DEPARTMENT OF THE AIR FORCE

HEADQUARTERS 49TH FIGHTER WING (ACC)
HOLLOMAN AIR FORCE BASE, NEW MEXICO

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29 SEP 1992

FROM: 49 CES/CEV
550 Tabosa Avenue
Holloman AFB, New Mexico 88330-8458

SUBJ: RCRA Facility Investigation

TO: US Environmental Protection Agency, Region VI
Attn: Rich Mayer
Hazardous Waste Division
1445 Ross Ave
Dallas, TX 75202-2733

1. In response to your 26 June 92 letter regarding the T-38 Test Cell and Building 828, Holloman is submitting the required RCRA Facility Investigation (RFI) Workplans for these sites.

2. If you have any questions, please contact Roger Wilkson or Warren Neff at (505) 479-3931.

GORDON R. JANIEC, Lt Col, USAF
Base Civil Engineer

1 Atch
RFI Workplan

cc: w/Atch
Benito Garcia, NMED

RECEIVED
OCT - 5 1992

Global Power for America

RCRA FACILITY INVESTIGATION (RFI) WORKPLAN

FOR

T-38 TEST CELL (SWMU 229) AND BLDG. 828 (SWMU 230)

Prepared by

49 CES/CEV
Holloman Air Force Base, NM

September 1992

DRAFT

SITE SAFETY AND HEALTH PLAN (SSHP)

Resource Conservation and Recovery Act
Facility Investigation of
Solid Waste Management Units

Prepared by:

49 CES/CEV
Holloman Air Force Base, NM

September 1992

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1.0 INTRODUCTION

This Site Safety and Health Plan (SSHP) describes the policies and procedures that will be in force for the subsurface investigation at Holloman Air Force Base, New Mexico. The tasks to be performed are:

- Installation of groundwater monitor wells using hollow-stem auger drilling techniques;
- Drilling test borings using hollow-stem auger drilling techniques;
- Collection and analyses of soil samples;
- Development and "slug" testing of all monitor wells installed.

It is intended that this SSHP will be directly applicable to all personnel working at the site. This document will be provided to all contractors for instructional purposes only. Subcontractors are required to provide their own Health and Safety Plan to the prime contractor for informational purposes. Prior to start of field activities, an official of each subcontractor will certify to the Contractor Program Manager that all field personnel have had a medical examination, safety training, and that appropriate safety equipment will be available and used by the subcontracting team. All members of each subcontracting team will sign a statement stating that they have read and understand this SSHP.

1.1 Staff Organization and Responsibilities

Personnel responsible for the operation of this program are as follows:

Program Manager:	Assigned by contractor (Responsible for overall project accomplishment);
Project Director:	Assigned by contractor (reports to Program Manager);
Remedial Investigation Task Leader:	Assigned by contractor (reports to Project Director);
Supervising Field Geologist:	Assigned by contractor (reports to Task Leader);

Environmental Affairs Coordinator:	Assigned by contractor (coordinates with Project Director/ Task Leader/Supervising Field Geologist);
Professional Industrial Hygienist:	Assigned by contractor (provides consultative assistance to Program Manager and Project Director/Task Leader/Supervising Field Geologist);
Drilling and Trenching Supervisor:	Assigned by contractor (reports to Supervising Field Geologist).

Resumes of Contractor personnel involved in this investigation shall be provided to Holloman AFB Environmental Flight prior to start of any work.

1.2 Responsibilities of the Program Manager, Project Director, and Task Leader

The Program Manager, Project Director, and Task Leader have overall responsibility to ensure that the site Health and Safety program is implemented in accordance with all applicable federal, state, and local requirements.

Specific safety responsibilities of the Program Manager, Project Director, and Task Leader are to:

- Ensure that there is a detailed SSHP available on-site;
- Ensure safety and health equipment is procured on time;
- Ensure that field, including subcontractor, personnel have the required pre- and post-medical examinations, and are properly trained in safety, health, and emergency response procedures;
- Coordinate the reporting of any accidents or injuries; and
- Interface with the Contracting Officer if any problems arise which require alterations to, or deviations from, the SSHP.

1.3 Responsibilities of the Supervising Field Geologist

The Supervising Field Geologist will be responsible for executing the safety, health, and emergency response procedures that are described in this SSHP. These procedures cover all on-site activities of contractor and sub-contractor personnel. The responsibilities of the Supervising Field Geologist are listed below:

- Initiate contact with the base emergency response agencies (police, fire, medical) to advise them of the drilling activities and to ensure accuracy of the emergency phone numbers;
- Coordinate field activities with base personnel on a regular basis;
- Locate the support facilities in an uncontaminated area;
- Implement the safety, health, and emergency response training described in Section 4 of this plan;
- Monitor airborne contaminants;
- Observe site activities to ensure the proper use of personal protective equipment and proper application of safety practices;
- Take appropriate action, as described in this Plan, regarding accidents, fires, or other emergency situations;
- Conduct periodic safety review sessions for the drilling crew and other on-site personnel;
- Ensure that work schedules, dependent on work levels and outside temperature, are set each day and adhered to throughout the work day;
- Ensure that the field team observes the work zone and decontamination procedures as described in this plan;
- Ensure that safety equipment is properly maintained or disposed (respirators are to be cleaned daily);
- Ensure proper handling and shipping of potentially hazardous samples;

- Initiate corrective action for observed safety violations and report unsuccessful attempts to correct a violation to the Program Manager; and

- Stop work if unsafe conditions exist.

1.4 Responsibilities of the Subcontractor Supervisors

Each Subcontractor Supervisor will be responsible for the performance of the duties presented below with respect to that Subcontractor's specific activities:

- Among subcontractor workers, enforce the safety, health, and emergency response procedures that are presented in this plan;

- Initiate any corrective actions and, as appropriate, disciplinary, and/or dismissal measures; and

- Perform daily equipment and site safety inspections.

1.5 Environmental Affairs Coordinator

The Environmental Affairs Coordinator will be responsible for:

- Scheduling any necessary medical examinations;

- Performing preliminary respirator fit tests; and

- Approving the Site Safety and Health Plan.

1.6 Professional Industrial Hygienist

The Industrial Hygienist will be available to:

- Determine the degree of personnel protective equipment necessary and consistent with the potential exposures;

- Advise on the use of site sampling equipment; and

- Assist as needed in preparation or modification of the SSHP.

1.7 Medical Considerations

All Contractor project personnel shall be enrolled in an ongoing medical surveillance program per the requirements of OSHA's hazardous waste operations standard (29 CFR 1910.120). Therefore, all personnel will have had a medical examination within 12 months prior to the start of field activities and will have another medical examination within 12 months after the end of field activities.

A general medical examination will be performed if an employee develops signs or symptoms indicating possible overexposure to hazardous substances and/or heat stress. Since no substances or conditions are expected at the site to produce disease or biological changes not detected by the general surveillance program, no routine project-specific medical monitoring will be conducted.

2.0 FIELD ACTIVITIES/HAZARD ANALYSIS

2.1 Sampling Locations

Two sites are addressed in this CDAP. Information regarding the site location and past disposal practices will be collected and documented. In addition to site descriptions, the field activities, sampling rationale, sample locations and chemical analyses are discussed for each site. The locations of the T-38 Test Cell and Bldg. 828 are shown on Figure 2-1. Monitor wells and soil borings will be the methods used to investigate the sites.

2.1.1 Site T-38 Test Cell Fuel Spill

2.1.1.1 Site Description

The T-38 Test Cell is located northeast of Building 638 adjacent to the E-W taxiway (Figure 2-1). This SWMU is located near existing SWMUs 19 (Bldg. 638 Oil/Water Separator) and 53 (Bldg. 638 Waste Accumulation Area). The spill site is located approximately 60 feet south of SWMU 19 and 53.

The T-38 Test Cell facility is used to test jet engines. From 1978 to present, JP-4 jet fuel has been stored at the facility in a 5000 gallon above ground storage tank. The storage tank is diked and inventoried on a regular basis. In 1991, approximately 2000 gallons of JP-4 were released due to leaking underground piping. Subsequent to this spill, the piping was replaced with above ground piping. No sampling has been accomplished to date.

2.1.1.2 Site Investigation

Field activities and chemical analyses for the T-38 Test Cell are discussed in the following paragraphs. Figure 2-2 illustrates the proposed monitor well and soil boring locations.

A total of 14 soil borings will be drilled to groundwater to collect soil samples for chemical analysis. The sampling locations can be viewed in Figure 2-2. The borings will be spaced 25 feet apart in 4 rows. The rows will be spaced 25 feet apart and boring centers

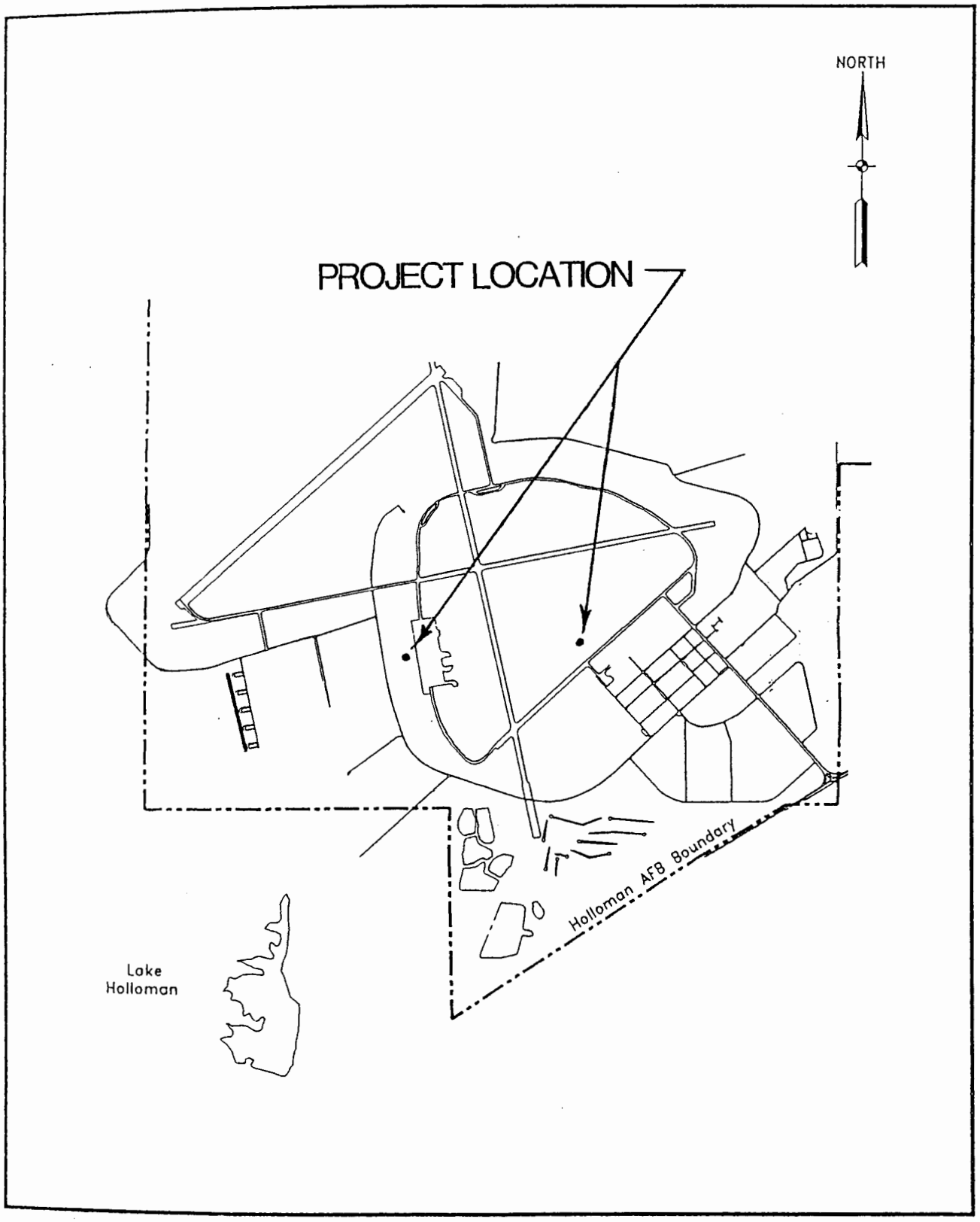

Figure 2-1 Location of sites in Main Base

will be offset from each other by 25 feet. Split spoon samples will be collected every 2.5 feet for the first 10 feet and every 5 feet thereafter to groundwater. For all soil borings, the soil analyses will include volatile organics, petroleum hydrocarbons, organolead, and total metals.

A total of four monitor wells are proposed for site. One well will be installed upgradient and three wells will be installed at downgradient locations. The proposed locations of the monitoring wells can be viewed in Figure 2-2. These wells will be developed, sampled, and tested to determine point permeability of the aquifer. One round of groundwater samples will be collected and analyzed for volatile organics, anions, (anions refer to nitrate/nitrite, sulfate, fluoride, chloride, phosphate, and alkalinity each time it is mentioned), total dissolved solids, organolead and total metals. In addition, a total of two soil samples will be collected from monitor well borings and analyzed for geotechnical analyses.

2.1.2 Site Building 828 Fuel Spill

2.1.2.1 Site Description

Building 828 is located in the West Area of the base (Figure 2-1). From 1987 to present, Bldg. 828 has been used to refuel aircraft support equipment. Three above ground storage tanks (6000 gallon capacity) are located at the facility. One tank contains diesel, one contains JP-4, and one contains unleaded gasoline. The 6000 gallon JP-4 tank and the 6000 gallon unleaded gasoline tank are used to fuel aircraft support equipment. The fuel tanks are diked and inventoried on a regular basis.

In 1991, 4700 gallons of unleaded gasoline were released to the environment when piping under the unleaded gasoline dispenser was broken and caused the fuel leak. The underground piping was repaired after the leak was detected. No sampling has been accomplished to date.

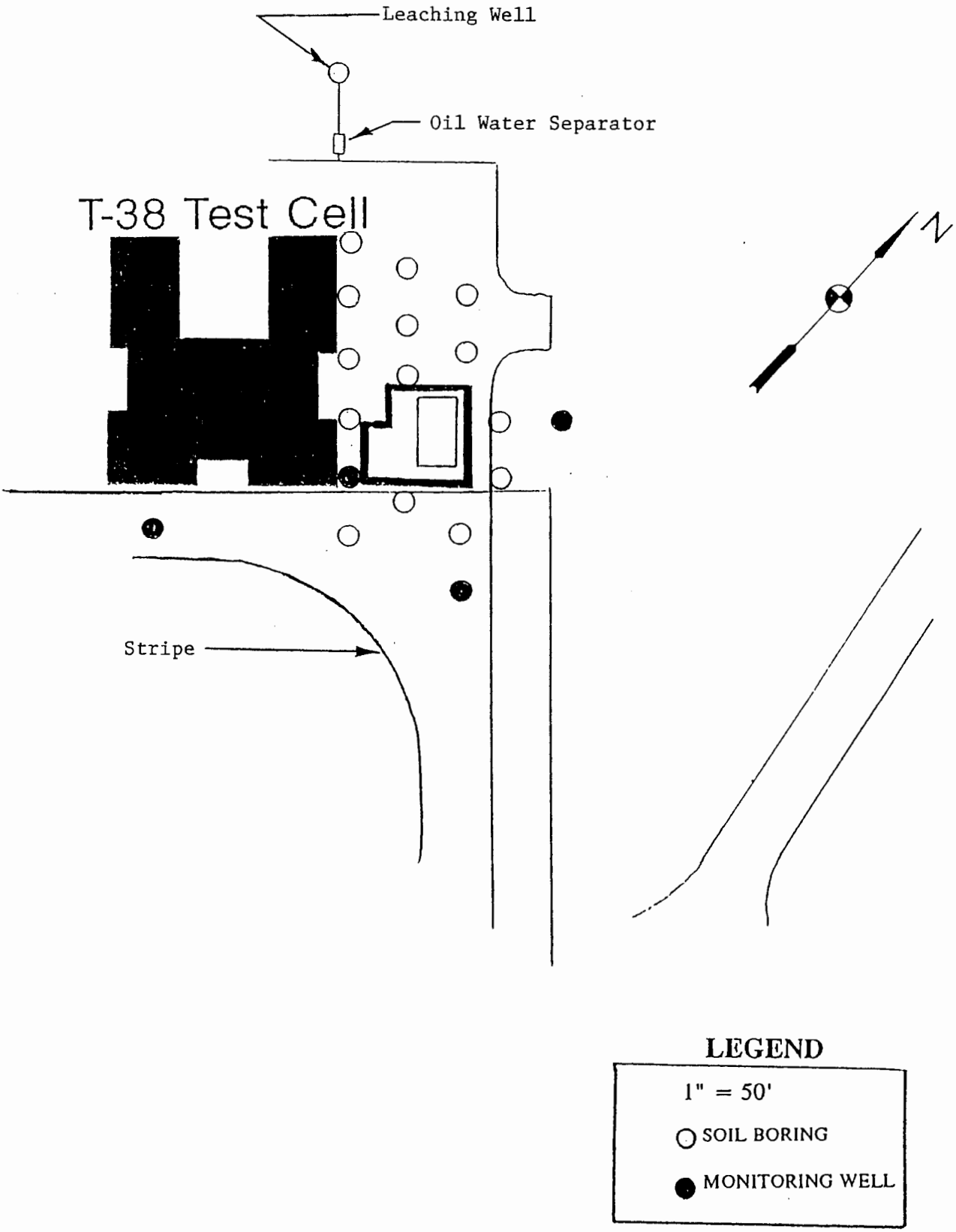

Figure 2-2 T-38 Test Cell Site Map

2.1.2.1 Site Investigation

Field activities and chemical analyses for the Building 828 Fuel Spill Site are discussed in the following paragraphs. Figure 2-3 illustrates the proposed monitor well, and soil boring locations.

A total of 16 soil borings will be drilled to groundwater to collect soil samples for chemical analysis. The sampling locations can be viewed in Figure 2-3. The borings will be spaced 25 feet apart in 5 rows. The rows will be spaced 25 feet apart. Split spoon samples will be collected every 2.5 feet for the first 10 feet and every 5 feet thereafter to groundwater. For all soil borings, the soil analyses will include volatile organics, petroleum hydrocarbons, organolead and total metals.

A total of 5 monitor wells are proposed for site. One well will be installed upgradient and 4 wells will be installed at downgradient locations. The proposed locations of the monitoring wells can be viewed in Figure 2-3. These wells will be developed, sampled, and tested to determine point permeability of the aquifer. One round of groundwater samples will be collected and analyzed for volatile organics, anions, (anions refer to nitrate/nitrite, sulfate, fluoride, chloride, phosphate, and alkalinity each time it is mentioned), total dissolved solids, organolead and total metals. In addition, a total of two soil samples will be collected from monitor well borings and analyzed for geotechnical analyses.

2.2 Hazard Analysis

The field activities to be conducted during this program will involve potential health and safety risks to field team members. An analysis of these potential hazards are discussed individually in the following subsections.

The general types of hazards associated with this program are described below.

Mechanical Hazards:	Cuts, contusions (bruises), being struck by or striking objects, or being caught between objects.
Electrical Hazards:	Possible excavation of buried cables and contact with overhead power lines during drilling. Electrical storms.
Chemical Hazards:	Field exposure to chemicals listed in Section 3.1 of this plan.

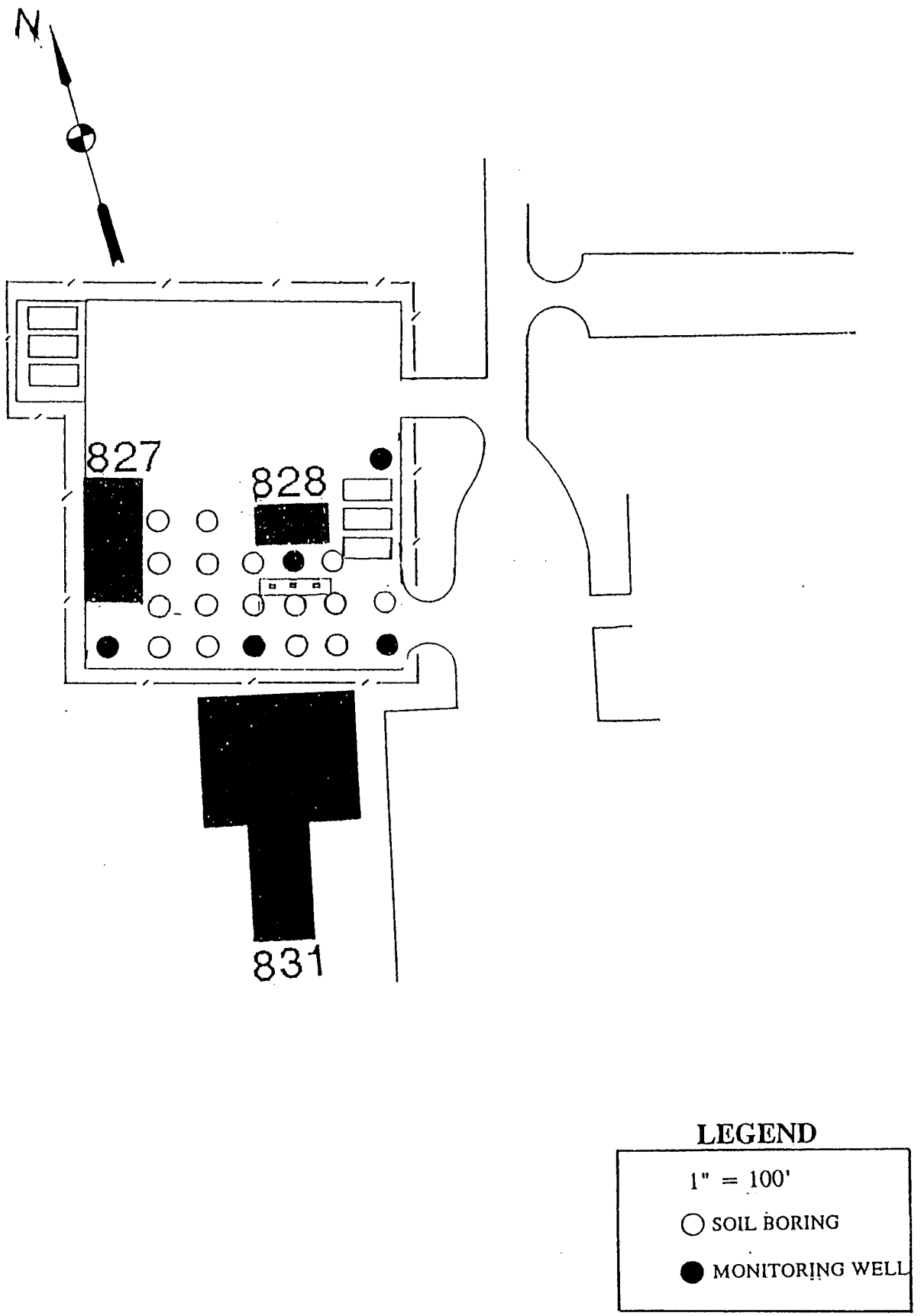

Figure 2-3 Building 828 Fuel Spill

Chemical Hazards:	Field exposure to chemicals listed in Section 3.1 of this plan.
Fire Hazards:	Possible excavation of buried gas lines. Grass fires. Equipment fires.
Thermal Hazards:	Exposure to outside temperature extremes, especially heat stress when wearing protective clothing.
Acoustical Hazards:	Exposure to excessive noise during drilling operations involving hollow-stem augering.
Explosive Hazards:	Explosion of fuels or fuel residue that may be located at some sites.

Table 2-1 lists field activities and associated hazards. Table 6-1 lists specific chemical hazards for each site.

2.2.1 Hazard Analysis - Hollow-Stem Auger Drilling and Well Installation

Hollow-stem auger drilling activities will take place at the 30 proposed soil boring and monitor well locations. Hollow-stem auger drilling activities will potentially expose field personnel to the hazards listed below:

Chemical Hazards

Chemical hazards would result from exposure to chemical contamination present in ground water and soils. Suspected and confirmed chemical contamination varies at the different sites and is summarized in Table 6-1.

Table 2-1.

Field Activities and Associated Hazards
During the Holloman AFB Remedial Investigation

Activity	Mechanical	Electrical	Fire	Explosive	Thermal	Acoustical	Chemical
Borehole drilling and soil sampling	X	X	X	X	X	X	X
Monitor well installation	X	X	X	X	X	X	X
Ground water sampling	X				X		X
Aquifer (Slug) tests	X				X		X
Surface sampling	X	X	X		X		X
Sample handling							X
Surveying	X				X		
Decontamination activities	X	X	X		X	X	X

Drilling personnel will also be exposed to exhaust vapors from the equipment operation.

Physical Hazards

Exposure to physical hazards associated with hollow-stem augering include the following:

- Snapping cables;
- Brush, equipment, or gas-main fires;
- Being hit by equipment;
- Becoming entwined in rotating tools;
- Falling objects;
- Drilling into buried utilities or waste ordinance;
- Exposure to excessive noise; and
- Exposure to extreme outside temperatures.

2.2.2 Hazard Analysis - Development, Slug Testing, and Sampling of Monitor Wells

During development and sampling of monitor wells there is a high potential for exposure to contaminated groundwater. The various types of chemical contaminants listed in Table 6-1 will be considered present during well development, slug testing, and sampling, and appropriate protective equipment will be worn. Physical hazards include: fire hazards with pumping equipment; general mechanical hazards; and thermal hazards.

2.2.3 Hazard Analysis - Sample Preparation and Shipment

After the ground water samples have been collected in sampling containers, the samples must be preserved, as appropriate, and properly packaged to protect shipping personnel from potential exposure to contaminants. There is no great hazard in performing the packaging operation, yet if this operation is not done properly, unsuspecting individuals may be exposed if the containers leak or break. Shipping procedures are described in detail in the CDAP. Preservation of water samples may involve the use of acids or bases to adjust sample pH. Proper precautions must be taken to avoid contact with these reagents.

3.0 HEALTH HAZARD INFORMATION

Chemical Hazard information is reported below for chemicals suspected at sites. Chemical Hazards are listed by site in Table 6-1.

3.1 Chemical Hazards

Chemical hazards to the field team occur either by direct contact of liquid or solid samples from the site with human tissue or through inhalation of volatile organic vapors. Every effort will be made to avoid chemical hazards.

3.1.1 Polynuclear Aromatic Hydrocarbons (PAHs)

Certain PAHs, benzo(a)pyrene and chrysene in particular, have been demonstrated to be carcinogenic in test animals and are suspected of having carcinogenic potential for humans. Benzo(a)pyrene has been shown to cause the formation of stomach, mammary, lung, and skin cancers. The OSHA-PEL for benzo(a) pyrene and chrysene is listed under the PEL for coal tar pitch volatiles, which is 0.2 mg/m^3.

3.1.2 Toxic Metal Particulate

3.1.2.1 Lead

Inhalation, ingestion, and dermal absorption of lead causes central nervous system, blood, gastrointestinal, gums, and kidney effects. The early effects are nonspecific and are difficult to distinguish from the symptoms of minor seasonal illnesses. The OSHA-PEL for lead is 0.05 mg/m^3.

3.1.3 Volatile Organic Compounds and Petroleum Hydrocarbon Liquids

The volatile organic compounds (VOC) and petroleum hydrocarbon liquids and vapors that may be encountered at the site are classified as neurotoxicants, hepatotoxicants, nephrotoxicants, hemotoxicants, irritants, carcinogens, teratogens, and allergic sensitizers.

The exact identify of these compounds is unknown. Benzene is expected as one component. Since the toxicity of benzene is greater than that from other VOCs, the decision to upgrade from Level D to Level C is based on the assumption that the phtoionization detector is identifying benzene. If the level measured is equal to background, it is assumed that no risk is posed from air emissions at the site. Inhalation of and skin exposure to the above toxic substances produce the following health effects: central nervous system depression with symptoms of dizziness, unconsciousness, and coma; muscular weakness; staggering; skin paresthesias; pulmonary edema; nausea and vomiting; abdominal pain; irritation of eyes, nose, throat, and skin; and bone marrow, kidney, liver, and hemolytic disorders.

3.2 Physical Hazards

Field personnel can be exposed to a number of physical hazards during this project. Physical hazards that may be encountered are:

- Noise;
- Climbing hazards;
- Heat injury;
- Lacerations and contusions;
- Snake, insect, and animal injuries;
- Lifting hazards;
- Electrical hazards;
- Buried hazards; and
- Packaging and shipping hazards.

General considerations are discussed here followed by specific comments in Section 4.

Noise Exposure

The noise level of the rig and backhoe probably will not exceed the level of 85 db. Therefore, hearing protection will not be necessary under normal drilling conditions.

Climbing Hazards

In the course of the drilling activity, workers may have to work on equipment by climbing the mast. The drilling subcontractor will insure that climbing activities will conform with any applicable NIOSH and OSHA requirements. These activities will be overseen by the Drilling Supervisor and Supervising Field Geologist.

Heat Injury

During this project, workers may be required to wear protective clothing which insulates the body. A hazard may exist if workers wear protective clothing in temperatures over 65°F. Much of the field activities on this project are projected to occur over summer months; therefore, heat associated injuries could be a factor.

Lacerations and Contusions (Cuts and Bruises)

The field team may cut and bruise themselves during this project. Drilling activities usually involve contact with moving machinery and physical objects. The Supervising Field Geologist should be prepared to deal with cuts and bruises. A First Aid Kit will be present at each drill site.

Snake, Insect, and Animal Injuries

The field team should be aware that site activities, mainly in remote areas, may disturb the local wildlife population. Therefore, there is potential for field personnel to be bitten by snakes, animals, and insects. Prompt first aid measures are extremely important. All field team members should be properly briefed regarding the potential for encountering wildlife as well as prompt first aid procedures in the event of a snake, insect, or animal bite.

Lifting Hazards

Field team members may be exposed to injury caused by lifting heavy objects due to the fact that drilling operations involve manual movement of heavy drilling casing, auger flights, and various other pieces of equipment. All field team members should be

trained in the proper method used to lift heavy equipment and cautioned against lifting objects that are too heavy for one person.

Electrical Hazards

Drill rigs must not be raised within 50 feet of overhead power lines. When using extension cords, ensure they are is in good condition. Never use extension cords in wet areas without plugging the extension cord into a ground fault interrupter (GFI). GFIs will sense a short to ground and cut power.

Buried Hazards

Whenever the ground is penetrated, the potential for drilling into buried hazards exists. To minimize the hazard, field personnel should take the actions listed below:

- During the planning/mobilization phase, the Supervising Field Geologist should consult with base personnel about the location of underground utility lines (gas and electrical) as well as buried drums, cylinders, or other potentially hazardous items; and

- If drilling cuttings indicate any signs of buried drums, cylinders, metal or concrete, cease drilling immediately and contact the Base Environmental Coordinator for further guidance.

Packaging and Shipping Hazards

All samples collected from Holloman AFB will be transported to Contractor's contracted laboratories in compliance with Department of Transportation regulations. The instructions given below must be followed to comply with DOT regulations and reduce the risk of breakage in transportation. Specific details are contained in the Sampling Plan for Holloman AFB (published separately).

- Package the primary container to protect it from breaking.

- Wrap the primary container with absorbent brown paper (wadding).

- Place the primary container in a plastic bag (zip-lock).

- Classify and secure the shipping containers according to DOT regulations.

3.3 Other Hazards

In addition to the chemical and physical hazards discussed in the previous section, certain sites at Holloman AFB have specific hazards not previously discussed. These hazards are discussed below by site.

Site T-38 Test Cell Fuel Spill--This is located next to an active taxiway for aircraft. The proper authorities will be contacted prior to beginning field activities and all activities will occur at a safe distance from the taxiway.

Site Building 828 Fuel Spill--This site is located at an active refueling station for Aeroground Space Equipment (AGE); vehicle traffic will be present along with maintenance activities in the area. Contractor shall be aware of activities around all work and provide proper precautionary measures (i.e., signs and barricades).

4.0 PERSONAL PROTECTIVE EQUIPMENT

During drilling and sampling at test well sites, the concentrations of organic vapors will be monitored continuously using a HNU® meter with a photoionization detector (PID) in the breathing zone. When drilling and sampling activities are completed, monitoring will be done at the discretion of the Geologist on-site. The HNU® will have a 11.3 electron volt detector lamp because the ionization potentials of several of the expected contaminants are within this range. Personal protective equipment will be determined by real time measurements with the HNU®. The Supervising Field Geologist/Task Leader will be in charge of determining the level of protection required. Table 4-1 lists the personal protective equipment required for the four levels of protection.

4.1 Dermal Protection

The drilling operations may expose the Contractor employees to certain dermal hazards should contaminated soil or ground water come in contact with their skin, hands, and/or eyes.

When the chance for skin, hand, and/or eye contact is present, the following protective clothing will be worn:

- Inner glove of Latex will be worn by all field team members when they are handling the soils or groundwater samples from the drilling operations. The type of outer glove is contaminant specific (see Table 4-1).

- Disposable Tyvek coveralls will be worn by the field team when handling the drill cuttings, samples, or drilling equipment that has contacted potentially contaminated material.

Table 4-1

Equipment Requirements for the Levels of Protection

	LEVEL			
	D*	**C**	**B**	**A**
Hard hat	X	X	X	
Safety glasses/splash shield	X	X	X	
Disposable (Tyvek®) coveralls	X	X	X	
Steel toed, butyl rubber or neoprene boots		X	X	
Latex inner glove	X	X	X	
Other outer glove **	X	X	X	
Air purifying full face respirator with OV/HEPA filter cartridge	X	X		
Butyl rubber splash apron			X	
Supplied air respirator or SCBA			X	X
Totally encapsulated				X
Chemical resistant suit			X	
Disposable boot protectors	X			
Leather steel toed boots	X			

* Air Purifying Respirator (full- or half-face) must be carried in Level D protection.

** Outer gloves include nitrile, silver shield, and vinyl types. Selection will be made based on suspected contaminants (See Table 6-2).

- Eye protection (safety glasses) will be worn by all field team members during all drilling activities. Splash goggles will be worn during steam cleaning.

- Neoprene or PVC boots with steel toes and shanks will be worn by all field team members during activities that require them to stand or walk through contaminated soils or water.

4.2 Respiratory Protection

If photoionization detector (PID) data indicates that there are potentially hazardous air concentrations of hazardous chemicals on site, workers must upgrade to Level C protection. See Tables 4-1 and 6-2 for further information on protective equipment and upgrades.

4.3 Hearing Protection

Noise levels from drilling rigs are not above 85 decibels and, therefore, are not hazardous to health. However, activities conducted near operating aircraft engines and taxiway and maintenance areas in conjunction with normal drilling activities may exceed acceptable noise levels. In general, if two people standing three feet are unable to hear each other, noise levels can be considered unacceptable. If excessive noise levels are reached, the field team may wear either or both of the devices listed below during drilling operations:

- Disposable, single size, ear plugs, or fitted ear plugs; and

- Ear muffs.

Noise monitoring will not be conducted.

4.4 Head Protection

Head protection will be worn by all employees at all times while they are on site. The type of head protection selected for this project is a non-metallic, impact resistant hard hat (Class A helmet).

4.5 Safety and First Aid Equipment

All on-site personnel will wear steel-toed safety boots meeting ANSI standards. First aid equipment will also be provided by the contractor and will include a first aid kit (as referenced in US Army Corps of Engineers Safety and Health Requirements Manual EM 385-1-1, paragraph 04.B.01) and a 15 minute eye wash.

5.0 PERSONNEL TRAINING

All authorized on-site personnel will have taken the required OSHA 40-hour Hazardous Waste Training Course. In addition, signed documentation certifying completion of the 8-hour annual refresher training will be required when necessary. A site specific safety orientation will be conducted by the Supervising Field Geologist for all employees, subcontractor personnel, official visitors, and government employees. Section 5.4 describes the contents of the site specific safety orientation.

5.1 General Safety Procedures

- All on-site personnel will observe the following general safe work practices:

  - Exclusion of food, drink and tobacco products from contamination reduction zones;

  - Prohibition of loose clothing, hair, and jewelry around moving equipment; and

  - Implementation of "Buddy System" whereby a pair of co-workers "watch out" for each other while in proximity of potential physical work hazards.

5.2 Respiratory Protection

Respiratory protection will be available for field personnel to use as required. The respirators, their proper use, and maintenance are the responsibility of each contracting company that has field personnel.

5.2.1 Respiratory Protection and the Nature and Extent of the Hazard

The probability of chemical hazards may make it necessary for the field team to avoid respiratory exposure through the use of respiratory protection devices. Airborne contamination that can present an inhalation exposure hazard in the field activities of this project can be present both as dusts and vapors. The vapors are all from organic chemicals. Hazardous chemicals are not known to be present at high concentrations in the soil and water, but must be assumed to be present and potentially airborne at each drilling or sampling site.

5.2.2 Full-Face Air Purifying Respirator

The full-face air purifying respirator equipped with organic vapor cartridges is capable of filtering airborne gases, mists, and fumes out of inhaled air. This mask does not provide oxygen and should not be used in oxygen deficient atmospheres. The mask will not provide adequate protection if the face seal is not tight. All members of the field team will be required to be clean shaven before wearing this mask. It is a violation of OSHA regulations to wear this mask with any facial hair that interferes with the face seal.

5.3 Personal Hygiene Practices

The field team must pay strict attention to sanitation and washing requirements to avoid personal contamination. The following instructions will be discussed and must be followed:

- Never put anything in the mouth, including fingers;
- All employees must wash their hands, forearms, face, and neck before eating, drinking, smoking, or using the restroom. There will be no exceptions to this rule; and
- At the end of the day, each employee will shower thoroughly.

5.4 On-Site Safety, Health, and Emergency Response Training

An on-site orientation session will be required for all on-site personnel and will include the following:

- Health effects and hazards of the chemicals identified or suspected to be on-site;
- Hazards and protection against heat/cold and snakes, insects, and animals;
- Implementation of the "Buddy System";
- Decontamination procedures;

Prohibitions in areas and zones, including:

- Site layout;
- Procedures for entry and exit of areas and zones; and
- Standard safe work practices;

- Emergency procedures, including:
  - Emergency contacts;
  - Instructions for implementing the emergency plan; and
  - Location of emergency equipment; and

- Review of information contained in Site Safety and Health Plan.

6.0 EXPOSURE MONITORING PLAN

Potential chemical and physical hazards will be monitored continuously by the Supervising Field Geologist to ensure that potential hazards are identified, evaluated, and controlled. Potential chemical hazards for each site are listed in Table 6-1. Protective equipment (i.e., respirators) will be upgraded, and other control measures will be implemented, as specified in Table 6-2.

6.1 Chemical Exposure Monitoring

Real time monitoring for organic vapor concentrations in the breathing zones, cuttings, soil samples, and downhole will be conducted during field operations with an HNU® photoionization detector (PID) equipped with an 11.3 eV probe. This device will respond to gases and vapors that have an ionization potential less than the electron voltage of the lamp including nitrotoluene (9.82 eV) and nitrobenzene (9.92 eV). An HNU® Model PI-101 OVM with a photoionization detector or the equivalent will be taken into the field and operated during drilling activities and other soil disturbing activities where contaminated soil or ground water may be encountered. Air monitoring will be conducted whenever new soil is broken and at least hourly after that. Air monitoring will also be done when a well is opened for the first time while sampling. The instrument will be calibrated using known calibration gases at the beginning and the end of the field project. If air concentration levels in the breathing zone exceed the background level, Level C protection must be donned (see Table 6-2).

Table 6-1
Chemical Hazards at Holloman AFB Sites

	SITES	
	T-38 Test Cell Fuel Spill	Building 828 Fuel Spill
PAHs	X	X
Heavy Metals (Pb)	X	X
Volatile Organic Hydrocarbons	X	X
Liquid Petroleum Hydrocarbons	X	X

Table 6-2

Personal Protection, Monitoring and Upgrade Requirements at Holloman AFB Sites

	SITES	
	T-38 Test Cell Fuel Spill	Building 828 Fuel Spill
Minimun Level of Protection	D	D
Outer Glove Requirement	V,N	V,N
Photoionization Dectector[1]	X	X
Explosimeter[2]	X	X

NOTES:

[1] To Level C protection if above background readings in breathing zone on the photoionization.

[2] Extinguish ignition sources and evacuate site if explosimeter indicates atmosphere within explosive range.

KEY:

Level of Protection D, Level D.
Gloves: N= Nitrile; V= Vinyl.

6.2 Heat Injury Control and Monitoring

Workers who wear protective clothing will be at increased risk of heat injury when temperatures are above 65°F and/or under heavy workload in protective clothing. The Supervising Field Geologist will operate a heat stress control and monitoring program to ensure that workers are:

- Getting adequate rest breaks depending on work levels and outside temperatures;
- Adequately replacing lost fluids; and
- Keeping body temperatures in a normal range.

6.2.1 Heat Injury Control

The Supervising Field Geologist will set work and break schedules, depending on the outside temperature, in coordination with the drilling supervisor. Generally, workers conducting drilling activities in protective clothing need to break in the shade at least 10 minutes out of every hour during elevated temperatures (approximately 80°F or greater). Rest time should also include fluid replacement with electrolytes (e.g., water, Gatorade or equivalent).

6.2.2 Heat Injury Monitoring

When workers are using protective clothing in elevated temperatures, they should perform monitoring activities for heat stress. Method of heat stress monitoring include:

- Measurement of worker heart rate;
- Observation for signs and symptoms of heat stress; and
- Measurement of internal body temperature.

Heart rate (HR) is measured by the radial pulse during 30 seconds as early as possible in the resting period. The HR at the beginning of the rest period should not exceed

110 beats per minute. If the HR is in excess of the above value, the next work period will be shortened by 10 minutes while the length of the rest period stays the same.

Workers that exhibit signs of heat stress should be allowed to rest until the signs are no longer observable. The signs of heat stress are:

- Pale, clammy skin progressing to hot, dry and red skin;
- Profuse perspiration;
- Cramps;
- Headaches;
- Nausea; and
- Fainting.

If the worker exhibits signs of heat stress, body temperature will be measured by using a "fever detector" strap that is placed on the forehead of the worker. Worker body temperature should not exceed 100°F. If the worker body temperature exceeds this value, the work period will be shortened by 10 minutes while the length of the rest period stays the same.

6.3 Snake, Insect, and Animal Bite Injury

The Supervising Field Geologist will obtain information from the Fish and Wildlife office regarding the types of wildlife which could be encountered while performing field activities, particularly in remote locations. Each team member will be briefed regarding types of wildlife as well as immediate first-aid measures.

6.3.1 Snakebite

If an individual is bitten by a snake, the basic rule is -- TREAT ALL SNAKEBITES AS POISONOUS. A probability exists that all snakes may be potential carriers of tetanus (lockjaw); if bitten by any snake, whether poisonous or not, seek medical attention immediately. If bitten, either identify and/or kill the snake and take it to the hospital for identification. This information is valuable to medical personnel when treating snakebites.

The following first-aid steps should be taken if bitten:

- Seek medical help. In the interim--

  - Remain calm, but act swiftly, and chances of survival are good (Less than one percent of properly treated snakebites are fatal. Without treatment, the fatality rate is 10 to 16 percent);

  - Immobilize the affected area in a position below the horizontal plane of the heart;

  - Place a lightly constricting band two to four inches closer to the heart than the site of the bite. Reapply the constricting band ahead of the swelling if it moves up the arm or leg. The constricting band should be placed tightly enough to stop the flow of blood in surface vessels, but not so tight as to stop the pulse;

  - Do not attempt to cut open the bite or suck out venom. If venom should seep through any damaged or lacerated tissues in the mouth, it could cause immediate unconsciousness and/or death; and

  - If possible, kill the snake and take it along with the patient to the medical facility for identification. This can greatly aid in proper treatment.

6.3.2 Insect Bites/Stings

An insect bite or sting can cause pain, disease, and inflammation. If not treated correctly, some bites/stings may cause serious illness or even death. During seasons of the year when insects are prevalent, the first line of defense is the use of an insect repellant, applied at two to three hour intervals. In the event of an insect bite/sting, there are certain principles that apply:

- In extreme cases, transport the victim to the nearest medical facility. In other cases --

  - Wash area of bite/sting with soap and water. Do not scrub;

  - Avoid scratching (except to remove stinger), rubbing, or in any way irritating the area. In the process of rubbing or scratching, you may spread the toxin or introduce infection;

- Watch for signs of allergic reaction and be prepared to perform CPR and treat for shock;
- If possible, identify or capture the insect for positive identification;
- Keep the victim as calm and reassured as possible;
- Since many of these injuries cause swelling, remove jewelry before the area swells. Ice may be used to reduce swelling, ease the pain, and slow absorption of venom.

6.3.3 Animal Bites

Animal bites (both wild or domestic) can result in both infection and disease. Tetanus, rabies, and various types of fevers can follow an untreated animal bite. Because of these possible complications, the animal causing the bite should, if possible, be captured or killed (without damaging the head). The animal can then be observed and tested by competent authorities to determine if diseases were being carried. An individual bitten by an animal should be treated as follows:

- Seek medical help. In the interim --
  - Clean the wound thoroughly with soap or detergent solution;
  - Flush it well with water;
  - Cover with a sterile dressing;
  - Immobilize an injured extremity; and
  - If unable to capture or kill the animal, provide medical personnel with any information possible to help identify the animal so that they can provide appropriate treatment.

7.0 WORK ZONES AND DECONTAMINATION PROCEDURES

To minimize the possibility of transferring hazardous substances from the site, contamination control procedures are needed. Contaminants must be removed from clothing, personnel and equipment prior to relocation from a work zone.

7.1 Work Zones

Prevention of exposure and spread of contamination will be controlled through the establishment of work zones. Three work zones will be used in this project: (1) Exclusion Zone; (2) Decontamination Zone; and (3) Support Zone. At each applicable site, the zones will be established and defined by the Supervising Field Geologist or Task Leader.

7.1.1 Exclusion Zone

The Exclusion Zone is the area where disturbance activities (test well installation) are conducted and where contaminants may be present. Only properly authorized and trained individuals, wearing appropriate personal protective equipment, will be allowed to enter and work in this zone.

7.1.2 Decontamination Zone

The Decontamination Zone is the area where personnel and equipment are cleaned before moving to/through the support zone. The decontamination zone and support zones will be located upwind from the borehole drilling operations if possible.

A Decontamination Zone will be set up in a concentric circle around each drilling site as site conditions dictate. Some areas will be confined by natural or man-made buildings and other obstructions which will limit the size and shape of the exclusion and decontamination zones. As site conditions will allow, decontamination operations will be conducted in an area no closer than 25 feet from the borehole.

7.1.3 Support Zone

The Support Zone is the area where the field team can congregate when not performing site work. This area is the break area, eating area, storage area, and staging area. It is extremely important to locate the Support Zone in an area that is known to be free of contamination and as far as possible upwind of drilling activities.

7.2 Decontamination Procedures

Personal protective equipment, drilling, and sampling equipment can become contaminated in a number of ways including:

- Contacting vapors, gases, mists, or particulates in the air;
- Being splashed by materials while sampling or handling sample containers;
- Coming in contact with contaminated soil or water; and
- Using previously contaminated equipment or instruments.

Protective clothing and respirators may become contaminated during work. The use of proper decontamination procedures will ensure that contaminants are not spread to clean areas, such as the support zone, where unsuspecting personnel would be exposed to potential hazards. Prior to leaving the decontamination zone, all expendable items (towels, gloves, paper, Tyvek) used at an individual drilling site will be placed in one of the 55-gallon drums used to contain the borehole cuttings for the particular site. If the soil and groundwater samples are found to be uncontaminated, the disposables may be considered to be uncontaminated and disposed of in a sanitary landfill. However, if samples are contaminated, the disposables must be handled as contaminated. The Holloman AFB landfill is a sanitary landfill. Under no circumstances shall the drill crew dispose of products of drilling in this landfill, or any other sanitary landfill, until lab analyses confirm that soil and ground water is uncontaminated. Wash and rinse water used in decontamination procedures for sampling equipment will be placed in a oil water separator designated by base environmental personnel. Spent solvent used for decontaminating sampling equipment will be contained in a 5-gallon bucket with a lid. All reusable items such as respirators and hard hats suspected of being contaminated will be decontaminated prior to moving into the support zone.

7.2.1 Equipment Decontamination Procedures

Equipment decontamination will be performed by detergent washing and clean water rinsing for all equipment that is not water sensitive. Such equipment includes:

- Personal protective gear, such as respirators, hard hats, boots, and safety goggles;
- All sampling equipment such as spades, shovels, the outside of sample containers and notebooks, geological surveying equipment, and incidental equipment contaminated during the course of work; and
- Formation samplers such as split-spoons and Shelby tubes will be decontaminated with clean water, detergent water, solvent (non-hazardous and pesticide grade) rinse, and reagent water rinse.

7.2.2 Drilling Rig Decontamination Procedures

The drilling rigs (air rotary or hollow stem auger rigs) will be steam cleaned after contacting soils or liquids suspected of being contaminated at the completion of each hole. An area for decontamination will be established by the Supervising Field Geologist in coordination with the BEC. Attention should be paid to the following procedures to decontaminate the equipment correctly and safely.

- All steam cleaning personnel will protect their eyes during all steam cleaning operations;
- Storage of fuel for the steam cleaner must be secured in a safe place, away from ignition sources;
- If the steam cleaner is operated with electricity, provisions will be made to keep the electrical cord up off the wet ground;
- Steam clean with potable water all drilling flights and pipe that have contacted soils or liquids. The drilling equipment should be laid on clean pallets or steel racks to avoid contaminated mud, dirty pavement or other unclean equipment; and
- Modified EPA Level D personal protection is required when performing decontamination of the drilling equipment. This consists of a modified Tyvek suit.

7.2.3 Personal Protective Equipment (PPE) Decontamination Procedures

PPE will be decontaminated or disposed of in the following manner:

- Outer gloves will be removed and disposed of in a designated trash container. Hard hats, safety glasses, and boots will be cleaned at the end of the day, if necessary. Wash and rinse stations will be set up within the decontamination zone using detergent, potable water, and brushes. Hard hats, safety glasses, and other nonporous reusable items must be washed with a complexing agent or detergent.

- Tyvek coveralls will be removed.

- Undergloves and respirator (if used) will be removed in the support zone.

- Disassemble and wash respirators (if used) with detergent at the end of each work day.

- Disposable garments, gloves, and spent respirator cartridges will be deposited in designated covered containers for eventual disposal.

8.0 FIRST AID, EMERGENCY RESPONSE, AND COMMUNICATION

The objective of emergency response and communication is to ensure that effective actions are implemented in a timely manner to minimize or control the effects of adverse events (fires, injuries, equipment failures). The following subsections describe the basic emergency responses required for the field investigation.

8.1 Accident and Emergency Medical Response

Before beginning site activities, the Supervising Field Geologist will ensure that each field team member knows where the nearest emergency medical facility is and how to get there. The closest hospital is the Gerald Champion Memorial Hospital (Alamogordo). The telephone numbers of the local emergency services will be available in the Support Zone, and the Supervising Field Geologist will brief the field team on the procedures for calling for help in an emergency. A list of emergency phone numbers, maps, and accident report forms are included in Appendix A.

The field team will be aware of the location of a first aid kit kept on site. The Supervising Field Geologist or Task Leader should be prepared to handle minor injuries and perform CPR.

Depending on the severity of an accident or medical emergency, the Supervising Field Geologist and Drilling Supervisor will be responsible for:

- Removing the injured or ill person from the hazardous area;
- Transportation of the injured worker to a medical facility;
- Requesting emergency medical assistance; or
- Treatment of minor injuries.

Accidents or medical emergencies that require support will be brought to the attention of the Holloman AFB Emergency Operations Center as soon as possible. The Supervising Field Geologist will cooperate with the Emergency Operations Center in accomplishing all required administrative functions. In addition, he will notify the

Environmental Affairs Coordinator, Program Manager, Project Director, and the subcontractor (for accidents involving subcontractor personnel).

Prior to starting site work, the Supervising Field Geologist will provide the following information to Holloman AFB emergency medical personnel:

- Locations of drilling sites;
- Number of site workers;
- Hazards involved with site work; and
- Anticipated types and severities of injuries.

8.2 Fire Emergency Procedures

The threat of fire on this particular project is considered slight, due to the fact that any contaminated material would be aqueous or solid in nature. Fire hazards can, however, exist during the following activities:

- Equipment refueling;
- Steam cleaner fuel storage and refueling activities;
- Welding activities; or
- Decontamination with solvents.

The Supervising Field Geologist will check to see that each vehicle and drilling rig fire extinguisher is appropriate for the fire hazard presented by this project. Subcontractors are required to provide the appropriate extinguisher for their equipment and vehicles. Generally, Type A, B, C extinguishers will be appropriate and must be hydrostat tested within the past year.

Immediately upon discovery of any fire, the field team will notify the Supervising Field Geologist. All large fires will require the help of the fire department, and the Supervising Field Geologist should call for help at the earliest possible time. Be aware that

toxic products produced in a fire situation can be very dangerous; and the fire department personnel should be briefed on these hazards before attending to the fire.

In event of a fire, the Supervising Field Geologist or Drilling Supervisor will direct precautionary actions on-site after notifying the fire department. These precautionary actions include:

- Notification of all site personnel that a fire exists and to return to the support area;
- Immediate shutdown of site activities;
- Accounting for all site workers; and
- Site evacuation to a predetermined evacuation area if such is necessary.

8.3 Emergency Communications and Services

The following is a list of emergency phone numbers and agencies:

- Emergency Telephones (Alamogordo)--911;
- Base Fire Department--479-7228;
- Security Police--479-7171;
- Base EOD--479-5141;
- Track Control--679-2181;
- Nearest Civilian Hospital Facility--439-2100;
- Civilian Ambulance Service--911; and
- Base Environmental Division--479-3931.

A separate list of emergency telephone numbers and facility locations is also provided as Appendix A of this Plan. Sufficient copies are also available for each worker and each vehicle. Prior to start of site activities, the Supervising Field Geologist will call to verify the telephone numbers and then make distribution to workers and vehicles.

8.4 Accident Prevention

Potential physical, chemical, biological, and safety hazards have been previously discussed in this Site Safety and Health Plan. Field personnel are required to be aware of potential hazards and to use appropriate protective gear to prevent accidents. If an accident does occur, the Program Manager/Supervising Geologist will complete and submit an Accident Report on ENG Form 3394, and a "First Report of Injury" to be submitted to the Environmental Affairs Coordinator.

DRAFT

COMMUNITY RELATION PLAN (CRP)

Resource Conservation and Recovery Act
Facility Investigation of
Solid Waste Management Units

Prepared by:

49 CES/CEV
Holloman Air Force Base, NM

September 1992

DRAFT

COMMUNITY RELATION PLAN (CRP)

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1.0 SUMMARY

The Hazardous and Solid Waste Amendments (HSWA) to the Resource Conservation and Recovery Act (RCRA) were enacted into law on November 8, 1984. One of the major provisions (Section 30004(u)) of these amendments requires corrective action for releases of hazardous waste or constituents from solid waste management units (SWMUs) at hazardous waste treatment, storage or disposal facilities. Under this provision, any facility applying for a RCRA hazardous waste management facility permit will be subject to a RCRA Facility Assessment (RFA). The RFA is conducted by the regulatory agency and is designed to identify SWMUs which are, or are suspected to be, the source of a release to the environment. If any such units are identified, the owner or operator of the facility will be directed to perform a RCRA Facility Investigation (RFI) to obtain information on the nature and extent of the release so that the need for interim corrective measures or a Corrective Measures Study (CMS) can be determined. Information collected during the RFI can also be used by the owner or operator to aid in formulating and implementing appropriate corrective measures. Such corrective measures may range from stopping the release through the application of a source control technique to a full-scale cleanup of the affected area. In cases where releases are sufficiently characterized, the regulatory agency may require the owner or operator to collect specific information needed to implement corrective measures during the RFI.

The RFI Work Plan consists of three documents prepared concurrently:

a. Chemical Data Acquisition Plan
b. Site Safety and Health Plan
c. Community Relations Plan

This document provides information regarding the community Relations Plan and supplements the Chemical Data Acquisition Plan.

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2.0 OVERVIEW OF HOLLOMAN AFB COMMUNITY RELATIONS PLAN

2.1 SCOPE AND PURPOSE

The purpose of the Holloman AFB Community Relations Plan is to have a specific plan of action as part of the RCRA Facility Investigation.

The Community Relations Plan enables the base to disseminate timely and accurate information to those elected and appointed officials, members of the news media and to citizens. This plan will also address citizen inquires and concerns and solicit information for the decision making from all segments of the community, and ensure that the most accurate information is provided. The Community Relations Plan will also provide a central, consistent information source for these individuals to contact regarding any questions they may have.

This Community Relations Plan will also be a method by which Holloman AFB personnel will be kept aware of community concerns, information, needs and activities.

2.2 TARGET AREAS

This plan is intended to provide the following information regarding plans, progress and problems involved in this action:

- City, township, county, state, and federal officials (elected and appointed).
- Members of the news media (newspaper, radio and television).
- Residents in the City of Alamogordo, as well as those throughout Otero County.

2.3 PLAN DEVELOPMENT

This plan has been tailored to the anticipated concerns and questions of the community.

These sections follow:

- Site Description.
- Highlights of program/techniques and timing.

2.4 HOLLOMAN AFB CONTACTS

The Holloman AFB Public Affairs Office will oversee all community relations activities for this RCRA Facility Investigation. The primary contact Lt. Chris Harvey at

(505) 479-5406. The Mailing Address is 49 FW/PA, 490 First Street, Holloman AFB, New Mexico 88330-8458.

The contact for technical information regarding this RFI will be 49 CES/CEV (Environmental Engineering). Since technical activities are conducted under the auspices of 49 CES/CEV, personnel from this office will act as advisors to 49 FW/PA.

3.0 SITE DESCRIPTION

3.1 LOCATION

Holloman AFB is located in Otero County, approximately 7 miles west of the City of Alamogordo (Figure 3-1). The base is situated on approximately 50,700 acres of land in central New Mexico.

3.2 OWNERSHIP/OPERATION

Holloman AFB is part of Air Combat Command of the United States Air Force. It is currently the home of the 49th Fighter Wing which is an F-117A fighter unit. Since 1968, the primary mission of the 49th Fighter Wing has been to maintain an F-15 Tactical Fighter Wing, capable of day, night, and all weather combat operations and remain committed to NATO.

In 1977, the 479th Tactical Training Wing was activated on Holloman AFB. This wing was equipped with T-38 Talon aircraft and provide Lead-In Fighter Training to new pilots and weapon systems officers entering the tactical fighter force. The 479th Tactical Training Wing was inactivated in 1991 and the Tactical Training Group was activated the same day.

In 1991, the primary mission of the 49th Fighter Wing has been to maintain an F-117A Stealth Fighter and remain committed to NATO.

3.3 ENVIRONMENTAL ISSUES

Wastes have been generated and disposed of at Holloman AFB since the beginning of industrial operations in 1942. The major industrial operations which have occurred at the base include jet engine repair, pneumatic and hydraulic systems maintenance, aerospace ground equipment (AGE) maintenance, corrosion control, vehicle maintenance shops. These industrial operations generate varying quantities of waste oils, recoverable fuels, spent solvents and cleaners.

A RCRA Facility Assessment for the U.S. EPA conducted in 1988, and based on this review of Solid Waste Management Units (SWMUs), EPA has directed that 112 such units be evaluated for releases of contaminants to the environment. This phase of the RCRA Facility Investigation is 36 SWMUs (Table 3-1).

3.4 COMMUNITY INVOLVEMENT

Since its activation in 1942, Holloman has had a close relationship with the City of Alamogordo. At no time

in the past years of operation has there been contention within the community about the operation of the base, its mission for national defense, or its responsibility as a corporate citizen. As shown in Figure 3-1, Holloman AFB and the City of Alamogordo are integrated into a single unit.

3.5 POTENTIAL COMMUNITY CONCERNS

The primary concern would be centered on potential impacts to groundwater and soil. Any activity, past or present, that would affect water and soil quality must be carefully evaluated by all concerned.

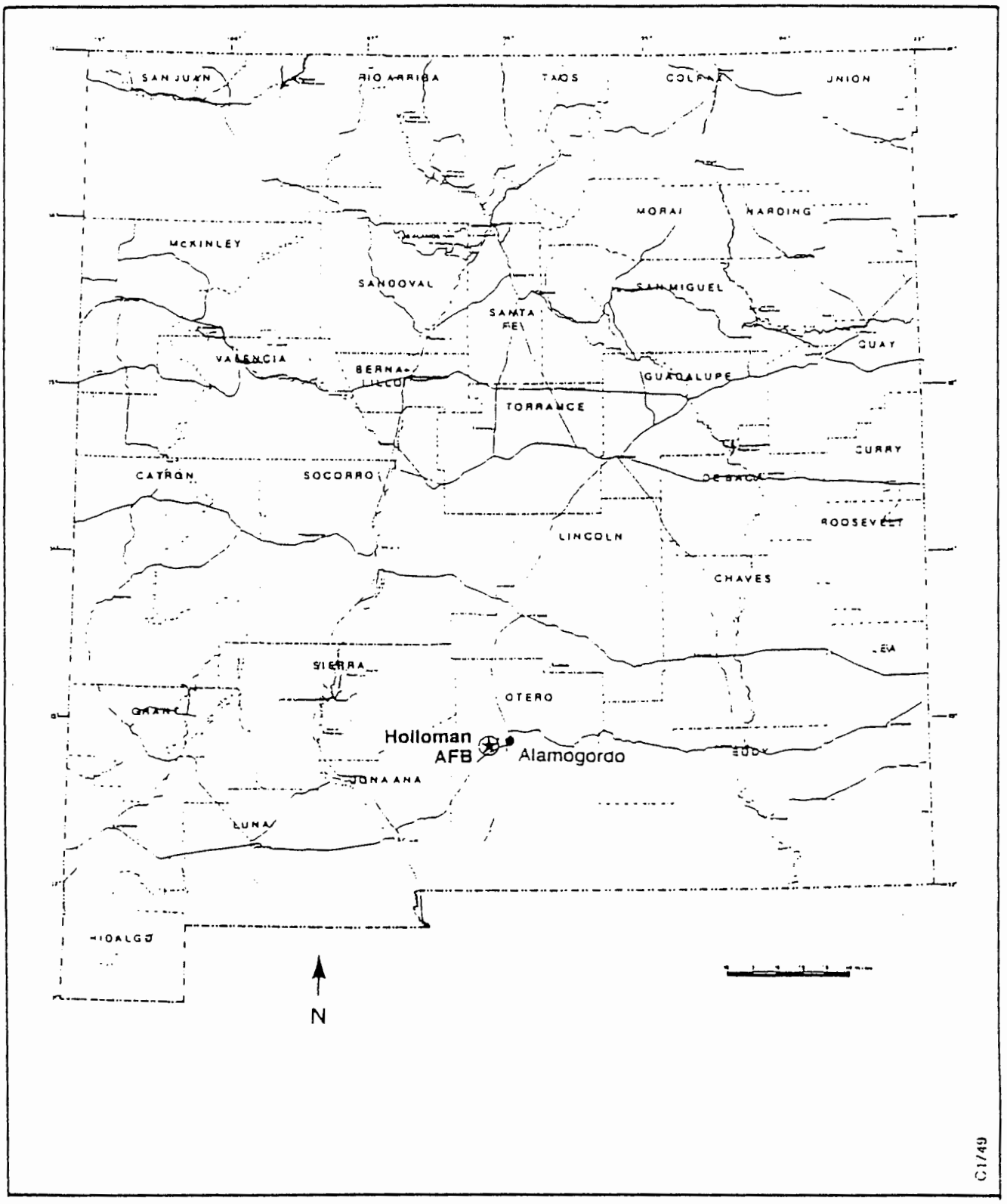

Figure 3-1 Location Map of Holloman AFB, New Mexico

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TABLE 3-1 (Table 2 of HAFB's HSWA Permit)

Solid Waste Management Units (SWMUs) of concern in this Community Relations Plan designated by the U.S. Environmental Protection Agency (EPA), Region VI.

SWMU#	Unit Name
118	Bldg. 21 Pesticides Holding Tank
119	Bldg. 121 Waste Oil Tank
120	Bldg. 309 Waste Oil Tank
121	Bldg. 316 Waste Oil Tank
123	Bldg. 704 Waste Oil Tank
124	Bldg. 752 Waste Oil Tank
125	Bldg. 868 Fire Water Tank
126	Bldg. 1000 Waste Oil Tank
127	Bldg. 1092 Waste Oil Tank
128	Bldg. 1166 Waste Oil Tank
129	Blldg. 1191 Spill Tank
135	Bldg. 1092 Oil/Water Separator Drainage Pit
136	Bldg. 1119 Washrack Drainage Area
138	Bldg. 166 Oil/Water Separator Drainage Pit
141	Pad 9 Drainage Pit
155	Sludge Drying Beds
156	Imhoff Tanks (5)
AOC-U	Lost River Basin
164	Bldg. 1080 Pond
177	Bldg. 1176 Sumps
181	Bldg. 1176 Drainage Trough
183	Air Base Sewer System
184	Wastewater Recirculating Line
101	Bldg. 121 Landfill
54	Bldg. 702 WAA
56	Bldg. 807 WAA
63	Bldg. 867 WAA
71	Bldg. 1778A WAA
75	DRMO Hazardous Waste Storage Area
78	Trim Pad 3 WAA
91	Bldg. 816 Washrack

4.0 HIGHLIGHTS OF THE PROGRAM TECHNIQUES AND TIMING

The Community Relations Plan program for the environmental investigation activities at Holloman AFB throughout the RCRA Facility Investigation. These objectives are:

- Provide the community with information
- Continue two-way communication between Holloman AFB and Community
- Response to community concerns and needs that arise during the RCRA Facility Investigation
- Provide effective management of the community relations program

Two methods of communication will used to provide primary information. First, community leaders and local government officials will be identified by the 49 FW/PA as having relevant interest and would be leaders of local environmental groups, such as the local chapter of the Sierra Club. Government leaders having relevant authority would include the City of Alamogordo mayor, Otero County commissioners, and local health department officials. These persons will be invited to attend briefings at major junctures in the RFI, and if needed, the Corrective Measure Study process.

Second, press release will be issued to print, radio, and television media as necessary. At a minimum , press releases will be issued concurrently with the briefing discussed above. Press releases will issued by the public affairs officer, 49 FW/PA. The 49 FW/PA will be listed as the base point of contact on all written releases.

DRAFT

CHEMICAL DATA ACQUISITION PLAN (CDAP)

Resource Conservation and Recovery Act
Facility Investigation of
Solid Waste Management Units

Prepared by:

49 CES/CEV
Holloman Air Force Base, NM

September 1992

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1.0 PROJECT DESCRIPTION

1.1 Background

Two sites of fuel contamination were recently identified on Holloman Air Force Base (AFB). In order to determine the vertical and lateral extent of contamination, a RCRA Facility Investigation will be implemented on these two sites. Neither of the sites was identified in the RCRA Facility Assessment Report (A.T. Kearney, September 1988). The sites identified for this investigation include:

- T-38 Test Cell Fuel Spill
- Bldg. 828 Fuel Spill

1.2 Objective

The objective of the contracted work at Holloman AFB is to provide a preliminary determination of the presence or absence of chemical contamination at the above mentioned sites. Data gathered in this report will be used for a contamination evaluation report, and a Corrective Measures Study (CMS)/Feasibility Study. The following activities will be completed for this RCRA Facility Investigation.

- Drilling and installation of monitor wells at each of the sites to sample groundwater in upgradient and downgradient locations;
- Collection and chemical analysis of groundwater samples from the monitoring wells;
- Collection of selected soil samples for geotechnical analysis (grain size, moisture content, Atterberg limits, and porosity) from well boring core sample.

- Collection of soil samples from soil borings at each site;
- Chemical analysis of selected soil samples taken from the borings;

1.3 Environmental Setting

The following discussion of the meteorology, physical geography, soils, geology, and hydrology are from previous reports such as the Holloman Air Force Base Installation Restoration Program Records Search (CH2M Hill, August 1983) and the Holloman Air Force Base RCRA Facilities Assessment (A.T. Kearney, September 1988).

1.3.1 Meteorology

Holloman AFB is centered in the Tularosa Basin with mountain ranges to the east and west. The climate is arid with low annual rainfall and low relative humidity. The mountain ranges to the east and to the west have a dramatic influence on the local weather; they provide orographic lifting to produce summer thunderstorms and modify approaching weather systems. Holloman AFB receives most of its total annual rainfall from thunderstorm activity during the May through October period. The winter season is generally dry, characterized by clear skies and erratic snowfall from year to year. The period from March through May is characterized by a strong southerly wind flow and periods of blowing dust and sand. Meteorological data for Holloman AFB is presented in Table 1-1. The mean annual lake evaporation rate, commonly used to estimate the mean annual evapotranspiration rate, averages an estimated 67 inches per year. Therefore, the annual net precipitation (mean annual precipitation minus mean annual evapotranspiration) for the Holloman AFB area is approximately -59 inches per year.

1.3.2 Physical Geography

Holloman AFB is located in the southern part of the Tularosa Basin (Figure 1-1). The basin is approximately 120 miles long and 35 miles wide, extending from the southern end of Chupadera Mesa almost to the Texas border. The Tularosa Basin is part of a structural basin which is more than 200 miles long and 24 to 60 miles wide, extending from southeastern Socorro County, New Mexico southward to Chihuahua, Mexico. In the vicinity of the base, the Tularosa Basin is bounded 8 miles to the east by the Sacramento Mountains and 20 miles to the west by the San Andres Mountains.

Elevations within the Tularosa Basin range from 4,400 feet above mean sea level (ft-msl) at the northeast corner to 4,000 ft-msl in the southwest corner, sloping downward to the southwest. Elevations at the base range from 4,100 to 4,028 ft-msl, excluding Tularosa Peak. Elevations in the Sacramento Mountains reach 12,000 ft-msl and range from 7,000 to 9,000 ft-msl within the San Andres Mountains.

The Tularosa Basin is a closed basin with regard to surface drainage. No surface water leaves the basin. Surface water is either lost to evaporation and infiltration or collects in the lowest point in the basin at or near Lake Lucero. This lake is located at the southwest edge of the gypsum dune field west of the base. Surface water within the basin makes its way to Lake Lucero. Here, also a discharge point for groundwater, sulfate salts are concentrated by evaporation. The prevailing southwest winds then pick up and transport the salts, primarily gypsum, in a northeasterly direction to continue building the dune field of the White Sands National Monument.

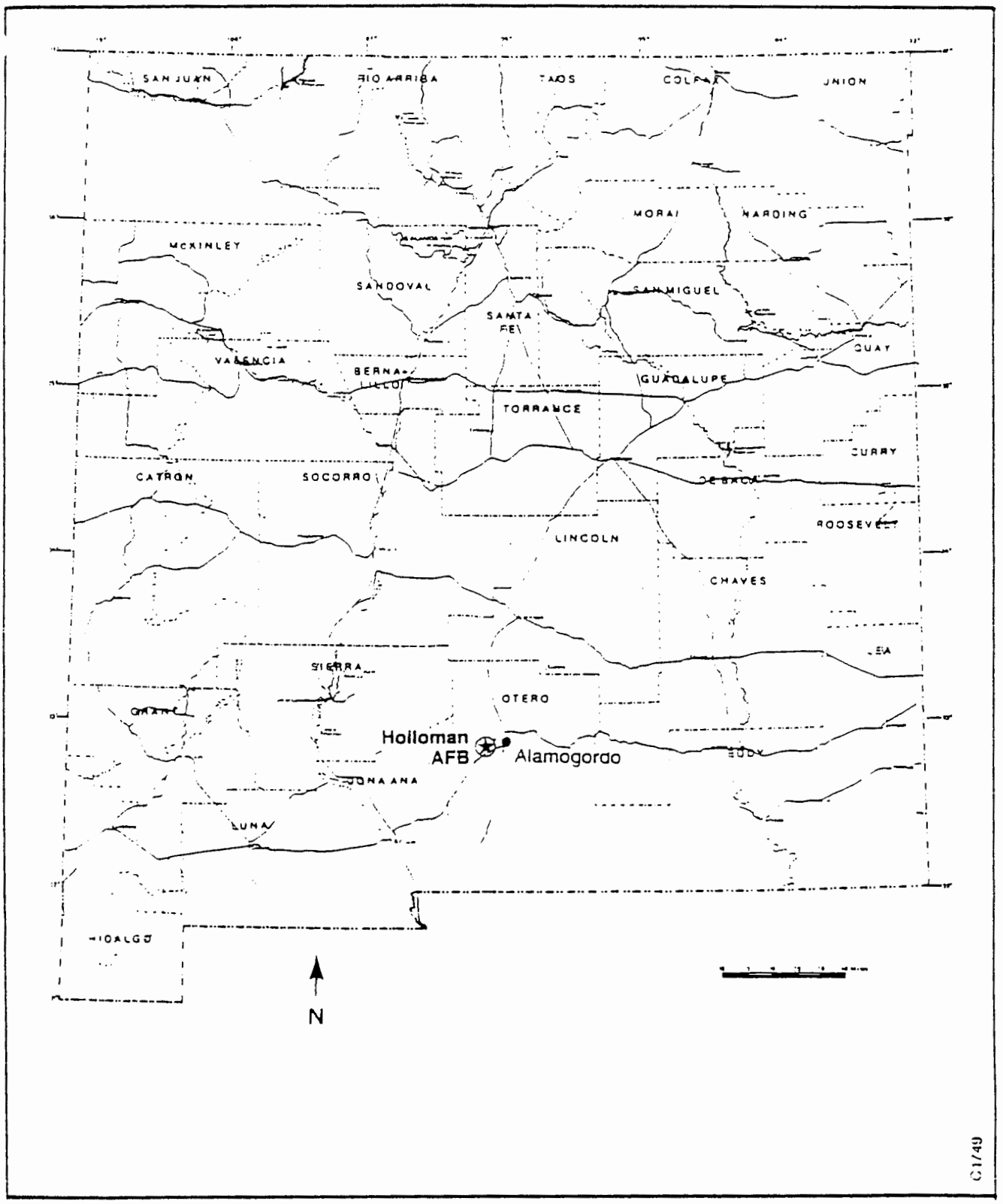


Figure I-1. Location Map of Holloman AFB, New Mexico

Table 1-1

Meteorological Data for Holloman AFB[a]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual Average or Extreme
Temperature (°F)													
Monthly mean	41	46	52	61	69	81	79	73	62	49	49	42	61
Mean daily high	54	60	66	76	84	93	91	86	76	63	63	55	75
Mean daily low	28	31	37	45	54	68	66	60	48	35	35	26	47
Record high	78	80	90	94	103	108	106	102	92	82	82	75	109
Record low	-11	0	9	23	26	52	54	38	26	3	3	2	-11
Precipitation (in)													
Monthly mean	0.5	0.4	0.3	0.2	0.4	0.7	1.2	1.3	1.2	0.9	0.3	0.5	7.9
Record maximum	1.9	1.4	3.0	0.8	2.9	3.6	3.7	4.4	3.9	4.2	2.5	2.4	4.4
Record minimum	0	T[b]	0	0	0	T	T	0.2	T	0	0	0	0
Relative humidity (%)													
4 a.m. mean	66	61	52	40	42	42	60	66	68	61	61	63	57
1 p.m. mean	42	35	27	19	20	19	31	35	38	34	34	37	31
Surface wind													
Mean velocity (Kt)	4	4	6	7	6	6	5	5	4	4	4	4	5
Prevailing direction	N	N	S	S	S	S	S	S	S	S	S	S	S

[a]Source: Holloman Air Force Base Installation Program Records Search; CH2M Hill; August 1983.
Period of record: September 1942 to December 1981.

[b]T = trace.

The base is crossed by several southwest trending "arroyos" or intermittent stream beds including Lost River (the largest), Dillard Draw-Malone Draw and several smaller tributaries such as Red Arroyo and Arroyo Cavacita. Lost River is fed by groundwater seeps or springs. The river appears and disappears along its course as springs add water and evapotranspiration and infiltration recapture it.

1.3.4 Soils and Geology

Most of the base is covered with well drained soils (fine sandy loam) formed in gypsiferous sediments of eolian (wind blown) or alluvial (stream deposition) origin. The soils are thin and overlie discontinuous beds of gypsum. The soils are nearly level with slopes ranging from 0 to 5 percent. Permeability of the soil horizons range from 4×10^{-4} to 1×10^{-3} cm/sec (moderately permeable).

Geologically, the Tularosa Basin is a graben structure, bounded on the east and west by mountains which are actually tilted fault blocks. The basin had its beginning over 270 million years ago when most of southern New Mexico was covered by a shallow sea. During the succeeding years, there were periods of inundation and each cycle left behind successive layers of sediments. Then, approximately 70 million years ago, a major mountain building episode occurred creating the Rocky Mountains. This upheaval caused the Tularosa area to be uplifted, forming a broad, gentle arch. As time passed, tectonic adjustments to the mountain building event took place and the top of this arch or dome collapsed (approximately 10 million years ago) along nearly vertical fault planes. The large area, which collapsed or settled, formed what is now the Tularosa Basin.

The fault planes have produced steep scarps clearly visible on the west side of the Sacramento Mountains. The basin, itself, is underlain mostly by unconsolidated bolson deposits more than 4,000 feet thick in the vicinity of Holloman AFB. A bolson is a basin

which has no surface drainage outlet. Bolson deposits refer to sediments carried by water into the closed basin or bolson. Only the uppermost bolson deposits are of significance to this investigation.

1.3.4 Hydrology

Surface water resources within the Tularosa Basin are limited by the high evapotranspiration rate and low annual rainfall. Perennial streams occur in the mountainous regions surrounding the basin including Rio Tularosa, Rio Bonita, and Eagle Creek. Rio Bonita, located northeast of Tularosa and approximately 60 miles from Holloman AFB discharges to Bonita Lake which in turn is tapped for water supply, some of which is transmitted by pipeline to the base.

The intermittent streams and arroyos occurring within the basin are important drainage features only during the infrequent heavy rainfall, conveying surface water southwest to the basin's lowest elevation point.

Man-made and/or modified surface water features have some significance in an area otherwise devoid of lakes, rivers, and streams. The wastewater treatment system at Holloman AFB consists of six aeration/evaporation lagoons located in the southwest corner of the base. Just southwest of these lagoons, a natural playa occurs which receives discharge from the base as well as seepage from the sewage lagoons. The inundated portion of the playa is referred to as Lake Holloman. Surface drainage within the undeveloped parts of the base is controlled by the major arroyos including Lost River and Dillard Draw and their tributaries. Surface flows are directed southwest toward the White Sands National Monument. Drainage within the developed portion of the base flows by way of ditches and culverts to the southwest corner of the base, in the vicinity of the wastewater treatment lagoons.

Groundwater occurs within the unconsolidated bolson fill at Holloman AFB. The base obtains most of its water supply from wells installed in the fill. The base well fields (Boles, Douglas, and San Andres) are located off base at the foot of the Sacramento Mountains just south of Alamogordo. Groundwater beneath Holloman AFB is highly mineralized containing dissolved solids in excess of 10,000 parts per million.

At the base of the Sacramento Mountains, the hydraulic gradient is quite steep but then flattens out quickly. In the vicinity of Holloman AFB, the ground surface slopes to the southwest gently but at a slightly higher rate than the water table. Depth to water table at the well fields near the mountains is 270 feet or more below land surface (bls), while at Holloman AFB the water table is 5 to 10 feet bls. Like surface drainage, groundwater flows predominately to the southwest, discharging by evapotranspiration. However, local groundwater flow direction appears to be influenced by the arroyos and draws. The extent that the arroyos may effect groundwater flow throughout the base is unknown.

The bolson fill is derived from salvage rocks, such as limestone, dolomite and particularly gypsum, of the surrounding mountains. Fresh water recharges the fill at the base of the mountains. Since the bolson fill consists of highly soluble materials, groundwater will quickly dissolve formation minerals and water quality will degrade with increased contact time. In fact, the only fresh groundwater in the vicinity is near the source recharge.

2.0 CHEMICAL DATA QUALITY OBJECTIVES

The objective of this work effort is to investigate two contaminated sites at Holloman AFB, New Mexico, and to make recommendations regarding site remediation where contaminants exceed the accepted safe level for humans and/or environment. The scope of work for each site is discussed in detail in Section 4. The presence or absence of chemical contamination will be determined by detection, or non-detection, of chemicals in subsurface soil samples, and groundwater samples. Results of chemical analyses will be compared to federal guidelines. Recommendations regarding site remediation will be made where contaminants exceed accepted safe levels for humans and/or the environment. Data quality objectives (DQOs) are to:

- Collect the samples specified in Section 4 to adequately determine the presence or absence of contamination at the Holloman AFB sites;
- Ensure data comparability through the use of standard methods and controlled systems to collect and analyze samples;
- Provide analytical results of known and acceptable precision and accuracy; and
- Confidently evaluate the risks posed by the sites to human health and the environment.

Measurement data representativeness is a function of a sampling strategy and will be achieved using the procedures discussed in Section 4, Field Activities. Data comparability will be achieved using standard methods and standard units of measure as specified in the methods described in Section 6. Analytical imprecisional bias will be controlled through the use of a QC program using prescribed QC samples and corrective actions specified in Section 6. Imprecision and bias in natural matrix samples will be estimated by standard QC methods such as matrix spikes, field duplicates, and field and trip blanks. Confirmation of identity will be performed using second column confirmation procedures for samples with detected compounds using GC and HPLC analytical methods.

A quality assurance/quality control (QA/QC) program will be used to ensure that data quality objectives are met for the Holloman AFB project. QA/QC efforts are

twofold. First, they provide the mechanism for ongoing control and evaluation of measurement data quality throughout the course of the project (i.e., system capability). Second, they specify quality control data to be used to define natural-matrix data quality for various measurement parameters, in terms of precision and accuracy. Control of measurement data quality (i.e., control of error sources that affect data quality) is possible for sample collection and analysis. However, matrix interference, or non-homogeneity, is not amenable to control and thus imprecision or bias due to these natural sources of error must be estimated from QC samples. For this project, sample collection error will be controlled through the use of standard sample collection methods and field logbooks. Sample analysis error will be controlled through the use of standard analytical methods, for which standard operating procedures (SOPs) which are to be performed on a capable analytical system, with quality control (QC) efforts as directed in published procedures. Natural matrix error will be estimated by standard QC methods such as matrix spikes, field duplicates, and field and trip blanks.

2.1 Analytical Capability

Efforts to control measurement error require that the analytical system be capable, in control, and appropriately sensitive for all analyses. System capability, in terms of accuracy and precision, may be documented by reporting system QC data (e.g., continuing calibration, quality control check samples (QCCS), and method spikes). System capability, in terms of sensitivity, may be documented through the use of maximum detection limits for system blanks (e.g., reagent, system and method blanks) and calibration standards. System control may be documented through the use of control charts or other statistical methods that indicate system performance over time.

Precision and accuracy objectives, in terms of maximum allowable imprecision and inaccuracy, for the various measurement parameters associated with site characterization efforts, are presented in Table 2-1 and Table 2-2, for soil and groundwater samples, respectively. Data capture objectives for all constituents is 90%. Precision values presented in Table 2-1 and Table 2-2 represent a measure of variability for replicate measurements of the same parameter in clean-matrix, laboratory QC samples, expressed in terms of the coefficient of variation (CV, or relative standard deviation). CVs compared to precision objectives in Table 2-1 and Table 2-2 are calculated from data such as a series of continuing calibration

results and QCCS results. Accuracy values for clean-matrix laboratory samples include components of both random error (i.e., variability due to imprecision) and systematic error (i.e., bias), and thus reflect the total analytical error for a given measurement, expressed as a percentage of the true value. The average relative percent difference between true and measured concentrations in continuing calibration and QCCS samples may be compared to accuracy objectives in Table 2-1 and Table 2-2. The basis for these estimates are, in most cases, described in the methods. The analytical laboratory will be able to document that the QA/QC procedure in each standard method, Chapter One and Method 8000 of SW846, 3rd edition, Method 1020 of Standard Methods for Examination of Water and Wastewater, 17th edition, or US Army Corps of Engineers Guidance Document ER 1110-1-263, will be followed for all analytical work. Accuracy and precision estimates for samples in a natural matrix (which is much more difficult from an analytical standpoint) would not be expected to be within the objectives presented in Tables 2-1 and 2-2.

Sample detection limits must normally be sensitive to concentrations at or below maximum contaminant levels (MCLs) or New Mexico Human Health Standards (HHS). Clean-matrix detection limits that must be achieved, and associated MCLs for drinking water, are presented in Table 2-3. It is important to note that for a number of compounds, the specified detection limit does not reach the MCL or HHS for the methods included in this investigation. As reported in Section 1.0, groundwater in the Holloman AFB area is non-potable. Natural sample detection limits will depend on dilution effects. In general, dilutions will be performed only as directed in each representative method. For target analytes on GC/MS analyses, dilution will be performed if the target analyte concentrations exceed the calibration range. For non-target analytes on GC/MS analyses, dilutions will be performed when non-target analyte response interferes with target analyte response, and to achieve an internal standard response of approximately 20% of the maximum peak response. When samples are diluted after an initial undiluted analysis, data for target analytes with response within the calibration range for the undiluted analysis will be collected and reported with target analytes from diluted analyses, except in cases where method detection limits listed in the table exceed MCLs and HHSs as previously discussed. For these compounds, high method detection limits will not result in unusable data, if natural sample detection limits exceed MCLs or HHSs for any other compounds, the analytical laboratory must document what prompted the higher detection limits and the maximum concentrations that were allowable on the calibration curve. This level of effort is required on a sample-by-sample basis and may not be applied to batches of samples.

Table 2-1

Estimated Precision and Accuracy Objectives for Soil Samples

Parameter	Method	Precision[a]	Accuracy[b]
Metals	SW6010 ICPES	10%	+/- 10%
Arsenic	SW7060 Graphite Furnace AA	15%	+/- 15%
Lead	SW7421 Graphite Furnace AA	15%	+-/ 15%
Organic Lead	HML 338 AAS	50%	+/-50%
Mercury	SW7471 Cold Vapor AA	15%	+/- 15%
Selenium	SW7740 Graphite Furnace AA	15%	+/- 15%
Volitale Organic Compounds	SW8240 GC/MS	50%	Varies with component/analyses
Semivolatile Organic Compounds	SW8270 GC/MS	50%	Varies with component/analyses

Table 2.1
(Continued)

Parameter	Method	Precision[a]	Accuracy[b]
Pesticides/PCB's	SW8080 GC/ECD	50%	Varies with component/analyses
Organophosphorus Pesticides	SW8140 GC/FPD	50%	Varies with component/analyses
Chlorinated Herbicides	SW8150 GC/ECD	50%	Varies with component/analyses
Total Recoverable Petroleum Hydro.	E418.1 IR	20%	+/-15%
Oil and Grease	E413.2 IR	20%	+/-15%
Atterburg Limits	ASTM D4318	Not Specified	Not Specified
Particle Size Distribution	ASTM D422	Not Specified	Not Specified
Soil Moisture	ASTM D2216	Not Specified	Not Specified

a Coefficient of variation (CV or relative standard deviation) for replicate analytical determinations (exclusive of sampling variability). Average CV for a series of QCCS or continuing calibration samples will be compared to these objectives.

b Total error for a single measurement in a clean, laboratory-controlled matrix, including both systematic error (bias) and random error (variability due to imprecision), expressed as a percentage of the measured value. Average RPD for a series of QCCS or continuing calibration samples will be compared to these objectives.

c ICPES metals: antimony, beryllium, chromium, cadmium, copper, nickel, silver, thallium, and zinc.

Table 2-2

Estimated Precision and Accuracy Objectives for Groundwater Samples

Parameter	Method	Precision[a]	Accuracy[b]
Fluoride	E340.2	10%	+/- 10%
Sulfate	E300.0	10%	+/- 10%
Chloride	E300.0	10%	+/- 10%
Nitrate/Nitrite	E353.2	10%	+/- 10%
Phosphate	E365.2	10%	+/- 10%
Metals[c]	SW6010 ICPES	10%	+/- 10%
Arsenic	SW7060 Furnace AA	15%	+-/ 15%
Lead	SW7421 Furnace AA	15%	+-/ 15%
Organic Lead	HML 338 AAS	50%	+/-50%
Mercury	SW7471 Cold Vapor AA	15%	+/- 15%
Selenium	SW7740 Graphite Furnace AA	15%	+/- 15%
Volitale Organic Compounds	SW8240 GC/MS	50%	Varies with component/analyses

Table 2-2

(Continued)

Parameter	Method	Precision[a]	Accuracy[b]
Semivolatile Organic Compounds	SW8270 GC/MS	50%	Varies with component/analyses
Pesticides/PCB's	SW8080 GC/ECD	50%	Varies with component/analyses
Organophosphorus Pesticides	SW8140 GC/FPD	50%	Varies with component/analyses
Chlorinated Herbicides	SW8150 GC/ECD	50%	Varies with component/analyses
Explosives	SW8330 HPLC	20%	+/-15%

a Coefficient of variation (CV or relative standard deviation) for replicate analytical determinations (exclusive of sampling variability). Average CV for a series of QCCS or continuing calibration samples will be compared to these objectives.

b Total error for a single measurement in a clean, laboratory-controlled matrix, including both systematic error (bias) and random error (variability due to imprecision), expressed as a percentage of the measured value. Average RPD for a series of QCCS or continuing calibration samples will be compared to these objectives.

c ICPES metals: antimony, beryllium, chromium, cadmium, copper, nickel, silver, thallium, and zinc.

Table 2-3

Analytical Methods, Requested Detection Limits, and Maximum Contaminant Levels

Parameter	Analysis		Method Detection Limits[a]		Maximum Contaminant Level	
	Technique	Method (Water/Soil)	Water	Soil	MCL[b] (µg/L)	HHS[c] (mg/L)
GENERAL						
pH	Electrometric	SW-846:9045	N/A	N/A	–	6-9
Sulfate	IC	EPA:300.0	0.05 mg/L	N/A	500,000	600
Chloride	IC	EPA:300.0	0.02 mg/L	N/A	–	250
Fluoride	SIE	EPA:340.2	0.1 mg/L	N/A	4,000	1.6
Phosphate	Colorimetric	EPA:365.2	0.01 mg/L	N/A	–	–
Nitrate/nitrite	Colorimetric	EPA:353.2	0.02 mg/L	N/A	10,000	10
Total Dissolved Solids (TDS)	Gravimetric	EPA:160.1	9 mg/L	N/A	–	1,000
Total Recoverable Petroleum Hydrocarbons (TRPH)	IR	EPA:418.1	1 mg/L	1 mg/Kg	–	–
Oil and Grease	IR	EPA:413.2	0.4 mg/L	40 mg/Kg	–	–
Total Organic Carbon	Oxidation	SW-846:9060	N/A	0.11%	–	–
METALS						
Antimony	ICPES	SW-846:6010	0.1 mg/L	10 mg/Kg	5	–
Arsenic	GFAA	SW-846:7060	0.004 mg/L	0.4 mg/Kg	–	0.1
Beryllium	ICPES	SW-846:6010	0.002 mg/L	0.2 mg/Kg	1	–
Cadmium	ICPES	SW-846:6010	0.005 mg/L	0.5 mg/Kg	5	0.01
Chromium	ICPES	SW-846:6010	0.01 mg/L	1.0 mg/Kg	100	0.05
Lead	GFAA	SW-846:7421	0.003 mg/L	0.3 mg/Kg	5	0.05
Organic Lead	FAA/GFAA	HML:338	0.1 mg/L	2.0 mg/Kg	5	0.05
Mercury	CVAA	SW-846:7470/7471	0.0002 mg/L	0.0002 mg/Kg	2	0.002
Nickel	ICPES	SW-846:6010	0.02 mg/L	2.0 mg/Kg	100	0.2
Selenium	GFAA	SW-846:7740	0.005 mg/L	0.5 mg/Kg	50	0.05
Copper	ICPES	SW-846:6010	0.02 mg/L	2.0 mg/Kg	1300	1.0
Silver	ICPES	SW-846:6010	0.01 mg/L	1.0 mg/Kg	–	0.05
Thallium	ICPES	SW-846:6010	0.1 mg/L	10 mg/Kg	1	–
Zinc	ICPES	SW-846:6010	0.02 mg/L	2.0 mg/Kg	–	10
VOLATILE ORGANICS						
Acetone	GC/MS	SW-846:8240	100 µg/L	2000 µg/Kg	–	–

(Continued)

Table 2-3

(Continued)

Parameter	Analysis		Method Detection Limits[a]		Maximum Contaminant Level	
	Technique	Method (Water/Soil)	Water	Soil	MCL[b] (µg/L)	HHS[c] (mg/L)
Benzene	GC/MS	SW-846:8240	5 µg/L	100 µg/Kg	5	0.01
Bromodichloromethane	GC/MS	SW-846:8240	5 µg/L	100 µg/Kg	–	–
Bromoform	GC/MS	SW-846:8240	5 µg/L	100 µg/Kg	–	–
Bromomethane	GC/MS	SW-846:8240	10 µg/L	200 µg/Kg	–	–
Carbon disulfide	GC/MS	SW-846:8240	5 µg/L	100 µg/Kg	–	–
Carbon tetrachloride	GC/MS	SW-846:8240	5 µg/L	100 µg/Kg	5	0.01
Chlorobenzene	GC/MS	SW-846:8240	5 µg/L	100 µg/Kg	–	–
Chloroethane	GC/MS	SW-846:8240	10 µg/L	200 µg/Kg	–	–
2-Chloroethyl Vinyl Ether	GC/MS	SW-846:8240	10 µg/L	200 µg/Kg	–	–
Chloroform	GC/MS	SW-846:8240	5 µg/L	100 µg/Kg	–	0.1
Chloromethane	GC/MS	SW-846:8240	10 µg/L	200 µg/Kg	–	–
Dibromochloromethane	GC/MS	SW-846:8240	5 µg/L	100 µg/Kg	–	–
1,2-Dichloroethane	GC/MS	SW-846:8240	5 µg/L	100 µg/Kg	5	0.01
trans-1,2-Dichloroethene	GC/MS	SW-846:8240	5 µg/L	100 µg/Kg	100	–
1,1-Dichloroethane	GC/MS	SW-846:8240	5 µg/L	100 µg/Kg	–	0.025
1,1-Dichloroethene	GC/MS	SW-846:8240	5 µg/L	100 µg/Kg	7	0.005
1,2-Dichloropropane	GC/MS	SW-846:8240	5 µg/L	100 µg/Kg	5	–
cis-1,3-Dichloropropene	GC/MS	SW-846:8240	5 µg/L	100 µg/Kg	–	–
trans-1,3-Dichloropropene	GC/MS	SW-846:8240	5 µg/L	100 µg/Kg	–	–
Ethyl benzene	GC/MS	SW-846:8240	5 µg/L	100 µg/Kg	700	0.75
2-Hexanone	GC/MS	SW-846:8240	50 µg/L	1000 µg/Kg	–	–
Methylene chloride	GC/MS	SW-846:8240	5 µg/L	100 µg/Kg	–	0.1
2-Butanone (MEK)	GC/MS	SW-846:8240	100 µg/L	2000 µg/Kg	–	–
4-Methyl-2-pentanone	GC/MS	SW-846:8240	50 µg/L	1000 µg/Kg	–	–
Styrene	GC/MS	SW-846:8240	5 µg/L	100 µg/Kg	100	–
1,1,2,2-Tetrachloroethane	GC/MS	SW-846:8240	5 µg/L	100 µg/Kg	–	0.01
Tetrachloroethene	GC/MS	SW-846:8240	5 µg/L	100 µg/Kg	5	0.02
1,1,1-Trichloroethane	GC/MS	SW-846:8240	5 µg/L	100 µg/Kg	200	0.06
1,1,2-Trichloroethane	GC/MS	SW-846:8240	5 µg/L	100 µg/Kg	5	0.01

(Continued)

Table 2-3

(Continued)

Parameter	Analysis		Method Detection Limits[a]		Maximum Contaminant Level	
	Technique	Method (Water/Soil)	Water	Soil	MCL[b] (µg/L)	HHS[c] (mg/L)
Trichloroethene	GC/MS	SW-846:8240	5 µg/L	100 µg/Kg	5	0.1
Toluene	GC/MS	SW-846:8240	5 µg/L	100 µg/Kg	1,000	0.75
Vinyl Acetate	GC/MS	SW-846:8240	50 µg/L	5000 µg/Kg	–	–
Vinyl Chloride	GC/MS	Sw-846:8240	10 µg/L	200 µg/Kg	2	0.001
Xylenes (total)	GC/MS	SW-846:8240	5 µg/L	100 µg/Kg	10,000	0.62
SEMIVOLATILE ORGANICS						
Anthracene	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	–	0.03
Benzo(a)anthracene	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	0.2	0.03
Benzo(b)fluoranthene	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	0.2	0.03
Benzo(k)fluoranthene	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	0.2	0.03
Benzo(a)pyrene	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	0.2	0.0007
bis(2-Ethylhexyl)phthalate	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	–	–
Butyl benzyl phthalate	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	4	–
Chrysene	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	0.2	–
Dibenz(a,h)anthracene	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	0.2	–
1,2-Dichlorobenzene	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	600	–
1,3-Dichlorobenzene	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	600	–
1,4-Dichlorobenzene	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	75	–
Dimethylpthalate	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	4	–
Diethylphthalate	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	4	–
Di-n-butylphthalate	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	–	–
Di-n-octylphthalate	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	–	–
Fluoranthene	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	–	–
2-Methyl naphthalene	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	–	0.03
Naphthalene	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	–	0.03
Phenanthrene	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	0.2	0.03
Pyrene	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	0.2	0.03
2,4-Dimethylphenol	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	–	–
2,4-Dinitrophenol	GC/MS	SW-846:8270	50 µg/L	3300 µg/Kg	–	–

(Continued)

Table 2-3

(Continued)

Parameter	Analysis		Method Detection Limits[a]		Maximum Contaminant Level	
	Technique	Method (Water/Soil)	Water	Soil	MCL[b] (µg/L)	HHS[c] (mg/L)
4-Nitrophenol	GC/MS	SW-846:8270	50 µg/L	3300 µg/Kg	–	–
Phenol	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	–	–
Acenaphthene	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	–	–
Acenaphthylene	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	–	–
Benzoic acid	GC/MS	SW-846:8270	50 µg/L	3300 µg/Kg	–	–
Benzo(g,h,i)perylene	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	–	0.03
Benzyl Alcohol	GC/MS	SW-846:8270	20 µg/L	1300 µg/Kg	–	–
4-Bromophenyl phenyl ether	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	–	–
4-Chloroaniline	GC/MS	SW-846:8270	20 µg/L	1300 µg/Kg	–	–
4-Chloro-3-methylphenol	GC/MS	SW-846:8270	20 µg/L	1300 µg/Kg	–	–
bis(2-Chloroisopropyl)ether	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	–	–
bis(2-Chloroethyl)ether	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	–	–
2-Chloronaphthalene	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	–	–
2-Chlorophenol	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	–	–
bis(2-Chloroethoxy)methane	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	–	–
4-Chlorophenyl phenyl ether	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	–	–
Dibenzofuran	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	–	–
2,4-Dichlorophenol	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	–	–
3,3-Dichlorobenzidine	GC/MS	SW-846:8270	20 µg/L	1300 µg/Kg	–	–
2,4-Dinitrotoluene	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	–	–
2,6-Dinitrotoluene	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	–	–
4,6-Dinitro-2-methylphenol	GC/MS	SW-846:8270	50 µg/L	3300 µg/Kg	–	–
Fluorene	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	0.2	0.03
Hexachlorobenzene	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	1	–
Hexachlorocyclopentadiene	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	50	–
Hexachloroethane	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	–	–
Hexachlorobutadiene	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	–	–
Indeno(1,2,3-c,d)pyrene	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	0.2	0.03
Isophorone	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	–	–

(Continued)

Table 2-3

(Continued)

Parameter	Analysis		Method Detection Limits[a]		Maximum Contaminant Level	
	Technique	Method (Water/Soil)	Water	Soil	MCL[b] (µg/L)	HHS[c] (mg/L)
2-Methylphenol	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	–	–
4-Methylphenol	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	–	–
2-Nitroaniline	GC/MS	SW-846:8270	50 µg/L	3300 µg/Kg	–	–
3-Nitroaniline	GC/MS	SW-846:8270	50 µg/L	3300 µg/Kg	–	–
4-Nitroaniline	GC/MS	SW-846:8270	50 µg/L	3300 µg/Kg	–	–
Nitrobenzene	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	–	–
2-Nitrophenol	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	–	–
n-Nitroso-di-n-propylamine	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	–	–
n-Nitrosodiphenylamine	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	–	–
Pentachlorophenol	GC/MS	SW-846:8270	50 µg/L	3300 µg/Kg	1	–
1,2,4-Trichlorobenzene	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	9	–
2,4,5-Trichlorophenol	GC/MS	SW-846:8270	50 µg/L	3300 µg/Kg	–	–
2,4,6-Trichlorophenol	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg	–	–
ORGANOPHOSPHORUS PESTICIDES						
Demeton-O	GC/FPD	SW-846:8140	0.5 µg/L	50 µg/Kg	–	–
Demeton-S	GC/FPD	SW-846:8140	0.5 µg/L	50 µg/Kg	–	–
Dimethicate	GC/FPD	SW-846:8140	0.2 µg/L	20 µg/Kg	–	–
Disulfoton	GC/FPD	SW-846:8140	0.2 µg/L	20 µg/Kg	–	–
Ethyl parathion	GC/FPD	SW-846:8140	0.15 µg/L	15 µg/Kg	–	–
Fensulfothion	GC/FPD	SW-846:8140	1.5 µg/L	150 µg/Kg	–	–
Famphur	GC/FPD	SW-846:8140	0.5 µg/L	50 µg/Kg	–	–
Methyl azinphos	GC/FPD	SW-846:8140	1.5 µg/L	150 µg/Kg	–	–
Parthion methyl	GC/FPD	SW-846:8140	0.03 µg/L	3.0 µg/Kg	–	–
Phorate	GC/FPD	SW-846:8140	0.3 µg/L	30 µg/Kg	–	–
Ronnel	GC/FPD	SW-846:8140	0.3 µg/L	30 µg/Kg	–	–
Sulfotepp	GC/FPD	SW-846:8140	0.10 µg/L	10 µg/Kg	–	–
Thionazin	GC/FPD	SW-846:8140	1.0 µg/L	100 µg/Kg	–	–

(Continued)

Table 2-3

(Continued)

Parameter	Analysis		Method Detection Limits[a]		Maximum Contaminant Level	
	Technique	Method (Water/Soil)	Water	Soil	MCL[b] (µg/L)	HHS[c] (mg/L)
ORGANOCHLORINE PESTICIDES AND PCBs						
o,o,o-Triethylphosphorthioate	GC/FPD	SW-846:8140	1.0 µg/L	100 µg/Kg	–	–
Aldrin	GC/ECD	SW-846:8080	0.04 µg/L	1 µg/Kg	–	–
alpha-BHC	GC/ECD	SW-846:8080	0.03 µg/L	1 µg/Kg	–	–
beta-BHC	GC/ECD	SW-846:8080	0.06 µg/L	1 µg/Kg	–	–
delta-BHC	GC/ECD	SW-846:8080	0.09 µg/L	1 µg/Kg	–	–
gamma-BHC (Lindane)	GC/ECD	SW-846:8080	0.04 µg/L	1 µg/Kg	0.2	–
Chlordane (technical)	GC/ECD	SW-846:8080	0.14 µg/L	5 µg/Kg	2	–
4,4'-DDD	GC/ECD	SW-846:8080	0.11 µg/L	1 µg/Kg	–	–
4,4'-DDE	GC/ECD	SW-846:8080	0.04 µg/L	1 µg/Kg	–	–
4,4'-DDT	GC/ECD	SW-846:8080	0.12 µg/L	2 µg/Kg	–	–
Dieldrin	GC/ECD	SW-846:8080	0.02 µg/L	1 µg/Kg	–	–
Endosulfan I	GC/ECD	SW-846:8080	0.14 µg/L	1 µg/Kg	–	–
Endosulfan II	GC/ECD	SW-846:8080	0.04 µg/L	3 µg/Kg	–	–
Endosulfan sulfate	GC/ECD	SW-846:8080	0.66 µg/L	5 µg/Kg	–	–
Endrin	GC/ECD	SW-846:8080	0.06 µg/L	1 µg/Kg	2	–
Endrin aldehyde	GC/ECD	SW-846:8080	0.23 µg/L	2 µg/Kg	–	–
Heptachlor	GC/ECD	SW-846:8080	0.03 µg/L	1 µg/Kg	0.4	–
Heptachlor epoxide	GC/ECD	SW-846:8080	0.83 µg/L	1 µg/Kg	0.2	–
Methoxychlor	GC/ECD	SW-846:8080	0.05 µg/L	5 µg/Kg	40	–
Toxaphene	GC/ECD	SW-846:8080	0.5 µg/L	50 µg/Kg	3	--
PCB-1016	GC/ECD	SW-846:8080	0.1 µg/L	10 µg/Kg	0.5	0.001
PCB-1221	GC/ECD	SW-846:8080	0.1 µg/L	1.0 µg/Kg	0.5	0.001
PCB-1232	GC/ECD	SW-846:8080	0.2 µg/L	20 µg/Kg	0.5	0.001
PCB-1242	GC/ECD	SW-846:8080	0.1 µg/L	10 µg/Kg	0.5	0.001
PCB-1248	GC/ECD	SW-846:8080	0.1 µg/L	10 µg/Kg	0.5	0.001
PCB-1254	GC/ECD	SW-846:8080	0.2 µg/L	20 µg/Kg	0.5	0.001
PCB-1260	GC/ECD	SW-846:8080	1.0 µg/L	20 µg/Kg	0.5	0.001

(Continued)

Table 2-3

(Continued)

Parameter	Analysis		Method Detection Limits[a]		Maximum Contaminant Level	
	Technique	Method (Water/Soil)	Water	Soil	MCL[b] (µg/L)	HHS[c] (mg/L)
CHLORINATED HERBICIDES						
2,4-D	GC/ECD	SW-846:8150	12 µg/L	120 µg/Kg	70	–
2,4-DB	GC/ECD	SW-846:8150	9.1 µg/L	91 µg/Kg	–	–
2,4,5-T	GC/ECD	SW-846:8150	2.0 µg/L	20 µg/Kg	–	–
2,4,5-TP (Silvex)	GC/ECD	SW-846:8150	1.7 µg/L	17 µg/Kg	50	–
Dalapon	GC/ECD	SW-846:8150	58 µg/L	580 µg/Kg	200	–
Dicamba	GC/ECD	SW-846:8150	2.7 µg/L	27 µg/Kg	–	–
Dichloroprop	GC/ECD	SW-846:8150	6.5 µg/L	65 µg/Kg	–	–
Dinoseb	GC/ECD	SW-846:8150	0.7 µg/L	15 µg/Kg	7	–
MCPA	GC/ECD	SW-846:8150	2500 µg/L	24,900 µg/Kg	–	–
MCPP	GC/ECD	SW-846:8150	1900 µg/L	19,200 µg/Kg	–	–
GEOTECHNICAL						
Particle Size Distribution	Sieving	ASTM D422	N/A	>0.075mm	–	–
Atterburg Limits	Oven-Dry/ Gravimetric	ASTM D4318	N/A	0.1%	–	–
Soil Moisture	Gravimetric	ASTM D2216	N/A	0.1%	–	–
EXPLOSIVES						
HMX	HPLC	SW-846:8330	0.563 µg/L	N/A	–	–
RDX	HPLC	SW-846:8330	0.412 µg/L	N/A	–	–
1,3,5-TNB	HPLC	SW-846:8330	0.425 µg/L	N/A	–	–
1,3-DNB	HPLC	SW-846:8330	0.549 µg/L	N/A	–	–
NB	HPLC	SW-846:8330	0.817 µg/L	N/A	–	–
Tetryl	HPLC	SW-846:8330	1.18 µg/L	N/A	–	–
2-NT	HPLC	SW-846:8330	1.09 µg/L	N/A	–	–
4-NT	HPLC	SW-846:8330	0.714 µg/L	N/A	–	–
3-NT	HPLC	SW-846:8330	0.805 µg/L	N/A	–	–
2,4,6-TNT	HPLC	SW-846:8330	0.451 µg/L	N/A	–	–
2,6-DNT	HPLC	SW-846:8330	0.260 µg/L	N/A	–	–

(Continued)

Table 2-3

(Continued)

Parameter	Analysis		Method Detection Limits[a]		Maximum Contaminant Level	
	Technique	Method (Water/Soil)	Water	Soil	MCL[b] (µg/L)	HHS[c] (mg/L)
2,4-DNT	HPLC	SW-846:8330	0.260 µg/L	N/A	--	--

[a] Method Detection Limit is the minimum concentration of a substance that can be measured and reported. Method Detection Limits are highly matrix dependent and may not always be achievable.
[b] Federal Drinking Water Standards Maximum Contaminant Levels (MCL), Office of Drinking Water, USEPA.
[c] New Mexico Standards for Groundwater, Human Health Standards (HHS), New Mexico Water Quality Control Comrnission Regulations, November 24, 1988.

IR = Infrared Spectrometry
ICPES = Inductively Coupled Plasma Emission Spectroscopy
GFAA = Graphite Furnace Atomic Absorption
GVAA = Cold Vapor Atomic Absorption
GC/MS = Gas Chromatography/Mass Spectrometry
SW-846 = Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, U.S. EPA, Office of Solid Waste and Emergency Response, November 1986, third edition.
EPA = Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020.
N/A = Not Applicable
IC = Ion Chromatography
GC/FPD = Gas Chromatography/Flame Photometric Detector
GC/ECD = Gas Chromatography/Electron Capture Detector
HPLC = High Performance Liquid Chromatography
FAA = Flame Atomic Absorption
HML = California Department of Health Services; Hazardous Materials Laboratory

2.2 Definition of Quality Assurance (QA) Samples

External QA samples will consist of field duplicates and field blanks collected in similar sample containers and handled in the same manner as field samples. Field duplicate samples and field blanks will each be collected at a minimum frequency of 5% of all field samples collected. Field duplicates will be assigned the same sample number as the initial sample so that results may be used as an independent assessment of combined sampling and analytical variability.

2.2.1 Field Duplicates

Collection procedures for field duplicates will depend on the matrix. For the soil matrix, split samples will be used as a field duplicate sample for all analyses except volatile organics. Split samples will be a homogenized soil sample, divided into two or more splits, and identified as unique samples. Analyses of split soil samples will be confined to analyses for non-volatile species since homogenization would increase variability or completely lose volatiles. Field duplicates of non-homogenized soil will be collected for volatile organics. For the water matrix, field duplicates will be collected at the same time as initial samples using the same bailer and other collection procedures.

Duplicate samples are analyzed for the purpose of assessing precision, including variability associated with both the laboratory analysis and the sample collection process. Duplicate samples will be collected in immediate succession, using identical recovery techniques, and treated in an identical manner during storage, transportation, and analysis.

2.3 Definitions of Laboratory Quality Control (QC) Samples

The following quality control samples will be used to control and assess data quality:

- System blank - deionized water analyzed after calibration to assess system contamination.

- Reagent blank - reagent water taken through the digestion/extraction process as though it were an actual sample.

- Calibration check sample - a standard used to verify instrument calibration.

- QC check sample (QCCS) - known concentration of alternate-source reference materials spiked into an aliquot of deionized water. This sample is taken through the digestion/extraction process as though it were an actual sample. The purpose of a QCCS analysis is to determine whether failure to meet QC acceptance criteria for a matrix spike is due to matrix interference in the sample, or to an out-of-control condition associated with the analytical system.

- Method spike - known concentration of standard materials (i.e., materials used for calibration purposes) spiked into an aliquot of deionized water. This sample is processed (i.e., extracted, digested) like all natural matrix samples. The purpose of a method spike, or blank spike, is to determine if the analytical system is in control, and capable, per method specifications.

- Matrix spike/matrix spike duplicates (MS/MSD) - splits from field samples spiked with known concentrations of reference materials and taken through the entire digestion/extraction process. The matrix spike allows the laboratory to assess the efficiency of extraction, accuracy of the analysis, and possible matrix effects. Analysis of a duplicate matrix spike, another aliquot of the sample spiked at the same concentration as the MS, allows the laboratory to assess precision at known concen trations.

- Surrogate spikes - For GC and GC/MS analyses, identifiable compounds not present in the sample matrix are added to every field sample.

- Duplicate analyses - samples split in the lab and treated as two independent samples. For Holloman AFB, approximately 5% of each sample batch will be analyzed in duplicate for the water quality parameters, as required by the appropriate method.

- ICPES interference check sample - an ICPES QC check sample which contains interferents and analyte concentrations at levels specified by EPA. Analyzed at the beginning and end of each sample analysis sequence, results are used to verify inter-element and background correction factors.

3.0 PROJECT ORGANIZATION AND FUNCTIONAL AREA RESPONSIBILITIES

The contractor's project team for the Holloman AFB project will be composed of a Program Manager, a Project Director, a Quality Assurance Coordinator, and one or more Task Leaders. Roles and responsibilities of key personnel are discussed below.

3.1 Roles and Responsibilities

The contractor shall assign a Program Manager for this project. In this role, he or she will have the overall responsibility, authority, and accountability for the project. He or she will function as the primary interface between Holloman, subcontractor management, and the project team. In executing these duties, he or she will:

- Have responsibility for meeting all contractual requirements for the task;
- Administer and supervise all contractual requirements for the task;
- Direct formulation of work plans in accordance with client directions;
- Have responsibility for assuring that required staffing levels and technical expertise are provided;
- Keep Holloman's Base Environmental Coordinator (BEC) informed on all aspects of the program including expenditures, progress, problems, and recommended solutions;
- Be available to Holloman's BEC for action on any problem requiring additional management or technical support;
- Keep Holloman management informed on all matters relating to the program; and
- Review technical project outputs prior to issue.

The contractor will assign a Project Director for this project. In this capacity, he will be responsible for organizing and directing the technical activities of the project and for reporting the results of these activities. He will have day-to-day interaction with the Technical Staff. In the execution of these duties, the Project Director will:

- Establish technical objectives and assist the Program Manager in the preparation and review of work plans;

- Be responsible for responding to work plan revisions;

- Advise the Program Manager of technical progress, expenditures, program needs, potential problems, and recommended solutions;

- Assure technical quality of reports, memoranda, and other communications through review of results;

- Maintain contact with Holloman management in areas that require decisions on technical matters; and,

- Confer with the contractor's Program Manager in the selection of supporting Technical Staff and be responsible for reviewing their performance through the program.

The contractor will assign a Quality Assurance Coordinator (QAC). In this role, he or she will be responsible for development and execution of QA activities in all phases of the project, including test plan design, execution, data reduction, and reporting. His or her responsibilities will include:

- Coordinating any external QA audit activities requested by Holloman;

- Serving as an in-house consultant to the Project Director and Task Leaders in defining data quality goals or requirements and in development of a project-specific, internal quality control system which is responsive to these goals;

- Coordinating preparation of the project quality assurance reports that document the project-specific policies, organization, objectives, functional activities, and specific QA and QC procedures and activities designed to achieve data quality goals or requirements;

- Providing independent review of the project approach, methods, and experimental design;

- Providing the mechanism whereby quality assurance problems may be brought to the immediate attention of the Project Director and Program Manager or, if warranted, may be brought directly to the attention of the

supervisor of the technical staff through the Quality Assurance Director, for implementation of corrective action; and

- Documenting the results of all QA/QC activities in reports to Holloman management.

The contractor shall assign a task leader for all tasks pertaining to the conduct of the RCRA Facility Investigation (RFI). His responsibilities include the literature search, plans, field activities, and the RFI report. The contractor will assign an individual to identify defensible pathways and receptors for the site.

General responsibilities of Task Leaders include:

- Responsibility for ensuring that deliverables required for their task are delivered on schedule and within budget;
- Coordination of day-to-day activities of project team members working on their task;
- Maintaining close contact with the Project Director so that schedule, budget, and/or technical problems are addressed in a timely manner;
- Coordination of day-to-day QC activities required for their respective tasks as part of the internal QC system;
- Ensuring compliance with all QC acceptance criteria as specified in the QA Plan; and
- Keeping the QA Coordinator and Project Director advised of any quality problems which arise.

The contractor will assign a Supervisory Geologist. He or she will be responsible for all on-site activities, including monitor well installation, sample collection, field analysis, chain of custody, and reporting. He or she will also be responsible for the contractor's field staff. Other key project personnel, reporting to the Supervisory Geologist, include the subcontractor staff manager. Subcontractor staff managers assume ultimate responsibility for all operations in their subcontracts. Subcontractors and key personnel are discussed below.

3.2 Laboratory Qualifications

All laboratory and geotechnical analyses will be performed at EPA approved and certified laboratories. Documentation of certification will be made available to Holloman prior to initiation of any analyses

3.3 Drilling

The contractor will subcontract drilling operations to a licensed New Mexico water-well driller. The contractor will ensure that the drillers follow all protocols set forth in this workplan.

3.4 Survey Activities

The surveying of boreholes and monitor wells will be completed by a licensed surveyor. The surveyor will be registered in the State of New Mexico and will follow all survey protocols outlined in the workplan for this delivery order.

4.0 FIELD ACTIVITIES

In order to achieve the objectives of this program, the contractor will perform a series of field tasks at Holloman AFB. These activities were developed according to this workplan for Holloman AFB. The activities include: 1) utility clearance; 2) soil and groundwater sampling; 3) monitor well installation and development; 4) aquifer testing; 5) soil gas survey and 6) surveying of wells and borings. Each of these activities is discussed in detail in this section.

4.1 List of Equipment, Containers, and Supplies

The implementation of the field activities will require specific equipment, containers, and supplies for the collection of field samples as summarized below.

Drilling and Sampling Equipment

- Hollow stem auger drill rigs;
- Split spoon samplers, Shelby tube samplers;
- Teflon® bailers;
- Other purge and sampling equipment as required;
- Stainless steel spoons;
- Stainless steel compositing pan
- Slide hammer;
- Hand auger (stainless steel);
- Stainless steel cover for pan
- Stainless steel bucket augers
- Auger accessories

- Stainless steel or Teflon®-coated sample cutting wire;
- Polypropylene rope
- Plastic sheeting;
- DOT - approved drums for soil collection;
- Centrifugal pumps; and
- Surge blocks.

Sampling Bottles

- 40 ml VOA vials
- 250 ml wide-mouth glass with Teflon cap
- 500 ml wide-mouth glass with Teflon cap
- 1 L high density polyethylene
- 1 L amber glass with Teflon cap
- 500 ml plastic
- Bottle mesh
- 1 quart plastic freezer bags, (for transporting bottles and ice).

Chemicals

- ALCONOX trisodium phosphate soap - Radian;
- Conductivity standard, 1413 μohms;
- Hexane (Pesticide Grade);
- HCl (AR Select)
- HNO_3 (AR Select)

- H_2SO_4 (AR Select)
- Nitrogen;
- Ultra pure hydrogen;
- pH buffer (4, 7, 10);
- Reagent water, ASTM Type I; and
- Ultra High Purity (UHP) air.

Miscellaneous Field Gear and Instrumentation

- Bailer brushes
- Bulbs, N-butyl, no contact;
- Digital titrator kit
- Alkalinity test kit;
- Draeger tubes for appropriate suspected contaminants;
- E-line/well probe or steel tape;
- Filter (.45 μm)
- Filtering unit, pressure filter
- Nephelometric turbidity standards;
- Photoelectric nephlometer;
- Photoionization detector
- Latex gloves;
- First aid kit.

- Nitrile gloves
- Organic vapor analyzer
- pH/conductivity meter
- Pipettes, glass disposable;
- Prefilters
- Air purifying respirators including supplies of appropriate cartridges;
- Squirt bottles (polyethylene);
- Tape measure
- Thermometer
- Butyl rubber splash aprons and gloves;
- Gloves - latex, nitrite and silver shield gloves;
- Tyvek coveralls;
- Type A, B, C fire extinguisher;
- Eye wash;
- Explosimeter;
- Hermit transducers and data loggers;

4.2 Sampling Locations

Two sites are addressed in this CDAP. Information regarding the site location and past disposal practices will be collected and documented. In addition to site descriptions, the field activities, sampling rationale, sample locations and chemical analyses are discussed for each site. The locations of the T-38 Test Cell and Bldg. 828 are shown on Figure 4-1. Monitor wells and soil borings will be the methods used to investigate the sites.

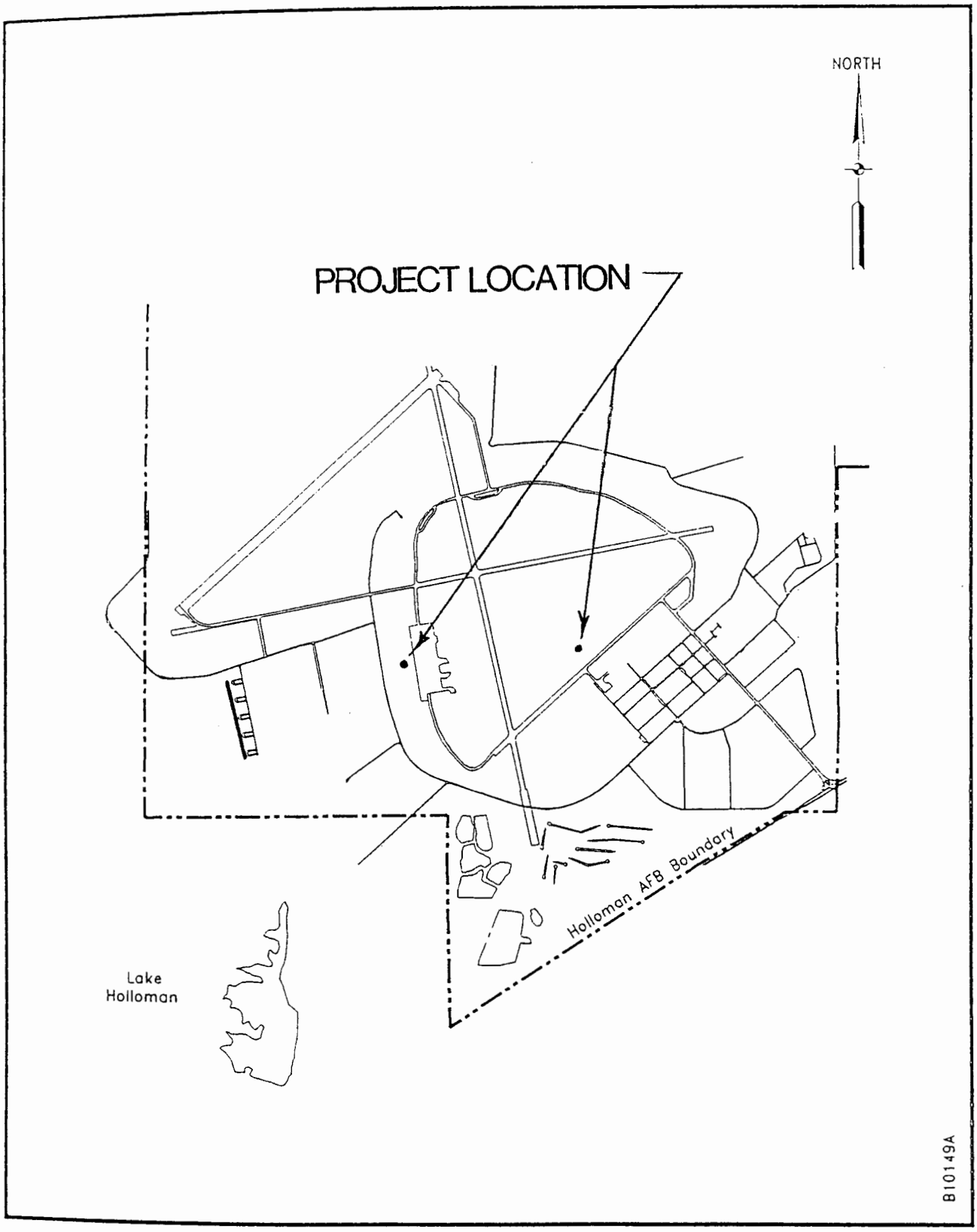


Figure 4-1 Map Showing Site Locations in the Main Base Area

4.2.1 T-38 Test Cell Fuel Spill

4.2.1.1 Site Description

The T-38 Test Cell is located northeast of Building 638 adjacent to the E-W taxiway (Figure 4-1). This SWMU is located near existing SWMUs 19 (Bldg. 638 Oil/Water Separator) and 53 (Bldg. 638 Waste Accumulation Area). The spill site is located approximately 60 feet south of SWMUs 19 and 53.

The T-38 Test Cell facility is used to test jet engines. From 1978 to present, JP-4 jet fuel has been stored at the facility in a 5000 gallon above ground storage tank. The storage tank is diked and inventoried on a regular basis. In 1991, approximately 2000 gallons of JP-4 were released due to leaking underground piping. Subsequent to this spill, the piping was replaced with above ground piping. No sampling has been accomplished to date.

4.2.1.2 Site Investigation

Field activities and chemical analyses for the T-38 Test Cell are discussed in the following paragraphs. Figure 4-2 illustrates the proposed monitor well, and soil boring locations.

A total of 14 soil borings will be drilled to groundwater to collect soil samples for chemical analysis. The sampling locations can be viewed in Figure 4-2. The borings will be spaced 25 feet apart in 4 rows. The rows will be spaced 25 feet apart and boring centers will be offset from each other by 25 feet. Split spoon samples will be collected every 2.5 feet for the first 10 feet and every 5 feet thereafter to groundwater. For all soil borings, the soil analyses will include volatile organics, petroleum hydrocarbons, organolead, and total metals.

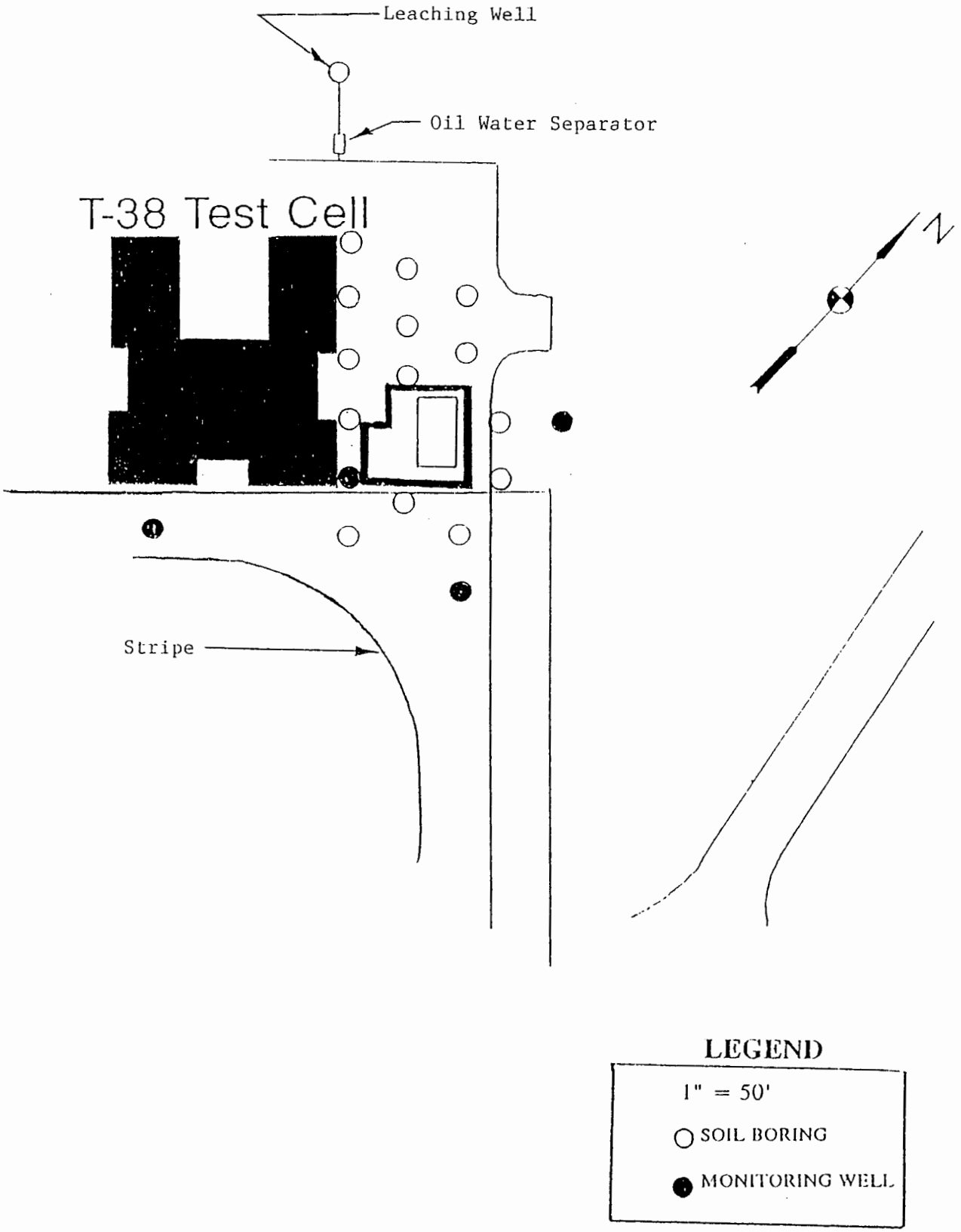


Figure 4-2 Map showing T-38 Test Cell Fuel Spill Site

A total of four monitor wells are proposed for site. One well will be installed upgradient and three wells will be installed at downgradient locations. The proposed locations of the monitoring wells can be viewed in Figure 4-2. These wells will be developed, sampled, and tested to determine point permeability of the aquifer. Field methods for these activities are outlined in Section 4.5. One round of groundwater samples will be collected and analyzed for volatile organics, anions, (anions refer to nitrate/nitrite, sulfate, fluoride, chloride, phosphate, and alkalinity each time it is mentioned), total dissolved solids, organolead and total metals. In addition, a total of two soil samples will be collected from monitor well borings and analyzed for geotechnical analyses, as outlined in Section 4.4.1.

4.2.2 Bldg. 828 Fuel Spill

4.2.1.1 Site Description

Building 828 is located in the West Area of the base (Figure 4-1). From 1987 to present, Bldg. 828 has been used to refuel aircraft support equipment. Three above ground storage tanks (6000 gallon capacity) are located at the facility. One tank contains diesel, one contains JP-4, and one contains unleaded gasoline. The 6000 gallon JP-4 tank and the 6000 gallon unleaded gasoline tank are used to fuel aircraft support equipment. The fuel tanks are diked and inventoried on a regular basis.

In 1991, 4700 gallons of unleaded gasoline were released to the environment when piping under the unleaded gasoline dispenser was broken and caused the fuel leak. The underground piping was repaired after the leak was detected. No sampling has been accomplished to date.

4.2.1.2 Site Investigation

Field activities and chemical analyses for the Building 828 Fuel Spill Site are discussed in the following paragraphs. Figure 4-3 illustrates the proposed monitor well and soil boring locations.

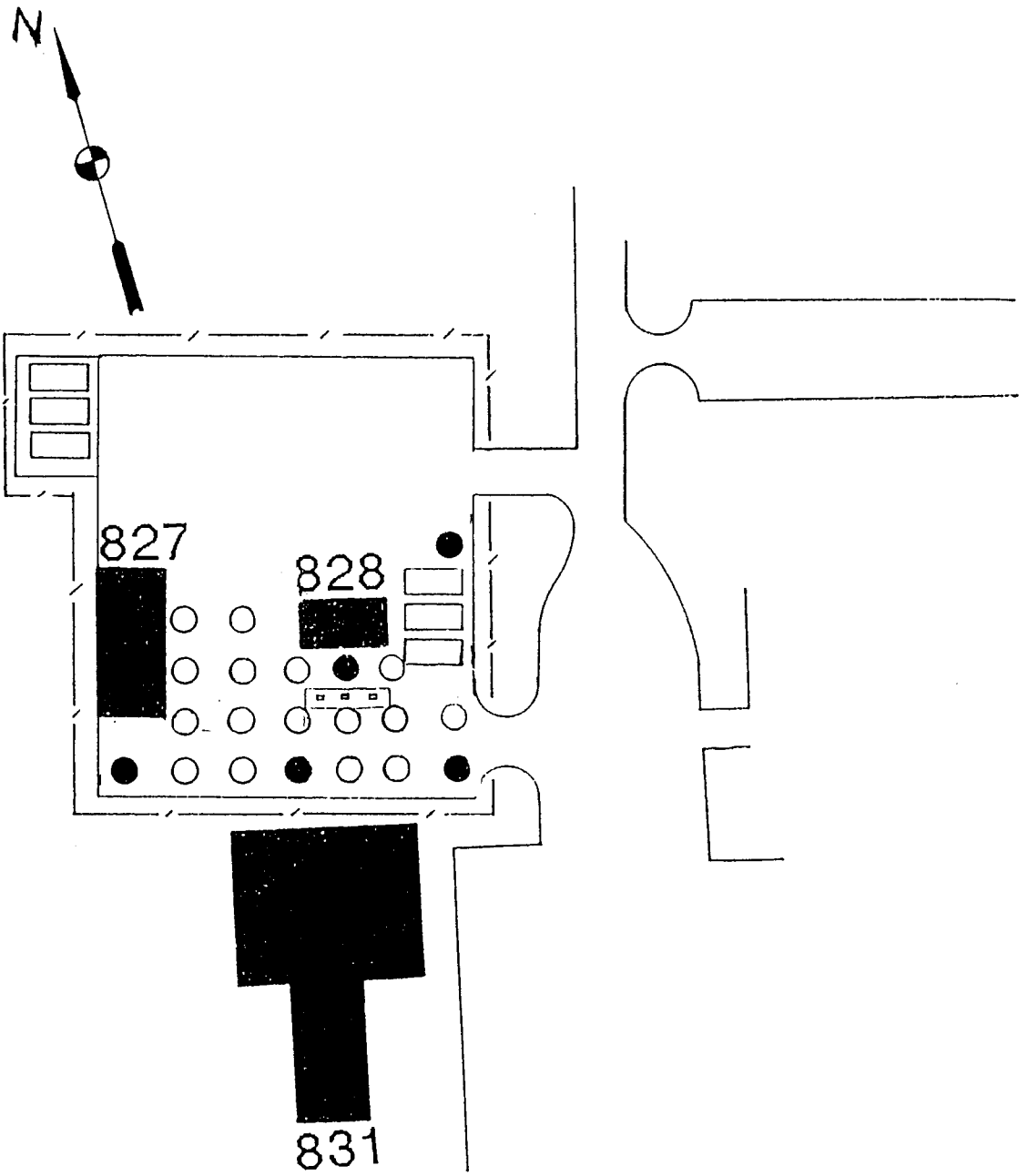


Figure 4-3 Map showing Building 828 Fuel Spill Site

LEGEND

1" = 100'

○ SOIL BORING

● MONITORING WELL

A total of 16 soil borings will be drilled to groundwater to collect soil samples for chemical analysis. The sampling locations can be viewed in Figure 4-3. The borings will be spaced 25 feet apart in 5 rows. The rows will be spaced 25 feet apart. Split spoon samples will be collected every 2.5 feet for the first 10 feet and every 5 feet thereafter to groundwater. For all soil borings, the soil analyses will include volatile organics, petroleum hydrocarbons, organolead and total metals.

A total of five monitor wells are proposed for the site. One well will be installed upgradient and four wells will be installed at downgradient locations. The proposed locations of the monitoring wells can be viewed in Figure 4-3. These wells will be developed, sampled, and tested to determine point permeability of the aquifer. Field methods for these activities are outlined in Section 4.5. One round of groundwater samples will be collected and analyzed for volatile organics, anions, (anions refer to nitrate/nitrite, sulfate, fluoride, chloride, phosphate, and alkalinity each time it is mentioned), total dissolved solids, organolead and total metals. In addition, a total of two soil samples will be collected from monitor well borings and analyzed for geotechnical analyses, as outlined in Section 4.4.1.

4.3 General Information and Definitions

4.3.1 Laboratory Information

4.3.1.1 Contractor Laboratories

All chemical analyses will be conducted by EPA certified laboratories.

4.3.2 Decontamination Procedures for Sampling Equipment

To ensure that soil and water sampling equipment are not contaminated or cross-contaminated by materials and equipment used in the course of the investigation, the following

procedures will be used to decontaminate hand augers, split-spoon samplers, water-level probes, Teflon® Bailers, and other sampling equipment between and before usage:

- Wash with ALCONOX® detergent;
- Rinse with potable water;
- Rinse with reagent grade hexane;
- Rinse with laboratory reagent grade water; and
- Allow to air dry.

The drilling augers and rods will be decontaminated with a high pressure, high temperature steam cleaner between each boring and monitor well. This method may also be used for split-spoon samplers unless samples are being collected for chemical analysis, in which case the decontamination procedure described above will be used. The drill rig will be decontaminated with the steam cleaner between each site. Wash and rinse water used during all decontamination activities will be handled according to the procedures outlined in Section 4.3.6.

4.3.3 Water-Level Measurements and Survey

The following procedures will be followed when performing water-level measurements:

- Wear protective clothing and equipment as required by the project Site Safety and Health Plan (SSHP);
- Unlock the well cover and remove the PVC cap;
- Using a photoionization detector (PID) or flame ionization detector (FID), monitor the air above the well opening and breathing zone to determine volatile organic emissions. Record the levels in the Field Log Book and proceed if the vapors in the breathing zone are below levels specified in the SSHP. If not, proceed as outlined in the SSHP;

- Inspect well, noting any deterioration, damage, or apparent tampering. Notify the Base Environmental Coordinator (BEC) if any repairs are necessary;

- Note height of stickup of protective casing above ground level and the distance between protective casing top to the top of the inner casing;

- Before each measurement, decontaminate the water-level probe as outlined in Section 4.3.2 of this CDAP;

- Lower the electronic probe into the well until water is encountered and note the depth on the calibrated tape relative to the surveyed reference point;

- Repeat the water-level measurement until two consecutive measurements agree within 0.01 foot;

- Sound the total depth of the well by lowering the probe to the bottom of the well;

- Record the depth to water on the sample recovery log form or Field Log Book;

- Decontaminate probe and the entire length of the water-level indicator which entered the well; and

- Cap and lock the well if no more activities will occur.

After all the monitor wells have been installed and developed, at least one synoptic water-level survey will be performed on all the wells installed during this investigation. The requirements for the synoptic water level survey are:

- The survey will be completed in one 24-hour period free of recharge events;

- An oil-water interface probe will be used to measure any non-aqueous layer if present;

- A water-level-meter calibration will be performed if more than one probe is being used; and

- The procedures for performing water-level measurements described above will be followed.

Water level meters will be calibrated by measuring the water level in a single well with all the probes. If the measurements vary, the difference will be documented in the Field Log Book, and adjustments will be made after the survey is completed.

4.3.4 Description of Field Instrument Calibration for the pH/Specific Conductivity Meter

Because of the wide variety of pH/specific conductivity meters and accessories, detailed operation procedures cannot be incorporated into this method. Each analyst must be acquainted with the operation of each system and familiar with all instrument functions. Special attention to care of the electrodes is recommended.

Before and after each day of sampling, a calibration check will be performed to ensure the pH/specific conductivity meter is working properly. The following steps outline pH instrument calibration:

- Each instrument/electrode system must be calibrated at a minimum of three points (typically pH buffers 4, 7, and 10) that bracket the expected pH of the samples and are approximately three pH units or more apart. Various instrument designs may involve use of a "balance" or "standardize" dial or slope adjustment as outlined in the manufacturer's instructions. Repeat adjustments on successive portions of the two buffer solutions until readings are within 0.05 pH units of the buffer solution value.

- Place the sample or buffer solution in a clean glass beaker using a sufficient volume to cover the sensing elements of the electrodes and to give adequate clearance of the magnetic stirring bar. If field measurements are being made, the electrodes may be immersed directly in the sample stream to an adequate depth and moved in a manner to ensure sufficient sample movement across the electrode-sensing element as indicated by drift-free (less than 0.1 pH readings).

- If the sample temperature differs by more than 2°C from the buffer solution, the measured pH values must be corrected. The instrument will be equipped with manual or automatic compensators that electronically adjust for temperature differences. Refer to manufacturer's instructions.

- The electrodes will be thoroughly rinsed with distilled water and gently wiped prior to measuring pH of samples. Immerse the electrodes into the sample beaker or sample stream and gently stir at a constant rate to provide homogeneity and suspension of solids. Note and record sample pH and temperature. Repeat measurement on successive volumes of sample until values differ by less than 0.1 pH units. Two or three volume changes are usually sufficient.

The specific conductivity of the meter will be calibrated with a single standard of potassium chloride in water. Depending on instrument design, a "balance," "slope," or "standardize" dial will be adjusted as detailed in the manufacturer's instructions in order to reflect the specific conductivity of the standard solution. The specific conductivity meter will be capable of readings of $> 100,000$ μohms as the groundwater at Holloman AFB is very high in dissolved solids (measured as TDS).

4.3.5 Disposal of Drill Cuttings, Development Water and Purge Water

All drill cuttings will be considered potentially contaminated except unsaturated cuttings from monitor well boreholes not placed in areas of expected contamination. These clean cuttings will either be spread out at the site or collected and transported to a location on Base specified by the Base Environmental Coordinator (BEC). This will be done with a backhoe at each site after completion of drilling activities at all sites. Cuttings from all test borings, along with saturated cuttings from monitor well borings, will be drummed on pallets, labeled, and banded together. At the completion of all drilling activities, these pallets will be collected and transported to a location on Base specified by the BEC for storage.

All drums will be adequately labeled prior to being moved to the staging area. Drums labels will be painted, not using a "Magic Marker" or equivalent felt-tip marker or be labeled on the top. At a minimum, drums will be labeled as to the type of material contained, site

number and location, boring numbers, and the telephone number of the BEC. The eventual disposal of the contents of these drums will be determined by the results of the associated analytical tests for the various sites of this project. The contractor will be responsible for providing analytical results to the BEC. The contractor will be responsible for off-base disposal of any drums that contain contaminated material.

All development water, purge water, and decontamination water will be considered potentially contaminated. One decontamination station will be constructed to handle all project wastewater. The potentially contaminated water will be collected in a plastic lined basin and allowed to evaporate. The basin will be constructed as a large above-ground swimming pool and have a minimum depth of four feet. The station will be constructed at a location specified by the BEC. The size will be large enough to hold rainfall and run-off water without allowing overflow. Evaporation rates are very high at Holloman AFB (67 inches per year), which will provide an environmentally safe method of water disposal. After all activities are completed, the plastic liner will be drummed and transported to a location on the Base specified by the BEC. If directed by the BEC, the decontamination station will be removed and the site will be restored to its previous condition at the completion of site activities.

4.3.6 Site Restoration

Each site will be restored to its original state within 10 working days of completion of the field investigation. The restoration efforts will meet the approval of the Base Environmental Coordinator's (BEC's) office. Appropriate photographs will be taken both before and after field work activities to document this restoration. Copies of these photographs will be provided to the BEC within one week after they are taken.

4.4 Sampling and Preservation Procedures

Sampling and analytical efforts to be completed for the Holloman RFI are to characterize the soil and/or groundwater at two sites. The following section discusses the sampling methodologies and field documentation procedures. For each sampling methodology the following are discussed: sample locations; sampling and QA/QC procedures; analyses; and

sample containers, preservation, and holding times. Figures 4-2 and 4-3 in Section 4.2 show the sites and the proposed soil and groundwater sampling locations selected for the Holloman AFB RFI.

4.4.1 Soil Boring Samples

4.4.1.1 Sampling Procedures--Analytical Samples

Soil samples will be obtained using a split-spoon sampler (ASTM Method D 1586-84). A 140-pound drop hammer will be used to drive the split-spoon a maximum of 2 feet. The blow counts will be counted every 6 inches. After removing the split-spoon, it is opened lengthwise to allow screening for volatile organic emissions with a photoionization detector (PID) or a flame ionization detector (FID). Immediately following the screening, samples for volatile organic compounds will be collected. A representative sample from the entire length of the split-spoon will be collected prior to compositing or homogenization. Volatile organic samples are collected first to minimize the loss of volatile organic compounds. The samples for the other analyses either will be collected from a discrete interval (one split-spoon) or will be a composite of several intervals (two or more split-spoons). Homogenization and compositing will be done in a decontaminated stainless steel bowl. All sample collection will be done with decontaminated stainless steel equipment and minimum contact with decontaminated gloves.

After the samples are collected, visual, physical and other characteristics will be recorded on the boring logs. Soil will be classified according to the Unified Soil Classification System. Logging requirements are explained in detail in Section 4.5.2.2.

Upon completion of the boring, the boring will be backfilled with cement grout. The cement grout will consist of a mixture of one bag of Portland cement (ASTM C 150), 7 gallons of water and 3 to 5 pounds of bentonite powder. If water is encountered in the boring, a water level measurement will be taken prior to grouting the boring. Grout will be pumped through a tremie pipe which extends to within 10 feet of the bottom of the boring. Pumping will continue until undiluted grout flows from the top of the boring. If the grout settles, the hole will be topped off with grout.

4.4.1.2 Geotechnical Samples

A total of 2 soil samples will be collected from the screened interval for geotechnical analysis from monitor well locations for each site.

Some of the geotechnical analyses require that the sample is undisturbed; therefore, shelby tubes, or a similar method will be used for sample recovery. A shelby tube sampler is advanced by using steady pressure and will not be impact driven. Proper sealing of the shelby tube samples will be accomplished by using cryptocrystalline paraffin and care will be taken so that the samples are not jarred or dropped.

4.4.1.3 Quality Assurance/Quality Control Sample Procedures

The following paragraphs discuss the field QA/QC samples for analytical soil samples and their collection frequency and procedures.

QA and QC Split Samples - QA and QC split samples (duplicates) will be collected for all analyses for each analyte. The soil will be homogenized and divided equally among all containers for both standard and duplicate samples.

Matrix Spike and Matrix Spike Duplicate (MS/MSD) - QC MS/MSD samples will be collected for each analysis. No extra set of sample containers will be necessary for the MS and MSD analyses samples except for SW 8240.

Trip Blanks - QA and QC trip blanks consist of 40 mL VOA vials filled by the laboratory with Type I reagent water. Trip blanks will accompany all ice chests that contain volatile organic samples during both the sampling activities and the shipping procedures.

4.4.1.4 Analyses

Soil samples collected for chemical analysis will be analyzed by an EPA certified laboratory for all chemical analysis. At each site, one saturated sample from each of

two monitor well borings will be collected by Shelby tube from the screened interval and analyzed for atterburg limits (ASTM D 4318), grain-size distribution (ASTM D 421 & 422 - without hydrometer test) and porosity.

4.4.1.5 Sample Containers, Preservation, and Holding Times

The sample containers, preservation measures, and holding times for the soil analyses to be conducted are summarized in Table 4-1. All containers used for chemical analyses will be pre-cleaned by the supplier, in accordance with EPA protocol.

When placing samples in VOA vials, all bottles will be gently packed and capped without headspace. The remaining bottles will be filled allowing for adequate headspace. The sample label will be affixed to the bottle, labeled with the field sample number and the other required information in indelible ink (Section 5.0).

All soil samples collected for chemical analysis will be chilled to approximately 4°C during collection and shipment with regular ice in a plastic bag. The samples will be stored upright in a durable ice chest. Sufficient packing material (e.g., vermiculite) will be used to separate the bottles, filling any intervening voids.

4.4.2 Groundwater Samples

4.4.2.1 Sample Locations

One round of groundwater samples will be collected from all eight (1 upgradient, 3 downgradient at each site) monitor wells .

4.4.2.2 Groundwater Sampling Procedures

Prior to any sampling, the depth to the groundwater and total well depth will be measured from the surveyed reference point at the wellhead of each monitoring well. The reference point will be identified by a notch on the top north side of the PVC well casing. Water-level measurements will be made with a decontaminated electronic water-level meter

Table 4-1

Summary of Soil Sampling and Analysis Requirements

Reference Method	Parameter	Method Type	Container Type, No., and Volume[a]	Preservation and Storage Requirements	Sample Preparation Procedures	Maximum Holding Time (Preparation)	Maximum Holding Time (Analysis)
SW-846:6010	Sb, Cu, Tl, Be, Cd, Ag, Cr, Ni, Zn	ICPES	(1) 250 mL glass bottle or polyethylene[b]	Refrigerated at 4°C	SW-846:3050 Acid digestion	N/S	6 months
SW-846:7060	As	GFAA	(1) 250 mL glass bottle or polyethylene[b]	Refrigerated at 4°C	SW-846:3050 Acid digestion	N/S	6 months
SW-846:7421	Pb	GFAA	(1) 250 mL glass bottle or polyethylene[b]	Refrigerated at 4°C	SW-846:3050 Acid digestion	N/S	6 months
SW-846:7471	Hg	CVAA	(1) 250 mL glass bottle or polyethylene[b]	Refrigerated at 4°C	SW-846:7471 Acid digestion	N/S	28 days
SW-846:7740	Se	GFAA	(1) 250 mL glass bottle or polyethylene[b]	Refrigerated at 4°C	SW-846:3050 Acid digestion	N/S	6 months
HML:338	Organic Lead	FAA/GFAA	(1) 250 mL glass Teflon-lined cap	Refrigerated at 4°C	HML:338 Xylene Extraction	N/S	N/S
SW-846:8240	Volatile Organics	GC/MS	(3) 40 mL VOA vials	Refrigerated at 4°C	SW-846:5030 Purge and Trap	N/A	14 days
SW-846:8270	Semivolatile Organics Compounds	GC/MS	(1) 250 mL glass bottle with Teflon lined cap	Refrigerated at 4°C	SW-846:3550 Sonication	14 days	40 days

(Continued)

Table 4-1

(Continued)

Reference Method	Parameter	Method Type	Container Type, No., and Volume[a]	Preservation and Storage Requirements	Sample Preparation Procedures	Maximum Holding Time (Preparation)	Maximum Holding Time (Analysis)
SW-846:8080	Pesticides/PCBs	GC/ECD	(1) 250mL glass, Teflon-lined cap	Refrigerated at 4°C	SW-846:3550 Sonication	14 days	40 days
SW-846:8140	Organophosphorus Pesticides	GC/FPD	(1) 250 mL glass, Teflon-lined cap	Refrigerated at 4°C	SW-846:3550 Sonication	14 days	40 days
SW-846:8150	Chlorinated Herbicides	GC/ECD	(1) 250 mL glass, Teflon-lined cap	Refrigerated at 4°C	SW-846:8150 Extraction/Esterification	14 days	40 days
EPA:418.1	Total Recoverable Petroleum Hydrocarbons	IR	(1) 250 mL glass, Teflon-lined cap	Refrigerated at 4°C	SW-846:9071 Soxhlet Extraction	NS	28 days
ASTM D422	Particle Size Distribution	Sieving	(1) 500 mL glass	none	N/A	N/A	NS
ASTM D4318	Atterburg Limits	Gravimetric	(1) 250 mL glass	none	ASTM D4318 Rolling/ Oven-Dry	NS	NS
ASTM D2216	Moisture	Gravimetric	(1) 250 mL glass	none	ASTM D2216 Oven-Dry	NS	immediately
SW-846:9045	pH	Electrometric	(1) 250 mL glass	none	SW-846:9045 Dissolution	immediately	immediately
SW-846:8020	Aromatic Volatile Organics	GC/PID	(2) 40 mL VOA vilas	Refrigerated at 4°C	SW-846:5030 Purge and Trap	N/A	14 days
EPA:413.2	Oil and Grease	IR	(1) 500 mL glass bottle	Refrigerated at 4°C	N/A	N/A	28 days

(Continued)

Table 4-1

(Continued)

Reference Method	Parameter	Method Type	Container Type, No., and Volume[a]	Preservation and Storage Requirements	Sample Preparation Procedures	Maximum Holding Time (Preparation)	Maximum Holding Time (Analysis)
Sw-846:9060	Total Organic Carbon	Oxidation/NDIR	(1) 500 mL glass bottle	Refrigerated at 4°C	N/A	N/A	14 days

ICPES = Inductively Coupled Plasma Emission Spectroscopy
FAA = Flame Atomic Absorption
GFAA = Graphite Furnace Atomic Absorption
CVAA = Cold Vapor Atomic Absorption
IR = Infrared Spectrometry
GC/MS = Gas Chromatograph/Mass Spectrometric
GC/FID = Gas Chromatograph/Flame Ionization Detector
GC/FPD = Gas Chromatograph/Flame Photometric Detector
GC/ECD = Gas Chromatograph/Electron Capture Detector
N/A = Not applicable
N/S = Not specified
GC/PID = Gas Chromatography/Photoionization Detector

[a]Extra sample must be collected for matrix spike/matrix spike duplicate analysis.

[b]One 250 mL bottle will provide sufficient sample volume for all metals analyses.

and reported to the nearest 0.01 foot. Measurements will be taken repeatedly until two consecutive measurements are consistent within 0.01 foot. Detailed instructions for taking water-level measurements are outlined in Section 4.3.3.

The measurements will be used to calculate the well volumes required for purging. Casing volumes will be determined using the formula:

$$\text{Volume (gallons)} = r^2h \times 7.48 \text{ gal}$$

where: r = radius of the well casing (feet); and
h = height of the wetted column (feet).

A minimum of five wetted well casing volumes of groundwater will be purged from each well prior to sample collection. Purging will be accomplished by using a pump or a Teflon® bailer with new polypropylene rope. All purging equipment that is placed down the well will be decontaminated prior to use. If a well is pumped or bailed dry prior to purging five wetted well volumes, groundwater samples will be collected as soon as the well has recovered sufficiently to collect the necessary samples. Purge water will be poured into a five-gallon bucket and containerized. Disposal of the purge water will be handled as discussed in Section 4.3.6.

If a non-aqueous layer is detected, the thickness will be determined and a sample will be collected prior to purging the well. The sample will be exclusively sent to a QA laboratory for analysis. Following purging, special attention will be given to minimize any possible contamination of the groundwater from a non-aqueous layer if present.

Groundwater samples will be collected with a decontaminated Teflon® bailer or the same bailer that was used for purging the well. Clean, disposable gloves will be worn during sampling activities and a polypropylene line will be used to lower the bailer into the well. Care will be taken to minimize disturbance of the groundwater. Groundwater will be

collected from the middle of the screened interval of the well. Samples will be containerized in the following order to minimize the loss of volatile compounds:

- Volatile organic compounds;
- Semivolatile organic compounds; and
- Metals.

Field measurements of temperature, pH, and specific conductivity will be made before and after all samples have been collected. Also, alkalinity will be analyzed in the field.

Samples will be immediately placed on ice and maintained at 4°C until they are received by the laboratory. As required, samples will be pH-adjusted prior to shipment. Samples will be packaged, shipped and stored in a manner which avoids contamination and ensures sample integrity.

4.4.2.3 Quality Assurance/Quality Control Sample Procedure

The following paragraphs discuss the field QA/QC samples for groundwater and their collection frequency and procedures.

QA and QC Split Samples - One QA and QC split sample will be collected. Split samples will be poured from the same bailer so that all containers will have a representative portion.

Matrix Spike and Matrix Spike Duplicate (MS/MSD) - A QC MS/MSD sample will be collected at each site for each analysis. The samples will be poured from the same bailer so that all containers will have a representative portion. Three extra sets of bottles are required; one set for MS, the second for MSD and a third for laboratory duplicates for each analysis

QC Rinsate Samples - A QC rinsate sample will be collected at each site for each analyte. Rinsate blanks will be collected by pouring laboratory grade

reagent water in a decontaminated Teflon® bailer prior to sampling a well. The water will then be poured into the appropriate container for all analyses that will be performed on samples collected at that well.

Trip Blanks - QA and QC trip blank samples will accompany field sample containers with volatile organic samples only. Two trip blank vials will be required to accompany each shipment of groundwater samples for volatile organic analysis from the time of collection to the arrival at the laboratory.

4.4.2.4 Analyses

Groundwater samples will be sent to an EPA certified laboratory for analysis.

4.4.2.5 Sample Containers, Preservations, and Holding Times

In order to preserve the integrity of the groundwater sample before it is analyzed, proper sample containment, preservation methods, holding times and shipping and chain-of-custody procedures must be followed. Sample bottles, preservation methods, and holding times are given in Table 4-2. All sample bottles and containers will be pre-cleaned and checked according to EPA protocols.

When placing samples in VOA vials, all bottles will be gently filled and capped without any headspace. The remaining bottles will be filled allowing for adequate headspace. The sample label will be affixed to the bottle, labeled with the field sample number, and the other required information in indelible ink (Section 5.0).

All groundwater samples will be kept cool during collection and shipment with regular ice contained in a plastic bag. The samples will be stored upright in a durable ice chest. Sufficient packing material (e.g., vermiculite) will be used to separate and protect the bottles.

Table 4-2

Summary of Groundwater Sampling and Analysis Requirements

Reference Method[a]	Parameter	Method Type	Container Type, No., and Volume	Preservation and Storage Requirements	Sample Preparation Procedures	Maximum Holding Time (Preparation)	Maximum Holding Time (Analysis)
SW-846:6010	Sb, Be, Cd, Cr, Cu, Tl, Zn, Ag, Ni	ICPES	(1) 500 mL polyethylene bottle[c]	Filter in field, pH <2 w/HNO_3	SW-846:3005 HNO_3/HCl digestion	N/S	6 months
SW-846:7060	As	GFAA	(1) 500mL polyethylene bottle[c]	Filter in field, pH <2 w/HNO_3	SW-846:7060 HNO_3/H_2O_2 digestion and addition of nickel nitrate	N/S	6 months
SW-846:7421	Pb	GFAA	(1) 500 mL polyethylene bottle[c]	Filter in field, pH <2 w/HNO_3	SW-846:3020 HNO_3 digestion	N/S	6 months
HML:338	Organic Lead	FAA/GFAA	(1) 1000 mL glass teflon-lined cap	Refrigerated at 4°C	HML:338 Xylene Extraction	N/S	N/S
SW-846:7470	Hg	CVAA	(1) 500 mL polyethylene bottle[c]	Filter in field, pH <2 w/HNO_3	SW-846:7470 Acid digestion	N/S	28 days
SW-846:7740	Se	GFAA	(1) 500mL polyethylene bottle[c]	Filter in field, pH <2 w/HNO_3	SW-846:7740 HNO_3/H_2O_2 digestion, addition of nickel nitrate	N/S	6 months
SW-846:8080	Pesticides/PCBs	GC/ECD	(1) 1000 mL amber glass, teflon-lined cap	Refrigerated at 4°C	Sw-846:3520 Extraction	7 days	40 days
SW-846:8140	Organophosphorus Pesticides	GC/FPD	(1) 1000 mL amber glass, teflon-lined cap	Refrigerated at 4°C	SW-846:3520 Extraction	7 days	40 days
SW-846:8150	Chlorinated Herbicides	GC/ECD	(1) 1000 mL amber glass, teflon-lined cap	Refrigerated at 4°C	SW-846:8150 Extraction/Esterification	7 days	40 days

(Continued)

Table 4-2

(Continued)

Reference Method[a]	Parameter	Method Type	Container Type, No., and Volume	Preservation and Storage Requirements	Sample Preparation Procedures	Maximum Holding Time (Preparation)	Maximum Holding Time (Analysis)
EPA:300.0	Chloride and Sulfate	IC	(1) 1000 mL amber glass	Refrigerated at 4°C	N/A	N/A	28 days
EPA:310.1	Alkalinity	Titrametric	(1) 1000 mL amber glass	Refrigerated at 4°C	N/A	N/A	28 days
EPA:353.2	Nitrate/Nitrite	Colorimetric	(1) 1000 mL amber glass	Refrigerated at 4°C, H_2SO_4 to pH2	N/A	N/A	28 days
EPA:160.1	Total Dissolved Solids	Gravimetric	(1) 250 mL amber glass	Refrigerated at 4°C	N/A	N/A	48 hours
SW-846:8330	Explosives	HPLC	(1) 2.34 L amber glass	Refrigerated at 4°C	SW-846:8330 Salting Out	7 days	40 days
SW-846:8240	Volatile Organics	GC/MS	(3) 40 mL VOA vials[d]	Refrigerated at 4°C, pH <2 w/HCl	SW-846:5030 Purge and Trap	N/A	14 days
SW-846:8270	Semivolatile Organics	GC/MS	(1) 1000 mL glass; TFE-lined cap[d]	Refrigerated at 4°C	SW-846:3520 Liquid-Liquid Extraction	7 days	40 days
SW-846:9310	Gross Alpha and Beta	Gas-Flow proportional counting	(1) 1000 mL glass or plastic	Refrigerated at 4°C, pH<2 w/HNO_3	Oven dry	N/A	6 months
EPA:365.2	Phosphate	Colorimetric	(1) 1000 mL glass	Refrigerated at 4°C	N/A	N/A	48 hours
EPA:340.2	Fluoride	SIE	(1) 500 mL plastic bottle	None	N/A	N/A	28 days

(Continued)

Table 4-2

(Continued)

FAA = Flame Atomic Absorption
ICPES = Inductively Coupled Plasma Emission Spectroscopy
GFAA = Graphite Furnace Atomic Absorption
CVAA = Cold Vapor Atomic Absorption
IC = Ion Chromatography
IR = Infrared Spectrometry
GC/MS = Gas Chromatograph/Mass Spectrometric
GC/ECD = Gas Chromatograph/Electron Capture Detector
GC/PID = Gas Chromatography/Photoionization Detector
GC/FID = Gas Chromatograph/Flame Ionization Detector
GC/FPD = Gas Chromatograph/Flame Photometric Detector
SIE = Selective Ion Electrode
N/A = Not applicable
N/S = Not specified
CVAA = Cold Vapor Atomic Absorption

[a]Extra sample must be collected for matrix spike/matrix spike duplicate analysis.

[b]One 500 mL sample will provide sufficient sample volume for all metals analyses, except for organic lead.

4.4.3 Field Documentation

4.4.3.1 Field Log Book and Other Documentation

A Field Log Book is kept by the contractor Supervising Geologist. All other personnel involved in field activities will be required to keep a similar log book. The field log book will serve primarily as a daily log of activities carried out during the investigation. Any observations during drilling activities not included in the drilling log will be recorded in this book. Other observations may be included as the situation dictates for a thorough record to reconstruct the events concerning all field activities. The field log book is a bound book with sequentially numbered pages and with a unique document control number.

A separate log book will also be used during sampling activities to record sampling locations and the unique number assigned to the corresponding samples collected from that particular monitor well or soil sampling location. This will be done in addition to the required chain-of-custody forms.

The Supervising Geologist will complete A-E Daily Quality Control Reports (A-E DQCR) at the end of each day. These reports will be completed and sent to the BEC on a weekly basis.

4.4.3.2 Photographs

Field activities will be visually documented by the contractor Supervising Geologist with 35-mm color slides. The Supervising Geologist will record photographs with a brief description of each in the field log book. At a minimum, photos of the site will be taken of each site before and after the field investigation to document site restoration.

4.5 Monitor Well Installation Plan

Eight new groundwater monitor wells will be installed at two locations. These new monitor wells will be properly developed, sampled, and analyzed for parameters

according to the workplan. In-situ permeability testing will be conducted on the wells in order to assist in the evaluation of the hydrogeologic conditions present at Holloman AFB. Well construction will be in accordance with specifications contained in the CDAP for the purpose of examining the groundwater for the presence of contamination and defining the local hydrogeology. Procedures in the workplan will be followed for protection of the water-yielding zones from contamination, and all state and local certification requirements will be met. An experienced geologist or hydrogeologist will be on site for all drilling operations.

4.5.1 Drilling Equipment and Materials

All drilling will be accomplished using the hollow-stem auger method. This method performs well in unconsolidated sediments, allows the rig to operate without the use of drilling fluids, and permits ease of collection for relatively undisturbed formation samples. For the depths and geology involved, this drilling method will provide fast and efficient performance. The hollow-stem auger rig will use five-foot sections of at least 8-inch O.D. and 3.75-inch I.D. hollow-stem auger flight. In borings that will receive monitoring wells, the boring diameter will be such that there will be at least two (2) inches of annular space between the formation exposed at the boring wall and the outside diameter of the centered well casing. Samples from the soil borings will be collected with a standard split-spoon sampler (ASTM D 1586-84) or thin-wall tube sampler (ASTM-D 1587-74) using standard sampling methods.

4.5.2 Drilling Procedures

4.5.2.1 Initial Activities

The exact location and depth of test wells for each site will be determined in the field by the Supervising Geologist or Task Leader in consultation with the BEC or field representative. Field drilling operations and logistics will be coordinated with the Holloman AFB Environmental Engineering Department and the appropriate Base authorities to obtain digging permits.

4.5.2.2 Drilling Protocol

Soil core samples will be collected continuously to the total depth drilled for the first boring at each site for the purpose of describing subsurface geology. For subsequent monitor well borings, the borehole will be sampled at intervals determined by the on-site geologist. All borehole lithological descriptions will be made by the geologist on site and recorded on a borehole lithologic form shown in Figure 4-4. The soil samples will be visually classified according to the Unified Soil Classification System.

The total depths of each well and the screened interval will be decided by the on-site geologist on a site-by-site basis. The depths and construction of each well will depend on the geology and groundwater conditions encountered during drilling. Boreholes that are not completed as wells will be entirely plugged to the surface with a bentonite/cement slurry emplaced through the hollow stem augers. All cuttings produced from drilling activities will be managed as discussed in Section 4.3.5.

4.5.3 Well Installation

Upon reaching a depth of approximately 10 feet below the water table, each well will be installed to provide representative water samples from the uppermost water bearing zone. The length of the screen will be installed above and below the water table to allow for water table fluctuation and to collect a light non-aqueous phase layer, if present.

4.5.3.1 Well Screen and Casing

The screen will consist of two-inch diameter, Schedule 40 PVC continuous wrap design which meets ASTM F 480-81. The screen size will be 0.010 or 0.020 inch, and the proper screen size for each well will be determined by the Geologist on-site. The screened section will be joined to a two-inch diameter, Schedule 40 PVC (which also meets ASTM F 480-81), flush threaded casing. The casing will extend from the top of the screen to at least ground surface. The material lengths selected will be based on site-specific groundwater conditions encountered (a 10-foot screen is recommended). The screen will be capped with a threaded PVC cap or plug at the bottom, and all connections will be flush jointed and

DRILLING LOG

HOLE NO.

61773

1. COMPANY NAME RADIAN CORPORATION

2. DRILLING SUBCONTRACTOR SOUTHWEST ENG INC

SHEET 1 OF SHEETS

3. PROJECT HOLLOMAN AFB RI/FS

4. LOCATION

5. NAME OF DRILLER

6. MANUFACTURER'S DESIGNATION OF DRILL

7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT

8. HOLE LOCATION

9. SURFACE ELEVATION

10. DATE STARTED

11. DATE COMPLETED

12. OVERBURDEN THICKNESS

15. DEPTH GROUNDWATER ENCOUNTERED

13. DEPTH DRILLED INTO ROCK

16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED

14. TOTAL DEPTH OF HOLE

17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)

18. GEOTECHNICAL SAMPLES: DISTURBED | UNDISTURBED

19. TOTAL NUMBER OF CORE BOXES

20. SAMPLES FOR CHEMICAL ANALYSIS: VOC | METALS | OTHER (SPECIFY) | OTHER (SPECIFY) | OTHER (SPECIFY)

21. TOTAL CORE RECOVERY %

22. DEPOSITION OF HOLE: BACKFILLED | MONITORING WELL | OTHER (SPECIFY)

23. SIGNATURE OF INSPECTOR

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h

PROJECT

HOLE NO.

Figure 4-4 Borehole Logging Form

DRILLING LOG

HOLE NO.

PROJECT HOLLOMAN AFB RI/FS

INSPECTOR

SHEET OF SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h

PROJECT

HOLE NO.

Figure 4-4 (Continued)

threaded. Since all well screen and casing materials will be centered in the borehole through the use of the hollow stem auger drilling method, centralizers will not be necessary for the alignment of the well. Prior to installation, the casing and screen sections will be thoroughly washed with potable water using a high-temperature, high-pressure sprayer. No solvent PVC or other glue will be used in the construction of the wells. A typical monitor well construction schematic is shown in Figure 4-5. A sample form for recording well completion data in the field is shown in Figure 4-6. Monitor well completion diagrams will be submitted to the USACE-PM within 10 calendar days after monitor well installation is completed.

4.5.3.2 Filter Pack

After the casing and screen have been installed for each well, a sand or gravel pack will be emplaced in the annular space around the well. The pack will consist of washed and bagged rounded sand with a grain size distribution of 16-40 gradation. The Geologist on-site will select the filter pack compatible with the screen and the formation at each well. The pack will be introduced into place between the well casing and inside wall of the hollow stem auger in such a manner as to avoid bridging and ensure a continuous filter pack. The pack will be checked with a weighted steel tape to ensure that no bridging has occurred. Augers will be retracted in one- to two-foot intervals. Sand will be added and measurements completed at each interval until packing has been completed. The filter pack will extend approximately 1 foot below and 2 to 4 feet above the well screen.

4.5.3.3 Bentonite Seal

A granular bentonite/water slurry will be placed above the sand/gravel pack to a minimum thickness of 3 feet to provide an adequate seal. The bentonite will be tremied into place through the augers. Augers will be retracted and measurements will be made to ensure proper seal placement.

4.5.3.4 Grout Mixture

Neat cement grout will be emplaced from above the top of the bentonite seal to land surface. Cement grout shall consist of a mixture of not more than 7 gallons of water and

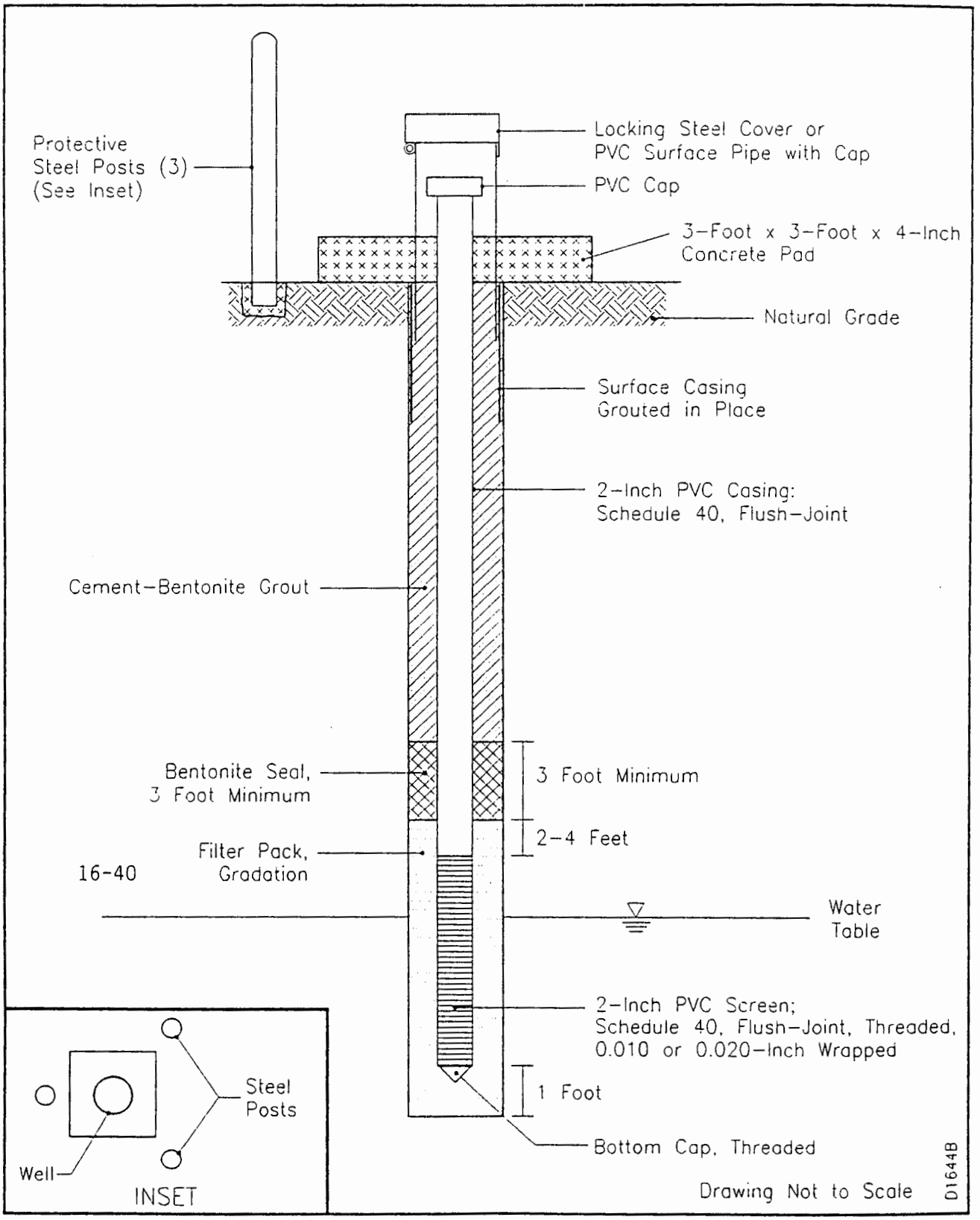
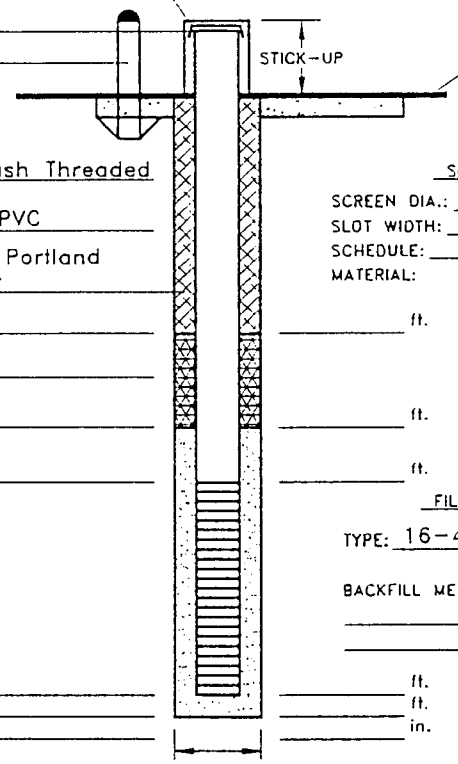


Figure 4-5 Typical Monitor Well Construction

ELEVATION GROUND WATER			PROJECT HOLLOMAN AFB RI/FS
DATE INSTALLED	STARTED	COMPLETED	LOCATION (Coordinates or Station)
ELEVATION TOP OF HOLE			SIGNATURE OF INSPECTOR/INSTALLER
DRILLING METHOD			WELL NO. (as shown on drawing: title and file number)

MONITORING WELL CONSTRUCTION DIAGRAM

(ALL MEASUREMENTS FROM GROUND SURFACE)



PROTECTIVE CASING

TYPE OF PROTECTIVE CASING. _____

TOP OF WELL

PROTECTIVE POSTS

CASING DIAMETER: 2 in.

TYPE OF PIPE JOINTS: Flush Threaded

TYPE OF BLANK CASING: PVC

BACKFILL/GROUT MIX ETC. Type I Portland Cement

TOP OF SEAL

TYPE OF SEAL:

TOP OF FILTERPACK

TOP OF SCREEN

FILTER PACK

BOTTOM OF WELL

BOTTOM OF BORING

BORING DIAMETER

LENGTH OF SOLID PIPE _____ ft.

WELL SCREEN LENGTH _____ ft.

GROUND SURFACE

CONCRETE PAD MIN. _____ THICKNESS

SCREEN INFORMATION

SCREEN DIA.: 2 in.

SLOT WIDTH: 0.010 in.

SCHEDULE: 40

MATERIAL: ☒ PVC ☐ STAINLESS STEEL ☐ OTHER (DESCRIBE) _____

_____ ft.

_____ ft.

_____ ft.

FILTERPACK MATERIAL

TYPE: 16-40 Colorado Silica Sand

BACKFILL METHOD: _____

_____ ft.

_____ ft.

_____ in.

WELL DEVELOPMENT

METHOD: _____

TIME SPENT DEVELOPING: _____

VOLUME OF WATER REMOVED: _____

VOLUME OF WATER ADDED: _____

DESCRIPTION OF PREDEVELOPMENT WATER: _____

DESCRIPTION OF POST DEVELOPMENT WATER: _____

WATER LEVEL SUMMARY

WATER LEVEL MEASUREMENTS

DATE/TIME/LEVEL _____

DEPTH FROM TOP CASING AFTER DEVELOPMENT: _____

G1775

Figure 4-6 Monitor Well Completion Form

3 pounds of powdered bentonite to each 94-pound sack of Portland Cement (ASTM C 150) (3% bentonite). A tremie pipe will be used to emplace the grout. The tremie pipe shall be plugged at the bottom and perforated or slotted on the sides to prevent grout from penetrating the bentonite seal. Grouting procedures will continue through auger retraction until undiluted grout flows from the boring at the ground surface.

4.5.3.5 Surface Completions of Monitor Wells

Above-ground surface completion will be used for all monitor wells except at Sites 8 and 9, where the well completion will be flush-mounted. The PVC well casing will be extended 1.5 to 2.0 feet above land surface and a suitable vented cap or other casing cap will be provided for each well. The extended PVC casing will be shielded with at least a four-inch diameter steel protective casing. The protective steel casing will be placed over the PVC well casing and cap and will be seated in a minimum 3-foot by 3-foot by 4-inch thick concrete surface pad which is sloped away from the well. All protective casings will be installed with keyed-alike locks and caps. Wells will be finished as a flush completion with the ground or pavement, since they are in areas of heavy traffic. Temporary, secure, watertight caps will be provided for incomplete wells or open boreholes anytime active construction or development operations are halted.

4.5.3.6 Monitor Well Log Book

A log book will be prepared for the purpose of maintaining a record of all personnel who access the monitoring wells. The log book will contain the keys to the well caps and will remain in the possession of the BEC at the conclusion of the field activities. A warning will be clearly visible in the log book stating the responsibility of the individual to use special procedures that are required to protect the integrity of the wells and of the data obtained from them. The log book will also contain a detailed description of the decontamination procedures required for any equipment entering the well. The log pages will include, as a minimum, labeled columns for the date, individual's name and organization, well number, well location, and purpose or activity performed (i.e., sample, measure water level, etc.).

4.5.4 Monitor Well Development

Each new monitor well will be developed as soon as is practical after completion, but not earlier than 48 hours after grouting is completed in order to allow the cement grout to set up. The monitor wells will be developed by pumping, surging, and/or bailing without the use of any additives. Temperature, pH, and specific conductivity will be measured during development activities and recorded on the Well Development Record (Figure 4-7). Development will continue until these parameters have stabilized (less than 10% change between four consecutive readings) and the water is clear and free of sediment to the fullest extent possible. If the parameters have not stabilized after four hours of continuous development activities, then the BEC will be contacted for further direction.

After final development of the well, a water sample will be collected in a one-liter clear glass container and immediately photographed. The photograph will be taken against a white background and a 35-mm slide will be submitted as a part of the well log. Fines remaining in the water will not be allowed to settle out prior to taking the photograph. The depth of any sediment which collects in the bottom of the jar after the sample is allowed to settle will be noted on the record of well development. The nephelometric turbidity of the water will be determined in accordance with ASTM D-1889 and the results will be shown on the final well construction log.

All water removed during development will be handled as discussed in Section 4.3.5 of this plan.

4.5.5 Surveying of Test Wells and Boreholes

A registered professional land surveyor will be retained to survey the vertical elevations and coordinates of the wells and the tops of the boreholes. The following are the survey requirements for wells and boreholes:

- Determine ground elevations to the closest 0.1 foot;
- Determine elevation of the mark point notch in the top of the PVC well to the closest 0.01 foot; and

GROUND WATER DEVELOPMENT RECORD

Well ID _____
Time/Date Start Development _____
Installation ID _____
Project _____
Initial/Final Groundwater Depth _____/_____ (FT) Below Measuring Point
Initial/Final Depth to Bottom of Well _____/_____(FT) Below Measuring Point
Time/Date Finish Development _____
Logger Code _____
Type, Size/Capacitiy of Pump or Bailer _____
Total Volume to Purge for 3/5 (circle one) Well Volumes _____ Gallons
Actual Purged Volume _____ Gallons

Time	Cumulative Volume (gallons)	Clarity/Color	pH	Specific Conductivity (µmhos)	Temp °C	Comments

Figure 4-7 Groundwater Development Record

- Determine coordinates of the well to 1.0 foot.

Elevations will be referenced to the National Geodetic Vertical Datum of 1929, if easily accessible, or to an existing local vertical datum. Coordinates will be referenced to the State Plane Coordinate System, if easily accessible, or to an existing local grid system.
Two permanent control monuments with brass, bronze, or aluminum alloy caps will be set in accessible locations within the limits of the work at each site. These monuments will be set no closer than 500 feet to each other. Coordinates and elevations will be established to the closest 0.01 foot for each monument.

Each well will be labeled with a permanent corrosion-resistant tag on the outer steel protective casing. The tag will identify the well number, depth, date of installation, Holloman Air Force Base, and the adjusted top of casing elevation. The well will also be clearly identified as a groundwater monitoring well.

4.5.6 Aquifer Tests

Slug tests will be conducted on all newly installed monitor wells after the completion of groundwater sampling. The slug test will provide an indication of aquifer response characteristics such as transmissivity and hydraulic conductivity. Also, this test is ideally suited for low-producing formations that cannot be pumped. The resulting data will be used in conjunction with other geologic and hydrogeologic data. The slug test equipment will be decontaminated between test wells to prevent any cross contamination.

Slug tests will be performed at selected locations by introducing a stainless steel "slug" into the monitor well beneath the water surface. Once the water level has been allowed to adjust back to its original level, the slug will be quickly removed, lowering the water level in the well. The response of the aquifer to this loss in head will be measured with time using a data logger attached to a pressure transducer that measures water levels in the well.

One method that will be used to calculate the hydraulic conductivities was developed by Bouwer and Rice (1976) and later updated by Bouwer (1989). The formula for calculating hydraulic conductivity using field data is as follows:

$$K = (r_c^2 \ln (R_e/r_w)/2L)(1/t)(\ln(Y_o/Y_t))$$

where:

r_c	=	radius of well (feet);
R_e	=	effective radius over which Y_t is dissipated (feet);
r_w	=	radius of borehole (feet);
ln	=	natural log;
ln	=	(R_e/r_w) is obtained by an empirical relation which is dependent on site specific parameters listed in Bouwer and Rice (1974). Values for these parameters are obtained from curves presented in Bouwer and Rice;
L	=	length of screen (feet);
t	=	time between change in water levels from Y_o to Y_t (seconds);
Y_o	=	difference between water level at start of test and static water level (feet);
Y_t	=	difference between water level at time t in seconds after test started and static water level (feet); and
K	=	hydraulic conductivity (ft/sec).

In the event that semi-confined or confined conditions are encountered, a computerized model called STEPMATCH (marketed by In-Situ, Inc.) may also be used for data analysis. This computerized method also has the advantage of reducing human errors common to manual curve-matching procedures. STEPMATCH is best used with data from low permeability aquifers and confining layers.

STEPMATCH is based on the analytical solution presented by Ramey et al. (1975), wherein they have modified type-curves published by Cooper, et al. (1967) by including a skin effect term to account for the wellbore resistance to fluid flow. STEPMATCH was developed to automatically compute the best values of transmissivity and skin, using the Newton-Raphson iterative method and nonlinear least squares. The best values are obtained by matching the slug test data with "families" of type curves, each curve representing a combination of skin and transmissivity values. The user supplies the raw data corresponding to the slug test conditions and an initial estimate for the transmissivity. If the test conditions are strongly affected by skin, an initial estimate for the skin is required. Otherwise a zero skin

is assumed to start the iteration procedure. If the program does not converge on a "final" estimate, the user is prompted for a different set of initial estimates. Spurious data are automatically neglected in the analysis. In addition, the user may also specify only a certain range of data to be considered for analysis and thus ignore the part of the data set which may have higher measurement error due to field test conditions or equipment limitations.

5.0 SAMPLE CHAIN OF CUSTODY, PACKING, AND TRANSPORTATION

A sample label (Figure 5-1) will be affixed to all sampling containers submitted for laboratory analysis. Sample labels identify the sample by documenting the sample type, sampler(s) initials, sampling locations, depth, time, and date. The unique number assigned to each sample is also noted on the sample label. Indelible ink will be used to complete all sample labels.

A chain-of-custody form (Figure 5-2) will be used to record the number of samples collected and the corresponding laboratory analyses; indelible ink will be used. Information on this form includes time and date of sample, sample number, type of sample, sampler's name, preservatives used, and any special instructions. Samples collected for matrix spike/matrix spike duplicate analysis will be identified on the chain-of-custody form. A copy of the chain-of-custody form will be retained by the sampler, and will be maintained in a file of field documentation.

All samples will be kept cool during collection and shipment with regular ice in a plastic bag. The samples will be stored upright in a durable ice chest. Sufficient packing material (i.e., vermiculite) will be used to separate the bottles, filling any intervening voids.

The ice will be placed above and around the top of the sample containers. The remaining space will be filled with additional packing material. The chain-of-custody form will be sealed in a plastic Zip-loc® bag and affixed to the top lid of the cooler. The cooler will be secured by completely wrapping it with strapping tape around both ends. If there is a drain on the cooler, it will be taped shut. The cooler will be labeled with "This Side Up" arrows on two opposing sides. Custody seals will also be affixed to coolers to indicate tampering.

Groundwater and soil samples will be shipped to the laboratory by overnight courier on a daily basis.

ATTENTION:
BEFORE OPENING
NOTE IF CONTAINER WAS
TAMPERED WITH.

CUSTODY # _____

ATTENTION:
BEFORE OPENING
NOTE IF CONTAINER WAS
TAMPERED WITH.

8-90-12896

Field Number _____
Sample Type: _____
Client: _____
Location: _____
Preservative: _____
Sampler: _____
Date: _____
Comment: _____

6-89-31426

Figure 5-1. Example Sample Label and Custody Seal

RADIAN CORPORATION

Chain of Custody Record

Page _____ of _____

PROJECT

SITE

COLLECTED BY *(Signature)*

FIELD SAMPLE ID	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	ANALYSES								REMARKS	SAM ID NO. *(for lab use only)*

REMARKS	RELINQUISHED BY:	DATE	TIME

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS

Figure 5-2. Sample Chain-of-Custody Record

6.0 LABORATORY ANALYTICAL PROCEDURES

The methods and procedures that will be used to prepare and analyze samples are discussed in this section. Most chemical analyses will be performed according to the following publications:

- SW-846, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, U.S. EPA, Office of Solid Waste and Emergency Response, November 1986, third edition.

- EPA, Methods for Chemical Analysis of Water and Wastes, EPA Publication No. 600/4-79-020, March 1983.

- ASTM, 1990 Annual Book of ASTM Standards, American Society for Testing and Materials, Philadelphia, PA, 1990.

- California Department of Health Services, Hazardous Materials Laboraotry Method 338, Revision 0, September 1987.

Most analytical methods to be used in this project (Table 6-1) require the measurement system to initially satisfy specific criteria for calibration linearity, reference material recovery, and freedom from contamination. Results of control samples, which are analyzed at a 10% frequency to monitor any changes in the quality of data being produced, indicate which corrective actions are necessary to correct an out-of-control condition. An out-of-control condition is defined as:

- Detection of any compounds of interest in a reagent blank at $\geq$ 5 times the limit of detection;

- Failure to meet the acceptance criteria for recovery of any compound of interest in a QC sample; or,

Table 6-1

Analytical Methods

Parameter	Preparation		Analysis		Method Detection Limits[a]	
	Technique	Method (Water/Soil)	Technique	Method (Water/Soil)	Water	Soil
GENERAL						
pH	Dissolution	SW-846:9045	Electrometric	SW-846:9045	N/A	N/A
Sulfate	N/A	N/A	IC	EPA:300.0	0.05 mg/L	N/A
Oil and Grease	Extraction	SW-846:3550	IR	EPA:413.2	0.4 mg/L	40 mg/Kg
Total Organic Carbon	N/A	N/A	IR	SW-846:9060	1.0 mg/L	0.11%
Chloride	N/A	N/A	IC	EPA:300.0	0.02 mg/L	N/A
Fluoride	N/A	N/A	SIE	EPA:340.2	0.1 mg/L	N/A
Phosphate	N/A	N/A	Colorimetric	EPA:365.2	0.01 mg/L	N/A
Nitrate/nitrite	Hydrazine reduction	EPA:353.2	Colorimetric	EPA:353.2	0.02 mg/L	N/A
Total Dissolved Solids (TDS)	N/A	N/A	Gravimetric	EPA:160.1	9 mg/L	N/A
Total Recoverable Petroleum Hydrocarbons (TRPH)	Soxhlet/Sonication Extraction	SW-846:9071/3550	IR	EPA:418.1	0.4 mg/L	40 mg/Kg
METALS						
Antimony	Acid Digestion	SW-846:3005/3050	ICPES	SW-846:6010	0.1 mg/L	10 mg/Kg
Arsenic	Acid Digestion	SW-846:7060/3050	GFAA	SW-846:7060	0.004 mg/L	0.4 mg/Kg
Beryllium	Acid Digestion	SW-846:3005/3050	ICPES	SW-846:6010	0.002 mg/L	0.2 mg/Kg
Cadmium	Acid Digestion	SW-846:3005/3050	ICPES	SW-846:6010	0.005 mg/L	0.5 mg/Kg
Chromium	Acid Digestion	SW-846:3005/3050	ICPES	SW-846:6010	0.01 mg/L	1.0 mg/Kg
Lead	Acid Digestion	SW-846:3020/3050	GFAA	SW-846:7421	0.003 mg/L	0.3 g/Kg

(Continued)

Table 6-1

(Continued)

Parameter	Preparation		Analysis		Method Detection Limits[a]	
	Technique	Method (Water/Soil)	Technique	Method (Water/Soil)	Water	Soil
Mercury	Acid Digestion	SW-846:7470/7471	CVAA	SW-846:7470/7471	0.0002 mg/L	0.0002 mg/Kg
Nickel	Acid Digestion	SW-846:3005/3050	ICPES	SW-846:6010	0.02 mg/L	2.0 mg/Kg
Selenium	Acid Digestion	SW-846:7740/3050	GFAA	SW-846:7740	0.005 mg/L	0.5 mg/Kg
Copper	Acid Digestion	SW-846:3005/3050	ICPES	SW-846:6010	0.02 mg/L	2.0 mg/Kg
Silver	Acid Digestion	SW-846:3005/3050	ICPES	SW-846:6010	0.01 mg/L	1.0 mg/Kg
Thallium	Acid Digestion	SW-846:3005/3050	ICPES	SW-846:6010	0.1 mg/L	10 mg/Kg
Zinc	Acid Digestion	SW-846:3005/3050	ICPES	SW-846:6010	0.02 mg/L	2.0 mg/Kg
Organic Lead	Xylene Extraction	HML:338	FAA/GFAA	HML:338	0.1 mg/L	2.0 mg/Kg
VOLATILE ORGANICS						
Acetone	Purge & Trap	SW-846:5030	GC/MS	SW-846:8240	100 μg/L	2,000 μg/Kg
Benzene	Purge & Trap	SW-846:5030	GC/MS	SW-846:8240	5 μg/L	100 μg/Kg
Bromodichloromethane	Purge & Trap	SW-846:5030	GC/MS	SW-846:8240	5 μg/L	100 μg/Kg
Bromoform	Purge & Trap	SW-846:5030	GC/MS	SW-846:8240	5 μg/L	100 μg/Kg
Bromomethane	Purge & Trap	SW-846:5030	GC/MS	SW-846:8240	10 μg/L	200 μg/Kg
Carbon disulfide	Purge & Trap	SW-846:5030	GC/MS	SW-846:8240	5 μg/L	100 μg/Kg
Carbon tetrachloride	Purge & Trap	SW-846:5030	GC/MS	SW-846:8240	5 μg/L	100 μg/Kg
Chlorobenzene	Purge & Trap	SW-846:5030	GC/MS	SW-846:8240	5 μg/L	100 μg/Kg
Chloroethane	Purge & Trap	SW-846:5030	GC/MS	SW-846:8240	10 μg/L	200 μg/Kg
2-Chloroethyl Vinyl Ether	Purge & Trap	SW-846:5030	GC/MS	SW-846:8240	10 μg/L	200 μg/Kg
Chloroform	Purge & Trap	SW-846:5030	GC/MS	SW-846:8240	5 μg/L	100 μg/Kg

(Continued)

Table 6-1

(Continued)

Parameter	Preparation		Analysis		Method Detection Limits[a]	
	Technique	Method (Water/Soil)	Technique	Method (Water/Soil)	Water	Soil
Chloromethane	Purge & Trap	SW-846:5030	GC/MS	SW-846:8240	10 μg/L	200 μg/Kg
Dibromochloromethane	Purge & Trap	SW-846:5030	GC/MS	SW-846:8240	5 μg/L	100 μg/Kg
1,2-Dichloroethane	Purge & Trap	SW-846:5030	GC/MS	SW-846:8240	5 μg/L	100 μg/Kg
trans-1,2-Dichloroethene	Purge & Trap	SW-846:5030	GC/MS	SW-846:8240	5 μg/L	100 μg/Kg
1,1-Dichloroethane	Purge & Trap	SW-846:5030	GC/MS	SW-846:8240	5 μg/L	100 μg/Kg
1,1-Dichloroethene	Purge & Trap	SW-846:5030	GC/MS	SW-846:8240	5 μg/L	100 μg/Kg
1,2-Dichloropropane	Purge & Trap	SW-846:5030	GC/MS	SW-846:8240	5 μg/L	100 μg/Kg
cis-1,3-Dichloropropene	Purge & Trap	SW-846:5030	GC/MS	SW-846:8240	5 μg/L	100 μg/Kg
trans-1,3-Dichloropropene	Purge & Trap	SW-846:5030	GC/MS	SW-846:8240	5 μg/L	100 μg/Kg
Ethyl benzene	Purge & Trap	SW-846:5030	GC/MS	SW-846:8240	5 μg/L	100 μg/Kg
2-Hexanone	Purge & Trap	SW-846:5030	GC/MS	SW-846:8240	50 μg/L	1,000 μg/Kg
Methylene chloride	Purge & Trap	SW-846:5030	GC/MS	SW-846:8240	5 μg/L	100 μg/Kg
2-Butanone (MEK)	Purge & Trap	SW-846:5030	GC/MS	SW-846:8240	100 μg/L	2,000 μg/Kg
4-Methyl-2-pentanone	Purge & Trap	SW-846:5030	GC/MS	SW-846:8240	50 μg/L	1,000 μg/Kg
Styrene	Purge & Trap	SW-846:5030	GC/MS	SW-846:8240	5 μg/L	100 μg/Kg
1,1,2,2-Tetrachloroethane	Purge & Trap	SW-846:5030	GC/MS	SW-846:8240	5 μg/L	100 μg/Kg
Tetrachloroethene	Purge & Trap	SW-846:5030	GC/MS	SW-846:8240	5 μg/L	100 μg/Kg
1,1,1-Trichloroethane	Purge & Trap	SW-846:5030	GC/MS	SW-846:8240	5 μg/L	100 μg/Kg
1,1,2-Trichloroethane	Purge & Trap	SW-846:5030	GC/MS	SW-846:8240	5 μg/L	100 μg/Kg
Trichloroethene	Purge & Trap	SW-846:5030	GC/MS	SW-846:8240	5 μg/L	100 μg/Kg

(Continued)

Table 6-1

(Continued)

Parameter	Preparation		Analysis		Method Detection Limits[a]	
	Technique	Method (Water/Soil)	Technique	Method (Water/Soil)	Water	Soil
Toluene	Purge & Trap	SW-846:5030	GC/MS	SW-846:8240	5 µg/L	100 µg/Kg
Vinyl Acetate	Purge & Trap	SW-846:5030	GC/MS	SW-846:8240	50 µg/L	1,000 µg/Kg
Vinyl Chloride	Purge & Trap	SW-846:5030	GC/MS	Sw-846:8240	10 µg/L	200 µg/Kg
Xylenes (total)	Purge & Trap	SW-846:5030	GC/MS	SW-846:8240	5 µg/L	100 µg/Kg
SEMIVOLATILE ORGANICS						
Anthracene	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg
Benzo(a)anthracene	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg
Benzo(b)fluoranthene	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg
Benzo(k)fluoranthene	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg
Benzo(a)pyrene	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg
bis(2-Ethylhexyl)phthalate	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg
Butyl benzyl phthalate	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg
Chrysene	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg
Dibenz(a,h)anthracene	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg
1,2-Dichlorobenzene	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg
1,3-Dichlorobenzene	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg
1,4-Dichlorobenzene	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg
Dichlorobenzene	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg
Dimethylphthalate	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg
Diethylphthalate	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg

(Continued)

Table 6-1

(Continued)

Parameter	Preparation		Analysis		Method Detection Limits[a]	
	Technique	Method (Water/Soil)	Technique	Method (Water/Soil)	Water	Soil
Di-n-butylphthalate	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg
Di-n-octylphthalate	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg
Fluoranthene	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg
2-Methyl naphthalene	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg
Naphthalene	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg
Phenanthrene	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg
Pyrene	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg
2,4-Dimethylphenol	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg
2,4-Dinitrophenol	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	50 µg/L	3300 µg/Kg
4-Nitrophenol	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	50 µg/L	3300 µg/Kg
Phenol	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg
Acenaphthene	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg
Acenaphthylene	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg
Benzoic acid	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	50 µg/L	3300 µg/Kg
Benzo(g,h,i)perylene	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg
Benzyl Alcohol	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	20 µg/L	1300 µg/Kg
4-Bromophenyl phenyl ether	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg
4-Chloroaniline	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	20 µg/L	1300 µg/Kg
4-Chloro-3-methylphenol	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	20 µg/L	1300 µg/Kg
bis(2-Chloroisopropyl)ether	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 µg/L	660 µg/Kg

(Continued)

Table 6-1

(Continued)

Parameter	Preparation		Analysis		Method Detection Limits[a]	
	Technique	Method (Water/Soil)	Technique	Method (Water/Soil)	Water	Soil
bis(2-Chloroethyl)ether	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 μg/L	660 μg/Kg
2-Chloronaphthalene	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 μg/L	660 μg/Kg
2-Chlorophenol	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 μg/L	660 μg/Kg
bis(2-Chloroethoxy)methane	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 μg/L	660 μg/Kg
4-Chlorophenyl phenyl ether	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 μg/L	660 μg/Kg
Dibenzofuran	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 μg/L	660 μg/Kg
2,4-Dichlorophenol	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 μg/L	660 μg/Kg
3,3-Dichlorobenzidine	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	20 μg/L	1300 μg/Kg
2,4-Dinitrotoluene	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 μg/L	660 μg/Kg
2,6-Dinitrotoluene	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 μg/L	660 μg/Kg
4,6-Dinitro-2-methylphenol	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	50 μg/L	3300 μg/Kg
Fluorene	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 μg/L	660 μg/Kg
Hexachlorobenzene	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 μg/L	660 μg/Kg
Hexachlorocyclopentadiene	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 μg/L	660 μg/Kg
Hexachloroethane	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 μg/L	660 μg/Kg
Hexachlorobutadiene	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 μg/L	660 μg/Kg
Indeno(1,2,3-c,d)pyrene	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 μg/L	660 μg/Kg
Isophorone	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 μg/L	660 μg/Kg
2-Methylphenol	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 μg/L	660 μg/Kg
4-Methylphenol	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 μg/L	660 μg/Kg

(Continued)

Table 6-1

(Continued)

Parameter	Preparation		Analysis		Method Detection Limits[a]	
	Technique	Method (Water/Soil)	Technique	Method (Water/Soil)	Water	Soil
2-Nitroaniline	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	50 μg/L	3300 μg/Kg
3-Nitroaniline	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	50 μg/L	3300 μg/Kg
4-Nitroaniline	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	50 μg/L	3300 μg/Kg
Nitrobenzene	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 μg/L	660 μg/Kg
2-Nitrophenol	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 μg/L	660 μg/Kg
n-Nitroso-di-n-propylamine	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 μg/L	660 μg/Kg
n-Nitrosodiphenylamine	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 μg/L	660 μg/Kg
Pentachlorophenol	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	50 μg/L	3300 μg/Kg
1,2,4-Trichlorobenzene	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	10 μg/L	660 μg/Kg
2,4,5-Trichlorophenol	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	50 μg/L	3300 μg/Kg
2,4,6-Trichlorophenol	Extraction	SW-846:3520/3550	GC/MS	SW-846:8270	μg/L	μg/Kg
ORGANOPHOSPHORUS PESTICIDES						
Demeton-O	Extraction	SW-846:3520/3550	GC/FPD	SW-846:8140	0.5 μg/L	50 μg/Kg
Demeton-S	Extraction	SW-846:3520/3550	GC/FPD	SW-846:8140	0.5 μg/L	50 μg/Kg
Dimethioate	Extraction	SW-846:3520/3550	GC/FPD	SW-846:8140	0.2 μg/L	20 μg/Kg
Disulfoton	Extraction	SW-846:3520/3550	GC/FPD	SW-846:8140	0.2 μg/L	20 μg/Kg
Ethyl parathion	Extraction	SW-846:3520/3550	GC/FPD	SW-846:8140	0.15 μg/L	15 μg/Kg
Fensulfothion	Extraction	SW-846:3520/3550	GC/FPD	SW-846:8140	1.5 μg/L	150 μg/Kg
Famphur	Extraction	SW-846:3520/3550	GC/FPD	SW-846:8140	0.5 μg/L	50 μg/Kg
Methyl azinphos	Extraction	SW-846:3520/3550	GC/FPD	SW-846:8140	1.5 μg/L	150 μg/Kg

(Continued)

Table 6-1

(Continued)

Parameter	Preparation		Analysis		Method Detection Limits[a]	
	Technique	Method (Water/Soil)	Technique	Method (Water/Soil)	Water	Soil
Parthion methyl	Extraction	SW-846:3520/3550	GC/FPD	SW-846:8140	0.03 μg/L	3.0 μg/Kg
Phorate	Extraction	SW-846:3520/3550	GC/FPD	SW-846:8140	0.3 μg/L	30 μg/Kg
Ronnel	Extraction	SW-846:3520/3550	GC/FPD	SW-846:8140	0.3 μg/L	30 μg/Kg
Sulfotepp	Extraction	SW-846:3520/3550	GC/FPD	SW-846:8140	0.10 μg/L	10 μg/Kg
Thionazin	Extraction	SW-846:3520/3550	GC/FPD	SW-846:8140	1.0 μg/L	100 μg/Kg
o,o,o-Triethylphosphorthioate	Extraction	SW-846:3520/3550	GC/FPD	SW-846:8140	1.0 μg/L	100 μg/Kg
ORGANOCHLORINE PESTICIDES AND PCBs						
Aldrin	Extraction	SW-846:3520/3550	GC/ECD	SW-846:8080	0.04 μg/L	1 μg/Kg
alpha-BHC	Extraction	SW-846:3520/3550	GC/ECD	SW-846:8080	0.03 μg/L	1 μg/Kg
beta-BHC	Extraction	SW-846:3520/3550	GC/ECD	SW-846:8080	0.06 μg/L	1 μg/Kg
delta-BHC	Extraction	SW-846:3520/3550	GC/ECD	SW-846:8080	0.09 μg/L	1 μg/Kg
gamma-BHC (Lindane)	Extraction	SW-846:3520/3550	GC/ECD	SW-846:8080	0.04 μg/L	1 μg/Kg
Chlordane (technical)	Extraction	SW-846:3520/3550	GC/ECD	SW-846:8080	0.14 μg/L	5 μg/Kg
4,4'-DDD	Extraction	SW-846:3520/3550	GC/ECD	SW-846:8080	0.11 μg/L	1 μg/Kg
4,4'-DDE	Extraction	SW-846:3520/3550	GC/ECD	SW-846:8080	0.04 μg/L	1 μg/Kg
4,4'-DDT	Extraction	SW-846:3520/3550	GC/ECD	SW-846:8080	0.12 μg/L	2 μg/Kg
Dieldrin	Extraction	SW-846:3520/3550	GC/ECD	SW-846:8080	0.02 μg/L	1 μg/Kg
Endosulfan I	Extraction	SW-846:3520/3550	GC/ECD	SW-846:8080	0.14 μg/L	1 μg/Kg

(Continued)

Table 6-1

(Continued)

Parameter	Preparation		Analysis		Method Detection Limits[a]	
	Technique	Method (Water/Soil)	Technique	Method (Water/Soil)	Water	Soil
Endosulfan II	Extraction	SW-846:3520/3550	GC/ECD	SW-846:8080	0.04 μg/L	3 μg/Kg
Endosulfan sulfate	Extraction	SW-846:3520/3550	GC/ECD	SW-846:8080	0.66 μg/L	5 μg/Kg
Endrin	Extraction	SW-846:3520/3550	GC/ECD	SW-846:8080	0.06 μg/L	1 μg/Kg
Endrin aldehyde	Extraction	SW-846:3520/3550	GC/ECD	SW-846:8080	0.23 μg/L	2 μg/Kg
Heptachlor	Extraction	SW-846:3520/3550	GC/ECD	SW-846:8080	0.03 μg/L	1 μg/Kg
Heptachlor epoxide	Extraction	SW-846:3520/3550	GC/ECD	SW-846:8080	0.83 μg/L	1 μg/Kg
Methoxychlor	Extraction	SW-846:3520/3550	GC/ECD	SW-846:8080	0.05 μg/L	5 μg/Kg
Toxaphene	Extraction	SW-846:3520/3550	GC/ECD	SW-846:8080	0.5 μg/L	50 μg/Kg
PCB-1016	Extraction	SW-846:3520/3550	GC/ECD	SW-846:8080	0.1 μg/L	10 μg/Kg
PCB-1221	Extraction	SW-846:3520/3550	GC/ECD	SW-846:8080	0.1 μg/L	10 μg/Kg
PCB-1232	Extraction	SW-846:3520/3550	GC/ECD	SW-846:8080	0.2 μg/L	20 μg/Kg
PCB-1242	Extraction	SW-846:3520/3550	GC/ECD	SW-846:8080	0.1 μg/L	10 μg/Kg
PCB-1248	Extraction	SW-846:3520/3550	GC/ECD	SW-846:8080	0.1 μg/L	10 μg/Kg
PCB-1254	Extraction	SW-846:3520/3550	GC/ECD	SW-846:8080	1.0 μg/L	20 μg/Kg
PCB-1260	Extraction	SW-846:3520/3550	GC/ECD	SW-846:8080	1.0 μg/L	20 μg/Kg

(Continued)

Table 6-1

(Continued)

Parameter	Preparation		Analysis		Method Detection Limits[a]	
	Technique	Method (Water/Soil)	Technique	Method (Water/Soil)	Water	Soil
CHLORINATED HERBICIDES						
2,4-D	Extraction/ Esterification	SW-846:8150	GC/ECD	SW-846:8150	12 μg/L	120 μg/Kg
2,4-DB	Extraction/ Esterification	SW-846:8150	GC/ECD	SW-846:8150	9.1 μg/L	91 μg/Kg
2,4,5-T	Extraction/ Esterification	SW-846:8150	GC/ECD	SW-846:8150	2.0 μg/L	20 μg/Kg
2,4,5-TP (Silvex)	Extraction/ Esterification	SW-846:8150	GC/ECD	SW-846:8150	1.7 μg/L	17 μg/Kg
Dalapon	Extraction/ Esterification	SW-846:8150	GC/ECD	SW-846:8150	58 μg/L	580 μg/Kg
Dicamba	Extraction/ Esterification	SW-846:8150	GC/ECD	SW-846:8150	2.7 μg/L	27 μg/Kg
Dichloroprop	Extraction/ Esterification	SW-846:8150	GC/ECD	SW-846:8150	6.5 μg/L	65 μg/Kg
Dinoseb	Extraction/ Esterification	SW-846:8150	GC/ECD	SW-846:8150	0.7 μg/L	15 μg/Kg
MCPA	Extraction/ Esterification	SW-846:8150	GC/ECD	SW-846:8150	2500 μg/L	24,900 μg/Kg
MCPP	Extraction/ Esterification	Sw-846:8150	GC/ECD	SW-846:8150	1900 μg/L	19,200 μg/Kg
GEOTECHNICAL						
Particle Size Distribution	N/A	N/A	Sieving	ASTM D422	N/A	>0.075mm
Atterburg Limits	Rolling	ASTM D4318	Oven-Dry/ Gravimetric	ASTM D4318	N/A	0.1%

(Continued)

Table 6-1

(Continued)

Parameter	Preparation		Analysis		Method Detection Limits[a]	
	Technique	Method (Water/Soil)	Technique	Method (Water/Soil)	Water	Soil
Moisture	Oven-Dry	ASTM D2216	Gravimetric	ASTM D2216	N/A	0.1%
EXPLOSIVES						
HMX	Salting-out	SW-846:8330	HPLC	SW-846:8330	0.563 μg/L	NA
RDX	Salting-out	SW-846:8330	HPLC	SW-846:8330	0.412 μg/L	NA
1,3,5-TNB	Salting-out	SW-846:8330	HPLC	SW-846:8330	0.425 μg/L	NA
1,3-DNB	Salting-out	SW-846:8330	HPLC	SW-846:8330	0.549 μg/L	NA
NB	Salting-out	SW-846:8330	HPLC	SW-846:8330	0.817 μg/L	NA
Tetryl	Salting-out	SW-846:8330	HPLC	SW-846:8330	1.18 μg/L	NA
2,4,6-TNT	Salting-out	SW-846:8330	HPLC	SW-846:8330	0.415 μg/L	NA
2,6-DNT	Salting-out	SW-846:8330	HPLC	SW-846:8330	0.260 μg/L	NA
2,4-DNT	Salting-out	SW-846:8330	HPLC	SW-846:8330	0.260 μg/L	NA
2-NT	Salting-out	SW-846:8330	HPLC	SW-846:8330	1.09 μg/L	NA
4-NT	Salting-out	SW-846:8330	HPLC	SW-846:8330	0.714 μg/L	NA
3-NT	Salting-out	SW-846:8330	HPLC	SW-846:8330	0.805 μg/L	NA

(Continued)

Table 6-1

(Continued)

[a]Method Detection Limit is the minimum concentration of a substance that can be measured and reported. Method Detection Limits are highly matrix dependent and may not always be achievable.

IR	=	Infrared Spectrometry
ICPES	=	Inductively Coupled Plasma Emission Spectroscopy
GFAA	=	Graphite Furnace Atomic Absorption
CVAA	=	Cold Vapor Atomic Absorption
GC/MS	=	Gas Chromatography/Mass Spectrometry
SW-846	=	Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, U.S. EPA, Office of Solid Waste and Emergency Response, November 1986, third edition.
EPA	=	Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020.
N/A	=	Not Applicable
IC	=	Ion Chromatography
GC/ECD	=	Gas Chromatography/Electron Capture Detection
GC/FID	=	Gas Chromatography/Flame Photometric Detection
HPLC	=	High Performance Liquid Chromatography
SIE	=	Selective Ion Electrode
HML	=	California Department of Health Services, Hazardous Materials Laboratory Method.

- Exceeding the action limit for matrix spike recovery and subsequent failure to meet the acceptance criteria for a QC check sample for the same parameter(s). Any parameter which fails the matrix spike test but passes the QC check sample test will be flagged as suspect for the parameter due to matrix effects.

When an out-of-control situation is detected, efforts are undertaken to determine the cause. Procedures related to corrective actions are described below.

During the course of the Holloman Investigation, it will be the responsibility of the laboratory QC officers, Project Director, Task Leaders, and other project team members to see that all measurement procedures are followed as specified and that measurement data meet the prescribed acceptance criteria (Table 6-2). In the event a problem arises, it is imperative that prompt action be taken to correct the problem(s). Laboratory supervisors will initiate corrective action in the event of QC results which exceed acceptability limits. Corrective action may also be initiated upon identification of some other problems or potential problems. Corrective action may also be initiated by the Laboratory QC officer based upon QC data or other anomalies noted during data review.

For this project, the following corrective actions will be implemented when surrogate spike compounds are recovered outside the method criteria:

- Check to be sure there are no errors in calculations, surrogate solutions, and internal standards. Also, check instrument performance;
- Recalculate the data and/or reanalyze the extract if any of the above checks reveal a problem;
- Analyze an extracted quality control check sample (QCCS);
- If the QCCS compounds are recovered within criteria, flag data as matrix effect; and
- If the QCCS compounds are recovered outside criteria, reextract and reanalyze the sample, report both sets of results.

Table 6-2

Summary of Internal Quality Control Procedures

Analytical Method	Parameter	Quality Control Check	Frequency[a]	Acceptance Criteria	Corrective Action
SW-846:9045	pH	Laboratory Control Sample	After calibration and after every 10 samples	Analysis within 0.1 pH unit of true value	1) Repeat check 2) Repeat calibration
		Duplicate Analysis	5%	Agreement within 0.2 pH units	Repeat sample analyses
		Duplicate Analysis (USACE[b])	5%	None	Will be used to determine sampling/analytical variability
		Field Equipment Blank	5%, or 1 per sampling event	None	Will be used to determine sources of contamination
EPA:418.1	TRPH	Laboratory Multipoint Calibration	Initially and as required	r >0.995	Repeat calibration
		Control sample or QCCS	5%, or 1 per 20 samples	Recovery between 90-110%	Repeat calibration
		Method Blank	1 per batch	None	Used to assess analytical contamination
		Matrix Spike	5%	50-150% Recovery	1) Run check sample (QCCS) 2) Correct Problem 3) Flag data
		Matrix Spike Duplicate	5%	RPD $\leq$50%	1) Run check sample (QCCS) 2) Correct Problem 3) Flag data
		Duplicate Analysis (USACE[b])	5%	None	Will be used to determine sampling/analytical variability
		Field Equipment Blank	5%, or 1 per sampling event	None	Will be used to determine sources of contamination
		Duplicate sample	5%	None	Used to assess sampling/analytical variability
EPA:353.2	Nitrate-nitrite	Laboratory Multipoint calibration	Initially	r >0.995	Repeat calibration
		QC check sample	Initially and after every 10 samples	Measured value within ±10% of actual value	1) Repeat check 2) Repeat calibration and check
		Method blank analysis	Daily	None	Used to indicate analytical contaminants
		Spiked sample analyses	5%; minimum of 1 per set	Recovery ±10% of true value	1) Obtain second value 2) Flag data

(Continued)

Table 6-2

(Continued)

Analytical Method	Parameter	Quality Control Check	Frequency[a]	Acceptance Criteria	Corrective Action
EPA:353.2 (Continued)	Nitrate-nitrite (Continued)	Duplicate analysis (USACE[b])	5%	None	Used to quantitate analytical variability
HML:338	Organic Lead	Laboratory Multipoint calibration (minimum of 3)	Daily	Corr. Coeff. is ≥0.9950	Repeat calibration
		Control sample or QCCS	1 per 20 samples	Recovery between 85-115%	1) Repeat control sample analysis 2) Reanalyze samples
		Method Blank	1 per batch	Within 5 x MDL	Used to assess analytical contamination
		Matrix Spike Duplicate	5%	Within 20% RPD	1) Run check sample (QCCS) 2) Correct problem 3) If QCCS fails, reanalyze samples 4) Flag data
		Matrix Spike	5%	75-125% Recovery	1) Run check sample (QCCS) 2) Correct problem 3) If QCCS fails, reanalyze samples 4) Flag data
		Duplicate analysis (USACE[b])	5%	None	Used to quantitate analytical variability
		Field Field Blank	5%, or 1 per sampling event	None	Used to determine matrix interference
		Duplicate Sample	5%, 1 per 20 samples	None	Will be used to determine sources of contamination
SW-846:6010	Metals (ICPES)	QC check sample analysis (second source QC check sample)	1 per digestion batch ≥20 samples	Measured value within ±10% of true value for element of interest	Repeat calibration
		Preparation blank	1 per digestion batch ≥20 samples	<5 x Method detection limit	1) Reanalyze 2) Recalibrate 3) Reanalyze 4) Redigest samples if reanalysis fails
		Calibration blank	10%	<5 x Method detection limit	1) Rerun 2) Clean system 3) Reanalyze sample 4) Redigest samples if reanalysis fails

(Continued)

Table 6-2

(Continued)

Analytical Method	Parameter	Quality Control Check	Frequency[a]	Acceptance Criteria	Corrective Action
SW-846:6010 (Continued)	Metals (ICPES) (Continued)	Calibration check	10%	Measured value within ±10% of true value for element of interest	Repeat calibration
		Matrix spike analysis	5%	75-125% of true value	1) Analyze method spike (or QCCS) 2) If method spike is ok; flag data 3) If method spike not ok; see lab supervisor and reanalyze samples
		Matrix spike duplicate	5%	Relative percent difference ≤20% and 75-125% of true value	1) Analyze method spike (or QCCS) 2) If method spike is ok; flag data 3) If method spike not ok; see lab supervisor and reanalyze samples
		ICP interference check	Run at beginning and end of daily run	80-120% of true value for EPA check sample elements	1) Repeat calibration 2) See lab manager
		ICP linear range check	Quarterly	Measured value within ±5% of expected value	Tests upper limit of ICP linear range
		Instrument detection limit	Quarterly	<MDL	Used to verify current IDL
		Duplicate analyses (USACE[b])	5%	None	Used to quantitate analytical variability
		Field Duplicate field sample	5%, minimum one per program	None	Determine sampling/analytical variability
		Equipment blanks	5%, minimum one per program	None	Used to determine sources of contamination
EPA:300.0	Chloride and Sulfate	Laboratory Multipoint calibration	Daily, prior to analyses	r >0.995	Repeat calibration
		QC check sample (QCCS)	10%	90-110%	Recalibrate
		Method blanks	10%	<DL	Reanalyze
		Duplicate analyses (USACE[b])	5%	None	Used to determine sampling/analytical variability
		Matrix spike	5%	85-115% Recovery	1) Check calculations 2) Reanalyze 3) Flag data

(Continued)

Table 6-2

(Continued)

Analytical Method	Parameter	Quality Control Check	Frequency[a]	Acceptance Criteria	Corrective Action
EPA:300.0 (Continued)	Chloride and Sulfate (Continued)	Matrix spike duplicate	5%	85-115% Recovery RPD <20%	1) Check calculations 2) Reanalyze 3) Flag data
		Field Equipment blank	5%	None	Used to determine sources of contamination
		Duplicate samples	5%	None	Used to determine sampling/analytical variability
EPA:160.1	Total Dissolved Solids (TDS)	Laboratory Balance calibration	Daily-Class S	±0.0004g for 1.0000g weight	Recalibrate balance
		Duplicate analysis	5%	RPD <15%	1) Obtain third value 2) Flag data
		Field Duplicate sample	5%	None	Used to determine sampling/analytical variability
		Equipment blank	5%	None	Used to determine sources of contamination
EPA:365.2	Phosphate	Laboratory Multipoint calibration	Daily, prior to analyses	r >0.995	Repeat calibration
		QC check sample (QCCS)	10%	90-110%	Recalibrate
		Method blanks	10%	<DL	Reanalyze
		Duplicate analyses (USACE[b])	5%	None	Used to determine sampling/analytical variability
		Matrix spike	5%	85-115% Recovery	1) Check calculations 2) Reanalyze 3) Flag data
		Matrix spike duplicate	5%	85-115% Recovery RPD <20%	1) Check calculations 2) Reanalyze 3) Flag data
		Field Equipment blank	5%	None	Used to determine sources of contamination

(Continued)

Table 6-2

(Continued)

Analytical Method	Parameter	Quality Control Check	Frequency[a]	Acceptance Criteria	Corrective Action
EPA:365.2 (Continued)	Phosphate (Continued)	Duplicate samples	5%	None	Used to determine sampling/analytical variability
SW-846:8270	Semivolatile Organic Compounds	Laboratory Check of mass spectral ion intensities using DFTPP	Daily prior to sample analysis	Refer to method	Retune instrument Repeat DFTPP analysis
		5-point calibration at 10-200 ppb range	Initial calibration	RF variability for specific compounds <30% RSD	Repeat calibration
		System performance check	Every 12 hours	Minimum average response factor of 0.050	1) Evaluate system 2) Repeat calibration
		Continuing calibration check compounds (CCC)	Every 12 hours	Single-point RF for each CCC within 30% of average multi-point RF	1) Evaluate system 2) Take corrective action 3) Repeat test 4) See lab manager
		Surrogate spikes	Every sample	Based on method (Table 8)	1) Evaluate system 2) Recalculate data and/or reanalyze extract 3) Analyze QCCS, if QCCS fails, reextract and reanalyze samples 4) Flag data and report analysis and reanalysis results
		Internal standards	Every sample	Refer to method (Table 5)	1) Inspect mass spectrometer 2) Correct problems and repeat calibration 3) Reanalyze samples
		Extraction blank	Daily prior to sample analysis	<DL except for phthalate esters which may be 5 x DL	1) Run solvent blank 2) Evaluate system
		Matrix spike	5%	Refer to method (Table 6)	1) Run check sample (QCCS) 2) Correct problem 3) If QCCS fails, reanalyze samples 4) Flag data
		Matrix spike duplicate	5%	≤50% RPD and recovery within limits of method (Table 6)	1) Run check samples (QCCS) 2) Correct problem 3) If QCCS fails, reanalyze samples 4) Flag data
		Duplicate analysis (USACE[b])	5%	None	Used to quantitate analytical variability

(Continued)

Table 6-2

(Continued)

Analytical Method	Parameter	Quality Control Check	Frequency[a]	Acceptance Criteria	Corrective Action
SW-846:8270 (Continued)	Semivolatile Organic Compounds (Continued)	Field Equipment blank	5%	None	Will be used to determine sources of contamination
		Duplicate field sample	5%	None	Will be used to determine analytical variability
SW-846:8330	Explosives	Laboratory Multipoint calibration	Daily prior to analyses	r >0.995	Repeat calibration
		Continuing calibration check	10%	±15% of true value	Recalibrate
		Preparation blank	5%	<Detection limit	1) Reanalyze 2) Redigest if reanalysis fails
		Calibration blank	Daily	<Detection limit	1) Rerun 2) Clean system 3) Redigest samples if reanalysis fails
		Quality control check samples (QCCS)	5%	±15% of true value	1) Recalibrate 2) Reanalyze affected samples
		Matrix spike analysis	5%	80-120% of true value	1) Analyze QCCS 2) If QCCS ok; flag data 3) If QCCS not ok; reanalyze samples
		Matrix spike duplicate	5%	RPD <20% and 80-120% recovery	1) Analyze QCCS 2) If QCCS ok; flag data 3) If QCCS not ok; reanalyze samples
		Duplicate analysis (USACE[b])	5%	None	Used to quantitate analytical variability
		Field Duplicate field samples	5%; minimum one per program	None	Determine sampling/analytical variability
		Equipment blanks	5%; minimum one per program	None	Used to determine source of contamination
		Laboratory Multipoint calibration (minimum five points)	Initially and as required	RSD <20%	Repeat calibration

(Continued)

Table 6-2

(Continued)

Analytical Method	Parameter	Quality Control Check	Frequency[a]	Acceptance Criteria	Corrective Action
SW-846:8330 (Continued)	Explosives (Continued)	Calibration check sample	Daily prior to sample analyses	RPD <15%	Repeat 5-point calibration
SW-846:8150	Herbicides	Surrogate spikes	Every sample	Based on method	1) Evaluate system 2) Recalculate data and/or reanalyze extract 3) Analyze QCCS, if QCCS fails, reextract and reanalyze sample 4) Flag data and report analysis and reanalysis results
		Quality control check sample (QCCS	5%	±15% of true value	1) Recalibrate 2) Reanalyze affected samples
		Method blank	5%	<MDL	Used to assess contamination
		Matrix spike	5%	Refer to method	1) Analyze QCCS 2) Correct problem 3) If QCCS is ok; flag data 4) If QCCS is not ok; reanalyze samples
		Matrix spike duplicate	5%	RPD <50% and recovery within method specified limits	1) Analyze QCCS 2) Correct problem 3) If QCCS is ok; flag data 4) If QCCS is not ok; reanalyze samples
		Duplicate analysis (USACE[b])	5%	None	Used to quantitate analytical variability
		Field Duplicate field samples	5% minimum one per program	None	Will be used to determine sampling and analytical variability
		Equipment blanks	5% minimum one per program	None	Used to assess sources of contamination
SW-846:8240	Volatile Organic Compounds	Laboratory Check of mass spectral ion intensities using BFB	Daily prior to sample analysis	Refer to method (Table 3)	1) Retune instrument 2) Repeat BFB analysis
		5-point calibration at 10-200 ppb range	Initial calibration; and as required	RF variability for specific compounds <25% RSD	Repeat calibration
		System performance check	Every 12 hours	RF ≥0.300 (0.250 for bromoform)	1) Evaluate system 2) Repeat calibration

(Continued)

Table 6-2

(Continued)

Analytical Method	Parameter	Quality Control Check	Frequency[a]	Acceptance Criteria	Corrective Action
SW-846:8240 (Continued)	Volatile Organic Compounds (Continued)	Calibration check compounds	Every 12 hours	% Difference <30%	1) Evaluate system 2) Repeat test 3) Recalibrate
		Surrogate spikes	Every sample	Based on method (Table 8)	1) Evaluate system 2) Recalculate data and/or reanalyze extract 3) Reanalyze sample 4) Flag data and report analysis and reanalysis results
		Internal standards	Every sample	Refer to method (Table 5)	1) Inspect mass spectrometer 2) Correct problem 3) Repeat calibration 4) Reanalyze samples
		Extraction	Daily prior to analyses	<DL except for common laboratory contaminants which may be 5 x DL	1) Run solvent blank 2) Reanalyze blank and samples
		Matrix spike	5%	Refer to method (Table 6)	1) Run check samples (QCCS) 2) Correct problem 3) If QCCS is ok; flag data 4) If QCCS is not ok; reanalyze samples
		Matrix spike duplicate	5%	≤50% RPD and recovery within limits of method (Table 6)	1) Run check sample (QCCS) 2) Correct problem 3) If QCCS is ok; flag data 4) If QCCS is not ok; reanalyze samples
		Duplicate analyses (USACE[b])	5%	None	Used to quantitate analytical variability
		Field Duplicate field samples	5%	None	Used to determine sampling/analytical variability
		Equipment blank	10%; or one per sampling event	None	Will be used to determine sources of contamination
		Trip blank	5%; or one per sampling event	None	Will be used to determine sources of contamination
		Laboratory Multipoint calibration (minimum five points)	Initially, as required	RSD <20%	Repeat calibration

(Continued)

Table 6-2

(Continued)

Analytical Method	Parameter	Quality Control Check	Frequency[a]	Acceptance Criteria	Corrective Action
SW-846:8080	Organochlorine Pesticides and PCBs	Calibration check sample	Daily prior to sample analyses	RPD <15%	Repeat 5-point calibration
		DDT and endrin degradation check sample	Daily prior to analyses	Degradation ≤20% (see method)	1) Follow maintenance in Method 8000, see Section 7.7 2) Recalibrate
		Surrogate spikes	Every sample	Based on method	1) Evaluate system 2) Recalculate data and/or reanalyze extract 3) Analyze QCCS, if QCCS fails reextract and reanalyze sample 4) Flag data and report analysis and reanalysis results
		Method blank	5%	None	Used to assess contamination
		QC check sample (QCCS)	5%	Refer to method (Table 3)	1) Evaluate system 2) Repeat test for criteria that failed
		Matrix spike	5%	Refer to method (Table 3)	1) Analyze QCCS 2) Correct problem 3) If QCCS is ok; flag data 4) If QCCS is not ok; reanalyze samples
		Matrix spike duplicate	5%	RPD <50% and recovery within method specified limits (Table 3)	1) Analyze QCCS 2) Correct problem 3) If QCCS is ok; flag data 4) If QCCS is not ok; reanalyze samples
		Duplicate analysis (USACE[b])	5%	None	Used to quantitate analytical variability
		Field Duplicate field samples	5%; minimum one per program	None	Will be used to determine analytical variability
		Equipment blanks	5%; minimum one per program	None	Used assess sources of contamination
		Laboratory Multipoint calibration (minimum five points)	Initially, as required	RSD <20%	Repeat calibration

(Continued)

Table 6-2

(Continued)

Analytical Method	Parameter	Quality Control Check	Frequency[a]	Acceptance Criteria	Corrective Action
SW-846:8140	Organophosphorus Pesticides	Calibration check sample	Daily prior to sample analyses	RPD <15%	Repeat 5-point calibration
		Surrogate spikes	Every sample	Based on method	1) Evaluate system 2) Recalculate data and/or reanalyze extract 3) Analyze QCCS, if QCCS fails, reextract and reanalyze sample 4) Flag data and report analysis and reanalysis results
		Method blank	5%	None	Used to assess contamination
		QC check sample (QCCS)	5%	Refer to method	1) Evaluate system 2) Repeat test for criteria that failed
		Matrix spike	5%	Refer to method	1) Analyze QCCS 2) Correct problem 3) If QCCS is ok; flag data 4) If QCCS is not ok; reanalyze samples
		Matrix spike duplicate	5%	RPD <50% and recovery within method specified limits	1) Analyze QCCS 2) Correct problem 3) If QCCS is ok; flag data 4) If QCCS is not ok; reanalyze samples
		Duplicate analysis (USACE[b])	5%	None	Used to quantitate analytical variability
		Field Duplicate field samples	5%; minimum one per program	None	Will be used to determine analytical variability
		Equipment blanks	5%; minimum one per program	None	Used to assess sources of contamination
EPA:340.2	Fluoride	Laboratory Multipoint calibration	Daily, prior to analyses	r >0.995	Repeat calibration
		QC check sample (QCCS)	10%, or minimum of 1 per batch	±10% error	Repeat calibration
		Blank	10%, or minimum of 1 per batch	≤5 x MDL	Reanalyze

(Continued)

Table 6-2

(Continued)

Analytical Method	Parameter	Quality Control Check	Frequency[a]	Acceptance Criteria	Corrective Action
EPA:340.2 (Continued)	Fluoride (Continued)	Duplicate analyses	10%, or minimum of 1 per batch	RPD <10%	1) Obtain 3rd value 2) Flag data
		Matrix spike	5%, or minimum of 1 per batch	±15% error	1) Check calculations 2) Reanalyze to verify 3) Flag data if matrix effect (QCCS ok)
		Matrix spike duplicate	5%	±15% error and RPD <20%	1) Check calculations 2) Reanalyze to verify 3) Flag data if QCCS is ok; matrix effect
		Duplicate analysis (USACE[b])	5%	None	Used to quantitate analytical variability
		Field Duplicate samples	5%	None	Used to assess sampling/analytical variability
		Equipment blank	5% minimum of one	None	Used to determine sources of contamination
EPA:413.2	Oil and Grease	Laboratory Multipoint calibration	Daily	r >0.995	Repeat calibration
		QC check sample	10%	85-115	Recalibrate
		Duplicate analysis	10%	RPD <20%	1) Reanalyze to verify 2) Flag data
		Blank	1 per analytical set	<5 x MDL	Reanalyze
		Matrix spike	5%	75-125% Recovery	1) Check calculations 2) Reanalyze to verify 3) Flag data if QCCS is ok; matrix effect
		Matrix spike duplicate	5%	75-125% Recovery and RPD <20%	1) Check calculations 2) Reanalyze to verify 3) If QCCS is ok; end result verified; flag data as matrix effect
		Duplicate analysis (USACE[b])	5%	None	Used to sampling/analytical variability

(Continued)

Table 6-2

(Continued)

Analytical Method	Parameter	Quality Control Check	Frequency[a]	Acceptance Criteria	Corrective Action
EPA:413.2 (Continued)	Oil and Grease (Continued)	Field Duplicate samples	5%, minimum of one	None	Used to determine sources of contamination
		Equipment blank	5%, minimum of one	None	Used to determine sources of contamination
SW-846:9060	Total Organic Carbon (TOC)	Laboratory Multipoint calibration	Daily, prior to sample analyses	r $\geq$0.995	Repeat calibration
		QC check standard	10% or minimum of 1 per batch	±2% error	Repeat calibration
		Blank	One per batch	<5 x MDL	Reanalyze samples
		Duplicate analysis	10%	RPD <20%	1) Obtain 3rd value 2) Flag data
		Duplicate analysis (USACE[b])	5%	None	Used to quantitate sampling/analytical variability
		Field Duplicate samples	5%	None	Used to assess sampling/analytical variability
		Equipment blank	5%	None	Used to determine sources of contamination
SW-846:9310	Gross Alpha Gross Beta	Laboratory Multipoint calibration	Daily	r >0.995	Recalibrate
		Blank	1 per batch of samples	<MDL	Flag data
		Duplicate analysis	10%	RPD <20%	Repeat sample analyses
		Duplicate analysis (USACE[b])	5%	None	Used to quantitate sampling/analytical variability
		Field Duplicate samples	5%	None	Used to assess sampling/analytical variability
		Equipment blank	5%	None	Used to determine sources of contamination

(Continued)

Table 6-2

(Continued)

[a] Frequencies for duplicate samples and field blanks are computed based on the total number of samples taken for and the number of analyses specified in the SOW.
[b] USACE required QC.

TPH = Total Petroleum Hydrocarbons
QCCS = Quality Control Check Samples
MDL = Method Detection Limit
N/A = Not Applicable
TRPH = Total Recoverable Petroleum Hydrocarbons
RF = Response Factor
DL = Detection Limit
RPD = Relative Percent Difference

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Both analyses will be reported. A brief description of the analysis and the corrective action taken will be included in the laboratory report.

Data reduction involves taking instrument responses or other raw data and calculating concentrations for each target analyte. Data validation involves examining the systems producing the data to be sure they are operating properly and quality objectives have been met. Data will be reviewed and validated by the laboratory QC officer. Data will be validated for conformance with method specifications including:

- Calibration;
- Duplicate analysis;
- Blank analysis;
- Spike analysis;
- Sample data calculations; and
- Quality control sample frequency.

The quality control activities implemented in this project will provide a basis for assessing the accuracy and precision of all data. Calculations are presented below.

Accuracy

For this project, accuracy of the measurement data will be assessed and controlled by continuing calibration check samples (CCCS), quality control check samples (QCCS), and method spikes (blank spikes). These results will be used to control accuracy within acceptable limits by requiring that they meet specific criteria. As CCCS, QCCS, and method spike samples are analyzed, recoveries will be calculated and compared to pre-established acceptance limits. Recovery is calculated as the measured value divided by the actual value times 100. Overall inaccuracy will be calculated as the average of (100% recovery). This inaccuracy estimate includes systematic bias and random bias and will be compared to Table 2-1 and Table 2-2 to determine data acceptability.

Precision

For this project, precision will be assessed and controlled through the use of sequential CCCS, QCCS, and duplicate analyses. The coefficient of variation (CV) will be used to estimate precision for sequential CCCS and QCCS and is calculated by:

$$CV = \frac{\text{Standard Deviation}}{\text{Mean}} \times 100$$

The relative percent difference (RPD) will be used to estimate precision for analytical duplicates and is calculated by:

$$RPD = \frac{X_1 - X_2}{(X_1 + X_2)/2} \times 100$$

The standard analytical methods and procedures that will be used for aqueous samples are briefly discussed in the following subsections.

6.1 Volatile Organics - SW 8240

6.1.1 Groundwater Matrix

Groundwater samples will be analyzed to determine the natural concentrations of volatile organics in the groundwater at the Holloman AFB sites.

6.1.1.1 Sample Preparation

Sample preparation for analysis of groundwater samples by Method 8240 will follow Method 5030, purge and trap.

6.1.2 Soil Matrix

Soil samples will be analyzed to determine the natural concentrations of volatile organics in the soil at the Holloman AFB sites listed in Table 4-2.

6.1.2.1 Sample Preparation

Sample preparation for analysis of soil samples by Method 8240 will follow Method 5030, purge and trap. The procedure for low-level concentrations will be followed.

6.1.3 Analytical Method

The presence and concentration of purgeable halocarbon and organic compounds (volatile organics) in groundwater and soil samples will be determined by EPA Method 8240. This method uses a purge and trap gas chromatography/mass spectrometry (GC/MS) technique. An inert gas is bubbled through water to transfer the purgeable organic compounds from the liquid to the vapor phase. The vapor is then swept through a sorbent trap where the purgeables are trapped. The trap is backflushed and heated to desorb the purgeable organics onto a gas chromatographic capillary column where they are separated and then detected with a mass spectrometer.

6.1.4 Preventive Maintenance

A preventive maintenance program will be followed to ensure the availability and accuracy of instruments. Records of repairs and adjustments will be maintained and available for inspection, upon request.

6.1.5 Instrument Calibration and Frequency

Samples for volatile organics will be analyzed by scanning gas chromatography/mass spectrometry (GC/MS) following SW-846 Method 8240, 3rd ed. Analyte identification and quantitation will be performed using response factors and retention times generated from a five point calibration curve, relative to the closest eluting of three internal standards. The three internal standards are:

- Bromochloromethane;
- 1,4-Difluorobenzene; and
- Chlorobenzene-d_5.

Tentatively identified compounds are identified only when a good match (Purity & Fit >.75) is obtained between the unknown spectra and the library spectra. The tentatively identified compound is then quantitated using a response factor of 1.0, with respect to the closest eluting internal standard.

6.1.6 Internal Quality Control Checks

The mass spectrometer will be tuned daily to give an acceptable spectrum for bromofluorobenzene (BFB). Relative ion abundance criteria for BFB are given in SW-846.

System performance will be verified initially and after every 12 hours to ensure a minimum average response factor of 0.3 (0.25 for bromoform) for the following system performance check compounds (SPCCs):

- Chloromethane;
- 1,1-Dichloroethane;
- Bromoform;
- 1,1,2,2-Tetrachloroethane; and
- Chlorobenzene.

A 5-point calibration, used for generating response factors, will be performed daily. The relative standard deviation (RSD) must be less than 25 percent for the five response factors calculated for each of the following calibration check compounds (CCCs):

- _1,1-Dichloroethene;
- Chloroform;
- 1,2-Dichloropropane;
- Toluene;
- Ethylbenzene; and

- Vinyl chloride.

A continuing (every 12 hours) calibration check will be performed, following the system performance check, using the CCCs listed above. A single concentration of each CCC will be analyzed and a response factor calculated.

6.1.7 Corrective Action

The single-point RF for each CCC must be within 25 percent of the average 5-point RF; otherwise, a new 5-point calibration must be generated.

6.1.8 Data Reduction, Validation, and Documentation

Data will be reduced, validated, and reported according to laboratory Standard Operating Procedures (SOPs).

6.2 Arsenic by Furnace AA - SW 7060

6.2.1 Groundwater Matrix

Groundwater samples will be analyzed to determine the natural concentrations of arsenic in the groundwater at the Holloman AFB sites.

6.2.1.1 Sample Preparation

Samples will be prepared following EPA Method 7060 "Acid Digestion Procedure For Aqueous Furnace Atomic Absorption Analysis".

6.2.2 Soil Matrix

Soil samples will be analyzed to determine the natural concentrations of arsenic in the soil at the Holloman AFB sites.

6.2.2.1 Sample Preparation

Samples will be prepared following EPA Method 3050 "Acid Digestion Procedure For Aqueous Furnace Atomic Absorption Analysis".

6.2.3 Analytical Method

Following the laboratory SOP, a sample aliquot will be placed in a graphite tube in the furnace, evaporated, charred, and atomized. Radiation from a given excited element is passed through the vapor containing ground-state atoms of arsenic. The intensity of the radiation decreases in proportion to the amount of ground-state atoms present. A monochromator isolates the characteristic radiation from the hollow cathode tube or electrodeless discharge lamp, and a photosensitive device measures the attenuated transmitted radiation.

6.2.4 Preventive Maintenance

A preventive maintenance program will be followed to ensure the availability and accuracy of instruments. Records of repairs and adjustments will be maintained and available for inspection, upon request.

6.2.5 Instrument Calibration and Frequency

A multi-point calibration curve with a correlation coefficient of greater than 0.995 must be generated daily, prior to analyses.

6.2.6 Data Reduction, Validation, and Documentation

Data will be reduced, validated, and reported according to laboratory Standard Operating Procedures (SOPs).

6.3 Metals by ICPES - EPA Method 6010

6.3.1 Groundwater Matrix

Groundwater samples will be analyzed to determine the natural concentrations of antimony, beryllium, cadmium, chromium, copper, nickel, silver, thallium, and zinc in the groundwater at the Holloman AFB sites.

6.3.1.1 Sample Preparation

Groundwater samples will be prepared according to EPA Method 3005.

6.3.2 Soil Matrix

Soil samples will be analyzed to determine the natural concentrations of antimony, beryllium, cadmium, chromium, copper, nickel, silver, thallium, and zinc in the soil at the Holloman AFB sites.

6.3.2.1 Sample Preparation

Soil samples will be prepared according to EPA Method 3050.

6.3.3 Analytical Method

Metals (antimony, beryllium, cadmium, chromium, copper, nickel, silver, thallium, and zinc) will be determined by EPA Method 6010 which allows the simultaneous, or sequential, measurement of elements using Inductively Coupled Plasma Emission Spectroscopy (ICPES). This method measures the element emitted light by optical spectrometry. Samples are nebulized, and the resulting aerosol is transported to the plasma torch. Element specific atomic-line emission spectra are produced which are dispersed by a grating spectrometer and monitored for intensity by photomultiplier tubes.

6.3.4 Preventive Maintenance

A preventive maintenance program will be followed to ensure the availability and accuracy of instruments. Records of repairs and adjustments will be maintained and available for inspection, upon request.

6.3.5 Instrument Calibration and Frequency

Detailed calibration procedures for ICPES systems are described in SW-846, 3rd ed. A response factor is calculated daily for each metal based on three exposures of a calibration standard and calibration blank. The RF is calculated and stored in the ICPES computer.

6.3.6 Internal Quality Control Checks

Following calibration, a mid-level calibration check sample is analyzed. Calibration is verified by analyzing a QC check standard (prepared independently of calibration standards) every 20 samples.

6.3.7 Corrective Action

Following calibration, a mid-level calibration check sample is analyzed; agreement between the measured value and the expected value must be within 5 percent for analyses to proceed. Calibration is verified by analyzing a QC check standard (prepared independently of calibration standards) every 10 samples; agreement within ± 15 percent of the expected value is required for all metals analyzed by ICPES.

6.3.8 Data Reduction, Validation, and Documentation

Data will be reduced, validated, and reported according to laboratory Standard Operating Procedures (SOPs).

6.4 Organic Lead by Furnace AA - SW 7421

6.4.1 Groundwater Matrix

Groundwater samples will be analyzed to determine the natural concentrations of organic lead in the groundwater at the Holloman AFB sites.

6.4.1.1 Sample Preparation

Samples will be prepared following California Department of Health Services Hazardous Materials Laboratory (HML) Method 338. Organolead is separated from the groundwater matrix by extraction with xylene. The organolead in the extract is reacted with Aliquot 336® and iodine and then diluted with MIBK.

6.4.2 Soil Matrix

Soil samples will be analyzed to determine the natural concentrations of organic lead in the soil at the Holloman AFB site.

6.4.2.1 Sample Preparation

Samples will be prepared following California Department of Health Services Hazardous Materials Laboratory Method 338. Organolead is separated from the soil matrix by extraction with xylene. The organolead in the extract is reacted with Aliquot 336® and iodine and then diluted with MIBK.

6.4.3 Analytical Method

Following HML and the laboratory SOP, organic lead will be measured by flame (FAA) or graphite furnace (GFAA) atomic absorption. With GFAA, an aliquot will be

placed in a graphite tube in the furnace, evaporated, charred, and atomized. Radiation from a given excited element is passed through the vapor containing ground-state atoms of lead. The intensity of the radiation decreases in proportion to the amount of ground-state atoms present. A monochromator isolates the characteristic radiation from the hollow cathode tube or electrodeless discharge lamp, and a photosensitive device measures the attenuated transmitted radiation. With FLAA, the sample aliquot is aspirated and atomized in a flame. A light beam from a hollow cathode lamp is directed through the flame into a monochromator, and onto the detector that measures the light absorbed.

6.4.4 Preventive Maintenance

A preventive maintenance program will be followed to ensure the availability and accuracy of instruments. Records of repairs and adjustments will be maintained and available for inspection, upon request.

6.4.5 Instrument Calibration and Frequency

A multi-point calibration curve with a correlation coefficient of greater than 0.995 must be generated daily, prior to analyses.

6.4.6 Data Reduction, Validation, and Documentation

Data will be reduced, validated, and reported according to laboratory Standard Operating Procedures (SOPs).

6.5 Selenium by Furnace AA - SW 7740

6.5.1 Groundwater Matrix

Groundwater samples will be analyzed to determine the natural concentrations of selenium in the groundwater at the Holloman AFB sites.

6.5.1.1 Sample Preparation

Samples will be prepared following EPA Method 7740 "Acid Digestion Procedure For Aqueous Furnace Atomic Absorption Analysis".

6.5.2 Soil Matrix

Soil samples will be analyzed to determine the natural concentrations of selenium in the soil at the Holloman AFB sites.

6.5.2.1 Sample Preparation

Samples will be prepared following EPA Method 3050 "Acid Digestion Procedure For Aqueous Furnace Atomic Absorption Analysis".

6.5.2 Analytical Method

Following EPA Method 7740 and the laboratory SOP, a sample aliquot will be placed in a graphite tube in the furnace, evaporated, charred, and atomized. Radiation from a given excited element is passed through the vapor containing ground-state atoms of selenium. The intensity of the radiation decreases in proportion to the amount of ground-state atoms present. A monochromator isolates the characteristic radiation from the hollow cathode tube or electrodeless discharge lamp, and a photosensitive device measures the attenuated transmitted radiation.

6.5.4 Preventive Maintenance

A preventive maintenance program will be followed to ensure the availability and accuracy of instruments. Records of repairs and adjustments will be maintained and available for inspection, upon request.

6.5.5 Instrument Calibration and Frequency

A multi-point calibration curve with a correlation coefficient of greater than 0.995 must be generated daily, prior to analyses.

6.5.6 Data Reduction, Validation, and Documentation

Data will be reduced, validated, and reported according to laboratory Standard Operating Procedures (SOPs).

6.6 Chloride and Sulfate - EPA 300.0

6.6.1 Groundwater Matrix

Only groundwater samples will be analyzed by Method 300.0 for chloride and sulfate to determine the natural concentrations of these analytes in the groundwater at the Holloman AFB sites.

6.6.1.1 Sample Preparation

Samples will be prepared as directed in the method.

6.6.2 Analytical Method

A small volume of sample is introduced into anion chromatograph. The anions are separated and measured using a system comprised of a guard column, separator column, suppressor column, and conductivity detector.

6.6.3 Preventive Maintenance

A preventive maintenance program will be followed to ensure the availability and accuracy of instruments. Records of repairs and adjustments will be maintained and available for inspection, upon request.

6.6.4 Instrument Calibration and Frequency

Three-point calibration curves are prepared daily. QCCS samples are analyzed to verify calibration at a frequency of one for every 10 samples analyzed.

6.6.5 Data Reduction, Validation, and Documentation

Data will be reduced, validated, and reported according to laboratory Standard Operating Procedures (SOPs).

6.7 Nitrate/Nitrite - EPA Method 353.2

6.7.1 Groundwater Matrix

All samples will be of a groundwater matrix, and will be analyzed to determine the natural concentration of nitrate or nitrite in the groundwater at the Holloman AFB sites.

6.7.1.1 Sample Preparation

All samples will be prepared as described in the method.

6.7.2 Analytical Method

Nitrate/nitrite in groundwater samples will be determined by the spectrophotometric method using EPA Method 353.2.

6.7.3 Preventive Maintenance

A preventive maintenance program will be followed to ensure the availability and accuracy of instruments. Records of repairs and adjustments will be maintained and available for inspection, upon request.

6.7.4 Instrument Calibration and Frequency

A multi-point calibration curve (minimum of three points) is prepared daily by analyzing standard solutions of nitrate. The calibration curve is verified by analyzing quality control check samples. A calibration curve is deemed acceptable if the correlation coefficient is greater than or equal to 0.995 and recoveries for a QC check sample are within plus or minus 10 percent.

6.7.5 Data Reduction, Validation, and Documentation

Data will be reduced, validated, and reported according to laboratory Standard Operating Procedures (SOPs).

6.8 Total Dissolved Solids - EPA Method 160.1

6.8.1 Groundwater Matrix

Groundwater matrix samples will be analyzed to determine the levels of dissolved solids in the groundwater at the Holloman AFB sites.

6.8.1.1 Sample Preparation

This section is not applicable to Method 160.1.

6.8.2 Analytical Method

Total dissolved solids (TDS) will be determined by the gravimetric method using EPA Method 160.1. A well-mixed sample is filtered, evaporated, and dried to constant weight at 180°C.

6.8.3 Preventive Maintenance

A preventive maintenance program will be followed to ensure the availability and accuracy of instruments. Records of repairs and adjustments will be maintained and available for inspection, upon request.

6.8.4 Data Reduction, Validation, and Documentation

Data will be reduced, validated, and reported according to laboratory Standard Operating Procedures (SOPs).

6.9 Total Recoverable Petroleum Hydrocarbons - EPA 418.1

6.9.1 Soil Matrix

All samples analyzed will be of a soil matrix, and will be analyzed to determine the natural concentrations of fluorocarbon-113 extractable petroleum hydrocarbons in the soil at the Holloman AFB sites.

6.9.1.1 Sample Preparation

All samples will be extracted following the soxhlet extraction method described in EPA Method 9071, using fluorocarbon-113.

6.9.2 Analytical Method

Total recoverable petroleum hydrocarbons in soil samples will be determined by the infrared spectrophotometric method described in EPA Method 418.1.

6.9.3 Preventive Maintenance

A preventive maintenance program will be followed to ensure the availability and accuracy of instruments. Records of repairs and adjustments will be maintained and available for inspection, upon request.

6.9.4 Instrument Calibration and Frequency

A multi-point calibration curve is generated initially, and when the QC check sample is recovered outside the limits of 90-110%, a valid calibration curve will generate a correlation coefficient of greater than 0.995.

6.9.5 Data Reduction, Validation, and Documentation

Data will be reduced, validated, and reported according to laboratory Standard Operating Procedures (SOPs).

6.10 Soil pH - SW 9045

6.10.1 Soil Matrix

Soil samples will be analyzed to determine the pH level of the soil at the Holloman AFB sites.

6.10.1.1 Sample Preparation

The soil is mixed with either Type II water or with a calcium chloride solution as described in Method 9045.

6.10.2 Analytical Method

After most of the soil is allowed to settle, the pH of the solution is measured electrometrically.

6.10.3 Preventive Maintenance

A preventive maintenance program will be followed to ensure the availability and accuracy of instruments. Records of repairs and adjustments will be maintained and available for inspection, upon request.

6.10.4 Instrument Calibration and Frequency

The pH meter will be calibrated with a minimum of two buffer solutions, daily prior to analysis.

6.10.5 Data Reduction, Validation, and Documentation

Data will be reduced, validated, and reported according to laboratory Standard Operating Procedures (SOPs).

6.11 Oil and Grease-EPA 413.2

6.11.1 Soil Matrix

Soil samples will be analyzed to determine the natural concentrations of oil and grease in the soil at the Holloman AFB sites.

6.11.1.1 Sample Preparation

Soil samples will be prepared using Method 3550 (sonication) wilth fluorocarbon-113.

6.11.2 Analytical Method

EPA Method 413.2 is an infrared spectroscopy technique. This method is used to determine the concentration of oil and grease. Operating parameters and interferences are described in Method 413.2.

6.11.3 Preventive Maintenance

A preventive maintenance program will be followed to ensure the availability and accuracy of instruments. Records of repairs and adjustments will be maintained and available for inspection, upon request.

6.11.4 Data Reduction, Validation, and Documentation

Data will be reduced, validated, and reported according to laboratory Standard Operating Procedures (SOPs).

6.12 Total Phosphate-EPA 365.2

6.12.1 Groundwater Matrix

Groundwater samples will be analyzed to determine the natural concentrations of total phosphate in the groundwater at the Holloman AFB sites.

6.12.1.1 Sample Preparation

This section is not applicable to this method.

6.12.2 Analytical Method

Ammonium molybdate and antimony potassium tartrate react in an acid medium with dilute solutions of phosphorus to form an antimony-phosphomolybdate complex. This complex is reduced to an intensely blue-colored complex with ascorbic acid. The color is proportional to the total phosphorus concentration.

6.12.3 Preventive Maintenance

A preventive maintenance program will be followed to ensure the availability and accuracy of instruments. Records of repairs and adjustments will be maintained and available for inspection, upon request.

6.12.4 Instrument Calibration and Frequency

A calibration curve consisting of a blank and five standards is constructed daily. The correlation coefficient for the linear regression must be equal to or greater than 0.995. A QC check sample is analyzed at a frequency of 10 percent. The acceptable recovery error for the check sample is ± 10 percent.

6.12.5 Data Reduction, Validation, and Documentation

Data will be reduced, validated, and reported according to Laboratory-Standard Operating Procedures (SOPs).

6.13 Fluoride-EPA 340.2

6.13.1 Groundwater Matrix

Groundwater samples will be analyzed to determine the natural concentrations of fluoride in the groundwater at the Holloman AFB sites.

6.13.1.1 Sample Preparation

This section is not applicable to the method.

6.13.2 Analytical Method

Fluoride is determined potentiometrically using a fluoride selective electrode with a standard single junction sleeve-type reference electrode. The potentiometric measurements are made with a pH meter having an expanded millivolt scale.

6.13.3 Preventive Maintenance

A preventive maintenance program will be followed to ensure the availability and accuracy of instruments. Records of repairs and adjustments will be maintained and available for inspection, upon request.

6.13.4 Instrument Calibration and Frequency

5-point calibration curves are prepared daily. QCCS samples are analyzed to verify calibration at a frequency of 10% of samples analyzed; recovery must be within 10 percent of the expected value.

6.13.5 Data Reduction, Validation, and Documentation

Data will be reduced, validated, and reported according to laboratory Standard Operating Procedures (SOPs).

6.14 Organic Lead by Atomic Absorption Spectrometry HML 338

6.14.1 Groundwater Matrix

Groundwater samples will be analyzed to determine the natural concentrations of organic lead in the groundwater at the Holloman AFB sites.

6.14.1.1 Sample Preparation

Samples will be prepared following California Department of Health Services Hazardous Materials Laboratory (HML) Method 338. Organolead is separated from the groundwater matrix by extraction with xylene. The organolead in the extract is reacted with Aliquot 336® and iodine and then diluted with MIBK.

6.14.2 Soil Matrix

Soil samples will be analyzed to determine the natural concentrations of organic lead in the soil at the Holloman AFB sites.

6.14.2.1 Sample Preparation

Samples will be prepared following California Department of Health Services Hazardous Materials Laboratory Method (HML) 338. Organolead is separated from the soil matrix by extraction with xylene. The organolead in the extract is reacted with Aliquot 336® and iodine and then diluted with MIBK.

6.14.3 Analytical Method

Following HML and the laboratory SOP, organic lead will be measured by flame (FAA) or graphite furnace (GFAA) atomic absorption. With GFAA, an aliquot will be placed in a graphite tube in the furnace, evaporated, charred, and atomized. Radiation from a given excited element is passed through the vapor containing ground-state atoms of lead. The intensity of the radiation decreases in proportion to the amount of ground-state atoms present. A monochromator isolates the characteristic radiation from the hollow cathode tube or electrodeless discharge lamp, and a photosensitive device measures the attenuated transmitted radiation. With FLAA, the sample aliquot is aspirated and atomized in a flame. A light beam from a hollow cathode lamp is directed through the flame into a monochromator, and onto the detector that measures the light absorbed.

6.14.4 Preventive Maintenance

A preventive maintenance program will be followed to ensure the availability and accuracy of instruments. Records of repairs and adjustments will be maintained and available for inspection, upon request.

6.14.5 Instrument Calibration and Frequency

A multi-point calibration curve with a correlation coefficient of greater than 0.995 must be generated daily, prior to analyses.

6.14.6 Data Reduction, Validation, and Documentation

Data will be reduced, validated, and reported according to laboratory Standard Operating Procedures (SOPs).

6.15 Geotechnical Analyses - ASTM D421, D422, D4318, D2216

6.15.1 Soil Matrix

Soil samples will be analyzed to determine geotechnical characteristics of the soil at the Holloman AFB sites.

6.15.2 Analytical Methods

Particle (grain) size distribution will be determined by sieve analysis according to ASTM Standards D421-85 and D422-85. Hydrometer analyses will not be performed.

The atterburg limits, liquid limit, and plastic limit will be determined according to ASTM Standard D4318-84.

Soil moisture will be determined gravimetrically according to ASTM Standard D2216-80.

Unsaturated permeability will be determined gravimetrically according to Corps of Engineers Method EM-1110-1906.

Porosity testing is based on Soil Indexing Formulas provided in the Civil Engineering Reference Manual, Fourth Edition authored by Michael Lindebrug, P.E. The formula for porosity is defined as the volume of voids divided by the total volume of the sample. This formula can be rewritten in the following format.

$$1 - (W_S/GVp_W)$$

Where: W_S/V = Unit dry weight of the sample;
G = Specific gravity of the solids; and
p_W = Unit weight of water.