DEPARTMENT OF THE AIR FORCE

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

07 APR 1995

MEMORANDUM FOR HAZARDOUS AND RADIOACTIVE MATERIALS BUREAU
Attn Mr Ron Kern
New Mexico Environment Dept (NMED)
525 Camino De Los Marquez
P.O. Box 26110
Santa Fe, NM 87502

US EPA REGION VI (6H-CS)
Attn Mr Barry Feldman
First Interstate Bank Tower
1445 Ross Avenue
Dallas, Texas 75202-2733

APR 1995
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PROGRAM

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

SUBJECT: Long Term Groundwater Monitoring Plan for Holloman AFB (HAFB) Lagoons

1. Enclosed please find the Draft Final Long-Term Monitoring Plan for the sewage lagoons. The groundwater monitoring requirements for the lagoons are identified in item VI.C. of the Federal Facilities Compliance Agreement signed by US Environmental Protection Agency-Region VI, New Mexico Environment Department, and HAFB on 20 Dec 1988.

2. Approval of this plan will resolve Alleged Violation Number 9 of the Federal Facilities Compliance Agreement. Please also note that funding requests for the monitoring program must be based upon the plan. Therefore, we request written comments be submitted to us in a timely manner and that written approval be provided when the plan is suitable.

3. Please direct written comments and any questions to Dr Fred Fisher of the Civil Engineer Environmental Flight, 49 CES/CEV, (505) 475-3931/5062.

Howard E. Moffitt
HOWARD E. MOFFITT
Deputy Base Civil Engineer

Attachment:
Monitoring Plan

cc (w/o Attachment):
Ms Stephanie Kruse
Hazardous and Radioactive Materials Bureau
New Mexico Environment Dept
525 Camino De Los Marquez
P.O. Box 26110
Santa Fe, NM 87502

Mr Lowell Seaton
US EPA Region VI (6H-PN)
First Interstate Bank Tower
1445 Ross Avenue
Dallas, Texas 75202-2733

Mr Mark Wilson
US Fish and Wildlife Service
2105 Osuna, NE
Albuquerque, NM 87113

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Headquarters, Air Combat Command
Langley Air Force Base,
Virginia

Long-term Monitoring Plan for the Sewage Lagoons

April 1995

49th FIGHTER WING

49 CES/CEV
Holloman Air Force Base,
New Mexico

PURPOSE OF DOCUMENT

A. This long-term monitoring (LTM) plan is for use by the selected contractor and laboratory to conduct the groundwater monitoring at the Holloman Air Force Base (AFB) sewage lagoons. It was prepared for and in cooperation with the Environmental Flight: 49 CES/CEV, 550 Tabosa Avenue, Holloman AFB, NM 88330-8458, (505) 474-3931.

B. The LTM plan has been prepared to guide and document the groundwater monitoring programs for the sewage lagoons. Its purpose is to develop a LTM program that is protective of human health and the environment and that satisfies the requirements of the Federal Facilities Compliance Agreement.

C. The LTM plan contains a description of the monitoring requirements and supporting rationale. Standard operating procedures are included to guide field activities and a quality assurance project plan is included to guide laboratory activities. The plan also provides a mechanism to guide and track results and conclusions over the lifetime of the LTM program.

DCN 94-612-001-24-02

LONG-TERM MONITORING PLAN FOR THE SEWAGE LAGOONS

Prepared for:

49 CES/CEV
Holloman Air Force Base, NM
and
HQ ACC/CEV
Langley Air Force Base, VA

Prepared by:

Radian Corporation
8501 North Mopac Boulevard
Austin, Texas 78720-1088

Under Contract No. DACW45-93-0027 with:

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

Revison 0: April 1995

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Section 1
INTRODUCTION

This long-term monitoring (LTM) plan has been prepared to guide and document the future groundwater monitoring requirements for the Holloman Air Force Base (AFB) sewage lagoons. Section 1 contains an overview of the regulatory programs currently governing groundwater monitoring investigations at the sewage lagoons and presents the purpose, technical approach, and objectives of the LTM program. The location of the sewage lagoons is shown in Figure 1-1. Section 1 concludes with an overview of the remaining sections of this LTM plan.

1.1 Regulatory Background

1.1.1 Federal Facilities Compliance Agreement

The sewage lagoons are a series of surface impoundments in Holloman AFB's wastewater treatment facility. These units are regulated as hazardous waste management units (HWMUs) under the Resource Conservation and Recovery Act (RCRA) because of past waste management practices and suspected discharges of listed hazardous wastes into the wastewater treatment system. In 1988, a Federal Facilities Compliance Agreement (FFCA) was signed by the U.S. Environmental Protection Agency (EPA) Region VI, Holloman AFB, and the New Mexico Environment Department (NMED) to resolve issues raised in two Notices of Noncompliance filed by EPA Region VI on 23 August 1985 and 4 February 1987. The notices cited violations of the Base under RCRA for failing to install a groundwater monitoring system. To satisfy the requirements of Part IX of the FFCA, a RCRA groundwater monitoring program was initiated at the sewage lagoons in 1989, in accordance with 40 CFR Part 265, Subpart F. The purpose of the groundwater monitoring program was to determine the nature and downgradient extent of hazardous waste constituents in the shallow aquifer at the wastewater treatment facility. A historical summary of the groundwater monitoring program prior to this plan is provided in Figure 1-2.

The results of the most recent investigation are contained in the *Phase I Groundwater Assessment Monitoring Report* (Radian, 1993). As documented in that study, the nature and extent of contamination in the shallow aquifer have been adequately defined; therefore, the Base is within compliance and now wishes to eliminate Part IX of the FFCA. If permission is granted by NMED, groundwater monitoring at the sewage lagoons will continue in accordance with 40 CFR Part 264, Subpart F, as outlined in this LTM plan.

1.2 Technical Approach

The purpose of this LTM plan is to outline the long-term groundwater monitoring requirements of the sewage lagoons.

Using infomation gathered during previous site investigations at the sewage lagoons, Holloman AFB has developed an overall technical approach for future groundwater monitoring. To maintain consistency with the regulatory programs under which these units are currently managed, the LTM plan has been designed in accordance with 40 CFR 264, Subpart F.

A consistent procedure for evaluating the units will be used to determine whether hazardous waste constituents (i.e., organo-chlorine pesticides and metals) known to exist in the groundwater downgradient of the sewage lagoons will increase to levels that may pose a risk to human health or the environment. The overall goals of the LTM program, as well as the specific strategies and actions necessary to achieve these goals, are presented in Figure 1-3.

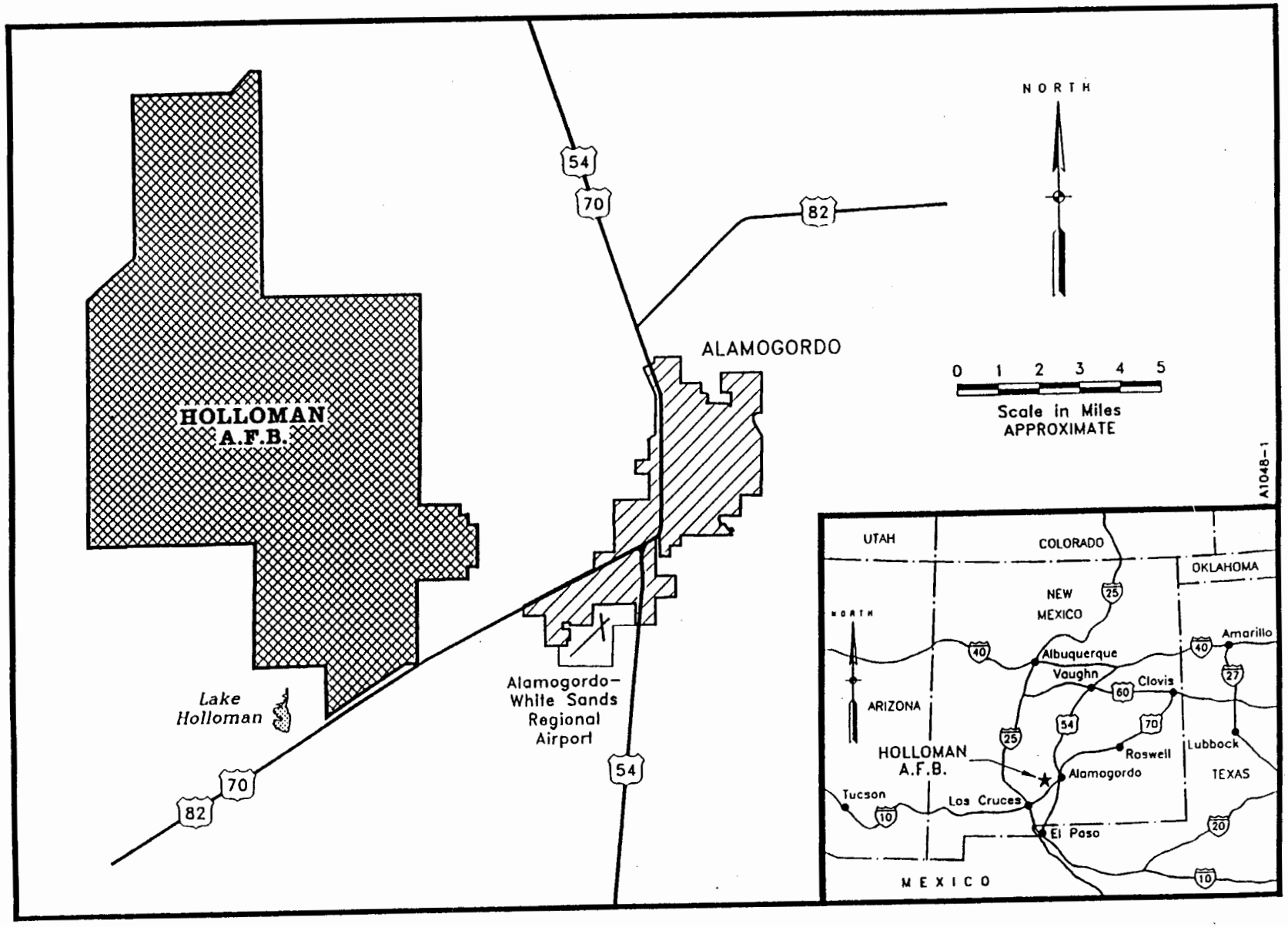

Figure 1-1. Location of Holloman AFB and Layout of Sewage Lagoons

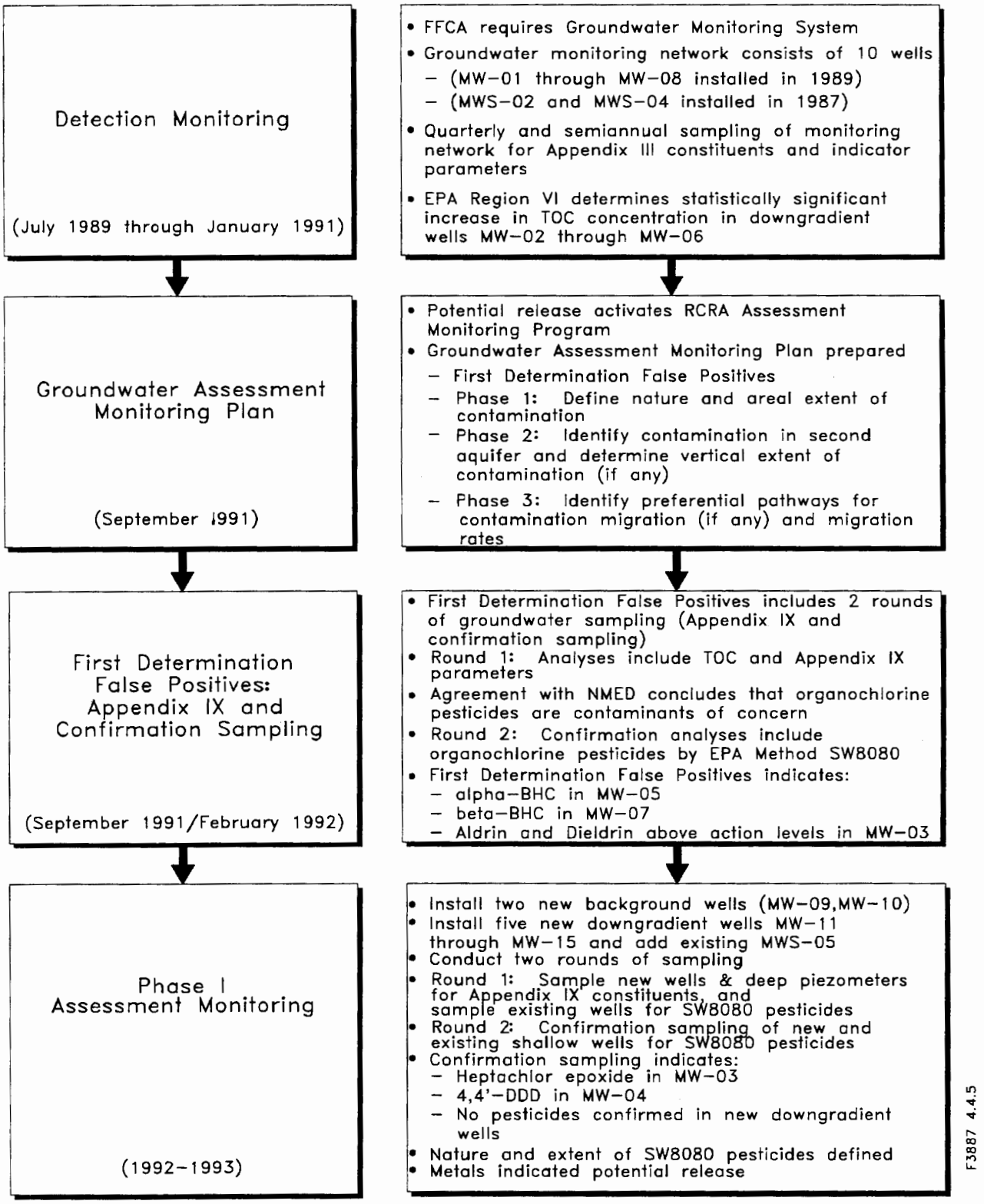

Figure 1-2. Historical Summary of Groundwater Monitoring Program for the Sewage Lagoons

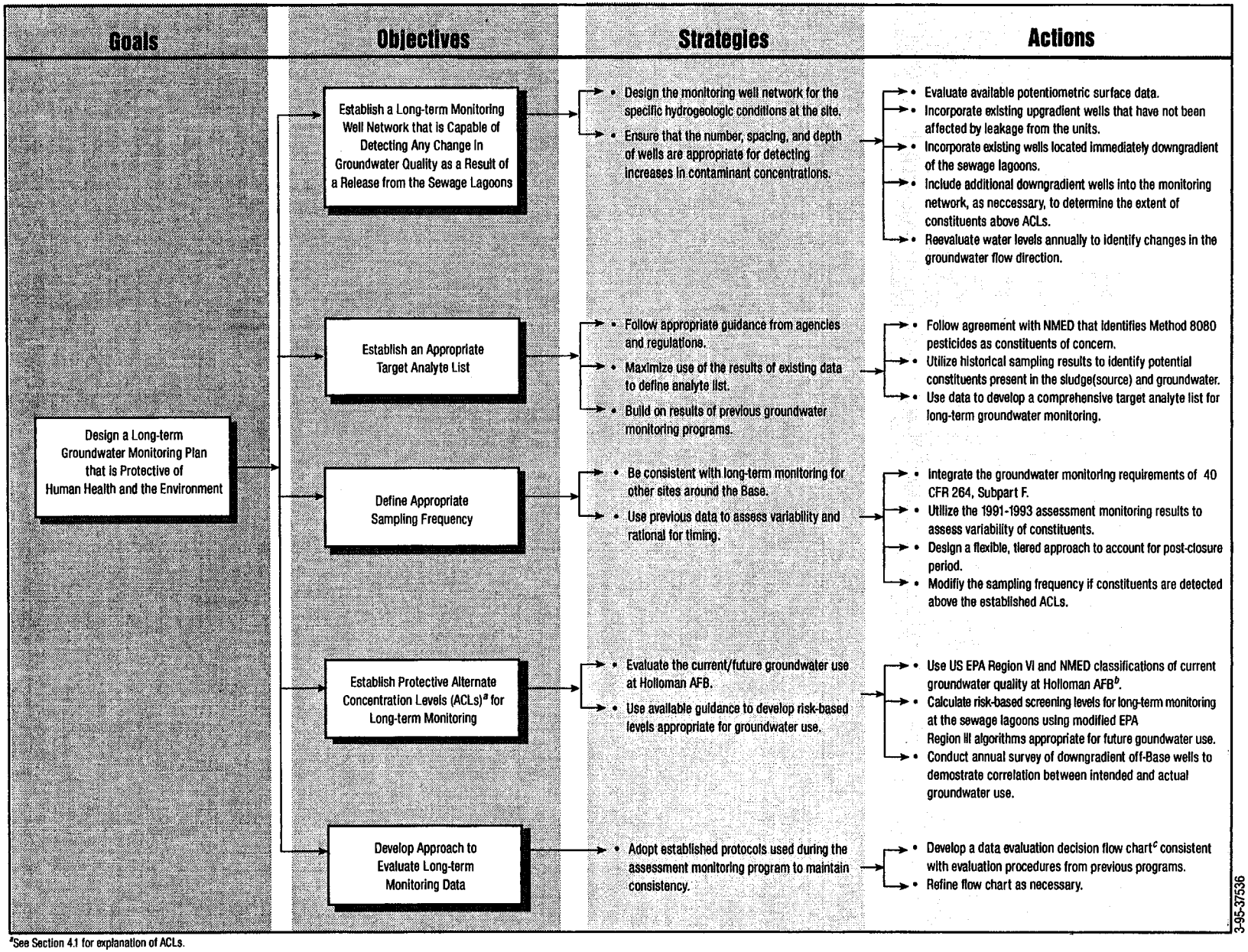

Figure 1-3. Objectives, Strategies, and Actions for the Long-term Monitoring Program

[a]See Section 4.1 for explanation of ACLs.

[b]*Guidelines for Groundwater Classification Under the EPA Groundwater Protection Strategy (U.S. EPA, 1986); New Mexico Water Quality Control Commision Regulations* (NM WQCC 82-1, as amended through August 18, 1991, Parts 3-100 through 3-103)

[c]The decision flowchart is shown on Figure 4-2.

1.3 Data Quality Objectives

Data quality objectives (DQOs) are statements that define the type, quantity, and quality of data necessary to address a problem before a study begins. DQOs have been established for the LTM program to ensure that sufficient data are available for decision makers to resolve project objectives. The decision maker for sewage lagoons is NMED.

EPA has published a seven-step process to DQO development as guidance. These seven steps have been designed to allow decision makers to define the data requirements and acceptable levels of decision errors during planning, before data are collected. The DQO process is iterative, that is, outputs from one step may affect previous steps. This process ultimately leads to a more efficient data sampling program design.

DQOs for the LTM program are presented in Figure 1-4. The DQOs have been integrated into a consistent LTM approach to achieve the requirements of 40 CFR 264, Subpart F.

1.4 Use of This LTM Plan

In addition to the introduction, this LTM plan contains the following sections:

- Section 2 presents information about the geology, hydrogeology, and groundwater quality in the vicinity of the sewage lagoons. This information is fundamental to the technical development of the LTM program and the identification of likely contaminant pathways necessary for tracking and characterizing plume movement.
- Section 3 provides a detailed description of the sampling locations, parameters, and frequency, as well as the standard operating procedures (SOPs) for collecting samples.
- Section 4 contains the methods and procedures that will be used to evaluate and document the results of groundwater sampling data collected during the LTM field investigations.
- Section 5 provides a practical understanding of data management issues specific to this LTM program.
- Section 6 presents a general schedule for implementation of this LTM plan.
- Section 7 is designed to maintain new figures, tables, and other revisions to this LTM plan that may become necessary in the future as a result of required modifications to the LTM program.
- Section 8 contains a list of references cited in this LTM plan.

Also included in this LTM plan are standard operating procedures (Appendix A), a quality assurance project plan (Appendix B), monitor well competion diagrams (Appendix C), agency correspondence (Appendix D), and chemical specific values used to calculate the ACLs (Appendix E).

Step 1. State the Problem to be Resolved

Design a LTM system that is protective of human health and the environment and that integrates the requirements of 40 CFR 264, Subpart F and the RCRA corrective action program.

Step 2. Identify the Decision

Evaluate whether organochlorine pesticides and metals exceed the established ACLs for groundwater at the sewage lagoons and Lakes Holloman and Stinky.

Step 3. Identify the Inputs to the Decision

Scheduled long-term groundwater sampling investigations will determine whether organchloride pesticides and/or metals concentrations are above the protective ACL.

Step 4. Define the Boundaries of the Study

Monitor groundwater in the shallow aquifer downgradient of the sewage lagoons and Lakes Holloman and Stinky.

Step 5. Develop a Decision Rule

If none of the sample constituents are detected above the ACL, it will be concluded that no significant risk to human health and the environment is present, and the regularly scheduled LTM program will continue.

Step 6. Specify the Acceptable Uncertainty Limits

a) If any sample constituent is detected above the established ACL during the scheduled sampling event(s) then first determination false positives (FDFP) sampling will be conducted to confirm the results.

b) If any sample constituent(s) exceeded during an initial round of regular sampling is confirmed above the ACL through FDFP sampling, then assessment monitoring will begin immediately to determine the downgradient extent of contamination above the ACL.

Step 7. Optimize the Design for Obtaining the Data

a) Groundwater samples will be collected from existing monitor wells located immediately downgradient and upgradient of the sewage lagoons and Lakes Holloman and Stinky to facilitate a quick and effective detection of a release from either unit.

b) Additional monitor wells will be added to the monitoring network, as appropriate, to determine the downgradient extent of any contaminants detected above the ACLs.

11-94-37536

Figure 1-4. DQOs of the LTM Program

Section 2
ENVIRONMENTAL SETTING

This section presents the current understanding of the geology, hydrogeology, and groundwater quality at the site. Additional information regarding the overall environmental setting (age, structure, and geologic history) at Holloman AFB is contained in the *Hydrogeologic Investigation Report and Groundwater Monitoring Plan* (HIR/GWMP) (Radian, July 1989) and the *Remedial Investigation Report— Investigation, Study and Recommendation for 29 Waste Sites* (Radian, June 1992). The reader is referred to these reports for a more detailed discussion of these topics.

2.1 Geology

The subsurface conditions at the site have been defined by direct sampling and observation of the drilling operations of soil and/or monitor well borings drilled between 1987 and 1993. Figures 2-1 and 2-2 illustrate and describe the general stratigraphy of the site.

The sediments consist of sand, silt, and clay and are subdivided into six very broadly definable units that appear to be fairly continuous across the site (Figure 2-1). The top 2 to 3 ft is either the Holloman-Gypsum Land-Yesum or Mead silty clay loam soil complexes. The soil complexes grade into the upper sand unit, which consists of 6 to 30 ft of sand, silt, or silty sand. Below the upper sand is a fairly continuous upper clay unit that ranges in thickness from 1 to 15 ft. In places, the upper clay unit is not present and the upper sand is interconnected with a middle sand unit that consists of 7 to 15 ft of sand, silt, or silty sand. A continuous middle clay unit underlies the middle sand. The middle clay is reddish brown with abundant gypsum crystals, and ranges from 10 to 40 ft thick. A lower sand unit consisting of interbedded sand, clay, and silt lies beneath the middle clay. This unit is lithologically heterogeneous and ranges from 10 to 20 ft thick.

At three of the six deep boring locations, the lower sand is underlain by a green, stiff plastic clay. The clay was encountered in Borings D-2, D-3, and D-4 at 63, 65, and 53 ft, respectively. This green clay may be present at locations D-1, D-5, and D-6 at elevations below the total depth drilled; however, on the basis of the expected depth of occurrence from the cross sections, it is more likely that the green clay is absent at these locations.

2.2 Hydrology

2.2.1 Surface Water

The wastewater treatment facility consists of seven aeration/evaporation lagoons, which receive approximately 1.2 million gal. of residential and industrial wastewater per day. Wastewater entering the facility flows in parallel into Ponds A or B, then in series through Ponds C, D, E, and G. The discharge from the last impoundment in the series (Pond G) flows via an open ditch to Lakes Holloman and Stinky for eventual evaporation. In addition to the runoff from the sewage lagoons, this ditch receives runoff from the golf course, the flight line approach zone, lawn-irrigation, and the roadside. Water entering the ditch discharges into the lower eastern part of Lake Holloman. During high water conditions, overflow from Lake Holloman discharges into and accumulates in Lake Stinky. All ponds and lakes are unlined and surface water infiltrates into groundwater.

2.2.2 Groundwater

The groundwater elevation was surveyed in March, April, and August 1993 to determine seasonal variation associated with precipitation and

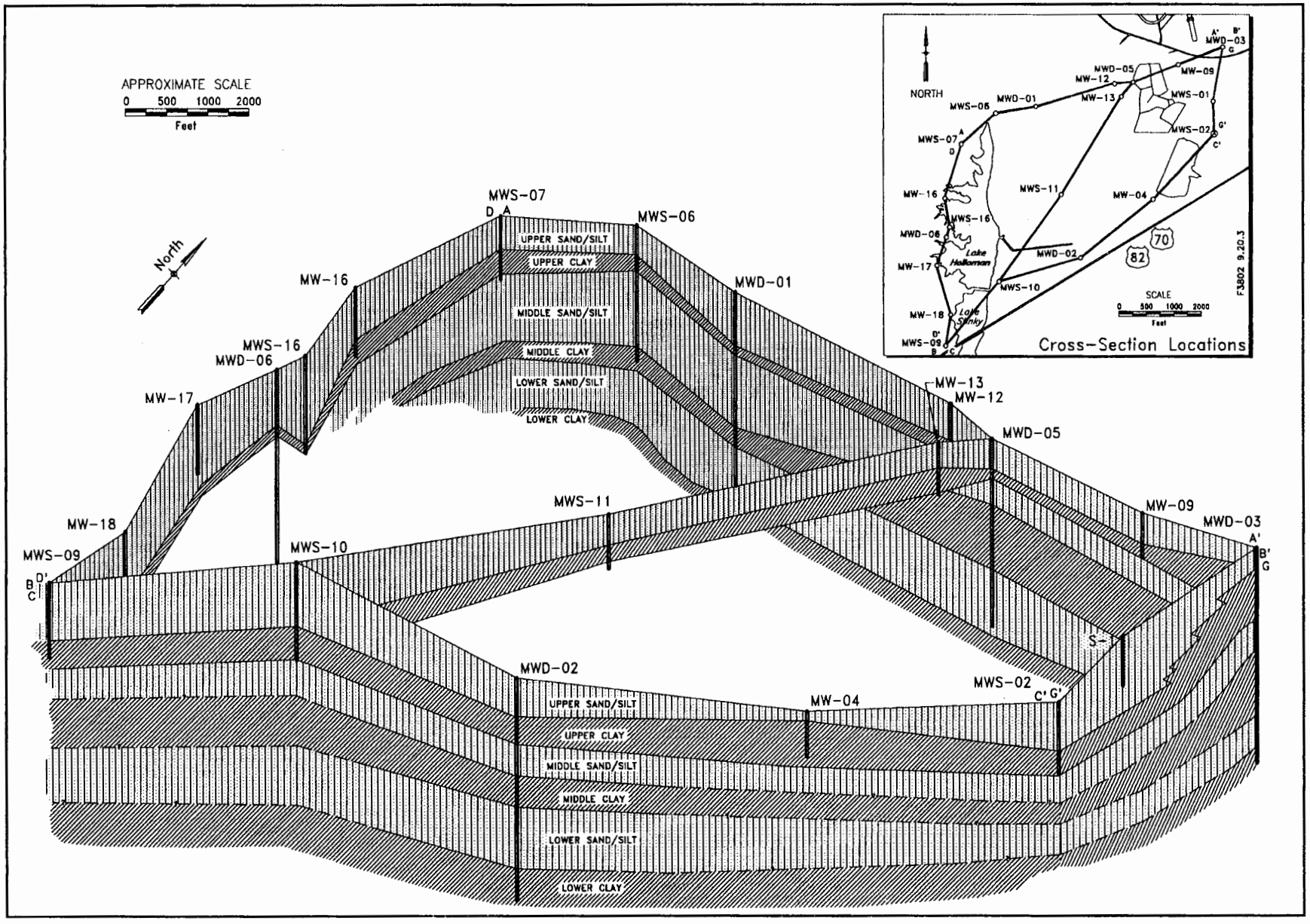

Figure 2-1. Stratigraphic Fence Diagram

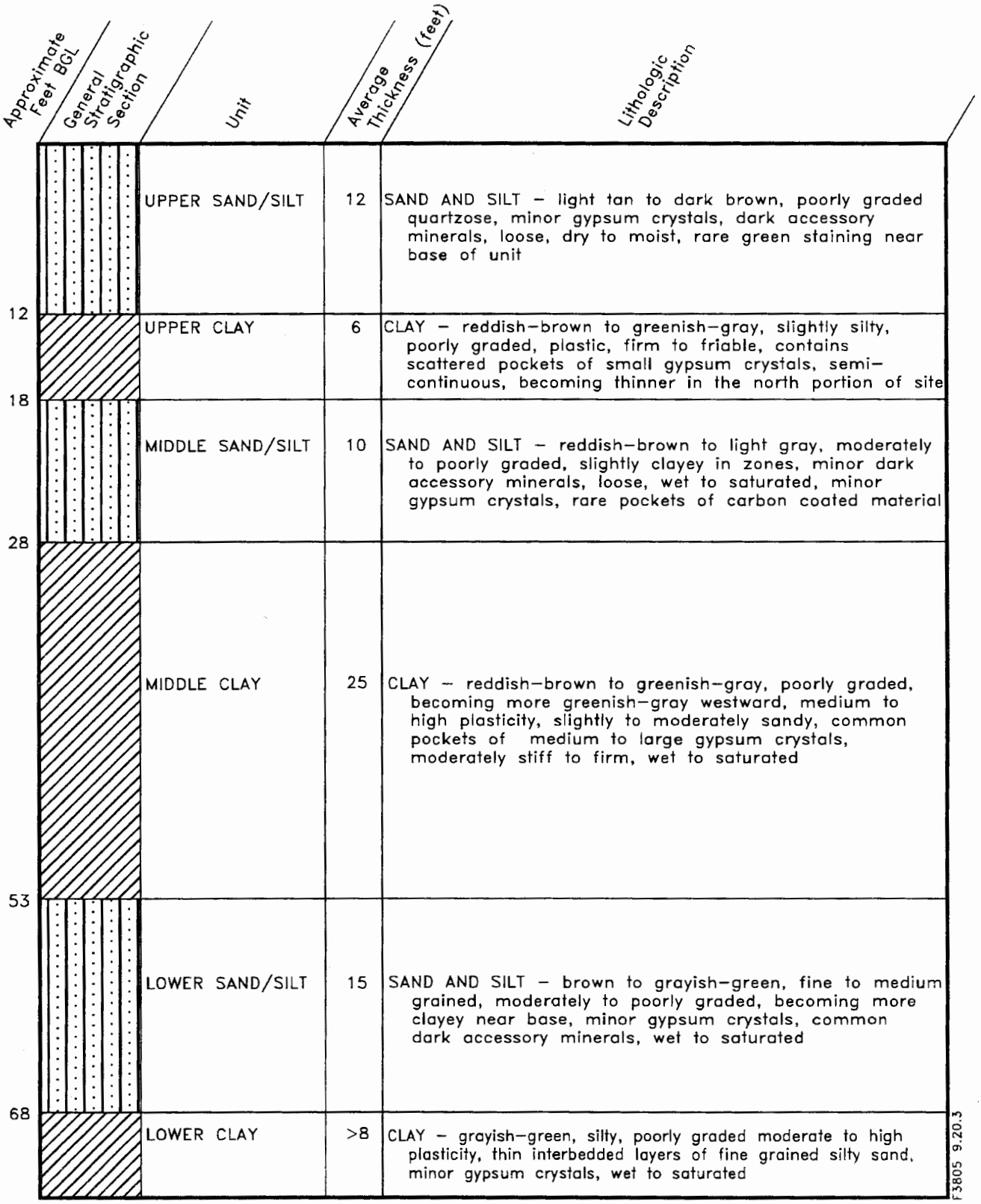

Figure 2-2. Generalized Description of Stratigraphic Section

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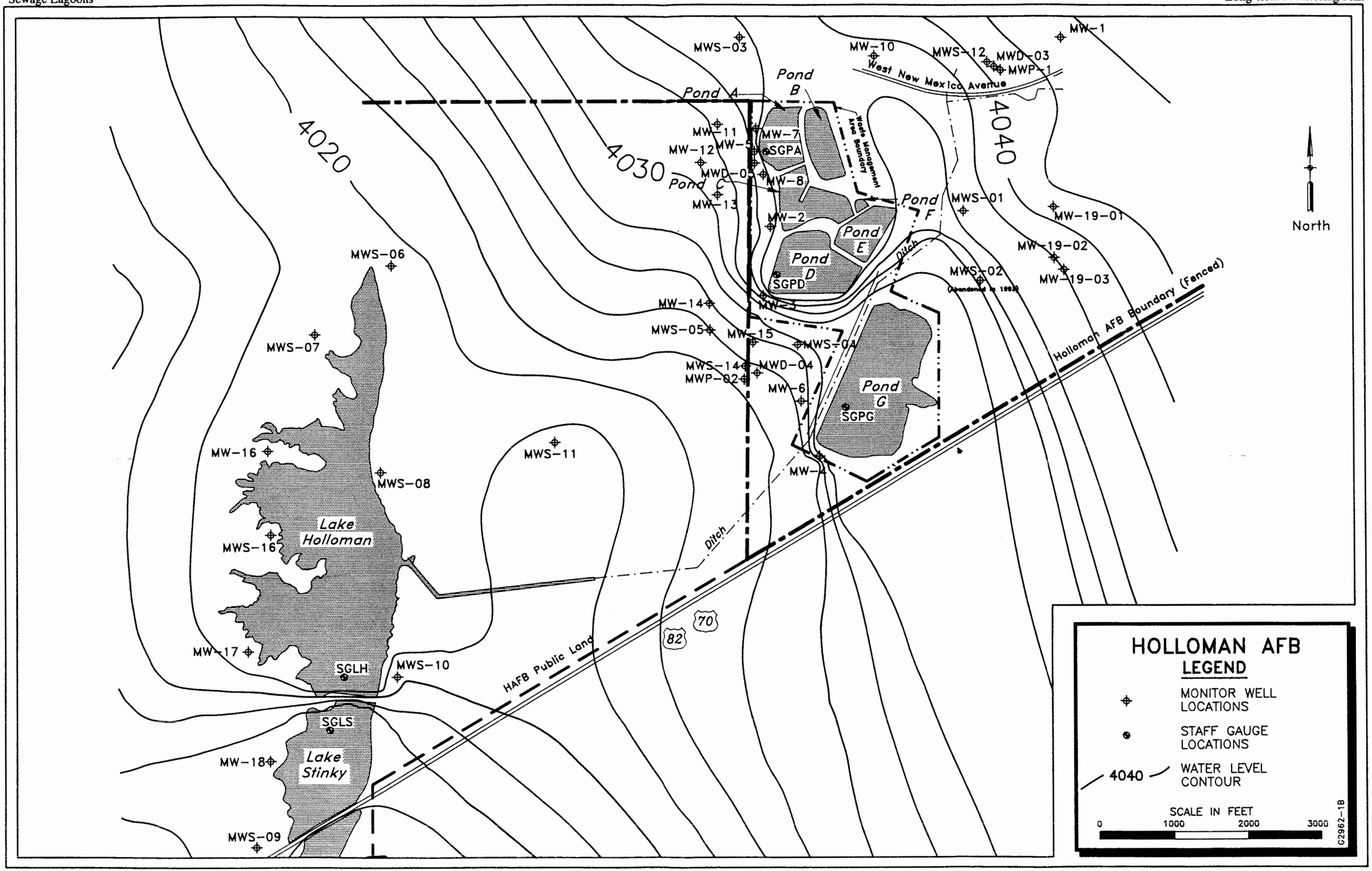


Figure 2-3. Groundwater Contour Map (April 1993)

evaporation rates at Holloman AFB. As part of the survey, surface water elevations were measured in Ponds A, D, and G and in Lakes Holloman and Stinky to provide data necessary to characterize local relationships between surface water and groundwater. Figure 2-3 illustrates the contoured groundwater surface as measured during the April 1993 survey.

In the vicinity of the wastewater treatment facility, the depth to groundwater ranges from 2 ft below ground level (BGL) near the sewage lagoons to 13 ft BGL near Lakes Holloman and Stinky. Under an average hydraulic gradient of 0.3, the groundwater flows consistently from northeast to southwest. However, surface water in the unlined lakes causes groundwater mounding. Immediately to the east of Lakes Holloman and Stinky, groundwater flows toward the southeast, not southwest. Direct evidence of this can be seen by comparing the elevation of surface water during August in Lake Holloman (4018.8 ft msl) with that of groundwater in monitor wells MWS-08 and MWS-11 (4018.33 and 4016.32 ft msl, respectively). There is approximately a 0.5- to 2.5-ft difference in water elevations, indicating water flows away from Lake Holloman toward monitor wells MWS-08 and MWS-11. Figure 2-3 reflects the degree of mounding associated with the ponds.

2.2.3 Aquifer Test Results

Two types of aquifer tests were conducted during the 1987 hydrogeologic investigation (HI) at the Base: slug tests and pump tests. The purpose of aquifer testing was to determine aquifer characteristics such as transmissivity (T), storage coefficient (S), and hydraulic conductivity (K).

From these data, groundwater flow velocity was calculated and the extent of vertical hydraulic communication between the shallow and deeper water-bearing zones was estimated. The information derived from these studies for the saturated zones beneath the sewage treatment lagoons was generally consistent. Aquifer characteristics from monitor wells near the lagoons are summarized below.

- The first affected "aquifer" is composed of saturated sands, silts, and clays, which are hydraulically interconnected.
- There are discontinuous clays separating coarser grained, shallow water-bearing sand and silt units from deeper units of equal or greater grain size.
- The term "aquifer" may be used to describe hundreds of feet of bolson fill sediments beneath Holloman AFB. The basal contact of the bolson is estimated to be the top of Permian bedrock (depth unknown).
- The bolson fill "aquifer" exists under water table conditions in the first saturated shallow zone. However, with increased depth, successive clay and silt units create semiconfining conditions as shown in the response of observation wells S-13 and S-14 during the pump test. Artesian conditions do not exist at the depths investigated.
- Aquifer yield is based solely on the porosity and permeability of the units screened; there are no secondary porosity factors to consider.
- Slug test methods generally revealed high T and S values, possibly due to the interference of the sand pack, and unsaturated portions of the screened interval above the static water level.
- A comparison of T and S calculations from the slug tests and two pump tests are similar. A comparison of the two test methods indicates that the first saturated sand has higher T and S values than deeper saturated units do. The upper sand is a well drained, sandy loam of the Holloman-Gypsum Land-Yesum complex. With increasing depth, the sediments

generally become progressively finer grained.

2.3 Groundwater Quality

Groundwater quality in the Tularosa Basin is potable to the east and west of Holloman AFB near recharge areas, but groundwater becomes progressively more mineralized as it flows downgradient toward the interior of the basin. This decrease in water quality can be attributed to slow groundwater migration from recharge to discharge areas and the presence of readily soluble minerals in the bolson sediments.

The groundwater beneath Holloman AFB is designated as unfit for human consumption based on New Mexico Water Quality Control Commission Regulations (NM WQCC 82-1, as amended through August 18, 1991, Parts 3-100 through 3-103) because it exceeds New Mexico human health standards (HHSs) for total dissolved solids (TDS) and sulfate. Average values of other groundwater quality parameters measured at Holloman AFB (chloride, fluoride, and nitrate-nitrite) also exceed HHSs and, except for fluoride, also exceed federal primary and secondary drinking water maximum contaminant levels (MCLs; SMCLs) (Radian, June 1992). Water quality parameters reflect that the groundwater in this area is not potable.

Although EPA guidelines for groundwater classification are not recognized by the State of New Mexico, EPA guidelines [*Guidelines for Groundwater Classification Under the EPA Groundwater Protection Strategy* (EPA, 1986)] classify the groundwater beneath Holloman AFB as a Class III B aquifer. Class III groundwater, characterized by having a TDS concentration greater than 10,000 mg/L, is not considered a source or a potential source of drinking water. Class III B groundwater is characterized by a low degree of interconnection to adjacent surface waters or groundwater of a higher class. The average-measured TDS value for groundwater is greater than 10,000 mg/L (Radian, June 1992). Because the Tularosa Basin is a closed basin, its groundwater does not discharge or connect to any adjacent aquifers. Adjacent surface waters include groundwater surfacing in Malone Draw and Lake Holloman. The TDS in Lake Holloman range from a winter low of 12,400 mg/L to a summer high of 17,000 mg/L (Cole et al., 1981); therefore, groundwater at Holloman AFB is not interconnected with surface water of a higher class. In this latest investigation, TDS ranged from 11,000 to 12,000 mg/L in Lake Holloman and was 14,000 mg/L in Lake Stinky.

Section 3
SAMPLING AND ANALYSIS PLAN

This section outlines the overall field sampling and analysis plan and provides descriptions of the methods and techniques that will be followed during the LTM program. Detailed SOPs for all tasks necessary to successfully complete the LTM field investigations are provided in Appendix A. These SOPs have been printed on hard stock for easy field use. Specific field quality assurance/quality control (QA/QC) measures that will be implemented during the LTM program to evaluate the reliability of the analytical results are presented in the *Quality Assurance Project Plan* (QAPP) located in Appendix B.

In accordance with EPA guidance on implementing a groundwater detection monitoring investigation, the field program was designed and techniques were chosen with the following criteria in mind:

- Ability to yield representative groundwater samples;
- Compatibility with analytical considerations;
- Minimal waste generation;
- Practicality;
- Simplicity and ease of operation; and
- Safety.

3.1 Description of the LTM Network

The groundwater detection monitoring network has been designed for the specific hydrogeologic conditions at the site and is constructed in accordance with the *RCRA Technical Enforcement Guidance Document* (EPA, 1986) to detect any constituents migrating from the sewage lagoons. The number and placement of the wells are intended to be consistent with the requirements set forth by 40 CFR Section 264.97(a), such that:

- Background wells are not affected by the facility; and
- Hydraulically downgradient wells are capable of immediately detecting an increase in organochlorine pesticides and/or metals that may migrate from the sewage lagoons to the uppermost aquifer.

As shown in Figure 3-1, the LTM network consists of a total of 10 wells: monitor wells MW-01 and MW-10 are located hydraulically upgradient of the units; monitor wells MW-02 through MW-08 and MWS-04 are located immediately downgradient of the sewage lagoons. Because the uppermost water-bearing zone is most susceptible to any contaminants migrating from the units, the LTM monitor wells are all screened at shallow depths (5 to 15 ft bls). Table 3-1 lists the specifications for the LTM network wells. Well completion diagrams for all wells are provided in Appendix C.

Because of the long duration (i.e., 30 years after closure) of the LTM program, future modifications to this LTM network are possible. The need for future changes will be evaluated using the results of analytical sampling data and site-specific hydrogeologic information collected at the site during the regularly scheduled (see Section 3.3) sampling rounds. Section 7 of this LTM plan (Revisions) will be updated, as necessary, to include new site figures and the rationale for changes to the LTM network as the program evolves.

3.2 Analytical Parameters

This section identifies the analytical requirements for the LTM program and describes why these parameters are suitable for determining the presence and concentration of contaminants

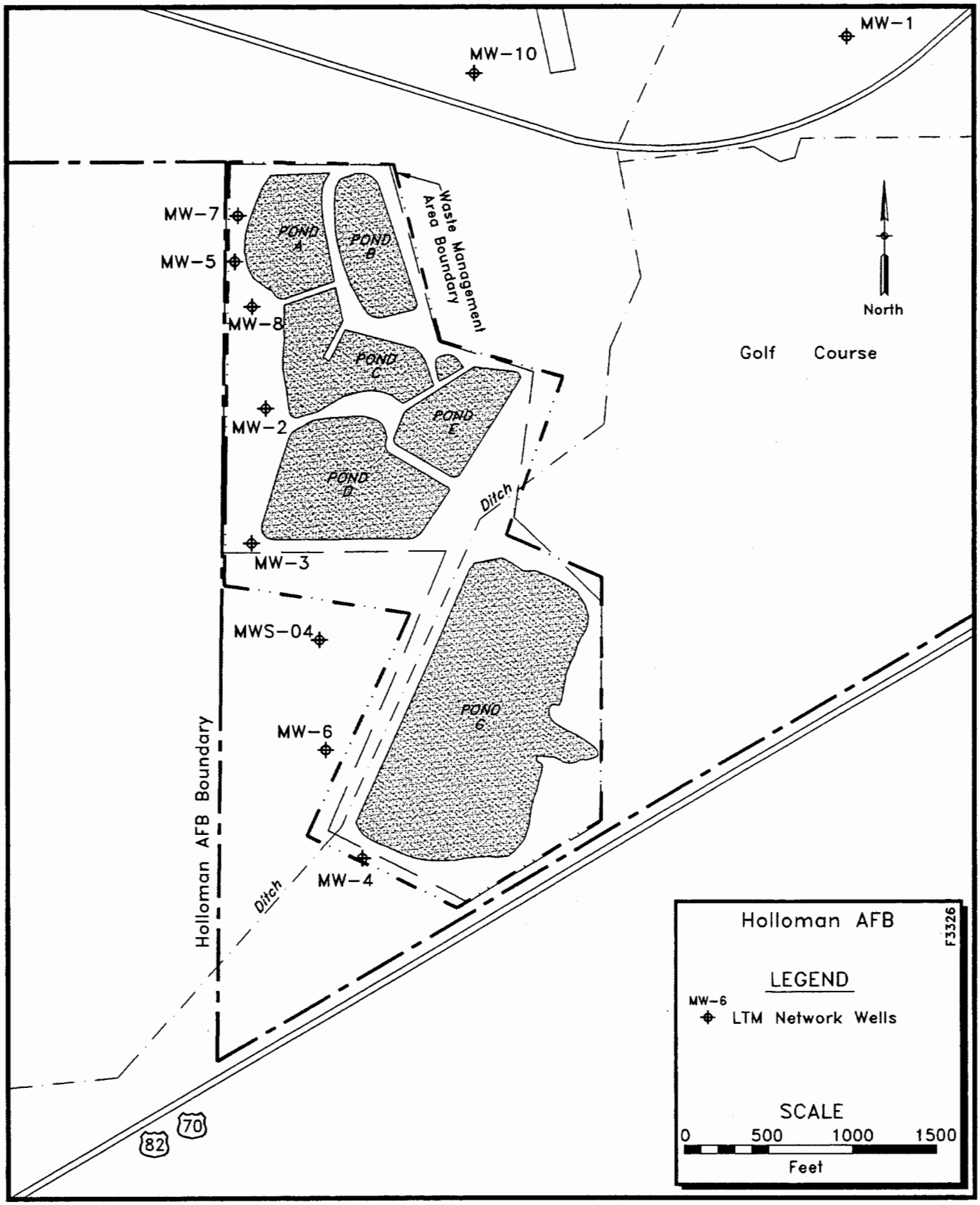


Figure 3-1. LTM Network for the Sewage Treatment Lagoons, Holloman AFB, New Mexico

Table 3-1
Specifications for LTM Network Wells

Well I.D.	Up-gradient	Down-Gradient	NM State Plane Coordinates East;North	Top of Casing Elevation (Ft. MSL)	Concrete Pad Elevation (Ft. MSL)	Total Depth (Ft. bls)	Screened Interval (Ft. bls)	Construction Specifications
MW-0 1	X		548658.60; 666311.53	4053.42	4050.96	14.97	4.90-14.51	4" 316 St. Steel
MW-0 2		X	544566.85; 663814,83	4039.78	4037.45	15.00	4.99-14.54	4" 316 St. Steel
MW-0 3		X	544469.13; 662878.19	4037.38	4035.19	15.01	5.00-14.55	4" 316 St. Steel
MW-0 4		X	545215.83; 660699.42	4030.30	4028.08	15.00	4.99-14.54	4" 316 St. Steel
MW-0 5		X	544358.30; 664830.97	4039.30	4036.96	15.00	4.97-14.54	4" 316 St. Steel
MW-0 6		X	544970.02; 661445.18	4031.21	4028.85	14.99	4.52-14.53	4" 316 St. Steel
MW-0 7		X	544379.85; 665147.61	4039.88	4037.78	15.19	4.72-14.73	4" 316 St. Steel
MW-0 8		X	544474.40; 664520.54	4040.50	4038.20	15.00	4.99-14.54	4" 316 St. Steel
MW-10	X		539545.00 657713.58	4030.00	4027.85	20.00	4.71-14.79	2" Sch. 40 PVC
MWS-04		X	544926.56; 662213.66	4034.46	4031.49	11	6-11	2" Sch. 40 PVC

potentially migrating from the sewage lagoons. Knowledge gained during site-specific investigations at the sewage lagoons between 1988 and 1993 has been used to refine the analytical scope of the LTM program by focusing on those contaminants that are known to exist in the sludge (potential source of contamination) and groundwater.

Site investigations conducted at Ponds A through G (1988-1993) have identified the presence of organochlorine pesticides and metals in the sludge. As discussed in Section 2.3, the ponds are unlined; therefore, leaching of these constituents from the base of these units is believed to be the primary source of constituents present in the groundwater. Results of chemical analyses of groundwater collected during assessment monitoring at the sewage lagoons identified these same constituents at lower concentrations in the groundwater downgradient of the sewage lagoons. Introduction of these contaminants into the sewage lagoons was discontinued in 1985; therefore, it is expected that contaminant concentrations in the groundwater will decrease over time.

A summary of the sampling parameters for the LTM program is presented in Table 3-2. This list of constituents was developed in accordance with 40 CFR Section 264.93 and includes all of the constituents of concern that have previously been detected and confirmed in the potential source and groundwater at the sewage lagoons. These parameters will be analyzed according to methods published in *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*, SW-846 (U.S. EPA, Office of Solid Waste and Emergency Response, November 1986, third edition) (18). For specific sample methods and QA/QC procedures for these constituents, refer to the QAPP located in Appendix B of this plan.

3.3 Sampling Frequency

The sampling frequency and duration established for the LTM program are designed to be consistent with the overall requirements of 40 CFR, Sections 264.96 and 264.97, while also accounting for the variability of analytical results observed during the assessment monitoring program. As required under 40 CFR Sections 264.96 and 264.97, groundwater sampling at the sewage lagoons must be conducted at least annually throughout the active life of the waste management area. Until closure of the units and for a period of four years after closure, the sewage lagoons will be monitored annually after which they will go to a biennial schedule. LTM will continue for a period 30 years after closure. Section 6 provides a detailed schedule.

3.4 Investigation Methods

Specific guidelines have been developed to ensure that the goals of LTM at the sewage lagoons are met. The following sections present an overview of the sampling techniques and outline the procedures for obtaining groundwater samples. For the level of detail necessary to complete the sampling properly, refer to the specific methodologies presented in SOPs A1 through A10, which cover all aspects of sample collection procedures. A list of the SOPs that will be cited in the sections below is presented in Table 3-3.

3.4.1 Groundwater Sampling

Existing wells at the site are equipped with dedicated stainless steel bladder pumps. Groundwater samples will be collected from these wells using the methods and techniques outlined in SOP A1. All sampling equipment must be thoroughly decontaminated to prevent cross-contamination of samples and reduce risk of exposure to potential wastes by the field crew. The sampling equipment will be decontaminated in the field with nonphosphate soap, solvents, and water as specified in SOP A2.

Table 3-2
Summary of Groundwater Sampling and Analysis Requirements

Reference Method	Parameter	Method Type	Container Type, No., and Volume[a]	Preservation and Storage Requirements	Sample Prepartion Procedures	Maximum Holding Time (Preparation)	Maximum Holding Time (Analysis)
SW-846:6010	Sb, Ba, Be, Cd, Co, Cr, Cu, Mn Sn, Zn, Ag, Ni, V	ICPES	(1) 1000 mL polyethylene bottle[b]	pH <2 w/HNO_3	SW-846:3005 HNO_3/HCl digestion	N/S	6 months
SW-846:7060	As	GFAA	(1) 1000mL polyethylene bottle[b]	pH <2 w/HNO_3	SW-846:7060 HNO_3/H_2O_2 digestion and addition of nickel nitrate	N/S	6 months
SW-846:7421	Pb	GFAA	(1) 1000 mL polyethylene bottle[b]	pH <2 w/HNO_3	SW-846:3020 HNO_3 digestion	N/S	6 months
SW-846:7470	Hg	CVAA	(1) 1000 mL polyethylene bottle[b]	pH <2 w/HNO_3	SW-846:7470 Acid digestion	N/S	28 days
SW-846:7740	Se	GFAA	(1) 1000 mL polyethylene bottle[b]	pH <2 w/HNO_3	SW-846:7740 HNO_3/H_2O_2 digestion and addition of nickel nitrate	N/S	6 months
SW-846:7841	Tl	GFAA	(1) 1000 mL polyethylene bottle[b]	pH <2 w/HNO_3	SW-846:3020 HNO_3 digestion	N/S	6 months
SW-846:8080	Organochlorine Pesticides	GC/ECD	(2) 1000 mL amber glass, Teflon-lined cap	Refrigerated at 4°C	SW-846:3510/ 3520 Extraction	14 days	40 days

ICPES = Inductively Coupled Plasma Emission Spectroscopy
GFAA = Graphite Furnace Atomic Absorption
CVAA = Cold Vapor Atomic Absorption
GC/ECD = Gas Chromatography/Electron Capture Detector
N/A = Not applicable
N/S = Not specified

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

[b] One 1000 mL sample will provide sufficient sample volume for all metals and hardness analyses.

NOTE: Total (unfiltered) metals will be collected.

Table 3-3
Standard Operating Procedures

Appendix	Standard Operating Procedure
A1	Groundwater Sampling
A2	Sampling Equipment Decontamination
A3	Documentation, Sample Handling, Chain of Custody, and Shipping
A4	Field Management of Investigation-Derived Waste
A5	Staking, Utility Clearance, and Permitting
A6	Hollow-Stem Auger Drilling
A7	Lithologic Description and Geotechnical Sampling
A8	Monitor Well Installation
A9	Monitor Well Development
A10	Location Surveying

3.4.2 Sample Handling and Packing

Immediately after collection, samples will be cooled in ice chests until they are ready to be analyzed. Samples that are to be sent off Base to a laboratory will be individually placed in sealed plastic bags and packed in an ice-filled cooler. During the packing process, the sample custodian will be in custody of the samples; prior to shipment, chain-of-custody documentation will be completed and the cooler will be closed with signed and dated custody seals. Details of the sample handling, chain-of-custody, and shipping procedures are provided in SOP A3.

3.4.3 Field QA/QC Samples

In addition to the sample handling procedures, field QA/QC will be controlled by compliance with standard sample preservation techniques, sample hold times, and by periodic field QC samples. Preservation requirements and techniques are detailed in SOPs A1 and A3; sample hold times for water samples are listed in SOP A1. Field QA/QC samples, including trip and equipment blanks, as well as duplicates, will be collected. Table 3-4 lists these sample types and their collection frequency.

For work conducted through the Omaha District U.S. Army Corps of Engineers (USACE), all QA samples will be sent to the Missouri River Division (MRD) laboratory. The address for MRD is provided below. Prior to shipping, a laboratory information management system number will be assigned to all QA samples.

CEMRD-ED-LC
USACE—MRD
420 South 18th Street
Omaha, NE 68102
(402) 444-4314

3.4.4 Record Keeping

Accurate and thorough record keeping is essential to all aspects of the field effort. The contractor will maintain field records that will enable the re-creation of all sampling and measurement activities performed during the LTM program. The field team leader, supervisory rig geologist, and field chemist will maintain daily logs during all LTM events in a permanently bound, numbered notebook with sequentially numbered pages. All other loose-leaf documentation will be maintained in a three-ring binder.

All activities conducted during the LTM program will be recorded, including, at a minimum, the location, date and time, identity of people performing the activity, and weather conditions. Notes on all pertinent sampling information and any conditions that may affect the sample integrity will also be recorded as specified in SOP A3.

Table 3-4
Additional Sampling Requirements for QA/QC

Sample Type	Purpose	Frequency
QC Duplicate	Provide a measure of method variability in both sampling and analytical procedures.	10% of all samples sent to the laboratory.
QA Duplicate	Assess method variability between separate analytical laboratories (MRD laboratory, as appropriate).	10% of all samples sent to the laboratory.
QC MS/MSD	Assess the efficiency of extraction, accuracy of the analysis, and possible matrix effects. The MSD assesses the precision at known concentrations.	5% of all samples sent to the laboratory.
QC Equipment Blank	Demonstrate that a nondedicated sampling device has been adequately cleaned.	5% of all samples sent to the laboratory.

During the course of the LTM program, the contractor will store all documentation in a secure, central location.

3.4.5 Management of Investigation-Derived Waste

The investigation-derived waste (IDW) generated as part of the LTM field program is regulated under RCRA as directed in Title 40 of the Code of Federal Regulations (40 CFR), Parts 260-270, Department of Transportation (DOT) regulations (49 CFR Parts 171-179), and the New Mexico Solid Waste Management Regulations. IDW management will follow the guidance established in the *Chemical Data Acquisition Plan (CDAP): Sewage Lagoons and Lakes Investigation* (Radian, 1993). SOP A4 outlines the procedures to be followed for IDW handling, storage, and disposal during the LTM program.

3.5 Additional Monitoring Wells

Should any of the sampling constituents exceed the ACL during regularly scheduled sampling events, additional monitor wells may be installed to determine the downgradient extent of contamination. Prior to beginning drilling operations, obtain clearances from all on-Base and off-Base utilities (see SOP A5).

3.5.1 Hollow-Stem Auger Drilling

Monitor wells will be completed with a hollow-stem auger (HSA) rig equipped with a continuous sampler. With HSA drilling, as the augers are rotated and pressed downward, the cuttings are rotated up the continuous flighting. For monitor well installation, well casing is installed through the augers after the drill sting is raised. SOP A6 presents a detailed description of the HSA drilling technique.

3.5.2 Geologic Standards

To achieve a consistent and accurate description of soils at each site, the unconsolidated material retrieved from each borehole will be classified and described following the Unified Soil Classification System with a Munsell color chart. At minimum, a section of soil will be logged once for every 5-ft interval of depth. Visible contamination, as evidenced by dark staining and/or oily texture, will be highlighted in the comments section of the logging forms.

To obtain more accurate characterization of soils within the screened interval, one geotechnical sample will be taken from within the 10-ft interval through which the well will be screened. Each sample will be analyzed for grain size distribution (ASTM D421 and ASTM D422). The procedure for logging soil and collecting geotechnical samples, along with an example of the logging form, is presented in SOP A7.

3.5.3 Monitor Well Installation

All monitor wells will be constructed in a manner that complies with all applicable federal, state, and local regulations. SOP A8 outlines the methods for monitor well installation.

3.5.4 Monitor Well Development

Groundwater sampling of any new monitoring wells will not commence until a minimum of two days has elapsed since completion of well development (SOP A9), allowing time for stabilization of groundwater conditions in the well.

3.5.5 Surveying

All newly installed monitor well locations will be surveyed by a State of New Mexico registered land surveyor. Surveying requirements are outlined in SOP A10.

Section 4
PROCEDURES FOR EVALUATING LTM DATA

This section contains the methods and procedures that will be used to evaluate and document the results of groundwater sampling data collected during the LTM program. Established protocols used during the assessment monitoring program for the sewage lagoons have been adopted for analysis of the LTM data to maintain consistency and to enable easy transition between these programs should a return to assessment monitoring become necessary. The overall approach to data evaluation is shown in Figure 4-1.

4.1 Alternate Concentration Levels (ACLs)

As discussed in Section 2.3, the groundwater beneath Holloman AFB is designated as unfit for human consumption because it exceeds New Mexico HHSs for TDS and sulfate. In addition to being unfit for human consumption, the groundwater below Holloman AFB does not discharge or connect to any adjacent aquifers and is not interconnected with surface water of a higher class; therefore, as documented in a 1992 letter written to the Base (Appendix D), it is not necessary to remediate groundwater at Holloman AFB unless the groundwater contains dense nonaqueous phase liquids (DNAPLs) or light nonaqueous phase liquids (LNAPLs). In accordance with these conditions, ACLs are proposed for long-term groundwater monitoring at the sewage lagoons.

The ACLs presented in Tables 4-1 and 4-2 are risk-based concentrations assuming dermal contact with the groundwater. The algorithm used to calculate the ACLs is taken from *Risk Assessment Guidance for Superfund* (RAGS), Part A (USEPA, 1989). This algorithm and a description of the default values that were used in the calculations are presented in Table 4-3. It should be noted that the groundwater downgradient from the sewage lagoons within the Base boundary is not intended to be used for either residential, commercial, or industrial purposes. The naturally occurring high TDS and sulfate concentrations make it unsuitable for use.

Future groundwater conditions are not anticipated to change and it is highly unlikely that the groundwater will ever be used as a source of drinking water. However, beginning with the first annual groundwater sampling event, an off-Base well survey will be conducted with the regularly scheduled monitoring events for a distance of 2 miles downgradient of the point of compliance to ensure that the groundwater is not being used for drinking or domestic use.

4.2 First Determination False Positive

During each sampling event, the LTM network wells will be sampled for Method 8080 pesticides and metals, and the analytical results will be evaluated as outlined in Figure 4-1.

Analytical results for the organochlorine pesticide and metal constituents will be compared to the ACLs listed on Tables 4-1 and 4-2, respectively. The presence of any constituent above the ACL during the initial round of sampling will trigger immediate first determination false positive (FDFP) sampling to confirm the results of those parameters detected. If any detected concentration is confirmed above the ACL through FDFP sampling, it will be concluded that a release of hazardous waste and/or hazardous waste constituents above the ACL has occurred from the sewage lagoons and assessment monitoring will begin immediately to identify the nature and extent of the release above the ACL.

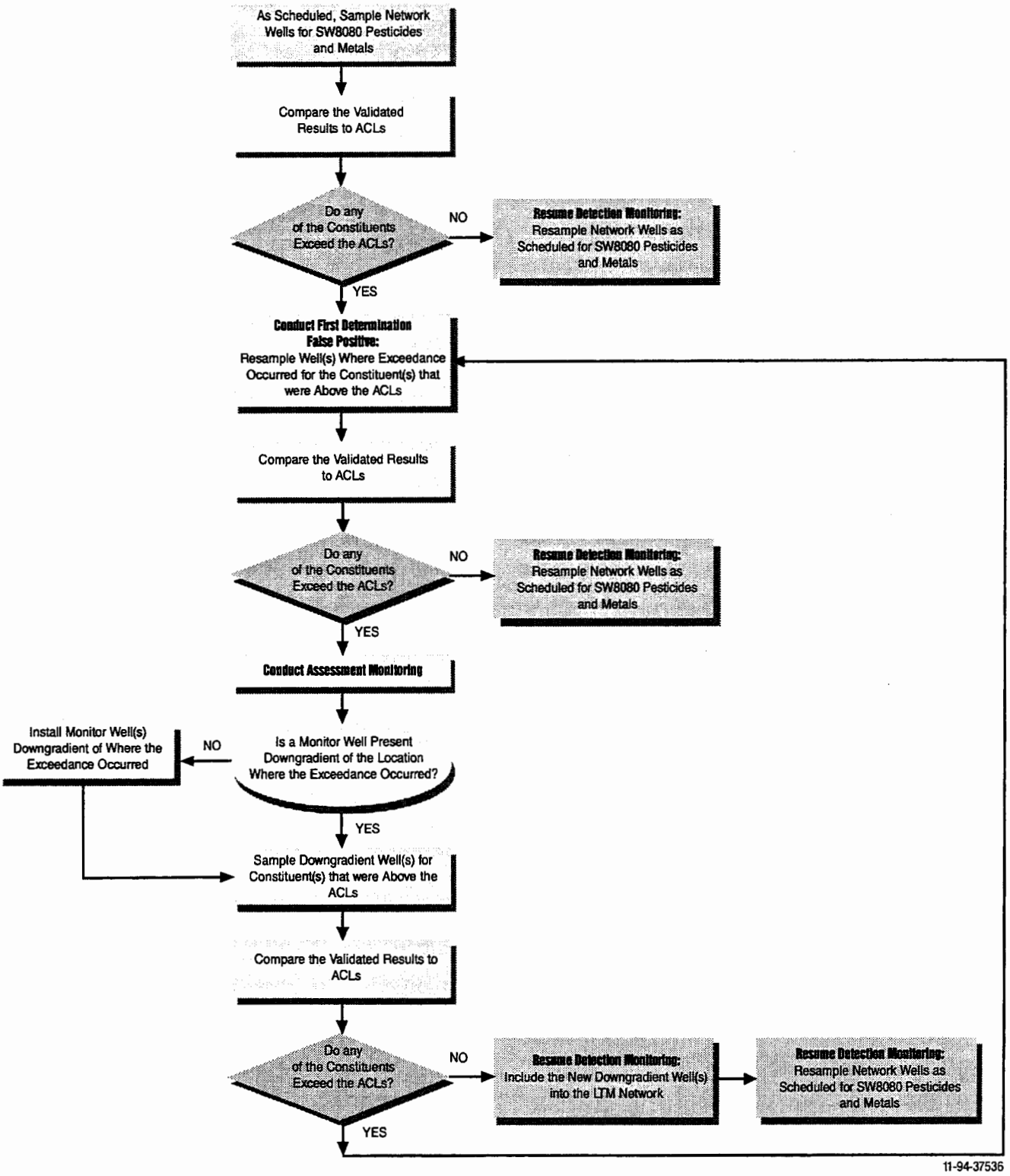


Figure 4-1. Data Evaluation Process

Table 4-1
Summary of ACLs for Organochlorine Pesticides

Chemical Name	ACL (mg/L)
4,4'-DDD	0.03
4,4'-DDE	0.02
4,4'-DDT	0.01
Aldrin	0.05
Chlordane	0.04
Dieldrin	0.006
Endosulfan I	232
Endosulfan II	226
Endosulfan sulfate	16
Endrin	1
Endrin aldehyde	0.02
Heptachlor	0.04
Heptachlor epoxide	0.02
Methoxychlor	15
Toxaphene	0.12
alpha-BHC	0.02
beta-BHC	0.07
delta-BHC	1.64
gamma-BHC	0.35

Table 4-2
Summary of ACLs for Metals

Chemical Name	ACL (mg/L)
SW6010	
Antimony	2
Barium	6720
Beryllium	0.43
Cadmium (water)	3
Chromium	2580
Cobalt	310
Copper	191
Manganese	26
Nickel	258
Silver	26
Tin	3100
Vanadium	36
Zinc	2480
SW7060	
Arsenic	1
SW7421	
Lead	ND[a]
SW7470	
Mercury	2
SW7740	
Selenium	26
SW7841	
Thallium	8

[a] No dermal value for lead calculated. Lead poses no toxicity risk from dermal exposure due to its extremely low permeability coefficient.

Table 4-3
Risk-Based Screening Algorithm for Industrial Water

***Carcinogen:**

$$C\ (mg/L) = \frac{Risk \times BWa \times 365\ days/yr \times ATc \times 1000\ cm^3/L}{EF \times EDa \times (SFo/ABS) \times PC \times SA \times ET}$$

***Noncarcinogen:**

$$C\ (mg/L) = \frac{HQ \times BWa \times 365\ days/yr \times ATn \times 1000\ cm^3/L\ RfDo \times ABS}{PC \times SA \times EF \times EDa \times ET}$$

Exposure Variables		Definitions (units)	Assumptions
Risk	=	Target Cancer Risk (unitless)	10^{-5}
ATc	=	Averagaging Time Carcinogens (y)	70
EF	=	Exposure frequency (d/y)	250
SF(o)[b]	=	Chemical-Specific Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	--
HQ	=	Target Hazard Quotient (unitless)	1
BWa	=	Body Weight, Adult (kg)	70
ATn	=	Averaging Time Non-carcinogens (y)	25
EDa	=	Exposure Duration, Adult (y)	25
RfDo[b]	=	Reference Dose Oral (mg/kg/d)	--
ABS[b]	=	Absorption Factor (unitless)	--
PC[b]	=	Permeability Coefficient (cm/hour)	--
SA[c]	=	Surface Area Exposed (cm^2)	1980
ET	=	Exposure Time (hours/day)	0.5

[a] Equations are based on adult exposure only.
[b] Chemical specific values for these parameters are presented in Appendix E.
[c] Assumes dermal contact of the hands, face, and forearms.

Source: *Risk Assessment Guidance for Superfund* (RAGS), Part A (USEPA, 1989).

If no constituent(s) is confirmed above the ACL through FDFP sampling, it will be concluded that no release has occurred and detection monitoring will resume as outlined in Section 3 of this plan. If the data support a return to detection monitoring, the basis for this determination will be completely documented. A discussion of the possible reason(s) the false positive determination may have occurred, as well as approaches to prevent or reduce the likelihood of future false positive, will be included.

4.3 Assessment Monitoring

Confirmation of a release of hazardous waste and/or hazardous waste constituents from the sewage lagoons as described above will immediately trigger assessment monitoring to define the downgradient extent of the release. The well(s) located immediately downgradient of the location(s) where the release occurred will be sampled for those constituents that were above the ACLs. If no well is present downgradient of the location where the release occurred, one will be installed and sampled. Guidance for the proper number and placement of additional wells is provided in the *RCRA Groundwater Monitoring Technical Enforcement Guidance Document* (USEPA, 1986). Refer to SOP A8 for the methods and techniques to be used to install and complete new monitoring wells.

Once in place, the downgradient well(s) will be sampled for those constituents that were detected and confirmed above the ACL. The analytical results will be compared to the ACL presented in Tables 4-1 and 4-2. The presence of any organochlorine pesticide or metal constituent(s) above the ACL during the initial round of sampling will immediately trigger FDFP sampling to confirm the results of those constituents detected. If any constituent confirmed above the ACL through FDFP sampling, additional monitoring wells will be installed in the downgradient direction until the extent of contamination above the ACL is defined.

If no constituent(s) is detected and confirmed above the ACL during FDFP sampling, the downgradient well(s) will be included in the LTM network and detection monitoring will resume; all network wells will be resampled as scheduled for method 8080 pesticides and metals.

4.4 Data Reporting

A sampling summary technical memorandum will be prepared and submitted to the regulatory agencies following completion of each regular sampling event to document the results and conclusions of the sampling event. A detailed description of the reporting requirements is presented in SOP A3.

Section 5
DATA MANAGEMENT

This section of the LTM plan provides a comprehensive guide for the management of all data generated during the LTM program. This includes not only analytical data but also field notebooks, project files, and progress reports. This section will ensure that data collected will be properly handled and documented for future use. The contractor will use a field notebook, soil boring logs, sample custody forms, sample labels, sample inventories, and laboratory log books to track and document project data. The contractor will establish a data management plan to meet all data deliverables, which will include the requirements of the Installation Restoration Program Information Management System (IRPIMS).

There are six goals for the data management task:

- To archive project data and procedures in order to substantiate conclusions and recommend the LTM program;
- To provide timely access to an organized body of data in order to facilitate analysis and decision making throughout the investigation;
- To provide a useful centralized index of project information;
- To present project information in tabular and graphic form;
- To communicate data to the U.S. Air Force electronically; and
- To provide convenient and efficient access to project data for future components of the LTM program.

The data management process discussed below addresses data and reporting requirements of the LTM program. The data management system implemented by the contractor will be capable of accurately and quickly tracking all pertinent information associated with the LTM program. In particular, once the contractor receives the laboratory results and performs necessary data loading and data validation procedures, the Base will be notified within five working days with the intial results.

5.1 Field Data Record

A bound numbered field notebook will be used to permanently record all field activities and general observations. Section 3 of the LTM plan identifies groundwater sample locations and sample depths.

All pages of the field notebook will be signed and dated by the supervising field geologist who is entering the data. Also, the names and affiliations of all visitors on site will be entered in the notebook, as well as general notes on project progress, problems encountered, deviations from plans (with rationale), and so forth.

Chain-of-custody documentation will also be completed to document the chain of possession and track the samples throughout shipping, handling, and analysis.

5.2 Field Data

Field data will include the data record (log books, etc.), results of field analysis, and survey results. Field analysis data (including results, duplicates, blanks, standards, etc.) should be recorded in a lab log book (similar to the field notebook). The contractor should organize these data so that they can be easily integrated into the electronic data management system (EDMS). The contractor should create the EDMS such that all spatial data (i.e., survey data and boring logs) can be incorporated and used easily.

The contractor will maintain field records sufficient to recreate all sampling and measurement activities and, at a minimum, the contractor will keep information for the field program as specified in the IRPIMS data loading handbook. In addition, the contractor will prepare the analytical data informal technical information reports as described in Section 4.2.2 of the IRP handbook.

5.3 Laboratory Data

The laboratory will maintain logs (hardcopy and electronic) that will be used to permanently record all laboratory data, including sample IDs, analytical results, detection limits, analytical methods, and other related data. Both electronic and hardcopy logs will be required as part of routine data transfer. At a minimum, the contractor will record the information that is required to be included in the IRPIMS data files, as specified in the IRPIMS data loading handbook. In addition, the contractor will provide USACE with copies of the laboratory data packages for QA/QC evaluation.

5.4 Project File

The contractor will maintain a project file at a single location in which copies of all project data and written communications are stored. Contents of the project file will include progress reports, field data, laboratory data, copies of maps, and all other facility description data. Copies of these data shall also be provided to the Base environmental coordinator (BEC) as required. The EDMS will be considered a component of the project file but will not preclude the need to keep all original hardcopy data in the project file.

The BEC will maintain a project file at Holloman AFB that contains all information and data reports regarding the LTM program. The contractor will provide the Base with copies of all files and documents discussed below. A subject file index will be maintained such that documents in the file can be found easily. The project file will be maintained for a minimum of five years after the completion of the LTM program.

5.5 IRPIMS Reporting

During the LTM program, all data will be organized and reported according to the IRPIMS requirements contained in the IRPIMS data loading handbook. The data collected will be submitted by the contractor to the Air Force Center for Environmental Excellence (AFCEE) for IRPIMS data loading.

5.6 Annual LTM Reports

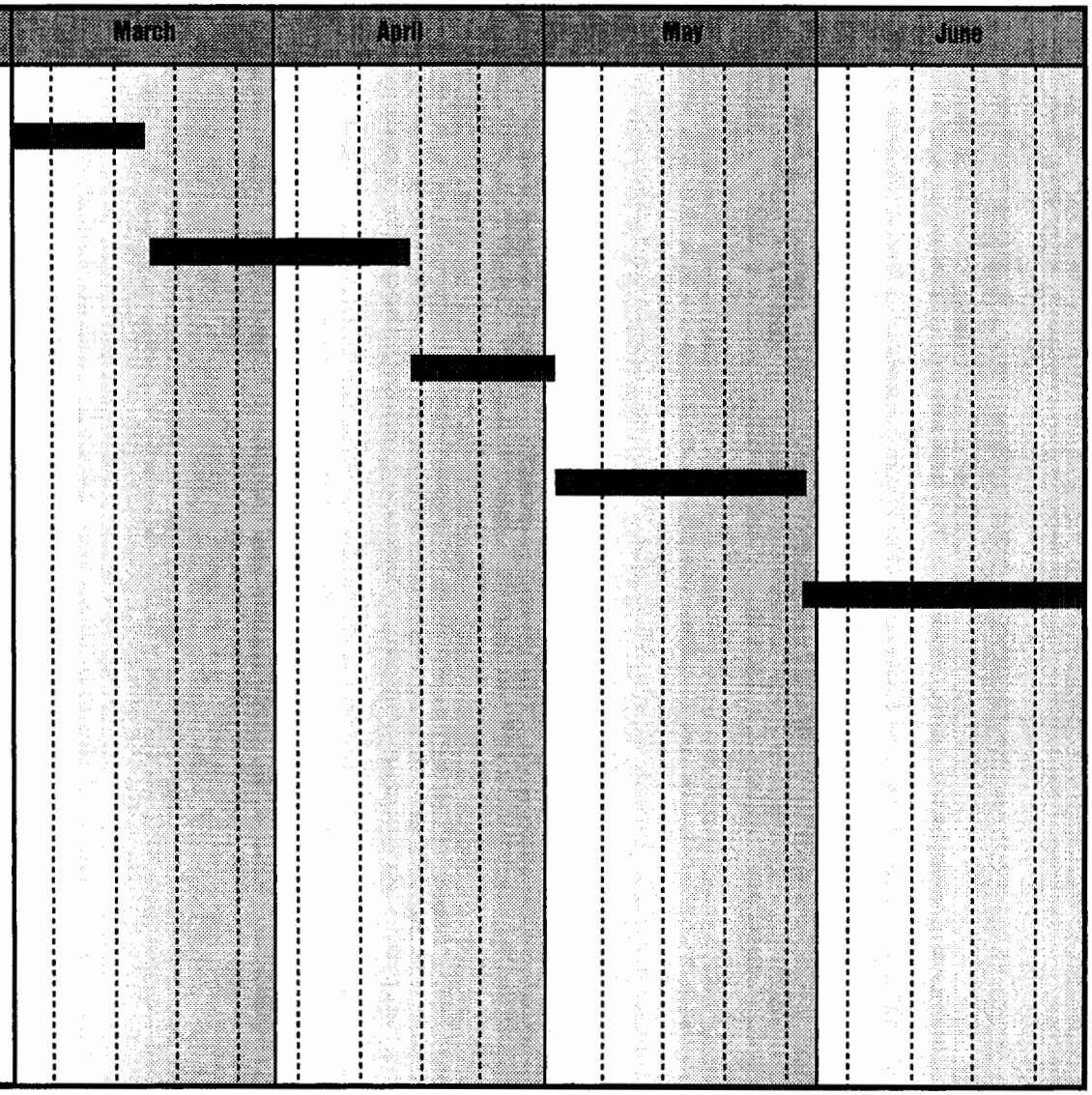
Data gathered during the LTM should be organized in tabular and graphical representations by the EDMS to allow for and to illustrate conclusions. Information gathered during LTM activities as to the nature and extent of any potential releases from the sewage lagoons will be included in the annual reports.

Section 6
LTM SCHEDULE

A sampling event schedule for the implementation of the LTM plan is presented in Figure 6-1. As shown, the duration of each scheduled sampling event includes collection and analysis of groundwater samples, validation of results, preparation of the technical memorandum, and review and approval by the regulatory agencies. This level of effort assumes that none of the constituents will exceed the ACL. Should any of the constituents be detected above the established ACL and require additional field work to either confirm the results or sample downgradient wells to define the extent of a potential release, the schedule will be modified, as appropriate. Table 6-1 illustrates the proposed schedule for the sewage lagoons.

As acknowledged by EPA (RCRA TEGD, 1986), estimating the duration of a program beyond the initial phase of sampling cannot be done with a high degree of certainty because the scope of each subsequent event is dependent on the results of the preceding phase(s). It is estimated, however, that additional time would be required for each additional phase of sampling that may be required to confirm the initial sampling results through FDFP sampling or to define the nature and extent of a potential release through assessment monitoring. A schedule for this additional time will be proposed at the point when an ACL is exceeded. Modifications to the schedule should be addressed in Section 7.

Activity	Start Date	End Date
Sample Collection	1 March	15 March
Receive Analytical Results	15 March	15 April
Validate Analytical Results	15 April	1 May
Prepare Technical Memorandum	1 May	30 May
Review/Approval by Agencies	30 May	30 June



11-94-37536

Figure 6-1. Proposed Schedule for Sampling Events

Table 6-1
Scheduled Sampling Rounds

Year	Sampling Round, Sewage Lagoons
1995	1
1996	2
1997[a]	3
1998	4
1999	5
2000	6
2001	7
2003	8
2005	9
2007	10
2009	11
2011	12
2013	13
2015	14
2017	15
2019	16
2021	17
2023	18
2025	19
2027	20

[a] It is estimated that the sewage lagoons will be closed in 1997. 1998 will commence the post-closure sampling period proposed to last for 30 years.

Section 7
REVISIONS

This section has been designed to serve as a data bank for new site figures, tables, and other revisions that are required to complete the LTM program as it evolves. Through a quick review of this section, the changing personnel involved in the LTM program (over time) will be able to obtain a chronological summary of the events leading up to the current date and the changes that have occurred throughout the course of the LTM program. As part of the reporting procedures, the contractor in charge of sampling shall be required to complete and update Table 7-1 to provide a continuous summary of the results of the LTM event and modifications to the LTM plan (i.e., LTM network, sampling parameters or frequencies, changes in regulatory status) for the sewage lagoons. This will serve to provide an accurate and complete record of the LTM program as it evolves.

Table 7-1
Summary of Results, Sewage Lagoons

Sampling Round (Year)	Date	Contractor	Results	Location of Applicable Materials
Example	1995	Radian Corporation 8501 N. Mopac Austin, TX 78720 (512) 454-4797 Contact: David Robbins	No constituents detected above the ACLs. No changes to the LTM plan are needed. Regularly scheduled sampling will be conducted in one year for organochlorine pesticides and metals.	*Sampling Summary Technical Memorandum* (Radian, 1995)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

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APPENDIX A

Standard Operating Procedures for Field Methods

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SOP A1
GROUNDWATER SAMPLING

A1-1.0 OBJECTIVE

This standard operating procedure (SOP) outlines the methods used for conducting groundwater sampling. These procedures will be followed to ensure that samples collected from monitor wells are representative of the groundwater in the formation within which the well is screened. Groundwater sampling of any new monitor wells shall not commence until a minimum of two days has elapsed since completion of well development, allowing time for stabilization of groundwater conditions in the well.

A1-2.0 EQUIPMENT AND MATERIALS

Existing wells at the site are either equipped with dedicated Teflon® and stainless steel bladder pumps. The existing wells and wells that will be installed during the long-term monitoring (LTM) program will be purged and sampled with the dedicated bladder pumps.

Equipment and materials required for groundwater sampling consist of the following:

- Bladder pump with Teflon bladder and stainless steel case;
- Control box;
- Compressed gas source;
- Air lines;
- Portable submersible centrifugal purge pump and discharge hose;
- Electrical source (gasoline-powered portable generator);
- Electric water level meter (E-line);
- pH/temperature/specific conductance/dissolved oxygen/redox potential meter, flow-through cell and calibration standards;
- pH paper;
- Decontamination supplies as specified in SOP A2;
- Sample containers, preservatives, coolers, sample labels, and ice (see Table A-1);
- Field documentation (field log book, groundwater sampling logs, etc.);
- Waste containers as specified in the SOP A4; and
- Health and safety equipment as specified in the health and safety plan (HSP).

A1-3.0 METHODOLOGY

The following procedures are written with separate steps for 1) wells equipped with dedicated bladder pump systems and 2) wells in which dedicated bladder pumps may be installed.

1) Ensure that all equipment is properly calibrated and operated by following the manuals provided by the equipment manufacturer. Record results of the equipment check in the log book.

2) Locate well and record well number, site, date, time, weather conditions, and condition of well completion on the groundwater sampling log (Attachment A1-1) and in the field log book.

3) Open well, noting condition of inner well seal/cap on the groundwater sampling log, and measure depth to water and total well depth with a decontaminated E-line.

4) Calculate total submerged casing volume, using the following formula:

$$V = 3.14\ r^2 L \times 7.48\ \text{gal./ft}^3,$$

where:

V = submerged casing volume;
r = inside radius of casing (ft); and
L = height of water column in well (ft).

Table A-1
Container and Preservation Requirements for Water Samples

Reference Method	Parameter	Container[a]	Preservation	Maximum Holding Time (Preparation)	Maximum Holding Time (Analysis)
SW-846:6010	Sb, Ba, Be, Cd, Cr, Co, Cu, Mn, Ni, Ag, V, Zn, Sn	One 1-L polyethylene bottle	pH<2 with HNO_3, Cool to 4°C (no filter)	N/A	28 days for Hg; 6 months for other metals
SW-846:7060	As				
SW-846:7421	Pb				
SW-846:7470	Hg				
SW-846:7740	Se				
SW-846:7841	Tl				
SW-846:8080	Organochlorine Pesticides	One 1-L amber glass bottle[b]	Cool to 4°C	14 days	40 days

[a]Volume may vary depending on laboratory requirements.
[b] One extra bottle will be collected per sample ID.
N/A = not applicable
NOTE: Metals are Total Metals (unfiltered).

5) Although the dedicated pumps included in each monitoring well are constructed of 316 stainless steel and Teflon, there is a potential for corrosion of the pumps due to the naturally occurring high TDS and sulfate concentrations in the groundwater. Therefore, prior to sampling, the pump in each well will be visually inspected for signs of corrosion and/or other physical deterioration. A photograph will be taken of each pump for documentation. Corroded or damaged pumps should either be repaired on-site with replacement parts supplied by the contractor or replaced wit new pumps of similar construction. In addition to the repair or replacement of pumps, QC equipment blank samples will be collected from a minimum of 10% of the wells sampled to ensure the quality of analytical data.

Steps 6a and 7a apply to wells with existing dedicated bladder pump systems:

6a) Connect air lines from regulated compressed gas source to control box.

7a) Start gasoline-powered air compressor (situate downwind from well head) and start air flow, controlling discharge and refill cycle rate of the bladder with the knobs on the control box. Flow rate can be adjusted with the throttle knob on the control box.

Steps 6b and 7b apply to wells in which dedicated bladder pumps may be installed prior to sampling.

6b) Attach air lines, sample lines, and lifting lines to pump. Lifting lines should bear the weight of the pump with air and sampling lines attached to lifting lines approximately every 10 ft with appropriate devices made of inert materials. All lines and pumps should be thoroughly decontaminated prior to installation.

7b) Lower pump into well to desired level (near top of water column) and fix in place following manufacturer's specifications.

8a and 8b) For dedicated bladder pumps, connect the flow-through cell to the discharge hose. Direct the discharge into the 65-gal. tank located adjacent to the well.

9) Wells should be purged at a low flow rate (approx. 0.25 gal./minute).

10) Measure pH, specific conductance, temperature, dissolved oxygen, and redox potential of the discharge water throughout purging. Measurements should be recorded at an interval sufficient to determine changes in water quality parameters: a maximum of one reading every gallon for wells containing a small volume of water, and a minimum of about five readings per purge. Purging will be complete when these parameters have stabilized to within ±0.10 pH units, 10% change in ms/cm specific conductance, and ±1°C over a successive well volume. A minimum of three wetted borehole volumes will be purged. Record the water quality readings and the volume purged on the groundwater sampling log.

11) Collect one final depth-to-water measurement with the decontaminated E-line to ensure that sufficient water remains in the well to fill all required sample containers.

12) Reduce the pumping rate for sampling. Organochlorine pesticide (SW8080) samples should be collected first, with no headspace remaining in capped bottles.

13) Samples for metals analyses should have the preservatives added to the full sample bottle until the desired pH is reached.

14) Complete the sample labels accurately and legibly and affix to the sample bottles with clear packaging tape. Individual sample bottles will be placed in Ziploc® bags and stored on ice prior to shipping (see SOP A3).

15) Collect and manage all wastes as outlined in SOP A4.

16) Decontaminate all sampling equipment that has touched contaminated water, soil, or wastes (see SOP A2).

A1-4.0 COMMENTS

- Dedicated sampling devices are installed in all wells to minimize the potential for cross-contamination and reduce the need for decontamination.
- If the well should be pumped dry during purging, the sampler will wait until sufficient water has recharged to the well, and then proceed to sample as outlined in this SOP.

IRP GROUNDWATER SAMPLING LOG

SHEET ____ OF ____

PROJECT		SAMPLER	
INSTALLATION ID	***WELL ID***	***LOG DATE***	***LOG TIME***
PERFORMED BY RAD	SATURATED THICKNESS	WELL VOLUME $(\pi(\frac{r}{12})^2 h * 7.48)$	
WATER LEVEL INITIAL FINAL	***TOTAL DEPTH*** INITIAL FINAL	AMOUNT TO PURGE	
PURGE METHOD:			

Time (LOGTIME)	Cum. Volume (gal)	Water Quality				Water Level	Comments
		Temp.	pH	Cond.	Turb.		
Final Measurements							

SAMPLING METHOD					
Sample ID	(MATRIX)	Preservative	Analysis	Sample Type Code (SACode)	Comments

F4062 4.20.4

SOP A2
SAMPLING EQUIPMENT DECONTAMINATION

A2-1.0 OBJECTIVE

Decontamination of boring equipment and sampling tools is performed as a quality assurance (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.

A2-2.0 EQUIPMENT AND MATERIAL NEEDS

Equipment and materials requred to decontaminate sampling equipment consist of the following:

- Soap: Liquinox®, Alconox®, 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 SOP A5;
- A high-pressure, hot water/steam cleaner; and
- Health and safety equipment as outlined in the HSP.

A2-3.0 METHODOLOGY

Small, reusable equipment, including water 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.

A2-3.1 Presampling Decontamination Activities

1) Don the appropriate personal protective equipment (PPE), as specified in the HSP and as required for the specific work area.

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

3) Decontaminate all new equipment or equipment not previously decontaminated before use.

4) 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.

A2-3.2 Decontaminating Sampling Equipment

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

2) Wash equipment with a brush and a phosphate-free detergent solution (Alconox or similar laboratory detergent).

3) Rinse equipment thoroughly with potable water.

4) Rinse with pesticide-grade isopropanol to dissolve and remove coatings of organic contaminants.

5) Double rinse the equipment with reagent- grade water.

6) 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.

7) 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 visqueen can be substituted for the aluminum foil.

A2-3.3 Decontamination of Large Equipment

Drilling equipment (rigs, drill rods, augers, bits, etc.) 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 waste management plan (see SOP 4).

A2-4.0 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 SOP A4 (Field Management of Investigation-Derived Waste).
- 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.

SOP A3
DOCUMENTATION, SAMPLE HANDLING, CHAIN OF CUSTODY, AND SHIPPING

A3-1.0 OBJECTIVE

This SOP contains specific details concerning sample control, documentation, and transportation procedures. Refer to Section 3 of this LTM Plan for information that covers the specific type and number of samples to be collected and the destination of the collected samples. Collection, preservation, and analysis of samples and documentation of data shall be performed as described in other SOPs.

A3-2.0 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 (Attachment A3-1);
- Custody seals;
- Groundwater sample identification labels;
- Groundwater sampling log form; and
- A-E Daily Quality Control Report (DQCR) (Attachment A3-2).

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 Ziploc bags;
- Protective mesh for various sample bottle sizes;
- Absorbent material for packing samples; and
- Ice.

A3-3.0 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 log books, instrument calibration log books, 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 log book, including uncompleted work.

A3-3.1 Sample Control and Documentation

All log books 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 three-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 log book is assigned makes an entry, that person should date and sign the entry. All project log books 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.

The field team leader will complete A-E DQCRs (Attachment A3-2) at the end of each day. The completed reports will be sent weekly to the USACE-PM and the Base Environmental Coordinator.

A3-3.2 Sample Labeling

In addition to the field log book, 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, container, and any special instructions. Labels should be completed with black waterproof ink.

A3-3.3 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:

1) 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;
- Matrix spike/matrix spike duplicate (MS/MSD) analysis;
- Relinquisher's signature, date, and time; and
- Special instructions.

2) 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.

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

4) Ensure that each container has a properly completed label.

5) Place a strip of clear plastic strapping tape over the label and around the sample jar to prevent ink on the label from running.

6) Place a sleeve of Flex Guard Poly mesh around the sample jar(s) to prevent breakage during shipment.

7) Place the sample containers in Ziploc bags. Containers from the same sample location and depth can be placed in the same bag, but separate samples from different sites to prevent cross- contamination.

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

9) 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 placed 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.

10) Place small Ziploc bags of ice among the sample containers to maintain the samples at or below 4°C during transport.

11) Add any needed absorbent to fill all void spaces.

12) Seal the completed chain-of-custody form for the appropriate cooler in a Ziploc 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.

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

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

15) Affix "This Side Up" arrows on two opposing sides of the cooler. No U.S. Department of Transportation (DOT) placards are required.

No DOT or International Air Transport Association (IATA) shipping papers are required. However, if samples are shipped by Federal Express or another overnight carrier, the appropriate airbill must be completed. There are no DOT or IATA restrictions on the mode of transportation.

A3-4.0 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 samples, monitor the temperature with a thermometer and be careful not to freeze water samples.

A-E DAILY QUALITY CONTROL REPORT

DATE:	M	T	W	Th	F	S	Su

COE Project Manager:
Contract Number:
Project:

SUBCONTRACTORS ON SITE:	EQUIPMENT ON SITE:

WORK PERFORMED (INCLUDING SAMPLING):

QUALITY CONTROL ACTIVITIES (INCLUDING CALIBRATIONS):

HEALTH AND SAFETY LEVELS AND ACTIVITIES:

PROBLEMS ENCOUNTERED/CORRECTIVE ACTION TAKEN:

SPECIAL NOTES:

TOMORROW'S EXPECTATIONS:

BY:_____ TITLE: _____

SOP A4
FIELD MANAGEMENT OF INVESTIGATION-DERIVED WASTE (IDW)

A4-1.0 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 LTM field program. IDW management techniques emphasize waste minimization.

A4-2.0 EQUIPMENT AND MATERIALS

Equipment and materials required to manage IDW in the field consist of the following:

- Plastic holding container for purge/development water;
- PPE;
- Waste inventory form (Attachment A4-1);
- Organic vapor meter (OVM);
- DOT-approved drums and containers (if necessary);
- IDW "Analysis Pending" labels (if necessary);
- Indelible marker (i.e., Sharpie);
- Clear adhesive tape;
- Ratchet, socket, and crescent wrench for opening/closing drums (if necessary);
- Plastic buckets for carrying purge water to drums;
- Absorbent pads or booms for cleaning up spills; and
- Wooden pallets.

A4-3.0 METHODOLOGY

Historical data generated from previous groundwater investigations have been used to determine the appropriate fate of the IDW for long-term groundwater monitoring at the sewage lagoons. Both soil and groundwater collected downgradient of the sewage lagoons have been analyzed for Appendix IX parameters. Appendix IX results provide the total concentration of constituents present in the soil or groundwater.

The standard analysis used to determine if soil or water is characteristically hazardous is the Toxicity Characteric Leaching Procedure (TCLP). TCLP measurements represent analyte concentrations expected to leach from soil or water over time. Total concentrations of analytes determined by the Appendix IX methods are always greater than TCLP concentrations of the same analyte. Therefore, Appendix IX parameters provide a conservative screen to estimate TCLP concentrations.

None of the Appendix IX constituents historically detected in soil or groundwater at the sewage lagoons or lakes exceed the toxicity characteristic (TC) for hazardous waste. Therefore, all the soil and groundwater waste that will be derived during the LTM investigations at the sewage lagoons and lakes will be considered nonhazardous.

A4-3.1 Purge/Development Water

1) Conduct sampling in accordance with SOP A1.

2) Soil and groundwater will be monitored with an OVM and carefully observed for visual contamination (i.e., staining, sheen, etc.) and odor to determine whether unanticipated conditions are encountered.

3) If no headspace reading is detected and the field data do not suggest that the waste may be hazardous, spread soil cuttings at the ground surface around the monitor wells; discharge the

well development water to the ground surface; and discharge the groundwater sampling purge water to the ground surface around the well. *Important*: Make sure that the Base has submitted a notice of intent to discharge prior to disposing of any waste as described above.

4) If there is a reason to believe that the wastes may be hazardous (i.e., the soil is stained or a sheen is noted on the water surface), containerize the wastes in DOT-approved 55-gal. drums and follow the steps outlined in Step 5.

5) 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 03-01-SB); and
- Name and phone number of Holloman AFB contact (CES/CEV).

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

6) Move the drums to an IDW staging area established by the Base.

7) Analyze the drum(s) and compare the results with the TCLP levels.

A4-3.2 PPE and Disposable Sampling Equipment Waste

1) Remove excess solid and liquid waste from PPE and disposable sampling equipment;

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

3) Dispose of trash bags in a dumpster at the IDW staging area; and

4) 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.

A4-4.0 COMMENTS

- Be sure each container is labeled in accordance with Step 5 of the Methodology section of this SOP. Be sure that the contractor's name never appears on the label; only the contact person at Holloman AFB should appear on the label.
- If IDW that may be hazardous is spread on the ground at the boring location, Holloman AFB is potentially liable for unauthorized land disposal of hazardous waste. All IDW pending analysis must be moved to the drum staging area. Only IDW that is not stained and has no volatile organic compounds (VOCs) detected in the head-space analysis may be spread around the borehole.
- Be sure to complete the Waste Inventory Form at the end of each sampling event.

Page _____ of _____

CONTAINERIZED MATERIALS LOG

Project _____

City _____ State _____

Drum Number	Well or Boring Number	Material Type	Date Filed First	Date Filed Last	Location Moved to	Final Disposition	Signatures of Movers

HAZARDOUS WASTE

FEDERAL LAW PROHIBITS IMPROPER DISPOSAL

IF FOUND, CONTACT THE NEAREST POLICE, OR
PUBLIC SAFETY AUTHORITY, OR THE
U.S. ENVIRONMENTAL PROTECTION AGENCY

PROPER D.O.T.
SHIPPING NAME _____ UN or NA# _____

GENERATOR INFORMATION:

NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

EPA
ID NO. _____

EPA
WASTE NO. _____

ACCUMULATION
START DATE _____

MANIFEST
DOCUMENT NO. _____

HANDLE WITH CARE!

CONTAINS HAZARDOUS OR TOXIC WASTES

STYLE WM-6-P

Printed by LABELMASTER, Div. of AMERICAN LABELMARK CO., INC., CHICAGO, IL 60646

SOP A5
STAKING, UTILITY CLEARANCE, AND PERMITTING

A5-1.0 OBJECTIVE

To ensure the health and safety of field sampling personnel and prevent damage to underground utilities during drilling, 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 hollow-stem 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.

A5-2.0 EQUIPMENT AND MATERIALS

Equipment and materials required consist of the following:

- Wooden stakes, lathes, hubs, surveyor flags, and/or spray paint;
- Small sledge-type hammer;
- Large crowbar or hooks to aid in removing oil/water separator (O/WS) lids;
- Permanent marker;
- Site maps from Section 2; and
- Base Civil Engineering Clearance Request (AF Form 103).

A5-3.0 METHODOLOGY

1) Begin the site clearance procedure by locating and marking all monitor well locations at each site, using the following guidelines:

- If possible, procure utility maps ahead of time so that the preliminary positioning of sample locations will avoid underground obstructions.
- Visually scan each new monitor well 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 monitor well number (e.g., "MW-01"). If the location is on a paved surface, it should be marked with spray paint.

2) To obtain all utility clearances, site tours must be completed with appropriate representatives of the Base utilities (electric, plumbing, and Army cable) and Blue Stake.

Blue Stake coordinates the locating of non-Base utilities on Base, including US West phone lines, Simmons' cable lines, and Standard Transpipe fuel lines. They will provide you with a control number and submit locator requests for you.

Obtain clearance by contacting the locators listed below and arrange for site tours:

Exterior Plumbing	X5990	Chuck Price
Exterior Electric	X3781	Guy Williams/ Jack Quost
Army Cable (for North- and West-Base sites)		
Blue Stake	905-437-7700	

- 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 Phase II 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.

3) To obtain the actual digging permit, a Base Civil Engineering Clearance Request Form (AF103) must be completed and signed by appropriate parties (see Attachment A1-1). (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 a representative of Civil Engineering's Environmental Flight (CEV). Once a digging permit has been issued, it is valid for one month.

A5-4.0 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. Drilling permits should be reviewed and signed if necessary by the field manager.
- Blue Stake requires a 10-day to 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.
- If the investigation is expected to last beyond the expiration date of the excavation permit, leave a four-day minimum lead time to obtain clearances and a new digging permit.

BASE CIVIL ENGINEERING WORK CLEARANCE REQUEST

DATE PREPARED

1. Clearance is requested to proceed with work at _____

on Work Order/Job No. _____, Contract No. _____, involving excavation or utility disturbance per attached sketch. The area involved ☐ Has ☐ Has not been staked or clearly marked.

TYPE OF FACILITY/WORK INVOLVED

	A. PAVEMENTS		B. DRAINAGE SYSTEMS		C. RAILROAD TRACKS		D. FIRE DETECTION AND PROTECTION SYSTEMS		E. UTILITY ☐ OVERHEAD ☐ UNDERGROUND
	F. COMM. ☐ OVERHEAD ☐ UNDERGROUND		G. AIRCRAFT OR VEHICULAR TRAFFIC FLOW		H. SECURITY		I. OTHER *(Specify)*		

3. INSTRUCTIONS: The BCE work clearance request is used for any work (contract or in house) that may disrupt aircraft or vehicular traffic flow, base utility services, protection provided by fire and intrusion alarm system, or routine activities of the installation. This form is used to coordinate the required work with key base activities and keep customer inconvenience to a minimum. It is also used to identify potentially hazardous work conditions in an attempt to prevent accidents. The work clearance request is processed just prior to the start of work. If delays are encountered and the conditions at the job site change (or may have changed) this work clearance request must be reprocessed.

4. DATE CLEARANCE REQUIRED	5. DATE CLEARANCE TERMINATED

6. REQUESTING OFFICIAL *(Signature)*	7. PHONE NO.	8. ORGANIZATION

CLEARANCE REVIEW

	ORGANIZATION	REMARKS	REVIEWER'S NAME AND INITIALS
9. BASE CIVIL ENGINEERING	A. ELECTRICAL DISTRIBUTION		
	B. STEAM DISTRIBUTION		
	C. WATER DISTRIBUTION		
	D. POL DISTRIBUTION		
	E. SEWER LINES		
	F. DRAINAGE SYSTEMS		
	G. PAVEMENTS, GROUNDS, RAILROADS		
	H. FIRE DEPARTMENT		
	I. ENGINEERING & ENVIRONMENTAL PLANNING		
	J. CATHODIC PROTECTION		
	K. OTHER		
10. SECURITY POLICE			
11. SAFETY			
12. COMMUNICATIONS			
BASE OPERATIONS			
14. COMMERCIAL UTILITY COMPANY *(Telephone, Gas, Electrical, etc.)*			
15. OTHER *(Specify)*			

16. **REMARKS** *(This section must describe specific precautionary measures to be taken before and during work accomplishment. Specific comments concerning the approved method of excavation, hand or powered equipment should be included.)*

REQUESTED CLEARANCE	☐ APPROVED ☐ DISAPPROVED
DATE	**SIGNATURE OF APPROVING OFFICER** *(Chief of Operations or Chief of Engineering and Environmental Planning)*

★U.S.GPO:1988-0-201-386/70203

SOP A6
HOLLOW-STEM AUGER (HSA) DRILLING

A6-1.0 OBJECTIVE

Hollow-stem auger (HSA) drilling provides a means of advancing a borehole for installation of a groundwater monitoring well. Monitor well completion materials can be easily installed through the center of the augers, while the augers maintain the integrity of the borehole and seal the surrounding formation from the sampler and the interval being sampled.

HSA drilling activities will be conducted in accordance with:

- U.S. Environmental Protection Agency (EPA). 1991. *Environmental Compliance Branch, Standard Operating Procedures and Quality Assurance Manual (SOPQAM)*, U.S. EPA, Region IV, Environmental Services Division, Athens, Georgia.
- Korte, Nic, and Peter Kearl. 1985. *Procedures for the Collection and Preservation of Groundwater and Surface Water Samples and for the Installation of Monitoring Wells: Second Edition.* U.S. Department of Energy Report G-J/TMC-08. Technical Measurements Center, Grand Junction Project Office, Grand Junction, Colorado.

A6-2.0 EQUIPMENT AND MATERIALS

Equipment and materials required to conduct HSA drilling consist of the following:

- HSA drilling rig, equipped with continuous-sample split spoons and, at a minimum, 60 ft of approximately 8-in.-O.D. and 6-in.-ID hollow-stem auger (provided by subcontractor);
- Support vehicles (supplied by subcontractor);
- Equipment for lithologic logging as listed in SOP A7;
- Sampling equipment as outlined in SOP A7;
- Waste containers as listed in SOP A4; and
- Health and safety equipment as outlined in the HSP.

A6-3.0 METHODOLOGY

1) Obtain clearances from all on-Base and off-Base utilities (see SOP A1). **Do not start drilling without all utilities marked.**

2) Begin drilling. The drill rig should be equipped with a special drill bit and stem that allow a decontaminated 5-ft split spoon to be lowered through the drill stem and locked into place just below the bottom of the drill bit. Termed continuous core sampling, this method will allow for easy collection of relatively undisturbed formation samples. After each 5-ft run is complete, retrieve the sampler on the wire line and visually describe the soil as outlined in SOP A7.

3) Continue drilling until water table is encountered. After reaching the water table, use an electronic water level meter to measure the depth to the groundwater table and record the measurement in the field notebook. This value (depth to groundwater) will be used to calculate the length of well casing that will be needed for the new well.

4) Resume drilling as specified above until the desired total depth of the well is reached. For wells using a 10-ft screen to monitor the shallow aquifer, the desired total depth of the well is approximately 9 ft below the depth of the water table. Following the procedures outlined in SOP

A8, install monitor well completion materials through the center of the augers, while the augers maintain the integrity of the borehole and seal the surrounding formation from the sampler and the interval being sampled.

5) Collect and manage all wastes as indicated in SOP A4

SOP A7
LITHOLOGIC DESCRIPTION AND GEOTECHNICAL SAMPLING

A7-1.0 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]).

A7-2.0 EQUIPMENT AND MATERIALS

Equipment and materials required for lithologic discriptions and geotechnical sampling consist of the following:

- Tape measure;
- Munsell 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 (Attachment A7-1); and
- Health and safety equipment as specified in the HSP.

A7-3.0 METHODOLOGY

1) 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.

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

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

4) Identify the color using the Munsell chart.

5) 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).

6) 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.); and
- USCS Code (*SM*).

7) Note all visible contamination, photoionization detector/flame ionization detector (PID/FID) measurements, odor, or any observed evidence of contamination in the sample.

8) 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.

9) Collect a sample, if necessary, for geotechnical analysis.

10) Place the sample in a Ziploc bag and seal with as little air as possible.

11) Label the bag for shipment to a lab for geotechnical grain size distribution (ASTM D421 and D422).

A7-4.0 COMMENTS

- Obtaining a good sample for chemical analysis is the first priority; collect chemical samples for 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 and OVM 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 judgment to infer contacts and lithology, using the tests listed in the ASTM method will ensure consistent results.

DRILLING LOG

1. COMPANY NAME	2. DRILLING SUBCONTRACTOR	HOLE NO.
		SHEET 1 OF SHEETS
3. PROJECT	4. LOCATION	
5. NAME OF DRILLER	6. MANUFACTURER'S DESIGNATION OF DRILL	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	8. HOLE LOCATION	
	9. SURFACE ELEVATION	
	10. DATE STARTED	11. DATE COMPLETED
12. OVERBURDEN THICKNESS	15. DEPTH GROUNDWATER ENCOUNTERED	
13. DEPTH DRILLED INTO ROCK	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
14. TOTAL DEPTH OF HOLE	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %

22. DEPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS/RECOVERY h
	1						
	2						
	3						
	4						
	5						
	6						
	7						
	8						
	9						

PROJECT	HOLE NO.

DRILLING LOG

HOLE NO.

PROJECT

INSPECTOR

SHEET 2 OF SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS/RECOVERY h
	11						
	12						
	13						
	14						
	15						
	16						
	17						
	18						
	19						
	20						
	21						
	22						
	23						
	24						
	25						
	26						
	27						

PROJECT

HOLE NO.

SOP A8
MONITOR WELL INSTALLATION

A8-1.0 OBJECTIVE

Monitor wells will be installed in order to collect representative samples of groundwater and to measure the static water level. All monitor wells will be constructed in a manner that complies with all applicable federal, state, and local regulations. For further information on well installation procedures, please refer to the *Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells* (National Water Well Association, 1989).

A8-2.0 EQUIPMENT AND MATERIALS

Equipment and materials required to install monitor wells consist of the following:

- HSA drilling rig (supplied by subcontractor);
- Grout mixing and pumping equipment with a tremie system equipped with a side emptying discharge attachment;
- Well materials (supplied by subcontractor);
  - — 10 and 5 ft lengths of 2-in.-diameter, flush-threaded, Schedule 40 PVC well screen with 0.01-in. slots and flush threads,
  - — 2-in.-diameter, flush-threaded, Schedule 40 PVC,
  - — Washed silica, #16-40 grade filter sand,
  - — 1/4-in. sodium bentonite pellets,
  - — Neat cement grout (3-5% bentonite powder, 94 lb Portland cement, and 7 gal. water),
  - — Locking steel protective casing and guard posts or flush boxes,
  - — Concrete, and
  - — Protective steel posts (3-in. dia.).
- Vented surge block and bailer;
- Indelible ink pen;
- Monitor well construction diagram;
- Weighted measuring tape;
- Electric water level meter (E-line);
- Waste containers as specified in SOP A4; and
- Safety equipment as specified in the HSP.

A8-3.0 METHODOLOGY

1) Immediately prior to the completion of the borehole, remove the well screen and riser from the packaging and check it for imperfections as well as oil or ink. If the well materials are not clean, decontaminate them using the procedures outlined in SOP A2.

2) Once the borehole is at the desired depth, clean the borehole thoroughly, making sure not to smear the screened interval with clay or fines that may make development more difficult and time consuming. Then, check the depth to water (using E-line) and to the bottom of the borehole (using the weighted tape).

4) If the borehole is clear to the desired depth, begin installing the well within the auger. Place the well screen inside the augers and hold it in place using a slip lock or other instrument designed to suspend well screen. Do not use a pipe or chain wrench.

5) Attach the riser to the screen suspended in the augers and attach a top cap to the top of the riser. Remove the slip lock and use a winch attached to the top cap to slowly lower the well screen and riser to a point low enough that another section of pipe can be attached to the top of the riser.

6) Continue attaching riser using the techniques outlined in Steps 4 and 5 until the well rests on the bottom of the borehole. Use Schedule 40 PVC riser for all installation below and above the water table. When complete, the top of the well should be 2.5 ft above the ground surface.

7) When all of the riser is set in place, lower a tremie pipe between the well and augers. The bottom of the tremie should be lowered to a depth of no more than 5 ft above the bottom of the borehole.

8) When the tremie is in place, begin adding sand slowly, washing it into place using clean, potable water. Check the depth to sand continuously with a weighted tape.

9) As the sand level rises, raise the tremie pipe slowly so that the bottom of the tremie pipe is between 3 and 5 ft from the top of the filter sand.

10) Pull the augers as the filter sand is added, and continue until the sand has reached a height of 1-2 ft above the top of the well screen.

11) When the filter sand is at the desired height, retract the augers so that they are just above the top of the filter sand.

12) Lower the decontaminated (see SOP A2) bailer into the well and remove several bailers of water in order to remove sand and fines from the well. Bail until less than 1 in. of sand is recovered in the bailer. Remove the bailer and lower the decontaminated (see SOP A2) surge block into the well and surge it vigorously across the screen length to settle the filter pack. Remove the surge block and resume bailing until only trace amounts of sand are removed. Place all developed water and sand into the container of saturated soil cuttings.

13) Check the depth to the top of the filter pack and verify that it is between 1-2 ft above the top of the well screen. Use the tremie to add additional sand as required.

14) Remove the tremie pipe and begin pouring bentonite pellets between the well casing and the boring. Pour bentonite slowly to prevent bridging. After each vertical foot of bentonite added to the borehole, use 1 gal. of purified water to hydrate the bentonite. Check the height of the bentonite continuously and when the bentonite is at least 3 ft above the top of the filter pack, retract the augers to above the bentonite. If the bentonite pellets are installed above the water table, add clean potable water to the top of the pellets and allow the bentonite to hydrate for at least a half hour.

15) When the bentonite has hydrated, replace the tremie pipe (with a side-emptying discharge attachment) between the drive casing and well and attach it to the grout mixing and pumping equipment. Make sure that the bottom of the tremie pipe is between 3-5 ft from the top of the bentonite.

16) Mix the neat cement grout and begin pumping it into the borehole, retracting the augers as the grout is added. Pump the grout until it is visible at the top of the borehole.

17) Remove the tremie system and retract the augers completely. If the grout has fallen below the top of the borehole, add additional grout.

18) After the grout has hardened for at least 24 hours, place the protective casing or flush box in the borehole and support it at the appropriate height (2.7 ft above the ground surface for a stick-up completion and 3 in. above the surface for a flush completion).

19) Build a 4-ft^2 form at least 4 in. deep around the well completion, with edges of the form no less than 2 ft from the edge of protective casing. Pour concrete into the form and smooth the concrete so that it slopes gently away from the well completion.

20) Install three 3-in.-diameter protective steel posts at even intervals around all aboveground completed wells.

21) Lock the well cap. Well is now ready for development (see SOP A9).

22) Collect and manage all waste as specified in SOP A4.

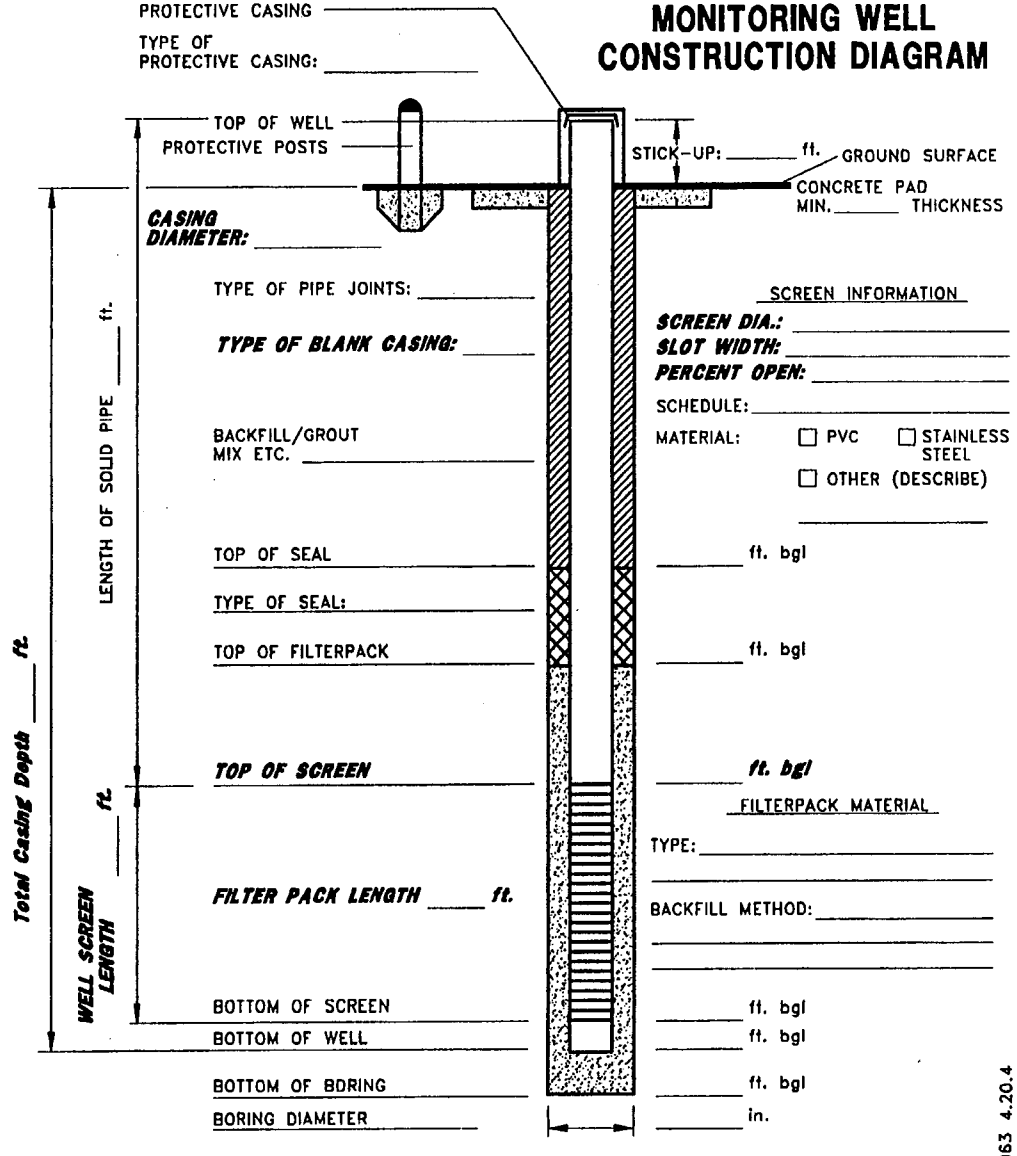
23) Complete the monitor construction diagram (Attachment A8-1).

A8-4.0 COMMENTS

- Be sure to measure the actual lengths of all well materials carefully. Well screen and riser sections are rarely exact lengths, and on each section can add up.
- Careful, precise depth measurements and slow rates for sand and bentonite installation are the keys to a superior well construction. A half hour saved on installation may result in the need to reinstall the well.
- The well completion will be a permanent feature that will be visible and obvious. Make sure that completions are neat and attractive. Any time the well riser needs to be cut to achieve the proper height for the stick up, it should be cut with a hack saw before installation, or with a pipe cutter after installation so that the cut is even and level.
- In the event that a pure pocket of dense non-aqueous phase liquid is encountered during drilling, stainless steel screen and riser will need to be used instead of PVC below the water table.
- The subcontractor shall produce a well completion report and submit it to the state within 30 days of the completion of the well.

MONITORING WELL CONSTRUCTION DIAGRAM

Project	***Well I.D.***	
Well Owner	***Well Type***	
Installer	***Date Started***	Date Completed
Location Coordinates:		
(North)	***(East)***	
Elevation Top of Casing	***Completion Method***	
Sole Source Aquifer Code		
Drilling Method	***Completion Zone***	
Remarks		



SOP A9
WELL DEVELOPMENT

A9-1.0 OBJECTIVE

Each monitoring well installed during the investigation will be developed to:

- Remove fine-grained native soil material that collected in the well casing during construction;
- Flush the filter pack to restore the natural hydraulic conductivity around the well to predrilling (undisturbed) conditions; and
- Remove drilling fluids used during well construction or other constituents potentially carried down within the well during drilling to allow for accurate chemical measurements to be made during well sampling and to reduce potential cross-contamination within the borehole.

The contractor will develop the wells. During well development, water quality parameters will be measured and pumping rates will be documented, the latter of which can be used to select sample purge rates and pumping test rates during future field activities. Water level measurements should be collected during development to assess the specific capacity of the well.

A9-2.0 EQUIPMENT AND MATERIALS

Equipment and materials required for well development include:

- Water level probe;
- pH/temperature/electrical conductivity/ redox potential meter and calibration standards;
- Turbidity meter;
- Clear glass jars;
- Water bailer and appropriate pumping equipment;
- Well development log (see Attachment A9-1);
- Camera and film;
- Decontamination equipment as specified in SOP A4;
- Waste management equipment as specified in the Waste Management Plan (WMP); and
- Health and safety equipment as specified in the HSP.

A9-3.0 METHODOLOGY

1) Begin developing no sooner than 48 hours after a well has been constructed;

2) Prior to the start of development activities, clean all well development equipment following proper decontamination procedures as specified in SOP A2;

3) Measure vapor readings at the well head using field screening equipment outlined in the HSP;

4) Before developing a well, measure the total well depth and the depth to the top of the water table, and record the measurements in the well development log;

5) Use a bailer to collect water for initial water quality parameter measurements (pH, temperature, electrical conductance, and turbidity readings), and record these readings in the well development log;

6) Take photographs to document water quality prior to development;

7) Alternately purge and bail the well until minimal fines are produced and the purged water begins to clear;

8) Take water quality measurements frequently, at least every half hour, or more frequently as visual observations or water quality measurements indicate that the quality of the water is changing;

9) Contain purge water in appropriate containers, and handle according to SOP A4;

10) Install a development pump (typically 2- to 5-gpm capacity, submersible or centrifugal pump);

11) Purge water from the well with the pump, at a rate approximately equal to or greater than the anticipated purging/sampling rate.

12) Continue water quality measurements until the following criteria for continuing development have been met:

- Develop for a minimum period of four hours per well,
- Develop for a maximum period of eight hours per well,
- Develop until the pH, temperature, specific conductivity, and redox potential have stabilized to within 10% of the previous two readings, and until sediment in the water has cleared to a point such that the turbidity meter reads less than 30 nephelometric turbidity units (NTUs);
- Develop at least as much water as was introduced during drilling, if any, has been removed from the well; and
- Develop until one well casing volume and one filter pack volume have been purged;

13) Record all measurements in the well development log;

14) Continue to contain the purge water according to methods outlined in SOP A4; and

15) When development is complete, measure and record a final total well depth and top of the water table depth, and take a final photgraph to document water quality.

A9-4.0 COMMENTS

- No water or other fluids, other than natural formation water, should be added during development of that well.
- Wells at the site are expected to produce sufficient volumes of water to allow for standard development. However, slow producing wells may need to be developed using an alternative procedure. If, during the initial phases of development, a well is bailed dry, development should be performed by bailing the well, allowing it to recover to at least 90% of the initial water level, and repeating the bailing until dry/recovery method at least three times. Water quality measurements (pH, electrical conductance, temperature, and turbidity) should be collected at least three times during bailing.

MONITORING WELL DEVELOPMENT RECORD

INSTALLATION	WELL ID		DATE	TIME
PERFORMED BY	WATER LEVEL		TOTAL DEPTH	
	INITIAL	FINAL	INITIAL	FINAL
DEVELOPMENT METHOD		SURGE TECHNIQUE		
FIELD MEASUREMENTS				

Time	Cum. Volume (gal)	Water Quality				Comments
		Temp	pH	Cond	Turbidity	
						Final Measurements

Total Volume Removed	Comments
Development Time	

SOP A10
LOCATION SURVEYING

A10-1.0 OBJECTIVE

The location of every sampling point shall be surveyed by a State of New Mexico registered land surveyor. This will provide a permanent record of sampling locations and information that can be used in future reports.

A10-2.0 EQUIPMENT AND MATERIALS

The surveying subcontractor shall supply all equipment and materials that will be used during the surveying acitivity.

A10-3.0 METHODOLOGY

The surveying subcontractor may use either traditional survey techniques or a global positioning system (GPS) to satisfy the following survey requirements:

- Horizontal coordinates of each sampling location must be measured to an accuracy of 0.10 ft in reference to the State Plane Coordinate System.
- Ground elevations of each monitor well location will be measured to the nearest 0.10 ft relative to mean sea level of the National Geodetic Vertical Datum of 1983. (If the 1983 datum is not available, references may be made to the 1929 datum).
- The top of casing elevation will be measured to the nearest 0.01 ft relative to mean sea level of the National Geodetic Vertical Datum of 1983. (If the 1983 datum is not available, refer to the 1929 datum).
- To aid in accurate reconstruction of site figures and future plans of the site, one permanent reference point shall also be surveyed. This point should be the nearest building corner (i.e., Bldg. 752) or a suitable alternative reference point.

A10-4.0 COMMENTS

- To assist the surveying effort and minimize the chance of missed survey points, provide the surveyors with a completed site map with locations of all newly installed monitor wells.

APPENDIX B

Quality Assurance Project Plan (QAPP)

DCN 94-670-008-02-01

LONG-TERM MONITORING PLAN FOR THE SEWAGE LAGOONS

QUALITY ASSURANCE PROJECT PLAN

Prepared for:

49 CES/CEV
Holloman Air Force Base, NM
and
HQ ACC/DEVC
Langley Air Force Base, VA

Prepared by:

Radian Corporation
8501 North Mopac Boulevard
Austin, Texas 78720-1088

Under Contract No. DACW45-93-0027 with:

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

Revision 0: December 1994
Revision 1: March 1995

QUALITY ASSURANCE PROJECT PLAN APPROVAL

This quality assurance project plan was developed to ensure that all environmental data generated as part of the long-term monitoring of the sewage lagoons and lakes at Holloman Air Force Base, New Mexico, are scientifically valid, defensible, comparable, and of known and acceptable precision and accuracy. The below signatures of key project personnel indicate concurrence with the procedures specified in the plan and a commitment to disseminate the plan and the philosophy of quality to all project personnel.

	Signature	Date
Project Manager, USACE-Omaha		
Project Chemist, USACE-Omaha		
Project QA Officer, USACE-MRD Laboratory		
Project Manager, RFI Contractor		
QA Coordinator, Contractor		
Laboratory Director, Laboratory Contractor		
Laboratory Director, Laboratory Contractor		
Project Coordinator, NMED		

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Section 1
INTRODUCTION

This quality assurance project plan (QAPP) has been prepared for submission as part of the field and laboratory procedures and site-specific sampling plans for the long-term monitoring (LTM) plan for the sewage lagoons subject to requirements of the Federal Facility Compliance Agreement for Holloman Air Force Base (AFB) (the Base) in New Mexico. The QAPP is submitted by Holloman AFB to the U.S. Environmental Protection Agency (EPA), Region VI and to the New Mexico Environment Department (NMED).

The QAPP provides guidance for the collection and analysis of all soil, waste, and water samples pertaining to the LTM program for the sewage lagoons at Holloman AFB. These RCRA-required sampling and analysis programs are collectively referred to in the QAPP as the "project." The guidance provided by the QAPP is intended to lead to the production of data that are technically defensible for all legal and regulatory purposes and of known quality. The QAPP is not, however, a work plan. It lists sample types and analytical methods, but does not specify all possible sample locations; for that information, additional sources must be consulted, particularly Sections 3 and 4 (for site-specific sampling plans) of the LTM plan.

This QAPP has been designed to explain sample handling and laboratory procedures that are common to all samples collected at Holloman AFB during the LTM activities. For example, following an initial sample preparation, the determination of analyte concentrations (e.g., by gas chromatography [GC] or gas chromatography/mass spectrometry [GC/MS]) follows standard methods with established procedures. This QAPP is intended to provide a thorough picture of these common quality assurance/quality control (QA/QC) elements. During the course of the project, new or different procedures or methods may be incorporated into the plan, for reasons such as advances in measurement science, improvements in analytical laboratory production techniques, or changes in regulatory requirements or approaches. Any such changes or additions will be described in the written QAPP in the form of addenda, or revisions to the QAPP following approval by EPA Region VI and NMED.

This QAPP addresses the QA elements required by "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans," EPA 29 December 1980 (QAMS-005-80).

Section 2
PROJECT ORGANIZATION AND FUNCTIONAL AREA RESPONSIBILITIES

The contractor's project team for the Holloman AFB LTM program for the sewage lagoons will be composed of a team leader, a quality assurance coordinator (QAC), and one or more task leaders. Roles and responsibilities of key personnel are discussed below.

2.1 Roles and Responsibilities

The United States Army Corps of Engineers (USACE) Missouri River Division (MRD) or its laboratory is responsible for providing QA services to the USACE project manager and chemist. This QA program will include validation of contractor laboratories, analysis of QA duplicate samples, and a review of the reported analytical data and the assessment of data quality. The analysis of QA duplicate samples by a laboratory independent of the contractor laboratory provides an assessment of data comparability.

The contractor team leader will be responsible for organizing and directing the technical activities of the project throughout the course of the investigation and for reporting the results of these activities. In this role, he/she will have overall responsibility, authority, and accountability for the project, as well as day-to-day interaction with the technical staff. In the execution of these duties, he/she will:

- Establish technical objectives and review and modify the work plans in accordance with client direction;
- Be responsible for responding to work plan revisions;
- Have responsibility for meeting all contractual requirements for the task;
- Be responsible for meeting budget and schedules;
- Ensure technical quality of reports, memoranda, and other communications through review of results;
- Maintain contact with the USACE project manager and inform him/her of all aspects of the project, including progress, problems, and recommended solutions;
- Have responsibility for ensuring that required staffing levels and technical expertise are provided; and
- Be responsible for reviewing project staff performance through the program.

The QAC will be responsible for development and execution of QA activities in all phases of the project, including test plan design, execution, data reduction, and reporting. His/her responsibilities will include:

- Coordinating any external QA audit activities requested by the USACE;
- Serving as an in-house consultant to the project task leaders in defining data quality goals or requirements, and in development of a project-specific, internal QC system that is responsive to these goals;
- Coordinating preparation of the project QA reports that document the project-specific policies, organization, objectives, functional activities, and specific QA and QC procedures and activities designed to achieve data quality goals or requirements;
- Providing independent review of the project approach, methods, and experimental design;
- Providing the mechanism whereby QA problems may be brought to the immediate attention of the project director, if

warranted, and may be brought directly to the attention of upper management for implementation of corrective action; and

- Documenting the results of all QA/QC activities in reports to internal management and to clients.

A task leader will be designated for all tasks pertaining to the conduct of the LTM program. His/her responsibilities include the plans, field activities, and the regular annual LTM report.

General responsibilities of task leaders include:

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

The supervising geologist will be responsible for all on-site activities, including monitor well installation, sample collection, field analysis, chain of custody, and reporting. He/she will also be responsible for field staff. The supervising geologist will be responsible for completing daily quality control reports (DQCRs). Other key project personnel reporting to the supervising geologist include the subcontractor staff manager. Subcontractor staff managers assume ultimate responsibility for all operations in their subcontracts. Subcontractors and key personnel are discussed below.

2.2 Subcontractor Qualifications

Minimum qualifications of project subcontractors are summarized in the following sections.

2.2.1 Analytical Laboratory

The analytical laboratory's qualifications include current USACE validation (within 18 months). The analytical laboratory representative will have ultimate responsibility for all analyses performed at the analytical laboratory. The assigned laboratory representative is responsible for ensuring that work is performed according to the Holloman AFB LTM plan and this QAPP.

2.2.2 Drilling

A drilling company will be subcontracted to provide all drilling services. This company will be a licensed New Mexico water-well driller. The assigned representative will be responsible for completing the work as stated in the Holloman AFB LTM plan.

2.2.3 Survey Activities

The surveying of sampling points will be completed by a licensed surveyor registered in the State of New Mexico, and will follow all survey protocols outlined in the Holloman AFB LTM plan.

Section 3
CHEMICAL DATA QUALITY OBJECTIVES

To support the overall objectives, chemical data quality objectives (DQOs) must be established. The chemical DQOs are to:

- Collect samples specified in Sections 3 and 4 of the LTM plan to assess whether a release has occurred to the groundwater;
- 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
- Provide 95 percent data completeness for analytical results representing each matrix-method combination.

Measurement data representativeness is a function of sampling strategy and will be achieved using the procedures discussed in Sections 3 and 4 of the LTM plan. Potential for sample contamination will be minimized by the use of decontamination procedures specified in standard operating procedure (SOP) A2 of the LTM plan. Data comparability will be achieved using standard methods and standard units of measure as specified in the methods described in Section 7 and Table A-1. Analytical imprecisional bias will be controlled through the use of a QC program using prescribed QC samples and the corrective actions specified in Section 9 and Table A-3. Imprecision and bias in natural matrix samples will be estimated by standard QC methods such as matrix spikes and field duplicates.

A QA/QC program will be used to ensure that the chemical DQOs are met for this program. QA/QC efforts are twofold. First, they provide the mechanism for ongoing control and evaluation of measurement data quality throughout the course of the project (i.e., system capability). Second, they specify QC data to be used to define natural-matrix data quality for various measurement parameters in terms of precision and accuracy. Control of measurement data quality (i.e., control of error sources that affect data quality) is possible for sample collection and analysis. However, matrix interference, or nonhomogeneity, is not amenable to control and thus imprecision or bias due to these natural sources of error must be estimated from QC samples. For this project, sample collection error will be controlled through the use of standard sample collection methods and field log books. Sample analysis error will be controlled by the use of standard analytical methods, laboratory SOPs, continual system evaluation, and the use of QC practices as directed in published procedures. Natural matrix error will be estimated by standard QC methods such as matrix spikes and field duplicates.

3.1 Analytical Capability

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

Precision and accuracy objectives, in terms of maximum allowable imprecision and inaccuracy, for the various measurement parameters

associated with site characterization efforts are presented in Table 3-1. Precision values presented in Table 3-1 represent a measure of variability for replicate measurements of the same parameter in clean-matrix, QCCS, expressed in terms of the relative percent difference (RPD). RPDs compared with precision objectives in Table 3-1 are calculated from data such as duplicate QCCS results. Accuracy values for clean-matrix laboratory samples include components of both random error (i.e., variability from imprecision) and systematic error (i.e., bias), and thus reflect the total analytical error for a given measurement, expressed as a percentage of the true value. The percent difference between true and measured concentrations in continuing calibration and QCCS samples may be compared with accuracy objectives in Table 3-1.

Accuracy and precision estimates for samples in a natural matrix would not routinely be expected to be within the objectives presented in Table 3-1 because variability of a matrix cannot be controlled, only estimated. The basis for these estimates are, in most cases, described in the methods. The analytical laboratory will be able to document that the QA/QC procedure in each standard method, chapter 1, and Method 8000 of SW-846, 3rd edition, or USACE Guidance Document ER 1110-1-263, was followed for all analytical work.

Data completeness is a measurement of the amount of valid data obtained compared with the amount that was expected. Ultimately, the goal is to obtain valid data for all analyses. Conditions that prevent complete data capture, such as significant sample matrix difficulties or sample loss, should be addressed in a timely fashion to determine which corrective actions should be taken. Data completeness objectives for all constituents is 95 percent.

Sample detection limits must normally be sensitive to concentrations at or below RCRA action levels and/or health limits. (It is important to note that for a number of compounds, the specified reporting limit does not reach the RCRA-required limit for the methods included in this investigation. Although known limitations exist, data will be considered usable because they are generated using current promulgated methods and in most cases the sample-specific detection limit is lower than the reporting limit.) Natural sample reporting limits will also depend on dilution effects. In general, dilutions will be performed only as directed in each representative method. For target analytes on GC/MS and GC analyses, dilution will be performed if the target analyte concentrations exceed the calibration range. For nontarget analytes on GC/MS and GC analyses, dilutions will be performed when nontarget analyte response interferes with target analyte response, and to achieve an internal standard response of approximately 20 percent of the maximum peak response. When samples are diluted after an initial undiluted analysis, data for target analytes with responses within the calibration range in the undiluted analysis will be collected and reported with target analytes that required diluted analyses, except in cases where reporting limits exceed RCRA-specified limits as previously discussed. For these compounds, high method reporting limits will not result in unusable data. If natural sample reporting limits exceed RCRA-required limits for any other compounds, the analytical laboratory must document what prompted the higher reporting limits and the maximum concentrations that were allowable on the calibration curve. This level of effort is required on a sample-by-sample basis and may not be applied to batches of samples.

Table 3-1
Analytical Precision and Accuracy Objectives

Parameter	Method	Precision[a]	Accuracy[b]
Metals[c]	SW6010 ICPES	20%	80-120%
Antimony	SW7041 Graphite Furnace AA	20%	75-125%
Arsenic	SW7060 Graphite Furnace AA	20%	75-125%
Lead	SW7421 Graphite Furnace AA	20%	75-125%
Mercury	SW7470/7471 Cold Vapor AA	20%	80-120%
Selenium	SW7740 Graphite Furnace AA	20%	75-125%
Thallium	SW7841 Graphite Furnace AA	20%	75-125%
Organochlorine Pesticides	SW8080 GC/ECD	See Method SW8080, Table 3	See Method SW8080, Table 3

[a]Relative percent difference (RPD) for replicate analytical determinations (exclusive of sampling variability). RPD for duplicate QCCS samples will be compared to these objectives.

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

[c]ICPES metals: aluminum, barium, beryllium, cadmium, calcium, chromium (total), cobalt, copper, iron, magnesium, manganese, nickel, potassium, silver, sodium, vanadium and zinc.

SW = *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods,* U.S. EPA, Office of Solid Waste and Emergency Response, November 1986, Third Edition.

QC procedures used as an ongoing control (i.e., feedback mechanism) for the analytical system are presented in Section 9. For each method, control procedures, acceptance criteria, and corrective actions are detailed. Data for each control procedure will be evaluated against acceptance criteria presented in Table A-3 to prove the analytical system was in control during sample analyses and thus, results are defensible. This table is a summary of information from SW-846 chapter 1, Method 8000, and individual methods. As such, it is intended to be used as a guide.

Section 4
DATA QUALITY CALCULATIONS

Precision and accuracy are the two most important indicators of measurement data quality. Precision is a measure of variability associated with a measurement system. Accuracy expresses the degree to which a measured value agrees with the true value for a given parameter. Accuracy includes elements of both bias and precision. This section provides instructions for calculating data quality in terms of precision and accuracy.

4.1 Precision

For the Holloman sewage lagoons LTM program, precision will be assessed and controlled through the use of duplicate QCCS analyses. Acceptance criteria are listed in Table A-3. Precision will also be evaluated, but not controlled, through the use of duplicate matrix spike and duplicate field sample analyses.

The RPD will be used to estimate precision for duplicate QCCS analyses and is calculated by:

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

4.2 Accuracy

For this project, accuracy of the measurement data will be assessed and controlled by continuing calibration check samples (CCCS) and QCCS. These results will be used to control accuracy within acceptable limits by requiring that they meet specific criteria. As CCCS and QCCS are analyzed, recoveries will be calculated and compared with preestablished acceptance limits (see Table A-3). Accuracy will also be evaluated, but not controlled, through the use of matrix spike and surrogate spike analyses. Percent recovery is calculated as the measured value divided by the actual value times 100. Overall inaccuracy will be calculated as the average of percentages not recovered (100 percent recovery). This inaccuracy estimate includes systematic bias and random bias, and will be compared, in terms of percent recovery, with Table 3-1.

Section 5
SAMPLING PROCEDURES

For a description of sampling procedures, including quality control measures, see Sections 3 and 4 in the Holloman AFB LTM plan. Tables 5-1 and 5-2 list the sample containers, holding times, and preservation requirements for each method.

Table 5-1
Container Requirements for Soil Samples

Reference Method	Parameter	Container[a]	Maximum Holding Time (Preparation)	Maximum Holding Time (Analysis)
SW-846:1311	Toxicity Characteristic Leaching Procedure (TCLP)	One 250-mL wide-mouth glass jar, no head-space for volatiles	Volatiles-14 days to TCLP extractions Semivolatiles-14 days to TCLP extraction, 7 days to preparative extraction Hg-28 days to TCLP extraction Other metals-6 months to TCLP extraction, 6 months to preparative extraction	Volatiles-14 days Semivolatiles-40 days Hg-28 days Other metals-6 months

Note: All samples will be cooled to 4°C.

[a]All containers will have Teflon-lined lids. The container volume may vary pending laboratory-specific requirements. Verify container requirements with contracting laboratory prior to sampling.

N/A = not applicable.

Table 5-2
Container and Preservation Requirements for Water Samples

Reference Method	Parameter	Container[a]	Preservation	Maximum Holding Time (Preparation)	Maximum Holding Time (Analysis)
SW-846:6010	Al, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Mg, Mn, Ni, K, Ag, Na, V, Zn	One 1-L polyethylene bottle	pH<2 with HNO_3, Cool to 4°C	N/A	28 days for Hg; 6 months for other metals
SW-846:7041	Sb				
SW-846:7060	As				
SW-846:7421	Pb				
SW-846:7470	Hg				
SW-846:7740	Se				
SW-846:7841	Tl				
SW-846:8080	Organochlorine Pesticides	One 1-L amber glass bottle[b]	Cool to 4°C	7 days	40 days

[a]Volume may vary depending on laboratory requirements.

N/A = not applicable

Section 6
SAMPLE CHAIN OF CUSTODY, PACKING, AND TRANSPORTATION

Sample chain of custody, packing, and transportation are discussed in SOP A3 of the Holloman AFB LTM plan.

Upon receipt of the samples by the laboratory, sample integrity will be inspected and documented on a chain-of-custody addendum (Figure 6-1). Sample temperatures will be checked and recorded, evidence of other preservatives will be reviewed, physical condition of each sample container will be checked, whether custody seals are intact will be recorded along with freight bill identification numbers, and chain-of-custody records will be reviewed for consistency with the shipment. If any indication of a lack of sample integrity is found, the field task leader will be contacted to discuss implementation of corrective actions. The field task leader will notify the USACE project manager or chemist for concurrence on corrective action to be implemented.

CUSTODY NUMBER: 93-0009

Chain-of-Custody Addendum

Received by: _____ Work Order(s): _____

Date: _____ _____

Unpacked Date: _____ _____

_____ _____

Number of Outer Containers Received with Chain-of-Custody: _____ Client Code: _____

(Check the appropriate answer. Add comments or explanations as needed.)

Present	_____ Yes	_____ No
Custody Number	_____ #	_____ No
Container Sealed with Tape	_____ Yes	_____ No
Seal is Intact	_____ Yes	_____ No

If seal is not intact, list airbill number of that container(s).

_____

Sample Temperature Upon Arrival: By: _____ Pyrometer # _____

The temperature of the container(s) is: (acceptable tolerance 2-6°C)

1___°C 2___°C 3___°C 4___°C 5___°C 6___°C 7___°C

When samples are received not requiring cooling: _____ NA

If the temperature(s) are outside the acceptable range of 2-6°C

Client Services was notified: (_____ CSC) _____ Yes

OK to analyze samples: _____ Yes _____ No

il samples not listed below were within the acceptable temperature tolerance of 2-6°C. Samples affected and their temperatures.

Sample ID	Temperature (°C)	Sample ID	Temperature (°C)	Sample ID	Temperature (°C)

Figure 6-1. Example Chain-of-Custody Addendum

Condition of Bottles/Containers By: _____ (Comment any problems)

Bottles received match COC _____ Yes _____ No

Bottles received intact _____ Yes _____ No

Comments: _____

pH of Samples/Preservation By: _____ (Comment any problem)

Acid preserved samples are <2 pH (as indicated by * on COC) _____ Yes _____ No

Base preserved samples are >12 pH (as indicated by # on COC) _____ Yes _____ No

Water samples for cyanide checked (as indicated by √ on COC) _____ Yes _____ No

Water sulfide samples appear to be preserved with zinc acetate _____ Yes _____ No

_____ NA

If pH/preservation is ouside acceptable limits, Client Services was notified

(_____ CSC) _____ Yes Adjust _____ Yes _____ No

Sample id's and pH of samples received outside of acceptable pH range. All other samples not listed are at the appropriate pH.

Sample ID	pH	Sample ID	pH	Sample ID	pH	Sample ID	pH

Comments: _____

Shipping Documentation

Freightbill is available and attached to chain-of-custody.

_____ Yes _____ No

Other Comments: _____

Client chain-of-custody is signed/dated with time by sample control as received, with the sample control addendum number noted in the comments section.

_____ Yes _____ No

Sample Control Addendum Verified by: _____ Date: _____

Figure 6-1. (Continued)

Section 7
ANALYTICAL PROCEDURES

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

- SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*, U.S. EPA, Office of Solid Waste and Emergency Response, November 1986, third edition.
- EPA, *Methods for Chemical Analysis of Water and Wastes*, EPA Publication No. 600/4-79-020, March 1983.

Individual parameters and analytical methods to be followed are listed in Table A-1. Information is provided for groundwater matrices. Section 3 provides tabular summaries of analyses to be performed on groundwater samples collected at each of the Holloman AFB LTM network wells.

The laboratory will perform instrument-specific demonstration of capability (DOC) and method detection limit (MDL) studies to demonstrate the ability to meet project-specific reporting limits. Analyses will only be performed on instruments with valid and current MDL and DOC studies.

7.1 Metals by ICPES—SW-846 Method 6010

Groundwater samples will be analyzed to determine concentrations of aluminum, barium, beryllium, cadmium, calcium, chromium (total), cobalt, copper, iron, magnesium, manganese, nickel, potassium, silver, sodium, vanadium, and zinc. Water samples will be prepared according to EPA Method 3005. This method describes acid digestion of aqueous samples for analysis by inductively coupled plasma emission spectroscopy (ICPES).

Following acid digestion, metals will be determined by Method 6010, which allows the simultaneous, or sequential, measurement of elements using ICPES. This method measures the element-emitted light by optical spectrometry. Samples are nebulized, and the resulting aerosol is transported to the plasma torch. Element-specific atomic-line emission spectra are produced, which are dispersed by a grating spectrometer and monitored for intensity by photomultiplier tubes.

7.2 Metals by Furnace AA—SW-846 Methods 7041, 7060, 7421, 7740, and 7841

Groundwater samples will be analyzed to determine concentrations of antimony, arsenic, lead, selenium, and thallium. Groundwater samples will be prepared following EPA Method 3020. (This method describes acid digestion of soil samples for analysis by graphite furnace atomic absorption [GFAA] or ICPES.)

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

7.3 Mercury—SW-846 Methods 7470 and 7471

Groundwater samples will be analyzed to determine concentrations of mercury. Groundwater samples will be prepared as directed in Method 7470 or 7471. This closed system preparation includes heating the sample for two hours in a water bath.

Following EPA Method 7470 or 7471 and the laboratory SOP, mercury in the sample is reduced to the elemental state and aerated from solution in a closed system. The mercury vapor passes through a cell positioned in the light path of an atomic absorption spectrometer for detection and measurement.

7.4 Organochlorine Pesticides—SW-846 Method 8080

Groundwater samples will be analyzed to determine concentrations of organochlorine pesticides. Prior to analysis, groundwater samples are extracted at a neutral pH using methylene chloride as a solvent. Extractions will follow EPA Method 3520, which describes a continuous liquid-liquid extraction technique, or EPA Method 3510, which describes a separatory funnel extraction technique.

Method 8080 is a GC method using electron capture detection or halide-specific detection. This method is used to determine the concentration of certain organochlorine pesticides with second-column confirmation. Second-column confirmation analysis will be performed for all target analytes detected. A compound is confirmed if it is detected on both columns. Operating parameters and interferences are described in Method 8080.

7.5 Toxicity Characteristic Leaching Procedure (TCLP)

Investigation-derived wastes (e.g., soil) and waste samples will be analyzed for purposes of characterization. These analyses will include preparation by SW-846 Method 1311, which is the toxicity characteristic leaching procedure (TCLP).

The TCLP is used to determine the concentration of organic (semivolatile and volatile) and inorganic (metals) constituents that are leachable from waste or other material. Samples will be prepared according to TCLP procedures to characterize the material before disposal. Samples are extracted with an acidic extraction fluid for an 18-hour period using a solid-to-liquid ratio of 1:20. After the extraction period, the solids are filtered from the liquid and the liquid is analyzed by methods outlined in SW-846. Leachates prepared for volatile analysis are prepared in a zero headspace extractor (ZHE).

Quality control is accomplished by preparing a TCLP blank at a rate of one blank per batch or 10 percent, whichever is greater. Additional leachate is prepared so that matrix spike/matrix spike duplicates (MS/MSD) may be run at a rate of 5 percent of samples or one per waste type, whichever is greater. These QA measures are in accordance with requirements set forth in SW-846 Method 1311, Sections 8 and 40 CFR Parts 261, 264, 265, 268, 271, and 302, Volume 55 Number 126, June 29, 1990.

Section 8
CALIBRATION PROCEDURES

Documented calibration procedures are necessary to provide consistency in preparing equipment for specific analytical measurements. Established calibration procedures then provide a mechanism for ensuring that measurements made with a specific type of equipment are comparable. Information is presented in this section that pertains to the calibration of analytical systems. Calibration requirements for each analytical method used for this project are described in the following subsections and are summarized in Table A-2.

8.1 Metals by ICPES—SW-846 Method 6010

SW-846 Method 6010 is used to measure elements with ICPES.

Detailed calibration procedures for ICPES systems are described in SW-846, 3rd edition. A response factor is calculated daily for each metal on the basis of three determinations of a calibration standard and calibration blank. Following calibration, a high-level calibration check sample is analyzed; agreement between the measured value and the expected value must be within 5 percent for the analyses to proceed. Calibration is verified by analyzing a QC check standard, prepared independently of calibration standards, every 10 samples. Agreement within 10 percent of the expected value is required for all target analytes; otherwise, the system must be recalibrated. When a calibration check does not agree with the expected value (±10 percent), the samples that have been analyzed since the last calibration check was made will be reanalyzed.

8.2 Metals by GFAA—SW-846 Methods 7041, 7060, 7421, 7740, and 7841

SW-846 Methods 7041, 7060, 7421, 7740, and 7841 are GFAA techniques for determination of antimony, arsenic, lead, selenium, and thallium, respectively.

The calibration procedures for the graphite furnace systems are described in the respective SW-846, 3rd edition methods. A multipoint calibration curve is generated daily for each element using a calibration blank and three up-scale standards. The correlation coefficient for the linear regression equation must exceed 0.995 to be acceptable. Calibration will be verified every 10 samples by analyzing a QC check sample and calibration blank. Agreement within ±10 percent of the expected value is required; otherwise, a new calibration curve must be generated.

8.3 Mercury by CVAA—SW-846 Methods 7470 and 7471

SW-846 Methods 7470 and 7471 are cold vapor atomic absorption (CVAA) techniques for determination of mercury in soil samples.

The calibration procedures for the CVAA system is described in the respective SW-846, 3rd edition methods. A multipoint calibration curve is generated daily using a calibration blank and three up-scale standards. The correlation coefficient for the linear regression equation must exceed 0.995 to be acceptable. Calibration will be verified every 10 samples by analyzing a QC check sample and calibration blank. Agreement within plus or minus 15 percent of the expected value is required; otherwise, a new calibration curve must be generated.

8.4 Organochlorine Pesticides—SW-846 Method 8080

Samples for organochloride pesticides are analyzed by GC following SW-846 Method 8080. Method 8080 is used to determine the concentration of various organochlorine pesticides.

The external standard quantitation discussed in the method is used to quantitate all pesticides. The retention time window is calculated for each pesticide after adjusting the GC operating conditions for the routine retention times of 4,4'-DDT. The GC/electron capture detector (ECD) is initially calibrated at a minimum of five concentrations with the exception of two compounds, diallate and chlorobenzilate. The average calibration factor is acceptable if the relative standard deviation (RSD) for the calibration factors at each level does not exceed 20 percent. Concentration of the components in a standard varies depending on the response of the compounds in the analytical system. Breakdown of 4,4'-DDT and endrin is also monitored; breakdown may not exceed 20 percent. A single point initial calibration using the low standard will be performed for diallate and chlorobenzilate. If these compounds are detected in any samples, a five-point calibration will be performed and the samples will be reanalyzed. The single-point calibration check analyses are performed at the beginning and end of each analytical sequence, as required by Method 8080. A single-point calibration check must agree within ±15 percent of the multipoint response; otherwise, the instrument is recalibrated.

Section 9
INTERNAL QUALITY CONTROL

Internal QC procedures to be used for laboratory testing and analysis are presented in Table A-3. Tables A-4, A-5, and A-6 present detailed listings of tolerance limits for QCCSs, matrix spike analyses, and surrogate spike recoveries, respectively. QC samples will be prepared and analyzed according to the descriptions presented in Section 7 of this QAPP.

Most analytical methods to be used in this project require the measurement system to initially satisfy specific criteria for calibration linearity, reference material recovery, and freedom from contamination. Results of control samples, which are analyzed at a 5 to 10 percent frequency to monitor any changes in the quality of data being produced, indicate which corrective actions are necessary to correct an out-of-control condition. An out-of-control condition is defined as:

- Detection of any compounds of interest in a method blank at concentrations equal to or greater than the reporting limit (or required detection limit);
- Failure to meet the acceptance criteria for recovery of any compound of interest in a QC sample; or
- Exceeding the acceptance criteria for matrix spike recovery and subsequent failure to meet the acceptance criteria for a QCCS for the same parameter(s). Any parameter that fails the matrix spike test but passes the QCCS test will be flagged as suspect for the parameter due to matrix effects.

When an out-of-control situation is detected, efforts will be undertaken to determine the cause. Corrective actions for routine QC checks are outlined in Table A-3. Procedures related to corrective actions are described below.

During the course of the LTM program at the sewage lagoons, it will be the responsibility of the laboratory staff, team leader, task leaders, and other project team members to see that all measurement procedures are followed as specified and that measurement data meet the prescribed acceptance criteria. In the event a problem arises, it is imperative that prompt action be taken to correct the problem(s). Laboratory analysts and/or supervisors will initiate corrective action in the event of QC results that exceed acceptance criteria specified in Table A-3. Corrective action may also be initiated upon identification of some other problems or potential problems. Corrective action may also be initiated by the laboratory quality officer if QC data or other anomalies are noted during data review. Within 24 hours of the identification of a QC problem that will compromise data quality, the USACE project manager or chemist will be verbally notified.

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

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

Both analyses will be reported. A brief description of the analysis and the corrective action taken will be included in the laboratory report. These corrective actions are summarized in Table A-3.

9.1 Method Blank

A method blank is an aliquot of reagent water, or clean solid matrix, taken through the analytical process as though it were an actual sample. The purpose of a method blank analysis is to monitor and control laboratory sources of contamination. At a minimum, one laboratory method blank will be analyzed for each analytical or preparation batch.

9.2 Equipment Blank

An equipment blank is an aliquot of ASTM Type II water poured over or through the sampling equipment. The equipment blank demonstrates that the sampling equipment has been adequately cleaned. For groundwater samples, equipment blanks will be collected at a 10 percent frequency and analyzed for all matrices and parameters for which the investigative samples are analyzed.

9.3 Matrix Spike

An MS is a split from a field sample spiked with known concentrations of reference materials and taken through the entire preparation and analytical measurement procedures. The MS allows the laboratory to assess the efficiency of extraction/digestion, accuracy of the analysis, and possible matrix effects. MS analyses will be performed on a 5 percent frequency for each matrix as required by SW-846.

9.4 Matrix Spike Duplicate

An MSD is a second aliquot of the same sample as the MS that is also spiked. Method precision for the matrix can be estimated by calculating the RPDs between the recoveries of the spiking compounds. MSD analyses will be performed on a 5 percent frequency for each matrix.

9.5 Duplicate Sample

Duplicate solid samples will be collected by splitting a single into two equal parts for the purpose of analysis. Duplicate water samples will be included in the project by collecting two samples from the same location at the same time. Unique sample numbers will be assigned to field duplicates so that they will be indistinguishable from other analytical samples. The purpose of collecting and analyzing duplicate samples is to provide a measure of method variability (i.e., total variability from imprecision in both sampling and analytical procedures). Duplicate samples will be collected at a frequency of 10 percent (1 per 10 or fewer samples) and analyzed for all matrices and parameters. Both QA duplicates (analyzed by USACE MRD laboratory) and QC duplicates (analyzed by contractor laboratory) will be included.

9.6 Quality Control Check Sample

A QCCS is a sample having a known concentration of reference materials spiked into an aliquot of deionized water. It is taken through the sample preparation process as well as the analytical measurement process. The purpose of a QCCS analysis is to determine whether failure to meet QC acceptance criteria for an MS is due to matrix interference in the sample, or to out-of-control conditions associated with the analytical system.

9.7 Surrogate Compound

Surrogates are organic compounds that are similar to analytes of interest in chemical composition, extraction, and chromatography, but which are not normally found in environmental samples. These compounds are spiked into all blanks, standards, samples, and spiked samples prior to extraction and analysis by the appropriate method. Percent recoveries are calculated and reported for each surrogate. Surrogate spike recoveries can be used to assess method accuracy of individual samples.

9.8 Internal Standard

Internal standards are similar in analytical behavior to the compounds of interest and are not affected by method or matrix interferences. Internal standard calibration procedures are followed for volatile and semivolatile organic analyses. One or more internal standards are added to all samples analyzed by these methods, including calibrations standards.

Section 10
DATA REDUCTION, VALIDATION, AND REPORTING

All analytical data generated will be extensively checked for accuracy and completeness. The data validation process consists of data generation, reduction, review, and reporting by the analytical laboratory. Data will be reviewed by the LTM program contractor QAC. Laboratory data reports will be submitted to USACE for QA review by USACE MRD laboratory.

10.1 Data Reduction, Validation, and Reporting by the Laboratory

The data analysis required to calculate sample concentrations will proceed according to procedures outlined in the analytical methods identified in Table A-1. Data reduction involves taking instrument responses or other raw data and calculating concentrations for each target analyte. Data validation involves examining the systems producing the data to be sure they are operating properly and quality objectives have been met. Data will be reviewed and validated by the analyst and/or laboratory manager. Data will be validated for conformance with method specifications, including:

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

The QC activities implemented in this project will provide a basis for assessing the accuracy and precision of all data. Frequencies and acceptance criteria for these tests are presented in Table A-3. Calculations are presented in Section 4 of this QAPP.

10.2 Data Review and Validation by the RFI Contractor

In addition, data will be reviewed by an independent party not associated with the laboratory (i.e., LTM program contractor QAC) to ensure that analytical results received from the laboratory are valid and meet the QA objectives. An example checklist used for this data review is presented in Figure 10-1. Data quality calculations used during this review to estimate precision and accuracy are presented in Section 4 of this QAPP.

10.3 Data Reduction and Reporting by the RFI Data Management Contractor

A data management plan is included in this QAPP to facilitate the organizing and reporting of investigation data and results. The Base environmental coordinator (BEC) will oversee all aspects of the work and will be responsible for ensuring that proper procedures are followed and that tracking of the accumulated data during the investigation is performed. The contractor will use a field notebook, soil boring logs, sample custody forms, sample labels, sample inventories, and laboratory logbooks to track and document project data. The BEC (or designee) will establish a data management plan to meet the data deliverable requirements of the Installation Restoration Program Information Management System (IRPIMS), and will collect all sample and analytical reports and submit them to the appropriate person for further evaluation.

There are five goals for the data management task:

- Provide timely access to an organized body of data to facilitate analysis and decision making throughout the investigation.

- Provide a useful index of project information;
- Present a useful index of project information;
- Communicate data to the U.S. Air Force electronically; and
- Report progress on the project.

This section will refer to the following documents:

- *Installation Restoration Program Information Management System (IRPIMS) Data Loading Handbook—Version 2.2*, January 1991.
- *Handbook to Support the Installation Restoration Program (IRP) Statements of Work, Vol. I: Remedial Investigation/ Feasibility Studies (RI/FS)*, May 1991.

These two documents will be referred to as the IRPIMS Data Loading Handbook and the IRP Handbook, respectively.

The data management plan presented below addresses data and report processing procedures, project file requirements, and project-related progress reporting procedures and documents. An example format for data presentation/reduction is provided and discussed. The data management system implemented by the contractor will be capable of accurately and quickly tracking all pertinent information associated with the project.

10.3.1 IRPIMS Reporting

The contractor will submit data to IRPIMS in accordance with the instructions in the latest version of the IRPIMS Data Loading Handbook, which is available at the beginning of the investigation. To perform this task, the contractor will establish a data management system plan to meet the requirements of IRPIMS and will have available the following minimum hardware and software configuration:

- IBM PC AT (80286 based, 8 Mhz minimum) microcomputer or functional equivalent configured with a hard disk of at least 30-MB capacity that is dedicated to IRPIMS data loading tasks, one floppy disk drive (minimum of 360 MB), 640 KB of RAM, and MS-DOS Version 3.3 or higher;
- No memory-resident software should be loaded in order that the maximum amount of memory is available on the system;
- A color monitor with an adaptor capable of a resolution of 640 x 480 pixels (minimum of EGA standard) will be useful (but is not required); and
- A 30286 math coprocessor is advised but is not required.

The ASCII data files specified in the IRPIMS Data Loading Handbook will be submitted on one of the following disk formats: 5.25 in. 360 KB (double density), 5.25 in. 1.2 MB (high density), 3.5 in. 720 KB (double density), or 3.5 in. 1.44 MB (high density). The contractor will deliver the IRPIMS data files to the U.S. Air Force Center for Environmental Excellence (AFCEE-ESO) in sequence according to a controlled time schedule identified in the IRPIMS Data Loading Handbook.

All contractor data deliverables will be sent to:

Environmental Restoration Division
ATTN: IRPIMS Data Management
AFCEE-ESO/ERD
Brooks AFB, TX 78235-5000

A transmittal letter must accompany data file submissions and state what contract and delivery order the submission is fulfilling, and identify which submission group and file names are included. Any files not required by the scope of work (SOW) will be noted in the transmittal letter

and references given to the sections of the SOW that excuse the omitted files. The contractor will obtain a current list of existing IRPIMS site and sampling location identifiers from the technical project manager (TPM). Data submitted in the IRPIMS data files will be in accordance with the appropriate valid value lists found in the appendix to the IRPIMS Data Loading Handbook.

All data submitted by the contractor will correspond exactly with the data contained in the original laboratory reports and other documents associated with sampling and laboratory contractual tasks. All files delivered by the contractor are to be error free and in compliance with the IRPIMS Data Loading Handbook. Any errors identified by AFCEE-ESO in the submission(s) will be corrected by Radian.

The contractor may use the current version of the IRPIMS Contractor Data Loading Tool (CDLT) to construct the IRPIMS data files. The data files will be checked with the IRPIMS Quality Control Tool (QC Tool) and for compliance with requirements in the IRPIMS Data Loading Handbook.

10.3.2 Data Analysis and Reporting

Analysis of data collected will follow three basic approaches:

- Tabular summarization;
- Graphical analysis; and
- Statistical analysis.

Tabular summarization will be used to present the results of all data collection efforts. Graphical and statistical analyses will be used to further determine the presence or absence of potential contaminants. Graphical methods are particularly useful for comparing detectable concentrations and detection limits with federal or state regulatory limits. Statistical methods are useful for determining whether detectable concentrations of naturally occurring constituents are significantly greater than "natural," or "background," concentrations.

The contractor will compile and report the data generated during the project in a timely fashion.

Tabular Summarization

Tables summarizing field and/or laboratory data will be generated from the project database. Data in the tables will be verified against hardcopy laboratory reports. Tables may present both results for each independent sample collected and a site summary using descriptive statistics (e.g., average, standard deviation, etc.). For laboratory data, both natural sample and QC sample results will be reported.

Tables will be used in the report as a convenient means of presenting a summary of the analytical results. Examples of the types of reports to be presented in these reports is presented in Figures 10-2 through 10-10. Analytical laboratory reports will be stored at the site for a minimum of five years and will be made available to agency reviewers upon request. Surveyed sample locations will also be presented on tables as well as on figures.

Graphical Analysis

Graphs of data may be generated to pictorially present analytical data. Types of graphs developed may include:

- Scatter plots of sample concentrations with threshold lines indicating regulatory or health-based limits;
- Vertical bar charts; and
- Contour plots.

Statistical Analysis

Statistical methods will be used to determine if detectable concentrations of inorganic constituents at a site are significantly greater than concentrations that occur naturally.

Analytical Data Review

Lab/Work Order:	Sample Matrix: *(circle one)* Soil Groundwater
Report Date:	**Method:**
Reviewer:	**Review Date:**

Acceptable: ____ Yes ____ No *(circle or explain)*

Hard Copy / Reissue / Database Change / Raw Data

Adherence to Holding Time Requirements:

____ All preparation and analysis holding time requirements were met.

____ The following holding time violations are noted:

Corrections/Information Required: *(provide explanation)*

Complete 4-page document found in Attachment B

Corrections/Information Received:

Verified By: _____ Date: _____

Figure 10-1. Example Data Review Checklist

TABLE B6 RESULTS OF INORGANIC ANALYSES FOR WATER SAMPLES, HOLLOMAN SEWAGE LAGOONS AND LAKES INVESTIGATION.

PARAMETER	SITE ID / LOCATION ID / SAMPLE ID: MW-09 / 9303-MW-09-01				MW-10 / 9303-MW-10-01				MW-11 / 9303-MW-11-01				MW-12 / 9303-MW-12-01			
E130.2 - Hardness (mg/L)																
Hardness, as CaCO3	16000		(250)	[25.00000]	20000		(250)	[25.00000]	14000		(250)	[25.00000]	12000		(250)	[25.00000]
E160.1 - Residue, Filterable (TDS) (mg/L)																
Total dissolved solids	37000		(10)	[1.000000]	44000		(10)	[1.000000]	40000		(10)	[1.000000]	37000		(10)	[1.000000]
SW6010 - Metals (mg/L)																
Antimony	-0.25	@	(0.1)	[1]	-0.46	@	(0.1)	[1]	0.5	@	(1)	[10]	0.053	@	(1)	[10]
Barium	0.016	@	(0.01)	[1]	0.015	@	(0.01)	[1]	0.031	@	(0.01)	[1]	0.018	@	(0.01)	[1]
Beryllium	-0.00021		(0.002)	[1]	0.0002	@	(0.002)	[1]	-0.00057		(0.002)	[1]	0.00016	@	(0.002)	[1]
Cadmium	0.013	@	(0.005)	[1]	0.01	@	(0.005)	[1]	0.012	@	(0.005)	[1]	0.013	@	(0.005)	[1]
Chromium	0.00042	@	(0.01)	[1]	-0.029	@	(0.01)	[1]	-0.0078	@	(0.01)	[1]	-0.013	@	(0.01)	[1]
Cobalt	-0.0073	@	(0.01)	[1]	-0.0031	@	(0.01)	[1]	0.0076	@	(0.01)	[1]	-0.0088	@	(0.01)	[1]
Copper	-0.012	@	(0.02)	[1]	-0.012	@	(0.02)	[1]	-0.01	@	(0.02)	[1]	-0.011	@	(0.02)	[1]
Nickel	0.0073	@	(0.02)	[1]	-0.0024	@	(0.02)	[1]	0.0026	@	(0.02)	[1]	-0.013	@	(0.02)	[1]
Silver	-0.018	@	(0.01)	[1]	-0.018	@	(0.01)	[1]	-0.007	@	(0.01)	[1]	-0.0032	@	(0.01)	[1]
Thallium	0.13	@	(0.1)	[1]	0.19	@	(0.1)	[1]	0.47	@	(0.1)	[1]	0.35	@	(0.1)	[1]
Tin	-0.048	@	(0.6)	[1]	-0.0089	@	(0.6)	[1]	0.021	@	(0.6)	[1]	0.035	@	(0.6)	[1]
Vanadium	-0.00072		(0.02)	[1]	0.0019	@	(0.02)	[1]	0.024	@	(0.02)	[1]	0.014	@	(0.02)	[1]
Zinc	-0.005	@	(0.02)	[1]	-0.0052	@	(0.02)	[1]	0.0037	@	(0.02)	[1]	-0.0049	@	(0.02)	[1]
SW7060 - Arsenic (mg/L)																
Arsenic	-0.01	@	(0.004)	[1]	0.012	@	(0.008)	[2]	-0.031	@	(0.016)	[4]	-0.011	@	(0.016)	[4]
SW7421 - Lead (mg/L)																
Lead	-0.012	@	(0.012)	[4]	-0.0188	@	(0.012)	[4]	-0.01	@	(0.006)	[2]	-0.008	@	(0.006)	[2]
SW7470 - Mercury (mg/L)																
Mercury	-0.00001		(0.00018)	[1]	-0.00001		(0.00018)	[1]	0	@	(0.00018)	[1]	0.00001		(0.00018)	[1]
SW7740 - Selenium (mg/L)																
Selenium	-0.0081	@	(0.005)	[1]	0.051		(0.005)	[1]	-0.019	@	(0.01)	[2]	0.018	@	(0.01)	[2]
SW7841 - Thallium (mg/L)																
Thallium	-0.0036	@	(0.02)	[4]	-0.0044	@	(0.02)	[4]	0.0024	@	(0.02)	[4]	-0.002	@	(0.02)	[4]
SW9012 - Total Cyanide (mg/L)																

Compiled: 14 September 1993 () = Reporting Limit [] = Factor ND = Not Detected NA = Not Applicable * - Value considered suspect, Refer to QC Report

NOTE: Reported results for sample IDs ending with a 'D' represent dissolved metals concentrations.

Figure 10-2. Example of Inorganic Data Report Table

TABLE B6 RESULTS OF ORGANIC ANALYSES FOR WATER SAMPLES, HOLLOMAN SEWAGE LAGOONS AND LAKES INVESTIGATION.

PARAMETER	MW-01 9303-MW-01-01				MW-02 9303-MW-02-01				MW-03 9303-MW-03-01				MW-04 9303-MW-04-01			
SW8080 - Organochlorine Pesticides and PCBs (ug/L)																
4,4'-DDD	ND		(0.0095)	[0.952380]	ND		(0.0096)	[0.956937]	ND		(0.0095)	[0.952380]	0.047	@	(0.0095)	[0.952380]
4,4'-DDE	ND		(0.0095)	[0.952380]	ND		(0.0096)	[0.956937]	ND		(0.0095)	[0.952380]	ND		(0.0095)	[0.952380]
4,4'-DDT	ND		(0.019)	[0.952380]	ND		(0.019)	[0.956937]	ND		(0.019)	[0.952380]	ND		(0.019)	[0.952380]
Aldrin	ND		(0.0095)	[0.952380]	ND		(0.0096)	[0.956937]	ND		(0.0095)	[0.952380]	ND		(0.0095)	[0.952380]
Dieldrin	ND		(0.0095)	[0.952380]	0.017	@	(0.0096)	[0.956937]	0.02	X@	(0.0095)	[0.952380]	ND		(0.0095)	[0.952380]
Endosulfan I	ND		(0.0095)	[0.952380]	ND		(0.0096)	[0.956937]	ND		(0.0095)	[0.952380]	ND		(0.0095)	[0.952380]
Endosulfan II	ND		(0.029)	[0.952380]	0.017	J	(0.029)	[0.956937]	0.022	J	(0.029)	[0.952380]	ND		(0.029)	[0.952380]
Endosulfan Sulfate	0.0084	J	(0.048)	[0.952380]	0.013	J	(0.048)	[0.956937]	0.018	J	(0.048)	[0.952380]	0.038	J	(0.048)	[0.952380]
Endrin	ND		(0.0095)	[0.952380]	ND		(0.0096)	[0.956937]	0.02	X@	(0.0095)	[0.952380]	ND		(0.0095)	[0.952380]
Endrin Aldehyde	ND		(0.019)	[0.952380]	0.0044	JX	(0.019)	[0.956937]	ND		(0.019)	[0.952380]	0.04	G@	(0.019)	[0.952380]
Heptachlor	ND		(0.0095)	[0.952380]	ND		(0.0096)	[0.956937]	ND		(0.0095)	[0.952380]	ND		(0.0095)	[0.952380]
Heptachlor epoxide	0.016	X@	(0.0095)	[0.952380]	0.0085	J	(0.0096)	[0.956937]	0.016	@	(0.0095)	[0.952380]	0.37	G	(0.0095)	[0.952380]
Isodrin	ND		(0.0095)	[0.952380]	ND		(0.0096)	[0.956937]	ND		(0.0095)	[0.952380]	ND		(0.0095)	[0.952380]
Kepone	ND		(0.0095)	[0.952380]	ND		(0.0096)	[0.956937]	ND		(0.0095)	[0.952380]	ND		(0.0095)	[0.952380]
Methoxychlor	ND		(0.048)	[0.952380]	ND		(0.048)	[0.956937]	ND		(0.048)	[0.952380]	0.016	JX	(0.048)	[0.952380]
Toxaphene	ND		(0.48)	[0.952380]	ND		(0.48)	[0.956937]	ND		(0.48)	[0.952380]	ND		(0.48)	[0.952380]
alpha-BHC	ND		(0.0095)	[0.952380]	ND		(0.0096)	[0.956937]	ND		(0.0095)	[0.952380]	0.1	X	(0.0095)	[0.952380]
alpha-Chlordane	ND		(0.0095)	[0.952380]	0.0083	JX	(0.0096)	[0.956937]	0.015	X@	(0.0095)	[0.952380]	ND		(0.0095)	[0.952380]
beta-BHC	ND		(0.0095)	[0.952380]	ND		(0.0096)	[0.956937]	ND		(0.0095)	[0.952380]	ND		(0.0095)	[0.952380]
delta-BHC	ND		(0.0095)	[0.952380]	ND		(0.0096)	[0.956937]	0.035	X@	(0.0095)	[0.952380]	ND		(0.0095)	[0.952380]
gamma-BHC	ND		(0.0095)	[0.952380]	0.016	X@	(0.0096)	[0.956937]	0.018	X@	(0.0095)	[0.952380]	0.059	X	(0.0095)	[0.952380]
gamma-Chlordane	ND		(0.0095)	[0.952380]	0.042	X@	(0.0096)	[0.956937]	0.026	X@	(0.0095)	[0.952380]	0.072	X	(0.0095)	[0.952380]

Compiled: 14 September 1993 () = Reporting Limit [] = Factor ND = Not Detected NA = Not Applicable * - Value considered suspect, Refer to QC Report

NOTE: Reported results for sample IDs ending with a 'D' represent dissolved metals concentrations.

Figure 10-3. Example of Organic Data Report Table

TABLE C7 SUMMARY OF BLANK RESULTS, WATER SAMPLES, HOLLOMAN SEWAGE LAGOONS AND LAKES INVESTIGATION

Analyte	Number of Blanks	Number Above Reporting Limit	Concentration Range
SW7421 - Lead, (mg/L)			
Type of Blank : Equipment Blank			
Lead	3	2	0.00 - 0.0039
Type of Blank : Method Blank			
Lead	7	0	-0.0010 - 0.0021
SW7470 - Mercury, (mg/L)			
Type of Blank : Equipment Blank			
Mercury	3	0	-0.00011 - 0.00
Type of Blank : Method Blank			
Mercury	3	0	-0.00010 - 0.00
SW7740 - Selenium, (mg/L)			
Type of Blank : Equipment Blank			
Selenium	3	0	-0.0026 - 0.00
Type of Blank : Method Blank			
Selenium	5	0	-0.0019 - 0.0011
SW7841 - Thallium, (mg/L)			
Type of Blank : Equipment Blank			
Thallium	3	0	-0.00060 - 0.0015
Type of Blank : Method Blank			
Thallium	6	0	-0.00080 - 0.0010
SW8080 - Organochlorine Pesticides and PCBs, (ug/L)			
Type of Blank : Equipment Blank			
4,4'-DDD	4	0	NC
4,4'-DDE	4	0	NC
4,4'-DDT	4	0	NC
Aldrin	4	1	0.020 - 0.020
Dieldrin	4	0	NC
Endosulfan I	4	0	NC
Endosulfan II	4	0	0.015 - 0.015
Endosulfan Sulfate	4	0	0.033 - 0.034
Endrin	4	0	0.0024 - 0.0090
Endrin Aldehyde	4	0	0.0080 - 0.0080
Heptachlor	4	3	0.18 - 0.27
Heptachlor epoxide	4	1	0.0040 - 0.082
Isodrin	4	0	NC
Kepone	2	0	NC
Methoxychlor	4	0	NC

Compiled: 7 July 1993 ND = Not Detected NC = Not Calculable C7-2

Figure 10-4. Example of Summary Blank Results

TABLE C8 DETAILED LISTING OF BLANK RESULTS, WATER SAMPLES, HOLLOMAN SEWAGE LAGOONS AND LAKES INVESTIGATION

DATE ANALYZED	SAMPLE ID	BATCH ID	RESULT	REPORTING LIMIT	UNITS	FACTOR
Method : SW8080						
Analyte : PCB-1254						
Type of Blank : Equipment Blank						
16 December 1992	92-12-05-03	GC692121612-14	ND	0.19	ug/L	0.95238
19 December 1992	92-12-23-03	GC792121812-14	ND	0.19	ug/L	0.970873
26 March 1993	9303-MW-17-03	CHGC1_3032512	ND	0.19	ug/L	0.961538
Total Number of Blanks = 3			Concentration Range NC			
Total Number above Reporting Limit = 0			Maximum Reporting Limit = 0.19			
Type of Blank : Method Blank						
16 December 1992	METHOD BLANK	GC692121612-14	ND	0.2	ug/L	1
17 December 1992	METHOD BLANK	GC692121612-14	ND	0.2	ug/L	1
18 December 1992	METHOD BLANK	GC792121812-14	ND	0.2	ug/L	1
19 December 1992	METHOD BLANK	GC792121812-31	ND	0.2	ug/L	1
26 March 1993	METHOD BLANK	CHGC1_303251201	ND	0.2	ug/L	1
9 April 1993	METHOD BLANK	CHGC6_304081201	ND	0.2	ug/L	1
Total Number of Blanks = 6			Concentration Range NC			
Total Number above Reporting Limit = 0			Maximum Reporting Limit = 0.2			
Method : SW8080						
Analyte : PCB-1260						
Type of Blank : Equipment Blank						
16 December 1992	92-12-05-03	GC692121612-14	ND	0.19	ug/L	0.95238
19 December 1992	92-12-23-03	GC792121812-14	NO	0.19	ug/L	0.970873
26 March 1993	9303-MW-17-03	CHGC1_3032512	ND	0.19	ug/L	0.961538
Total Number of Blanks = 3			Concentration Range NC			
Total Number above Reporting Limit = 0			Maximum Reporting Limit = 0.19			
Type of Blank : Method Blank						
16 December 1992	METHOD BLANK	GC692121612-14	ND	0.2	ug/L	1
17 December 1992	METHOD BLANK	GC692121612-14	ND	0.2	ug/L	1
18 December 1992	METHOD BLANK	GC792121812-14	ND	0.2	ug/L	1
19 December 1992	METHOD BLANK	GC792121812-31	ND	0.2	ug/L	1
26 March 1993	METHOD BLANK	CHGC1_303251201	ND	0.2	ug/L	1
9 April 1993	METHOD BLANK	CHGC6_304081201	ND	0.2	ug/L	1
Total Number of Blanks = 6			Concentration Range NC			

Compiled: 6 July 1993 ND = Not Detected NC = Not Calculable NA = Not Applicable C8-25
* - Value considered suspect, Refer to QC Report () = Data Flag
NOTE: Reported results for sample IDs ending with D represent dissolved metals concentractions

Figure 10-5. Example of Detailed Blank Results

TABLE C9 SUMMARY LISTING OF SPIKE RESULTS, WATER SAMPLES, HOLLOMAN SEWAGE LAGOONS AND LAKES INVESTIGATION

Analyte	Mean Recovery	Standard Deviation	Number of Samples	Below Acceptance	Above Acceptance	Acceptance Criteria
Method : E130.2 - Hardness						
Type of Spike : Laboratory Control						
Hardness, as CaC03	101.7	4.08	6	0	0	85-115
Type of Spike : Matrix Spike						
Hardness, as CaC03	97.5	7.58	6	0	0	75-125
Method : E160.1 - Residue, Filterable (TDS)						
Type of Spike : Laboratory Control						
Total dissolved solids	106.6	5.43	16	0	0	75-125
Method : SW6010 - Metals						
Type of Spike : Laboratory Control						
Antimony	100.8	5.79	12	0	0	80-120
Barium	96.4	3.96	8	0	0	80-120
Beryllium	98.4	4.40	10	0	0	80-120
Cadmium	95.8	2.76	8	0	0	80-120
Chromium	95.5	3.46	8	0	0	80-120
Cobalt	95.1	3.23	8	0	0	80-120
Copper	95.0	3.16	8	0	0	80-120
Nickel	97.0	3.59	8	0	0	80-120
Silver	93.5	5.18	8	0	0	80-120
Thallium	93.9	5.64	8	0	0	80-120
Tin	97.6	3.96	8	0	0	80-120
Vanadium	95.4	3.38	8	0	0	80-120
Zinc	96.9	2.90	8	0	0	80-120
Type of Spike : Matrix Spike						
Antimony	97.6	58.79	10	1	1	75-125
Barium	97.1	7.96	10	0	0	75-125
Beryllium	89.9	6.87	10	0	0	75-125
Cadmium	90.1	4.84	10	0	0	75-125
Chromium	87.9	6.08	10	0	0	75-125
Cobalt	85.3	6.93	10	0	0	75-125
Copper	94.6	5.04	10	0	0	75-125
Nickel	85.6	7.04	10	0	0	75-125
Silver	88.2	4.73	10	0	0	75-125
Thallium	86.8	8.65	10	1	0	75-125
Tin	86.5	7.72	10	1	0	75-125
Vanadium	93.0	6.57	10	0	0	75-125
Zinc	91.3	6.17	10	0	0	75-125

Date Compiled: 2 July 1993 ND = Not Detected NC = Not Calculable NS = Not Specified C9-1

Figure 10-6. Example of Summary Spike Results

TABLE C10 DETAILED LISTING OF SPIKE RESULTS, WATER SAMPLES, HOLLOMAN SEWAGE LAGOONS AND LAKES INVESTIGATION

Method : SW6010
Spiked Analyte : Cobalt, continued

Type of Spike : Matrix Spike

DATE ANALYZED	SAMPLE ID	BATCH ID	% RECOVERY
04/08/93	9303-MW-23-01-01D MS	EMJA61304081603	80.00
04/08/93	9303-MW-23-01-01D MSD	EMJA61304081603	77.00

Number of Samples	: 10	Below acceptance :	0
Mean % Recovery	: 85.3	Above acceptance :	0
Standard Deviation	: 6.93	Acceptance Criteria :	75-125

Method : SW6010
Spiked Analyte : Copper

Type of Spike : Laboratory Control

03/23/93	LCS	EMJA61303231602	96.00
03/23/93	LCS DUP	EMJA61303231602	96.00
03/29/93	LCS	EMJA61303291001	96.00
03/29/93	LCS DUP	EMJA61303291001	97.00
04/08/93	LCS	EMJA61304081602	90.00
04/08/93	LCS DUP	EMJA61304081602	90.00
04/08/93	LCS	EMJA61304081603	97.00
04/08/93	LCS DUP	EMJA61304081603	98.00

Number of Samples	: 8	Below acceptance :	0
Mean % Recovery	: 95.0	Above acceptance :	0
Standard Deviation	: 3.16	Acceptance Criteria :	80-120

Type of Spike : Matrix Spike

03/29/93	9303-MW-12-01 MS	EMJA61303291001	91.00
03/29/93	9303-MW-12-01 MSD	EMJA61303291001	94.00
04/08/93	9303-MW-BG-02-01 MS	EMJA61304081602	106.00
04/08/93	9303-MW-BG-02-01 MSD	EMJA61304081602	97.00
04/08/93	9303-MW-BG-02-01D MS	EMJA61304081602	89.00
04/08/93	9303-MW-BG-02-01D MSD	EMJA61304081602	94.00
04/08/93	9303-MW-23-01-01 MS	EMJA61304081603	92.00
04/08/93	9303-MW-23-01-01 MSD	EMJA61304081603	99.00
04/08/93	9303-MW-23-01-01D MS	EMJA61304081603	94.00
04/08/93	9303-MW-23-01-01D MSD	EMJA61304081603	90.00

Number of Samples	: 10	Below acceptance :	0
Mean % Recovery	: 94.6	Above acceptance :	0
Standard Deviation	: 5.04	Acceptance Criteria :	75-125

Date Compiled: 7 July 1993 ND = Not Detected NC = Not Calculable NS = Not Specified

* - Value is considered suspect, refer to QC Report () = Data Flag
NOTE: Reported results for sample IDs ending with D represent dissolved metals concentrations

Figure 10-7. Example of Detailed Spike Results

TABLE C11 PRECISION ESTIMATES BY SOURCE OF VARIABILITY, WATER SAMPLES, HOLLOMAN SEWAGE LAGOONS AND LAKES INVESTIGAT

Parameter	Number of Pairs	Range of Means	Units	Pooled SD	Pooled CV
E130.2 - Hardness					
Analytical Duplicate					
Hardness, as CaCO3	3	2100.0 - 16000.0	mg/L	40.82	0.7
Field Duplicate					
Hardness, as CaCO3	2	2150.0 - 12000.0	mg/L	50.00	2.3
Laboratory Control					
Hardness, as CaCO3	3	100.0 - 105.0	%	5.77	5.5
Matrix Spike					
Hardness, as CaCO3	3	95.0 - 100.0	% recvry	9.35	9.5
E160.1 - Residue, Filterable (TDS)					
Analytical Duplicate					
Total dissolved solids	2	4650.0 - 11000.0	mg/L	50.00	1.1
Field Duplicate					
Total dissolved solids	2	4600.0 - 36500.0	mg/L	500.00	1.4
Laboratory Control					
Total dissolved solids	7	98.5 - 113.5	%	2.41	2.3
SW6010 - Metals					
Field Duplicate					
Antimony	6	ND - ND	mg/L	NC	NC
Barium	7	0.016 - 0.17	mg/L	0.02	27.0
Beryllium	7	ND - 0.0014	mg/L	0.00	64.3
Cadmium	7	ND - 0.010	mg/L	0.00	46.2
Chromium	7	ND - 0.039	mg/L	0.01	67.3
Cobalt	7	ND - ND	mg/L	NC	NC
Copper	7	ND - 0.026	mg/L	0.00	2.8
Nickel	7	ND - 0.011	mg/L	0.01	122.3
Silver	7	ND - ND	mg/L	NC	NC
Thallium	7	ND - 0.26	mg/L	0.13	52.7
Tin	7	ND - ND	mg/L	NC	NC
Vanadium	7	ND - 0.13	mg/L	0.01	19.1
Zinc	7	ND - 0.055	mg/L	0.01	30.2
Laboratory Control					
Antimony	6	96.0 - 105.5	%	5.56	5.4
Barium	4	90.0 - 99.0	%	0.35	0.4
Beryllium	3	91.0 - 104.0	%	0.00	0.0
Cadmium	4	91.5 - 98.0	%	0.50	0.5
Chromium	4	90.0 - 98.0	%	0.50	0.5
Cobalt	4	90.0 - 97.0	%	0.79	0.8
Copper	4	90.0 - 97.5	%	0.50	0.5

Compiled: 6 July 1993 C11-1

NC = Not Calculable ND = Not Detected Statistics include only detected concentrations.

Figure 10-8. Example of Summary Duplicate Results

TABLE C12 DETAILED LISTING OF DUPLICATE RESULTS, WATER SAMPLES, HOLLOMAN SEWAGE LAGOONS AND LAKES INVESTIGATION

Parameter	Sample ID	Duplicate Sample ID	Value		Duplicate Value		Mean Value	Standard Deviation	RPD (%)
Arsenic	9303-MW-12-01 MS	9303-MW-12-01 MSD	83		86		84.5	2.1	4
Method = SW7060 - Arsenic, cont.									
Type = Matrix Spike (%), cont.									
Arsenic	9303-MW-23-01-01 MS	9303-MW-23-01-01 MSD	58	(Q)	49	(Q)	53.5	6.4	17
Arsenic	9303-MW-23-01-01D MS	9303-MW-23-01-01D MSD	0	(Q)	0	(Q)	0	0.0	NC
Arsenic	9303-MW-BG-02-01 MS	9303-MW-BG-02-01 MSD	107		104		105.5	2.1	3
Arsenic	9303-MW-BG-02-01D MS	9303-MW-BG-02-01D MSD	108		110		109	1.4	2
Method = SW7421 - Lead									
Type = Field Duplicate (mg/L)									
Lead	9303-MW-04-01-01	9303-MW-04-01-02	-0.00	(@)	0.002	(@)	0	0.0	NC
Lead	9303-MW-04-01-01D	9303-MW-04-01-02D	-0.00	(@)	-0.004	(@)	-0.003	0.0	67
Lead	9303-MW-12-01	9303-MW-12-02	-0.00	(@)	-0.01	(@)	-0.009	0.0	22
Lead	9303-MW-23-01-01	9303-MW-23-01-02	-0.00	(@)	0	(@)	-0.003	0.0	200
Lead	9303-MW-23-01-01D	9303-MW-23-01-02D	-0.01	(@)	-0.004	(@)	-0.007	0.0	86
Lead	9303-MW-BG-02-01	9303-MW-BG-02-02	0.012	(@)	0.014	(@)	0.013	0.0	15
Lead	9303-MW-BG-02-01D	9303-MW-BG-02-02D	0.003	(@)	0	(@)	0.00175	0.0	200
Type = Laboratory Control (%)									
Lead	LCS	LCS DUP	104		108		106	2.8	4
Lead	LCS	LCS DUP	102		100		101	1.4	2
Lead	LCS	LCS DUP	104		102		103	1.4	2
Lead	LCS	LCS DUP	100		104		102	2.8	4
Lead	LCS	LCS DUP	108		106		107	1.4	2
Lead	LCS	LCS DUP	101		101		101	0.0	0
Type = Matrix Spike (%)									
Lead	9303-MW-12-01 MS	9303-MW-12-01 MSD	32	(Q)	28	(Q)	30	2.8	13
Lead	9303-MW-23-01-01 MS	9303-MW-23-01-01 MSD	64	(Q)	64	(Q)	64	0.0	0
Lead	9303-MW-23-01-01D MS	9303-MW-23-01-01D MSD	40	(Q)	48	(Q)	44	5.7	18
Lead	9303-MW-BG-02-01 MS	9303-MW-BG-02-01 MSD	88		86		87	1.4	2

Compiled: 6 July 1993

NC = Not Calculable ND = Not Detected () = Data Flag * - Value considered suspect, Refer to QC Report

NOTE: Reported results for sample IDs ending with D represent dissolved metals concentrations

Figure 10-9. Example of Detailed Duplicate Results

J16 DATE AND BATCH SUMMARY, WATER SAMPLES, Holloman Table 2 Phase 1 RFI

ANALYTICAL METHOD	ANALYTICAL BATCH ID	PREPARATION METHOD	PREPARATION BATCH ID	LEACHATE BATCH ID	DATE COLLECTED	DATE PREPARED	DATE LEACHED	DATE ANALYZED
Sample ID : 032-U01-01-01 MS								
SW6010 - Metals	EMJA61312202100	ICP Digestion	IDIG931217171000		12/6/93	12/17/93		12/20/93
SW6010 - Metals	EMJA61312302245	ICP Digestion	IDIG931217171000		12/6/93	12/17/93		12/30/93
SW7470 - Mercury	AAZ4__312162300	NONE			12/6/93	12/16/93		12/17/93
SW7740 - Selenium	AAZ3__312271430	GFAA Digestion	GDIG931217143000		12/6/93	12/17/93		12/27/93
SW8270 - Semivolatile Organics	MSMSD3312170854	Set Funnel extraction	3510931215141000		12/6/93	12/15/93		12/17/93
Sample ID : 032-U01-01-01 MSD								
SW6010 - Metals	EMJA61312202100	ICP Digestion	IDIG931217171000		12/6/93	12/17/93		12/20/93
SW6010 - Metals	EMJA61312302245	ICP Digestion	IDIG931217171000		12/6/93	12/17/93		12/30/93
SW7470 - Mercury	AAZ4__312162300	NONE			12/6/93	12/16/93		12/17/93
SW7740 - Selenium	AAZ3__312271430	GFAA Digestion	GDIG931217143000		12/6/93	12/17/93		12/27/93
SW8270 - Semivolatile Organics	MSMSD3312170854	Set Funnel extraction	3510931215141000		12/6/93	12/15/93		12/17/93
Sample ID : 032-U01-01-01 N								
SW6010 - Metals	EMJA61312202100	ICP Digestion	IDIG931217171000		12/6/93	12/17/93		12/20/93
SW6010 - Metals	EMJA61312302245	ICP Digestion	IDIG931217171000		12/6/93	12/17/93		12/30/93
SW7470 - Mercury	AAZ4__312162300	NONE			12/6/93	12/16/93		12/17/93
SW7740 - Selenium	AAZ3__312271430	GFAA Digestion	GDIG931217143000		12/6/93	12/17/93		12/27/93
SW8240 - Volatile Organics	MSMSDA402111131	METHOD			12/6/93			2/11/94
SW8270 - Semivolatile Organics	MSMSD3312170854	Set Funnel extraction	3510931215141000		12/6/93	12/15/93		12/17/93
Sample ID : 032-U01-01-01 ND								
SW6010 - Metals	EMJA61312202100	ICP Digestion	IDIG931217171000		12/6/93	12/17/93		12/20/93
SW6010 - Metals	EMJA61312302245	ICP Digestion	IDIG931217171000		12/6/93	12/17/93		12/30/93
SW7740 - Selenium	AAZ3__312271430	GFAA Digestion	GDIG931217143000		12/6/93	12/17/93		12/27/93

Compiled: 12 April 1994 N = Normal Sample MS = Matrix Spike MSD = Matrix Spike Duplicate FD = Field Duplicate J16-1
EB = Equipment Blank TB = Trip Blank ND = Analytical Duplicate

Figure 10-10. Example Data and Batch Report

Section 11
QUALITY ASSURANCE AUDITS

The purpose of QA audits discussed in this QAPP is to provide an objective, independent assessment of a measurement effort. QA auditing ensures that sample collection, data generating, data gathering, and measurement activities produce reliable and useful results. Cases can occur in which inadequacies are identified in the measurement system. In such cases, audits provide the mechanism for beginning the process of corrective action implementation.

With the exception of USACE MRD laboratory audits, no QA audits are scheduled. However, at the discretion of the Base or USACE, QA audits may be implemented.

QA audits play an important role in an overall QA/QC program. This section provides guidance descriptions of the role of the QA auditor and the nature of QA audits.

A QA auditor is the person who designs and/or performs QA performance and systems audits. Since QA audits represent, by definition, independent assessments of a measurement system and associated data quality, the auditor must be functionally independent of the measurement effort to ensure objectivity. However, the auditor must be familiar enough with the objectives, principles, and procedures of the measurement efforts to be able to perform a thorough and effective evaluation of the measurement system. Especially important is the ability to identify components of the system that are critical to overall data quality. For this reason, the audit focuses heavily on those elements. The auditor's technical background and experience should also provide a basis for appropriate audit standard selection, audit design, and data interpretation.

QA audits may include both internal and external audits of field and laboratory activities. External audits are those conducted by an independent organization or technical support group and may include participation in interlaboratory comparison studies and certification testing. Internal laboratory audits are conducted by the laboratory's QAC. External laboratory and field audits may be conducted by the LTM program contractor QAC if indicated during the program.

The following paragraphs describe the purpose of several types of audits and identify the questions that are, and are not, addressed by each type of audit.

11.1 Technical Systems Audits

A technical systems audit is an on-site, qualitative review of the various aspects of a total sampling and/or analytical system. It is an assessment of overall effectiveness. It represents an objective and insightful evaluation of a set of interactive systems with respect to strengths, deficiencies, and potential areas of concern. Typically, the audit consists of observations and documentation of all aspects of the measurement effort.

Technical systems audits should be based on the approved QAPP. These audits review questions regarding:

- Calibration procedures and documentation;
- Completeness of data forms, notebooks, and other reporting requirements;
- Data review and validation procedures;
- Data storage, filing, and record-keeping procedures;

- Sample custody procedures;
- Quality control procedures and documentation;
- Operating conditions of facilities and equipment;
- Documentation of maintenance activities; and
- Systems and operations overview.

Detailed systems audit checklists may be prepared prior to each audit. The checklist delineates the critical aspects of each methodology and measurement system, and are used by auditors to document all observations. The checklists are based on audit criteria specified by the QAC and the approved QAPP.

Technical systems audits do not answer quantitative questions about the measurement system. The organization's policies regarding the role of QA are not answered. Concerns involving assessments of the data quality indicators are also not addressed.

11.2 Performance Evaluation Audits

The purpose of performance evaluation audits is to quantitatively assess the measurement data quality. These audits provide a direct evaluation of the various measurement systems' capabilities to generate quality data. This is accomplished by challenging the measurement system with accepted reference standards. These reference standards may be submitted to the laboratory as if they were additional field samples; consequently, they provide an evaluation without the laboratory being aware of the audit.

Performance evaluation audits answer questions regarding the following:

- Accuracy and precision of the measurement system;
- The quality control data as compared with the actual data collected;
- The measurement system as a function of established control limits; and
- Significant deviations of the quality over time.

Although the answers to these questions will help determine when a system is out of control, questions as to the appropriate corrective action may not always be evident. Questions regarding qualitative issues, such as management policies, sample custody procedures, record keeping, and data handling systems are not addressed in a performance evaluation audit.

11.3 Audits of Data Quality

The purpose of data quality audits is to assess data quality indicators. Audits for data quality provide information required to characterize data quality by answering questions regarding:

- Adequacy of data recording and transfer;
- Precision and bias of resultant data;
- Adequacy of data calculation, generation, and processing;
- Documentation of procedures; and
- Identification of data quality indicators to inform users of limitations and applicability.

Audits of data quality answer questions of whether the data collection efforts need modifications, and whether the use and documentation of QC procedures are adequate. Audits of data quality do not, however, answer technical questions such as those concerning the operating conditions of facilities and equipment.

11.4 Postaudit Debriefing

Following each audit, a postaudit debriefing session is conducted. The purpose of this session is to discuss preliminary audit results with the audit participants. If the audit reveals a critical deficiency, recommendations for corrective

action should be presented. The debriefing session is followed by a detailed audit report that identifies areas of concern and recommendations for corrective actions.

Section 12
CORRECTIVE ACTION

During the course of the field investigation, it will be the LTM field investigations contractor team leader's responsibility to notify the USACE project manager of any situation prompting significant changes that may affect data quality (e.g., a change in sampling or borehole locations). Appropriate corrective actions to take will be determined by USACE. Monthly reports will include confirmation notices of all circumstances associated with corrective actions taken.

It will be the responsibility of the laboratory supervisor to see that all measurement procedures are followed as specified and that measurement data meet the prescribed acceptance criteria. In the event a problem arises, it is imperative that prompt action be taken to correct the problem. Problems requiring major corrective action will be documented by the use of "malfunction reporting forms." An example of such a form is presented in Figure 12-1. The project QAC will be included in the distribution for each malfunction report issued for this program to ensure prompt notification of the USACE project manager or chemist. The laboratory supervisor will initiate corrective action in the event that QC results that exceed acceptability limits or if some other problem or potential problem is identified.

Potential problems identified by the QAC on the basis of QC data or audit results may be documented by use of "Information Request Forms." An example of such a form is presented in Figure 12-2. Corrective action may also be initiated by the QAC on the basis of QC data, audit results, USACE CQARS, or responses to information requests. The USACE project manager or chemist will be notified of significant problems for concurrence with corrective actions implemented.

MALFUNCTION REPORT

Malfunction Report Number _____

Malfunction Type _____
1 - QC Limits Exceeded
2 - Documentation
3 - Other (explain)

Urgency Level _____
1 - Requires immediate attention
2 - Should be addressed within 7 days
3 - Requires written explanation within 14 days

Laboratory: _____ Reported to: _____

Location: _____ Position: _____

Contract: _____

Date/Time of Malfunction: _____ Date Reported: _____

Malfunction Reported by: _____

Matrix: ☐ Solid ☐ Water ☐ Air ☐ Other _____

Description of Problem: _____

Action: _____

Date/Time Resolved: _____ By Whom: _____

(Upon completion, send copies to distribution listed and return original to person who reported the malfunction.)

Distribution: _____ _____ _____ _____ _____ _____

White - Original Yellow - Laboratory Supervisor's Copy Pink - Originator's Copy

Figure 12-1. Malfunction Reporting Form

INFORMATION REQUEST

IR #: _____ **Distribution Copies To:** _____
TO: _____ _____
FROM: _____ _____
DATE: _____ _____

Project Reference: _____ **LAB Reference:** _____
Information Required:

Support Documentation Required: ☐ Yes ☐ No

Date Information Required: _____

Response:

Follow-up Required: ☐ Yes ☐ No

Additional Comments:

Date Resolved: _____ **Verified By:** _____

WHITE: Return with information YELLOW: Retain for your records PINK: File Copy GOLD: Originator's Copy

Revision 0: 5/88

4-88-30369

Figure 12-2. Information Request Form

Section 13
PREVENTIVE MAINTENANCE

The primary objective of a preventive maintenance program is to help ensure the timely and effective completion of a measurement effort. A preventive maintenance program is designed to minimize the down time of crucial sampling and/or analytical equipment because of expected or unexpected component failure. In implementing this program, efforts are focused on three primary areas:

- Establishment of maintenance responsibilities;
- Establishment of maintenance schedules for major and/or critical instrumentation and apparatus; and
- Establishment of an adequate inventory of critical spare parts and equipment.

Each of these efforts is discussed in the following sections.

13.1 Maintenance Responsibilities

Equipment and apparatus used in environmental measurement programs fall into two general categories:

- Equipment that is permanently assigned to a specific laboratory (e.g., metals laboratory, GC/MS laboratory, etc.); and
- Equipment that is available for field or laboratory use on an as-needed basis (e.g., field sampling equipment, mobile laboratories, etc.).

Maintenance responsibilities for permanently assigned equipment are assigned to the respective laboratory managers. The laboratory managers then establish maintenance procedures and schedules for each major equipment item. Specific responsibilities for specific items may be delegated to laboratory personnel, although the laboratory managers retain responsibility for ensuring adherence to prescribed protocol.

Nonassigned equipment includes field pH and conductivity meters, water level meter, thermometer, real-time monitoring instrumentation, and organic vapor analyzer or HNu instrumentation. Equipment in this category requires three related maintenance efforts:

- Ensuring that available equipment is functional and ready for use;
- Maintenance during use; and
- Check-out and servicing after use.

13.2 Maintenance Schedules

The effectiveness of any maintenance program depends to a large extent on adherence to specific maintenance schedules for each major equipment item. A schedule is established for all routine maintenance activities (Table 13-1). Note that this schedule will be subject to change should conditions warrant. Other maintenance activities may also be identified as requiring attention on an as-needed basis. In addition, field testing equipment (e.g., pH meters) will be inspected prior to use and serviced or replaced as necessary. Manufacturers' recommendations provide the primary basis for the established maintenance schedules, and manufacturers' service personnel provide primary maintenance for many major instruments (e.g., GC/MS instruments, atomic absorption spectrometers, analytical balances, etc.). Maintenance activities are documented in a maintenance log, which indicates the required frequency for each procedure and provides for dated entries. An example log is presented as Figure 13-1.

13.3 Spare Parts

Along with a schedule for maintenance activities, an adequate inventory of spare parts is required to minimize equipment down time. This inventory should emphasize those parts (and supplies) that:

- Are subject to frequent failure;
- Have limited useful lifetimes; or
- Cannot be obtained promptly should failure occur.

The supervising geologist and the respective laboratory managers will be responsible for maintaining an adequate inventory of necessary spare parts. Field task leaders will have names and phone numbers of vendor contacts to ensure that replacement parts or instrumentation can be received within 24 hours of instrument failure.

Table 13-1
Instrument Maintenance Schedule

Instrument	Maintenance	Frequency
AA	Tuning/Service Call	Quarterly
	Clean Fan Filter	Annually
	Replace Lamps	As Needed
	Change Tubing	As Needed
	Clean Windows	As Needed
	Clean or Replace Cones	As Needed
ICPES	Check Disc Drive	Daily
	Run Diagnostics	Daily
	Clean Torch	Weekly
	Clean Nebulizer	Weekly
	Clean Fan Filter	Monthly
	Replace Pump Oil	Quarterly
	Replace Tubing	As Needed
GC	Clean detector	As Neeed
	Replace Septa	As Needed
	Replace Column	As Needed
	Replace Injector Liners	As Needed
	Replace Splitter	As Needed
OVA-FID	Recharge or Replace Battery	As Needed
	Monitor Fuel and/or Combustion Air Supply Gauges	Hourly
	Perform Routine Maintenance as Described in the Manual	As Needed
	Check for Leaks	Daily
pH Meter	Check Fuse and Sensor	Weekly
	Clean Meter	As Needed
	Rinse Probe	After Each Measurement
Conductivity Meter	Clean Meter	As Needed
	Recharge or Replace Battery	As Needed
Water Level Meter	Clean Meter	As Needed
	Wipe Probe Dry and Place Into Probe Holder	After Each Measurement
	Recharge or Replace Battery	As Needed
Thermometer	Clean	As Needed
	Replace	If broken or mercury separates

Project No.
Book No. 23032 TITLE Maintenance - HF-#5

From Page No.

4-27-90 Installed new splitter, DB-608 on Side A (9572543) and DB-5 on Side B (9721141). Baked out for 24 hrs
HM, RSM
DB-608 (# 9639445) & DB-5 (#9672424) were taken off

6/22/90 New splitter installed; ≅ 15 in cut off of each column
HM, RSM

10/5/90 - cut off 1" from each column.
- Plugged off both detectors and cooked at 350°C for about 4 hours.
- Both columns were baked at 275°C for 4 hours with carrier gas flowing, but detached from the detector ends.
MBT.

10/24/90 - Replaced TCD splitter.
- Cut off ~12" from each column.
- All peaks - nice + sharp with no tailing.
MBT

10/29/90 - Both ECD signals are high. (150 + 300)
- took out both detectors + sent back to HP for cleaning.
Part # for ECD 14233 - 64570 - $515/each.
MBT.

To Page No.

Witnessed & Understood by me. | Date | Invented by | Date

Figure 13-1. Example of Maintenance Log

Section 14
QUALITY ASSURANCE REPORTING

Effective management of a field sampling and analytical effort requires timely assessment and review of field activities. This will require effective interaction and feedback among the team leader, QAC, field team members, and USACE.

The team leader and appropriate project team members will be responsible for keeping the QAC up to date regarding the status of their respective tasks so that quick and effective solutions can be implemented should any data quality problems arise. The use of DQCR also provides an effective mechanism for ensuring ongoing evaluation of measurement efforts. The DQCRs are submitted to the USACE project manager weekly. These DQCRs may address some or all of the following as appropriate:

- Weather conditions;
- Summary of activities and work performed;
- Summary of calibration data and QC data;
- Summary of unscheduled maintenance activities;
- Summary of problems and corrective actions taken;
- Health and safety levels and actions; and
- Work scheduled for the next day.

14.1 Quality Assurance Reporting

Major project reports will include QA/QC sections that summarize QC data collected during the program, as well as any major QA problems and resolutions. The QA/QC section in the final LTM plan will include an assessment of measurement accuracy, precision, and completeness as described in Sections 3 and 4 of this QAPP. It will also summarize any QC problems and resolutions that occurred during sample collection and any analytical anomalies experienced.

Problems requiring swift resolution will be brought to the immediate attention of the USACE project manager via the malfunction reporting/corrective action scheme discussed in Section 12.

14.2 QAPP Revisions

In the event that changes to the QAPP are needed, the following steps will be taken:

- Problems or deficiencies in the QAPP will be identified and discussed with the LTM contractor management team;
- The contractor management team will determine changes to be made;
- Potential changes will be submitted to the USACE project manager for approval;
- When approved by USACE project manager, the QAPP revisions will be submitted to EPA and NMED for review and approval; and
- When approved by EPA and NMED, the QAPP will be revised and changes will be implemented by the project team.

ATTACHMENT A
OF
APPENDIX B

Internal Quality Control Tables

Table A-1
Analytical Methods

Parameter	Preparation		Analysis		Reporting Limit[a,b]
	Technique	Method (Water)	Technique	Method (Water/Soil)	Water
METALS (mg/L or mg/kg)					
Aluminum	Acid Digestion	SW3005	ICPES	SW6010	0.1
Barium	Acid Digestion	SW3005	ICPES	SW6010	0.01
Beryllium	Acid Digestion	SW3005	ICPES	SW6010	0.002
Cadmium	Acid Digestion	SW3005	ICPES	SW6010	0.005
Chromium	Acid Digestion	SW3005	ICPES	SW6010	0.01
Chromium	Acid Digestion	SW3005	ICPES	SW6010	0.01
Cobalt	Acid Digestion	SW3005	ICPES	SW6010	0.01
Copper	Acid Digestion	SW3005	ICPES	SW6010	0.02
Iron	Acid Digestion	SW3005	ICPES	SW6010	0.1
Magnesium	Acid Digestion	SW3005	ICPES	SW6010	0.2
Manganese	Acid Digestion	SW3005	ICPES	SW6010	0.01
Nickel	Acid Digestion	SW3005	ICPES	SW6010	0.04
Potassium	Acid Digestion	SW3005	ICPES	SW6010	5
Silver	Acid Digestion	SW3005	ICPES	SW6010	0.01
Sodium	Acid Digestion	SW3005	ICPES	SW6010	5
Vanadium	Acid Digestion	SW3005	ICPES	SW6010	0.01
Zinc	Acid Digestion	SW3005	ICPES	SW6010	0.02
Antimony	Acid Digestion	SW3020	GFAA	SW7041	0.01
Arsenic	Acid Digestion	SW3020	GFAA	SW7060	0.005
Lead	Acid Digestion	SW3020	GFAA	SW7421	0.005
Mercury	Acid Digestion	SW7470	CVAA	SW7470/SW7471	0.0002
Selenium	Acid Digestion	SW3020	GFAA	SW7740	0.005
Thallium	Acid Digestion	SW3020	GFAA	SW7841	0.005
ORGANOCHLORINE PESTICIDES (μg/L)					
Aldrin	Extraction	SW3510/SW3520	GC/ECD	SW8080	0.005
alpha-BHC	Extraction	SW3510/SW3520	GC/ECD	SW8080	0.005
beta-BHC	Extraction	SW3510/SW3520	GC/ECD	SW8080	0.005
delta-BHC	Extraction	SW3510/SW3520	GC/ECD	SW8080	0.005
gamma-BHC (Lindane)	Extraction	SW3510/SW3520	GC/ECD	SW8080	0.005
Chlordane (technical)	Extraction	SW3510/SW3520	GC/ECD	SW8080	0.005
4,4'-DDD	Extraction	SW3510/SW3520	GC/ECD	SW8080	0.01
4,4'-DDE	Extraction	SW3510/SW3520	GC/ECD	SW8080	0.01
4,4'-DDT	Extraction	SW3510/SW3520	GC/ECD	SW8080	0.01
Dieldrin	Extraction	SW3510/SW3520	GC/ECD	SW8080	0.006
Endosulfan I	Extraction	SW3510/SW3520	GC/ECD	SW8080	0.005
Endosulfan II	Extraction	SW3510/SW3520	GC/ECD	SW8080	0.01
Endosulfan sulfate	Extraction	SW3510/SW3520	GC/ECD	SW8080	0.01

Table A-1
(Continued)

Parameter	Preparation		Analysis		Reporting Limit[a,b]
	Technique	Method (Water)	Technique	Method (Water/Soil)	Water
Endrin	Extraction	SW3510/SW3520	GC/ECD	SW8080	0.01
Endrin aldehyde	Extraction	SW3510/SW3520	GC/ECD	SW8080	0.01
Heptachlor	Extraction	SW3510/SW3520	GC/ECD	SW8080	0.005
Heptachlor epoxide	Extraction	SW3510/SW3520	GC/ECD	SW8080	0.005
Isodrin	Extraction	SW3510/SW3520	GC/ECD	SW8080	0.10
Methoxychlor	Extraction	SW3510/SW3520	GC/ECD	SW8080	0.05
Toxaphene	Extraction	SW3510/SW3520	GC/ECD	SW8080	0.25

- Reporting Limit is the minimum concentration of a substance that can be measured and reported for multiple instruments. Reporting Limits are highly matrix dependent and may not always be achievable. Reporting limits provided in this table are based on method detection limits and practical quantitation limit guidance found in SW-846, but are not MDLs or PQLs. Reporting limits listed are on a wet-weight basis.

CVAA = Cold Vapor Atomic Absorption
GC/ECD = Gas Chromatography/Electron Capture Device
GFAA = Graphite Furnace Atomic Absorption
ICPES = Inductively Coupled Plasma Emission Spectroscopy
N/A = Not Applicable
NS = Not Specified

Table A-2
Summary of Calibration Procedures

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
SW6010	Metals (ICPES)	Mixed Calibration Standards (2 concentrations)	Daily, and 10%	Measured value within ±10% of true value for element of interest	Repeat calibration
		Calibration blank	10%	All analytes <MRL	1) Rerun 2) Clean system 3) Reanalyze sample 4) Redigest samples if reanalysis fails
		Calibration check	10%	Measured value within ±10% of true value for element of interest	Repeat calibration
SW7041 SW7060 SW7421 SW7470 SW7471 SW7740 SW7841	Metals (AA)	Multipoint calibration (minimum of three concentrations)	Daily, prior to analyses	$r \geq 0.995$	1) Repeat test 2) Take corrective action 3) Repeat calibration and test
		Calibration Blank	10%, or minimum of one per batch	<MRL	1) Clean system 2) Reanalyze
SW8080	Organochlorine Pesticides and PCBs	Multipoint Calibration (minimum five points)	Initially, as required	RSD <20%	Repeat calibration
		Calibration Check Sample	Daily, beginning and end of sequence	Measured values ±15% of true values	Repeat 5-point calibration

RF = Response Factor
RPD = Relative Percent Difference
RSD = Relative Standard Deviation
MRL = Method Reporting Limit
NS = Not Specified
TRPH = Total Recoverable Petroleum Hydrocarbons
THF = Tetrahydrofuran

Table A-3
Summary of Internal Quality Control Procedures

Analytical Method	Parameter	Quality Control Check	Frequency[a]	Acceptance Criteria	Corrective Action
SW6010	Metals (ICPES)	Laboratory QC check sample (QCCS)	1 per digestion batch ≤20 samples	Measured value within ±20% of true value for element of interest	Analyze a second QCCS. If recovery for same analytes are still out, stop, identify, and correct problem before proceeding.
		Method blank	1 per digestion batch ≤20 samples	All analytes <MRL	1) Reanalyze. 2) Recalibrate. 3) Reanalyze. 4) Redigest samples if reanalysis fails.
		Matrix spike analysis	5%	75-125% Recovery	1) Analyze method spike (or QCCS). 2) If method spike is ok; flag data. 3) If method spike not ok; see lab supervisor and reanalyze samples.
		Matrix spike duplicate	5%	Relative percent difference ≤20% and 75-125% recovery	1) Analyze method spike (or QCCS). 2) If method spike is ok; flag data. 3) If method spike not ok; see lab supervisor and reanalyze samples.
		ICPES interference check	Run at beginning and end of daily run	80-120% of true value for EPA check sample elements	1) Repeat calibration. 2) See lab manager.
		ICP linear range check	Quarterly	Measured value within ±5% of expected value	Tests upper limit of ICP linear range.
		QA duplicate sample (USACE[b])	10%	None	Used to quantitate analytical variability.
		Field Duplicate field sample	10%	None	Determine sampling/analytical variability.
		Equipment blanks	5%, water samples only	None	Used to determine sources of contamination.
SW7041 SW7060 SW7421 SW7470 SW7471 SW7740 SW7841	Metals (AA)	Laboratory QC check sample (QCCS)	10%	Measured value within ±20% of expected value	Analyze a second QCCS. If recovery for same analytes are still out, stop, identify, and correct problem before proceeding.
		Preparation blank	10%	<MRL	1) Reanalyze. 2) Clean system. 3) Redigest and reanalyze.
		Matrix spike	5%	75-125% Recovery	1) Run check sample (QCCS). 2) Correct problem. 3) if QCCS fails, reanalyze samples. 4) If not, flag data.

Table A-3
(Continued)

Analytical Method	Parameter	Quality Control Check	Frequency[a]	Acceptance Criteria	Corrective Action
		Matrix Spike Duplicate	5%	Within 20% RPD and 75-125% Recovery	1) Run check sample (QCCS). 2) Correct problem. 3) If QCCS fails, reanalyze samples. 4) If not, flag data.
		QA duplicate sample (USACE[b])	10%	None	Will be used to determine sampling/ analytical variability.
		Field Duplicate sample	10%	None	Determine sampling/analytical variability.
		Equipment blank	5%, water samples only	None	Will be used to determine sources of contamination.
SW8080	Organochlorine Pesticides and PCBs	Laboratory DDT and endrin degradation check sample	Daily prior to analyses	Degradation ≤20% (see method)	1) Follow maintenance in Method 8000, see Section 7.7. 2) Recalibrate.
		Surrogate Spikes	Every sample	See Table A-6	1) Evaluate system 2) Recalculate data and/or reanalyze extract. 3) Analyze QCCS, if QCCS fails, reextract and reanalyze sample. 4) Flag data and report analysis and reanalysis results.
		Method Blank	5%	<MRL	Used to assess contamination.
		QC Check Sample (QCCS)	5%	See Table A-4	1) Evaluate system. 2) Repeat test for criteria that failed.
		Matrix Spike	5%	See Table A-5	1) Analyze QCCS. 2) Correct problem. 3) If QCCS is ok, flag data. 4) If QCCS is not ok, reanalyze samples.
		Matrix Spike Duplicate	5%	See Table A-5	1) Analyze QCCS. 2) Correct problem. 3) If QCCS is ok, flag data. 4) If QCCS is not ok, reanalyze samples.
		QA Duplicate Sample (USACE[b])	10%	None	Used to quantitate analytical variability.
		Field Duplicate field samples	10%	None	Will be used to determine analytical variability.

Table A-3
(Continued)

Analytical Method	Parameter	Quality Control Check	Frequency[a]	Acceptance Criteria	Corrective Action
SW8080 (cont.)		Equipment Blank	5%, water samples only	None	Used to assess sources of contamination.

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

[b] USACE required QA duplicate samples to be analyzed by USACE MRD Laboratory.

QCCS = Quality Control Check Sample
RPD = Relative Percent Difference
MRL = Method Reporting Limit

Table A-4
Summary of Tolerance Limits for Quality Control Check Samples

Analyte	Accuracy (% Recovery)		Precision (RPD)	
	Water	Soil	Water	Soil
METHOD SW6010				
Aluminum	80-120	80-120	20	20
Barium	80-120	80-120	20	20
Beryllium	80-120	80-120	20	20
Cadmium	80-120	80-120	20	20
Calcium	80-120	80-120	20	20
Chromium	80-120	80-120	20	20
Cobalt	80-120	80-120	20	20
Copper	80-120	80-120	20	20
Iron	80-120	80-120	20	20
Magnesium	80-120	80-120	20	20
Manganese	80-120	80-120	20	20
Nickel	80-120	80-120	20	20
Potassium	80-120	80-120	20	20
Silver	80-120	80-120	20	20
Sodium	80-120	80-120	20	20
Vanadium	80-120	80-120	20	20
Zinc	80-120	80-120	20	20
METHOD SW7041				
Antimony	75-125	75-125	20	20
METHOD SW7060				
Arsenic	75-125	75-125	20	20
METHOD SW7421				
Lead	75-125	75-125	20	20
METHODS SW7470 AND SW7471				
Mercury	75-125	75-125	20	20
METHOD SW7740				
Selenium	75-125	75-125	20	20
METHOD SW7841				
Thallium	75-125	75-125	20	20
METHOD SW8080				
Aldrin	42-122	42-122	50	50
gamma-BHC	32-127	32-127	50	50
4,4'-DDT	25-160	25-160	50	50
Dieldrin	36-146	36-146	50	50
Endrin	30-147	30-147	50	50
Heptachlor	34-111	34-111	50	50

Table A-4
(Continued)

[a] Tolerance Limits for target analytes not listed in Table A-4 are:
Accuracy (water and soil) 50-150% recovery;
Precision (water and soil) RPD ≤50.

D = Detected
N/A = Not Applicable
TRPH = Total Recoverable Petroleum Hydrocarbons
RPD = Relative Percent Difference

Table A-5
Summary of Tolerance Limits for Matrix Spike Analyses

Analyte	Accuracy (% Recovery)		Precision (RPD)	
	Water	Soil	Water	Soil
METHOD SW6010				
Aluminum	75-125	75-125	20	20
Barium	75-125	75-125	20	20
Beryllium	75-125	75-125	20	20
Cadmium	75-125	75-125	20	20
Calcium	75-125	75-125	20	20
Chromium	75-125	75-125	20	20
Cobalt	75-125	75-125	20	20
Copper	75-125	75-125	20	20
Iron	75-125	75-125	20	20
Magnesium	75-125	75-125	20	20
Manganese	75-125	75-125	20	20
Nickel	75-125	75-125	20	20
Potassium	75-125	75-125	20	20
Silver	75-125	75-125	20	20
Sodium	75-125	75-125	20	20
Vanadium	75-125	75-125	20	20
Zinc	75-125	75-125	20	20
METHOD SW7041				
Antimony	75-125	D-308	20	20
METHOD SW7060				
Arsenic	75-125	37-167	20	20
METHOD SW7421				
Lead	75-125	50-150	20	20
METHODS SW7470 AND SW7471				
Mercury	75-125	48-148	20	20
METHOD SW7740				
Selenium	75-125	49-149	20	20
METHOD SW7841				
Thallium	75-125	48-152	20	20
METHOD SW8080				
Aldrin	42-122	42-122	50	50
gamma-BHC	32-127	32-127	50	50
4,4'-DDT	25-160	25-160	50	50
Dieldrin	36-146	36-146	50	50
Endrin	30-147	30-147	50	50

Table A-5
(Continued)

Analyte	Accuracy (% Recovery)		Precision (RPD)	
	Water	Soil	Water	Soil
Heptachlor	40-131	53-125	50	50

D = Detected
TPRH = Total Recoverable Petroleum Hydrocarbons
RPD = Relative Percent Difference

Table A-6
Summary of Surrogate Spike Tolerance Limits

Surrogate Compound	Water (% Recovery)	Soil (% Recovery)
METHOD SW8080		
Tetrachloro-m-xylene	20-150	20-150
Dibutylchlorendate (DBC)	20-150	20-150

ATTACHMENT B
OF
APPENDIX B

Example Data Review Checklist

Analytical Data Review

Lab/Work Order:	Sample Matrix: *(circle one)* Soil Groundwater
Report Date:	Method:
Reviewer:	Review Date:

Acceptable: ____ Yes ____ No *(circle or explain)*

Hard Copy / Reissue / Database Change / Raw Data

Adherence to Holding Time Requirements:

____ All preparation and analysis holding time requirements were met.

____ The following holding time violations are noted:

Corrections/Information Required: *(provide explanation)*

Corrections/Information Received:

Verified By: _____ Date: _____

Quality Control Results

Review Question	Yes	No	Comments/Findings
1. Measurement results for all QAPP specified target analytes are reported.			
2. Were uncensored data reported?			
3. Are there comments for all flags requiring comments?			
4. Do the comments make sense?			
5. Was a method blank analyzed with each batch?			
6. Target analytes were not detected in method blank analyses above the detection limit.			
7. Target analytes were not detected in field blank analyses above the detection limit.			
8. Was an LCS/LCSD pair analyzed with each batch?			
9. LCS/LCSD recoveries are all within the QAPP specifications.			
10. Was an MS/MSD pair analyzed with each batch?			
11. Were the MS/MSD recoveries within QAPP specifications?			
12. Were the MS/MSD RPDs within QAPP specifications?			
13. No lab comments were included in report. If lab comments were provided, list the comments.			

Qualified Data

Method	Sample ID	Type	Batch	Analyte	Qualification

Other Comments

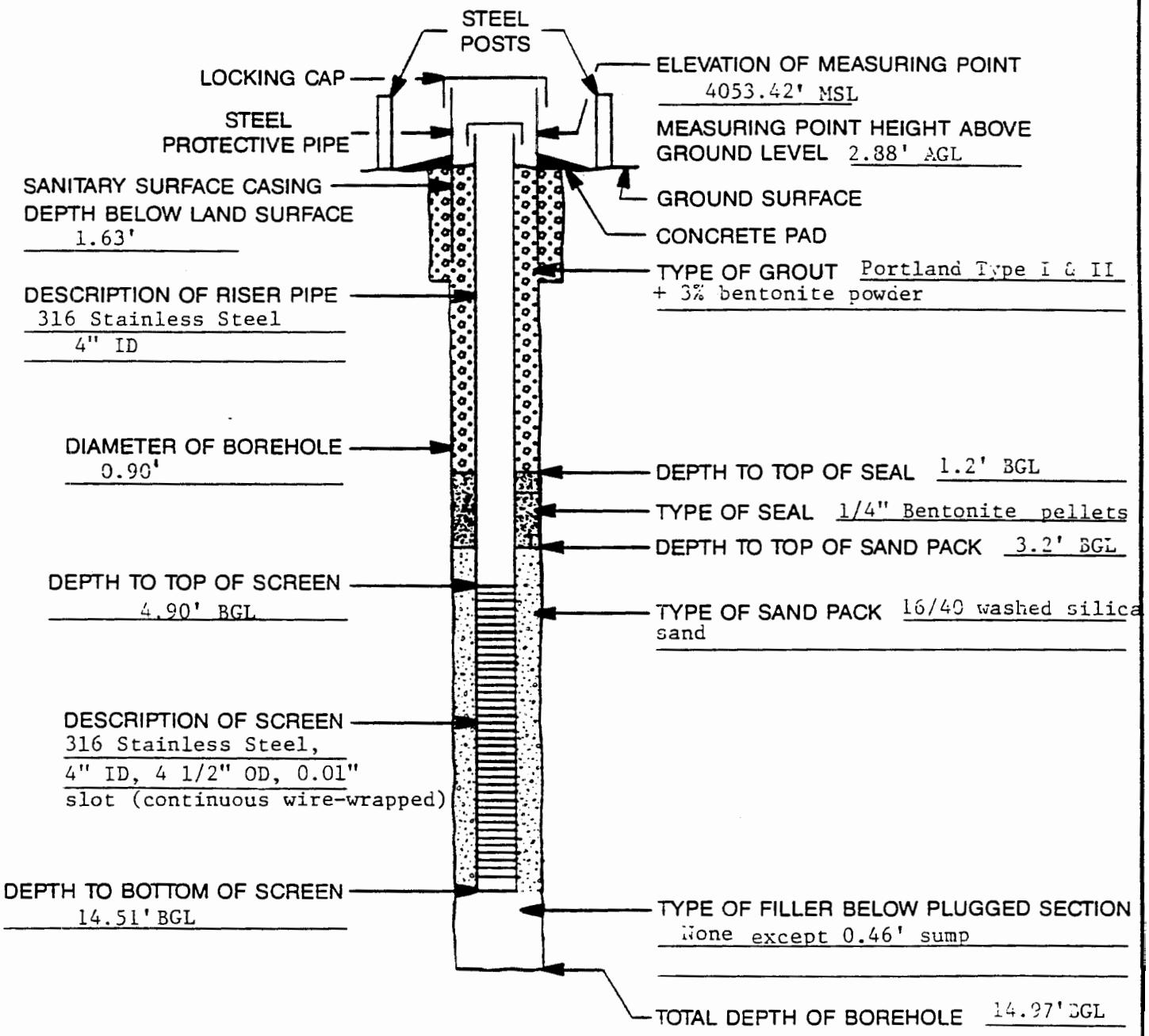
APPENDIX C

Well Completion Diagrams

WELL CONSTRUCTION SCHEMATIC

PROJECT Holloman AFB GWMP
SITE Sewage Lagoons - Upgradient Well
COORDINATES x=548,658.60 y=666,311.53
DATE COMPLETED 7/12/89
SUPERVISED BY H. M. Tomich - Radian Corp.
DRILLER Bob Kingsley, J. Winnek Drilling, Inc.
DRILLING METHOD Hollow Stem Auger

WELL NO. MW-1
AQUIFER Shallow
DEPTH TO WATER 9.73' BGL
0900 7/13/89

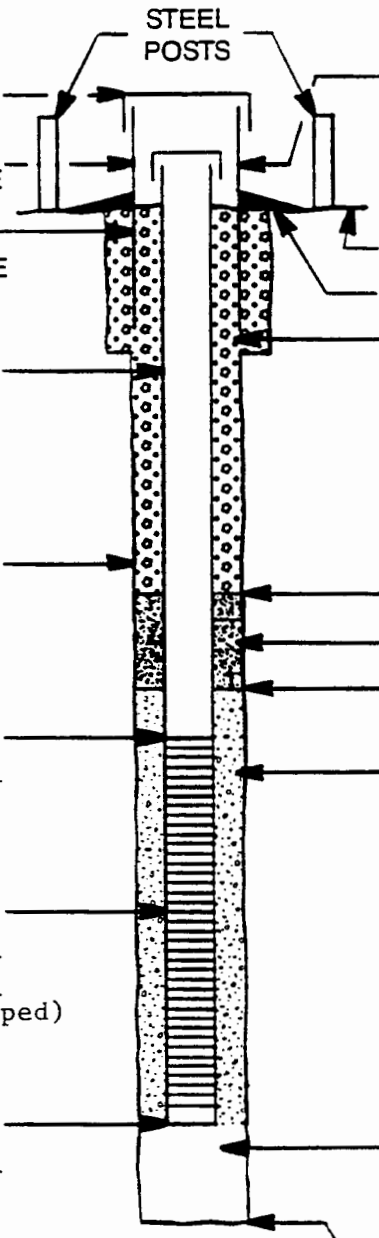


D87 - 1240A

WELL CONSTRUCTION SCHEMATIC

PROJECT Holloman AFB GWMP
SITE SW of Pond D (downgradient)
COORDINATES x=544,566.85 y=663,814.83
DATE COMPLETED 7/15/89
SUPERVISED BY H.M. Tomich - Radian Corp.
DRILLER Bob Kingsley, J. Winnek Drilling Inc.
DRILLING METHOD Hollow Stem Auger

WELL NO. MW-2
AQUIFER Shallow
DEPTH TO WATER 7.741 BGL
1448 7/15/89

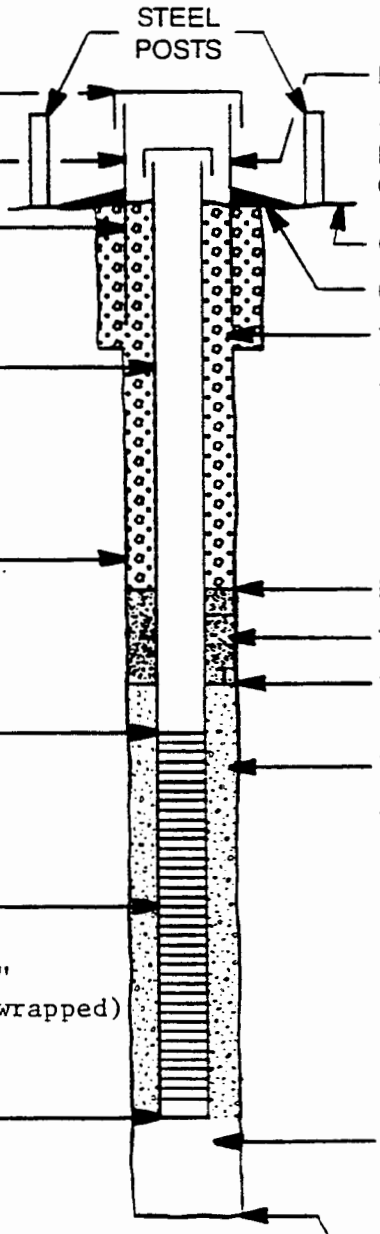


D87 - 12

WELL CONSTRUCTION SCHEMATIC

PROJECT Holloman AFB GWMP
SITE Downgradient of Lagoon G
COORDINATES X= 544,469.13 y=662,878.19
DATE COMPLETED 7/15/89
SUPERVISED BY H.M. Tomich - Radian Corp.
DRILLER Bob Kingslev, J. Winnek Drilling Inc.
DRILLING METHOD Hollow Stem Auger

WELL NO. MW-3
AQUIFER Shallow
DEPTH TO WATER 9.10' BGL
1005 7/15/89

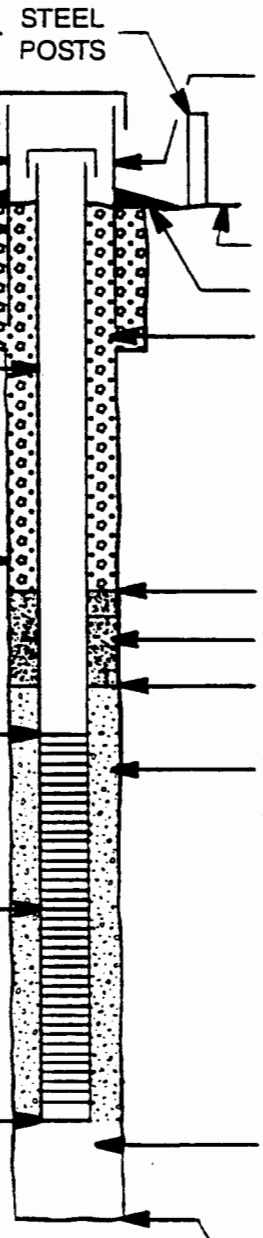


D87 - 1240A

WELL CONSTRUCTION SCHEMATIC

PROJECT Holloman AFB GWMP
SITE Downgradient of sewage lagoon G
COORDINATES y=545215.83 x=660699.42
DATE COMPLETED 7/13/89
SUPERVISED BY H.M. Tomich - Radian Corp.
DRILLER Bob Kingsley, J. Winnek Drilling, Inc.
DRILLING METHOD Hollow Stem Auger

WELL NO. MW-4
AQUIFER Shallow
DEPTH TO WATER 9.73' BGL
1325 7/13/89

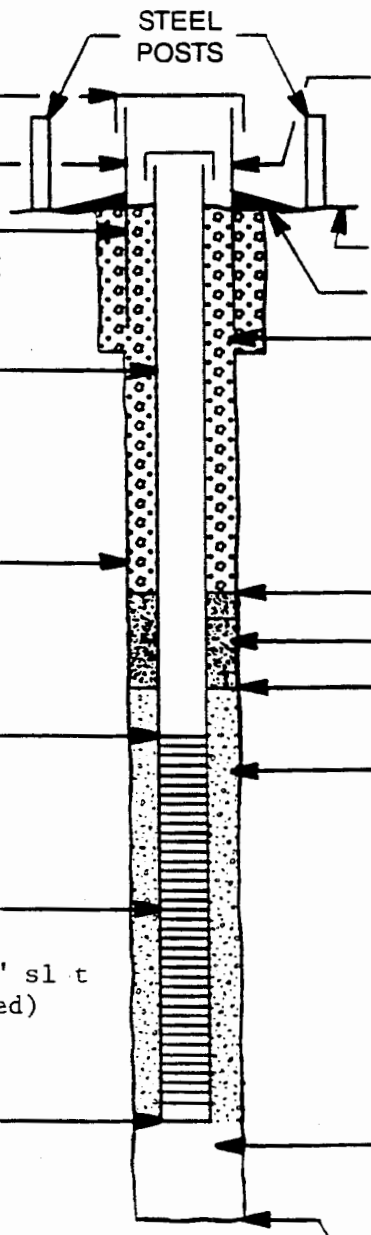


D87 -

WELL CONSTRUCTION SCHEMATIC

PROJECT Holloman AFB GWMP
SITE Downgradient of sewage Lagoon A
COORDINATES x=544,358.30 y=664,830.97
DATE COMPLETED 7/16/89
SUPERVISED BY H.M. Tomich - Radian Corp.
DRILLER Bob Kingsley - J. Winnek Drilling, Inc.
DRILLING METHOD Hollow Stem Auger

WELL NO. MW-5
AQUIFER Shallow
DEPTH TO WATER 5.37' BGL
7/22/89

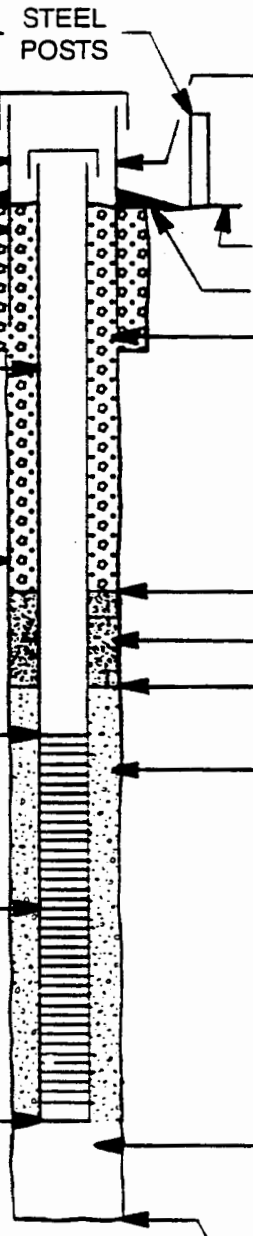


D87 - 1240A

WELL CONSTRUCTION SCHEMATIC

PROJECT Holloman AFB GWMP
SITE Downgradient of sewage lagoons
COORDINATES y=544970.02 x=661445.18
DATE COMPLETED 7/14/89
SUPERVISED BY H.M. Tomich - Radian Corp.
DRILLER Bob Kingsley, J. Winnek Drilling, Inc.
DRILLING METHOD Hollow Stem Auger

WELL NO. MW-6
AQUIFER Shallow
DEPTH TO WATER 10.1' BGL
1251 7/14/89



STEEL POSTS

LOCKING CAP

STEEL PROTECTIVE PIPE

SANITARY SURFACE CASING
DEPTH BELOW LAND SURFACE
1.6'BGL

DESCRIPTION OF RISER PIPE
316 Stainless Steel
4" ID

DIAMETER OF BOREHOLE
0.90'

DEPTH TO TOP OF SCREEN
4.52' BGL

DESCRIPTION OF SCREEN
316 Stainless Steel,
4" ID, 4 1/2" OD, 0.01" slot
(continuous wire-wrapped)

DEPTH TO BOTTOM OF SCREEN
14.53' BGL

ELEVATION OF MEASURING POINT
4031.21' MSL

MEASURING POINT HEIGHT ABOVE GROUND LEVEL 2.76' AGL

GROUND SURFACE

CONCRETE PAD

TYPE OF GROUT Portland Cement
Type I & II + powdered Bentonite

DEPTH TO TOP OF SEAL 1.0' BGL

TYPE OF SEAL 1/4" Bentonite pellets

DEPTH TO TOP OF SAND PACK 3.00' BGL

TYPE OF SAND PACK 16/40 washed
Silica Sand

TYPE OF FILLER BELOW PLUGGED SECTION
None except 0.46 sump

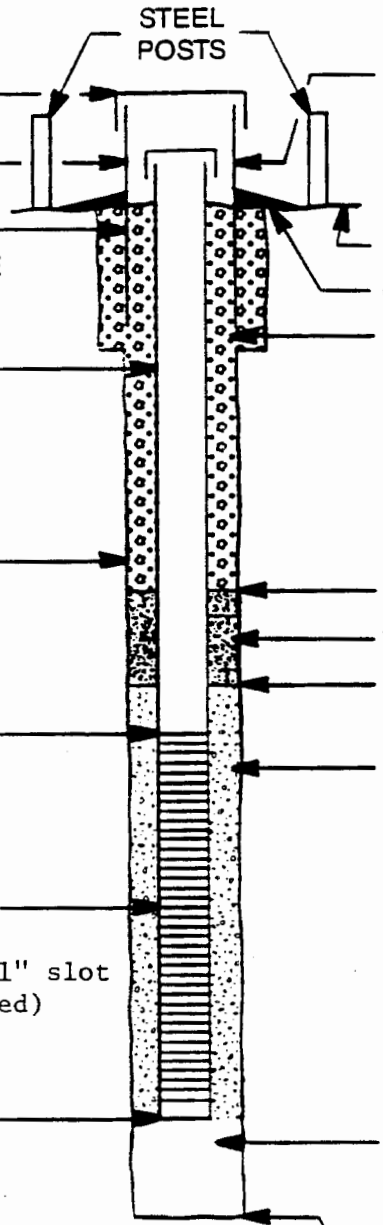
TOTAL DEPTH OF BOREHOLE 15.05' BGL

D87 - 12

WELL CONSTRUCTION SCHEMATIC

PROJECT Holloman AFB GWMP
SITE Downgradient of sewage lagoon A
COORDINATES x=544,379.85 y=665,147.61
DATE COMPLETED 7/17/89
SUPERVISED BY H.M. Tomich - Radian Corp.
DRILLER Bob Kingsley - J. Winnek Drilling, Inc.
DRILLING METHOD Hollow Stem Auger

WELL NO. MW-7
AQUIFER Shallow
DEPTH TO WATER 13.25'BGL
1140 7/17/89



STEEL POSTS

LOCKING CAP

STEEL PROTECTIVE PIPE

SANITARY SURFACE CASING DEPTH BELOW LAND SURFACE 1.64' BGL

DESCRIPTION OF RISER PIPE 316 Stainless Steel 4" ID

DIAMETER OF BOREHOLE 0.90'

DEPTH TO TOP OF SCREEN 4.72' BGL

DESCRIPTION OF SCREEN 316 stainless steel 4" ID, 4 1/2" OD, 0.01" slot (continuous wire-wrapped)

DEPTH TO BOTTOM OF SCREEN 14.73' BGL

ELEVATION OF MEASURING POINT 4039.88' MSL

MEASURING POINT HEIGHT ABOVE GROUND LEVEL 2.51'

GROUND SURFACE

CONCRETE PAD

TYPE OF GROUT Portland Cement Type I&II + powdered bentonite

DEPTH TO TOP OF SEAL 1.1' BGL

TYPE OF SEAL 1/4" Bentonite Pellets

DEPTH TO TOP OF SAND PACK 3.2'

TYPE OF SAND PACK 16/40 washed silica sand

TYPE OF FILLER BELOW PLUGGED SECTION None except 0.46' sump

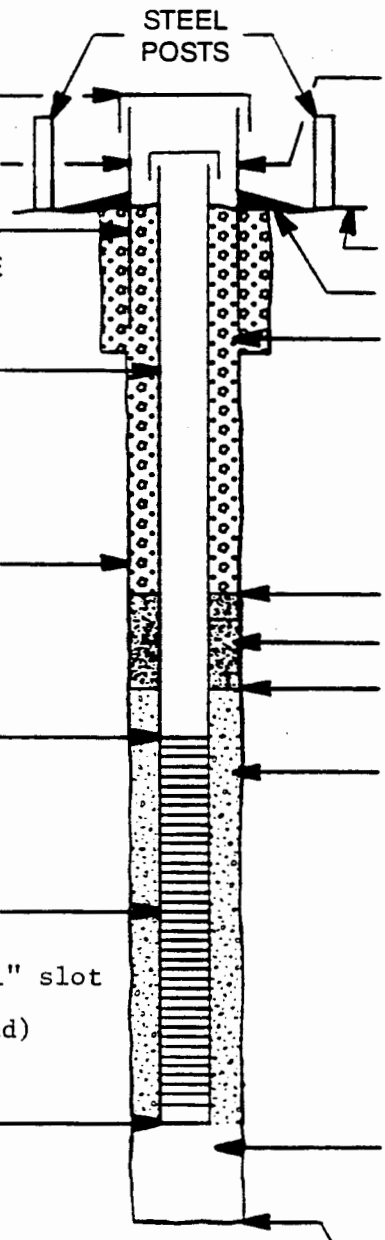
TOTAL DEPTH OF BOREHOLE 15.19' BGL

D87 - 1240A

WELL CONSTRUCTION SCHEMATIC

PROJECT Holloman AFB GWMP
SITE Sewage Lagoons between A&C westside
COORDINATES x=544,474.40 y=664,520.54
DATE COMPLETED 7/16/89
SUPERVISED BY H. M. Tomich - Radian Corp.
DRILLER Bob Kingsley - J. Winnek Drilling, Inc.
DRILLING METHOD Hollow Stem Auger

WELL NO. MW-8
AQUIFER Shallow
DEPTH TO WATER 9.88' BGL
0820 7/16/89

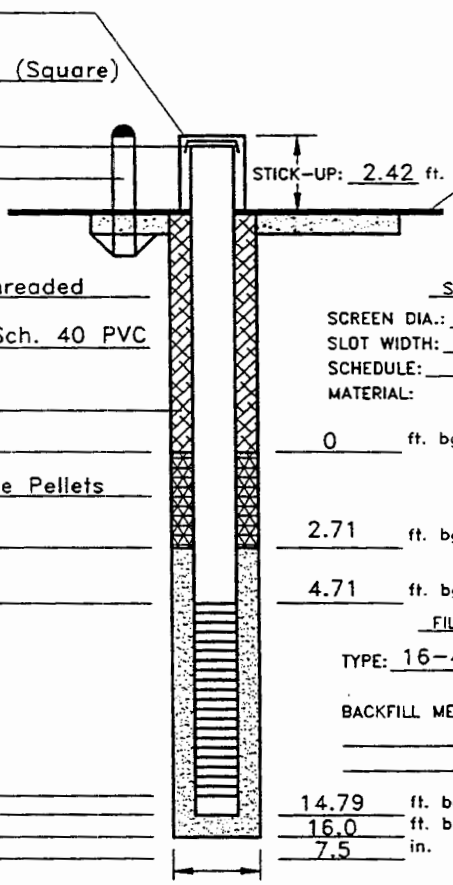


D87 - 12

ELEVATION GROUND WATER: NA			PROJECT: HAFB DETECTION MONITORING NETWORK
DATE INSTALLED: 14 FEB 92	STARTED: 0830	COMPLETED: 1115	LOCATION (Coordinates or Station): 666135.76(Y), 546007.93(X)
ELEVATION TOP OF CASING: 4045.81 ft. MSL			SIGNATURE OF INSPECTOR/INSTALLER: RP
DRILLING METHOD: HOLLOW STEM AUGER TO TOTAL DEPTH			WELL NO. (as shown on drawing: title and file number): MW-10

MONITORING WELL CONSTRUCTION DIAGRAM

(ALL MEASUREMENTS FROM GROUND SURFACE)



PROTECTIVE CASING

TYPE OF PROTECTIVE CASING: Metal (Square)

TOP OF WELL

PROTECTIVE POSTS: 3

CASING DIAMETER: 2 in.

TYPE OF PIPE JOINTS: Threaded

TYPE OF BLANK CASING: Sch. 40 PVC

BACKFILL/GROUT MIX ETC.: NA

TOP OF SEAL: 0 ft. bgl

TYPE OF SEAL: Bentonite Pellets

TOP OF FILTERPACK: 2.71 ft. bgi

TOP OF SCREEN: 4.71 ft. bgl

FILTER PACK

BOTTOM OF WELL: 14.79 ft. bgl

BOTTOM OF BORING: 16.0 ft. bgl

BORING DIAMETER: 7.5 in.

LENGTH OF SOLID PIPE: 7.02 ft.

WELL SCREEN LENGTH: 10.08 ft.

STICK-UP: 2.42 ft.

GROUND SURFACE

CONCRETE PAD MIN. 4.0 THICKNESS

SCREEN INFORMATION

SCREEN DIA.: 2 in.

SLOT WIDTH: 0.010 in. PVC wrapped

SCHEDULE: 40

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

FILTERPACK MATERIAL

TYPE: 16-40 Colorado Silica Sand

BACKFILL METHOD: Tremie pipe

WELL DEVELOPMENT

METHOD: Pump and surge block

TIME SPENT DEVELOPING: 8 hours 12 minutes

VOLUME OF WATER REMOVED: 185 gallons

VOLUME OF WATER ADDED: 0

DESCRIPTION OF PREDEVELOPMENT WATER: Sitly, sandy opaque, tan colored

DESCRIPTION OF PDST DEVELOPMENT WATER: Translucent, no sand, slightly silty

WATER LEVEL SUMMARY

WATER LEVEL MEASUREMENTS

DATE/TIME/LEVEL: 19 FEB 92/0845/7.06 ft. BMP

DEPTH FROM TOP CASING AFTER DEVELOPMENT:

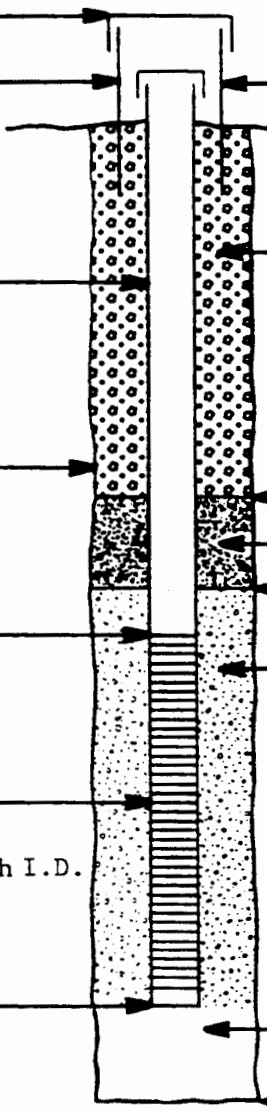
19 FEB 92/1806/7.5 ft. BMP

F2848

WELL CONSTRUCTION SCHEMATIC

PROJECT Holloman AFB Hydrogeologic Investigation
SITE Holloman AFB, New Mexico
COORDINATES x = 544926.5640, y = 662213.6641
DATE COMPLETED 21 August 1987
SUPERVISED BY Gary Henderson
DRILLER Kingsley/Winnek, Inc.
DRILLING METHOD Hollow stem auger

WELL NO. S-4
AQUIFER Shallow
DEPTH TO WATER 8 ft. BGL



LOCKING CAP

STEEL PROTECTIVE PIPE

ELEVATION OF MEASURING POINT 4034.46 ft. MSL

MEASURING POINT HEIGHT ABOVE GROUND LEVEL 3.04 ft.

GROUND SURFACE

TYPE OF GROUT Type I-II Portland Cement

DESCRIPTION OF RISER PIPE PVC Schedule 40, 2 inch I.D.

DIAMETER OF BOREHOLE 8 inches

DEPTH TO TOP OF SEAL 2 ft. BGL

TYPE OF SEAL bentonite

DEPTH TO TOP OF SAND PACK 4 ft. BGL

DEPTH TO TOP OF SCREEN 6 ft. BGL

TYPE OF SAND PACK Colorado Silica Sand 10-20

DESCRIPTION OF SCREEN PVC Schedule 40, 0.020 inch slot, 2 inch I.D.

DEPTH TO BOTTOM OF SCREEN 11 ft. BGL

TYPE OF FILLER BELOW PLUGGED SECTION Colorado Silica Sand 11-20 ft. BGL

TOTAL DEPTH OF BOREHOLE 18 ft. BGL

DP7 - 1240A

APPENDIX D

Correspondence

Letter from Lowell Seaton, EPA Region VI

To Be Added

July 22, 1992

Mr. Howard E. Moffitt, Deputy Base Civil Engineer
49 CES/CEV
Holloman Air Force Base, NM 88330-5000

Dear Mr. Moffitt:

Under the auspices of the Defense-State Memorandum of Agreement concerning IRP sites at Holloman Air Force Base, I am responding to your letter of May 28 to Kathleen M. Sisneros concerning ground water remediation and soil cleanup standards for petroleum product releases at Holloman AFB.

Your understanding is correct that ground water remediation at these sites will not be required. As discussed verbally and mentioned in correspondence relating specifically to underground storage tank sites, any floating hydrocarbon must be removed from the ground water surface, and all "highly contaminated soil" must be removed or remediated. Dissolved phase hydrocarbon contamination of the ground water beneath the base need not be remediated.

The Underground Storage Tank Bureau does not believe it to be feasible at present to assign a numerical value to the regulatory definition of "highly contaminated soil" because of the many site-specific variables that can influence the determination.

As a method of settling this issue, we propose that Holloman AFB staff who will be in Santa Fe on July 28 to discuss the current Remedial Investigation report for IRP sites bring with them a kilogram or two of dry soil known to be representative of that beneath the hydrocarbon release sites. NMED staff will procure a small amount of gasoline and diesel fuel, 1000 ppm of both products can be added to the soil in our laboratory, and the resulting mixture can be evaluated by UST Bureau personnel to determine whether 1000 ppm is less than "highly contaminated". If so, NMED has no objection to its use as the appropriate soil cleanup level.

If you have any questions concerning any of this please contact David Morgan at 505-827-2754.

Sincerely,

Steven J. Cary, Chief
Ground Water Protection and Remediation Bureau

c: Edward Horst, NMED HRMB
Bob Sweeney, NMED USTB

STATE OF NEW MEXICO
ENVIRONMENT DEPARTMENT

Bruce King
Governor

Joanna M. Espinosa
Secretary

Jim Curry
Deputy Secretary

APPENDIX E

Summary of Chemical Specific Values Used to Calculate ACLs

Table E-1
Chemical Specific Values for Organochlorine Pesticides

Chemical	Oral Slope Factor (Sfo) (mg/kg/day)$^{-1}$	Oral Reference Dose (RfDo) (mg/kg/day)	Absorption Factor (ABS) (unitless)	Permeability Coefficient (cm/hr)
4,4'-DDD	2.40e-01	0.00e+00 [b]	0.7	0.28
4,4'-DDE	3.40e-01	0.00e+00 [b]	0.7	0.24
4,4'-DDT	3.40e-01	5.00e-04	0.7	0.43
Aldrin	1.70e+01	3.00e-05	0.5	0.0016
Chlordane	1.30e+00	6.00e-05	0.8	0.046
Dieldrin	1.60e+01	5.00e-05	0.5	0.016
Endosulfan I	0.00e+00 [a]	6.00e-03	0.78	0.00208
Endosulfan II	0.00e+00 [a]	6.00e-03	0.85	0.00233
Endosulfan sulfate	0.00e+00 [a]	6.00e-03	0.05	0.00198
Endrin	0.00e+00 [a]	3.00e-04	0.5	0.016
Endrin aldehyde	0.00e+00 [a]	3.00e-04	0.05	0.0856
Heptachlor	4.50e+00	5.00e-04	0.66	0.011
Heptachlor epoxide	9.10e+00	1.00e-05	0.66	0.011
Methoxychlor	0.00e+00 [a]	5.00e-03	0.9	0.0312
Toxaphene	1.10e+00	0.00e+00 [b]	0.665	0.015
alpha BHC	6.30e+00	0.00e+00 [b]	0.95	0.022
beta BHC	1.80e+00	2.70e-04	0.95	0.022
delta BHC	0.00e+00 [a]	4.50e-04	0.919	0.026
gamma BHC	1.30e+00	3.00e-04	0.994	0.0064

[a] No slope factor has been derived for this chemical.
[b] No reference dose has been derived for this chemical.

Table E-2
Chemical Specific Values for Metals

Chemical	Oral Slope Factor (SFo) (mg/kg/day) $^{-1}$	Oral Reference Dose (RfDo) (mg/kg/day)	Absorption Factor (ABS) (unitless)	Permeability Coefficient (cm/hr)
SW6010				
Antimony	0.00e+00 [a]	4.00e-04	0.05	0.001
Barium	0.00e+00 [a]	7.00e-02	0.93	0.001
Beryllium	4.30e+00	5.00e-03	1	0.00155
Cadmium (water)	0.00e+00 [a]	5.00e-04	0.05	0.001
Chromium	0.00e+00 [a]	1.00e+00	0.05	0.002
Cobalt	0.00e+00 [a]	6.00e-02	0.05	0.001
Copper	0.00e+00 [a]	3.70e-02	0.05	0.001
Manganese (water)	0.00e+00 [a]	5.00e-03	0.05	0.001
Nickel	0.00e+00 [a]	2.00e-02	0.05	0.0004
Silver	0.00e+00 [a]	5.00e-03	0.05	0.001
Tin	0.00e+00 [a]	6.00e-01	0.05	0.001
Vanadium	0.00e+00 [a]	7.00e-03	0.05	0.001
Zinc	0.00e+00 [a]	3.00e-01	0.08	0.001
SW7060				
Arsenic	1.75e+00	3.00e-04	0.95	0.00155
SW7421				
Lead	0.00e+00 [a]	4.00e+02	0.1	0.001
SW7470				
Mercury	0.00e+00 [a]	3.00e-04	0.05	0.001
SW7740				
Selenium	0.00e+00 [a]	5.00e-03	0.05	0.001
SW7841				
Thallium	0.00e+00 [a]	8.00e-05	0.99	0.001

[a] No slope factor has been derived for this chemical.