes __ No __	is not generally	
Skin/eye absorption	Yes __ No __	considered toxic.	
Skin/eye contact	Yes __ No __		
Carinogenic	Yes __ No __		
Teratogenic	Yes __ No __		
Mutagenic	Yes __ No __		
Aquatic	Yes __ No __		
Other: ✓	Yes ✓ No __	Experimental Tumorigen	SAX

C. TOXICOLOGICAL HAZARD

C. TOXICOLOGICAL HAZARD	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes ✓ No __		
Toxic byproduct(s):	Yes __ No __		
Flammability	Yes __ No __		
LFL			
UFL			
Explosivity	Yes __ No __		
LEL			
UEL			

OH/WPPHAZ0/5

HAZARDOUS SUBSTANCE INFORMATION FORM

COMMON NAME: Toluene CHEMICAL NAME: Toluene

SYNONYMS Toluol, Methyl Benzene; Methylbenzol; Phenylmethane.

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas ___ Liquid X Solid ___ (at ambient temps of 20°C-25°C)			
Molecular weight	92.14	g/g-mole	NIOSH
Density[a]		g/ml	
Specific gravity[a]	0.867 @ 20°C	°F/°C	"
Solubility: water	.050 lbs/100 lbs H2O @ 68.02°F	°F/°C	
Solubility[b]:	@	°F/°C	
Boiling point	231.1°F = 110.6°C	°F/°C	"
Melting point	-139°F = -95.0°C	°F/°C	"
Vapor pressure	36.7 mmHg @ 30°	°F/°C	SAX
Vapor density	.0078 lb/ft3 @ 70°F	°F/°C	
Flash point (open cup X; closed cup X)	O.C = 55°F; C.C = 40°F	°F/°C	NIOSH
Other: IDLH	2000 ppm		NIOSH

II. HAZARDOUS CHARACTERISTICS

A. Exposure limits (TLV, PEL, other)	CONCENTRATION	SOURCE
OSHA PEL:	TWA 200 ppm	SAX
ACGIH TLV:	TWA 100 ppm	SAX
DFG MAK:	100 ppm (375 mg/m3)	SAX
CEIL :	300 PPM	NIOSH

B. TOXICOLOGICAL HAZARD	HAZARD?	EFFECTS	SOURCE
Inhalation	Yes ✓ No ___	Inhale 200PPM for 8hrs = Impairement of coord.nation and REACTION TIME. Dizziness Headache.	
Ingestion	Yes ✓ No ___	Vomiting; Griping; Depressed Respiration.	
Skin/eye absorption	Yes ✓ No ___	Drys Skin	
Skin/eye contact	Yes ✓ No ___	Irritates Eyes	
Carinogenic	Yes ___ No ___		
Teratogenic	Yes ___ No ___		
Mutagenic	Yes ✓ No ___	Mutagenic data	SAX
Aquatic	Yes ✓ No ___	1180 mg/l/96hr/sunfish/TLm/fresh water.	
Other: Aspirated	Yes ✓ No ___	Coughing, Rapidly developing Pulmonary edema	

C. TOXICOLOGICAL HAZARD	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes ✓ No ___		
Toxic byproduct(s):	Yes ___ No ___		
Flammability	Yes ✓ No ___		NIOSH
LFL		1.27%	
UFL		7%	
Explosivity	Yes ✓ No ___		NIOSH
LEL		1.3%	
UEL		7.1%	

OH/WPPHAZ0/5

Hazardous Substance Information Form

COMMON NAME: Toluol/Methylbenzene **CHEMICAL NAME:** Toluene

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas____ Liquid X Solid____ (at ambient temps of 20°C-25°C)			GE MSDS
Molecular weight	92.15	g/g-mole	GE MSDS
Density[a]	0.866	g/ml	GE MSDS
Specific gravity[a]	0.87 @	°F/°C	GE MSDS
Solubility: water	insoluble @	°F/°C	GE MSDS
Solubility[b]: ____________	@	°F/°C	GE MSDS
Boiling point	111	°F/[✓ °C]	GE MSDS
Melting point	-95	°F/[✓ °C]	GE MSDS
Vapor pressure	36.7 mmHg @ 30	°F/[✓ °C]	GE MSDS
Vapor density	3.14 @	°F/°C	GE MSDS
Flash point (open cup____; closed cup X)	40	[✓ °F]/°C	GE MSDS
Other:			

II. HAZARDOUS CHARACTERISTICS

OSHATLV=200 ppm
TLV=mglm^3/8hrTLV,PEL...TWA skin
TW = 200 ppm (inhil→cns)

A. TOXICOLOGICAL HAZARD	HAZARD?	EFFECTS	SOURCE
Inhalation	[✓ Yes] No	vapor @ 100ppm headache, drowsiness, nausea	NIOSH
Ingestion	[✓ Yes] No	irritates digestive tract - systemic effects from absorption	
Skin/eye absorption	[✓ Yes] No	defatting of skin irritation of eyes-corneal burn	
Skin/eye contact	[✓ Yes] No	100-200ppmitching	
Carcinogenic	Yes No		
Teratogenic	Yes No		
Mutagenic	Yes No		
Aquatic	Yes No		
Other: ________	Yes No		

B. TOXICOLOGICAL HAZARD	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	[✓ Yes] No		GE MSDS
Toxic byproduct(s): Oxidation in air forms Oxides	[✓ Yes] No		GE MSDS GE MSDS
Flammability	[✓ Yes] No		
LFL		1.4	GE MSDS
UFL		6.7	GE MSDS
Explosivity	Yes [✓ No]		
LEL		NA	GE MSDS
UEL		NA	GE MSDS

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[a] Only one is necessary.

[b] For organic compounds, recovery of spilled material by solvent extraction may require solubility data.

HAZARDOUS SUBSTANCE INFORMATION FORM

COMMON NAME: 1,1,1 Trichloroethane CHEMICAL NAME: 1,1,1 Trichloroethane
SYNONYMS Trichloroethane; methyl Chloroform Aerothene; Chloroethene, Chlorothene; methyl trichloromethane.

I. PHYSICAL/CHEMICAL PROPERTIES

Natural physical state: Gas____ Liquid X Solid____
(at ambient temps of 20°C-25°C)

			SOURCE
Molecular weight	133.41	g/g-mole	NIOSH
Density[a]		g/ml	
Specific gravity[a]	1.31 @ 20°C	°F/°C	
Solubility: water	.070lb/100lbH2O @ 68.02°F	°F/°C	
Solubility[b]: ____	@	°F/°C	"
Boiling point	165°F = 74°C	°F/°C	"
Melting point	<-38°F = <-39°C	°F/°C	"
Vapor pressure	100 mmHg @ 20.0°	°F/°C	SAX
Vapor density	1.3376 @ 20°/4°	°F/°C	SAX
Flash point (open cup____; closed cup____)	NONE	°F/°C	
Other:			

II. HAZARDOUS CHARACTERISTICS

A. Exposure limits (TLV, PEL, other)	CONCENTRATION	SOURCE
OSHA PEL:	TWA 350 ppm	SAX
DFG MAK:	200ppm (2080mg/m3)	"

B. TOXICOLOGICAL HAZARD	HAZARD?	EFFECTS	SOURCE
Inhalation	Yes ✓ No__	Asphyxiation + loss of consciousness ;Loss of equilibrium.	Chris Data Sou-
Ingestion	Yes ✓ No__	Feeling of Nausea.	
Skin/eye absorption	Yes ✓ No__	Slightly Irritating + Lachrymatory.	
Skin/eye contact	Yes ✓ No__	Defatting action may cause dermatitis.	
Carinogenic	Yes__ No__		
Teratogenic	Yes__ No__		
Mutagenic	Yes__ No__		
Aquatic	Yes ✓ No__	75-150 ppm/pinfish/TLm/ Salt water	
Other: ____	Yes__ No__		

C. TOXICOLOGICAL HAZARD	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes ✓ No__		
Toxic byproduct(s):	Yes__ No__		
Flammability	Yes ✓ No__		Chris Data Sou
LFL		1.6%	
UFL		7%	
Explosivity	Yes__ No__		
LEL			
UEL			

OH/WPPHAZ0/5

Hazardous Substance Information Form

COMMON NAME: TCE **CHEMICAL NAME:** Trichloroethylene

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas___ Liquid X Solid___ (at ambient temps of 20°C-25°C)			GE MSDS
Molecular weight	131.39	g/g-mole	GE MSDS
Density[a]		g/ml	GE MSDS
Specific gravity[a]	1.45 @ 20	°F/[✓ °C]	GE MSDS
Solubility: water	0.1% @ 25	°F/[✓ °C]	GE MSDS
Solubility[b]: ______	@	°F/°C	GE MSDS
Boiling point	87	°F/[✓ °C]	GE MSDS
Melting point		°F/°C	GE MSDS
Vapor pressure	58 mmHg @ 20	°F/[✓ °C]	GE MSDS
Vapor density	4.54 @	°F/°C	GE MSDS
Flash point (open cup___; closed cup___)	none	°F/°C	GE MSDS
Other:			

II. HAZARDOUS CHARACTERISTICS

TLV,PEL... 100 PPM/ 8 h TWA

A. TOXICOLOGICAL HAZARD	HAZARD?	EFFECTS	SOURCE
Inhalation	[✓ Yes] No	Irritation of nose & throat above TLV(NIOSH)	
Ingestion	Yes No	drowsiness, headache, nausea, unconciousness and maybe death	
Skin/eye absorption	[✓ Yes] No	irritation, lacrimation-eye	
Skin/eye contact	[✓ Yes] No	dermititis-skin	
Carcinogenic	[✓ Yes] No	Potential carcinogen	
Teratogenic	Yes No		
Mutagenic	Yes No		
Aquatic	Yes No		
Other: ______	Yes No		

B. TOXICOLOGICAL HAZARD	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	[✓ Yes] No	In O_2 rich air only with high temperatures	GE MSDS
Toxic byproduct(s):	Yes No		
Flammability	[✓ Yes] No		
LFL 57%/100°C		15.0%/2.5%	GE MSDS
UFL		40%/90%	GE MSDS
Explosivity	Yes No		
LEL			
UEL			

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[a] Only one is necessary.

[b] For organic compounds, recovery of spilled material by solvent extraction may require solubility data.

HAZARDOUS SUBSTANCE INFORMATION FORM

COMMON NAME: Techloeoethylene CHEMICAL NAME: Techioecethylene

SYNONYMS Tecene; Alglylenl; Chlorylen; Germalgene; Trethylene; Trichloran; Tc Acetylene Trichloride;

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas ___ (at ambient temps of 20°C-25°C)	Liquid X Solid ___		CHRIS DATA Sh
Molecular weight	131.39	g/g-mole	"
Density[a]		g/ml	"
Specific gravity[a]	1.46 @ 20°C	°F/°C	"
Solubility: water	@	°F/°C	"
Solubility[b]: ___	@	°F/°C	"
Boiling point	189°F = 87°C	°F/°C	"
Melting point	-123.5°F = -86.4°C	°F/°C	"
Vapor pressure	100 mmHg @ 32°	°F/°C	SAX
Vapor density	4.53 @	°F/°C	SAX
Flash point (open cup ___; closed cup X)	C.C. = 90°F	°F/°C	Chris Data Sheet
Other: IDLH	Carcinogenic		"

II. HAZARDOUS CHARACTERISTICS

A. Exposure limits (TLV, PEL, other)

	CONCENTRATION	SOURCE
OSHA PEL:	TWA 100ppm	SAX
ACGIH TLV:	TWA 50 ppm	"
DFK MAK:	50ppm (260 mg/m3)	"
CEIL:	200 ppm	NIOSH

B. TOXICOLOGICAL HAZARD

	HAZARD?	EFFECTS	SOURCE
Inhalation	[✓ Yes] No ___	Blurred vision disturbed CNS; Resulting in Cardiac Failure.	CHRIS DATA SHEET
Ingestion	[✓ Yes] No ___	Irritation of nose + throat.	"
Skin/eye absorption	[✓ Yes] No ___	Defatting action can cause dermatitis.	"
Skin/eye contact	[✓ Yes] No ___	Slightly irritating sensation + Lachrymation.	"
Carinogenic	[✓ Yes] No ___	Carcinogenic	
Teratogenic	[✓ Yes] No ___	Experimental Teratogen. ⇒ SAX	
Mutagenic	Yes ___ No ___		
Aquatic	[✓ Yes] No ___	660mg/l/40hr/daphnia/kill/fresh water	
Other: ___	Yes ___ No ___		

C. TOXICOLOGICAL HAZARD

	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	[✓ Yes] No ___		CHRIS DATA Sh
Toxic byproduct(s): ___	Yes ___ No ___		SAX
Flammability	[✓ Yes] No ___		
LFL		8.0 %	CHRIS DATA SHEET
UFL		10.5 %	"
Explosivity	[✓ Yes] No ___		
LEL		11%	NIOSH
UEL		41%	"

OH/WPPHAZO/5

HAZARDOUS SUBSTANCE INFORMATION FORM

COMMON NAME: Vanadium CHEMICAL NAME: Vanadium (V)
SYNONYMS ______

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas____ Liquid____ Solid____ (at ambient temps of 20°C-25°C)			
Molecular weight Atomic Weight:	50.94	g/g-mole	SAX
Density[a]		g/ml	
Specific gravity[a]	●	°F/°C	
Solubility: water	Insoluble ●	°F/°C	SAX
Solubility[b]: ______	●	°F/°C	
Boiling point	bp = 3000°	°F/°C	SAX
Melting point	mp = 1917°	°F/°C	SAX
Vapor pressure	mmHg ●	°F/°C	
Vapor density	d = 6.11 ● 18.7°	°F/°C	SAX
Flash point (open cup____; closed cup____)		°F/°C	
Other: ______			

II. HAZARDOUS CHARACTERISTICS

A. Exposure limits (TLV, PEL, other)

	CONCENTRATION	SOURCE

B. TOXICOLOGICAL HAZARD

	HAZARD?	EFFECTS	SOURCE
Inhalation	Yes___ No___		
Ingestion	Yes___ No___		
Skin/eye absorption	Yes___ No___		
Skin/eye contact	Yes___ No___		
Carinogenic	Yes ✓ No___	Experimental Carcinogen.	SAX
Teratogenic	Yes___ No___		
Mutagenic	Yes___ No___		
Aquatic	Yes___ No___		
Other: ______	Yes___ No___		

C. TOXICOLOGICAL HAZARD

	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes___ No___	Flammable in	SAX
Toxic byproduct(s):	Yes___ No___	dust form from	
______		heat or flame,	
______		sparks.	
Flammability	Yes___ No___		
LFL			
UFL			
Explosivity	Yes___ No___		
LEL			
UEL			

OH/WPPHAZO/5

HAZARDOUS SUBSTANCE INFORMATION FORM

COMMON NAME: Vinyl Chloride CHEMICAL NAME: Vinyl Chloride

SYNONYMS Chloroethylene; Vinyl C Monomer; Chloroethene; Monochloroethylene, Ethylene monochlo- Monochloroethene; Trovidur.

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas X Liquid ___ Solid ___ (at ambient temps of 20°C-25°C)			CHRIS DATA SHEETS
Molecular weight	62.50	g/g-mole	"
Density[a]		g/ml	
Specific gravity[a]	0.969 @ -13°C	°F/°C	"
Solubility: water	.60016/100g H₂O @ 68.02°F	°F/°C	"
Solubility[b]: ___	@	°F/°C	
Boiling point	7.2°F = 13.8°C	°F/°C	"
Melting point	-244.8°F = -153.8°C	°F/°C	"
Vapor pressure	2600 mmHg @ 25°	°F/°C	SAX
Vapor density	2.15 @	°F/°C	SAX
Flash point (open cup X ; closed cup ___)	O.C. = -110°F	°F/°C	CHRIS DATA SHEETS
Other: IDLH	Ca		

II. HAZARDOUS CHARACTERISTICS

A. Exposure limits (TLV, PEL, other)

	CONCENTRATION	SOURCE
OSHA PEL:	TWA 1 PPM	SAX
ACGIH TLV:	TWA 5 PPM	"
TRK:	3 PPM	"
15min CeiL:	1 PPM 5 PPM	NIOSH

B. TOXICOLOGICAL HAZARD

	HAZARD?	EFFECTS	SOURCE
Inhalation	Yes ✓ No ___	Lung Irritation Dizziness; Anesthesia;	CHRIS DATA SHEETS
Ingestion	Yes ___ No ___		
Skin/eye absorption	Yes ✓ No ___	Frostbite;	CHRIS DATA SHEETS
Skin/eye contact	Yes ✓ No ___	Irritating to Eyes	"
Carinogenic	Yes ✓ No ___	Human Brain Carcinogen =	SAX
Teratogenic	Yes ___ No ___		
Mutagenic	Yes ___ No ___		
Aquatic	Yes ___ No ___		
Other: ___	Yes ___ No ___		

C. TOXICOLOGICAL HAZARD

	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes ___ No ___		
Toxic byproduct(s):	Yes ___ No ___		
___			
~~Flammability~~	Yes ✓ No ___		CHRIS Data Sheets
LFL		4%	
UFL		26%	
Explosivity	Yes ✓ No ___		NIOSH
LEL		3.6	
UEL		33	

HAZARDOUS SUBSTANCE INFORMATION FORM

COMMON NAME: Xylenes (o-, m-, and p-isomers) CHEMICAL NAME: Xylenes

SYNONYMS p-ortho-Xylene; 1,2-Dimethyl-benzene; meta-Xylene; 1,3-Dimethyl-benzene; para-Xylene; 1,4-Dimethyl-benzene

I. PHYSICAL/CHEMICAL PROPERTIES

SOURCE

Natural physical state: Gas___ Liquid X Solid___ ___
(at ambient temps of 20°C-25°C)

Molecular weight 106.18 g/g-mole SAX

Density^{a} 0.864 @ 20°/4° g/ml SAX

Specific gravity^{a} m-0.864/o-0.880/p-0.861 @ 20°C °F/°C Chris Data Sheet

Solubility: water Insoluble @ ___ °F/°C "

Solubility^{b}: ___ @ ___ °F/°C ___

Boiling point 292/282/281°F °F/°C NIOSH

Melting point -13/-54/55°F °F/°C "

Vapor pressure 6.72 mmHg @ 21° °F/°C SAX

Vapor density ___ @ ___ °F/°C SAX

Flash point ___ °F/°C ___
(open cup X; closed cup X)
m-Xylene = C.C = 84°F
o-Xylene = C.C = 63°F; O.C = 75°F (Chris Data Sheet
p-Xylene = C.C. = 81°F

SAX ⇒ Other: Composition:
As nonaromatics ⇒ 0.07%; Toluene ⇒ 4%; Ethyl Benzene ⇒ 19.27%; P-Xylene ⇒ 7.84%; m-Xylene ⇒ 65.01%; o-Xylene ⇒ 7.63%; C9 + Aromatics = 0.0

II. HAZARDOUS CHARACTERISTICS

A. Exposure limits (TLV, PEL, other) CONCENTRATION SOURCE

OSHA PEL = TWA 100PPM SAX

ACGIH TLV = TWA (All isomers) 100PPM "

DFG MAK = (All isomers) 100PPM (440mg/m3)

10-min Ceil = 200PPM NIOSH

B. TOXICOLOGICAL HAZARD HAZARD? EFFECTS SOURCE

Inhalation Yes ✓ No___ Headache + Dizziness Chris Data Sh

Ingestion Yes ✓ No___ Nausea; Vomiting; Coma "

Skin/eye absorption Yes ✓ No___ Irritation of Eyes. ___

Skin/eye contact Yes ✓ No___ Irritation of Skin ___

Carinogenic Yes___ No___ ___ ___

Teratogenic Yes___ No___ O-Xylene ⇒ 7100mg/l/96hr/D. magna/TLm/Fresh

Mutagenic Yes___ No___ m-Xylene/p-Xylene

Aquatic Yes ✓ No___ 22PPM/22PPM 96HR/Bluegill/TLm/Fresh

Other: IDLH Yes ✓ No___ 1000ppm NIOSH

B.O.D. = m-Xylene = 0%/16, 5 days, 0% (theor.) 8 days; O-Xylene B.O.D = 0%/16 5 days; p-Xylene B.O.D = 0%/16 in 5 days.

C. TOXICOLOGICAL HAZARD HAZARD? CONCENTRATIONS SOURCE

Combustibility Yes___ No___ ___ ___

Toxic byproduct(s): Yes___ No___ ___ ___

Flammability Yes ✓ No___ m-Xylene/o-Xylene/p-Xylene/ Chris Data Sheets

LFL 1.1%/1.1%/1.1%/

UFL 6.4%/7.0%/6.6%/

Explosivity Yes ✓ No___

LEL 1/1.1/1.1% NIOSH

UEL 6/7/7% "

OH/WPPHAZO/5

Hazardous Substance Information Form

COMMON NAME: Xylenes **CHEMICAL NAME:** Mixed Isomers of Xylene

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas___ Liquid X Solid___ (at ambient temps of 20°C-25°C)			GE MSDS
Molecular weight	106.18	g/g-mole	GE MSDS
Density[a]		g/ml	GE MSDS
Specific gravity[a]	.86-.87 @	°F/°C	GE MSDS
Solubility: water	Negligibl @	°F/°C	GE MSDS
Solubility[b]: ____________	@	°F/°C	GE MSDS
Boiling point	135-145	°F/[✓ °C]	GE MSDS
Melting point	-48 - +13	°F/[✓ °C]	GE MSDS
Vapor pressure	6 mmHg @ 20	°F/[✓ °C]	GE MSDS
Vapor density	3.7 @	°F/°C	GE MSDS
Flash point (open cup____; closed cup X)	> 77	[✓ °F]/°C	GE MSDS
Other:			

II. HAZARDOUS CHARACTERISTICS

OSHA TLV, TLV, PEL... 100ppm/10 hr TWA

TLV = 435 mg/m3/8hr TWA

A. TOXICOLOGICAL HAZARD	HAZARD?	EFFECTS	SOURCE NIO SH
Inhalation	[✓ Yes] No	@TLV=Irritation and dizziness >200ppm anesthetic effect	
Ingestion	[✓ Yes] No	Aspiration into lungs if swallowed	
Skin/eye absorption	[✓ Yes] No		
Skin/eye contact	[✓ Yes] No	Irritation and defatting of skin, burns in eyes	
Carcinogenic	[✓ Yes] No	Potential to man	
Teratogenic	Yes No		
Mutagenic	Yes No		
Aquatic	Yes No		
Other: ________	Yes No		

B. TOXICOLOGICAL HAZARD	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes [✓ No]		GE MSDS
Toxic byproduct(s):	[✓ Yes] No		GE MSDS
in heat or fire CO, and			
Oxides of nitrogen			GE MSDS
Flammability	[✓ Yes] No		
LFL		1.0	GE MSDS
UFL		7.0	GE MSDS
Explosivity	[✓ Yes] No		
LEL in heat or flame			GE MSDS
UEL			GE MSDS

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[a] Only one is necessary.

[b] For organic compounds, recovery of spilled material by solvent extraction may require solubility data.

HAZARDOUS SUBSTANCE INFORMATION FORM

COMMON NAME: ZINC CHEMICAL NAME: ZINC (Zn)
SYNONYMS Blue Powder; Pigment BLACK 16; Granular zinc; zinc DUST; Zi
, Bu

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas ____ Liquid ____ Solid ____ (at ambient temps of 20°C-25°C)			
Molecular weight Atomic Weight:	65.37	g/g-mole	SAX
Density[a]		g/ml	
Specific gravity[a]	@	°F/°C	
Solubility: water	@	°F/°C	
Solubility[b]: ____	@	°F/°C	
Boiling point	bp ~ 908°	°F/°C	
Melting point	mp = 419.8°	°F/°C	
Vapor pressure	1mm mmHg @ 487°	°F/°C	
Vapor density	d = 7.14 @ 25°	°F/°C	
Flash point (open cup ____; closed cup ____)		°F/°C	
Other:			

II. HAZARDOUS CHARACTERISTICS

A. Exposure limits (TLV, PEL, other)	CONCENTRATION	SOURCE

B. TOXICOLOGICAL HAZARD	HAZARD?	EFFECTS	SOURCE
Inhalation	Yes___ No___	Pure zinc powder, dust fume is relatively non-toxic to humans by inhalation.	SAX
Ingestion	Yes___ No___		
Skin/eye absorption	Yes ✓ No___	Human Skin Irritant and Pulmonary Effects.	SAX
Skin/eye contact	Yes___ No___		
Carinogenic	Yes___ No___		
Teratogenic	Yes___ No___	Zinc is not inherently	
Mutagenic	Yes___ No___		
Aquatic	Yes___ No___		
Other: ____	Yes___ No___		

C. TOXICOLOGICAL HAZARD	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes___ No___	Explosion in the form of dust when reacted with acids.	SAX
Toxic byproduct(s): ____	Yes___ No___		
Flammability LFL UFL	Yes___ No___	Flammable in the form of dust when exposed to heat or flame.	
Explosivity LEL UEL	Yes___ No___		

3.0 APPENDIX A

- Sampling and Analysis/Work Plan Subtask 2A
  Study Area Survey
- Sampling and Analysis/Work Plan Subtask 2C
  Geophysical Investigation
- Sampling and Analysis/Work Plan Subtask 2D
  Air Sampling
- Sampling and Analysis/Work Plan Subtask 2E
  Surface Water and Sediment Sampling
- Sampling and Analysis/Work Plan Subtask 2F
  Monitoring Well Installation Program
- Sampling and Analysis/Work Plan Subtask 2G
  Groundwater Sampling
- Sampling and Analysis/Work Plan Subtask 2H
  Soils and Subsurface Investigation
- Sampling and Analysis/Work Plan Subtask 2I
  Treatability Studies