INSTALLATION RESTORATION PROGRAM ENGINEERING EVALUATION/ COST ANALYSIS FIELD INVESTIGATION WORK PLAN FOR IRP SITES NO.7 AND NO.8

120th FIGHTER WING
MONTANA AIR NATIONAL GUARD
GREAT FALLS INTERNATIONAL AIRPORT
GREAT FALLS, MONTANA

SEPTEMBER 1997

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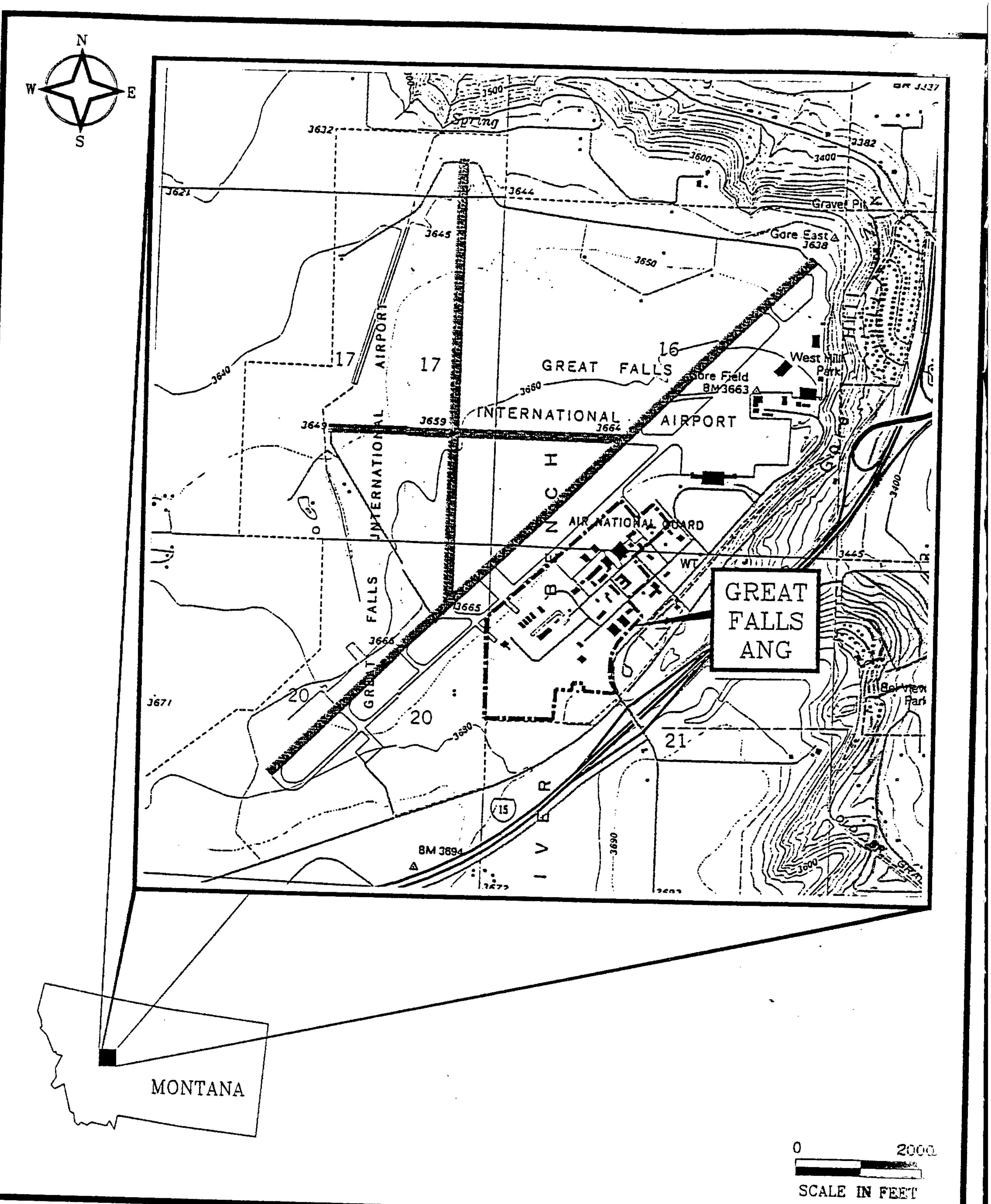

INSIDE FRONT COVER

GF-EECA\TOPO

INSTALLATION LOCATION MAP

120th FW, Montana Air National Guard
Great Falls, Montana

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SEPTEMBER 1997

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 074-0188

1. AGENCY USE ONLY (Leave blank)	**2. REPORT DATE** September 1997	**3. REPORT TYPE AND DATES COVERED** FINAL

4. TITLE AND SUBTITLE

Installation Restoration Program, Engineering Evaluation/Cost Analysis
Field Investigation Work Plan – IRP Sites No.7 and No.8
Montana Air National Guard, Great Falls, Montana

5. FUNDING NUMBERS

6. AUTHOR(S)

Operational Technologies, Inc.

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

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8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

Air National Guard Readiness Center/CEVR
3500 Fetchet Ave
Andrews AFB, MD 20762

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT

Approved for Public Release, distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT ***(Maximum 200 Words)***

A field Investigation will be conducted at IRP Sites No. 7 (Dry Well off Corrosion Control Building) and No. 8 (Dry Well off Composite Maintenance Building), Montana Air National Guard, Great Falls International Airport, Great Falls, Montana. The Remedial Investigation (RI), completed in May 1997, recommended that an Engineering Evaluation/Cost Analysis be performed at Sites 7 and 8 to determine the significance of the groundwater contamination, and what remedial measures, if any, should be taken. The field investigation will consist of installing four (4) monitoring wells at each site, collecting and analyzing groundwater from each well, and measuring hydraulic properties of the groundwater. The objectives of this investigation will be to assess the extent of groundwater contamination, to determine the potential risk of the contamination to human health and the environment, and to evaluate removal action alternatives.

14. SUBJECT TERMS Work Plan, Engineering Evaluation/Cost Analysis, Installation Restoration Program	**15. NUMBER OF PAGES** 225 **16. PRICE CODE**

17. SECURITY CLASSIFICATION OF REPORT **Unclassified**	**18. SECURITY CLASSIFICATION OF THIS PAGE** **Unclassified**	**19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified**	**20. LIMITATION OF ABSTRACT** **None**

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. Z39-18

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Prepared For

ANG/CEVR
ANDREWS AFB, MARYLAND

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G309-101

Engineering Evaluation/Cost Analysis
Field Investigation Work Plan
For IRP Sites No. 7 and No. 8
120th FW, Montana ANG, Great Falls, Montana

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LIST OF ACRONYMS

AAS	Atomic Absorption Spectrophotometer
AFB	Air Force Base
ANG	Air National Guard
ANG/CEVR	Air National Guard Readiness Center/Installation Restoration Program Branch
AOCs	Area of Concerns
ARARs	Applicable or Relevant and Appropriate Requirements
ASTM	American Society for Testing and Materials
AWQC	Ambient Water Quality Criteria
BLS	Below Land Surface
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
C	Celsius
° C	Degrees Centigrade
CAA	Clean Air Act
CECRA	Comprehensive Evnironmental Cleanup & Responsibility Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability
CEQP	Corporate Environmental Quality Assurance/Quality Control Plan
CFR	Code of Federal Regulations
CGI	Combustible Gas Indicator
cm/sec	centimeters per second
CWA	Clean Water Act
DD	Decision Document
DERP	Defense Environmental Restoration Program
DoD	Department of Defense
DOT	Department of Transportation
EE/CA	Engineering Evaluation/Cost Analysis
° F	Degrees Fahrenheit
FFS	Focused Feasibility Study
FG	Fighter Group
FOD	Foreign Object Disposal
FS	Feasibility Study
ft/min	feet per minute
FTA	Fire-Training Area
FW	Fighter Wing
GC	Gas Chromatography
gpm	Gallons per minute
GPR	Ground Penetrating Radar
HASP	Health and Safety Plan
HAZWRAP	Hazardous Waste Remedial Actions Program
HMTC	Hazardous Materials Technical Center
ICP	Inductively Coupled Plasma

LIST OF ACRONYMS (Continued)

IDL	Instrument detection limit
IDW	Investigation Derived Waste
IRA	Interim Remedial Action
IRP	Installation Restoration Program
JP	Jet propellant
LEL	Lower Explosive Limit
MANG	Montana Air National Guard
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goals
MDEQ	Montana Department of Environmental Quality
MDHES	Montana Department of Health and Environmental Sciences
MDL	Method detection limit
mg/kg	milligram per kilogram
mg/L	milligram per liter
mmhos	millimhos
MW	Monitoring Well
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NCR	Nonconformance Report
NGB	National Guard Bureau
NIOSH	National Institute for Occupational Safety and Health
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
OpTech	Operational Technologies Corporation
OSHA	Occupational Safety and Health Administration
PA	Preliminary Assessment
PAHs	Polynuclear Aromatic Hydrocarbons
PC	Percent completeness
PID	Photoionization Detector
PM	Project Manager
PM_{10}	Particulate Matter
POL	Petroleum, Oil, and Lubricants
PPE	Personal Protective Equipment
PPM	Priority pollutant metals
PR	Percentage recovery
PRE	Preliminary Risk Evaluation
PRG	Preliminary Remediation Goals
PRQL	Project required quantitation limit
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
QAM	Quality Assurance Manager

LIST OF ACRONYMS (Concluded)

QAPP	Quality Assurance Project Plan
QC	Quality Control
RA	Remedial Action
RBC	Risk-based concentrations
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RI	Remedial Investigation
RPD	Relative percent difference
SARA	Superfund Amendments and Reauthorization Act of 1986
SB	Soil Borings
SDWA	Safe Drinking Water Act
SI	Site Investigation (Inspection)
SOW	Scope of Work
SVOCs	Semivolatile Organic Compounds
TPH	Total Petroleum Hydrocarbons
μg/L	microgram per liter
USAF	United States Air Force
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VOA	Volatile organic analysis
VOC	Volatile Organic Compound

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SECTION 1.0 INTRODUCTION

This Work Plan outlines activities for conducting an additional field investigation of Installation Restoration Program (IRP) Site No. 7, Dry Well Off Corrosion Control Building (Building 23), and IRP Site No. 8, Dry Well Off Composite Maintenance Building (Building 32), at 120th Fighter Wing (FW), Montana Air National Guard (MANG) (hereafter referred to as the Base), Great Falls International Airport, Great Falls, Montana (Figure 1.1 and Figure 1.2).

Operational Technologies Corporation (OpTech) is contracted by the Air National Guard Readiness Center Installation Restoration Program Branch (ANG/CEVR) to conduct field investigations for the Engineering Evaluation/Cost Analysis (EE/CA) for IRP Sites No. 7 and No. 8. The EE/CA is conducted under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986.

The Defense Environmental Restoration Program (DERP) was established in 1984 to promote and coordinate efforts for the valuation and cleanup of contamination at Department of Defense (DoD) installations. On 23 January 1987, Presidential Executive Order 12580 was issued which assigned the responsibility of the Secretary of Defense for carrying out DERP within the overall framework of SARA and CERCLA. The IRP was established under DERP to identify, investigate, and clean up contamination at installations. The IRP is focused on cleanup of contamination associated with past DoD activities to ensure that threats to public health are eliminated and to restore natural resources for future use. The ANG/CEVR manages the IRP and related activities.

1.1 PROJECT OBJECTIVES AND SCOPE

1.1.1 Field Investigation Objectives and Scope

The purpose of this Work Plan is to describe the field investigation to be conducted at IRP Sites No. 7 and No. 8. The field investigation at IRP Sites No. 7 and No. 8 will consist of field activities designed to adequately characterize the nature and extent of contamination to support the specific objectives of a non-time-critical removal action (i.e., where the release poses no immediate threat to public health, welfare, or the environment), supplementing existing data. Information gathered during the field investigation, and existing data from

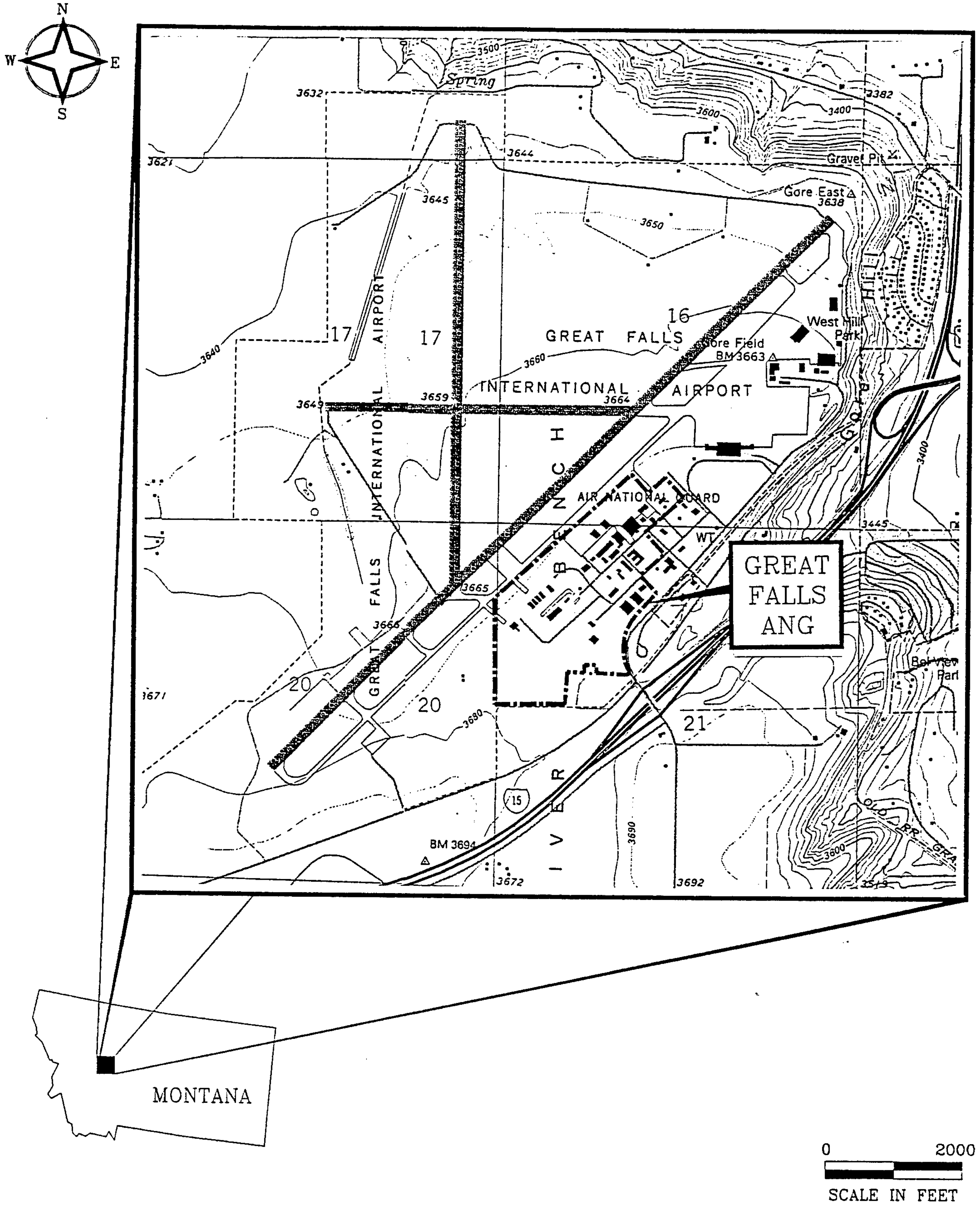

FIGURE 1.1

GF-EECA\TOPO

INSTALLATION LOCATION MAP
120th FW, Montana Air National Guard
Great Falls, Montana

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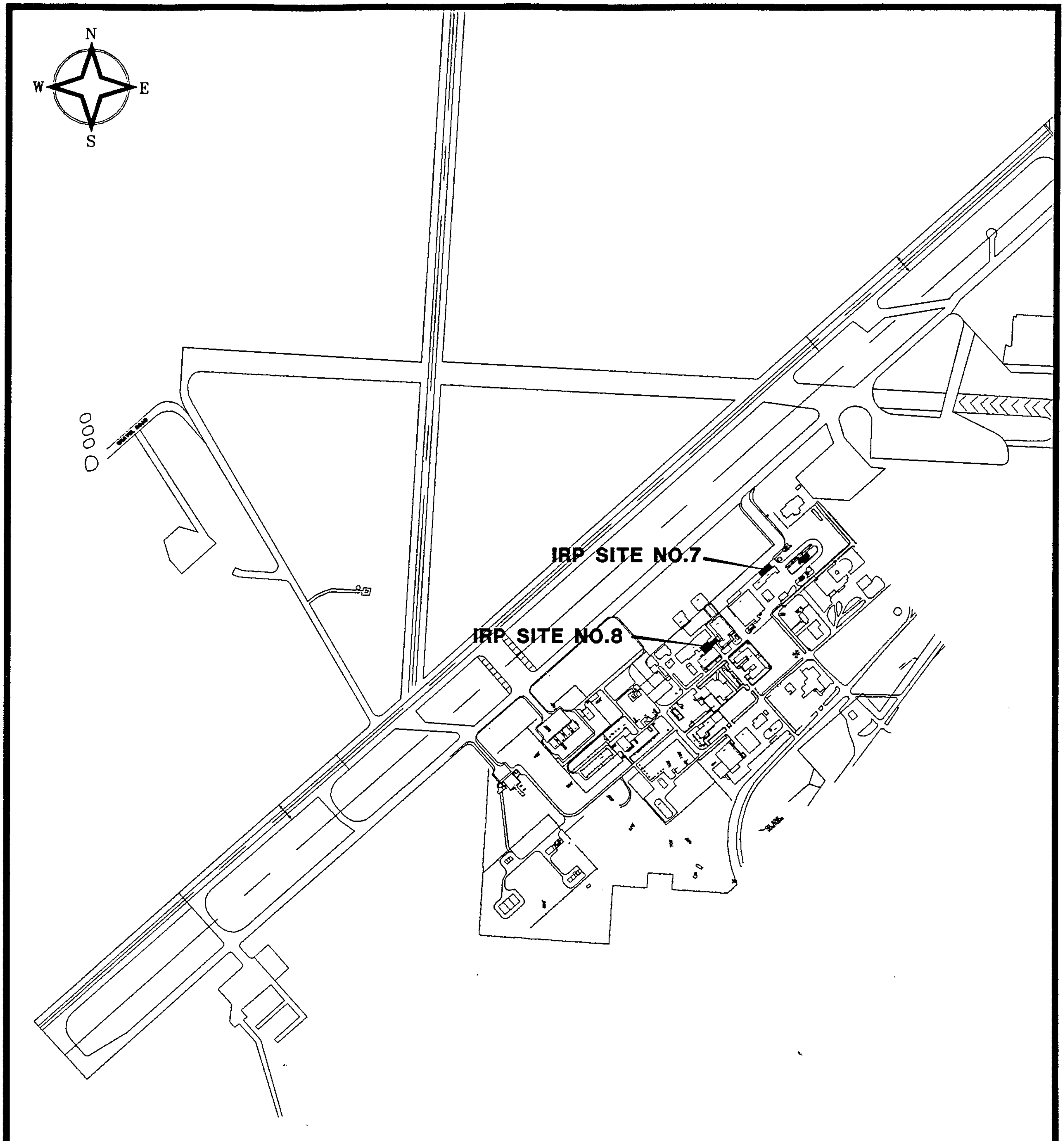

LEGEND

▨ IRP SITE

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SOURCE: MODIFIED FROM 120th FG. CIVIL ENGINEERING AND ENGINEERING SCIENCE, 1992.

FIGURE 1.2

GF-EECA\SITE_7-8

IRP SITE LOCATIONS MAP
120th FW, Montana Air National Guard
Great Falls, Montana

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previous investigations, will be used to support a risk-based decision within the EE/CA. The overall objective of this field investigation is to obtain sufficient, accurate, and representative data to support a risk-based decision for IRP Sites No. 7 and No. 8.

This field investigation will meet these objectives by:

- Installing four, 4-inch-diameter, flush-mounted, bedrock monitoring wells at IRP Site No. 7. These monitoring wells will be constructed to permit use as product extraction wells;
- Installing four, 4-inch-diameter, flush-mounted, bedrock monitoring wells at IRP Site No. 8.
- Collecting drill cuttings from every 5-foot interval for lithologic description for the newly installed monitoring wells;
- Collecting two rounds of groundwater from all existing and newly installed monitoring wells for chemical analyses;
- Collecting a water sample from one newly installed monitoring well at each site for laboratory analysis of remedial design parameters;
- Collecting three rounds of water-level measurements from all existing monitoring wells and two rounds of water-level measurements from all newly installed monitoring wells for interpretation of the direction of groundwater movement at IRP Sites No. 7 and No. 8;
- Perform falling and rising head slug tests on two of the new monitoring wells at each IRP Site No. 7 and No. 8 to determine hydraulic conductivity;
- Conducting a product thickness test at IRP Site 7-MW-1 and newly installed wells, if free product is present;
- Re-completion of surface well completions at existing monitoring wells: 6-MW-1, 7-MW-1, BG-1, and 8-MW-1;
- Land-farming of soil cuttings stored at the Base and any additional cuttings collected

during this investigation;

- Surveying the locations of all new monitoring wells at IRP Sites No. 7 and No. 8 to define their locations and elevations for future reference. All new well installations will be referenced both horizontally and vertically; and

- Assessing contaminant receptors or potential exposure risks presented by the sites.

Optional field work will be conducted at IRP Sites No. 7 and No. 8 upon receiving an official notice to proceed from the National Guard Bureau (NGB) contracting officer. The scope of the optional field work is as follows:

- Installing four additional monitoring wells, if required, at IRP Sites No. 7 and No. 8, and collecting two rounds of water-level measurements and groundwater samples;

- Conducting a pilot test (a total of four monitoring wells) for a vacuum-enhanced pump and treat system at IRP Sites No. 7 and No. 8;

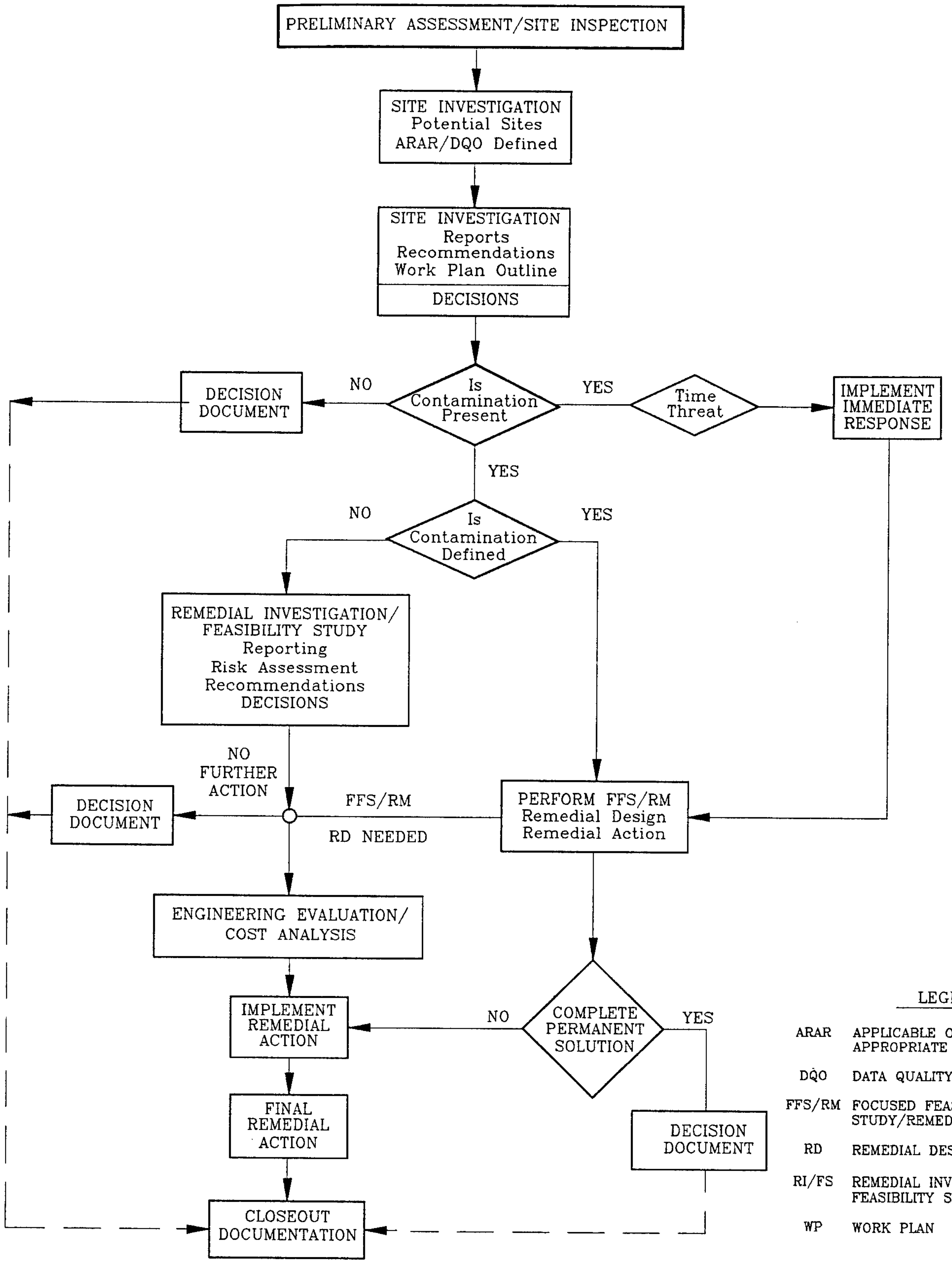
- Conducting bedrock coring at two locations to collect undisturbed and continuous cores fracture orientation at IRP Sites No. 7 and No. 8; and

- Conducting down-hole video camera examination at up to four of the newly installed wells to identify fractures at IRP Sites No. 7 and No. 8.

1.2 INSTALLATION RESTORATION PROGRAM DESCRIPTION

A brief description of the IRP program is presented in order to understand the context in which some of the previous work was done (Figure 1.3). The six phases of the current IRP program are:

> Preliminary Assessment - The purpose of the Preliminary Assessment (PA) is to identify Area of Concerns (AOCs) that may pose a hazard to public health or the environment as a result of past spills or disposal practices at the Base, or that may have an adverse effect by the persistence of contaminants in the environment.



LEGEND

ARAR	APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
DQO	DATA QUALITY OBJECTIVES
FFS/RM	FOCUSED FEASIBILITY STUDY/REMEDIAL MEASURE
RD	REMEDIAL DESIGN
RI/FS	REMEDIAL INVESTIGATION/ FEASIBILITY STUDY
WP	WORK PLAN

SOURCE: HAZWRAP, 1997.

NOT TO SCALE

FIGURE 1.3

GR-EECA\FLOWCHRT

INSTALLATION RESTORATION PROGRAM FLOW CHART
120th FW, Montana Air National Guard
Great Falls, Montana

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Site Investigation - A Site Investigation (SI) (Inspection) is conducted to confirm the presence or absence of environmental contamination and to assess the risks to potential receptors, either human or environmental.

Remedial Investigation - A Remedial Investigation (RI) is performed for each site requiring continuing investigation to quantify and qualify prior findings, and to provide a basis for the Feasibility Study (FS). The RI will include a Work Plan, field investigation, risk assessment, and a Final Report. An RI is often an iterative process; further investigation may be required to adequately support a choice of action alternatives or provide sufficient information for an FS.

Feasibility Study - The Feasibility Study (FS) is performed to choose the most advantageous remediation method from among practical alternatives. Selection of remediation methods is based on engineering feasibility, protectiveness of public health and the environment, regulatory requirements, and cost. The FS includes development of alternative remediation techniques, screening of these alternatives, a detailed analysis of plausible alternatives, an environmental assessment of these alternatives, selection of the preferred alternative, and preparation of a report documenting these selections and the selection rationale. In addition, a record of decision is prepared that records the recommended action required.

Engineering Evaluation/Cost Analysis - An EE/CA can be performed in lieu of an RI and FS to analyze removal action alternatives for a site. The removal action alternatives are analyzed for effectiveness, implementability, and cost. The EE/CA process provides a vehicle for public involvement and evaluates and recommends the appropriate response.

Remedial Design - If remediation is required, Remedial Design (RD) will be initiated. The RD consists of plans and specifications to implement the selected (RA).

Removal Action - A Removal Action is a form of interim remedial action (IRA) taken when the contamination at a site meets specific criteria. As lead agent, the ANG can determine an IRA is appropriate at any time.

Remedial Action - RA is the final cleanup phase of the IRP program and will be implemented as specified in the RD.

1.3 GENERAL INVESTIGATION APPROACH

This Work Plan provides a description of the activities proposed to quantify the horizontal and vertical magnitude and extent of contamination at IRP Sites No. 7 and No. 8, as well as the possible migration of any of the contaminants from the sites.

The field investigation at IRP Site No. 7 will involve installation of monitoring wells, collection and analyses of two rounds of groundwater samples from the newly installed and existing monitoring wells (including limited remedial design parameters), collection of drill cuttings at 5-foot intervals for lithologic description, aquifer testing, conducting a product thickness test (if free product is present), and surveying.

The field investigation at IRP Site No. 8 will include the installation of monitoring wells, collection and analysis of two rounds of groundwater samples from newly installed wells and the existing monitoring wells, collection of drill cuttings at 5-foot intervals for lithologic description, aquifer testing, and surveying.

In addition, a risk evaluation will be performed to address possible risk to human health and the environment and to support informed decisions on removal technologies (if required) which may be proposed for any of the two sites.

The report generated as a result of this field investigation will contain data to support future EE/CA activities.

1.4 WORK PLAN STRUCTURE

1.4.1 Work Plan Outline

The Work Plan provides a description of the activities for the investigation and is organized into eighteen sections and two appendices.

Section 1.0	**Introduction**, defines the purpose and scope of the investigation.
Section 2.0	**Project Management Approach**, provides a description of the project management plan for the execution of this project.

Section 3.0	**Facility Background Information**, provides background information on the environmental setting of the Base, and the IRP sites which are the subjects of this inspection.
Section 4.0	**Environmental Setting**, provides information on physical characteristics that apply to the Base and the IRP sites that are the subjects of the Work Plan.
Section 5.0	**Permit Requirements**, provide information on applicable permit requirements for investigation in this Work Plan.
Section 6.0	**Investigative Approach**, describes the overall approach and the specific inspection activities for the IRP sites.
Section 7.0	**Field Investigative Procedures**, describe in detail the procedures used for each applicable investigative method for each site.
Section 8.0	**Sample and Data Collection Procedures**, describes specific protocols to be implemented in retrieving, handling, and storing environmental samples, as well as the methodology for obtaining other site inspection data.
Section 9.0	**Applicable or Relevant and Appropriate Requirements (ARARs)**, provide a brief description of ARARs.
Section 10.0	**Contaminant Fate and Transport**, discusses data requirements and objectives associated with determining contaminant fate and transport.
Section 11.0	**Risk Evaluation**, discusses risk evaluation procedures.
Section 12.0	**Engineering Evaluation/Cost Analysis (EE/CA)**, discusses the EE/CA process.
Section 13.0	**Equipment Decontamination Procedures**, describes the procedures for cleaning sampling equipment.

Section 14.0 **Investigation Derived Waste Handling Procedures**, addresses the handling, storing, classifying, and disposal and/or treatment of wastes produces during the investigation.

Section 15.0 **Project Schedules and Deliverables**, presents the project time frame for accomplishing the required investigation.

Section 16.0 **Site-Specific Action Memorandum**, presents the site-specific Action Memorandum.

Section 17.0 **EE/CA Report**, presents the structure of the EE/CA Report with an annotated outline.

Section 18.0 **References**, provides a listing of references used in preparation of the investigative Work Plan.

Appendix A Presents the Health and Safety Plan (HASP) which was developed for operations at the Base.

Appendix B Presents the Quality Assurance Project Plan (QAPP) which displays the overall policies, data quality objectives, specific quality assurance and quality control requirements, procedures, responsibilities, chain-of-custody, and documentation that will be employed.

SECTION 2.0 PROJECT MANAGEMENT APPROACH

The successful execution of this project requires a strong, qualified project team. Accordingly, OpTech will establish an experienced team of professionals who have prior field investigation experience.

2.1 PROJECT MANAGEMENT ORGANIZATION

The project will be managed and executed by personnel selected by OpTech who will ensure that the objectives of the field investigation are met. Drilling and well installation, analytical services, and surveying support will be provided by firms experienced in performing their specific assigned tasks, and which possess the required permits, licenses, and accreditations necessary to work in Montana. The organization and responsibilities of OpTech personnel who are considered key project personnel are shown in Figure 2.1 and described below:

The project team will include the following key professionals:

> The Program Manager will be responsible for the overall execution of this project and for maintaining an open line of communication with the ANG/CEVR Project Manager.
>
> The Project Manager will directly supervise the project team and will serve as the point of contact with the ANG/CEVR Project Manager, provide technical direction and technical interface with the ANG/CEVR, direct field operations, and coordinate contractor and subcontractor support.
>
> The Site Manager will directly supervise the field investigation project team and provide technical direction and technical interface with the Project Manager.
>
> The Manager of Quality Assurance/Quality Control (QA/QC) will be responsible for developing standardized quality assurance procedures for this project, and for ensuring the effective procedures and control are implemented to achieve a high level of project accuracy.

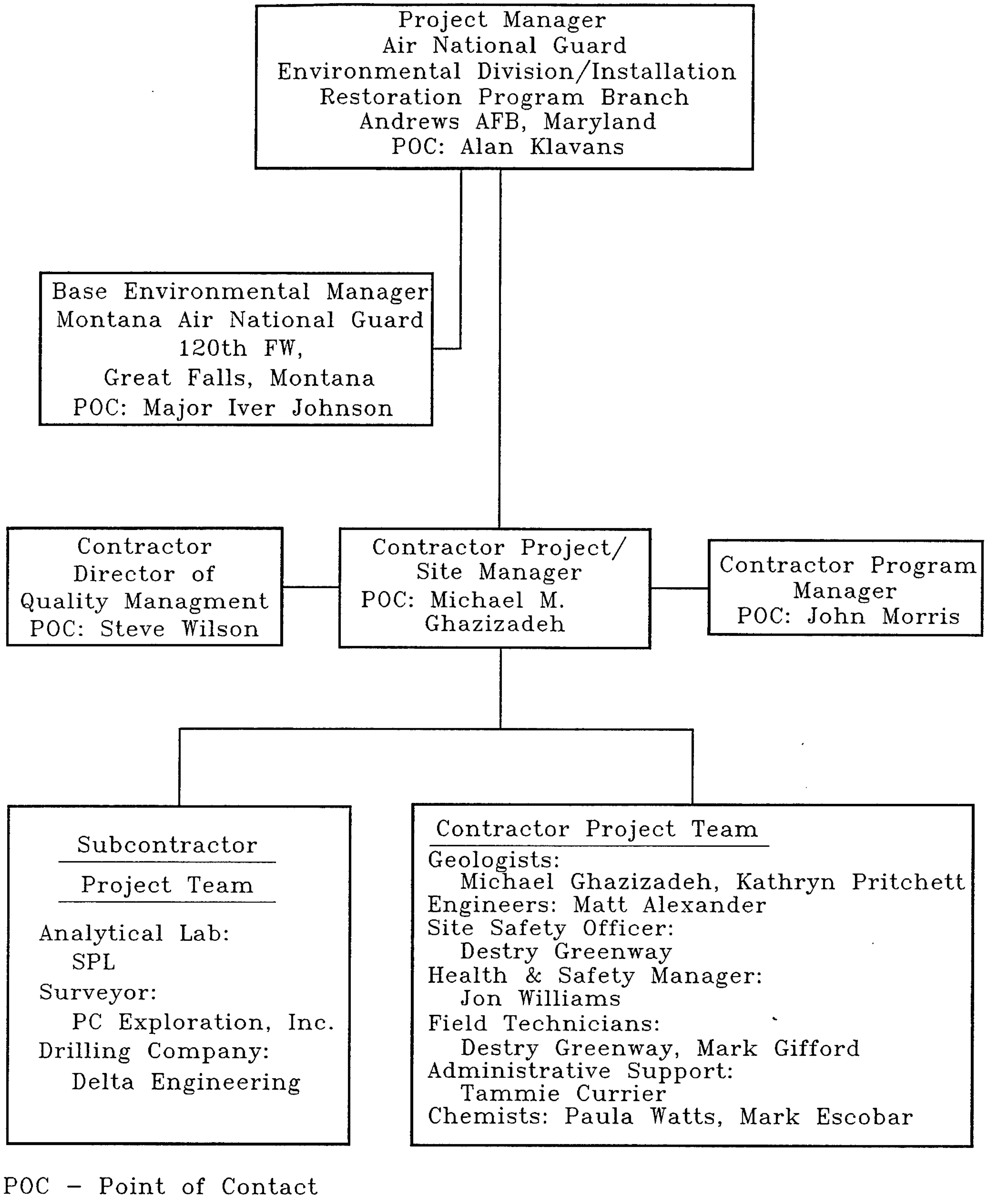

FIGURE 2.1

GR-EECA\PMO

PROJECT MANAGEMENT ORGANIZATION
120th FW, Montana Air National Guard
Great Falls, Montana

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The Health and Safety Manager will be responsible for assuring that physical and chemical hazards will be appropriately mitigated through effective execution of the HASP.

Project Personnel will include qualified geologists, engineers, and other specialties required to conduct the field investigation.

2.2 PROJECT PROCEDURES

An open line of communication will be maintained between the Project Manager and the project team to ensure that all project objectives are met. Samples will be properly collected and identified with verifiable sample custody as an integral part of the field work. All sampling activities will be carried out in accordance with the QAPP. The overall field investigation will be executed within the time frame of the project schedule. All information pertinent to field observations and sampling will be indelibly recorded in bound field notebooks on a daily basis. A copy of each daily log entry from field personnel will be placed in the project file. The field notebooks will, at a minimum, contain the following information for this investigation:

- Date, time, and type of activity;
- Names and affiliations of persons on-site;
- Weather conditions;
- Sampling and preservation procedures;
- Sampling locations, depth, and conditions;
- Time of sampling and sample description;
- Remarks; and
- Signature of author.

2.3 QUALITY MANAGEMENT

The QA/QC Manager will be responsible for ensuring that all quality control (QC) procedures are followed. Immediate corrective action will be taken at any time they are deemed necessary. All quality control procedures will be directed in accordance with the QAPP.

2.4 SUBCONTRACT MANAGEMENT

OpTech is responsible for the cost, schedule, and quality of all work performed under this contract delivery order, including the work of subcontractors. OpTech may elect to hire subcontractors for the drilling, analytical services, and surveying support. These subcontractors will support OpTech's efforts at the Base and will be selected through a fair procurement and competitive process. OpTech's Project Manager will maintain oversight of the subcontractor completion of specified tasks with respect to technical performance, quality, and adherence to cost and schedule. All subcontractor activity will be in compliance with the QAPP and the HASP prepared for the field investigation.

SECTION 3.0 FACILITY BACKGROUND INFORMATION

3.1 FACILITY DESCRIPTION

The Base is located at the Great Falls International Airport in Great Falls, Montana. The International Airport is located in Cascade County, and is approximately three miles southwest of the City of Great Falls, which is located in central Montana (Figure 1.1). The Base occupies approximately 125 acres of land leased from the airport authority on the southeast corner of the 1,762-acre airport, and consists of over fifty buildings. In addition, the Base has planned to lease approximately 107 additional acres on the north side of the Base for proposed missile maintenance and storage facilities (Hazardous Materials Technical Center (HMTC), 1988).

The Base is bordered on the west by agricultural land, and on the north and northwest by residential areas. The area south of the Base is designated industrial and commercial, and an open area southwest of the Base is used for active outdoor recreation.

The 120th FW's mission is to serve the United States Air Force (USAF) and the DoD with a defense fighter wing that can be mobilized in time of war or national emergency. In addition, the 120th FW ensures air sovereignty in its assigned air defense sectors, and provides aircraft to intercept airborne objects posing a threat to the United States as part of the overall air defense system for the North American continent (Engineering-Science, 1992). The major support operations performed at the Base that use and dispose of hazardous wastes/hazardous material include aircraft maintenance, ground maintenance, petroleum, oil, and lubricant (POL) management, and facilities maintenance. These activities generate varying quantities of waste oils, recovered fuels, spent cleaners, solvents, and acids.

The Base was first used as a military installation, called Gore Field, before World War II when it headquartered the Army Air Corps 7th Ferry Group. The 7th Ferry Group airlifted equipment and supplies to the Soviet Union. The USAF and the ANG were formed after the end of World War II.

The present 120th FW began in 1947 as the 186th Fighter Squadron, and was equipped with the P-51 "Mustang" aircraft, later designated the F-51. The 186th was mobilized for the Korean conflict with the F-51 in 1951, reformed at the Great Falls International Airport in 1952, and became the first ANG unit in the U.S. to be assigned the F-86A aircraft in 1953.

The installation was expanded in 1954, with the construction of six new buildings. The unit converted to the F-89C aircraft in 1955.

In 1956, the 186th Fighter Squadron was redesignated by the USAF as the 120th Fighter Group (FG). The aircraft were updated to the F-89H in 1959, and again in 1960 to the F89-J, which required the runway to be extended. From 1966 to 1972, the Base utilized the F-120A aircraft, at which time it converted to the F-106A aircraft in 1972.

The 120th FW's mission was expanded in 1984 when it was assigned the additional task of operating an Alert Detachment at Davis-Monthan Air Force Base (AFB) in Tucson, Arizona. Since 1987, the unit has flown the F-16 "Fighting Falcon".

3.2 IRP SITE DESCRIPTION

3.2.1 IRP Site No. 7 - Dry Well Off Corrosion Control Building Area (Building 23)

IRP Site No. 7 is located on the southern side of the airport facility, within the eastern portion of the Base (Figure 1.2). The site is flat, mostly paved, with a raised lawn area located on the north-northwest side of Building 23. A dry well, for which construction details are not known, has been identified as requiring additional investigation. This well, located within 10 feet of the northwest wall of Building 23, is currently covered by the raised lawn area. Base personnel have indicated that the dry well may have been removed, and a ground-penetrating radar (GPR) survey at the area indicates an area of subsurface soil disturbance at the presumed location. A second dry well, suspected of being located off the east corner of Building 23, cannot be verified as having ever been installed.

The dry well northwest of Building 23 at IRP Site No. 7 was used from 1955 until 1964 for disposal of hazardous wastes. Approximately 9,400 gallons of motor pool waste oils and fuels were disposed of, via an underground pipe, to the dry well.

3.2.2 IRP Site No. 8 - Dry Well Off Composite Maintenance Building Area (Building 32)

IRP Site No. 8 is located on the southern side of the airport facility, within the eastern portion of the Base (Figure 1.2). The site, located between Buildings 30 and 32, is flat and paved. A dry well is located approximately midway between the two buildings, but is currently paved over with asphalt. The dry well at IRP Site No. 8 was used from 1971 until 1977 for disposal of small amounts of waste engine oil, hydraulic fluids, paint stripper and thinners, jet propellant fuel (JP-4), and PD-680.

3.3 PREVIOUS INVESTIGATIONS

In August 1988, under the ANG-directed IRP, a PA of the Base was conducted by Dynamac Corporation under a HMTC contract. The results of the PA are summarized in the Preliminary Assessment (HMTC, 1988). The PA consisted of an on-site visit which included interviews with past and present Base employees, the acquisition and analysis of pertinent information and records on the Base's hazardous materials use, generation, and disposal practices, and the analysis of available geologic, hydrologic, meteorologic, and environmental data from Federal, State, and local agencies.

As a result, investigators identified eight AOCs (IRP Sites No. 1 through 8) on the Base that were potentially contaminated with hazardous material/hazardous wastes and exhibited the potential for contaminant migration to surface water and groundwater (HMTC, 1988).

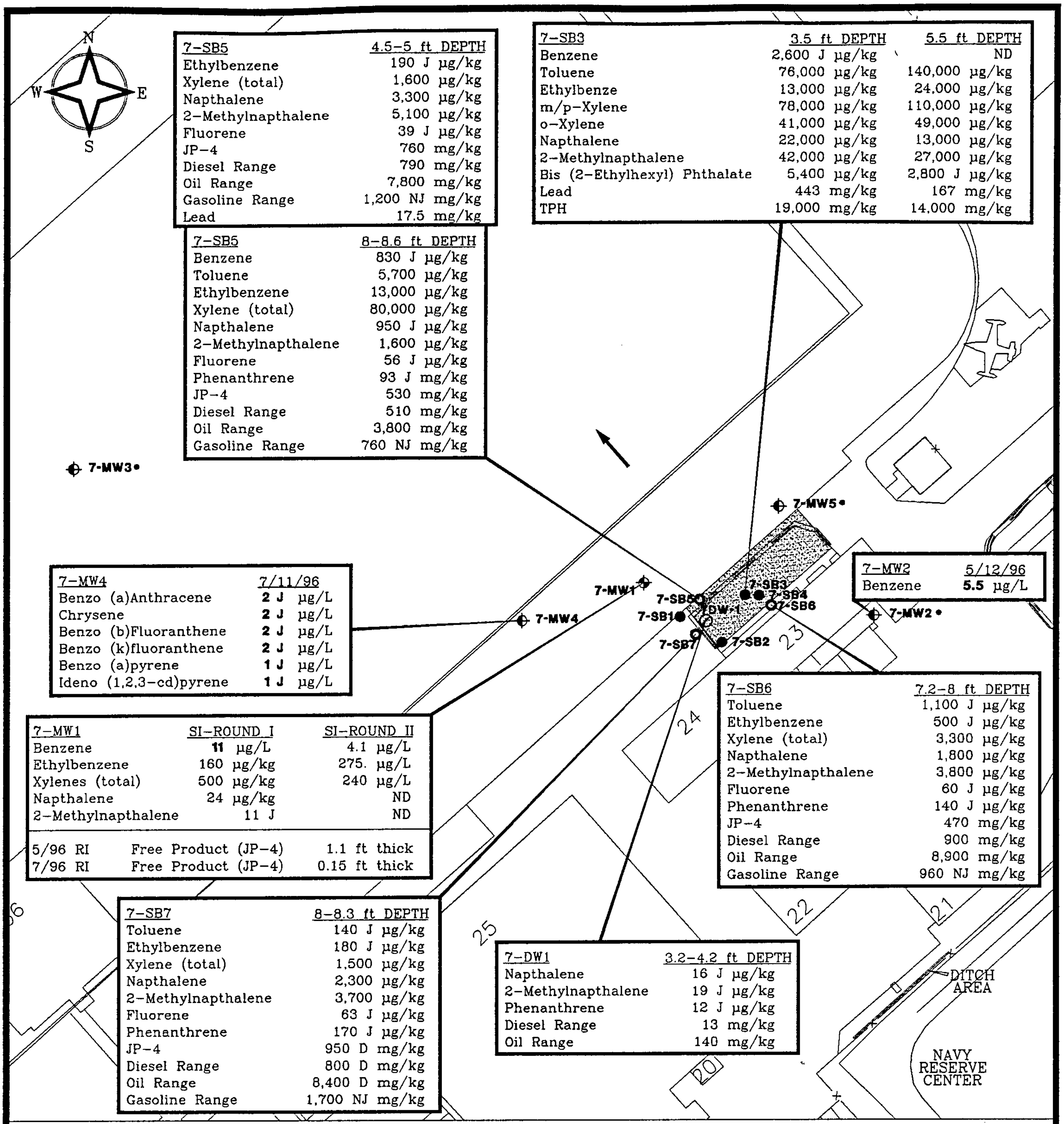
In October 1989, an SI of the eight AOCs identified in the PA as requiring further investigation was implemented by Engineering-Science under a contract with Hazardous Waste Remedial Actions Program (HAZWRAP) Support Contracting Office, and operated by Martin Marietta Energy Systems, Inc. The results of the SI are summarized in the Site Investigation Report - Volume I (Engineering-Science, 1992). The SI Report recommended the preparation of a no further action decision document for four of the eight sites (IRP Sites Nos. 2, 3, 4, and 5). A Focused Feasibility Study (FFS) was recommended for the soils at IRP Site No. 1 since elevated concentrations of total petroleum hydrocarbons (TPH) in the soil, for which no risk evaluation criteria exists, were deemed a potential ecological threat and a possible threat of contamination to the groundwater. An RI was recommended for the soils and groundwater at IRP Sites No. 6, No. 7, and No. 8 due to contamination exceeding the risk evaluation criteria for various analytes (Engineering-Science, 1992).

For IRP Site No. 1, a Source Removal Action Plan for soils and an Action Memorandum were submitted to the Montana Department of Environmental Quality (MDEQ) in February and July 1992, respectively. The Removal Action Plan, using aboveground bioremediation of contaminated soil at IRP Site No. 1 (Current Fire Training Area), was implemented from April through October 1994. In February 1995, the Removal Action Plan Summary Report (AGI, 1995) was issued; in May 30, 1995, in a letter entitled "Closure of Site No. 1, the Current Fire Training Area at the Great Falls International Airport," the MDEQ determined that no further action was required to close IRP Site No. 1, noting that the site met all MDEQ criteria for existing and proposed site uses and that the site posed no significant risk to public health, safety, or welfare (Montana Department of Health and Environmental Sciences (MDHES), 1995).

From April through May, 1996, a RI was performed at IRP Sites No. 1 (groundwater investigation only), No. 6, No. 7, and No. 8 by OpTech under a contract with HAZWRAP, a division of Lockheed Martin Energy Systems, Inc., located in Oak Ridge, Tennessee. The results of the RI are summarized in the Remedial Investigation Report - Volume I (HAZWRAP, 1997). Based on field investigation results, the RI report recommended: (1) preparation of a decision document (DD) to support no further action for groundwater at IRP Site No. 1; (2) a no further action DD for groundwater and soils at Site No. 6; (3) a no further action DD for soils at IRP Sites No. 7 and No. 8; and (4) preparation of an EE/CA to evaluate potential remedial measures for groundwater at IRP Sites No. 7 and No. 8 (HAZWRAP, 1997).

3.3.1 IRP Site No. 7 - Dry Well Off Corrosion Control Building Area (Building 23)

An SI was conducted at IRP Site No. 7 in 1990 and 1991 by Engineering-Science, Inc. (Engineering-Science, 1992). The field investigation consisted of the collection of soil samples for chemical analyses from four soil borings, installation of one monitoring well, collection of groundwater samples for chemical analyses, collection of water-level data to determine the direction of groundwater movement, and the use of GPR to determine the location of the dry well. Fuel-related compounds were found in soil samples collected from soil boring 7-SB3 (Figure 3.1). The soil boring location of 7-SB3, 25 feet upgradient and to the east of the dry well, suggests this occurrence may not be related to the dry well itself and may represent an isolated fuel spill (HAZWRAP, 1997). No fuel compounds were found in soil samples collected from soil boring locations 7-SB1 (located downgradient 20 feet from the dry well) and 7-SB4 (located adjacent to 7-SB3) (HAZWRAP, 1997). Fuel-related compounds were also found in the groundwater samples from monitoring well 7-MW1 (Figure 3.1). Only benzene, at a concentration exceeding the applicable or relevant and appropriate requirements (ARARs) of 5 micrograms per liter (µg/L), was found in the groundwater collected during the first sampling round. The metals arsenic, barium, lead, and zinc were found in the groundwater samples at concentrations less than the ARARs.



7-SB5	4.5-5 ft DEPTH
Ethylbenzene	190 J µg/kg
Xylene (total)	1,600 µg/kg
Napthalene	3,300 µg/kg
2-Methylnapthalene	5,100 µg/kg
Fluorene	39 J µg/kg
JP-4	760 mg/kg
Diesel Range	790 mg/kg
Oil Range	7,800 mg/kg
Gasoline Range	1,200 NJ mg/kg
Lead	17.5 mg/kg

7-SB5	8-8.6 ft DEPTH
Benzene	830 J µg/kg
Toluene	5,700 µg/kg
Ethylbenzene	13,000 µg/kg
Xylene (total)	80,000 µg/kg
Napthalene	950 J µg/kg
2-Methylnapthalene	1,600 µg/kg
Fluorene	56 J µg/kg
Phenanthrene	93 J mg/kg
JP-4	530 mg/kg
Diesel Range	510 mg/kg
Oil Range	3,800 mg/kg
Gasoline Range	760 NJ mg/kg

7-SB3	3.5 ft DEPTH	5.5 ft DEPTH
Benzene	2,600 J µg/kg	ND
Toluene	76,000 µg/kg	140,000 µg/kg
Ethylbenze	13,000 µg/kg	24,000 µg/kg
m/p-Xylene	78,000 µg/kg	110,000 µg/kg
o-Xylene	41,000 µg/kg	49,000 µg/kg
Napthalene	22,000 µg/kg	13,000 µg/kg
2-Methylnapthalene	42,000 µg/kg	27,000 µg/kg
Bis (2-Ethylhexyl) Phthalate	5,400 µg/kg	2,800 J µg/kg
Lead	443 mg/kg	167 mg/kg
TPH	19,000 mg/kg	14,000 mg/kg

7-MW2	5/12/96
Benzene	**5.5** µg/L

7-MW4	7/11/96
Benzo (a)Anthracene	**2 J** µg/L
Chrysene	**2 J** µg/L
Benzo (b)Fluoranthene	**2 J** µg/L
Benzo (k)fluoranthene	**2 J** µg/L
Benzo (a)pyrene	**1 J** µg/L
Ideno (1,2,3-cd)pyrene	**1 J** µg/L

7-MW1	SI-ROUND I	SI-ROUND II
Benzene	**11** µg/L	4.1 µg/L
Ethylbenzene	160 µg/kg	275. µg/L
Xylenes (total)	500 µg/kg	240 µg/L
Napthalene	24 µg/kg	ND
2-Methylnapthalene	11 J	ND
5/96 RI	Free Product (JP-4)	1.1 ft thick
7/96 RI	Free Product (JP-4)	0.15 ft thick

7-SB6	7.2-8 ft DEPTH
Toluene	1,100 J µg/kg
Ethylbenzene	500 J µg/kg
Xylene (total)	3,300 µg/kg
Napthalene	1,800 µg/kg
2-Methylnapthalene	3,800 µg/kg
Fluorene	60 J µg/kg
Phenanthrene	140 J µg/kg
JP-4	470 mg/kg
Diesel Range	900 mg/kg
Oil Range	8,900 mg/kg
Gasoline Range	960 NJ mg/kg

7-SB7	8-8.3 ft DEPTH
Toluene	140 J µg/kg
Ethylbenzene	180 J µg/kg
Xylene (total)	1,500 µg/kg
Napthalene	2,300 µg/kg
2-Methylnapthalene	3,700 µg/kg
Fluorene	63 J µg/kg
Phenanthrene	170 J µg/kg
JP-4	950 D mg/kg
Diesel Range	800 D mg/kg
Oil Range	8,400 D mg/kg
Gasoline Range	1,700 NJ mg/kg

7-DW1	3.2-4.2 ft DEPTH
Napthalene	16 J µg/kg
2-Methylnapthalene	19 J µg/kg
Phenanthrene	12 J µg/kg
Diesel Range	13 mg/kg
Oil Range	140 mg/kg

LEGEND

▨ IRP SITE	⊕ SI MONITORING WELL	**11** CONCENTRATION EXCEEDS ARARs	µg/L MICROGRAMS PER LITER
⊘ DRY WELL	⊕ RI MONITORING WELL	• MONITORING WELLS THAT WERE SLUG TESTED DURING THE RI.	mg/kg MILLIGRAMS PER KILOGRAM
○ RI SOIL BORING	● SI SOIL BORING	ND NOT DETECTED	J ESTIMATED VALUE
		← DIRECTION OF GROUNDWATER FLOW	N PRESUMPTIVE EVIDENCE OF COMPOUND

D DILUTED SAMPLE

0 100
SCALE IN FEET

SOURCE: HAZWRAP, 1997.

FIGURE 3.1

GF-EECA\ANALYT-7

IRP SITE NO.7 SI AND RI SAMPLING LOCATIONS AND SUMMARY OF ANALYTICAL RESULTS

120th FW, Montana Air National Guard
Great Falls, Montana

OPTECH
OPERATIONAL TECHNOLOGIES CORPORATION

SEPTEMBER 1997

An RI was conducted in 1996 by HAZWRAP (HAZWRAP, 1997). The field investigation included collection of soil samples for chemical analyses from four soil borings (including a dry well boring), installation of four monitoring wells, collection of groundwater samples for chemical analyses, collection of water-level data to determine the direction of groundwater movement, and conducting slug tests from three newly installed monitoring wells to determine hydraulic conductivities. Fuel-related compounds were found in soil samples collected from soil borings 7-SB5, 7-SB6, and 7-SB7 (Figure 3.1). Concentrations were higher in the samples collected at refusal at the weathered sandstone/bedrock interface (HAZWRAP, 1997). Benzene was found only in the soil sample collected at the 8- to 8.6-foot interval from soil boring 7-SB5 at a concentration of 830 micrograms per kilogram (µg/kg). The soil samples collected from the boring advanced at the location believed to be that of the dry well, 7-DW1, indicated detections of relatively low-level volatile organic compounds (VOCs) (HAZWRAP, 1997). The boring was advanced to auger refusal at a depth of 4.2 feet below land surface (BLS).

Other analytes detected at low levels were trichloroethene, carbon disulfide, chloroform, and 4-methyl-2-pentanone. Petroleum hydrocarbons, detected as JP-4, diesel, oil, and gasoline-range organics, were detected in all soil samples collected during RI field investigations. Maximum concentrations were: JP-4, 950 µg/kg; diesel, 900 µg/kg; oil, 8,900 µg/kg; and gasoline range, 1,700 µg/kg (Figure 3.1). Fuel-related semivolatile organic compounds (SVOCs), naphthalene and 2-methylnaphthalene, were detected in soil samples with maximum concentrations of 3,300 µg/kg and 5,100 µg/kg, respectively (Figure 3.1). Four metals were detected in soil samples collected at IRP Sites No. 7 during the RI field investigation, with maximum concentrations of: arsenic, 11.1 mg/kg; copper, 32.1 mg/kg; lead, 17.5 mg/kg; and zinc, 68.6 mg/kg; all within the range of concentrations found in the Western United States (Shacklette, 1984).

Benzene was detected in the first round of sampling of 7-MW2 during the RI at a level of 5.5 µg/L (benzene has a State and Federal maximum contaminant level (MCL) of 5 µg/L) (Figure 3.1). The following chlorinated compounds were also detected in groundwater samples during the RI field investigation: 1,1-dichloroethene, 1,1-dichloroethane, cis-1,2-dichloroethene, 1,1,1-trichloroethane, carbon tetrachloride, trichloroethene, and tetrachloroethene at concentrations below the Federal and State ARARs.

Six polynuclear aromatic hydrocarbons (PAHs) were detected in the groundwater sample collected from 7-MW4 during the second round of RI sampling at concentrations in excess of both Federal and State ARARs (Figure 3.1). Montana Water Quality Standards (Human

Health Standards) are 0.044 μg/L for all of the above PAHs except benzo[a]pyrene, which is 0.02 μg/L. Low levels of petroleum hydrocarbons were detected in all four monitoring wells during the RI investigation. Prior to the RI field activities, free product (initially 1.32 feet thick) was present in the existing monitoring well 7-MW1. During the SI, groundwater sampling of the well had not identified free product in 7-MW1. A sample of the product was collected, and a gas chromatograph (GC) fingerprint analysis for JP-4-range and JP-8-range fuels was performed. The product thicknesses that were measured in monitoring well 7-MW1 in May 1996 and July 1996 were 1.1 feet and 0.15 foot, respectively. JP-4 in the dissolved phase was present at a maximum concentration of 7.7 mg/L, as were diesel- and gasoline-range organics at maximum concentrations of 1.89 mg/L and 1.4 mg/L, respectively. Eight metals (arsenic, barium, beryllium, chromium, copper, lead, nickel, and zinc) were detected in both dissolved and filtered samples in both rounds of groundwater analyses during RI field investigations. However, none of the inorganic data exceeded Federal or State ARARs.

3.3.2 IRP Site No. 8 - Dry Well Off Composite Maintenance Building Area (Building 32)

An SI was conducted at IRP Site No. 8 in 1990 and 1991 by Engineering-Science, Inc. (Engineering-Science, 1992). The field investigation included collection of soil samples for chemical analyses from five soil borings, installation of one monitoring well, collection of groundwater samples for chemical analyses, collection of water-level data to determine the direction of groundwater movement, conducting GPR to determine the location of the dry well, and conducting a soil vapor survey. The SI reported high concentrations of VOCs during the soil vapor survey. Soil samples collected from the soil borings, drilled close to the former location of the dry well during the SI field investigation, contained levels of fuels and solvent contamination above background. Arsenic, copper, and lead were also found at levels above background. Concentration levels of VOCs, SVOCs, and metals were below applicable PRE values. Trichloroethene and 1,2-dichloroethene were detected in a groundwater sample collected during the SI investigation at concentrations above State and Federal ARARs (Figure 3.2).

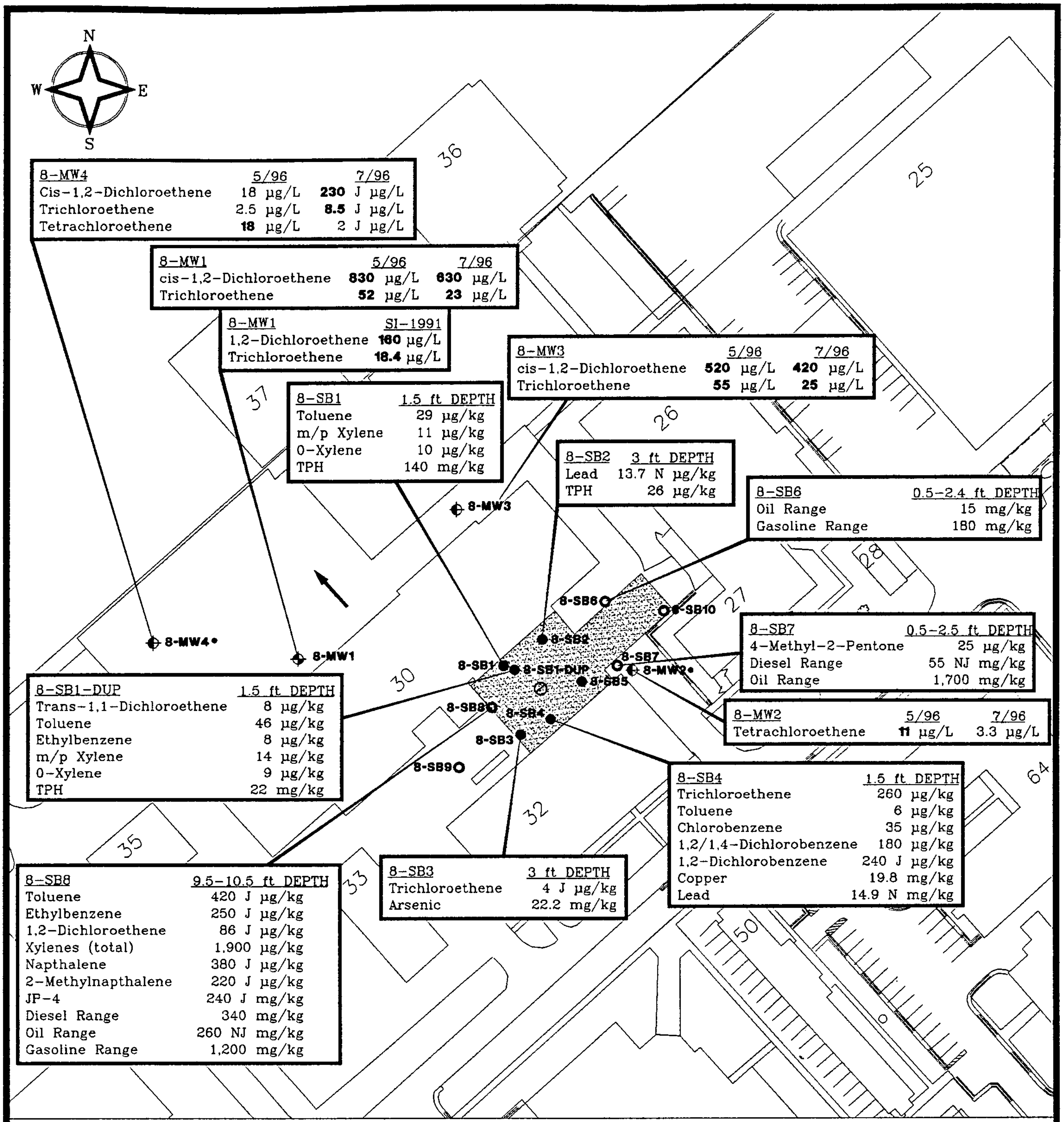
An RI was conducted in 1996 by HAZWRAP (HAZWRAP, 1997). The field investigation included collection of soil samples for chemical analyses from five soil borings, installation of three monitoring wells, collection of groundwater samples for chemical analyses, collection of water-level data to determine the direction of groundwater movement, and conducting slug tests at two monitoring wells. During the RI, low levels of fuel and other VOC compounds were detected in the soil samples collected from the five borings. Only soil boring 8-SB8 had contamination on the same order of magnitude found during the SI (Figure 3.2). The chlorinated compound 1,1,2-trichloroethane was detected in only one boring, 8-SB6, at a maximum qualified concentration of 1 μg/kg; 1,2-dichloroethene was detected only in 8-SB8 with a maximum qualified concentration of 86 μg/kg.

Petroleum hydrocarbons, included diesel-, gasoline-, and oil-range compounds, were found in soil samples collected during the RI investigation in three borings: 8-SB6, 8-SB7, and 8-SB8 at maximum concentrations of 340 mg/kg, 1,200 mg/kg, and 1,700 mg/kg, respectively. Fuel-related SVOCs, naphthalene and 2-methylnaphthalene, were present only in sample 8-SB8 (collected at refusal) at a qualified 380 μg/kg and 220 μg/kg, respectively. Arsenic (up to 22.4 mg/kg), copper (up to 37.4 mg/kg), lead (up to 17.2 kg), and zinc (up to 137 mg/kg) were detected in soil samples at concentrations within the range of those normally found in the Western United States (Shacklette, 1984).

Cis-1,2-dichloroethene, trichoroethene, and tetrachloroethene were found in groundwater samples at concentrations exceeding the State and Federal ARARs (Figure 3.2). SVOCs and petroleum hydrocarbons were not found above regulatory limits in any groundwater samples collected during the RI investigation. Mercury and antimony were detected in groundwater samples during the RI field investigation. Mercury, detected at a level of 0.46 μg/L in a dissolved sample, was above the MDEQ ARARs of 0.14 μg/L and antimony, detected at an estimated 6 μg/L, was equal to both the Federal and State ARARs of 6 μg/L.

3.3.3 Other Previous Investigation Activities

Water-level data were collected Base-wide during the SI and RI investigations. The potentiometric maps interpreted from the water-level data are presented in Figures 3.3 through 3.6. The general direction of the groundwater movement (Base-wide) is towards the northwest. Based on the slug test analyses performed during the RI, the average hydraulic conductivities at IRP Sites No. 7 and No. 8 are 2.44×10^{-2} feet per minute (ft/min) (1.24×10^{-2} centimeters per second (cm/sec)) and 9.86×10^{-3} ft/min (5.01×10^{-3} cm/sec), respectively.



8-MW4	5/96	7/96
Cis-1,2-Dichloroethene	18 µg/L	**230** J µg/L
Trichloroethene	2.5 µg/L	**8.5** J µg/L
Tetrachloroethene	**18** µg/L	2 J µg/L

8-MW1	5/96	7/96
cis-1,2-Dichloroethene	**830** µg/L	**630** µg/L
Trichloroethene	**52** µg/L	**23** µg/L

8-MW1	SI-1991
1,2-Dichloroethene	**160** µg/L
Trichloroethene	**18.4** µg/L

8-MW3	5/96	7/96
cis-1,2-Dichloroethene	**520** µg/L	**420** µg/L
Trichloroethene	**55** µg/L	**25** µg/L

8-SB1	1.5 ft DEPTH
Toluene	29 µg/kg
m/p Xylene	11 µg/kg
O-Xylene	10 µg/kg
TPH	140 mg/kg

8-SB2	3 ft DEPTH
Lead	13.7 N µg/kg
TPH	26 µg/kg

8-SB6	0.5-2.4 ft DEPTH
Oil Range	15 mg/kg
Gasoline Range	180 mg/kg

8-SB7	0.5-2.5 ft DEPTH
4-Methyl-2-Pentone	25 µg/kg
Diesel Range	55 NJ mg/kg
Oil Range	1,700 mg/kg

8-MW2	5/96	7/96
Tetrachloroethene	**11** µg/L	3.3 µg/L

8-SB1-DUP	1.5 ft DEPTH
Trans-1,1-Dichloroethene	8 µg/kg
Toluene	46 µg/kg
Ethylbenzene	8 µg/kg
m/p Xylene	14 µg/kg
O-Xylene	9 µg/kg
TPH	22 mg/kg

8-SB4	1.5 ft DEPTH
Trichloroethene	260 µg/kg
Toluene	6 µg/kg
Chlorobenzene	35 µg/kg
1,2/1,4-Dichlorobenzene	180 µg/kg
1,2-Dichlorobenzene	240 J µg/kg
Copper	19.8 mg/kg
Lead	14.9 N mg/kg

8-SB8	9.5-10.5 ft DEPTH
Toluene	420 J µg/kg
Ethylbenzene	250 J µg/kg
1,2-Dichloroethene	86 J µg/kg
Xylenes (total)	1,900 µg/kg
Napthalene	380 J µg/kg
2-Methylnapthalene	220 J µg/kg
JP-4	240 J mg/kg
Diesel Range	340 mg/kg
Oil Range	260 NJ mg/kg
Gasoline Range	1,200 mg/kg

8-SB3	3 ft DEPTH
Trichloroethene	4 J µg/kg
Arsenic	22.2 mg/kg

LEGEND

▨	IRP SITE	⊕	SI MONITORING WELL	**11**	CONCENTRATION EXCEEDS ARARs	µg/L	MICROGRAMS PER LITER
⊘	DRY WELL	⊕	RI MONITORING WELL	•	MONITORING WELLS THAT WERE SLUG TESTED DURING THE RI.	mg/kg	MILLIGRAMS PER KILOGRAM
○	RI SOIL BORING	●	SI SOIL BORING	ND	NOT DETECTED	J	ESTIMATED VALUE
				←	DIRECTION OF GROUNDWATER FLOW	N	PRESUMPTIVE EVIDENCE OF ANALYTE

0 100

SCALE IN FEET

SOURCE: HAZWRAP, 1997.

FIGURE 3.2

GF-EECA\ANALYT-8

IRP SITE NO.8 SI AND RI SAMPLING LOCATIONS AND SUMMARY OF ANALYTICAL RESULTS

120th FW, Montana Air National Guard
Great Falls, Montana

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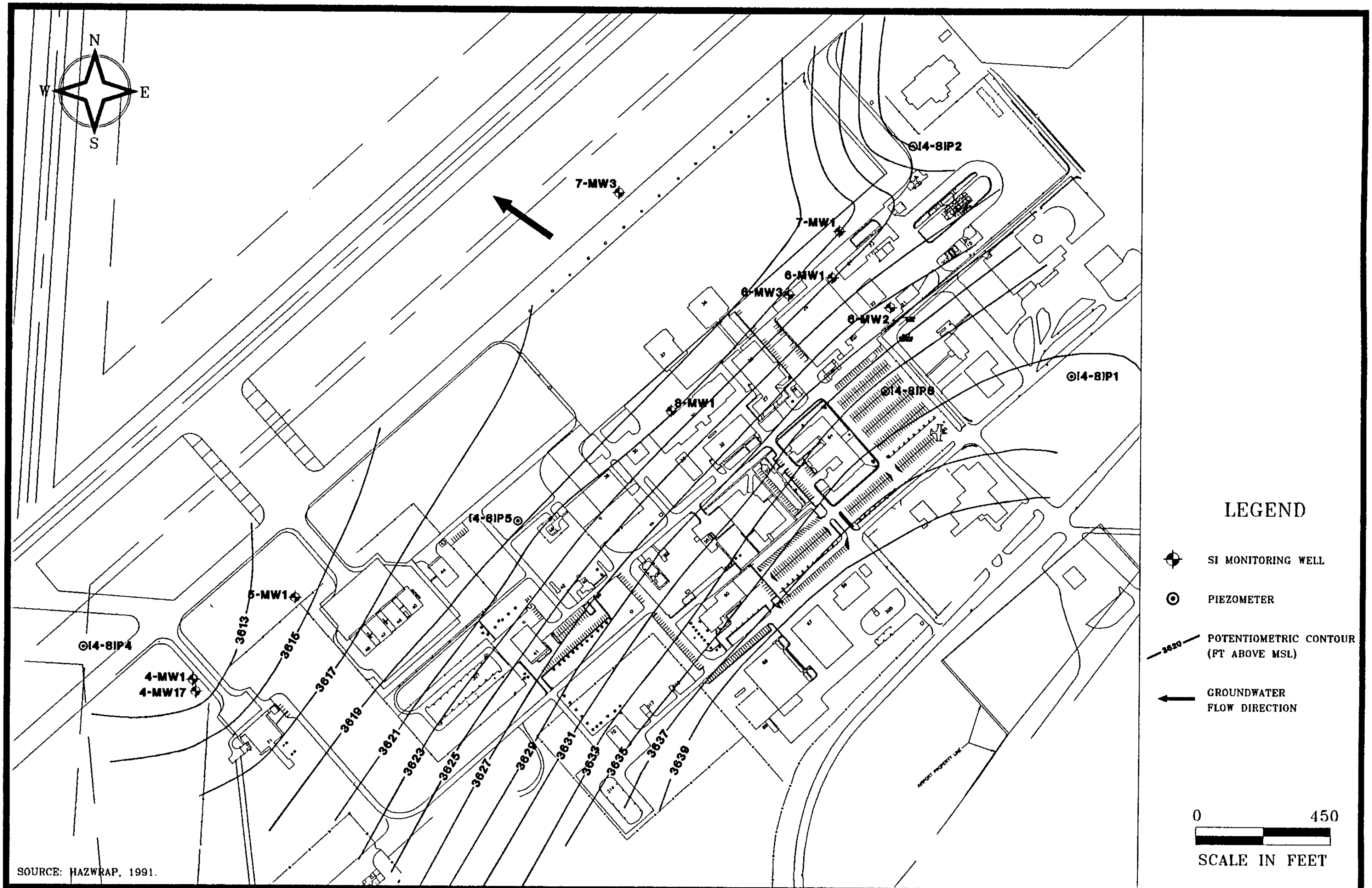
OPERATIONAL TECHNOLOGIES CORPORATION

SEPTEMBER 1997



SOURCE: HAZWRAP, 1991.

FIGURE 3.3

GF-EECA\POTENT

GROUNDWATER POTENTIOMETRIC CONTOUR MAP (SI INVESTIGATION) 1990 AND 1991

120th FW, Montana Air National Guard
Great Falls, Montana

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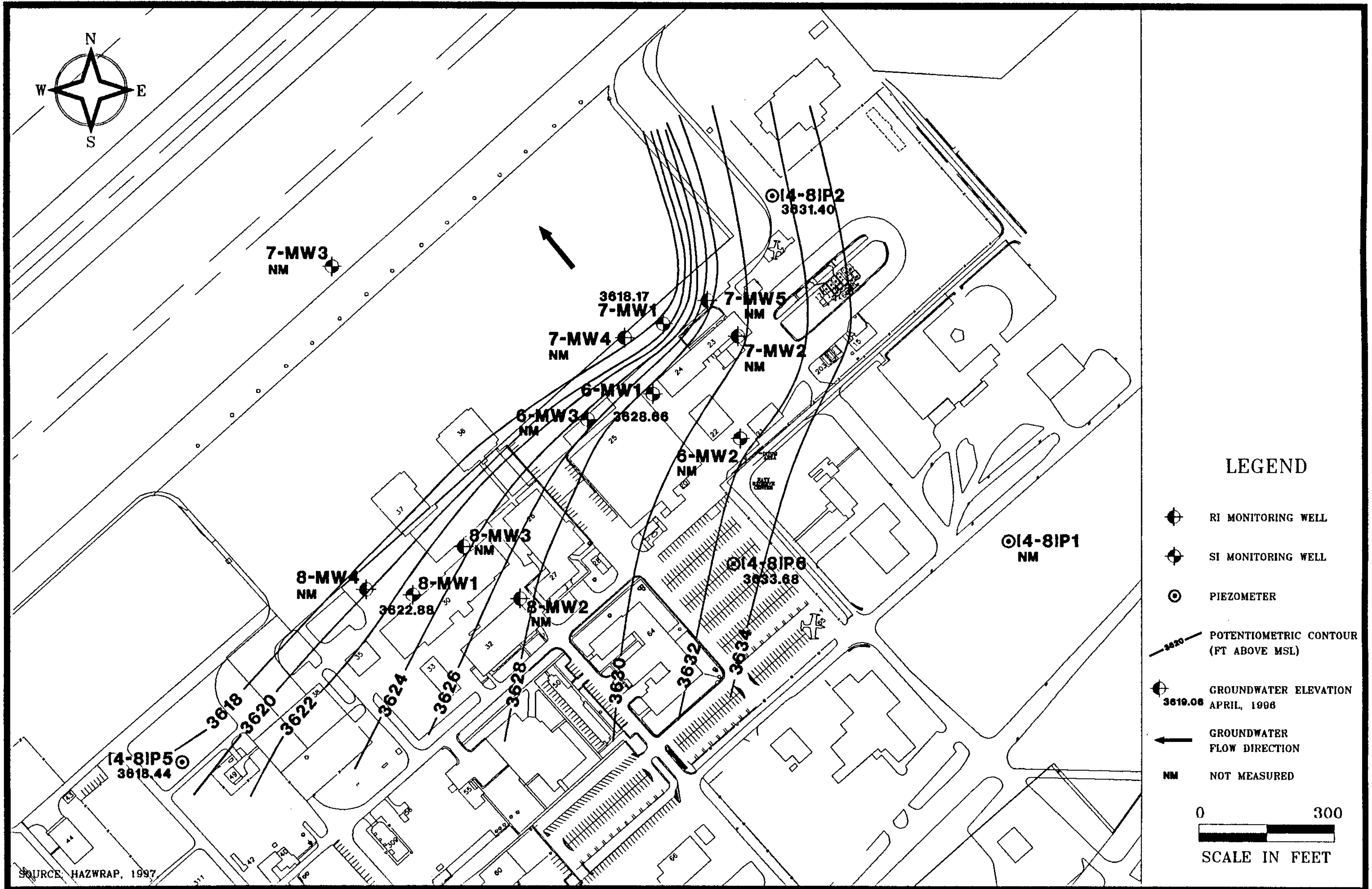
SEPTEMBER 1997



SOURCE: HAZWRAP, 1997

FIGURE 3.4

GF-EECA\POTENT

GROUNDWATER POTENTIOMETRIC CONTOUR MAP
(RI INVESTIGATION) APRIL 1996
120th FW, Montana Air National Guard
Great Falls, Montana

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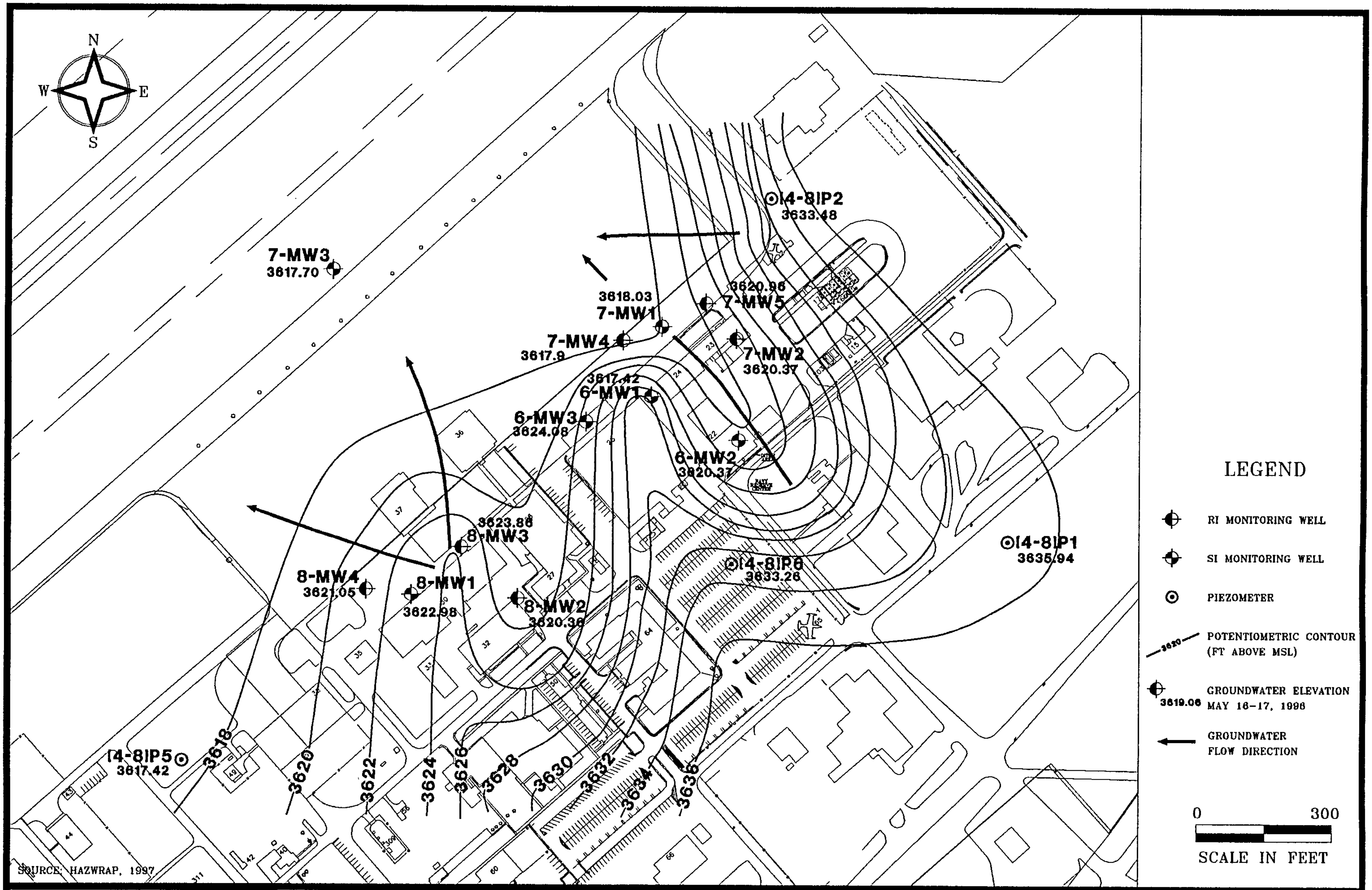
SEPTEMBER 1997



SOURCE: HAZWRAP, 1997

FIGURE 3.5

GF-EECA\POTENT

GROUNDWATER POTENTIOMETRIC CONTOUR MAP
(RI INVESTIGATION) MAY 1996
120th FW, Montana Air National Guard
Great Falls, Montana

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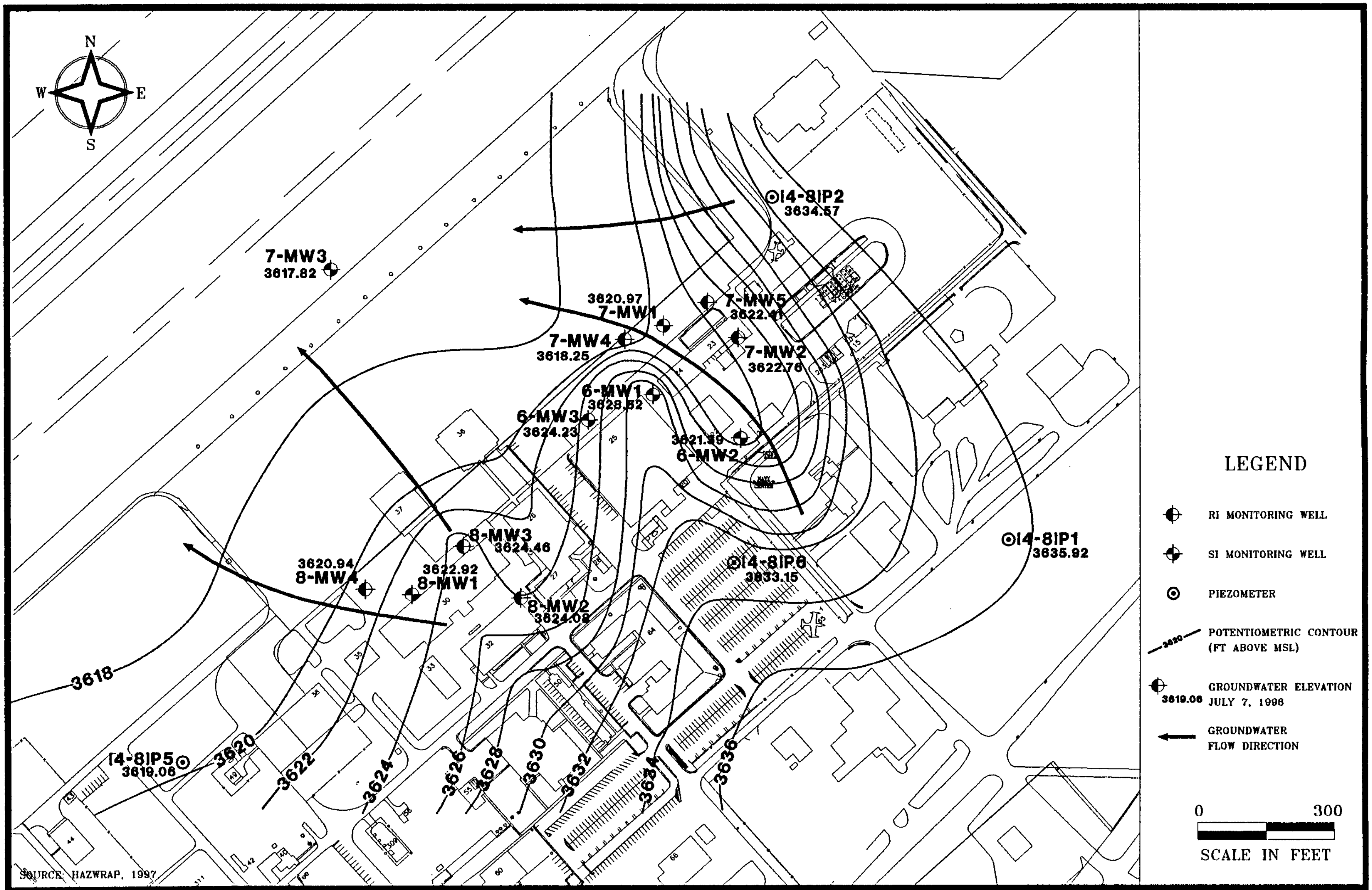
OPERATIONAL TECHNOLOGIES CORPORATION

SEPTEMBER 1997



SOURCE: HAZWRAP, 1997

FIGURE 3.6

GF-EECA\POTENT

GROUNDWATER POTENTIOMETRIC CONTOUR MAP
(RI INVESTIGATION) JULY 1996

120th FW, Montana Air National Guard
Great Falls, Montana

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OPERATIONAL TECHNOLOGIES CORPORATION

SEPTEMBER 1997

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SECTION 4.0 ENVIRONMENTAL SETTING

The City of Great Falls is located in central Montana, east of the Continental Divide, 91 miles northeast of Helena, and about 120 miles south of the Canadian border (Figure 4.1). Major highways serving the city are Interstate 15, U.S. Highways 87 and 89, and Montana Highway 200. Great Falls is the dominant urban area in Cascade County, Montana, and is the trade center for twelve surrounding counties. The Montana ANGB lies approximately 3 miles southwest of Great Falls, on the northeastern edge of the Sun River bench, a topographic feature situated about 350 ft above the confluence of the Sun and Missouri Rivers. The elevation of the installation is 3,679 ft. The area of the Base is located in the Great Plains Physiographic province east of the boundary of the Northern Rocky Mountains province and the Great Plains province.

4.1 METEOROLOGY

The climate of the Great Falls area is semiarid. The mean annual precipitation is about 15 inches per year, and the net precipitation value is approximately -19 inches per year (NOAA, 1994). The maximum rainfall intensity, based on a 1-year, 24-hour rainfall, is 1.25 inches. Approximately 70 percent of the annual total rainfall normally occurs between April and September. The mean annual temperature is about 45° Fahrenheit (F), with winters averaging 25°F and summers averaging 66°F.

4.2 GEOLOGY

4.2.1 Regional Geology

The Base is situated on the northeastern edge of the Sun River bench, a plateau of Cretaceous-aged rock that rises about 350 feet above Great Falls and slopes gently to the northwest (Figure 4.2). Cross Section A-A', Figure 4.3, shows the bench in relation to the valley floor and the relative positions of geologic units underlying the area.

The rock units that underlie the Base are, in descending order, the Taft Hill and Flood Members of the Blackleaf Formation, which belong to the Colorado Group, and the Kootenai Formation, all of which are of Cretaceous age; Morrison and Swift Formations of Jurassic age; and the Madison Group of Mississippian age.

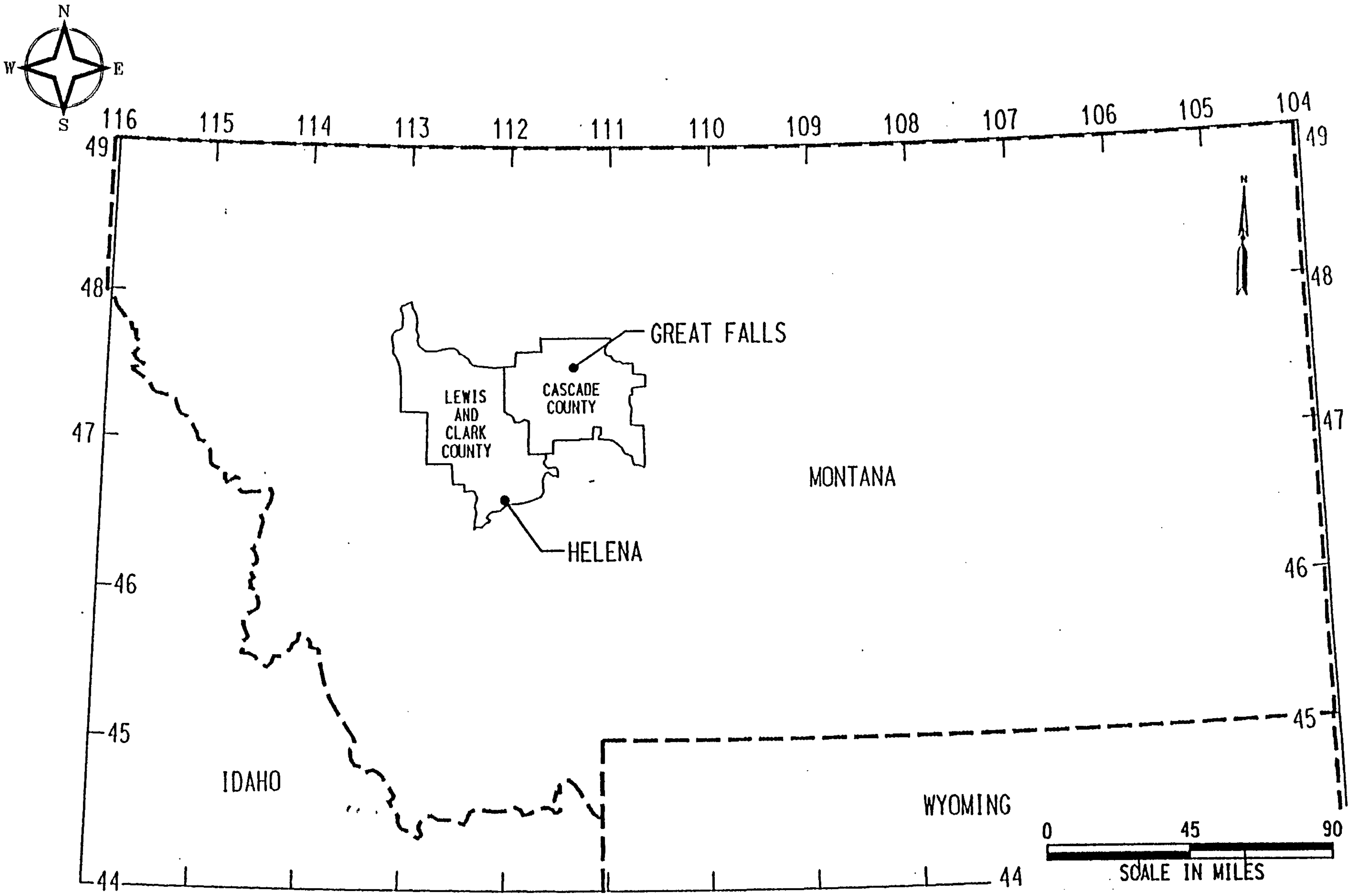


FIGURE 4.1

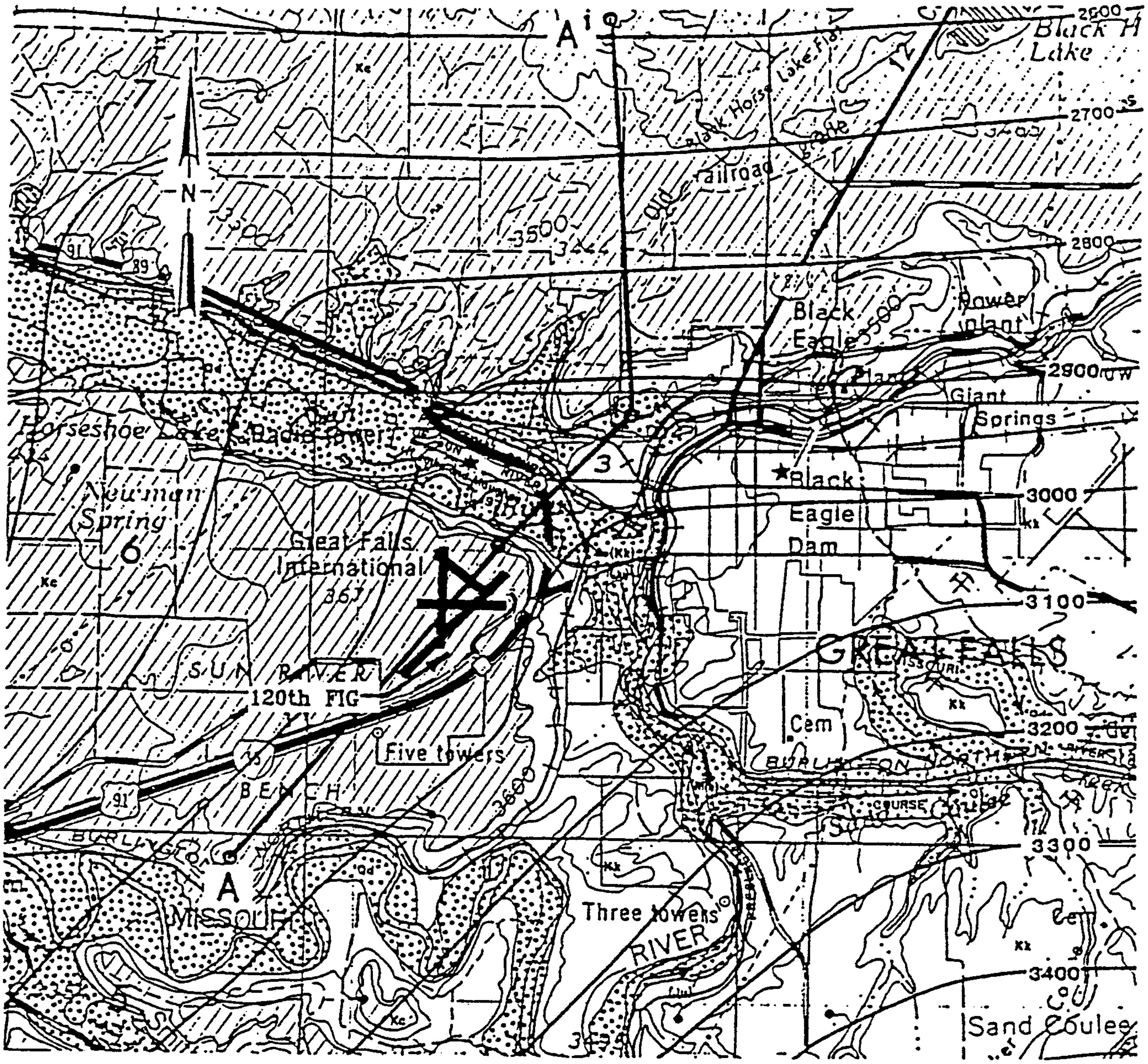
GF-EECA\CNPMAP

REGIONAL LOCATION MAP

120th FW, Montana Air National Guard
Great Falls, Montana

OPTECH
OPERATIONAL TECHNOLOGIES
CORPORATION

SEPTEMBER 1997



- Qd QUATERNARY DEPOSITS
- Kc COLORADO GROUP
- Kk KOOTENAI FORMATION
- Jm MORRISON FORMATION
- Js SWIFT FORMATION
- Mm MADISON GROUP

A ——— A1 LOCATION OF CROSS SECTION

— 2800 — Elevation of the top of the Madison group

1 1/2 0 1 2 3 4 5 MILES

CONTOUR INTERVAL 200 FEET
WITH SUPPLEMENTARY CONTOURS AT 100-FOOT INTERVALS
DATUM IS SEA LEVEL

SOURCE: APPRAISAL OF WATER IN BEDROCK AQUIFERS, NORTHERN CASCADE COUNTY, MONTANA. K.R. WILKE 1983 M.B.M.G. MEMOIR #54.

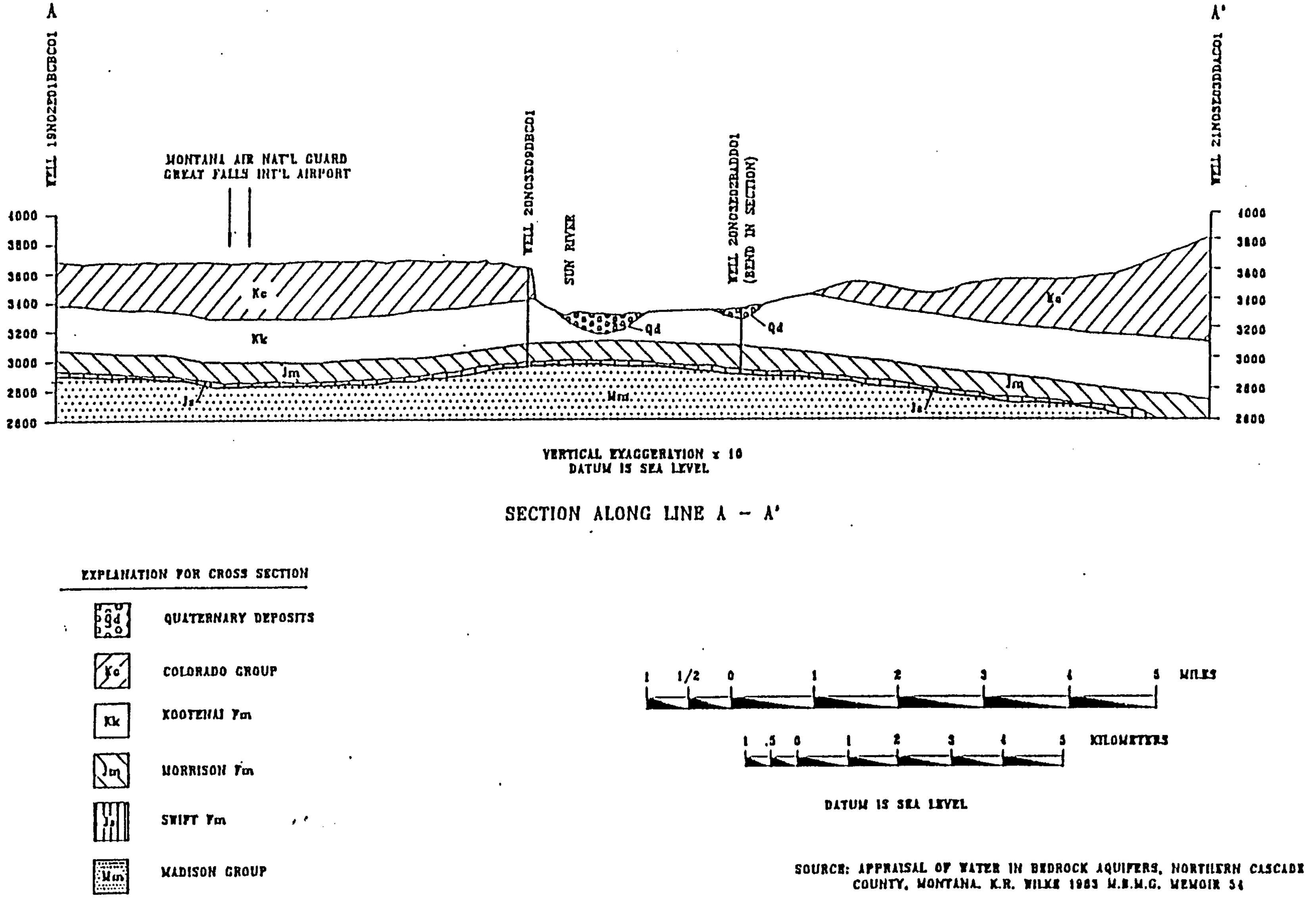
FIGURE 4.2

GF-EECA\CNPGEO

REGIONAL GEOLOGIC MAP
120th FW, Montana Air National Guard
Great Falls, Montana

OPTECH
OPERATIONAL TECHNOLOGIES CORPORATION

SEPTEMBER 1997



VERTICAL EXAGGERATION x 10
DATUM IS SEA LEVEL

SECTION ALONG LINE A – A'

DATUM IS SEA LEVEL

SOURCE: APPRAISAL OF WATER IN BEDROCK AQUIFERS, NORTHERN CASCADE COUNTY, MONTANA. K.R. WILKE 1983 M.B.M.G. MEMOIR 54

FIGURE 4.3

GF-EECA\CNPCROSS

GEOLOGIC CROSS–SECTION A–A'

120th FW, Montana Air National Guard
Great Falls, Montana

OPTECH
OPERATIONAL TECHNOLOGIES
CORPORATION

SEPTEMBER 1997

Erosional remnants of the Taft Hill Member outcrop, at and around the Base, make up the majority of the unconsolidated to semiconsolidated material found in the upper 15 to 20 feet of material underlying the Base. This member consists of marine strata of medium gray, soft, bentonitic clayey to silt shale and greenish-grey glauconitic sandstone, and contains beds of nonglauconitic sandstone, siltstone, bentonite, and calcareous concretions (Lemke, 1977). At the type locality for this formation, which is west of the Base, the member is approximately 250 feet thick with the beds thinning to the east (Fox, 1966).

The Flood Member is the first competent rock encountered at the Base. This member is composed of marine strata consisting of a lower unit of sandstone and siltstone, a middle unit of shale that is soft and dark gray, and an upper unit of cliff-forming sandstone. The upper unit accounts for 48 percent of the total thickness, with the shale accounting for 32 percent and the lower unit 16 percent (Wilke, 1983). At the type section for this formation, located 5 miles southwest of Great Falls, the member is 138 feet thick and ranges up to approximately 200 feet thick west of the Base. The upper sandstone forms the cliffs around the edge of the Sun River bench and consists of light gray, very fine to medium-grained quartz and chert sandstone. The sandstone weathers tan-brown to red-brown, and has either a clayey matrix or siliceous cement. The sandstone is characterized by massive beds showing vertical and horizontal joins, occasional fossil wood, and widely scattered ferricinous calcareous dark brown to red concentrations 1 to 4 inches in diameter (Fox 1966).

The contact between the upper and middle units of the Flood is gradational. The middle unit consists of interbedded sandstones and shales that slump extensively. The sandstone is tan and fine to medium-grained and weathers to a light tan gray. Although some beds are argillaceous and friable, siliceous cement is common. The shale beds are dark gray and weather light gray, are both sandy and silty, and are generally calcareous. Also, an occasional laminae of coal was found along with some pyrite deposits.

The Kootenai Formation underlies the Flood Member and consists of 350 to 400 feet of nonmarine, interbedded, dark red, purple, or greenish-gray shales and siltstone with discontinuous light gray to buff sandstone beds and a few impure limestone lenses (Wilke, 1983). The formation is divided into three members; an upper, mostly mudstone and shale member, a lower sandstone and siltstone member, and a basal sandstone known as the Sunburst Sandstone.

The Morrison Formation lies unconformably under the Kootenai Formation and is about 100 to 180 feet thick. It is composed of varicolored, mainly greenish-gray, interbedded shale and siltstone with some discontinuous limestone and sandstone beds (Wilke, 1983).

The Swift Formation unconformably overlies the Madison Group. The formation is mostly fine-grained, light gray, cross-bedded quartz sandstone of marine origin and is cemented predominantly with calcite. In the Great Falls area, the formation is 5 to 20 feet thick and thickens to the east and southeast (Wilke, 1983).

The Madison Group is composed of massive to thin beds of gray, dense limestone with interbeds of shale and chert (Wilke, 1983). The top of this unit is approximately 800 to 900 feet below the top of the Sun River bench.

4.2.2 Local Geology

The geology of the Base is characterized as surface soil consisting of brown sand and clay with gravel and weathered sandstone both interpreted to be from the Taft Hill Member of the Colorado Group. Thickness of the surface soils ranges from 2 to 4 feet across the Base and is underlain by the weathered sandstone. The unconsolidated deposits are underlain by competent sandstone of the Flood Member. The depth to sandstone ranges from 8 to 19 feet BLS. The thickness of the sandstone ranges from 38 to 44 feet. Relatively flat-lying bedrock with no major structural displacement lies beneath the weathered and competent sandstone.

4.3 SOILS

The Base is situated on sandy, silty loams and loamy sands of the Tally-Azaar-Litten Association (Soil Conservation Service, 1973). Of this group, about 45 percent is Tally soils, 20 percent Azaar soils, 15 percent Litten soils, and 20 percent minor soils. In a typical soil profile, the surface layer is approximately 7 inches thick and consists of a dark grayish-brown fine sandy loam and an underlying material of light brown and grayish-brown fine sandy to silty clay loam. Permeability is moderate, surface runoff is low, and the available water capacity is very low. Total thickness of the soil ranges from 20 inches to greater than 40 inches (Soil Conservation Service, 1973).

4.4 SURFACE WATER HYDROLOGY

4.4.1 Regional Surface Water Hydrology

The Base lies on the northeastern edge of the Sun River bench, a topographic feature situated about 350 feet above the Sun and Missouri Rivers south and southwest of Great Falls. The elevation of the Base is 3,674 feet above mean sea level. The Sun River bench is a relatively flat plateau that slopes down toward the northwest at approximately 50 feet per mile. The Base is located in the Great Plains physiographic province, east of the boundary of the Northern Rocky Mountains province and the Great Plains province. The Great Plains are generally flat with areas of negative relief such as the Missouri River valley and areas of positive relief such as the Highwood Mountains.

The Missouri River originates on the eastern flank of the Continental Divide, flows northeasterly, and bisects and traverses Great Falls Township from the south to the northeast. The Sun River flows east from its headwaters near the Continental Divide and joins the Missouri River at Great Falls. The confluence of the two rivers is about two miles northeast of the Base (Figure 4.4). The Base obtains potable water from the City of Great Falls, which obtains its water supply from the Missouri River.

4.4.2 Local Surface Water Hydrology

The Base storm runoff drains into the Sun River via a network of swales, ditches, culverts, drop inlets, collector pipes, and trunk lines. Other runoff at the Base flows into sanitary sewers and eventually reaches the city's waste treatment facility, which discharges to the Missouri River. Figure 4.5 illustrates the drainage system at the Base.

4.5 HYDROGEOLOGY

4.5.1 Regional Hydrogeology

Groundwater at the Base is present in each of the rock units described above. The shallowest groundwater encountered at the Base occurs in the upper sandstone of the Flood Member. Regional groundwater flow in the area is to the west-northwest. Each of the aquifers is discussed below.

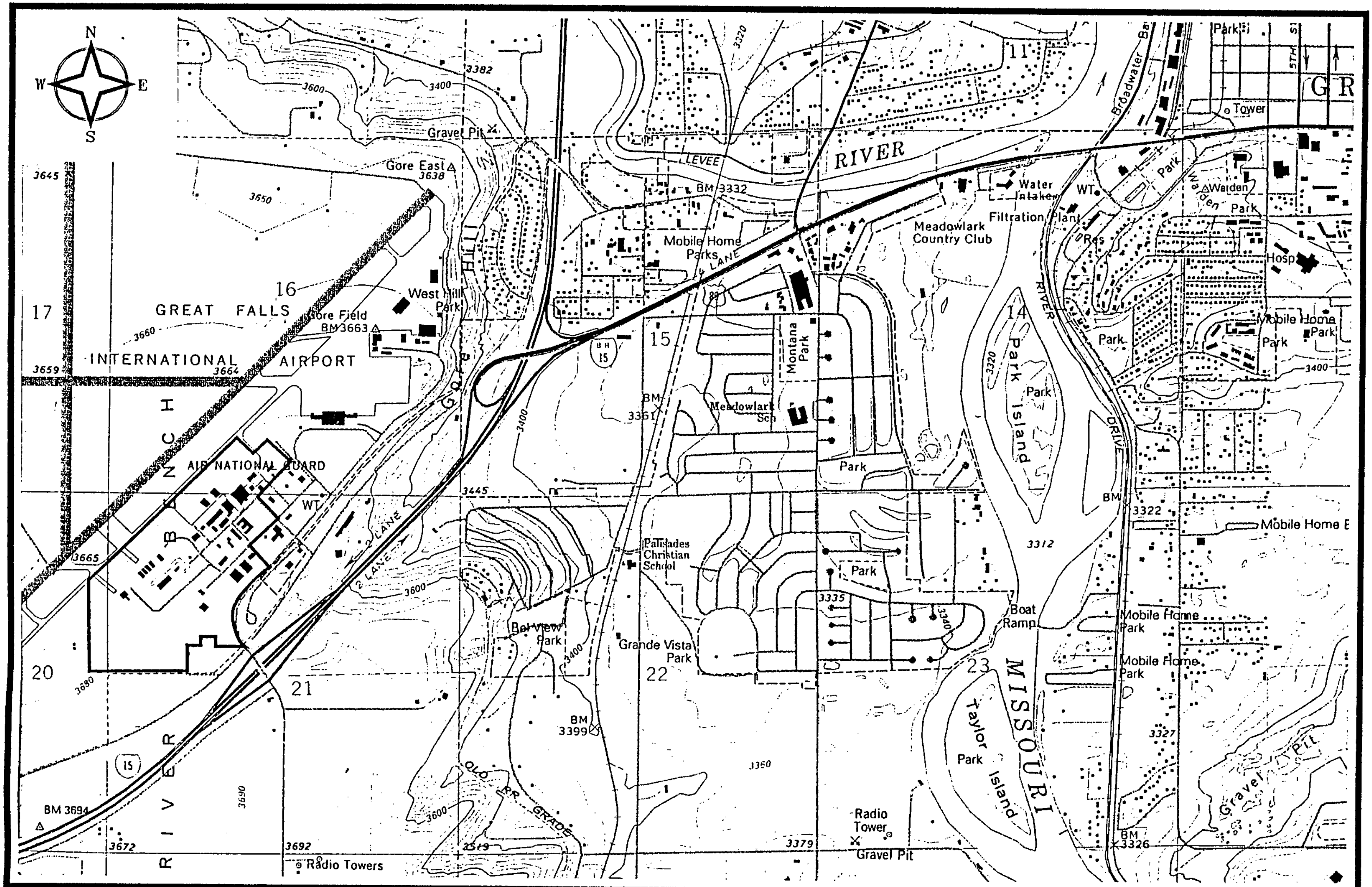


FIGURE 4.4

GF-EECA\CNPCROSS

TOPOGRAPHY AND SURFACE WATER BODIES

120th FW, Montana Air National Guard
Great Falls, Montana

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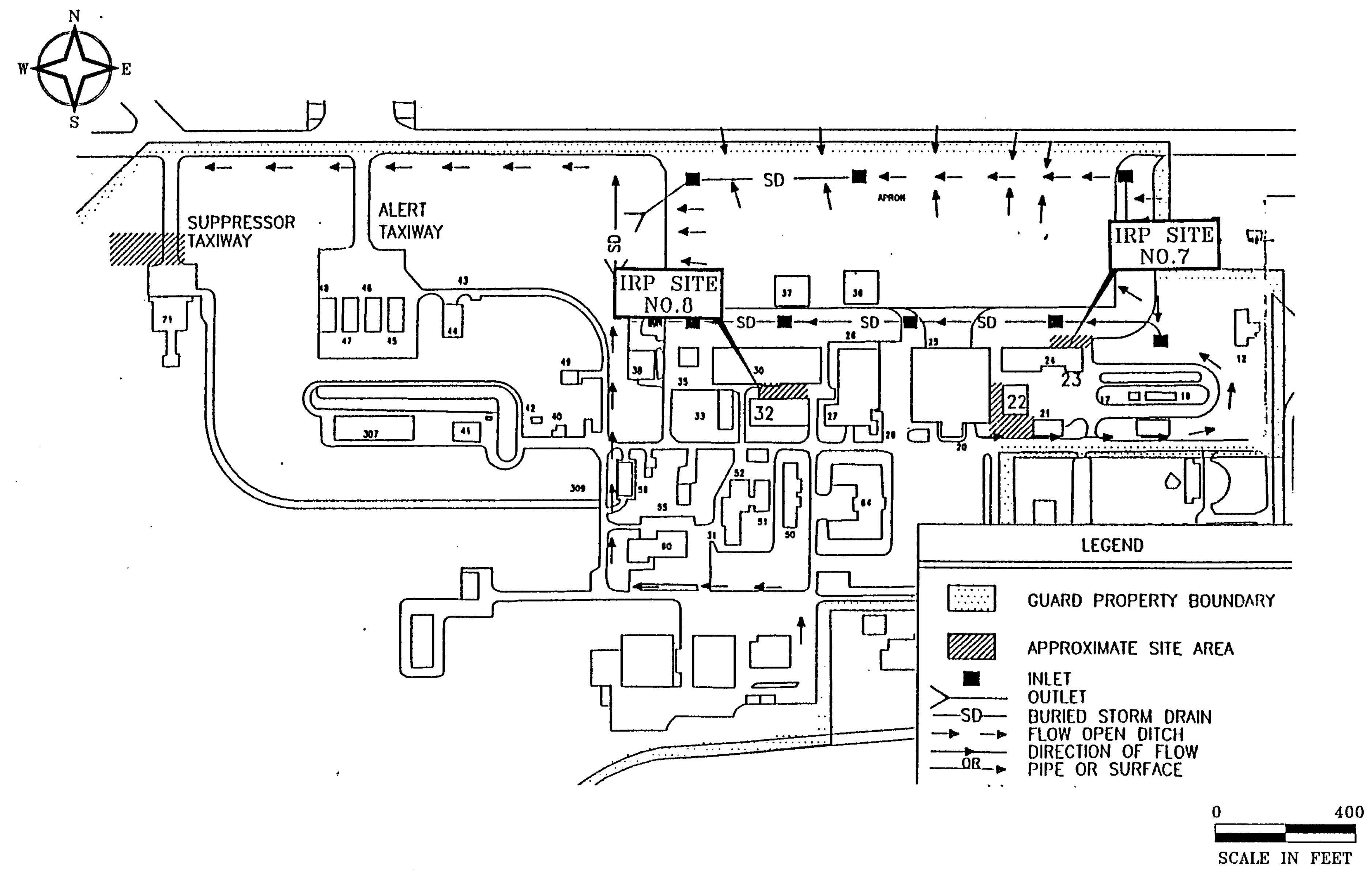

SOURCE: MODIFIED FROM 120th FG CIVIL ENGINEERING AND ENGINEERING SCIENCE, 1992.

FIGURE 4.5

GF-EECA\CNPDRAIN

INSTALLATION DRAINAGE

120th FW, Montana Air National Guard
Great Falls, Montana

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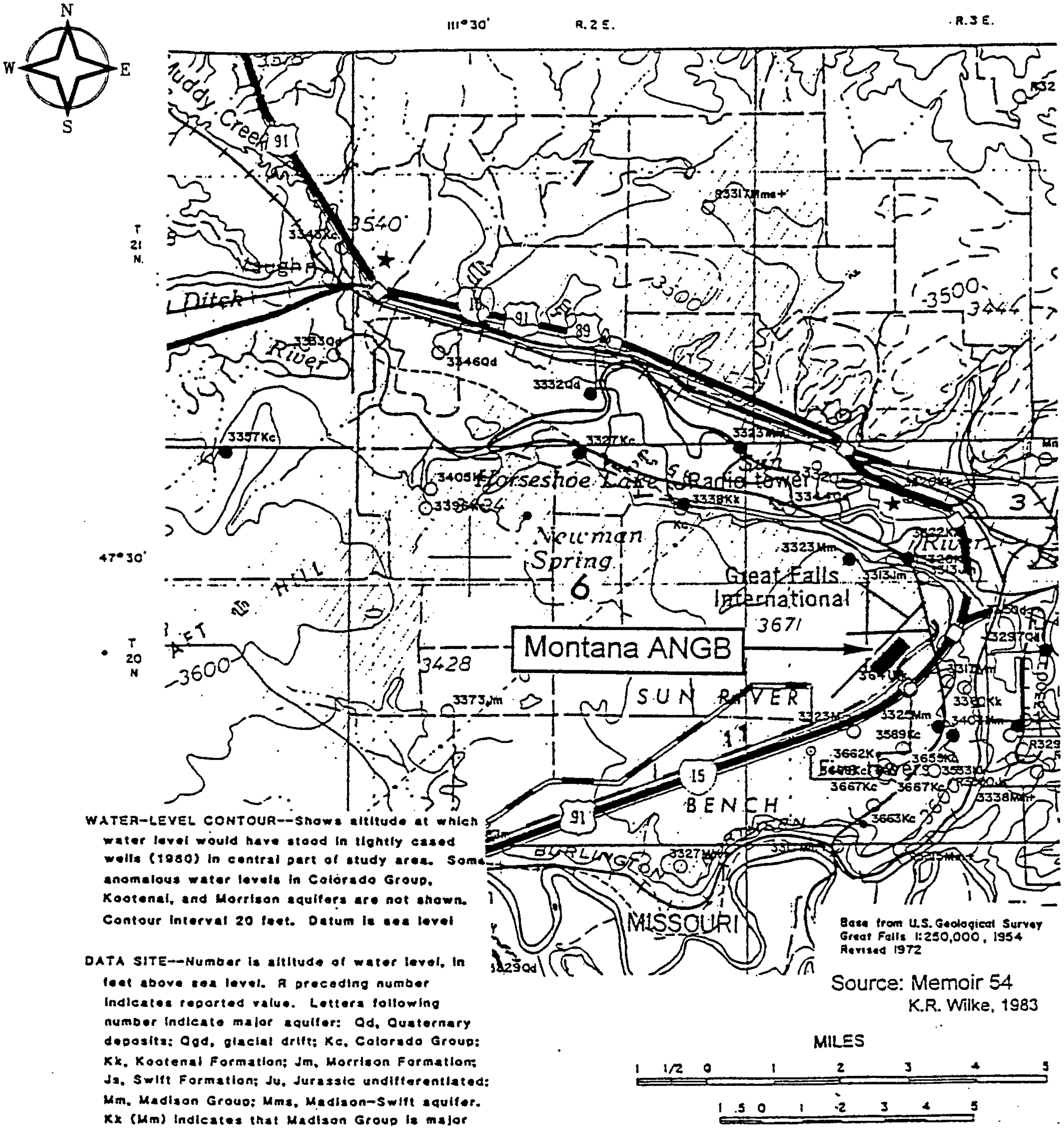
The Flood Sandstone on the Sun River bench is a perched aquifer (Wilke, 1983). North and west of the bench, hydrologic conditions change from perched to water table to confined. The relatively impermeable shale in the underlying Kootenai and the shales found in the middle of the Flood retard the vertical movement of the water, producing the perched condition. The general groundwater flow in the Flood is to the north-northwest. However, due to seasonal fluctuations, surface topography, and variations in the underlying confining shales of the area, there may be localized perched conditions which are evident at the Base.

Wells completed in the Flood commonly range from 20 to 100 feet BLS and are important sources of water for domestic and stock uses on the bench. Reported well yields range from 6 to 40 gallons per minute (gpm) (Wilke, 1983). Well logs were obtained from the State of Montana and evaluated for active wells Based on the regional gradient (north-northwest). Well logs were examined from the area between the Base and the river, and were not examined for wells across the river. The logs indicate several active wells within a mile of the Base to the north, northwest, and southeast (Figure 4.6). The Flood Member is recharged mainly from infiltration of precipitation on the bench. Groundwater movement is generally downdip, or to the northwest, except near outcrop boundaries. Therefore, local gradients at each site at the Base are influenced by proximity to the cliffs and local topographic features. This conclusion is supported by the presence of springs, along with cliffs, that surround the bench. Limited water quality data are available for the Flood, but samples indicate that the water is of a sodium sulfate and sodium bicarbonate type, with dissolved solids concentrations ranging from 2,700 to 2,800 milligrams per liter (mg/L) (Wilke, 1983).

The basal sandstone and the discontinuous sandstones of the Kootenai Formation also form an important aquifer in the area. Water levels reflect water table conditions, although some water levels on the bench reflect perched conditions (Wilke, 1983). Like the Flood, the Kootenai is believed to become confined north and west of the bench. There are some wells in the vicinity of the Base completed in the Kootenai. These wells are used for domestic purposes. Well yields are reported to range from 5 to 50 gpm, with water levels ranging from 24 to 115 foot BLS (Wilke, 1983). The groundwater movement of the Kootenai is thought to be to the northwest following the regional dip, although local gradients may also be influenced as with the Flood Member. The water of the Kootenai characteristically contains magnesium, sodium, bicarbonate, and sulfate, with dissolved solids concentrations ranging from 558 to 1,550 mg/L (Wilke, 1983).



WATER-LEVEL CONTOUR--Shows altitude at which water level would have stood in tightly cased wells (1980) in central part of study area. Some anomalous water levels in Colorado Group, Kootenai, and Morrison aquifers are not shown. Contour interval 20 feet. Datum is sea level

DATA SITE--Number is altitude of water level, in feet above sea level. R preceding number indicates reported value. Letters following number indicate major aquifer: Qd, Quaternary deposits; Qgd, glacial drift; Kc, Colorado Group; Kk, Kootenai Formation; Jm, Morrison Formation; Js, Swift Formation; Ju, Jurassic undifferentiated; Mm, Madison Group; Mms, Madison-Swift aquifer. Kk (Mm) indicates that Madison Group is major aquifer although spring issues from Kootenai. Plus (+) indicates well is completed in more than one aquifer.

Source: Memoir 54
K.R. Wilke, 1983

LEGEND

○ WELL	♂ SPRING	▨ AREA UNDERLAIN BY COLORADO GROUP
● WELL SAMPLED FOR FOR CHEMICAL ANALYSIS	● SPRING SAMPLED FOR FOR CHEMICAL ANALYSIS	—— CONTACT – DASHED WHERE CONCEALED OR CONJECTURED

SOURCE: HAZWRAP, 1996.

FIGURE 4.6

GF-EECA\CNPWELLS

LOCATION OF WATER WELLS
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The water-bearing units of the Morrison Formation are relatively undefined, with sandstone beds of varying thicknesses and areal extents supplying water to wells. There are a few domestic wells in the vicinity of the site completed in the Morrison. Reported yields range from 4 to 72 gpm, with water levels ranging from 52 to 308 foot BLS. Limited water quality data are available for the Morrison and reflect no common chemical characteristics, with dissolved solids concentrations ranging from 908 to 1,480 mg/L (Wilke, 1983).

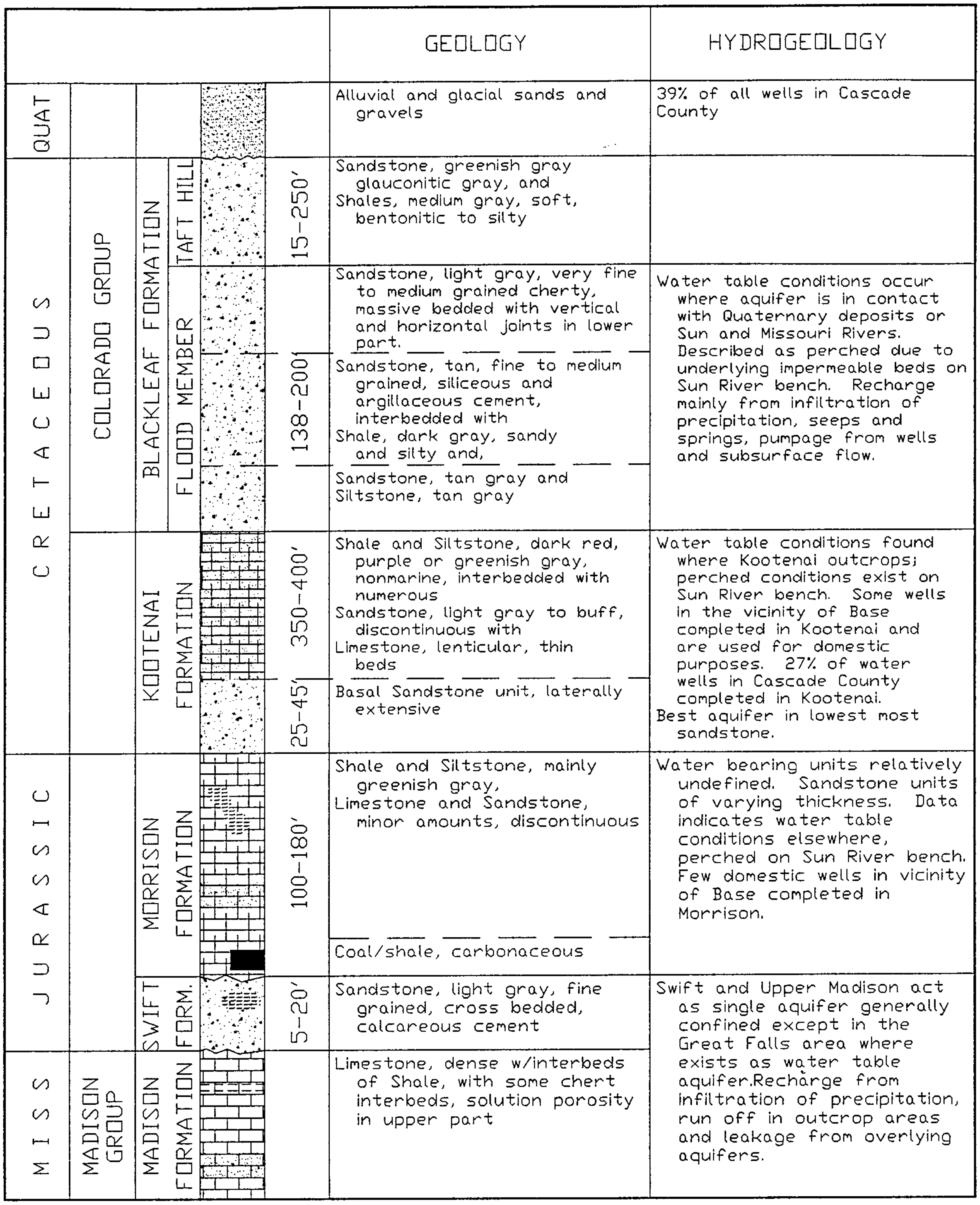
The upper limestone of the Madison and the Swift sandstone can be considered as a single aquifer. The Madison-Swift aquifer is generally confined except in the area around Great Falls, Montana, where water levels indicate water table conditions. Reported yields from wells in the aquifer range from 3 to 338 gpm, with water levels ranging from 7 to 340 feet BLS. Groundwater movement is generally to the northwest. Water quality data reflect a calcium sulfate type water, with large concentrations of iron and fluoride and dissolved solids concentrations ranging from 520 to 1,570 mg/L. The Madison-Swift is recharged from infiltration of precipitation and runoff in outcrop areas and from leakage of overlying aquifers (Wilke, 1983).

The unconsolidated quaternary-deposits aquifer in the Great Falls area is generally less than 40 feet thick and contains alluvium of the Sun and Missouri rivers. The unconsolidated deposits overlie, and are hydraulically connected to, parts of all the bedrock aquifers in the Great Falls area, with the exception of the Colorado Group on the Sun River bench (Wilke, 1983). These relationships are shown in Figure 4.7 - Stratigraphic/Hydrologic Column.

4.5.2 Local Hydrogeology

Groundwater flow at the Base is generally north to northwest with an average gradient of 95 feet per mile. Figures 3.3 through 3.8 show the water level contours across the Base from water-level measurements collected from 1995 to 1997. Depth to groundwater measurements collected during the SI and RI field activities range from 40.97 feet to 54.81 feet across the Base.

Water level measurements collected from 1-MW1 during both the SI and RI are anomalous as compared to all other measurements collected in the area of IRP Site No. 1 and may possibly indicate this well is completed in a different horizon. Thus, the water level contours shown in Figures 3.3 through 3.6 do not take into account the water level measurements collected from 1-MW1.



						GEOLOGY	HYDROGEOLOGY
QUAT						Alluvial and glacial sands and gravels	39% of all wells in Cascade County
CRETACEOUS	COLORADO GROUP	BLACKLEAF FORMATION	TAFT HILL		15-250'	Sandstone, greenish gray glauconitic gray, and Shales, medium gray, soft, bentonitic to silty	
			FLOOD MEMBER		138-200'	Sandstone, light gray, very fine to medium grained cherty, massive bedded with vertical and horizontal joints in lower part. Sandstone, tan, fine to medium grained, siliceous and argillaceous cement, interbedded with Shale, dark gray, sandy and silty and, Sandstone, tan gray and Siltstone, tan gray	Water table conditions occur where aquifer is in contact with Quaternary deposits or Sun and Missouri Rivers. Described as perched due to underlying impermeable beds on Sun River bench. Recharge mainly from infiltration of precipitation, seeps and springs, pumpage from wells and subsurface flow.
		KOOTENAI FORMATION			350-400'	Shale and Siltstone, dark red, purple or greenish gray, nonmarine, interbedded with numerous Sandstone, light gray to buff, discontinuous with Limestone, lenticular, thin beds	Water table conditions found where Kootenai outcrops; perched conditions exist on Sun River bench. Some wells in the vicinity of Base completed in Kootenai and are used for domestic purposes. 27% of water wells in Cascade County completed in Kootenai. Best aquifer in lowest most sandstone.
					25-45'	Basal Sandstone unit, laterally extensive	
JURASSIC		MORRISON FORMATION			100-180'	Shale and Siltstone, mainly greenish gray, Limestone and Sandstone, minor amounts, discontinuous Coal/shale, carbonaceous	Water bearing units relatively undefined. Sandstone units of varying thickness. Data indicates water table conditions elsewhere, perched on Sun River bench. Few domestic wells in vicinity of Base completed in Morrison.
		SWIFT FORM.			5-20'	Sandstone, light gray, fine grained, cross bedded, calcareous cement	Swift and Upper Madison act as single aquifer generally confined except in the Great Falls area where exists as water table aquifer.Recharge from infiltration of precipitation, run off in outcrop areas and leakage from overlying aquifers.
MISS	MADISON GROUP	MADISON FORMATION				Limestone, dense w/interbeds of Shale, with some chert interbeds, solution porosity in upper part	

SOURCE: AFTER WILKE, 1983.

FIGURE 4.7

GF-EECA\STRATCOL

STRATIGRAPHIC/HYDROGEOLOGIC COLUMN
120th FW, Montana ANG
Great Falls, Montana

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4.6 CRITICAL ENVIRONMENTS

The Montana Department of Fish, Wildlife, and Parks reviewed their files with respect to the presence of rare, threatened, or endangered animals, plants, and natural communities and/or significant wildlife habitat within a 4-mile radius of the Great Falls International Airport. Table 4.1 lists those species that are endangered or threatened.

The Bald Eagle (threatened) and Peregrine Falcon (endangered) fly over Great Falls during spring and fall migrations; no problems regarding these species have been reported to date. The Piping Plover, Least Tern, and Pallid Sturgeon are found along the Missouri River, but only in the eastern part of the State below the Fort Peck dam.

Table 4.1
Threatened and Endangered Species - Montana
120th Fighter Wing, Montana ANG, Great Falls, Montana

Common Name	Scientific Name	Status	Range-Montana
Black-footed Ferret	Mustela nigripes	E	Prairie dog complexes; East. MT
Grey Wolf	Canis lupus	E	Forest; West. MT
Grizzly Bear	Ursus aretos horribilis	T	Alpine/subalpine coniferous forest; West. MT
Bald Eagle	Haliaeetus leucocphalus	T	Forested riparian; Statewide
Peregrine Falcon	Falco peregrinus	E	Forests near cliffs; Statewide
Whooping Crane	Crus americana	E	Wetlands; migrant Statewide
Piping Plover	Charadrius melodus	T	Missouri River sandbars, alkaline beaches; NE MT
Least Tern	Sterna antillarum	E	Yellowstone, Missouri River sandbars, beaches; East. MT
Pallid Sturgeon	Scaphirhynchus albus	E	Bottom dwelling; Missouri, Yellowstone Rivers
White Sturgeon (Kootenai River pop.)	Acipenser transmontanus	E	Kootenai River, NW MT
Water Howellia	Howellia aquatilis	T	Wetlands; Swan Valley, NW MT

ENDANGERED (E) - Any species that is in danger of extinction throughout all or a significant portion of its range.
THREATENED (T) - Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

SECTION 5.0 PERMITS

In accordance with CERCLA, no permits are required for on-site work. Also, no permits are required by the MDEQ or by the Base Civil Engineer for any work proposed for this investigation. However, locations of monitoring wells will be approved and cleared for utilities by the Base Civil Engineering Department. Drilling contractors are required to be registered in the State of Montana.

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SECTION 6.0 INVESTIGATIVE APPROACH

This section presents the Work Plan objectives, general approach to the sampling strategy and rationale, and brief descriptions of the field investigation activities.

6.1 WORK PLAN OBJECTIVES

The objectives of the Work Plan is to acquire data of sufficient quality to (1) define the extent of confirmed environmental contamination, (2) develop a risk evaluation that addresses factors of human health and the environment, and (3) support risk-Based decisions on removal action technologies. These objectives require quantification of the horizontal and vertical extent of contamination, the magnitude of contamination and the migration of any contaminants from the sites. Also, to ensure that all field activities will be performed in a manner approved and agreed upon by the ANG/CEVR, MDEQ, and OpTech.

6.2 GENERAL APPROACH - SAMPLING STRATEGY AND RATIONALE

The mode of contamination at IRP Site No. 7, as described in Section 3.0, is surface spillage of JP-4 and possible subsurface infiltration using the dry well. The mode of contamination at IRP Site No. 8 is infiltration of paints, paint strippers, solvents, and other flammables from a dry well in the maintenance shop into the soil and groundwater. The data collected during this investigation and from previous investigations will be used for a risk evaluation within the EE/CA enabling risk-Based decision-making. A summary of the field investigations at IRP Sites No. 7 and No. 8 is presented in Table 6.1.

6.2.1 Monitoring Well Installation

Four-inch-diameter monitoring wells will be installed at IRP Sites No. 7 and No. 8 for collection of groundwater samples for laboratory analyses. These monitoring wells will be constructed to permit use as product extraction wells. Each monitoring well will be screened in the bedrock to determine the extent of contamination in the groundwater. During RI investigations, free product (JP-4) was found in 7-MW1, and fuel-related compounds were found above regulatory limits in groundwater samples collected from monitoring wells 7-MW2 and 7-MW4 at IRP Site No. 7. Chlorinated solvents were found in groundwater samples collected from all monitoring wells at IRP Site No . 8. The analytical data (in addition to the

Table 6.1
Summary of the Field Investigation at IRP Sites No. 7 and No. 8
120th FW, Montana ANG, Great Falls, Montana

IRP Site No.	Sample Location Type	Type of Investigation	Analyses
7	MW1 MW2 MW3 MW4 MW5	• Collect three rounds of water-level measurements. • Collect two rounds of groundwater samples for chemical analyses • Conduct a product thickness test at 7-MW1.	• Chlorinated Solvents - 8010^1 TPH - Modified 8015^1 BTEX - 8020^1 PPM - 6010/7000^1
	MW6 MW7 MW8 MW9	• Install monitoring wells and collect two rounds of groundwater samples for chemical analyses. • Collect one groundwater sample from one monitoring well for RD parameters. • Collect two rounds of water-level measurements. • Conduct slug tests on two monitoring wells. • Conduct a product thickness test, if free product exists. • Collect drill cuttings at every 5-foot interval for lithologic description.	• Chlorinated Solvents - 8010^1 TPH - Modified 8015^1 BTEX - 8020^1 PPM - 6010/7000^1 • RD Parameters^2
8	MW1 MW2 MW3 MW4	• Collect three rounds of water-level measurements. • Collect two rounds of groundwater samples for chemical analyses.	• Chlorinated Solvent - 8010^1 TPH - Modified 8015^1 BTEX - 8020^1 PPM - 6010/7000^1
	MW5 MW6 MW7 MW8	• Install monitoring wells and collect two rounds of groundwater samples for chemical analyses. • Collect one groundwater sample from one monitoring well for RD parameters. • Collect two rounds of water-level measurements. • Conduct slug tests on two monitoring wells. • Collect drill cuttings at every 5-foot interval for lithologic description.	• Chlorinated Solvent - 8010^1 TPH - Modified 8015^1 BTEX - 8020^1 PPM - 6010/7000^1 • RD Parameters^2

Table 6.1 (Concluded)
Summary of the Field Investigation at IRP Sites No. 7 and No. 8
120th FW, Montana ANG, Great Falls, Montana

IRP Site No.	Sample Location Type	Type of Investigation	Analyses
Base-wide	6-MW1 7-MW1 8-MW1 BG-1	• Re-complete surface well completions to prevent surface runoff from entering wells.	NA

MW - Monitoring Well
PPM - Priority Pollutant Metals
BTEX - Benzene, Toluene, Ethylbenzene, and Xylenes.
TPH - Total Petroleum Hydrocarbons

USEPA - United States Environmental Protection Agency.
NA - Not Applicable
[1] USEPA SW846 Solid Waste Analytical Methods
RD - Remedial Design

[2] RD parameters include pH, Kjeldahl nitrogen, nitrate-nitrogen, nitrite-nitrogen, ammonia-nitrogen, total phosphorus, calcium, potassium, magnesium, sodium, chloride, heterotrophic plate count, hydrocarbon plate count, biological oxygen demand, chemical oxygen demand, total organic carbon, total suspended solids, total dissolved solids, total alkalinity, total hardness, and *in-situ* dissolved oxygen (field measurement). In addition, at each monitoring well (newly installed) where chlorinated hydrocarbons are present, the following parameters will also be measured; ferrous and ferric iron, sulfides, sulfates, and methane.

previous analytical data) will be evaluated to determine groundwater contamination conditions and the extent of free product and its thickness at IRP Site No. 7, and to determine the extent of groundwater contamination at IRP Site No. 8. Drill cuttings will be collected at every 5-foot interval from the boreholes of the monitoring wells at IRP Sites No. 7 and No. 8 for lithologic description.

6.2.2 Confirmation Sampling

Confirmation samples will be collected at IRP Sites No. 7 and No. 8 and submitted to a fixed-Base laboratory for chemical analyses. Two rounds of groundwater samples will be collected from the existing and newly installed monitoring wells at IRP Sites No. 7 and No. 8. The analytical data will be compared to the analytical data from previous investigations to determine the presence and/or extent of groundwater contamination at IRP Sites No. 7 and No. 8.

A groundwater sample will be collected from one newly installed monitoring well at each site for laboratory analyses of remedial design parameters. These parameters are presented in Table 6.2.

6.2.3 Surveying

Upon completion of drilling activities at IRP Sites No. 7 and No. 8, all newly installed monitoring wells will be surveyed by a State-licensed surveyor. The monitoring wells will be surveyed within 0.1 foot horizontal and 0.01 foot vertical accuracy.

6.2.4 Field Measurement

Field measurement data will include groundwater temperature, pH, turbidity, conductivity, *in-situ* dissolved oxygen and photoionization detector (PID) measurements.

6.2.5 Aquifer Testing

To support decisions on removal action technologies evaluation, and to provide additional hydrogeologic characteristics of the aquifer at IRP Sites No. 7 and No. 8, slug tests are proposed for two newly installed monitoring wells at each site. Both rising head and falling head slug tests will be performed. Hydraulic conductivity and porosity of the hydrologic unit will be estimated based on the information gathered, and will be used to calculate the average linear velocity of groundwater at IRP Sites No. 7 and No. 8.

6.2.6 Analytical Methods

Groundwater samples collected at IRP Site No. 7 and No. 8 will be analyzed for chlorinated solvents, (United States Environmental Protection Agency (USEPA) Method SW846-8010), benzene, toluene, ethylbenzene, and xylenes (BTEX) (USEPA Method SW846-8020), TPH (Modified Method 8015), and priority pollutant metals (PPM) (USEPA Method SW846-6010/7000). A summary of the laboratory analyses is presented in Table 6.2.

6.2.7 Free Product Thickness Test

Free-product thickness will be measured in existing monitoring well 7-MW1 and newly installed wells at IRP Site No. 7, if free product exists. Measurements will be conducted based on 10-minute intervals for a total of four hours. Graphical presentation of product thickness versus time will be plotted on semi-log paper to determine the actual thickness of free product in the wells and recharge rate.

6.2.8 Recompletion of Existing Monitoring Well Surface Completion

Four existing monitoring wells' surface completion at IRP Sites No. 6, No. 7, and No. 8 (7-MW1, 6-MW1, 8-MW1, and BG-1) will be recompleted to prevent surface water run-off entering wells. The existing manholes will be removed and replaced with a new manhole and grouted with Portland cement.

6.2.9 Disposal of Investigation Derived Wastes

Soil cuttings generated during previous RI investigations, and cuttings which will be collected during this investigation, will be spread into a diked cell over 4-mil poly sheeting in a designated area located at the northwest corner of the Base. The soil will be 6 inches thick and will be overturned periodically to allow air and moisture to penetrate into the soil mass to improve natural biological activities.

6.3 OPTIONAL WORK

Optional field work may be conducted at IRP Sites No. 7 and No. 8 upon receiving an official notice to proceed from the NGB Contracting Officer.

6.3.1 Vacuum-Enhanced Pump and Treat Pilot Test

Upon completion of monitoring well installation at IRP Sites No. 7 and No. 8, and evaluation of the groundwater analytical results from the first round of sampling event, a pilot vacuum-enhanced pump and treat test may be conducted on one well at each of the IRP Sites No. 7 and No. 8.

The pilot test will be performed for a period of 8 hours, unless the system stabilizes within 4 or less hours. At least two observation wells at each site will be used to monitor changes in the subsurface system (groundwater level and air flow). Results will be used to evaluate removal action alternatives.

6.3.2 Bedrock Coring

One monitoring well location at each of the IRP Sites No. 7 and No. 8 will be cored to identify the natural fracture system and their orientation. Continuous bedrock cores will be collected from a depth of 20 to 70 feet, and be submitted to a fixed-Base laboratory for fracture analysis. Fracture analysis will be used to evaluate removal action alternatives.

6.3.3 Video Examination of Boreholes

Upon completion of drilling the boreholes for the monitoring wells, a video examination of these boreholes at each IRP Sites No. 7 and No. 8 will be performed to identify the locations and possibly orientation of bedrock fracture system.

6.3.4 Monitoring Well Installation

Four, 4-inch-diameter, flush-mounted, bedrock monitoring wells will be installed at IRP Sites No. 7 and No. 8, if required. Two rounds of water-level measurements and groundwater samples will be collected. The groundwater water samples will be analyzed for chlorinated solvents, BTEX, TPH, and PPM.

6.4 FIELD INVESTIGATION ACTIVITIES

6.4.1 IRP Site No. 7 - Dry Well Off Corrosion Control Building (Building 23)

6.4.1.1 Monitoring Well Installation

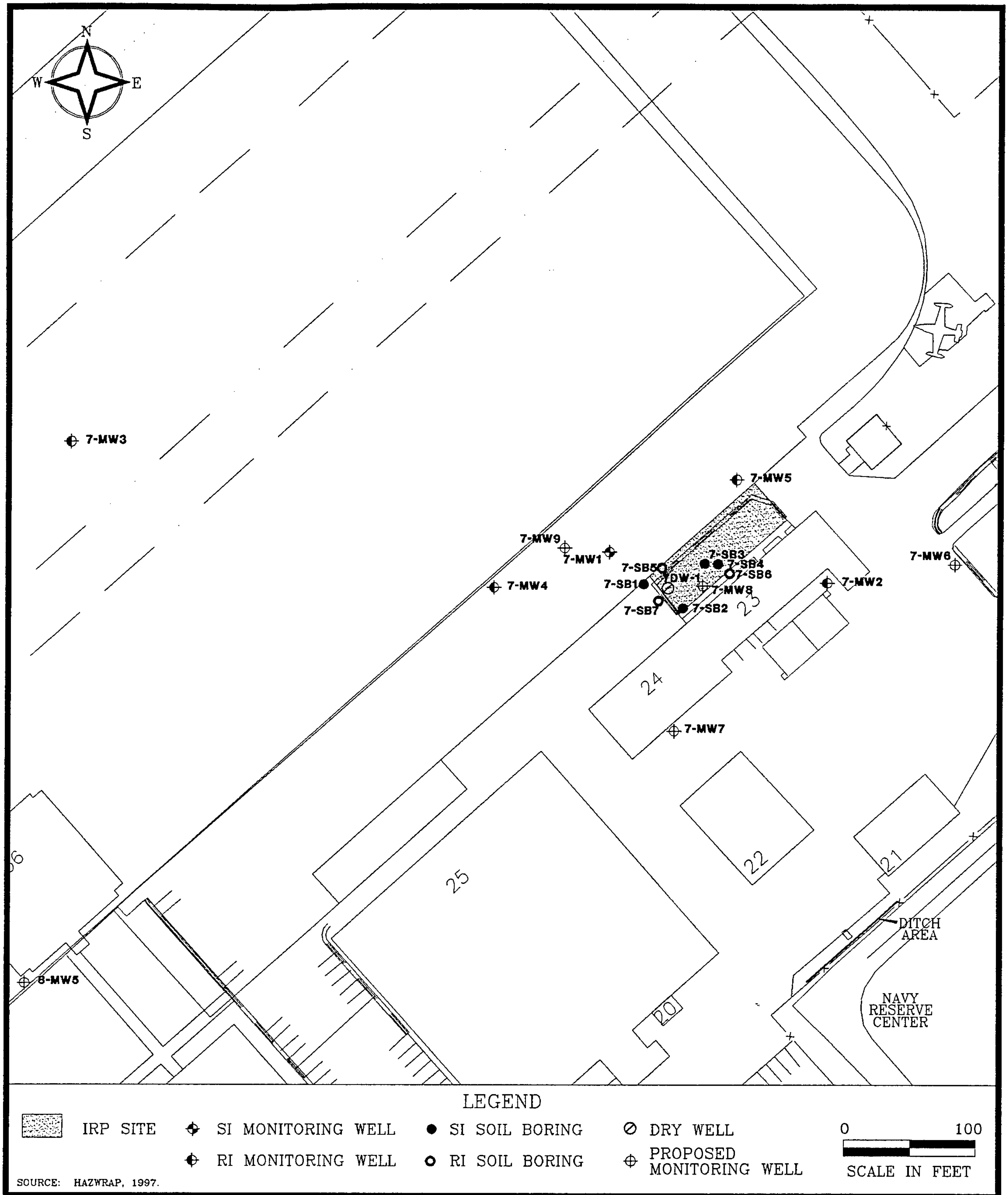
Groundwater data collected during the SI and RI indicated fuel-related contamination near IRP Site No. 7. To characterize the extent and migration pathways of contamination, four additional monitoring wells (7-MW6, 7-MW7, 7-MW8 and 7-MW9) will be installed (Figure 6.1). Monitoring well 7-MW6 will be located east of the dry well as upgradient control, and to determine if contaminants are coming from outside sources. Monitoring well 7-MW8 will be located south of the dry well to define the extent of free product at the site. Monitoring well 7-MW9 will act as downgradient control for IRP Site No. 7 to identify the extent of free product in monitoring well 7-MW1, if it exists. Monitoring well 7-MW7 will be located 150 feet south of the dry well and will be used to determine the extent of groundwater contamination. Data from the newly installed monitoring wells, and data collected from existing monitoring wells, will assist in defining groundwater contamination extent and presence of free product. Monitoring well installation procedures are discussed in Section 7.1.4.

6.4.1.2 Groundwater Sampling

Two rounds of groundwater samples will be collected from the existing monitoring wells and the newly installed monitoring wells at IRP Site No. 7 using the procedures outlined in Subsection 8.1.2. Groundwater temperature, pH, turbidity, and PID measurements will be measured and recorded in the field. Documentation and calibration procedures for field measurements are discussed in the project QAPP, Appendix B.

6.4.1.3 Groundwater-Level Data Collection

Three rounds of water-level measurements will be collected from the existing monitoring wells, and two rounds of water-level measurements will be collected from the newly installed monitoring wells during the field investigation. One round will be taken prior to installing the new monitoring wells to insure current groundwater flow direction. Two rounds of water-



SOURCE: HAZWRAP, 1997.

FIGURE 6.1

GF-EECA\SAMP-7

IRP SITE NO.7 EXISTING AND PROPOSED SAMPLING LOCATIONS
120th FW, Montana Air National Guard
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level measurements will be obtained from each new well, concurrent with measurements in existing wells. The groundwater-level data will be used for the interpretation of the potentiometric surface to determine the direction of groundwater movement. The average hydraulic gradient will be estimated from the potentiometric surface map.

6.4.1.4 Analytical Parameters

Soils samples will be collected from each of the monitoring well drilling locations and screened to ensure that no measurable VOCs are present in the vadose zone prior to monitoring well installation. The drill cuttings will be scanned with a PID for organic vapors. Groundwater samples will be submitted for fixed-base laboratory analyses. Groundwater samples will be analyzed for chlorinated solvents, TPH, BTEX and metals (filtered and unfiltered) (Table 6.2). Analytical methods are discussed in Subsection 6.2.6 and the QAPP, Appendix B.

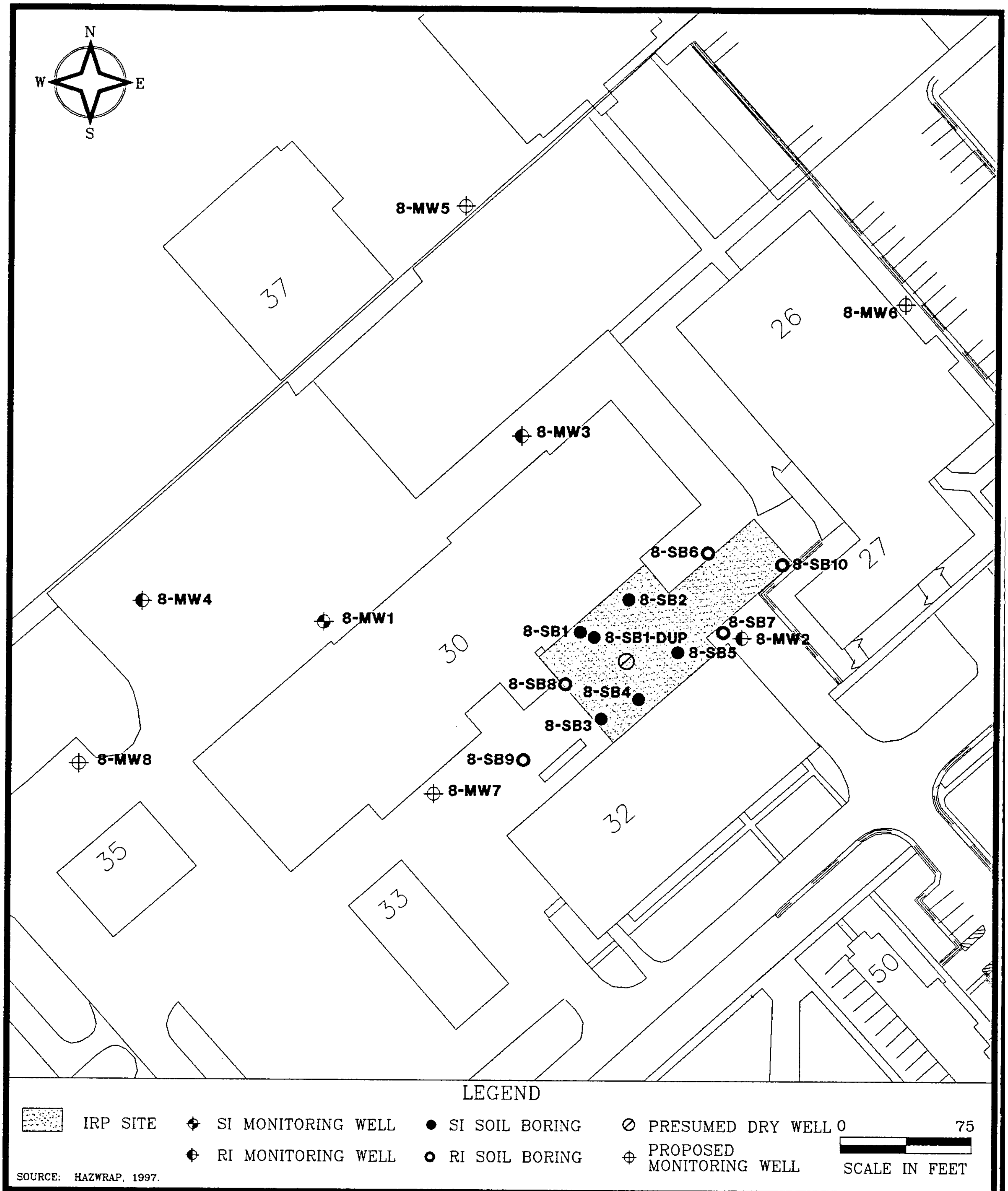
6.4.1.5 Aquifer Testing

Rising head and falling head slug tests will be conducted on two newly installed monitoring wells (7-MW6 and 7-MW8) at IRP Site No. 7 to determine the hydraulic conductivity of the hydrologic unit within the screened interval. Aquifer test procedures are presented in Subsection 7.1.9.

6.4.2 IRP Site No. 8 - Dry Well Off Composite Maintenance Building (Building 32)

6.4.2.1 Monitoring Well Installation

Groundwater contamination was found during the SI and RI at monitoring wells 8-MW1 through 8-MW4. The contaminants of concern are 1,2-dichloroethene,and trichloroethene. IRP Site No. 8 groundwater contamination was determined to be above ARARs. The source of contamination may be the solvents disposed of in the dry well located at IRP Site No. 8. Four additional monitoring wells (8-MW5, 8-MW6, 8-MW7, and 8-MW8) are proposed for IRP Site No. 8 to more fully delineate the area of groundwater contamination (Figure 6.2). Monitoring well 8-MW6 will be located northeast of the dry well, east of Building 30, to act as upgradient control of the area of groundwater contamination. Monitoring well 8-MW5 will



SOURCE: HAZWRAP, 1997.

FIGURE 6.2

GF-EECA\SAMP-8

IRP SITE NO.8 EXISTING AND PROPOSED SAMPLING LOCATIONS
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be located north of the dry well, north of Building 30, to act as downgradient control of the area of groundwater contaminatin. Monitoring well 8-MW7 will be located southwest of the area of contamination to act as upgradient control of the dry well and of 8-MW1 (where groundwater contamination was encountered during the SI and RI). Monitoring well 8-MW8 will be installed west of Building 30 to act as a downgradient-crossgradient control of 8-MW1. Groundwater samples will be collected from the existing and newly installed monitoring wells. Monitoring wll installation procedures are discussed in Subsection 7.1.4.

6.4.2.2 Groundwater Sampling

Two rounds of groundwater samples will be collected from the existing monitoring wells and the newly installed monitoring wells at IRP Site No. 7 using the procedures outlined in Subsection 8.1.2. Groundwater temperature, pH, turbidity, and PID measurements will be measured and recorded in the field. Documentation and calibration procedures for field measurements are discussed in the project QAPP.

6.4.2.3 Groundwater-Level Data Collection

Three rounds of water-level measurements will be collected from the existing monitoring wells, and two rounds of water-level measurements will be collected from the newly installed monitoring wells during the field investigation. One round will be taken prior to installing the new monitoring wells to insure current groundwater flow direction. Two rounds of water-level measurements will be obtained from each new well, concurrent with measurements in existing wells. The groundwater-level data will be used for the interpretation of the potentiometric surface to determine the direction of groundwater movement. The average hydraulic gradient will be estimated from the potentiometric surface map.

6.4.2.4 Analytical Parameters

Soil samples will be collected from each of the monitoring well drilling locations and screened to ensure that no measurable VOCs are present in the vadose zone prior to monitoring well installation. The drill cuttings will be screened with a PID for organic vapors. Groundwater samples will be submitted for fixed-Base laboratory analyses. Groundwater samples will be analyzed for chlorinated solvents, TPH, BTEX and metals (filtered and unfiltered) (Table 6.2). Analytical methods are discussed in Subsection 6.2.6 and the QAPP.

6.4.2.5 Aquifer Testing

Rising head and falling head slug tests will be conducted on two newly installed wells (8-MW6 and 8-MW8) to determine the hydraulic conductivity of the hydrologic unit within the screened interval. Aquifer test procedures are presented in Subsection 7.1.9.

Table 6.2
Drilling and Laboratory Analyses Summary Table.
120th FW, Montana Air National Guard, Great Falls, Montana

IRP Sites No.	Matrix	Fixed-Based Laboratory Analytical Parameters	Sample Quantities (two rounds)	Trip Blank	Field Blank	Field Duplicate	Remedial Design Parameters
7	Water	Chlorinated Solvents	18	7	1	4	1[a]
		TPH	18				
		BTEX	18				
		Metal (filtered and unfiltered)	36				
8	Water	Chlorinated Solvents	16	6	1	4	1[a]
		TPH	16				
		BTEX\	16				
		Metal (filtered and unfiltered)	32				

Analytical Methods:

Metals = SW846/6010-7000 Series
TPH = SW846/8015 (Diesel/ JP4 Range)
BTEX = SW846/8020
Chlorinated Solvent = SW846/8010

In addition, at each monitoring well (newly installed) where chlorinated hydrocarbons are present, the following parameters will also be measured: ferrous and ferric iron, sulfides, sulfates, and methane.

[a]-RD parameters include pH, Kjeldahl nitrogen, nitrate-nitrogen, nitrite-nitrogen, ammonia-nitrogen, total phosphorus, calcium, potassium, magnesium, sodium, chloride, heterotrophic plate count, hydrocarbon plate count, biological oxygen demand, chemical oxygen demand, total organic carbon, total suspended solids, total dissolved solids, total alkalinity, total hardness, and *in-situ* dissolved oxygen (field measurement). In addition, at each monitoring well (newly installed) where chlorinated hydrocarbons are present, the following parameters will also be measured; ferrous and ferric iron, sulfides, sulfates, and methane.

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SECTION 7.0 FIELD INVESTIGATION PROCEDURES

7.1 INVESTIGATIVE METHODS AND PROCEDURES

Mobilization includes the effort required by the contractor and subcontractors to prepare for field activities. A qualified drilling firm will be retained to install monitoring wells. The selected drilling firm will mobilize personnel and equipment to meet or exceed ANG and MDEQ requirements.

Prior to any drilling activities, the Base Civil Engineering Department will be consulted for utility locations. A general review of underground utility maps, for the area in the vicinity of the drilling site, will be made and digging permits completed and submitted to the appropriate Base personnel for approval. Any fees, permits or licenses required will be obtained prior to initiation of the field activities. In the event that any of the proposed drilling locations are found to interfere with buried utilities, the borings will be relocated as close as possible to the original location. Relocated drilling locations will be approved by the OpTech Project Manager and the ANG PM. Proposed drilling locations will be staked in the field for inspection and approval by appropriate Base personnel and the 120th FW Civil Engineer. This procedure will minimize the likelihood of damage to buried utilities. Once all activities have been completed at each specific drilling point, the location will be staked to facilitate subsequent surveying.

7.1.1 Field Operations Preparation

A qualified drilling contractor licensed in the State of Montana will be obtained for drilling boreholes and for installing monitoring wells. The selected drilling contractor will mobilize personnel and equipment to meet or exceed applicable State requirements. Montana ANG representatives will be notified to determine the location of the decontamination area prior to drilling activities.

All field personnel will be provided with the appropriate personal protective equipment (PPE), safety training and field monitoring equipment, including PID, conductivity meters, pH meters and thermometers. All field equipment will be checked out prior to mobilization to assure proper operation.

Following completion of all drilling activities, each site will be restored as closely as possible to its pre-investigation condition. Demobilization will include decontamination of equipment used on the project and site cleanup. Well sites will be inspected to ensure that the sites are clean and well covers are locked. Drilling equipment will be decontaminated, and all equipment and unused construction materials will be removed from the site.

Work at IRP Sites No. 7 and No. 8 will begin at Level D protection with frequent monitoring to assure that Level D is appropriate. Protection Level C equipment and trained personnel will be available so that work can proceed at Level C, if required. All contractor and subcontractor personnel will adhere to the OpTech HASP requirements, and will be capable of working at Level C. All work will be performed in a manner consistent with MDEQ laws and regulations.

A qualified laboratory will be contracted prior to mobilization for fixed-base confirmatory analysis. Fixed-base laboratory analysis will meet or exceed definitive data quality requirements. Provisions will be made with the fixed-base laboratory for securing the proper sample containers, labels, chain-of-custody forms, sample stabilization supplies, insulated sample shipping containers, packing materials, and procedures for receiving of shipments by the laboratory. Fixed-base laboratory sample collection requirements including sample volume, preservation, holding times and sample custody are discussed in the QAPP (Appendix B).

7.1.2 Land Survey

Upon completion of drilling activities, all newly installed monitoring wells at IRP Sites No. 7 and No. 8 will be surveyed by the State-licensed surveyor. The horizontal and vertical positions of all borings and wells surveyed by the State-licensed surveyor will be to a horizontal accuracy of ±0.1 foot and a vertical accuracy of ±0.01 foot, and tied to a permanent marker near the site. The permanent marker will be tied to the National Geodetic Vertical Datum of 1929.

7.1.3 Water-Level Measurements

Groundwater level data will be collected as part of the field effort. Water levels will be measured using an electric water-level indicator or an interface probe. Data will be collected from all monitoring wells during field operations. After well development, water levels in the monitoring wells will be permitted to stabilize for a minimum of 24 hours before water-level measurements are taken. Each measurement will be made from a known point of elevation marked on the well casing, as surveyed by a Montana registered licensed surveyor. For all wells, the reference point will be the north side of the casing.

All equipment used for water-level measurements will be calibrated and decontaminated prior to mobilization to the first well. The static water level will be measured from the north side of each well, and the reference point will be marked on each well casing. The total depth of the wells will be measured to the nearest 0.01 foot, and the equipment decontaminated before moving to the next location.

7.1.4 Monitoring Well Installation

Monitoring wells will be used to obtain groundwater samples for the evaluation of contamination and migration pathways. These monitoring wells will be constructed to permit use as product extraction wells. All monitoring wells will be constructed in accordance with current Montana regulations and will be installed by a licensed well driller. In addition, all permits required for well construction will be obtained.

Prior to finalizing the new monitoring well locations at each site, water-level measurements will be collected from existing monitoring wells at IRP Sites No. 7 and No. 8 in order to determine the current groundwater elevation and flow direction.

Monitoring wells will be constructed of 4-inch-diameter, Schedule 40 polyvinyl chloride (PVC), flush-threaded riser pipe with a 10-foot PVC screen which meet Montana regulations. The screens will be 0.010-inch machine-slotted and fitted with a bottom cap, and the riser will be topped with a locking air-tight cap. In choosing both depth and length of the well screens, annual fluctuation of the water table has been taken into consideration. The well construction materials will be decontaminated before installation in the boreholes. The anticipated depth for all monitoring wells is approximately 70 feet.

Prior to placement of well materials into the borehole, the well string will be centered and suspended such that it does not rest on the bottom of the borehole. The sand pack will be silica sand certified clean by the manufacturer, with a 20/40 sieve size. Based on previous investigations, the sand pack and screen slot size have been designed such that the screen does not become plugged and aquifer material is not introduced into the well annulus. As the sand pack is emplaced, approximately 6 inches of sand will be allowed to flow into the space between the bottom of the well string and the bottom of the borehole. All risers will be set round, plumb, and true to line. Three centralizers will be used in each well to assure alignment of the wells.

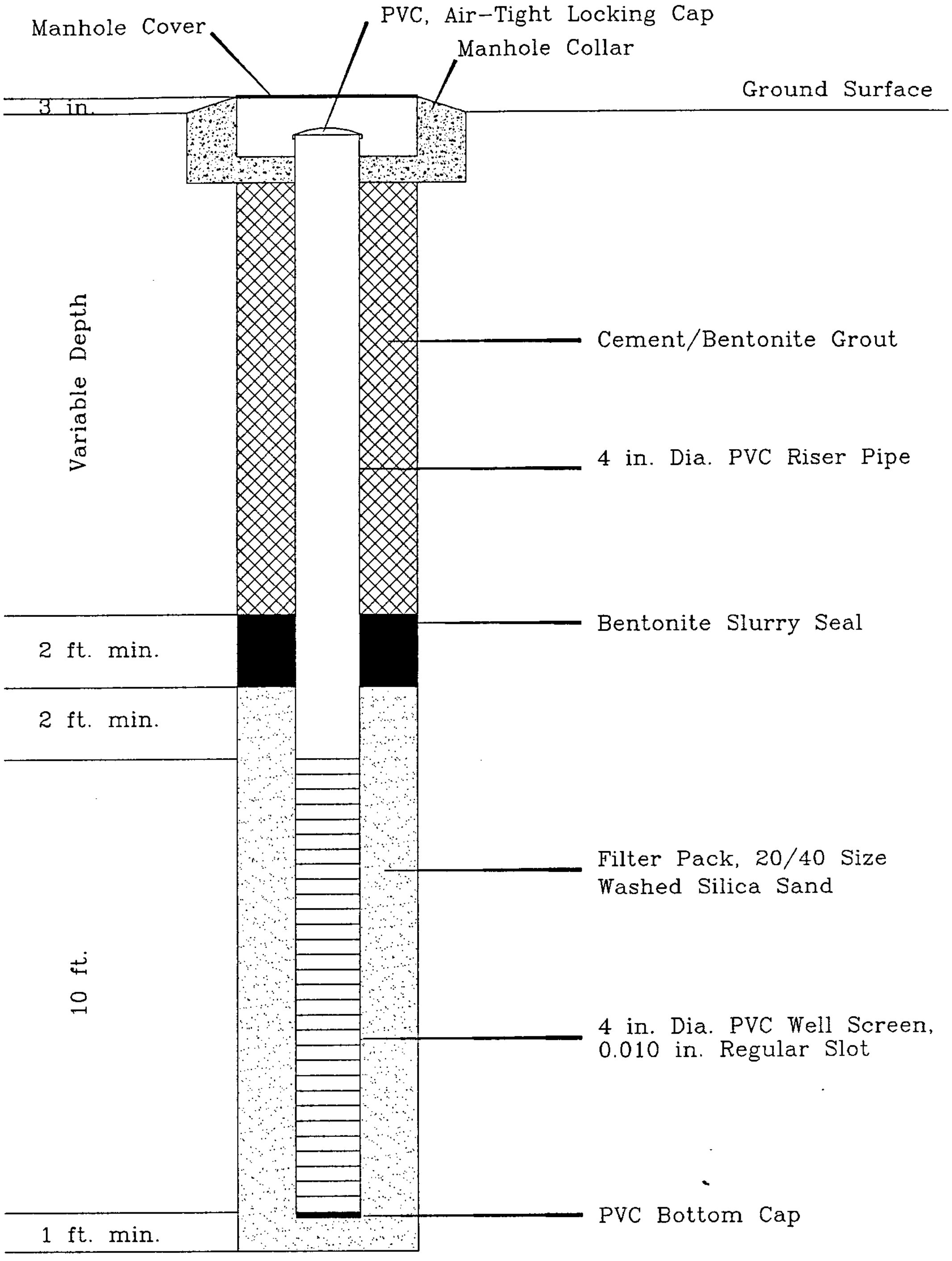
The sand pack will be placed from the bottom of the borehole to at least 2 feet above the top of the well screen by the tremie pipe method. Potable water may be used to aid the emplacement of the sand pack, and will be analyzed at a fixed-base laboratory via field blank samples.

A 2-foot layer of 100 percent sodium bentonite seal will be placed into the annulus on top of the sand pack. A hydrated bentonite slurry will be used. A grout mixture will be placed from the top of the bentonite seal to the ground surface. The grout mixture will be mixed at the following proportions: 94 pounds of neat Type 1 Portland or American Petroleum Institute Class A cement to not more than 4 pounds of 100 percent sodium bentonite powder with not more than 8 gallons of water. In accordance with the Statement of Work (SOW), all wells will be completed by flush surface mount. The casing will be cut 2 to 3 inches BLS and fitted with a protective locking lid consisting of a cast-iron valve box assembly. The valve box will be placed in the center of the hole with the top just above the ground surface. Concrete will be placed around the value box and sloped to divert drainage. The well head will also be fitted with a locking air-tight cap. The well number will be clearly marked on the valve box lid and well casing. All well assemblies will be secured with keyed-alike brass or stainless-steel locks. The well lock keys and copies of all well installation and registration paperwork will be provided to the 120th FW on-site representative. Figure 7.1 shows a typical monitoring well construction configuration.

7.1.5 Air Monitoring During Drilling

During all drilling operations, a PID will be used to monitor the breathing zone for organic vapors to determine the need for respiratory protection.

Additionally, a combustible gas indicator (CGI) will be used during drilling operations to monitor for explosive gases. Special actions will be required if explosive vapors reach 10% of



NOT TO SCALE

FIGURE 7.1

GR-EECA\FLUSH

TYPICAL FLUSH MOUNT
MONITORING WELL CONSTRUCTION
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the lower explosive limit (LEL). These actions are described in the site Health and Safety Plan, Appendix A.

7.1.6 Monitoring Well Development

The wells will be developed between 24 to 48 hours after installation and completion to allow sufficient time for the grout to set. The monitoring wells will be developed by gentle surging without the use of any type of acids, dispersing agents or explosives. No water or other liquid will be introduced into the well during development other than formation water from that well. Care will be exercised to ensure that the screen is not damaged during development. Water from well development will be retained in 1,000 gallon polyethylene tanks. After development, the wells shall stabilize a minimum of one day prior to purging and sampling. A bailer will be used to develop monitoring wells.

The water levels in each well will be measured before development begins. An electric water-level indicator accurate to ±0.01 feet will be used to measure the depth to water from a prescribed point on the well casing.

Stabilization and recovery testing will be conducted at each well location. For this testing, the specific conductance, pH and temperature will be measured at intervals of one well volume until three successive readings yield equivalent values within the following for each parameter:

Specific Conductance (temperature corrected): ± 10 millimhos (mmhos)
pH: ± 0.1 pH units
Temperature: ± 0.5° Celsius (C)

The volume of water present in the well will be calculated as follows:

Volume of well in gallons = (0.0408) x (Well diameter in inches)^2 x (Ft. of water column)

Well development will continue until the temperature, specific conductance, and pH have stabilized and the groundwater removed is clear and free from sand. A record as to how much water was removed during the development of the well will be maintained. Physical and chemical parameters including temperature, pH and specific conductance of the water will be measured during well development.

A brief discussion of the procedures involved in conducting these field measurements are discussed below:

Temperature Measurement

The temperature of the water will be measured using a certified mercury thermometer. The mercury thermometer will also be used to check the electronic digital thermometer that will be used to provide temperature compensation for the pH and conductivity meter. The mercury thermometer and electronic digital thermometer will be decontaminated prior to use.

pH Measurement

The pH of the water will be measured using a portable pH meter. The meter will be calibrated daily using buffer solutions of the appropriate range of expected pH values. The meter will also berecalibrated periodically during periods of continued use as recommended by the manufacturer. The probe of the pH meter will be decontaminated prior to each use.

Specific Conductance Measurement

The specific conductance of the water will be measured with a portable specific conductance meter. A standard potassium chloride solution will be used to calibrate the instrument daily. The meter will also be recalibrated periodically during periods of continued use as recommended by the manufacturer. The probe of the specific conductance meter will be decontaminated prior to each use.

7.1.7 Documentation of Field Activities

7.1.7.1 Borehole Logging

An experienced geologist will be present at the operating drill rig for logging samples, monitoring drilling operations, recording soil and groundwater data, monitoring and recording well installation procedures of that rig, and preparing boring logs and well diagrams. The lithology recorded by the geologist during the drilling of each borehole will be based on visual inspection of soil sampled supplemented by examination of drill cuttings. Material will be classified using the Unified Soil Classification System and described according to American Society for Testing and Materials (ASTM) D2488-69, "Description of Soils (Visual Manual Procedure)."

The following information will be logged for each boring;

- Boring identification number;
- Name of driller and geologist;
- Method of drilling;
- Bit size;
- Sampling method and depth;
- PID readings;
- Hole location and elevation;
- Reference elevations for all depth measurements;
- Detailed soil descriptions, including soil moisture/saturation condition;
- Depth at which each distinct stratum is at which each distinct stratum is encountered;
- Depth at which groundwater is first encountered while drilling;
- Depth of completed boring or well;
- Location of any fractures, joints, faults, cavities, or weathered zones identified; and
- Signatures of those performing this work.

7.1.7.2 Monitoring Well Development

The following information will be recorded in a field log for developing each monitoring well:

- Date;
- Well number and location;
- Reference evaluations for all depth measurements;
- Depth at which groundwater is first encountered while drilling and 24 hours after completion;
- Depth of complete well;
- Depth and type of well casing;
- Static water level upon completion of the well and after development

- Depth to water table before development begins;
- Total volume of groundwater recovered;
- Depth to top of the screen;
- Pertinent construction details, such as description of sand pack material;
- Purge method and rate;
- Documentation of pH and specific conductance meter calibration;
- Temperature, pH and specific conductance measure for the initial groundwater sample and for subsequent sampling; and
- Signatures of those peforming the work.

7.1.8 Free Product Measurement

Free product thickness will be measured at IRP Site No. 7, existing monitoring well 7-MW1 and newly installed wells, if free product exists. An empirical test method (T.S. Gruszczenski, 1989) will be performed to measure product thickness by bailing out fluids, and the rising water/product levels are recorded with time (every 10 minutes), using an oil/water interface probe.

The recorded rising water/product level results will be plotted on a semi-log paper. The inflection point on the curve will be used to interpret the actual equilibrium point during the accumulation of water and product.

7.1.9 Aquifer Testing

Additional hydrogeologic characteristics of the hydrologic unit will be determined at IRP Sites No. 7 and No. 8 to aid in estimating travel time associated with contaminant movement. The parameters needed to calculate these estimates include the hydraulic conductivity of the hydrologic unit. Slug tests are proposed for the newly installed monitoring wells 7-MW6 and 7-MW7 at IRP Site No. 7, and at 8-MW5 and 8-MW6 at IRP Site No. 8. Both rising head and falling head slug tests will be performed. The wells will be opened, a PID reading taken, and the total depth of the well and static water level recorded. A decontaminated slug, constructed of PVC (solid), is lowered into the water column as quickly as possible without causing the water in the well to be greatly disturbed or introducing outside water into the well. The slug is lowered below the water surface until maximum displacement of water has occurred. After the water level rises in response to the slug, the water level in the well drops towards the initial static level. The slug is removed from the well after the pre-displacement water level has been reached. The water level will initially drop as the slug is being removed from the water, and then rise toward the initial static level in the well. The drop and rise in water level will then be measured at closely spaced time intervals using an *In-Situ* Hermit Data Logger, Model 1000C. The resulting data obtained while the water level is dropping and rising to its static level are used to compute hydraulic conductivity using the slug test analysis methods of Bouwer and Rice (1976) and Bouwer (1989), if judged to be appropriate based on site hydrogeologic characteristics. Hydraulic conductivity and porosity of the hydrologic unit will be estimated based on the information gathered, and will be used to calculate the average linear velocity of groundwater at IRP Sites No. 7 and No. 8.

7.1.10 Demobilization Activities

Demobilization will occur after completion of field activities and will include decontamination of equipment used on the project and completion of site cleanup. All wells and boring sites will be inspected to ensure that the sites are clean and well covers are locked before departure. All sampling equipment and drilling equipment will be decontaminated away from the monitoring well sites, in the designated decontamination area prior to departure. The PM will be responsible for ensuring that the decontamination area is kept clean and orderly. All decontaminated equipment and unused construction materials will be removed from the sites. Following completion of all drilling activities, each site will be restored as closely as possible to its pre-investigation condition. Prior to demobilization, soil cuttings to be remediated, and which are contained in 55-gallon drums, will be spread over poly sheeting in a designated area. All IDW, including IDW generated during past IRP activities will be disposed of or removed from the Base.

SECTION 8.0 SAMPLE AND DATA COLLECTION PROCEDURES

Based on requirements of the Statement of Work and the ANG, groundwater samples collected at IRP Site No. 7 and No. 8 will be analyzed for chlorinated solvents, TPH, BTEX, and limited remedial design parameters.

8.1 GROUNDWATER

Specific sample collection procedures and protocols associated with the sampling, sample handling, shipment, and analysis are presented in this section and the Corporate Environmental Quality Assurance/Quality Control Plan (CEQP) (OpTech, 1992).

8.1.1 Well Purging Procedures

Each monitoring well will be purged immediately prior to sample collection. Well purging equipment will be positioned so that any potential volatile organic source, such as vehicles or air compressors, are downwind of the well. This will preclude contamination caused by entrainment of volatile contaminants in the sample from these sources.

Monitoring wells will be purged using a bailer decontaminated prior to use or a disposable bailer. Purging is considered complete when the indicator parameters of pH, temperature, and conductivity have stabilized and the volume of water in the screen and well casing have been removed from the well three times. If well yield is sufficient, additional well volumes may be removed until the temperature, specific conductance, and pH of the well have stabilized. Wells that recharge extremely slowly will be purged dry, allowed to recharge, and purged again. The amount of fluid purged will be measured and recorded.

A 5-gallon bucket (or similar container of known capacity) will be used to measure the amount of water removed from the well during the purging process. Purged water will be collected in steel, plastic-lined 55-gallon drums, segregated by well. Proper management and disposal of water will be determined after sampling has been completed and laboratory analyses results have been obtained.

8.1.2 Groundwater Sampling Procedures

Groundwater samples will be collected from the five existing monitoring wells and four newly installed wells at IRP Site No. 7 and from the four existing monitoring wells and four newly installed monitoring wells at IRP Site No. 8 (Table 6.1). Groundwater samples will be collected according to the following procedures:

- Groundwater samples will not be collected until at least 24 to 48 hours after development of newly installed monitoring wells (wells must be allowed to reach equilibrium).

- Before wells are purged and sampled, well headspace will be checked for organic vapors using a PID.

- Immediately prior to collecting samples, the static water level below the top of the casing in the wells will be measured and recorded in the field notebook.

- Whenever feasible, monitoring wells expected to be uncontaminated will be sampled first, followed by wells with increasing potential of contamination.

- Prior to sample collection, the volume of water in the screen and well casing will be purged three times. If well yield is sufficient, additional well volumes may be removed until the temperature, specific conductance, and pH of the well have stabilized. Wells that recharge extremely slow will be purged dry, allowed to recharge to a sufficient volume, and purged again. The amount of fluid purged will be measured and recorded. The groundwater level will be allowed to return to approximately static conditions before collecting groundwater samples.

- Wells will be sampled using decontaminated Teflon™ bailers and new polyvinyl rope (a new line will be used for each well).

- All sampling equipment will be kept off contaminated soil to prevent cross-contamination of the samples (e.g., equipment will be placed on polyethylene plastic sheeting).

- The bailer will be gently lowered its full length through the air/water interface in order to retrieve a groundwater sample with minimal disturbance to the sample and groundwater column.

- Any free-floating product on top of the water table which is detected by the sample, by odor, or by its adherence to the water level gauge will be measured to determine its thickness. The product thickness will be determined using an oil/water interface probe. After the water level and product measurements have been made, a minimum of three borehole volumes of water will be removed from the well. Field measurements of groundwater temperature, pH, turbidity, and conductivity will be measured to ensure that the well has stabilized after three volumes. If the well has not stabilized, then two more volumes may be purged for a total maximum of five borehole volumes. The water in the well will be allowed to recover near its original level before samples are collected (80% of the original static water level). If the yield is less than three well volumes, it will be purged dry and allowed to recover. Water samples will then be collected within 24 hours.

8.2 FIELD QUALITY CONTROL

Field duplicate samples, field blanks, and trip blanks will be submitted to the analytical laboratory for assessment of the quality of data resulting from the field sampling program. Field and trip blank samples will be analyzed to check for ambient conditions at the site that may have caused sample contamination.

One field duplicate will be collected for every 10 or fewer investigative samples per sample matrix. One field blank will be collected per field event consisting of ASTM Type II water. One laboratory-prepared VOC analysis trip blank, consisting of distilled, de-ionized, or ultra pure water, will be included along with each shipment of samples.

All samples will be chilled to 4° C or less and maintained at or below that temperature during transport and subsequent storage at the analytical laboratory. Sample cooling will be accomplished by placing double-bagged ice in the coolers to chill samples. Prior to shipping, ice will be refreshed, if necessary, to maintain the proper sample temperature. In no case will samples be retained on-site over 24 hours.

The quality control level of effort for the field measurement of pH consists of a pre-measurement calibration and a post-measurement verification using two standard reference solutions each time. This procedure will be performed at least once per day or more often as necessary. The quality control effort for field conductivity measurements will include a daily calibration of the instrument using standard solutions of known conductivity.

SECTION 9.0 SUMMARY OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

During any environmental investigation, a variety of Federal, State, and local regulations or requirements may govern specific actions. This section provides a brief summary of potential ARARs that have been identified.

9.1 INTRODUCTION

Generally, ARARs are used in determining the appropriate extent of site cleanup, developing site-specific remedial response directives, formulating removal action objectives and alternatives, and directing site cleanup under the selected actions. ARARs not only guide the selection and evaluation of EE/CA removal action objectives, but also provide guidelines for any field investigations performed. Preliminary ARARs help focus field activities that provide data needed for the EE/CA, and also provide guidance for conducting field work in an environmentally sound manner. ARARs are reevaluated and either refined or expanded as field work progresses and as more information about a particular site is collected.

As described in the National Oil and Hazardous Substance Pollution Contingency Plan (NCP), ARARs are categorized into three groups. Location-specific ARARs pertain to existing natural features (e.g., wetlands, streams, floodplains, and sensitive ecosystems), man-made site features (e.g., existing landfills and disposal areas), and places of historic or archaeological significance. Chemical-specific ARARs are usually health- or risk-based standards that limit the concentration of a chemical found in or discharged to the environment. Action-specific ARARs are usually technology- or activity-based limitations that control actions at hazardous waste sites and thereby pertain to proposed site remedies.

9.2 SUMMARY OF POTENTIAL ARARs

Section 120 of CERCLA, as amended by SARA of 1986, addresses the management of Federal facilities. The IRP has been designed to mirror SI requirements under CERCLA. Federal Resource Conservation and Recovery Act (RCRA) regulations govern investigation derived waste (IDW) from field investigation activities.

Federal regulations promulgated pursuant to the Safe Drinking Water Act (SDWA) govern the quality, usage, and discharge of groundwater used as a public drinking water supply. MCLs specified in 40 Code of Federal Regulations (CFR) 141.11-141.16 are legally enforceable Federal drinking water standards established by USEPA. Maximum contaminant level goals (MCLGs) specified in 40 CFR 141.50-141.52 are nonenforceable, health-based goals for drinking water.

The Federal Clean Water Act (CWA) and pursuant regulations provide potential location, chemical, and action-specific ARARs for IRP activities at the Base. USEPA has promulgated Ambient Water Quality Criteria (AWQC) for surface water through 40 CFR 131. Aligned with Federal CWA criteria, the standard governing AWQC presents scientific data and guidance on the environmental effects of pollutants, rather than establishing only regulatory requirements.

National Pollutant Discharge Elimination Systems (NPDES) regulations govern discharges to surface water and control surface water runoff from Base stormwater discharge systems. Promulgation of CWA Section 402 and formal ARARs are established for NPDES through 40 CFR 122 and 40 CFR 125, and provide action- and chemical-specific ARARs.

All site operations are governed by Occupational Safety and Health Act (OSHA) standards of health and safety under 29 CFR 1910. Other applicable OSHA ARARs include health and safety for Federal service contracts (29 CFR 1926) and recordkeeping and reporting under 29 CFR 1904.

If material containing hazardous wastes is to be transported off-site, United States Department of Transportation (USDOT) hazardous material transportation requirements in 49 CFR 171-179, pursuant to the Federal Hazardous Materials Transportation Act, may be action-specific ARARs for field investigation activities. These requirements are supplemental to RCRA transporter requirements in 40 CFR 263.

The Federal Clean Air Act (CAA) may provide action- and chemical-specific ARARs for IRP activities, including subsequent field investigations and removal actions, which may include soil excavation or incineration. All removal action activities must comply with National Primary and Secondary Ambient Air Quality Standards found in 40 CFR 50. Rules governing particulate matter less than 10 microns in size (PM_{10}) are contained in 40 CFR 50, and are important from the potential detrimental effects of such particles on the lungs.

9.3 FEDERAL GUIDANCE TO BE CONSIDERED

In addition to Federal and State requirements that may be applicable or relevant and appropriate to IRP activities, Federal nonregulatory criteria must be considered. These chemical-specific criteria, used to help characterize risks and to set cleanup goals, include the following:

- Risk Reference Doses;
- Health Advisories;
- Carcinogen Assessment Group Potency Factors;
- Acceptable Intake Values, Chronic and Subchronic; and
- USEPA Guidance on water-related fate of 129 priority pollutants.

9.4 STATE REQUIREMENTS

In addition to Federal ARARs, several State of Montana regulations may be applicable or relevant and appropriate to EE/CA activities and potential remedial alternatives at the Montana ANG.

Montana Hazardous Waste and Underground Storage Act. The MDEQ regulates Underground Storage Tanks (USTs), imposing requirements for release detection notification and reporting, corrective actions, closures, and other subjects. If during the course of the investigation an UST is found to be leaking, these ARARs will become applicable action-specific standards.

Montana Comprehensive Environmental Cleanup and Responsibility Act (CECRA). The MDEQ regulates State superfund sites under CECRA, a regulatory program which parallels the Federal CERCLA program. CECRA may provide applicable requirements for EE/CA and remedial activities at the 120th FW site.

Montana Hazardous Waste Management Regulations. Rules and criteria for the identification, storage, treatment, transportation, and disposal of hazardous wastes are established in these regulations. These regulations provide potential applicable ARARs for EE/CA activities involving the movement or removal of hazardous wastes.

Montana Numeric Water Quality Standards. Standards have been written to supplement Federal water quality requirements and may be considered potential applicable action- or chemical-specific ARARs for the EE/CA or planned remedial actions. The MDEQ regulates all public water supplies in the State and has established applicable MCLs which may be used as cleanup levels for remedial activities.

Montana Remedial Action Regulations for Hazardous Substance Spills. The MDEQ uses these regulations as baseline guidance when considering candidate remedial activities and in analyzing contaminants among sites requiring remedial action. These regulations provide potential applicable ARARs for EE/CA activities and subsequent remedial actions.

9.5 LOCATION-SPECIFIC ARARs

There are no wetlands or surface water bodies either on-site or downgradient of the sites. As stated previously, however, new information discovered during the field investigation and subsequent laboratory analyses may broaden the initial set of project ARARs.

SECTION 10.0 CONTAMINANT FATE AND TRANSPORT

10.1 OBJECTIVES

General concepts, and specific chemical and physical properties which will affect the transport of identified contaminants at each site, will be evaluated with respect to the geologic and hydrogeologic conditions at each site. From this information, fate and transport will be evaluated.

10.2 DATA REQUIREMENTS

The following items will be addressed at each site where any contamination is found:

- Potential routes of migration;
- Contaminant persistence and degradation;
- Contaminant mobility and migration;
- Contaminant migration in soil; and
- Contaminant migration in groundwater.

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SECTION 11.0 BASELINE RISK ASSESSMENT PROCEDURES

This section will include procedures for conducting a baseline risk assessment at IRP Sites No. 7, and No. 8. The risk assessment will be conducted in accordance with methodology described in the Risk Assessment Guidance for Superfund Public Health Evaluation Manual, Part A (USEPA, 1989) and the Risk Assessment Guidance for Superfund Environmental Evaluation Manual (USEPA, 1989). The risk assessment will include the items described in the following subsections.

Hazard Identification

In the event that multiple chemicals/contaminants are found to be present at a site, a subset of chemicals that pose the greatest potential risk will be selected. These chemicals/contaminants chosen for further hazard identification will be selected based on concentration and/or quantity, toxicity, detection frequency, mobility, persistence, and local background level.

Toxicity Assessment

The toxicity assessment requires collection of available evidence regarding the potential for particular contaminants to cause adverse effects in exposed individuals. This information is used in conjunction with total exposure estimates to determine the relationship between the extent of exposure to a contaminant and the increased likelihood and/or severity of adverse effects in the exposed individual.

Exposure Assessment

The objective of the exposure assessment is to estimate the type and magnitude of exposures from the contaminants found to be present or migrating from a site. The exposure assessment will include the following:

- Characterization of exposure setting and the identification of potential receptors (i.e., population) which may be at risk;
- Identification of exposure pathways, that is, identification of how contaminants may migrate from a source to an existing or potential point of human contact; and

- Quantification of the exposure, that is, estimation of magnitude, frequency and duration of the exposure. This step will also include the comparison of exposure point concentrations to Federal and State ARARs to assess the significance of detected chemicals. Other available criteria, for comparison purposes, will be obtained where ARARs are not available.

Risk Characterization

The toxicology and exposure data obtained for each considered chemical/contaminant at each site will be used to obtain a qualitative or quantitative risk characterization. An uncertainty assessment will be completed identifying all sources of uncertainty in the risk assessment and the effect of the uncertainty on the outcome (i.e. overestimate, underestimate, or unknown).

11.1 ALTERNATIVE RISK ASSESSMENT METHOD

To be consistent with the previous RI risk assessment evaluation at IRP Sites No. 7 and No. 8 (provided in Final RI Report, 1997), the preliminary risk evaluation (PRE) method may be applied upon approval by the ANG PM.

A PRE method is a screening-level risk assessment intended to identify contaminants in each affected medium that could be associated with potential adverse effects to exposed human or ecological receptors. The results of the PRE will be used to determine which sites, if any, should be investigated further or require no further action. In general, conservative (health protective) assumptions are used throughout a screening risk assessment that do not consider site-specific information in detail. This type of evaluation is particularly useful in establishing those sites that require no further action based on worst-case assumptions. The PRE is not the equivalent of a baseline risk assessment. The level of effort for the PRE differs from the baseline risk assessment. A baseline risk assessment is intended to fully characterize and quantify, on a site-specific basis with site-specific parameters, all exposures to all likely receptors across all media. The PRE is limited to a screening-level risk assessment with limited quantification and modeling based on available data.

Site-Specific Objectives of the Preliminary Risk Evaluation

The objective of the PRE is to provide data in sufficient quantity and quality to proceed to a decision point with respect to further investigation or remediation of the site if either of these is warranted. The PRE will be used to support recommendations for one of the following alternatives:

- Decision Document (DD) (no further action),
- Study Remedial Alternatives and Remedial Measure

The methodology employed for the risk evaluation phase of the project is based on principles contained in the Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Parts A and B (USEPA 1989 and 1991a); Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Part A, Supplemental Guidance, Standard Default Exposure Factors (USEPA 1991b); and Data Useability in Risk Assessment (USEPA 1992). Because USEPA Region VIII has used USEPA Region III and Region IX methods in the past for site screening and risk-based concentration development, this PRE will use the most recent version of the USEPA Region III and Region IX methods for applying risk-based concentrations (RBCs) and preliminary remediation goals (PRGs) for site screening (USEPA 1996a and b).

In evaluating risk for the EE/CA study, only groundwater data collected in this study at IRP Sites No. 7 and No. 8 will be utilized. In this method the following will be evaluated:

- Chemical of potential concern
- Chemical and physical properties of contaminants of potential concern
- Exposure evaluation
- Characterization of exposure setting including current and future land use
- Exposure pathways
- Quantification of exposure
- Toxicity assessment
- Risk characterization
- Uncertainty assessment
- Ecological preliminary risk evaluation

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SECTION 12.0 EE/CA ELEMENTS

12.1 PURPOSE AND ORGANIZATION

An EE/CA is required by the NCP for all non-time-critical removal actions. The EE/CA process provides a vehicle for public involvement in the evaluation of removal action alternatives and recommends the appropriate response. An EE/CA outline (USEPA, 1993) is given below:

EE/CA Outline

- **Executive Summary**
- **Site Characterization**
    - **Site Description and Background**
    - **Previous Removal Actions**
    - **Source, Nature, and Extent of Contamination**
    - **Analytical Data**
    - **Streamlined Risk Evaluation**
- **Identification of Removal Action Objectives**
    - **Statutory Limits on Removal Actions**
    - **Determination of Removal Scope**
    - **Determination of Removal Schedule**
    - **Planned Remedial Activities**
- **Identification and Analysis of Removal Action Alternatives**
    - **Effectiveness**
    - **Implementability**
    - **Cost**
- **Comparative Analysis of Removal Action Alternatives**
- **Recommended Removal Action Alternative**

12.2 EE/CA EXECUTIVE SUMMARY

The EE/CA Executive Summary provides a general overview of the contents of the EE/CA. It will contain a brief discussion of the site and the current or potential threat posed by conditions. The Executive Summary will also identify the scope and objectives of the removal action, as well as the removal action alternatives. Finally, this section of the EE/CA will provide information on the recommended removal action alternative.

The Executive Summary will make the contents of the EE/CA more accessible to review by the public, and is analogous in this respect to the Proposed Plan used in the remedial process. This summary can then be used in the Action Memorandum, which will include a description of the EE/CA.

12.3 SITE CHARACTERIZATION

The EE/CA will summarize available data on the physical, demographic, and other characteristics of the site and surrounding areas. These data may be available from a removal site evaluation, from previous investigations, or from other activities at the site. Documents providing information for the EE/CA will be placed in the administrative record for the site. Whatever the source, the data on the site will provide background engineering information for analysis of removal alternatives. Because of the CERCLA preference for treatment over containment or land disposal, it is important, that alternatives that employ treatment and that yield permanent solutions, be fully evaluated for non-time-critical removal actions and early RAs. Furthermore, potential differences between early action and long-term action data quality objectives and risk assessment goals will be reconciled as early as possible.

12.4 IDENTIFICATION OF REMOVAL ACTION SCOPE, GOALS, AND OBJECTIVES

Identifying the scope, goals, and objectives for a removal action is a critical step in the EE/CA and in the conduct of non-time-critical removal actions. At any release, where the lead agency determines there is a threat to public health, welfare, or the environment, a removal action may be taken to abate, prevent, minimize, stabilize, mitigate, or eliminate the release or threat of release.

These objectives will be achieved by meeting specified cleanup levels while working within the statutory limits and attaining ARARs to the extent practicable.

12.5 IDENTIFICATION AND ANALYSIS OF REMOVAL ACTION ALTERNATIVES

Based on the analysis of the nature and extent of contamination and on the cleanup objectives developed in the previous section, the ANG will identify and assess a limited number of alternatives appropriate for addressing the removal action objectives. If there is insufficient information to evaluate action alternatives, or if data quality is suspect, the ANG will collect any additional technical information needed.

12.6 COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES

Once the alternatives have been described and individually assessed against the criteria, a comparative analysis will be conducted to evaluate the relative performance of each alternative in relation to each of the criteria. This is in contrast to the preceding analysis in which each alternative was analyzed independently without consideration of other alternatives. The purpose of the comparative analysis is to identify the advantages and disadvantages of each alternative relative to one another so that key tradeoffs that would affect the remedy selection can be identified.

12.7 RECOMMENDED REMOVAL ACTION ALTERNATIVE

The EE/CA will identify the action that best satisfies the evaluation criteria based on the comparative analysis in the previous section. This description should briefly describe the evaluation process used to develop the recommended action. The ANG, in conjunction with the MDEQ, will determine the recommended action. This determination will be placed in the administrative record file concurrently with the EE/CA. This section of the EE/CA may enhance public involvement efforts by describing clearly why the alternative was recommended. Because the EE/CA is open to public comment and evaluation and because preparation of a written response to significant comments is required, the recommended alternative may not always be the final alternative selected in the Action Memorandum. The Action Memorandum and the administrative record should provide enough detail to justify the final alternative selected.

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SECTION 13.0 EQUIPMENT DECONTAMINATION PROCEDURES

In order to prevent cross-contamination, all nondedicated sampling equipment (i.e. hand augers, etc.) will be decontaminated prior to use and between samples using the following procedures. Sampling equipment will be washed using a brush and laboratory-grade detergent (AlconoxÔ), followed by a rinse with potable water, an ASTM Type II reagent water, and isopropyl alcohol. Decontaminated sampling equipment will be allowed to air dry and will be wrapped in aluminum foil. Wrapped equipment will be stored in such a manner as to reduce the potential for accidental contamination.

Testing and monitoring equipment (probes, thermometers, etc.) that come in contact with soil or groundwater samples will be decontaminated by being rinsed with an ASTM Type II reagent water, and pesticide-grade methanol. They will then be allowed to dry completely before being used. This decontamination procedure will be followed immediately after each use of the equipment.

Drilling and testing equipment (drill rig equipment, augers, PVC pipe) will be decontaminated prior to use and between monitoring well installations. Equipment will be moved to a site-specific decontamination area where the equipment will be thoroughly steam-cleaned. The decontamination area will be located near site activities to reduce the potential spread of contamination, and located upwind to reduce the chance of airborne contamination. Liquid from decontamination activities will be collected and drummed, and handled as IDW.

Auger flights, drill rig(s), and tools will be thoroughly steam-cleaned in the designated decontamination area before initial use and after the completion of each monitoring well. Likewise, all casing and screens installed in monitoring wells will be thoroughly steam-cleaned before placement within the wellbore.

Line used to lower aqueous sampling equipment into the well will be used only for the well being sampled.

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SECTION 14.0 INVESTIGATIVE DERIVED WASTE (IDW)

During the field investigations several types of solid and liquid wastes may be generated, including soil cuttings, disposable equipment and supplies, decontamination fluids, and well development and purge waters. The ultimate disposal of these wastes is dependent upon the degree of environmental contamination present at the site and the likelihood that these wastes would be similarly contaminated. Prior to demobilization, all IDW, including IDW generated during past IRP activities will be disposed of or removed from the Base. The following discussion outlines a strategy for management of these wastes.

14.1 SOIL CUTTINGS

Drill cuttings, determined by field screening to be contaminated, will be containerized upon the completion of each boring. Cuttings will be segregated by placing cuttings from one boring only into a drum (or drums) and labeled appropriately. In accordance with Montana regulations, the noncontaminated drill cuttings will be returned to their source. If it is necessary for soil to remain stockpiled overnight, it will be covered with plastic sheeting. However, all drill cuttings from the Foreign Object Damage (FOD) areas located adjacent to Site No. 7 will be containerized immediately upon the completion of those borings. Soil cuttings will be disposed or spread into cells for bioremediation at a designated Base location (to be approved by the ANG PM and MDEQ).

14.2 WELL DEVELOPMENT AND PURGE WATERS

Purge and development water from groundwater monitoring will be containerized in 55-gallon drums at the well head. The waters will then be transported to, pumped into, and stored in a poly storage tank until final disposal. A water sample will be collected and analyzed at the fixed-base laboratory to determine final disposition. Analysis will include target compounds analyzed at the fixed-based laboratory during the investigation.

14.3 DECONTAMINATION FLUIDS

Water generated from the decontamination of heavy equipment will be collected in a sump in the decontamination pad, and pumped into a poly storage tank at the decontamination pad area for disposal. Non-alcohol- or methanol-containing wastewater from decontamination of sampling equipment will be containerized separately from the alcohol- or methanol-containing wastewater and stored in poly storage containers at the decontamination area. A water sample of decontaminated waste will be collected and analyzed by the fixed-base laboratory to determine proper disposal method.

14.4 DRILLING INCIDENTALS

Discarded protective clothing, plastic, aluminum foil and other drilling incidentals will be containerized and staged in a designated staging area. Custody of all drummed material, including soil cuttings, well development and purged waste, decontamination fluids, and PPE will be properly stored and turned over to the Base at the end of the field effort.

SECTION 15.0 PROJECT SCHEDULES, MEETINGS, PUBLIC RELATIONS SUPPORT, AND MONTHLY REPORTS

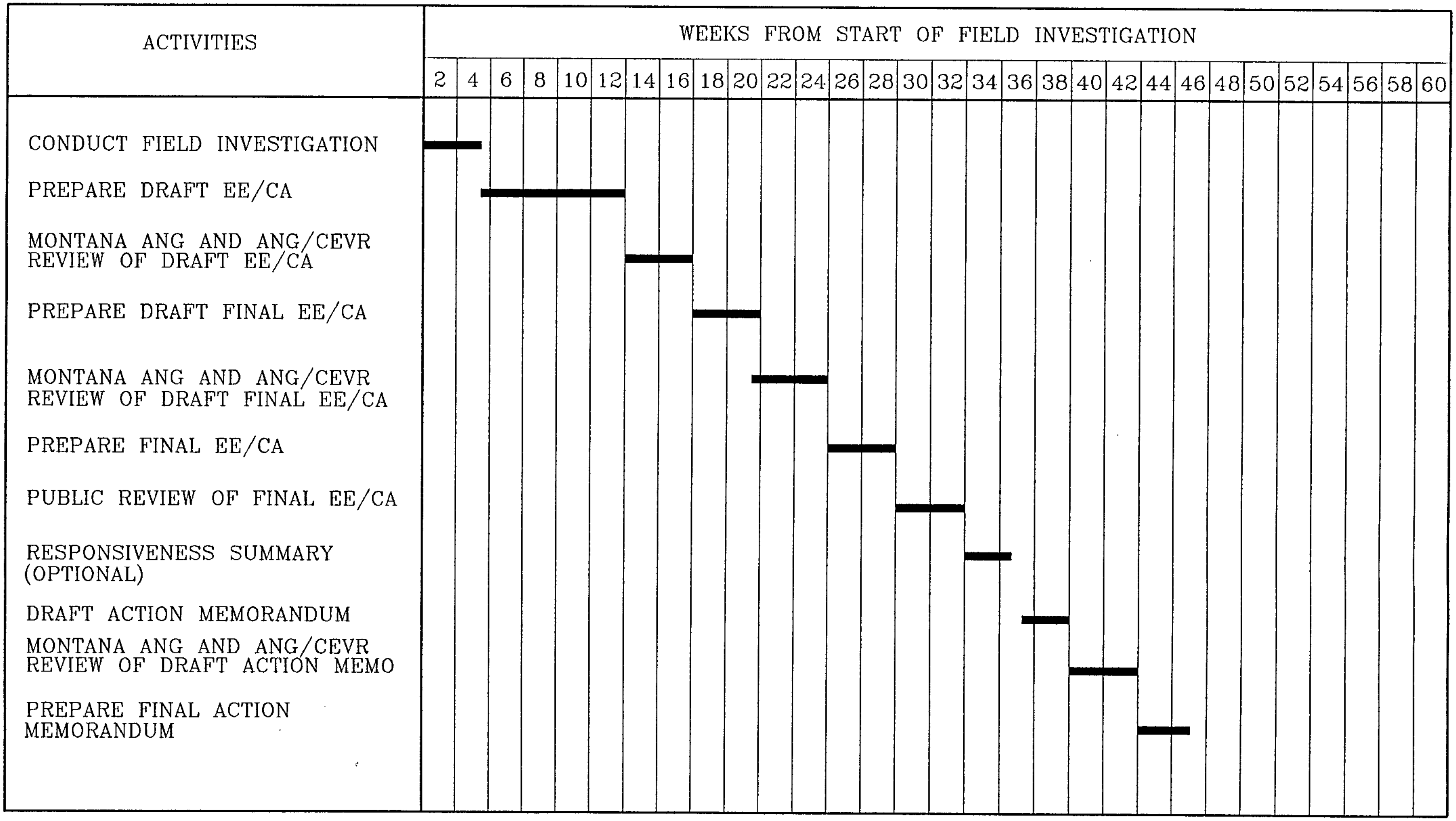
15.1 PROJECT SCHEDULE

The project schedule presented in Figure 15.1 outlines benchmark events for accomplishing preparation of the EE/CA WP and other field events. Schedule status will be revised and/or updated as necessary to reflect any significant changes to the project tasks as they are completed. Updated schedules will be submitted with the monthly progress reports to the ANG PM, with any deviations noted and explained. Significant events which may occur to affect the schedule will be reported out-of-cycle where necessary, if deemed appropriate to insure efficient project implementation.

The fieldwork implementation assumes that the majority of the field work will be performed on a scheduled five-day, 10-hour-per-day week. Field work is also assumed to be conducted at health and safety protective Level D. However, if protective Level C, or greater, is required based on more hazardous conditions than anticipated, the time required for field work implementation could lengthen significantly.

15.2 MEETINGS

Upon submittal of the EE/CA Report to the MDEQ, OpTech may be required to attend a regulatory briefing to discuss the report findings and recommendations. Within one week of meeting completion, five copies of summary minutes will be submitted to the ANG PM for review and approval. The minutes will include a summary of key issues discussed and their disposition, a list of meeting attendees with address and telephone numbers, and any other pertinent information discussed at the meeting. Upon approval, copies of the minutes will be submitted to persons included on a distribution list compiled from the meeting attendee list. Minutes will not be distributed to individuals or organizations whose names do not appear on the distribution list without prior authorization from the ANG PM.



EE/CA: ENGINEERING
EVALUATION/COST ANALYSIS

FIGURE 15.1

GR-EECA\SCHED

ENGINEERING EVALUATION/COST ANALYSIS SCHEDULE

120th FW, Montana Air National Guard
Great Falls, Montana

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SEPTEMBER 1997

15.3 PUBLIC RELATIONS SUPPORT

The 120th FW, in conjunction with the Air National Guard Readiness Center, is responsible for all community relations involving the Base. OpTech shall, however, attend all public meetings to act in a technical advisory role in support of the Base, if required. OpTech will not initiate any public or media contact, and will refer all public or media inquiry to the appropriate Air National Guard Readiness Center and Base public affairs contact. These meetings will be of varying duration and at various locations.

15.4 MONTHLY PROGRESS REPORTS

A monthly letter report summarizing contract progress to date will be submitted to the ANG PM. The report will be a management summary and will address any problems encountered in completing project tasks, as well as any changes in scope or direction of the project. The report will be formatted on a work breakdown structure basis to show the actual effort expended versus the scheduled levels of effort, the remaining duration, and the planned and accrued costs.

The letter report will be accompanied by a Contract Management Summary Work Sheet which will include: activity start date if the activity started during the reporting month; the activity finish date if the activity was finished during the reporting month; and the remaining days to complete any ongoing activities. The monthly progress report shall be submitted to the ANG PM no later than the eighth working day of each month for the duration of the Task Order.

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SECTION 16.0 SITE-SPECIFIC ACTION MEMORANDUM REPORT

16.1 SITE-SPECIFIC ACTION MEMORANDUM PURPOSE

The report outline structure includes all information detailing the results of the field investigation in accordance with the site-specific action memorandum format and will include separately bound appendices.

16.2 MEMORANDUM FORMAT

The proposed memorandum format will consist of an executive summary, seven sections, references, and supporting appendices. The annotated memorandum is listed below as follows:

- **TABLE OF CONTENTS**
- **LIST OF FIGURES**
- **LIST OF TABLES**
- **ACRONYM LIST**
- **EXECUTIVE SUMMARY**
- **1.0 PURPOSE**
- **2.0 SITE CONDITIONS**
  - **2.1 Removal Site Evaluation**
    - **2.1.1 Site Profile**
      - **2.1.1.1 Physical location**
      - **2.1.1.2 Site characteristics**
      - **2.1.1.3 Source, nature, and current extent of contamination**
      - **2.1.1.4 Maps, pictures, and other graphic representations**
    - **2.1.2 Qualitative risk evaluation**
  - **2.2 Other Cleanup Actions**
    - **2.2.1 Previous actions**
    - **2.2.2 Current actions**
- **3.0 THREATS TO PUBLIC HEALTH, WELFARE, OR THE ENVIRONMENT, AND STATUTORY AND REGULATORY AUTHORITIES**
  - **3.1 Threats to Public Health and Welfare**
  - **3.2 Threats to the Environment**
- **4.0 IDENTIFICATION OF REMOVAL ACTION OBJECTIVES**
  - **4.1 Determination of removal scope**
  - **4.2 Determination of removal schedule**
- **5.0 SELECTED ACTION(S) AND ESTIMATED COSTS**
  - **5.1 Justification for EE/CA**
  - **5.2 Proposed Action**
    - **5.2.1 Proposed action description**
    - **5.2.2 Applicable or Relevant and Appropriate Requirements**
    - **5.2.3 Contribution to remedial performance**
    - **5.2.4 Conceptual design**
    - **5.2.5 Project schedule**
- **6.0 EXPECTED CHANGE IN SITUATION SHOULD ACTION BE DELAYED OR NOT TAKEN**

7.0 RECOMMENDATIONS SUMMARY
8.0 REFERENCES

APPENDICES
DAILY FIELD LOG
FIELD CHANGE REQUEST FORM
AQUIFER TEST RESULTS
BORING LOGS
WELL CONSTRUCTION DIAGRAMS
SCREENING RESULTS
CHAIN-OF-CUSTODY FORMS
FIELD ANALYTICAL DATA
QA/QC EVALUATION RESULTS

SECTION 17.0 ENGINEERING EVALUATION/COST ANALYSIS REPORT

17.1 EE/CA REPORT PURPOSE

The EE/CA Report will propose, evaluate, and recommend removal action alternatives.

17.2 EE/CA REPORT FORMAT

The EE/CA Report format will consist of an executive summary and seven sections. The EE/CA Report format is listed below as follows:

- **TABLE OF CONTENTS**
- **LIST OF FIGURES**
- **LIST OF TABLES**
- **ACRONYM LIST**
- **EXECUTIVE SUMMARY**
- **SECTION 1.0 INTRODUCTION**
  - **1.1 Purpose and Scope of the Engineering Evaluation/Cost Analysis**
  - **1.2 Statutory Authority**
- **SECTION 2.0 SITE CHARACTERIZATION**
  - **2.1 Description and History**
  - **2.2 Site Conditions**
    - **2.2.1 Surrounding Land Use**
    - **2.2.2 Hydrogeology**
      - **2.2.2.1 Regional**
      - **2.2.2.2 Site-Specific**
    - **2.2.3 Hydrology**
      - **2.2.3.1 Regional**
      - **2.2.3.2 Site-Specific**
  - **2.3 Contamination Assessment**
    - **2.3.1 Summary of Site Investigation Results**
      - **2.3.1.1 Soils and Sediment Contamination**
      - **2.3.1.2 Groundwater and Surface Water Contamination**
  - **2.4 Risk Evaluation**
  - **2.5 Removal Action Justification**
- **SECTION 3.0 IDENTIFICATION OF REMOVAL ACTION OBJECTIVES**
  - **3.1 General Statement of the Removal Action Objectives**
  - **3.2 Applicable or Relevant and Appropriate Requirements**
    - **3.2.1 Chemical-Specific Applicable or Relevant and Appropriate Requirements**
    - **3.2.2 Location-Specific Applicable or Relevant and Appropriate Requirements**
    - **3.2.3 Action-Specific Applicable or Relevant and Appropriate Requirements**
    - **3.2.4 State Requirements**
  - **3.3 Site-Specific Removal Action Objectives, Scope, and Schedule**
- **SECTION 4.0 IDENTIFICATION OF REMOVAL ACTION ALTERNATIVES**
  - **4.1 Rationale for Selection of Alternatives**
  - **4.2 Basis for Comparison of Alternatives**
  - **4.3 Description of Alternatives**
    - **4.3.1 Alternative 1 - No Action**

SECTION 18.0 REFERENCES

ANG/VCEVR, 1996. Draft ANG Installation Restoration Program Investigation Protocol, Andrews AFB, Maryland.

AGI, 1995. *Summary Report - Bioremediation of Contaminated Soil, Montana Air National Guard, Great Falls, Montana.*

Bouwer, H. & Rice, R. C., 1976. A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells. Water Resources Research, 12(3), 423-428.

Bouwer, H., 1989. The Bouwer and Rice Slug Test-An Update. Ground Water Journal, 17(3), 307-309.

Engineering-Science, Inc., 1992. Site Investigation Report. 120th Fighter Interceptor Group, Montana Air National Guard, Great Falls International Airport.

Fox, R.D., 1966. Geology and Groundwater Resources of the Cascade - Ulm Area, Montana. Montana Bureau of Mines and Geology, Bulletin 52.

Gruszczenski, 1989. Determination of a Realistic Estimate of the Actual Formation Product Thickness Using Monitoring Wells: A Field Bailout Test. S&ME, Inc., Atlanta, Georgia.

HAZWRAP, 1997. Final Remedial Investigation Report Volume I and II, Oak Ridge, Tennessee.

HMTC, 1988. Preliminary Assessment for 120th Fighter Interceptor Group, Montana Air National Guard, Great Falls International Airport. Hazardous Materials Technical Center.

Lemke, R.W., 1977. Geologic Map of the Great Falls Quadrangle, Montana. U.S. Geological Survey Geologic Quadrangle Map GQ-1414. Scale 1:62, 500.

MDHES, 1995. Cleanup Guidelines for Petroleum Releases Under the Montana Underground Storage Tank Program, Montana Department of Health and Environmental Sciences Solid and Hazardous Waste Bureau Underground Storage Tank Program, April 1994.

NOAA, 1994. Local Climatological Data - Annual Summary with Comparative Date, Great Falls, Montana.

Operational Technologies Corporation (OpTech), 1992. Corporate Environmental Quality Assurance/Quality Control Plan. San Antonio, Texas.

Operational Technologies Corporation (OpTech), 1995. Corporate Health and Safety Manual. San Antonio, Texas.

Operational Technologies Corporation, (OpTech), April 1996. *Final Remedial Investigation/Feasibility Study Work Plan.*

Soil Conservation Service, 1973. "Soil Survey of Cascade County Area, Montana," U.S. Department of Agriculture Soil Conservation Service in cooperation with Montana Agricultural Experiment Station.

U.S. Environmental Protection Agency, 1988. *Superfund Exposure Assessment Manual.* EPA/540/1-88/001, Office of Emergency and Remedial Response, Washington, D.C.

U.S. Environmental Protection Agency, 1989. *Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual Part A. Interim Final.* Office of Emergency and Remedial Response, EPA 540/1-89/002.

U.S. Environmental Protection Agency, 1991a. *Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals)*, Interim 9285.7-01B. Office of Emergency and Remedial Response.

U.S. Environmental Protection Agency, 1991b. *Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors*, Publication 9285.6-03, Office of Emergency and Remedial Response, Washington, D.C., NTIS PB91-921314.

U.S. Environmenal Protection Agency, 1992. *Guidance for Data Useability in Risk Assessment.* 4285.7-09A7B, Office of Emergency and Remedial Response.

U.S. Environmental Protection Agency, 1993. *Guidance or conducting Non-Time-Critical Removal Actions Under CERCLA.* EPA540-R-93-057, Office of Emergency and Remedial Response.

Wilke, K. R., 1983. *Appraisal of Water in Bedrock Aquifers, Northern Cascade County, Montana,* Montana Bureau of Mines and Geology Memoir 54, Butte, Montana.

APPENDIX A

HEALTH AND SAFETY PLAN

EMERGENCY CONTACTS AND AIR MONITORING ACTION LEVELS

EMERGENCY CONTACTS

In the event of any situation of unplanned occurrence requiring assistance, the appropriate contact(s) will be made from the list below. For emergency situations, contact will first be made with the Site Manager (SM), who will notify emergency personnel, and then contact the appropriate response teams. This emergency contacts list must be kept in an easily accessible location at the site.

Montana ANG, International Airport, Great Falls, Montana Emergency Contacts

Contact	Phone Number
Major Iver Johnson	(406)791-6330
Base Fire Department	911
Base Security	2336
Base Clinic (Ambulance)	2288
Base First Aid Station	2325

Note: The 120th Fighter Wing has a clinic with an ambulance on Base for first-responder emergencies.

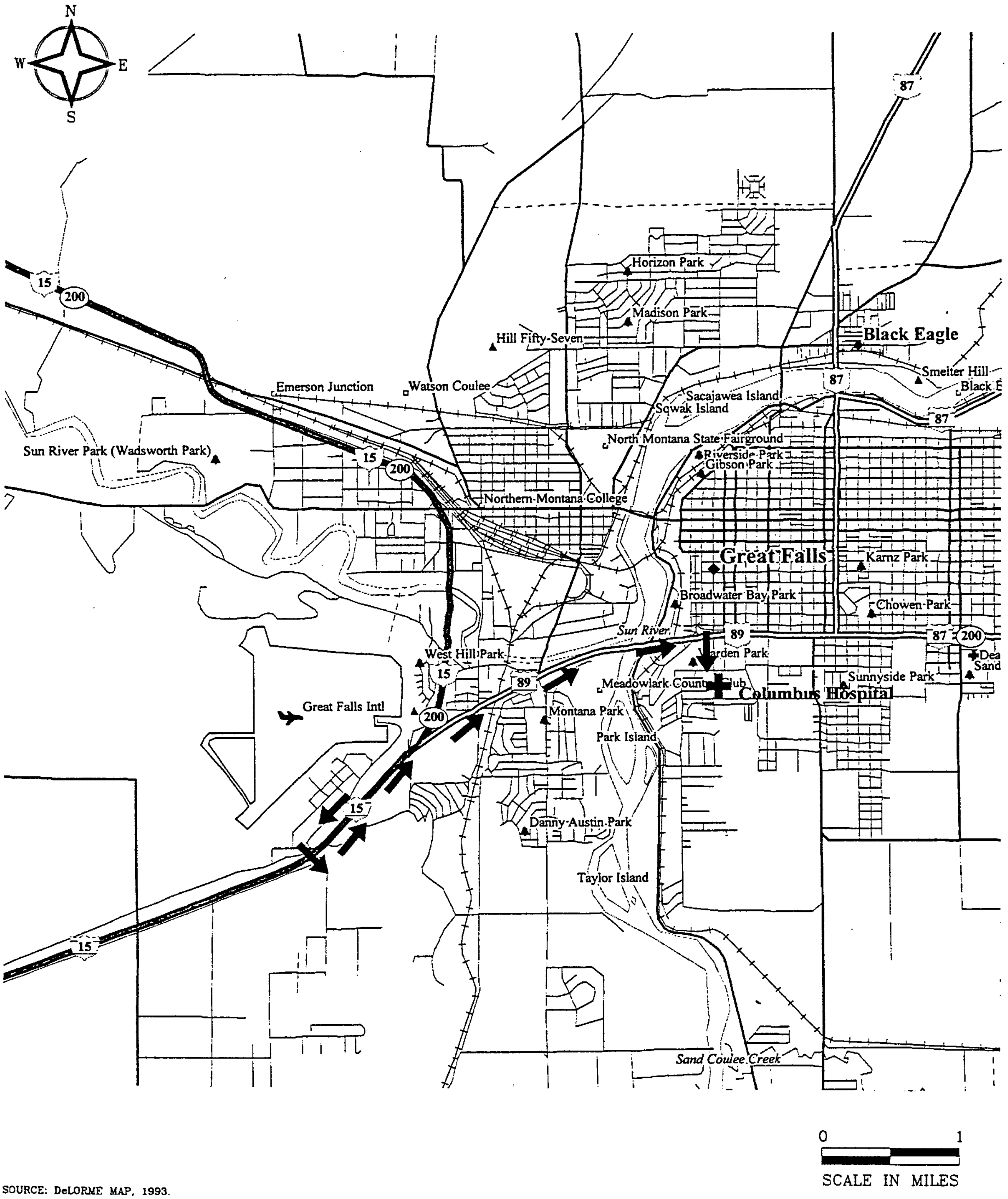
Medical Emergency

Contact	Phone Number
New Columbus Hospital	(406)727-3333
Hospital Emergency Room	(406)727-3333
Ambulance	911
Blue Star Ambulance	(406)453-0049
Great Falls Emergency Service	(406)453-5300

Fastest route to hospital: From the front gate of the Montana Air National Guard, proceed southwest via the access road and cross under Interstate 15 (I-15). Turn left and enter the freeway. The road will immediately split; take the right-hand "Y" and head east on I-15/State 200/State 89. Cross the Missouri River and slow to exit on 4th Street, heading south. The

New Columbus Hospital is only two blocks south of the freeway at the intersection of 4th Street and 13th Avenue.

Travel time from site: 10 minutes. Figure A.1 shows a route map to the New Columbus Hospital.



SOURCE: DeLORME MAP, 1993.

FIGURE A.1

GF-EECA\CNPHOSP

MOST DIRECT EMERGENCY
ROUTE TO NEAREST HOSPITAL
120th FW, Montana Air National Guard
Great Falls, Montana

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SEPTEMBER 1997

AIR MONITORING ACTION LEVELS

Concentration of Organic Vapor in Breathing Zone	Action
1 ppm benzene	Stop work until levels dissipate, or ventilate area.
> 100 ppm* toluene, xylene, or ethylbenzene	Stop work until levels dissipate, or ventilate area.

*Based on Threshold Limit Value - Time Weighted Average (TLV-TWA) exposure limits for toluene, xylene, and ethyl benzene, assuming benzene does not exceed 1 part per million (ppm).

EMERGENCY RESPONSE PLAN

OpTech's health and safety policy is to evacuate personnel from areas involved in hazardous material emergencies and to summon outside assistance from agencies with personnel trained to deal with the specific emergency. This section outlines the procedures to be followed by OpTech personnel in the event of a site emergency. These procedures are to be reviewed during the on-site safety briefings conducted by the Site Safety Officer (SSO).

Paramedics should be summoned in the event of a serious injury; they will arrange to transport the victim to the nearest appropriate facility. A first aid kit will be available at the site for use in case of minor injuries. If anyone receives a splash or particle in the eye, the portable eyewash will be used to irrigate the eye for 15 minutes. If direct contact with contaminants occurs, affected skin areas should be washed immediately with soap and water.

In the event of serious trauma or unknown chemical exposure, the employee should be stabilized by one group of employees while the emergency phone number list is consulted and an ambulance immediately requested.

Workers with suspected back or neck injuries are **NOT** to be moved until professional emergency assistance arrives.

At least one person at the site will have current certification in First Aid and Cardiopulmonary Resuscitation (CPR).

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LIST OF ACRONYMS

ACGIH	American Counsel of Governmental Industrial Hygienists
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
C	Ceiling
CFR	Code of Federal Regulations
CHSC	Corporate Health and Safety Coordinator
CPR	Cardiopulmonary Resuscitation
CRE	Contamination reduction zone
DCE	Dichloroethene
DOT	Department of Transportation
F	Fahrenheit
FW	Fighter Wing
HASP	Health and Safety Plan
HAZWRAP	Hazardous Waste Remedial Actions Program
HEPA	High Efficiency Particulate Air
IRP	Installation Restoration Program
LEL	Lower Explosive Limit
MSDS	Material Safety Data Sheets
MSHA	Mine Safety and Health Administration
NIOSH	National Institute for Occupational Safety and Health
OpTech	Operational Technologies Corporation
OSHA	Occupational Safety and Health Act
OVA	Organic vapor analyzer
PEL	Permissible Exposure Limit
PM	Project Manager
PPE	Personal Protective Equipment
ppm	parts per million
RI	Remedial Investigation
SM	Site Manager
SSO	Site and Safety Officer
SSR	Subcontractor's Safety Representative
STEL	Short Term Exposure Limit
TCE	Trichloroethene

LIST OF ACRONYMS (Concluded)

TLV	Threshold Limit Value
TWA	Time Weighted Average
WP	Work Plan

SECTION A1.0 INTRODUCTION

A1.1 PURPOSE AND POLICY

The purpose of this safety plan is to establish personnel protection standards and mandatory safety practices and procedures for all work conducted at he 120th Fighter Wing, Montana Air National Guard, International Airport, Great Falls, Montana. The plan assigns responsibilities, establishes standard operating procedures, and provides for contingencies that may arise while performing field activities at two on-Base Installation Restoration Program (IRP) sites (Sites No. 7 and No. 8).

The provisions of the plan are mandatory for all on-site field personnel. Any supplemental plans used by subcontractors must conform to this plan. All personnel who engage in on-site project activities must be familiar with this plan and comply with its requirements.

A1.2 APPLICABILITY

This plan was developed specifically for operations at the 120th FW at the Montana Air National Guard, at Great Falls, Montana. The plan assigns responsibilities, establishes personal protection standards and mandatory safety procedures, and provides for contingencies that may arise while operations are being conducted at the sites. This plan complies with, but does not replace, Federal Health and Safety Regulations as set forth in 29 CFR 1910 and 1926. This plan is to be used by OpTech personnel as a supplement to such rules, regulations, and guidance.

The provisions of the plan are mandatory for all on-site OpTech employees engaged in hazardous material management activities, including, but not limited to: initial site reconnaissance, preliminary field investigation, mobilization, project operations, and demobilization.

A1.2.1 Modification of Plan

Changing and/or unanticipated site conditions may require modification of this site safety plan in order to maintain a safe and healthful work environment. Any proposed changes to this plan should be reviewed with the OpTech Corporate Health and Safety Coordinator (CHSC) or designee, prior to change implementation. If this is not feasible, the Project Manager (PM) may modify the plan and record all changes in the field log book. Under no circumstances will plan modifications to this plan conflict with Federal, State, or local health and safety regulations.

A1.2.2 Subcontractor Responsibilities

OpTech will provide a copy of this Health and Safety Plan (HASP) to each site subcontractor in order to fulfill its obligation under 29 CFR 1910.120(b) (15) to inform subcontractors of site hazards. Each subcontractor shall provide a conforming HASP for its employees covering any exposure to hazardous materials and shall complete all work in accordance with that plan. The subcontractor shall hold OpTech harmless from, and indemnify it against, all liability in the case of any injury. OpTech reserves the right to review and approve the subcontractor's plan at any time.

Subcontractors are responsible for supervising their employees and maintaining safe working conditions at the work site. OpTech, through its PM or SSO, reserves the right to suspend the subcontractor's site work and ask the subcontractor's personnel to evacuate the hazard area in the vent of grossly inadequate health and safety precautions on the part of the subcontractor or the belief that the subcontractor's personnel are or may be exposed to an immediate health hazard.

Employees of subcontractors must have completed appropriate site safety training and medial evaluation prior to conducting work involving possible exposure to hazardous materials. It is the subcontractor's responsibility to provide the required level of training and medical evaluations to their employees. Subcontractors are responsible for obtaining, maintaining, and properly utilizing their own safety equipment in accordance with their health and safety plan requirements. This includes personal protective equipment (PPE) such as respirators, disposable clothing, hard hats or other equipment detailed in the HASP. Subcontractors are responsible for performing respirator fit tests. OpTech does not rent or loan safety equipment.

A1.3 SITE LOCATION

Two sites at the 120th FW are to be investigated by OpTech under formal Engineering Evaluation/Cost Analysis (EE/CA) tasking from the Air National Guard Readiness Center:

- Site No. 7 - Dry Well Off Corrosion Control Building Area (Bldg. 23); and
- Site No. 8 - Dry Well Off Composite Maintenance Building Area (Bldg. 32).

A1.4 SCOPE OF WORK

The EE/CA Work Plan addresses specific environmental assessment activities necessary to accomplish the Remedial Investigation at the two sites. Drilling, sampling, and analytical activities will be performed to evaluate the nature and extent of contamination at each of the two sites, to fully characterize each site, and to aid in identifying an appropriate remedial action (if required).

The field activities to be performed at the Base include installing monitoring wells (with four additional wells optional). Sampling of existing and newly installed well will be performed. The field program is detailed in Section 6.3 of the Work Plan (WP).

OpTech field personnel will provide project management oversight and assistance during the installation of wells. Soil sampling at 5-foot intervals to describe lithology will be performed during the drilling of boreholes. Soil samples will not be collected for laboratory analyses. Drill cuttings will be either placed in drums for proper disposal.

A1.5 HEALTH AND SAFETY PLANNING

OpTech will confirm with local agencies and the Base Environmental Coordinator that all underground utilities have been located prior to the commencement of drilling activities. The deactivation of utilities should be certified by the proper utility company personnel, and the certification retained in the permanent log and project files.

Skin contact with potentially contaminated soil or water will be minimized by wearing personal protective clothing. Eye protection is required on-site to minimize potential exposure to eye injuries from dirt or splashing. Inhalation of vapors during drilling and groundwater sampling will be minimized by air monitoring, engineering controls, close attention to wind direction, and the use of respiratory protection if action levels are exceeded. No eating or drinking, no chewing gum or tobacco products, and no smoking are allowed in the exclusion zone. Dermal contact with contaminated materials will be minimized by the wearing of gloves when handling sample materials. Additionally, personnel will be reminded of the need for good personal hygiene (e.g., thoroughly washing face and hands with soap and water before eating or drinking).

An instrument capable of detecting hydrocarbons will be used to monitor for vapors. The monitor will be used on a continuing basis, to monitor in the immediate vicinity of the drill site and soils adjacent to the borehole. If readings exceed an average of 10 ppm above background levels for more than one minute, monitoring in the breathing zone of the person working nearest the site will start immediately, and personnel will don protective equipment.

A1.6 RESPONSIBILITIES

The contractor and all subcontractors involved in handling contaminated soils are required to ensure that all on-site employees, visitors, subcontractors, and their supplies/vendors comply with the minimum standards set forth by the Occupational Safety and health Administration (OSHA) and by the contractor's or subcontractor's site HASP. These standards and provisions for job safety and health protection are located in the Occupational Safety and Health Act of 1970. Any specific operation, machine, or process not covered in these plans may be governed by other applicable local, State and Federal regulations. The contractor and subcontractors are required to know and comply with the safety regulations applicable to their operations. The provisions of this HASP, along with the applicable regulations issued by governmental entities, will be strictly adhered to by OpTech.

A1.7 PROJECT TEAM ORGANIZATION

The project team, at a minimum, will include a SM, SSO and a field team involved in on-site investigations and operations. When site activities are particularly complex or when project planning dictates, a PM may also be on-site to direct site operations. A description of responsibilities follows.

A1.7.1 Project Manager

The PM shall direct on-site investigations and operational efforts. The PM may delegate all or part of these duties to the SM. At the site, the PM, assisted by the SSO, has primary responsibility for:

- Seeing that appropriate PPE and direct monitoring equipment is available, calibrated, and properly utilized by all on-site personnel;
- Establishing that personnel are aware of the provisions of the HASP, are instructed in the work practices necessary to ensure safety, and are familiar with emergency procedures;
- Establishing that all field personnel have a minimum of 40 hours health and safety training; have received 8-hour refresher training within the last year (as applicable); have appropriate medical clearances and are fit for duty; and have been fit tested for the appropriate respirators;
- Seeing that personnel are aware of the potential hazards associated with site operations;
- Monitoring the safety performance of all personnel to ensure that the required work practices are employed and that site personnel display a good level of safety consciousness;
- Correcting any work practices or conditions that may result in injury or exposure to hazardous substances;
- Seeing to the completion of Plan Acceptance forms by OpTech personnel;
- Halting site operations, if necessary, in the event of an emergency or to correct unsafe work practices; and
- Reviewing and approving the project HASP.

A1.7.2 Site Manager

The SM shall assume all responsibilities of the PM when the PM is not on-site. In addition, the SM will be responsible for:

- Acting as on-site liaison with the Air National Guard, and/or regulatory agency representatives on behalf of the Guard;
- Ensuring that all notifications to the State regulatory agencies, fire marshall, and other agencies have been made;
- Confirming that all underground utilities have been located prior to drilling;
- Ensuring that all work is performed in accordance with governing regulations and industry standards; and
- Keeping detailed record of all site activities in the project log book.

A1.7.3 Site Safety Officer

The SSO's duties may be carried out by the PM or SM. The SSO shall:

- Implement the project HASP and report any deviations from the anticipated conditions described in the plan to the PM;
- Determine that health and safety monitoring equipment is used properly and is calibrated in accordance with manufacturer's instructions or other standards, and that results are properly recorded and filed;
- Verify with the OpTech CHSC and Subcontractor's Safety Representative (SSR) that assigned personnel have current fit-for-duty medical and training authorizations;
- Perform any other non-safety-interfering duties as directed by the PM;
- Notify the SM of any site personnel who have special medical problems (e.g., allergies, controlled medical conditions), in order to determine fitness for work and to jointly monitor their performance;
- Conduct daily "tailgate" or other safety meetings and complete the Site Safety Briefing Report;
- Provide ongoing review of protection levels as project work is performed, and inform the PM of the need to upgrade or downgrade levels as appropriate;
- Monitor decontamination procedures to ensure safe practices are observed;
- Monitor and record readings from instruments to ensure a safe work site;
- Halt site operations, if necessary, in the event of an emergency or to correct unsafe work practices;
- Prepare any accident/incident reports, coordinate with OpTech corporate headquarters on any significant incidents; and
- Review and approve the project HASP.

A1.7.4 Field Team

Project personnel involve in on-site investigations and operations are responsible for:

- Taking all reasonable precautions to prevent injury to themselves and to their fellow employees;

- Performing only those tasks that they believe they can do safely, and immediately reporting any accidents and/or unsafe conditions to the SSO or PM.
- Implementing the procedure set forth in the HASP, and reporting any deviations from the procedures described in the Plan to the SSO or PM for action.
- Notifying the PM and SSO of any special medical problems (e.g., allergies, required medications) and insuring that all on-site personnel are aware of any such problems.
- Reviewing the project HASP and signing the Acceptance Form.

A1.8 SUBCONTRACTOR'S SAFETY REPRESENTATIVE

Each Subcontractor is required to designate a SSR. The SSR is responsible for the safe and healthful performance of work by his work force and subcontractors. During the Subcontractor's activities on-site, the SSR will perform continuing work area inspections, and conduct safety meetings and safety orientations for all new employees. The SSR will attend periodic safety meetings with the SSO. The SSR will also investigate accidents and overexposure involving subcontractor personnel.

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SECTION A2.0 SAFETY AND HEALTH RISK ANALYSIS

A2.1 CHEMICAL HAZARDS

A number of products containing hazardous chemicals may be encountered at the 120th FW site. Detailed information on the nature of these hazards may be found in the Material Safety Data Sheets (MSDSs) which are included as part of this HASP.

Historical information has identified fuels and solvents to be the primary contaminants of concern, with possible limited metals contaminations. The constituents of concern identified in the SI and 1, 1-DCE, 1, 2-DCE, TCE, benzene, toluene, o-xylene, bis (2-Etlhexyl) phthalate, lead, methyl alcohol (used for decontamination) and TPH. The toxicological properties of these compounds are shown in Table A2.1. Compound concentrations which exceed health exposure standards may be present in the soil and groundwater. The primary routes of exposure for these chemicals are inhalation, skin absorption, and eye contact. The symptoms of exposure can range from none to irritation of the eyes, nose, and respiratory system; headache; staggered gait; fatigue; and dermatitis. Table A2.1 lists some properties of the compounds that could be found at the sites to be investigated. Table A2.1 also lists permissible exposure levels for the contaminants which may be encountered.

The TLV-TWA value represents the time-weighted average concentration for a normal 8-hour workday and a 40-hour work week to which nearly all workers may be repeatedly exposed, day after day, without adverse effect.

Some of the compound can form explosive mixtures in air. The lower explosive limits (LEL) for gasoline and each of these gasoline constituents are presented in Table A2.1. Smoking will not be allowed except in designated areas.

Potential exposure to site personnel will be only for a short period of time (intermittent for several days); therefore, the low levels of contaminants detected by previous site investigations are not a major concern. However, the site is not fully characterized, so the potential for

Table A2.1
Toxicologic Properties of Compounds
120th FW, Montana ANG, Great Falls, Montana

Compound	LEL[1] (%)	TLV[2] (ppm)	IDLH[3] (ppm)	Odor Threshold[4] (ppm)	Odor Characteristic	Acute Toxic Effects
Gasoline	NA[7]	300	NA[7]	< 0.01 - 10	Gasoline	Dizziness, headache, lack of coordination
Benzene	1.3	0.1[5] - 1.0[6]	2,000	4.68	Aromatic	Headache, dizziness, lassitude (inhalation); inflammation, blistering (dermal)
Ethylbenzene	1.0	100	2,000	0.25-200	Aromatic	Irritation of skin, eyes, nose, and upper respiratory tract
Toluene	1.3	100	2,000	0.17-40	Aromatic, Sour	Nausea, headache, confusion, incoordination
Xylenes	1.1	100	10,000	0.5	Aromatic	Upper respiratory tract irritation; eye irritation; blistering and cracking skin

[1] LEL – Lower Explosive Limit.

[2] TLV – Threshold Limit Value (ACGIH, 1991-92).

[3] IDLH – level which is Immediately Dangerous to Life and Health.

[4] Different sources list different warning concentrations. When a range is given, use the highest concentration.

[5] Proposed change by ACGIH. Benzene is a recognized carcinogen.

[6] This value is not a TLV, but rather an OSHA short-term exposure limit.

[7] NA – Not Available.

Sources: CHRIS computer database, 1992.
New Jersey Hazardous Substance Fact Sheets database, 1992.
NIOSH Pocket Guide to Chemical Hazards, 1990.
1991-1992 Threshold Limit Values, ACGIH, 1991.

exposure to elevated levels of these contaminants may exist. Overviews of the hazards associated with exposure to the chemicals found on-site to date are presented below in terms of:

PEL	Permissible Exposure Limit
C	Ceiling
LV	Threshold Limit Value (American Counsel of Governmental Industrial Hygienists (ACGIH) Guidance)
TLV-STEL	Short Term Exposure Limit (ACGIH Guidance)
LEL	Lower Explosive Limit

OSHA PELs, ACGIH TLVs and TWAs are defined as concentrations for an 8-hour work day, 40-hour work week to which almost all workers can be repeatedly exposed without suffering adverse health effects.

STEL is defined as the concentration to which workers can be exposed for short time periods without irritation, tissue damage, or narcosis sufficient to likely cause impairment of self-rescue or precipitate accidental injury. It is a 15-minute time-weighted average that should not be exceeded at any time during the work day. A ceiling value (C) is a concentration that should not be exceeded at any time in any work day.

LEL is defined as the minimum concentration of vapor in air below which propagation of a flame will not occur in the presence of an ignition source.

The following potential exposures may exist during field operations:

- Skin contact with contaminated soil or water;
- Inhalation of vapors; and
- Ingestion of contaminated soil dusts, especially if poor personal hygiene is practiced.

Skin contact with potentially contaminated soil or water will be minimized by wearing PPE clothing (as described in Section 3.0). Inhalation of vapors during drilling or soil and water sampling will be minimized by air monitoring, engineering controls, and the use of respiratory protection of action levels are exceeded.

A2.2 PHYSICAL HAZARDS

A2.2.1 Construction Hazards

Employees must implement safe work practices in accordance with OSHA regulations while working on-site. In addition to the hazardous substances and environments present on-site, other physical hazards may exist from the drilling and sampling process, including risk of injury while working in or around heavy equipment. Work areas must be kept clear of stockpiled materials. Work areas will be barricaded to protect both public and operational personnel.

A2.2.2 Heavy Equipment

Operation of heavy equipment in drilling activities presents potential physical hazards to personnel. PPE such as steel-toed shoes, safety glasses or goggles, and hard hats must be worn whenever such equipment is present. Personnel should at all times be aware of the location and operation of heavy equipment (e.g., drill rigs), and take precautions to avoid getting in the way of their operation. Traffic safety vests should be worn by personnel working near heavy equipment.

A2.2.3 Noise Hazards

The primary noise hazard on-site is from heavy equipment. All personnel within 25 feet of operating equipment shall wear hearing protective devices (either muffs or plugs) during active equipment operation periods. The SM or SSO will determine and enforce any other noise protection requirements.

A2.2.4 Explosion

Gasoline vapors can be highly explosive, having a flash point of about -40°Fahrenheit (F), and are considered to be a fire hazard. The potential exists for explosive atmospheres at the site due to the presence of gasoline. Decisions will be based on the LEL as determined by the combustible gas indicator as follows:

- 10 percent LEL: Work to proceed with caution, continuous monitoring is required. Non-sparking tools should be used at the site.

- 20 percent LEL: Work to stop and all personnel evacuate to a safe area. Work should not resume until site condition is reevaluated by the SSO and deemed safe.

- Fire suppression equipment is to be present at all times during drilling operations in areas where fire potential exists.

A2.2.5 Heat Stress

The use of protective equipment, if required, may create heat stress. Monitoring of personnel wearing personal protective clothing should commence when the ambient temperature is 70°F or above. Monitoring frequency should increase as the ambient temperature increases, or as slow recovery rates are observed. Heat stress monitoring will be performed by a person with a current first aid certification who is trained to recognize heat stress symptoms.

A2.2.6 Prevention of Heat Stress

Proper training and preventive measures will aid in averting loss of worker productivity and serious illness. Heat stress prevention is particularly important because once a person suffers a heat stroke or heat exhaustion, that person may be predisposed to additional heat-related illness. To avoid heat stress, the following steps should be taken:

- Adjust work schedules (i.e. shorter work periods, work during cooler hours)

- Modify work and rest schedules according to monitoring requirements.

- Mandate work slowdowns as needed.

- Provide shelter or shaded areas to protect personnel during rest periods.

- Maintain worker's body fluids at normal levels. The normal thirst mechanism is not sensitive enough to ensure that enough water will be drunk to replace lost sweat. When heavy sweating occurs, encourage the worker to drink fluids frequently. The SSO is responsible for initiating a "mandatory drinking policy" of warranted by on-site conditions. Under that policy, all on-site personnel will be required to drink according to the clock, not when they feel thirsty.

- Heat stress will be a mandatory daily briefing item as determined by the SSO.

A2.2.7 Cold-Related Illness

In the winter months, thermal injury due to cold exposure can become a problem for field personnel. Systemic cold exposure is referred to as hypothermia, while local cold exposure is generally labeled frostbite.

- Hypothermia is defined as a decrease in the patient core temperature below 96°F. Symptoms of hypothermia include shivering, apathy, listlessness, sleepiness, and unconsciousness.

- Frostbite is both a general and medical term given to areas of local cold injury. Unlike systemic hypothermia, frostbite rarely occurs unless the ambient temperatures are less than freezing and usually less than 20°F. Frostbite produces a sudden blanching or whitening of the skin; the skin has a waxy or white appearance and is firm to the touch; tissues are cold, pale, and solid.

A2.2.8 Prevention of Cold-Related Illnesses

- Educate workers to recognize the symptoms of frostbite and hypothermia.
- Identify and limit known risk factors.
- Prohibit use of phenothiazine (a sedative).
- Identify/warn/limit use of beta blockers.
- Assure the availability of enclosed, heated environment on or adjacent to the site.
- Develop capability for temperature recording at the site.

A2.3 BIOLOGICAL HAZARDS

Rattlesnakes are commonly sighted in the area of field activities at the 120th FW site. Noise and vibration from operations should frighten off most snakes. Personnel should avoid contact, and use caution in areas of long grass.

SECTION A3.0 PERSONNEL PROTECTION AND MONITORING

A3.1 MEDICAL SURVEILLANCE

OpTech employees the services of a licensed occupational health physician with knowledge and experience in the hazards associated with the project to provide the medical examinations and surveillance herein.

Personnel involved in this operation have undergone medical surveillance at 12-month intervals. The medical exam is performed under the direction of a licensed occupational health physician. A medical evaluation of the fitness of an individual for employment on hazardous waste projects, or any indicated restrictions on that person's utilization, is provided by the physician.

A3.2 SITE-SPECIFIC TRAINING

The SSO will be responsible for developing a site-specific occupational hazard training program and providing training to all OpTech personnel who are to work at the facility. This training will consist of the following topics:

- Names of personnel responsible for site safety and health;
- Safety, health, and hazards at the site;
- Proper use of PPE;
- Work practices by which the employee can minimize risk from hazards;
- Safe use of engineering controls and equipment of the site;
- Acute effects of contaminants at the site; and
- Decontamination procedures.

A3.3 PERSONAL PROTECTIVE EQUIPMENT AND ACTION LEVELS

Level D protection will be worn for initial entry on-site and initially for all activities. Level D protection consists of:

- Standard work clothes. Tyvek coveralls are optional if there is a possibility of contact with contaminated soils;
- Safety glasses

- Safety boots
- Nitrile, latex, or vinyl gloves - mandatory during all sampling activities
- Hard hat; and
- Splash protection if contact with contaminated liquid is possible.

Level C protection will be worn in the event activities must be performed in the presence of organic vapors in excess of 100 ppm. Level C protection consists of all level D equipment, plus negative-pressure respirators equipped with organic vapor cartridges.

A3.4 MONITORING REQUIREMENTS

A3.4.1 Routine Monitoring for Organic Vapors

Benzene has the lowest PEL - 1 ppm - of all of the suspected contaminants on-site. Specific monitoring for airborne benzene will be performed daily during field activities using Draeger tubes with pretubes. In the event benzene is detected at or in excess of 1 ppm, work at the site will be suspended. Should these levels dissipate, work will continue; if the levels persist, ventilation of the area by fans will be evaluated.

Negative-pressure respirators equipped with organic vapor cartridges will be kept on hand for emergency purposes. In the vent that benzene levels are between 1 ppm and 10 ppm, or total organic vapors exceed 100 ppm and levels do not dissipate, emergency activities will be performed in Level C protection until fans are brought on-site.

Monitoring for organic vapors in the breathing zone will be conducted with organic vapor detection equipment. Readings will be taken under the following circumstances:

- Upon initial entry onto the site
- When weather conditions change
- While work is in progress on the site
- When work begins on another portion of the site

A3.4.2 Routine Monitoring for Explosive Environment

Air monitoring will be conducted for combustible gases and vapors. A combustible gas indicator is the instrument of choice in determining the concentration of flammable vapor in the air. Guidelines have been established by the National Institute for Occupational Safety and Health (NIOSH) concerning the action levels to be utilized when working in a potentially explosive environment. A combustible gas indicator/O2 meter will be used to monitor ambient conditions at all times during drilling operations. Oxygen concentrations should be measured prior to taking combustible readings to determine if there is sufficient oxygen (10%) to operate the combustible gas indicator.

The combustible gas indicator is intended for use only in normal atmospheres, not those that are oxygen enriched or deficient. Oxygen concentrations that are less than or greater than normal may cause erroneous readings.

All monitoring equipment used during these studies must be certified for operation in a class I atmosphere. A class I atmosphere consists of flammable vapors and gases, such as gasoline and hydrogen. The instrument's instruction manual contains information on the use of the instrument in an explosive atmosphere.

NIOSH guidelines on the use of the combustible gas indicator:

LEL Reading	Action
<10% LEL	Continue operations
10%-20%LEL	Increase monitoring frequency
>20% LEL	Shut down operations and evaluate source, ventilate.

When readings exceed 20 percent LEL on the indicator, *all activities must cease* to allow time for the combustible gases to dissipate.

A3.4.3 Oxygen Monitoring

NIOSH requires the use of self-contained breathing apparatus when oxygen concentrations fall below 19.5 percent. This condition is not likely be encountered, since there should be no activities performed in confined work spaces. However, should the situation change, an oxygen indicator should be used to monitor the atmosphere oxygen concentration during site activities. Prior to entering an excavation or tank, an oxygen meter will be used to test for adequate oxygen levels. Decisions will be based on oxygen concentrations as followed:

Oxygen Concentration	Action
20.8%	Continue operations
<20.8%, but >19.5%	Continuous monitoring of O2 concentrations
<19%	Do not enter, ventilate, and determine if supplied air is required

A3.4.4 Monitoring for Heat Stress

To monitor the worker, one of the following methods may be used:

- Heart rate: Count the radial pulse during a 30-second period as early as possible in the rest period. If the rate exceeds 100 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same. If the heart rate still exceeds 100 beats per minute at the next rest period, shorten the following work cycle by one-third.

- Oral temperature: Use a clinical thermometer (3 minutes under the tongue) or similar device to measure the oral temperature at the end of the work period (before drinking).

- If oral temperature exceeds 99.6° F (37.6° C), shorten the next work cycle by one-third without changing the rest period.

- If oral temperature still exceeds 99.6° F (37.6° C) at the beginning of the next rest period, shorten the following cycle by one-third.

- Do not permit a worker to wear a semipermeable or impermeable garment when oral temperature exceeds 100.6° F (38.1° C).

Suggested frequency of physiological monitoring of workers is shown on Table A3.1.

A3.4.5 Monitoring for Cold-Related Illness

Start oral temperature recording at job site:

- At the SM's discretion when worker's performances or metal status changes in a manner which may indicate cold-related illness.

Table A3.1

Suggested Frequency of Physiological Monitoring for Workers$_{1,2}$

120th FW, Montana ANG, Great Falls, Montana

Adjusted Temperature[3]	Normal Work Emsemble [4]	Impermeable Ensemble
90° F (32.2° C) or above	After each 45 minutes of work	After each 15 minutes of work
87.5° - 90° F (30.8°-32.2° C)	After each 60 minutes of work	After each 30 minutes of work
82.5° - 87.5° F (28.1° - 30.8° C)		After each 60 minutes of work
77.5° - 82.5° F (25.3° - 28.1° C)		After each 90 minutes of work
72.5° - 77.5° F (22.5° - 25.3° C)		After each 120 minutes of work

1 Source: Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities. (NIOSH 1985)

2 For work levels of 250 kilocalories/hour.

3 Calculate the adjusted air temperature (ta adj) by using this equation: ta adj°F = ta°F + (0.13 x % sunshine). Measure air temperature (ta) with a standard mercury-in-glass thermometer, with the bulb shielded from radiant heat. Estimate percent sunshine by judging what percent of the time the sun is not covered by clouds that are thick enough to produce a shadow. (100 percent sunshine = no cloud cover and a sharp, distinct shadow; 0 percent sunshine = no shadows.)

4 A normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.

- At worker's request.
- As a screening measure, two times per shift, under unusually hazardous conditions (e.g., wind chill less than 20°F, or wind chill less than 30°F with precipitation).
- As a screening measure whenever any one worker on the site develops hypothermia.

Any person developing moderate hypothermia (a core temperature of 92°F) cannot return to work for 48 hours.

A3.5 BACKGROUND READINGS

All direct-reading instrument readings will be evaluated relative to background readings, not "zero". Prior to the start of work at each shift, and whenever there is a significant shift in wind direction, instrument readings will be obtained upwind of the site operating zone in order to determine the level of "background" readings from local vehicle traffic, emissions from nearby operations unrelated to the site, etc. Site readings will be evaluated against these background readings.

A3.6 DATA LOGGING

All exposure monitoring data, background readings, and daily instrument calibrations will be logged in the field log book. All monitoring instruments will be calibrated, in accordance with the manufacturer's instructions, prior to the start of each shift and when inconsistent or erratic readings are obtained. If an instrument cannot be calibrated to specification, or becomes otherwise inoperable, all site work will cease until the instrument is appropriately repaired or replaced.

A3.7 DUST CONTROL

If drilling operations generate a sustained visible dust cloud, a water mist will be applied to reduce dust generation. If the mist is not effective in reducing dust generation, personnel will don respirators (half-face or full-face as appropriate for analyzer readings) with combination organic vapor - high efficiency particulate air (HEPA) filter cartridges (such as Mine Safety Appliance's GMC-H cartridges).

A3.8 PERSONAL PROTECTIVE EQUIPMENT

Minimum Protective Equipment for Site Personnel:

- Hardhat
- Safety glasses
- Steel-toed boots

Work/Exclusion Zone Requirements:

- Hardhat
- Eye protection (face shield or safety glasses)
- Chemical-resistant steel-toed boots
- Ear protection in vicinity of heavy equipment
- Work gloves
- Coveralls

If analyzer reading greater than 10 ppm in work area, add:

- Tyvek coveralls
- Nitrile gloves
- Surgical latex or vinyl gloves

If analyzer reading greater than 25 ppm in breathing zone, add:

- Half-face respirator with organic vapor cartridges

If analyzer reading greater than 100 ppm in breathing zone, add:

- Full-face respirator with organic vapor cartridges

If potential for liquid contact exists:

- Use poly-coated Tyvek coveralls in place of uncoated Tyvek

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SECTION A4.0 SITE CONTROLS MEASURES, ACCIDENT PREVENTION, AND CONTINGENCY PLAN

A4.1 SITE CONTROL MEASURES

The site control measures discussed in this section will be followed to minimize potential contamination of workers, protect the public from potential site hazards, and to control access to the sites. Site control involves the physical arrangement and control of the operation zones and the methods for removing contaminants from workers and equipment. Site organization is discussed in this section.

Barricades and barricade tape should be used to delineate an exclusion zone around the drilling area. The barriers should be set in a 25-foot radius (as practical) around the work area. A short piece of barricade tape can be affixed to an equipment cab to serve as a wind-direction tell-tale. A five-foot opening in the barricades at the support zone (upwind of the equipment) will serve as the personnel and equipment entry and exit point. The personnel decontamination station will be established at this point. All entry to and exit from the drilling work area will be made at this opening in order to control potential sources of contamination (i.e., leave contaminated soil and debris in the exclusion area).

At the end of the shift, the site must be barricaded or otherwise secured. All soils are to be placed on plastic and covered. All decontamination fluids are to be drummed, and the drums shall be properly marked and labeled in accordance with applicable Department of Transportation (DOT) regulations (49 CFR 172).

The PM or SSO will determine an upwind evacuation area prior to each shift, and all personnel will be notified of its location. A compressed gas horn will be used to signal an evacuation in the event of an emergency. Three blasts of the horn will be the signal to immediately stop work and proceed to the evacuation area.

The SSO will ensure that all site visitors are logged in the project log book and that all personnel who enter the work zone do so only with permission of the SSO and after a field briefing of the current activities and potential site hazards.

A4.2 SITE ORGANIZATION-OPERATION ZONE

Any time respirators are worn, the following operation zones will be established on the site or around the tanks.

- Exclusion zone (contamination zone)
- Contamination reduction zone
- Support zone

If the field crew members are wearing protective clothing such as gloves or Tyvek suits but are not wearing respirators (level D modified), the field crew will establish a decontamination area to avoid spreading contaminants off site. The SM and/or SSO is responsible for establishing the size and distance between zones at the site or around the site feature.

A4.3 WORK ZONES

A4.3.1 Exclusion Zone (Contamination Zone)

The exclusion zone constitutes the place where active investigation or cleanup operations take place. Within the exclusion zone, prescribed levels of protection must be worn by all personnel. The hotline, or exclusion zone boundary, is initially established based on the presence of actual wastes or apparent spilled material, or through air monitoring. The hotline is placed around all physical indicators of hazardous substances (drums, tanks, ponds, liquid runoff, defoliated areas). The hotline may be readjusted based on subsequent observations and measurements. The boundary should be physically secure and posted or well defined by physical and geographic limits.

- Exclusion zone - A 25-foot (as practical) circle around the site will be defined before work starts. The encircled area will constitute the "Exclusion Zone". This zone is where potentially hazardous contaminants and physical hazards to the workers will be contained. Full personal protection may be required in this area. Plastic sheeting (visqueen) and/or tarps will be used to control cuttings or spoils pilled, or placed on the ground during drilling operations. The size of the Exclusion Zone may be altered to accommodate site conditions and to ensure contaminant containment.

Under some circumstances, the exclusion zone may be subdivided into zones based on environmental measurements of expected on-site work conditions.

A4.3.2 Contamination Reduction Zone

Between the exclusion zone and the support zone is the contamination reduction zone. This zone serves to prevent or reduce the transfer of hazardous materials which may have been picked up by personnel or equipment leaving the exclusion zone.

- Contamination Reduction Zone (CRZ) - A corridor leading from the Exclusion Zone will be defined, and will lead from the work area to a break area. All decontamination activities will occur in this area. A waste container will be placed at the end of the corridor so contaminated disposal equipment can be placed inside and covered. Surface/soil contamination in this area should be controlled suing plastic sheeting. No OpTech personnel will be permitted into the CRZ of Exclusion Zone without permission of the SM or SSO.

A4.3.3 Support Zone

The support zone is the outermost area of the site and is considered a noncontaminated or clean area. The support zone contains the command post for field operations, first aid stations, and other investigation and cleanup support. Normal work clothes are appropriate apparel within this zone; potentially contaminated personnel clothing, equipment, etc., are not permitted.

- Support Zone - a Support Zone, the outermost part of the site, must be defined for each field activity. Support equipment is located in this uncontaminated or clean area. Normal work clothes are appropriate within this zone. The location of this zone depends on factors such as accessibility, wind direction (upwind of rig), and resources (i.e., roads, shelter, utilities).

A4.4 SAFE WORK PRACTICES

To ensure a strong safety awareness program during drilling operations and monitoring well construction, personnel must have adequate training, this HASP must be communicated to the employees, and standing orders must be developed and communicated to the employees. Standing orders for personnel entering the exclusion zone are as follows:

- Eating, drinking, chewing gum or tobacco, and smoking are prohibited in the contaminated or potentially contaminated area of where the possibility for the transfer of contamination exists.

- No matches or lighters in zone.

- No personal vehicles are allowed in either the exclusion or contamination reduction zones.

- Check in and check out at access control points.

- The buddy system will be used at all times when performing sampling for hazardous material when the first action level criterion has been exceeded.

- All PPE will be used as specified and required.

- Avoid contact with potentially contaminated substances. Do not walk through puddles, pools, mud, etc. Avoid, whenever possible, kneeling on the ground, leaning or sitting on equipment or the ground. Do not place monitoring equipment on potentially contaminated surfaces.

- Discovery of unusual or unexpected conditions will result in immediate evaluation and reassessment of site conditions and health safety practices.

- Conduct safety briefings prior to on-site work.

- Take precautions to reduce injuries from heavy equipment and other tools.

- All field crew members should make use of their senses to alert them to potentially dangerous situations in which they should not become involved (i.e., presence of strong, irritating or nauseating odors).

- Prevent, to the extent possible, spillages. In the event that a spillage occurs, contain liquid if possible.

- Prevent splashing of the contaminated materials.

- Field crew members shall be familiar with the physical characteristics of investigations, including:
    - - Wind direction in relation to contaminated area
    - - Accessibility to equipment and vehicles
    - - Communications
    - - Hot zone (areas of known or suspected contamination)
    - - Site access
    - - Nearest potable water sources

- The number of personnel and equipment in the contaminated area should be minimized but only to the extent consistent with workforce requirements of safe site operations.

- All wastes generated during OpTech and/or subcontractor activities at the site will be disposed of as directed by the PM.

The following guidelines will be followed while working on-site:

- Heavy equipment: Only qualified operators will be allowed to operated heavy equipment. Subcontractors will be required to use the safe work guidelines included in the OSHA General Industry (29 CFR 1910) and Construction Industry (29 CFR 1926) Standards.

- Power lines: When operating heavy equipment, such as drilling rigs near power lines, workers will take care to ensure that the boom or rigging always maintains a safe distance from power lines (20 feet minimum). Any underground utility lines must also be located and appropriate precautions taken before any drilling is done.

- Swing radius: All swing equipment, such as cranes or backhoes, will have the swing radius guarded to prevent workers from being struck by the rotating machinery.
- Electrical equipment: All electrical equipment will be properly grounded and class approved for the location.

- Machine guarding: All machinery on-site will be properly guarded to prevent contact with rotating shafts, blades, or gears.

- Flammable materials: When work involves flammable materials, adequate ventilating and control of all ignition sources will be maintained. This may include:
  - - Nonsparking tools
  - - Explosion proof equipment (intrinsically safe)
  - - Class-approved electrical equipment
  - - No smoking or open lights
  - - No welding

A4.5 HEALTH AND SAFETY EQUIPMENT CHECKLIST

The following list included normal health and safety equipment taken to the field:

Hardhats
Safety glasses
Ear plug or muffs
Tyvek and polycoated Tyvek coveralls
Chemical resistant steel-toed boots
Work gloves
Nitrile gloves
Surgical vinyl, nitrile, or latex inner gloves
Plastic sheeting (visqueen)
55-gal 17-H drums (for contaminated solids) and 17-E drums (for liquids)
Drum liners
Barricade tape and barricades
Wash tubs and scrub brushes
Decon solution
Folding chairs
5- or 10-gal portable eyewash
Respirator sanitizing equipment
First Aid kit
Drinking water
Gatorade or similar drink

Type ABC fire extinguishers
Half-face and full-face respirators (NIOSH/MSHA approved)
Organic vapor cartridges
OVA and calibration kit
Garden sprayer
Compressed gas horn
Duct tape

A4.6 ACCIDENT PREVENTION

On a day-to-day basis, all personnel should be constantly alert for indicators of potentially hazardous situations and for signs and symptoms in themselves and others that warn of hazardous conditions and exposures. Rapid recognition of dangerous situations can avert an emergency. Before daily work assignments, regular meetings will beheld, with discussion on;

- Tasks to be performed
- Time constraints (e.g., rest breaks, cartridge changes)
- Hazards that may be encountered, including their effects, how to recognize symptoms or monitor them, concentration limits, or other danger signals
- Emergency procedures

A4.6.1 Heavy Equipment Operation

Prior to any drilling activity, efforts will be made to determine whether underground installations will be encountered and, if so, where these installations are located. Hard hats and safety boots, at a minimum, must be worn within 50 feet of the drill rig. The drilling rig cannot be operated within 10 feet of power lines. The SM or SSO will provide constant on-site supervision of the drilling subcontractor to ensure that all health and safety requirements are being met. If deficiencies are noted, work will be stopped and corrective action will be taken (e.g., retrain, purchase additional safety equipment). Reports of health and safety deficiencies and the corrective action taken will be forwarded to the PM.

A4.6.2 Sampling Practices

For all sampling activities, the following standard safety procedures shall be employed:

- All sampling equipment should be cleaned before proceeding to the site.
- At the sampling site, sampling equipment should be cleaned after each use.
- Work in "cleaner" areas should be conducted first where practical.
- The minimum number of personnel necessary to achieve the objectives shall be within 25 feet of the drilling, or sampling activity.
- If emergency and backup subcontracted personnel are at the site, they should remain 25 feet from the drilling, or sampling activity, where practical.
- All unauthorized personnel will remain outside exclusion zones at all times.

A4.7 SITE SECURITY

Site security is necessary to prevent exposure of unauthorized, unprotected individual in the work area. Because of the increased hazards from equipment and potential exposures, site security will be enforced by the SSO, who will ensure that only authorized personnel are allowed in the work area and that personnel have the required level of PPE.

A4.8 COMMUNICATION

The communication network will be set up to alert site personnel of emergencies and to summon outside emergency assistance, and all site personnel will be trained on the use of the network. Where voice communication is not feasible, an alarm system will be set up to alert employees of emergencies. In some cases, radio communications may be used to communicate with personnel in the exclusion zone. If phone service is not readily available, radios, or portable phones will be used to communicate with outside agencies. Emergency phone numbers and the emergency route to the nearest hospital will be posted in a readily available location and all site personnel will be briefed daily on its location.

A4.9 CONTINGENCY PLAN

In the event that an emergency develops on-site, the procedures delineated herein are to be immediately followed. Emergency conditions are considered to exist if:

- Any member of the field crew is involved in an accident or experiences any adverse effects or symptoms of exposure while on-site.
- A condition is discovered that suggests the existence of a situation more hazardous than anticipated.

A4.9.1 Chemical Exposure

If a member of the field crew demonstrates symptoms of chemical exposure of any sort, the procedures outlined below will be followed:

- Another team member (buddy) will remove the individual from the immediate area of contamination. The buddy must advise the SM of the chemical exposure. The field team will contact the appropriate emergency response agency.
- Precautions will be taken to avoid exposure of other individuals to the chemical.
- If the chemical is on the individual's clothing, the chemical will be neutralized or removed if it is safe to do so.
- If the chemical has contacted the skin, the skin will be washed with copious amounts of water.
- In case of eye contact, an emergency eyewash will be used, washing the eyes for at least 15 minutes.
- As required, the affected person will be conveyed to the nearest hospital emergency room for treatment. The OpTech PM will be called immediately, and will assume that OpTech's occupational health and safety physician gets in contact with the emergency room to assist in treatment options.

- All chemical exposure incidents must be reported in writing to the CHSC. The SSO or SM is responsible for completing the accident report form.

- Immediate follow-up action will be taken to correct the situation which caused the exposure.

A4.9.2 Personal Injury

In case of person injury at the site, the following procedures will be followed:

- Another team member (buddy) will signal the field team leader that an injury has occurred.

- A field team member trained in first aid can administer treatment to an injured worker.

- The victim will then be transported to the nearest hospital or medical center. If necessary, an ambulance will be called to transport the victim. OpTech will be immediately contacted to activate OpTech's occupational health and safety physician. The physician will contact the emergency room to assist in treatment as necessary.

- The SM or SSO is responsible for making certain that an accident report form is completed. This form is to be submitted to the OpTech CHSC by fax or as soon as possible. Immediate follow-up action must be taken to correct the situation that caused the accident.

A4.9.3 Evacuation Procedures

- The SM will initiate the evacuation procedure by signaling the team to leave the site with three blasts of the air horn.

- All personnel in the work area will evacuate the area and meet in the common designated area.

- All personnel suspected to be in or near the contract work area must be accounted for and the whereabouts of missing persons determined immediately.

- Further instructions will then be given by the SM.

Procedures implemented in the event of a major fire, explosion, or on-site health emergency crisis:

- A field team member will notify the paramedics and/or fire department, as necessary,

- The SM will signal the evacuation procedure previously outlined and implement the entire procedure.

- The area will be isolated.

- Field team members will be instructed to stay upwind of any fire.

- The area surrounding the problem source will be kept clear after the incident occurs.

A4.10 DECONTAMINATION PROCEDURES

If the vapor readings indicate respirator use, the following steps will be followed whenever personnel leave the exclusion zone/work area:

1. Remove all equipment, sample containers, and notes to the CRZ. Obtain decontamination solutions and decon the shovels, auger flights, etc. by brushing them under a water rinse. A high-pressure steam cleaner may also be used for decon. All waste and spent decon solutions will be properly contained.

2. Scrub boots and gloves with a stiff bristle brush and water. Washtubs and chairs will be provided.

3. Remove outer gloves (and boot covers, if used).

4. Remove Tyvek coverall; discard in provided container.

5. Remove hardhat and eye protection.

6. Remove respirator.

7. Remove inner gloves.

8. Wash hands and face.

The decontamination area will be covered with plastic sheeting which will be replaced when torn or heavily soiled, and at the end of each shift.

Each worker will be responsible for cleaning, sanitizing and storing their own respirator in accordance with manufacturer's guidance (i.e., washing in warm water and detergent or sanitizing solution, air drying, and storing in a plastic storage bag). Cartridges will be changed as soon as breakthrough occurs (detection of organic vapor odor while wearing the respirator) and at the end of each shift. Respirators will be kept in storage bags or boxes when not in use.

All spent decontamination fluids (rinse water, etc.) shall be handled as hazardous waste until lab results indicate otherwise. Fluids shall be placed in proper containers, such as drums, and worked and labeled in accordance with 49 CFR 172.

A4.10.1 Decontamination-Medical Emergencies

In the event of physical injury or other serious medical concerns, immediate first-aid is to be administered in lieu of further decontamination efforts.

A4.10.2 Decontamination of Tools

When all work activities have been completed, contaminated tools will be totally decontaminated. It is expected that all tools will be constructed of non-porous, non-absorbent materials, This will aid the decontamination process. Any tool, which is made of a porous/absorbent material will be discarded and disposed of as a hazardous waste if it cannot be properly decontaminated.

Tools will be placed on a decontamination pad or into a bucket and thoroughly washed using a soap solution and brushing, followed by a fresh-water rinse. All visible particles are to be removed before the tool is considered clean.

Those tools which would be damaged by a high pressure spray will be cleaned manually, using a soap solution and mechanical brush, followed by a fresh-water rinse.

A4.10.3 Heavy Equipment Decontamination

At locations where it is likely that heavy equipment will come in contact with contaminated soil, such heavy equipment will be decontaminated upon leaving the exclusion zone. This is generally not necessary when drilling through concrete or other "clean" pavement.

Partial decontamination efforts will be conducted in the exclusion zone. As much mud, dirt, rocks, etc., as possible will be mechanically removed from the tires, tracks, or outside of the equipment.

The heavy equipment will then be driven onto a decontamination pad located adjacent to the exclusion zone if lab results indicate otherwise. Fluids shall be placed in proper containers, such as drums, and worked and labeled in accordance with 49 CFR 172.

Following the washing, the heavy equipment will be driven into the support zone. Under no circumstances should heavy equipment be allowed to leave the site if it is not decontaminated.

A4.11 PLACES OF REFUGE

The SSO will designate the assembly area prior to the start of work, and will include emergency information in the daily "tailgate" briefing. In the event of a site emergency requiring evacuation, all personnel will evacuate to a predesignated area located in the support zone, a safe distance from the exclusion zone boundary ("hot lines"). The SSO will designate the assembly area prior to the start of work and will include emergency information in the daily "tailgate" briefing.

A4.12 FIRE

Whenever the possibility of a fire or explosion exists which could affect field investigation personnel or adjacent work area personnel, or which could occur as the result of the investigation, an emergency action plan is prepared as part of the task specification. The emergency action plan includes the following:

- Training is provided to employees by the SSO, including how and when to use the equipment, and evacuation drills; and
- The primary and alternate evacuation routes and places of assembly are posted at the investigation-site.

Contractors and subcontractors must conform with the emergency action plan and are trained accordingly.

To protect against fires, the following special precautions must be taken:

- Before any flame-producing devices, i.e., cutting torches or welding irons, are used in the exclusion zone, the SSO must be contacted. A detailed inspection of the work area will be conducted to determine if potential fire sources exist. The fire sources must be removed to at least 35 feet away before work can commence;
- Two full 20-pound ABC fire extinguishers must be located at the work area when cutting/welding is being conducted; and
- Upon completion of the cutting/welding activities the area will be inspected for hot metal, slag, etc.

Type ABC fire extinguishers will be available on-site to contain and extinguish small fires. The local fire department should be summoned in the event of any fire on-site.

A4.13 SAFETY EYEWASH

A 10-gallon, 15-minute safety eyewash or small, portable eyewash bottles will be available at the site for the sole purpose of flushing foreign particles or contaminants out of eyes. The SSO will demonstrate the proper operation of the unit prior to the start of work.

A4.14 ACCIDENT/INCIDENT REPORT

In the event of an injury or illness, work is to be stopped until the SSO and the CHSO have determined the cause of the incident and have taken the appropriate action. Any injury or illness, regardless of severity, is to be reported, and an accident report form must be filled out and forwarded to OpTech corporate headquarters as soon as possible.

A4.15 OPERATION SHUTDOWN

Under certain extreme hazardous situations the on-site personnel, SSO or SSR may request that operations be temporarily suspended while the underlying hazard is corrected or controlled. During operation shutdown, all personnel will be required to stand upwind to prevent exposure to fugitive emissions. The SSO will have ultimate authority for operations shutdown and restart.

A4.16 SPILL OR HAZARDOUS MATERIALS RELEASE

Small spills will be immediately reported to the SSO and dealt with according to chemical manufacturers' recommended procedures. Spills or release of hazardous materials which result in human exposure or offsite environmental contamination will be promptly reported by the SSO to the proper authorities and appropriate measure taken to contain and/or collect the material for approved storage and disposal.

A4.17 COMMUNITY SAFETY

There is a low potential for migration of chemicals from the site other than through groundwater or air emissions, both of which would be expected to contain low concentrations of hazardous material. In the unlikely event that significant offsite release of contaminants occur during the course of the field work, the appropriate State and local authorities will be notified immediately and appropriate actions will be taken to protect the public health and mitigate the contaminant release.

A4.18 TRAINING AND MEDICAL SURVEILLANCE

All OpTech site personnel will have met the requirements of 29 CFR 1910.120 (e), including 40-hour training or its recognized equivalent annual refresher training and supervisor training. All OpTech site personnel are participating in medical surveillance programs that meet the requirements of 29 CFR 1910.120(f). The CHC will maintain current copies of training certificates and statements of medical program participation for all site personnel.

In addition, all OpTech site personnel and subcontractor personnel will sign a copy of the Safety Plan Compliance Agreement Form. The PM will maintain these agreements at the site, and forward them to the CHC at the conclusion of the operation.

Prior to the start of operations at the site, the SSO will conduct a tailgate safety meeting; which will include all personnel involved at the site. At this meeting, the SSO will discuss:

- General contents of this HASP;
- Types of hazards at the site and means for minimizing exposure to them;
- The type of monitoring that will be performed;
- PPE that will be used;
- Location and use of emergency equipment; and
- Emergency evacuation signals and procedures.

Subsequent site safety briefings will be conducted prior to each shift to review pertinent safety issues, discuss any problems, and outline safety aspects of the shift's tasks.

A4.19 RECORDKEEPING

The PM and SSO are responsible for site recordkeeping. Prior to the start of work, they will review this plan; if there are no changes to be made, they will approve the plan.

All OpTech personnel will review the HASP and sign the Safety Plan Compliance Agreement Form; copies of these forms will be forwarded to the CHSC.

The SSO will conduct a "tailgate" Site Safety Briefing prior to each shift (usually the first on-site activity of the morning) and all attendees and briefing subjects will be listed in the filed log book. Copies will be available to the CHSC.

Any accident or exposure incident will be investigated and a report prepared and forwarded to the office administrative manager and the CHSC.

All instrument readings and calibrations, PPE use and changes, health and safety-related issues, and deviations from or problems with this HASP will be recorded in the SSO's field notebook. As required, all portions of the SSO's field notebook will be available to the CHSC for review at the completion of field operations.

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Tab 1

Safety Plan compliance Agreement

SAFETY PLAN COMPLIANCE AGREEMENT
For
120th Fighter Wing, Montana Air National Guard
Great Falls, Montana

I have received a copy of the Health and Safety Plan for the Project. I have reviewed the plan, understand it, and agree to comply with all of its provisions. I understand that I could be prohibited from working on the project for violating any of the health and safety requirements specified in the plan.

Name	Signature	Date
Name	Signature	Date
Name	Signature	Date
Name	Signature	Date
Name	Signature	Date
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Tab 2

Material Safety Data Sheets for Chemicals Most Likely to be Encountered at the Site

BENZENE
HAZARD MATERIAL INFORMATION SHEET

ECTION 1 MATERIAL IDENTIFICATION

azardous Material Name: Benzene
ommon Synonyms: Benzol; Phenyl Hydride; Coal Naphtha
ormula: C_6H_6 Formula Wt: 78.10
AS No.: 71-43-2
IOSH/RTECS No.: CY1400000
nformation Researched: 11/22/96

ECTION 2 HAZARD COMMUNICATIONS

PRECAUTIONARY LABELING

Hazard Ranking System

Health	4	Extreme (Cancer Causing)
Flammability	3	Severe (Flammable)
Reactivity	0	None
Contact	1	Slight

Hazard Ratings Are 0 To 4
(i.e., 0 = No Hazard; 4 = Extreme Hazard).

PRECAUTIONARY LABEL STATEMENTS

POISON DANGER
EXTREMELY FLAMMABLE
CAUTION: BENZENE, CANCER HAZARD
HARMFUL IF SWALLOWED, INHALED,
OR ABSORBED THROUGH SKIN
EXCEPTIONAL HEALTH HAZARD -
READ MATERIAL SAFETY DATA SHEET
KEEP AWAY FROM HEAT, SPARKS, FLAME.
AVOID CONTACT WITH EYES, SKIN, CLOTHING.
AVOID BREATHING VAPOR.
KEEP IN TIGHTLY CLOSED CONTAINER.
USE WITH ADEQUATE VENTILATION.
WASH THOROUGHLY AFTER HANDLING.
IN CASE OF FIRE,
USE ALCOHOL FOAM, DRY CHEMICAL,
CARBON DIOXIDE -
WATER MAY BE INEFFECTIVE.
FLUSH SPILL AREA WITH WATER SPRAY.

Storage Color Code: Red Stripe (Store Separately)

SECTION 3 PHYSICAL DATA

Boiling Point: 80°C (176°F)
Specific Gravity: 0.88 (H_2O=1)
Vapor Pressure(mmHg): 74.6
Melting Point: 6°C (43°F)
Vapor Density(Air=1): 2.77
% Volatiles By Volume: 100
Evaporation Rate: N/A (Butyl Acetate=1)
Solubility(H_2O): Negligible (Less Than 0.1 %)
Appearance & Odor: Clear colorless liquid having characteristic aromatic odor.

SECTION 4 FIRE AND EXPLOSION

Flash Point (Closed Cup: -11°C (12°F)
NFPA 704M Rating: 2-3-0
Flammable Limits: Upper - 8.0 % Lower - 1.3 %
Fire Extinguishing Media: Use alcohol foam, dry chemical or carbon dioxide (water may be ineffective).

Special Fire-Fighting Procedures
Firefighters should wear proper protective equipment and self-contained; breathing apparatus with full facepiece operated in positive pressure mode. Move containers from fire area if it can be done without risk. Use water to keep fire-exposed containers cool.

Unusual Fire & Explosion Hazards
Vapors may flow along surfaces to distant ignition sources and flash back. Closed containers exposed to heat may explode. Contact with strong oxidizers may cause fire.

Toxic Gases Produced
Carbon monoxide, carbon dioxide

SECTION 5 HEALTH HAZARD DATA

This substance is listed as ACGIH suspect human carcinogen, NTP human carcinogen, IARC human carcinogen (Group 1). Acceptable maximum peak above the acceptance ceiling concentration for an eight-hour shift = 50 ppm for 10 minutes; (PEL) Ceiling = 25 ppm; Threshold Limit Value (TLV/TWA): 32 mg/m^3 (10 ppm); Short-Term Exposure Limit (STEL): 16 mg/m^3 (5 ppm); Permissible Exposure Limit (PEL): 3 mg/m^3 (1 ppm).

Effects Of Acute Overexposure:
Inhalation Vapors: Headache, nausea, vomiting, dizziness, narcosis, suffocation, lower blood pressure, central nervous system depression, severe irritation or burns of the respiratory system, pulmonary edema, or lung inflammation.
Contact With Liquid: May cause irritating to skin and eyes. Prolonged skin contact may result in dermatitis.
Eye Contact: May cause temporary corneal damage.
Ingestion: May cause nausea, vomiting, headaches, dizziness, gastro-intestinal irritation, blurred vision, lowering of blood pressure.
Chronic Effects: Irreversible injury to blood forming tissue may result from chronic low level exposure.
Target Organs
Blood, central nervous system, eyes, skin, bone marrow, respiratory system
Medical conditions generally aggravated by exposure
None identified

BENZENE
HAZARD MATERIAL INFORMATION SHEET

SECTION 5 HEALTH HAZARD DATA...CONCLUDED

Routes Of Entry
Ingestion, inhalation, eye contact, skin contact, absorption

Emergency And First Aid Procedures:
Call a physician.
If swallowed, do not induce vomiting.
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.
In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes.

SECTION 6 REACTIVITY DATA

Stability: Stable
Hazardous Polymerization: Will not occur.
Conditions To Avoid: Heat, flame, other sources of ignition
Incompatibles: Strong oxidizing agents, sulfuric acid, nitric acid
Decomposition Products: Carbon monoxide, carbon dioxide

SECTION 7 SPILL AND DISPOSAL PROCEDURES

Steps To Be Taken In The Event Of A Spill Or Discharge
Wear self-contained breathing apparatus and full protective clothing.
Shut off ignition sources; no flares, smoking or flames in area. Stop leak if you can do so without risk. Use water spray to reduce vapors. Take up with sand or other non-combustible absorbent material and place into container for later disposal. Flush area with water.

Disposal Procedure
Dispose in accordance with all applicable federal, state, and local environmental regulations.

EPA Hazardous Waste Number: U019 (Toxic Waste)

SECTION 8 PROTECTIVE EQUIPMENT

Ventilation: Use general or local exhaust ventilation to meet TLV requirements.
Respiratory Protection: Respiratory protection required if airborne concentration exceeds PEL of 1ppm; negative pressure cartridge respirator with organic vapor cartridges is advised. At concentrations above 25 ppm, a air supplied pressure-demand respirator or self-contained breathing apparatus is advised.
Eye/Skin Protection: Safety goggles and face shield, uniform, protective suit, polyvinyl alcohol gloves are recommended.

SECTION 9 STORAGE AND HANDLING PRECAUTIONS

Storage Color Code: Red stripe (store separately)
Special Precautions: Bond and ground containers when transferring liquid. Keep container tightly closed. Store in a cool, dry, well-ventilated, flammable liquid storage area.

SECTION 10 TRANSPORTATION DATA AND ADDITIONAL INFORMATION

Domestic (D.O.T.)

Proper Shipping Name	Benzene (Benzol)
Hazard Class	Flammable Liquid
UN/NA	UN1114
Labels	Flammable Liquid
Reportable Quantity	1000 Lbs.

International (I.M.O.)

Proper Shipping Name	Benzene
Hazard Class	3.2
UN/NA	UN1114
Labels	Flammable Liquid

SECTION 11 REFERENCES

"NIOSH Pocket Guide To Chemical Hazards;" U.S. Department of Health and Human Services, Center for Disease Control and Prevention (CDC) & National Institute of Occupational Safety and Health; Copyright: June 1994.

"1996 Threshold Limit Values for Chemical Substances and Physical Agents Biological Exposure Indices;" American Conference of Government Industrial Hygienist.

"Hazardous Chemicals Data Book; Second Edition;" Edited by Weiss; Published by Noyes Data Corporation, Park Ridge, New Jersey; Copyright 1986.

"Tomes;" by Micromedex, Inc., Englewood, Colorado; 1996 Edition.

TOLUENE
HAZARD MATERIAL INFORMATION SHEET

SECTION 1 MATERIAL IDENTIFICATION

Hazardous Material Name: Toluene
Common Synonyms: Methylbenzene; Methylbenzol; Phenyl Methane; Toluol
Formula: $C_6H_5CH_3$ Formula Wt: 92.14
CAS No.: 108-88-3
NIOSH/RTECS No.: XS5250000
Information Researched: 11/22/96

SECTION 2 HAZARD COMMUNICATIONS

PRECAUTIONARY LABELING

Hazard Ranking System

Health	2	Moderate
Flammability	3	Severe (Flammable)
Reactivity	0	None
Contact	2	Moderate

Hazard Ratings Are 0 To 4
(i.e., 0 = No Hazard; 4 = Extreme Hazard).

PRECAUTIONARY LABEL STATEMENTS

WARNING
FLAMMABLE
CAUSES IRRITATION
HARMFUL IF SWALLOWED, INHALED,
OR ABSORBED THROUGH SKIN
READ MATERIAL SAFETY DATA SHEET
KEEP AWAY FROM HEAT, SPARKS, FLAME.
AVOID CONTACT WITH EYES, SKIN, CLOTHING.
AVOID BREATHING VAPOR.
KEEP IN TIGHTLY CLOSED CONTAINER.
USE WITH ADEQUATE VENTILATION.
WASH THOROUGHLY AFTER HANDLING.
IN CASE OF FIRE,
USE ALCOHOL FOAM, DRY CHEMICAL,
CARBON DIOXIDE -
WATER MAY BE INEFFECTIVE.
FLUSH SPILL AREA WITH WATER SPRAY.

Storage Color Code: Red (Flammable)

SECTION 3 PHYSICAL DATA

Boiling Point: 111°C (232°F) Specific Gravity: 0.87 (H_2O=1)
Vapor Pressure(mmHg): 22 Melting Point: -95°C (-139°F)
Vapor Density(Air=1): 3.2 % Volatiles By Volume: 100
Evaporation Rate: 2.24 (Butyl Acetate=1)
Solubility(H_2O): Negligible (Less Than 0.1 %)
Appearance & Odor: Clear colorless liquid benzene-like odor.

SECTION 4 FIRE AND EXPLOSION

Flash Point (Closed Cup): 4°C (40°F)
NFPA 704M Rating: 2-3-0
Flammable Limits: Upper - 7.1 % Lower - 1.2 %
Fire Extinguishing Media: Use alcohol foam, dry chemical or carbon dioxide (water may be ineffective).

Special Fire-Fighting Procedures:
Firefighters should wear proper protective equipment and self-contained; breathing apparatus with full facepiece operated in positive pressure mode. Move containers from fire area if it can be done without risk. Use water to keep fire-exposed containers cool.

Unusual Fire & Explosion Hazards:
Vapors may flow along surfaces to distant ignition sources and flash back. Closed containers exposed to heat may explode. Contact with strong oxidizers may cause fire.

Toxic Gases Produced:
Carbon monoxide, carbon dioxide

SECTION 5 HEALTH HAZARD DATA

Acceptable maximum peak above the acceptance ceiling concentration for an eight-hour shift = 500 ppm for 10 minutes; (PEL) Ceiling = 300 ppm; Threshold Limit Value (TLV/TWA): 188 mg/m^3 (50 ppm); Permissible Exposure Limit (PEL): 753 mg/m^3 (200 ppm)

Effects Of Acute Overexposure:
Inhalation Vapors: Headache, nausea, vomiting, dizziness, narcosis, coughing, lower blood pressure, central nervous system depression, severe irritation or burns of the respiratory system, pulmonary edema, or lung inflammation.
Contact with liquid may cause irritating to skin and eyes.
Prolonged skin contact may result in dermatitis.
Eye Contact: May cause temporary corneal damage.
Ingestion: May cause nausea, vomiting, headaches, dizziness, gastro-intestinal irritation, blurred vision, lowering of blood pressure.
Chronic Effects: Overexposure may result in kidney and liver damage.
Target Organs: Central nervous system, liver, skin, kidneys, and respiratory system
Medical conditions generally aggravated by exposure:
None identified
Routes Of Entry
Ingestion, inhalation, eye contact, skin contact, absorption

TOLUENE
HAZARD MATERIAL INFORMATION SHEET

SECTION 5 HEALTH HAZARD DATA...CONCLUDED

Emergency And First Aid Procedures:
Call a physician.
If swallowed, do not induce vomiting.
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.
In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes.

SECTION 6 REACTIVITY DATA

Stability: Stable
Hazardous Polymerization: Will not occur
Conditions To Avoid: Heat, flame, other sources of ignition
Incompatibles: Strong oxidizing agents - - sulfuric acid, nitric acid, organic acids, and other acids.
Decomposition Products: Carbon monoxide, carbon dioxide

SECTION 7 SPILL AND DISPOSAL PROCEDURES

Steps To Be Taken In The Event Of A Spill Or Discharge
Wear self-contained breathing apparatus and full protective clothing.
Shut off ignition sources; no flares, smoking or flames in area. Stop leak if you can do so without risk. Use water spray to reduce vapors. Take up with sand or other non-combustible absorbent materia, and place into container for later disposal. Flush area with water.

Disposal Procedure
Dispose in accordance with all applicable federal, state, and local environmental regulations.

EPA Hazardous Waste Number: U220 (Toxic Waste)

SECTION 8 PROTECTIVE EQUIPMENT

Ventilation: Use general or local exhaust ventilation to meet TLV requirements.
Respiratory Protection: Respiratory protection required if airborne concentration exceeds TLV of 50 ppm; negative pressure cartridge respirator with organic vapor cartridges is advised. At concentrations above 500 ppm, air supplied pressure-demand respirator or self-contained breathing apparatus is advised.
Eye/Skin Protection: Safety goggles and face shield, uniform, protective suit, polyvinyl alcohol gloves are recommended.

SECTION 9 STORAGE AND HANDLING PRECAUTIONS

Storage Color Code: Red (Flammable)
Special Precautions: Bond and ground containers when transferring liquid. Keep container tightly closed. store in a cool, dry, well-ventilated, flammable liquid storage area.

SECTION 10 TRANSPORTATION DATA AND ADDITIONAL INFORMATION

Domestic (D.O.T.)
Proper Shipping Name: Toluene
Hazard Class: Flammable Liquid
UN/NA: UN1294
Labels: Flammable Liquid
Reportable Quantity: 1000 Lbs.

International (I.M.O.)
Proper Shipping Name: Toluene
Hazard Class: 3.2
UN/NA: UN1294
Labels: Flammable Liquid

SECTION 11 REFERENCES

"NIOSH Pocket Guide To Chemical Hazards;" U.S. Department of Health and Human Services, Center for Disease Control and Prevention (CDC) & National Institute of Occupational Safety and Health(NIOSH); Copyright: June 1994.

"1996 Threshold Limit Values for Chemical Substances and Physical Agents Biological Exposure Indices;" American Conference of Government Industrial Hygienist.

"Hazardous Chemicals Data Book; Second Edition;" Edited by Weiss; Published by Noyes Data Corporation, Park Ridge, New Jersey; Copyright 1986.

"Tomes;" by Micromedex, Inc., Englewood, Colorado; 1996 Edition.

ETHYLBENZENE
HAZARD MATERIAL INFORMATION SHEET

SECTION 1 MATERIAL IDENTIFICATION

Hazardous Material Name: Ethylbenzene
Common Synonyms: Ethylbenzol; Phenylethane
Formula: $C_6H_5CH_2CH_3$ Formula Wt: 106.2
CAS No.: 100-41-4
NIOSH/RTECS No.: DA0700000
nformation Researched: 11/22/96

SECTION 2 HAZARD COMMUNICATIONS

PRECAUTIONARY LABELING

Hazard Ranking System

Health	2	Moderate
Flammability	3	Severe (Flammable)
Reactivity	0	None
Contact	2	Moderate

Hazard Ratings Are 0 To 4
(i.e., 0 = No Hazard; 4 = Extreme Hazard).

PRECAUTIONARY LABEL STATEMENTS

WARNING
FLAMMABLE
CAUSES IRRITATION
HARMFUL IF SWALLOWED, INHALED,
OR ABSORBED THROUGH SKIN
READ MATERIAL SAFETY DATA SHEET
KEEP AWAY FROM HEAT, SPARKS, FLAME.
AVOID CONTACT WITH EYES, SKIN, CLOTHING.
AVOID BREATHING VAPOR.
KEEP IN TIGHTLY CLOSED CONTAINER.
USE WITH ADEQUATE VENTILATION.
WASH THOROUGHLY AFTER HANDLING.
IN CASE OF FIRE,
USE ALCOHOL FOAM, DRY CHEMICAL,
CARBON DIOXIDE -
WATER MAY BE INEFFECTIVE.
FLUSH SPILL AREA WITH WATER SPRAY.

Storage Color Code: Red (Flammable)

SECTION 3 PHYSICAL DATA

Boiling Point: 136°C (277°F) Specific Gravity: 0.867 ($H_2O=1$)
Vapor Pressure (mmHg): 7.1 Melting Point: -95°C (-139°F)
Vapor Density(Air=1): 3.7 % Volatiles By Volume: 100
Evaporation Rate: < 1 (Butyl Acetate=1)
Solubility(H_2O): 0.015%
Appearance & Odor: Clear colorless liquid with aromatic odor.

SECTION 4 FIRE AND EXPLOSION

Flash Point (Closed Cup): 15°C (59°F)
Autoignition: 432°F (810°F)
NFPA 704M Rating: 2-3-0
Flammable Limits: Upper - 7.8 % Lower - 1.0 %
Fire Extinguishing Media: Use alcohol-resistant foam, dry chemical or carbon dioxide (water may be ineffective).

Special Fire-Fighting Procedures
Firefighters should wear proper protective equipment and self-contained; breathing apparatus with full facepiece operated in positive pressure mode. Move containers from fire area if it can be done without risk. Use water to keep fire-exposed containers cool.

Unusual Fire & Explosion Hazards
Vapors may flow along surfaces to distant ignition sources and flash back. Closed containers exposed to heat may explode. Contact with strong oxidizers may cause fire.

Toxic Gases Produced:
Carbon monoxide and carbon dioxide

SECTION 5 HEALTH HAZARD DATA

Threshold Limit Value (TLV/TWA): 435 mg/m^3 (100 ppm);
Short Term Exposure Limit (STEL): 543 mg/m^3 (125 ppm);
Permissible Exposure Limit (PEL): 435 mg/m^3 (100 ppm)

Effects Of Acute Overexposure:
Inhalation Vapors: Headache, nausea, vomiting, dizziness, narcosis, loss of consciousness, coughing, lower blood pressure, central nervous system depression, irritation of the respiratory system, pulmonary edema, or lung inflammation.
Contact With Liquid: May cause irritating to skin and eyes. Prolonged skin contact may result in dermatitis.
Eye Contact: May cause temporary corneal damage.
Ingestion: May cause nausea, vomiting, headaches, dizziness, gastro-intestinal irritation, blurred vision, lowering of blood pressure.
Chronic Effects: Overexposure may result in kidney and liver damage.
Target Organs
Central nervous system, liver, skin, kidneys, GI tract, blood, eyes, and respiratory system
Medical conditions generally aggravated by exposure
None identified
Routes Of Entry: Ingestion, inhalation, eye contact, skin contact, and absorption

ETHYLBENZENE
HAZARD MATERIAL INFORMATION SHEET

SECTION 5 HEALTH HAZARD DATA...CONCLUDED

Emergency And First Aid Procedures:
Call a physician.
If swallowed, do not induce vomiting.
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.
In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes.

SECTION 6 REACTIVITY DATA

Stability: Stable
Hazardous Polymerization: Will not occur.
Conditions To Avoid: Heat, flame, other sources of ignition
Incompatibles: Strong oxidizing agents - - sulfuric acid, nitric acid, organic acids, and other acids.
Decomposition Products: Carbon monoxide, carbon dioxide

SECTION 7 SPILL AND DISPOSAL PROCEDURES

Steps To Be Taken In The Event Of A Spill Or Discharge:
Wear self-contained breathing apparatus and full protective clothing.
Shut off ignition sources; no flares, smoking or flames in area. Stop leak if you can do so without risk. Use water spray to reduce vapors. Take up with sand or other non-combustible absorbent material and place into container for later disposal. Flush area with water.

Disposal Procedure
Dispose in accordance with all applicable federal, state, and local environmental regulations.

EPA Hazardous Waste Number: N/A

SECTION 8 PROTECTIVE EQUIPMENT

Ventilation: Use general or local exhaust ventilation to meet TLV requirements.
Respiratory Protection: Respiratory protection required if airborne concentration exceeds PEL of 100 ppm; negative pressure cartridge respirator with organic vapor cartridges is advised. At concentrations above 800 ppm, air supplied pressure-demand respirator or self-contained breathing apparatus is advised.
Eye/Skin Protection: Safety goggles and face shield, uniform, protective suit, nitrile gloves are recommended.

SECTION 9 STORAGE AND HANDLING PRECAUTIONS

Storage Color Code: Red (Flammable)
Special Precautions: Bond and ground containers when transferring liquid. Keep container tightly closed. Store in a cool, dry, well-ventilated, flammable liquid storage area.

SECTION 10 TRANSPORTATION DATA AND ADDITIONAL INFORMATION

Domestic (D.O.T.)
Proper Shipping Name: Ethylbenzene
Hazard Class: 3 Flammable Liquid
UN/NA: UN1175
Labels: Flammable Liquid
Reportable Quantity: 1000 Lbs.

International (I.M.O.)
Proper Shipping Name: Ethylbenzene
Hazard Class: 3.2
UN/NA: UN1175
Labels: Flammable Liquid

SECTION 11 REFERENCES

"NIOSH Pocket Guide To Chemical Hazards;" U.S. Department of Health and Human Services, Center for Disease Control and Prevention (CDC) & National Institute of Occupational Safety and Health; Copyright: June 1994.

"1996 Threshold Limit Values for Chemical Substances and Physical Agents Biological Exposure Indices;" American Conference of Government Industrial Hygienist.

"Hazardous Chemicals Data Book; Second Edition;" Edited by Weiss; Published by Noyes Data Corporation, Park Ridge, New Jersey; Copyright 1986.

"Tomes;" by Micromedex, Inc., Englewood, Colorado; 1996 Edition.

XYLENES
HAZARD MATERIAL INFORMATION SHEET

ECTION 1 MATERIAL IDENTIFICATION

azardous Material Name: Xylenes
ommon Synonyms: Dimethylbenzene; Dimethylbenzol; Xylol
ormula: $C_6H_4(CH_3)_2$ Formula Wt: 106.17
AS No.: 1330-20-7
IOSH/RTECS No.: ZE210000
nformation Researched: 11/22/96
n-Xylene, CAS No.: 108-38-3;
-Xylene, CAS No.: 95-47-6;
-Xylene, CAS No.: 106-42-3

ECTION 2 HAZARD COMMUNICATIONS

PRECAUTIONARY LABELING

Hazard Ranking System

Health	2	Moderate
Flammability	3	Severe (Flammable)
Reactivity	0	None
Contact	2	Moderate

Hazard Ratings Are 0 To 4
(i.e., 0 = No Hazard; 4 = Extreme Hazard).

PRECAUTIONARY LABEL STATEMENTS

WARNING
FLAMMABLE
CAUSES IRRITATION
HARMFUL IF SWALLOWED, INHALED,
OR ABSORBED THROUGH SKIN
READ MATERIAL SAFETY DATA SHEET
KEEP AWAY FROM HEAT, SPARKS, FLAME.
AVOID CONTACT WITH EYES, SKIN, CLOTHING.
AVOID BREATHING VAPOR.
KEEP IN TIGHTLY CLOSED CONTAINER.
USE WITH ADEQUATE VENTILATION.
WASH THOROUGHLY AFTER HANDLING.
IN CASE OF FIRE,
USE ALCOHOL FOAM, DRY CHEMICAL,
CARBON DIOXIDE -
WATER MAY BE INEFFECTIVE.
FLUSH SPILL AREA WITH WATER SPRAY.

Storage Color Code: Red (Flammable)

SECTION 3 PHYSICAL DATA

Boiling Point: 137°C (279°F) Specific Gravity: 0.87 (H_2O=1)
Vapor Pressure (mmHg): 5.1 Melting Point: -48°C (-54°F)
Vapor Density(Air=1): 3.7 % Volatiles By Volume: 100
Evaporation Rate: 0.7 (Butyl Acetate=1)
Solubility(H_2O): Negligible (Less Than 0.1 %)
Appearance & Odor: Clear liquid with sweet pleasant odor.

SECTION 4 FIRE AND EXPLOSION

Flash Point (Closed Cup): 27°C (80°F)
NFPA 704M Rating: 2-3-0
Flammable Limits: Upper - 7.0 % Lower - 1.1 %
Fire Extinguishing Media: Use alcohol foam, dry chemical or carbon dioxide (water may be ineffective).

Special Fire-Fighting Procedures
Firefighters should wear proper protective equipment and self-contained; breathing apparatus with full facepiece operated in positive pressure mode. Move containers from fire area if it can be done without risk. Use water to keep fire-exposed containers cool.

Unusual Fire & Explosion Hazards
Vapors may flow along surfaces to distant ignition sources and flash back. Closed containers exposed to heat may explode. Contact with strong oxidizers may cause fire.

Toxic Gases Produced:
Carbon monoxide and carbon dioxide

SECTION 5 HEALTH HAZARD DATA

Threshold Limit Value (TLV/TWA): 188 mg/m^3 (50 ppm);
Short Term Exposure Limit (STEL): 655 mg/m^3 (150 ppm);
Permissible Exposure Limit (PEL): 435 mg/m^3 (100 ppm)

Effects Of Acute Overexposure:
Inhalation Vapors: Headache, nausea, vomiting, dizziness, narcosis, loss of consciousness, coughing, lower blood pressure, central nervous system depression, irritation of the respiratory system, pulmonary edema, or lung inflammation.
Contact With Liquid: May cause irritating to skin and eyes. Prolonged skin contact may result in dermatitis.
Eye Contact: May cause temporary corneal damage.
Ingestion: May cause nausea, vomiting, headaches, dizziness, gastro-intestinal irritation, blurred vision, lowering of blood pressure.
Chronic Effects: Overexposure may result in kidney and liver damage.
Target Organs
Central nervous system, liver, skin, kidneys, GI tract, blood, eyes, and respiratory system
Medical conditions generally aggravated by exposure
None identified
Routes Of Entry: Ingestion, inhalation, eye contact, skin contact, and absorption

XYLENES
HAZARD MATERIAL INFORMATION SHEET

SECTION 5 HEALTH HAZARD DATA...CONCLUDED

Emergency And First Aid Procedures:
Call a physician.
If swallowed, do not induce vomiting.
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.
In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes.

SECTION 6 REACTIVITY DATA

Stability: Stable
Hazardous Polymerization: Will not occur.
Conditions To Avoid: Heat, flame, other sources of ignition
Incompatibles: Strong oxidizing agents - - sulfuric acid, nitric acid, organic acids, and other acids.
Decomposition Products: Carbon monoxide, carbon dioxide

SECTION 7 SPILL AND DISPOSAL PROCEDURES

Steps To Be Taken In The Event Of A Spill Or Discharge:
Wear self-contained breathing apparatus and full protective clothing.
Shut off ignition sources; no flares, smoking or flames in area. Stop leak if you can do so without risk. Use water spray to reduce vapors. Take up with sand or other non-combustible absorbent material and place into container for later disposal. Flush area with water.

Disposal Procedure
Dispose in accordance with all applicable federal, state, and local environmental regulations.

EPA Hazardous Waste Number: U239 (Toxic Waste)

SECTION 8 PROTECTIVE EQUIPMENT

Ventilation: Use general or local exhaust ventilation to meet TLV requirements.
Respiratory Protection: Respiratory protection required if airborne concentration exceeds PEL of 100 ppm; negative pressure cartridge respirator with organic vapor cartridges is advised. At concentrations above 900 ppm, air supplied pressure-demand respirator or self-contained breathing apparatus is advised.
Eye/Skin Protection: Safety goggles and face shield, uniform, protective suit, nitrile gloves are recommended.

SECTION 9 STORAGE AND HANDLING PRECAUTIONS

Storage Color Code: Red (Flammable)
Special Precautions: Bond and ground containers when transferring liquid. Keep container tightly closed. Store in a cool, dry, well-ventilated, flammable liquid storage area.

SECTION 10 TRANSPORTATION DATA AND ADDITIONAL INFORMATION

Domestic (D.O.T.)
Proper Shipping Name: Xylene
Hazard Class: Flammable Liquid
UN/NA: UN1307
Labels: Flammable Liquid
Reportable Quantity: 1000 Lbs.

International (I.M.O.)
Proper Shipping Name: Xylene
Hazard Class: 3.3
UN/NA: UN1307
Labels: Flammable Liquid

SECTION 11 REFERENCES

"NIOSH Pocket Guide To Chemical Hazards;" U.S. Department of Health and Human Services, Center for Disease Control and Prevention (CDC) & National Institute of Occupational Safety and Health; Copyright: June 1994.

"1996 Threshold Limit Values for Chemical Substances and Physical Agents Biological Exposure Indices;" American Conference of Government Industrial Hygienist.

"Hazardous Chemicals Data Book; Second Edition;" Edited by Weiss; Published by Noyes Data Corporation, Park Ridge, New Jersey; Copyright 1986.

"Tomes;" by Micromedex, Inc., Englewood, Colorado; 1996 Edition.

JP-4
HAZARD MATERIAL INFORMATION SHEET

SECTION 1 MATERIAL IDENTIFICATION

Hazardous Material Name: JP-4
Common Synonyms: Aviation Kerosene, Jet Fuel.
Note: Complex mixture of light hydrocarbon distillates.
Formula: C_9 - C_{20} Formula Wt: NA
CAS No.: 50815-00-4
NIOSH/RTECS No.: NY9340000
Information Researched: 12/3/96

SECTION 2 HAZARD COMMUNICATIONS

PRECAUTIONARY LABELING

Hazard Ranking System

Health	2	Moderate
Flammability	3	Severe (Flammable)
Reactivity	0	None
Contact	1	Slight

Hazard Ratings Are 0 To 4
(i.e., 0 = No Hazard; 4 = Extreme Hazard).

PRECAUTIONARY LABEL STATEMENTS

CAUTION
COMBUSTIBLE
CAUSES IRRITATION TO EYES AND SKIN
HARMFUL IF SWALLOWED, INHALED,
OR ABSORBED THROUGH SKIN
READ MATERIAL SAFETY DATA SHEET
KEEP AWAY FROM HEAT, SPARKS, FLAME.
AVOID CONTACT WITH EYES, SKIN, CLOTHING.
REMOVE CONTAMINATED CLOTHING AND SHOES
KEEP IN TIGHTLY CLOSED CONTAINER.
USE WITH ADEQUATE VENTILATION.
WASH THOROUGHLY AFTER HANDLING.
IN CASE OF FIRE,
USE FOAM, DRY CHEMICAL, CARBON DIOXIDE
WATER MAY BE INEFFECTIVE ON FIRE.
COOL EXPOSED CONTAINERS WITH WATER SPRAY.

Storage Color Code: Red (Combustible)

SECTION 3 PHYSICAL DATA

Boiling Range: 120-500°F Vapor Density(Air=1): NA
Specific Gravity: 0.75 ($H_2O=1$) Reid Vapor Pressure: 2 psia
Melting Point: <-54 °F Solubility(H_2O): Trace
% Volatiles By Volume: ~100
Evaporation Rate: < 1 (Butyl Acetate=1)
Appearance & Odor: A pale yellow to water-white liquid with characteristic fuel oil odor. Odor threshold ~1 ppm

SECTION 4 FIRE AND EXPLOSION

Flash Point (Closed Cup): -10 to 30 °F Autoignition: 442 °F
NFPA 704M Rating: 0-2-0
Flammable Limits: Upper - 8.0 % Lower - 1.3 %
Fire Extinguishing Media: Use foam, dry chemical or carbon dioxide (water may be ineffective).

Special Fire-Fighting Procedures
Firefighters should wear proper protective equipment and self-contained; breathing apparatus with full facepiece operated in positive pressure mode. Move containers from fire area if it can be done without risk. Use water to keep fire-exposed containers cool.

Unusual Fire & Explosion Hazards
Vapors may flow along surfaces to distant ignition sources and flash back. Closed containers exposed to heat may explode. Contact with strong oxidizers may cause fire.

Toxic Gases Produced:
Carbon monoxide and carbon dioxide

SECTION 5 HEALTH HAZARD DATA

Recommended Exposure Limit (REL/TWA): 100 ppm;
Short Term Exposure Limit (STEL): None;
Permissible Exposure Limit (PEL): None

Effects Of Acute Overexposure:
Inhalation Vapors: Slight irritation of the respiratory system.
Contact With Liquid: May cause irritating to skin and eyes. Prolonged skin contact may result in dermatitis.
Eye Contact: May cause smarting and reddening of eye.
Ingestion: May cause gastro-intestinal irritation, coughing, gagging, dyspnea, substernal distress, blurred vision, and pulmonary edema (if aspirated), minor central nervous system depression, and possible pneumonitis.
Chronic Effects: Overexposure may result in kidney and liver damage.
Target Organs
Central nervous system, skin, eyes, and respiratory system
Medical conditions generally aggravated by exposure
Disease effecting the target organs mentioned above.
Routes Of Entry: Ingestion, inhalation, eye contact, skin contact, and absorption
Emergency And First Aid Procedures:
Call a physician.
If swallowed, do not induce vomiting. If not breathing, apply artificial respiration. If breathing is difficult, give oxygen.

JP-4
HAZARD MATERIAL INFORMATION SHEET

SECTION 5 HEALTH HAZARD DATA...CONTINUED

Emergency And First Aid Procedures continued..:
If inhaled, remove to fresh air. If not breathing, give artificial resuscitation. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes.

SECTION 6 REACTIVITY DATA

Stability: Stable, under normal conditions.
Hazardous Polymerization: Will not occur.
Conditions To Avoid: Heat, flame, other sources of ignition
Incompatibles: Strong oxidizing agents - - sulfuric acid, nitric acid, organic acids, and other acids.
Decomposition Products: Carbon monoxide, carbon dioxide

SECTION 7 SPILL AND DISPOSAL PROCEDURES

Steps To Be Taken In The Event Of A Spill Or Discharge:
Wear protective clothing.
Shut off ignition sources; no flares, smoking or flames in area. Stop leak if you can do so without risk. Use water spray to reduce vapors. Take up with sand or other non-combustible absorbent material and place into container for later disposal. For small spills, flush area with water.

Disposal Procedure
Dispose in accordance with all applicable federal, state, and local environmental regulations.

EPA Hazardous Waste Number: N/A

SECTION 8 PROTECTIVE EQUIPMENT

Ventilation: Use general or local exhaust ventilation to meet TLV requirements.
Respiratory Protection: Respiratory protection not required under normal exposure conditions, if however, airborne concentration exceeds REL of 100 ppm; negative pressure cartridge respirator with organic vapor cartridges is advised. At concentrations above 1,000 ppm, air supplied pressure-demand respirator or self-contained breathing apparatus is advised.
Eye/Skin Protection: If liquid contact possible; safety goggles and face shield, protective suit, and neoprene gloves are recommended.

SECTION 9 STORAGE AND HANDLING PRECAUTIONS

Storage Color Code: Red (Combustible)
Special Precautions: Bond and ground containers when transferring liquid. Keep container tightly closed. Store in a cool, dry, well-ventilated, flammable liquid storage area.

SECTION 10 TRANSPORTATION DATA AND ADDITIONAL INFORMATION

Domestic (D.O.T.)
Proper Shipping Name: Fuel, Aviation, Turbine Engine
Hazard Class: Combustible Liquid
UN/NA: UN1863
Labels: Combustible Liquid
Reportable Quantity: NA

International (I.M.O.)
Proper Shipping Name: Fuel, Aviation, Turbine
Hazard Class: 3.2
UN/NA: UN1863
Labels: Combustible Liquid

SECTION 11 REFERENCES

"NIOSH Pocket Guide To Chemical Hazards;" U.S. Department of Health and Human Services, Center for Disease Control and Prevention (CDC) & National Institute of Occupational Safety and Health; Copyright: June 1994.

"1996 Threshold Limit Values for Chemical Substances and Physical Agents Biological Exposure Indices;" American Conference of Government Industrial Hygienist.

"Hazardous Chemicals Data Book; Second Edition;" Edited by Weiss; Published by Noyes Data Corporation, Park Ridge, New Jersey; Copyright 1986.

"Tomes;" by Micromedex, Inc., Englewood, Colorado; 1996 Edition.

Revision Date: December 3, 1996

TRICHLOROETHYLENE (TCE)
HAZARD MATERIAL INFORMATION SHEET

SECTION 1 MATERIAL IDENTIFICATION

Hazardous Material Name: Trichloroethylene (TCE)
Common Synonyms: Trichloroethene, Trethlene, and Trilene.
Formula: $CLCH=CCL_2$ Formula Wt: 131.4
CAS No.: 79-01-6
NIOSH/RTECS No.: KX4550000
Information Researched: 1/22/97

SECTION 2 HAZARD COMMUNICATIONS

PRECAUTIONARY LABELING

Hazard Ranking System

Health	2	Moderate (Potential Carcinogen)
Flammability	1	Slight (Flammable)
Reactivity	0	Not Reactive
Contact	1	Slight (Irritant)

Hazard Ratings Are 0 To 4
(i.e., 0 = No Hazard; 4 = Extreme Hazard).

PRECAUTIONARY LABEL STATEMENTS

WARNING
POISON
NOT FOR HOUSEHOLD USE
CAUTION: TRICHLOROETHYLENE, POTENTIAL CARCINOGEN
HARMFUL IF SWALLOWED, INHALED,
OR ABSORBED THROUGH SKIN
HEALTH HAZARD -
READ MATERIAL SAFETY DATA SHEET
AVOID CONTACT WITH HEAT, SPARKS, & FLAME,
WILL BURN IF HEATED,
DECOMPOSE TO
HYDROCHLORIC ACID & CARBON MONOXIDE.
AVOID CONTACT WITH EYES, SKIN, CLOTHING.
AVOID BREATHING VAPOR.
KEEP IN TIGHTLY CLOSED CONTAINER.
USE WITH ADEQUATE VENTILATION.
WASH THOROUGHLY AFTER HANDLING.
USE ABSORBENT FOR SPILLS.

Storage Color Code: Blue (Health Hazard)

SECTION 3 PHYSICAL DATA

Boiling Point: 87°C (189°F) Specific Gravity: 1.46 (H_2O=1)
Vapor Pressure(mmHg): 58 Melting Point: -86°C (-124°F)
Vapor Density(Air=1): 4.5 % Volatiles By Volume: 100
Evaporation Rate: N/A (Butyl Acetate=1)
Solubility(H_2O): 0.0001 %
Appearance & Odor: Clear, colorless liquid with sweet ethereal or chloroform-like odor.

SECTION 4 FIRE AND EXPLOSION

Flash Point (Closed Cup): 90°F Ignition Temp.: 770°F
NFPA 704M Rating: 2-1-0
Flammable Limits: Upper - 10.5% Lower - 8.0%
Fire Extinguishing Media: Small fires: Dry chemical or CO_2. Large Fires: Water spray, fog, or foam.
Special Fire-Fighting Procedures:
Firefighters should wear proper protective equipment and self-contained; breathing apparatus with full facepiece operated in positive pressure mode. Structural firefighters' protective clothing will provide limited protection from these materials. Move containers from fire area if it can be done without risk. Use water spray to keep fire-exposed containers cool.
Unusual Fire & Explosion Hazards: Closed containers exposed to heat may explode.
Toxic Gases Produced
Hydrogen chloride, chlorine, phosgene, and carbon monoxide may be produced from decomposition.

SECTION 5 HEALTH HAZARD DATA

This substance is listed by NIOSH as a potential occupational carcinogen and by International Agency for Cancer Research (IARC) as a not classifiable as to carcinogencity to humans (Group 3). Exposure Limits: American Conference of Government Industrial Hygienist (ACGIH) threshold limit value (TLV/TWA): 296 mg/m^3 (50 ppm); short term exposure limit (STEL): 100 ppm. Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL): 100 ppm (skin); Ceiling Limit: 200 ppm (300 ppm for a 5 minute peak in any 2 hours).
IDLH Value: 1,000 ppm
Effects Of Acute Overexposure:
Inhalation Vapors: Headache, nausea, vomiting, dizziness, narcosis, tremors in fingers, central nervous system depression, irritation of the respiratory system, myocardial irritability, and lung inflammation.
Contact With Liquid: May cause irritating to skin and eyes. Liquid can be absorbed through the skin. Prolonged skin contact may result in dermatitis.
Eye Contact: May cause irritation and damage to cornea.
Ingestion: Will causes nausea, headaches, dizziness, vomiting, gastro-intestinal irritation, and abdominal pain.
Chronic Effects: Overexposure may result in damage to central nervous system, kidney and/or liver.
Target Organs: Central nervous system, eyes, skin, respiratory system (lungs), liver, gastro-intestinal tract, and kidneys.
Medical Conditions Generally Aggravated by Exposure:
Liver disorders, kidney disorders, alcoholism, and central nervous system disorders.
Routes Of Entry:
Ingestion, inhalation, eye contact, skin contact, and absorption.

TRICHLOROETHYLENE (TCE)
HAZARD MATERIAL INFORMATION SHEET

SECTION 5 HEALTH HAZARD DATA...CONCLUDED

Emergency And First Aid Procedures:
Call a physician. If swallowed and victim is conscious, have victim drink water or milk and induce vomiting, then get medical attention immediately. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove any contaminated clothing and shoes. Wash clothing before reuse.

Notes To Physician: If aspirate, pulmonary edema may occur. Do not administer adrenaline or epinephrine.

SECTION 6 REACTIVITY DATA

Stability: Stable
Hazardous Polymerization: Will not occur.
Conditions To Avoid: Heat, flame, other sources of ignition
Incompatibles: Chemically active metals, strong caustics, dinitrogen tetraoxide, sodium metal, potassium metal, and strong oxidizing agents (sulfuric acid, nitric acid, etc.).
Decomposes slowly when exposed to light or heat.
Decomposition Products: Hydrogen chloride, chlorine, dichloroacetylene, and phosgene

SECTION 7 SPILL AND DISPOSAL PROCEDURES

Steps To Be Taken In The Event Of A Spill Or Discharge
Wear self-contained breathing apparatus and full protective clothing. Stop leak if you can do so without risk. Use water spray to reduce vapors. Take up with sand or other non-combustible absorbent material and place into container for later disposal. Use absorbent material to absorb material.

Disposal Procedure
Dispose in accordance with all applicable federal, state, and local environmental regulations.

EPA Hazardous Waste Number: U 228 (Toxic Waste)

SECTION 8 PROTECTIVE EQUIPMENT

Ventilation: Use general or local exhaust ventilation to meet TLV requirements.
Respiratory Protection: Respiratory protection required if airborne concentration exceeds TLV of 100 ppm; negative pressure cartridge respirator with organic vapor cartridges is advised. At concentrations above 1,000 ppm, a air supplied pressure-demand respirator or self-contained breathing apparatus is advised.
Eye/Skin Protection: Safety goggles and face shield, uniform, protective suit, neoprene or polyvinyl alcohol gloves are recommended.

SECTION 9 STORAGE AND HANDLING PRECAUTIONS

Storage Color Code: Blue (Health Hazard)
Special Precautions: Keep container tightly closed. Store in a secure storage area for poisons.

SECTION 10 TRANSPORTATION DATA AND ADDITIONAL INFORMATION

Domestic (D.O.T.)
Proper Shipping Name: Trichloroethylene
Hazard Class: ORM-A or 6.1, Poison
UN/NA: 1710
Labels: None (for ORM-A) or Poison (for 6.1)
Reportable Quantity: 100 Lbs.

International (I.M.O.)
Proper Shipping Name: Trichloroethylene
Hazard Class: 6.1, Poison B
UN/NA: 1710
Labels: St. Andrew's Cross

SECTION 11 REFERENCES

"NIOSH Pocket Guide To Chemical Hazards;" U. S. Department of Health and Human Services, Center for Disease Control and Prevention (CDC) & National Institute of Occupational Safety and Health; Copyright: June 1994.

"1996 Threshold Limit Values for Chemical Substances and Physical Agents Biological Exposure Indices;" American Conference of Government Industrial Hygienist.

"Hazardous Chemicals Data Book; Second Edition;" Edited by Weiss; Published by Noyes Data Corporation, Park Ridge, New Jersey; Copyright 1986.

"Tomes;" by Micromedex, Inc., Englewood, Colorado; 1996 Edition.

"1993 Emergency Response Guidebook;" U. S. Department of Transportation, Research and Special Programs Administration U. S. Government Printing Office, Washington D. C.; Copyright, October 1993.

1, 2 - DICHLOROETHANE
HAZARD MATERIAL INFORMATION SHEET

SECTION 1 MATERIAL IDENTIFICATION

Hazardous Material Name: 1,2 -Dichloroethane
Common Synonyms: Ethylene Dichloride; Glycol Dichloride; EDC; Brocide.
Formula: $C_2H_4Cl_2$ Formula Wt: 98.9
CAS No.: 107-06-2
NIOSH/RTECS No.: K10525000
Information Researched: 12/13/96

SECTION 2 HAZARD COMMUNICATIONS

PRECAUTIONARY LABELING

Hazard Ranking System

Health	2	Moderate (Cancer Causing)
Flammability	3	Severe (Flammable)
Reactivity	1	Slight (With Other Chemicals)
Contact	2	Moderate (Irritant)

Hazard Ratings Are 0 To 4
(i.e., 0 = No Hazard; 4 = Extreme Hazard).

PRECAUTIONARY LABEL STATEMENTS

FLAMMABLE DANGER
NOT FOR HOUSEHOLD USE
CAUTION: 1, 2 DICHLOROETHANE, ANIMAL CARCINOGEN
HARMFUL IF SWALLOWED, INHALED,
OR CONTACT WITH SKIN
HEALTH HAZARD - READ MATERIAL SAFETY DATA SHEET
KEEP AWAY FROM HEAT, SPARKS, FLAME.
AVOID CONTACT WITH EYES, SKIN, CLOTHING.
AVOID BREATHING VAPOR.
KEEP IN TIGHTLY CLOSED CONTAINER.
USE WITH ADEQUATE VENTILATION.
WASH THOROUGHLY AFTER HANDLING.
ABSORB SPILLS WITH INERT MATERIAL.

Storage Color Code: Blue (Health Hazard)

SECTION 3 PHYSICAL DATA

Boiling Point: 84°C (182°F) Specific Gravity: 1.25 (H_2O=1)
Vapor Pressure(mmHg): 66 Melting Point: -36°C (-33°F)
Vapor Density(Air=1): 3.5 % Volatiles By Volume: 100
Evaporation Rate: 0.3 (Butyl Acetate=1)
Solubility(H_2O): Slightly soluble in water.
Appearance & Odor: Colorless liquid with characteristic chloroform-like odor.

SECTION 4 FIRE AND EXPLOSION

Flash Point (Closed Cup): 55°F Ignition Temp.: 775°F
NFPA 704M Rating: 2-3-1
Flammable Limits: Upper - 15.6% Lower - 6.2%
Fire Extinguishing Media: Use foam, carbon dioxide, or dry chemical. Water may be ineffective.
Special Fire-Fighting Procedures:
Firefighters should wear proper protective equipment and self-contained; breathing apparatus with full facepiece operated in positive pressure mode. Move containers from fire area if it can be done without risk. Use water to keep fire-exposed containers cool.
Unusual Fire & Explosion Hazards:
Closed containers exposed to heat may explode.
Toxic Gases Produced
Irritant gases - -hydrogen chloride, phosgene, chlorine are produced.

SECTION 5 HEALTH HAZARD DATA

This substance is listed as ACGIH A3- animal carcinogen, NTP suspect carcinogen, IARC group 2 carcinogen. Acceptable maximum peak above the acceptance ceiling concentration for an eight-hour shift = 100 ppm for 5 minutes; (PEL) Ceiling = 200 ppm; Threshold Limit Value (TLV/TWA): 40 mg/m^3 (10 ppm); Short-Term Exposure Limit (STEL): N/A; Permissible Exposure Limit (PEL): 202 mg/m^3 (50 ppm).

Effects Of Acute Overexposure:
Inhalation Vapors: Headache, nausea, vomiting, dizziness, central nervous system depression, irritation of the respiratory system, unconsciousness, and coma (only extreme cases).
Contact With Liquid: May cause irritating to skin and severe irritation to eyes.
Liquid may be absorbed through the skin. Prolonged skin contact may result in dermatitis.
Eye Contact: May cause irreversible corneal damage.
Ingestion: May cause nausea, vomiting, headaches, dizziness, gastro-intestinal irritation, blurred vision, liver damage, and kidney damage.
Chronic Effects: Overexposure may result in dermatitis of skin, and damage to kidney and/or liver. Prolonged and repeated contact with eyes may cause conjunctivitis. Possible cancer hazard, based on animal tests.
Target Organs:
Central nervous system, eyes, skin, respiratory system (lungs), liver, and kidneys.
Medical Conditions Generally Aggravated by Exposure:
Liver disorders, kidney disorders, and central nervous system disorders.
Routes Of Entry:
Ingestion, inhalation, eye contact, skin contact, and absorption.

1, 2 - DICHLOROETHANE
HAZARD MATERIAL INFORMATION SHEET

SECTION 5 HEALTH HAZARD DATA...CONCLUDED

Emergency And First Aid Procedures...concluded:
Call a physician. If swallowed and victim is alert, give 2-4 cups of milk or water and get immediate medical aid. If inhaled, remove to fresh air. If not breathing, give respiratory resuscitation. If breathing difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove any contaminated clothing and shoes. Wash clothing before reuse.

Notes To Physician:
Treat symptomatically and supportively.

SECTION 6 REACTIVITY DATA

Stability: Stable
Hazardous Polymerization: Will not occur.
Conditions To Avoid: Heat, flame, other sources of ignition
Incompatibles: Alkali metals, sodium metal, potassium metal, chemically active metals, strong oxidizing agents (sulfuric acid, nitric acid, etc.), ketone solvents, organic peroxides, liquid ammonia, and strong bases. Explosions can occur with mixtures of this material and liquid ammonia or dimethylproplyamine.
Decomposition Products: Hydrogen chloride, chlorine, and phosgene.

SECTION 7 SPILL AND DISPOSAL PROCEDURES

Steps To Be Taken In The Event Of A Spill Or Discharge
Wear self-contained breathing apparatus and full protective clothing. Stop leak if you can do so without risk. Use water spray to reduce vapors. Take up with sand or other non-combustible absorbent material and place into container for later disposal.
Disposal Procedure
Dispose in accordance with all applicable federal, state, and local environmental regulations.

EPA Hazardous Waste Number: U077 (Toxic Waste)

SECTION 8 PROTECTIVE EQUIPMENT

Ventilation: Use general or local exhaust ventilation to meet TLV requirements.
Respiratory Protection: Respiratory protection required if airborne concentration exceeds PEL of 10 ppm; negative pressure cartridge respirator with organic vapor cartridges is advised. At concentrations above 100 ppm, a air supplied pressure-demand respirator or self-contained breathing apparatus is advised.
Eye/Skin Protection: Safety goggles and face shield, uniform, protective suit, neoprene rubber gloves are recommended.

SECTION 9 STORAGE AND HANDLING PRECAUTIONS

Storage Color Code: Red (Flammable Hazard)
Special Precautions: Keep container tightly closed. Store in a secure storage area for flammables and poisons.

SECTION 10 TRANSPORTATION DATA AND ADDITIONAL INFORMATION

Domestic (D.O.T.)
Proper Shipping Name: Ethylene Dichloride
Hazard Class: 3/Poison
UN/NA: UN1184
Labels: Poison
Reportable Quantity: N/A

International (I.M.O.)
Proper Shipping Name: 1, 2-Dichloroethane
Hazard Class: 3.2
UN/NA: UN1184
Labels: Poison

SECTION 11 REFERENCES

"NIOSH Pocket Guide To Chemical Hazards;" U.S. Department of Health and Human Services, Center for Diseas Control and Prevention (CDC) & National Institute of Occupational Safety and Health; Copyright: June 1994.

"1996 Threshold Limit Values for Chemical Substances and Physical Agents Biological Exposure Indices;" American Conference of Government Industrial Hygienist.

"Hazardous Chemicals Data Book; Second Edition;" Edited b Weiss; Published by Noyes Data Corporation, Park Ridge, New Jersey; Copyright 1986.

"Tomes;" by Micromedex, Inc., Englewood, Colorado; 1996 Edition.

"1993 Emergency Response Guidebook;" U.S. Department of Transportation, Research and Special Programs Administration U.S. Government Printing Office, Washington D.C.; Copyright, October 1993.

1, 2 - DICHLOROETHANE
HAZARD MATERIAL INFORMATION SHEET

SECTION 1 MATERIAL IDENTIFICATION

Hazardous Material Name: 1,2 -Dichloroethane
Common Synonyms: Ethylene Dichloride; Glycol Dichloride; EDC; Brocide.
Formula: $C_2H_4Cl_2$ Formula Wt: 98.9
CAS No.: 107-06-2
NIOSH/RTECS No.: K10525000
Information Researched: 12/13/96

SECTION 2 HAZARD COMMUNICATIONS

PRECAUTIONARY LABELING

Hazard Ranking System

Health	2	Moderate (Cancer Causing)
Flammability	3	Severe (Flammable)
Reactivity	1	Slight (With Other Chemicals)
Contact	2	Moderate (Irritant)

Hazard Ratings Are 0 To 4
(i.e., 0 = No Hazard; 4 = Extreme Hazard).

PRECAUTIONARY LABEL STATEMENTS

FLAMMABLE DANGER
NOT FOR HOUSEHOLD USE
CAUTION: 1, 2 DICHLOROETHANE, ANIMAL CARCINOGEN
HARMFUL IF SWALLOWED, INHALED,
OR CONTACT WITH SKIN
HEALTH HAZARD - READ MATERIAL SAFETY DATA SHEET
KEEP AWAY FROM HEAT, SPARKS, FLAME.
AVOID CONTACT WITH EYES, SKIN, CLOTHING.
AVOID BREATHING VAPOR.
KEEP IN TIGHTLY CLOSED CONTAINER.
USE WITH ADEQUATE VENTILATION.
WASH THOROUGHLY AFTER HANDLING.
ABSORB SPILLS WITH INERT MATERIAL.

Storage Color Code: Blue (Health Hazard)

SECTION 3 PHYSICAL DATA

Boiling Point: 84°C (182°F) Specific Gravity: 1.25 (H_2O=1)
Vapor Pressure(mmHg): 66 Melting Point: -36°C (-33°F)
Vapor Density(Air=1): 3.5 % Volatiles By Volume: 100
Evaporation Rate: 0.3 (Butyl Acetate=1)
Solubility(H_2O): Slightly soluble in water.
Appearance & Odor: Colorless liquid with characteristic chloroform-like odor.

SECTION 4 FIRE AND EXPLOSION

Flash Point (Closed Cup): 55°F Ignition Temp.: 775°F
NFPA 704M Rating: 2-3-1
Flammable Limits: Upper - 15.6% Lower - 6.2%
Fire Extinguishing Media: Use foam, carbon dioxide, or dry chemical. Water may be ineffective.
Special Fire-Fighting Procedures:
Firefighters should wear proper protective equipment and self-contained; breathing apparatus with full facepiece operated in positive pressure mode. Move containers from fire area if it can be done without risk. Use water to keep fire-exposed containers cool.
Unusual Fire & Explosion Hazards:
Closed containers exposed to heat may explode.
Toxic Gases Produced
Irritant gases - -hydrogen chloride, phosgene, chlorine are produced.

SECTION 5 HEALTH HAZARD DATA

This substance is listed as ACGIH A3- animal carcinogen, NTP suspect carcinogen, IARC group 2 carcinogen. Acceptable maximum peak above the acceptance ceiling concentration for an eight-hour shift = 100 ppm for 5 minutes; (PEL) Ceiling = 200 ppm; Threshold Limit Value (TLV/TWA): 40 mg/m^3 (10 ppm); Short-Term Exposure Limit (STEL): N/A; Permissible Exposure Limit (PEL): 202 mg/m^3 (50 ppm).

Effects Of Acute Overexposure:
Inhalation Vapors: Headache, nausea, vomiting, dizziness, central nervous system depression, irritation of the respiratory system, unconsciousness, and coma (only extreme cases).
Contact With Liquid: May cause irritating to skin and severe irritation to eyes.
Liquid may be absorbed through the skin. Prolonged skin contact may result in dermatitis.
Eye Contact: May cause irreversible corneal damage.
Ingestion: May cause nausea, vomiting, headaches, dizziness, gastro-intestinal irritation, blurred vision, liver damage, and kidney damage.
Chronic Effects: Overexposure may result in dermatitis of skin, and damage to kidney and/or liver. Prolonged and repeated contact with eyes may cause conjunctivitis. Possible cancer hazard, based on animal tests.
Target Organs:
Central nervous system, eyes, skin, respiratory system (lungs), liver, and kidneys.
Medical Conditions Generally Aggravated by Exposure:
Liver disorders, kidney disorders, and central nervous system disorders.
Routes Of Entry:
Ingestion, inhalation, eye contact, skin contact, and absorption.

1, 2 - DICHLOROETHANE
HAZARD MATERIAL INFORMATION SHEET

SECTION 5 HEALTH HAZARD DATA...CONCLUDED

Emergency And First Aid Procedures...concluded:
Call a physician. If swallowed and victim is alert, give 2-4 cups of milk or water and get immediate medical aid. If inhaled, remove to fresh air. If not breathing, give respiratory resuscitation. If breathing difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove any contaminated clothing and shoes. Wash clothing before reuse.

Notes To Physician:
Treat symptomatically and supportively.

SECTION 6 REACTIVITY DATA

Stability: Stable
Hazardous Polymerization: Will not occur.
Conditions To Avoid: Heat, flame, other sources of ignition
Incompatibles: Alkali metals, sodium metal, potassium metal, chemically active metals, strong oxidizing agents (sulfuric acid, nitric acid, etc.), ketone solvents, organic peroxides, liquid ammonia, and strong bases. Explosions can occur with mixtures of this material and liquid ammonia or dimethylproplyamine.
Decomposition Products: Hydrogen chloride, chlorine, and phosgene.

SECTION 7 SPILL AND DISPOSAL PROCEDURES

Steps To Be Taken In The Event Of A Spill Or Discharge
Wear self-contained breathing apparatus and full protective clothing. Stop leak if you can do so without risk. Use water spray to reduce vapors. Take up with sand or other non-combustible absorbent material and place into container for later disposal.
Disposal Procedure
Dispose in accordance with all applicable federal, state, and local environmental regulations.

EPA Hazardous Waste Number: U077 (Toxic Waste)

SECTION 8 PROTECTIVE EQUIPMENT

Ventilation: Use general or local exhaust ventilation to meet TLV requirements.
Respiratory Protection: Respiratory protection required if airborne concentration exceeds PEL of 10 ppm; negative pressure cartridge respirator with organic vapor cartridges is advised. At concentrations above 100 ppm, a air supplied pressure-demand respirator or self-contained breathing apparatus is advised.
Eye/Skin Protection: Safety goggles and face shield, uniform, protective suit, neoprene rubber gloves are recommended.

SECTION 9 STORAGE AND HANDLING PRECAUTIONS

Storage Color Code: Red (Flammable Hazard)
Special Precautions: Keep container tightly closed. Store in a secure storage area for flammables and poisons.

SECTION 10 TRANSPORTATION DATA AND ADDITIONAL INFORMATION

Domestic (D.O.T.)
Proper Shipping Name: Ethylene Dichloride
Hazard Class: 3/Poison
UN/NA: UN1184
Labels: Poison
Reportable Quantity: N/A

International (I.M.O.)
Proper Shipping Name: 1, 2-Dichloroethane
Hazard Class: 3.2
UN/NA: UN1184
Labels: Poison

SECTION 11 REFERENCES

"NIOSH Pocket Guide To Chemical Hazards;" U.S. Department of Health and Human Services, Center for Disease Control and Prevention (CDC) & National Institute of Occupational Safety and Health; Copyright: June 1994.

"1996 Threshold Limit Values for Chemical Substances and Physical Agents Biological Exposure Indices;" American Conference of Government Industrial Hygienist.

"Hazardous Chemicals Data Book; Second Edition;" Edited by Weiss; Published by Noyes Data Corporation, Park Ridge, New Jersey; Copyright 1986.

"Tomes;" by Micromedex, Inc., Englewood, Colorado; 1996 Edition.

"1993 Emergency Response Guidebook;" U.S. Department of Transportation, Research and Special Programs Administration U.S. Government Printing Office, Washington D.C.; Copyright, October 1993.

1, 1, 2 - TRICHLOROETHANE (TCA)
HAZARD MATERIAL INFORMATION SHEET

ECTION 1 MATERIAL IDENTIFICATION

azardous Material Name: Trichloroethane (TCA)
ommon Synonyms: Beta-trichloroethane, Vinyl trichloride, nd Ethane trichloride.
ormula: $CHCL_2CH_2CL$ Formula Wt: 133.4
AS No.: 79-00-5
IOSH/RTECS No.: KJ3150000
nformation Researched: 1/21/97

ECTION 2 HAZARD COMMUNICATIONS

PRECAUTIONARY LABELING

Hazard Ranking System

Health	3	Severe (Potential Carcinogen)
Flammability	1	Slight (Flammable)
Reactivity	0	Not Reactive
Contact	1	Slight (Irritant)

Hazard Ratings Are 0 To 4
i.e., 0 = No Hazard; 4 = Extreme Hazard).

PRECAUTIONARY LABEL STATEMENTS

WARNING
POISON
NOT FOR HOUSEHOLD USE
AUTION: TRICHLOROETHANE. POTENTIAL CARCINOGEN
HARMFUL IF SWALLOWED, INHALED,
OR ABSORBED THROUGH SKIN
HEALTH HAZARD -
READ MATERIAL SAFETY DATA SHEET
AVOID CONTACT WITH HEAT, SPARKS, & FLAME,
WILL BURN IF HEATED,
DECOMPOSE TO
HYDROCHLORIC ACID & CARBON MONOXIDE.
AVOID CONTACT WITH EYES, SKIN, CLOTHING.
AVOID BREATHING VAPOR.
KEEP IN TIGHTLY CLOSED CONTAINER.
USE WITH ADEQUATE VENTILATION.
WASH THOROUGHLY AFTER HANDLING.
USE ABSORBENT FOR SPILLS.

Storage Color Code: Blue (Health Hazard)

SECTION 3 PHYSICAL DATA

Boiling Point: 114°C (237°F)
Specific Gravity: 1.44 ($H_2O=1$)
Vapor Pressure(mmHg): 19
Melting Point: -37°C (-34°F)
Vapor Density(Air=1): 4.6
% Volatiles By Volume: 100
Evaporation Rate: N/A (Butyl Acetate=1)
Solubility(H_2O): 0.4 %
Appearance & Odor: Clear, colorless liquid with sweet ethereal or chloroform-like odor.

SECTION 4 FIRE AND EXPLOSION

Flash Point (Closed Cup): None
NFPA 704M Rating: 3-1-0
Flammable Limits: Upper - 13.3% Lower - 8.4%
Fire Extinguishing Media: Small fires: Dry chemical or CO_2. Large Fires: Water spray, fog, or foam.
Special Fire-Fighting Procedures:
Firefighters should wear proper protective equipment and self-contained; breathing apparatus with full facepiece operated in positive pressure mode. Structural firefighters' protective clothing will provide limited protection from these materials. Move containers from fire area if it can be done without risk. Use water spray to keep fire-exposed containers cool.
Unusual Fire & Explosion Hazards: Closed containers exposed to heat may explode. Forms explosive vapor-air mixture at 109° or higher.
Toxic Gases Produced
Hydrogen chloride, chlorine, phosgene, and carbon monoxide may be produced from decomposition.

SECTION 5 HEALTH HAZARD DATA

This substance is listed by NIOSH as a potential occupational carcinogen. Exposure Limits: American Conference of Government Industrial Hygienist (ACGIH) threshold limit value (TLV/TWA): 45 mg/m^3 (10 ppm) (skin). Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL): 10 ppm (skin).
IDLH Value: 100 ppm
Effects Of Acute Overexposure:
Inhalation Vapors: Headache, nausea, vomiting, dizziness, narcosis, tremors in fingers, central nervous system depression, irritation of the respiratory system, myocardial irritability, and lung inflammation.
Contact With Liquid: May cause irritating to skin and eyes. Liquid can be absorbed through the skin. Prolonged skin contact may result in dermatitis.
Eye Contact: May cause irritation and damage to cornea.
Ingestion: Will causes nausea, headaches, dizziness, vomiting, gastro-intestinal irritation, and abdominal pain.
Chronic Effects: Overexposure may result in damage to central nervous system, kidney and/or liver.
Target Organs: Central nervous system, eyes, skin, respiratory system (lungs), liver, gastro-intestinal tract, and kidneys.
Medical Conditions Generally Aggravated by Exposure:
Liver disorders, kidney disorders, alcoholism, and central nervous system disorders.
Routes Of Entry:
Ingestion, inhalation, eye contact, skin contact, and absorption.

1, 1, 2 - TRICHLOROETHANE (TCA)
HAZARD MATERIAL INFORMATION SHEET

SECTION 5 HEALTH HAZARD DATA...CONCLUDED

Emergency And First Aid Procedures:
Call a physician. If swallowed, do not induce vomiting and. get medical attention immediately. If inhaled, remove to fresh air. If not breathing, give artificial respiration.
If breathing is difficult, give oxygen.
In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove any contaminated clothing and shoes. Wash clothing before reuse.

Notes To Physician: NA

SECTION 6 REACTIVITY DATA

Stability: Stable
Hazardous Polymerization: Will not occur.
Conditions To Avoid: Heat, flame, other sources of ignition
Incompatibles: Chemically active metals, strong caustics, dinitrogen tetraoxide, sodium metal, potassium metal, and strong oxidizing agents (sulfuric acid, nitric acid, etc.).
Decomposes slowly when exposed to light or heat.
Decomposition Products: Hydrogen chloride, chlorine, and phosgene.

SECTION 7 SPILL AND DISPOSAL PROCEDURES

Steps To Be Taken In The Event Of A Spill Or Discharge
Wear self-contained breathing apparatus and full protective clothing. Stop leak if you can do so without risk. Use water spray to reduce vapors. Take up with sand or other non-combustible absorbent material and place into container for later disposal. Use absorbent material to absorb material.

Disposal Procedure
Dispose in accordance with all applicable federal, state, and local environmental regulations.

EPA Hazardous Waste Number: U 227 (Toxic Waste)

SECTION 8 PROTECTIVE EQUIPMENT

Ventilation: Use general or local exhaust ventilation to meet TLV requirements.
Respiratory Protection: Respiratory protection required if airborne concentration exceeds TLV of 10 ppm; negative pressure cartridge respirator with organic vapor cartridges is advised. At concentrations above 100 ppm, a air supplied pressure-demand respirator or self-contained breathing apparatus is advised.
Eye/Skin Protection: Safety goggles and face shield, uniform, protective suit, neoprene or polyvinyl alcohol gloves are recommended.

SECTION 9 STORAGE AND HANDLING PRECAUTIONS

Storage Color Code: Blue (Health Hazard)
Special Precautions: Keep container tightly closed. Store in a secure storage area for poisons.

SECTION 10 TRANSPORTATION DATA AND ADDITIONAL INFORMATION

Domestic (D.O.T.)
Proper Shipping Name: Trichloroethane
Hazard Class: ORM-A
UN/NA: UN2831
Labels: None
Reportable Quantity: 100 Lbs.

International (I.M.O.)
Proper Shipping Name: Trichloroethane
Hazard Class: Poison B
UN/NA: UN2831
Labels: St. Andrew's Cross

SECTION 11 REFERENCES

"NIOSH Pocket Guide To Chemical Hazards;" U. S. Department of Health and Human Services, Center for Diseas Control and Prevention (CDC) & National Institute of Occupational Safety and Health; Copyright: June 1994.

"1996 Threshold Limit Values for Chemical Substances and Physical Agents Biological Exposure Indices;" American Conference of Government Industrial Hygienist.

"Hazardous Chemicals Data Book; Second Edition;" Edited b Weiss; Published by Noyes Data Corporation, Park Ridge, New Jersey; Copyright 1986.

"Tomes;" by Micromedex, Inc., Englewood, Colorado; 1996 Edition.

"1993 Emergency Response Guidebook;" U. S. Department o Transportation, Research and Special Programs Administratio U. S. Government Printing Office, Washington D. C.; Copyright, October 1993.

1, 1, 1 - TRICHLOROETHANE (TCA)
HAZARD MATERIAL INFORMATION SHEET

SECTION 1 MATERIAL IDENTIFICATION

Hazardous Material Name: 1, 1, 1 - Trichloroethane (TCA)
Common Synonyms: Methyl chloroform, Chlorothane, Trichloran, Trielene, and Alpha - T.
Formula: CH_3CCL_3 Formula Wt: 133.4
CAS No.: 71-55-56
NIOSH/RTECS No.: KJ2975000
Information Researched: 1/22/97

SECTION 2 HAZARD COMMUNICATIONS

PRECAUTIONARY LABELING

Hazard Ranking System

Health	2	Moderate (Poison)
Flammability	1	Slight (Flammable)
Reactivity	0	Not Reactive
Contact	1	Slight (Irritant)

Hazard Ratings Are 0 To 4
(i.e., 0 = No Hazard; 4 = Extreme Hazard).

PRECAUTIONARY LABEL STATEMENTS

WARNING
POISON
NOT FOR HOUSEHOLD USE
CAUTION: TRICHLOROETHANE, SUSPECT CARCINOGEN
HARMFUL IF SWALLOWED, INHALED,
OR ABSORBED THROUGH SKIN
HEALTH HAZARD -
READ MATERIAL SAFETY DATA SHEET
AVOID CONTACT WITH HEAT, SPARKS, & FLAME,
WILL BURN IF HEATED,
DECOMPOSE TO
HYDROCHLORIC ACID & CARBON MONOXIDE.
AVOID CONTACT WITH EYES, SKIN, CLOTHING.
AVOID BREATHING VAPOR.
KEEP IN TIGHTLY CLOSED CONTAINER.
USE WITH ADEQUATE VENTILATION.
WASH THOROUGHLY AFTER HANDLING.
USE ABSORBENT FOR SPILLS.

Storage Color Code: Blue (Health Hazard)

SECTION 3 PHYSICAL DATA

Boiling Point: 74°C (165°F) Specific Gravity: 1.34 $(H_2O=1)$
Vapor Pressure(mmHg): 100 Melting Point: -30°C (-23°F)
Vapor Density(Air=1): 4.6 % Volatiles By Volume: 100
Evaporation Rate: N/A (Butyl Acetate=1)
Solubility(H_2O): 0.44 %
Appearance & Odor: Clear, colorless liquid with sweet ethereal or mild chloroform-like odor.

SECTION 4 FIRE AND EXPLOSION

Flash Point (Closed Cup): None Ignition Point: 932°F
NFPA 704M Rating: 2-1-0
Flammable Limits: Upper - 12.5% Lower - 7.5%
Fire Extinguishing Media: Small fires: Dry chemical or CO_2. Large Fires: Water spray, fog, or foam.
Special Fire-Fighting Procedures:
Firefighters should wear proper protective equipment and self-contained; breathing apparatus with full facepiece operated in positive pressure mode. Structural firefighters' protective clothing will provide limited protection from these materials. Move containers from fire area if it can be done without risk. Use water spray to keep fire-exposed containers cool.
Unusual Fire & Explosion Hazards: Closed containers exposed to heat may explode. Forms explosive vapor-air mixture at 109° or higher.
Toxic Gases Produced
Hydrogen chloride, chlorine, phosgene, and carbon monoxide may be produced from decomposition.

SECTION 5 HEALTH HAZARD DATA

This substance is listed by NIOSH as a suspected occupational carcinogen due to its structure and by the International Agency for Research on Cancer (IARC) as a not carcinogenic to Humans (Group 3). Exposure Limits: American Conference of Government Industrial Hygienist (ACGIH) threshold limit value (TLV/TWA): 1910 mg/m^3 (350 ppm). Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL): 350 ppm.
IDLH Value: 700 ppm
Effects Of Acute Overexposure:
Inhalation Vapors: Headache, nausea, vomiting, dizziness, narcosis, tremors in fingers, central nervous system depression, irritation of the respiratory system, cardiac arrhythmia, and lung inflammation.
Contact With Liquid: May cause irritating to skin and eyes. Prolonged skin contact may result in dermatitis.
Eye Contact: May cause irritation and damage to cornea.
Ingestion: Will causes nausea, headaches, dizziness, vomiting, gastro-intestinal irritation, and abdominal pain.
Chronic Effects: Overexposure may result in damage to brain and central nervous system, kidney and/or liver.
Target Organs: Central nervous system, eyes, skin, respiratory system (lungs), liver, gastro-intestinal tract, and kidneys.
Medical Conditions Generally Aggravated by Exposure:
Liver disorders, kidney disorders, alcoholism, and central nervous system disorders.
Routes Of Entry:
Ingestion, inhalation, eye contact, and skin contact.

1, 1, 1 - TRICHLOROETHANE (TCA)
HAZARD MATERIAL INFORMATION SHEET

SECTION 5 HEALTH HAZARD DATA...CONCLUDED

Emergency And First Aid Procedures:
Call a physician. If swallowed, do not induce vomiting and. get medical attention immediately. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove any contaminated clothing and shoes. Wash clothing before reuse.

Notes To Physician: NA

SECTION 6 REACTIVITY DATA

Stability: Stable
Hazardous Polymerization: Will not occur.
Conditions To Avoid: Heat, flame, other sources of ignition
Incompatibles: Chemically active metals, strong caustics, dinitrogen tetraoxide, sodium metal, potassium metal, and strong oxidizing agents (sulfuric acid, nitric acid, etc.).
Decomposes slowly when exposed to light or heat.
Decomposition Products: Hydrogen chloride, chlorine, and phosgene.

SECTION 7 SPILL AND DISPOSAL PROCEDURES

Steps To Be Taken In The Event Of A Spill Or Discharge
Wear self-contained breathing apparatus and full protective clothing. Stop leak if you can do so without risk. Use water spray to reduce vapors. Take up with sand or other non-combustible absorbent material and place into container for later disposal. Use absorbent material to absorb material.

Disposal Procedure
Dispose in accordance with all applicable federal, state, and local environmental regulations.

EPA Hazardous Waste Number: U 226 (Toxic Waste)

SECTION 8 PROTECTIVE EQUIPMENT

Ventilation: Use general or local exhaust ventilation to meet TLV requirements.
Respiratory Protection: Respiratory protection required if airborne concentration exceeds TLV of 350 ppm; negative pressure cartridge respirator with organic vapor cartridges is advised. At concentrations above 700 ppm, a air supplied pressure-demand respirator or self-contained breathing apparatus is advised.
Eye/Skin Protection: Safety goggles and face shield, uniform, protective suit, neoprene or polyvinyl alcohol gloves are recommended.

SECTION 9 STORAGE AND HANDLING PRECAUTIONS

Storage Color Code: Blue (Health Hazard)
Special Precautions: Keep container tightly closed. Store in a secure storage area for poisons.

SECTION 10 TRANSPORTATION DATA AND ADDITIONAL INFORMATION

Domestic (D.O.T.)
Proper Shipping Name: Trichloroethane
Hazard Class: ORM-A
UN/NA: UN2831
Labels: None
Reportable Quantity: 1,000 Lbs.

International (I.M.O.)
Proper Shipping Name: Trichloroethane
Hazard Class: Poison B
UN/NA: UN2831
Labels: St. Andrew's Cross

SECTION 11 REFERENCES

"NIOSH Pocket Guide To Chemical Hazards;" U. S. Department of Health and Human Services, Center for Disease Control and Prevention (CDC) & National Institute of Occupational Safety and Health; Copyright: June 1994.

"1996 Threshold Limit Values for Chemical Substances and Physical Agents Biological Exposure Indices;" American Conference of Government Industrial Hygienist.

"Hazardous Chemicals Data Book; Second Edition;" Edited b Weiss; Published by Noyes Data Corporation, Park Ridge, New Jersey; Copyright 1986.

"Tomes;" by Micromedex, Inc., Englewood, Colorado; 1996 Edition.

"1993 Emergency Response Guidebook;" U. S. Department o Transportation, Research and Special Programs Administration U. S. Government Printing Office, Washington D. C.; Copyright, October 1993.

TETRACHLOROETHENE (PCE)
HAZARD MATERIAL INFORMATION SHEET

SECTION 1 MATERIAL IDENTIFICATION

Hazardous Material Name: Tetrachloroethene (PCE)
Common Synonyms: Perchloroethylene, Tetrachloroethylene, Perclene, Perclor, Carbon bichloride, and Carbon dichloride.
Formula: $CL_2C=CCL_2$ Formula Wt: 165.8
CAS No.: 127-18-4
NIOSH/RTECS No.: KX3850000
Information Researched: 1/21/97

SECTION 2 HAZARD COMMUNICATIONS

PRECAUTIONARY LABELING

Hazard Ranking System

Health	2	Moderate (Potential Carcinogen)
Flammability	0	No Hazard (Non-Flammable)
Reactivity	1	Slight (Other Chemicals)
Contact	1	Slight (Irritant)

Hazard Ratings Are 0 To 4
(i.e., 0 = No Hazard; 4 = Extreme Hazard).

PRECAUTIONARY LABEL STATEMENTS

WARNING
POISON
NOT FOR HOUSEHOLD USE
CAUTION: TETRACHLOROETHENE, ANIMAL CARCINOGEN
HARMFUL IF SWALLOWED, INHALED,
OR ABSORBED THROUGH SKIN
HEALTH HAZARD -
READ MATERIAL SAFETY DATA SHEET
AVOID CONTACT WITH HEAT & FLAME,
WILL DECOMPOSE TO
HYDROCHLORIC ACID & CARBON MONOXIDE.
AVOID CONTACT WITH EYES, SKIN, CLOTHING.
AVOID BREATHING VAPOR.
KEEP IN TIGHTLY CLOSED CONTAINER.
USE WITH ADEQUATE VENTILATION.
WASH THOROUGHLY AFTER HANDLING.
USE ABSORBENT FOR SPILLS.

Storage Color Code: Blue (Health Hazard)

SECTION 3 PHYSICAL DATA

Boiling Point: 121°C (250°F) Specific Gravity: 1.63 (H_2O=1)
Vapor Pressure(mmHg): 14 Melting Point: -8°C (-22°F)
Vapor Density(Air=1): 5.7 % Volatiles By Volume: 100
Evaporation Rate: N/A (Butyl Acetate=1)
Solubility(H_2O): 0.02 %
Appearance & Odor: Clear colorless, clear non-flammable liquid with sweet ethereal or chloroform-like odor.

SECTION 4 FIRE AND EXPLOSION

Flash Point (Closed Cup): N/A
NFPA 704M Rating: 2-0-0
Flammable Limits: Upper - N/A Lower - N/A
Fire Extinguishing Media: N/A

Special Fire-Fighting Procedures:
Firefighters should wear proper protective equipment and self-contained; breathing apparatus with full facepiece operated in positive pressure mode. Structural firefighters' protective clothing will provide limited protection from these materials. Move containers from fire area if it can be done without risk. Use water spray to keep fire-exposed containers cool.

Unusual Fire & Explosion Hazards:
Closed containers exposed to heat may explode.

Toxic Gases Produced
Hydrogen chloride, chlorine, phosgene, and carbon monoxide may be produced from decomposition.

SECTION 5 HEALTH HAZARD DATA

This substance is listed by NIOSH as a potential occupational carcinogen. Exposure Limits: American Conference of Government Industrial Hygienist (ACGIH) threshold limit value (TLV/TWA): 170 mg/m^3 (25 ppm); short term exposure limit (STEL): 685 mg/m^3 (100 ppm). Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL): 100 ppm; OSHA - Ceiling Value: 200 ppm; Peak Value (5 minutes in any 3 hr.): 300 ppm.
IDLH Value: 150 ppm
Effects Of Acute Overexposure:
Inhalation Vapors: Headache, nausea, vomiting, dizziness, narcosis, tremors in fingers, central nervous system depression, irritation of the respiratory system, cardiac arrhythmias, and lung inflammation.
Contact With Liquid: May cause irritating to skin and eyes. Liquid is readily absorbed through the skin. Prolonged skin contact may result in dermatitis.
Eye Contact: May cause irritation and damage to cornea.
Ingestion: Will causes nausea, headaches, dizziness, vomiting, gastro-intestinal irritation, and abdominal pain.
Chronic Effects: Overexposure may result in damage to central nervous system, kidney and/or liver.
Target Organs: Central nervous system, eyes, skin, respiratory system (lungs), liver, gastro-intestinal tract, and kidneys.
Medical Conditions Generally Aggravated by Exposure:
Liver disorders, kidney disorders, alcoholism, and central nervous system disorders.
Routes Of Entry:
Ingestion, inhalation, eye contact, skin contact, and absorption.

TETRACHLOROETHENE (PCE)
HAZARD MATERIAL INFORMATION SHEET

SECTION 5 HEALTH HAZARD DATA...CONCLUDED

Emergency And First Aid Procedures:
Call a physician. If swallowed, do not induce vomiting and. get medical attention immediately. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.
In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove any contaminated clothing and shoes. Wash clothing before reuse.

Notes To Physician: NA

SECTION 6 REACTIVITY DATA

Stability: Stable
Hazardous Polymerization: Will not occur.
Conditions To Avoid: Heat, flame, other sources of ignition
Incompatibles: Chemically active metals, strong caustics, dinitrogen tetraoxide, sodium metal, potassium metal, and strong oxidizing agents (sulfuric acid, nitric acid, etc.).
Decomposes slowly when exposed to light or heat.
Decomposition Products: Hydrogen chloride, chlorine, and phosgene.

SECTION 7 SPILL AND DISPOSAL PROCEDURES

Steps To Be Taken In The Event Of A Spill Or Discharge
Wear self-contained breathing apparatus and full protective clothing. Stop leak if you can do so without risk. Use water spray to reduce vapors. Take up with sand or other non-combustible absorbent material and place into container for later disposal. Use absorbent material to absorb material.

Disposal Procedure
Dispose in accordance with all applicable federal, state, and local environmental regulations.

EPA Hazardous Waste Number: U 210 (Toxic Waste)

SECTION 8 PROTECTIVE EQUIPMENT

Ventilation: Use general or local exhaust ventilation to meet TLV requirements.
Respiratory Protection: Respiratory protection required if airborne concentration exceeds TLV of 25 ppm; negative pressure cartridge respirator with organic vapor cartridges is advised. At concentrations above 150 ppm, a air supplied pressure-demand respirator or self-contained breathing apparatus is advised.
Eye/Skin Protection: Safety goggles and face shield, uniform, protective suit, polyvinyl alcohol gloves are recommended.

SECTION 9 STORAGE AND HANDLING PRECAUTIONS

Storage Color Code: Blue (Health Hazard)
Special Precautions: Keep container tightly closed. Store in a secure storage area for poisons.

SECTION 10 TRANSPORTATION DATA AND ADDITIONAL INFORMATION

Domestic (D.O.T.)
Proper Shipping Name: Tetrachloroethylene or Perchloroethylene
Hazard Class: 6.1, Poison
UN/NA: UN1897
Labels: Poison
Reportable Quantity: 100 Lbs.

International (I.M.O.)
Proper Shipping Name: Tetrachloroethylene
Hazard Class: 6.1
UN/NA: UN1897
Labels: Poison

SECTION 11 REFERENCES

"NIOSH Pocket Guide To Chemical Hazards;" U. S. Department of Health and Human Services, Center for Disease Control and Prevention (CDC) & National Institute of Occupational Safety and Health; Copyright: June 1994.

"1996 Threshold Limit Values for Chemical Substances and Physical Agents Biological Exposure Indices;" American Conference of Government Industrial Hygienist.

"Hazardous Chemicals Data Book; Second Edition;" Edited by Weiss; Published by Noyes Data Corporation, Park Ridge, New Jersey; Copyright 1986.

"Tomes;" by Micromedex, Inc., Englewood, Colorado; 1996 Edition.

"1993 Emergency Response Guidebook;" U. S. Department of Transportation, Research and Special Programs Administration U. S. Government Printing Office, Washington D. C.; Copyright, October 1993.

APPENDIX B

QUALITY ASSURANCE PROJECT PLAN

APPENDIX B
QUALITY ASSURANCE PROJECT PLAN

SECTION B1.0 PROJECT DESCRIPTION

This Quality Assurance Project Plan (QAPP), as part of the Field Investigation Work Plan, describes the methods and procedures that will be used by OpTech, at IRP Site No. 7, Dry Well Off Corrosion Control Building Area, and IRP Site No. 8, Dry Well Off Composite Maintenance Building Area, at the 120th Fighter Wing, Montana Air National Guard, Great Falls, Montana (hereafter called the base). The methods and procedures are documented to ensure quality, precision, accuracy, and completeness of data collected and generated during the field investigation. The OpTech Corporate Environmental Quality Assurance/Quality Control Plan (CEQP) (OpTech, 1992) has been approved by the ANG/CEVR for investigations at IRP sites. The methods and procedures that will be used for this field investigation are documented in the CEQP and in this Work Plan and will be referenced appropriately. The project description is presented in Section 1.0 of this Work Plan. The facility background information and site descriptions are presented in Section 3.0 of this Work Plan.

The Data Quality Objective for the laboratory analyses is USEPA Level III.

SECTION B2.0 PROJECT ORGANIZATION AND RESPONSIBILITY

The project organization and responsibility are presented in Section 2.0 of this Work Plan.

SECTION B3.0 FIELD PROCEDURES

B3.1 MOBILIZATION

The procedure for mobilization is presented in Section 7.1 of this Work Plan.

B3.2 DECONTAMINATION PROCEDURES

The decontamination procedures are presented in Section 13.0 of this Work Plan.

B3.3 SURVEYING

The procedure for surveying is presented in Subsection 7.1.2 of this Work Plan.

B3.4 DRILLING PROCEDURE

The drilling procedures are presented in Subsection 7.1.1 of this Work Plan.

B3.5 BOREHOLE LOGGING

The procedure for borehole logging is presented in Subsection 7.1.7.1 of this Work Plan.

B3.6 MONITORING WELL INSTALLATION

The procedures for monitoring well installation, development, and documentation of construction and development are presented in Subsections 7.1.4, 7.1.6, and 7.1.7.2, respectively of this Work Plan.

B3.7 WATER-LEVEL MEASUREMENT

The procedure for collection of groundwater-level measurements is presented in Subsection 7.1.3 of this Work Plan.

B3.8 SLUG TEST METHOD

The procedure for rising-head slug testing is presented in Subsection 7.1.9 of this Work Plan.

SECTION B4.0 SAMPLING PROCEDURES

B4.1 GROUNDWATER SAMPLES

Operational Technologies Corporation follows the established sampling procedures contained in *Volume II: Field Manual Physical/Chemical Methods* of SW-846, <u>Test Methods for Evaluating Solid Waste</u>, 3rd edition, November 1986, the methods contained in 40 CFR Part

136, Guidelines Establishing Test Procedures for the Analysis of Pollutants (as amended through October 8, 1991), and the US EPA publication A Compendium of Superfund Field Operations Methods, EPA/540/P-87/001, December 1987, as appropriate. Standard EPA sampling protocols will be used for collecting aqueous samples and will use the following specific procedures:

(a) All sampling equipment will be decontaminated prior to use and between samples using laboratory-grade detergent and tap water, ASTM Type I reagent water, and pesticide-grade methanol rinses, in that order. Additionally, a final hexane rinse may be required as specified in the Project Work Plan.

(b) Decontaminated equipment is allowed to air dry and is then wrapped in a non-plastic material (usually aluminum foil) and stored so that the potential for accidental contamination is reduced.

(c) Filtration may be required for some aqueous samples prior to filling sample containers destined for certain types of analyses. The Project Work Plan will specify if filtration is required.

(d) Line used to lower aqueous sampling equipment into the well will be used only for the well being sampled.

(e) Water-level probes will be decontaminated before use in each well.

(f) Sample containers to be used for aqueous samples will be appropriate for the method of analysis specified.

The analysis of volatile organic compounds calls for exacting procedures to maintain the integrity of the sampling process. Field sampling protocols will be in strict accordance with EPA SW-846 sampling procedures. For each discrete sampling location, two 40-mL screw-top VOA vials with Teflon-faced silicone septums will be filled until the meniscus bulges over the rim of the vial. The Teflon-lined vial cap will be tightened onto the vial in such a manner as to not allow any headspace. To make certain the vials are completely full, the samplers will invert the vials, tap the sides, and check for bubbles. If bubbles appear, the sample must be retaken. Sample labels will be filled out to include preservation technique, field tracking logs completed and the Chain-of-Custody form filled out. Samples will then be inverted and placed on ice in the cooler and chilled to 4° C. Care must be taken not to sample near any running motor or any type of exhaust system because discharged fumes and vapors may contaminate the samples.

When sampling water for total recoverable petroleum hydrocarbons, sample containers will not be pre-rinsed with sample prior to collection. At each discrete sampling location, two 1-liter glass containers are filled to the top with sample and the Teflon-lined caps replaced. the containers are properly logged and placed in the cooler and kept at 4° C. Like sampling procedures for volatile organics, care must be taken not to contaminate samples from any nearby exhaust sources.

Metal sample containers will not be pre-rinsed with sample prior to collection. Before sampling, approximately 2 milliliters of 1:1 nitric acid (HNO_3) will be added to each sample container. This preservation technique will be noted on the sample label and in the Chain-of-Custody form. For each discrete sampling location, one 1-liter high density polyethylene bottle is filled with sample and the plastic cap replaced. The turbidity of each sample will be noted at this time. The filled sample bottle will be placed in the cooler and chilled to 4° C.

When sampling water for anions, sample bottles will not be pre-rinsed with sample. For each discrete sampling location, one 2-liter high density polyethylene bottle is filled with the sample matrix and immediately placed in the cooler to chill to 4° C. A second 2-liter bottle is filled with the sample matrix and preserved by adding approximately 2 mL of 1:1 HNO_3. This preservation technique is to be noted on the sample label and on the Chain-of-Custody form.

1-liter high density polyethylene bottles will be used for sampling total dissolved solids. After filling the sample bottle, the bottle will be capped with a Teflon-lined lid and immediately placed on ice in the cooler to chill to 4° C.

B4.2 DUPLICATE SAMPLING PROCEDURES FOR QUALITY ASSURANCE/ QUALITY CONTROL

Quality control procedures are embedded in OpTech field sampling procedures to ensure the precision of sampling protocols and, in turn, to ensure that the analytical results from field samples are accurate. Accordingly, duplicate samples are taken to cross check sampling and analytical procedures

Duplicate water samples are collected as a quality assurance/quality control means of assessing the precision of site sampling protocols. One duplicate is taken for every 10 samples. Duplicates will be coded in such a manner so that laboratory personnel will not recognize them as QA/QC samples. Field duplicates, however, do not release the analytical laboratory from its own internal QA/QC procedures.

When duplicates samples are collected, the first sample to be collected should be that for volatile analysis, since volatilization is increased with disturbance of the well and with sample handling. The first bailer volume should be used to fill the sample VOA vials, while a second bailer volume should be used to fill the duplicate sample vials. Sample procedures for the various Project Work Plan parameters are described above. In all cases, samples will be labeled correctly, field tracking logs or Chain-of-Custody forms filled out, and the samples placed in the cooler on ice.

B4.3 DECONTAMINATION OF FIELD EQUIPMENT

All non-disposable field equipment will be decontaminated prior to field sampling, between sampling events, field sites or monitor wells, and after sampling activities have been completed. Standard OpTech decontamination procedures call for scrubbing sampling equipment with a laboratory-grade detergent (such as Liqui-Nox or Alconox), followed by a rinse with potable water, a rinse by ASTM Type I reagent water and pesticide-grade methanol. All equipment are allowed to air dry and are either wrapped in aluminum foil after drying or positioned to preclude inadvertent contamination prior to reuse. Bailers are allowed to air dry before lowering them into monitor wells. Bailer lines are replaced between wells and care is taken to ensure the bailer line does touch the ground and become contaminated. Water level monitoring probes and their measuring tapes are scrubbed with laboratory-grade detergent and rinsed with ASTM Type I reagent water before insertion into monitor wells.

Drilling equipment is decontaminated away from the monitor well site in the designated decontamination area. Steam or laboratory-grade detergent (Liqui-Nox or Alconox) is used for decontamination prior to drilling and between drilling sites. The Project Manager is responsible for ensuring that the decontamination area is kept clean and orderly.

SECTION B5.0 SAMPLE CUSTODY, RECORDS, AND DOCUMENTATION

A critical aspect of preserving QA/QC standards in the assessment of environmental sites is the strict control of samples from the time of their field collection, through shipment, to receipt and analysis by the laboratory. OpTech Chain-of-Custody procedures include training of all field personnel in the need for strict Chain-of-Custody control, procedures for the completion of the OpTech Chain-of-Custody form, and the need for complete written documentation of transfer actions.

Per EPA guidance, a sample is deemed to be in an individual's positive custody if the sample is (1) in the physical possession or view of the responsible party, (2) locked in a secure container to prevent tampering, or (3) placed in a secured area that is restricted to authorized personnel only.

B5.1 CHAIN- OF- CUSTODY

B5.1.1 Sample Labels

All samples will be labeled at the time of their field collection. Labels will be completed in indelible ink and will include all information on the label. Because labels may occasionally or inadvertently become wet during field sampling operations, it is recommended that baseline label information be partially completed prior to sampling.

5.1.2 Chain-of-Custody Record

Sample chain-of-custody procedures require that possession and handling of the sample from time of collection through completed laboratory analysis be strictly controlled and documented through written record. The record must clearly show the control and transfer of the sample through the entire analytical sequence to ensure the sample has not been tampered with in any way. Similarly, strict chain-of-custody procedures will ensure that samples do not become mixed up with each other. A completed chain-of-custody record may support potential litigation; it must therefore be clear and defensible.

The chain-of-custody record must be standardized. All field personnel engaged in sampling operations will be trained on the use of the Chain-of-Custody form and which are the mandatory items they are responsible for completing. In all cases, however, the Project Manger will personally review all Chain-of-Custody forms prior to sample shipping to ensure the forms are complete and accurate. Any changes to the form will be made by drawing a single horizontal line through the erroneous entry, writing in the corrected entry, and initialing the change.

B5.1.3 Custody and Shipment of Samples

The Chain-of-Custody record is an integral part of the shipment of samples. When samples are released, the individual relinquishing the samples signs and writes the date and time on the Chain-of-Custody record. The individual receiving the samples signs, dates, and records the time of receipt. The Chain-of-Custody record is the single official documentation of all transference of the sample custody until the samples have arrived at the laboratory. Should samples be split between analytical laboratories, a separate Chain-of-Custody record will be prepared for each shipment. Normally shipment will be by Federal Express or similar carrier to ensure shipment is accomplished as soon as possible, usually overnight.

B5.1.4 Laboratory Custody Procedures

Although OpTech cannot control internal procedures at analytical laboratories, OpTech managers can review the analytical laboratory's Quality Assurance Manual to review internal sample control procedures. Accordingly, OpTech requires written procedures to be in effect to assure positive control of samples in accordance with EPA guidelines. Laboratory custody procedures will include:

(a) A designated sample custodian who will receipt for field samples, examine the Chain-of-Custody form for anomalies, and examine the incoming samples for condition of container and seals, evidence of leakage, and any indication of possible tampering

(b) An internal laboratory tracking and control system to maintain positive control of field samples

(c) Storage of samples in a locked area to maintain sample integrity
(d) Internal quality review of analytical procedures and results

B5.2 PREPARATION OF SAMPLES FOR SHIPMENT

Care must be taken to carefully prepare field samples for shipment to the analytical laboratory to preclude loss of information from a destroyed sample and to eliminate the health and safety risk to shippers/handlers. Before shipping procedures are determined, the Project Manager must determine the category of the sample. In accordance with the Code of Federal Regulations, 49 CFR 171-177, the Department of Transportation (DOT) is concerned with two basic types of field samples:

(a) Environmental Samples: These are samples of soil, water, or air usually collected off-site of a hazardous waste dump or chemical spill and are therefore not expected to be contaminated with high concentrations of toxic materials. The function of environmental sample collection is usually to monitor the extent of contamination and/or the off-site transport of contaminated materials. If there is a doubt as to the suitability of a sample to this classification, it should be placed in the Hazardous Substance category. It is expected that OpTech would be shipping Environmental Samples to analytical laboratories.

(b) Hazardous Substances: Samples falling into this group are known or expected to be contaminated at concentrations that are potentially harmful; including, but not limited to, on-site samples of soil or water, samples from drums or bulk storage tanks, contaminated pools, lagoons, etc., and leachates from hazardous waste sites.

B5.3 SHIPPING ENVIRONMENTAL SAMPLES

The following general instructions apply to the shipping of Environmental Samples:

(a) Properly labeled sample bottles will be sealed into a plastic bag and then into a metal paint can (or equivalent) such as the sample bag is surrounded on all sides with an absorbent cushioning material, such as vermiculite. The top of the can will be securely affixed.

(b) A "This Side Up" label will be placed on the top of the can top. Arrows indicating the can top will be affixed to the sides of the can.

(c) An "Environmental Sample" label will be affixed to the outside of the can.

(d) A layer of absorbent cushioning material, such as vermiculite, will be placed in the bottom of a hard plastic-lined metal cooler.

(e) Environmental Sample cans will be placed in the cooler with the top up. Cushioning material will be filled around the cans.

(f) Plastic sealed bags of ice will be placed in the cooler to maintain the proper temperature of 4° C.

(g) The Chain-of-Custody form(s) should be placed in the cooler prior to closing.

(h) After the cooler is closed, the lid will be sealed to the bottom of the cooler with fiberglass tape.

(i) Several wraps of tape will be passed around the cooler perpendicular to the seal to ensure the lid will not open if the latch is damaged or released.

(j) The cooler drain plug will be taped closed.

(k) A complete address label will be placed on the lid of the cooler including the name, address, and telephone number of the receiving analytical laboratory. OpTech's name, address, and telephone number will be included on the address label (49 CFR §261.4(d)(2)).

(l) A "This End Up" label will be placed on the lid of the cooler and "This End Up" arrows placed on all four sides.

(m) The cooler will be secured with a hasp and lock (if so equipped) or a custody seal signed and affixed across the cooler lid and side.

(n) The cooler is now ready for shipment via commercial air cargo transporter, rail, or truck to the analytical laboratory.

Of note, the following "hazardous" compounds as preservatives to Environmental Samples will not alter the classification provided the following criteria are met:

(a) Hydrochloric acid solutions at concentrations 0.04 percent (w/w) or less

(b) Mercuric chloride in water solutions at concentrations less than or equal to 0.004 percent (w/w)

(c) Nitric acid in water, concentrations less than or equal to 0.15 percent (w/w)

(d) Sulfuric acid solutions, concentrations less than or equal to 0.035 percent (w/w)

(e) Sodium hydroxide in water, concentrations less than or equal to 0.080 percent (w/w)

(f) Phosphoric acid in water, concentrations yielding a pH range between 4 and 2

B5.4 SHIPPING HAZARDOUS WASTE SAMPLES

Samples known or suspected to contain hazardous materials must be regarded as hazardous substances and be transported in accordance with DOT requirements. Samples with known or suspected hazardous constituents should be prepared and shipped as specified in 49 CFR 101, the DOT Hazardous Materials Table. When the exact nature of a substance is unknown or in question, a tentative class assignment should be made (49 CFR §172.402(h) and §173.2) assuming a worst case designation. Start with the most severe classification of the sequence of precedence (49 CFR §173.2) shown in Section 6.0, Table 6.1, unless reliable information exists for elimination of that category. Therefore, a sample would be treated as radioactive unless knowledge of the sample or radiation detection measurements contradict this classification. Poison A would then the next designation to be considered, until reliable information provides for assigning it to the next applicable category. Of the Poison A group, bromoacetone, cyanogen chloride (at temperatures less than 13.1° C), hydrocyanic acid (prussic) solution, methyldichloroarsine, and phosgene (diphosgene) occur as liquids. If a liquid can, by available reliable information, be exempted from this category, or if the sample is a solid, then the next designation to apply is Flammable Liquid.

The packaging procedures previously described for Environmental Samples are suitable for the Flammable Liquids and all subsequent categories. There are additional requirements, however.

(a) With the exception of sampling protocols that call for no headspace, sample bottles should be filled allowing sufficient usage (approximately 10 percent of volume) to prevent the liquid from completely filling the bottle at 55° C (130° F).

(b) Sample bottles should contain no more than 1 quart of liquid.

(c) Labeling on the cooler must include:

    (1) A "Laboratory Samples" label
    (2) A "This End Up" label on the cooler lid
    (3) "This End Up" arrows on all four sides of the cooler
    (4) A "Flammable Liquid, N.O.S." label (Note: N.O.S. stands for Not Otherwise Specified)
    (5) An address label with the name, address, and telephone number of the receiving laboratory and a return address with the same information for OpTech as the sender

(d) Air transportation is permitted only for cargo only aircraft (no passengers).

B5.5 NOTIFICATION OF THE ANALYTICAL LABORATORY

At least 24 hours prior to shipment of field samples, the analytical laboratory should be notified of the shipment. The lab should be given all shipping information, including airbill number, courier company, and number of shipment containers. Notification of the laboratory is especially important if the shipment is to arrive on the weekend, so that the laboratory may take any necessary steps to receive the shipment.

SECTION B6.0 INTERNAL QUALITY CONTROL CHECKS

OpTech requires the integrity of field sampling protocols to be checked by standardized quality control procedures. Accordingly, OpTech uses standard field sample quality control checks, including field blanks, equipment blanks (washes), trip blanks, and field replicates, as appropriate. Field blanks, equipment blanks, and trip blanks are prepared using ASTM Type I reagent water and sample bottles randomly selected from sample bottles prepared for environmental samples. Since disposable sampling equipment will be used exclusively, equipment blanks will not be collected for this project.

B6.1 FIELD BLANKS

Field blanks are prepared at the beginning of each sampling event at each discrete sampling siege by pouring ASTM Type I reagent water in to prepared sample bottles. The sample bottles reflect the same type normally used to collect samples at the site (they are representative of the sample bottles in use). The field blanks are labeled, sealed, handled, shipped, and analyzed in the same manner as the environmental samples. Because field blanks and environmental samples are collected under the same field conditions, field blank analyses are used to indicate the presence of external contaminants introduced during sampling operations.

B6.2 TRIP BLANKS

Trip blanks are prepared at the beginning of the sampling trip by pouring ASTM Type I reagent water into prepared sample bottles. The sample bottles reflect the same type normally used to collect samples at the site (they are representative of the sample bottles in use). The containers are filled to the same level as the field samples are to be filled. The trip blanks, prepared by the analytical laboratory, are shipped to OpTech along with the field sample bottles, and are stored with the unused sample bottles. Trip blanks are not opened during the sampling events. They are then shipped to the field site and then shipped back to the laboratory along with the other completed field samples. The water used to prepare each batch of trip blanks is analyzed for VOCs. The results of the trip blank analyses are reported along with the associated environmental and QA/QC samples. Analysis of trip blanks is used to assess contamination of sample containers during shipping and storage at the field site, and contamination of samples during transport back to the laboratory. One trip blank will be included in each shipping container containing samples for VOC analysis.

B6.3 FIELD QA|QC REQUIREMENTS

All samples shipped from field sites back to the analytical laboratory are properly labeled, sealed, and controlled on Chain-of-Custody records. OpTech QA/QC standards call for a normal batch of QA/QC samples as specified in EPA guidelines. Typically, for each day of sampling, the following QA/QC samples are collected:

(a) One trip blank per cooler per sampling team for each batch of VOC samples
(b) One field blank per water source
(c) One field duplicate for every 10 or fewer water samples collected. A duplicate sample is collected independently at a sampling location during one sampling action. Field duplicates are labeled exactly like other environmental samples so as not to identify that they are duplicate samples. Field duplicates are used to evaluate the reproducibility of sampling protocols.

B6.4 LABORATORY QA/QC REQUIREMENTS

OpTech does not possess its own internal analytical laboratory capable of performing a full range of analytical protocols on field samples. Rather, OpTech contracts with an analytical laboratory for analytical support. OpTech QA/QC standards dictate, however, that the analytical laboratory follow EPA quality control checks to preserve analytical precision and accuracy. Accordingly, OpTech requires that the analytical laboratory perform matrix spike/matrix spike duplicates at a level of one matrix spike per 20 field samples in each sample matrix (i.e., soil, water, surface water, and sediment). The Project Manager communicates the matrix spike analyses requirements to the analytical laboratory.

B6.4.1 Matrix Spikes

Matrix spikes are replicate samples spiked with a known concentration of a spike compound. The spiked samples are taken through the entire laboratory analytical processes in order to check the precision and accuracy of laboratory results. After the value of the sample is determined, the value of the sample spike is computed. Should the sample also have a value of the spike analyte, the value of the sample is subtracted from the value of the spike and the percent recovery of the spike is calculated using the following equation:

$$\%\ \text{Recovery} = \frac{(\text{Spike Sample Result} - \text{Sample Result}) \times 100}{\text{Spike Added}}$$

Because sample values may sometimes fall outside the operating range of the analytical instrument, they may be diluted to bring the parameters within the operating range. Although the dilution may adjust the sample analyte to the proper concentration, the spike may be diluted to such an extent that it falls below the range of detection. In such cases, it is not possible to report spike recovery for the particular analyte.

B6.4.2 Control Charts

OpTech requires that analytical laboratories monitor the quality of their laboratory analytical processes using control charts. The laboratory QA/QC manual should specify the use of control charts to keep analytical processes stable and within control limits.

SECTION B7.0 QUALITY ASSURANCE OBJECTIVES FOR DATA MEASUREMENT IN TERMS OF PRECISION, ACCURACY, COMPLETENESS, REPRESENTATIVENESS, AND COMPARABILITY

The quality assurance objectives for all data measurements include considerations of precision and accuracy, completeness, representativeness, and comparability. Procedures used to assess data precision and accuracy are in accordance with 44 Federal Register (FR) 69533, "Guidelines Establishing Test Procedures for the Analyses of Pollutants, Appendix III, Example Quality Assurance and Quality Control Procedures for Organic Priority Pollutants," 3 December 1979. Parts of this section incorporate by reference USEPA guidance (USEPA, 1986).

B7.1 PRECISION

Measurement objectives for precision for this project will include field data as well as laboratory analytical data.

B7.1.1 Field Data Collection

The field measurement data include pH, dissolved oxygen conductivity, temperature, photoionization detector (PID) readings, and groundwater-level measurements. The objective for precision of field data collection methods is to achieve and maintain the factory equipment specifications for the field equipment.

For the pH meter, precision will be tested by multiple readings in the medium of concern. Consecutive readings should agree within ± 0.1 pH units after the instrument has been field calibrated with standard buffers before each use. The thermometer will be visually inspected prior to each use. The portable PID will be calibrated each day prior to field use. If calibration readings deviate ± 15 percent from the concentration of the calibration gas, the instrument will be returned for maintenance. Water-level indicator readings will be precise within ± 0.01 feet for duplicate measurements. Otherwise, the instrument will be returned to the factory for service.

B7.1.2 Precision of Laboratory Data

The objective for precision for the selected laboratory is to equal or exceed the precision demonstrated for the applied analytical methods on similar samples. Precision is evaluated most directly by recording and comparing multiple measurements of the same parameter on the same exact sample under the same conditions. It is expressed in terms of Relative Percent Difference (RPD) and it is calculated as follows:

$$RPD = [(X1 - X2)/X] \times 100$$

Where:

$X1$ = analyte concentration of first duplicate;
$X2$ = analyte concentration of second duplicate; and
X = average analyte concentration of duplicates one and two.

Acceptable levels of precision will vary according to the sample matrix, the specific analytical method, and the analytical concentration relative to the method detection limit.

For organic analytes, RPD criteria are evaluated on samples spiked in duplicate with specific compounds. The compounds used for spiking are listed on Table B7.1 along with advisory limits on the RPD for each of them.

For inorganic analytes, the control limit on RPD is ± 20 percent if both analyses are greater than the project required quantitation limit (PRQL). The quantitation limit is the minimum concentration of analyte that can be determined by the analytical method within the quality control limits for the specific method. The quantitation limits are matrix-dependent, with limits for soil samples being significantly higher than those for water for comparable analyses. If either or both the analysis results are below five times the PRQL, then the RPD is not calculated; instead, the results must agree within ± 20 percent of the PRQL.

Table B7.1
Recovery and Relative Difference Advisory Limits[1] for Matrix Spike and Matrix Spike Duplicate Samples for Organic Analytes
120th FW, Montana ANG, Great Falls, Montana

Fraction	Matrix Spike Compound	Water[2]	
		PR (percent)	RPD (percent)
VOA	Benzene	39-150	29
VOA	Chlorobenzene (Method SW8010)	38-150	35
VOA	Chlorobenzene (Method SW8020)	55-135	25
VOA	1,1-Dichloroethene	28-167	47
VOA	Toluene	46-148	28
VOA	Trichloroethene	35-146	30

PR - Percent Recovery.
RPD - Relative Percentage Difference.
VOA - Volatile Organic Analysis.

[1] These limits are for advisory purposes only as noted in March 1990 CLP SOW (p. E-16/VOA, para. 7.3.)

[2] PR and RPD values for VOAs in water are for samples utilizing either a 5- or 25-milliliter purge volume.

B7.2 ACCURACY

Accuracy is defined as the degree to which the measured value represents the true value of that parameter. The accuracy of the data affect the number of significant figures which may be used in reporting the data. Accuracy is expressed as Percentage Recovery (PR) and is calculated using the following formula:

$$PR = [(A - B)/C] \times 100$$

Where:

A = spiked sample result;

B = sample result; and
C = spike added.

The objective for accuracy of field measurements is to achieve and maintain factory specifications for the field equipment.

B7.3 COMPLETENESS

The completeness of the data is the amount of valid data obtained from the measurement system, either field or laboratory, as compared with the amount of data expected from the system. At the end of each sampling event, an assessment of the completeness of data will be performed and, if any data omissions are apparent, an attempt will be made to re-sample the parameter in question, if feasible. The specific objective for completeness of this project shall be greater than or equal to 90 percent. It is expressed as Percent Completeness (PC) and is calculated using the following formula:

$$PC = (A/B) \times 100$$

Where:

A = the actual number of valid analytical results obtained; and
B = the theoretical number of results obtainable under ideal conditions.

B7.4 REPRESENTATIVENESS

Samples taken must be representative of the population. Where appropriate, the population will be statistically characterized to express the degree to which the data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, a process, or an environmental condition.

Sample selection and handling procedures will incorporate consideration of obtaining the most representative sample possible. Representativeness of specific samples will be achieved by the following:

- Collecting samples from the location fully representing the site conditions;
- Using appropriate sampling procedures and equipment;
- Using appropriate analytical methodologies for the parameters and detection limits required; and
- Analyzing within the appropriate holding time.

To assess the representativeness of the sample collection procedures, some samples will be collected in duplicate. One of the duplicates will be given a "coded" or false sample identifier, and both it and the original sample will be analyzed. Comparisons of the results from the original sample and its coded field duplicate will allow for an evaluation of the representativeness of the sampling. One coded field duplicate will be collected every 20 samples.

Trip blanks will accompany all VOA samples shipped to the laboratory.

Water-source blanks will be collected to assess the potential for contamination from the water used for the final decontamination rinse and from the water used for steam-cleaning. A water source blank is defined as water poured into a sample container in the field, handled like a sample, and transported to the laboratory for analysis. Each lot of water used in final decontamination rinses and each source of water used for steam-cleaning will be tested by at least one water-source blank. Trip, rinseate, and field blanks will be clearly marked and will not be used for matrix spike/matrix spike duplicate or sample duplicate analyses.

To ensure that the sampling equipment has been successfully decontaminated, rinseate water samples will be collected and analyzed for the same parameters of the samples.

B7.5 COMPARABILITY

All data will be calculated and reported in units consistent with other organizations reporting similar data. The results of analyses can be compared with analyses by other laboratories because the objectives of this project for comparability are:

- To demonstrate traceability of standards to National Bureau of Standards (NBS) or USEPA sources;

- To use standard methodology;
- To report results from similar matrices in consistent units;
- To apply appropriate levels of quality control within the context of the Laboratory Quality Assurance Program;
- To participate in interlaboratory studies to document laboratory performance; and
- To insure that the analytical system is in control by analyzing blank spikes, standard reference samples, or other laboratory control samples.

By using traceable standards and standard analytical methodology, the field and laboratory analytical results can be compared to other studies performed similarly. The laboratory QA Program documents internal performance evaluations, and interlaboratory studies, including USEPA Performance Evaluation Studies, used to document performance compared to other laboratories.

B7.6 MONTHLY QA STATUS REPORTS

The Quality Assurance Manager (QAM) shall regularly report to the Operations Manager on the status, effectiveness, and needs of the project QA program by providing him with a monthly QA status report. The following QA information shall be provided:

- QA Plan - list title, numbers, and whether issued or revised;
- Procedures - list procedures issued or revised;
- Audits - list audits conducted and reports issued;
- Surveillance - list surveillance conducted, reports issued, and events scheduled for next reporting period;
- QA Training and Awareness - list title and length of all training sessions conducted and number of attendees;
- Quality Failures - summarize data on all nonconformance reports (NCRs); and
- Corrective Actions - provide information on outstanding actions as well as those that are expected to be completed during the next month.

SECTION B8.0 CALIBRATION PROCEDURES AND FREQUENCY

B8.1 CALIBRATION OF FIELD EQUIPMENT

An integral part of OpTech's Quality Assurance/Quality Control procedures for environmental field investigations is to ensure that strict standards of equipment integrity are maintained, resulting in the generation of field data that is accurate and defensible. Calibration establishes a reproducible reference point against which field sample measurements may be correlated. Field equipment will be calibrated on a daily basis prior to use using standardized procedures that meet the equipment manufacturer's calibration requirements. Should field personnel note a reading that might indicate the equipment is out of calibration, the equipment will be immediately recalibrated and the measurement retaken.

B8.1.1 HNu Photoionization Detector (PID)

The PID is used to detect, measure, and record real-time levels of many organic and inorganic vapors in the air. The PID will respond to most vaporous compounds that have an ionization potential less than or equal to that supplied by the ionizing device in the detector, an ultraviolet lamp. The magnitude of this response is a function of the detector sensitivity and the concentration and ionization properties of the individual compound. Though it can be calibrated to a specific compound, the PID cannot distinguish among detectable compounds in a gaseous matrix and therefore indicates an integrated response in relation to the response factors of all ionizable compounds present.

To make a quick check of the PID to ensure that it is operating and responsive, the probe and readout may be brought close to the calibration gas container and the valve on the container opened slightly. A response on the PID's readout indicates the instrument is operational.

The most accurate method of calibrating the instrument is to connect one side of the "T" valve to the pressurized container of calibration gas. The second side of the "T" valve is then connected to a rotameter and the third portion of the "T" valve connected directly to the 8-inch extension of the photoionization probe. The valve on the pressurized container of calibration gas is cracked open until a slight flow is indicated on the rotameter. The instrument draws in the volume of sample gas required for detection and the flow on the rotameter indicates an excess of sample. The Span knob should now be adjusted so that the instrument is reading the exact concentration of the calibration gas. If the instrument Span setting is changed, the instrument should be turned back to the Standby position and the electronic zero should be readjusted as necessary.

The calibration gas should be prepared in the same matrix (air, nitrogen, hydrogen, etc.) in which it is to be measured, otherwise an inaccurate reading may be obtained. Normally, OpTech field personnel will be using an air matrix. Each calibration gas is an approved part of the PID and is obtained by OpTech from HNu or from a certified source. Calibration with toxic gases should never be performed indoors, except under a laboratory hood.

The battery level of the PID should be checked as a part of the calibration process. If in doubt, the battery should be recharged or changed in accordance with the owner's manual. The PID should be checked to ensure it is clean and free of any dirt or liquids resulting from field use.

B8.1.2 Specific Conductance Meter

Calibration of the specific conductance meter will be performed each day prior to field use. A standard calibration solution of potassium chloride or sodium chloride will be used. With the meter off, the meter's mechanical zero setting should be checked. Adjustment with a screwdriver may be necessary to obtain a zero reading. After turning the meter on, the battery check switch will be depressed. Verify that the needle swings to the battery check area. A clean, dry probe will be attached to the meter and inserted into the calibration solution. In accordance with manufacturer's instructions, the meter will be adjusted to match the known calibration solution conductance level.

B8.1.3 pH Meter

Calibration is performed at the start of each sampling day using National Bureau of Standards traceable buffer solutions which bracket the pH range expected in the samples. The lower of the two known pH buffer solutions (pH 4, for example) will be poured into the sampling cup and the instrument probe inserted into the buffer solution. After 30 seconds, the pH reading should be taken. The meter should be calibrated according to manufacturer's instructions. The sampling cup will be emptied and the cup and probe rinsed with demineralized water. The higher (pH 9, for example) pH buffer solution will be poured into the sampling cup, the probe reinserted into the cup of solution, and the calibration process repeated in accordance with manufacturer's directions.

B8.1.4 Water Level Indicator

The water level indicator is calibrated by the manufacturer for water level measurements. Field personnel should check the general condition of the probe and tape to ensure readings are as accurate as possible. The battery level for the water level indicator should be monitored closely, especially when used in cold climates.

B8.1.5 Temperature Meter

OpTech normally measures the temperature of water samples using the one-piece specific conductance/pH/temperature meter. The temperature portion of the meter will be checked using a quality-grade (National Bureau of Standards-traceable) thermometer. At least two points within the temperature range will be checked when the instrument is calibrated.

B8.2 LABORATORY EQUIPMENT

The OpTech Project Manager and Manager of Quality Assurance will review the QA/QC manual published by the analytical laboratory selected for the project for internal calibration procedures. Baseline standards will be checked to ensure that laboratory instruments are calibrated on a regular basis, preferably daily. Calibration solutions will be prepared fresh for each analysis and discarded after use. Calibration standards must be traceable using National Bureau of Standards reference standards or quality control solutions from the Environmental Protection Agency under the Contract Laboratory Program (CLP). Laboratory calibration actions must be documented and control limits established and verified. Should equipment perform beyond control limits, analysis must be terminated, the problem corrected, the instrument recalibrated, and the calibration reverified. In some cases, multiple concentrations of analytes (usually three to five) may be used for repeat calibrations of laboratory equipment.

SECTION B9.0 DATA REDUCTION, VALIDATION, AND REPORTING

B9.1 DATA REDUCTION

B9.1.1 Laboratory Data

The procedures used for calculations and data reduction are specified in each analysis method referenced previously. Raw data are entered in bound laboratory notebooks. A separate book is maintained for each analytical procedure. The data entered are sufficient to document all factors used to arrive at the reported value for each sample. Calculations may include factors such as sample dilution ratios or conversion to dry-weight basis for solid samples. Instrument chart recordings and computer or calculator printouts are labeled and attached to their respective pages or are cross-referenced and stored in the project file.

All calculations shall be checked by the analyst prior to reporting the results. In addition, the analyst's supervisor or a designated alternate shall check a minimum of 10 percent of all calculations from the raw data to final value stages prior to releasing the analytical report for a group of samples. Results obtained from extreme ends of standard curves generated by linear regression programs will be checked against graphically produced standard curves if the correlation coefficient of a program curve is less than 0.995.

Concentration units will be listed on reports and any special conditions noted. The analysis report includes the unique sample number given each sample, details of sample receipt and report preparation.

B9.2 DATA REVIEW AND VALIDATION

Laboratory data generated will be reviewed and verified.

B9.3 REPORTING

For all analyses, data reporting will be according to requirements as published in the current Statements of Work or equivalent. For all analyses, as a minimum, the laboratory report will show traceability to sample analyzed, and will contain the following information:

- Project identification;
- Field sample number;
- Laboratory sample number;
- Sample matrix description;
- Date of sample collection;
- Date of sample receipt at laboratory;
- Analytical method description and reference citation;
- Individual parameter results;
- Date of analysis (extraction, first run, and subsequent runs);
- Quantitation limits achieved;
- Dilution or concentration factors; and
- Corresponding QC report (to include method blanks, blank/spikes, and continuing calibration checks).

All analytical reports shall be in the format for USEPA Level III and include all of the deliverables.

B9.3.1 USEPA Data Qualifiers

For analysis reports, these USEPA-defined laboratory data qualifiers will be required.

B9.3.1.2 Organic Data Qualifiers

The eight USEPA-defined data qualifiers for organics analysis are:

> U - Indicates element was analyzed for but not detected. Report as the PRQL. The PRQL must be reported upon the basis of dilutions made and percentage moisture for soils.

J - Indicates an estimated value. A value less than PRQL but greater than Method Detection Limit (MDL) is reported. The PRQL must be adjusted for dilutions made and percentage moisture for soil.

B - The compound was found in the blank as well as the sample.

E - Compounds identified whose concentrations exceed the calibrated range of the instrument receive this flag. When the sample is diluted and reanalyzed and compounds found in the original analysis are diluted out, both results are reported on separate analytical reports.

D - Identifies all compounds quantified when a sample has been diluted and reanalyzed.
X - Other flags may be required to properly qualify the results for a specific situation. The flag selected must be clearly defined in the Case Narrative.

If more than five qualifiers are required for a sample, use the "X" flag to combine several other qualifiers and explain in the Case Narrative.

The combination of flags "BU" or "UB" is prohibited because the "B" flag is used only if the compound is found in the sample.

B9.3.2.2 Inorganic Data Qualifiers

The USEPA-defined symbols for reporting the type of metals analyses are:

P - Inductively Coupled Plasma Emission Spectrophotometer (ICP).
A - Atomic Absorption Spectrophotometer (AAS) flame.
F - AAS furnace.
CV - Cold vapor.
NA - Analyte not required.

The nine USEPA-identified data qualifiers for inorganics analyses are:

B - The reported value is less than PRQL, but greater than Instrument Detection Limit (IDL).

E - The value is estimated due to interference. An explanation is required under comments on the form or on the cover page if the interference applies to all samples in the set.

M - Duplicate injection precision is not met (AAS furnace analyses are performed in duplicate. The absorbance/concentration values must agree within ± 20 percent).

N - The percentage recovery of the spiked sample is not within the control limits.

S - The reported value was determined by the method standard additions.

W - The analysis spike, a spike added to the sample digestate, has a percent recovery out of control limits (85 - 115 percent), and the sample absorbance is less than 50 percent of the spike absorbance.

***** - The RPD for duplicate analyses is not within control limits.

+ - The correlation coefficient for the Method Standard Addition is less than 0.995.

Note: No combination of "S," "W," and "+" can be used. These flags are mutually exclusive.

SECTION B10.0 AUDITS

The procedures for performance and system audits are presented in Section 10.0 in the CEQP (OpTech, 1992).

SECTION B11.0 PREVENTIVE MAINTENANCE

B11.1 PREVENTIVE MAINTENANCE PROCEDURES

Equipment, instruments, tools, gauges, and other items requiring preventive maintenance will be serviced in accordance with the manufacturer's specified recommendations.

B11.2 SCHEDULES

Manufacturer's procedures identify the schedule for servicing critical items in order to minimize the downtime of the measurement system. It will be the responsibility of the operator to adhere to this maintenance schedule and to arrange any necessary and prompt service as required. Service to the equipment, instruments, tools, gauges, and other items will be performed by qualified personnel.

In the absence of any manufacturer's recommended maintenance criteria, a maintenance procedure will be developed by the operator based upon experience and previous use of the equipment.

B11.3 METHOD-SPECIFIC PREVENTIVE MAINTENANCE

In the event that a laboratory or field method mandates specific preventive maintenance procedures which are more frequent than those recommended by the manufacturer, then the frequency specified in the method will be followed.

B11.4 RECORDS

Logs shall be established to record maintenance and service procedures and schedules. All maintenance records will be documented and made traceable to the specific equipment, instruments, tools, and gauges.

Records produced will be reviewed, maintained, and filed by the operators at the laboratories and by the date and sample control personnel when and if equipment, instruments, tools, and gauges are used at the site.

B11.5 SPARE PARTS

A list of critical spare parts will be identified by the operator and requested from the manufacturer. These spare parts will be stored for immediate availability in order to reduce downtime.

SECTION B12.0 NONCONFORMANCES AND CORRECTIVE ACTIONS

Nonconforming equipment, items, material, activities, services, conditions, and unusual incidents that could affect compliance with project requirements shall be identified, controlled, reported, and corrected in a timely manner. A nonconformance shall be considered as any malfunction, deviation, deficiency, failure, or error that renders the quality of an item, service, etc., unacceptable or indeterminate. All project personnel have the responsibility to identify a significant condition adverse to quality and initiate an nonconformance report (NCR). A review of nonconformance shall be conducted and a disposition given for the item, activity, or condition. The disposition of a nonconformance shall be documented and approved by the Project Manager and the QAM.

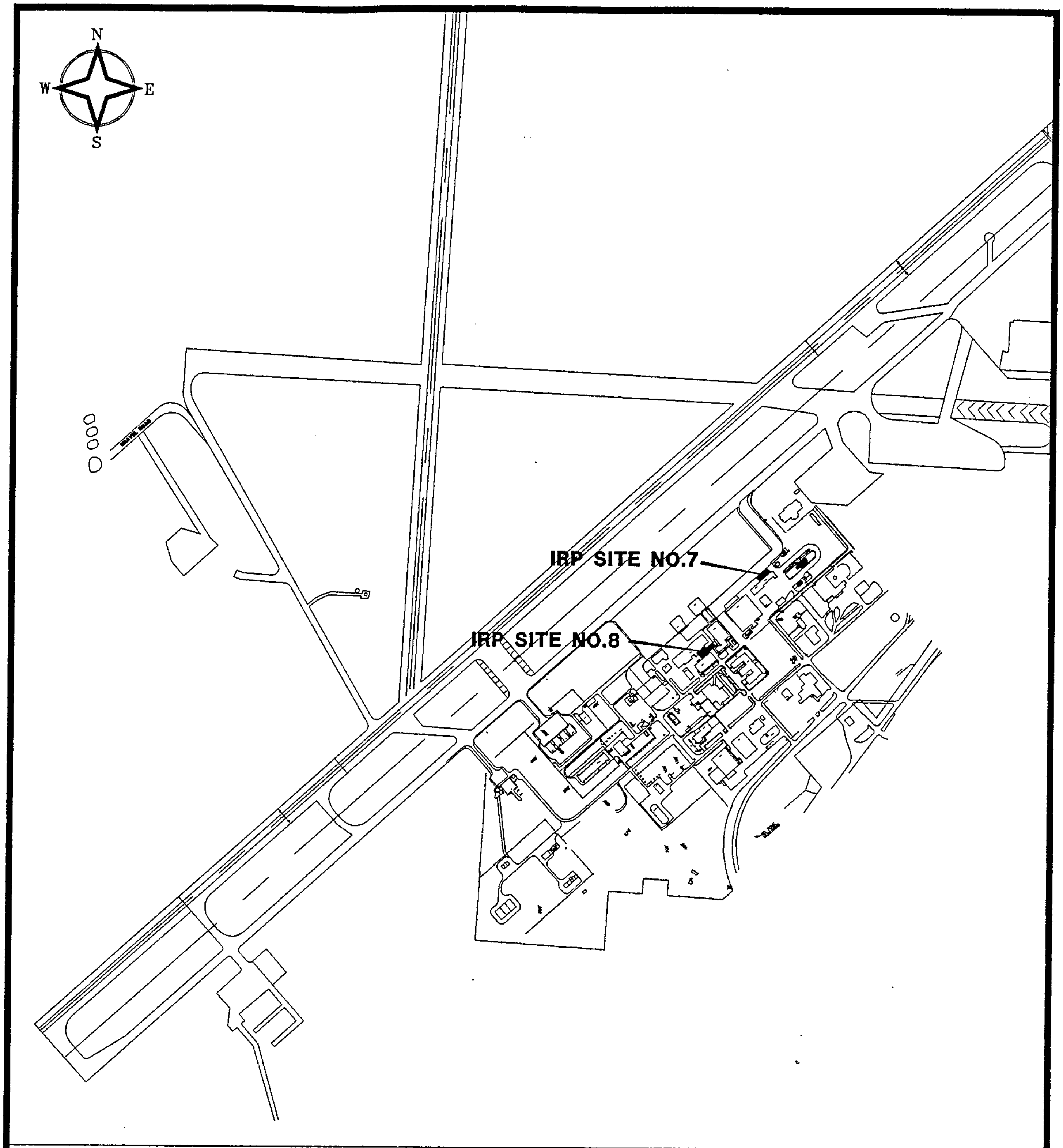
Corrective actions for NCRs shall be initiated and implemented. The modification, repair, rework, or replacements of nonconformity items or activities shall require verification of acceptability and fitness for intended use. In certain circumstances determined by the Project Manager, it may be necessary to complete and verify corrective action adequacy before work can continue.

The item or activity that has the NCR may be temporarily stopped during investigation of the NCR and determination of corrective action. If the Project Manager and QAM determine that the nonconformance does not adversely affect the quality or use of the work, the work may continue pending resolution of the nonconformance and application of corrective action(s). This decision shall be documented on the NCR and made before continuing the work. Records of NCR(s) and corrective actions shall be maintained in the project file. The Project Manager shall notify the ANG/CEVR Project Manager of nonconformances that could impact the project schedule or results of work and indicate the corrective action taken or planned to eliminate the nonconformance.

SECTION B13.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

At appropriate intervals during the project, the Project Manager will provide the Manager of Quality Assurance with documentation of field activities, including compiled field data sets and corrective action documentation. Additionally, the Project Manager and the Manager of Quality Assurance will discuss project QA/QC trends as evidenced by field documentation. Situations requiring immediate action by OpTech corporate headquarters (i.e., equipment replacement, additive resources, etc.) to preserve quality service to OpTech's client will be presented to the OpTech President by the Manager of Quality Assurance.

QA/QC project data will be reviewed by the Manager of Quality Assurance to update internal OpTech QA/QC procedures and field protocols. Recommendations on additive equipment, personnel, or training will be presented to the OpTech President for consideration and approval. "Lessons learned" from field activities will be used in the follow-on preparation of project-specific QAPPs, Project Work Plans, and Health and Safety Plans.



LEGEND

▨ IRP SITE

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SCALE IN FEET

SOURCE: MODIFIED FROM 120th FG, CIVIL ENGINEERING AND ENGINEERING SCIENCE, 1992.

INSIDE
BACK
COVER

GF-EECA\SITE_7-8

IRP SITE LOCATIONS MAP

120th FW, Montana Air National Guard
Great Falls, Montana

OPTECH
OPERATIONAL TECHNOLOGIES
CORPORATION

SEPTEMBER 1997