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

MEMORANDUM FOR NEW MEXICO ENVIRONMENT DEPARTMENT

FEB 0 2 2009

Attn: Mr. James Bearzi
Hazardous Waste Bureau
2905 Rodeo Park Drive East
Santa Fe NM 87105-6303

FROM: 49 CES/CD
550 Tabosa Ave
Holloman AFB NM 88330-8458

SUBJECT: Base-wide Septic Tanks Solid Waste Management Units RFI Work Plan (January 2009) Holloman AFB, NM6572124422 HWB-HAFB

1. The subject work plan is hereby submitted to NMED for review.

2. I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

3. If you have any questions, please feel free to contact Mr. David Scruggs at (575) 572-5395.

A. DAVID BUDAK
Deputy Base Civil Engineer

Attachment:
RCRA Facilities Investigation (RFI) Work Plan

cc:

(w/Atch)	(w/o Atch)	(w/o Atch)
Mr. David Strasser	Mr. Will Moats	Ms. Laurie King
Hazardous Waste Bureau	Hazardous Waste Bureau	USEPA, Region 6 (6PD-F)
5500 San Antonio Dr. NE	5500 San Antonio Dr. NE	1445 Ross Ave., Ste 1200
Albuquerque, NM 87109	Albuquerque, NM 87109	Dallas, TX 75202-2733

Basewide Septic Tank Solid Waste Management Units
RCRA Facility Investigation Work Plan
Holloman AFB, New Mexico

Prepared For:

49th CES/CEA
Holloman Air Force Base
New Mexico

Prepared By:

U.S. Army Corps of Engineers
Omaha District
Omaha, Nebraska

January 2009

DRAFT
Basewide Septic Tank Solid Waste Management Units
RCRA Facility Investigation Work Plan
Holloman AFB, New Mexico

Table of Contents

1 INTRODUCTION 1-1
1.1 Purpose and Objectives 1-2
1.2 Document Organization 1-2
2 PHYSICAL AND ENVIRONMENTAL SETTING 2-1
2.1 Holloman Air Force Base and Site Description 2-1
2.2 Holloman Air Force Base History 2-1
2.3 Physiography and Topography 2-1
2.4 Surface Water and Hydrology 2-2
2.5 Regional Geology and Soils 2-2
2.5.1 Geology 2-2
2.5.2 Soils 2-3
2.6 Regional Hydrogeology 2-4
2.7 Climate 2-5
2.8 Current and Future Land Use 2-5
2.9 Current and Future Water Uses 2-5
3 TECHNICAL APPROACH, INVESTIGATIVE ACTIVITIES, AND FIELD METHODOLOGIES 3-1
3.1 Technical Approach 3-1
3.2 Investigation Activities 3-4
3.2.1 Baseline Assessment 3-4
3.2.2 Initial System Assessment 3-5
3.2.3 Technical Memorandum Reporting 3-6
3.2.4 Final System Assessment 3-7
3.2.5 Evaluate Analytical Results And Additional System Assessment 3-9
3.2.6 Remedial Investigation Report 3-9
3.3 Field Investigation Methodologies 3-10
3.3.1 Pre-Investigation Requirements 3-10
3.3.2 Field Activities 3-11
4 PROJECT QUALITY ASSURANCE 4-1
4.1 Data Quality Objectives Process 4-1
4.1.1 Precision 4-2
4.1.2 Accuracy 4-2
4.1.3 Completeness 4-2
4.1.4 Representativeness 4-3
4.1.5 Comparability 4-3
4.1.6 Sensitivity 4-3
4.1.7 Data Validation 4-4
4.2 Standard Operating Procedures 4-5
4.3 Sample Identification 4-5
4.4 Project Documentation 4-5

4.4.1 Sample Documentation 4-5
4.4.2 Field Logbook 4-6
4.4.3 Field Screening Data 4-6
4.4.4 Data Reporting 4-7
4.5 Organization and Schedule 4-7
5 HEALTH AND SAFETY REQUIREMENTS 5-1
6 REFERENCES 6-1

Tables

Table 3-1 Septic tank system sites identified by their respective building numbers, Holloman AFB, New Mexico.
Table 3-2 Sample containers by sample media.

Figures

Figure 2-1 Location of Holloman AFB, New Mexico.
Figure 2-2 Soil types at Holloman AFB, New Mexico, based on United States Department of Agriculture (USDA) Soil Conservation Services classifications.
Figure 2-3 Groundwater contour map showing groundwater elevation contours across Holloman AFB, New Mexico, based on 2002 measurements taken from the shallow aquifer.
Figure 3-1 Locations of septic tank systems identified by the buildings they served, Holloman AFB, New Mexico.
Figure 3-2 Flow diagram identifying activities to meet the objectives of the investigative technical approach for the septic tank systems.

Appendices

Appendix A New Mexico Environment Department Correspondence
Appendix B Approved Holloman AFB Standard Operating Procedures

Acronyms

°F	degrees Fahrenheit
%R	percent recovery
AAF	Army Air Field
AF Fm	Air Force Form
amsl	above mean sea level
ANSI	American National Standards Institute
bgs	below ground surface
COCs	chemicals of concern
DPT	Direct Push Technology
DQOs	data quality objectives
DRO	Diesel Range Organics
EDD	electronic data deliverables
ERP	Environmental Restoration Program
ERPIMS	Environmental Restoration Program Information Management System
FID	flame-ionization detector
GPS	global positioning system
GRO	Gasoline Range Organics
HAFB	Holloman Air Force Base
HSA	Hollow Stem Auger
IDLs	instrument detection limits
IDW	Investigation-Derived Waste
LCS	laboratory control samples
LCSD	laboratory control samples duplicate
MDL	method detection limits
mg/L	milligrams per liter
MS	matrix spike
MSD	matrix spike duplicate
NAD	North American Datum
NMED	New Mexico Environment Department
NMWQCC	New Mexico Water Quality Control Commission
ORO	Oil Range Organics

OSHA	Occupational Safety and Health Administration
OVA	organic vapor analyzer
PID	photoionization detector
PPE	personal protective equipment
PQLs	practical quantitation limits
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RFI	Resource Conservation and Recovery Act Facility Investigation
RLs	reporting limits
RPD	relative percent difference
SAR	SWMU Assessment Report
SOPs	standard operating procedures
SSLs	soil screening levels
SVOCs	Semi-Volatile Organic Compounds
SWMUs	Solid Waste Management Units
TAL	target analyte list
TB	trip blank
TDS	total dissolved solid
TPH	total petroleum hydrocarbons
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
VOCs	Volatile Organic Compounds

1 INTRODUCTION

Additional investigation of several Solid Waste Management Units (SWMUs) relative to currently inactive or removed septic systems located across Holloman Air Force Base (HAFB) is required. The United States Army Corps of Engineers (USACE) was retained by HAFB to prepare this work plan to serve as the primary working document to guide the investigation, enabling the acquisition of all pertinent project components to ultimately address project objectives. To meet project objectives, this work plan provides the relevant current site specific information along with investigation and data collection requirements as outlined in two letters submitted by New Mexico Environment Department (NMED) in response to a SWMU Assessment Report provided by HAFB to the department. These two letters, titled: 1) Notice of Deficiency on SWMU Assessment Report, Holloman AFB Septic Tanks, April 2007 and 2) Notice of Disapproval: Partial Response to Notice of Deficiency on SWMU Assessment Report, Septic Tanks, March 2008; are provided in Appendix A.

Septic tank systems are currently located across HAFB that serve buildings used for various operational support functions. Some of the septic tank systems remain active, while others have been removed from service when their associated building was connected to the basewide sewage handling and treatment system or for other reasons. Additionally, at some of the inactivated septic tank systems the actual septic tank has been excavated and removed from the ground. Each septic tank system has been assigned to an investigation category based on the status of the system relative to its current state of activity (i.e., still in use or removed from use) and the use of the building it served (i.e., potential and type of chemicals of concern [COCs] to be introduced into the septic system based on building use history). There are three investigation categories: category 1 - further site investigation required, category 2 - further preliminary research is required to determine if the system should be placed in category 1 or 3, and category 3 - further site investigation or further preliminary research is not required. Category 1 and 2 septic tank systems are inactive, while some have had their tanks removed. There are numerous other septic tank systems that were originally aligned into category 3 requiring no further action, therefore these systems will not be discussed in this work plan (however, they will be added to the RFI report to document their status). Their alignment into category 3 was based on no potential for the systems to act as contaminant sources due to the historical use of the buildings they served (i.e., municipal waste only) or they are currently in use and therefore do not require investigation under this program.

Under this work plan there are 9 and 25 septic tank systems that are aligned into investigation categories 1 and 2, respectively. The primary environmental media of concern at the site is soil, therefore sampling and analysis will be concentrated on this media. However, at all category 1 septic tank system sites a groundwater sample will also be obtained from the shallow groundwater zone.

1.1 Purpose and Objectives

The primary purpose of this Resource Conservation and Recovery Act Facility Investigation (RFI) at each septic system is to delineate potential COCs that may have been released to the environment and provide physical and spatial data to allow for design and implementation of future remedial and abandonment activities as required.

Specific data quality objectives (DQOs) for each septic system consist of the following:

- Initial alignment of systems into proper investigatory categories.
- Identification of all current/historical uses and system components and realignment of category 2 systems.
- Completion and acceptance by stakeholders of planned detailed system investigatory measures.
- Determination of nature and extent of potential COCs at each system.
- Evaluation of risk and initial remedial track for each system.

The technical approach to meet these DQOs is discussed in Chapter 3. Additionally, DQOs for ensuring acceptable data is obtained specific to chemical analysis of field samples is discussed in Chapter 4. Major work elements to meet the DQOs include: development of addendums to the approved Holloman basewide quality assurance project and health and safety plans; existing information review; field work to include trenching, septic tank/soil/groundwater sampling and analysis; data analysis; and report writing.

1.2 Document Organization

This work plan is organized into the following chapters with supporting tables, figures, and appendices.

- **Chapter 1 - Introduction:** Primary objectives of the project are identified for the Multiple SWMU Septic Tank project.
- **Chapter 2 – Physical and Environmental Setting:** Pertinent descriptions of the history, location, physiography, topography, surface water, hydrology, regional geology, soils, regional hydrogeology, climate, and current and future land and water use for HAFB are provided.
- **Chapter 3 – Technical Approach and Investigative Activities:** Approaches that will be followed allowing for collection of appropriate data sets and reporting to meet primary project objectives are described in this chapter. Additionally, the types of field work and analytical requirements will be discussed.
- **Chapter 4 – Project Quality Assurance:** Summary discussions pertaining to data quality objectives, standard operating procedures, sample identification, and project documentation are included in this chapter.
- **Chapter 5 – Health and Safety Requirements:** Health and safety requirements associated with the various work efforts under investigation activities presented in this RFI work plan are discussed in this chapter.

- **Chapter 6 - References:** Full references for existing documentation cited throughout this RFI work plan are presented in this chapter.

Tables and figures referenced throughout the RFI work plan are included following Chapter 6. Also, supporting documentation is included in appendices.

2 PHYSICAL AND ENVIRONMENTAL SETTING

2.1 Holloman Air Force Base and Site Description

HAFB is situated in south central New Mexico, in the northwest central part of Otero County, approximately 75 miles north-northeast of El Paso, Texas (Figure 2-1). HAFB has a population of 6,000 and occupies about 50,000 acres in the northeast quarter of Section 1, Township 17 South, Range 8 East. The White Sands Missile Range testing facilities occupy additional land extending northward from the base. Private and public owned lands border the remainder of HAFB. The major highway servicing HAFB is Highway 70, which runs southwest from the town of Alamogordo and separates HAFB from publicly owned lands to the south. Alamogordo, which has a population of approximately 35,000, is located about 7 miles east of the base.

2.2 Holloman Air Force Base History

HAFB was first established in 1942 as Alamogordo Army Air Field (AAF). From 1942 through 1945, Alamogordo AAF served as the training grounds for over 20 different flight groups, flying primarily B-17s, B-24s, and B-29s. After World War II, most operation had ceased at the base. In 1947, Air Material Command announced the air field would be its primary site for the testing and development of unmanned aircraft, guided missiles, and other research programs. On January 13, 1948, the Alamogordo installation was renamed Holloman Air Force Base, in honor of the late Col. George V. Holloman; a pioneer in guided missile research. In 1968, the 49th Tactical Fighter Wing arrived at HAFB and has remained since. Today, HAFB also serves as the training center for the German Air Force's Tactical Training Center.

2.3 Physiography and Topography

HAFB is located within the Sacramento Mountains Physiographic Province on the western edge of the Sacramento Mountains. HAFB is approximately 59,600 acres in area, and is located at a mean elevation 4,093 feet above mean sea level (amsl). The region is characterized by high tablelands with rolling summit plains; cuesta-formed mountains dipping eastward and of west-facing escarpments with the wide bracketed basin forming the basin and range complex. The base is located in the Tularosa Sub-basin which is part of the Central Closed Basins. The bordering mountains rise abruptly to altitudes of 7,000 to 12,000 feet amsl. The San Andres Mountains bound the basin to the west (about 30 miles) with the Sacramento Mountains approximately 10 miles to the east (Figure 2-1). At its widest, the basin is about 60 miles east to west and stretches approximately 150 miles north to south. The septic tank sites are located throughout the base.

2.4 Surface Water and Hydrology

The Tularosa Basin contains all of the surface flow in its boundaries. The nearest inflow of surface waters to the base comes from the Lost River, located in the north-central region of the base. The upper reaches of the Three Rivers and the Sacramento River are perennial in the basin. HAFB is dissected by several southwest trending arroyos that control the surface drainage. Hay Draw arroyo is located in the far north. Malone and Rita's Draws, which drain into the Lost River and Dillard Draw arroyos, are located along the eastern perimeter of the Base. Approximately 10,000 years ago, indications are of a much wetter climate. The present day Lake Otero encompassed a much larger area, possibly upwards of several hundred square miles. Its remains are the Alkali Flat and Lake Lucero. Lake Lucero is a temporary feature of merely a few inches in depth during the rainy season.

Ancient lakes and streams deposited water bearing deposits over the older bedrock basement materials. Fractures, cracks, and fissures in the Permian and Pennsylvanian bedrock yield small quantities of relatively good quality water in the deeper peripheral. Potable water is only found from wells near the edges of the basin with more saline water towards the center. Two of the principal sources of potable water are a long narrow area on the upslope sides of Tularosa and Alamogordo with the other in the far southwestern part of the basin. A portion of Alamogordo's water, as well as the Base's, is supplied from Lake Bonito (which is in the Pecos River Basin).

2.5 Regional Geology and Soils

2.5.1 Geology

The sedimentary rocks which make up the adjacent mountain ranges are between 500 and 250 million years old (WSMR, 2003a). During the period when the area was submerged under the shallow intra-continental sea, the layers of limestone, shale, gypsum, and sandstone were deposited. In time, these layers were pushed upward through various tectonic forces forming a large bulge on the surface. Approximately 10 million years ago the center began to subside resulting in a vertical drop of thousands of feet leaving the edges still standing (the present day Sacramento and San Andres mountain ranges). In the millions of years following, rainfall, snowmelt, and wind eroded the mountain sediments depositing them in the valley (i.e., Tularosa Basin). Water carrying eroded limestone, dolomite, gravel, and other materials continue to flow into the basin.

As the Tularosa Basin is a bolson, which is a basin with no surface drainage outlet, sediments carried by surface water into a closed basin are bolson deposits. The overlying alluvium generally consists of unconsolidated gravels, sands, and clays. Soils in the basin are derived from the adjacent ranges as erosional deposits of limestone, dolomite, and gypsum. A fining sequence from the ranges towards the basin's center characterizes the area with the near surface soils as alluvial, eolian, and lacustrine deposits. The

alluvial fan deposits are laterally discontinuous units of interbedded sand, silt, and clay while the eolian deposits consist primarily of gypsum sands. The eolian and alluvial deposits are usually indistinguishable due to the reworking of the alluvial sediment by eolian processes. The playa, or lacustrine deposits, consist of clay containing gypsum and are contiguous with the alluvial fan and eolian deposits throughout the base. There has been the identification of stiff caliche layers, varying in thickness, at different areas of the base.

2.5.2 Soils

The United States Department of Agriculture (USDA) Soil Conservation Service has identified two soil associations in the vicinity of HAFB; the Holloman-Gypsum Land-Yesum complex, and the Mead silty clay loam (Figure 2-2). The permeability of these horizons ranges from $4x10^{-4}$ to $1x10^{-3}$ centimeters per second.

The Holloman-Gypsum Land-Yesum complex, 0 to 5 percent sloped soil consists of larger areas of shallow and deep, well drained soils and areas of exposed gypsum. The Holloman soil makes up about 35 percent of the complex. Typically, the surface layer is light brown very fine sandy loam about 3 inches thick. The upper 13 inches of the substratum is pink very fine sandy loam that is very high in gypsum. Below that, the substratum is white gypsum to a depth of more than 60 inches. This soil is calcareous and mildly alkaline to moderately alkaline throughout. Permeability is moderate, and available water capacity is very low.

Gypsum land makes up about 30 percent of the Holloman-Gypsum Land-Yesum complex, 0 to 5 percent slopes. Typically, less than 1 inch of very fine sandy loam overlies soft to hard, white gypsum. The deep Yesum very fine sandy loam makes up about 20 percent of the complex. Typically, the surface layer is light brown very fine sandy loam about 3 inches thick. The upper 9 inches of the substratum is light brown fine sandy loam that is very high in gypsum. Below that, the substratum is pink very fine sandy loam to a depth of more than 60 inches. The soil is calcareous throughout and is mildly alkaline. Permeability is moderate, and available water capacity is moderate. Many fine gypsum crystals are found throughout the profile.

The soil type located across the main drainage area for the installation is Mead silty clay loam, 0 to 1 percent slopes. This deep, poorly drained, nearly level soil is on outer fringes of alluvial fans. This soil formed in fine textured alluvium over lacustrine lake sediment. It is very high in salt content because of periodic flooding and poor drainage. Slope are smooth and concave. Typically, the surface layer is reddish brown silty clay loam and clay loam about 5 inches thick. The substratum, to a depth of 48 inches, is light reddish brown clay that has a high content of salts. Below that, the substratum is lacustrine material of variable texture and color to a depth of more than 60 inches. Included with this soil are areas of Holloman soils and Gypsum land along the margins of the unit of steep, short gully sides and knolls. These inclusions make up about 15 percent of the map unit for this soil type. Individual areas are generally smaller than 10 acres.

This soil is moderately calcareous throughout and is moderately to strongly alkaline. It has a layer of salt that is more soluble than gypsum. Permeability is very low, and available water capacity is low.

2.6 Regional Hydrogeology

Groundwater occurs as an unconfined aquifer in the unconsolidated deposits of the central basin, with the primary source of recharge as rainfall percolation and minor amounts of stream run-off along the western edge of the Sacramento Mountains. Surface water/rainfall migrates downward into the alluvial sediments at the edge of the shallow aquifer near the ranges, and flows downgradient through progressively finer-grained sediments towards the central basin. Because the Tularosa Basin is a closed system, water that enters the area only leaves either through evaporation or percolation. This elevated amount of percolation results in a fairly high water table. Beneath HAFB, groundwater ranges from 5 to 50 feet below ground surface. Flow for the base is generally towards the southwest with localized influences from the variations in the topography of the base. In the northern and western portions of the base, groundwater flows more to the west towards the Ritas Draw, Malone Draw, and Lost River drainages. Groundwater flow is affected by local topography in areas immediately adjacent to arroyos, where groundwater flows directly toward the drainages regardless of the regional flow pattern. A general groundwater contour map is provided as Figure 2-3.

Groundwater quality in the Tularosa Basin is of potable quality at the recharge areas in close proximity to the Sacramento Mountains and becomes increasingly mineralized toward the central portion of the basin and discharge areas. The majority (over 70%) of the Environmental Restoration Program (ERP) sites/SWMUs located across HAFB, have groundwater monitoring wells containing water with an average total dissolved solid (TDS) concentration greater than 10,000 milligrams per liter (mg/L). This TDS data supports the hypothesis that TDS concentrations below 10,000 mg/L at HAFB are caused by dilution of natural groundwater quality from leaking water lines and surface irrigation from the domestic water supply. TDS concentrations greater than 10,000 mg/L exceed the New Mexico Water Quality commission limit as potable water and this, the groundwater beneath HAFB has been designated as unfit for human consumption. Likewise, the United States Environmental Protection Agency (USEPA) guidelines have identified the groundwater as a Class IIIB water source, characterized by TDS concentrations exceeding 10,000 mg/L. Class IIIB groundwater is also characterized by a low degree of interconnection with adjacent surface water or groundwater of a higher class. Groundwater does not discharge or connect to any adjacent aquifers because the Tularosa Basin is a closed basin. Adjacent surface waters include Lost River and Lake Holloman, which also have high concentrations of TDS, and are not considered potential drinking water sources.

2.7 Climate

As a whole, New Mexico has a mild, arid to semi-arid continental climate characterized by light precipitation totals, abundant sunshine, relatively low humidity, and relatively large annual and diurnal temperature ranges (WRCC, 2003). The climate of the Central Closed Basins varies with elevation. The base is located in the low areas and is characterized by warm temperatures and dry air. Daytime temperatures often exceed 100 degrees Fahrenheit (°F) in the summer months and are in the middle 50s in the winter. A preponderance of clear skies and relatively low humidity permits rapid time cooling resulting in average diurnal temperature ranges of 25 to 35°F. Potential evapotranspiration, at 67 inches per year, significantly exceeds annual precipitation, usually less than 10 inches. Arid conditions resulting from very low rainfall amounts, coupled with the topographically induced wind patterns combining with the sparse vegetation, tend to cause localized "dust devils." The annual rainfall for Alamogordo is 12 inches per year. Much of the precipitation falls during the mid-summer monsoonal period (July and August) as brief, yet frequent, intense thunderstorms culminating to 30-40% of the total annual rainfall.

2.8 Current and Future Land Use

The land surrounding HAFB consists of residential areas to the east and northeast (City of Alamogordo), rangeland to the south, the White Sands National Monument to the west, and areas where military activities are conducted to the north. The desert terrain of the area immediately surrounding HAFB has limited development, and there are no agricultural operations, residential communities, or large industrial operations located adjacent to the base. HAFB is an active military installation and is expected to remain active for the foreseeable future. No transfer of military property to the public is anticipated, and public access to the base is restricted (Foster Wheeler, 2002).

Residential development on the base is limited by environmental and operational constraints imposed by the 100-year floodplain, historic sites, and areas identified under the Installation Restoration Program. Safety and noise zones also limit residential development on HAFB. Future plans for residential development on the base include renovation of existing structures, replacement of inefficient buildings, and expansion into open areas in the southeast corner of the base (HAFB, 2000). Future land use is not expected to differ significantly from current land use practices (Foster Wheeler, 2002).

2.9 Current and Future Water Uses

At present, the primary fresh water resource for the City of Alamogordo and HAFB is Lake Bonita, located 60 miles northeast of the Tularosa Basin. Currently, there are no potable supplies of groundwater or surface water located on the base. HAFB obtains its water supply from the city of Alamogordo and the HAFB wells in the Boles, San Andres, and Douglas well fields at the base of the Sacramento Mountains. No water supply wells

are located on or near the base because of poor groundwater quality (TDS concentrations greater than 10,000 mg/L). The nearest production well downgradient from HAFB is a livestock well located 13 miles southwest of ERP site DP-63. There are no potable or irrigation wells near to or immediately downgradient of the base (Foster Wheeler, 2002).

3 TECHNICAL APPROACH, INVESTIGATIVE ACTIVITIES, AND FIELD METHODOLOGIES

The overall technical approach outlining general procedures to follow to fulfill the project purpose and DQOs are discussed. Identification of and supporting criteria for investigation activities required to meet the technical approaches are also discussed, followed by a presentation of field methodology procedures.

3.1 Technical Approach

The technical approach for achieving the project purpose and objectives is discussed in this section. This technical approach provides a systematic operational work frame allowing the most efficient work effort to be realized. As previously stated, the primary purpose of the RFI at each septic system is to delineate potential COCs that may have been released to the environment and provide physical and spatial data to allow for design and implementation of future remedial and abandonment activities as required.

Septic tank systems are currently located across HAFB that serve buildings used for various operational support functions. Some of the septic tank systems remain active, while others were removed from service when their associated building was connected to the base-wide sewage handling and treatment system or for other reasons. Additionally, at some of the inactivated septic tank systems the actual septic tank has been excavated and removed from the ground. A SWMU Assessment Report (SAR) concerning known septic tank systems located throughout the base included readily available system information at the time it was developed. The SAR, dated April 2007 (HAFB, 2007), was submitted by HAFB to NMED for their review during 2007.

Based on review of obtainable current and historical information, each septic tank system has been assigned to an investigation category based on the status of the system relative to its current state of activity (i.e., still in use or removed from use) and the use of the building it served (i.e., potential for and type(s) of COC(s) to be introduced into the septic system based on building use history). There are three investigation categories: category 1 - further site investigation required, category 2 - further preliminary research is required allowing the determination if the system should be placed in category 1 or 3, and category 3 - further site investigation or further preliminary research is not required. Category 1 and 2 septic tank systems are inactive, while some have had their tanks removed. There were numerous other septic tank systems that were originally aligned into category 3 requiring no further action, therefore these systems will not be discussed in this work plan (however, they will be added to the RFI report to document their status). Their alignment into category 3 was based on no potential for the systems to act as contaminant sources due to the historical use of the buildings they served (i.e., municipal waste only) or they are currently in use and therefore do not require investigation under this program.

Under this work plan there are 9 and 25 septic tank systems that are aligned into investigation categories 1 and 2, respectively. Septic tank systems are identified according to the identification numbers of the buildings they served. Table 3-1 provides a listing of the septic tank systems along with their current respective investigative category identified by the building numbers the systems served. Documentation of NMED correspondence respective of SAR review (Appendix A) provides the basis for the initial investigative category assignments. Septic tank system locations are shown on Figure 3-1 and identified by the buildings they served (systems 639 and 640 are not shown and will need to be field located).

The primary environmental media of concern at the site is soil, therefore sampling and analysis will be concentrated on this media. However, a groundwater sample will also be obtained from the shallow groundwater zone at all septic tank system sites ultimately determined to meet category 1 status. The investigative technical approach showing the steps required for category 1 and category 2 septic tank systems are provided below.

Category 1 Septic Tank System Investigation Technical Approach:

1. Verify/determine structural layout of septic tank system components through previous studies, records search, and visual inspection and the historical use(s) of the building it served.

2. Verify/determine through trenching the presence, location, and depths of the distribution lines, septic tank, and leachfield for each system. Determine if fluid is present in the septic tank. If fluid is present, sample and analyze for list of potential COCs based on NMED correspondence, provided in Appendix A, and historical use(s) of the building it served to define if the tank is a potential source and for abandonment criteria.

3. Develop scaled figures showing all septic tank system components for all category 1 septic systems. Layout boring locations and sample depths based on previous findings. Additionally, re-evaluate and adjust as necessary original scheduled list of analytes based on analysis of all obtained septic-tank fluid samples.

4. Complete a concise technical memorandum describing all previous findings and identify final boring locations, sample depths, and analyte lists along with supporting rationale. Present technical memorandum to HAFB for their comment/concurrence, then finalize technical memorandum.

5. Perform finalized boring, sampling, and analysis program as outlined in the technical memorandum.

6. Evaluate analytical results obtained from step 5 against comparative concentration criteria Residential Soil Screening Levels (SSLs), New Mexico Water Quality Control Commission (NMWQCC) published groundwater quality standards, and

background study results as appropriate. If results are at or below the comparative concentration criteria then proceed to step 7 below, otherwise determine and complete additional sampling points to fully delineate targeted medium and analyte(s).

7. Complete single RFI report addressing all septic tank system sites evaluated under this program (including category 3 systems).

Category 2 Septic Tank System Investigation Technical Approach:

1. Complete records search, historical use(s) of building served, and visual inspection to initially determine if septic system should be considered a category 3 system (based on historical use(s) of building served). If it is determined as a category 3 system then no further investigation is required. Otherwise, additional investigation work is required as follows.

2. Verify/determine structural layout of septic tank system components through additional review of previous studies, records search, and visual inspection.

3. Verify/determine through trenching the presence, location, and depths of the distribution lines, septic tank, and leachfield for each system. Determine if fluid is present in the septic tank. If fluid is present, sample and analyze for list of potential COCs based on historical use(s) of associated building to define if the tank is a potential source and for future abandonment criteria.

4. Develop scaled figures showing all septic tank system components for all qualifying category 2 septic systems. Layout boring locations and sample depths based on previous findings. Additionally, reevaluate and adjust as necessary original scheduled list of analytes based on analysis of respective septic-tank fluid sample.

5. Complete a concise technical memorandum describing all previous findings (to include rationale to justify how category 2 systems meet either category 1 or 3 placement criteria) and identify final boring locations, sample depths, and analyte lists along with supporting rationale. Present technical memorandum to HAFB for their comment/concurrence, then finalize technical memorandum.

6. Perform finalized boring, sampling, and analysis program as outlined in the technical memorandum.

7. Evaluate analytical results obtained from step 6 against comparative concentration criteria Residential Soil Screening Levels (SSLs), New Mexico Water Quality Control Commission (NMWQCC) published groundwater quality standards, and background study results as appropriate. If results are at or below the comparative concentration criteria then proceed to step 8 below, otherwise

determine and complete additional sampling points to fully delineate targeted medium and analyte(s).

8. Complete single RFI report addressing all septic tank system sites evaluated under this program.

Septic tank system components (as referenced in the above technical approach) that are required to be addressed under this work plan include all floor drains, sumps, lavatory facilities, distribution lines, septic tank, and leachfield (drain laterals).

3.2 Investigation Activities

Identification of and supporting criteria for investigation activities required to fulfill various steps outlined in categories 1 and 2 technical approaches, presented in section 3.1, are discussed in this section. For clarity, discussions are divided into baseline assessment, initial assessment, technical memorandum reporting, final system assessment, and remedial investigation report sections and each are linked to specific technical approach steps. Additionally, a flow diagram identifying the investigative activities to meet the objectives of the technical approach is presented on Figure 3-2.

3.2.1 Baseline Assessment

Baseline assessment activities (i.e., category 1, step 1 and category 2, steps 1 and 2) associated with obtaining required data to meet the purpose of this RFI include evaluation of previous studies, records search, and visual inspection for all category 1 and 2 septic tank systems. Completing this assessment activity will also support the detailed planning and commencement of appropriate field investigation activities. All previously completed studies and record search information shall be obtained from HAFB and other sources, and reviewed for pertinent information pertaining to the design and configurations of septic tank system components, as-built conditions and plans, historical use(s) of their respective buildings identifying potential COCs, changes made to the septic tank system use such as disconnection from its associated building, etc. A visual inspection of each septic tank system shall be completed to verify findings resulting from the previously completed studies and records search activities, and to identify any septic tank system components that may not have been identified during the previously completed studies and records search activities. Also, cleanouts, septic tank lids, and other internal plumbing in buildings shall be visually identified to aid in determining the septic tank location and system layout. Sketches based on available shop drawings and actual measurements of all system components shall be developed as a basis for initial system assessment activities discussed in the following section. Digital photographs shall be taken at each septic tank system site depicting all system components and associated building. Additionally, the suspected area of the leachfield shall also be photographed. Photographs shall be obtained prior to any intrusive activities. (It should be noted depending on the historical use of buildings serving category 2 systems, such as only

simple municipal waste streams being produced from the buildings, that these systems can be realigned as category 3 systems and no further field activities will be required. However, supporting information and rationale will be presented in the technical memorandum discussed in section 3.2.3.)

3.2.2 Initial System Assessment

Initial septic tank system assessment activities (i.e., category 1, step 2 and category 2, step 3) associated with obtaining the required data to meet the purpose of this RFI include verification and/or determination through trenching of the presence, location, and depths of the distribution line, septic tank, and leachfield for each system. This initial system assessment is required for all category 1 and 2 septic tank systems. At sites where the septic tank has been previously removed (Table 3-1), identification of the distribution lines and leachfield drain laterals are still required to be identified. The distribution line shall be located where it exits the building and where it enters the septic tank. A trench shall be place to expose the entire length of the septic tank's opposite end from where the distribution line enters it, allowing for the horizontal dimension of the tank to be determined for future remedial and abandonment planning. Trenches shall be placed in the leachfield to determine locations and depth of the drain laterals in three areas, thereby facilitating proper soil boring placement and soil sampling depths (as discussed in section 3.2.3).

The determination if fluid is present in septic tanks shall be conducted, and if septic tank fluid is present it shall be sampled and analyzed; additionally, a thickness measurement of the fluids shall also be obtained for qualitative and disposal purposes only. At sites where septic tanks have been previously removed, fluid sampling/measuring is not a requirement. Sampling, analysis, and thickness measurements of septic tank fluids (if present) will aid in qualitative evaluation of the tanks potential sources as well as help evaluate the environmental data (in conjunction with the historical use(s) of the buildings) and the volumes and disposal options when septic fluids in the tanks are removed during potential future remedial activities. (Measurements from ground surface to the top and bottom of the tank shall be performed and recorded.) Field duplicates will be collected at the frequency of one in 10 samples collected or one per batch, whichever is greater. Matrix spike/matrix spike duplicate (MS/MSD) samples will be collected at a frequency of one set per 20 samples. Based on currently available information, potential COCs to be analyzed for in fluid samples (if present) are shown in Table 3-1. USEPA sample preparation and analytical methods (shown as sample preparation/analytical method) for potential tank fluid COCs are as follows:

- Total Petroleum Hydrocarbons (TPH): 3580/8015M
- Volatile Organic Compounds (VOCs): 3585/8260B
- Semi-Volatile Organic Compounds (SVOCs): 3580/8270D
- Target Analyte List (TAL) Metals: 3052/6010C and 7471A
- Tritium: 906.0M/906.0M
- Explosives: 3580/8330B

It should be noted that reporting and method detection limits of all the analytical methods listed above will be at qualitative levels, aiding in the determination if the septic tank fluid is a potential source to soil and groundwater. TPH analysis shall consist of diesel range organics (DRO), gasoline range organics (GRO), and oil range organics (ORO) fractions. If desired, the contractor may propose alternative analytical methods. All proposed procedures are subject to the USACE project chemist's approval.

3.2.3 Technical Memorandum Reporting

Technical memorandum reporting activities (i.e., category 1, steps 3 and 4 and category 2, steps 4 and 5) shall be completed by compiling and analyzing required data derived from Baseline and Initial System Assessments, described above, for all category 1 and 2 septic tank systems. The overall purpose of developing this memorandum is to present the basis, rationale, and criteria for sampling activities to be performed during Final System Assessment work activities to fulfill RFI requirements and to obtain concurrence from HAFB for these activities. Draft and final versions of the technical memorandum shall be completed.

Primary elements, and their respective requirements, to be concisely presented in the technical memorandum shall include:

- Previous Study and Record Search: Descriptions of all septic tank system components and historical use(s) of their respective buildings.
- Visual Inspection: Documentation of results of visual inspection efforts, to include supportive system component sketches and photographic documentation.
- Trenching Activities: Detailed discussion of overall trenching activities and results pertaining to finding and exposing of distribution lines, septic tanks, and leachfield as-built conditions.
- Fluid Sampling Activities: Presentation of analytical results obtained from fluid sampling of septic tanks.
- Septic Tank System Re-Categorization: Rationale supporting the re-categorization of category 2 systems into categories 1 or 3 shall be presented.
- Boring and Sampling Plan: Discuss in detail the rationale for boring placement and soil sampling depths for category 1 systems and category 2 systems warranting further investigation. Additionally, placement of a temporary groundwater monitoring well and groundwater sample analysis to be performed shall also be discussed.
- Supporting Figures, Tables, and Appendices: For each septic tank system site, a figure shall be developed showing the plan-view layout of all system components. The figures shall be to scale, include site coordinates and north arrow, and show all proposed soil boring and groundwater monitoring well locations. Tank fluid thickness and analytical data and appropriate system component physical data shall be tabulated. Supporting documentation such as photographs (with descriptions of system components) shall be included in the appendices.

3.2.4 Final System Assessment

Final septic tank system assessment activities (i.e., category 1, step 5 and category 2, step 6) associated with obtaining required data to meet the purpose of this RFI include fulfilling all sampling and analysis requirements presented in the finalized technical memorandum. For each septic tank system retained for further investigation (i.e., initially identified category 1 systems and category 2 systems reorganized to category 1 systems) as a result of information presented in the finalized technical memorandum, sampling and analysis requirements will consist of the installation of soil borings, collecting soil samples, installation of a temporary groundwater monitoring well, collection of a groundwater sample, and analysis of soil and groundwater samples. A description of each of these sampling and analysis requirements is presented below. Actual field investigative methodologies to meet the sampling and analysis requirements are described in section 3.3.

3.2.4.1 Soil Boring Installation, Sample Collection, and Analysis

Within each septic tank system leachfield, three soil borings shall be completed at drain line locations determined from trenching results (described in section 3.2.2). Soil borings shall be completed using hollow stem auger (HAS) drilling techniques or direct push technology (DPT) depending on the amount of soil required to be retained for sample analysis. Using either the HSA or DPT drilling techniques, soil samples shall be collected with a 5-foot long, stainless steel continuous sampling barrel to enable accurate lithologic descriptions of materials encountered to be recorded on drill logs and provide a sufficient retention volume of soil to fulfill analytical procedures. Two soil samples shall be collected from each boring for analytical purposes, the first at the bottom and within 2 lateral feet of the leachfield distribution line and the second 5-feet directly below the first sample. However, if the water table is encountered prior to the second soil-sample collection interval, the soil sample shall be collected from just above the water table.

The analysis of soil samples collected for this RFI will follow USEPA protocol. A listing of the septic tank systems and their currently known respective analytical suites are shown in Table 3-1. (Final analytical suites for each system will be developed and provided in the finalized technical memorandum primarily based on the historical use of the building the septic tank system served and any septic tank fluid sample results that may be obtained.) Field duplicates will be collected at the frequency of one in 10 samples collected or one per batch whichever is greater. MS/MSD samples will be collected at a frequency of one set per 20 samples. The soil samples will be properly preserved and shipped under strict chain-of-custody to a contractor selected laboratory that meets USACE selection criteria. Required volumes and sample containers to support potential soil COCs analysis are shown in Table 3-2. USEPA sample preparation and analytical methods (shown as sample preparation/analytical method) for potential soil COCs are as follows:

- TPH (DRO, GRO, ORO): 3550B/8015M

- VOCs: 5035B/8260B
- SVOCs: 5550B/8270D
- TAL Metals: 3050B/6010C and 7471A
- Tritium: 906.0M/906.0M
- Explosives: 8330B/8330B

3.2.4.2 Groundwater Monitoring Well Installation, Sample Collection, and Analysis

Within each septic tank system leachfield, one temporary groundwater monitoring well shall be installed. The soil boring for installation of the monitoring well shall be completed using HAS or DPT drilling techniques. Using either the HSA or DPT drilling techniques, soil samples shall be collected with a 5-foot long, stainless steel continuous sampling barrel to enable accurate lithologic descriptions of materials encountered to be recorded on drill logs. One of the borings utilized to collect soil samples described in section 3.2.4.1 can be extended to accommodate monitoring well installation. The screen of the monitoring well shall be placed such that a groundwater sample can be obtained from the top of the saturated zone. One groundwater sample shall be collected from each monitoring well. It should be noted that groundwater may not require testing if it is determined that limited impacts to the soil column have been realized from the septic tank's leachfield, the groundwater is under confined conditions where recharge from the leachfield would not impact it, or if previous monitoring has been performed at or near the site from which conclusions can be drawn on any currently known impacts to the groundwater.

The analysis of groundwater samples collected for this RFI will follow USEPA protocol. A listing of the septic tank systems and their currently known respective analytical suites are shown in Table 3-1. (Final analytical suites for each system will be developed and provided in the finalized technical memorandum primarily based on the historical use of the building the septic tank system served and any septic tank fluid sample results that may be obtained.) Field duplicates will be collected at the frequency of one in 10 samples collected or one per batch whichever is greater. MS/MSD samples will be collected at a frequency of one set per 20 samples. The groundwater samples will be properly preserved and shipped under strict chain-of-custody to a contractor selected laboratory that meets USACE selection criteria. Required volumes and sample containers to support potential groundwater COCs analysis are shown in Table 3-2. USEPA sample preparation and analytical methods (shown as sample preparation/analytical method) for potential groundwater COCs are as follows:

- TPH (DRO, GRO, ORO): 3510C/8015M
- VOCs: 5030B/8260B
- SVOCs: 3510 or 3520/8270D
- TAL Metals: 3010A/6010C and 7470A
- Tritium: 906.0M/906.0M
- Explosives: 3535 or 8330B/8330B

- TDS: 160.1/160.1

3.2.5 Evaluate Analytical Results And Additional System Assessment

Evaluate analytical results and additional system assessment activities (i.e., category 1, step6 and category 2, step7) shall be completed. Analytical results derived from sampling and analysis of soil and groundwater completed during the final system assessment activities (described in section 3.2.4) shall be completed to determine if further delineation is required. Soil and groundwater analytical results will be evaluated against SSLs and NMWQCC standards, respectively. Additionally, soil and groundwater results will be evaluated against background concentration levels that are currently being developed, as appropriate. If COC analytical results are at or below the comparative concentration standards then additional delineation will not be required. However, if COC analytical results exceed comparative concentration standards and are attributed to the septic system then additional system assessment shall be performed until delineation is achieved. Additional "step-out" sampling point locations and appropriate COCs shall be determined for soil and groundwater as required. Completion of these additional sampling points and analysis of the samples shall be performed to enable complete horizontal and vertical COC delineation of the targeted medium. Field duplicates and MS/MSD samples for soil and groundwater will be collected at frequencies outlined in sections 3.2.4.1 and 3.2.4.2, respectively.

3.2.6 Remedial Investigation Report

A RFI report (i.e., category 1, step 7 and category 2, step 8) shall be developed based on all activities associated with this project. All pertinent information shall be presented to meet the purpose and objectives of the project. Rational for boring placement, COCs selection, groundwater sampling needs shall be presented along with all applicable supporting information such as septic tank system drawings, photographs, historical building use, plume delineations, etc. Identification of data gaps and recommendations for additional work shall be included if applicable.

A risk-based approach will be used to evaluate results from sampling activities at the site. For any chemicals that are detected in soil, the concentration determined by laboratory analysis will be evaluated against the SSLs provided in Appendix A of the revised NMED guidance document *Technical Background Document for Development of Soil Screening Levels, Revision 4.0* (NMED, 2006a).

In addition to the risk evaluation, metals and radionuclide concentrations for soil and groundwater will be evaluated against the results of the base-wide background study currently being developed and implemented, as appropriate.

For chemicals detected in groundwater, the results will be compared to the NMWQCC published groundwater quality standards. The NMWQCC standards are for aquifers with

TDS concentrations less than or equal to 10,000 mg/L (20.6.2.3101 New Mexico Administrative Code). The TDS concentration is a direct measure of the presence of total ions in the aquifer and is one of the primary criteria for classifying the aquifer based on its use as a potential drinking water source. Under the NMWQCC regulations, if TDS in groundwater is more than 10,000 mg/L, the aquifer is classified as non-potable and results will be compared to the USEPA Maximum Containment Levels.

Based on the guidance provided by the NMED pertaining to the remediation of petroleum-impacted sites at HAFB, a TPH screening level of 940 mg/kg will be used to evaluate the laboratory analytical data. The 940 mg/kg action level for petroleum contaminated soil is the Residential Direct Exposure Limit for kerosene and jet fuel, listed in Table 2b of the *New Mexico Environment Department TPH Screening Guidelines* (NMED, 2006b).

3.3 Field Investigation Methodologies

Field investigation methodologies associated with obtaining required data to meet the purpose of this RFI are presented in this section. These investigation methodologies will support the completion of the septic tank system investigation plans for category 1 and 2 sites presented in section 3.1.

3.3.1 Pre-Investigation Requirements

Before site-specific activities can begin, there are several pre-investigation documents and approval requirements to be met, including Air Force Form (AF Fm) 332 approval, base dig permits with utility clearances, site security measures, and facility manager notifications of the intended operations. The contractor will coordinate project requests for base installation support services through the 49th CES/CEV. Pertinent to the start of activities, a pre-investigation meeting and site walk-through will be conducted with the USACE resident engineer or their assignee, HAFB personnel, and the contractor's site manager, to inspect site-specific conditions for equipment access, equipment staging, decontamination area(s), potential site hazards, and emergency evacuation routes. Also reviewed at this time will be project procedures in accordance with the schedule and planned activities.

3.3.1.1 AF Form 332

Prior to initiating the confirmatory sampling activities, a completed and approved AF FM 332 will be obtained. This form seeks the authorization of construction work at HAFB and is required for the initiation of any construction type work, where the work activities described in this work plan meet the definition of construction type work. This work order describes what activities will take place at each respective location.

3.3.1.2 Dig Permit/Utility Clearances

Prior to the submittal of the dig permit(s) (AF Fm 103), the drilling and trenching locations will be clearly delineated by the contractor with marker flags, stakes, or paint, as appropriate to the surface material. Utility clearance approvals will be completed by the appropriate HAFB utility office (e.g., telephone, sewer, water, natural gas, etc.). Upon receipt of the approved dig permit with the utility clearances, the contractor's site manager or other authorized contractor project personnel will complete a site walk-through confirming the dig permit authorization and make any required changes.

3.3.1.3 Site Security

Site security is concerned with safety at the sampling locations during all trenching, drilling, and sampling activities and will be addressed as outlined in the Basewide Health and Safety Plan (Bhate, 2003b) and any addendum to the plan. At a minimum the exclusion zone at each trenching and sampling location will be secured with caution tape, and traffic cones surrounding the perimeter of the location. The size of each exclusion zone will be determined by the size of the digging and support equipment, and the prevailing sampling location conditions. Open boreholes will not be left unattended without first securing the immediate area surrounding the borehole, and covering the opening so that it does not become a hazard. Open trenches shall never be left unattended.

3.3.2 Field Activities

3.3.2.1 Investigation Methodology Requirements

Field activities will be performed in accordance with quality assurance and the health and safety requirements presented in Chapters 4 and 5, respectively, as well as other applicable USACE mandated procedures for laboratories. The field work for sampling activities will be conducted in accordance with approved HAFB standard operating procedures (SOPs) provided in the Basewide Quality Assurance Project Plan (QAPP) (Bhate, 2003a) and in Appendix B of this work plan. These SOPs outline methodologies for soil boring advancement, soil sampling, soil sample description, groundwater sampling, sample management, equipment decontamination, and chain-of-custody procedures. Sample nomenclature will follow the Environmental Restoration Program Information Management System (ERPIMS) format. The specific approved HAFB SOPs for this sampling event are listed below:

- HAFB SOP-1, Documentation, Sample Handling, Chain-of-Custody, and Shipping
- HAFB SOP-2, Sampling Equipment Decontamination
- HAFB SOP-3, Staking, Utility Clearance, and Permitting
- HAFB SOP-4, Direct Push Sampling for Soil and Groundwater

- HAFB SOP-5, Soil Sampling for Chemical Analysis
- HAFB SOP-6, Procedure for Field Screening of Volatile Organics
- HAFB SOP-7, Lithologic Description and Geotechnical Sampling
- HAFB SOP-8, Groundwater Sampling for Chemical Analysis
- HAFB SOP-9, Field Management of Investigation-Derived Waste (IDW)
- HAFB SOP-10, Borehole Abandonment and Site Restoration

An approved SOP for trenching (to verify/determine locations and depths of distribution lines, septic tanks, and drain fields) and septic tank sampling do not exist, therefore field methodologies associated with these two activities will be described in this chapter. Further information on surveying requirements, temporary monitoring well construction materials, groundwater sampling procedures in addition to those outlined in SOP-8, and soil and groundwater sample identification will be presented below.

3.3.2.1.1 Septic Tank Fluid Sampling

After the septic tank is located, the top shall be removed and a bailer lowered into the tank to determine if fluid is present. If fluid is present in the septic tank, a sample shall be retained in the bailer, emptied into appropriate sample containers, and analyzed for potential COCs identified during historical uses of the building the septic tank system serviced. The thickness of the fluid and any layering within the fluid, due to density differences, shall be measured and recorded. The distance to the bottom of the septic tank from the surface and top of the tank shall be measured by lowering a graduated device (e.g., tape measure, rod, etc.) and recorded. Appropriate air monitoring shall be conducted during all field activities associated with the septic tank fluid sampling. A specific section shall be included in a health and safety plan addressing all pertinent safety concerns respective of trenching activities.

3.3.2.1.2 Temporary Groundwater Monitoring Well Construction

A temporary groundwater monitoring well shall be installed at each required septic tank system site for purposes of obtaining groundwater samples to determine if negative impacts to groundwater have been found. Septic tank system sites and the actual locations of the monitoring wells shall be identified in the finalized technical memorandum, but they shall be confined to leachfield areas. Borings utilized to obtain soil samples from the leachfields may be extended and used to install the monitoring wells if they meet location criteria. The anticipated maximum depth of groundwater is approximately 25 feet bgs.

Temporary monitoring wells shall be constructed of 10-foot, 1-inch nominal diameter, 0.010- or 0.020-inch slotted schedule 40 polyvinyl chloride (PVC) pre-packed screen (10/20 Colorado silica sand). The riser shall be comprised of flush threaded, 1-inch nominal diameter, PVC casing. The casing shall extend at least 2 feet above the ground's surface and be capped. The screen shall be placed so it straddles the water table and is

submerged at least 5 feet. At a minimum, 2 feet of annular space above the top of the screen shall be capped with granular bentonite or ¼-inch diameter bentonite pellets. As these are temporary monitoring wells, the remainder of the borehole shall be backfilled with a bentonite grout slurry.

3.3.2.1.3 Groundwater Sampling

One groundwater sample shall be collected from each temporary groundwater monitoring well. In general, sampling activities shall be conducted in accordance with HAFB SOP-1 and HAFB SOP-8. Prior to the collection of a groundwater sample, depth to water and total well depth measurements shall be taken with using an electronic water level indicator and recorded on the sampling form. Groundwater shall be purged from the well using a peristaltic or small diameter submersible pump as needed. The sample tubing or pump intake shall be set in the bottom third of the submerged portion of the screen. Field measurements of pH, temperature, dissolved oxygen, oxidation reduction potential, conductivity, turbidity, and groundwater level shall be measured and recorded during well purging activities. The wells shall be purged until at least three well volumes have been removed, and the water level, pH, dissolved oxygen, oxidation reduction potential, conductivity, and turbidity have stabilized by +/- 10 percent for at least three consecutive readings. After purging of three well volumes and stabilization of field parameters have been achieved, the sample shall be collected from the discharge tubing (all monitoring equipment shall be removed from the discharge tubing, i.e., flow-through cell, prior to obtaining a sample). (If the well pumps dry, a sample shall be obtained as soon as the well has sufficiently recharged.) At each septic tank system site the groundwater sample shall be analyzed for the same respective COCs required for soil analysis, as appropriate.

3.3.2.1.4 Soil and Groundwater Sample Identification

Each sample collected will be identified on the sample label and chain-of-custody records, regardless of type. Sample documentation, handling, and shipping will be in accordance with HAFB SOP-1. Sample collection information inclusive of the container type, quantity for soil and groundwater samples, and sample identification nomenclature for all samples collected during this SWMU Septic Tank project will be performed in accordance with the QAPP Addendum. Field duplicate samples will appear in sequence with the regular samples. An example of the soil sample identification nomenclature for soil samples collected from a boring will be as follows:

ST308-SB01-5-a

Investigation identifier: ST308 = Septic Tank and site number (e.g., Building 308)
Sample type identifier: SB = soil boring
Sequential soil boring number: 01, 02, 03, etc.
Ending depth below ground surface of sample interval: 5

Reserved for (quality assurance [QA]) sample identifiers: a = field duplicate, TB = trip blank, MS = matrix spike, MSD = matrix spike duplicate

An example of the groundwater sample identification nomenclature for groundwater samples collected from a temporary monitoring well will be as follows:

ST308-TMW01-a

Investigation identifier: ST308 = Septic Tank and site number (e.g., Building 308)
Sample type identifier: TMW = temporary monitoring well
Temporary monitoring well number: 01, 02, 03, etc. (should require only 01)
Reserved for (QA) sample identifiers: a = field duplicate, TB = trip blank, MS = matrix spike, MSD = matrix spike duplicate

An example of the septic tank fluid sample identification nomenclature for samples collected from a septic tank will be as follows:

ST308-TF01-a

Investigation identifier: ST308 = Septic Tank and site number (e.g., Building 308)
Sample type identifier: TF = tank fluid
Sequential tank number: 01, 02, 03, etc. (should require only 01)
Reserved for (QA) sample identifiers: a = field duplicate, TB = trip blank, MS = matrix spike, MSD = matrix spike duplicate

3.3.2.1.5 Trenching

Trenches shall be dug for purposes of identifying the location and depths of distribution lines, septic tanks, and leachfield septic system components as described in section 3.2.2. The trenches shall only expose, and not excavate or remove, the system components. The trenches shall be dug with a backhoe capable of reaching 5-10 feet bgs with a minimum width of 1 foot. Trench depths and lengths shall be kept as shallow and short, respectively, as possible to minimize disruption of the land surface. Spoils from the trench shall be placed next to the trench on plastic, and returned to the trench after required information is obtained. During trench backfill, the soils shall be compacted at 1- to 2-foot lifts with the backhoe's buck and tracks/tires at the ground's surface. Air monitoring shall be commenced during trenching and under no circumstances shall anyone be allowed to enter a trench. Surveying stakes shall be placed and labeled to identify the septic system components. All pertinent information shall be recorded in a field book for later reference.

3.3.2.1.6 Surveying

Survey coordinates of the ground's surface shall be obtained where the septic tank distribution line leaves the building it served and where it enters the septic tank, where it leaves the septic tank to enter the leachfield, and at soil boring locations. At soil boring locations, a surveying stake labeled with the boring's location number will be placed at or immediately adjacent to the actual boring location. Additionally, survey coordinates of the temporary monitoring wells, to include the ground's surface and top of well casing, shall also be obtained. A qualified surveyor will perform the measurements with Trimble® Geometrics Pro XR global positioning system (GPS) equipment in accordance with methods described in the Basewide QAPP. All horizontal coordinates will be referenced to the State Plane Coordinate system, New Mexico Central and surveyed to an accuracy of +/- 1.0 foot. Vertical elevations will be referenced to North American Datum (NAD) 1983 coordinate system to an accuracy of +/-0.01 foot.

3.3.2.1.7 Restoration

Upon completion of all field activities, the sampling locations will be restored to their original condition or that acceptable to the HAFB representative. All activity areas shall be canvassed for trash, debris, etc. during working activities and at completion of field work.

4 PROJECT QUALITY ASSURANCE

4.1 Data Quality Objectives Process

To support the overall investigation objectives, chemical specific DQOs have been established in addition to the overall project DQOs presented in Chapter 1. These DQOs are qualitative and quantitative statements that specify the quality of data required too meet the goals of site characterization, risk assessments, and remedial design. Data developed during the investigation will be used to support site-specific studies of the SWMUs under consideration in this work plan.

DQOs will be used to:

- 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 to provide a minimum of 95 percent data completeness for analytical results representing each matrix-method combination.

The level of analytical support to meet these goals will be both screening and definitive data. Prior to initiating any field work, the contractor shall submit a Site Specific Addendum to the Basewide Quality Assurance Project Plan to the USACE for approval. This addendum will allow the contractor to implement appropriate additional site specific quality assurance criteria (not identified in the Basewide QAPP (Bhate, 2003a)) to meet project data quality requirements. The detection reporting limits for all analytical parameters and quality assurance sampling requirements (duplicate and MS/MSD) shall be summarized by the contractor in the addendum. As part of analytical reporting requirements for the definitive data, all reporting laboratories performing work under this work plan will provide the following data, in addition to the data deliverables that may be described in the Site Specific Addendum to the Quality Assurance Project Plan:

- Sample identification numbers cross-referenced with laboratory identification numbers and quality control (QC) sample numbers.
- Problems with arriving samples noted on chain-of-custody.
- Each analyte reported as an actual value or less than a specified detection limit.
- Dilution factors, preparation dates, and analysis dates.

QC sample results for laboratory blanks, surrogate spikes, matrix spikes (MS), laboratory control samples (LCS), field duplicates, and trip blanks will be used to evaluate the reliability of the data. The data developed during the investigation will meet the chosen objectives for precision, accuracy, representativeness, completeness, comparability, and sensitivity.

4.1.1 Precision

Precision is a measure of the degree of reproducibility of an analytical value and is used as a check on the quality of the sampling and analytical procedures. Laboratory replicates, field duplicates, and duplicate analysis (such as MS/MSD and LCS/LCS duplicates [LCSD]) are used to quantify precision. Laboratory replicates measure the analytical precision, whereas field duplicate analysis provides a precision measurement that includes the sampling and the potential variability of the sample matrix.

Precision of the analytical method, at each stage is expressed in terms of a relative percent difference (RPD) between duplicate determinations. A detailed calculation of the RPD is presented in the Basewide QAPP. Soil sample measurements are usually less precise than water sample measurements because it is more difficult to achieve a homogeneous, representative sample. Based on this, the precision targets for soil field duplicates will be an RPD of 30 or less. The laboratory RPDs shall be presented in the Site Specific Addendum to the Basewide QAPP.

As mentioned in the previous section, field duplicates will be collected at the frequency of one in 10 samples collected or one per batch whichever is greater. MS/MSD samples will be collected at a frequency of one set per 20 samples.

4.1.2 Accuracy

Accuracy is the degree to which a measurement agrees with the actual value, i.e., the amount of measurement bias. Accuracy is expressed as a percent recovery (%R) of a known concentration of referenced material. For the background study at HAFB, MS/MSDs will be used to determine the accuracy for a given method and sample matrix. An aliquot of a normal sample will be designated as the MS/MSD. The laboratory will spike the MS/MSD sample set as a described below.

The spiked compounds will include representative compounds that are qualified during the method, and spiked during sample preparation, on a specially prepared aliquot of the sample matrix. Results of these spiked aliquots are then compared to the native concentrations of the analytes spiked, and a %R is calculated. The %R of the spiked compound is used as an assessment of analytical accuracy on the sample matrix analyzed, which is essential in identifying sample matrix interferences. The %R will be between 75 and 125 percent.

4.1.3 Completeness

Data completeness represents the percentage of valid data collection from a sampling/analytical program or measurement system compared to the amount expected to be obtained under optimal conditions. The completeness goal for the definitive samples

is 95%. The completeness results will be calculated following data validation and review.

4.1.4 Representativeness

Representativeness is a qualitative parameter that expresses the degree to which sample data actually represent the matrix conditions. Requirements and procedures for sample collection and handling are designed to maximize sample representativeness. Representativeness can also be monitored by reviewing field documentation and by performing field QA audits. The determination of the representativeness of the data will be performed by:

- Comparing actual sampling procedures and chain-of-custody forms to those described in the work plan.
- Identifying and eliminating non-representative data in site characterization activities.
- Evaluating holding times and condition of samples on arrival at the laboratory.

The objective of this element is to eliminate all non-representative data.

4.1.5 Comparability

Comparability is a qualitative measure of the confidence with which one data set can be compared to another. These data sets include data generated by different laboratories, data generated by laboratories in previous investigative phases, data generated by the same laboratory over a period of several years, or data obtained using differing sampling techniques or analytical protocols. The measurement comparability objective of this work plan is to generate consistent data using standard test methods, standard field data sheets, and uniform concentration units. These data are intended to be accepted and used by other investigators who are considering specific sites within HAFB.

4.1.6 Sensitivity

Sensitivity is a general term referring to the calibration sensitivity and the analytical sensitivity of a piece of equipment, used to establish detection/quantitation/reporting limits. Several limits have been established to describe sensitivity requirements (i.e., instrument detection limits [IDLs], method detection limit [MDLs], practical quantitation limits [PQLs], reporting limits [RLs]). Because IDLs and MDLs are normally based on a reagent water matrix or a purified soil matrix, published IDLs and MDLs are presumed not to be consistently achievable for environmental samples. It is because of this inconsistency and the goal to promote the generation of comparable data that the following definitions shall be used to meet the project DQOs:

- IDL – The IDL reference the absolute limit of detection for a compound or analyte in a media that is free from matrix interference at a level greater than two times the noise level f the instrument. Certain programs require the laboratory to publish IDLs on an annual basis; however, achievement of these detection levels generally cannot be met during routine analyses.

- MDL – The MDL is the minimum concentration of an analyte that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero, and is determined from the analysis of the sample in a given matrix containing the analyte. The laboratory is required to perform an MDL study during the initial setup of the analytical procedure and annually thereafter. An MDL study is also performed whenever the basic chemistry of the procedure is changed. When MDLs are reported with analytical data, they should be adjusted for sample weight, moisture content, and volumetric dilution on a per sample basis. The project specific MDLs shall be presented in the Site Specific Addendum to the Basewide QAPP.

- PQL – Because of the amount of error associated with results quantitated at the IDL or MDL and the fact that the MDL may not be attainable for the project matrices, the PQL is established at a factor of 5 to 10 times the MDL, but no lower than 3 times the MDL for the target analytes. The PQL represents the value at which the laboratory has demonstrated the ability to reliably quantitate target analytes within a prescribed performance criterion for the method performed. The PQL is often based on the lowest standard used in the initial calibration curve or as a low-level calibration verification standard.

- RL – The RL is the threshold value below which the laboratory reports a result as non-detected and is established at a level between the laboratory's PQL and the level needed to meet project requirements. The RL is usually based upon project-specific requirements including risk-based concentrations of concern, or regulatory action levels. The RLs for this project shall be presented in the Site Specific Addendum to the Basewide QAPP.

4.1.7 Data Validation

Data validation includes the elements of verification, in which a complete accuracy check of the laboratory hardcopies are checked against the electronic data deliverables (EDD), in order to assure agreement; however, the assessment process is designed to result in data that are of "known" accuracy and precision. Individual data that cannot be validated under established criteria for acceptance are flagged to indicate that the results are either estimated, or unusable. Validation is an alternative to adversarial review and is performed by a qualified chemist who can exercise the use of professional judgment during the qualification process.

A 100% data validation of the definitive analytical data will be conducted by the contractor's project chemist, in order to verify compliance with the Basewide QAPP (and Site Specific Addendum as applicable) and the specified methodology. Data validation procedures will be based on USEPA National Functional Guidelines for Organic Data Review (USEPA, 1999), and the USEPA National Functional Guidelines for Inorganic Data Review (USEPA, 2004). Upon completion of the data validation process, the usability of the data will be determined and reported.

4.2 Standard Operating Procedures

A complete listing and presentation of applicable approved SOPs for completing the field sampling activities are located in Appendix A of the Basewide QAPP. Additionally, the SOPs are currently provided in Appendix B of this work plan.

4.3 Sample Identification

Each environmental sample (including field QC samples) will be identified on the sample label (which will be attached to the individual sample container) and the chain-of-custody records. Field duplicates will be submitted with other field samples and will appear in sequence with the regular samples. The sample identifier nomenclature will adhere to the procedures and guidelines established in Basewide QAPP. Sample labeling procedures will adhere to the format provided in the Basewide QAPP.

4.4 Project Documentation

The field operations documentation will provide consistent procedures and formats for documentation and management of field records and collected samples.

4.4.1 Sample Documentation

Sample documentation, identification, and tracking will adhere to the prescribed methods found in the Basewide QAPP. All sampling activities will include documentation of significant activities, potential environmental influences during sampling, field variances, and sample identification information. At a minimum, field logbooks will be utilize to record dates and times, sampling protocols, project numbers, and sampler's name. Other pertinent information will include chain-of-custody numbers and air-bill tracking number. Chain-of-custody forms will be completed and included with each sample shipment; on chain-of-custody per cooler.

At a minimum, the following sample collection information will be recorded in the field logbook:

- Date and time
- Sample identification number
- Project number
- Sampler name
- Preservative(s) used
- Analysis
- Map or schematic of sampling location (to be provided in technical memorandum submitted to stakeholders for review)

4.4.2 Field Logbook

Personnel will use only bound field logbooks for the maintenance of field records. The project manager will ensure that all field notes can be efficiently traced, filed, and retrieved. All entries will be recorded in indelible, waterproof ink. If errors are made, corrections will be made by crossing a single line through the error, correcting the information, and initialing and dating the correction. Entries in the field logbook will be made as described below.

Documentation of reporting of events and activities will be made in chronological order on the right page of an open logbook. All entries will be dated and time of entry recorded. At the beginning of each day's entry, the personnel will draw a diagonal line originating from the bottom left corner of the page to the conclusion of the entry and sign along the line indicating the conclusion of the entry or day's activity. Once completed, the field logbooks become accountable documents and will be maintained as part of the project files. The following general requirements apply to field logbooks:

- The left page of the logbook will be used for auxiliary reporting such as sketches, table, etc.
- The date will be recorded at the top of every page in the left-hand corner of the right page.
- The time of entry recordings will be in columnar form down the left-hand side of the right page.

4.4.3 Field Screening Data

The field analytical data collected at the sampling locations will include the field screening readings for selection of personal protective equipment (PPE), as well as field screening for headspace analysis. The breathing zone of the soil sampling and exploratory trenching locations and septic tank access points will be screened in the field at the time these efforts are performed for VOCs utilizing an organic vapor analyzer (OVA) or appropriate photoionization detector (PID). If a high a high humidity condition exists at the time of sample collection, a flame-ionization detector (FID) is recommended because a PID is not a completely reliable screening instrument under these conditions. The field screening data will be recorded in the field logbook and drill log as appropriate.

4.4.4 Data Reporting

Data collected during the sampling of screening and definitive samples, will be reported according to the Basewide QAPP (and Site Specific Addendum as applicable). The data will be provided in tabular form as well as an appendix of the original laboratory analytical report. Figures and/or graphical depictions (e.g., chromatographs, etc.) will be generated indicating concentrations of the respective media for all samples. An ERPIMS submittal will be required for this project.

4.5 Organization and Schedule

The USACE prepared this work plan to serve as the primary overall working document for the project. The contractor performing the actual field work shall provide to the USACE for review an organizational chart outlining key personnel and their duties (to include office and field personnel). Additionally, a schedule shall be developed and submitted by the contractor detailing primary work elements and start dates and associated work durations. It should be noted that initiation of work other than the development of this work plan will be dependant on funding availability.

5 HEALTH AND SAFETY REQUIREMENTS

Project health and safety practices will adhere to the approved Basewide Health and Safety Plan (Bhate, 2003b). Prior to initiating any field work, the contractor shall submit a Site Specific Addendum to the Basewide Health and Safety Plan to the USACE for approval. This addendum will allow the contractor to implement appropriate additional safety criteria (not identified in the Basewide Health and Safety Plan) to meet project safety requirements. A specific section shall be included in the addendum to the approved Basewide Health and Safety Plan addressing all pertinent safety concerns respective of trenching activities. It is anticipated that no greater than modified level D PPE will be required to complete the investigation activities. This includes at a minimum: Occupational Safety and Health Administration (OSHA) approved safety shoes, American National Standards Institute (ANSI) approved safety glasses (Z87.1) and hard hat (Z89.1-1997: type 1), sleeved shirt and long pants, and as required, hearing protection, leather work gloves, and nitrile gloves during sampling.

6 REFERENCES

Bhate Environmental Associates, Inc., November 2003a. Basewide Quality Assurance Project Plan.

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Foster Wheeler Environmental Corporation, December 2002. Draft Report for the Remedial Investigation of DP-63 – Disposal Pit 63, Holloman Air Force Base, New Mexico.

Holloman Air Force Base, 2000. Horizons 2000 Facility Improvement Plan.

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NMAC 20.6.2, New Mexico Water Quality Control Commission Regulations, September 15, 2002, http://www.nmenv.state.nm.us/NMED_Regs/gwb/20_6_2_NMAC.pdf

NMED, June 2006a, *Technical Background Document for Development of Soil Screening Levels Revision 4.0*

NMED, October 2006b, *New Mexico Environment Department TPH Screening Guidelines*

United States Environmental Protection Agency, 2004. USEPA National Functional Guidelines for Inorganic Data Review.

White Sands Missile Range (WSMR), 2003. Public Affairs Office: Tularosa Basin Geology, http://wsmr.army.mil/paopage/Pages/WU%2360.htm

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Tables

Table 3-1. Septic tank system sites identified by their respective building numbers, Holloman AFB, New Mexico.

Bldg Number	Year Completed	Dimensions[1]	Capacity[2]	Activity Status	Investigation Category	Analyses[3]
308	1965	TBD	TBD	Inactive	1	TPH, VOCs, SVOCs, and TAL Metals
639	NA	TBD	TBD	Inactive	2	TBD
640	NA	TBD	TBD	Inactive	2	TBD
700	NA	TBD	TBD	Inactive	2	TBD
702	NA	TBD	TBD	Inactive	2	TBD
920	1959	4'2"x7'x7'9.5"	1600	Inactive	2	TBD
921	1959	4'2"x7'x7'9.5"	1600	Inactive	2	TBD
922	1959	4'2"x7'x7'9.5"	1600	Inactive	2	TBD
924	1987	4'2"x7'x7'9.5"	1600	Inactive	2	TBD
1142	NA	TBD	TBD	Inactive	2	TBD
1158	NA	TBD	TBD	Inactive	2	TBD
1174	NA	TBD	TBD	Inactive	2	TBD
1178	NA	TBD	TBD	Inactive	2	TBD
1179	NA	TBD	TBD	Inactive	2	TBD
1180	NA	TBD	TBD	Inactive	2	TBD
1183	NA	TBD	TBD	Inactive	2	TBD
1190	1952	9'x4'x8'10"	3000	Inactive	1	TPH, VOCs, SVOCs, and TAL Metals
1194	1987	4'x4'x8'10"	1350	Inactive	1	TPH, VOCs, SVOCs, and TAL Metals
1196	1993	4'6"x11'x6'	1300	Inactive	2	TBD
1199	1957	TBD	500	Inactive	1	TPH, VOCs, SVOCs, and TAL Metals
1200	1954	4'x8'x4'	1000	Inactive	1	TPH, VOCs, SVOCs, TAL Metals, and Tritium
1201	1951	4'8"x9'4"x6'2"	650	Inactive	1	TPH, VOCs, SVOCs, TAL Metals, and Tritium
1221	1983	TBD	1100	Inactive	1	Explosives
1251	NA	TBD	TBD	Inactive	1	TPH, VOCs, SVOCs, and TAL Metals
638	NA	TBD	TBD	Removed	2	TBD
642	NA	TBD	TBD	Removed	2	TBD
1142	NA	TBD	TBD	Removed	2	TBD
1155	NA	TBD	TBD	Removed	2	TBD
1166	1960	TBD	450	Removed	2	TBD
1168	NA	TBD	TBD	Removed	2	TBD
1175	1949	5'1"x10'4"x6'10"	2970	Removed	2	TBD
1176	1959	TBD	640	Removed	2	TBD
1173	NA	TBD	TBD	Removed	2	TBD
1269	1966	4'6"x9'	500	Removed	1	TPH, VOCs, SVOCs, TAL Metals, and Tritium

Notes:
NA = Not Available
TBD = To Be Determined
1 = Dimension will be estimated from data collected during septic tank trenching and fluid sampling results.
2 = Capacity will be estimated from data collected during septic tank trenching and fluid sampling results.
3 = Analysis is for soil, groundwater, and tank fluid; finalized analytes will be determined from historical research and presented in technical memorandum.
VOCs = Volatile Organic Compounds
SVOCs = Semi-Volatile Organic Compounds
TPH = Total Petroleum Hydrocarbons
TAL Metals = Target Analyte List Metals
' = foot
" = inch

Investigation Category:
1 = Further site investigation required.
2 = Research required to determine if further site investigation is required .

Table 3-2.
Sample containers by sample media.

Media	ANALYTE GROUP					
	TPH	VOCs	SVOCs	TAL Metals (Mercury)	Tritium	Explosives
Soil	8 oz glass jar	Encore/40 or 60 mL vials [2]	250 mL CWM [o1]	1 L HDPE [3] (250 mL HDPE or glass)	4 oz glass jar	250 mL CWM [o1]
	1	3	1	1	1	1
Groundwater	40 mL vials (pre-tared)	40 mL vials [2]	2 x 1 LAG per chemical parameter	250 mL CWM (250 mL CWM)	0.5 L glass bottle	2 1 L AG per chemical parameter
	1	3	1	1	1	1

All groundwater samples will be analyzed for total dissolved solids and require 1 L amber glass bottle.

TPH - Total Petroleum Hydrocarbons
VOCs - Volatile Organic Compounds
SVOCs - Semi-volatile Organic Compounds
TAL - Target Analyte List
oz - Ounce
mL -Milliliter
L - Liter
AG - Amber Glass bottle(s) with Teflon-lined cap(s).
CWM - Clear wide-mouth glass jar(s) with Teflon-lined lid(s).
HDPE – High-Density Polyethylene bottle

[o] = The subset chemical parameters under Extractable Organics may be collected in the same container for soils.
[1] = High-concentration waste samples do not need cooling.
[2] = Container must have PTFE (Teflon)-lined seals (Teflon-lined septa for volatile organic analyte (VOA) vials)
[3] = Metals and cyanide may be collected in the same container for soils.

Figures

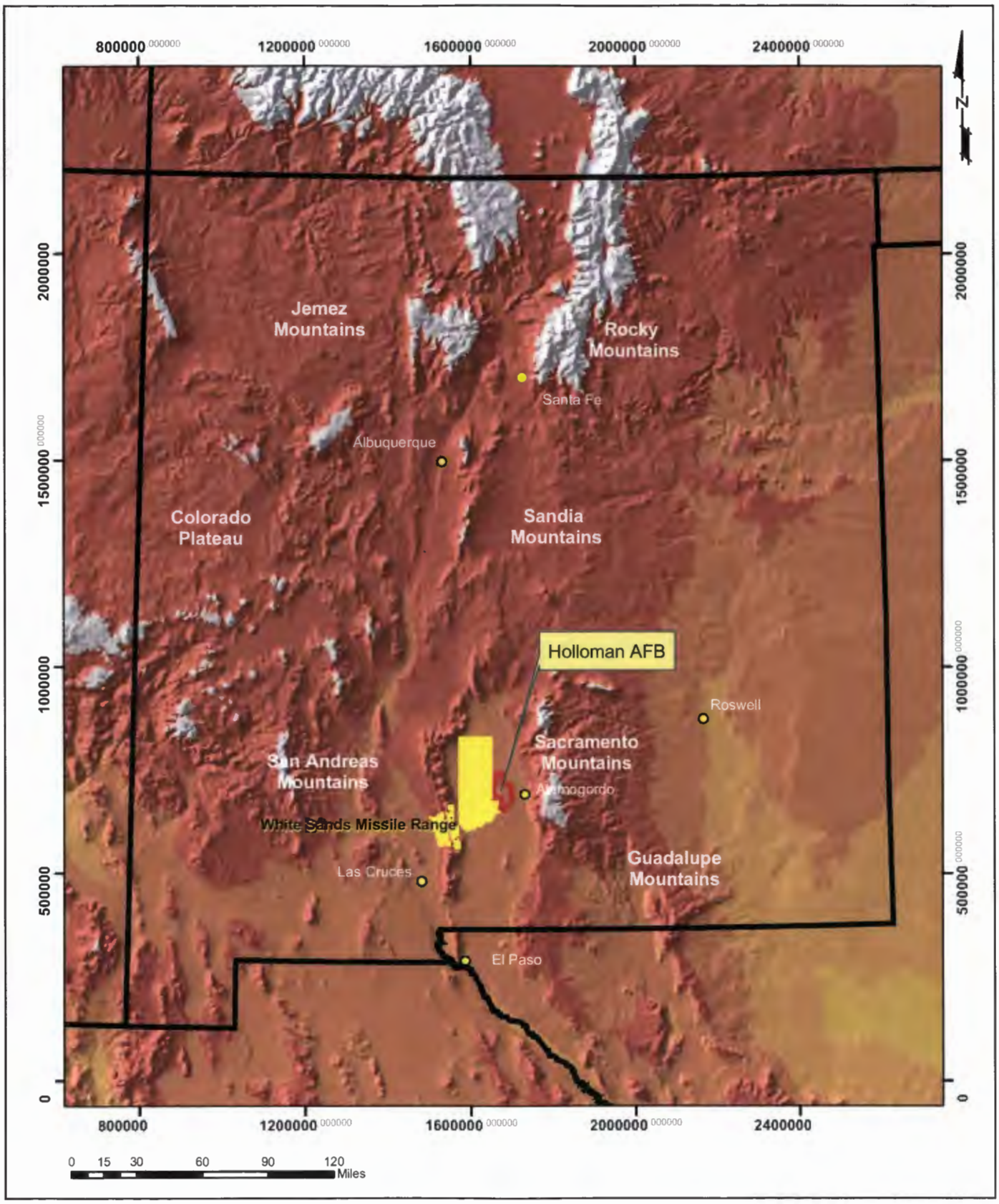


Figure 2-1. Location of Holloman Air Force Base, New Mexico.

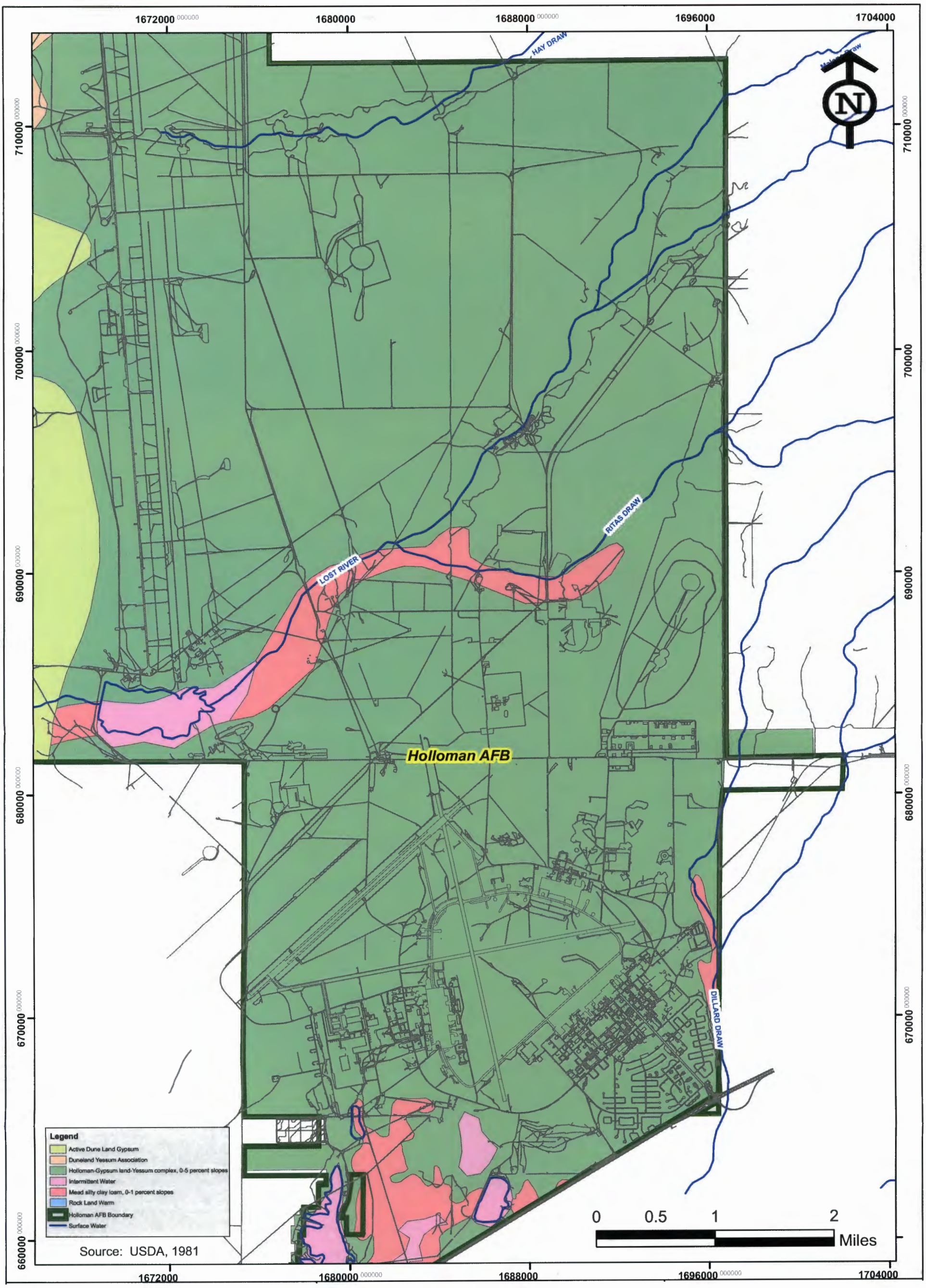


Figure 2-2. Soil types at Holloman Air Force Base, New Mexico, based on United States Department of Agriculture (USDA) Soil Conservation Service classifications.

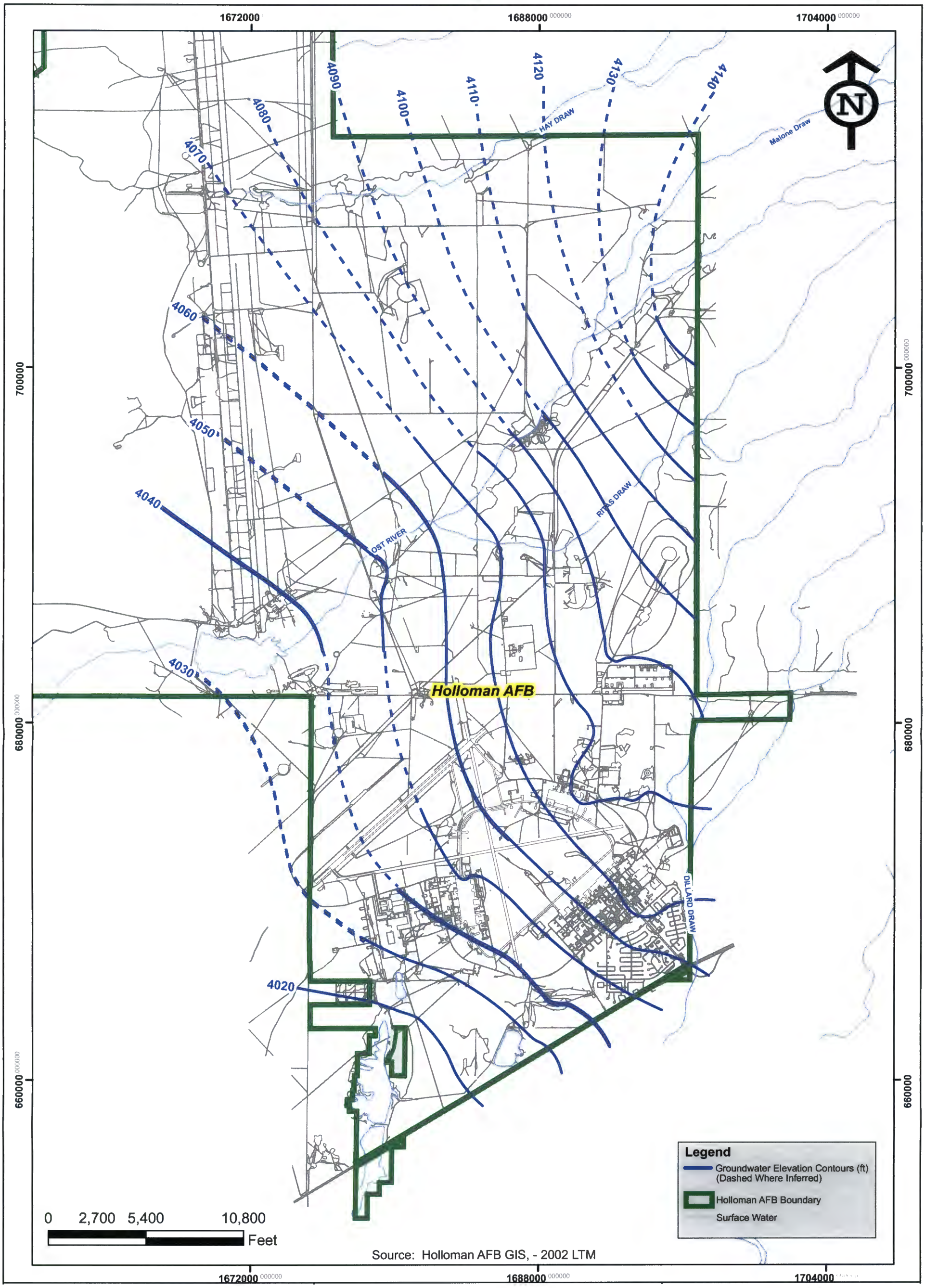
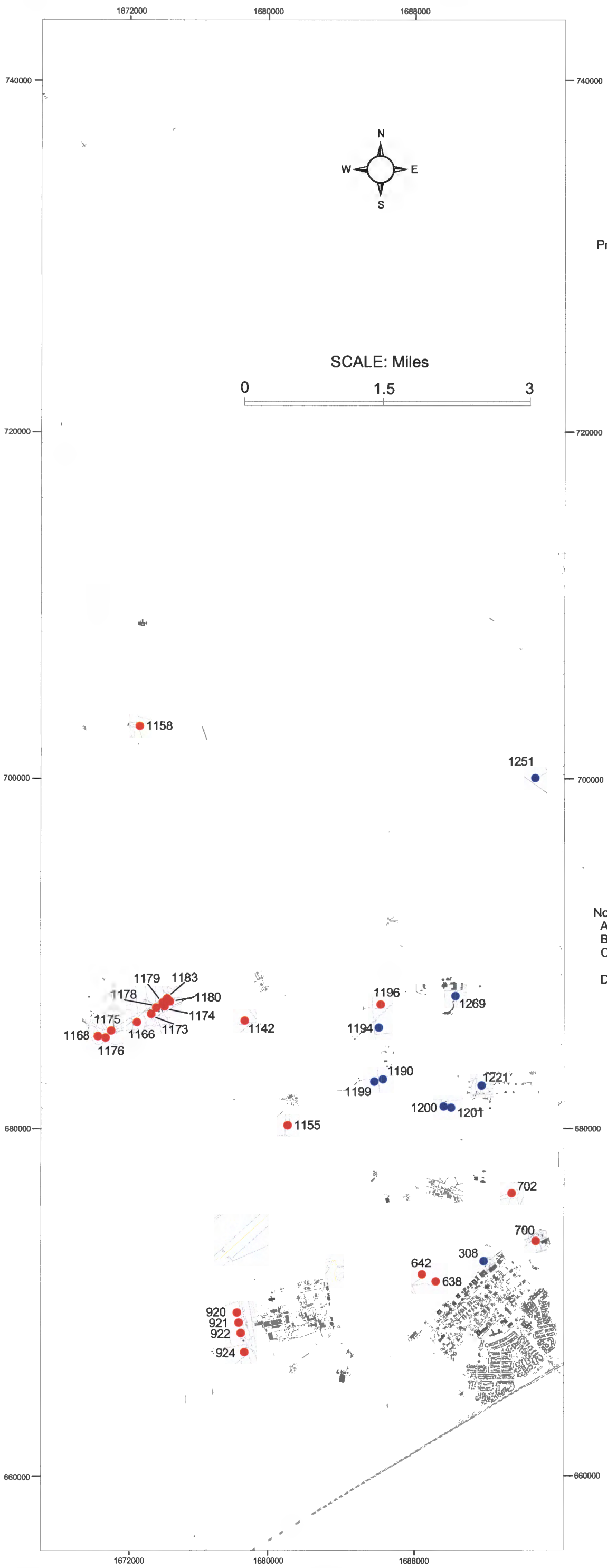


Figure 2-3. Groundwater contour map showing groundwater elevation contours across Holloman Air Force Base, New Mexico, based on 2002 measurements taken from the shallow aquifer.



Projection: New Mexico State Plane Central Zone, North American Datum 1983 (ft)

Legend

● 1200
Category 1 Septic Tank System

● 1176
Category 2 Septic Tank System

Notes:
A) Categories are based on original listings.
B) Category 1 systems require further investigation.
C) Category 2 systems require historical research to determine if further investigation is required.
D) Category 2 systems 639 and 640 need to be located.

Figure 3-1. Locations of septic tank systems identified by the buildings they serve, Holloman AFB, New Mexico.

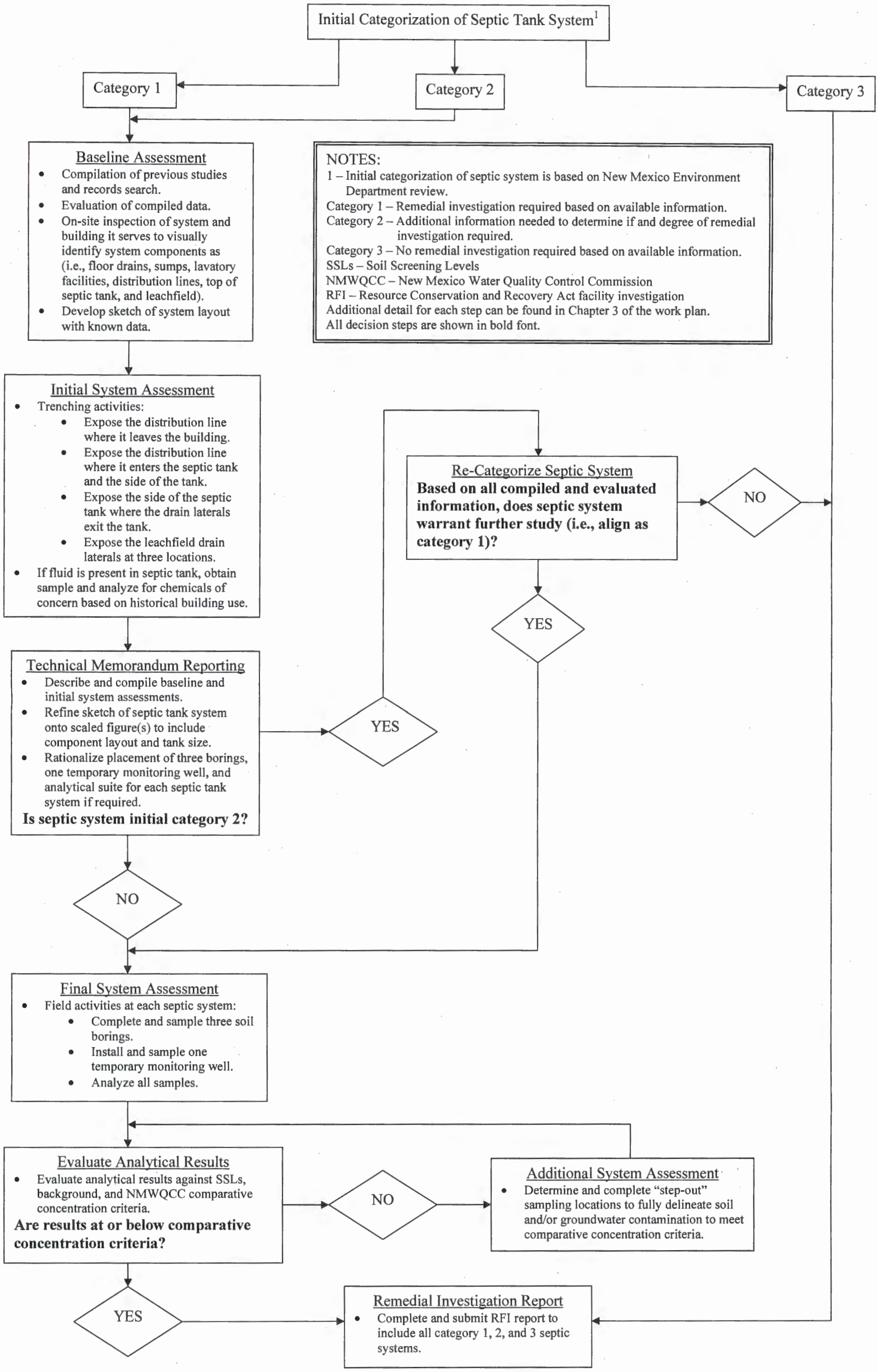


Figure 3-2. Flow diagram identifying activities to meet the objectives of the investigative technical approach for the septic tank systems.

Appendices

Appendix A

New Mexico Environment Department Correspondence

NEW MEXICO
ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

BILL RICHARDSON
Governor

DIANE DENISH
Lieutenant Governor

RON CURRY
Secretary

CINDY PADILLA
Deputy Secretary

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

September 13, 2007

REC'D SEP 18 2007

Ms. Debbie Hartell, Chief
Environmental Flight
49 CES/CEV
550 Tabosa Ave.
Holloman AFB, NM 88330-8458

RE: NOTICE OF DEFICIENCY ON SWMU ASSESSMENT REPORT, HOLLOMAN AIR FORCE BASE SEPTIC TANKS, APRIL 2007
HOLLOMAN AIR FORCE BASE, NM6572124422
HWB-HAFB-07-005

Dear Ms. Hartell:

The New Mexico Environment Department (NMED) has reviewed the April 2007 Solid Waste Management Unit (SWMU) Assessment Report (SAR), *Holloman Air Force Base Septic Tanks*, submitted by Holloman Air Force Base (the Permittee). This document was submitted in response to an August 30, 2006 request by the NMED to locate and describe septic systems base-wide to allow the NMED to determine which, if any, systems require further investigation as possible SWMUs. NMED has the following general and site specific comments, including requirements for further investigation.

GENERAL COMMENTS

1. Active Systems

The SWMU Assessment Report (SAR) lists twenty five (25) active septic systems located throughout the base. NMED concurs that no investigations are currently required at these sites. However, NMED must be notified ninety days before any of these systems are deactivated or removed so that a determination can be made if investigation of any of

these systems is required.

2. **Inactive and Removed Systems**

The Permittee must confirm that all sites still in use with inactive or removed septic systems have been connected to the base waste water treatment system and provide the dates of the connections.

3. **Removed Systems**

The Permittee must submit copies of any field notes, reports and/or sampling results associated with the removal of the septic systems that show that these systems were removed in accordance with the NMED Liquid Waste Regulation, 20.7.3.307 NMAC. These submittals must provide information indicating that any potential source of hazardous constituent contamination does not remain. Based on this documentation, NMED will determine whether any of the sites with removed septic systems are appropriate for no further action or subject to further investigation requirements.

4. **Early Missile Test Site, AOC-L (OT-37) and High-Speed Test Track**

This Early Missile Test Site was not listed as a site that historically used septic systems. Also, with the exception of sites at the extreme southern end of the High-Speed Test Track, no sites along the track or in the vicinity of the track were listed as historically using septic systems.

The Permittee is required to confirm whether or not these sites historically used septic systems and, if so, provide the required background information.

5. **Septic System Leachfields**

The SAR did not include any information regarding the potential for leachfields to be located adjacent to the septic tanks. Leachfields are a potential point of discharge for any hazardous constituents discharged into the septic tank.

For all of the sites for which the NMED is requiring further investigation, all leachfields and distribution lines associated with inactive septic tanks must be located and placed on a map. For all inactive septic system sites where the locations and depths of the septic tanks and leachfield distribution lines are unknown, the Permittee shall excavate a portion of the tank and leachfield for purposes of determining any needed soil sample locations and depths. Where needed, leachfield investigations shall include an array of NMED-approved sampling locations (usually not less than three) with samples typically collected at the bottom and at five feet below the bottom of distribution lines.

6. **Sumps and Floor Drains**

The SAR did not include any information regarding the existence or locations of any sumps or floor drains that may drain into septic systems.

For all of the sites for which the NMED is requiring further investigation, all floor drains and sumps that drain into the septic system must be located and a description of contaminants of potential concern that could have been discharged into the drains must be provided (see next comment).

7. **Contaminants of Potential Concern**

The SAR did not include any information regarding the contaminants of potential concern at septic system sites.

For all of the sites for which the NMED is requiring further investigation, the Permittee must submit a description of past and present activities and a list of contaminants of potential concern (COPCs) for each site. Site investigation and sampling will be based on knowledge of past and present processes/activities at each site from which a list of COPCs is developed. The list of COPCs is the minimum list of analytes for which the Permittee intends to collect environmental samples to be submitted for laboratory analysis.

8. **Report Maps**

The maps provided in the SAR are deficient. For all of the sites for which the NMED is requiring further investigation, maps provided in the investigation reports must be to scale and include:

a. A base-wide site map so that the reader can accurately locate the subject site.
b. A coordinate system (i.e., UTM, latitude/longitude) and the boundaries of the site shown on all site maps.
c. A north arrow.
d. The locations of the septic tanks, sumps, floor drains, distribution lines and leachfields.
e. Any proposed sample locations must be shown accurately.

9. **RCRA Facility Investigation Work Plans and Reports**

For all of the sites for which the NMED is requiring further investigation, RCRA Facility Investigation (RFI) work plans must be submitted in accordance with Part 4, Section IV.E.1. of the Hazardous Waste Facility Permit. A work plan may be submitted for each individual site or all sites may be included in one work plan. Upon completion of the investigation, the Permittee must submit a final RFI Report in accordance with Part 4, Section IV.E.3. of the Hazardous Waste Facility Permit.

Site Specific Comments (All Inactive Systems)

10. Building 308

Before a decision can be made as to whether or not further investigation of this site is necessary, the Permittee is required to provide a description of the processes involved in the historic weapons calibration operations. For example, solvent use and, if so, what type(s) should be able to be determined from these descriptions. The Permittee is also required to provide a general description of the types of aircraft support equipment currently stored in the building.

In addition, Permit Table B (summary of SWMUs not requiring corrective action) lists Building 308 as SWMU 51, *Building 308 Waste Accumulation Area*. The Permittee is required to explain why this site was considered a waste accumulation area. According to the Table, the U.S. Environmental Protection Agency listed the site in 1988 as a SWMU with no further action required.

11. Buildings 920, 921 922 and 924

Permit Table B (summary of SWMUs not requiring corrective action) lists Buildings 920 through 924 as SWMU 134, *Buildings 920-924 Drainage Ditch*. This SWMU was granted No Further Action (NFA) status by the NMED in February 2001. Before a decision can be made as to whether or not further investigation of this site is necessary, the Permittee is required to explain why this site was considered a SWMU and what was done to achieve NFA status. This can be done by submitting the Statement of Basis for the NFA decision or by providing a brief explanatory discussion.

In addition, the Permittee's recently submitted document providing maps of the Base's monitoring wells shows monitoring wells MW24-01, MW24-03, MW24-05 and MW24-06 in the vicinity of these buildings. The Permittee is required to provide the results of all sampling and analysis activities associated with these wells. Also, the January 2003 Base aerial photomap showing the locations of Basewide restoration sites depicts site OT-24 immediately south of Building 924. Site OT-24 is not listed on the Permit Tables summarizing SWMUs. The Permittee is therefore required to provide a description of site OT-24, including a summary of all activities at this site and COPCs.

Regarding Building 924, the SAR indicates that this building was used for maintenance of radar tracking equipment. Before a decision can be made as to whether or not further investigation of this site is necessary, the Permittee is required to provide a description of the processes involved in the radar equipment maintenance operations. For example, solvent use and, if so, what type(s) should be able to be determined from these descriptions.

12. Building 1091

This septic system serviced a now demolished air traffic control tower. Therefore, no further investigation of this site is necessary.

13. Building 1097

This septic system services a radio transmission facility. Therefore, no further investigation of this site is necessary.

14. Building 1190

This building was demolished in 2002, and it appears that the septic system is still in place. The SAR did not provide a description of the lavatory facilities or drains that discharged into the septic system. The history of the building provided in the SAR indicates that it was historically used for unconventional fuels testing and storage and included a shop, a laboratory and dressing rooms.

Because this building was associated with unconventional fuels storage and testing, the Permittee is required to submit a RFI work plan (see General Comments #8 and #9) to locate the inactive septic system, including any sumps and/or floor drains, the leachfield and the distribution lines (see General Comment #5), and develop a list of COPCs that may have discharged into the system (see General Comment #7). NMED believes COPCs should include total petroleum hydrocarbons (TPH), volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs) and metals (Target Analyte List or TAL). Based on the locations and depths of the septic system components, the Permittee shall include in the work plan soil sampling and analysis in accordance with General Comments #5 and #7. As there is no evidence that the septic tank has been emptied, a sample of the contents of the tank, if any, shall be collected and analyzed for the COPCs to be analyzed for in the leachfield and distribution line soils. A RFI Report prepared in accordance with General Comment #9 must then be submitted to present the results of the site characterization.

15. Building 1194

The history of the building provided in the SAR indicates that it was historically used for missile assembly and test activities and unconventional fuels storage. It appears that the septic system is still in place.

Due to the fact that this building was associated with missile assembly and test activities and unconventional fuels storage, the Permittee is required to investigate the site as required in Comment #14 above.

16. Building 1196

Before a decision can be made as to whether or not further investigation of this site is necessary, the Permittee is required to provide a description of the processes involved in the historic missile assembly operations in this building. For example, solvent use and, if so, what type(s) should be able to be determine from these descriptions.

17. Building 1199

The history of the building provided in the SAR indicates that it was historically used as a rocket fuel laboratory. It appears that the septic system is still in place.

Due to the fact that this building was used as a rocket fuel laboratory, the Permittee is required to investigate the site as required in Comment #14 above.

18. Buildings 1200 and 1201

Permit Table A (summary of SWMUs requiring corrective action) lists the locations of these buildings as part of SWMU PRI-A (OT-32), *Primate Research Lab Sewer Line*. This SWMU is part of a multi-site Accelerated Corrective Measures (ACM) Work Plan submitted to the NMED in November 2006 and approved by the NMED on April 24, 2007. According to the ACM Work Plan, approximately 3,000 – 4,000 feet of the sewer line leading from the area of the former Primate Research Institute (PRI) was corroded and portions had collapsed. The work plan indicates that solvents and tritium tracers were used at the PRI and may have been discharged during the sewer line collapse. The work plan proposes further soil and groundwater sampling along the sewer line for VOCs, SVOCs, TPH, TAL metals and tritium.

The SAR did not provide a description of the lavatory facilities or drains that discharged into the septic system. The history of the buildings provided in the SAR indicates that they were historically used as space biology laboratories were animal experiments were conducted. It appears that the septic systems are still in place.

The Permittee is therefore required to investigate the sites as required in Comment #14 above, with the addition of tritium to the list of COPCs.

19. Building 1219

This septic system services administrative offices. Therefore, no further investigation of this site is necessary.

20. Building 1221

The history of the building provided in the SAR indicates that it was historically used for ammunition storage. It appears that the septic system is still in place.

Due to the fact that this building was used for ammunition storage, the Permittee is required to investigate the site as required in Comment #14 above, with the exception that samples only need to be analyzed for explosives.

21. Buildings 1226, 1235 and 1239

The history of these buildings provided in the SAR indicates that they were historically used for munitions maintenance. It appears that the septic systems are still in place.

Due to the fact that these buildings were used for munitions maintenance, the Permittee is required to investigate the sites as required in Comment #14 above, with the addition of explosives to the list of COPCs.

22. Building 1250

This septic system serviced a former water pumping station. Therefore, no further investigation of this site is necessary.

23. Building 1251

The history of the building provided in the SAR indicates that it was historically used as a research and testing shop. The SAR did not provide a description of the current use or of any drains that discharged into the septic system. It appears that the septic system is still in place.

Due to the fact that this building was used as a research and testing shop, the Permittee is required to investigate the site as required in Comment #14 above.

24. Building 1269

The history of the building provided in the SAR indicates that it was historically used as a medical science laboratory. The SAR did not provide a description of any drains that discharged into the septic system. It appears that the septic system is still in place.

Due to the fact that this building was used as a medical science laboratory, the Permittee is required to investigate the site as required in Comment #14 above, with the addition of tritium to the list of COPCs.

The Permittee must respond within ninety (90) calendar days of receipt of this letter. If you have any questions regarding this matter or if you would like to discuss the comments prior to your response, please contact David Strasser of my staff at (505) 222-9526.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

cc: J. Kieling, NMED HWB
W. Moats, NMED HWB
C. Amindyas, NMED HWB
D. Strasser, NMED HWB
R. Sturdivant, EPA, Region 6 (6PD-F)
File: HAFB 2007 and Reading
HWB-HAFB-07-005

NEW MEXICO ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

BILL RICHARDSON
Governor

DIANE DENISH
Lieutenant Governor

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

RON CURRY
Secretary

JON GOLDSTEIN
Deputy Secretary

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

June 19, 2008

Mr. David Scruggs, Chief
Environmental Restoration Program
49 CES/CEVR
550 Tabosa Ave.
Holloman AFB, NM 88330-8458

SUBJECT: NOTICE OF DISAPPROVAL: PARTIAL RESPONSE TO NOTICE OF DEFICIENCY ON SWMU ASSESSMENT REPORT, SEPTIC TANKS, MARCH 13, 2008
HOLLOMAN AIR FORCE BASE, NM, EPA ID# NM6572124422
HWB-HAFB-07-005

Dear Mr. Scruggs:

The New Mexico Environment Department (NMED) has reviewed Holloman Air Force Base's (the Permittee's) March 13, 2008 partial response to NMED's September 13, 2007 Notice of Deficiency (NOD) for the SWMU Assessment Report (SAR) for the Permittee's septic tanks dated April 2007. NMED has determined that the partial response is inadequate. The Permittee is required to address the following comments before the NMED can make a decision about approval of the SAR and the future investigation requirements for the septic systems. The comment numbers addressed herein are the comment numbers from the NMED NOD.

1. **General Comment**

The NMED acknowledges the Permittee's assertion that many of the NOD comments will be fully addressed by the submittal of a future work plan, pending receipt of funds. These comment numbers are 3, 4, 5, 6, 7, 8, 9, 11, 14, 15, 16, 17, 18, 20 and 23. The

Permittee shall provide a date, subject to NMED's review and approval, for the submission of this work plan.

2. **Comment #2**

The response to this comment states that Buildings 1219, 1226, 1235 and 1239 still have active septic systems that were erroneously reported as being inactive. Therefore, no investigation of these systems is required at this time. However, the Permittee is reminded that the NMED must be notified within 90 days before any of these septic systems are deactivated or removed. The Permittee must also revise the "*Septic Tank Map Location and Status*" table that was submitted with the map volume of the SAR to indicate the changed status of these systems.

3. **Comment #2**

The response to this comment states that Building 702 has been newly added to the list of inactive septic systems. The Permittee is required to provide the location of this building and a description of the historical activities associated with this building to allow the NMED to determine if this system will require further investigation. The Permittee must also revise the "*Septic Tank Map Location and Status*" table that was submitted with the map volume of the SAR to add this building to the list of inactive septic systems.

4. **Comment #2**

The response to this comment states that Buildings 638, 642, 1142, 1168, 1155 and 1269 have been newly added to the list of removed septic systems. The Permittee is required to provide the locations of these buildings and a description of the historical activities associated with each building to allow the NMED to determine if these systems will require further investigation. The Permittee must also revise the "*Septic Tank Map Location and Status*" table that was submitted with the map volume of the SAR to add these buildings to the list of removed septic systems.

5. **Comments #3 and #8**

Attachment #23 was submitted as part of the response to these two comments. This Attachment is unreadable as submitted. The Permittee is required to resubmit this Attachment so that all notations can be read and, preferably, in color. It also must be no larger than 11" X 17" (folded, multiple sheets).

6. **Comment #4**

The response to this comment only addressed those buildings at the south end of the test track, which the NMED was already aware of. It did not identify any other buildings that

are on or in the vicinity of the entire length of the track, nor did it address the buildings at the Early Missile Test site (OT-37). The Permittee is again required to identify any buildings along the entire length of the test track and at OT-37 that historically used or are presently using septic systems. The Permittee is required to provide the locations of these systems and a description of the historical activities associated with each building and current status to allow the NMED to determine if these systems will require further investigation. The Permittee must also revise the "*Septic Tank Map Location and Status*" table that was submitted with the map volume of the SAR to add these buildings to the list of septic systems.

7. **Comment #5**

This comment required that the Permittee locate and map all leachfields and distribution lines at septic system sites for which the NMED is requiring further investigation. The Permittee is advised that the sites for which the NMED has determined that further investigation is required, to date, are at the following buildings: 308, 1190, 1194, 1199, 1200, 1201, 1221 and 1251. The sites that may require further investigation, to date, pending proposed further preliminary research, are at the following buildings: 639, 640, 700, 702, 920, 921, 922, 924, 1142, 1158, 1174, 1178, 1179, 1180, 1183 and 1196.

The response to this comment included the submission, as attachments, of large blueprints showing locations of systems for some of the sites requiring further investigation. The Permittee is advised that these blueprints do not satisfy the requirements of this comment. Individual drawings must be prepared for each system requiring further investigation that show the locations and depths of all leachfield components and distribution lines. This information may be obtained from some of the blueprints while other locations may require excavation. These drawings must meet the requirements of Comment #8 of the NOD. In addition, no drawings shall be larger than 11" X 17", folded. NMED acknowledges that sampling requirements will be addressed in a future work plan. This work plan shall include the preparation of the drawings required by this comment.

8. **Comment #5**

The response to this comment references the following buildings with septic systems that were not addressed in the initial SAR: 639, 640, 700, 1142, 1158, 1174, 1178, 1179, 1180 and 1183. The Permittee is required to provide the locations of these systems and a description of the historical activities associated with each building and current status to allow the NMED to determine if these systems will require further investigation. The Permittee must also revise the "*Septic Tank Map Location and Status*" table that was submitted with the map volume of the SAR to add these buildings to the list of septic systems.

9. **Comment #6**

As indicated in item #7 above, the Permittee is advised that the blueprints submitted in response to this comment as attachments are not acceptable. The requirement of this comment to locate all floor drains and sumps that could drain into the septic systems requiring further investigation shall be met by showing the drains and sumps on the drawings required by item #7 above. NMED acknowledges that this comment will be addressed in the future work plan.

10. **Comment #7**

The response to this comment provides information about materials previously stored in Buildings 1091 and 1097. The Permittee is reminded that NMED previously determined that no further investigation is required at these sites based on preliminary information already provided. The Permittee must clarify why these buildings were included in the response to this comment.

11. **Comment #8**

As indicated in item #7 above, the Permittee is advised that the blueprints submitted in response to this comment as attachments are not acceptable. All drawings submitted with the future work plan must meet the requirements of Comment #8 of the NOD and as specified in the above comments.

12. **Comment #10**

The response to this comment provides a description of the types of hazardous materials/ waste used in Building 308. Given this information, the NMED has determined that this septic system must be investigated as specified in Comment #14 of the NOD. See item #7 above for a current listing of systems that the NMED has determined must be investigated and those that may need to be investigated.

Please respond to this Notice of Disapproval within ninety (90) calendar days of receipt of this notice. If you have any questions regarding this matter or if you would like to discuss the comments prior to your response, please contact David Strasser of my staff at (505) 222-9526.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

cc: J. Kieling, NMED HWB
W. Moats, NMED HWB
C. Amindyas, NMED HWB
D. Strasser, NMED HWB
L. King, EPA, Region 6 (6PD-F)
File: HAFB 2008 and Reading
HWB-HAFB-07-005

Appendix B

Approved Holloman Air Force Base Standard Operating Procedures

Holloman Air Force Base
Approved Standard Operating Procedures

HAFB SOP-1	Documentation, Sample Handling, Chain-of-Custody, and Shipping
HAFB SOP-2	Sampling Equipment Decontamination
HAFB SOP-3	Staking, Utility Clearance, and Permitting
HAFB SOP-4	Direct Push Sampling for Soil and Groundwater
HAFB SOP-5	Soil Sampling for Chemical Analysis
HAFB SOP-6	Procedure for Field Screening of Volatile Organics
HAFB SOP-7	Lithologic Description and Geotechnical Sampling
HAFB SOP-8	Groundwater Sampling for Chemical Analysis
HAFB SOP-9	Field Management of Investigation-Derived Waste (IDW)
HAFB SOP-10	Borehole Abandonment and Site Restoration

HAFB SOP-1
DOCUMENTATION, SAMPLE HANDLING, CHAIN-OF-CUSTODY, AND SHIPPING

1.0 OBJECTIVE

This SOP contains specific details concerning sample control, documentation, and transportation procedures.

2.0 EQUIPMENT AND MATERIAL

The following equipment will be necessary to complete sample documentation, handling, and shipment:

Forms and Records

Log books;

Chain-of-custody forms;

Custody seals;

Sample identification labels; and,

Shipping Supplies

Clear tape;

Rigid plastic coolers;

Strapping tape;

"This Side Up" arrow labels;

Address labels;

Heavy-duty plastic trash bags and ties;

Small and large re-sealable plastic bags;

Protective mesh for various sample bottle sizes;

Absorbent material for packing samples; and

Ice.

3.0 METHODOLOGY

Sample control and documentation are necessary to ensure the defensibility of data and to verify the quality and quantity of work performed in the field. Accountable documents include field logbooks, instrument calibration logbooks, sample logs, correspondence, sample labels, chain-of-custody forms, photographs, and analytical records. All information pertinent to a field activity must be entered into a logbook, including uncompleted work.

3.1 SAMPLE CONTROL AND DOCUMENTATION

All logbooks should be numbered and are to be bound with consecutively numbered pages; log book pages and data should never be removed. Loose-leaf forms, sample logs, and figures used for sample location will be kept in a 3-ring binder. Indelible black ink will be used for recording all data. At minimum, the following data should be recorded during the course of the investigation:

Date, field observations, and weather conditions, including any unusual circumstances;

Calibration of field equipment before sample analysis;

Names of field crew members;

Name of the sample collector;

Identification of sampling location and depth of sample;

Rough sketch of sampling location related to significant physical objects;

Depth to water at groundwater sampling locations;

Purge method and purge volume;

Sample collection method;

Types and numbers of sample containers used;

Preservatives used;

Results of field analysis; and

Sample observations (color, turbidity, odor, soil type, etc.).

To change an incorrect entry, draw a line through the entry, write the change above or adjacent to the entry, and date and initial the change. If anyone other than the person to whom a logbook is assigned makes an entry, that person should date and sign the entry. All project logbooks are to be turned over to the document control officer at the end of each work period and to a central file at the end of the field activity.

3.2 SAMPLE LABELING

In addition to the field logbook, a complete sample label should be filled out for each sample.

All sample containers should be sealed immediately after sample collection. Samplers should place the completed sample label onto the sample container and secure it with clear tape. Sample labels must identify the sample ID, site, sample type, sampler's initials, sampling location, depth, time, date, analyses requested, laboratory, containers, and any special instructions. Labels should be completed with black waterproof ink.

3.3 SAMPLE CONTROL/CHAIN-OF-CUSTODY/SHIPMENT

Once the samples have been collected and labeled, they should be kept cool with ice or in a refrigerator. The following procedures are for sample handling and shipment to a laboratory for analysis:

A. Fill out a chain-of-custody form for every sample shipping container (cooler). Information recorded on this form includes the following:

Samples collected and corresponding laboratory analyses;

Time and date of sample;

Sample number;

Type of sample;

Sampler's initials;

Preservatives used;

MS/MSD analysis;

Relinquisher's signature, date, and time; and

Special instructions.

B. Double check the information on the chain-of-custody form against the sample labels and sample logs. Make sure each sample is accounted for and that samples are being sent to the correct laboratory.

C. Wipe the sample container exteriors clean with a paper towel dampened with clean water.

D. Ensure that each container has a properly completed label.

E. Place the sample containers in resealable plastic bags. Containers from the same sample location and depth can be placed in the same bag, but separate samples from different sites will not be placed in the same bag to prevent cross-contamination.

F. Place the sample container(s) in a cooler lined with a large plastic garbage bag.

G. Pack the container(s) with ample amounts of packing material to prevent possible breakage and absorb liquid material released should breakage occur. This material should be place under the container(s) and between all containers for multiple container shipments to prevent the containers from touching each other or the bottom of the shipping container.

H. Place ice among the sample containers to maintain the samples at or below 4°C during transport.

I. Add any needed absorbent to fill all void spaces.

J. Seal the completed chain-of-custody form for the appropriate cooler in a resealable plastic bag and tape it to the inside of the top lid of the cooler. The sample custodian should retain the pink copy of the form and maintain it in a file of field documentation.

K. Securely close the outer shipping container with strapping tape around both ends. If there is a drain on the cooler, tape it shut.

L. Affix signed and dated custody seals to all closures on the shipping container to prevent tampering.

M Affix "This Side Up" arrows on two opposing sides of the cooler. No DOT placards are required.

Compliance with all applicable DOT and International Air Transport Association (IATA) shipping regulations is required.

4.0 COMMENTS

To expedite the sampling and shipping process, it is recommended that preprinted sample labels, chain-of-custody forms, address labels, and overnight delivery forms be used.

If using a refrigerator to store sample, monitor the temperature using a thermometer and be careful not to freeze water samples.

HAFB SOP-2
SAMPLING EQUIPMENT DECONTAMINATION

1.0 OBJECTIVE

Decontamination of boring equipment and sampling tools is performed as a QA measure and safety precaution. It helps prevent cross-contamination among samples and helps maintain a clean working environment for the safety of field personnel. The methodology for decontamination was prepared in accordance with the following documents:

EPA. 1991. *Environmental Compliance Branch, Standard Operating Procedures and Quality Assurance Manual* (SOPQAM), U.S. Environmental Protection Agency, Region IV, Environmental Services Division, Athens, Georgia.

NIOSH, OSHA, USCG, and EPA. 1985. *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities.* Prepared by the National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), U.S. Coast Guard (USCG), and EPA. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, NIOSH report, October 1985. Washington, D.C.: U.S. Government Printing Office.

2.0 EQUIPMENT AND MATERIAL NEEDS

Soap: Laboratory grade, non-phosphated - or equivalent;

Tap water;

Reagent-grade water;

Pesticide-grade isopropanol;

Cleaning brushes;

Cleaning containers: plastic bucket and galvanized steel pans;

Waste containers as outlined in HAFB SOP-9; and

Health and safety equipment as outlined in the SSHP.

3.0 METHODOLOGY

Small, reusable equipment, including sampling equipment, is mainly decontaminated by rinsing with liquids that include soap or detergent solutions, tap water, deionized water, or solvents. Following decontamination, if the equipment is not to be reused immediately, it will be stored, protected from recontamination by wrapping in aluminum foil, and appropriately rinsed before the next use.

3.1 PRE-SAMPLING DECONTAMINATION ACTIVITIES

A. Don the appropriate PPE, as specified in the SSHP and as required for the specific work area.

B. Assemble containers and equipment for decontamination, designing the decontamination station in such a manner as to prevent liquid from spilling onto the ground.

C. Decontaminate all new equipment or equipment not previously decontaminated before use.

D. If the protective wrapping on a piece of precleaned equipment has been torn, or if there is any question about its cleanliness, the equipment should be considered contaminated and undergo the full decontamination procedures before it is used.

3.2 DECONTAMINATING SAMPLING EQUIPMENT

A. Remove any solid particles from the equipment or material by brushing and rinsing with available potable water. This will remove gross contamination.

B. Wash equipment with a brush and a phosphate-free detergent solution.

C. Rinse equipment thoroughly with potable water.

D. Double rinse the equipment with reagent-grade water.

E. Allow equipment to air dry thoroughly. If there is not enough time to air dry completely, the equipment should be rinsed with copious amounts of reagent water. Equipment may then be reused immediately.

F. Unless the equipment is going to be used immediately, it must be wrapped in new aluminum foil, shiny side out, to keep it clean until needed. For large bulky equipment, new plastic sheeting can be substituted for the aluminum foil.

3.3 DECONTAMINATION OF LARGE EQUIPMENT

Drilling equipment (rigs, drill rods, augers, bits, etc.), DPT equipment, and other large pieces of field equipment, unable to be decontaminated using the method described above, must be high-pressure steam cleaned before and after each use.

Steam cleaning will be performed at an appropriate central decontamination area specified by the Base. The decontamination area must be capable of containing decontamination fluids and allow for managing of investigation-derived wastes (IDW) as specified in the appropriate SOP.

3.4 COMMENTS

Any field equipment not used during a field activity must be decontaminated before its return to the equipment stock for reuse at another site. This requirement applies even if the aluminum foil on precleaned equipment is not torn. This requirement can be waived only if after initial decontamination, the equipment was sealed in plastic.

At each phase of the decontamination process, decontamination fluids and rinsates should be collected and managed as outlined in the appropriate SOP.

Isopropanol rinse should be omitted for any equipment such as plastic well-sounding tapes.

Solvents should not be used on any type of non-Teflon plastic equipment that will contact an environmental sample or be introduced into a monitoring well.

HAFB SOP-3
STAKING, UTILITY CLEARANCE, AND PERMITTING

1.0 OBJECTIVE

To ensure the health and safety of field sampling personnel and prevent damage to underground utilities during soil sampling, precautions must be taken to properly locate hazards such as gas lines, high-voltage electrical lines, water mains, communication lines, sewer lines, and so forth.

Before any intrusive work (including hand-auger borings) can begin at Holloman Air Force Base (AFB), sampling locations at each site must be cleared and a proper digging permit must be obtained.

2.0 EQUIPMENT AND MATERIAL NEEDS

Wooden stakes, lathes, hubs, surveyor flags, and/or spray paint;

Small sledge-type hammer;

Permanent marker;

Site maps from Section 2; and

Base Civil Engineering Clearance Request (Air Force Form #103).

3.0 METHODOLOGY

A) Begin the site clearance procure by locating and marking all soil boring locations at each site, using the following guidelines:

If possible, procure ahead of time utility maps so that the preliminary positioning of sample locations will avoid underground obstructions.

Visually scan each sample location to be sure that there are no obvious underground lines or obstructions.

Pound the flag and the hub/stake firmly into the ground, making sure that it is clearly marked with the site number and the borehole number (DP-01). If the location is on a paved surface, it should be marked with spray paint.

B) To obtain all utility clearances, site tours must be completed with appropriate representatives of the Base utilities (electric, plumbing, and Army cable) and New Mexico One Call.

New Mexico One Call coordinates the location of on-Base utilities, including US West phone lines, Simmons' cable lines, and Standard Transport pipe fuel lines. They will provide you with a control number and submit locator requests for you. New Mexico One Call can be reached at (800) 321-2537.

During the site tours, have the locators mark utility locations with flags or spray paint.

If possible, obtain a blanket site clearance to cover possible additional boring locations at the site. (For certain utilities, this may not be possible. In which case, inquire about the procedure necessary to gain additional clearances).

If obstructions exist or if a borehole must be moved to avoid utilities, it should be relocated to a position that satisfies the intent of the original location.

C) To obtain the actual digging permit, a Base Civil Engineering Clearance Request Forms (AF103) must be completed and signed by appropriate parties. (Note that the locators should also sign the form in the appropriate space, as well as initial the site figures.) This process is usually expedited through coordination with representative of Civil Engineering's Environmental Flight (CEV). Once a digging permit has been issued, it is valid for one month.

4.0 COMMENTS

Proper preparation in the initial location and staking is critical for expediting the sampling process. If sampling locations are not properly marked and cleared, significant costs could be incurred through delays while waiting for drilling permits.

NM One Call requires a 48-hour advance notice before drilling may proceed.

Utility locators may require information about how long the job will last, the type of marker being used, and the location of the boreholes. Be prepared to provide the various utility locators and signatories on the drilling permit with multiple copies of site figures and location maps.

When doing any intrusive work on the Base, the contractor must have a valid permit on hand.

HAFB SOP-4
DIRECT PUSH SAMPLING FOR SOIL AND GROUNDWATER

1.0 OBJECTIVE

Direct push technology (DPT) will be used to rapidly collect soil and water samples. This technique provides for collection of undisturbed samples and does not generate soil cuttings. This SOP discusses the DPT method only; for actual soil and groundwater sampling procedures. Please refer to the appropriate SOPs for soil and groundwater sampling.

2.0 EQUIPMENT AND MATERIAL NEEDS

The DPT operator will need a copy of the subcontractor work plan, waste containers and appropriate health and safety gear. The DPT subcontractor will provide all additional equipment and materials. The DPT subcontractor should be equipped with a rig capable of pushing 20 ft and collecting soil and groundwater samples from any interval within that depth. Equipment should include at minimum the following items:

Hydraulic ram with hammer assembly;

1- to 1.5-inch diameter drill rods;

Piston-type, split-spoon, or equivalent soil sampling device that allows for lithologic characterization and retrieval of at least 400 mL of sample volume;

GeoProbe, Hydrocone, bailer, Teflon tubing and peristaltic pump, or equivalent water sampling device;

Small diameter PVC riser and screen to make temporary wells if recovery is too slow;

Decontamination equipment; and

Health and safety equipment, as outlined in the SSHP.

3.0 METHODOLOGY

A) Verify that the subcontractor has the necessary drilling and sampling equipment, as well as proper decontamination supplies.

B) Confirm that sampling locations are staked and that the clearances from all on-Base and off-Base utilities have been obtained. Do not begin the sampling until proper digging permits have been obtained and all of the utilities have been marked.

C) Locate the sample location and position the DPT rig. If the sample point is on thick asphalt or concrete, the DPT subcontractor will use hammer-drill or equivalent to drill a hole through the pavement.

D) Verify that the sampling tip has been properly decontaminated.

E) For soil sampling, hydraulically advance the sampler to above the target sample interval, unlock the piston point, and advance the sampling device through the sampling interval:

Pull the rods using the hydraulic apparatus and remove the sample insert or split spoon.

Log the soil and collect the required samples as specified in the field sampling plan.

F) Continue sampling at additional depth intervals or abandon the borehole, as appropriate for the location.

G) If groundwater sampling is necessary, advance the sampler into the water table and collect a sample with the sampling device.

H) Collect and manage all wastes as specified in the IDW SOP.

I) Abandon all boreholes and repair pavement before moving to a new site (see the SOP for abandonment).

4.0 COMMENTS

If a buried object impedes the DPT sampler or if an insufficient sample volume is recovered, reposition the rig in a location to satisfy the intent of the original sample point and try again. Note this on the borehole logging form.

If the total recovered sample volume is insufficient for both screening and laboratory analysis, a second hole will be pushed as close as possible to the original hole and an additional sample will be taken from the same depth interval. The two samples will be composited prior to sampling for chemical analysis.

If a situation arises in which the groundwater recharge is too slow to allow sampling, a PVC well can be inserted temporarily for sampling at a later time.

HAFB SOP-5
SOIL SAMPLING FOR CHEMICAL ANALYSIS

1.0 OBJECTIVE

Soil samples will be collected for chemical analysis to enable determination of the nature and extent of contamination in soil. Groundwater samples will be collected from monitoring wells or from with inert tubing through the direct push sampling methods.

The following procedures were designed to ensure consistent and high quality data collection and are in accordance with EPA procedures for sample collection as detailed in the following document:

EPA. 1991. *Environmental Compliance Branch, Standard Operating Procedures and Quality Assurance Manual* (SOPQAM), U.S. Environmental Protection Agency, Region IV, Environmental Services Division, Athens, Georgia.

2.0 EQUIPMENT AND MATERIAL NEEDS

Appropriate number and types of sample containers (see Table HAFB5-1);

Precleaned stainless steel sampling spoons and knife;

Sample coolers and ice;

Appropriate field documentation forms and an indelible ink pen;

Sampling equipment decontamination supplies;

Waste containers;

Health and safety equipment, as specified in the SSHP.

3.0 METHODOLOGY

A) Verify that the subcontractor has the necessary drilling and sampling equipment, as well as proper decontamination supplies.

B) Confirm that sampling locations are staked and that the clearances from all on-Base and off-Base utilities have been obtained. Do not begin the sampling until proper digging permits have been obtained and all of the utilities have been marked.

C) Locate the sample location and position the DPT rig. If the sample point is on thick asphalt or concrete, the DPT subcontractor will use hammer-drill or equivalent to drill a hole through the pavement.

D) Verify that the sampling tip has been properly decontaminated, as specified in decontamination SOP before beginning penetration.

E) For soil sampling, hydraulically advance the sampler to above the target sample interval, unlock the piston point, and advance the sampling device through the sampling interval:

Pull the rods using the hydraulic apparatus and remove the sample insert or split spoon.

Log the soil and collect the required samples as specified in Field Sampling Plan (FSP).

F) Continue sampling at additional depth intervals or abandon the borehole, as appropriate for the location. To determine if sufficient depth has been covered, see the FSP section of this document.

G) If groundwater sampling is necessary, advance the sampler into the water table and collect a sample with the sampling device as specified in appropriate SOP.

H) Collect and manage all wastes as specified in the appropriate SOP.

l) Abandon all boreholes and repair pavement before moving to a new site as specified in appropriate SOP.

4.0 COMMENTS

The supervising geologist should be prepared and have all the supplies available on site to conduct all planned sampling at each site.

Container and preservation requirements for various analytical methods are detailed in Table HAFB5-1.

TABLE HAFB5-1
CONTAINER AND PRESERVATION REQUIREMENTS FOR SOIL SAMPLING

Reference Method	Parameter	Container[1, 2]	Sample Preservation	Maximum Holding Time[3]	
				Extraction	Analysis
EPA 8015	TPH-gas/diesel/ BTEX	1.4 oz wide mouth jar, G	Ice to 4°C	--	14d
EPA 418.1	TRPH	1 x 8 oz wide mouth jar, G	Ice to 4°C	--	14 d
EPA 8260	Volatile Organics	2 x 40 mL G, Septa vial	Ice to 4°C	--	14 d
EPA 8270	B/N/A	1 x 8 oz wide mouth jar, G	Ice to 4°C	7 d	40 d
TAL 6000/7010 series	Metals	1 x 8 oz wide mouth jar, G	Ice to 4°C	--	6 months
SW-846:9045	pH	1 x 2 oz wide moth jar, G	Not specified	--	ASAP
EPA 8080	PCBs/ Pesticides	1 x 8 oz wide mouth jar, G	Ice to 4°C	7 d	40 d
Full suite (8240, 8270, 6000/ 7010)	TCLP	2 x 8 oz wide mouth jar, G	Ice to 4°C	--	14d

[1] All containers must have Teflon-lined seals (Teflon-lined septa for all VOA vials). G= Glass, P = High-density polyethylene.
[2] Container volume may vary slightly depending upon laboratory specific requirements.
[3] When only one holding time is given, it implies total holding time from sampling until analysis.

HAFB SOP-6
PROCEDURE FOR FIELD SCREENING OF VOLATILE ORGANICS

1.0 OBJECTIVE

Soil samples can be screened in the field for relative concentrations of total volatile organic constituents (VOCs) rapidly and inexpensively. It is important to note, however, that the screening technique is relative and will not quantify the exact concentration of the particular constituents present in the sample matrix. The procedure is only used to determine the relative concentrations of VOCs between sets of soil samples. For example, if 10 soil samples are collected vertically from one soil boring, the screening technique can be used to determine which samples may have relatively higher concentrations of VOCs with respect to the other samples. Section 2.0 covers equipment required to perform the screening. Section 3.0 presents the steps required to perform the sampling.

2.0 EQUIPMENT AND MATERIAL

The following equipment is required for field VOC screening:

A photoionization detector (PID) or a flame ionization detector (FID);

Sample containers such as glass jars and aluminum foil or resealable plastic bags; and,

Calibration gas for the FID or PID (Isobutylene for PIDs, methane for FIDs).

3.0 METHODOLOGY

The following steps are employed when screening soil samples for total concentrations of VOCs. The procedure assumes that a fraction of the soil sample has already been collected using the soil sample procedure SOPs.

A) Place a fraction of the soil sample collected in a glass jar and cover the jar mouth with aluminum foil or place the sample in a resealable plastic bag. Place the samples in a warm place or area of stable temperature such as a building or temperature controlled environment.

B) Allow all the samples to equilibrate to the temperature-controlled environment.

C) Turn the PID and FID on and calibrate the instrument using the appropriate calibration gas (i.e. methane for a FID and isobutylene for a PID) using the procedures specified by the manufacturer.

D) Insert the probe from the PID or FID into the headspace of the jar (i.e., through the aluminum foil lined lid or through the plastic bag and collect a sample of the air in the headspace of the jar.

E) Observe and record the headspace measurement as parts per million (ppm) in the field notebook or soil boring log. Note which type of instrument and the calibration gas that was used.

F) Repeat steps D and E until all the samples have been screened.

4.0 COMMENTS

Obtaining a good sample for chemical analysis for VOCs is the first priority.

Field screening the sample for VOCs using a PID or FID is second priority.

Transcribing the lithologic descriptions and collecting geotechnical samples is the last priority.

HAFB SOP-7
LITHOLOGIC DESCRIPTION AND GEOTECHNICAL SAMPLING

1.0 OBJECTIVE

Lithologic logging will be performed to define the subsurface geology. All soils will be described using the Unified Soils Classification System (ASTM Designation D 2488-84: Standard Practice for Description and Identification of Soils [Visual-Manual Procedure]).

2.0 EQUIPMENT AND MATERIAL NEEDS

Tape measure;

Munsall soil color chart;

Hand lens;

Knife or spatula;

Dropper with 10% HCl for calcium carbonate test;

LaMotte soil texture kit or small vial;

Water;

Borehole log forms; and

Health and safety equipment, as specified in the SSHP.

3.0 METHODOLOGY

A) Note penetration rates and comments in "remarks" section of logging form (e.g., "easy penetration", "hammering required", "2 ft in 3 minutes", etc.). If using a drop hammer, record blow counts.

B) Measure entire sample length and record recovery (as total footage recovered over the total length that sampler was pushed) to nearest tenth of a foot. Mark lithologic changes on logging form.

C) Separate a small, representative portion of each distinct soil to be identified.

D) Identify the color using the Munsall chart.

E) Identify the soil type using the field tests outlined in the ASTM guidance. All required tests considered appropriate for soil type should be performed (i.e. tests for fine-grained soils, such as plasticity, need not be performed on coarse-grained soil).

F) Record descriptions of the soil on the borehole log form. To facilitate the comparison of logs, all descriptions should use the following order and style:

Soil type (*Silty SAND w/Clay*);

Soil Color (*Moderate yellow brown (10YR5/4)*);

Moisture content;

Angularity and shape of particles (if a sand or gravel);

Consistency;

Cementation;

Structure;

Dry strength;

Dilatancy;

Toughness;

Plasticity;

Miscellaneous descriptors (roots, nodules, odors, texture percentages from the LaMotte kit, etc.);

USCS Code (*SM*).

G) Note all visible contamination, PID/FID measurements, odor, or any observed evidence of contamination in the sample.

H) As necessary, identify the percentages of sand, silt, and clay in each sample using a LaMotte soil texture kit, or by settling using a small vial or bottle.

I) The sample should be placed in a soil jar or steel tube and sealed with as little air as possible (Table HAFB7-1).

J) Label the contained for shipment to a lab for geotechnical grain size distribution (without the hydrocarbons portion of the test) (ASTM D421 and D422), Atterberg Limits (ASTM D4318), and moisture content (ASTM D2216).

4.0 COMMENTS

Obtaining a good sample for chemical analysis is the first priority; collect chemical samples for volatile organic compounds (VOCs) before logging the soil core or taking geotechnical samples.

Because visible contamination and field screening by FID/PID is used to define extent of contamination, it is essential that all observations concerning odor and staining and PID or FID readings are recorded on the logging form.

Consistent logging is important for accurate characterization of site geology. Although the geologist may need to use his/her professional judgement to infer contacts and lithology, using the tests listed in the ASTM method will ensure consistent results.

TABLE HAFB7-1
CONTAINER AND PRESERVATION REQUIREMENTS FOR GEOTECHNICAL

Reference Method	Parameter	Minimum Volume	Container
ASTM D4318	Atterberg Limits	100 grams	4 oz glass jar[1]
ASTM D2216	Moisture content	50-100 grams	4 oz glass jar[1]
ASTM D421 & 422	Grain size	30-40 grams	2- to 4- oz glass jar[1]

[1] OK to combine these analyses into a larger container

HAFB SOP-8
GROUNDWATER SAMPLING FOR CHEMICAL ANALYSIS

1.0 OBJECTIVE

Water samples will be collected for chemical analysis to enable determination of the nature and extent of contamination in groundwater. Groundwater samples will be collected from monitoring wells or with inert tubing through the direct push sampling methods.

The following procedures were designed to ensure consistent and high quality data collection and are in accordance with EPA procedures for sample collection as detailed in the following document:

EPA. 1991. *Environmental Compliance Branch, Standard Operating Procedures and Quality Assurance Manual* (SOPQAM), U.S. Environmental Protection Agency, Region IV, Environmental Services Division, Athens, Georgia.

2.0 EQUIPMENT AND MATERIAL NEEDS

Appropriate number and types of sample containers (see Table HAFB8-1);

Precleaned stainless steel sampling spoons and knife;

Sample coolers and ice;

Appropriate field documentation forms and an indelible ink pen;

Sampling equipment decontamination supplies;

Waste containers;

Health and safety equipment, as specified in the SSHP.

3.0 METHODOLOGY

A) Ensure that all equipment is properly calibrated and operating by following the manuals provided by the equipment manufacturer. Record results of the equipment in the logbook.

B) Calculate the approximate volume of the inert tubing (Teflon) using the formula

$$V = 3.1415 \times r^2 \times \text{Length} \times 7.48 \text{ gal/ft}^3$$

Or if the tubing is ¼-inch diameter, simply multiply the tubing length by 0.0102 gal/foot.

C) Attach the peristaltic pump to the tubing as indicted in the pump instructions.

D) Purge the tubing slowly at first to avoid entraining air in the tube. Purge the appropriate volume and store it in the appropriate waste container.

E) Fill sample bottles in the following order:

- Volatile organic compounds
- Semi-volatile organic compounds
- Metals
- Wet tests

F) Place sample containers on ice and handle as indicted in the appropriate SOP.

G) When sampling is complete, remove tubing from the DPT rods and dispose of all IDW as directed in the SOP.

H) Abandon the boring as directed in the appropriate SOP.

4.0 COMMENTS

The supervising geologist should be prepared and have all the supplies available on site to conduct all planned sampling at each site.

Container and preservation requirements for various analytical methods are detailed in Table HAFB8-1.

TABLE HAFB8-1
CONTAINER AND PRESERVATION REQUIREMENTS FOR GROUNDWATER SAMPLING

Reference Method	Parameter	Container[1,2]	Sample Preservation	Maximum Holding Time[3]	
				Extraction	Analysis
EPA 8015	TPH-gas/diesel/ BTEX	500 mL brown glass bottle	Ice to 4°C	--	14d
EPA 8260	Volatile organic compounds	3x40 mL G, Septa vials	Ice to 4°C, pH <2 with HCl	--	14 d
EPA 8270	B/N/A	2 x 1 L brown glass	Ice to 4°C	7 d	40 d
TAL 6000/7010 series	Metals	500 mL plastic bottle	Ice to 4°C pH <2 with HNO3	--	6 months
SW-846:9045	pH	500 mL plastic	Ice to 4°C	--	24 hrs
EPA 8080	PCBs/ Pesticides	2 x 1 L brown glass	Ice to 4°C	7 d	40 d
	Radionuclides	1 L plastic	Ice to 4°C	--	14d

[1] All containers must have Teflon-lined seals (Teflon-lined septa for all VOA vials). Glass = brown glass, Plastic = High-density polyethylene.
[2] Container volume may vary slightly depending upon laboratory specific requirements.
[3] When only one holding time is given, it implies total holding time from sampling until analysis.

HAFB SOP-9
FIELD MANAGEMENT OF INVESTIGATION-DERIVED WASTE (IDW)

1.0 OBJECTIVE

To collect and manage IDW in accordance with state and federal regulations, this SOP provides easy-to-follow procedures for characterizing, handling, storing and disposing of IDW generated during the additional characterization program. IDW management techniques emphasize waste minimization.

2.0 EQUIPMENT AND MATERIAL NEEDS

DOT-approved drums and containers;

IDW "Analysis Pending" labels;

"Hazardous Waste" labels and Non Hazardous labels;

Indelible markers (i.e., Sharpie);

Clear adhesive tape;

Ratchet, socket, and crescent wrench for opening/closing drums;

PPE;

Plastic buckets for carrying purge water to drums;

Absorbent pads or booms for cleaning up spills;

Wooden pallets;

Waste inventory form; and

PID or FID.

3.0 METHODOLOGY

3.1 SOIL AND WATER IDW

A) Conduct sampling in accordance with the soil and groundwater sampling SOPs.

B) If soil is stained, place excess soil (and any excess water sample) in appropriately sized DOT-approved drums or cans. DO NOT PUT SOIL AND WATER IN SAME CONTAINER.

C) Place an adhesive label on the side of the container. Using an indelible marker, write the following information on the label

The phrase "Analysis Pending"

Accumulation start date

Name of waste (e.g., soil from soil or well boring ID numbers)

Name and phone number of Holloman AFB contact (CES/CEV)

D) When label is complete, cover it with a piece of clear adhesive tape.

E) If soil is not stained, conduct VOC screening with a PID or FID.

F) If no VOCs are detected in headspace analysis, spread excess soil and water (if any) around borehole.

G) If VOCs are detected in the soil, place excess soil and water (if any) in DOT-approved drums, and label the drum (or container) in accordance with step C) above. DO NOT PUT SOIL AND WATER IN SAME CONTAINER.

H) If the site is developed and will not accommodate the spreading of soils then soils containing TPH concentration less than 940 ppm will be spread at a site to be designated by the Base.

I) If soils are containerized move to IDW drum storage area.

J) Waste characterization will be conducted utilizing previously collected soil analytical results and additional characterization results. No soil generated during the POL remediation activities at the SWMUs was characterized as hazardous waste. If soils contain TPH in excess of 940 ppm, arrangements will be made for off-site disposal at a permitted petroleum-contaminated soil disposal facility. Decontamination solutions will either be spread on site or placed in the Base sanitary sewer system, following approval from the Base.

3.2 PPE AND DISPOSABLE SAMPLING EQUIPMENT WASTE

A) Remove excess solid and liquid waste from PPE and disposable sampling equipment.

B) Place all PPE and sampling equipment to be disposed of in sealed plastic trash bags.

C) Dispose of trash bags in a dumpster at the IDW staging area.

D) If a Base dumpster is not located near the IDW staging area, arrange for one that can be used during the course of the investigation.

HAFB SOP-10
BOREHOLE ABANDONMENT AND SITE RESTORATION

1.0 OBJECTIVE

All boreholes must be sealed to prevent the spread of contaminants with depth and to eliminate direct pathways from the surface to the subsurface and groundwater. Surface materials such as asphalt and cement that have been drilled or pushed through must also be repaired to a satisfactory condition.

2.0 EQUIPMENT AND MATERIAL NEEDS

Bentonite chips or granular bentonite and funnel;

Cold-patch asphalt material and quick-set concrete;

Ample amounts of water; and

Health and safety equipment, as specified in the SSHP.

3.0 METHODOLOGY

In general, borehole abandonment will be completed by the DPT or HSA subcontractor under supervision of the rig geologist. The subcontractor will supply all necessary materials listed above. The contractor, however, may need small amounts of bentonite to seal hand-auger boreholes.

A) After a boring has been completed by **DPT technique**, leave the drive rods in place pending abandonment.

B) Add bentonite chips or granular bentonite slowly into the top of the drive rods using a funnel. As the rods are being slowly pulled from the borehole, add bentonite to complete the seal to the surface.

C) If the rods have been driven into groundwater, it will not be possible to seal the borehole through the rods. (The bentonite chips will stick to the inside of the rods, clogging the end). In this case, carefully extract the rods and slowly add bentonite chips, being careful not to allow bridging.

D) Hydrate the seal using ample amounts of potable water.

E) If the borehole is through asphalt or concrete, leave the seal below the bottom of the pavement to allow for sufficient fill and patching material.