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ENTERED

Ms Barbara Hoditschek
Program Manager, RCRA Permits
Hazardous and Radioactive Materials Bureau
New Mexico Environment Department
1190 St Francis Blvd
Santa Fe NM 87502

Dear Ms Hoditschek

Attached is one (1) copy of the Draft Phase I RCRA Facility Investigation (RFI) Work Plans for Landfill No 5 (SWMU No 113, IRP No LF-5). The Work Plans consist of two (2) volumes. The Work Plan, Project Management Plan, Data Management Plan, Site Safety and Health Plan and Data Quality Collection Assurance Plan are all incorporated within these two volumes.

On August 30, 1993 a tentative schedule, which has yet to be finalized, was submitted to your office. It is anticipated that Dr Janice Stowell of my Environmental Flight and Mr Steve Alexander of your office will discuss this schedule during the week of September 27, 1993. I am certain that through the mutual cooperation of my Environmental Flight and your staff, we will be able to make the RFI for Landfill No 5 a valid tool for studying contamination at state-wide landfills.

Dr Janice Stowell is the Cannon Air Force Base point of contact for the Landfill No 5 RFI. Please address any questions concerning this investigation to her at (505)784-4348 or (505)784-2739.

Sincerely

WILLIAM M. GUTH, Colonel, USAF
Commander

1 Atch
RFI Work Plan

cc: Mr Steve Alexander, NMED
Mr David Morgan, NMED
Mr William Honker, EPA

Global Power for America

QUALITY ASSURANCE PROJECT PLAN
APPENDIX A-D

LIBRARY COPY

RCRA FACILITY INVESTIGATIONS APPENDIX III SWMUs - PHASE I

CANNON AIR FORCE BASE, NEW MEXICO

Prepared for
U.S. Department of the Army
Corps of Engineers, Omaha District
Omaha, Nebraska

October 1993

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C3M11W

APPENDIX A

STANDARD OPERATING PROCEDURES

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Standard Operating Procedure No. 1	-	Equipment Decontamination
Standard Operating Procedure No. 2	-	(not used)
Standard Operating Procedure No. 3	-	(not used)
Standard Operating Procedure No. 4	-	(not used)
Standard Operating Procedure No. 5	-	Sludge and Sediment Sampling
Standard Operating Procedure No. 6	-	Surface Soil Sampling
Standard Operating Procedure No. 7	-	Subsurface Drilling and Sampling
Standard Operating Procedure No. 8	-	Lithologic Description of Subsurface Samples
Standard Operating Procedure No. 9	-	Borehole Abandonment
Standard Operating Procedure No. 10	-	Surface Water Sampling
Standard Operating Procedure No. 11	-	Identification and Description of Field Sampling Sites
Standard Operating Procedure No. 12	-	Sample Handling, Documentation, and Analysis
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Standard Operating Procedure No. 14	-	Headspace Analysis
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1.0
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STANDARD OPERATING PROCEDURE NO. 1
EQUIPMENT DECONTAMINATION

CANNON AIR FORCE BASE
REMEDIAL INVESTIGATION
CLOVIS, NEW MEXICO

USACE CONTRACT NO. DACW-45-93-D-0005

W-C PROJECT NUMBER C3M11W

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3.0
INTRODUCTION

The purpose of this document is to define the standard procedure for equipment decontamination for the Cannon Air Force Base project. This Standard Operating Procedure (SOP) serves as a supplement to the Quality Assurance Project Plan (QAPP) and the Field Sampling Plan (FSP). This procedure is intended to be used with the SAP and the other SOPs.

The overall objective of multimedia sampling programs is to obtain samples which accurately depict the chemical, physical, and/or biological conditions at the sampling site. Extraneous contaminant materials can be brought to a sampling location and/or introduced into the medium of interest during the sampling program (e.g., by bailing or pumping of groundwater with equipment previously contaminated at another sampling site). Trace quantities of these materials can contaminate the sample and lead to false positive analytical results and, ultimately, to an incorrect assessment of the conditions associated with the site. Decontamination of sampling equipment (e.g., bailers, pumps, tubing, soil, and sediment sampling equipment) and field support equipment (e.g., drill rigs, vehicles) is required at Cannon Air Force Base to ensure that sampling cross-contamination is prevented, and that on-site contaminants are not carried off site.

4.0
RESPONSIBILITIES AND QUALIFICATIONS

The Woodward-Clyde (W-C) Cannon AFB Project Manager is responsible for assuring that equipment decontamination is conducted according to this procedure. The Project Manager will designate qualified project staff to complete this procedure.

The designated project staff are responsible for completing the equipment decontamination process according to this procedure. They report their progress, and any problems, to the Task Leader or Project Manager. Staff members are responsible for understanding the activities assigned to them and the quality assurance requirements associated with the activities.

The W-C Project QA/QC Officer or designee will be responsible for periodically reviewing decontamination activities to assure that they are completed according to this procedure. Problems related to equipment decontamination are also the responsibility of the W-C Task Leader.

All personnel assigned to complete this procedure shall be qualified to perform the portions of the procedure assigned to them. The Project Manager will make the appraisal of qualifications and will document the qualifications in the project Quality Assurance files. The Project Manager's appraisal of qualifications will include a comparison of the requirements of the job assignment with the relevant experience and training of the prospective assignee; it will also include a determination whether future training is required, and, if required, by what method. On-the-job training is an acceptable method, provided such training is received from a person qualified to perform the trainee's assignment and the results of that training are documented.

5.0
PROCEDURE

5.1 EQUIPMENT LIST

The following is a list of equipment that may be needed to perform decontamination:

- Brushes
- Wash tubs (minimum of 3) or
- 5-gallon buckets (minimum of 3)
- Scrapers
- Steam cleaner or high-pressure sprayer (portable)
- Large metal horse trough
- Disposal drums
- Sponges
- Paper towels
- Alconox detergent (or equivalent)
- Pesticide-grade isopropanol
- Potable tap water
- Deionized water
- Garden-type water sprayers
- Nitric acid (5% by volume) or hydrochloric acid (0.1N)
- Plastic tubing for bailers
- Plastic trash bags

5.2 DECONTAMINATION

5.2.1 Personnel

A temporary personnel decontamination line will be set up around each exclusion zone. If contamination is not encountered, a dry decontamination station may be established which consists of discarding of disposable PPE.

If real-time monitoring instruments indicate that contamination has been encountered (i.e., action levels are exceeded requiring an upgrade from initial PPE levels), or if the initial PPE is B or C, a complete personnel decontamination station will be established.

The temporary decontamination line should provide space to wash and rinse boots, gloves, and all sampling or measuring equipment prior to placing the equipment into a vehicle, and a container to dispose of used disposable items such as gloves, tape, or tyvek (if used).

The decontamination procedure for field personnel shall include:

1. Glove and boot wash in an Alconox solution
2. Glove and boot rinse
3. Duct tape removal
4. Outer glove removal
5. Coverall removal
6. Respirator removal (if used)
7. Inner glove removal

5.2.2 Sampling Equipment

The following steps will be used to decontaminate small sampling equipment, such as bailers, stainless steel trowels, stainless steel liners, plastic caps for liners, etc.:

- Personnel will dress in suitable safety equipment to reduce personal exposure.

- Gross contamination on equipment will be scraped off at the sampling site.

- Equipment that will not be damaged by water will be either steam cleaned and/or placed in a wash tub or bucket containing Alconox or low-sudsing detergent along with potable water and scrubbed with a bristle brush or similar utensil. Equipment will be rinsed with tap water in a second wash tub or bucket followed by a double deionized water rinse.

- The water level indicator will be decontaminated using the equipment decontamination procedure described in the third bulleted item. Care will be taken to prevent damage to equipment.

- Rinse and detergent waters will be replaced with new solutions between borings or sample locations.

- Used rinse and detergent water will be contained in 55-gallon drums or holding tanks for storage at the Old Entomology Rinse Area.

Following decontamination, equipment will be placed in a clean area or in clean plastic.

5.2.3 Drilling and Heavy Equipment

Prior to moving onto each solid waste management unit (SWMU), drilling and heavy equipment will be decontaminated at the decontamination area (Old Entomology Rinse Area). Between each boring, augers will be decontaminated downslope and a minimum of 50 feet away from sampling locations using a portable steam cleaner and large metal trough. The following steps will be used to decontaminate drilling and heavy equipment:

- Personnel will dress in suitable safety equipment to reduce personal exposure.

- Equipment showing gross contamination or having drill cuttings caked on will be scraped off with a flat-bladed scraper at the sampling site.

- Drill rig, augers, drill bits, and shovels will be sprayed with detergent water by a high-pressure washer, then rinsed with potable water. Care should be taken to adequately clean the insides of the hollow-stem augers.

- Decontamination water generated at each SWMU will be contained in the trough and pumped into drums for disposal at the central decontamination station. Soil cuttings generated during drilling will be contained in drums.

- Drums will be labeled with matrix, depth, location, date, boring numbers, and drum I.D. number.

The designated clean area at the Old Entomology Rinse Area will be protected from potential contamination by several techniques: the setting up of exclusion zones; temporary decontamination lines set up around each exclusion zone as needed; gross contamination on equipment will be scraped off at the sampling site; used rinse and detergent water will be contained in 55-gallon drums or nonleaking holding tanks; any soil cuttings will be contained in 55-gallon drums; and following decontamination, all equipment will be placed in clean plastic or designated clean area.

Following decontamination, drilling equipment will be placed on the clean drill rig and moved to the clean area at the Old Entomology Rinse Area. If the equipment is not used immediately, it should be stored at the designated clean area at the Old Entomology Rinse Area.

5.2.4 Equipment Leaving the Site

Vehicles used for nonconstruction activities shall be cleaned on an as-needed basis as determined by the Site Safety Officer by soap and water on the outside and vacuuming the inside. Cleaning will be required for very dirty vehicles which will be leaving the area. The cleaning shall take place on site. On-site equipment such as drilling rigs will be pressure washed on site before the equipment is removed from the site to limit off-site exposure to potential contaminants.

5.2.5 Wastewater

It will be necessary to contain small volumes of used wash and rinse solutions and transport them to the central decontamination area (Old Entomology Rinse Area). This wastewater will be containerized in labeled drums and stored in a secured area at the Old Entomology Rinse Area. The SOP on Investigation-Derived Waste (No. 15) will govern the final disposal of this wastewater.

5.2.6 Other Wastes

Solid wastes such as used personal protective equipment will be collected in drums. When drums are full, they will be sealed. Each drum will be labeled with its contents and the date, using paint or other permanent marker. Drums will be stored in a secured area at the Old Entomology Rinse Area and managed according to SOP No. 15 - Investigation-Derived Wastes.

5.3 DOCUMENTATION

Sampling personnel will be responsible for documenting the decontamination of sampling and drilling equipment. The documentation will be recorded with waterproof ink in the sampler's field notebook with consecutively numbered pages. The information entered in the field book concerning decontamination should include the following:

- Decontamination personnel
- Date and start and end times
- Decontamination steps/observations
- Weather conditions
- Waste drum(s) generated and I.D. numbers

Equipment rinsate samples will be taken of the decontaminated sampling equipment to verify the effectiveness of the decontamination procedures as specified in the FSP. The rinsate procedure will include rinsing deionized water through or over a decontaminated sampling tool (such as a split-spoon sampler or Teflon bailer) and collecting the rinsate water into the sample bottles, which will be sent to the laboratory for analysis. The rinsate procedure, including the sample number, will be recorded in the field notebook. The Field Manager may decide additional rinsates would be appropriate to help monitor decontamination procedures, in which case the QA/QC Officer should be notified.

1.0
TITLE PAGE

STANDARD OPERATING PROCEDURE NO. 5
SLUDGE AND SEDIMENT SAMPLING

CANNON AIR FORCE BASE REMEDIAL INVESTIGATION
CLOVIS, NEW MEXICO

USACE CONTRACT NO. DACW-45-93-D-0005

W-C PROJECT NUMBER C3M11W

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3.0
PURPOSE AND SCOPE

The purpose of this document is to define the standard procedure for collecting sludge and/or lake sediment samples for the Cannon AFB project. This Standard Operating Procedure (SOP) serves as a supplement to the Quality Assurance Project Plan (QAPP) and the Field Sampling Plan (FSP). This procedure gives descriptions of equipment, field procedures, and QA/QC procedures necessary to collect sludge and/or lake sediment samples. The sample locations and frequency of collection are specified in the FSP.

This procedure is intended to be used together with the FSP and several other SOPs. Sample identification, labeling, handling, and chain-of-custody procedures are described in SOP No. 12. SOP No. 12 also includes the listing of sample containers, preservatives, and holding times applicable to samples collected using this SOP. SOP No. 1 describes decontamination procedures which are also applicable to this SOP.

4.0
RESPONSIBILITIES AND QUALIFICATIONS

The Woodward-Clyde (W-C) Cannon AFB Project Manager is responsible for assuring that these procedures are followed during field operations by reviewing the field notebooks and analytical data when they are available. The Project Manager will designate qualified project staff to complete this procedure and the required reviews.

The designated project staff are responsible for completing the review and reporting progress according to this procedure. They report their progress, and any problems, to the Task Leader or Project Manager. Staff members are responsible for understanding the activities assigned to them and the quality assurance requirements associated with the activities.

The W-C Project QA/QC Officer or designee will be responsible for periodically reviewing sludge sampling activities to assure that they are being completed according to this procedure. Problems related to reporting by the field crew are also the responsibility of the W-C Task Leader.

All personnel assigned to complete this procedure shall be qualified to perform the portions of the procedure assigned to them. The Project Manager will make the appraisal of qualifications and will document the qualifications in the project Quality Assurance files. The Project Manager's appraisal of qualifications will include a comparison of the requirements of the job assignment with the relevant experience and training of the prospective assignee; it will also include a determination whether future training is required, and, if required, by what method. On-the-job training is an acceptable method, provided such training is received from a person qualified to perform the trainee's assignment and the results of that training are documented.

5.0
SLUDGE AND/OR LAKE SEDIMENT SAMPLING PROCEDURES

5.1 EQUIPMENT LIST

Sample bottles with preservatives added will be obtained from the analytical laboratory. Several extra sample bottles will be obtained in case of breakage or other problems.

Equipment used during sludge and/or lake sediment sample collection:

- Sample bottles
- Cooler with ice
- Polyethylene or glass jar for field measurement samples
- Measuring tape with weighted end
- Glass or polyethylene sample collection container
- Plastic squeeze bottle filled with deionized or distilled water
- Plastic sheeting
- Appropriate health and safety equipment
- Hand coring device
- Petite Ponar dredge
- Stainless steel bowl
- Stainless steel spoons

Equipment used during decontamination:

- Alconox soap (or equivalent)
- Potable tap water
- Deionized or distilled water
- Large sponges
- Decontamination buckets/pails
- Several spray or squirt bottles

5.2 SAMPLING PROCEDURES

This section gives the step-by-step procedures for collecting sludge and/or lake sediment samples. Observations made during sample collection should be recorded in the field notebook and field data sheet as specified in Section 5.4 of this SOP.

5.2.1 Decontamination Equipment

Before any sampling begins, and between samples, all sample collection equipment shall be decontaminated. If dedicated equipment is used, it should be rinsed with deionized water. Mobile decontamination supplies will be provided so that equipment can be decontaminated in the field. The decontamination solutions shall be replaced with clean solutions between each decontamination operation (i.e, between each sample location). A discussion of equipment and personnel decontamination is contained in SOP No. 1, Decontamination, and in the Site Safety and Health Plan (SSHP).

5.2.2 Obtaining Sludge and/or Lake Sediment Samples

The following procedures are to be used to collect sludge and/or lake sediment samples:

1. Assemble all necessary sample collection equipment.

2. Make sure that the sample labels have been filled out for the sampling location. Assemble bottles for filling.

3. Rinse the collection devices (coring or dredge) with distilled/deionized water.

4. Where the boat has arrived on the sampling location, assemble the coring device and attach a dedicated line to the core tube. Lower the coring device until the coring devices reaches the point of refusal. Retrieve the coring device and measure the recovered core. If there is less than 4 inches of material within the core discard the retrieved core. If there is more than 4 inches, place the recovered material in a stainless steel bowl and go to No. 5.

If there is less than 4 inches, the Ponar dredge should be used to collect the core samples. Lower the dredge to the bottom and "trip the device." Recover the dredge and place the recovered material in a stainless steel bowl.

5. Bottle filling order:

   a. Fill all of the VOC bottles first with the material in the stainless steel bowl.

   b. Homogenize the remaining material and fill the remaining sample containers.

6. The sample collection and field analysis equipment will be fully decontaminated after sample collection is complete at each station following the decontamination procedures outlined in SOP No. 1 pertaining to equipment decontamination.

7. Record time of sampling and complete field documentation.

5.2.3 Field Quality Assurance/Quality Control Samples

Quality assurance/quality control (QA/QC) samples will be collected during sampling as specified in the FSP.

QA/QC samples are designed to help identify potential sources of sample contamination and evaluate potential error introduced by sample collection and handling. All QA/QC samples are labeled with QA/QC identification numbers and sent to the laboratory with the other samples for analyses.

Rinsate Samples

A decontamination rinsate sample of sampling equipment is intended to check if decontamination procedures have been effective. For the sampling operation, a rinsate sample will be collected from the decontaminated sampling equipment before it is used to obtain the sample. Deionized water will be rinsed over a decontaminated sampling apparatus and transferred to the sample bottles. The same parameters that are being analyzed in the samples

will be collected from the decontaminated sampling equipment before it is used to obtain the sample. Deionized water will be rinsed over a decontaminated sampling apparatus and transferred to the sample bottles. The same parameters that are being analyzed in the samples will be analyzed in the rinsate samples. The rinsate sample is assigned a QA/QC sample identification number, stored in an iced cooler, and shipped to the laboratory on the day it is collected.

Duplicate Samples

Duplicate samples are samples collected side-by-side to check for the natural sample variance and the consistency of field techniques and laboratory analysis. For the surface water sampling, a duplicate sample will be collected at the same time as the initial sample. The initial sample bottles for volatile organic analyses will be filled first, the duplicate sample bottles for volatile organic analyses and so on until all necessary sample bottles for both the initial sample and the duplicate sample have been filled. The duplicate sample will be handled in the same manner as the initial sample. The duplicate surface water sample will be assigned a QA/QC identification number, stored in an iced cooler, and shipped to the laboratory on the day it is collected.

Field Blanks

Field blanks check for contamination of samples due to factors at the sampling site. For a field blank, a volatile organic sample bottle is taken empty to the field and filled at the sampling site with organic-free deionized water at the time the sample is collected. The sample will be assigned a QA/QC identification number, stored in an iced cooler, and shipped to the laboratory with the other samples.

5.3 SAMPLE HANDLING

Sample containers and preservatives are specified in SOP No. 12, Sample Handling, Documentation, and Analysis. Samples will be labeled and handled as described in SOP No. 12. The parameters for analysis also are specified in the FSP.

5.4 DOCUMENTATION

5.4.1 Field Sampling Data Sheet

A field sampling data sheet will be completed at each sample location (Figure 1). Items not applicable to the sampling will be labeled as not applicable (NA). The information on the data sheet includes the following:

- Sampling location
- Date and time of sampling
- Person performing sampling
- Color (describe), odor (describe)
- Classify sediment (granular, sand, silt, etc.)
- Sample identification number
- Number of samples taken
- Preservation of samples
- Record of any QC samples from site
- Any irregularities or problems which may have a bearing on sampling quality.

5.4.2 Field Notes

Field notes will also be kept during sampling activities. The following information will be recorded in the bound field notebook using waterproof ink:

- Names of personnel
- Weather conditions
- Date and time of sampling
- Location and sample station number
- Times that procedures and measurements are completed
- Decontamination times

FIGURE 1

FIELD SAMPLING DATA SHEET

Location Identification: _____ Date: _____
Samplers' Signature: _____ Time: _____
Weather: _____

Sample Identification: _____

Description of Sludge: _____

Containers	Number	Preservatives

QA/QC Samples Collected: _____

Comments: _____

1.0
TITLE PAGE

STANDARD OPERATING PROCEDURE NO. 6
SURFACE SOIL SAMPLING

CANNON AIR FORCE BASE REMEDIAL INVESTIGATION
CLOVIS, NEW MEXICO

USACE CONTRACT NO. DACW-45-93-D-0005

W-C PROJECT NUMBER C3M11W

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3.0
PURPOSE AND SCOPE

The purpose of this document is to define the standard procedure for collecting surface soil samples for the Cannon AFB project. This Standard Operating Procedure (SOP) serves as a supplement to the Quality Assurance Project Plan (QAPP) and the Field Sampling Plan (FSP). This procedure gives descriptions of equipment, field procedures, and QA/QC procedures necessary to collect surface soil samples. The sample locations and frequency of collection are specified in the FSP.

This procedure is intended to be used together with the FSP and several other SOPs. Sample identification, labeling, handling, and chain-of-custody procedures are described in SOP No. 12. SOP No. 12 also includes the listing of sample containers, preservatives, and holding times applicable to sample collected using this SOP. SOP No. 1 describes decontamination procedures which are also applicable to this SOP.

4.0
RESPONSIBILITIES AND QUALIFICATIONS

The Woodward-Clyde (W-C) Cannon AFB Project Manager is responsible for assuring that these procedures are followed during field operations by reviewing the field notebooks and analytical data when they are available. The Project Manager will designate qualified project staff to complete this procedure and the required reviews.

The designated project staff are responsible for completing the review and reporting progress according to this procedure. They report their progress, and any problems, to the Task Leader or Project Manager. Staff members are responsible for understanding the activities assigned to them and the quality assurance requirements associated with the activities.

The W-C Project QA/QC Officer or designee will be responsible for periodically reviewing surface soil sampling activities to assure that they are being completed according to this procedure. Problems related to reporting by the field crew are also the responsibility of the W-C Task Leader.

All personnel assigned to complete this procedure shall be qualified to perform the portions of the procedure assigned to them. The Project Manager will make the appraisal of qualifications and will document the qualifications in the project Quality Assurance files. The Project Manager's appraisal of qualifications will include a comparison of the requirements of the job assignment with the relevant experience and training of the prospective assignee; it will also include a determination whether future training is required, and, if required, by what method. On-the-job training is an acceptable method, provided such training is received from a person qualified to perform the trainee's assignment and the results of that training are documented.

5.0
PROCEDURE

5.1 EQUIPMENT LIST

Equipment to be used in surface soil sampling is as follows:

- Stainless steel or Teflon-coated hand auger
- Ruler with 1/10-foot increments
- Field notebook
- Stainless steel knife
- Stainless steel spoons/trowels
- Stainless steel mixing bowl
- Sample containers supplied by analytical laboratory
- Sample container labels
- Cooler with ice and vermiculite
- Clear cellophane tape to cover labels
- Paper towels
- Camera with film
- Waterproof marking pens
- Plastic sheeting
- Plastic bags
- Electric tape
- Health and Safety Equipment as specified in the HSP

Equipment used during decontamination:

- Alconox soap (or equivalent)
- Potable tap water
- Deionized or distilled water
- Isopropanol (0.1N)
- Nitric acid (0.05N) or hydrochloric acid (0.1N)

- Large sponges
- Decontamination buckets/pails
- Several spray or squirt bottles

5.2 SAMPLING PROCEDURES

This section provides step-by-step procedures for surface soil sampling with a hand auger. Observations made during the sampling effort should be recorded in the field notebook.

5.2.1 Equipment Decontamination

Before any samples are taken, the equipment must be decontaminated according to procedures specified in SOP No. 1 and in the Site Safety and Health Plan (SSHP). Sampling equipment will be decontaminated between sampling stations and between collection of samples at different depths at the same location.

5.2.2 Obtaining Surface Soil Samples

Upon arrival at the sampling site, entries will be made into the field notebook describing the sample location number, the general appearance of soil (i.e., noticeable stains etc.) and soil cover (e.g., grass, gravel), the time of sampling, and any unusual phenomenon. A plastic sheet should be placed near the sampling station and all sampling equipment should be placed on this sheet.

Clear any existing vegetation or other foreign matter from the sampling location surface. Using the hand auger or stainless steel spoon/trowel, collect samples from the appropriate depth as specified in the FSP. An appropriate amount of sample should be collected for the sample containers. When the sample has been collected, any amount on the side of the hand auger sampler in the smear zone should be removed by using the stainless steel knife. Since loose materials can easily volatize from the 0 to 0.5-foot interval, VOC samples will not be collected form this interval. Correspondingly, the VOC samples should be collected from the other 0.5-foot intervals since the sampler will be driven 2 feet at each sampling depth. The part of the recovered sample collected for volatile organic analysis should be placed into the

appropriate sample container as soon as possible. The remainder of the recovered sample should be placed in the mixing bowl as quickly as possible.

With the remaining recovered soil in the mixing bowl, the sample should be homogenized with a decontaminated mixing instrument (e.g., a stainless steel spoon). The remaining recovered soil should be divided equally into the remaining sample containers. QA/QC sample containers should be filled from the same mixtures as one of the samples. Sample containers shall be labeled in accordance with SOP No. 12 in indelible ink and covered with clear cellophane tape to preserve the integrity of the label.

5.2.3 Field Quality Assurance/Quality Control Procedures and Samples

QA/QC samples are designed to help identify potential sources of sample contamination and evaluate potential error introduced by sample collection and handling. All QA/QC samples are labeled with QA/QC identification numbers and sent to the laboratory with other samples for analysis. Specific QA/QC samples that will be collected at each SWMU are described in the FSP.

Rinsate Samples

An equipment rinsate sample of sampling equipment is intended to check if decontamination procedures have been effective. For surface soil sampling with a hand auger, a rinsate sample will be collected from the decontaminated auger. Organic free deionized water will be rinsed through the decontaminated auger and used to fill the sample bottles. The same parameters that are being analyzed in the surface soil samples will be analyzed in the rinsate samples. The rinsate sample is assigned a QA/QC sample identification number, stored in an iced cooler, and shipped to the laboratory on the day it is collected.

Duplicate Samples

Duplicate samples are samples collected to check for the natural sample variance and the consistency of field techniques and laboratory analysis. For surface soil sampling, the initial sample bottles for volatile organics will be filled first, then the sample will be homogenized

and the rest of the duplicate bottles filled until all necessary sample bottles for both the initial sample and the duplicate sample have been filled. The duplicate surface soil sample will be handled in the same manner as the primary sample. The duplicate sample will be assigned a QA/QC identification number, stored in an iced cooler, and shipped to the laboratory on the day it is collected.

Field Blanks

Field blanks check for contamination of samples due to factors at the sampling site. For a field blank, the same parameters that are being analyzed in the surface soil samples will be analyzed. Sample bottles are taken empty to the field and filled at the well site with organic-free deionized water at the time the soil sample is collected. The samples will be assigned a QA/QC identification numbered, stored in an iced cooler, and shipped to the laboratory with the other samples.

5.3 SAMPLE HANDLING

Sample containers and preservatives are specified in SOP No. 12, Sample Handling, Documentation, and Analysis. Samples will be labeled and handled as described in SOP No. 12.

5.4 DOCUMENTATION

5.4.1 Field Sampling Data Sheet

A field sampling data sheet will be completed at each sample location (Figure 1). Items not applicable to the sampling will be labeled as not applicable (NA). The information on the data sheet includes the following:

- Sampling location
- Date and time of sampling
- Person performing sampling
- Type of sample

- Type of soil cover
- Depth interval
- Soil type (describe)
- USCS Abbreviation
- Color (describe), staining (describe), odor (describe)
- Sample identification number
- Number of samples taken
- Preservation of samples
- Record of any QC samples from site
- Any irregularities or problems which may have a bearing on sample quality.

5.4.2 Field Notes

Field notes will also be kept during sampling activities. The following information will be recorded in the bound field notebook using waterproof ink:

- Names of personnel
- Weather conditions
- Date and time of sampling
- Location and sample station number
- Times that procedures and measurements are completed
- Decontamination times
- Calibration information

FIGURE 1

Field Sampling Data Sheet for Soil (Surface or Subsurface) Samples

Location Identification: Date: _____

Samplers' Signature: _____ Time: _____

Type of Sample: Surface: _____ Subsurface: _____

Type of Soil Cover: _____

Depth Interval: _____

Sample Identification: _____

Soil type (i.e. sand silt clay) _____

USCS Abbreviation _____

Color _____

Staining _____

Odor _____

Containers	Number	Preservatives

QA/QC Samples Collected: _____

Comments: _____

1.0
TITLE PAGE

STANDARD OPERATING PROCEDURE NO. 7
SUBSURFACE DRILLING AND SAMPLING

CANNON AIR FORCE BASE
REMEDIAL INVESTIGATION
CLOVIS, NEW MEXICO

USACE CONTRACT NO. DACW-45-93-D-0005

W-C PROJECT NUMBER C3M11W

2.0

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3.0
PURPOSE AND SCOPE

This Standard Operating Procedure (SOP) provides technical guidance and methods for subsurface drilling and sampling at Cannon Air Force Base. Soil samples will be collected and submitted for chemical and geotechnical (grain-size) analysis.

This SOP serves as a supplement to the Quality Assurance Project Plan (QAPP) and the Field Sampling Plan (FSP). This SOP is intended to be used with the FSP and other SOPs, such as SOP No. 8, Lithologic Description of Subsurface Samples.

The step-by-step procedures described herein are sufficiently detailed to allow field personnel to properly perform subsurface drilling and sampling.

4.0
RESPONSIBILITIES AND QUALIFICATIONS

The Woodward-Clyde (W-C) Cannon AFB Project Manager is responsible for assuring that subsurface drilling and sampling are performed in accordance with this Standard Operating Procedure. This Project Manager will designate qualified project staff to complete this procedure and the required reviews.

The designated project staff are responsible for performing subsurface drilling and sampling according to this procedure. They report their progress, and any problems, to the Task Leader or Project Manager. Staff members are responsible for understanding the activities assigned to them and the quality assurance requirements associated with the activities.

The W-C Project QA/QC Officer or designee will be responsible for periodically reviewing the activities associated with this procedure to assure that subsurface drilling and sampling are being completed according to this procedure.

All personnel assigned to complete this procedure shall be qualified to perform the portions of the procedure assigned to them. The Project Manager will make the appraisal of qualifications and will document the qualifications in the project Quality Assurance files. The Project Manager's appraisal of qualifications will include a comparison of the requirements of the job assignment with the relevant experience and training of the prospective assignee; it will also include a determination whether future training is required, and, if required, by what method. On-the-job training is an acceptable method, provided such training is received from a person qualified to perform the trainee's assignment and the results of that training are documented.

5.1 EQUIPMENT LIST

The following is a list of soil sampling equipment:

- California split-barrel sampler, 3-inch O.D. with liners or
- Split-spoon sampler, 3-inch O.D. (stainless steel)
- Cement for grouting (portland cement, Type II or V)
- Stainless steel mixing bowl
- Stainless steel stirring devices
- High-pressure steamer/sprayer (provided by drilling contractor)
- Long-handled bristle brushes
- Wash/rinse tubs
- Alconox detergent
- 0.1N hydrochloric acid
- Auger rig with appropriate equipment for drilling and sampling
- Weighted tape measure
- Water level probe
- Drums for containment of cuttings
- Appropriate health and safety equipment
- Logbook
- Boring log forms
- Tape (electrical and Teflon)
- Waterproof markers and labels
- Paper towels
- Baggies, ziploc bags
- Large plastic bags

5.2 DRILLING METHOD

Borings will be drilled using a truck-mounted drilling rig utilizing hollow-stem augers. Only potable water may be introduced into boreholes. The amount of water, if added, should be documented on the drill log and field notebook. No bentonite, barite, polymers, or other additives or viscosifying agents will be added to water introduced into the borehole or used during drilling. If lubrication is required on the drill pipe joints, Teflon tape or vegetable oil is acceptable. The rig shall be free of leaks which could contaminate the boreholes (i.e., hydraulic fluid, oil, gas, etc.).

Health and Safety equipment specified in the Site Safety and Health Plan (SSHP) will be donned before proceeding with subsurface drilling and soil sampling. The SSHP will specify action levels for various contaminants and the field monitoring required to measure ambient conditions.

All work areas around exploratory borings will be restored to a physical condition equivalent to that of predrilling, as near as practical. This will include drill cuttings removal and rut removal.

All drill cuttings will be containerized and moved to a central secured location for storage. Containers (drums) will be sealed, labeled with a paint pen, and recorded so that their contents can be identified as to material, source, and depth. Multiple drums from that same boring will have approximate depths labeled on each drum. The labeling will be such that it will be legible for the length of time that may transpire before final disposal of the drummed contents. Any water generated during drilling will be contained in labeled drums. The disposal of soil and water will be dependent on laboratory analytical results.

5.3 SOIL SAMPLING METHOD

Intact subsurface soil samples will be taken for physical description and chemical analyses. Samples will be collected as outlined in the Field Sampling Plan, in general, every 2-1/2 feet for the top 10 feet followed by every 10 feet thereafter. Sampling will be done in advance of the lead auger to minimize potential cross-contamination. Samples will be collected with

a California split-barrel sampler with stainless steel liners, or a stainless steel split-spoon sampler. The sampler will be driven with a 140-pound hammer and 30-inch drop for a total of 2 feet. Standard blow counts will be recorded for driving the sampler 6, 12, 18, and 24 inches, according to ASTM Method D 1586-84 with the N-value being the sum of the second and third 0.5-foot interval. Provisions will be made to use other sample collection methods if this method results in poor sample recovery in some depth intervals. Soil grab samples for volatile organic analyses will be obtained from the top stainless steel liner in the California split-barrel or by subsampling the material retrieved in the split spoon. Subsampling will be done immediately upon opening the split spoon, and shall be done as soon as possible once the split-spoon sample is taken from the boring. The portion of the split-spoon sample which represents slough will not be sampled. Compositing of soil samples for nonvolatile chemical analyses shall be performed in a stainless steel bowl using stainless steel stirring devices.

Soil samples from the liners of the California split-barrel samplers that are to undergo chemical and geotechnical analyses will be capped at the ends with 4-inch square Teflon tape and plastic end caps. The end caps will be taped with electrical tape. Soil samples from split-spoon samplers that are to undergo chemical and geotechnical analyses will be placed in glass or plastic jars with airtight, screw-type lids. A sample volume adequate for the analysis to be conducted will be collected. Minimum information on each sample container will include the project name, date, boring number, sample number, and depth of sample. All information that appears on the container will also appear on the boring log. Sample handling, documentation, and analysis procedures are more fully discussed in SOP No. 12.

5.4 DOCUMENTATION

5.4.1 Field Boring Log

A copy of the USACE Omaha District HTW field boring log is shown as Figure 1 in SOP No. 8. The appropriate spaces for drilling method and equipment shall be completed prior to drilling.

5.4.2 Field Sampling Data Sheet

A field sampling data sheet will be completed at each sample location (Figure 1). Items not applicable to the sampling will be labeled as not applicable (NA). The information on the data sheet includes the following:

- Sampling location
- Date and time of sampling
- Person performing sampling
- Soil type (describe), USCS Abbreviation
- Color (describe), staining (describe), odor (describe)
- Sample identification number
- Number of samples taken
- Preservation of samples
- Type of sample
- Type of soil cover
- Depth interval
- Record of any QC samples from site
- Any irregularities or problems which may have a bearing on sampling quality.

5.4.3 Field Notes

Field notes will also be kept during sampling activities. The following information will be recorded in the bound field notebook using waterproof ink:

- Names of personnel
- Weather conditions
- Date and time of sampling
- Location and sample station number
- Times that procedures and measurements are completed
- Decontamination times
- Calibration information

6.0
EQUIPMENT DECONTAMINATION PROCEDURES

Specific equipment decontamination procedures are described in the following paragraphs. Equipment decontamination will include:

- Drilling equipment decontamination (augers, drill stems, drill bits, other downhole equipment) will be conducted prior to drilling and between each boring location. Before any equipment is removed from the site, it will be decontaminated according to the procedure for decontamination of drilling and heavy equipment described in SOP No. 1.

- Sampling equipment decontamination (stainless steel split-spoon samplers, stainless steel stirring devices, etc.) will be conducted between individual sampling points to minimize potential cross-contamination. Soil sampling will require one clean stainless steel split-spoon sampler per sample. Sampling equipment will be decontaminated between each sample according to the procedure for decontamination of sampling equipment described in SOP No. 1.

6.1 DRILLING EQUIPMENT DECONTAMINATION PROCEDURES

Augers will be scraped off as they are withdrawn from a boring. The cuttings will be disposed of as outlined in Section 5.2. The following step in accordance with SOP No. 1, will be used to decontaminate drilling and heavy equipment:

- Personnel will dress in suitable safety equipment to reduce personal exposure.

- Equipment showing gross contamination or having drilling cuttings caked on will be scraped off with a flat-bladed scraper. The scrapings will be containerized. Drill cuttings should not be washed down the drain.

- Equipment that will not be damaged by water, such as drill rigs, augers, drill bits, and tools will be sprayed with detergent water by a high-pressure steamer, then rinsed with clear potable water. This water will be obtained at an approved source.

- Decontamination will continue until all equipment is devoid, both inside and out, of any asphaltic, bituminous, or other encrusting or coating materials, such as grease, gravel, and soil.

Following decontamination, drilling equipment will be placed on the clean drill rig and moved to a clean area. If the equipment is not used immediately, it should be stored in a designated secure, clean area and covered with plastic sheeting.

Drilling equipment will be decontaminated prior to drilling, between each boring, and prior to leaving the site. Decontamination will occur at the designated decontamination area.

6.2 SAMPLING EQUIPMENT DECONTAMINATION PROCEDURES

The following steps in accordance with SOP No. 1, will be used to decontaminate sampling equipment:

- Personnel will dress in suitable safety equipment to reduce personal exposure.

- Equipment showing gross contamination will be placed in a wash tub and the gross contamination will be scraped off with a flat-bladed scraper. The scrapings will be containerized.

- Equipment that will not be damaged by water will be placed in a wash tub containing Alconox (or low-sudsing detergent) along with potable water and scrubbed with a bristle brush or similar utensil. Equipment will be rinsed with clear potable water, in a second wash tub or bucket, followed by a double deionized water rinse.

- When sampling for organic volatiles, semivolatiles, or pesticides/PCB, the potable water rinse of the equipment will be followed by a double distilled or deionized water rinse.

- Equipment that may be damaged by water, such as an HNu or OVA, will be carefully wiped clean using a sponge and detergent water, and rinsed with deionized water. Oily or tarry contamination will be removed by sparing use of a solvent followed by a sponge and deionized water wipe-off. Care will be taken to prevent any equipment damage.

- Detergent waters will be replaced between borings. Rinse waters will be contained in pump sprayers to prevent used rinse water from contaminating subsequent samples.

Following decontamination, sampling equipment will be placed in a clean area on clean plastic sheeting to prevent contact with contaminated soil. If the equipment is not used immediately, it will be covered or wrapped in plastic sheeting to minimize potential airborne contamination.

Decontamination of all soil sampling equipment that will contact the sample will occur between samples.

6.3 DECONTAMINATION PROCEDURE DOCUMENTATION

Sampling personnel will be responsible for documenting the decontamination of sampling and drilling equipment. The documentation will be recorded with waterproof ink in the sampler's field notebook with consecutively numbered pages. The information entered in the field book concerning decontamination should include the following:

- Decontamination personnel
- Date and start and end times
- Decontamination steps/observations
- Weather conditions

FIGURE 1

Field Sampling Data Sheet for Soil (Surface or Subsurface) Samples

Location Identification: _____ Date: _____

Samplers' Signature: _____ Time: _____

Type of Sample: Surface: _____ Subsurface: _____

Type of Soil Cover: _____

Depth Interval: _____

Sample Identification: _____

Soil type (i.e. sand silt clay) _____

USCS Abbreviation _____

Color _____

Staining _____

Odor _____

Containers	Number	Preservatives

QA/QC Samples Collected: _____

Comments: _____

1.0
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STANDARD OPERATING PROCEDURE NO. 8
LITHOLOGIC DESCRIPTION OF SUBSURFACE SAMPLES

CANNON AIR FORCE BASE REMEDIAL INVESTIGATION
CLOVIS, NEW MEXICO

USACE CONTRACT NO. DACW-45-93-D-0005

W-C PROJECT NUMBER C3M11W

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3.0
PURPOSE AND SCOPE

This Standard Operating Procedure (SOP) provides technical guidance and methods for the lithologic logging of boreholes at Cannon Air Force Base. This SOP serves as a supplement to the Quality Assurance Project Plan (QAPP). This SOP is intended to be used with the QAPP and other SOPs, such as SOP No. 7, Subsurface Drilling and Soil Sampling.

The step-by-step procedures described herein are sufficiently detailed to allow field personnel to properly log boreholes.

4.0
RESPONSIBILITIES AND QUALIFICATIONS

The Woodward-Clyde (W-C) Cannon AFB Project Manager is responsible for assuring that lithologic logging of boreholes is performed in accordance with this Standard Operating Procedure. This Project Manager will designate qualified project staff to complete this procedure and the required reviews.

The designated project staff are responsible for logging boreholes according to this procedure. They report their progress, and any problems, to the Task Leader or Project Manager. Staff members are responsible for understanding the activities assigned to them and the quality assurance requirements associated with the activities.

The W-C Project QA/QC Officer or designee will be responsible for periodically reviewing the activities associated with this procedure to assure that borehole logging is being completed according to this procedure.

All personnel assigned to complete this procedure shall be qualified to perform the portions of the procedure assigned to them. The Project Manager will make the appraisal of qualifications and will document the qualifications in the project Quality Assurance files. The Project Manager's appraisal of qualifications will include a comparison of the requirements of the job assignment with the relevant experience and training of the prospective assignee; it will also include a determination whether future training is required, and, if required, by what method. On-the-job training is an acceptable method, provided such training is received from a person qualified to perform the trainee's assignment and the results of that training are documented.

5.0
PROCEDURES FOR LITHOLOGIC LOGGING OF BOREHOLES

A "site geologist" (geologist or geotechnical engineer) experienced in borehole drilling and soil sampling will be present at each operating drill rig. This site geologist will be responsible for logging samples, preparing samples for shipment to the laboratory for analyses, monitoring drilling operations, recording water losses or gains and groundwater data, and preparing boring logs.

All boring logs will subscribe to the following requirements:

- The boring log will be the form presented in Figure 1.
- Logs will be prepared in the field, as borings are drilled, by the site geologist. Each log will be signed by the preparer.
- All log entries will be printed. Photo reproductions will be clear and legible. Copies will be submitted to USACE-PM as borings are completed.
- Borehole depth information will be recorded to the nearest 0.1 foot.
- All relevant information blanks in the log heading and log body will be completed. If surveyed horizontal control is not available at the time of drilling, location sketches referenced by measuring distances or prominent surface features shall be shown on, or attached to, the log.
- A scale of 1 inch on the log form equalling 1 foot of boring will be used.
- Each and every material type encountered will be described on the log form. Material types will be logged directly from samples and indirectly interpolated using professional judgement, drill cuttings, drill action, etc., between sampling

intervals. The descriptions of intact soil samples will include the parameters listed in Table 1.

- Materials classifications will be in accordance with the Unified Soil Classification System (equivalent to ASTM D2487). Soil classifications will be made in the field at the time of sampling by the site geologist and are subject to change based on laboratory tests and subsequent review.

- In the field, visual estimates of the volume of secondary soil constituents can be reported by such terms as "trace" (1-10 percent), "little" (10-20 percent), "some" (20-35 percent), and "and" (35-50percent) or by an estimated specific percentage. The quantitative range of each of the terms used is to be defined either within a general legend or on each log.

- When used to supplement other sampling techniques, auger-flight cutting samples will be described in terms of the appropriate soil parameters, to the extent practical. "Classification" will be minimally described for these samples, along with a description of drill action and water losses/gains for the corresponding depth. Notations will be made on the log that these descriptions are based on observations of material other than samples; e.g., "from cuttings."

- The drilling equipment used will be described on each log. Information such as drill rod size, bit size and type, and rig manufacturer and model will be recorded.

- All special problems encountered during drilling and their resolution will be recorded on the log. This would include sudden tool drops, unrecovered tools in the borehole, and lost casings.

- The dates for the start and completion of borings will be recorded on the boring log. Changes in shift, day, driller, and site geologist will also be noted on the boring log.

- Stratigraphic/lithologic changes will be identified on the boring log by a solid horizontal line at the appropriate scale depth on the log which corresponds to measured borehole depths at which changes occur, measured and recorded to the nearest 0.1 foot. Gradational transitions and changes identified from cuttings or methods other than direct observation and measurement will be identified by a horizontal dashed line at the appropriate scale depth based on the best judgement of the logger.

- Logs will clearly show the depth intervals from which all samples are retained. The sampler type, diameter, and length of sampled interval and length (or percent) of sample recovery will be recorded for each driven or cored sample.

- Logs will identify the depth at which water is first encountered, the depth of water at the completion of drilling, and the stabilized depth to water. The absence of water in borings will also be indicated. Stabilized water level data will include time allowed for levels to stabilize.

- Logs will show borehole and sample diameters and depths at which drilling or sampling methods or equipment change.

- Logs will show total depth of penetration and sampling. The bottom of the hole will be so identified on the log by solid double lines from margin to margin with the notation "bottom of hole."

- Logs will identify any drilling fluid (water) losses, including depths at which they occur, rate of loss and total volume lost.

- Logs will show blow counts, hammer type and weight, and length of hammer fall for driven samplers. Blow counts will be recorded in half-foot increments when a standard penetration test is performed. For penetration less than a half-foot, the count will be annotated with the distance over which the count was taken. Refusal, if reached, will be noted.

- Logs will include all other information relevant to a particular investigation, but not limited to:

  - Odors
  - HNu/OVA measurements or other field screening or test results
  - Any observed evidence of contamination in samples, cuttings, or drilling fluid

- Significant color changes in the drilling fluid return will be recorded, even when intact soil samples or rock core are being obtained. The color change (from and to), depth at which change occurred, and a lithologic description of the cuttings before and after the change will be recorded.

- Special abbreviations used on a log will be defined either in the log where used, or in a general legend.

- Readings of instruments used to detect organic vapors, toxic or explosive gases, and oxygen will be recorded on the log, if these instruments are used. This includes readings taken at the annulus of the borehole, of an individual sample, or at a certain depth within the borehole.

TABLE 1

LOG DESCRIPTORS FOR SOIL SAMPLES

Parameter	Example
Depositional Environment and Formation, (if named and if known)	glacial till, Twin Cities Formation
Unified Soil Classification System	Sandy Clay
Secondary Components and Estimated Quantities either by percentages or by descriptive percentage ranges (Note: terms used to indicate ranges should be described on the log or in a general legend)	sand: fine, with trace of med.
Color	gray
Consistency (cohesive soil). Use relative term	very soft, soft, medium, stiff, very stiff, hard
Density (non-cohesive soil). Use relative term	loose, medium, dense, very dense
Moisture Content. (Use relative term. Do not express as a percentage unless a value has been measured)	dry, damp, moist, wet, saturated
Texture/Fabric/Bedding	no apparent bedding, numerous vertical iron-stained tight fractures
Grain Angularity	rounded sand grains
Sorting (sands)	poorly sorted
Structure	slickensides
Grain or fragment size	coarse
Note "Fill", "Top of Natural Ground", and "Top of Bedrock" where appropriate	

HTW 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 REC. %

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

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

HTW DRILLING LOG

HOLE NO.

PROJECT

INSPECTOR

SHEET OF SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
	6						
	7						
	8						
	9						
	10						
	11						
	12						
	13						
	14						

/CORPS-A/4-1-93

PROJECT:

HOLE NO.:

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STANDARD OPERATING PROCEDURE NO. 9
BOREHOLE ABANDONMENT

CANNON AIR FORCE BASE REMEDIAL INVESTIGATION
CLOVIS, NEW MEXICO

USACE CONTRACT NO. DACW-45-93-D-0005

W-C PROJECT NUMBER C3M11W

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3.0
PURPOSE AND SCOPE

The purpose of this document is to define the Standard Operating Procedure (SOP) for borehole abandonment at Cannon Air Force Base.

This SOP serves as a supplement to the Quality Assurance Project Plan (QAPP) and the Field Sampling Plan (FSP). This SOP is intended to be used with the FSP and other SOPs.

The step-by-step procedures described herein are sufficiently detailed to allow field personnel to properly perform abandonment.

4.0
RESPONSIBILITIES AND QUALIFICATIONS

The Woodward-Clyde (W-C) Cannon AFB Project Manager is responsible for assuring that borehole abandonment is performed in accordance with this Standard Operating Procedure. This Project Manager will designate qualified project staff to complete this procedure and the required reviews.

The designated project staff are responsible for performing borehole abandonment according to this procedure. They report their progress, and any problems, to the Task Leader or Project Manager. Staff members are responsible for understanding the activities assigned to them and the quality assurance requirements associated with the activities.

The W-C Project QA/QC Officer or designee will be responsible for periodically reviewing the activities associated with this procedure to assure that borehole abandonment is being completed according to this procedure.

All personnel assigned to complete this procedure shall be qualified to perform the portions of the procedure assigned to them. The Project Manager will make the appraisal of qualifications and will document the qualifications in the project Quality Assurance files. The Project Manager's appraisal of qualifications will include a comparison of the requirements of the job assignment with the relevant experience and training of the prospective assignee; it will also include a determination whether future training is required, and, if required, by what method. On-the-job training is an acceptable method, provided such training is received from a person qualified to perform the trainee's assignment and the results of that training are documented.

5.0
PROCEDURE FOR BOREHOLE ABANDONMENT

Abandonment is the procedure by which any boring (or well) is permanently closed. Abandonment procedures should preclude any current or subsequent discharges from entering the abandoned boring or well and thereby terminate access to the subsurface environment through that borehole.

Upon completion of soil sampling and advancement of the boring to its predetermined depth, the soil boring will be abandoned immediately, unless saturated conditions have been encountered. For borings encountering saturated conditions, a 24-hour groundwater level will be measured before backfilling. Borings left open overnight will be covered to lessen the potential for injury to personnel and to minimize the potential for any surface drainage to enter the boring. The following steps will be performed to abandon a boring:

1. All boreholes to be abandoned with a depth greater than 3 feet will be grouted. Upon completion of drilling, the borings will be grouted subsequent to the removal of the hollow-stem augers. Grouting will be accomplished by placing a tremie pipe to the bottom of the boring and pumping grout through this pipe until undiluted grout flows from the boring at ground surface. The grout mix will be in proportions of one sack (94 pounds) of Portland cement, 3-5 pounds of powdered bentonite, and a maximum of 7 gallons of water. The bentonite will be well mixed with the water prior to adding the cement. Twenty-four hours after grouting, the borehole will be checked for grout settlement and will be topped off to the ground surface with grout, if necessary. Borings less than 3 feet deep will be backfilled with native materials available adjacent to the boring.

2. Upon completion of the boring, all downhole equipment will be scraped clean as it is withdrawn from the hole. Decontamination and cuttings disposal will be performed in accordance with SOP No. 1, Equipment Decontamination and SOP No. 7, Subsurface Drilling and Soil Sampling.

3. Where borings penetrate surface pavements, walkways, or sidewalks, it will be necessary to patch the pavement surface following backfilling. Concrete pavements should be filled with low slump (less than 4 inches) concrete mix. Asphaltic concrete pavements should be filled with asphaltic concrete patch mix and thoroughly compacted by ramming. The surface of any patch should be screeded level upon completion. In freezing weather, the concrete mix must be protected from freezing for 48 hours after placement.

4. For each abandoned boring, a record on the boring log as well as in the field log book will be provided after the abandonment is completed. The record will include the data listed below; all depths should be measured from the ground surface.

   a. Project name and boring designation

   b. Location with respect to any replacement boring

   c. Open depth prior to grouting and depth to which grout pipe was placed

   d. Copy of the boring log

   e. Description and total quantity of grout used initially

   f. Description and daily quantities of grout used to compensate for settlement

   g. Dates of grouting

   h. Water level prior to grouting and date measured

1.0
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STANDARD OPERATING PROCEDURE NO. 10
SURFACE WATER SAMPLING

CANNON AIR FORCE BASE REMEDIAL INVESTIGATION
CLOVIS, NEW MEXICO

USACE CONTRACT NO. DACW-45-93-D-0005

W-C PROJECT NUMBER C3M11W

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FIGURE 1 - FIELD SAMPLING DATA SHEET FOR SLUDGE SAMPLES

3.0
PURPOSE AND SCOPE

The purpose of this document is to define the standard procedure for collecting surface water samples for the Cannon AFB project. This Standard Operating Procedure (SOP) serves as a supplement to the Quality Assurance Project Plan (QAPP) and the Field Sampling Plan (FSP). This procedure gives descriptions of equipment, field procedures, and QA/QC procedures necessary to collect surface water samples. The sample locations and frequency of collection are specified in the FSP.

This procedure is intended to be used with the FSP and several other SOPs. Sample identification, labeling, handling, and chain-of-custody procedures are described in SOP No. 12. SOP No. 12 also includes the listing of sample containers, preservatives, and holding times applicable to samples collected using this SOP. SOP No. 1 describes decontamination procedures which are also applicable to this SOP.

4.0
RESPONSIBILITIES AND QUALIFICATIONS

The Woodward-Clyde (W-C) Cannon AFB Project Manager is responsible for assuring that these procedures are followed during field operations by reviewing the field notebooks and analytical data when they are available. The Project Manager will designate qualified project staff to complete this procedure and the required reviews.

The designated project staff are responsible for completing the review and reporting progress according to this procedure. They report their progress, and any problems, to the Task Leader or Project Manager. Staff members are responsible for understanding the activities assigned to them and the quality assurance requirements associated with the activities.

The W-C Project QA/QC Officer or designee will be responsible for periodically reviewing the activities associated with this procedure to assure that they are being completed according to this procedure. Problems related to reporting by the field crew are the responsibility of the W-C Task Leader.

All personnel assigned to complete this procedure shall be qualified to perform the portions of the procedure assigned to them. The Project Manager will make the appraisal of qualifications and will document the qualifications in the project Quality Assurance files. The Project Manager's appraisal of qualifications will include a comparison of the requirements of the job assignment with the relevant experience and training of the prospective assignee; it will also include a determination whether future training is required, and, if required, by what method. On-the-job training is an acceptable method, provided such training is received from a person qualified to perform the trainee's assignment and the results of that training are documented.

5.1 EQUIPMENT LIST

Sample bottles with preservatives added will be obtained from the analytical laboratory. Several extra sample bottles will be obtained in case of breakage or other problems.

Equipment used during surface water sample collection:

- pH meter (with automatic temperature compensation)
- Specific conductivity meter
- Thermometer
- Sample bottles
- Cooler with ice
- Polyethylene or glass jar for field measurement samples
- Measuring tape with weighted end
- Glass or polyethylene sample collection container
- Plastic squeeze bottle filled with deionized or distilled water
- Plastic sheeting
- Appropriate health and safety equipment
- Water sampling bottle (Wildco Horizontal Beta bottle)
- Grease pencil
- Strapping tape

Equipment used during decontamination:

- Alconox soap (or equivalent)
- Potable tap water
- Isopropanol (0.1 N) pesticide grade
- Nitric acid (0.05 N) or hydrochloric acid (0.1 N)
- Deionized or distilled water
- Large sponges

- Decontamination buckets/pails
- Several spray or squirt bottles

5.2 SAMPLING PROCEDURES

This section gives the step-by-step procedures for collecting surface water samples. Observations made during sample collection should be recorded in the field notebook and field data sheet as specified in Section 5.4 of this SOP.

5.2.1 Decontamination Equipment

Before any sampling begins, and between samples, all sample collection equipment shall be decontaminated. If dedicated equipment is used, it should be rinsed with deionized water. Mobile decontamination supplies will be provided so that equipment can be decontaminated in the field. The decontamination solutions shall be replaced with clean solutions between each decontamination operation (i.e, between each sample location). A discussion of equipment and personnel decontamination is contained in SOP No. 1 Decontamination, and in the site Health and Safety Plan.

5.2.2 Instrument Calibration

Electronic equipment used during sampling includes a pH meter with temperature scale and a conductivity meter. Before going into the field, the sampler shall verify that all of these are operating properly. The pH and conductivity meters require calibration prior to use every day and must be recalibrated if they have been turned off, experience sustained periods of nonuse, or anytime readings are considered suspect. Calibration times and appropriate readings will be recorded in the field notebook. Specific instructions for calibrating the instruments are given in Section 6.0 of this SOP.

5.2.3 Obtaining Surface Water Samples

The following procedures are to be used to collect surface water samples:

1. Assemble all necessary sample collection equipment.

2. Make sure that the sample labels have been filled out for the sampling location. Assemble bottles for filling.

3. Rinse the surface water collection container with clean water.

4. When sampling surface water features, a discrete sample will be collected from the sampling areas specified in the FSP. Determine the approximate depth of the pond. Lower the sampler to 1/2 the depth at that location. Drop the messenger along the line after allowing fluids to enter the sampler. If depth is less than 1 foot, use a beaker with a bottle clamp to collect sample at mid-depth. Care should also be taken to avoid collecting items floating in the water. After the container is filled, carefully lift it out of the water and fill the sample bottles in the order given in Step 5 below. If insufficient sample volume has been collected, be sure the sampling apparatus is returned to the same area each time additional volumes are collected. Repeat the process until all of the sample has been collected. Cap the sample bottles before proceeding to the next location.

5. Bottle filling order:

   a. Slowly pour a portion into the sample bottles for volatile organics first and cap quickly.

   b. Slowly pour a portion of the sample into the sample bottles for all other analyses and cap quickly.

   c. Slowly pour an unfiltered portion into the sample container for field parameters, obtain field parameter measurements, and record. For composited samples, field parameters will be measured from a portion of the unpreserved composite.

6.. Place sample collection and field analysis equipment in a container with deionized water after sample collection is complete at each station.

7. For sample vials other than VOA vials, secure caps with strapping tape.

8. For sample bottles that are less than full, mark volume level on bottle with a grease pencil.

9. Sample collection and field analysis equipment will be fully decontaminated after sample collection is complete at each station following decontamination procedures outlined in SOP No. 1 pertaining to equipment decontamination.

10. Record time of sampling and complete field documentation.

5.2.4 Field Quality Assurance/Quality Control Samples

Quality assurance/quality control (QA/QC) samples will be collected during surface water sampling.

QA/QC samples are designed to help identify potential sources of sample contamination and evaluate potential error introduced by sample collection and handling. All QA/QC samples are labeled with QA/QC identification numbers and sent to the laboratory with the other samples for analyses. Specific QA/QC samples that will be collected at each SWMU are described in the FSP.

Rinsate Samples

A decontamination rinsate sample of sampling equipment is intended to check if decontamination procedures have been effective. For the surface water sampling operation, a rinsate sample will be collected from the decontaminated sampling equipment before it is used to obtain the sample. Deionized water will be rinsed over a decontaminated sampling apparatus and transferred to the sample bottles. The same parameters that are being analyzed in the water samples will be analyzed in the rinsate samples. The rinsate sample is assigned a QA/QC sample identification number, stored in an iced cooler, and shipped to the laboratory on the day it is collected.

Duplicate Samples

Duplicate samples are samples collected side-by-side to check for the natural sample variance and the consistency of field techniques and laboratory analysis. For the surface water sampling, a duplicate sample will be collected at the same time as the initial sample. The initial sample bottles for volatile organic analyses will be filled first, then the duplicate sample bottles for volatile organic analyses and so on until all necessary sample bottles for both the initial sample and the duplicate sample have been filled. The duplicate sample will be handled in the same manner as the initial sample. The duplicate surface water sample will be assigned a QA/QC identification number, stored in an iced cooler, and shipped to the laboratory on the day it is collected.

Field Blanks

Field blanks check for contamination of samples due to factors at the sampling site. For a field blank, a volatile organic sample bottle is taken empty to the field and filled at the sampling site with organic-free deionized water at the time the surface water sample is collected. The sample will be assigned a QA/QC identification number, stored in an iced cooler, and shipped to the laboratory with the other samples.

Matrix Spikes

Matrix spikes are used to determine long-term precision and accuracy of the analytical method on various matrices. For this procedure, duplicate samples are collected at a sampling site and spiking is done by the lab. Samples are labeled as matrix spikes for the lab. It is useful to collect both the matrix spike and duplicate at the same sampling site.

5.3 SAMPLE HANDLING

Sample containers and preservatives are specified in SOP No. 12, Sample Handling, Documentation, and Analysis. Samples will be labeled and handled as described in SOP No. 12. The parameters for analysis are specified in the FSP.

5.4 DOCUMENTATION

5.4.1 Field Sampling Data Sheet

A field sampling data sheet will be completed at each sample location (Figure 1). Items not applicable to the sampling will be labeled as not applicable (NA). The information on the data sheet includes the following:

Sampling location
Date and time of sampling
Person performing sampling
Conductivity, temperature, and pH during sampling
Color (describe), odor (describe), turbidity (y/n)
Sample identification number
Number of samples taken
Preservation of samples
Record of any QC samples from site
Any irregularities or problems noted in sampling procedures

5.4.2 Field Notes

Field notes will also be kept during sampling activities. The following information will be recorded in the bound field notebook using waterproof ink:

Names of personnel
Weather conditions
Date and time of sampling
Location and sample station number
Times that procedures and measurements are completed
Decontamination times
Calibration information
Calculations (e.g., calculation of flow rate)

6.1 pH METER

The pH meter must be calibrated each day before taking any readings of samples. Calibration and operation of the pH meter should follow the manufacturer's specific instructions. In general, calibration is done by adjusting the meter with standard buffers that bracket the expected pH of the field water. Calibration will consist of the following general procedures:

1. Adjust the reading of the pH meter with the electrode placed in the pH 7 buffer by using the calibration knob. Rinse the electrodes with distilled water between buffer adjustments.

2. Adjust the reading of the meter with the electrode placed in the pH 4 buffer with the slope (or temperature) knob.

3. Repeat steps 1 and 2 until the meter gives acceptable readings (±0.1 pH unit) for all the buffers used for calibration.

Note: Always use the same electrode for measurements that was used in the calibration. Recalibrate the meter if the electrode is replaced. Also, the temperature setting on the pH meter often does not match the sample temperature after calibration. The pH readings will still be accurate in these cases, provided that the response to the buffers is correct.

Record the time and temperature in the field notebook whenever the pH meter is calibrated.

6.2 CONDUCTIVITY METER

The conductivity meter must be calibrated each day before taking field measurements. Record time, temperature, and instrument response in the meter notebook. Calibration is done by noting the response of the meter to several standard conductivity solutions which bracket the values expected to be measured in the field. Standards of 100, 1,000, and 10,000 should be adequate for the samples expected. If the instrument has a calibration adjustment, set the

response to match the standards. Otherwise, simply record the instrument response to each standard in the field notebook.

FIGURE 1

Field Sampling Data Sheet for Surface Water Samples

Location Identification: _____ Date: _____
Samplers' Signature: _____ Time: _____
Weather: _____

Type of Sample: Composite _____ Grab _____

Sample Identification: _____

pH _____
Conductivity _____
Temperature _____
Flow rate (flumes)
or volume (surge pond) _____

Description of Water: _____

Color: _____
Odor: _____
Turbidity: Yes _____ No _____

Containers	Number	Preservatives

QA/QC Samples Collected: _____

Comments: _____

1.0
TITLE PAGE

STANDARD OPERATING PROCEDURE NO. 11
IDENTIFICATION AND DESCRIPTION OF FIELD SAMPLING SITES

CANNON AIR FORCE BASE
REMEDIAL INVESTIGATION
CLOVIS, NEW MEXICO

USACE CONTRACT NO. DACW-45-93-D-0005

W-C PROJECT NUMBER C3M11W

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3.0
PURPOSE AND SCOPE

The purpose of this document is to define the procedure for identification and description of field sampling sites for the remedial investigation (RI) activities at Cannon Air Force Base (Cannon AFB), Clovis, New Mexico. This standard operating procedure (SOP) serves as a supplement to the Quality Assurance Project Plan (QAPP) and the Field Sampling Plan (FSP). Sampling sites will be selected as described in the FSP. The purpose of this procedure is to identify sampling site locations which are not identified by another structure, such as a manhole, and to describe the site in such a manner that the site may be relocated for future investigative work at the site and/or for repetitive sampling.

4.0
RESPONSIBILITIES AND QUALIFICATIONS

The Woodward-Clyde (W-C) Cannon AFB Project Manager is responsible for assuring that identification and description of field sampling sites are performed according to this procedure. The Project Manager will designate qualified project staff to complete this procedure and the required reviews.

The designated project staff are responsible for field sampling site identification according to this procedure. They report their progress and any problems, to the Task Leader or Project Manager. Staff members are responsible for understanding the activities assigned to them and the quality assurance requirements associated with the activities.

The W-C Project QA/QC Officer or designee will be responsible for reviewing the field sampling site identification to assure this procedure is being followed.

All personnel assigned to complete this procedure shall be qualified to perform the portions of the procedure assigned to them. The Project Manager will make the appraisal of qualifications and will document the qualifications in the project Quality Assurance files. The Project Manager's appraisal of qualifications will include a comparison of the requirements of the job assignment with the relevant experience and training of the prospective assignee; it will also include a determination whether future training is required, and, if required, by what method. On-the-job training is an acceptable method, provided such training is received from a person qualified to perform the trainee's assignment and the results of that training are documented.

5.0
IDENTIFICATION AND DESCRIPTION PROCEDURE

5.1 EQUIPMENT LIST

- Fluorescent orange spray paint
- Survey stakes
- Fluorescent orange survey flagging
- Metal spikes/pins
- Camera and film
- Field notebook
- Waterproof pens and markers
- 100-foot measuring tape (marked in tenths of feet)

5.2 PROCEDURE

Some field sampling sites, such as monitoring wells, will have been previously located and surveyed, and are currently identified. The surface soil and subsurface soil boring locations cited as part of this investigation will require documentation of location for future reference. Prior to conducting sampling activities, this documentation will consist of clearly marking the sampling site with a stake marked with the sampling site location as specified in the FSP. The location will be measured using a measuring tape and described to the nearest tenth (0.1) foot from a permanent monument (i.e., fence post, concrete pad) or as directed by the FSP. This information will be recorded in the field notebook for future reference.

Following completion of sampling at a surface sample site, the sample site identification stake will be replaced and remarked as needed. For subsurface soil borings, which are grouted, a steel pin/spike will be placed "head up" in the center of the grout in addition to placing the sample site identification stake next to the abandoned soil boring. Prior to leaving the sampling site, a photograph should be taken which would allow some sort of sample site reconstruction if necessary (i.e., have identifiable permanent features as part of the photograph). All photography on base shall be done in accordance with direction and security protocol as defined by the Base Environmental Management Flight.

At the completion of the field activities, all sample site locations will be surveyed for horizontal location and vertical elevation from a permanent monument based on the Cannon AFB coordinate system by a New Mexico Registered Surveyor. At each site, all aboveground and, where possible, underground physical features shall be either verified with previous report mapping or determined as required. All aboveground physical features will be located/verified to the nearest foot. Permanent control monuments shall be placed in accessible locations within the limits of the work if existing permanent monuments are not located within 1,000 feet of a site. One set of monuments is allowable for adjacent sites. These monuments shall be set no closer than 500 feet to each other. Coordinates and elevations shall be established to the closest 0.01-foot for each monument. The location, identification, coordinates, and elevations of the wells and monuments shall be plotted on maps with a scale large enough to show their location with reference to other structures at the individual sites. A tabulated list of the monitoring wells and monuments, copies of all field books, and all computation sheets shall be prepared and submitted to W-C and the USACE. The tabulation shall consist of the designated number of the well or monument, the X and Y coordinates, and all the required elevations.

5.3 DOCUMENTATION

Identification and a description of each sampling site will be recorded in the field notebook. That information should include the following at a minimum:

- Sample site location identification
- Date of location installation
- Description of sample site location
- Type of sample site
- Description of installed marker
- Sample site location distance relative to/from permanent base landmark
- Location installer name

Photographs will be taken of the sample site location and recorded in the field notebook. Information concerning the photograph to accompany the above information is as follows:

- Roll number
- Photo number
- Photo direction
- Sampling site locations
- Points of intercept/scale in photograph

1.0
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STANDARD OPERATING PROCEDURE NO. 12
SAMPLE HANDLING, DOCUMENTATION, AND TRACKING

CANNON AIR FORCE BASE
REMEDIAL INVESTIGATION
CLOVIS, NEW MEXICO

USACE CONTRACT NO. DACW-45-93-D-0005

W-C PROJECT NUMBER C3M11W

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LIST OF FIGURES

FIGURE 1 COMPLETED SAMPLE LABEL
FIGURE 2 EXAMPLE A-E DAILY QUALITY CONTROL REPORT
FIGURE 3 EXAMPLE CHAIN-OF-CUSTODY FORM

3.0
PURPOSE AND SCOPE

The purpose of this document is to define the standard procedures for sample handling, documentation, and analysis for the Cannon Air Force Base project. This Standard Operating Procedure (SOP) serves as a supplement to the Quality Assurance Project Plan (QAPP) and the Field Sampling Plan (FSP). This procedure is intended to be used together with the FSP and other SOPs and is referenced in all SOPs that apply to sampling.

4.0
RESPONSIBILITIES AND QUALIFICATIONS

The Woodward-Clyde (W-C) Cannon AFB Project Manager is responsible for assuring that samples are handled, documented, and analyzed according to this procedure. The Project Manager will designate qualified project staff to complete this procedure and the required reviews.

The designated project staff are responsible for sample handling and documentation according to this procedure. They report their progress and any problems, to the Task Leader or Project Manager. Staff members are responsible for understanding the activities assigned to them and the quality assurance requirements associated with the activities.

The W-C Project QA/QC Officer or designee will be responsible for periodically reviewing sample handling and tracking activities to assure that they are being completed according to this procedure. The W-C Field Task Leader will be designated to assist in this process.

All personnel assigned to complete this procedure shall be qualified to perform the portions of the procedure assigned to them. The Project Manager will make the appraisal of qualifications and will document the qualifications in the project Quality Assurance files. The Project Manager's appraisal of qualifications will include a comparison of the requirements of the job assignment with the relevant experience and training of the prospective assignee; it will also include a determination whether future training is required, and, if required, by what method. On-the-job training is an acceptable method, provided such training is received from a person qualified to perform the trainee's assignment and the results of that training are documented.

5.0
PROCEDURES FOR SAMPLE HANDLING, DOCUMENTATION, AND ANALYSIS

5.1 SAMPLE LABELING

All sample labels should be filled out with waterproof ink and numbered. Soil samples collected in stainless steel liners will be capped immediately following collection and a completed label attached. For soil samples collected in jars and sample bottles for groundwater analyses, sample labels should be completed and attached prior to sample collection. A typical sample label is shown as Figure 1.

Labels may be partially completed prior to sample collection. The date, time, sampler's initials, and the sample identification number should not be completed until the time of sample collection. At a minimum, each numbered label shall contain the following information:

- Project/Facility (Cannon)
- Grab or composite sample
- Sampler's company affiliation
- Date and time of sample collection
- Analyses required
- Preservation used
- Sampler's initials
- Filtered (if applicable)
- MRD LIMS No. identified if sample is collected for USACE MRD Laboratory
- Sample identification (see below)

The sample designation system for all field (analytical and geotechnical) and quality assurance/quality control (QA/QC) samples is a three letter and eleven digit/letter unique identification for each sample (CANXXX-YYYY-ZZZZ). CANXXX is the facility identifier with CAN identifying Cannon AFB and XXX identifying the specific SWMU. The next four digits/letters (YYYY) identifies the specific sampled location. At Cannon AFB these include soil boring number, surface soil location number, monitoring well number, surface water location numbers, or sludge sampling locations. All sample location numbers are SWMU-specific with the first three numbers corresponding to the SWMU while the fourth number or letter corresponds to the specific soil boring, surface soil, monitoring well, or Playa Lake location. The last four digits (ZZZZ) are the sample identifier. The first number corresponds to the type of sample (i.e., 0 for soil (analytical), 2 for groundwater, 3 for surface water, 4 for soil (geotechnical), 5 for sludge, 6 for soil MS/MSD, and 7 for water MS/MSD). The last 3 numbers correspond to the beginning depth of the sample in feet BGS for all soil samples. The following is an example of an identification number:

```
                                  Soil (Analytical)
                     SWMU#46      |
CAN  046  -  0461  -  0000
|    |        |       |
Cannon  SWMU#  Boring #1   Approximate Depth of Top of Sample in Ft-BGS
AFB     46
```

Multiple soil samples could be collected from the same borehole; multiple water samples could be collected from the same monitoring well, or lagoon. The last three digits differentiate among these multiple samples. The soil sample identifier will represent the beginning depth at which the sample was collected. Groundwater samples from a given monitoring well may be numbered sequentially.

All QA/QC samples will be identified at the location where they were collected, and assigned a unique identification number following the same procedure above except for the last four digit (ZZZZ) number. The first two numbers of the QA/QC sample identifier correspond to a particular SWMU:

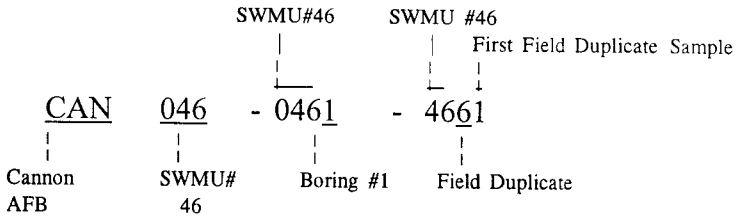
- 31 - SWMU No. 31 - AGE Maintenance Shop Pad
- 46 - SWMU No. 46 - Oil/Water Separator No. 196
- 47 - SWMU No. 47 - Oil/Water Separator No. 494

- 51 - SWMU No. 51 - Oil/Water Separator No. 375
- 55 - SWMU No. 55 - Lead and Acid Battery Accumulation Point
- 57 - SWMU No. 57 - Oil/Water Separator No. 379
- 61 - SWMU No. 61 - Oil/Water Separator No. 5077a
- 62 - SWMU No. 62 - Oil/Water Separator No. 5077b
- 63 - SWMU No. 63 - Oil/Water Separator No. 5077c
- 70 - SWMU No. 70 - Oil/Water Separator No. 326 and leach field
- 77 - SWMU No. 77 - Civil Engineering Contained Storage Area
- 92 - SWMU No. 92 - Oil/Water Separator No. 5120
- 93 - SWMU No. 93 - Oil/Water Separator No. 5121
- 94 - SWMU No. 94 - Oil/Water Separator No. 5144
- 103 - SWMU No. 103 - Wastewater Playa Lake
- 127 - SWMU No. 127 - Oil/Water Separator Near Tank 4095 (#1) and Leach Field

The third number corresponds to the type of QA/QC sample:

- 5 - Ambient Blank
- 6 - Field Duplicate
- 7 - Rinsate Blank
- 8 - Decon Water
- 9 - Trip Blank
- 0 - Missouri River Division Duplicate

The last number corresponds to the number of the particular QA/QC sample type. The only QA/QC sample types which are not identified as above is the matrix spike/matrix spike duplicate sample type. The samples which are chosen for MS/MSDs (MS/D for inorganics) analyses are labeled in the field as MS/MSD samples and are noted as such on the Chain-of-Custody forms. These samples are associated with a regular sample number as shown on Page 7 of this SOP. The following is an example of an identification number for a QA/QC Sample:



5.2 SAMPLE HANDLING

This section discusses proper sample containers, preservatives, and handling and shipping procedures. Tables 1 and 2 summarize the information contained in this section.

5.2.1 Sampling Containers

Certified, commercially clean sample containers shall be obtained from the contract analytical lab. If appropriate, the bottles shall be labeled by the lab to indicate the type of sample to be collected. Required preservatives (with the exception of sodium thiosulfate) shall be prepared and placed in the bottles for aqueous analyses at the laboratory prior to shipment to the site.

5.2.2 Sample Preservation

All samples will be stored on ice in an insulated cooler immediately following sample collection. Soil and sediment samples do not require additional preservation. As noted above, sample containers for aqueous samples will be sent by the laboratory containing the appropriate preservatives. However, if the field test for residual chlorine is positive at a given well, all sample bottles for that location, with the exception of those for dissolved metals, total cyanide and sulfide will require additional preservation with sodium thiosulfate. To preserve samples requiring sodium thiosulfate, follow the steps outlined below:

For SW-846 8240 Analyses:

- Add 4 drops of 10 percent sodium thiosulfate to 40 ml vial
- Slowly add sample to vial until almost full
- Add 4 drops of concentrated HCL to vial (convex meniscus)

- Cap vial tightly and check to determine that no air bubbles are present
- If air bubbles are present, discard sample vials and repeat procedure

For SW-846 Methods 8080, 8150, and 8270

- Add 1 ml 10 percent sodium thiosulfate to 1 liter amber glass bottle
- Slowly fill sample bottle until almost full and cap tightly

5.3 SAMPLE HANDLING AND SHIPPING

Sample containers will be placed in reclosable plastic storage bags and wrapped in protective packing material (if appropriate). Samples will then be placed in a cooler with ice (double bagged using plastic trash bags) for shipment to the laboratory. The drain on the cooler shall be taped shut. Samples collected in glass containers will be packed in foam liners and bubble packing or styrofoam peanuts to ensure that no breakage occurs during shipment. Samples will be shipped by overnight express carrier for delivery to the analytical laboratory and to the MRD laboratory.

A completed chain-of-custody form for each cooler will be placed in a ziploc bag and taped to the inside of the cooler lid. Coolers will be wrapped with strapping tape at two locations to secure lids. Numbered and signed custody seals shall be placed on the outside of each cooler. In addition, "Fragile" labels and "This Side Up" labels shall be placed on the outside of each cooler containing glass bottles. Put "This Side Up" labels on all four sides and "Fragile" labels on at least two sides. Note that each cooler cannot exceed the weight limit set by the shipper.

5.3.1 Holding Times and Analyses

The holding time is specified as the maximum allowable time between sample collection and analysis and/or extraction, based on the analyte of interest, stability factors, and preservation methods. Samples should be sent by overnight courier service to the laboratory daily after collection.

Chemical constituents which will be analyzed during the field investigation have been identified by SWMU in the FSP.

5.4 SAMPLE DOCUMENTATION AND TRACKING

This section describes documentation required in the field notes, Daily Quality Control Reports, and sample Chain-of-Custody requirements.

5.4.1 Field Notes

Documentation of observations and data acquired in the field will provide information on the acquisition of samples and also provide a permanent record of field activities. The observations and data will be recorded with waterproof ink in a permanently bound weatherproof field book with consecutively numbered pages and, if applicable, on field sampling data sheets.

The information in the field book will include the following as a minimum. Additional information is included in the specific SOPs regarding the appropriate data sheets.

- Project name
- Location of sample
- Sampler's signature
- Date and time of sample collection
- Sample identification numbers and sample depth (if applicable)
- Description of samples (matrix sampled), composite or grab sample
- Analysis to be performed
- Number and volume of samples
- Description of QA/QC samples (if collected)
- Sample methods or reference to the appropriate SOP
- Sample handling, including filtration and preservation, as appropriate for samples
- Field observations
- Results of any field measurements, such as depth to water, pH, temperature, conductivity and chlorine test results

- Personnel present

Changes or deletions in the field book should be lined out with a single strike mark, initialed and dated by person making change, and remain legible. Sufficient information should be recorded to allow the sampling event to be reconstructed without relying on the collector's memory.

Each page of the field book will be signed by the person making the entry. Anyone making entries in another person's field book will sign and date those entries.

5.4.2 A-E Daily Quality Control Report

To supplement the information recorded in the field book, A-E daily quality control reports (DQCRs) will also be maintained at every sampling location. An example of the DQCR is shown as Figure 2. DQCRs will be maintained by members of the field sampling team and cross-checked for completeness at the end of each day by the sampling team members and/or Field Manager. They will be signed and dated by individuals making entries and initialed by the reviewer upon completion. Copies of the DQCR will be forwarded to the Quality Assurance Officer for review and submitted to the USACE Project Manager, per USACE Appendix III site requirements.

5.4.3 Sample Chain-Of-Custody

During field sampling activities, traceability of the sample must be maintained from the time the samples are collected until laboratory data are issued. Information on the custody, transfer, handling, and shipping of samples will be recorded on a Chain-of-Custody (COC) form. An example COC form is shown as Figure 3.

The sample handler will be responsible for initiating and filling out the COC form. The COC will be signed by the sampler when the sampler relinquishes the samples to anyone else. It is not necessary for the shipping company to sign COC; however, the airbill shall be retained by the sample handler for tracking purposes. A COC form will be completed for each set of samples collected daily, and will contain the following information:

- Sampler's signature and affiliation
- Project number
- Date and time of collection
- Sample identification number
- Sample type/matrix
- Grab or composite sample
- Preservative used
- Analyses requested
- Number of containers
- Signature of persons relinquishing custody, dates, and times
- Signature of persons accepting custody, dates, and times (laboratory)
- Method of shipment (i.e. Federal Express)

The person responsible for delivery of the samples to the shipping company will sign the COC form, retain the last copy of the three-part COC form, document the method shipment, and send the original and the second copy of the COC form with the sample (taped in a ziploc bag to inner cooler lid). Upon receipt at the laboratory, the person receiving the samples will sign the COC form and return the second copy to the Project manager. Copies of the COC forms and all custody documentation will be received and kept in the central files. The original COC forms will remain with the samples until final disposition of the samples by the laboratory. The analytical laboratory will dispose of the samples in an appropriate manner 60 to 90 days after data reporting. After sample disposal, a copy of the original COC will be sent to the Project manager by the analytical laboratory to be incorporated into the central files. Sample tracking will be done by using W-C's Sample Information Management System (SIMSII) as described in the Data Management Plan.

TABLE 1

SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES FOR SOIL/SEDIMENT/SLUDGE SAMPLES CANNON AFB, NEW MEXICO

Method	Parameter	Number of Containers/Sample	Minimum Sample Size	Preservation	Holding Time
8240[1]	Volatile organics	2-4 oz. glass VOA jars with Teflon-lined septa	10g	4°C	14 days
8270	Semivolatile organics	1-8 oz. wide-mouth glass jar with Teflon-lined lid[2]	30g	4°C	Extract - 14 days Analyze - 40 days
8080	Pesticides and PCBs	1-8 oz. wide-mouth glass jar with Teflon-lined lid[2]	30g	4°C	Extract - 14 days Analyze - 40 days
8150	Herbicides	1-8 oz. wide-mouth glass jar with Teflon-lined lid[2]	50g	4°C	Extract - 14 days Analyze - 40 days
418.1	Petroleum hydrocarbons	1-8 oz. wide-mouth glass jar with Teflon-lined lid[3]	30g	4°C	28 days
6010	Metals[4]	1-8 oz. wide-mouth glass jar with Teflon-lined lid[3]	200g	4°C	6 months 28 days Hg

1 8240 with capillary column
2 2-8 oz. jars are sufficient for Methods 8270, 8080, and 8150 combined.
3 2-8 oz. jars are sufficient for Methods 418.1 and 6010 combined.
4 In addition to Method 6010, includes 7060 (arsenic), 7421 (lead), 7471 (mercury), 7740 (selenium), and 7841 (thallium)

TABLE 2

SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES FOR WATER SAMPLES CANNON AFB, NEW MEXICO

Method	Parameter	Number of Containers/Sample	Minimum Sample Size	Preservation	Holding Time
8240[1]	Volatile organics	2-40 ml glass VOA vials with Teflon-lined septa	40 ml	4°C and 4 drops HCL to pH < 2	14 days
8270	Semivolatile organics	2-1 L amber glass bottle with Teflon-lined lid[2]	1 L	4°C	Extract - 7 days Analyze - 40 days
8080	Pesticides/PCBs	2-1 L amber glass bottles with Teflon-lined lid[2]	1 L	4°C	Extract - 7 days Analyze - 40 days
8150	Herbicides	1-1 L amber glass bottle with Teflon-lined lid[2]	1 L	4°C	Extract - 7 days Analyze - 40 days
418.1	Petroleum hydrocarbons	1-1 L amber glass bottle with Teflon-lined lid	1 L	4°C and HCl to pH < 2	28 days
6010[4]	Metals	1-1 L polyethylene bottle	1 L	4°C and HNO_3 to pH < 2	28 days

1 Modified 8240 using capillary column
2 2-1 L glass bottles are sufficient for Methods 8270, 8080, 8150, and 8330 combined.
4 In addition to Method 6010, includes 7060 (arsenic), 7421 (lead), 7470 (mercury), 7740 (selenium), and 7841 (thallium).

USE BALLPOINT PEN ONLY

Company Name

Sample Description

Parameter

Date and Time

Sampler's Signature

Preservative
(circle one)

Acid

Base

Filtered

DRN BY SCR	DATE 08/25/93	TYPICAL SAMPLE LABEL CANNON AIR FORCE BASE NEW MEXICO	PROJECT No.	FIG. No.
CHK'D BY	REVISIONS: 0		C3M11W	1

CAD DYN DWG 25/1 12:3

FIGURE 2

Date _____

W-C DAILY QUALITY CONTROL REPORT

Day	S	M	T	W	TH	F	S

Weather	Bright Sun	Clear	Overcast	Rain	Snow
Temp	To 32	32-50	50-70	70-85	85 up
Wind	Still	Moderate	High	Report No.	
Humidity	Dry	Moderate	Humid		

COE Project Manager _____
Project _____
Project No. _____
Contract No. _____

Subcontractors on Site:
Equipment on Site:
Visitors on Site:
Work Performed (including sampling):

FIGURE 2 (continued)

Project _____ Report No. _____

Project No. _____ Date _____

Quality Control Activities (including field calibrations):
Health and Safety Levels and Activities:
Problems Encountered/Corrective Actions Taken:
Special Notes:
Tomorrow's Expectations:

By _____ Title _____

Woodward-Clyde
101 South 108 Avenue, Omaha, NE 68154 (402) 334-8181 Fax (402) 334-1984

CHAIN OF CUSTODY RECORD

Project Name	Project No.	Analytical Parameters
Project Location	Project Manager	
Sampler(s)		

Sample		Type		Sample Identification	Matrix	Containers		Remarks
Date	Time	Comp.	Grab			No.	Type	

Signatures	Date	Time	Shipping Details	Special Instructions
Relinquished by:			Method of Shipment	
Received by:			Airbill No.	
Relinquished by:			Lab Address	
Received for Laboratory by:				

1.0
TITLE PAGE

STANDARD OPERATING PROCEDURE NO. 14
HEADSPACE ANALYSIS

CANNON AIR FORCE BASE
REMEDIAL INVESTIGATION
CLOVIS, NEW MEXICO

USACE CONTRACT NO. DACW-45-93-D-0005

W-C PROJECT NUMBER C3M11W

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3.0
PURPOSE AND SCOPE

This document defines the standard procedures for performing headspace analysis of soil and water samples in the field at Cannon Air Force Base (AFB). This Standard Operating Procedure (SOP) serves as a supplement to the Quality Assurance Project Plan (QAPP) and the Field Sampling Plan (FSP), and gives the description of equipment and procedures for field screening of soil and water samples. Samples locations and frequency of collection are specified in FSP. This procedure is intended to be used together with the FSP and other SOPs.

Applicable SOPs are listed below:

- SOP No. 5 - Sludge and Sediment Sampling
- SOP No. 6 - Surface Soil Sampling
- SOP No. 7 - Subsurface Drilling and Sampling
- SOP No. 10 - Surface Water Sampling
- SOP No. 12 - Sample Handling, Documentation, and Analysis

4.0
RESPONSIBILITIES AND QUALIFICATIONS

The Woodward-Clyde (W-C) Cannon AFB Project Manager is responsible for assuring that headspace analysis is conducted according to this procedure. The Project Manager will designate qualified project staff to complete this procedure.

The designated project staff are responsible for completing the headspace analysis process according to this procedure. They report their progress, and any problems, to the Task Leader or Project Manager. Staff members are responsible for understanding the activities assigned to them and the quality assurance requirements associated with the activities.

The W-C Project QA/QC Officer or designee will be responsible for periodically reviewing headspace analysis to assure that they are completed according to this procedure. Problems related to headspace analysis are also the responsibility of the W-C Task Leader.

All personnel assigned to complete this procedure shall be qualified to perform the portions of the procedure assigned to them. The Project Manager will make the appraisal of qualifications and will document the qualifications in the project Quality Assurance files. The Project Manager's appraisal of qualifications will include a comparison of the requirements of the job assignment with the relevant experience and training of the prospective assignee; it will also include a determination whether future training is required, and, if required, by what method. On-the-job training is an acceptable method, provided such training is received from a person qualified to perform the trainee's assignment and the results of that training are documented.

5.1 EQUIPMENT LIST

The following equipment is required for headspace analysis:

- Clean glass sample containers
- Paper towels
- Aluminum foil
- Organic vapor analyzer equipped with a photoionization detector (PID) or flame ionization detector (FID)
- Field book
- Waterproof and permanent marking pens
- Daily quality Control Report form (DQCR)

5.2 FIELD SCREENING PROCEDURES

A portion of each soil or water sample will be placed in the appropriate glass container. The container should be filled approximately three-fourths full for water and one-half full for soil. The mouth of the container will be covered with aluminum foil, tightly capped, and the samples will be allowed to equilibrate for 30 minutes. Care must be taken in the selection of soils with respect to consistency and sample placement in the container in order to achieve comparability and consistency. The disposition of the sample in the container will be recorded in the field log book. All headspace material will be containerized as specified in SOP No. 15 after analysis.

The sample headspace in the container shall be analyzed with an organic vapor analyzer by removing the lid and inserting the instrument probe through the foil liner. Care must be taken in the selection of appropriate foil, placement of the foil on the container, and removal of the lid so as not to compromise the integrity of the seal. If the seal has been compromised, this will be recorded appropriately or a new sample taken if possible.

5.3 ORGANIC VAPOR ANALYZER SELECTION

The selection of the appropriate organic vapor analyzer equipped with either a PID or an FID shall be based on contaminants of concern and/or ambient conditions at the respective site. The lamp selected for the PID, where applicable, will be based on the relative ionization potentials of the expected volatile contaminants. The selected instrument and rationale for use will be recorded on the DQCR and in the field log book.

5.4 CALIBRATION

The instrument(s) selected for use in accordance with data quality objectives and site requirements shall be calibrated according to the manufacturers recommendations and specifications. These procedures will be attached to this SOP where applicable.

5.5 DOCUMENTATION

All procedures and field conditions shall be recorded on the DQCR and in the field log book. The record shall include a description of the material being screened as well as site conditions such as humidity and the equilibration time and temperature.

1.0
TITLE PAGE

STANDARD OPERATING PROCEDURE NO. 15
INVESTIGATION-DERIVED WASTES

CANNON AIR FORCE BASE
REMEDIAL INVESTIGATION
CLOVIS, NEW MEXICO

USACE CONTRACT NO. DACW-45-93-D-0005

W-C PROJECT NUMBER C3M11W

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3.0
PURPOSE AND SCOPE

This document defines the standard procedures for handling and final disposition of Investigation-Derived Wastes (IDW) at Cannon Air Force Base (AFB). This Standard Operating Procedure (SOP) serves as a supplement to the Quality Assurance Project Plan (QAPP) and the Field Sampling Plan (FSP).

Applicable SOPs are listed below:

- SOP No. 1 - Decontamination
- SOP No. 5 - Sludge and Sediment Sampling
- SOP No. 6 - Surface Soil Sampling
- SOP No. 7 - Subsurface Drilling and Sampling
- SOP No. 10 - Surface Water Sampling
- SOP No. 14 - Headspace Analysis

4.0
RESPONSIBILITIES AND QUALIFICATIONS

The Woodward-Clyde (W-C) Cannon AFB Project Manager is responsible for assuring that management of investigation-derived waste (IDW) is conducted according to this procedure. The Project Manager will designate qualified project staff to complete this procedure.

The designated project staff are responsible for handling IDW according to this procedure. They report their progress, and any problems, to the Task Leader or Project Manager. Staff members are responsible for understanding the activities assigned to them and the quality assurance requirements associated with the activities.

The W-C Project QA/QC Officer or designee will be responsible for periodically reviewing IDW activities to assure that they are completed according to this procedure. Problems related to equipment decontamination are also the responsibility of the W-C Task Leader.

All personnel assigned to complete this procedure shall be qualified to perform the portions of the procedure assigned to them. The Project Manager will make the appraisal of qualifications and will document the qualifications in the project Quality Assurance files. The Project Manager's appraisal of qualifications will include a comparison of the requirements of the job assignment with the relevant experience and training of the prospective assignee; it will also include a determination whether future training is required, and, if required, by what method. On-the-job training is an acceptable method, provided such training is received from a person qualified to perform the trainee's assignment and the results of that training are documented.

5.0
INVESTIGATION DERIVED WASTES

The fieldwork planned at Cannon AFB during the RCRA Facility Investigation (RFI) will produce investigation-derived wastes (IDW). These will consist of the soil from the drilling of soil borings and headspace analysis, the potable water used to decontaminate the drilling and sampling equipment and personnel, and the used Personnel Protective Equipment (PPE).

6.0
SOIL CUTTINGS

The soil cuttings generated by the drilling and sampling of all soil borings and monitoring wells will be placed into DOT rated 55-gallon drums. Mixing of the cuttings from several borings is permissible in order to fill the drums as full as possible. However, only cuttings from individual SWMUs can be mixed, and the splitting of cuttings from one boring into several drums should be avoided. The drums will be sealed and labeled with permanent markings indicating the SWMU number, the boring(s) number, the matrix, date, and drum ID number. The drums will then be moved to a temporary storage facility designated by Cannon AFB and placed on wooden pallets. Drums from individual SWMUs will be segregated from each other as much as possible. Final disposition of IDW will be handled by Cannon AFB.

7.0
DECONTAMINATION WATER

During the field activities, equipment used for the various sampling methods will be decontaminated before and after use according to the procedures in SOP No. 1. This water will be containerized and placed into a DOT-rated drum and transported to the temporary storage facility.

It is anticipated that this decontamination water will not have any significant levels of contaminants since it is originally potable water. A headspace analysis will be performed to determine if any significant volatile organic compounds (VOCs) are present. The results of the field screening will be given to the POTW to determine if the decontamination water is acceptable for discharge into the sanitary sewer. If the decontamination water is not acceptable, it will be characterized further to determine if it is necessary to ship to a licensed hazardous waste facility.

8.0
USED PERSONNEL PROTECTIVE EQUIPMENT

Any personnel protective equipment (i.e., gloves, duct tape, Tyvek, etc.) used during field activities will be placed into 55-gallon drums, sealed, and labeled with the appropriate information. **No mixing of wastes will be allowed (i.e., soil with PPE trash).** PPE from individual SWMUs does not need to be segregated. If the drum is not full after the work has been completed at one SWMU, PPE from the next SWMU may be placed into it.

APPENDIX B

CANNON DATA QUALITY REVIEW CHECKLIST

STANDARD OPERATING PROCEDURE NO. 1

CANNON DATA REVIEW
CANNON AFB, NEW MEXICO

Woodward-Clyde
Omaha, Nebraska
W-C Project No. C3M11W

Note: This Standard Operating Procedures has been prepared for the sole use of Woodward-Clyde and may not be specifically applicable to the activities of other organizations.

1.0
INTRODUCTION

The purpose and scope of this document is to define the Standard Operating Procedure (SOP) for reviewing analytical data for the Cannon AFB RI/FS project. This SOP will outline the procedures to be followed and should sufficiently detail actions to be taken by the data reviewer. Any time professional judgement is appropriate, but the data reviewer is not certain of the appropriate action to take, the reviewer should contact either the QA/QC Officer or the QA/QC Coordinator.

This procedure serves as a supplement to the Quality Assurance Project Plan (QAPP) and is patterned similar to USEPA Functional Guidelines for the Evaluation of Inorganic Analyses (July 1988) and the USEPA CLP National Functional Guidelines for Organic Data Review (June 1991 Draft). The technical scope of work utilizes SW-846 Methods as follows:

- 8240 Volatile Organics
- 8270 Semivolatile Organics
- 8080 Pesticides/PCBs
- 8150 Herbicides
- 6010 Metals
- 7000 series for Atomic Absorption
- 9010/9012 Cyanide
- 376.2 Sulfide

TRPH by Method 418.1 (Prep. Method #3550 for soils) will also be included.

Methods are to be specified on the chain-of-custody forms. The QAPP is the source for all acceptance criteria for holding times, accuracy, precision, surrogate recoveries, and reporting limits. Results for soil samples are to be given on a dry weight basis.

The following definitions provide brief explanations of the qualifiers assigned to the results in the data review process:

B Method Blank Contamination. The analyte was identified in the associated blank.

U Undetected. The analyte was analyzed for, but was not detected above the reporting limit.

J Estimated. The analyte was identified; the associated numerical value is an estimated quantity because the amount detected is below the required limits or it may be due to quality control criteria outside of control limits.

Q Other Qualifier. Professional judgement on the part of the reviewer has qualified the associated numerical value. Usage of this data may be limited and should occur only if the data user understands the limitations associated with the data.

R Rejected. The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

Quantitation limit qualifiers will include "J" and "B" values for all organic analyses. "J" values for Method 8240 (GC/MS volatiles) are given down to one-fifth the reporting limit, "J" values for Method 8270 (base neutral acid GC/MS semivolatiles) are given down to one-tenth the reporting limit, and Method 8080 and Method 8150 "J" values are given down to one-half the reporting limit. Also, "J" values are reported for metals detected between the Instrument Detection Limit (IDL) and the reporting limit.

CANNON AFB DATA REVIEW SOP

List Lab(s): _____

List Site(s): _____

List Data Package(s) Reviewed:

Report No.	Date	No. of Samples	QA/QC
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

List Analyses Applicable to the Data Package Review:

Part	Method	No	Yes	No	Soil	Water	Sediment and Biota
A	Volatile Organics	8240	____	____	____	____	____
B	Semivolatile Organics	8270	____	____	____	____	____
D	Pesticides/PCBs and Herbicides	8080 8150	____	____	____	____	____
E	Petroleum Hydrocarbons	418.1	____	____	____	____	____
G	Metals(6010) plus (7421, 7060, 7740, 7470) (Pb) (As) (Se) (Hg)		____	____	____	____	____
H	Water Quality Parameters						
	• Cyanide	9010/9012	____	____	____	____	____
	• Sulfide	376.2	____	____	____	____	____
	• TDS	160.1	____	____	____	____	____
	• Alkalinity	310.1	____	____	____	____	____
	• Chloride & Sulfate	300.0	____	____	____	____	____
	• Nitrate/Nitrite	353.3	____	____	____	____	____
	• Organic Carbon	ASA-9	____	____	____	____	____

		YES	NO	N/A
1.	Were all deliverables received? (Note: Check addendum to laboratory contract)	___	___	___
1.1	Cover page present?	___	___	___
1.2	Sample chain of custody present and completed correctly?	___	___	___
1.3	Sample analyses and chain of custody match?	___	___	___

ACTION: Make a list of any missing deliverables. Contact the W-C Project Laboratory Coordinator.

2.	Does the laboratory narrative indicate any problems with sample receipt, condition of samples, analytical problems or special notations for any of the data reviewed?	___	___	___

ACTION: Make a list on the Laboratory Narrative Summary Sheet of any problems cited which would affect the results for Method 8240 and use professional judgement to evaluate the effect on the quality of the data. (Consult EPA Functional Guidelines)

NOTE: If any sample analyzed as a soil contains more than 50% water, all data should be flagged as "J" (estimated). Also, if both VOA vials for a sample were noted to have had air bubbles, flag all positive results "J" (estimated) and all nondetects "R" (rejected).

	YES	NO	N/A

3. Holding Times

Have any Method 8240 holding times, determined from date of collection to date of analysis, been exceeded? ___ ___ ___

Note: Waters must be preserved with hydrochloric acid. All samples must be kept at 4°C. Analysis must be within 14 days. Refer to cooler temp on lab login sheet.

Note: Holding times as specified in the QAPP

ACTION: On the Holding Time Deviations Summary Sheet, list samples with analyses outside holding times.

ACTION: When holding times have been exceeded, use professional judgement to determine if qualification due to suspected low bias is needed. Consider factors such as sample preservation, cooler temps, number of days exceeded, etc. For any sample exceeding holding time, the data summary should explain what, if any, qualification was made. You may choose to qualify results as estimated "J" or, if holding times are grossly exceeded (e.g., greater than two times the required time), you may qualify non-detects as unusable "R" and other results estimated "J". In the case where a second analysis was run which exceeds the holding time but the original analysis did not, evaluation of the two results and professional judgement must be used in determining whether qualification is needed.

4. Blank Contamination

4.1 Has a method blank been analyzed for each set of samples or every 20 samples of similar matrix if set >20? ___ ___ ___

ACTION: If any method blank data are missing, make a list on the Method Blank Summary Form and contact the W-C Project Laboratory Coordinator.

		YES	NO	N/A
4.2	Do any method blanks have positive results?	___	___	___

ACTION: Prepare a list on the Method Blank Summary Table of the samples associated with each of the contaminated blanks and list also the concentrations and reporting limits for each contaminant.

4.3	Do any field or trip blanks have positive results by 8240?	___	___	___

ACTION: Prepare a list on the Field Blank Summary Table (Trip/Rinsate) of the samples associated with each of the contaminated blanks and list also the concentrations and reporting limits for each contaminant.

Note: Field blanks are generally collected at a rate of 1 for each ten samples. One trip blank should be present for each cooler of VOA samples.

Note: Only field blanks taken the same day as the samples are used to qualify data. Trip blanks are used to qualify only those samples shipped in the same cooler as the trip blank.

Field blank data should not be qualified using field QA/QC data. The field blank may be qualified on the basis of laboratory QA/QC data (LCS or method blank).

4.4	Must data be qualified due to any blank contamination (laboratory or field)?	___	___	___

ACTION: If the reported concentration of the compound is less than or equal to 10 times (10X) the amount in any method blank for the common laboratory contaminants (methylene chloride, acetone, and 2-butanone), or 5 times (5X) the amount for other volatile target compounds, the result is considered undetected

above contaminant levels. Therefore, on the validation copy, strike the amount (with a single line) in the results column, and record a U in place of the result. If the result was above the associated reporting limit, raise the reporting limit to the level of the result. Record actions on the Method Blanks Summary Form.

Specific Considerations:

1. If a volatile compound is found in a method blank, but not found in the sample, no action is taken. If the contaminants found are volatile target compounds (or interfacing, nontarget compounds) at significant concentrations above the QAPP Reporting Limit, then this should be noted and brought to the attention of the QA/QC Officer or the QA/QC Coordinator.

2. The reviewer should note that method blanks may not involve the same weights, volumes, or dilution factors as the associated samples. These factors must be taken into consideration when applying the "5X" and "10X" criteria, such that a comparison of the total amount of contamination is actually made.

3. Additionally, there may be instances where little or no contamination was present in the associated blanks, but qualification of the sample is deemed necessary. If the reviewer determines that the contamination is from a source other than the sample, he/she should qualify the data. Contamination introduced through dilution water is one example. Although it is not always possible to determine, instances of this occurring can be detected when contaminants are found in the diluted sample result, but are absent in the undiluted sample results. Since both results are not routinely reported, it may be impossible to verify this source of contamination. In this case, the "5X" or "10X" rules may not apply; the target compound should be reported as not detected, and an explanation of the data qualification should be provided in the data review narrative.

4. You must also consider if compounds, while not detected in the method blank directly associated with the sample, have been detected in other method blanks analyzed during the project or at approximately the same time and evaluate whether laboratory contamination is suspected.

ACTION: On the Method Blank Summary Form, list affected samples, qualifiers issued and any pertinent discussion necessary to explain the actions taken.

5. Laboratory Control Sample (LCS)

		YES	NO	N/A
5.1	Are the appropriate LCS present?	___	___	___
5.2	For the LCS, are any analytes "out"?	___	___	___

Note: The QC acceptance criteria below are for example only. Criteria must be project-specific as specified in the QAPP.

Method 8240	Soil/Sediment	Water
LCS	% Recovery	% Recovery
1,1-Dichloroethene	75-121	56-138
Trichloroethene	75-108	76-109
Benzene	81-118	78-119
Toluene	83-115	82-114
Chlorobenzene	81-115	84-117

ACTION: List LCS analytes not meeting the above criteria on the LCS Summary Form.

If the LCS criteria are not met, then the laboratory performance and method accuracy are in question. Professional judgement should be used to determine if the data should be qualified or rejected. The following guidance is suggested for qualifying sample data for which the associated LCS does not meet the required criteria.

1. Action on the LCS recovery should be based on both the number of compounds that are outside of the recovery criteria and the magnitude of the exceedance of the criteria.

2 If the LCS recovery criteria are not met, then the LCS results should be used to qualify sample data for the specific compounds that are included in the LCS solution. Professional judgement should be used to qualify data for compounds other than those compounds that are included in the LCS. Professional judgement to qualify non-LCS compounds should take into account the compound class, compound

recovery efficiency, analytical problems associated with each compound, and comparability in performance of the LCS compound to the non-LCS compound.

3. If the LCS recovery is greater than the upper limit specified in the QAPP, then positive sample results for the affected compound(s) should be qualified with a "J".

4. If the mass spectral criteria are met but the LCS recovery is less than the lower limit specified in the QAPP, then the associated detected target compounds should be qualified "J", and the associated nondetected target compounds should be qualified "R".

5. If more than half of the compounds in the LCS are not within the required recovery criteria, then all of the associated detected target compounds should be qualified "J" and all associated nondetected target compounds should be qualified "R".

6. Action on noncompliant surrogate recovery and internal standard performance should follow the procedures provided in VI.E and X.E, respectively. Professional judgement should be used to evaluate the impact that noncompliance for surrogate recovery and internal standard performance in the LCS has on the associated sample data.

7. It should be noted for TPO action if a laboratory fails to analyze an LCS with each SDG or if a laboratory consistently fails to generate acceptable LCS recoveries.

	YES	NO	N/A
6. <u>Surrogate Spikes</u>			
6.1 Are results for the appropriate surrogates present?	___	___	___
ACTION: If not, notify the W-C Project Laboratory Coordinator			
6.2 Were any of the surrogate recoveries outside QAPP specifications for any sample?	___	___	___

Note: Limits below are from the Dyess QAPP. Limits must be project specific as specified in the QAPP.

Method 8240		
Surrogate Analyte	Water	Soil
Toluene-d8	88-110	81-117
4-Bromofluorobenzene	86-115	74-121
1,2-Dichloroethane-d4	76-114	70-121

ACTION: If any surrogate recovery is out of specifications, samples affected should be listed along with degree of variance on the Surrogate Recovery Summary Sheet.

ACTION: If appropriate, qualify data according to the following table:

Method 8240	Surrogate Recovery		
	Above Upper Limit	From 10% to Lower Limit	Below 10%
Detected Analyte	J	J	J
Nondetected	No flag	UJ	R

7. <u>Matrix Spike/Matrix Spike Duplicate</u>

		YES	NO	N/A
7.1	Are Matrix Spike/Matrix Spike Duplicate data available for each matrix at each site?	___	___	___
7.2	Are the results within QAPP limits?	___	___	___

Note: Limits are taken from the QAPP. (Note: The limits listed below are for example only. Limits must be project-specific.

MS/MSD 8240	Soil/Sediment		Water	
Analyte	% Recovery	RPD	% Recovery	RPD
1,1-Dichloroethene	59-172	22	61-145	14
Trichloroethene	64-137	24	71-120	14
Benzene	66-142	21	76-127	11
Toluene	59-139	21	76-125	13
Chlorobenzene	60-133	21	75-130	13

ACTION: List on the MS/MSD Summary Form samples not meeting the above criteria.

Compare the relative percent difference (RPD) results of nonspiked compounds among the original result, the matrix spike, and the MS duplicate. Check approximately 10% of all calculations. Where problems are identified, calculate a further 10% as necessary.

7.3 How many % recoveries and RPDs are out of QC limits for MS/MSD data? Note outlying recoveries and associated samples on the MS/Duplicate Summary Form.

	Water	Soil
% R	_____ of 10	_____ of 10
RPD	_____ of 5	_____ of 5

ACTION:

1. No action is taken on MS/MSD data alone except that if MS and MSD both have less than 10% recovery for an analyte, negative results for that analyte should be rejected, and positive results should be flagged "J". This applies only to the sample used for the MS/MSD analysis. Use professional judgement for applicability to other samples.

2. The data reviewer should first try to determine to what extent the results of the MS/MSD affect the associated data. This determination should be made with regard to the MS/MSD sample itself as well as specific analytes for all samples associated with the MS/MSD.

3. In those instances where it can be determined that the results of the MS/MSD affect only the sample spiked, then qualification should be limited to this sample alone. However, it may be determined through the MS/MSD results that a laboratory is having a systematic problem in the analysis of one or more analytes, which affects all associated samples.

4. The reviewer must use professional judgement to determine the need for qualification of positive results of nonspiked compounds.

Note: If a field blank was used for the MS/MSD, a statement to that effect must be included for the W-C Project Laboratory Coordinator.

8. Field Duplicate

	YES	NO	N/A
Were any field duplicates submitted for 8240 analysis?	___	___	___

Note: Generally, one field duplicate is collected for every ten samples collected.

ACTION: Compare the reported results and calculate RPDs.

ACTION: Any gross variations should be noted in the review. It may be appropriate to confirm proper sample ID with field personnel. Associated sample results are qualified as estimated based on the following evaluation criteria.

As stated in the QAPP, for analytes with the sample concentrations greater than 5 times the reporting limit, the duplicate sample results should agree within 50 percent RPD for soil and 25 percent for aqueous samples. Also, for analytes with either or both concentrations less than 5 times the reporting limit, duplicate sample results should agree within ±2 times the reporting limit for soil and aqueous samples.

Note duplicate results, RPDs, and qualifiers on the Field Duplicate Results Summary Form.

	YES	NO	N/A
9. Compound Quantitation and Reporting Limits			
9.1 Are the reported results and corresponding reporting limits within QAPP limits?	___	___	___

9.2 Verify that reporting limits have been adjusted to reflect all sample dilutions and dry weight factors that are not accounted for by the method.

Note: Laboratory supplies dilution notices; check data package and/or the fax file for these notices.

ACTION: On the Sample Dilution Summary Form, list discrepancies, note elevated reporting limits (> than 10 times) (i.e. multiplier of QAPP limit), and list affected samples.

10. Conclusion

ACTION: Narrative should identify all problems and all qualifications should have an explanation. All affected samples should be identified and appropriate qualifiers and applicable concentrations added to validation data sheets.

A listing of each sample qualified along with the reason and the impact on data usability should be completed on the Summary of All Qualifications Form.

	YES	NO	N/A
1. Were all deliverables received? (Note: Check addendum to laboratory contract)	___	___	___
1.1 Cover page present?	___	___	___
1.2 Sample chain of custody present and completed correctly?	___	___	___
1.3 Sample analyses and chain of custody match?	___	___	___

ACTION: Make a list of any missing deliverables. Contact the W-C Project Laboratory Coordinator.

2. Does the laboratory narrative indicate any problems with sample receipt, condition of samples, analytical problems or special notations for any of the data reviewed?	___	___	___

ACTION: Make a list on the Laboratory Narrative Summary Sheet of any problems cited which would affect the results for Method 8270 and use professional judgement to evaluate the effect on the quality of the data. (Consult EPA Functional Guidelines)

Note: If any sample analyzed as a soil contains more than 50% water, all data should be flagged as "J" (estimated).

	YES	NO	N/A

3. Holding Times

Have any Method 8270 holding times, determined from date of collection to date of analysis, been exceeded? ___ ___ ___

Note: All samples must be kept at 4°C. For water samples, extraction must be within 7 days and analysis must be within 40 days of collection. For soil samples, extraction must be within 14 days and analysis must be within 40 days.

Note: Holding times as specified in the QAPP

ACTION: On the Holding Time Deviations Summary Sheet, list samples with analyses outside holding times.

ACTION: When holding times have been exceeded, use professional judgement to determine if qualification due to suspected low bias is needed. Consider factors such sample preservation, cooler temps, number of days exceeded, etc. For any sample exceeding holding time, the data summary should explain what, if any, qualification was made. You may choose to qualify results as estimated "J" or, if holding times are grossly exceeded (e.g., greater than two times the required time), you may qualify non-detects as unusable "R" and other results estimated "J". In the case where a second analysis was run which exceeds the holding time but the original analysis did not, evaluation of the two results and professional judgement must be used in determining whether qualification is needed.

4. Blank Contamination

4.1 Has a method blank been analyzed for each set of samples or every 20 samples of similar matrix if set >20? ___ ___ ___

ACTION: If any method blank data are missing, make a list on the Method Blank Summary Form and contact the W-C Project Laboratory Coordinator.

4.2 Do any method blanks have positive results? ___ ___ ___

ACTION: Prepare a list on the Method Blank Summary Form of the samples associated with each of the contaminated blanks and list also the concentrations

		YES	NO	N/A
	and reporting limits for each contaminant.			
4.3	Do any field blanks have positive results by 8270?	___	___	___

ACTION: Prepare a list on the Field Blank Summary Form of the samples associated with each of the contaminated blanks and list also the concentrations and reporting limits for each contaminant.

Note: Field blank frequency must be specified in the QAPP.

Note: Only field blanks taken the same day as the samples are used to qualify data. Field blanks should not be qualified using field QA/QC data. The field blank may be qualified on the basis of laboratory QA/QC data (LCS or method blank).

4.4	Must any data be qualified due to blank contamination?	___	___	___

ACTION: If the reported concentration of the compound is less than or equal to 10 times (10X) the amount in any blank for the common phthalate contaminants (i.e., Di-n-butyl phthalate, bis(2-Ethylhexyl) phthalate, Butyl benzyl phthalate, Di-n-octyl phthalate), or 5 times (5X) the amount for other semivolatile target compounds, the result is considered undetected above contaminant levels. Therefore, on the validation copy, strike the amount (with a single line) in the results column, and record a U in place of the result. If the result was above the associated reporting limit, raise the reporting limit to the level in the result. Record specific actions on the Method Blank Summary Form.

Specific Considerations:

1. If a semivolatile compound is found in a method blank, but not found in the sample, no action is taken. If the contaminants found are semivolatile target compounds (or interfacing, nontarget compounds) at significant concentrations above the QAPP Reporting Limit, then this should be noted and brought to the attention of the Project Laboratory Coordinator.

2. The reviewer should note that method blanks may not involve the same weights, volumes, or dilution factors as the associated samples. These factors must be taken into consideration when applying the "5X" and "10X" criteria, such that a comparison of the total amount of contamination is actually made.

3. Additionally, there may be instances where little or no contamination was present in the associated blanks, but qualification of the sample is deemed necessary. If the reviewer determines that the contamination is from a source other than the sample, he/she should qualify the data. Contamination introduced through dilution water is one example. Although it is not always possible to determine, instances of this occurring can be detected when contaminants are found in the diluted sample result, but are absent in the undiluted sample results. Since both results are not routinely reported, it may be impossible to verify this source of contamination. In this case, the "5X" or "10X" rules may not apply; the target compound should be reported as not detected, and an explanation of the data qualification should be provided in the data review narrative.

4. You must also consider if compounds, while not detected in the method blank directly associated with the sample, have been detected in other method blanks analyzed during the project or at approximately the same time and evaluate whether laboratory contamination is suspected.

ACTION: In the space provided on the Method Blank Summary Form, list affected samples, qualifiers issued and any pertinent discussion necessary to explain the actions taken.

5. Laboratory Control Sample (LCS)

	YES	NO	N/A
5.1 Are the appropriate LCS present?	___	___	___
5.2 For the LCS, are any analytes "out"?	___	___	___

Note: The QC acceptance criteria provided below are for example only. Criteria should be project-specific as specified in the QAPP

Semivolatile Organics (8270)	Soil/Sediment	Water
LCS	% Recovery	% Recovery
1,4-Dichlorobenzene	52-108	31-101
Pyrene	52-115	52-115
1,2,3-Trichlorobenzene	54-102	44-142
N-Nitroso-di-*n*-propylamine	55-108	49-109
4-Chloro-3-methylphenol	49-121	48-112
Acenaphthalene	60-103	48-145
4-Nitrophenol	33-120	29-124
2,4-Dinitrotoluene	61-106	52-104
Pentachlorophenol	21-139	25-132
2-Chlorophenol	42-114	50-104
Phenol	40-112	42-109

ACTION: List LCS analytes not meeting the above criteria on the LCS Summary Form.

If the LCS criteria are not met, then the laboratory performance and method accuracy are in question. Professional judgement should be used to determine if the data should be qualified or rejected. The following guidance is suggested for qualifying sample data for which the associated LCS does not meet the required criteria.

1. Action on the LCS recovery should be based on both the number of compounds that are outside of the recovery criteria and the magnitude of the exceedance of the criteria.

2 If the LCS recovery criteria are not met, then the LCS results should be used to qualify sample data for the specific compounds that are included in the LCS solution. Professional judgement should be used to qualify data for compounds other than those compounds that are included in the LCS. Professional judgement to qualify non-LCS compounds should take into account the compound class, compound recovery efficiency, analytical problems associated with each compound, and comparability in performance of the LCS compound to the non-LCS compound.

3. If the LCS recovery is greater than the upper limit specified in the QAPP, then positive sample results for the affected compound(s) should be qualified with a "J".

4. If the mass spectral criteria are met but the LCS recovery is less than the lower limit specified in the QAPP, then the associated detected target compounds should be qualified "J", and the associated nondetected target compounds should be qualified "R".

5. If more than half of the compounds in the LCS are not within the required recovery criteria, then all of the associated detected target compounds should be qualified "J" and all associated nondetected target compounds should be qualified "R".

6. Action on noncompliant surrogate recovery and internal standard performance should follow the procedures provided in VI.E and X.E, respectively. Professional judgement should be used to evaluate the impact that noncompliance for surrogate recovery and internal standard performance in the LCS has on the associated sample data.

7. It should be noted for TPO action if a laboratory fails to analyze an LCS with each SDG or if a laboratory consistently fails to generate acceptable LCS recoveries.

	YES	NO	N/A

6. Surrogate Spikes

6.1 Are results for the appropriate surrogates present? ___ ___ ___

ACTION: If not, notify the W-C Laboratory Coordinator.

6.2 Are any of the surrogate recoveries outside QAPP specifications for any sample? ___ ___ ___

Note: Limits must be project specific as specified in the QAPP

8270 - Surrogates	Water	Soil
Nitrobenzene-d5	35-114	23-120
2-Fluorobiphenyl	43-115	30-115
Terphenyl-d14	33-141	18-137
Phenol-d5	10-94	24-113
2-Fluorophenol	21-110	25-121
2,4,6-Tribromophenol	10-123	19-122

ACTION: If any surrogate recovery is out of specifications, samples affected should be listed along with degree of variance on the Surrogate Recovery Summary Sheet.

ACTION: If appropriate, qualify data according to the following table:

	Surrogate Recovery		
	Above Upper Limit	From 10% to Lower Limit	Below 10%
Detected Analyte	J	J	J
Nondetected	No flag	UJ	R

	YES	NO	N/A

7. Matrix Spike/Matrix Spike Duplicate

7.1 Are Matrix Spike/Matrix Spike Duplicate data available for each matrix at each site? ___ ___ ___

7.2 Are the results within QAPP limits? ___ ___ ___

Note: Limits are project-specific as specified in the QAPP. Limits listed below are for example only.

Semivolatile Organics (8270)	Soil/Sediment		Water	
	% Recovery	RPD	% Recovery	RPD
1,4-Dichlorobenzene	28-104	27	36-124	28
Pyrene	52-115	25	52-115	25
1,2,4-Trichlorobenzene	44-142	23	44-142	28
N-Nitroso-di-*n*-propylamine	41-126	38	41-115	38
4-Chloro-3-methylphenol	26-103	33	23-147	37
Acenaphthalene	47-137	19	47-118	28
4-Nitrophenol	11-114	47	10-132	47
2,4-Dinitrotoluene	39-139	22	39-139	22
Pentachlorophenol	17-109	47	14-103	49
2-Chlorophenol	25-102	29	27-123	29
Phenol	26-112	23	12-110	23

ACTION: Make a list at the end of this section of samples not meeting the above criteria.

Compare the relative percent deviation (RPD) results of nonspiked compounds among the original result, the matrix spike, and the MS duplicate. Check approximately 10% of all calculations. Where problems are identified, calculate a further 10% until no incorrect calculations are identified.

7.3 How many % recoveries and RPDs are out of QC limits? Note outlying recoveries and associated samples on MS/Duplicate Summary Form.

	Water	Soil
% R	_____ of 22	_____ of 22
RPD	_____ of 11	_____ of 11

ACTION:

1. No action is taken on MS/MSD data alone except that if MS and MSD both have less than 10% recovery for an analyte, negative results for that analyte should be rejected, and positive results should be flagged "J". This applies only to the sample used for the MS/MSD analysis. Use professional judgement for applicability to other samples.

2. The data reviewer should first try to determine to what extent the results of the MS/MSD affect the associated data. This determination should be made with regard to the MS/MSD sample itself as well as specific analytes for all samples associated with the MS/MSD.

3. In those instances where it can be determined that the results of the MS/MSD affect only the sample spiked, then qualification should be limited to this sample alone. However, it may be determined through the MS/MSD results that a laboratory is having a systematic problem in the analysis of one or more analytes, which affects all associated samples.

4. The reviewer must use professional judgement to determine the need for qualification of positive results of nonspiked compounds.

Note: If a field blank was used for the MS/MSD, a statement to that effect must be included for the W-C Project Laboratory Coordinator.

8. Field Duplicate

	YES	NO	N/A
Were any field duplicates submitted for 8270 analysis?	___	___	___

Note: Field duplicate frequency should be specified in the QAPP.

ACTION: Compare the reported results and calculate RPDs.

ACTION: Any gross variations should be noted in the review. It may be appropriate to confirm proper sample ID with field personnel. Associated sample results are qualified as estimated based on the following evaluation criteria.

As stated in the QAPP, for analytes with the sample concentrations greater than 5 times the reporting limit, the duplicate sample results should agree within 50 percent RPD for soil and 25 percent for aqueous samples. Also, for analytes with either or both concentrations less than 5 times the reporting limit, duplicate sample results should agree within ±2 times the reporting limit for soil and aqueous samples. Note duplicate results, RPDs, and qualifiers on the Field Duplicate Results Summary Form.

9. Compound Quantitation and Reporting Limits

9.1 Are the reported results and corresponding reporting limits within QAPP limits?	___	___	___

9.2 Verify that reporting limits have been adjusted to reflect all sample dilutions and dry weight factors that are not accounted for by the method.

Note: Laboratory supplies dilution notices; check data package and/or the fax file for these notices.

ACTION: On the Sample Dilution Summary Form, list discrepancies, note elevated reporting limits (i.e. multiplier of QAPP limit), and list affected samples.

10. Conclusion

ACTION: Narrative should identify all problems and all qualifications should have an explanation. All affected samples should be identified and appropriate qualifiers and applicable concentrations added to data sheets. An all qualifications summary table for this SDG should list each sample qualified along with the reason and impact on data usability.

PART D
METHODS 8080 AND 8150
PESTICIDES/PCBS, CHLORINATED HERBICIDES (CANNON AFB)

	YES	NO	N/A
1. Were all deliverables received? (Note: Check addendum to laboratory contract)	___	___	___
1.1 Cover page present?	___	___	___
1.2 Sample chain of custody present and completed correctly?	___	___	___
1.3 Sample analyses and chain of custody match?	___	___	___

ACTION: Make a list below of any missing deliverables. Contact the W-C Project Laboratory Coordinator.

2. Does the lab narrative indicate any problems with sample receipt, condition of samples, analytical problems or special notations for any of the data reviewed?	___	___	___

ACTION: Make a list on the Laboratory Narrative Summary Form of any problems cited which would affect the results for Method 8080 or 8150 and use professional judgement to evaluate the effect on the quality of the data. (Consult EPA Functional Guidelines)

NOTE: If any sample analyzed as a soil contains more than 50% water, all data should be flagged as "J" (estimated).

	YES	NO	N/A

3. Holding Times

Have any Method 8080 or 8150 holding times, determined from date of collection to date of analysis, been exceeded? ___ ___ ___

Note: All samples must be kept at 4°C. For water samples, extraction must be within 7 days and analysis must be within 40 days of collection. For soil samples, extraction must be within 14 days and analysis must be within 40 days.

Note: Holding time limits are to be as specified in the QAPP.

ACTION: On the Holding Time Deviation Summary Form, list samples with analyses outside holding times.

ACTION: When holding times have been exceeded, use professional judgement to determine if qualification due to suspected low bias is needed. Consider factors such sample preservation, cooler temps, number of days exceeded, etc. For any sample exceeding holding time, the data summary should explain what, if any, qualification was made. You may choose to qualify results as estimated "J" or, if holding times are grossly exceeded (e.g., greater than two times the required time), you may qualify non-detects as unusable "R" and other results estimated "J". In the case where a second analysis was run which exceeds the holding time but the original analysis did not, evaluation of the two results and professional judgement must be used in determining whether qualification is needed.

4. Blank Contamination

4.1 Has a method blank been analyzed for each set of samples or every 20 samples of similar matrix if set >20? ___ ___ ___

ACTION: If any method blank data are missing, make a list on the Method Blank Summary Form and contact the W-C Project Laboratory Coordinator.

4.2 Do any method blanks have positive results by either 8080 or 8150? ___ ___ ___

		YES	NO	N/A
ACTION:	Prepare a list of the samples associated with each of the contaminated blanks on the Method Blank Form and list the blank concentrations and reporting limits for each contaminant.			
4.3	Do any field blanks have positive results by either 8080 or 8150?	___	___	___
ACTION:	Prepare a list on the Field Blank Summary Form of the samples associated with each of the contaminated blanks.			
	Note: Only field blanks taken the same day as the samples are used to qualify data. Field blanks should not be qualified using field QA/QC. The field blank may be qualified on the basis of laboratory QA/QC data (LCS or method blank).			
4.4	Must any data be qualified due to blank contamination?	___	___	___
ACTION:	If the reported concentration of the compound is less than or equal to 5 times (5X) the amount for any target compound, the result is considered undetected above contaminant levels. Therefore, on the validation copy, strike the amount (with a single line) in the results column, and record a U in place of the result. If the result was above the associated reporting limit, raise the reporting limit to the level of the result. Record specific actions on the Method Blank Summary Form.			

Specific Considerations:

1. If a compound is found in a method blank, but not found in the sample, no action is taken. If the contaminants found are target compounds (or interfacing, nontarget compounds) at significant concentrations above the QAPP Reporting Limit, then this should be noted and brought to the attention of the W-C Project Laboratory Coordinator.

2. The reviewer should note that method blanks may not involve the same weights, volumes, or dilution factors as the associated samples. These factors must be taken into consideration when applying the "5X" criteria, such that a comparison of the total amount of contamination is actually made.

3. Additionally, there may be instances where little or no contamination was present in the associated blanks, but qualification of the sample is deemed necessary. If the reviewer determines that the contamination is from a source other than the sample, he/she should qualify the data. Contamination introduced through dilution water is one example. Although it is not always possible to determine, instances of this occurring can be detected when contaminants are found in the diluted sample result, but are absent in the undiluted sample results. Since both results are not routinely reported, it may be impossible to verify this source of contamination. In this case, the "5X" rule may not apply; the target compound should be reported as not detected, and an explanation of the data qualification should be provided in the data review narrative.

4. You must also consider if compounds, while not detected in the method blank directly associated with the sample, have been detected in other method blanks analyzed during the project or at approximately the same time and evaluate whether laboratory contamination is suspected.

ACTION: In the space provided on the Method Blank Summary Form, list affected samples, qualifiers issued and any pertinent discussion necessary to explain the actions taken.

5. Laboratory Control Sample (LCS)

		YES	NO	N/A
5.1	Are the appropriate LCS present?	___	___	___
5.2	For the LCS, are any analytes "out"?	___	___	___

Note: The QC acceptance criteria below are for example only. Criteria must be project-specific as specified in the QAPP.

LCS-Pesticide/PCBs	Soil/Sediment		Water	
Method 8080	% Recovery	RPD	% Recovery	RPD
gamma-BHC	41-125	25	56-111	25
Heptachlor	53-111	25	50-111	25
Aldrin	52-121	25	49-109	25
Dieldrin	47-115	25	47-111	25
Endrin	52-124	25	50-123	25
4,4′-DDT	37-135	25	45-117	25

LCS-Herbicides	Soil/Sediment		Water	
Method 8150	% Recovery	RPD	% Recovery	RPD
2,4-D	23-122	25	36-126	25
2,4,5-TP(Silvex)	41-127	25	52-135	25
2,4,5-T	15-151	25	41-158	25

ACTION: Make a list on the LCS Summary Form of analytes not meeting the above criteria.

If the LCS criteria are not met, then the laboratory performance and method accuracy are in question. Professional judgement should be used to determine if the data should be qualified or rejected. The following guidance is suggested for qualifying sample data for which the associated LCS does not meet the required criteria.

1. Action on the LCS recovery should be based on both the number of compounds that are outside of the recovery criteria and the magnitude of the exceedance of the criteria.

2 If the LCS recovery criteria are not met, then the LCS results should be used to qualify sample data for the specific compounds that are included in the LCS solution. Professional judgement should be used to qualify data for compounds other than those compounds that are included in the LCS. Professional judgement to qualify non-LCS compounds should take into account the compound class, compound recovery efficiency, analytical problems associated with each compound, and comparability in performance of the LCS compound to the non-LCS compound.

3. If the LCS recovery is greater than the upper limit specified in the QAPP, then positive sample results for the affected compound(s) should be qualified with a "J".

4. If the mass spectral criteria are met but the LCS recovery is less than the lower limit specified in the QAPP, then the associated detected target compounds should be qualified "J", and the associated nondetected target compounds should be qualified "R".

5. If more than half of the compounds in the LCS are not within the required recovery criteria, then all of the associated detected target compounds should be qualified "J" and all associated nondetected target compounds should be qualified "R".

6. Action on noncompliant surrogate recovery and internal standard performance should follow the procedures provided in VI.E and X.E, respectively. Professional judgement should be used to evaluate the impact that noncompliance for surrogate recovery and internal standard performance in the LCS has on the associated sample data.

7. It should be noted for TPO action if a laboratory fails to analyze an LCS with each SDG or if a laboratory consistently fails to generate acceptable LCS recoveries.

6. Surrogate Spikes

	YES	NO	N/A
6.1 Are results for the appropriate surrogates present?	___	___	___

ACTION: If not, notify the QA/QC Officer or the QA/QC Co-ordinator.

6.2 Are any of the surrogate recoveries outside QAPP specifications for any sample?	___	___	___

Note: The QC acceptance criteria below are for example only. Criteria must be project-specific as specified in the QAPP.

	Water	Soil
Method 8080 - Decachlorobiphenyl	41-135	41-135
Method 8150 - DCAA	51-138	63-129

ACTION: If any surrogate recovery is out of specifications, samples affected should be listed along with degree of variance. If significant variance exists, contact the W-C Project Laboratory Coordinator.

ACTION: Qualify the data as follows:

	Surrogate Recovery		
	Above Upper Limit	From 10% to Lower Limit	Below 10%
Detected Analyte	J	J	J
Nondetected	No flag	UJ	R

7. Matrix Spike/Matrix Spike Duplicate

		YES	NO	N/A
7.1	Are Matrix Spike/Matrix Spike Duplicate data available for each matrix at each site?	___	___	___
7.2	Are the results within QAPP limits?	___	___	___

Note: The QC acceptance criteria below are for example only. Criteria must be project-specific as specified in the QAPP.

Pesticides	Soil/Sediment		Water	
Method 8080	% Recovery	RPD	% Recovery	RPD
gamma-BHC	41-125	12	56-111	12
Heptachlor	53-111	12	50-111	21
Aldrin	52-121	14	49-109	16
Dieldrin	47-115	12	47-111	13
Endrin	52-124	13	50-123	16
4,4'-DDT	37-135	15	45-117	14

Herbicides
Method 8150

2,4-D	23-122	36	36-126	33
2,4,5-TP(Silvex)	41-127	26	52-135	28
2,4,5-T	15-151	23	41-158	34

ACTION: Make a list on the MS/MSD Summary Form of samples not meeting the above criteria.

Compare the relative percent deviation (RPD) results of nonspiked compounds among the original result, the matrix spike, and the MS duplicate. Check approximately 10% of all calculations. Where problems are identified, calculate a further 10% until no incorrect calculations are identified.

7.3 How many % recoveries are out of QC limits?

8080		8150	
Water	Soil	Water	Soil
_____ of 12	_____ of 12	_____ of 6	_____ of 6

7.4 How many RPDs for MS and MSD recoveries are outside QC limits?

8080		8150	
Water	Soil	Water	Soil
_____ of 6	_____ of 6	_____ of 3	_____ of 3

ACTION:

1. No action is taken on MS/MSD data alone except that if MS and MSD both have less than 10% recovery for an analyte, negative results for that analyte should be rejected, and positive results should be flagged "J". This applies only to the sample used for the MS/MSD analysis. Use professional judgement for applicability to other samples.

2. The data reviewer should first try to determine to what extent the results of the MS/MSD affect the associated data. This determination should be made with regard to the MS/MSD sample itself as well as specific analytes for all samples associated with the MS/MSD.

3. In those instances where it can be determined that the results of the MS/MSD affect only the sample spiked, then qualification should be limited to this sample alone. However, it may be determined through the MS/MSD results that a laboratory is having a systematic problem in the analysis of one or more analytes, which affects all associated samples.

4. The reviewer must use professional judgement to determine the need for qualification of positive results of nonspiked compounds.

	YES	NO	N/A
8. Field Duplicate			
Were any field duplicates submitted for 8080 or 8150 analysis?	___	___	___

ACTION: Compare the reported results and calculate RPDs.

ACTION: Any gross variations should be noted in the review. It may be appropriate to confirm proper sample ID with field personnel. Associated sample results are qualified as estimated based on the following evaluation criteria.

As stated in the QAPP, for analytes with the sample concentrations greater than 5 times the reporting limit, the duplicate sample results should agree within 50 percent RPD for soil and 25 percent for aqueous samples. Also, for analytes with either or both concentrations less than 5 times the reporting limit, duplicate sample results should agree within ±2 times the reporting limit for soil and aqueous samples. Note duplicate results, RPDs, and qualifiers on the Field Duplicate Results Summary Form.

9. Compound Quantitation and Reporting Limits			
9.1 Are the reported results and corresponding reporting limits within QAPP limits?	___	___	___

9.2 Verify that reporting limits have been adjusted to reflect all sample dilutions and dry weight factors that are not accounted for by the method.

	YES	NO	N/A
9.3 Were second column confirmation values reported?	___	___	___

Note: The laboratory supplies dilution notices via fax; check the file for these notices.

ACTION: On the Sample Dilution Summary Form, list discrepancies, note elevated reporting limits (> than 10 times) (i.e. multiplier of QAPP limit), and list affected samples.

10. Conclusion

ACTION: Narrative should identify all problems and all qualifications should have an explanation. All affected samples should be identified and appropriate qualifiers and applicable concentrations added to validation data sheets. Summarize all qualifications for these methods in this SDG on the Qualifications Summary Form.

PART E
METHODS 418.1, 9020, AND 9060
TOTAL RECOVERABLE PETROLEUM HYDROCARBONS,
TOTAL ORGANIC HALIDES (TOX), AND
TOTAL ORGANIC CARBONS (TOC) (CANNON AFB)

		YES	NO	N/A
1.	Were all deliverables received? (Note: Check addendum to laboratory contract)	___	___	___
1.1	Cover page present?	___	___	___
1.2	Sample chain of custody present and completed correctly?	___	___	___
1.3	Sample analyses and chain of custody match?	___	___	___

ACTION: Make a list below of any missing deliverables. Contact the W-C Project Laboratory Coordinator

2.	Does the lab narrative indicate any problems with sample receipt, condition of samples, analytical problems or special notations for any of the data reviewed?	___	___	___

ACTION: Make a list below of any problems cited which would affect the results for the above methods. Use professional judgement to evaluate the effect on the quality of the data.

NOTE: If any sample analyzed as a soil contains more than 50% water, all data should be flagged as "J" (estimated).

	YES	NO	N/A
3. Holding Times			
Have any Methods 418.1, 9020, and 9060 holding times, determined from date of collection to date of analysis, been exceeded?	___	___	___

Note: Waters must be preserved with acid to pH <2. All samples must be kept at 4°C and analysis must be within 28 days.

ACTION: List samples with analyses outside holding time criteria on the Holding Time Deviations Summary Form.

ACTION: When holding times have been exceeded, use professional judgement to determine if qualification due to suspected low bias is needed. Consider factors such sample preservation, cooler temps, number of days exceeded, etc. For any sample exceeding holding time, the data summary should explain what, if any, qualification was made. You may choose to qualify results as estimated "J" or, if holding times are grossly exceeded (e.g., greater than two times the required time), you may qualify non-detects as unusable "R" and other results estimated "J". In the case where a second analysis was run which exceeds the holding time but the original analysis did not, evaluation of the two results and professional judgement must be used in determining whether qualification is needed.

4. Blank Contamination			
4.1 Has a method blank been analyzed for each set of samples or every 20 samples of similar matrix if set >20?	___	___	___

ACTION: If any method blank data are missing, make a list below and contact the QA/QC Officer or the the QA/QC Coordinator.

4.2 Do any method blanks have positive results by 418.1?	___	___	___

		YES	NO	N/A
ACTION:	On the Method Blank Summary Form, list the samples associated with each of the contaminated blanks, and list the concentrations and reporting limits for each contaminant.			
4.3	Do any field blanks have positive results by 418.1, 9020, or 9060?	___	___	___
ACTION:	On the Field Blank Summary Form, list the samples associated with each of the contaminated blanks.			
	Note: Only field blanks taken the same day as the samples are used to qualify data. Field blanks may not be qualified using other field QA/QC data. Field blanks may be qualified for LCS or other laboratory QA/QC problems.			
4.4	Must any data be qualified due to blank contamination?	___	___	___
ACTION:	If the result is less than 5X the amount found in the method blank, strike the amount (with a single line) in the results column, report a "U" instead, and if necessary, raise the reporting limit to the result amount.			

5. <u>Laboratory Control Sample (LCS)</u>

5.1	Are the appropriate LCS present?	___	___	___
5.2	For the LCS, are any analytes "out"?	___	___	___

Note: QC acceptance criteria are project-specific as specified by the QAPP.

	Soil/Sediment		Water	
Method 418.1	% Recovery	RPD	% Recovery	RPD
TRPH	75-125	20	75-125	20
TOX	80-120	20	75-125	25
TOC	80-120	20	75-125	25

ACTION: Make a list on the LCS Summary Formof results not meeting the above criteria

	YES	NO	N/A
6. Field Duplicate			
Were any field duplicates submitted for 418.1, 9020, or 9060 analysis?	___	___	___

ACTION: Compare the reported results and calculate RPDs. on the Field Duplicate Summary Form.

ACTION: Any gross variations should be noted in the review. It may be appropriate to confirm proper sample ID with field personnel.

7. Compound Quantitation and Reporting Limits			
7.1 Are the reported results and corresponding reporting limits within QAPP limits?	___	___	___

7.2 Verify that reporting limits have been adjusted to reflect all sample dilutions and dry weight factors that are not accounted for by the method.

Note: The lab supplies dilution notices via fax; check the file for these notices.

ACTION: On the Sample Dilution Summary Form, list discrepancies, note elevated reporting limits (> than 10 times), and list affected samples.

8. Conclusion

ACTION: Narrative should identify all problems and all qualifications should have an explanation. All affected samples should be identified and appropriate qualifiers and applicable concentrations added to validation data sheets and on the Summary of Qualifications Form for these methods in the SDG.

	YES	NO	N/A
1. Were all deliverables received? (Note: Check addendum to laboratory contract)	___	___	___
1.1 Cover page present?	___	___	___
1.2 Sample chain of custody present and completed correctly?	___	___	___
1.3 Sample analyses and chain of custody match?	___	___	___

ACTION: Make a list below of any missing deliverables. Contact the W-C Project Laboratory Coordinator.

2. Does the lab narrative indicate any problems with sample receipt, condition of samples, analytical problems or special notations for any of the data reviewed?	___	___	___

ACTION: Make a list on the Laboratory Narrative Summary Form of any problems cited which would affect the results for metals. (Consult EPA Functional Guidelines)

ACTION: Use professional judgement to evaluate the effect on the quality of the data.

	YES	NO	N/A
3. Holding Times			
Have any holding times, determined from date of collection to date of analysis, been exceeded?	___	___	___

Note: For all metals, except mercury, holding times are 6 months and should be preserved with nitric acid to pH <2 and stored to 4°C. Mercury must be analyzed within 28 days from collection.

Note: Holding time limits are taken from the QAPP.

ACTION: On the Holding Time Deviations Form, list analyses outside holding times.

ACTION: Use professional judgement to determine if qualification is needed.

4. Blank Contamination

4.1 Has a preparation blank been analyzed for each set of samples or every 20 samples of similar matrix if set >20?	___	___	___

ACTION: If any preparation blank data are missing, make a list on the Method Blank Summary Form and contact the W-C Laboratory Coordinator.

4.2 Do any method blanks have positive results for any metal analytes?	___	___	___

ACTION: Prepare a list on the Method Blank Summary Form of the samples associated with each of the contaminated blanks and list below the blank concentrations for each.

4.3 Do any field blanks have positive results?	___	___	___

ACTION: Prepare a list on the Field Blank Summary Form of the samples associated with each of the contaminated blanks.

	YES	NO	N/A

Note: Only field blanks taken the same day as the samples are used to qualify data. Blanks may not be qualified using other field blank data. The field blank may be qualified for LCS, Matirx Spike, or preparation blank data.

4.4 Must any data be qualified due to blank contamination? ___ ___ ___

ACTION: Depends on the circumstances and origin of the blank. If the result is less than 5X the blank amount strike the amount (with a single line) in the results column, add a "U" flag, and raise the reporting limit to the result amount on the validation copy. List actions on the Method Blank Summary Form.

ACTION: In the space provided, list affected samples on the Method Blank Summary Form, qualifiers issued and any pertinent discussion necessary to explain the actions taken.

5. <u>Laboratory Control Sample (LCS)</u>

5.1 Are the appropriate LCS present? ___ ___ ___

5.2 For the LCS, are any analytes "out"? ___ ___ ___

ACTION: On the LCS Summary Form, list LCS analytes not meeting the applicable criteria.

1. Aqueous LCS

a. If the LCS recovery for any analyte falls within the range of 50-79% or >120%, qualify detected results as estimated "J".

b. If results are nondetect and the LCS recovery is greater than 120%, the data are acceptable.

c. If results are nondetect and the LCS falls within the range of 50-79%, qualify the data for the affected analytes as estimated "UJ".

d. If LCS recovery results are <50%, qualify the data for these samples as unusable.

2. Solid LCS

a. If the solid LCS recovery for any analyte falls outside the EPA control limits, qualify all sample detected results as estimated "J".

b. If the LCS results are higher than the control limits and the sample results are nondetect, the data are acceptable.

c. If the LCS results are lower than the control limits, qualify all nondetect sample results as estimated "UJ".

	YES	NO	N/A
6. <u>Matrix Spike (MS)</u>			
6.1 Are field MS data available for each matrix at each site?	___	___	___
Note: Contact the W-C Project Laboratory Coordinator to confirm this.			
6.2 Are lab QA/QC MS data available?	___	___	___
ACTION: Make a list of any missing MS data and contact the W-C Project Laboratory Coordinator.			
6.3 Are the results within QAPP limits?	___	___	___

Note: For example QAPP limits for accuracy can be 75-125% recovery for both waters and soils. Precision limits can be 20% for waters and 30% for soils for all analytes.

Note: If the sample concentration is more than 4X the spike concentration, the following action criteria do not apply.

ACTION: List samples not meeting the above criteria on the MS/Duplicate Summary Form.

6.4 How many % recoveries are out of QC limits?

	Water	Soil
FAA	_____ of 4	_____ of 4
CVAA	_____ of 1	_____ of 1
ICP	_____ of 20	_____ of 20

Note: Above numbers may vary based on the metals list requested (RCRA, PPL, or TAL).

ACTION: For aqueous samples, if spike recovery is less than 30%, reject all associated aqueous data; if between 30-74%, flag all associated aqueous data as estimated "J"; if between 126-150%, flag positive results "J" and nondetects "U"; if greater than 150%, reject all data not flagged "U".

ACTION: For all soil samples, if spike recovery is less than 10%, reject all associated soil data; if between 10% and the lower limit specified in the QAPP, flag all associated soil data as estimated "J"; if between the upper limit specified in the QAPP and 200%, flag positive results "J" and nondetects "U"; if greater than 200%, reject all data not flagged "U".

	YES	NO	N/A
7. <u>Laboratory and Field Duplicate</u>			
Were any field duplicates submitted for metals analysis?	___	___	___
Were laboratory duplicate data available for each matrix at each site?	___	___	___

ACTION: Compare the reported results and calculate RPDs on the Field Duplicate Summary Form.

ACTION: Any gross variations should be noted in the review. It may be appropriate to confirm proper sample ID with field personnel. (W-C Project Laboratory Coordinator) Associated sample results are qualified as estimated based on the following evaluation criteria.

As stated in the QAPP, for analytes with the sample concentrations greater than 5 times the reporting limit, the field duplicate sample results should agree within 50 percent RPD for soil and 25 percent for aqueous samples. Also, for analytes with either or both concentrations less than 5 times the reporting limit, field duplicate sample results should agree within ±2 times the reporting limit for soil and aqueous samples.

For analytes with the sample concentration greater than 5X the reporting limit, the laboratory duplicate sample results should agree within 35% of RPD for soils and 20% RPD for aqueous samples. For analytes with either or both concentrations less than 5X the reporting limit, laboratory duplicate results should agree within ±2X the reporting limit for soils and ±1X the reporting limit for aqueous samples.

Note: Field duplicate results, RPDs, and qualifiers on the Field Duplicate Results Summary Form. Laboratory duplicate results not meeting the above criteria should be listed on the MS/Duplicate Summary Form.

		YES	NO	N/A
8.	Compound Quantitation and Reporting Limits			
8.1	Are the reported results and corresponding reporting limits within QAPP limits?	___	___	___
8.2	Verify that reporting limits have been adjusted to reflect all sample dilutions and dry weight factors that are not accounted for by the method.			

Note: The lab supplies dilution notices via fax; check the file for these notices.

ACTION: On the Sample Dilution Summary Form, list discrepancies, note elevated reporting limits (> than 10 times) (i.e. multiplier of QAPP limit), and list affected samples.

9. Conclusion

ACTION: Narrative should identify all problems and all qualifications should have an explanation. All affected samples should be identified and appropriate qualifiers and applicable concentrations added to validation data sheets and summarized on the Qualification Summary Form.

TABLE 4-5
QC EVALUATION CRITERIA[1] FOR METALS FOR LABORATORY CONTROL SAMPLES AND MATRIX SPIKE/ MATRIX DUPLICATE SAMPLES

Parameter	Method	Water[1]	Soil[2]	Precision (RPD) %
Aluminum	3050/6010	75-125	47-153	20
Antimony	3050/6010	75-125	18-362	20/50(soil)
Arsenic-GFAA	3050/6010	75-125	59-141	20
Barium	3050/6010	75-125	76-124	20
Beryllium	3050/6010	75-125	53-131	20
Cadmium	3050/6010	75-125	68-132	20
Calcium	3050/6010	75-125	79-121	20
Chromium	3050/6010	75-125	66-133	20
Cobalt	3050/6010	75-125	70-130	20
Copper	3050/6010	75-125	70-132	20
Iron	3050/6010	75-125	66-134	20
Lead-GFAA	3020-3050/7421	75-125	66-135	20
Magnesium	3050/6010	75-125	74-126	20
Manganese	3050/6010	75-125	74-125	20
Mercury-CVAA	7470-7471	75-125	52-148	20
Nickel	3050/6010	75-125	67-133	20
Potassium	3050/6010	75-125	68-132	20
Silver	3050/6010	75-125	76-124	20
Sodium	3050/6010	75-125	57-130	20
Vanadium	3050/6010	75-125	73-127	20
Zinc	3050/6010	75-125	65-135	20

[1] Limits based on CLP SOW
[2] Limits based on interlaboratory study

RPD = Relative percent difference
ICP = Inductively coupled plasma spectrometry
GFAA = Graphite furnace atomic absorption
CVAA = Cold vapor atomic absorption

	YES	NO	N/A
1. Were all deliverables received? (Note: Check addendum to laboratory contract)	___	___	___
1.1 Cover page present?	___	___	___
1.2 Sample chain of custody present and completed correctly?	___	___	___
1.3 Sample analyses and chain of custody match?	___	___	___

ACTION: Make a list of any missing deliverables. Contact the W-C Project Laboratory Coordinator.

2. Does the laboratory narrative indicate any problems with sample receipt, condition of samples, analytical problems or special notations for any of the data reviewed?	___	___	___

ACTION: Make a list of any problems cited which would affect the results for the water quality methods and use professional judgement to evaluate the effect on the quality of the data.

	YES	NO	N/A

3. Holding Times

Have any holding times (for any method), determined from date of collection to date of analysis, been exceeded? ___ ___ ___

Water Quality Parameters

Cyanide	9010	_____	_____	14 days
	9012	_____	_____	7 days
Sulfide	9030	_____	_____	28 days

ACTION: When holding times have been exceeded, use professional judgement to determine if qualification due to suspected low bias is needed. Consider factors such sample preservation, cooler temps, number of days exceeded, etc. For any sample exceeding holding time, the data summary should explain what, if any, qualification was made. You may choose to qualify results as estimated "J" or, if holding times are grossly exceeded (e.g., greater than two times the required time), you may qualify non-detects as unusable "R" and other results estimated "J". In the case where a second analysis was run which exceeds the holding time but the original analysis did not, evaluation of the two results and professional judgement must be used in determining whether qualification is needed.

		YES	NO	N/A
4.	Blank Contamination			
4.1	Has a method blank been analyzed for each set of samples or every 20 samples of similar matrix if set >20?	___	___	___
ACTION:	If any method blank data are missing, make a list and contact the QA/QC Officer or the QA/QC Co-ordinator.			
4.2	Do any method blanks have positive results?	___	___	___
ACTION:	List the samples associated with each of the contaminated blanks and list the blank concentrations for each on the Method Blank Summary Form.			
4.3	Must any data be qualified due to blank contamination?	___	___	___
ACTION:	Depends on the circumstances and origin of the blank. If the result is less than 5X the blank amount for target compounds, strike the amount (with a single line) in the results column, add a "U" flag, and raise the reporting limit to the result amount.			
5.	Laboratory Control Sample (LCS)			
5.1	Are the appropriate LCS present for each method?	___	___	___
5.2	For each LCS, are any analytes "out"?	___	___	___

Note: QC acceptance criteria can be found in the QAPP. The following criteria are for example only.

Parameter	Method[1]	Matrix	Accuracy (% Recovery)	Precision (RPD)[2] %
Cyanide	9010/9012	Water	105-130	25
	9010/9012	Soil/Sediment	80-120	25
Sulfide	376.1 9030	Water	90-105	20

[1] EPA SW846, 3rd Edition and EPA 600/4-79-020 (1983)
[2] RPD = Relative percent difference

ACTION: List any missing LCS results on the LCS Summary Form and contact the W-C Project Laboratory Coordinator.

	YES	NO	N/A
6. Matrix Spike (MS)			
Are MS data available for each matrix at each site?	___	___	___
Are results outside of the limits specified in the QAPP?	___	___	___

ACTION: For all samples, if spike recovery is less than 10%, reject all associated data; if the spike recovery is between 10% and the lower limit specified in the QAPP, qualify all associated data as estimated; if between the upper limit specified in the QAPP and 200%, qualify associate positive results as estimated; if greater than 200%, reject all associated positive results.

Note: If the sample concentration is more than 4X the spike concentration, the above action criteria do not apply.

7. Laboratory Duplicate			
Were laboratory duplicate data available for each matrix for each site?	___	___	___

ACTION: Associated sample results are qualified as estimated based on the following evaluation criteria:

For analytes with both sample concentrations greater than 5X the reporting limit, the laboratory duplicate results should agree within 35% RPD for soils and 20% RPD for aqueous samples.

	YES	NO	N/A
For analytes with either or both sample concentrations less than 5X the reporting limit, duplicate results should agree within ±2X the reporting limit for soils and ±1X the reporting limit for aqueous samples.			

8. Field Duplicate

Were any field duplicates submitted for water quality analysis?	___	___	___

ACTION: Compare the reported results and calculate RPDs.

ACTION: Any gross variations should be noted in the review. It may be appropriate to confirm proper sample ID with field personnel. Associated sample results are qualified as estimated based on the following criteria.

As stated in the QAPP, for analytes with the sample concentrations greater than 5 times the reporting limit, the duplicate sample results should agree within 50 percent RPD for soil and 25 percent for aqueous samples. Also, for analytes with either or both concentrations less than 5 times the reporting limit, duplicate sample results should agree within ±2 times the reporting limit for soil and aqueous samples. Note duplicate results, RPDs, and qualifiers on the Field Duplicate Results Summary Form.

	YES	NO	N/A
9. Compound Quantitation and Reporting Limits			
7.1 Are the reported results and corresponding reporting limits within QAPP limits?	___	___	___

7.2 Verify that reporting limits have been adjusted to reflect all sample dilution factors that are not accounted for by the method.

Note: The laboratory supplies dilution notices via fax; check the file for these notices.

ACTION: On the Sample Dilution Summary Form, list discrepancies, note elevated reporting limits (> than 10 times), and list affected samples.

10. Conclusion

ACTION: Narrative should identify all problems and all qualifications should have an explanation. All affected samples should be identified and appropriate qualifiers and applicable concentrations added to validation data sheets. A summary table listing each sample qualified along with the reason and the impact on data usability should be completed on the Summary of Qualifications Form.

APPENDIX C

LABORATORY QUALITY MANAGEMENT PLAN (LQMP)

Rocky Mountain
Analytical Laboratory

Enseco
A CORNING Company

QUALITY ASSURANCE PROGRAM PLAN FOR ENVIRONMENTAL CHEMICAL ANALYSIS

Prepared By:
Enseco Incorporated

Revision: 3.5
May, 1992

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Appendix I — Enseco Recommended Maximum Holding Times and Sample Collection/Preservation Information

Appendix II — Standard Operating Procedures (SOP) Elements

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1. INTRODUCTION

Enseco Incorporated (Enseco) of Corning Lab Services Incorporated (CLSI) comprises the largest and most experienced network of environmental testing laboratories in the United States. The Enseco facilities are organized into four geographic regions:

Eastern Region:

- Enseco-East in Somerset, New Jersey
- Enseco-Erco Laboratory in Cambridge, Massachusetts

Central Region:

- Enseco-Rocky Mountain Analytical Laboratory in Arvada, Colorado
- Enseco-Mixed Waste Laboratory in Arvada, Colorado
- Enseco-Houston Technical Service Center in Houston, Texas

Western Region:

- Enseco-California Analytical Laboratory in Sacramento, California
- Enseco-CRL in Garden Grove, California
- Enseco-Air Toxics Laboratory in City of Industry, California
- Enseco-Mobile Laboratories in Garden Grove, California

Wadsworth/ALERT Region:

- Wadsworth/ALERT Laboratories in North Canton, Ohio
- Wadsworth/ALERT Laboratories in Pittsburgh, Pennsylvania
- Wadsworth/ALERT Laboratories in Tampa, Florida

Addresses and telephone numbers for these facilities are listed in Table 1-1.

This document describes the Enseco Quality Assurance policies and procedures related to chemical analysis for environmental pollutants in water, soil, and waste.

TABLE 1-1

ENSECO FACILITIES

Eastern Region

Enseco-East
2200 Cottontail Lane
Somerset, NJ 08875
(908) 469-5800
Facsimile (908) 469-7516

Enseco-Erco Laboratory
205 Alewife Brook Parkway
Cambridge, MA 02138
(617) 661-3111
Facsimile (617) 354-5258

Central Region

Enseco-Rocky Mountain Analytical Laboratory
4955 Yarrow Street
Arvada, CO 80002
(303) 421-6611
Facsimile (303) 431-7171

Enseco-Mixed Waste Laboratory
4955 Yarrow Street
Arvada, CO 80002
(303) 421-6611
Facsimile (303) 467-9136

Enseco-Houston Technical Service Center
1420 East North Belt, Ste. 120
Houston, TX 77032
(713) 987-9767
Facsimile (713) 987-9769

Western Region

Enseco-California Analytical Laboratory
2544 Industrial Boulevard
West Sacramento, CA 95691
(916) 372-1393
Facsimile (916) 372-1059

Enseco-CRL
7440 Lincoln Way
Garden Grove, CA 92641
(714) 898-6370
Facsimile (714) 891-5917

Enseco-Air Toxics Laboratory
18501 East Gale Ave, Ste. 130
City of Industry, CA 91748
(818) 965-1006
Facsimile (818) 965-1003

Enseco-Mobile Laboratories
7440 Lincoln Way
Garden Grove, CA 92641
(714) 898-6370
Facsimile (714) 891-5917

TABLE 1-1

ENSECO FACILITIES

(Continued)

Wadsworth/ALERT Region

Wadsworth/ALERT Laboratories
4101 Shuffel Drive, NW
North Canton, OH 44720
(216) 497-9396
Facsimile (216) 497-0772

Wadsworth/ALERT Laboratories
5910 Breckenridge Parkway
Breckenridge II, Suite H
Tampa, FL 33610
(813) 621-0784
Facsimile (813) 623-6021

Wadsworth/ALERT Laboratories
450 William Pitt Way, Bldg. 6
Pittsburgh, PA 15238
(412) 826-5477
Facsimile (412) 826-5571

2. QUALITY ASSURANCE POLICY

Enseco's commitment is to meet the client's requirements by providing quality environmental analytical services to both the public and private sectors. The quality management system at Enseco stresses process improvement and error prevention through training and planning. It provides for detection of errors that occur through quality control and auditing. The goal of each laboratory is to generate error-free work through the support of personal standards of performance, the attitude that errors can be prevented, and to devise permanent solutions for problems which are detected. A comprehensive system of measurement and display of key characteristics of the laboratory provides opportunity for continuous improvement. The extensive Quality Assurance program, as part of the quality management system, ensures the production of scientifically sound, legally defensible data of known, documentable and verifiable quality. This program relies on clearly defined objectives, well-documented procedures, a comprehensive audit system, and management support, both Corporate and Regional for its effectiveness.

All work at Enseco is conducted under this QAPP unless another approved program plan, project plan or contract is in place which describes a quality management system appropriate to the client's requirements to generate scientifically sound, legally defensible data of known, documentable and verifiable quality.

3. PURPOSE AND SCOPE OF DOCUMENT

Purpose

This QA Program Plan presents an overview of the essential elements of the Enseco QA program. This plan is modeled along EPA guidelines as outlined in "Interim Guidelines and Specifications for Preparing Quality Assurance Program Plans," QAMS-004/80, December 29, 1980 and "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans," QAMS-005/80, February, 1983. Both of these documents have been issued by the Office of Monitoring Systems and Quality Assurance, Office of Research and Development, U.S. Environmental Protection Agency (U.S. EPA). Elements above and beyond those specified in these two documents have been included in this QA Program Plan in order to completely describe the Enseco QA/QC system.

Scope

The Enseco QA program is designed to control and monitor the quality of data generated in Enseco laboratories. The program has four key elements.

- Demonstrating laboratory capability by providing information which documents the overall qualifications of the laboratory to perform environmental analyses;
- Establishing procedures for controlling laboratory operations which measure laboratory and instrument performance on a daily basis;
- Measuring matrix effects to determine the effect of a specific matrix on method performance, and
- Reporting appropriate QC information with the analytical results to enable the end-user to assess the quality of the data.

The specific procedures involved in implementing each aspect of the program are described in this document. An overview of these QC procedures, along with the section number in which each is discussed, is given in Table 3-1.

The QA/QC policies and procedures described herein are designed to eliminate systematic errors and minimize the occurrence of other errors. The QA program forms the framework for minimizing errors, identifying those errors which do occasionally occur, and correcting them at their source. These QA/QC policies and procedures must be coupled with the professional judgment of the technical staff in interpreting the events surrounding the generation of the final result to ensure that quality data is consistently produced, and decisions and corrective actions are fully documented.

In many instances, Enseco participates with its clients in the preparation and evaluation of project-specific Quality Assurance Project Plans (QAPjP). Typically the elements of the Enseco QAPP are incorporated into these documents. In some instances other requirements may be specified. Each QAPjP must be reviewed and signed by the QA Director or his/her designee of the Enseco facility entering into the client agreement to assure that minimum standards of quality exist by which the work can be evaluated as to its scientific and legal integrity. The QA Director must assure that both the analytical testing objectives and regulatory requirements of the project are described in the project plan. In the presence of an approved QAPjP, Enseco laboratories must follow the specific requirements of that project plan which supersedes the Enseco QAPP for any work explicitly associated with that QAPjP.

Table 3-1

ELEMENTS OF QA PROGRAM PLAN

Evaluation Criteria	Operational Elements	Section of QA Plan
LABORATORY QUALIFICATIONS	Facilities/equipment/staff	*
	Written SOPs for all laboratory procedures, including:	17
	Sample custody	7
	Calibration procedures	8
	Analytical procedures	9
	Data validation	10
	Documented QA program	1-15
	Laboratory certifications	12
LABORATORY PERFORMANCE	Check samples	12
	Laboratory Control Samples	11
	Calibration data/calibration verification	8
	Method detection limits	14
MATRIX EFFECTS	Matrix spike/matrix duplicate/ matrix spike duplicate analyses	11
	Sample surrogate recoveries	11
	Standard additions	11
	Field blanks	11
	Method detection limits (determined with specific sample matrix)	11
DATA REPORTING	Data reduction and validation	10
	Data reporting	10
	Reporting Limits	14

* Described in a separate document available from each facility.

4. DEFINITION OF TERMS

Quality Assurance (QA): the total integrated program for assuring the reliability of data generated in the laboratory.

Quality Control (QC): the routine application of specific, well-documented procedures to ensure the generation of data of known and accepted quality, thus fulfilling the objectives of the QA program.

Quality Assurance Program Plan (QAPP): an assemblage of management policies, objectives, principles, and general procedures outlining the techniques by which the laboratory produces data of known and accepted quality.

Quality Assurance Project Plan (QAPjP): an assemblage of detailed procedures describing how the laboratory will generate data that meet the Data Quality Objective (DQOs) of a specific project.

Standard Operating Procedure (SOP): a detailed, written description of a procedure designed to systematize and standardize the performance of the procedure.

Legally Defensible Data: data which are supported by a QAPP and documentation adequate to reconstruct the analytical process. Legal defensibility is not dependent on the level of deliverables.

Holding Time: the period of time during which a sample can be stored after collection and preservation according to method or client requirements.

Initiate Preparation: the point in time at which the separation of organic extractable compounds or metals from the sample matrix by solvent extraction, acid digestion, or leachate generation is begun.

Initiate Analysis: the point in time at which the sample, extract or digestate is introduced into an instrument or process which complies with the SOP for analysis of the parameter of interest.

Standard Additions (SA): the practice of adding a series of known amounts of an analyte to an environmental sample. The fortified samples are then analyzed and the recovery of the analytes calculated. The practice of SA's is generally used with metal analyses to compensate for the effect of the sample matrix on the accuracy of the analyses.

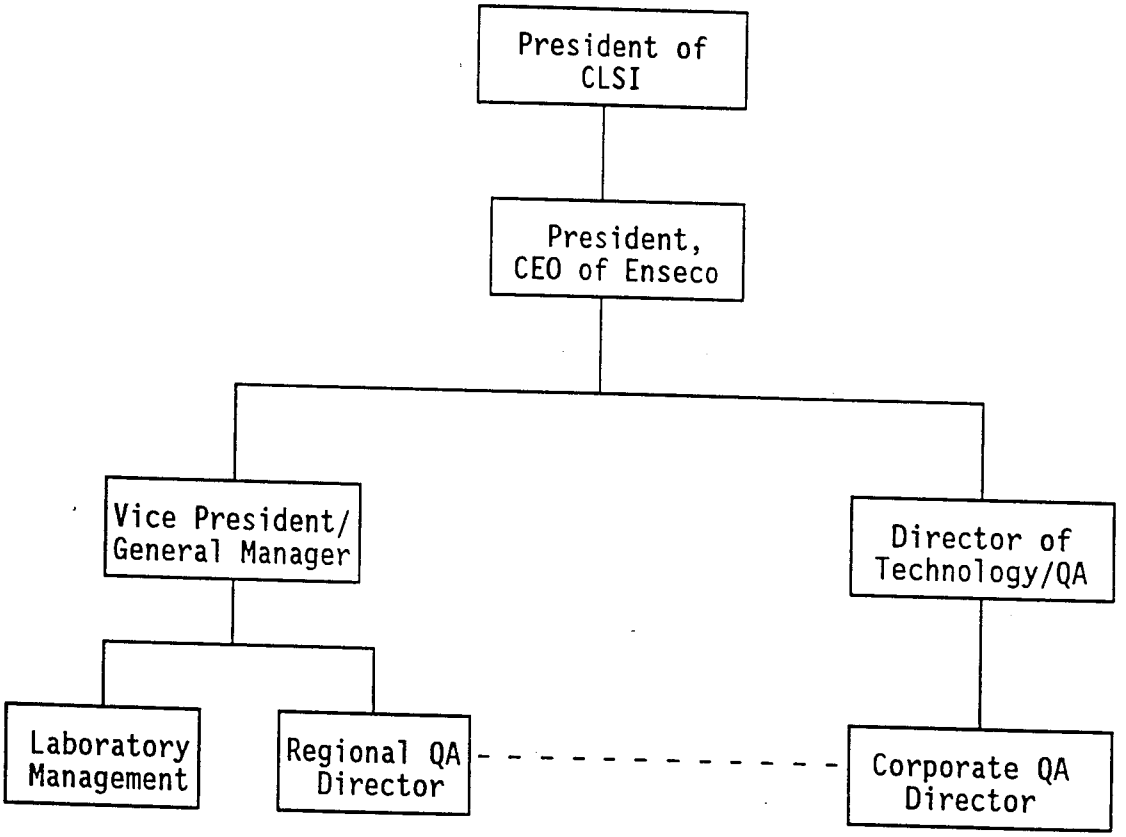
5. RESPONSIBILITIES AND AUTHORITIES

Executing an effective QA program in a large and complex multi-laboratory system demands the commitment and attention of both management and staff. The QA effort is administered by the Director of Technology/Quality Assurance who manages the Corporate Quality Assurance Office. The Director of Technology/Quality Assurance reports directly to the President and Chief Executive Officer (CEO) and has the responsibility for overseeing and regulating all laboratory functions (see Figure 5-1). The Corporate QA Director reports to the Director of Technology/Quality Assurance and has the responsibility of the day-to-day functions of the QA office. The QA Office operates independently of all areas generating analytical data to ensure complete objectivity in the evaluation of laboratory operations.

The implementation of the QA program within each region is administered by the Regional QA Director. The Regional QA Director reports to both the Corporate QA Director and to the Vice President/General Manager or the Assistant General Manager who manages the region. Each facility has a QA Director who monitors the day to day QA activities at that facility. The QA Director participates in the facility Quality Improvement Team (QIT) and management team meetings as a full partner of the management team to ensure the policies of the organization with respect to client service and quality are met. In addition, all scientists within the organization play a vital role in assuring the quality of their work. We believe that the success of Enseco is dependent upon the continued commitment of all within the organization to a strong and viable QA Program. The responsibilities and levels of authority within the organization are described below. The descriptions which follow are intended to address the functions required of these positions. Actual position titles may vary among the facilities.

FIGURE 5-1

QA ORGANIZATIONAL CHART



Corporate Quality Assurance Office

Members

The QA effort within Enseco is directed by the Corporate QA Director under the management of the Director of Technology/ Quality Assurance to carry out the responsibilities of the department.

Responsibilities

The Corporate QA Director is responsible for:

- Developing and implementing a Corporate QA program that ensures that all data generated in Enseco laboratories are scientifically sound, legally defensible, and of known precision and accuracy;
- Monitoring the QA Plan to ensure compliance with QA objectives in all Enseco laboratories;
- Developing and implementing new QA procedures within the corporation to improve data quality;
- Conducting audits and inspections of all Enseco laboratories on a regular basis, reporting the results of those audits to Regional and Corporate management, and recommending corrective actions as needed to ensure compliance with the Enseco QA Program Plan and/or applicable QA Project Plan;
- Establishing databases that accurately reflect the performance of each of the Enseco laboratories;

- Assisting facility QA Directors in the implementation of the Enseco QA Plan;
- Chairing the Enseco QA Committee, a working committee which includes all of the Regional and facility QA Directors and deals with QA issues on an ongoing basis;
- Monitoring the status of facility certifications;
- Conducting seminars on QA issues for both clients and staff; and
- Promoting sound QA practices within the environmental regulatory and analytical communities.

Authority

Both the Director of Technology/Quality Assurance and the Corporate QA Director have the authority on issues dealing with data quality and have the authority to require that procedures be amended or discontinued, or analyses suspended or repeated. The Director of Technology/Quality Assurance and the Corporate QA Director have the authority to recommend appropriate disciplinary action up to or including suspension or termination of employees on the grounds of dishonesty, incompetence, or repeated non-compliance with QA procedures. In addition, these Corporate Directors have the authority to overrule decisions and actions of the Regional and facility QA Directors and must approve the termination or transfer of any Regional or facility QA Director. The authority of the Corporate QA Director and the Director of Technology/Quality Assurance comes directly from the President of CLSI.

Regional Quality Assurance Departments

Members

Each Region has a Regional Quality Assurance Director who reports directly to the Vice President/General Manager and indirectly to the Corporate QA Director.

Responsibilities

The Regional QA Director is responsible for:

- Overseeing the implementation of the QA Plan within the Region to ensure compliance with the QA objectives;
- Assisting staff in maintaining regulatory analytical compliance;
- Overseeing and assisting the facility QA staff in meeting the responsibilities of the facility Quality Assurance Departments at each facility in the Region as described below;
- Reporting the status of the facility QA programs within the Region to the Corporate QA Director with formal and informal communications;
- Providing training opportunities relating to QA for both QA and laboratory staff;
- Conducting seminars on QA issues for clients;
- Assisting facility QA Directors and managers in resolution of data quality inquiries;
- Assisting the Corporate QA office in the writing of QA policies and procedures;

- Serving as a member of the QA Committee;
- Serving as a channel of communications between the Vice President/General Manager and the facility QA groups; and
- Meeting client requirements.

Authority

The Regional QA Director is the final authority within each region on all issues dealing with data quality. He/she has the authority to require that procedures be amended or discontinued or analyses suspended or repeated. In addition, the Regional QA Director has the authority to overrule decisions and actions of the facility QA Directors and must approve the termination or transfer of any facility QA Director. He/she can make recommendations to the Vice President/General Manager and the Corporate Director of QA regarding suspension or termination of employees for incompetence or non-compliance with QA procedures. The Regional QA Director reports to the Vice President/General Manager. The authority of the Regional QA Director comes directly from the Corporate QA Director.

Facility Quality Assurance Departments

Members

Each facility QA Department is managed by a QA Director. The QA Director reports directly to the laboratory management and the Regional QA Director. The QA Director is supported by a QA staff within the facility.

Responsibilities

The facility QA Director or his/her designee is responsible for:

- Implementing QA policies;
- Actively supporting the implementation of the QA Plan within the laboratory to ensure compliance with QA objectives;
- Assisting in maintaining regulatory analytical compliance;
- Conducting in-house audits to identify potential problems and ensure compliance with written SOPs;
- Establishing databases that reflect the performance of the laboratory and review data;
- Prescribing and monitoring corrective actions;
- Serving as the in-house client representative on all project inquiries involving data quality issues;
- Monitoring the preparation and verification of analytical standards;
- Assisting analysts in the writing of SOPs;
- Approving SOPs in concurrence with management;
- Reporting the status of the laboratory QA program to management and the Regional and Corporate QA Director with formal and informal communications;
- Maintaining records and archives of all QC data, PE results, audit comments, and customer inquiries concerning data quality;
- Assuring that the laboratory staff has access to current SOPs;
- Monitoring laboratory performance including holding times, PE performance, and meeting program and project specific requirements.

- Conducting seminars on QA issues for clients;
- Training laboratory staff on QA principles and requirements;
- Approving QA Project Plans;
- Assisting the Corporate QA office in the writing of QA policies and procedures;
- Serving as a member of the QA Committee;
- Auditing subcontractors; and
- Meeting client requirements.

Authority

The facility QA Director is the final authority within each facility on all issues dealing with data quality. He/she has the authority to require that procedures be amended or discontinued or analyses suspended or repeated. He/she can make recommendations to the Vice President/General Manager and the Regional QA Director regarding suspension or termination of employees for incompetence or non-compliance with QA procedures. The authority of the facility QA Director comes directly from the Corporate Director of QA through the Regional QA Director.

Facility Management

Members

The managers and supervisors who direct the analytical work at each facility are directly responsible for ensuring that all employees reporting to them are complying with the Enseco QA Plan.

Responsibilities

Facility management is responsible for:

- Actively implementing the Enseco QA Plan within the facility;
- Responding to and implementing corrective actions;
- Following the Corporate ethics statement;
- Maintaining accurate SOPs and enforcing their use in the laboratory;
- Providing training for laboratory staff;
- Maintaining a work environment that emphasizes the importance of data quality;
- Providing management support to the Corporate, Regional, and facility QA departments; and
- Meeting client requirements.

Authority

The managers and supervisors of the facility have the authority to accept or reject data based on compliance with well-defined QC criteria. In addition, managers and supervisors, with the approval of the QA department, can accept or reject data that fall outside of established QC guidelines if, in their judgment, there are technical reasons which warrant the acceptance or rejection of the data. These circumstances must be well documented and any need for corrective action identified by the incident must be defined and initiated. The authority of the facility management comes directly from the Vice President/General Manager.

Laboratory Personnel

Members

All facility personnel involved in the generation and reporting of data have a responsibility to understand and follow the Enseco QA Plan.

Responsibilities

Laboratory personnel are responsible for:

- Having a working knowledge of the Enseco QA Plan;
- Ensuring that all work is generated in compliance with the Enseco QA Plan;
- Following the Corporate ethics statement;
- Performing all work according to written SOPs and client-specific QAPjPs;
- Ensuring that all documentation related to their work is complete and accurate;
- Providing management and QA with immediate notification of quality problems; and
- Meeting client requirements.

Authority

Laboratory personnel have the authority to accept or reject data based on compliance with well-defined QC criteria. The acceptance of data that fall outside of established QC guidelines or rejection of data for technical reasons that meet established QC guidelines

must be approved by laboratory management and the QA department. Laboratory personnel have the authority to recommend a stop-work order due to quality problems. This recommendation can be made either to their supervisor or to the QA Department. The authority of the laboratory personnel flows from the Vice President/General Manager.

6. SAMPLING PROCEDURES

The generation of quality data begins with the collection of the sample, and therefore the integrity of the sample collection process is of concern to the laboratory. Samples must be collected in such a way that no foreign material is introduced into the sample and no material of interest escapes from the sample prior to analysis. To ensure sample integrity, the following must be considered:

- Samples must be collected in appropriate containers. In general, glass containers are used for organic parameters and polyethylene containers for inorganic/metal parameters (see Appendix I);
- The sample containers must be properly cleaned to ensure that the sample is not contaminated during the collection process;
- Samples must be preserved appropriately to minimize the loss of materials of interest due to adsorption, chemical or biological degradation, or volatilization (see Appendix I);
- Appropriate volumes of sample must be collected to ensure that the required detection limits can be met and quality control samples can be analyzed (see Appendix I); and
- Samples must be properly shipped to the laboratory, in the appropriate time frame, to ensure that holding times for the analyses can be met (see Appendix I).

Sample Containers and Preservatives

Enseco can make available to the client sample containers that are properly cleaned and preserved for use in sample collection. Appropriate containers and preservatives, and minimum sample volumes required for analyzing routine organic, metal, and wet chemistry parameters are listed in Appendix I.

Holding Times

EPA has established holding time requirements for some analyses. These holding time requirements are listed in Appendix I, along with container and preservative requirements. As indicated in Appendix I, holding time requirements differ depending on the regulatory program. Enseco follows the holding times given in SW-846, Update I of SW-846, 40 CFR Part 136, or Methods of Chemical Analysis of Water & Waste, based on the method source, unless otherwise instructed by the client. CLP holding times are followed when CLP protocols are requested by the client.

Sample Disposition

Sample disposition procedures, including disposition of empty sample containers, meet Federal and State regulations.

7. SAMPLE CUSTODY

Upon receipt by the laboratory, samples proceed through an orderly processing sequence specifically designed to ensure continuous integrity of both the sample and its documentation.

All samples are received by the facility's sample control group and are carefully checked for label identification, and completed, accurate chain-of-custody records. Each sample is then assigned a unique laboratory identification number through a computerized Laboratory Information Management System (LIMS) that stores all identifications and essential information. This process is summarized in Figure 7-1. Access to all Enseco laboratories is restricted to prevent any unauthorized contact with samples, extracts, or documentation.

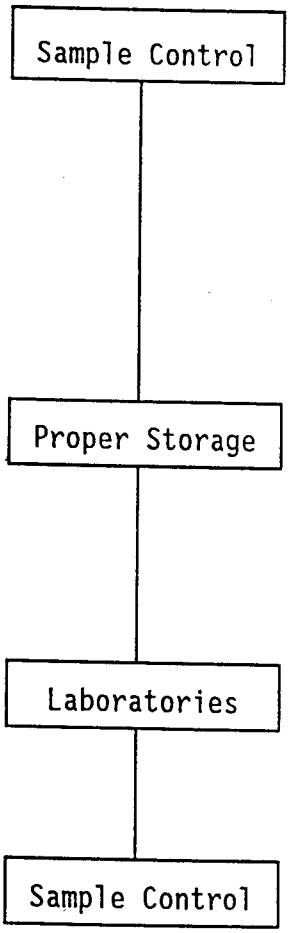
Samples must be transmitted under chain-of-custody both between the field and laboratory and between the laboratory and any subcontractor laboratory as documentation of sample possession. Samples are not transferred to subcontractor laboratories without prior approval of the client.

An example of a Chain-Of-Custody Record used to transmit samples from the client to the laboratory is given in Figure 7-2. An example of a Chain-Of-Custody Record (Interlaboratory Analysis Form) used to transmit samples to subcontractor laboratories is given in Figure 7-3.

Sample bottles provided to the client by Enseco are transmitted under custody.

FIGURE 7-1

ENSECO SAMPLE PROCESSING FLOW CHART



* Check and document physical condition of sample
* Log into LIMS
* Verify documentation and parameter assignment

* Store sample according to preservation guidelines
* Transfer sample to lab with proper documentation

* Document analytical work
* Return unused samples to Sample Control

* Return sample to client or arrange for sample disposal

FIGURE 7-2

Enseco
A Corning Company

Rocky Mountain Analytical Laboratory
4955 Yarrow Street
Arvada, CO 80002
303/421-6611 FAX: 303/431-7171

CHAIN OF CUSTODY

ENSECO CLIENT

PROJECT

SAMPLING COMPANY

SAMPLING SITE

TEAM LEADER

SAMPLE SAFE™ CONDITIONS

PACKED BY

SEAL NUMBER

SEAL INTACT UPON RECEIPT BY SAMPLING COMPANY

CONDITION OF CONTENTS

SEALED FOR SHIPPING BY

INITIAL CONTENTS TEMP °C

SEAL NUMBER

SAMPLING STATUS ☐ Done ☐ Continuing Until

SEAL INTACT UPON RECEIPT BY LAB ☐ Yes ☐ No

CONTENTS TEMPERATURE UPON RECEIPT BY LAB °C

DATE	TIME	SAMPLE ID/DESCRIPTION	SAMPLE TYPE	# CONTAINERS	ANALYSIS PARAMETERS	REMARKS

CUSTODY TRANSFERS PRIOR TO SHIPPING

RELINQUISHED BY (SIGNED)	RECEIVED BY (SIGNED)	DATE	TIME

SHIPPING DETAILS

DELIVERED TO SHIPPER BY

METHOD OF SHIPMENT

AIRBILL NUMBER

RECEIVED FOR LAB

SIGNED

DATE/TIME

ENSECO PROJECT NUMBER

ENS-1133

White - CLIENT Pink - LAB

FIGURE 7-3

INTERLABORATORY CHAIN OF CUSTODY

Enseco
A Corning Company

PAGE OF

SHIP TO

ATTENTION

ANALYTICAL REQUESTS

EXPORT ID

SAMPLE CONDITION UPON RECEIPT

SEND RESULTS TO

ATTENTION

COMMENTS

TEST PRICE

SUBTOTAL

DISCOUNT / SURCHARGE

TOTAL

*SPECIAL INSTRUCTIONS

WRITTEN RESULTS REQUIRED BY (DATE)

VERBAL/FAC RESULTS REQUIRED BY (DATE)

P.O. No

Q.C. ☐ STANDARD ENSECO ☐ CLP PROTOCOL ☐ PROJECT SPECIFIC

SAMPLE DISPOSAL ☐ ENSECO ☐ RETURN TO CLIENT ☐ PHONE

DETECTION LIMITS ☐ COMMON PRODUCTS ☐ OTHER*

HOLDING TIMES ☐ ENSECO ☐ EPA-CLP ☐ TIER ☐ OTHER*

RAW DATA COPIES NEEDED ☐ YES ☐ NO

CUSTODY SEALS INTACT ☐ YES ☐ NO ☐ WET WEIGHT ☐ DRY WEIGHT

RELINQUISHED DATE / TIME

RECEIVED DATE / TIME

ENS—1106

IMPORT COPY

8. CALIBRATION PROCEDURES AND FREQUENCY

Standard and Reagent Preparation

A critical element in the generation of quality data is the purity or quality and traceability of the standard solutions and reagents used in the analytical operations. Enseco continually monitors the quality of reagents and standard solutions through a series of well-documented procedures.

Primary reference standards and standard solutions used by the laboratories are obtained from an EPA Cooperator Supplier, the National Institute of Standards and Technology, or other reliable commercial sources to ensure the highest purity possible. All standards and standard solutions are tracked to identify the supplier, lot number, purity/concentration, receipt/preparation date, preparer's name, method of preparation, expiration date, and all other pertinent information.

Standard solutions are validated prior to use. Validation procedures can range from a check for chromatographic purity to verification of the concentration of the standard using a standard prepared at a different time or obtained from a different source. Stock and working standards are checked regularly for signs of deterioration, such as discoloration, formation of precipitates, or change in concentration. Care is exercised in the proper storage and handling of standard solutions, and all containers are labeled as to compound, concentration, solvent, expiration date, and preparation data (initials of preparer and date of preparation). Standards are stored separately from samples.

Reagents are examined for purity by subjecting an aliquot or subsample to the analytical method in which it will be used. In addition, bulk solvents are analyzed for undesirable contaminants prior to use in the laboratory. These analyses are documented.

Instrument Calibration and Tuning

Calibration of instrumentation is required to ensure that the analytical system is operating correctly and functioning at the proper sensitivity to meet established reporting limits. Each instrument is calibrated with standard solutions appropriate to the type of instrument and the working range established for the analytical method. The frequency of calibration and calibration verification and the concentration of calibration standards are determined by the manufacturer's guidelines, the analytical method, or the requirements of special contracts.

Gas Chromatography/Mass Spectrometry (GC/MS)

Prior to analysis of samples, the instrument is tuned with bromofluorobenzene (BFB) for volatile compounds and decafluorotriphenylphosphine (DFTPP) for semivolatile compounds or other tune criteria as specified by the method used. No samples are analyzed until the instrument has met the tuning criteria of the method.

In general, the instrument is then calibrated for all target compounds. An initial calibration curve is produced to define the working range. This initial calibration is evaluated on a daily

basis (when samples are analyzed) to ensure that the system is within calibration. If the continuing calibration standard does not meet the established criteria, corrective action is taken, which may include recalibration.

Chromatography

The field of chromatography involves a variety of instrumentation and detection systems. While calibration standards and acceptance criteria vary depending on the type of system and analytical methodology required for a specific analysis, the general principles of calibration apply uniformly. Each chromatographic system is calibrated prior to performance of analyses. Initial calibration consists of analyzing standards across the working range. The calibration is checked on a daily basis (when samples are analyzed) to ensure that the system remains within specifications. In addition, continuing calibration checks are performed at frequencies required by the method used. If the calibration checks do not meet established criteria, corrective action is taken which may include recalibration and reanalysis of samples. The corrective action procedures include examination of instrument performance and analysis information, consultation with the Supervisor and a decision path to determine if recalibration and reanalysis of samples back to the previous acceptable calibration check is warranted.

Metals

Metals analysis basically involves two types of analytical instrumentation: inductively coupled argon plasma emission spectroscopy (ICP), and atomic absorption spectroscopy (AA).

ICP

Each ICP is calibrated prior to any analyses being performed using criteria prescribed in the analytical method employed. The calibration is then verified using standards from an independent source. The working range of the instrument is established once every quarter using a linear range verification check standard. No values are reported out of the linear range without dilution.

A calibration curve is established daily by analyzing a minimum of two standards, one of which is a calibration blank. The calibration is monitored throughout the day by analyzing a Continuing Calibration Blank (CCB) and a Continuing Calibration Verification standard (CCV). If the verification standard and blank do not meet established criteria, corrective action must be performed. The corrective action procedures include examination of instrument performance and analysis information, consultation with the Supervisor and a decision path to determine if recalibration and reanalysis of samples back to the previously acceptable calibration check is warranted.

An interelement check standard is analyzed at the beginning and end of each analytical run on the ICP to verify that interelement and background correction factors have remained constant. Results outside of the established criteria trigger reanalysis of samples.

AA

Each AA unit is calibrated prior to any analyses being conducted. A calibration curve is prepared with a minimum of a calibration blank and three standards and then verified with a standard that has been

prepared from an independent source at a concentration near the middle of the calibration range. The calibration is then verified on an ongoing basis with a calibration blank (CCB) and a CCV. If the ongoing calibration standard and blank do not meet established acceptance criteria, corrective action must be performed. The corrective action procedures include examination of instrument performance and analysis information, consultation with the Supervisor and a decision path to determine if recalibration and reanalysis of samples back to the previously acceptable calibration check is warranted. For GFAA, all samples are spiked at the instrument to verify the absence of matrix effects or interferences. The method of standard additions or sample dilution is used when matrix interferences are present as determined by the results of the analytical spike.

Wet Chemistry

The field of conventional, non-metals analysis (wet chemistry) involves a variety of instrumental and wet chemical techniques. While calibration and standardization procedures vary depending on the type of system and analytical methodology required for a specific analysis, the general principles of calibration apply universally. Each system is calibrated prior to analyses being conducted. Calibration consists of defining the working range by use of a series of standard solutions and identifying potential interferences. The calibration is checked on an ongoing basis to ensure that the system remains within specifications. If the ongoing calibration check does not meet established criteria, corrective action must be performed. The corrective action procedures include examination of instrument performance and analysis information, consultation with the

Supervisor and a decision path to determine if recalibration and reanalysis of samples back to the previous acceptable calibration check is warranted. Continuing calibrations are not performed for non-instrumental methods such as Total Dissolved Solids.

9. ANALYTICAL PROCEDURES

Most analyses performed by Enseco are driven by regulatory concerns. Therefore, methods used at Enseco predominantly originate from regulatory agencies. Generally the methods used are those specified by the U.S. EPA and other federal agencies, state agencies, and professional organizations, as provided in the following references:

- Current EPA (CLP) protocols for the analysis of organic and inorganic hazardous substances including chlorinated dioxins and furans.
- "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act," 40 CFR, Part 136.
- "Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020 (revised March, 1983 or subsequent revision).
- "Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater," EPA-600/4-82-057 (July, 1982).
- "Test Methods for Evaluating Solid Waste" (SW-846), 2nd Edition (revised), Update I (1984), Update II (1985), 3rd Edition (1986), Update I (1989), Office of Solid Waste and Emergency Response, U.S. EPA.
- "Standard Methods for the Examination of Water and Wastewater," 16th Edition (1985) and 17th Edition (1989) American Public Health Association, American Water Works Association, Water Pollution Control Federation, Washington, DC (1985).
- "Official Methods of Analysis," 14th Edition, Association of Official Analytical Chemists, Arlington, VA (1984).
- "Methods for the Determination of Organic Compounds in Finished Drinking Water and Raw Source Water," U.S. EPA, Environmental Monitoring and Support Laboratory - Cincinnati (September, 1986 or subsequent revision).
- "Annual Book of ASTM Standards," Volumes 11.01, 11.02, 11.03, and 11.04, American Society for Testing and Materials (ASTM), Philadelphia, PA (1987).

- "Techniques of Water Resources Investigations of the United States Geological Survey (USGS), Book 5, Laboratory Analysis," USGS, Washington, DC (1979).

The choice of method is dependent on the objectives of the study in terms of qualitative certainty, quantitative sensitivity, precision and accuracy, the type of matrix to be analyzed, and the regulatory program. Each method used routinely is documented in the form of an SOP. The SOP contains detailed instructions concerning both the use and the expected performance of the method. Enseco may deviate from standard methodologies if necessary or appropriate due to the nature or composition of the sample, based on the reasonable judgment of Enseco.

10. DATA REDUCTION, VALIDATION, AND REPORTING

Data Reduction and Validation

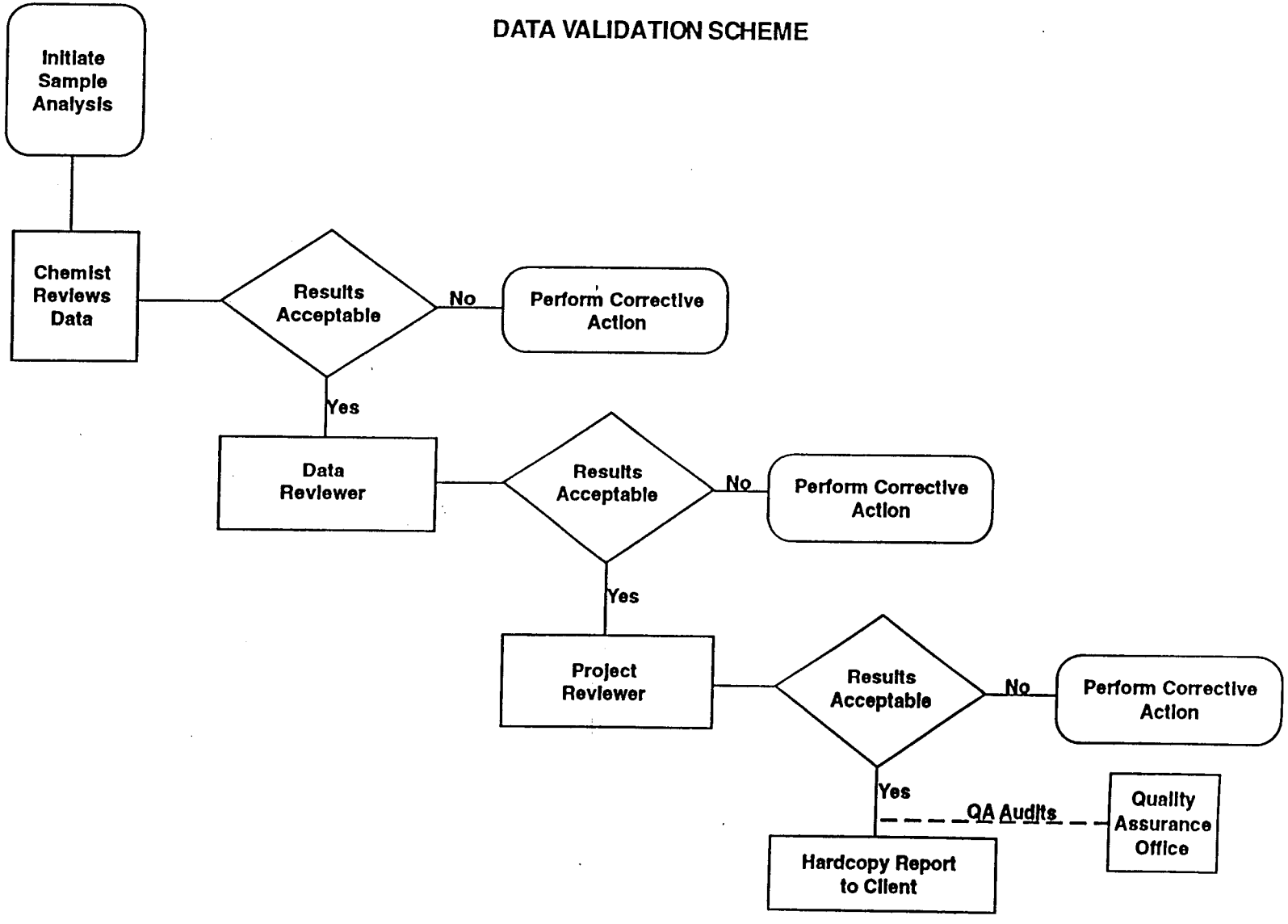
All analytical data generated within Enseco laboratories are extensively reviewed prior to report generation to assure the validity of the reported data. The data validation process consists of data generation, reduction, and three documented reviews (see Figure 10-1). The first review is performed by the person generating the data. This review assures that the work is done correctly the first time. The second review is an independent technical review of the data to ensure the work is error-free and to provide a mechanism to correct errors that are missed during the first review. The third review serves to ensure that the completed project meets the client's specifications. In each stage, the review process is documented by the signature of the reviewer and the date reviewed. In addition to the three reviews, a periodic random data audit is performed by the QA Department. This is described in Section 12. This review process is described below.

The analyst who generates the analytical data has the prime responsibility for the correctness and completeness of the data. All data are generated and reduced following protocols specified in laboratory SOPs. Each analyst reviews the quality of his or her work based on an established set of guidelines. The analyst reviews the data package to ensure that:

- Sample preparation information is correct and complete;
- Analysis information is correct and complete;

FIGURE 10-1

DATA VALIDATION SCHEME



- The appropriate SOPs have been followed;
- Analytical results are correct and complete;
- QC samples are within established control limits;
- Blanks are within appropriate QC limits;
- Analytical and/or preparation holding times are met;
- Special sample preparation and analytical requirements have been met; and
- Documentation is complete (e.g., all anomalies in the preparation and analysis have been documented, holding times are documented, etc.).

The data reduction and validation steps are documented, signed and dated by the analyst. The analyst then passes the data package to an independent reviewer, who performs a second review.

The second review is performed by a supervisor or data reviewer whose function is to provide an independent review of the data package. This review is also conducted according to an established set of guidelines and is structured to ensure that:

- Calibration data are appropriate to the method and completely documented;
- QC samples are within established guidelines;
- Qualitative identification of sample components is correct;
- Quantitative results are correct;
- Documentation is complete and correct (e.g., anomalies in the preparation and analysis have been documented; holding times are documented, etc.);

- The data are ready for incorporation into the final report; and
- The data package is complete and ready for data archive.

The second review is structured so that all calibration data and QC sample results are reviewed and all of the analytical results from 10% of the samples are checked back to the bench sheet. If no problems are found with the data package, the review is complete. If any problems are found with the data package, an additional 10% of the samples are checked to the bench sheet. The process continues until no errors are found or until the data package has been reviewed in its entirety.

An important element of the second review is the documentation of any errors that have been identified and corrected during the review process. Enseco believes that the data package submitted by the analyst should be error-free. Errors that are found are documented. The cause of the errors is then addressed by the supervisor with additional training or clarification of procedures to ensure that quality data will be generated at the bench.

The second data review is also documented and the signature of the reviewer and the date of review recorded. The reviewed data are then approved for release and a final report is prepared.

Before the report is released to the client, the project is reviewed for completeness and to ensure that the data meet the overall objectives of the project. This review is labeled the third review.

Each step of this review process involves evaluation of data quality based on both the results of the QC data and the professional judgment of those conducting the review. This application of technical knowledge and experience to the evaluation of the data is essential in ensuring that data of high quality are generated consistently.

Data Reporting

A variety of reporting formats, from computerized data tables, to complex reports discussing regulatory issues, to a CLP-deliverables package, are available. In general, Enseco reports contain:

General Discussion: Description of sample types, tests performed, any problems encountered and general comments are given.

Analytical Data: Data are reported by sample or by test with the appropriate significant figures and reporting limits, adjusted for dilution. Pertinent information including dates sampled, received, prepared, and extracted are provided.

Laboratory Performance QC Information: The results (Percent Recovery and Relative Percent Difference) of the Laboratory Control Samples analyzed with the project are listed, together with the control limits. Also, the analytical results for method blanks generated during analysis of organic, metals, and pertinent wet chemistry parameters are given.

Matrix-Specific QC Information: Results of any sample duplicates, matrix spikes, matrix spike duplicates or other project-specific QC requested by the client are also reported. The results include

supporting information such as amount spiked, percent recovery or percent difference.

Methodology: Reference for analytical methodology used is cited.

Other Deliverables: Other deliverables available include disk deliverables, sample raw data packages, complete deliverable packages, and custom report formats.

11. INTERNAL QC CHECKS

The Enseco QA/QC program controls, monitors, and assesses data quality with internal QC checks. Internal QC checks are used to answer three questions:

1) Are laboratory operations "in control," (i.e., operating within acceptable QC guidelines), during data generation?

2) What effect does the sample matrix have on the data being generated?

3) What effect do field conditions have on the analytical results?

The first question is answered by Laboratory Performance QC. Laboratory performance QC is based on the use of a standard, control matrix to generate precision and accuracy data that are compared, on a daily basis, to control limits. This information, in conjunction with method blank data, is used to assess daily laboratory performance.

The second question is addressed with Matrix-Specific QC. Matrix-Specific QC is based on the use of an actual environmental sample for precision and accuracy determinations and commonly relies on the analysis of matrix spikes, matrix duplicates, and matrix spike duplicates. This information is used to assess the effect of the matrix on analytical data.

The third question is addressed with Field QC samples. These samples, including field blanks, trip blanks, equipment blanks, field duplicates, and field splits monitor the collection, transport and storage of environmental samples.

Laboratory Performance QC is provided as a standard part of every routine Enseco analysis. Matrix-Specific QC is available as an option to the client and should be specified based on the types of matrices to be analyzed and the Data Quality Objectives (DQOs) and regulatory requirements of the project. A complete discussion of these programs follows.

Laboratory Performance QC Program

Laboratory Performance QC is performed for every routine Enseco analysis to demonstrate that laboratory operations are "in control". The main elements of Laboratory Performance QC are:

- The analysis of Laboratory Control Samples, which include Duplicate Control Samples (DCS), Single Control Samples (SCS), and method blanks, and
- The use of calibration standards to assure that both qualitative identification and quantitative measurements are within control limits.

The Laboratory Control Sample program is discussed below. Please refer to Section 8 of this manual for a discussion of calibration procedures.

Laboratory Control Samples (LCS)

Laboratory Control Samples (LCS) are well-characterized, laboratory generated samples used to monitor the laboratory's day-to-day performance of routine analytical methods. Three types of LCS are routinely analyzed: Duplicate Control Samples (DCS), Single Control Samples (SCS), and method blanks. Certain LCS (DCS, SCS) are used to monitor the precision and accuracy of the analytical process, independent of matrix

effects. Other LCS (method blanks) are used to identify any background interference or contamination of the analytical system which may lead to the reporting of elevated concentration levels or false positive data. Each of these LCS are described below.

The results of the LCS are compared to well-defined laboratory acceptance criteria to determine whether the laboratory system is "in control." Controlling lab operations with LCS (as opposed to matrix spike/matrix spike duplicate samples), offers the advantage of being able to differentiate quality problems due to laboratory procedural errors from those due to matrix effects. As a result, procedural errors can be identified and corrected by the analyst at the bench, without waiting for extensive senior level review or costly and time-consuming reanalysis of the sample.

Duplicate Control Samples (DCS)

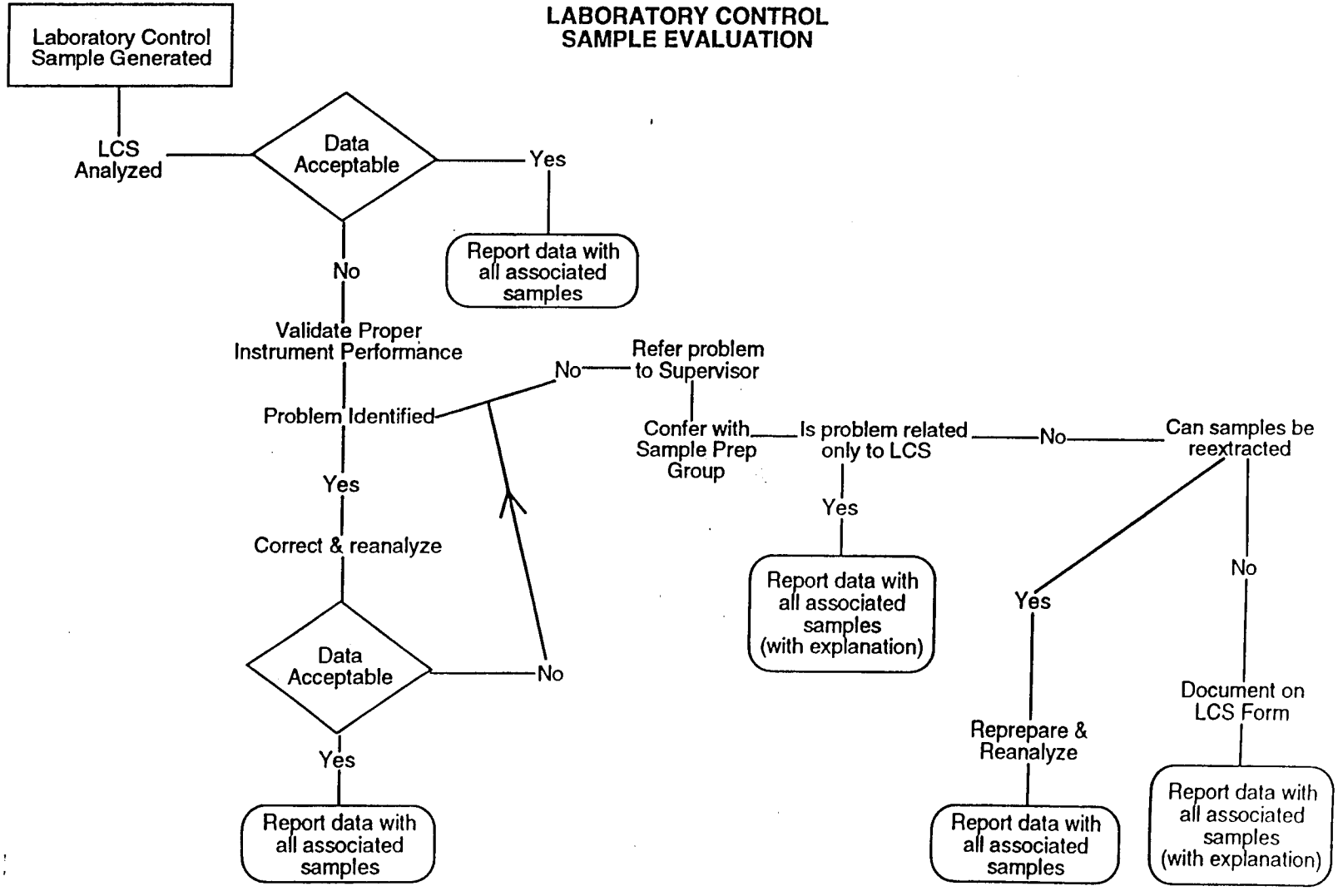
Duplicate Control Samples (DCS) are used to monitor the precision and accuracy of the analytical system on an on-going basis. Each DCS set consists of a standard, control matrix that is spiked with a group of target compounds representative of the method analytes. A DCS pair is analyzed for every 20 samples processed by the method. DCS are analyzed with environmental samples to provide evidence that the laboratory is performing the method within accepted QC guidelines for accuracy and precision.

Accuracy data (average recovery of each analyte in the DCS pair) and precision data (Relative Percent Difference [RPD] between each analyte in the DCS pair) are compared to control limits that have been established for each of the analytes contained in the DCS. Initially, control limits

for analytes spiked into the DCS are taken directly from the CLP program or published methods. If published limits are not available, either Enseco historical data are used to set the control limits or limits are estimated from method validation data. The control limits are recalculated periodically, as sufficient laboratory data become available. Control limits for accuracy for each analyte are based on the historical average recovery (mean of the average recoveries of the DCS pairs) plus or minus three standard deviation units. Control limits for precision for each analyte are based on the historical RPD. Acceptable RPDs range from zero (no difference between DCS results) to the average RPD plus three standard deviation units. Analytical data that are generated with a DCS pair which falls within the established control limits are judged to be in control. Data generated with a DCS pair which falls outside of the control limits are considered suspect and corrective action must be performed. The procedure used to evaluate data from control samples is given in Figure 11-1. The corrective action procedures include examination of instrument performance and preparation and analysis information, consultation with the supervisor, and finally a decision path for determining whether reanalysis is warranted.

DCS have been established for each routine analytical method. Reagent water is used as the control matrix for the analysis of aqueous samples and deionized water leachates of solids for wet chemistry parameters. The DCS compounds are spiked into reagent water and carried through the appropriate steps of the analysis. The control matrix for solids samples for organic analyses is typically standard Ottawa sand, an ASTM approved material for use in highway construction, due to its homogeneity. The DCS compounds are spiked into the Ottawa sand and carried through the appropriate steps of the analysis. For metal analyses, a spiked solid matrix from a commercial source is used. The DCS for some wet chemistry

FIGURE 11-1
LABORATORY CONTROL SAMPLE EVALUATION



parameters are obtained from a commercial source and used without dilution.

DCS precision and accuracy data are archived in the LIMS. In addition, the associated DCS data are reported with each set of sample results to enable the client to make a quality assessment of the data.

Single Control Samples (SCS)

As stated above, a DCS pair is analyzed with every 20 samples to measure the precision and accuracy of an analysis on an ongoing basis. However, samples are often analyzed in lots of less than 20, due to holding time or turn-around time requirements. Since it is necessary to have a measure of laboratory performance with each batch of samples processed, Enseco has instituted the SCS program.

An SCS consists of a control sample that is spiked with surrogate compounds appropriate to the method being used. In cases where no surrogate is available, (e.g., metals or wet chemistry) the analytes used for the DCS are spiked into the control sample. For some wet chemistry parameters, the SCS is obtained from a commercial source and used without dilution. An SCS is prepared for each sample lot for which the DCS pair are not analyzed. Recovery data generated from the SCS are compared to control limits that have been established for each of the compounds being monitored. Initially, CLP control limits or Enseco historical data are used to set the control limits. Control limits are recalculated periodically as sufficient SCS data are available. Control limits for SCS components are based on the historical average recovery in the SCS plus or minus three standard deviation units.

Analytical data that are generated with an SCS which falls within the control limits are judged to be in control. Data that are generated with an SCS which falls outside of acceptance criteria are considered suspect and corrective action must be performed. The protocols for evaluating SCS are identical to those established for DCS (see Figure 11-1). SCS recovery (accuracy) data are archived in the LIMS. In addition, the associated SCS data are reported with each set of sample results to enable the client to make a quality assessment of the data.

Method Blanks

Method blanks, also known as analytical, process or preparation blanks, are analyzed to assess the level of background interference or contamination which exists in the analytical system and which might lead to the reporting of elevated concentration levels or false positive data.

As part of the standard Enseco QC program, a method blank is analyzed with every batch of samples processed. A method blank consists of reagents specific to the method which are carried through every aspect of the procedure, including preparation, clean-up and analysis. The results of the method blank analysis are evaluated, in conjunction with other QC information, to determine the acceptability of the data generated for that batch of samples.

Ideally, the concentration of target analytes in the blank should be below the Reporting Limit for that analyte. In practice, however, some common laboratory solvents and metals are difficult to eliminate to the levels commonly reported in environmental analyses. Therefore, criteria for determining blank acceptability must be based on consideration of the analytical techniques used, analytes reported, and Reporting Limits required.

For organic analyses, the concentration of target analytes in the blank must be below the Reporting Limit for that analyte in order for the blank to be considered acceptable. An exception is made for common laboratory contaminants (methylene chloride, acetone, 2-butanone, and phthalate esters) which may be present in the blank at up to 5 times the Reporting Limit and still be considered acceptable. This policy has been established in recognition of the fact that these compounds are frequently found at low levels in method blanks due to the materials used in the collection, preparation, and analysis of samples for organic parameters.

For non-routine organic analyses, other components may be established as common contaminants for that particular analysis. For example, naphthalene is frequently found in PAH-SIM analyses. If, upon thorough review of the method during validation it is deemed impossible to eliminate trace amounts of analytes from the process, these analytes are likewise allowed at up to 5 times the reporting limit.

For metals and Wet Chemistry analyses, where the Reporting Limits are typically near the Instrument Detection Limit (IDL), the policy is that the concentration of the target analytes in the blank must be below two times the Reporting Limit. If the blank value for a target analyte lies below the Reporting Limit, the analyte is reported with no flag on the associated sample data. If the blank value lies between the Reporting Limit and two times the Reporting Limit, the analyte in the associated samples is flagged to indicate contamination was present in the blank. A blank containing an analyte(s) above two times the Reporting Limit is considered unacceptable unless the lowest concentration of the analyte in the associated samples is at least ten times the blank concentration or the concentration of the analyte in all samples associated with the blank is below the reporting limit.

In addition, for Wet Chemistry tests, the method SOP directs how the blank is treated. Generally, a reagent blank is used both to zero the equipment and as one of the calibration standards. If a preparation step is required for the analysis, then a preparation blank is also analyzed to determine the extent of contamination or background interference. Some methods require that the concentration of analyte found in this preparation blank be subtracted from the concentration of the analyte found in any associated sample prior to calculating the final result. Blanks have no application or significance for some Wet Chemistry parameters (e.g. pH).

If the blank for any test does not meet acceptance criteria, the source of contamination must be investigated and appropriate corrective action must be taken and documented. Investigation includes an evaluation of the data to determine the extent and effect of the contamination on the sample results. Corrective actions may include reanalysis of the blank, and/or repreparation and reanalysis of the blank and all associated samples. If a blank meets the criteria, but has analytes above the reporting limit, investigation should occur to determine whether any corrective action could eliminate an ongoing source of target analytes. Additional actions or explicit corrective action procedures detailed in protocols, methods or project-specific project plans must be followed when applicable.

For organic and metals analyses, and selected Wet Chemistry tests, method blank results are reported with each set of sample results. Sample results are <u>not</u> corrected for blank contamination unless required by the analytical method or requested by the client. Occasionally, due to limited sample volume or other constraints, the laboratory reports data associated with an unacceptable blank. In these cases, the actual

observed value (if any) is reported in the method blank. Sample results for any analyte(s) observed in the blank are flagged to indicate contamination was present in the associated method blank.

Matrix-Specific QC

Matrix-Specific QC is used to assess the effects of a sample matrix on the analytical data. The main elements of Matrix-Specific QC are:

- The analysis of matrix spikes, matrix duplicates, and matrix spike duplicates;
- Monitoring the recovery of surrogate compounds from environmental samples;
- Monitoring the results of standard additions in environmental samples; and
- The determination of method detection limits in a specific matrix.

Different regulatory programs have different requirements in terms of Matrix-Specific QC. At a minimum, the laboratories analyze matrix spikes, matrix spike duplicates or matrix duplicates at the frequency specified by the method, in order to meet the regulatory requirements of the method. These data are only reported when requested. These data are not used to control the laboratory. In order to ensure that the data generated meet all Data Quality Objectives, Enseco recommends that its clients request and include Matrix-Specific QC for their samples that fulfills the Data Quality Objectives and regulatory requirements of the project. A discussion of the different elements of Matrix-Specific QC follows.

Matrix Spikes, Matrix Duplicates, and Matrix Spike Duplicates

A Matrix Spike (MS) is an environmental sample to which known concentrations of representative target analytes have been added. The MS, in addition to an unspiked aliquot, is taken through the entire analytical procedure and the recovery of the analytes is calculated. Results are expressed as percent recovery. The MS is used to evaluate the effect of the sample matrix on the accuracy of the analysis.

A Matrix Duplicate (MD) is an environmental sample that is divided into two separate aliquots. The aliquots are processed separately and the results compared to determine the effects of the matrix on the precision of the analysis. Results are expressed as RPD.

A Matrix Spike Duplicate (MSD) is an environmental sample that is divided into two separate aliquots, each of which is spiked with known concentrations of analytes. The two spiked aliquots, in addition to an unspiked sample aliquot, are processed separately and the results compared to determine the effects of the matrix on the precision and accuracy of the analysis. Results are expressed as RPD and percent recovery.

Surrogate Recoveries

Surrogates are organic compounds which are similar to the analytes of interest in chemical behavior, but which are not normally found in environmental samples. Surrogates are added to samples to monitor the effect of the matrix on the accuracy of the analysis. Results are reported in terms of percent recovery.

Enseco routinely adds surrogates to samples requiring GC or GC/MS analysis and reports these surrogate recoveries to the client. The laboratory does not control its operations based on surrogate recoveries in environmental samples, however individual methods may dictate sample reanalyses based on surrogate criteria. When required by regulations, these method requirements supersede Enseco practices. As discussed earlier in this section, Enseco controls its analytical systems based on the results of Laboratory Control Samples. The surrogate recoveries are primarily used by the laboratory to assess matrix effects. However, obvious problems with sample preparation and analysis (e.g. evaporation to dryness, leaking septum, etc.) which can lead to poor surrogate spike recoveries must be ruled out prior to attributing low surrogate recoveries to matrix effects.

Field QC

Field QC are check samples that monitor contamination originating from the collection, transport or storage of environmental samples. These include trip blanks, equipment blanks and field blanks. A trip blank is a laboratory control matrix (typically water) which is sent to the field in an appropriate sample container, remains unopened in the field, and then is sent back to the laboratory. The purpose of the trip blank is to assess the impact of field and shipping conditions on the samples. An equipment blank is blank water that is poured through the sample collection device to check the adequacy of the cleaning procedures for the sampling equipment. The blank water used to generate the equipment blank may be provided by the laboratory. The results from field QC samples are reported to the client as samples in the same concentration units as the samples. Field blanks are samples of the same or similar matrix exposed to the sampling environment at the time of sampling. No

correction of the analytical data is done in the laboratory based on the analysis of field QC samples.

Matrix-Specific Detection Limits

Method Detection Limits (MDL's) determined on a specific sample matrix are called Matrix-Specific Detection Limits. See Section 14 for a discussion of detection and reporting limits.

12. PERFORMANCE AND SYSTEM AUDITS

Enseco laboratories participate in a variety of federal and state programs that subject each of the laboratories to stringent system and performance audits on a regular basis. A system audit is a review of laboratory operations conducted to verify that the laboratory has the necessary facilities, equipment, staff and procedures in place to generate acceptable data. A performance audit verifies the ability of the laboratory to correctly identify and quantitate compounds in blind check samples submitted by the auditing agency. The purpose of these audits is to identify those laboratories that are capable of generating scientifically sound data. The laboratories are approved or certified to perform environmental analyses under various programs (e.g., those administered by the U.S. Department of Energy, U.S. Air Force, U.S. Navy, and over 20 states). The most current list of certifications held by each laboratory is available upon request.

In addition to external audits conducted by certifying agencies or clients, Enseco regularly conducts the following internal audits:

- Data audits of randomly selected projects are reported. The frequency is determined by the error rate found. This is referred to as the QA data audit (see Figure 10-1). This audit includes verifying that holding times have been met, calibration checks are adequate, qualitative and quantitative results are correct, documentation is complete, and QC results are complete and accurate. Any problems identified require corrective actions.

- The facility QA Director conducts a system audit periodically. These audits may be coordinated at the regional level. Individual laboratory groups conduct semiannual self-audits of their systems. These system audits monitor the conformance of the laboratory to the QA program and include assessment of facilities, staff, SOPs, sample management, and general documentation procedures.

- The facility QA Director is responsible for conducting compliance audits of each laboratory group to assess compliance with specific contracts, SOPs, and other requirements. Each laboratory group shall be audited at least once per year.

- Periodic (at least yearly) audits conducted by the Corporate QA Office. These audits provide an independent review of the system for compliance with the QA program and assess resolution of previously identified problems.

- Special audits by the facility or Regional QA Director or Corporate QA Office when a problem is suspected.

Enseco laboratories also routinely analyze check samples as described below:

- Laboratory Control Samples (DCS, SCS, and method blanks) are analyzed at a frequency equal to at least 5% of the total number of samples analyzed (see Section 11).

- Enseco laboratories participate in the analyses of EPA check samples provided under the Water Supply (WS) and Water Pollution (WP) Performance Evaluation Studies. The results of these PE samples are tabulated by the Corporate QA Office to identify performance trends within the Enseco laboratories.

- The laboratories participate in multiple state certification programs which require that PE samples be analyzed periodically.

- Blind check samples from an independent commercial firm are sent to the laboratories periodically by the Corporate QA Office.

The results of these check samples are used to identify areas where additional training is needed or clarification of procedures is required. Corrective action reports are prepared to document the investigation of these results and corrective actions implemented to correct any deficiencies revealed by these programs.

In both the system and performance audit processes, the proper implementation of corrective actions must be assured to effect permanent solutions to problems detected.

13. PREVENTIVE MAINTENANCE

To minimize downtime and interruption of analytical work, preventive maintenance is routinely performed on each analytical instrument. Laboratory personnel are trained in routine maintenance procedures for most instrumentation. When repairs are necessary, they are performed by either trained staff or trained service engineers employed by the instrument manufacturer.

Each laboratory has SOPs on file that describe preventive maintenance procedures and schedules. The laboratories also maintain detailed logbooks documenting the preventive maintenance and repairs performed on each analytical instrument.

14. SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA QUALITY AND DETERMINE REPORTING LIMITS

Data Quality Assessment

The effectiveness of a QA program is measured by the quality of data generated by the laboratory. Data quality is judged in terms of its precision, accuracy, representativeness, completeness and comparability. These terms are described as follows:

Precision is the degree to which the measurement is reproducible. Precision can be assessed by replicate measurements of DCS, reference materials, or environmental samples. Enseco routinely monitors precision by comparing the RPD between DCS measurements with the upper control limit established at plus three standard deviations from the mean RPD of historical DCS data.

Precision is frequently determined by comparison of replicates. The standard deviation(s) of "n" measurements of "x" is commonly used to estimate precision and is calculated as follows:

$$s = \sqrt{\frac{1}{n-1} \sum_{i=1}^{n} (x_i - \bar{x})^2}$$

where a quantity "x" (e.g., a concentration) is measured "n" times.

The relative standard deviation, which expresses standard deviation as a percentage of the mean, is generally useful in the comparison of three or more replicates (although it may be applied in the case of n = 2).

$$RSD = 100\ (s/\bar{x})$$

where: RSD = relative standard deviation

s = standard deviation

$\bar{x}$ = mean

In the case of duplicates, the RPD between the two samples may be used to estimate precision.

$$RPD = \frac{|D_1 - D_2|}{(D_1 + D_2)/2} \times 100$$

where: RPD = relative percent difference

D_1 = first sample value

D_2 = second sample value (duplicate)

<u>Accuracy</u> is a determination of how close the measurement is to the true value. Accuracy can be assessed using LCS, standard reference materials, or spiked environmental samples. Unless specified otherwise in special contracts, Enseco monitors accuracy by comparing LCS results with control limits established at plus or minus three standard deviation units from the mean of historical LCS results.

The determination of the accuracy of a measurement requires a knowledge of the true or accepted value for the signal being measured. Accuracy may be calculated in terms of percent recovery as follows:

$$\text{Percent Recovery} = \frac{X}{T} \times 100$$

where: x = the observed value of measurement

T = "true" value

Representativeness is the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Analytical data should represent the sample analyzed. Enseco strives to accommodate all sample matrices. Some samples may require analysis of multiple phases to obtain representative results.

Completeness is a measure of the amount of valid data obtained from a measurement system compared with the amount that was expected to be obtained under normal conditions.

To be considered complete, the data set must contain all analytical results and data specified for the project. In addition, all data are compared to project requirements to ensure that specifications were met. Any deviations are reported in the report narrative.

The percent completeness for each set of samples can be calculated as follows:

$$\text{Completeness} = \frac{\text{valid data obtained}}{\text{total data planned}} \times 100\%$$

where valid data are determined by the data acceptance criteria defined in the project plan.

Comparability expresses the confidence with which one data set can be compared to another data set measuring the same property. Comparability is ensured through the use of established and approved analytical methods, consistency in the basis of analysis (wet weight, volume, etc.), consistency in reporting units (ppm, ppb, etc.), and analysis of standard reference materials.

Reporting Limits

Assuring the validity of quantitative measurements at low concentrations is an extremely difficult technical problem. With regulatory action levels being pushed lower and lower, the validity of any given measurement becomes even more important. The consequences of false positive or false negative data can be significant.

A number of terms have been used, by the EPA and other technical groups, to express the lowest concentration of an analyte which can be measured. Some of these terms, their definitions, and sources are listed in Table 14-1. A graphical representation of these terms is given in Figure 14-1.

Enseco has established a Reporting Limit (RL) for each analyte in each method. These Reporting Limits were established by collecting Method Detection Limit (MDL) data for organic and wet chemistry analyses and Instrument Detection Limit (IDL) data for metals analyses from each Enseco laboratory. The MDL data were collected using the procedures described in 40 CFR 136 Appendix B. IDL data were calculated using the procedures outlined in the EPA Contract Laboratory Program (CLP) Statement of Work dated 7/88. The MDL/IDL data were then compared to various limits published in EPA methods and in the regulations. For example for Volatile Organics, the MDL data generated in Enseco

laboratories were compared to the Practical Quantitation Limits (PQLs) published in SW-846 method 8240; the PQLs contained in the July 9, 1987, Federal Register Final Rulemaking on Appendix IX; the Contract Required Quantitation Limits (CRQLs) in the CLP Method for Volatile Organics; and the MDLs in Method 624. Then a Reporting Limit for each analyte was established which considered all of this information. The Reporting Limit was set at a level above which we were confident that our laboratories could detect and quantify the analyte consistently. Using this procedure, the Reporting Limits established are generally between 2 to 5 times the laboratory MDL or IDL. This range is consistent with the American Chemical Society definition for the Limit of Quantitation (LOQ). (See Table 14-1)

Enseco routinely reports results below the reporting limit as Not Detected (ND) because, by definition, the reliability of the data at that level is questionable. As an option, Enseco can report data below the reporting limit and flag the data as estimated. Reporting limits are adjusted for sample dilution.

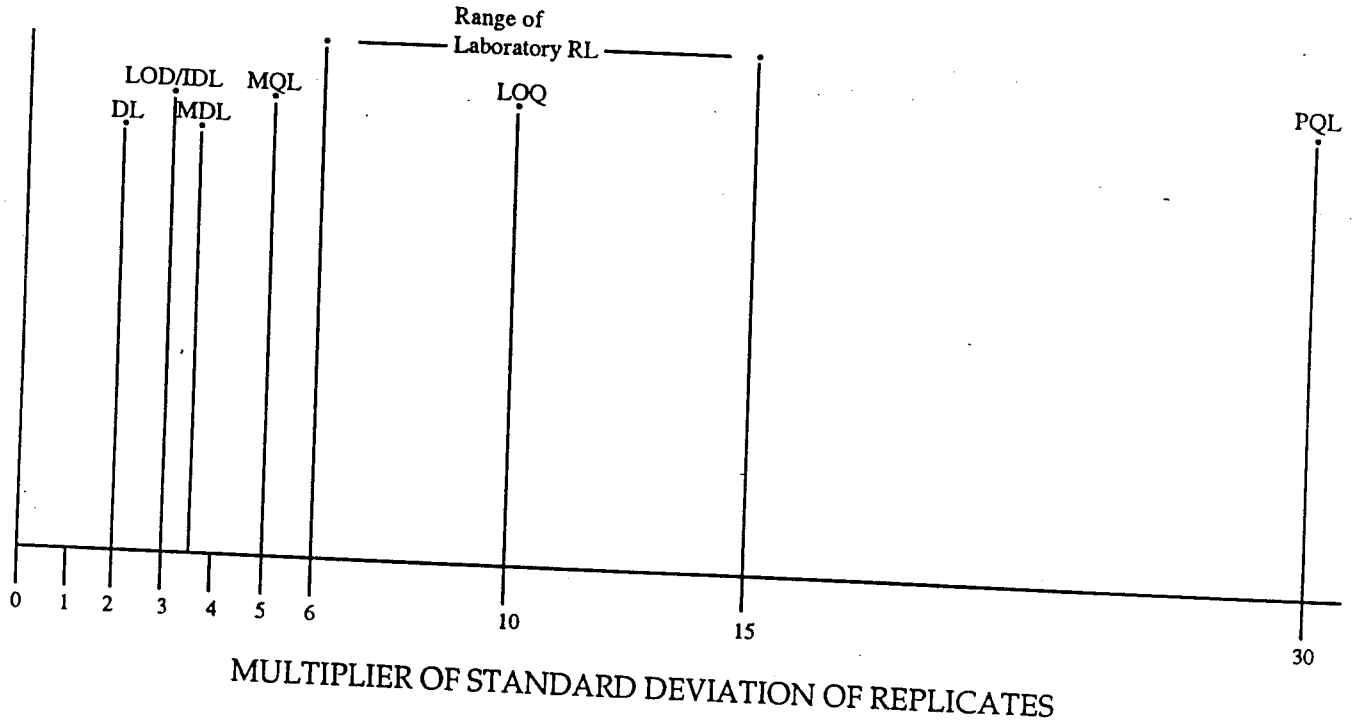
TABLE 14-1

DEFINITION OF DETECTION LIMIT TERMS

	DEFINITION	DETERMINATION	CALCULATION	SOURCE
Detection Limit (DL)	The concentration which is distinctly detectable above, but close to a blank.	Analysis of replicate standards	Two times the standard deviation	Methods for Chemical Analysis of Water and Wastes
Limit of Detection (LOD)	The lowest concentration that can be determined to be statistically different from a blank	Analysis of replicate samples	Three times the standard deviation	ACS Definition
Method Detection Limit (MDL)	The minimum concentration of a substance that can be identified, measured and reported with 99% confidence that the analyte concentration is greater than zero.	Analysis of a minimum of seven replicates spiked at 1 to 5 times the expected detection limit.	The standard deviation times the Student t-value at the desired confidence level. (For seven replicates, the value is 3.14)	40 CFR 136 Definition for EPA Water Programs
Instrument Detection Limit (IDL)	The smallest signal above background noise that an instrument can detect reliably.	Analysis of seven replicate standards on three non-consecutive days.	Three times the standard deviation	Contract Laboratory Program
Method Quantitation Limit (MQL)	The minimum concentration of a substance that can be measured and reported	Analysis of replicate samples	Five times the standard deviation	SW-846
Limit of Quantitation (LOQ)	The level above which quantitative results may be obtained with a specified degree of confidence	Analysis of replicate samples	Ten times the standard deviation	ACS Definition
Practical Quantitation Limit (PQL)	The lowest level that can be reliably determined within specified limits of precision and accuracy during routine laboratory operating conditions	Interlaboratory analysis of check samples	1) Ten times the MDL 2) Value where 80% of laboratories are within 20% of the true value	RCRA SDWA Program
Contract Required Detection Limit (CRDL)	Reporting limit specified for laboratories under contract to the EPA for Superfund activities	Unknown	Unknown	Contract Laboratory Program

FIGURE 14-1

Graphical Representation of Detection Limit Terms (See Table 14-1 for Definitions)



NOTE: The values along the horizontal "Standard Deviation (SD)" axis are approximate values and are meant to show the relative, not absolute, relationship between the terms.

15. CORRECTIVE ACTION

When errors, deficiencies, or out-of-control situations exist, the QA program provides systematic procedures, called "corrective actions," to resolve problems and restore proper functioning to the analytical system.

Laboratory personnel are alerted that corrective actions may be necessary if:

- QC data are outside the acceptable limits for precision and accuracy;
- Blanks contain contaminants above acceptable levels;
- Undesirable trends are detected in DCS and SCS recoveries or RPD between duplicates;
- There are unusual changes in detection limits;
- Deficiencies are detected during internal or external audits or from the results of performance evaluation samples; or
- Inquiries concerning data quality are received from clients.

Corrective action procedures are often handled at the bench level by the analyst, who reviews the preparation or extraction procedure for possible errors, checks the instrument calibration, spike and calibration mixes, instrument sensitivity, and so on. If the problem persists or cannot be identified, the matter is referred to the laboratory supervisor, manager and/or QA department for further investigation. Every effort must be made to determine the cause of the problem so that a permanent solution can be implemented. Once resolved, full documentation of the corrective action procedure is filed with the project records.

Investigations made by laboratory or QA personnel that result in corrective actions affecting more than one project must be documented and reported in the monthly QA report to management. Documentation of investigations of negative performance on PE samples and corrective actions taken is forwarded to the appropriate certifying agencies when required. These reports are always included in the monthly reports to management.

16. QA REPORTS TO MANAGEMENT

The reporting system is a valuable tool for measuring the overall effectiveness of the QA program. It serves as an instrument for evaluating the program design, identifying problems and trends, and planning for future needs. Facility QA Directors submit extensive monthly reports to the Regional QA Director who is responsible for submitting the regional report to the Vice President/General Manager and the Corporate QA office. These reports include:

- Results of site visits and audits by regulatory agencies and clients including the laboratory's response to deficiencies or action items required by the auditors;
- Results of internal audits including facility audits, contract compliance audits and periodic data audits;
- Performance evaluation sample results and corrective action reports;
- Summary of certification activity including new certifications applied for, certifications renewed and any actions taken by certifying agencies (suspensions, decertifications, probations or reinstatements);
- Discussion of specific client inquiries including summary of the issue, resolution, and correspondence between the client and the laboratory;
- Holding Time Violations, by facility and by department including narrative discussion of problem areas and corrective actions implemented;
- Performance on major contracts;
- Narrative including comments and recommendations on any pertinent issues.

The Corporate QA Director regularly reports on the status of the QA Program to each Vice President/General Manager, to the Director of Technology/Quality Assurance, and to the President and CEO. These reports summarize the information gathered through the laboratory reporting system and contain a thorough review and evaluation of laboratory operations throughout Enseco.

17. LABORATORY DOCUMENTATION

Complete and accurate documentation of analytical and procedural information is an important part of the QA program. The following describes different types of documentation used in the Enseco laboratories.

Standard Operating Procedures

Details of analytical and QC protocols are contained in Standard Operating Procedures (SOPs). SOPs are documents that contain detailed proprietary information on how to perform a laboratory procedure. Enseco has laboratory SOPs that describe:

- Performance of an Analytical Method;
- Preparation of Standards and Reagents;
- Equipment Operation, Calibration, and Maintenance; and
- General Laboratory Procedures.

Examples of the elements contained in these SOPs are given in Appendix II.

All SOPs are approved by the QA Department in concurrence with management, as documented by their signatures, before being implemented. The distribution of current SOPs and archiving of outdated ones is controlled through the QA Department.

Because of the detailed nature of SOPs, Enseco considers them to be proprietary documents. SOPs are available for review at each location.

LIMS

Enseco laboratories rely on a customized Laboratory Information Management System (LIMS) as the primary database. Client information, sample results, and QC results are all stored in the LIMS. Reports are generated directly from the database to eliminate transcription errors.

Laboratory Bench Sheets/Notebooks

Laboratory bench sheets or notebooks are used to document information from routine laboratory operations, including sample preparation and analysis. The information is recorded in a complete and organized manner such that the analysis can be reconstructed, if necessary. Portions of information from the bench sheet or notebook are also stored in the LIMS. Laboratory notebooks are also used to document information such as methods development information. Each bench sheet or notebook page is initialed and dated as information is entered.

Control Charts

Enseco laboratories use control charts to visually track precision and accuracy data. These control charts are used to identify trends in the analyses which may indicate a problem with the analytical procedure. When an adverse trend is detected, corrective action is performed.

Anomalies

Any situation which is outside of the normal scope of operations, as described in the laboratory SOPs, is documented. Examples of anomalous situations include: formation of a precipitate in an extract; formation of an emulsion during an extraction step; or missed holding times. These situations are documented to enable a thorough review of the data to occur. This documentation is maintained as part of the project record.

Out-of-Control situations are also documented. An Out-of-Control situation occurs when QC data fall outside of established control limits. At a minimum, the documentation associated with an Out-of-Control situation is reviewed by the supervisor. Out-of-Control situations trigger Corrective Action. Corrective Actions taken are also documented. The QA department must be notified when corrective actions affect more than an isolated occurrence of an event.

Project Files

The project file consists of a project summary file and a raw data file. The project summary file includes correspondence from the client,

(letters, phone logs, contracts, project plans) copies of preliminary and final reports, chain of custody, air bills, level 3 review checklists, QA review checklist when applicable and the summary file inventory. The raw data file includes sample data, QC data, benchsheets, level 1 and level 2 review checklists, instrument logbook pages pertinent to the project and the raw data file inventory. Contracts, project plans, calibration data and QC data may be stored separately from the project record. All project records must contain cross-references to any information stored separately from the project record. When a project is complete, all records are passed to the Document Custodian who inventories the file, checks for completeness, and puts the file into document archive.

Training Records

Employees participate in structured training which includes learning job skills; Environmental Health and Safety, First Aid and Hazard Communication training; quality training and other support skills (e.g. LIMS). Employee participation in and completion of company-sponsored or company-directed training programs must be documented.

APPENDIX I

MAXIMUM HOLDING TIMES AND SAMPLE COLLECTION/PRESERVATION INFORMATION

Sources:

Tables A-E
40 CFR Part 136
Methods for Chemical Analysis of Water and Wastes
SW-846, 3rd Edition, Update I
State of California Leaking Underground
Fuel Tank Field Manual, May 1988

Table F:
Contract Laboratory Program Statement of
Work for Organic Analysis dated 3/90 (as amended)
Contract Laboratory Program Statement of
Work for Inorganic Analysis dated 7/88

Table G:
Federal Register, June 29, 1990

A. VOLATILE ORGANICS

Matrix	Holding Time (From Date Sampled)	Container	Preservative	Minimum Sample Size
WATER SAMPLES				
No Residual Chlorine Present	14 days	3 40 mL vials with Teflon lined septum caps	HCl to pH<2, 4°C	40 mL
Residual Chlorine Present	14 days	3 40 mL vials with Teflon lined septum caps	4 drops of 10% sodium thiosulfate, HCl to pH<2, 4°C	40 mL
Acrolein and Acrylonitrile	14 days	3 40 mL vials with Teflon lined septum caps	Adjust to pH 4-5, 4°C	40 mL
SOIL/SEDIMENTS AND SLUDGES	14 days	Glass jar with Teflon liner or core tube	4°C	10 g
CONCENTRATED WASTE SAMPLES	14 days	Glass jar with Teflon liner or core tube	None	10 g

The above information applies to the following parameters and methods:

Parameter	Method
Volatile Halocarbons	601/8010 (GC)
Volatile Aromatics	602/8020 (GC)
Volatile Organics	624/8240/8260 (GC/MS), 8015 (GC)
Acrolein/Acrylonitrile	603/8030 (GC)

B. SEMIVOLATILE ORGANICS

Matrix	Holding Time (From Date Sampled)	Container	Preservative	Minimum Sample Size
WATER SAMPLES				
No Residual Chlorine Present	Samples must be extracted within 7 days and analyzed within 40 days of extraction.	1 liter glass with Teflon liner	4°C	1 liter
Residual Chlorine Present	Samples must be extracted within 7 days and analyzed within 40 days of extraction.	1 liter glass with Teflon liner	Add 3 mL 10% sodium thiosulfate per gallon, 4°C	1 liter
SOIL/SEDIMENTS AND SLUDGES	Samples must be extracted within 14 days and analyzed within 40 days of extraction.	Glass jar with Teflon liner or core tube	4°C	50 g
CONCENTRATED WASTE SAMPLES	Samples must be extracted within 14 days and analyzed within 40 days of extraction.	Glass jar with Teflon liner or core tube	None	50 g

The above information applies to the following parameters and methods:

Parameter	Method
Phenols	604/8040 (GC)
Phthalate Esters	606/8060 (GC)
Organochlorine Pesticides/PCBs	608/8080 (GC)
Polyaromatic Hydrocarbons	610/8310 (HPLC)
Organophosphate Pesticides	614/8140 (GC)
Phenoxy Acid Herbicides	615/8150 (GC)
Semivolatile Organics	625/8270 (GC/MS)
Carbamate & Urea Pesticides	632 (HPLC)

C. OTHER ORGANICS

Parameter	Method No.	Matrix	Holding Time[a] (from Date Sampled)	Container	Preservative	Min. Sample Size
Dioxins/Furans	8280	Water	30 days extn. 45 days anal.[b]	One liter glass	4°C	1000 ml
		Soil/Waste	30 days extn. 45 days anal.[b]	core tube or glass jar	4°C	50 g
Petroleum Hydrocarbons as Gasoline	TPH-Gasoline Purge & Trap (LUFT manual)	Water	14 days	3 40 mL vials with Teflon liners	4°C, HCl to pH < 2	40 mL
		Soil/Waste	14 days	Core tube or glass jar	4°C	50 g
Petroleum Hydrocarbons as Gasoline	TPH-Gasoline Extractable (LUFT manual)	Water	14 days extn. 40 days anal.	One liter glass	4°C, HCl to pH < 2	500 mL
		Soil/Waste	14 days extn. 40 days anal.	Core tube or glass jar	4°C	50 g
Petroleum Hydrocarbons as Diesel	TPH-Diesel Extractable (LUFT manual)	Water	14 days extn. 40 days anal.	One liter glass	4°C	500 mL
		Soil/Waste	14 days extn. 40 days anal.	Core tube or glass jar	4°C	50 g
Petroleum Hydrocarbons (TPH)	TPH-IR (418.1)	Water	28 days	One liter glass	4°C, H_2SO_4 to pH < 2	1000 mL

(a) extn: extraction anal: analysis
(b) from date of collection

D. METALS

Parameter	Method No.	Matrix	Holding Time (from Date Sampled to Analysis)	Container	Preservative(a)	Min. Sample Size
Metals (ICP)	200.7/6010	Water	6 months	Poly	HNO_3 to pH < 2.0	100 ml
		Soil/Waste	6 months	core tube/glass jar	4°C	10 g
Arsenic (GF-AA)	206.2/7060	Water	6 months	Poly	HNO_3 to pH < 2.0	100 ml
		Soil/Waste	6 months	core tube/glass jar	4°C	10 g
Mercury (CV-AA)	245.1/7470	Water	28 days	Poly	HNO_3 to pH < 2.0	100 ml
		Soil/Waste	28 days	core tube/glass jar	4°C	10 g
Selenium (GF-AA)	270.2/7740	Water	6 months	Poly	HNO_3 to pH < 2.0	100 ml
		Soil/Waste	6 months	core tube/glass jar	4°C	10 g
Thallium (GF-AA)	279.2/7841	Water	6 months	Poly	HNO_3 to pH < 2.0	100 ml
		Soil/Waste	6 months	core tube/glass jar	4°C	10 g
Lead (GF-AA)	239.2/7421	Water	6 months	Poly	HNO_3 to pH < 2.0	100 ml
		Soil/Waste	6 months	core tube/glass jar	4°C	10 g
Chromium (III/VI)	220.7/218.4/ 312B/7196	Water	24 hours	Poly	4°C	100 ml
		Soil/Waste	24 hours extn. (b)	core tube/glass jar	4°C	10 g

(a) Listed preservative is for total metals. Dissolved or suspended metals require filtration prior to pH adjustment.
(b) Holding time applies to extract obtained from leached sample.

E. WET CHEMISTRY

Parameter	Method No.	Matrix	Holding Time (from Date Sampled to Analysis)	Container	Preservative	Min. Sample Size
Acidity	305.1	Water	14 days	Poly	4°C	50 ml
Alkalinity	310.1	Water	14 days	Poly	4°C	50 ml
Ammonia	350.1	Water	28 days	Glass	4°C, H_2SO_4 to pH < 2	50 ml
Biochemical Oxygen Demand	405.1	Water	48 hours	Poly	4°C	200 ml
Bromide	300.0	Water	28 days	Poly	4°C	50 ml
Chemical Oxygen Demand	410.4	Water	28 days	Glass	4°C, H_2SO_4 to pH < 2	100 ml
Chloride	300.0	Water	28 days	Poly	4°C	50 ml
Chlorine, residual	330.1	Water	ASAP	Poly	4°C	100 ml
Coliform, Total & Fecal	909A/ 909C	Water	6 hours	Sterile poly	4°C, $Na_2S_2O_3$	100 ml

E. WET CHEMISTRY (Cont.)

Parameter	Method No.	Matrix	Holding Time (from Date Sampled)	Container	Preservative	Min. Sample Size
Color	110.2	Water	48 hours	Poly	4°C	100 ml
Cyanide	335.1/ 335.2/335.3	Water	14 days	Poly	4°C, NaOH to pH > 12 (a)	250 ml
Fluoride	340.2	Water	28 days	Poly	4°C	50 ml
Gross Alpha, Beta and Radium	9310/ 9315	Water	6 months	Poly	HNO_3 to pH < 2	2000 ml
Hardness	200.7/ 314A/314B	Water	6 months	Poly	HNO_3 to pH < 2	50 ml
Iodide	Dionex	Water	28 days	Poly	4°C	50 ml
Nitrate	353.2/300.0	Water	48 hours	Poly	4°C	50 ml
Nitrite	354.1	Water	48 hours	Poly	4°C	50 ml
Nitrite plus Nitrate	353.2	Water	28 days	Glass	4°C, H_2SO_4 to pH < 2	50 ml

E. WET CHEMISTRY (Cont.)

Parameter	Method No.	Matrix	Holding Time (from Date Sampled)	Container	Preservative	Min. Sample Size
Odor	140.1	Water	ASAP	Glass	4°C	1000 mL
Oil and Grease	413.1/ 413.2	Water	28 days	Glass	4°C, H_2SO_4 to pH < 2	1000 ml
Orthophosphate	365.3	Water	48 hours	Poly	4°C	100 ml
pH	150.1	Water	ASAP	Poly	4°C	50 ml
Phenolics	420.1/ 420.2	Water	28 days (b)	Glass	4°C, H_2SO_4 to pH < 2 (c)	100 ml
Specific Conductance	120.1	Water	28 days	Poly	4°C	50 ml
Sulfate	300.0	Water	28 days	Poly	4°C	50 ml
Sulfide	376.2	Water	7 days	Poly	4°C, NaOH to pH > 9 $Zn(C_2H_3O_3)_2$	100 ml
Sulfite	377.1	Water	ASAP	Poly	4°C	100 ml

E. WET CHEMISTRY (Cont.)

Parameter	Method No.	Matrix	Holding Time (from Date Sampled)	Container	Preservative	Min. Sample Size
Surfactants (MBAS)	425.1	Water	48 hours	Poly	4°C	100 ml
Total Dissolved Solids	160.1	Water	7 days	Poly	4°C	100 ml
Total Kjeldahl Nitrogen	351.2	Water	28 days	Glass	4°C, H_2SO_4 to pH < 2	100 ml
Total Organic Carbon (TOC)	415.1	Water	28 days	Glass	4°C, H_2SO_4 to pH < 2	100 ml
Total Organic Halogen (TOX)	9020	Water	28 days (d)	Glass	4°C, H_2SO_4 to pH < 2	200 ml
Total Phosphorus	365.3	Water	28 days	Glass	H_2SO_4 to pH < 2	100 ml
Total Solids	160.3	Water	7 days	Poly	4°C	100 ml
Total Suspended Solids	160.2	Water	7 days	Poly	4°C	100 ml

E. WET CHEMISTRY (Cont.)

Parameter	Method No.	Matrix	Holding Time (from Date Sampled)	Container	Preservative	Min. Sample Size
Total Volatile Solids	160.4	Water	7 days	Poly	4°C	100 ml
Turbidity	180.1	Water	48 hours	Poly	4°C	50 ml

a) Samples to be analyzed for cyanide should be field-tested for residual chlorine. If residual chlorine is detected, ascorbic acid should be added.

b) The 28 day holding time is specified in Table 1 of Methods for Chemical Analysis of Water and Wastes, issued March 1983. This information supercedes that contained in Method 420.1/420.2 published in 1979.

c) Samples to be analyzed for phenolics should be field-tested for residual chlorine. If residual chlorine is detected, ferrous ammonium sulfate should be added.

d) The 28 day holding time is specified in Table 2-20 of SW-846 3rd edition, Update I, 1987.

F. CLP HOLDING TIMES

Parameter	Matrix	Holding Time[a] (from Date Received)	Container	Preservative	Min. Sample Size
Volatile Organics	Water	10 days	3 40 mL vials with Teflon lined caps	4°C	40 mL
	Soil	10 days	Glass jar with Teflon liner or core tube	4°C	10 g
Extractable Organics	Water	5 days extn. 40 days anal.	1 liter glass with Teflon liner	4°C	1000 mL
	Soil	10 days extn. 40 days anal.	Glass jar with Teflon liner or core tube	4°C	50 g
Metals (other than Mercury)	Water	180 days	P,G [b]	HNO_3 to pH < 2	100 mL
	Soil	180 days	P,G	4°C	10 g
Mercury	Water	26 days	P,G	HNO_3 to pH < 2	100 mL
	Soil	26 days	P,G	4°C	10 g
Cyanide	Water	12 days	P,G	0.6 g ascorbic acid,[c] NaOH to pH >12, 4°C	100 mL
	Soil	12 days	P,G	4°C	10 g

(a) Holding times calculated from verified time of sample receipt (VTSR) at laboratory
(b) Polyethylene (P) or glass (G)
(c) Only used in the presence of residual chlorine

G. TCLP HOLDING TIMES

Parameter	Matrix	From: Field Collection To: TCLP Extraction	From: TCLP Extraction To: Analysis	Container	Preservative (1)	Min. Sample Size
Volatiles	Waste	14	14	Glass	4 degrees C	4 oz
Semivolatiles	Waste	14	(2)	Glass	4 degrees C	32 oz (3)
Mercury	Waste	28	28	Glass	4 degrees C	32 oz (3)
Metals (Except Mercury)	Waste	180	180	Glass	4 degrees C	32 oz (3)

(1) Preservative of incoming sample from field, unless refrigeration results in irreversible physical change to the sample. Refrigeration required for volatiles fraction.

(2) Two-tiered holding time: Must be prepared within 7 days of TCLP Extraction and must be analyzed within 40 days of analytical prep extraction.

(3) Smaller sample size is adequate for solid samples or individual fractions. A combined volume of 32 oz is recommended for semivolatiles and metals. A separate 4 oz container should always be used for the volatile fraction. Volatile fractions should be stored with minimal headspace.

APPENDIX II

STANDARD OPERATING PROCEDURES (SOP) ELEMENTS

ELEMENTS FOR SOP

LABORATORY, ANALYTICAL METHOD

Title (includes method number)

1. Scope and Application
   - 1.1 Analytes
   - 1.2 Detection limit (instrument and method)
   - 1.3 Applicable matrices
   - 1.4 Dynamic range
   - 1.5 Approximate analytical time (i.e., 5 minutes, 2 days)

2. Method Summary
   - 2.1 Generic description of method and chemistry behind it (i.e., extract with solvent, convert to methyl ester, analyze by electron-capture gas chromatography)

3. Comments
   - 3.1 Interferences
   - 3.2 Helpful hints

4. Safety Issues

5. Sample Collection, Preservation, Containers, and Holding Times

6. Apparatus

7. Reagents and Standards

8. Procedure (detailed step-by-step)
   - 8.1 Sample preparation
   - 8.2 Calibration
   - 8.3 Analysis

ELEMENTS FOR SOP

LABORATORY, ANALYTICAL METHOD

(continued)

9. QA/QC Requirements

   9.1 QC samples

   9.2 Acceptance criteria (precision and accuracy, % of multi-component QC analytes which must be within windows)

   9.3 Corrective action required (reference current QC manual)

10. Calculations

11. Reporting

   11.1 Reporting units

   11.2 Reporting limits

   11.3 Significant figures and reporting values below detection limit

   11.4 LIMS data entry

12. References

   12.1 Method source

   12.2 Deviations from source method and rationale

13. Appendices (optional)

   Additional information may be placed in appendices. This may include supporting data (e.g. method validation information), tables, flow charts, etc.

ELEMENTS FOR SOP

LABORATORY, STANDARDS AND REAGENTS

Title

1. Reagent/Standard Name

2. Type (reagent, calibration standard, DCS, SCS, stock solution, etc.)

3. Constituents/concentration/solvent

4. Safety Issues

5. Shelf Life

6. Procedure

   6.1 Preparation
   6.2 Documentation (purchase date, open date, labeling, etc.)
   6.3 Verification

7. Responsibilities

8. Appendices (optional) Any additional information.

ELEMENTS FOR SOP

LABORATORY, EQUIPMENT OPERATION, CALIBRATION, AND MAINTENANCE

Title

1. Purpose

2. Safety Issues (applicable to the specific equipment)

3. Procedure

   3.1 Initial start-up
   3.2 Calibration and performance documentation
   3.3 Example output
   3.4 Shut-down sequence
   3.5 Maintenance and maintenance records

4. Responsibilities

5. Comments

6. Definitions

7. Appendices (optional) Any additional information.

ELEMENTS FOR SOP

LABORATORY, PROCEDURAL

Title

1. Purpose
2. Policies
3. Safety Issues
4. Procedure
5. Responsibilities
6. Comments
7. Definitions
8. Appendices (optional) Any additional information.

APPENDIX D

RESUMES OF W-C KEY PERSONNEL FOR CANNON AFB

KENNETH H. NASS

geotechnical engineering
project management

EDUCATION

University of Minnesota: M.S., Civil Engineering, 1964
University of Minnesota: Bachelor of Civil Engineering, 1960

REGISTRATION

Professional Engineer, Nebraska, E-2624
Professional Engineer, Minnesota, #9487
Professional Engineer, South Dakota, #1889

PROFESSIONAL HISTORY

Woodward-Clyde, 1964 to present, Staff Engineer to Sr. Principal, Vice President, and Operating Unit Manager
University of Minnesota, 1963 to 1964, Research Assistant
Federal Aviation Agency, Western Region, 1960 to 1962, Field Engineer

REPRESENTATIVE EXPERIENCE

Mr. Nass currently manages the Omaha Operating Unit of Woodward-Clyde. He has over 28 years of experience directing and managing engineering and environmental projects in the greater Omaha metropolitan area.

Mr. Nass has managed five large indefinite-delivery contracts with the Omaha District U.S. Army Corps of Engineers. Under three of those contracts, projects completed included hazardous waste confirmation studies, remedial investigation/feasibility studies, asbestos investigations, detailed design of interim and final remedial actions, RCRA compliance studies, and groundwater investigations at both military installations and Superfund sites. These contracts have included environmental projects at Arnold Air Force Base (AFB), TN; Mountain Home AFB, ID; K.I. Sawyer AFB, MI; Dyess AFB, TX; Cannon AFB, NM; and Malmstrom AFB, MT. Hazardous waste confirmation studies have also been completed at over twenty NIKE and ATLAS Missile Base sites as well as three former Ordnance Plant sites. Numerous remediation design projects have also been completed for NPL and DOD sites, including Rocky Mountain Arsenal (RMA). Design projects completed at RMA, managed by Mr. Nass, include the interim action at Basin F, in-situ vitrification of the M-1 Basin, and vapor extraction of TCE from the Motor Pool site.

Mr. Nass also serves as the Responsible Professional for W-C's current environmental contract with Offutt AFB. Mr. Nass was instrumental in the development of the project scope and successful contract negotiations, which formed sound building blocks for this very important project.

Mr. Nass also has experience with the geotechnical aspects of civil engineering projects such as railroads, dams, highways, bridges, and pipelines. He managed a 4- to 5-year performance monitoring effort during construction of a new expressway in Omaha, Nebraska that included thick embankments on extensive soft clay deposits. Preliminary design started in 1977 and paving was finalized in 1989. Engineering aspects include internal drainage using wicks, staged construction and stabilizing berms. Other civil engineering projects include a new bridge over the Missouri River near Nebraska City, Nebraska, where foundations included mats on rock, friction caissons in rock, piles bearing on rock, and friction piles in sand. Pipeline experience includes major river crossing studies for the 42-inch gasline that extends from Monchy, Saskatchewan to Ventura, Iowa and investigation and remedial design of a major landslide along the pipeline route that occurred during construction. Dam experience includes managing the geotechnical studies for the earth dam constructed on Willow Creek near Pierce, Nebraska.

Mr. Nass has experience in the investigation, analysis, design, and construction of foundations for a broad range of structures ranging from small commercial buildings to high-rise office buildings. Mr. Nass has been the principal investigator on major structures in many cities in the United States. Projects include major expansions of medical facilities in Springfield, Massachusetts and Detroit, Michigan; and eight major prisons (2,250-bed units) in various cities in Texas. Mr. Nass has used most types of deep foundations for support of major structures in a wide variety of subsurface conditions.

AWARDS

Mr. Nass received the 1987 Woodward-Clyde Consultants Award for Sustained Excellence in Service to Clients

AFFILIATIONS

American Society of Civil Engineers
National Society for Professional Engineers
Nebraska Society of Professional Engineers
Omaha Engineers Club
Society of American Military Engineers

ROBERT C. KUHN

project management
environmental site remediation
industrial environmental management
railroad engineering
structural engineering/design
construction management
materials engineering
technical training - teaching

EDUCATION

University of Southern California: M.S., Civil Engineering, 1966
Iowa State University: B.S., Civil Engineering, 1962

REGISTRATION

Professional Engineer: California, Wyoming

PROFESSIONAL HISTORY

Woodward-Clyde, 1993 to present, Program Manager
Union Pacific Railroad Company, 1977 to 1993, Design Engineer to General Director Environmental Operations
Smith Emery Company, 1963 to 1977, Partner and Director of Engineering
City of Los Angeles, Department of Building and Safety, 1963 to 1968, Plan Check and Materials Research Engineer
Lockheed Aircraft Company, Spacecraft Division, 1962 to 1963, Stress Engineer
Leo A. Daly Company, 1958 to 1962, Surveyor and Draftsman

REPRESENTATIVE EXPERIENCE

Mr. Kuhn has more than 31 years experience in professional engineering. As a senior level project manager he has directed and managed complex, multi-million dollar environmental and engineering construction projects for major industries involving multidiscipline engineering, environmental, and construction teams. His focus has been on environmental management since 1984, and prior to that time his career was in construction management, structural engineering, and materials engineering. Mr. Kuhn has functioned as a department manager, project manager, engineering designer, structural inspector, environmental inspector, governmental regulatory agent, construction manager, teacher, and land surveyor.

- As General Director - Environmental Operations for one of the largest railroads in the United States, Mr. Kuhn directed the environmental management activities of a group of forty engineers and technicians, managing an annual environmental compliance budget of several tens of millions of dollars. He had direct project responsibility for several major environmental remediation projects, as well as general oversight responsibility for environmental compliance across a nineteen state transportation network. He has detailed knowledge of the full spectrum of environmental regulations that impact United States industries, and he is familiar with the processes of remedial

investigation and feasibility studies as required by EPA for sites contaminated with regulated chemicals.

- Hazardous waste management has been a significant activity for Mr. Kuhn in areas ranging from organizing compliance with hazardous waste generator regulations to responding to spills of hazardous materials at railroad accidents. He has been trained in accordance with OSHA requirements for Health and Safety for Hazardous Waste Operations and for Recognition of Hazardous Materials.

- Environmental site remediation, including investigation, remedial design, and remedial action field execution has been a significant part of Mr. Kuhn's experience. The largest project is a 365-acre creosote timber treating site with a 140-acre, 9.0-million-gallon plume of creosote pooled on the bedrock 15 feet below ground under the water surface. He directed a $35 million plus effort to characterize the site, contain the contaminants, and recover the free product for reuse. The project is nearing completion at this time.

- Emergency response is a significant aspect of railroad work. Mr. Kuhn dealt with structural emergencies for a major railroad for a period of several years as System Bridge Supervisor. This included a project to construct a 210-foot-long new bridge in a ten-day period following an accident which destroyed an existing bridge. He also dealt with emergencies related to hazardous materials spills. This involved coordination of contract responders while communicating with environmental and police and fire agencies at the scene.

- Structural engineering, including design, construction management, and materials quality control, represents a major part of Mr. Kuhn's experience. He has managed structural inspection and testing on numerous high-rise buildings in downtown Los Angeles, designed building structures, designed bridge structures, and managed field construction of railroad bridges across the western United States. Foundation design and construction for buildings and bridges has been a part of this work.

AWARDS

Mr. Kuhn was designated a "Soil and Water Conservation Steward" by the Governor of Nebraska in 1986 for his work in promoting and developing the use of "living snow fences" at rail facilities in Nebraska.

AFFILIATIONS

American Railway Engineering Association (AREA)
American Railway Bridge and Building Association
American Water Works Association (AWWA)
Society of American Military Engineers (SAME)
Air and Waste Management Association (AWMA)
Air and Waste Management Association

PUBLICATIONS

A list of publications is available upon request.

CURTIS J. CLOWE

project management
analytical chemistry
EPA Methods SW-846 and CLP
site assessment
underground tank closure
environmental and safety compliance

EDUCATION

Hastings College: B.A., Chemistry, 1984

REGISTRATION

Certified Underground Storage System Closer
Nebraska State Fire Marshal

HAZARDOUS WASTE TRAINING

W-C 40-Hour Hazardous Waste Operations Training, 1991
W-C 8-Hour Hazardous Waste Operations Supervisor Training, 1992
W-C 8-Hour Hazardous Waste Operations Refresher Training, 1992

PROFESSIONAL HISTORY

Woodward-Clyde Federal Services, 1993 to Present, Chemistry Section Manager
Woodward-Clyde Consultants, 1991 to 1993, Assistant Project Chemist
Environmental Safety Services, Inc. 1989 to 1991, Environmental Specialist II
Platte Chemical Co., 1987 to 1989, Manager Quality Control & Environment
SmithKline Animal Health Products, 1985 to 1987, Quality Control Chemist
A & L MidWest Agricultural Laboratory, 1984 to 1985, Analytical Chemist

REPRESENTATIVE EXPERIENCE

Mr. Clowe has over nine years of experience in the chemical and waste management field having either been responsible for or assisted in the management of environmental and safety compliance for a variety of industries including pharmaceutical, agrichemical, fertilizer, petroleum, feed and grain handling. Strengths include experience in performing and/or managing compliance audits, real estate site assessments, RCRA permitting, pollution prevention and waste management as well as knowledge in the areas of analytical instrumentation, methodology, quality assurance/quality control (QA/QC) and data management.

Since joining Woodward-Clyde, Mr. Clowe has been involved mostly in RCRA and CERCLA task management. His project activities have included:

- Prepared a Work Plan for the investigation of soils and sediments at a railroad yard and maintenance facility in Louisiana.

- Project QA/QC Coordinator for eight remedial investigations and three site inspections conducted at Offutt Air Force Base, Nebraska as part of the Air Force Installation Restoration Program (IRP) and RCRA Part B permitting. Activities included regulatory compliance, implementation of the Quality Assurance Project Plan, field QA/QC auditing of groundwater sampling activities, review/validation of the analytical data, laboratory coordination, and waste management.

- Project Database Manager for the RI/SI investigations at Offutt AFB. Activities included development of a relational database using standard Oracle® and ad hoc query/reporting using industry standard SQL query language.

- Project Chemist for the first year RCRA Groundwater Monitoring Program for Offutt AFB. Activities included regulatory compliance, laboratory coordination, data review, database management, field QA/QC auditing, and statistical evaluation/presentation of data.

- Project Chemist and Database Manager for a site assessment performed for a closed railroad yard and maintenance facility in Nebraska. Activities included development of the project database and ad hoc query/reporting using Microsoft® Excel, review/validation of the analytical data and report writing.

- Project Chemist for the Phase II Disposal Site Investigation, Crab Orchard National Wildlife Refuge, Illinois. Activities included review/validation of the analytical data and report writing.

- Project Chemist for the confirmatory sampling project at five missile sites in Nebraska and Colorado in support of work completed by the U.S. Army Corps of Engineers as part of the Defense Environmental Restoration Program (DERP). Activities included development of database, review/validation of the analytical data and report writing.

- Project Chemist for a RCRA Facility Investigation (RFI) and Groundwater Monitoring Program conducted at Dyess AFB, Texas. Responsibilities included laboratory coordination, preparation of the laboratory subcontract addendum, and preparation of a QAPP.

- Project Chemist for the remedial investigation conducted at the Former Nebraska Ordnance Plant, Mead, NE. Activities included field QA/QC auditing of groundwater sampling.

Prior to joining W-C, Mr. Clowe provided environmental and safety services to Farmland Industries and other clients located in Nebraska, Iowa, Minnesota, Colorado, Illinois,

Kansas, Indiana, South and North Dakota. Mr. Clowe has performed facility audits to determine state and federal EPA and OSHA regulatory compliance as well as inspected records and operational procedures as affected by up to 23 areas of regulation including OSHA General Industry and Longshoring Standards, RCRA, CERCLA, TSCA, FIFRA, CWA and EPCRA (SARA Title III). Mr. Clowe has experience in writing and reviewing Emergency Action Plans (EAP), Fire Prevention Plans (FPP), Hazard Communication Plans, Restricted Use Pesticide (RUP) Policies, Spill Prevention Control and Countermeasure Plans (SPCC), and Laboratory Chemical Hygiene Plans (LCHP).

In addition, Mr. Clowe has performed assessments of real property environmental and safety liabilities prior to transfer, merger and/or loan approval; performed facility investigations including evaluation of operating procedures and management practices for handling hazardous materials (i.e. ammonia) and hazardous waste (i.e. petroleum hydrocarbons, chlorinated solvents, plating compounds); performed site inspections to identify evidence of prior spills, leaks, and other signs of contamination in order to determine the need for sampling and analysis of soil or groundwater; performed sampling and analysis activities; prepared site histories through interviews with facility personnel, local residents, and local, state, and federal officials; and prepared reports describing investigation and detailing results of any sampling and analysis as well as all necessary contingency plans and waste generator reports required by the State.

Mr. Clowe has provided technical expertise on plant and laboratory operations for an agricultural chemical formulator operating on a 24-hour schedule and has established and maintained an ongoing large quantity generator environmental compliance program. He also established and maintained a quality control program to insure that all product shipments met specifications. As a part of the QC program, Mr. Clowe developed and/or formalized standard laboratory operating procedures including methodology as well as to implement/update data management protocols. As part of health and safety compliance, Mr. Clowe performed air and noise monitoring and biological (blood) monitoring of cholinesterase to monitor for exposure to organophosphate compounds.

AFFILIATIONS

American Industrial Hygiene Association (AIHA)
Nebraska Industrial Council on Environment (NICE)
American Chemical Society (ACS)

HONORS & AWARDS

- Appointed by Governor to the State Emergency Response Commission (SERC) as an chemical industry representative 1990-1993

- Served as Program Chairman for N.I.C.E, 1989-1990

- Served on ConAgra's Corporate Environmental and Safety Task Force, 1989
- Mr. Clowe was a corecipient of the IMPACT award which was given by SmithKline AHP in recognition of innovation and creativity, maximizing business results, productivity improvement, adapting to new challenges and opportunities, cost savings/revenue gain, and technical excellence, 1987.
- American Institute of Chemists Student Recognition and Research Foundation Outstanding Senior Award, 1984

PUBLICATIONS

Hines, Lance A., PhD., Steven E. Morrissette, Curtis J. Clowe, 1992. The Importance of Selecting Representative Samples in the Development of a Successful Treatability Study. Presented at the Eighth Annual Waste Testing and Quality Assurance Symposium sponsored by USEPA.

JOSEPH ALAN WATSON

remedial investigations(RI/FS)
RCRA facility investigations(RFI)
geologic investigations
hydrogeologic investigations
remediation alternatives
environmental site assessments
health and safety

EDUCATION

University of Nebraska at Omaha; B.S. Geology, December 1991
Research Assistant; U.N.O.'s Karakoram Expedition, Pakistan, 1984

HAZARDOUS WASTE TRAINING

Basic 40-Hour Health and Safety Training; Woodward-Clyde, 1987
Eight-Hour Waste Site Supervisor Training; Woodward-Clyde, 1990
Eight-Hour Advanced Level B Health and Safety Training; Woodward-Clyde, 1990
Radioactive Material Training, Nuclear Gauge Procedures; Troxler Electronics, Inc., 1987

PROFESSIONAL HISTORY

Woodward-Clyde, Omaha, Nebraska, 1987 to present, Engineering Technician to Assistant Project Manager

REPRESENTATIVE EXPERIENCE

Mr. Watson has over six years experience as a geologist on hazardous/toxic waste and geotechnical projects across the country. He has experience in various drilling methods; field classification and description of soil and rock; and field, map, and air photo geologic interpretation. In addition, Mr. Watson has represented Woodward-Clyde on construction projects. He has experience in the inspection of structural fill using various in situ testing methods, maintenance and monitoring of geotechnical instrumentation, laboratory testing procedures performed on undisturbed soil samples, and methods used to determine the physical properties of various structural fills. He also has experience in the inspection of the construction of straight-shaft piers and the installation of subsurface geotechnical instrumentation.

Mr. Watson's hazardous waste experience includes managing field activities on large CERCLA RI/FS projects, directing monitoring well installations, analytical sampling of various media, and completing health and safety monitoring for various projects. Mr. Watson's experience on hazardous waste projects is listed below:

REMEDIAL INVESTIGATIONS : RCRA FACILITY INVESTIGATIONS

- Site Manager for a Remedial Investigation (RI) at Offutt Air Force Base to define the soil and groundwater contamination. He was Site Health & Safety Officer and client representative during EPA oversight; provided QA/QC during the collection of soil and

groundwater samples; conducted groundwater sampling in EPA Level B personal protection; and performed air monitoring with a gas chromatograph during field operations.

- Site Health and Safety Officer for a large Remedial Investigation (RI) at a former munitions facility in Mead, Nebraska for the U.S. Army Corps of Engineers, Kansas City District. Responsibilities included the calibration and maintenance of all air monitoring equipment, maintaining inventory of health and safety supplies, and performing heat stress monitoring for all W-C employees and subcontractors.

- Site Manager and Health & Safety Officer for a large RCRA Facility Investigation (RFI) at Dyess Air Force Base for the U.S. Army Corps of Engineers, Omaha District. Responsibilities included the writing of the work plan for the quarterly groundwater sampling program; providing QA/QC during the collection of the groundwater samples; supervising the groundwater survey during the Nature and Extent investigation; and interfacing with the client and Air Force personnel.

- Site Manager and Site Health & Safety Officer for a Remedial Investigation (RI) to further define the soil and groundwater contamination at a former Naval Ammunition Depot in Hastings, Nebraska, for the U.S. Army Corps of Engineers, Kansas City District. Performed downhole geophysical logging of borings prior to well installation, and acted as client representative during EPA and NDEQ oversight, and during right-of-access meetings.

- Performed air sampling and health and safety monitoring during drilling operations of the RI/FS work at the Rocky Mountain Arsenal, Denver, Colorado, for the U.S. Army Corps of Engineers, Omaha District. Work was performed in Level B personal protective equipment.

- Site Health and Safety Officer and Field Manager for a detailed site assessment, including installation of VES wells and probes for remediation of TCE contamination of soil and groundwater in southwest Nebraska.

- Developed and reviewed Health and Safety Plans for large-scale Remedial Investigation/Feasibility Studies and small-scale Environmental Site Assessments.

- Conducted training classes for compliance with 29 CFR 1910.120.

- Determined well screen placement and installed PVC and stainless-steel monitoring wells using geophysical and video logs at depths down to 450 feet; directed a four-rig well development team and acted as interim Site Supervisor and Health & Safety Officer at a Class I toxic waste repository in central California.

- Directed the installation of a 400-foot deep, 12-inch extraction well; and collected data during a detailed aquifer test for a copper mine in New Mexico.

- Installed shallow and deep monitoring wells for the investigation of groundwater contamination at a World War II munitions plant in Hastings, Nebraska, for the U.S. Army Corps of Engineers.

GEOLOGIC/HYDROGEOLOGIC INVESTIGATIONS

- Evaluated the site hydrogeology of an area proposed for a municipal solid-waste landfill in Sarpy County, Nebraska.

REMEDIATION ALTERNATIVES

- Inspected the construction of a one-acre Land Treatment Demonstration Unit (LTDU), provided QA/QC during the installation of 40,000 square feet of HDPE liner and the installation of two background monitoring wells at a Superfund Site for a client in northwest Montana. This project was awarded a "No Migration" variance by the EPA.

- Inspected the construction of a clay-lined test landfill with 3:1 slopes and installed a Sealed Double Ring Infiltrometer for permitting of the closure of a natural gas refinery plant in west Texas.

- Inspected and provided QA/QC during the construction of a RCRA clay cap to close a drum landfill at a chemical plant near Cleveland, Ohio.

ENVIRONMENTAL SITE ASSESSMENTS

- Participated in a detailed site assessment for hydrocarbon contamination of groundwater at various sites for the Omaha Public Schools and for the Nebraska Military Department at Camp Ashland, Nebraska.

- Conducted air monitoring and collected soil and water samples during an investigation of surface and groundwater contamination at a sulfuric acid plant for an explosives manufacturer in Missouri.

AFFILIATIONS

American Industrial Hygiene Association
Nebraska Geological Society
Geological Society of America
Association of Groundwater Scientists and Engineers

BRIAN J. RUBY

field geology
site management
project scheduling
resource allocation
site investigations

EDUCATION

University of Denver: M.B.A., 1988
Fort Lewis College: B.S., Geology, 1979

PROFESSIONAL TRAINING

OSHA 40-Hour Training
OSHA Supervisor Training
Woodward-Clyde Level B Training
Rocky Flats Plant Radiation Training
Rocky Flats Plant General Employee Training

PROFESSIONAL HISTORY

Woodward-Clyde Federal Services, Senior Staff Scientist, 1991 - present
Echo Bay Mines, Ltd., Planning Analyst, Denver, 1989 - 1990
Manti-LaSal National Forest, Physical Science Technician, Price, 1985
Freeport Exploration Co., Associate Geologist, Lakewood, 1982 - 1984
Noranda Exploration Co., Assistant Geologist, Lakewood, 1981
Houston International Minerals Corp., Geologist, Denver, 1980-1981
Fort Lewis College, Geology Instructor, Durango, 1980
Geoexplorers International, Field Geologist, Denver, Summer, 1979
Houston Oil & Minerals Corp., Geologic Field Assistant, Central Nevada, Summer, 1978

REPRESENTATIVE EXPERIENCE

Since joining WCFS, Mr. Ruby has provided support and assistance for projects covering several aspects of the environmental and hazardous materials industry. Activities have ranged from operational audits to field data collection and site management.

Assignments in the last year include assisting in the Operational Startup Review (OSUR) audit for the TRUPAC loading operation at the Rocky Flats Plant; costing, planning and scheduling of various proposals and awarded Task Orders at the Rocky Mountain Arsenal; managing field crews in the collection of samples; and site management of a multi-faceted field effort at the Rocky Mountain Arsenal Superfund site. His geologic interpretation and field operations skills were employed in the office and the field in the preparation of and implementation of field efforts.

Resource planning and scheduling tasks utilizing Viewpoint planning software were performed on the following projects at the Rocky Mountain Arsenal (RMA):

- Task Order 10, Sand Creek Lateral Interim Remedial Action (IRA)

- Task Order 11, South Plants Ditches IRA
- Task Order 3, Phase III, FS Data Collection

Mr. Ruby was the sole responsible field geologist at RMA in support of the respective drilling and sampling tasks for:

- Task Order 3, Phase II, FS Data Collection
- Task Order 9, CERCLA Waste Facility IRA
- Task Order 10, Sand Creek Lateral IRA
- Task Order 11, South Plants Ditches IRA

Work performed consisted of collecting and logging soil samples obtained by hand and mechanical implements, field crew management, decontamination activities and waste management. Mr. Ruby is a seasoned rig geologist with experience in drilling and logging both soils and rock with auger, rotary, reverse circulation and diamond core technology. His soil drilling expertise includes the use of lined split spoon samplers in continuous core augers and geotechnical sampling with lined california tube samplers and Shelby tubes. A backhoe was employed to gather discrete and bulk samples during trenching operations, while hand-driven core samplers and scoops were used in sampling shallow material.

Mr. Ruby has also participated in field activities as a technician in health and safety, decontamination, and waste management. He has assisted in the staking and geophysical clearing of proposed sampling sites and in geophysical surveying to determine optimum drill site locations.

Mr. Ruby has completed the Woodward-Clyde Level B Training course and has worked extensively in both protection levels B and C during drilling and sampling activities within the most contaminated areas of the RMA, including the North and South Plants Study Areas, Section 36 and the former Basin F.

Most recently, Mr. Ruby was assigned as site manager for WCFS activities at RMA, where he was responsible for managing up to 25 employees and subcontractors in the execution of the following projects:

- Task Order 11, South Plants Ditches IRA - Lake sediment sampling and bathymetric survey, ditch and windblown sediment sampling, stormwater runoff sampling and field permeability testing.

- Task Order 3, Phase III FS Data Collection - Soil drilling, surficial soil sampling and collection of bulk samples during trenching operations.

- Task Order 5, Non-future Use Structures Sampling - Surveying and sampling of contaminated and non-contaminated structures to evaluate remediation and disposal alternatives.

Mr. Ruby was selected for a Woodward-Clyde Federal Services Outstanding Employee Award for his oversight of these field activities during his tenure as site manager.

Currently assigned to the DOE Rocky Flats Plant, Mr. Ruby is working as a rig geologist on the Operable Unit 6 RFI/RI Phase I and will also act as stratigrapher for the detailed logging of drill cores generated during this field effort.

Prior to entering the hazardous waste industry, Mr. Ruby acquired six years of professional experience performing geologic and administrative duties primarily in the mining industry. With broad field experience in geologic mapping, sampling, and drilling, Mr. Ruby has proven abilities in program design and implementation, team supervision and management, and project support. He has additional experience in higher education, employee training, federal permit compliance, and financial planning and forecasting. His education in Hazardous Materials Technology provides background in site investigations and environmental laws and policies. Specific job responsibilities in the past have included:

- Consolidation of actual and projected operating statistics to produce a monthly earnings forecast for a company with sales of $350 million;

- Modification of computerized financial forecasting models to enhance accuracy and provide additional data to management;

- Research, design and implementation of grassroots reconnaissance programs investigating and assessing significant gold occurrences in Idaho, Montana and Oregon. Detailed geologic mapping with aerial photos and field reconnaissance with attendant drill evaluation of acquired prospects. Supervision of heavy equipment and drilling contractors during project evaluation;

- Geologic mapping, sampling, drill core logging and mine crew supervision for an underground, test mining project; and

- Field verification of operator's compliance with U.S. Forest Service Special Use Permit stipulations covering energy activities on the national forest and bond release inspections for reclamation projects resulting from these operations.

JOHN S. STANSBURY, Ph.D.

risk assessment
ecological evaluation
water resources engineering
environmental engineering

EDUCATION

University of Nebraska-Lincoln: Ph. D., Engineering, 1991
University of Nebraska-Lincoln: M. S., Environmental Engineering, 1989
Kearney State College, Kearney NE: B. S., Biology, 1972

HAZARDOUS WASTE TRAINING

W-C 40-Hour Hazardous Waste Operations Training, 1991
W-C 8-Hour Hazardous Waste Operations Supervisor Training, 1992

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, 1991 to present, Assistant Project Engineer
University of Nebraska-Lincoln, 1989 to 1991, Research Engineer
Waverly Public Schools, 1977 to 1987, Science Teacher
Murdock Public Schools, 1974 to 1977, Science Teacher

REPRESENTATIVE EXPERIENCE

Dr. Stansbury has professional experience in water resources engineering including water transfer studies for conjunctive groundwater - surface water systems. He has experience with groundwater modeling, geographic information systems (GIS), and multi-criteria decision making (MCDM) methods. He has developed a MCDM method for selecting dredged material disposal alternatives based on human risks, ecological impacts, and costs. He has developed innovative methods for evaluation of uncertainty in risk assessment and dose-response assessment. Project experience includes evaluation of leaking underground storage tanks, RI/FS baseline risk assessment, RCRA interim corrective action planning and design.

SPECIFIC PROJECT EXPERIENCE

- Conducted water transfer study in south-central Nebraska which considered ecological and socio-economic impacts for a conjunctive groundwater - surface water system. GIS was used to map and evaluate impacts of transfers, and MCDM methods were used to compare transfer alternatives.

- Developed procedure to evaluate and select dredged material disposal technologies for U.S. Army Corps of Engineers. Alternative evaluations were based on human health risks, ecological impacts (e.g., toxicity, habitat disruption), and costs. MCDM methods were used to compare alternative technologies. Numerous meetings were held with Corps and State environmental officials in the

state of Washington and with Institute of Water Resources (Corps) personnel in Washington, D.C.

- Developed innovative methodology for incorporating and evaluating uncertainties in risk assessments and risk analyses (e.g., risk-cost trade-off analyses).

- Developed innovative methodology to incorporate uncertainties into dose-response assessments for use in risk assessments.

- Completed an RI/FS (CERCLA) baseline risk assessment for Offutt Air Force Base with several RI sites.

- Evaluated human health risks and environmental risks from underground storage tank spill sites at Offutt Air Force Base, Nebraska, and Papillion Creek. Used risk evaluation to select appropriate and cost-effective remedial actions.

- Developed interim corrective action plan under RCRA to remove floating fuel from groundwater at a POL site on Offutt Air Force Base (included assessment of risks in sanitary sewer and inhalation risks at site).

- Developed risk-based soil cleanup levels for contaminated soil at a landfill at Offutt Air Force Base.

- Produced "No Action" documents for ten RI sites at Offutt AFB.

- Developed and used statistical methodology for comparing site-related soil contamination concentrations with background concentrations. Methodology was to limit number of chemicals of concern at Offutt AFB SWMUs.

- Conducted qualitative risk assessment at Lincoln AFB missile site. The risk assessment included potential exposures to soils, air, surface water, and groundwater.

- Performed quantitative risk assessment for a landfill at Mountain Home AFB. The risk assessment included potential exposures to soils, air, and groundwater.

- Developed modeling/evaluation procedure for assessing potential of groundwater contamination in a deep aquifer at Mountain Home Air Force Base, Idaho.

- Managed development and production of project work plans for 14 RFI sites at Dyess AFB.

- Assessed human health risks and environmental risks at commercial hazardous waste disposal site in Ohio.

AFFILIATIONS

American Society of Civil Engineers
Water Pollution Control Federation
Chi Epsilon (Civil Engineering Honorary Society)
Sigma Xi (Honorary for Practicing Scientists)

PUBLICATIONS

A list of publications is available upon request.

LANCE A. HINES, Ph.D.

environmental chemistry
analytical chemistry
quality assurance
treatability and remedial design
project management
peer review

EDUCATION

University of Nebraska, Ph.D. Chemistry, 1987
University of Nebraska, M.A. Microbiology, 1978
University of Nebraska, B.S. and B.A. Biology, 1975

HAZARDOUS WASTE TRAINING

40-Hour Personnel Protection and Safety Training, 1987
Superfund Overview, 1987
Environmental Analytical Chemistry, 1987
Data Quality Objectives, 1987
Environmental Risk Assessment, 1988 and 1990
Field Screening Methods for Hazardous Waste Site Investigations, 1988
Sampling for Hazardous Materials, 1989
Portable Gas Chromatography, 1989
RCRA Corrective Action Workshop, 1989 and 1992
W-C Hazardous Waste Operations Supervisor Training, 1991

PROFESSIONAL HISTORY

Woodward-Clyde, Senior Project Manager 1992-present
Woodward-Clyde Consultants, Chemistry Section Manager, 1990-1992
US Army Corps of Engineers, Senior Chemist, 1986-1990
Eppley Cancer Institute, Research Associate, 1982-1986
Eppley Cancer Institute, Research Chemist, 1977-1982
University of Nebraska, Teaching Assistant, 1975-1977

REPRESENTATIVE EXPERIENCE

Dr. Hines has over 18 years experience in the chemical and hazardous waste management field. This experience includes numerous multidisciplinary studies involving the mechanisms of chemical carcinogenesis, site assessment, remedial investigation, feasibility studies, remedial design and remedial action for sites in over 30 states and 9 EPA regions with contaminated groundwater, soils, lagoons, tanks, drums, and debris. He has also provided technical guidance, review and consulting for the US Army, the US

Air Force, the USEPA, and industrial clients on local, state and federal lead projects. Dr. Hines has been involved with the development of methods for ASTM and EPA SW-846 concerning the generation and quality assurance of environmental data, data quality objectives, and data assessment. Specific assignments and project involvement are described below:

GENERAL

- Manage the chemistry and geochemistry section for the W-C Omaha Operations.
- Provide general technical support involving chemistry and quality assurance issues for remedial investigations and design.
- Develop Standard Operating Procedures used in the generation and management of environmental data.
- Coordinate data management activities including data validation and review.
- Serve as QA/QC Officer for remedial site investigations.
- Perform onsite QA audits for soil and groundwater and waste sampling.
- Prepare and implement Quality Assurance Project Plans (QAPPs) and assist project managers with the Data Quality Objectives (DQOs) development process.
- Peer review project documents for various deliverables nationwide.
- Manage remedial investigative (CERCLA and RCRA lead) and design projects.

AIR QUALITY

- Developed plan to investigate the release of polychlorinated dibenzodioxins and dibenzofurans into the ventilation system as the result of intense electrical discharges and fire in PCB-containing capacitors and other RADAR equipment
- Performed emergency response study to determine individual constituents and potential control measures for the off-gassing of sludges contaminated with chemical warfare agents and degradation products at Rocky Mountain Arsenal, Denver, Colorado.
- Assisted in the development of methodology for the field analysis of dimethyl mercury in the air at the Nyanza Superfund Site in Ashland, Massachusetts.

GROUNDWATER STUDIES AND DESIGN

- Assisted in the development of plans and oversight of the groundwater investigation and continued monitoring at Hamilton Army Air Station in Marin County, California.

- Conducted RCRA groundwater detection monitoring at Holloman AFB, New Mexico and provided review of analytical reports.

- Assisted in the development of the quarterly groundwater monitoring plan for Offutt Air Force Base, Nebraska

- Task leader for quality assurance and data management of a site assessment and groundwater study and design of a fuel recovery system for a confidential client in San Antonio, Texas.

- Provided technical guidance in the post-closure groundwater monitoring requirements for the New Lyme Superfund Site, Ashtabula County, Ohio.

- Assisted in the preparation of plans and provided technical assistance in the development of the groundwater treatment system design for the Bartolo Well Field, San Gabriel, California.

LANDFILLS

- Provided technical guidance and review of the remedial design and post-closure monitoring requirements for the New Lyme Superfund Site, Ashtabula County, Ohio.

- Provided technical guidance and quality assurance requirements for the operation and maintenance of Operating Industries Superfund Site, a large landfill located at Monterrey Park, California just east of Los Angeles.

- Provided technical assistance and quality assurance oversight in the investigation of various landfills at US Air Force Bases in California, Nevada, Idaho, Arizona, New Mexico, South Dakota, Nebraska as well as US Army facilities in California and Pennsylvania.

RCRA STUDIES AND DESIGN

- Evaluated and assisted in the integration of RCRA requirements into the USAF Installation Restoration Program which is Superfund-based. The evaluation

included review of Superfund guidance versus RCRA guidance concerning "Sites" versus "SWMU's" and involved negotiations with various State and Federal RCRA officials.

- Provided technical assistance and review of RCRA groundwater monitoring program for sites in New Mexico, Ohio, Nebraska, California, Virginia, Nevada, Idaho, and Arizona.

- Conducted and managed project completing a RCRA Facility Assessment for Solid Waste Management Units (SWMUs) in southern Florida associated with the extensive Hurricane Andrew damage.

- Currently managing projects involving Confirmation Studies and RCRA Facility Investigations in southern Florida.

REMEDIAL INVESTIGATIONS/FEASIBILITY STUDIES

- Task leader and Quality Assurance Officer including the development of Quality Assurance Project Plans (QAPPs) for various RI/FS including Offutt Air Force Base, Nebraska, KI Sawyer Air Force Base, Michigan, Omaha Shops of the Union Pacific Railroad.

- Assisted in the development, review, and oversight of multisite investigative activities under the Federal Installation Restoration Program for Edwards AFB, California; Ellsworth AFB, South Dakota; Fort Ord, California; Hamilton AFB, California; Luke AFB, Arizona; Mountain Home AFB, Idaho; Nellis AFB, Nevada; Holloman AFB, New Mexico; Grenier Military Airfield, New Hampshire, and Offutt AFB, Nebraska.

- Assisted in the development and oversight of investigative activities concerning contamination by PCBs, polychlorinated dibenzodioxins and dibenzofurans of a Space Command (NORAD) facility, Cavalier, Air Force Station, North Dakota.

- Assisted in the development of work plans for the investigation of soils and groundwater contaminated with trinitrotoluene at Tidewater, Virginia.

- Task leader for quality assurance and data management of a site assessment for a confidential client in Fort Worth, Texas.

REMEDIAL DESIGN

- Assisted in the development, review, and oversight of the remedial design for the stabilization of organic and acid sludges at Bruin Lagoon Superfund Site, Butler County, Pennsylvania.

- Task leader for the development, review, and oversight of predesign investigative activities and design of the removal of chemical lagoons, tanks, drums, buildings and debris at the Drake Chemical Superfund Site, Lock Haven, Pennsylvania.

- Provided technical guidance and review of remediation by on-site incineration of soils contaminated with trinitrotoluene (TNT) and other explosive compounds at the Cornhusker Army Ammunition Plant, Grand Island, Nebraska.

- Provided technical guidance and review of design activities for contaminated soils and groundwater by organics and metals, particularly mercury at the Nyanza Chemical Superfund Site, Ashland, Massachusetts.

- Task leader for the development of plans and establishment of a field laboratory and conducted rapid response action for the investigation and removal of the contents of 250 drums at England Air Force Base, Louisiana. This action involved the staging, opening, and hazard characterization of drums for the purposes of bulking, testing, and removing.

- Provided technical assistance and document review for the USEPA for remediation of heavy organic product contamination of soils and groundwater at the Ninth Avenue Dump Superfund Site, Gary, Indiana.

- Provided technical guidance and review of organic vapor extraction system for halogenated organic contaminated soils beneath a treatment lagoon at Letterkenney Army Depot, Chambersburg, Pennsylvania.

- Assisted in the development and oversight of predesign studies for the remediation involving the soil vapor extraction and groundwater treatment of a trichloroethene contaminated landfill at Newcumberland Army Depot, Newcumberland, Pennsylvania.

TREATABILITY STUDIES

- Project manage and direct stabilization/solidification treatability study for lead contaminated soils at C & R Battery Company, Inc. Superfund Site, Richmond, Virginia in support of the selected remedial design.

- Technical guidance and review of predesign and treatability studies concerning lead contaminated soils at the Arcanum Iron and Metal Superfund battery reclaiming site, Arcanum, Ohio.

- Assisted in the development, review, and oversight of predesign and treatability studies of organic and acid sludges at Bruin Lagoon Superfund Site, Butler County, Pennsylvania.

REGULATORY AGENCY INVOLVEMENT

- Technical assistance to USAF Tactical Air Command (TAC) Headquarters, Langley AFB, Virginia and the US Army concerning Federal Facility Agreements in Arizona, California, and New Mexico with the USEPA and respective State agencies.

- Involved in investigative and remedial planning and negotiations with USEPA officials in regions I, III, IV, V, VI, VII, VIII, IX, and X as well as State officials including California, Nevada, Idaho, Arizona, Colorado, New Mexico, Nebraska, Texas, Wisconsin, Indiana, Ohio, Massachusetts, Pennsylvania, Virginia, and Florida.

EXPERT WITNESS TESTIMONY

- Provided technical assistance in preparation of trial briefs and expert witness testimony for private law firm involving exposure of workers to hazardous constituents.

- Provided technical assistance in trial preparation, deposition, and expert witness testimony for US Army Corps of Engineers, Baltimore District, Office of Counsel involving a claim against the government related to the remediation of a Superfund site in Pennsylvania.

TECHNICAL COMMITTEES

- In conjunction with ASTM D34 committee proceedings, co-authored segments of quality assurance standard methods used by the USEPA in the revisions of Chapters 1, 9, and 10 of SW846 concerning the requirements for quality assurance in the generation of environmental data, development of Data Quality Objectives guidance and guidance for Data Assessment and Usability.

- Provided technical review for the design of the high level radioactive repository at Yucca Mountain near Las Vegas, Nevada for the Nuclear Regulatory Commission (NRC).

- Member of the American Society for Quality Control (ASQC) technical review committee for the integration or harmonization of Quality Assurance Program Requirements for Environmental Programs including the Department of Energy (DOE), the Department of Defense (DOD), the Nuclear Regulatory Commission (NRC), and the US Environmental Protection Agency (EPA).

HONORS AND AWARDS

Letter of Recognition for Outstanding Contribution in Support of Tactical Air Command
Recognition Award In Support of the USEPA Achieving Their Mandated "SARA 175"
Certificate of Appreciation from the Secretary of the Army
Official Commendation for Outstanding Performance, Department of the Army
University of Nebraska Board of Regents Graduate Research Fellowship Award
University of Nebraska Outstanding Student Award
Aksarben Scholarship
Glenn L. Martin Alumni Scholarship

AFFILIATIONS

Member, American Chemical Society
Member, American Society of Testing Materials
Member, Rho Chi National Honorary Society
Member, Beta Beta Beta National Honorary Society

SELECTED PUBLICATIONS

A list of selected publications is available upon request.

SELECTED PUBLICATIONS

Lawson TA, R Gingell, D Nagel, and LA Hines. 1981 *Methylation of hamster DNA by the carcinogen N-nitroso-bis(2-oxopropyl)amine.* Cancer Lett. 11:251-255.

Birt DF, and LA Hines. 1982 *Modification of circadian rhythms of drug metabolism in the Syrian hamster.* Drug-Nutr.Interact. 1:143-151.

Lawson TA, LA Hines, S Helgeson, and P Pour. 1982 *The persistence of DNA damage to the pancreas of Syrian Golden hamsters treated with N-nitroso-bis(2-oxopropyl)amine.* Chem.-Biol.Interact. 38:317-323.

Gold B, and LA Hines. 1984 *Evidence for the penetration of the nuclear envelope by hydroxymethylmethylnitrosamine using an intact nuclei model system.* IARC Sci Publ. 57:453-458.

Gold B, A Deshpande, W Linder, and LA Hines. 1984 *Reactions of alkane-diazotic acids at near neutral and basic pH in* $[^{18}O]H_2O$. J.Amer.Chem.Soc. 106: 2072-2077.

Johnson GE, DM Wolf, and LA Hines. 1991 *Voss: A cost-effective source area screening method.* Proc. SAME Tech. Transfer Conf. Environ. Cleanup. Denver, Colorado.

Hines LA, SE Morrissette, and CJ Clowe. 1992 *The importance of selecting representative samples in the development of a successful treatability study.* Proc.8th Ann.Waste Testing & Qual. Assur. Symp. Washington, D.C.

Hines, LA 1993 *Selecting Representative Samples.* Environmental Testing & Analysis, Volume 2, Number 2, March/April.

WORK PLAN SWMUs: 31, 46, 47, 51, 55, 57
61, 62, 63, 70, 77, 92
93, 94, 103, 127

LIBRARY COPY

RCRA FACILITY INVESTIGATIONS APPENDIX III SWMUs - PHASE I

CANNON AIR FORCE BASE, NEW MEXICO

Prepared for
U.S. Department of the Army
Corps of Engineers, Omaha District
Omaha, Nebraska

Septmeber 1993

C3M11W

CAFB OS 2

TITLE PAGE

WORK PLAN

CANNON AIR FORCE BASE RCRA FACILITY INVESTIGATION
APPENDIX III SWMUs
CLOVIS, NEW MEXICO

USACE CONTRACT NO. DACW-45-93-D-0005
DELIVERY ORDER NO. 0017
W-C PROJECT NUMBER C3M11W

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1.0
INTRODUCTION

This Work Plan details the work to be done for a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) to be completed for 16 Solid Waste Management Units (SWMUs) located on Cannon Air Force Base (Cannon AFB) near Clovis, New Mexico. The 16 SWMUs (See Table 1-1) are referred to as the "Appendix III", or third and last group of SWMUs at Cannon AFB. Prior to the work outlined in this Work Plan, the following listed environmental investigative activities have been completed at Cannon AFB:

- IRP Records Search - CH2M Hill - 1983
- Preliminary Review/VSI Report - RCRA Facility Assessment - A.T. Kearney - 1987
- RCRA Facility Investigation Work Plan for 27 SWMUs - Lee Wan and Associates, Inc. - 1990
- RI Investigation - Appendix I SWMUs - W-C - 1991-1992 (18 SWMUs called "First Third")
- RFI - Landfills 1 and 2 - W-C - 1992-1993
- RFI - Appendix II SWMUs - through USACE, Albuquerque, NM - 1993

Concurrently with the RFI on Appendix III SWMUs, W-C is completing Phase II RFI activities at the Old Entomology Rinse Area and at Landfill 5 under separate task orders.

This Work Plan follows the USACE specified guidance from the United States Environmental Protection Agency (USEPA) entitled "RCRA Facility Investigation (RFI) Guidance, Volumes 1-4, EPA 530/SW-89-031, May 1989. The planning documents for this project are comprised of this Work Plan along with the following documents:

- Project Management Plan (PMP)
- Data Management Plan (DMP)
- Field Sampling Plan (FSP)
- Quality Assurance Project Plan (QAPP)
- Site Safety and Health Plan (SSHP)

The overall intent of the RFI is to obtain the data necessary to sufficiently characterize nature and extent of contamination to support recommendations for further studies to identify corrective measures alternatives for each SWMU or to recommend "no further action" if warranted. The data collected during the RFI may also be used to evaluate human health and ecologic risks, and the data quality objective process will include this use as a data quality objective. The specific objectives of the RFI to be completed at Cannon AFB are to:

- Characterize the physical setting and nature and extent of potential hazardous wastes associated with each SWMU

- Evaluate the data collected to identify potential migration pathways and feasible potential corrective measures

- Perform a Screening Level Risk Assessment to evaluate human health risks associated with chemicals found at each SWMU (Note: A Baseline Risk Assessment may be required to support final recommendations on sites not eliminated by the screening level assessment)

- Develop recommendations for each SWMU regarding further investigation thru corrective measures studies or, where supported by the findings of the RFI, no further action.

The RFI Work Plan is organized as shown in the Table of Contents and in support of specific task descriptions it contains an initial evaluation of anticipated contaminants at each site and how they may spread into the surrounding soils and groundwater (conceptual site models). It also contains a development of Data Quality Objectives which serve as the basis for a sampling and analysis rationale for each site. The RFI Work Plan is configured to address the environmental regulatory needs of each site within the regulatory framework described, including ARARs.

TABLE 1-1

LIST OF APPENDIX III SWMUs

Site	SWMU Number
AGE Maintenance Shop	31
Oil/Water Sep #196	46
Oil/Water Sep #494	47
Oil/Water Sep #375	51
Oil/Water Sep #379	57
Oil/Water Sep #5077a,b,&c	61, 62, 63
Oil/Water Sep #326	70
Oil/Water Sep #5120	92
Oil/Water Sep #5121	93
Oil/Water Sep #5144	94
Oil/Water Sep #4095	127
Lead/Acid Battery Area	55
CE Cont. Stor. Area	77
Wastewater Playa Lake	103

2.0
SITE BACKGROUND AND SETTING

2.1 CANNON AFB OPERATIONAL HISTORY

Cannon AFB is located in Curry County, New Mexico, approximately 7 miles west of the City of Clovis. The base is situated on approximately 4,320 acres of land. The vicinity map of Cannon AFB is shown on Figure 2-1 and the site map of Cannon AFB is shown on Figure 2-2. Off-base facilities include the Melrose Bombing Range and the Conchas Lake Recreation Annex.

Cannon AFB dates to 1929, when Portair Field was established on the site. Portair Field was a civilian passenger terminal for early commercial transcontinental flights. In 1942, the Army Air Corps took control of the civilian airfield and it became known as the Clovis Army Air Base. In early 1945, the base was renamed Clovis Army Air Field. Flying, bombing, and gunnery classes continued through the end of World War II. By mid-1946, however, the airfield was placed on a reduced operational status and flying activities decreased. The installation was deactivated in May 1947. The types of aircraft stationed at Cannon AFB from 1942 to 1947 included B-17, B-24, and B-29 heavy bombers.

The base was reassigned to the Tactical Air Command in July 1951. The first unit, the 140th Fighter-Bomber Wing, arrived in October of that year. The airfield was formally reactivated in November 1951 as Clovis Air Force Base. Between 1952 and 1957, the 50th and 388th Fighter-Bomber Wings were activated, and, upon their transfer, were replaced by the 312th and 474th Groups. Predominant aircraft stationed at Cannon AFB from 1951 to 1957 included the P-51 "Mustang" fighter and the F-86 "Sabre" fighter jet.

In June 1957, the base became a permanent installation and was renamed Cannon Air Force Base in honor of the late General John K. Cannon, a former commander of the Tactical Air Command. In October 1957, the 312th and 474th Fighter-Bomber Groups were redesignated tactical fighter wings and the 832nd Air Division was activated to oversee their activities.

In 1959, the 312th Tactical Fighter Wing (TFW) was deactivated and replaced at Cannon AFB by the 27th TFW. In December 1965, the base's mission changed to that of a replacement training unit, and the 27th TFW became the largest such unit in the Tactical Air Command. The predominant aircraft stationed at Cannon AFB from 1957 to 1965 was the F-100 "Super Sabre" fighter jet.

The 832nd Air Division was deactivated in July 1975, leaving the 27th TFW the principal Air Force unit at Cannon AFB. In early 1981, the 27th TFW was designated a Rapid Deployment Joint Task Force member.

The primary mission of Cannon AFB has remained relatively unchanged since 1965, i.e., to develop and maintain an F-111 tactical fighter wing capable of day, night, and all-weather combat operations and to provide replacement training of combat aircrews for tactical organizations worldwide. Aircraft Stationed at Cannon AFB since 1965 include the F-100 "Super Sabre" fighter jet (1957-1969), the F-111A (1969), the F-111E (1969-1971) and the F-111D (1971-present). There are approximately 70 F-111D aircraft assigned to Cannon AFB. The total work force on Cannon AFB numbers approximately 4,000, which includes 3,500 military and 450 civil service.

In 1992, Cannon AFB became part of the Air Combat Command (ACC) as the result of the overall realignment of Air Force Commands and the ongoing downsizing of the U. S. Military.

2.2 SITE CHARACTERISTICS

2.2.1 Physical Geography

Cannon AFB is situated in the Southern High Plains Physiographic Province in the Llano Estacado subprovince. The Llano Estacado is a nearly flat plain sloping gently (10 to 15 feet per mile) to the east and southeast. Elevations in the eastern New Mexico portion of the Llano Estacado exceed 4,000 feet above mean sea level (msl). In the vicinity of Cannon AFB, elevations range from 4,250 feet to 4,350 feet above msl.

The most prominent geomorphic features in the vicinity of Cannon AFB are blowouts and broad, widely spaced valleys. Less common landforms are relict sand dunes located along the northern side of the Portales Valley south of the base. Relict dunes are not found on or near Cannon AFB.

Blowouts are broad shallow depressions which form as the result of soil erosion by wind. Blowouts commonly collect surface runoff from small to moderate sized drainage areas. During periods of rainfall, runoff collects in blowouts to form ephemeral playa lakes. Playas have no external surface drainage. Water is lost by infiltration to the soil and evaporation; without recharge, playa lakes persist for only a few days or weeks. Three playas are located within the base, and several more are found to the north and east of the base.

Stream valleys tend to be fairly broad and widely spaced. Streams are ephemeral and drainages are poorly developed. No streams exist on or near Cannon AFB. Running Water Draw and Frio Draw, located about 10 and 20 miles, respectively, north of Cannon AFB, are the nearest streams. These are second-order streams. Both streams are very straight, flow southeast, and have rectilinear drainage patterns with short laterals (W-C 1991).

2.2.2 Land Use Near Cannon AFB

Cannon AFB is located just south of U.S. Highway 60-84 in a farming and ranching area (Figure 2-1). The majority of the land surrounding Cannon AFB is productive, irrigated farmland or grassland. The major crops are wheat, sorghum, sugar beets, corn, cotton, alfalfa, barley, and peanuts. The land is also used for cattle grazing, both beef and dairy, and Clovis is considered the "Cattle Capital of the Southwest." There were 32,767 people living in Clovis in 1990, while the Cannon AFB population was estimated to be 4,650 in 1990 (W-C 1991).

2.2.3 Climatology

The climate of east-central New Mexico is classified as tropical semi-arid, with summer temperature and precipitation maxima. Average monthly temperatures range from a January low of 12°C (39°F) to a July high of 26°C (78°F). Extreme daily temperatures range from -24°C (-11°F) to 41°C (106°F) (Lee Wan and Associates 1990b). Average monthly precipitation ranges from 1 cm (0.4 inches) in winter to 6.9 cm (2.7 inches) in July (AWS

1986). The maximum recorded 24-hour rainfall is 12.2 cm (4.8 inches), which occurred in August. Rainfall occurs on eight or more days per month during the summer precipitation maximum. Mean annual precipitation is approximately 41 cm (16 inches). The mean annual evapotranspiration rate is 181.4 cm/yr (71.4 inches/yr) (Lee Wan and Associates 1990b). Prevailing winds are from the west at an average of 5 k/hr (3.1 mph) during fall, winter, and spring. During the summer, winds are from the south at an average of 3.7 km/hr (2.3 mph).

The atmosphere around the area of Cannon AFB is generally well mixed. The seasonal and annual average mixing heights can vary from 400 meters in the morning to 4,000 meters in the afternoon. The afternoon mixing heights are typically greater during the spring and fall seasons. The morning mixing heights are usually low, due to nighttime heat loss from the ground, producing surface-based temperature inversions. After sunrise, these inversions break up, and solar heating of the earth's surface causes vertical mixing in the atmosphere.

Dust is frequently entrained into the atmosphere in this region of the country because of gusty winds and the semiarid climate. The Texas Panhandle-eastern New Mexico area is considered the worst area in the United States for windblown dust. Occasionally, this windblown dust is of sufficient quantity to restrict visibility. Most of the seasonal dust storms occur in March and April, when the wind speeds are typically high (average 5 k/hr) (W-C 1991).

2.2.4 Geology

The near-surface stratigraphic units of interest at Cannon AFB are the Late Miocene-Late Pliocene age Ogallala Formation and the Early Triassic Dockum Group as shown in Figure 2-3.

The Dockum Group consists of three formations. The stratigraphically lowest unit is the Santa Rosa Sandstone. Overlying the Santa Rosa Sandstone are the Chinle and Redonda Formations. The Chinle and Redonda Formations are composed mainly of red shales with lesser interbedded sands, and are known locally as "redbeds." The top of the Dockum Group is marked by an erosional nonconformity having relief of up to several hundred feet (Lee Wan and Associates 1990b).

Overlying the Dockum Group redbeds is the Ogallala Formation. The Ogallala Formation extends from eastern New Mexico and Colorado into Texas, Oklahoma, Kansas, Nebraska, and South Dakota. Drillers' logs from Cannon AFB indicate that the Ogallala Formation varies from 360 feet to 415 feet in thickness. The incised upper surface of Triassic redbeds strongly influences Ogallala thickness. Stream valleys in the post-Triassic nonconformity are deep and trend dominantly east-west. Ogallala thickness may thus vary significantly over short north-south distances.

The Ogallala is erosionally truncated to the south along the abandoned Portales Valley, to the west along the Pecos River Valley, and to the north in a series of ephemeral stream valleys. The Ogallala Formation extends more than 125 miles to the east before terminating as an escarpment in Briscoe County, Texas. Springs and seeps are common along the erosional margins of the Ogallala.

The Ogallala dips gently and monoclinally to the southeast in the vicinity of Cannon AFB. As reported in Lee Wan and Associates (1990b), data suggest that some Quaternary warping may have occurred; however, most of the structures are well to the northwest and southwest of Cannon AFB. No faults or buried structural lineaments are known in the vicinity of Cannon AFB.

The Ogallala Formation is composed of unconsolidated poorly sorted gravel, sand, silts, and clays. The base of the Ogallala is generally marked by a gravel, cobble, and boulder deposit. This basal member contains sediments derived from igneous and sedimentary rocks transported from the mountains to the west. The Ogallala Formation was laid down by stream and overbank deposits formed within coalescing alluvial fans. These fans form a broad pediment along the eastern flank of the Rocky Mountains. As is typical of alluvial deposits, Ogallala internal stratigraphy varies vertically and horizontally over short distances.

Except where strongly cemented by calcium carbonate (caliche), the sediments of the Ogallala are loose and friable. Authigenic and allogenic clays are found as a trace to abundant matrix mineral (Lee Wan and Associates 1990b). As reported by Lee Wan and Associates (1990b), five zones have been distinguished within the Ogallala of east central New Mexico on the basis of clay minerals. Smectites (montmorillonites) and attapulgite (with sepeotite) are the dominant clays throughout the Ogallala. Illite is a lesser, but persistent clay, as is kaolinite.

Smectite is a swelling clay, causing deep cracks to form in dry surface soils. Smectite in particular and, to a lesser extent, attapulgite and illite, are clays with moderate to high cation exchange capacities (CEC). The formation as a whole should therefore have a relatively high CEC, which should inhibit the migration of charged contaminants, and especially ionic forms of metals.

Caliche is a major feature of the Ogallala Formation, occurring as nearly continuous to discontinuous layers throughout. A generalized geologic section at Cannon AFB is shown in Figure 2-3. Caliche is hard, white to pale tan on fresh surfaces, weathering to gray, and has a chalky appearance. Caliche forms as calcium carbonate, leached from overlying sediments, and precipitates in the pore space of the host sediments. Precipitation is caused by the evaporation of downward percolating water. The caliche may thus mark the position of ancient vadose zones. As reported in Lee Wan and Associates (1990b) radiocarbon dates for the upper "climax" caliche range from ~27,000 yrs. Before Present (B.P.) to ~42,000 yrs. B.P.

Caliche is relatively soluble in acidic water (pH < 7) or in waters containing dissolved CO_2. The top surface of the upper "climax" caliche in fresh outcrop shows solution etching.

The Ogallala has numerous continuous to discontinuous caliche layers throughout its thickness. The uppermost caliche, termed the "climax" caliche, is pisolitic (Lee Wan and Associates 1990b). The pisolites are thought to have formed as the caliche was repeatedly chemically-weathered and brecciated during Pleistocene pluvials and later recemented during drier intervals. This upper caliche outcrops around playas and the bounding escarpments of the Ogallala, and is locally termed "caprock." The "climax" caliche is typically 3 to 5 feet thick. Caliches which occur lower in the Ogallala are platy and harder. Caliche may be thin or absent below playas (W-C 1991).

2.2.5 Hydrogeology

The lower portion of the Ogallala Formation is the primary regional aquifer for both potable and irrigation water. No deeper aquifers are utilized in the vicinity of Cannon AFB. The Ogallala aquifer is part of the High Plains Aquifer which extends continuously from Wyoming and South Dakota into New Mexico and Texas. In east central New Mexico, the

Ogallala aquifer rests on Dockum Group redbeds, which serve as the basal confining layer. The Ogallala is a water table, or unconfined, aquifer (Lee Wan and Associates 1990b). The Ogallala aquifer has a southeasterly regional gradient of about 13 feet/mile. Well yields vary from less than one gallon per minute (gpm) in thin silts and sands, and up to 1600 gpm in thick sands and gravels (Lee Wan and Associates 1990b). Water quality is generally good, with hardness and fluorides being somewhat high (Lee Wan and Associates 1990b).

At Cannon AFB, the Ogallala aquifer has an average saturated thickness of 120 feet based on mid-1960s data. Saturated thickness ranges from 93 to 143 feet, and is influenced by the configuration of the erosional nonconformity surface marking the top of the Dockum Group. The local groundwater gradient is southeasterly at 7.5 feet/mile (Lee Wan and Associates 1990a). Figure 2-4 shows water table elevation contours for 1984. Flow within the saturated zone may be influenced by the configuration of the top of the Dockum Group. Yields in tests of Cannon AFB water wells have ranged from 776 l/min (205 gpm) to 4,353 l/min (1150 gpm). Specific capacities range from 0.14 m^3/m (11.4 gal/feet) to 0.35 m^3/m (27.9 gal/feet) (Lee Wan and Associates, 1990b).

Very rough estimates of hydraulic conductivity were made from well pump tests in water wells 5 and 9 (Figure 2-5) using the Theis equation. An estimate of hydraulic conductivity for water well 8 was based on water level recovery data using the Bouwer and Rice approach (Lee Wan and Associates 1990b). The data used in these calculations were obtained to evaluate pump rates, efficiency, and well yield, and were not intended for use in calculating aquifer properties. The results of these calculations should therefore be considered as first approximations.

Hydraulic conductivity values for water wells 5 and 9 were found to be approximately 2.0×10^{-3} cm/sec. Calculations for water well 8 result in a hydraulic conductivity of 2.0×10^{-2} cm/sec. These estimates appear to be low when compared to published hydraulic conductivity data for sands and gravels. As reported in Lee Wan and Associates (1990b) a groundwater flow velocity of about 45 m/yr (150 feet/yr) has been estimated. This calculates out to a hydraulic conductivity of approximately 1.0×10^{-1} cm/sec. Again, this appears to be low when compared with published data (Freeze and Cherry 1979).

The presence of interstitial clays may account for both the variability and low values of hydraulic conductivities. Boring logs from Cannon AFB IRP projects and published reports (Lee Wan and Associates 1990b) indicated that interstitial and interstratified clays are abundant in the Ogallala Formation. Additional aquifer testing will be required if it becomes necessary to more accurately determine hydraulic conductivity.

Recharge to the Ogallala is primarily through precipitation. As reported in Lee Wan and Associates (1990b), a recharge rate of 0.5 inches/year as calculated using the Theis equation. Lee Wan and Associates (1990b) reported that the recharge rate may be as much as 1.0 inches/yr. Due to the high evapotranspiration rate and low precipitation, recharge occurs only during heavy rainfall events in which the infiltration capacity of the soil is exceeded and runoff occurs, or during cool months when precipitation exceeds evapotranspiration. Excess runoff flows to playas, and the presence of water in playas allows deep percolation to the aquifer. The occurrence of this process is evidenced by the presence of clay deposits in, and thin or nonexistent caliche layers directly below, playas. Caliche is soluble in acidic rain waters, and is leached over time to form percolation pathways.

Discharge from the Ogallala occurs through well pumping and springs along the eroded margins. Spring discharge does not occur on or near Cannon AFB. Domestic and irrigation water wells are common on and around the base, however. The rate of discharge exceeds the rate of recharge. Water levels in the Ogallala have declined steadily from the 1930s to the present. A decline of 50 to 100 feet has been observed in the area around Clovis, New Mexico for the period from the 1930s to 1980. Lee Wan and Associates (1990b), states "the largest area of water level decline exceeding 100 feet occurs south of the Canadian River extending from Curry Co., New Mexico to Crosby Co., Texas."

The dominant uses of groundwater in the Cannon AFB area are for potable and irrigation water. Numerous wells are found in the Cannon AFB area, most of which provide only irrigation water (Figure 2-5).

The Ogallala will continue to be used as the primary source of potable and irrigation water for eastern New Mexico. The New Mexico State Engineer designated Curry County as a Water Basin in 1989. This designation allows for regulation of water rights, usage, and well drilling (W-C 1991).

2.2.6 Soils

Soils in the vicinity of Cannon AFB are classified as SM to SC under the Unified Classification Systems, and as aridisols (calciorthids) under the Soil Conservation Service Comprehensive Soil Classification System. The following summary is based on the Soil Conservation Service Curry County Soil Survey as reported in Lee Wan and Associates (1990b).

The most common soil type on the base is the Amarillo fine sandy loam, 0 to 2 percent slope phase (map symbol Ab Figure 2-6). This soil consists of a thin sandy A horizon, well defined clayey B_{1-3} horizons, with a calcic B_3 horizon at depths below 40 inches. The calcic B_3 horizon lies on a calcic C horizon, or on caliche. The Amarillo fine sandy loam is present on all relatively flat surfaces at the base, but is also found on slopes associated with playas (map symbol Ac).

Clovis fine sandy loams, 0-2 percent slope phase (map symbol Cb) and 2-5 percent slope phase (map symbol Cc), are very similar to Amarillo fine sandy loams. In the Clovis soils, the depth to the calcic C horizon ranges from 28 to 56 inches. The depth to caliche exceeds 56 inches. Clovis and Amarillo fine sandy loams occur in close association.

In a few limited areas, particularly along the steeper slopes around playas, Mausker fine sandy loam, 0 to 2 percent slope phase (map symbol Ma), and 2 to 5 percent phase (map symbol M6) are found. Mausker fine sandy loams have no B horizons and are very calcareous. The calcic C horizon is within 2 feet of the surface.

The A and B horizons of Amarillo and Clovis fine sandy loams are rapidly to moderately permeable. Mausker fine sandy loam A and Ac horizons are rapidly permeable. Permeabilities in calcic B and C horizons are moderate (Lee Wan and Associates 1990b).

2.2.7 Biological Resources

Land adjacent to Cannon AFB is primarily used for agriculture, and there is little natural vegetation remaining in the area. The wildlife species that are common to agricultural areas throughout the region include bobwhite quail and pheasant. There are a few playa lakes in

the area; these are used by upland game for cover, by waterfowl for resting and feeding, and by wildlife in general for drinking. Nearby riverbeds also provide water sources during rainy seasons. During periods of low rainfall, the riverbeds are dry (W-C 1991).

2.2.7.1 Plant Resources

The climate of the Base area is considered to be semiarid. The thin layer of topsoil in the vicinity of Cannon AFB is sandy loam, which is highly susceptible to wind erosion. The undisturbed natural vegetation is mostly shortgrass prairie, including blue grama grassland and mixed grama grassland vegetation types, which have moderately fast recovery rates.

Much of the study area has been previously cleared for agricultural crops. The predominant land use of the region is rangeland, primarily for cattle grazing. In general, moderately grazed rangeland areas of the types occurring in the project area are highly productive in terms of both forage quality and quantity. The rangeland in the vicinity may support up to 15 to 20 head of cattle per section, depending on the rainfall. Large trees do not uniformly exist in the vicinity of the range except where planted around buildings and other structures on the Base. Woodlands composed of large shrubs and small trees are confined to riparian areas and playa lakes in the vicinity (W-C 1991).

The following plants are candidate species for the Federal List of Endangered and Threatened Wildlife and Plants and are found within a 50-mile radius of Cannon AFB: chatterbox orchid (*Epipactus gigantea*), spiny aster (*Aster harridus*), Whittmans milkvetch (*Asragalus witmanil*), dune unicorn plant (*Proboscidea sabulosa*), and the tall plains spruce (*Eupjorbia strictior*). The dune unicorn plant is also on the state endangered plant species list. No federally protected endangered plants are known to be present on the Base (Lee Wan and Associates 1990b).

2.2.7.2 Wildlife Resources

The eastern New Mexico area contains many nongame wildlife species that are typical of the High Plains. Most of these species are distributed widely throughout the western United States. Species diversity is low in most habitats because of the low vegetation diversity. Most amphibian species are associated with riparian habitats and playa lakes. Reptiles are

found in all terrestrial habitat types but are most abundant in scrub/grasslands. Nocturnal rodents are the most abundant members of the small mammal community.

Grasslands on the High Plains support a variety of seed-eating sparrows and other ground-dwelling birds, both as residents and migrants. Raptors (hawks and owls) are relatively abundant in all habitats in the region. Insectivorous and tree-nesting species are most abundant in riparian areas. Shorebirds and waterbirds and migratory waterfowl in general utilize the rivers, playa lakes, and reservoirs of the region.

Two National Wildlife Refuges (NWRs) are located on the periphery of the Base area. The Grulla and Muleshoe NWRs are within 30 miles of Cannon AFB. These areas provide high-quality habitat for migratory and breeding waterfowl.

Big-game species in the area include mule deer, white-tailed deer, pronghorn, and barbary sheep. Pronghorn are the most abundant game animal in the area. Several species of upland game, such as quail, ring-necked pheasant, and turkey are common in the area. Reservoirs (Ute Lake, Conchas Lake, and Clayton Lake) and playa lakes are important waterfowl habitats in the region. Numerous species of native and introduced fish inhabit the rivers and perennial streams, and the reservoirs support recreational fishing of warm-water species such as walleye, crappie, channel catfish, largemouth bass, and bluegill.

As determined by the regional office of the U.S. Fish and Wildlife Service, two federally listed endangered animal species, the bald eagle and peregrine falcon, are known to inhabit the area within a 50-mile radius of Cannon AFB. The New Mexico Department of Game and Fish also indicated that the state endangered Mississippi kite, Baird's sparrow, and the black-footed ferret may also occur in the vicinity of the Base. The federal- and state-protected species are listed in Table 2-1.

Within Curry County, the only state-protected bird that is most likely to occur is the Mississippi kite. In New Mexico, since the early 1960s, this kite summers regularly and breeds in the Clovis region. The birds frequent the golf course at Cannon AFB. Two other state-protected birds within Curry County that may occur, but not regularly in recent time, are the McCown's longspur and Baird's sparrow. No information is available on the McCown's longspur in New Mexico; however, Baird's sparrow occurs mainly in autumn

during migration in the eastern plains and southern lowlands. Migrants appear as early as the first week of August and move further south by November. The species seems to have declined in abundance throughout its range in the Southwest due to the loss of shrubby shortgrass habitats.

State-protected birds known to occur infrequently are the bald eagle and the peregrine falcon. The bald eagle migrates and winters from the northern border of New Mexico to the Gila, lower Rio Grande, middle Pecos, and Canadian valleys. It is seen occasionally in summer and as a breeding bird, with nests reported in the extreme northern and western parts of the state. Winter and migrant populations appear to have increased with reservoir construction. The peregrine falcon is widely distributed but population numbers are low. The American subspecies breeds statewide in New Mexico, but mainly west of the eastern plains.

TABLE 2-1

FEDERAL- AND STATE-PROTECTED ANIMALS POTENTIALLY OCCURRING IN THE VICINITY OF CANNON AFB (CURRY COUNTY)

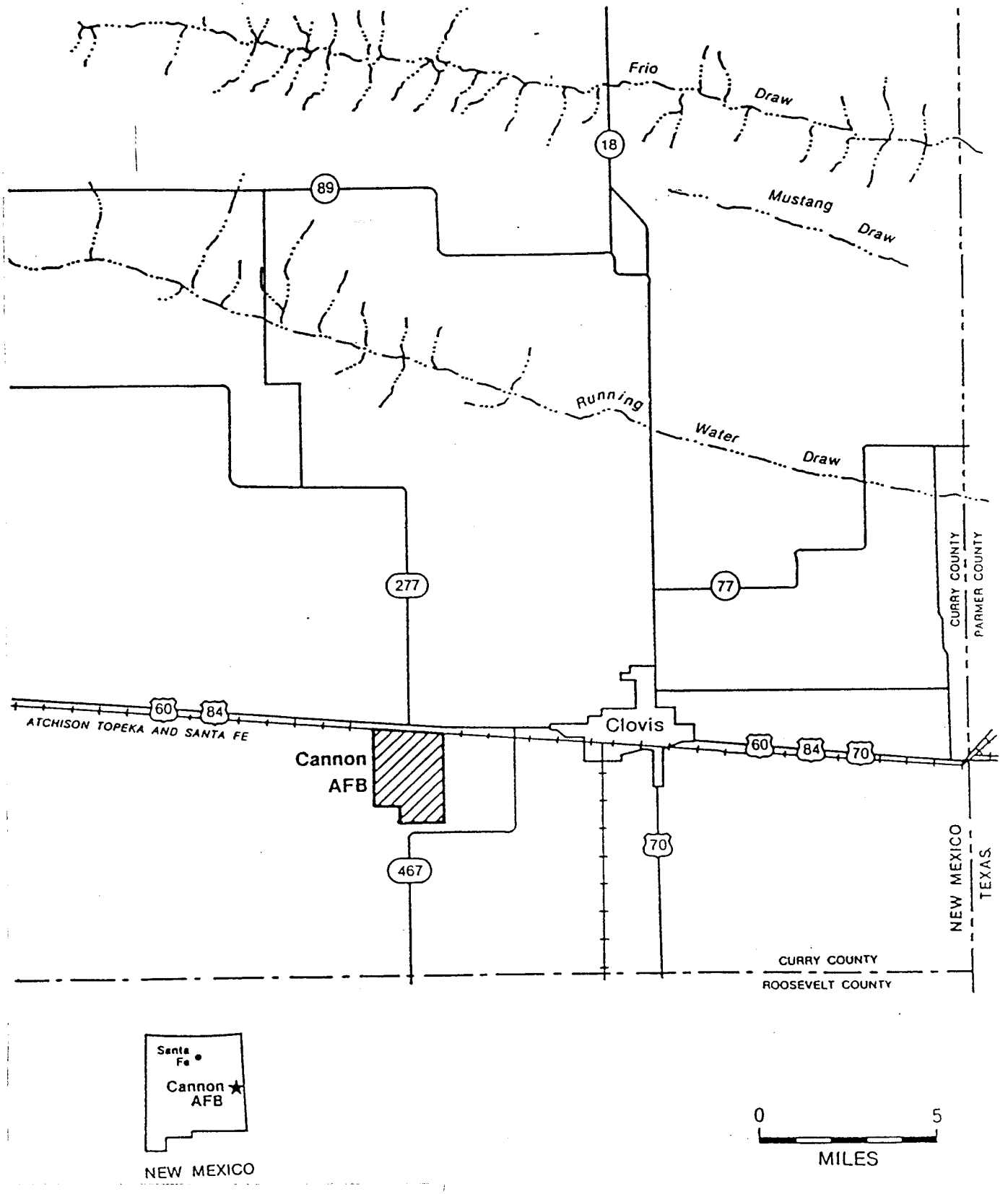
Common Name	Scientific Name	Federal Status	State Status
Birds			
Mississippi kite	Ictinia mississippiensis		Endangered (Group 2)
Barid's sparrow	Ammodramus baridii		Endangered (Group 2)
Bald eagle	Haliaeetus leucocephalus	Endangered	Endangered (Group 2)
Peregrine falcon	Falco perigrinus	Endangered	Endangered (Group 1)
Mammals			
Black-footed ferret	Mustela nigripes	Endangered	Possibly Extinct

Endangered (Group 1): Species whose prospects of survival or recruitment within the state are in jeopardy.

Endangered (Group 2): Species whose prospects of survival or recruitment within the state are likely to become jeopardized in the foreseeable future.

Possibly Extinct: Potentially no longer in existence in the state.

Source: Lee Wan and Associates 1990



SOURCE: FINAL REPORT, IRP PHASE II

DRN BY: JTA/SCR	DATE: 08/18/93	VICINITY MAP CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W	FIG. NO. 2-1
CHK'D BY:	DATE:			

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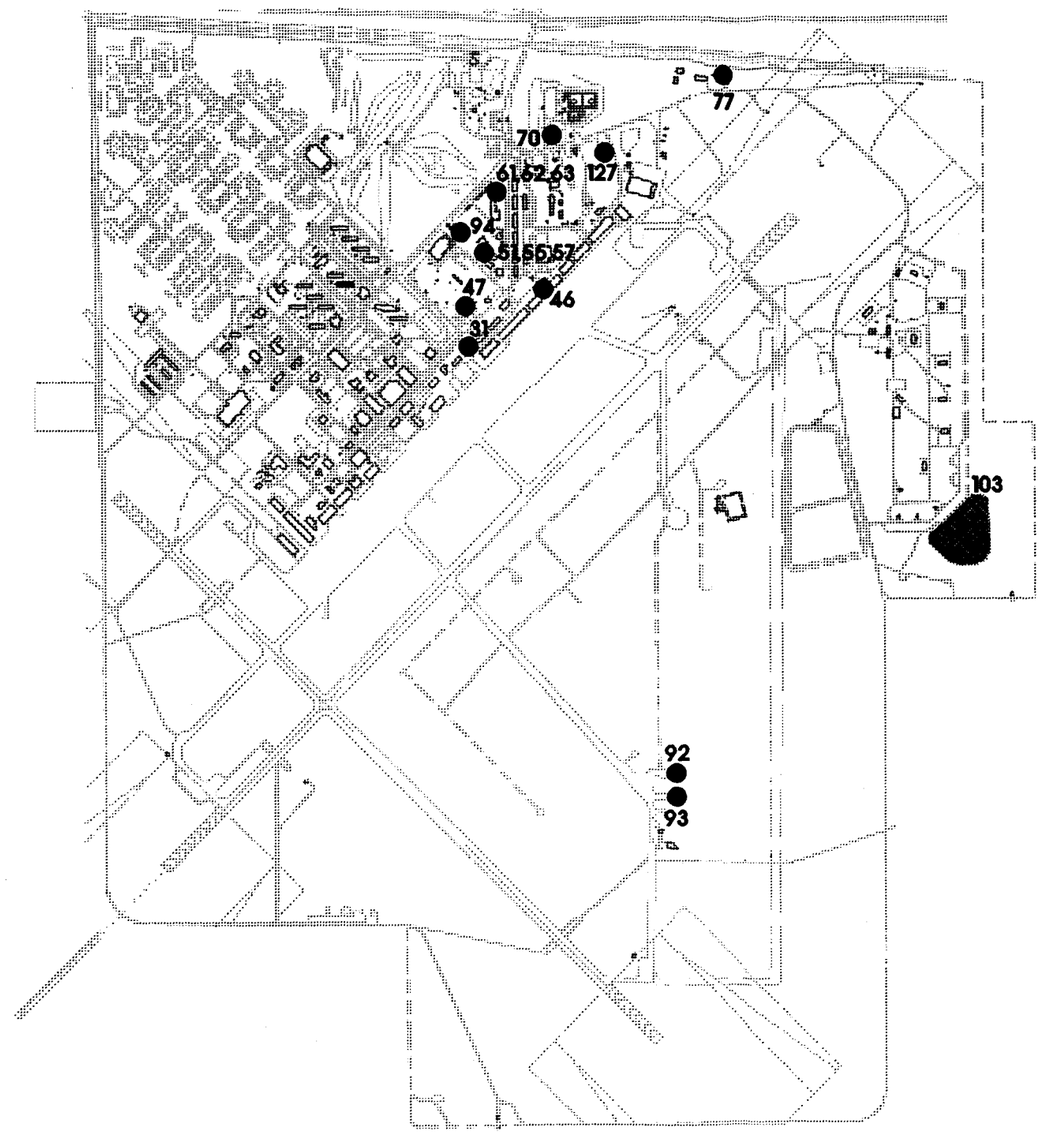

LEGEND

31 ● SOILD WASTE MANAGEMENT UNIT (SWMU) LOCATION AND NUMBER

SWMU No.	DESIGNATED AREA
31	AGE MAINTENANCE SHOP PAD
46	OIL/WATER SEPARATOR No. 196
47	OIL/WATER SEPARATOR No. 494
51	OIL/WATER SEPARATOR No. 375
55	LEAD ACID BATTERY ACCUMULATION POINT
57	OIL/WATER SEPARATOR No. 379
61	SAND TRAP No. 5077a
62	SAND TRAP No. 5077b
63	OIL/WATER SEPARATOR No. 5077c
70	OIL/WATER SEPARATOR No. 326
77	CIVIL ENGINEERING CONTAINER STORAGE AREA
92	OIL/WATER SEPARATOR No. 5120
93	OIL/WATER SEPARATOR No. 5121
94	OIL/WATER SEPARATOR No. 5144
103	WASTEWATER PLAYA LAKE
127	OIL/WATER SEPARATOR NEAR TANK 4095

N

2000 1000 0 2000

SCALE IN FEET

DRN. BY: CJG	DATE: 08/16/93	SITE PLAN AND LOCATION OF INVESTIGATED SWMU SITES CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W	FIG. NO. 2-2
CHK'D. BY:	REVISION: 0			

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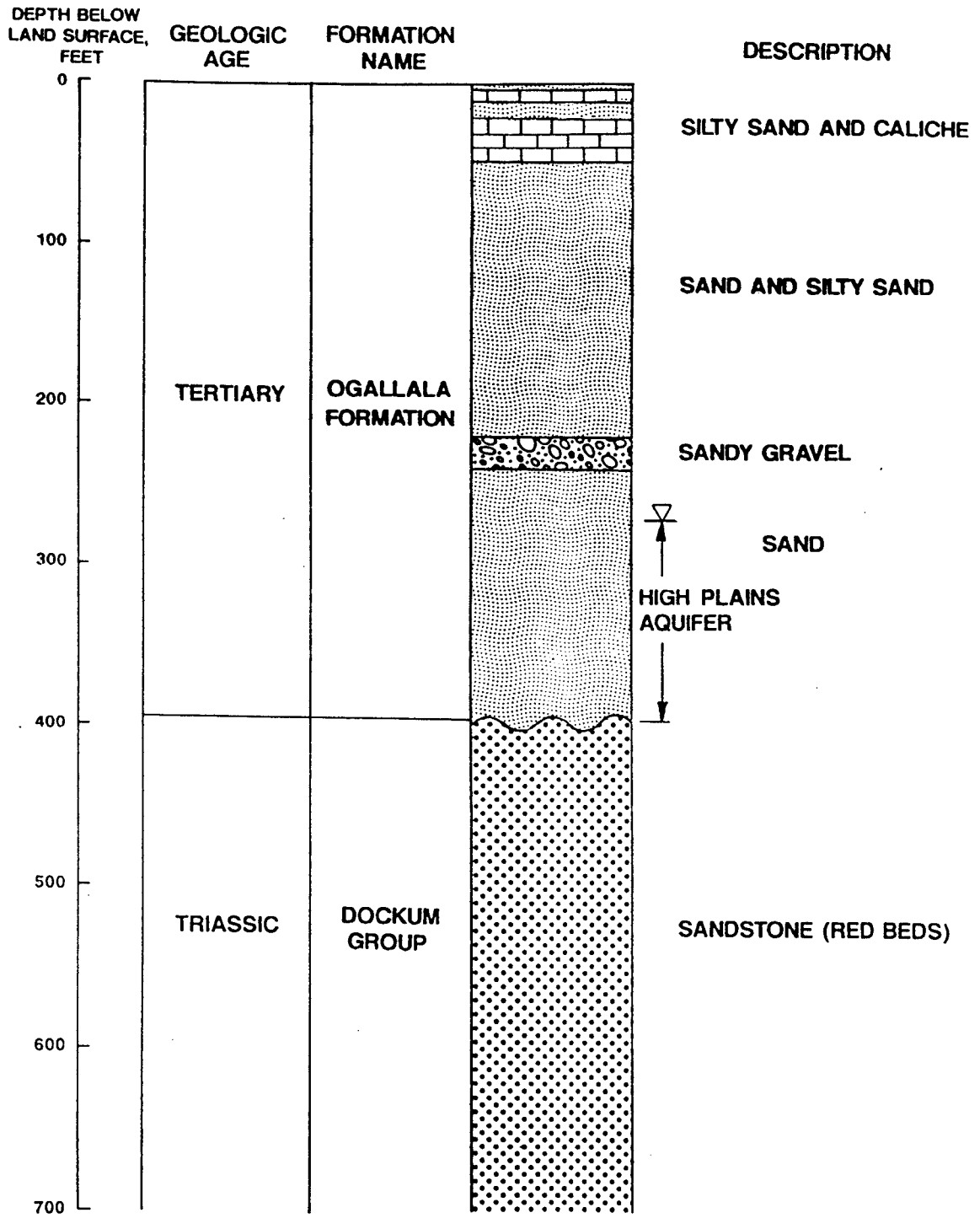


LEGEND

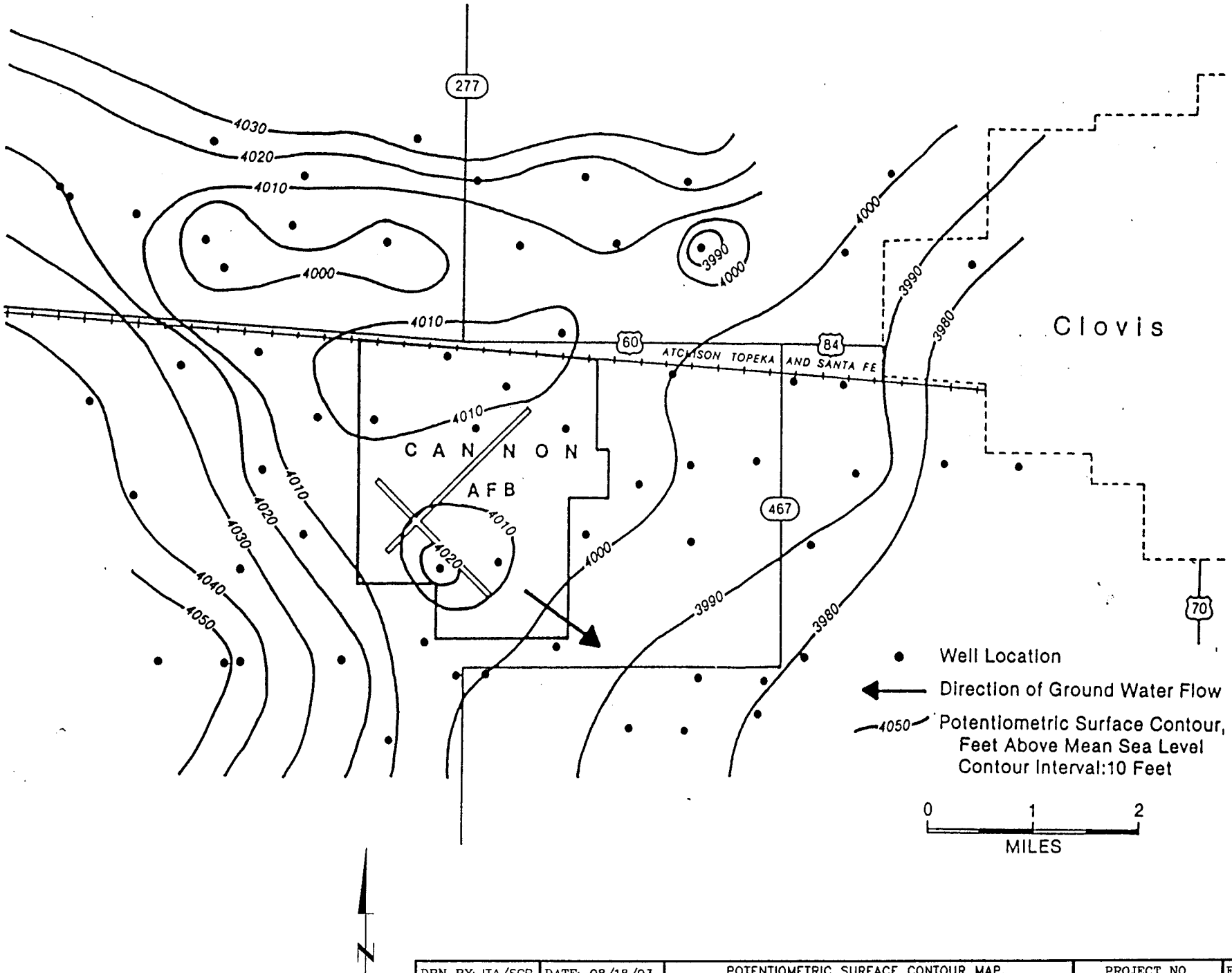
LITHOLOGIC CONTACT

UNCONFORMITY

WATER LEVEL

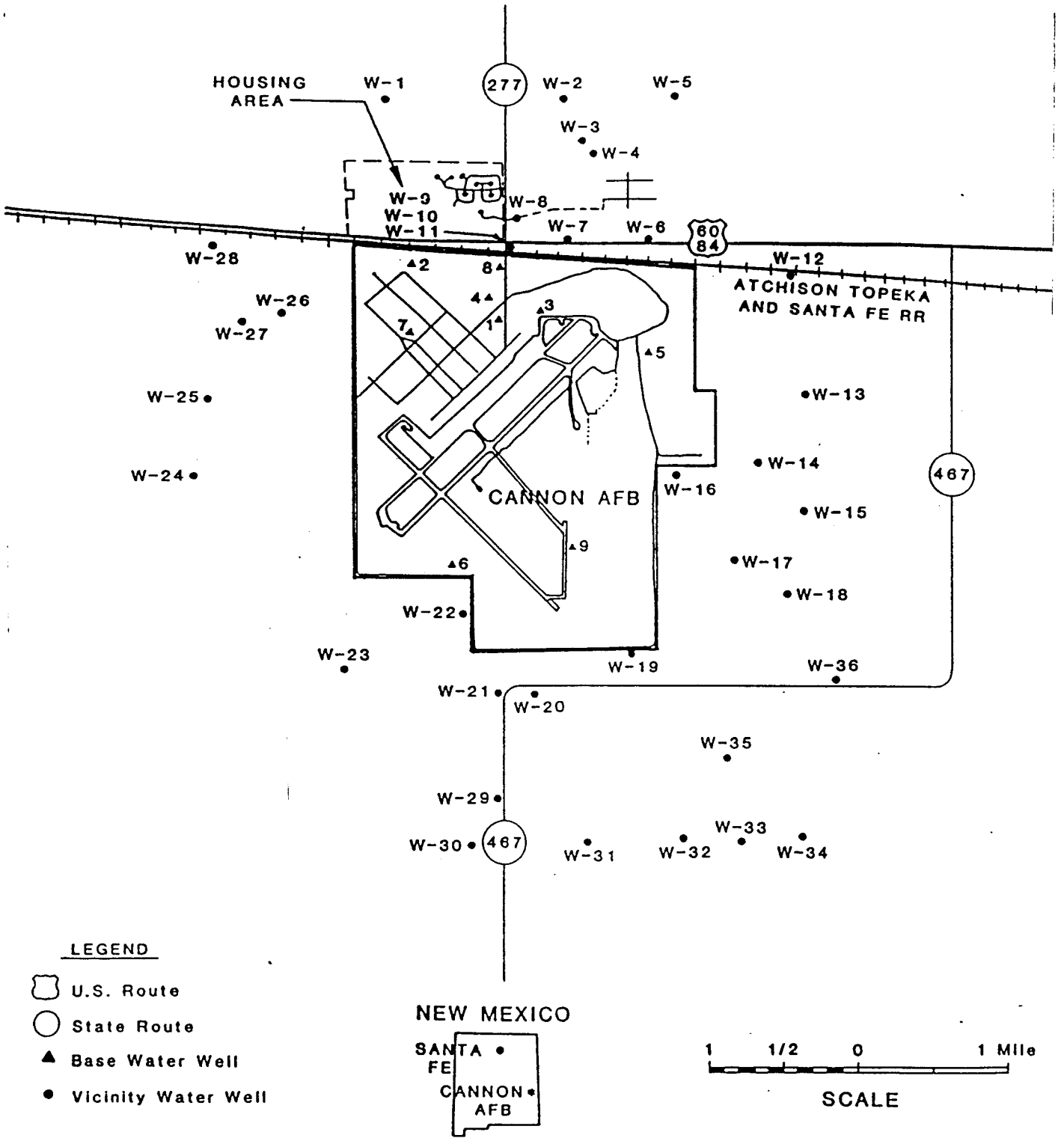
SOURCE: MODIFIED FROM GUTENTAG ET.AL., 1984

DRN BY: LLG/SCR	DATE: 08/18/93	GENERALIZED GEOLOGIC STRATA AT CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO 03M11M	FIG NO 2-3
CHK'D BY:	DATE:			



SOURCE: FINAL REPORT, IRP PHASE II

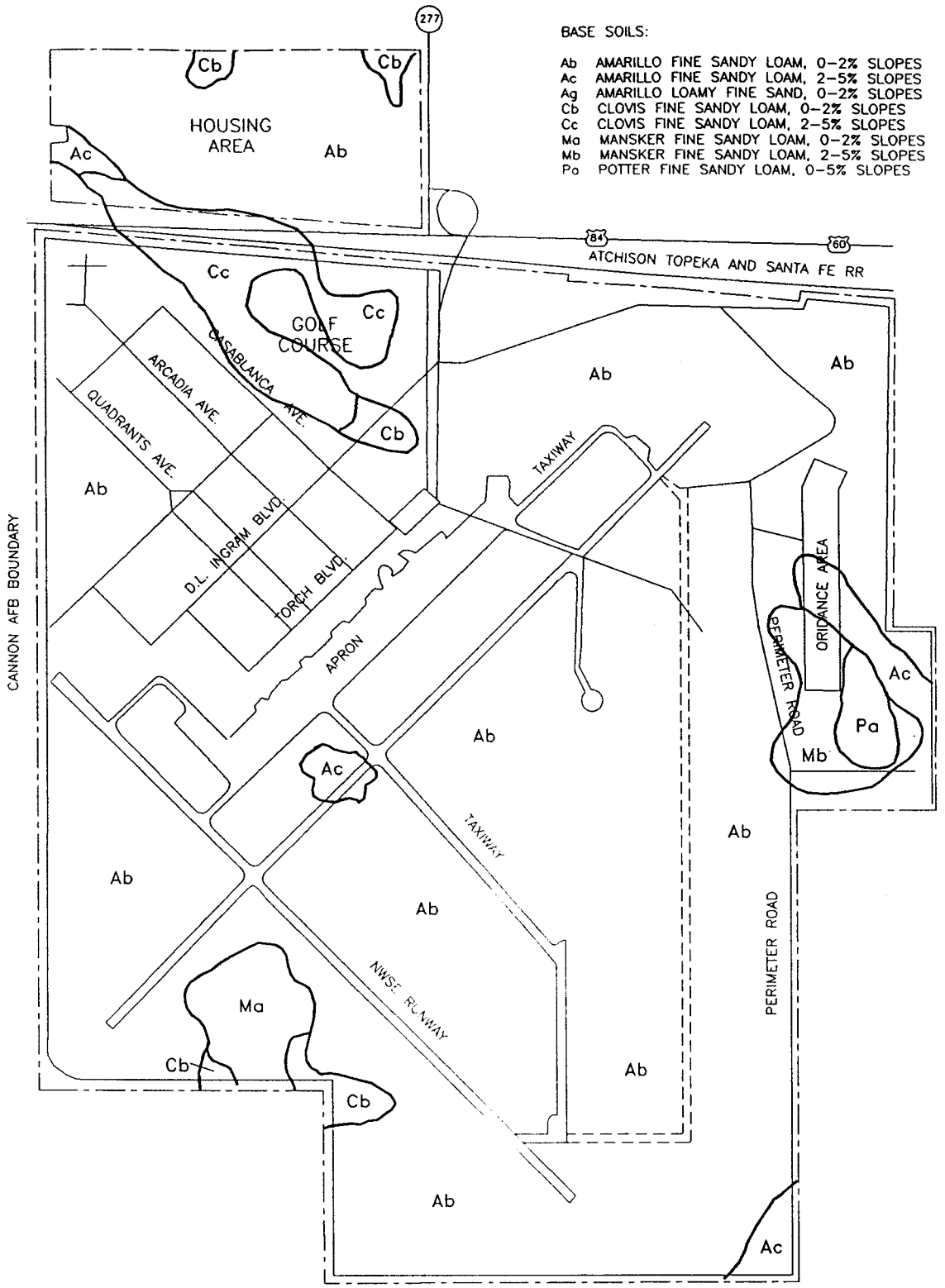
DRN BY: JTA/SCR	DATE: 08/18/93	POTENTIOMETRIC SURFACE CONTOUR MAP, VICINITY OF CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W	FIG. NO. 2-4
CHK'D BY:	REVISION: 0			



BASE MAP ADAPTED FROM: FINAL REPORT, IRP PHASE II

DRN BY: JTA/SCR	DATE: 08/18/93	WATER WELL LOCATIONS ON AND NEAR CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W	FIG. NO. 2-5
CHK'D BY:	DATE:			

08/18/1993 15:52



SOURCE: USDA-S.C.S., SOIL SURVEY OF CURRY COUNTY N.M., 1958

DRN BY: SCR	DATE: 08/18/93	DISTRIBUTION OF SOILS, BY TYPE CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W	FIG. NO. 2-6
CHK'D BY:	DATE:			

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3.0
INITIAL EVALUATION

The program approach for the RFI for the 16 Appendix III SWMUs at Cannon AFB is to review known information including results of past investigations, become familiar with past and present operations and the physical setting at each SWMU, then through use of the Data Quality Objectives Process, identify data needs and formulate a sampling plan to collect the necessary data for each SWMU. The rationale for sampling locations, number of samples and analytical parameters are presented in Section 4 of this Work Plan and the FSP. A discussion of the Data Quality Objectives (DQO) process and how it was applied to the planned RFI is presented in the following section.

3.1 DATA QUALITY OBJECTIVES PROCESS

3.1.1 Purpose of DQOs

DQOs are quantitative and qualitative statements derived from the outputs of each step of the DQO Process that:

- Clarify the study objectives;
- Define the most appropriate type of data to collect;
- Determine the most appropriate conditions from which to collect the data; and
- Specify the required decision accuracy parameters that will be used as the basis for establishing the quantity and quality of data needed to support the decision.

The DQOs are then used to develop a scientific and resource-effective sampling design.

3.1.2 DQO Process

The DQO Process is a series of planning steps based on the Scientific Method that is designed to ensure that the type, quantity, and quality of environmental data used in decision making are appropriate for the intended application.

The DQO Process was developed by the EPA to help Agency personnel avoid collecting data that are inconsequential to decision making. The process allows the decision makers to define their data requirements and acceptable levels of decision errors during planning, before they collect the data. Application of the DQO Process should result in data collection designs (sampling plans) that will yield results of appropriate quality for defensible decision making.

The DQO process consists of a number of steps and is often divided into three stages as illustrated in Table 3-1. The DQO process is integrated with development of the sampling and analysis plans and will be revised, as needed, based upon the results of each data collection activity. This process is outlined below.

3.1.2.1 Stage 1 - Identify Decision Types (Initial Evaluation)

Stage 1 of the DQO process identifies the individuals responsible for decisions, data uses, and available data; determines if additional data is needed; and identifies the types of decisions which will be made regarding site remediation. Available information on each SWMU at Cannon AFB will be compiled and analyzed to describe suspected sources, contaminant pathways, and potential receptors. Stage 1 results in the specification of the decision making process, identification of why additional data is needed, and sets the foundation for Stages 2 and 3 of the DQO development process as shown in Table 3-1.

3.1.2.2 Stage 2 - Identify Data Uses/Needs (Work Plan Rationale)

Stage 2 specifies the data (quantity/quality) necessary to meet the objectives set in Stage 1. This stage stipulates criteria for determining data adequacy. Stage 2 includes selection of the sampling approaches and the analytical options used for the site.

3.1.2.3 Stage 3 - Design Data Collection Program

Stage 3 specifies how to assemble data collection components and develop data collection documentation. Methods have been specified by which acceptable data will be obtained to make decisions. This information will be provided in the sampling and analysis plans.

3.1.3 Integration of DQOs with the Sampling and Analysis Plan and the Quality Assurance Plan

During Stage 2 of the DQO process, specific DQOs will be developed based on media or sample activity. The intent of Stage 3 is to compile the information and DQOs developed for specific tasks into a comprehensive data collection program. The output of the DQO process is a well-defined sampling and analysis plan with summary information provided in the work plan. The sampling and analysis plan will identify the individuals responsible and the procedures for field activities and sample analysis.

The DQO process also develops the requirements for assessing the quality of any data in the RFI program and determines data acceptability according to the RFI requirements. This review is the process of data acceptance and management and is addressed in the Quality Assurance Project Plan and the Data Management Plan (DMP). The DMP is presented in Appendix A.

The three-stage quality objective process was used to define the data objectives, specific task objectives, and quality assurance objectives for the Cannon AFB RFI as discussed in Section 4 below.

3.2 PAST WASTE MANAGEMENT PRACTICES

Information regarding specific past waste management practices for Cannon AFB is contained in past investigation reports and a summary of those practices is presented here as they relate to the 16 Appendix III SWMUs being investigated in the planned RFI. A list of the SWMUs (identified during the USEPA RCRA Facility Assessment) being investigated is shown in Table 1-1 and SWMU locations are shown on Figure 2-2. A more detailed description of past waste management practices and potential contaminants are discussed on a SWMU-by-

SWMU basis in Section 4 of this Work Plan. In general, base waste management activities included:

- Solid and hazardous waste disposal in landfills
- Fire training exercises using aircraft fuels
- Wastewater treatment activities
- Landfarming of fuel tank bottom sludges
- Collection of spent materials from aircraft engine testing/cleaning
- Disposal of industrial and sanitary wastewater potentially containing spent cleaning agents/oils into the sanitary sewer which ultimately discharged to the Playa Lake (SWMU #103)

The waste management practices that relate to the Appendix III SWMUs can be used to divide the SWMUs into five categories as follows:

- **Ten Sites With Oil/Water Separators** to remove petroleum products and other Light Non-Aqueous Phase Liquids (LNAPLs) from washwater or storm water prior to discharge to a sewer. The objective is to investigate the potential soil contamination (and Groundwater if appropriate) that could have resulted from a release of these materials through spillage, overflow, or leakage of the separator.

- **The AGE Maintenance Shop Building Pad**(SWMU #31) where servicing of equipment may have created a release of petroleum products into the soil below.

- **The Lead/Acid Battery Storage Area** (SWMU #55) where lead acid batteries could have released their fluid into the ground.

- **Civil Engineering Container Storage Area** (SWMU #77) where a variety of materials have been stored over the years and could have been released to the soil below.

- **The Wastewater Playa Lake** (SWMU #103) which has been the main receptor of industrial wastewater and sewage since the beginning of base operations in 1942.

Each of the above categories of waste disposal practices will be discussed further in Section 4.

3.3 BEHAVIOR OF CONTAMINANT PLUMES

The "pendant plume" model of contaminant migration in a semi-arid region with a deep unconfined water table forms the conceptual basis for soil and groundwater sampling at Cannon AFB (Kearney, 1987). Site-specific sampling plans are designed to account for the presence of clays, caliche, and release quantities. The pendant plume conceptual model for subsurface contaminant moderation is discussed below in more detail.

The behavior of contaminants in unsaturated clay-rich sediments and soils is a complex physicochemical process. Due to the depth to the water table (>200 ft) and lack of precipitation and water infiltration as a contaminant carrier, only large or continuous releases of liquid contaminants may be expected to reach the water table. The presence of low permeability (but not impermeable) caliche layers, as well as chemically active (i.e., high Cation Exchange Capacity [CEC]) clays, will also act to impede contaminant migration. Capillarity will also have a role in attenuating contaminant migration. As illustrated in Figure 3-1, a relatively small contaminant release will tend to form a "pendant plume". A pendant plume extends downward from the release site with little lateral spread. Downward migration will continue until capillarity and clay adsorption eliminates free liquids (i.e., liquids which can be drained rapidly by gravity. Pendant plumes may spread laterally if low permeability layers are encountered during downward movement (Figure 3-1) . However, in the absence of a carrier fluid such as water, lateral spread will be severely limited.

Relatively large plumes may not be fully attenuated by caliche or clays and may reach the water table. Figure 3-1 illustrates this situation. In this instance, a water table with a low gradient could limit the rate of migration.

Caliche, as a low-permeability barrier, will act to retard downward movement of contaminant plume. However, lateral spreading immediately above the caliche layer may occur. As a rule of thumb, a difference of permeability of two orders of magnitude or more will provide an effective barrier in the absence of significant head differences. While the vertical migration pathway provides a significant change in head, if generally small quantities of liquids are involved it is unlikely that the liquids would migrate to a great depth through competent caliche given the complex nature of flow in the unsaturated zone. However, migration along fractures in the caliche, where present, may allow deeper migration in some locations.

Clays, zeolites (e.g., heulandite), metal oxides, and humus are chemically active soil/sediment constituents which can impede or trap migrating contaminants. These particulates have large surface areas and slight to moderate electronegative surface and interlayer charges. Cationic contaminants in water may partition and adsorb to clay or humus. The degree of partitioning depends on clay CEC; amount of humus; types and concentrations of natural and contaminant ions; ionic valency; and the presence of dissolved organic co-contaminants (Matthess 1984). Multivalent cationic metals will tend to strongly sorb to clays. Semivolatile organics may also be sorbed to clays and humus. However, volatile organics such as xylene will not sorb and may actually increase permeability relative to organics. Areas in which fuel releases have occurred will therefore be sampled to greater depths than areas in which metals are of concern.

3.4 PRELIMINARY IDENTIFICATION OF CONTAMINANT MIGRATION PATHWAYS

The initial step in the evaluation of each SWMU is the development of an Exposure Pathway Flow Chart (EPFC), which provides a framework for evaluating potential risks associated with the SWMU, aids in the identification of data needs, and assists in the identification of appropriate preliminary remediation goals targeted to significant exposure pathways. The EPFC will be used initially to assist in the development of the sampling strategy for each SWMU. Upon completion of the field sampling program, the EPFC will be reviewed and modified (if necessary) in order to re-evaluate the SWMU, taking into consideration the analytical results and fate and transport properties of SWMU-related chemicals.

Figure 3-2 through 3-6 show EPFCs with chemical sources and potential human exposure pathways typical of SWMUs studied in this RFI. The EPFC presents chemical release sources and transport media, potential human receptors, and intake mechanisms for each potential exposure pathway. An exposure pathway describes the means by which release, transport, and intake by receptor populations of SWMU-related chemicals of concern occurs. An exposure pathway consists of four necessary elements:

- A source and mechanism of chemical release to the environment
- An environmental transport medium for the released chemical (e.g., air, groundwater, or surface water)
- A point of potential human exposure to transported chemicals (e.g., a domestic drinking water well)
- A human intake mechanism (e.g., inhalation or ingestion) at the point of exposure

All four elements must be present for an exposure pathway to be complete and for chemical exposure to occur. In the EPFCs, potentially significant pathways are denoted with solid lines, and pathways that are considered to be insignificant relative to other pathways are denoted with dashed lines.

Potential exposure pathways were evaluated with respect to potential chemical sources at each SWMU. Exposure pathways are considered to be potentially complete if there are chemical release and transport mechanisms and identified exposure points and receptors for that exposure pathway. Incomplete exposure pathways do not result in actual exposure to human or environmental receptors and, therefore, do not pose a potential risk. Incomplete exposure pathways are not shown on the EPFCs. Insignificant pathways are those that could conceivably be complete and result in an exposure, but the resulting exposure would undoubtedly be at levels that would not pose a significant risk.

The potential sources of chemical emissions from the SWMUs are presented in Figure 3-2 through 3-6. Many of the SWMUs are oil/water separators, which are potential sources for

petroleum hydrocarbons and solvents. The primary source is generally waste (e.g., fuels, oils, and solvents) that has leaked into subsurface soils or has been discharged or spilled on surface soil; the secondary sources are other media, such as subsurface soil or water, impacted by the primary source.

Chemicals from the primary or secondary source may be transported away from the primary source area, affecting other media that may in turn act as tertiary sources. Percolation and leaching of the wastes to the subsurface soil is shown as a primary chemical release mechanism. Subsurface soils are an important secondary source of potential chemical release. SWMU-related chemicals in soils may infiltrate/percolate through the soil and be released to groundwater. At some SWMUs, exposure may occur through surface water; therefore, a potential surface water exposure pathway could occur.

Other types of release mechanisms, such as direct contact, surface runoff, wind erosion, or volatilization to the atmosphere, are also depicted in the EPFCs. A portion of the SWMUs may be covered with clean soil or pavement; therefore, surface transport of chemicals by storm water runoff will be limited in extent. Transport by storm runoff is not considered a significant pathway for human exposure, for example, at an underground oil/water separator. Where a SWMU is covered by pavement, exposures will only be considered potentially significant for future-use scenarios (i.e., if the pavement is removed). Volatilization of chemicals and release of airborne particulates via wind erosion are potentially significant pathways of on-site inhalation exposure if significant surface contamination exists. Direct contact with contaminated soil via dermal contact and incidental soil ingestion is another potentially significant exposure pathway. Storm water runoff, volatile emissions, wind erosion, and direct contact with soil are not secondary release mechanisms at SWMUs covered by pavement or buildings.

3.5 PUBLIC HEALTH AND ENVIRONMENTAL IMPACTS

A Baseline Risk Assessment (BRA) may be conducted as a follow-on to this RFI for some or all of the SWMUs. This will require a modification to the SOS by the USACE. The data quality considerations for this RFI include as an objective that all data be of a quality to support a BRA should one be required at a later time.

3.6 PRELIMINARY IDENTIFICATION OF REMEDIAL ACTION TECHNOLOGIES

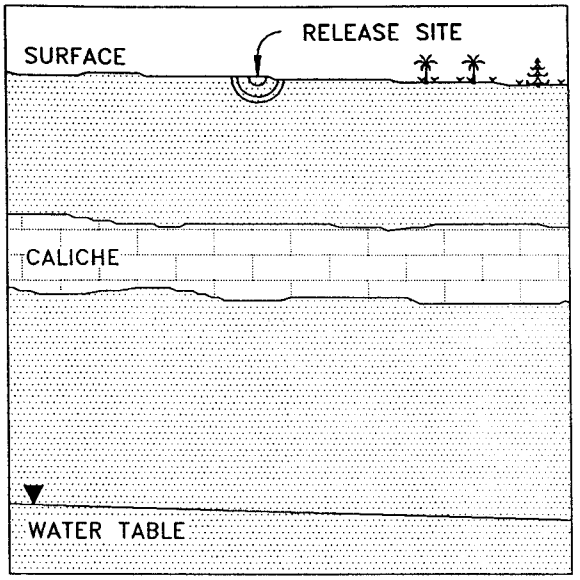
Possible corrective measures technologies have been preliminarily identified for the sites where enough data is available to do so. At this time the technologies under consideration include no action, excavation and removal or landfarming of soil vapor extraction, where soil permeabilities allow, of contaminated soils, and in situ bioremediation. During potential future Corrective Measure Studies (CMS) under RCRA these and perhaps other corrective measures technologies will need to be identified and evaluated.

The scope of this RFI does not involve any CMS activities. No further evaluation of corrective measures is anticipated within this RFI.

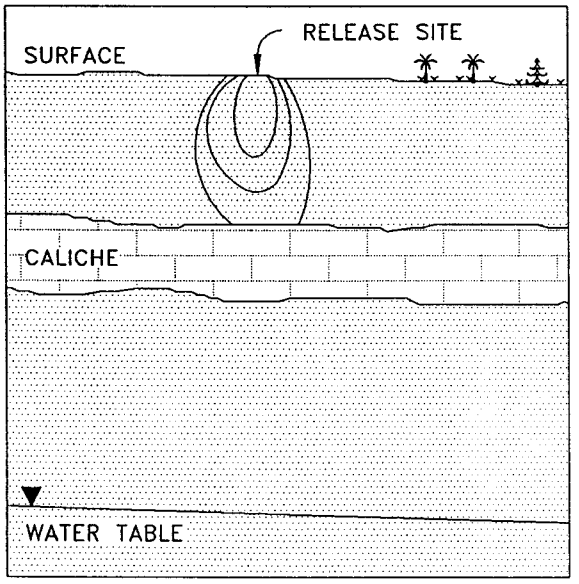
TABLE 3-1

DQO THREE-STAGE PROCESS

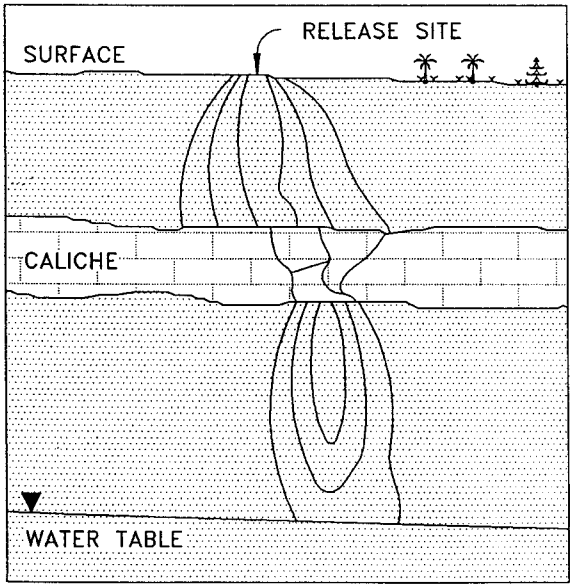
STAGE 1	STAGE 2	STAGE 3
IDENTIFY DECISION TYPES	IDENTIFY DATA USES/NEEDS	DESIGN DATA COLLECTION PROGRAM
• Identify and involve data users	• Identify data uses	• Assemble data collection components
• Evaluate available data	• Identify data types	• Develop data collection documentation
• Develop conceptual model	• Identify data quality needs	
• Specify objectives/decisions	• Identify data quantity needs	
	• Evaluate sampling/analysis options	
	• Review PARCC parameters	



A. SINGLE EVENT RELEASE OF A SMALL QUANTITY.



A. SINGLE EVENT RELEASE OF A LARGE QUANTITY.



A. CONTINUOUS RELEASE OF CONTAMINANTS. NOTE MIGRATION OF LIQUIDS THROUGH FRACTURES IN THE CALICHE.

NO SCALE

DRN BY JWB	DATE 08/19/92	PENDANT PLUMES CANNON AIR FORCE BASE NEW MEXICO	PROJECT No.	FIG. No.
CHK'D BY	REVISIONS: 0		C3M11W	3-1

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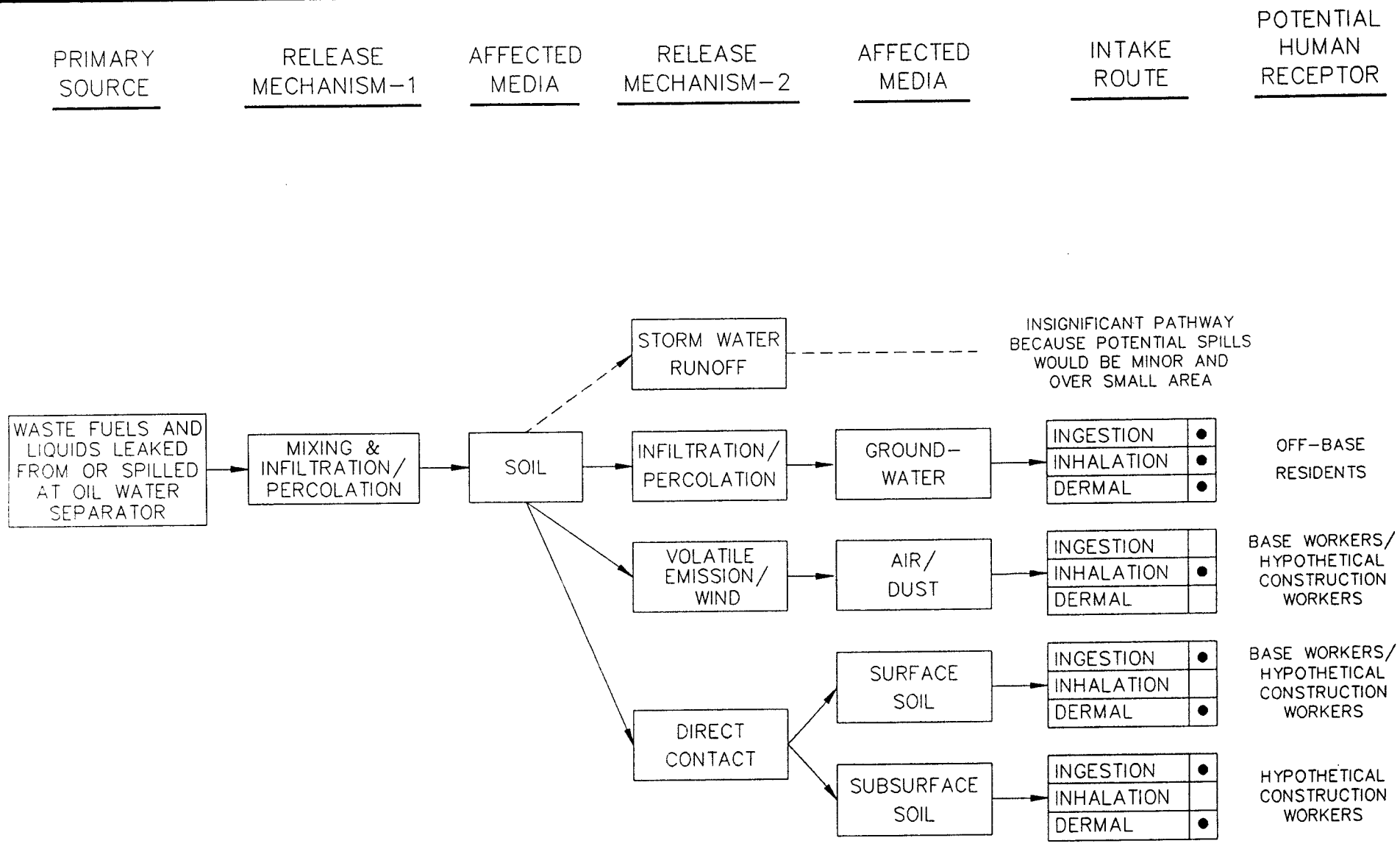


NOTE:

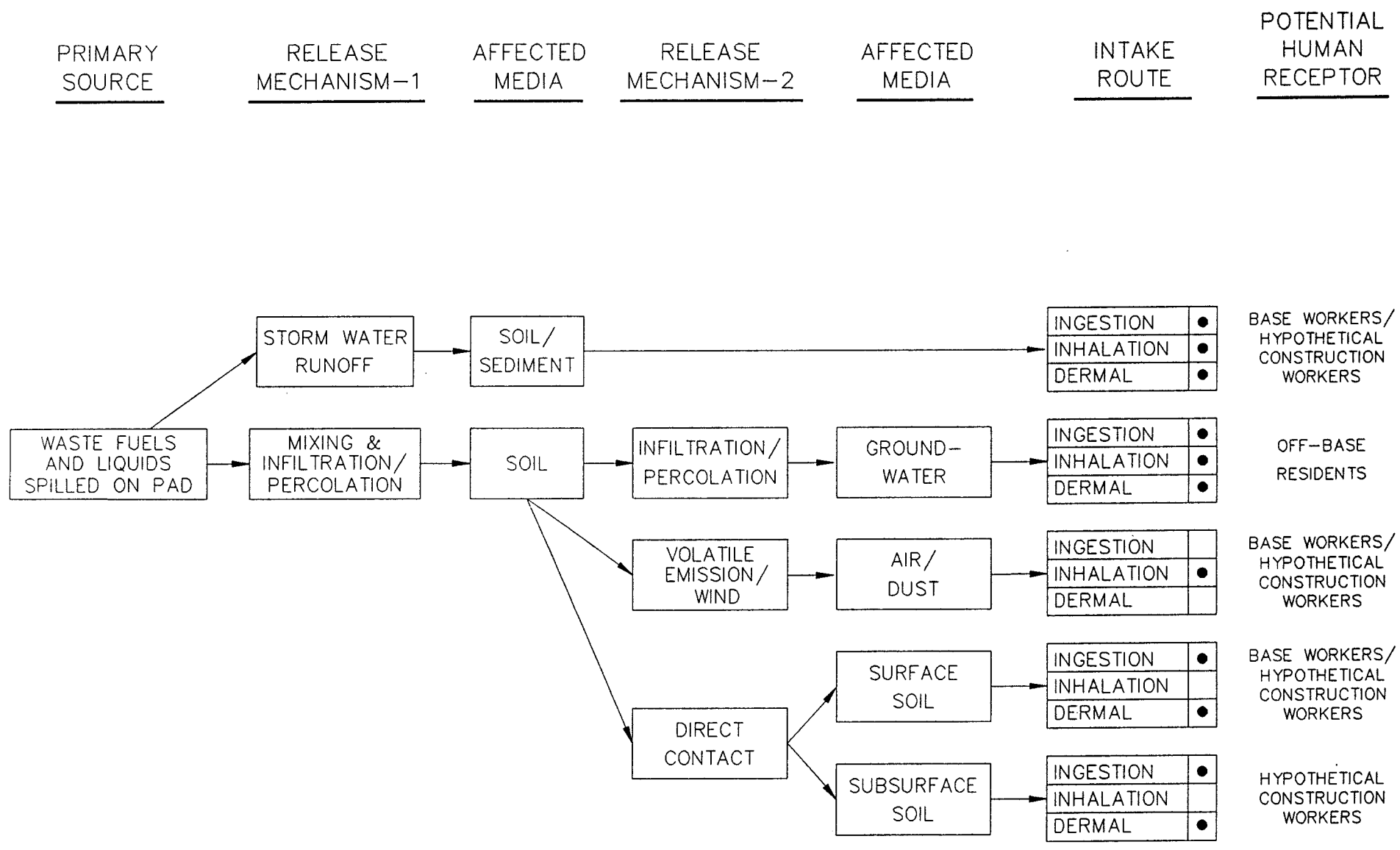
SOLID LINES REPRESENT POTENTIALLY COMPLETE PATHWAYS

DASHED LINES REPRESENT INCOMPLETE OR INSIGNIFICANT PATHWAYS

ONLY FUTURE USE EXPOSURES WILL BE CONSIDERED FOR SOILS PRESENTLY COVERED BY PAVEMENT

DRN BY JWB	DATE 08/19/93	PRELIMINARY EXPOSURE PATHWAY FLOW CHART OIL WATER SEPARATORS (SWMU's 46,47,51,57,61,62,63,70,92,93,94,127) CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W
CHK'D BY .	REVISIONS: 0		FIG. NO. 3-2

CAD FILE: C3M11W15.DWG V=MAINTINANCE 08/19/1993 15:04



NOTE:

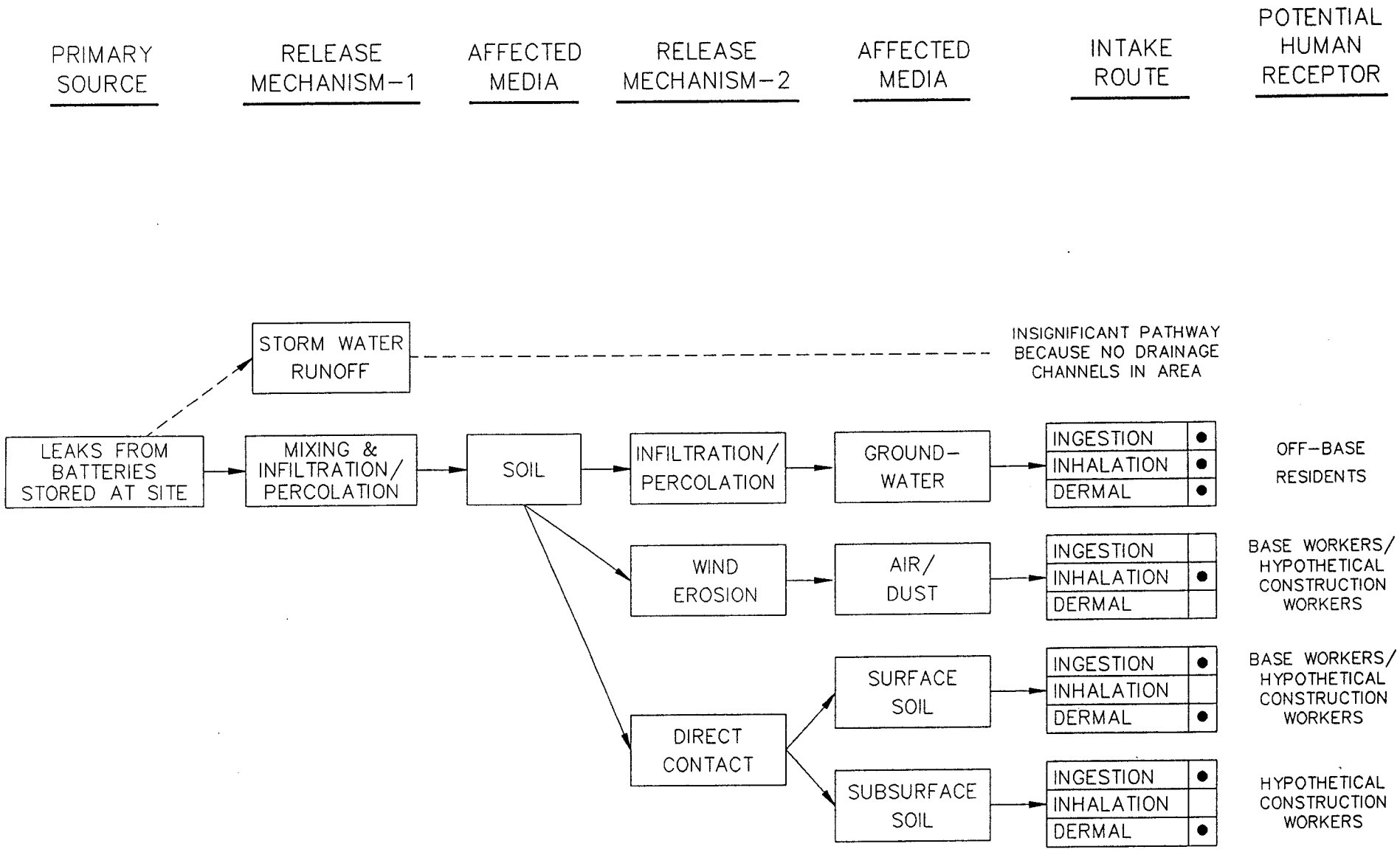
SOLID LINES REPRESENT POTENTIALLY COMPLETE PATHWAYS

DASHED LINES REPRESENT INCOMPLETE OR INSIGNIFICANT PATHWAYS

ONLY FUTURE USE EXPOSURES WILL BE CONSIDERED FOR SOILS PRESENTLY COVERED BY PAVEMENT

DRN BY JWB	DATE 08/19/93	PRELIMINARY EXPOSURE PATHWAY FLOW CHART AGE MAINTINANCE SHOP PAD SWMU - 31 CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO.	FIG. NO.
CHK'D BY	REVISIONS: 0		C3M11W	3-3

CAD FILE: C3M11W15.DWG V=BATTERY 08/19/1993 15:04



NOTE:

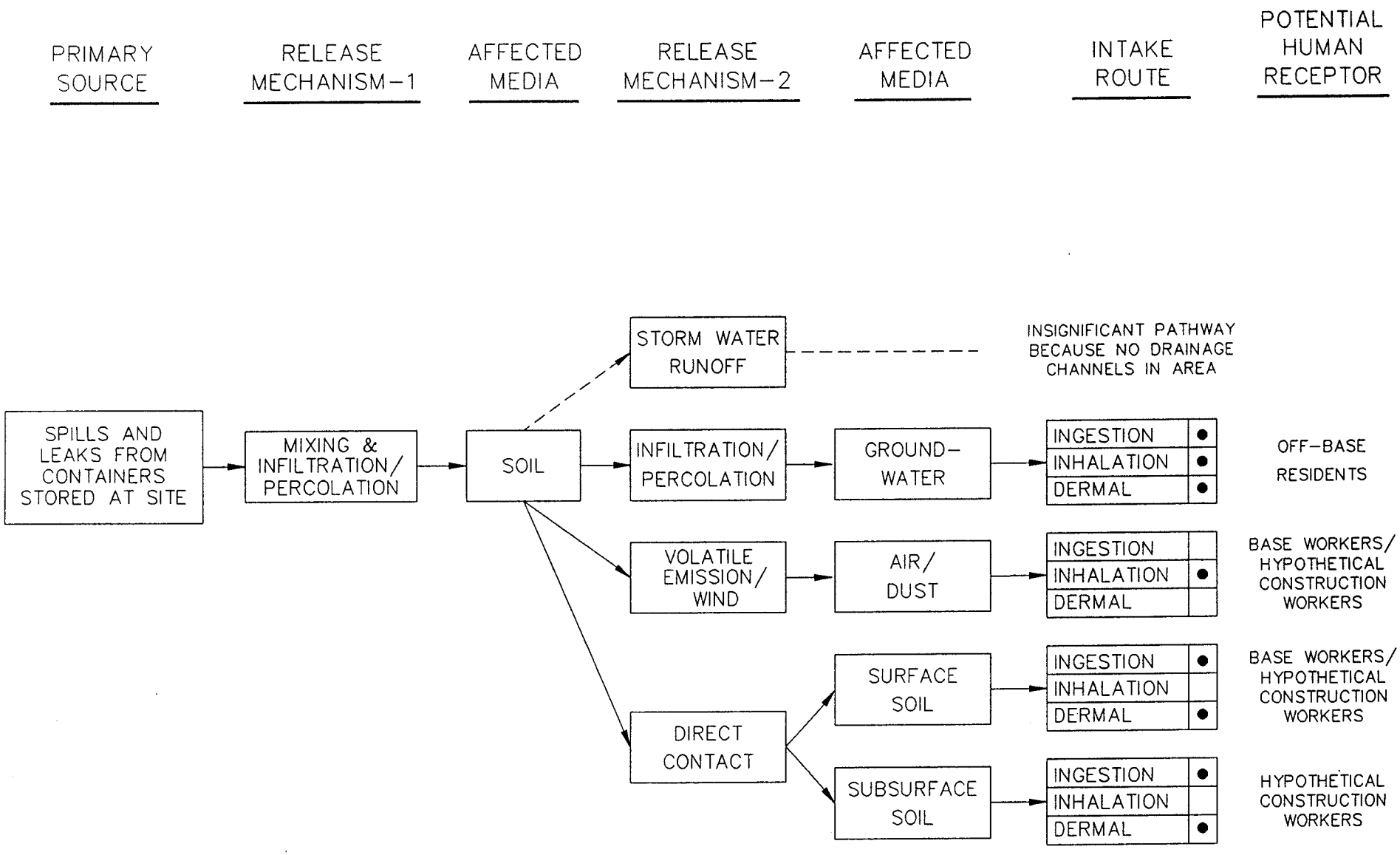
SOLID LINES REPRESENT POTENTIALLY COMPLETE PATHWAYS

DASHED LINES REPRESENT INCOMPLETE OR INSIGNIFICANT PATHWAYS

ONLY FUTURE USE EXPOSURES WILL BE CONSIDERED FOR SOILS PRESENTLY COVERED BY PAVEMENT

DRN BY JWB	DATE 08/19/93	PRELIMINARY EXPOSURE PATHWAY FLOW CHART LEAD ACID BATTERY STORAGE SITE SWMU - 55 CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W
CHK'D BY	REVISIONS: 0		FIG. NO. 3-4

CAD FILE: C3M11W15.DWG V=STORAGE 08/19/1993 15:04



NOTE:

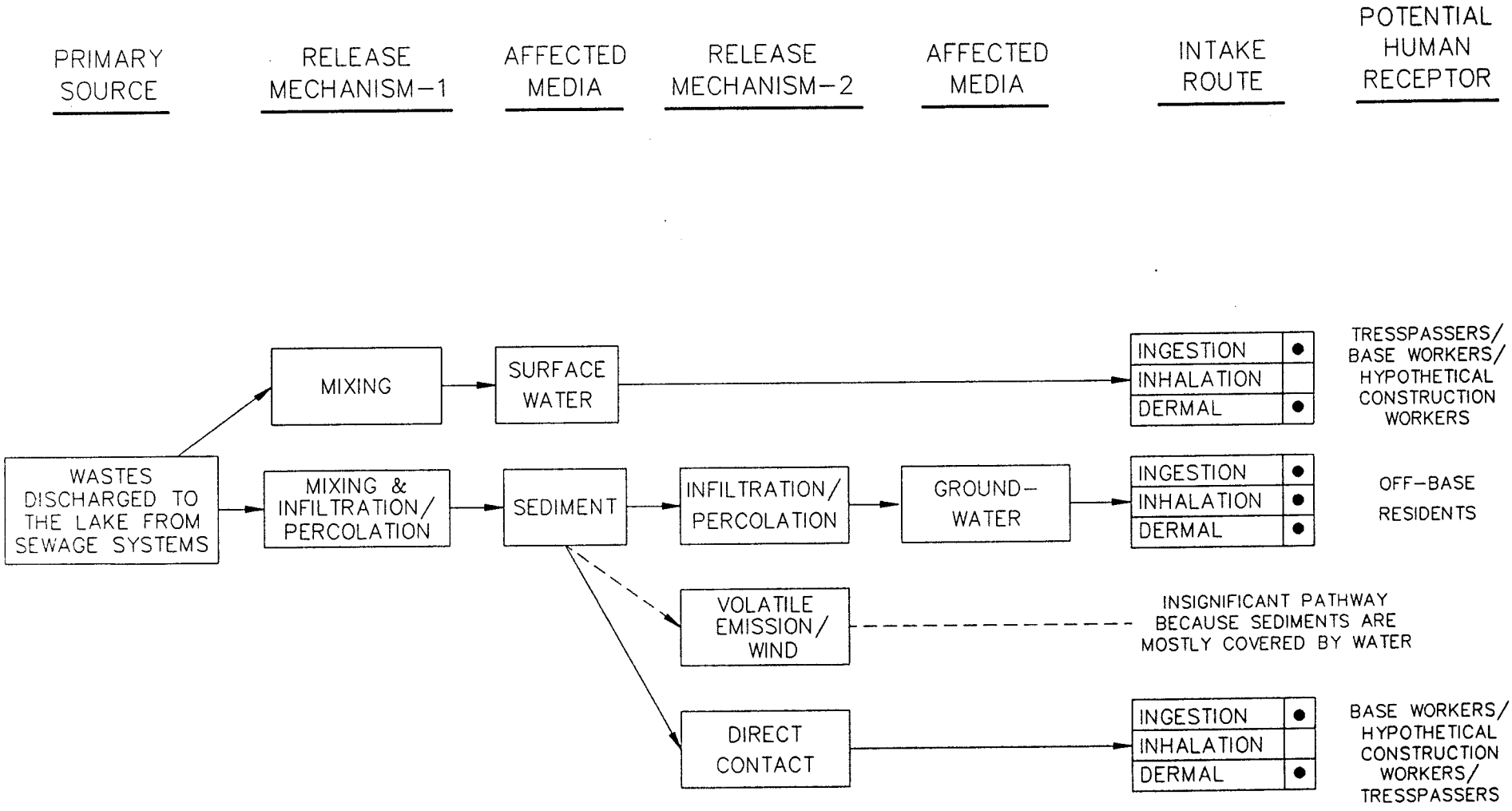
SOLID LINES REPRESENT POTENTIALLY COMPLETE PATHWAYS

DASHED LINES REPRESENT INCOMPLETE OR INSIGNIFICANT PATHWAYS

ONLY FUTURE USE EXPOSURES WILL BE CONSIDERED FOR SOILS PRESENTLY COVERED BY PAVEMENT

DRN BY JWB	DATE 08/19/93	PRELIMINARY EXPOSURE PATHWAY FLOW CHART CIVIL ENGINEERING CONAINER STORAGE AREA SWMU - 77 CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO.	FIG. NO.
CHK'D BY .	REVISIONS: 0		C3M11W	3-5

CAD FILE: C3M11W15.DWG V=LAKE 08/20/1993 16:58



NOTE:

SOLID LINES REPRESENT POTENTIALLY COMPLETE PATHWAYS

DASHED LINES REPRESENT INCOMPLETE OR INSIGNIFICANT PATHWAYS

DRN BY JWB	DATE 08/19/93	PRELIMINARY EXPOSURE PATHWAY FLOW CHART WASTEWATER PLAYA LAKE SWMU - 103 CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W
CHK'D BY	REVISIONS: 0		FIG. NO. 3-6

4.0
DQO STAGE II - WORK PLAN RATIONALE

The Work Plan rationale used is established to achieve the Data Quality Objectives (DQOs). Section 4 outlines the assessment of the data needs, data gaps, SWMU investigation approach, and data quality requirements needed to meet the objectives of the RFI. This forms the basis for completing the RFI.

The focus of the RFI is the investigation of potential soil, sediment, and surface water contamination that may have resulted from current or historical activities at 16 SWMUs located on Cannon AFB. The DQO process has been used to develop sampling plans and sample locations for the 16 SWMUs. The resulting sample locations are shown in Figures 4-2 through 4-12. The overall objective of this investigation at each SWMU is to evaluate whether or not a release of SWMU-related chemicals has occurred which could pose a significant risk to human health or the environment.

4.1 DATA QUALITY OBJECTIVES

The above objective suggests the following Data Quality Objectives.

- Collect environmental data of sufficient quality and quantity to characterize the nature and extent of contamination resulting from a release of SWMU-related chemicals to the degree that the potential for significant risk to human health or the environment can be determined.

- Collect environmental data of sufficient quality and quantity to evaluate the potential for releases to migrate toward receptors in all significant pathways as determined from conceptual modeling.

- Collect environmental data of sufficient quality to be used in a Health and Environmental Assessment, and collect data of sufficient quantity to address all appropriate exposure pathways.

- Collect sufficient quality and quantity of environmental data to support a recommendation of "no further action," if warranted, following the evaluation of the findings of the investigation.

- Collect data of a quality that can be used as part of any required follow-on study including a Corrective Measures Study.

4.2 DQO EVALUATION PROCESS

The following decision process has been used to assess the SWMU data needs and investigative approach for a SWMU. The DQO evaluation process is designed to provide data of sufficient quality and quantity to evaluate whether a release has occurred from a SWMU that could pose a risk to human health or the environment and to evaluate the need for additional data to complete a human health and environmental assessment (HEA) and possibly a Corrective Measure Study. The procedures to assess the data needs and investigative approach at each SWMU include:

- Assess existing site information to gather information regarding potential chemicals of concern and identify suspected sites of potential releases. Potential chemicals of concern are identified based on known uses of the site. The potential chemicals of concern have been determined by information provided concerning operating activities of each SWMU. If the list of potential chemicals of concern cannot be reduced based on known uses of the site the hazardous compounds identified in the QAPP will be considered the potential chemicals of concern. Sampling locations are identified based on information regarding releases that may have occurred from the SWMU (i.e., areas where the highest concentrations of SWMU-related chemicals are expected). Sampling locations are finalized by integrating the sampling locations from the Cannon AFB June 1992 FSP with the locations needed to fulfill the data needs required by the data quality objectives. The locations shown in Figures 4-2 through 4-12 are the result of this process.

- Collect soil, sediment, and surface water data to characterize the nature and extent of contamination that has been released from the SWMU, including an

evaluation of the potential for chemicals of concern to be transported to the groundwater at concentrations that may pose a human health threat. The nature and extent will be characterized at the suspected release sites; i.e., the areas with greatest concentrations of chemicals of concern, so that it can be evaluated as to whether a release has occurred which could pose a risk to human health or the environment. In addition, nature and extent will be characterized so that appropriate exposure pathways can be addressed in an HEA.

- Evaluate analytical results and determine chemicals of concern

- Evaluate potential impact to groundwater by determining if the vertical distribution of contamination decreases with depth. If it does not significantly decrease, it may not be possible to evaluate the impact to groundwater; so further investigation may be required.

- Compare maximum detected soil, sediment, and surface water concentrations of chemicals of concern to conservative risk based concentrations (RBCs) to evaluate whether a release has occurred that may pose an unacceptable risk to human health or the environment in the present or future.

- If the concentration of any SWMU-related chemicals of concern exceed RBCs, an HEA will be recommended.

- If the concentration of none of the SWMU-related chemicals of concern exceed RBCs, the concentration of contaminants must be insignificant, and therefore no further investigation will be recommended.

A decision diagram (Figure 4-1) was developed for the Cannon AFB RFI SWMUs to present a logical decision process that will be used to evaluate the data resulting from the investigation at each SWMU to assure that project objectives are met. This diagram shows the decision process to evaluate the soils and sediment/surface water exposure pathway.

4.3 RFI INVESTIGATION DECISION PROCESS

The RFI soils investigation decision process is designed to identify appropriate recommended actions for disposition of each SWMU investigated based on three alternative recommended actions for any given SWMU: no further action, interim action, and further investigation and evaluation in a final RFI/Corrective Measures Study (CMS). The recommendation for the selection of alternative action for each SWMU will depend upon whether chemicals of concern are detected in soils at levels that may pose an unacceptable risk to human health or the environment. This section provides a summary of the decision-making process that will be used to evaluate each SWMU. The methods proposed to provide screening-level human health and environmental risk evaluations are also presented in this section.

The decision process will be implemented by first evaluating and summarizing existing historical information and analytical data collected for each of the SWMUs. Historical information will be used to identify potential chemicals of concern and to identify potential sites of chemical release at a SWMU. Then environmental media will be sampled and analyzed for potential chemicals of concern. The analyte lists from which chemicals of concern will be selected are discussed in the QAPP. Sampling will be focused at points of potential releases from the SWMUs. SWMU-related chemicals of concern will be selected by identifying chemicals reported above the analytical reporting limits. Metals that do not exceed background levels will not be included as chemicals of concern. Organic chemicals that do not have EPA toxicity factors will not be considered as chemicals of concern. Concentrations of chemicals of concern detected at each SWMU will be evaluated for potential human health and environmental risks by completing a screening-level risk evaluation.

The risk evaluations are screening-level because they compare maximum detected concentrations (which are higher than concentrations to which people or ecological receptors would routinely be exposed) to highly conservative (protective) health risk-based criteria. For example, health risk-based criteria used in the evaluations are based on residential exposure assumptions, which are more stringent than criteria based on industrial use. Health risk-based criteria are based on 10^{-7} excess cancer risk or hazard quotient equal to 0.1. This conservative approach permits identifying SWMUs that pose no unacceptable risk under highly conservative exposure assumptions and that, therefore, warrant no further evaluation or action, and

identifying other SWMUs that may warrant further evaluation based on exceedance of stringent risk-based criteria.

The results of this screening-level risk evaluation will be used to analyze each SWMU and make recommendations regarding the three alternatives stated above. The recommendations will be made on the following basis:

- If no threat to human health exists based on comparison of maximum concentrations to stringent screening criteria, and no potential threat to the environment is apparent, then no further action will be recommended.

- If an unacceptable threat to human health or the environment is imminent, a source is well defined, and a source control is readily identified, an interim action to control the source will be recommended.

- If there is a potential threat to human health, the SWMU will be further evaluated by completing a Health and Environmental Assessment (HEA) on the SWMU.

4.4 DESCRIPTION OF THE DECISION PROCESS

The objective of the decision process is to evaluate each SWMU and to recommend appropriate actions for each SWMU. This decision process is designed for evaluation of the investigative results from the RFI on each SWMU and the screening-level risk evaluation. This process has also been used for the evaluation of existing historical data and the development of a sampling program designed to sample locations where the greatest contamination would be expected if releases had occurred. Figure 4-1 presents the decision diagram that will be followed for the SWMU investigations. The decision process consists of nine steps, which are described below.

Step 1: Evaluate analytical results from each SWMU to identify chemicals of concern (COCs). COCs are defined as chemicals whose concentrations exceed background levels, that are potentially SWMU-related, and that have EPA-

established toxicity values or that can otherwise be evaluated semi-quantitatively on a health risk basis (e.g., lead).

Step 2: Evaluate the potential impact to groundwater by assessing the vertical distribution of contamination. If significant concentrations of chemicals of concern do not decrease with depth, the impact to groundwater cannot be assessed, so further investigation will be recommended. Proceed to Step 3. If the concentrations of chemicals of concern decrease with depth, proceed to Step 4.

Step 3: Consult with project managers to develop investigation approach to collect data to characterize the potential for contaminants to be transported to groundwater. Proceed to Step 2.

Step 4: Compare the maximum concentrations detected at the SWMU with risk-based concentrations (RBCs). Samples will be taken at locations where the greatest contamination would be expected if releases had occurred (based on exposure pathway evaluation and field screening techniques). Therefore, the maximum detected chemical concentrations detected at each SWMU represent concentrations that would pose reasonable maximum human health risks at the SWMU. If no SWMU concentrations of COCs exceed RBCs, then no further action will be recommended. If any COCs are detected at concentrations exceeding RBCs, proceed to Step 5.

Step 5: Evaluate available data to determine if they are adequate to complete an HEA. If data are not adequate to complete an HEA, proceed to Step 6. If data are adequate to complete an HEA, proceed to Step 7.

Step 6: Consult with project managers and recommend collection of additional data as needed.

Step 7: Complete an HEA for the SWMU. The HEA uses more-detailed assessment methodologies (e.g., calculation of reasonable maximum exposure point concentrations based on all data from the SWMU and evaluation of

site-specific exposure scenarios) than are applied in the screening-level evaluation. This more-detailed evaluation is not needed at SWMUs that do not pose unacceptable risks based on the conservative screening-level risk evaluation. If no unacceptable risk is present, no further action for the SWMU will be recommended. If an unacceptable risk is present, proceed to Step 8.

Step 8: Evaluate the HEA to evaluate whether there is an imminent threat to human health. If an imminent health threat is present, an interim action will be recommended; proceed to Step 9. If no imminent threat is present, proceed to Step 10.

Step 9: Recommend design and conduct of Interim Action.

Step 10: Conduct a Corrective Measures Study for the SWMU.

4.5 SCREENING-LEVEL HEALTH RISK EVALUATION METHODOLOGY

This section provides a description of the approach that will be used in the screening-level health risk evaluation for each SWMU. Potential human health impacts will be evaluated by comparing maximum chemical concentrations found at that SWMU with risk-based concentrations (RBCs) that are calculated for this report using conservative health-based criteria.

The goal of this evaluation process is to make a determination as to whether or not a release has occurred at a SWMU that could pose a potential risk to human health or the environment. The risk-based approach outlined in this section provides an upper-bound estimate of potential human health impacts because conservative screening criteria and maximum chemical concentrations are used to estimate potential impacts. If no potential human health or environmental risks are indicated for a given SWMU using these conservative criteria, then no further investigation is recommended for a SWMU.

4.5.1 Derivation of Screening Criteria

Using RCRA guidance, the maximum concentrations of SWMU chemicals will be compared with risk-based criteria. These criteria were derived using the methodology described in RCRA Proposed Action Levels (EPA 1990).

The RBCs will be calculated using the methodology defined in RCRA Subpart S to calculated RCRA Action Levels; however, unlike Subpart S, these RBCs are based on 10^{-7} excess cancer risk or 0.1 hazard quotient. Subpart S action levels are based on 1×10^{-6} excess cancer risk for Class A (known) and Class B (probable) human carcinogens and a 1×10^{-5} excess cancer risk for Class C (possible) carcinogens, or a hazard quotient equal to 1 for ingestion assuming residential exposures. The lower risk level of 10^{-7} is imposed for screening in order to account for the possible additive effects of multiple exposure routes in addition to ingestion (i.e., dermal contact and inhalation of vapors or particulates released from soil), and exposure to multiple chemicals. The sources for the critical toxicity values (slope factors and reference doses) used to calculate RBCs will be the EPA's computer database, the Integrated Risk Information System [IRIS], which is updated on a monthly basis (EPA 1993), and the EPA's Health Effects Summary Tables [HEAST] (EPA 1993). It must be emphasized that this is a highly conservative approach used for screening purposes only; risks that would be estimated in a SWMU-specific quantitative HEA are likely to be much lower than the risk levels calculated using these screening criteria.

For noncarcinogens, RBCs are the concentrations in soil that are estimated to result in a "hazard quotient" (HQ) of 0.1 to a resident at the SWMU. A hazard quotient is the ratio of the estimated daily dose from the assumed exposure to a reference dose (RfD), established by EPA, that is considered safe for a lifetime of daily exposure. A hazard quotient of 1 means that no toxic effects are likely to occur, even to sensitive individuals exposed for a lifetime. A hazard quotient above 1 does not mean that toxic effects will necessarily occur, but that further evaluation of exposures and chemical toxicity is required. The more conservative HQ of 0.1 is used for screening to account for exposure to multiple chemicals and for exposure routes other than ingestion, such as dermal contact and inhalation of vapors or particulates released from soil. This is a highly conservative approach used for screening purposes only.

A maximum chemical concentration that exceeds a screening-level RBC does not mean that a health risk exists because the maximum concentration detected is not the concentration to which people would routinely be exposed, and the exposure assumptions used to derive the RBCs are for residential land use (not realistic for these SWMUs) and are not SWMU-specific. For example, the EPA-suggested intake parameters assume (1) that soil ingestion rates are 200 mg/day for children age 0 to 6 and 100 mg/day for adults, even though recent studies cited by EPA indicate soil ingestion rates may be significantly lower (by a factor of 4 or 5; Calabrese et al. 1989; Davis et al 1990); (2) that all of the soil/dust ingested per day is from contaminated soils at the SWMU; and (3) that exposure occurs daily for 30 years (6 years at the "child" soil ingestion rate of 200 mg/day). These assumptions could overestimate "reasonable maximum exposures", even for residential use. None of these "default" assumptions apply to current or likely future exposures at Cannon AFB. Based on the preliminary exposure evaluation, no residential exposures of any duration or magnitude occur or are likely to occur at these SWMUs. Occupational exposures are significantly less than residential, and conditions such as cold weather and clean soil cover would reduce or prevent contact with potentially contaminated soil.

It is important to note that RBCs are not cleanup goals. Cleanup goals are determined on a SWMU-specific basis. Rather, comparing soil concentrations to screening-level RBCs based on residential use, a 10^{-7} excess cancer risk level, and a HQ of 0.1 for noncarcinogens is adopted as a means of screening whether the chemicals in soils could pose a threat to human health. If the screening-level RBCs are not exceeded, no further action is recommended. If the screening-level RBCs are exceeded, a baseline HEA will be performed in the final RFI.

4.6 SWMU-SPECIFIC DQO PROCESS

The DQO process is applied to each SWMU as described in the following sections.

4.6.1 AGE Maintenance Shop Pad (SWMU 31)

This section describes the data needs and investigative activities for the AGE Maintenance shop pad (SWMU 31).

The AGE Maintenance shop pad is an open concrete area that surrounds Building 186 (Figure 4-2). The pad is approximately 50 feet wide and 100 feet long. Maintenance on aircraft support equipment is performed in Building 186 and on the south and east areas of the concrete pad. Staining is evident on the south and east portion of the pad; the north and west areas of the pad are stain free. The unit has been active since 1971. Wash-down water may flow off of the eastern portion of the pad onto the soil near the AGE drainage ditch. Major surface runoff is carried away by the AGE drainage ditch (SWMU No. 34) which was investigated by W-C in the Appendix I (first) set of SWMUs.

4.6.1.1 Data Needs

The data needed to meet the objectives of the investigation at this SWMU are:

- Characterization of concentrations of SWMU-related chemicals in surface soil at potential release points from the SWMU (i.e., at the area of highest anticipated concentration)

- Characterization of concentrations of SWMU-related chemicals in subsurface soil at potential release points from the SWMU (i.e., at the area of highest anticipated concentration)

- Characterization of the vertical distribution of concentrations of SWMU-related chemical of concern in soil to address the potential for transport to groundwater at concentrations of concern

4.6.1.2 Data Gaps

Since no previous fieldwork has been conducted for the RFI at this SWMU, the data gaps are identical to the data needs stated above.

4.6.1.3 SWMU Investigative Approach

The goal of the investigation is to satisfy the data needs; i.e., to eliminate the data gaps identified above. Potential release points from this SWMU include cracks in the pavement

where contaminants may have been transported to the underlying soils and the soil near the edge of the maintenance pad where wash water may have carried contaminants. Proposed sample locations and numbers are included in the field sampling plan. Soil borings will be drilled at potential release sites as indicated in Figure 4-2. Surface soil samples (from the soil borings) will be taken to evaluate whether the concentrations of SWMU-related chemicals at the surface (i.e., from a surface release) could pose a potential risk to human health or the environment. If the boring is located on the concrete pad, the surface soil sample will be taken from immediately beneath the pavement. Subsurface soil samples will be collected from the borings at depths of potential release sites to evaluate whether subsurface releases could pose human health or environmental risks. The subsurface soil samples collected will also be used to characterize the vertical distribution of contamination, so that the potential impact to groundwater can be addressed.

4.6.2 Oil/Water Separator 196 (SWMU 46)

This section describes the data needs and investigative activities for the oil/water separator at SWMU 46.

Oil/water separators are essentially underground tanks which receive waste water along with waste fuels, oils, etc. from Canon AFB facilities. In oil/water separators, water collects at the bottom and is removed through underground piping to the sanitary sewer, while fuels and oils which are less dense than water collect at the top of the water and are removed by pumping. Releases (if any) may have occurred either via underground leaks in the oil/water separators or via spills at the surface during pumping to disposal trucks. If releases have occurred as a result of the pumping activity, they should be limited to a small area surrounding the oil/ water separator opening.

The oil/water separator at SWMU 46 is located on the south east corner of Building 196 (Figure 4-3). Oil/water separator no. 196 is a three-compartment underground unit with a 560-gallon main compartment and a 135-gallon oil compartment. The unit is constructed of concrete and has been active since 1969.

4.6.2.1 Data Needs

The data needed to meet the objectives of the investigation at this SWMU are:

- Characterization of concentrations of SWMU-related chemicals in surface soil at potential release points from the SWMU (i.e., at the area of highest anticipated concentration)

- Characterization of concentrations of SWMU-related chemicals in subsurface soil at potential release points from the SWMU (i.e., at the area of highest anticipated concentration)

- Characterization of the vertical distribution of concentrations of SWMU-related chemical of concern in soil to address the potential for transport to groundwater at concentrations of concern

4.6.2.2 Data Gaps

Since no previous fieldwork has been conducted for the RFI at this SWMU, the data gaps are identical to the data needs stated above.

4.6.2.3 SWMU Investigative Approach

The goal of the investigation is to satisfy the data needs; i.e., to eliminate the data gaps identified above. Potential release points from this SWMU include leaks in the underground compartments, the connections for the inlet and outlet pipes, possible overflows of the compartments, and spills during oil removal. Soil borings will be drilled near the inlet and outlet pipes (Figure 4-3) to a depth sufficiently below the bottom of the unit where potential leaks from the bottom of the unit would be detected. Proposed sample locations and numbers are included in the field sampling plan. Surface soil samples (at the soil boring locations) will be taken to evaluate whether the concentrations of SWMU-related chemicals at the surface (i.e., from potential surface releases) could pose a potential risk to human health or the environment. For borings drilled through pavement, surface soil samples will be collected immediately beneath the pavement. Subsurface soil samples will be collected from the

borings to evaluate whether potential subsurface releases could pose human health or environmental risks. The subsurface soil samples collected will also be used to characterize the vertical distribution of contamination, so that the potential impact to groundwater can be addressed.

4.6.3 Oil/Water Separator 494 (SWMU 47)

This section describes the data needs and investigative activities for the oil/water separator and sand trap at SWMU 47.

The oil/water separator number 494 is located adjacent to the north wall of Building 494 (Figure 4-4). This separator is a three-compartment underground unit with a 50-gallon main compartment and a 50-gallon oil compartment. The unit is constructed of concrete. This oil/water separator receives wash water generated from vehicle maintenance operations conducted in Building 494. This effluent contains petroleum and synthetic lubricating oils and dirt. The units have been active since 1982. A 200-gallon concrete sand trap is located on the northeast corner of the building. The sand trap receives wash-down water from an auto body sanding booth located in the northeast corner of Building 494.

4.6.3.1 Data Needs

The data needed to meet the objectives of the investigation at this SWMU are:

- Characterization of concentrations of SWMU-related chemicals in surface soil at potential release points from the SWMU (i.e., at the area of highest anticipated concentration)

- Characterization of concentrations of SWMU-related chemicals in subsurface soil at potential release points from the SWMU (i.e., at the area of highest anticipated concentration)

- Characterization of the vertical distribution of concentrations of SWMU-related chemical of concern in soil to address the potential for transport to groundwater at concentrations of concern

4.6.3.2 Data Gaps

Since no previous fieldwork has been conducted for the RFI at this SWMU, the data gaps are identical to the data needs stated above.

4.6.3.3 SWMU Investigative Approach

The goal of the investigation is to satisfy the data needs; i.e., to eliminate the data gaps identified above. Potential release points from this SWMU include leaks in the underground compartments, the connections for the inlet and outlet pipes, possible overflows of the compartments, and spills during oil or sand removal. Soil borings will be drilled near the inlet and outlet pipes (Figure 4-4) to a depth sufficiently below the bottom of the units where potential leaks from the bottom of the units would be detected. Proposed sample locations and numbers are included in the field sampling plan. Surface soil samples (from the soil borings) will be taken to evaluate whether the concentrations of SWMU-related chemicals at the surface (i.e., from potential surface releases) could pose a potential risk to human health or the environment. For borings drilled through pavement, surface soil samples will be collected immediately beneath the pavement. Subsurface soil samples will be collected from the borings to evaluate whether potential subsurface releases could pose human health or environmental risks. The subsurface soil samples collected will also be used to characterize the vertical distribution of contamination, so that the potential impact to groundwater can be addressed.

4.6.4 Oil/Water Separator 375 (SWMU 51)

This section describes the data needs and investigative activities for the oil/water separator at SWMU 51.

Oil/water separators are essentially underground tanks which receive waste water along with waste fuels, oils, etc. from Canon AFB facilities. In oil/water separators, water collects at the bottom and is removed through underground piping to the sanitary sewer, while fuels and oils which are less dense than water collect at the top of the water and are removed by pumping. Releases (if any) may have occurred either via underground leaks in the oil/water separators or via spills at the surface during pumping to disposal trucks. If releases have occurred as

a result of the pumping activity, they should be limited to a small area surrounding the oil/ water separator opening.

The oil/water separator number 375 is located on the northwest side of Building 375 (Figure 4-5). This is a two compartment underground unit with a total capacity of 1,000 gallons. The unit is constructed of concrete. The unit receives wash water generated from vehicle maintenance operations. This effluent contains petroleum and synthetic lubricating oil and dirt. This unit has been active since 1968.

4.6.4.1 Data Needs

The data needed to meet the objectives of the investigation at this SWMU are:

- Characterization of concentrations of SWMU-related chemicals in surface soil at potential release points from the SWMU (i.e., at the area of highest anticipated concentration)

- Characterization of concentrations of SWMU-related chemicals in subsurface soil at potential release points from the SWMU (i.e., at the area of highest anticipated concentration)

- Characterization of the vertical distribution of concentrations of SWMU-related chemical of concern in soil to address the potential for transport to groundwater at concentrations of concern

4.6.4.2 Data Gaps

Since no previous fieldwork has been conducted for the RFI at this SWMU, the data gaps are identical to the data needs stated above.

4.6.4.3 SWMU Investigative Approach

The goal of the investigation is to satisfy the data needs; i.e., to eliminate the data gaps identified above. Potential release points from this SWMU include leaks in the underground

compartments, the connections for the inlet and outlet pipes, possible overflows of the compartments, and spills during oil removal. Soil borings will be drilled near the inlet and outlet pipes (Figure 4-5) to a depth sufficiently below the bottom of the unit where potential leaks from the bottom of the unit would be detected. Proposed sample locations and numbers are included in the field sampling plan. Surface soil samples (from the soil borings) will be taken to evaluate whether the concentrations of SWMU-related chemicals at the surface (i.e., from potential surface releases) could pose a potential risk to human health or the environment. For borings drilled through pavement, surface soil samples will be collected immediately beneath the pavement. Subsurface soil samples will be collected from the borings to evaluate whether potential subsurface releases could pose human health or environmental risks. The subsurface soil samples collected will also be used to characterize the vertical distribution of contamination, so that the potential impact to groundwater can be addressed.

4.6.5 Oil/Water Separator 379 (SWMU 57)

This section describes the data needs and investigative activities for the oil/water separator at SWMU 57.

The oil/water separator number 379 is located on the southwest side of Building 379 (Figure 4-5). This is a two-compartment underground unit with a total capacity of 500 gallons. The unit is constructed of concrete. This oil/water separator receives wash water generated from vehicle maintenance operations. This effluent contains petroleum and synthetic lubricating oils and dirt. The unit has been active since 1965.

4.6.5.1 <u>Data Needs</u>

The data needed to meet the objectives of the investigation at this SWMU are:

- Characterization of concentrations of SWMU-related chemicals in surface soil at potential release points from the SWMU (i.e., at the area of highest anticipated concentration)

- Characterization of concentrations of SWMU-related chemicals in subsurface soil at potential release points from the SWMU (i.e., at the area of highest anticipated concentration)

- Characterization of the vertical distribution of concentrations of SWMU-related chemical of concern in soil to address the potential for transport to groundwater at concentrations of concern

4.6.5.2 Data Gaps

Since no previous fieldwork has been conducted for the RFI at this SWMU, the data gaps are identical to the data needs stated above.

4.6.5.3 SWMU Investigative Approach

The goal of the investigation is to satisfy the data needs; i.e., to eliminate the data gaps identified above. Potential release points from this SWMU include leaks in the underground compartments, the connections for the inlet and outlet pipes, possible overflows of the compartments, and spills during oil removal. Soil borings will be drilled near the inlet and outlet pipes (Figure 4-5) to a depth sufficiently below the bottom of the unit where potential leaks from the bottom of the unit would be detected. Proposed sample locations and numbers are included in the field sampling plan. Surface soil samples (from the soil borings) will be taken to evaluate whether the concentrations of SWMU-related chemicals at the surface (i.e., from potential surface releases) could pose a potential risk to human health or the environment. For borings drilled through pavement, surface soil samples will be collected immediately beneath the pavement. Subsurface soil samples will be collected from the borings to evaluate whether potential subsurface releases could pose human health or environmental risks. The subsurface soil samples collected will also be used to characterize the vertical distribution of contamination, so that the potential impact to groundwater can be addressed.

4.6.6 Oil/Water Separator 5077c (SWMU 63), Sand Traps 5077a, and 5077b (SWMUs 61 and 62)

This section describes the data needs and investigative activities for the oil/water separator (SWMU 63) and the sand traps (SWMUs 61 and 62) at Facility 5077.

Facility 5077 is a vehicle washrack located in the Civil Engineering compound. The facility has two concrete 380-gallon sandtraps and one concrete 1,675-gallon oil/water separator (Figure 4-6). The sandtraps and the separator have been identified as SWMUs #61 (5077a), #62 (5077b), and #63 (5077c). These three SWMUs will be investigated as one unit for economy of scale. The unit receives wash water generated from the wash down of motor vehicles. This effluent contains petroleum and synthetic lubricating oils and dirt. Potential contaminants are the same for all three SWMUs (i.e., sand traps and oil/water separator). This unit has been active since 1957.

4.6.6.1 Data Needs

The data needed to meet the objectives of the investigation at these SWMUs are:

- Characterization of concentrations of SWMU-related chemicals in surface soil at potential release points from the SWMU (i.e., at the area of highest anticipated concentration)

- Characterization of concentrations of SWMU-related chemicals in subsurface soil at potential release points from the SWMU (i.e., at the area of highest anticipated concentration)

- Characterization of the vertical distribution of concentrations of SWMU-related chemical of concern in soil to address the potential for transport to groundwater at concentrations of concern

4.6.6.2 Data Gaps

Since no previous fieldwork has been conducted for the RFI at this SWMU, the data gaps are identical to the data needs stated above.

4.6.6.3 SWMU Investigative Approach

The goal of the investigation is to satisfy the data needs; i.e., to eliminate the data gaps identified above. Potential release points from this SWMU include leaks in the underground compartments, the connections for the inlet and outlet pipes, possible overflows of the compartments, and spills during oil or sand removal. Soil borings will be drilled near the inlet and outlet pipes (Figure 4-6) to a depth sufficiently below the bottom of the units where potential leaks from the bottom of the units would be detected. Proposed sample locations and numbers are included in the field sampling plan. Surface soil samples (from the soil borings) will be taken to evaluate whether the concentrations of SWMU-related chemicals at the surface (i.e., from potential surface releases) could pose a potential risk to human health or the environment. For borings drilled through pavement, surface soil samples will be collected immediately beneath the pavement. Subsurface soil samples will be collected from the borings to evaluate whether potential subsurface releases could pose human health or environmental risks. The subsurface soil samples collected will also be used to characterize the vertical distribution of contamination, so that the potential impact to groundwater can be addressed.

4.6.7 Oil/Water Separator 326 (SWMU 70)

This section describes the data needs and investigative activities for the oil/water separator at SWMU 70.

The oil/water separator number 326 is located on the northwest corner of Building 326 (Figure 4-7). This is a two compartment underground unit with a 50-gallon oil separator compartment and a detached 220-gallon underground oil storage tank. The separator and the tank are constructed of steel. The unit receives wash water generated from JP-4 fuel truck maintenance operations. This effluent, which drains into a 5-foot-diameter, rock filled

leaching well, may contain JP-4 fuel, petroleum and synthetic lubricating oils, and dirt. This unit has been active since 1960.

4.6.7.1 Data Needs

The data needed to meet the objectives of the investigation at this SWMU are:

- Characterization of concentrations of SWMU-related chemicals in surface soil at potential release points from the SWMU (i.e., at the area of highest anticipated concentration)

- Characterization of concentrations of SWMU-related chemicals in subsurface soil at potential release points from the SWMU (i.e., at the area of highest anticipated concentration)

- Characterization of the vertical distribution of concentrations of SWMU-related chemical of concern in soil to address the potential for transport to groundwater at concentrations of concern

4.6.7.2 Data Gaps

Since no previous fieldwork has been conducted for the RFI at this SWMU, the data gaps are identical to the data needs stated above.

4.6.7.3 SWMU Investigative Approach

The goal of the investigation is to satisfy the data needs; i.e., to eliminate the data gaps identified above. Potential release points from this SWMU include leaks in the underground compartments, the connections for the inlet and outlet pipes, possible overflows of the compartments, and spills during oil removal. Soil borings will be drilled near the inlet and outlet pipes (Figure 4-7) to a depth sufficiently below the bottom of the unit where potential leaks from the bottom of the unit would be detected. Proposed sample locations and numbers are included in the field sampling plan. Surface soil samples (from the soil borings) will be taken to evaluate whether the concentrations of SWMU-related chemicals at the surface (i.e.,

from potential surface releases) could pose a potential risk to human health or the environment. Subsurface soil samples will be collected from the borings to evaluate whether potential subsurface releases could pose human health or environmental risks. The subsurface soil samples collected will also be used to characterize the vertical distribution of contamination, so that the potential impact to groundwater can be addressed.

4.6.8 Oil/Water Separator 5120 (SWMU 92)

This section describes the data needs and investigative activities for the oil/water separator at SWMU 92.

The oil/water separator number 5120 is located east of Power Check Pad number 5120 (Figure 4-8). The separator is a two compartment unit with a detached 100-gallon oil storage tank. The unit received waste water generated from aircraft maintenance operations. This effluent, which drains into a rock filled leach well, may contain JP-4 fuel, petroleum and synthetic lubricating oils, and dirt. This unit was active from approximately 1957 to 1988. Facility 5120 was dismantled in 1988, but the oil/water separator remains in place.

4.6.8.1 Data Needs

The data needed to meet the objectives of the investigation at this SWMU are:

- Characterization of concentrations of SWMU-related chemicals in surface soil at potential release points from the SWMU (i.e., at the area of highest anticipated concentration)

- Characterization of concentrations of SWMU-related chemicals in subsurface soil at potential release points from the SWMU (i.e., at the area of highest anticipated concentration)

- Characterization of the vertical distribution of concentrations of SWMU-related chemical of concern in soil to address the potential for transport to groundwater at concentrations of concern

4.6.8.2 Data Gaps

Since no previous fieldwork has been conducted for the RFI at this SWMU, the data gaps are identical to the data needs stated above.

4.6.8.3 SWMU Investigative Approach

The goal of the investigation is to satisfy the data needs; i.e., to eliminate the data gaps identified above. Potential release points from this SWMU include leaks in the underground compartments, the connections for the inlet and outlet pipes, possible overflows of the compartments, and spills during oil removal. Soil borings will be drilled near the inlet and outlet pipes (Figure 4-8) to a depth sufficiently below the bottom of the unit where potential leaks from the bottom of the unit would be detected. Proposed sample locations and numbers are included in the field sampling plan. Surface soil samples (from the soil borings) will be taken to evaluate whether the concentrations of SWMU-related chemicals at the surface (i.e., from potential surface releases) could pose a potential risk to human health or the environment. For soil borings drilled through pavement, surface soil samples will be taken immediately beneath the pavement. Subsurface soil samples will be collected from the borings to evaluate whether potential subsurface releases could pose human health or environmental risks. The subsurface soil samples collected will also be used to characterize the vertical distribution of contamination, so that the potential impact to groundwater can be addressed.

4.6.9 Oil/Water Separator 5121 (SWMU 93)

This section describes the data needs and investigative activities for the oil/water separator at SWMU 93.

The oil/water separator number 5121 was located on the east side of Power Check Pad 5121 (Figure 4-8). The separator was a two-compartment underground unit with a detached 100-gallon oil storage tank. The unit received wash water generated from aircraft maintenance operations. This effluent contained JP-4 petroleum and synthetic lubricating oils and dirt. This unit was active from approximately 1957 to 1988. The recovered oils were directed to the 100-gallon oil holding tank and the waste water was directed to a leach well

located approximately 40 feet east of the separator. Facility 5121 was dismantled in 1988 and replaced with Facility 5123. Oil/water separator 5121 and the associated leach well were removed during the demolition of Building 5121 and the Facility 5123 was subsequently constructed on top of the separator's location.

4.6.9.1 Data Needs

The data needed to meet the objectives of the investigation at this SWMU are:

- Characterization of concentrations of SWMU-related chemicals in surface soil at potential release points from the SWMU (i.e., at the area of highest anticipated concentration)

- Characterization of concentrations of SWMU-related chemicals in subsurface soil at potential release points from the SWMU (i.e., at the area of highest anticipated concentration)

- Characterization of the vertical distribution of concentrations of SWMU-related chemical of concern in soil to address the potential for transport to groundwater at concentrations of concern

4.6.9.2 Data Gaps

Since no previous fieldwork has been conducted for the RFI at this SWMU, the data gaps are identical to the data needs stated above.

4.6.9.3 SWMU Investigative Approach

The goal of the investigation is to satisfy the data needs; i.e., to eliminate the data gaps identified above. Potential release points from this SWMU include leaks in the underground compartments, the connections for the inlet and outlet pipes, possible overflows of the compartments, and spills during oil removal, and the areas of discharge of waste water to the leach well. Soil borings will be drilled near the former locations of the oil/water separator and leach well (Figure 4-8) to a depth sufficiently below the bottoms of the units where

potential leaks from the bottoms of the units would be detected. Proposed sample locations and numbers are included in the field sampling plan. Surface soil samples (from the soil borings) will be taken to evaluate whether the concentrations of SWMU-related chemicals at the surface (i.e., from potential surface releases) could pose a potential risk to human health or the environment. Subsurface soil samples will be collected from the borings to evaluate whether potential subsurface releases could pose human health or environmental risks. The subsurface soil samples collected will also be used to characterize the vertical distribution of contamination, so that the potential impact to groundwater can be addressed.

4.6.10 Oil/Water Separator 5144 (SWMU 94)

This section describes the data needs and investigative activities for the oil/water separator and sand traps at SWMU 94.

SWMU number 94 consists of two sand traps and one 1700-gallon oil/water separator that serviced a two-bay vehicle wash rack (Figure 4-9). The washrack is located near the corner of D. L. Ingram Boulevard and Argentia Street. The units contained lubricating oils, dirt, and wash down water from vehicle washing operations. The unit was active from 1960 to approximately 1988. The facility has been dismantled, although the concrete wash bays, the sandtraps, and the separator remain in place.

4.6.10.1 Data Needs

The data needed to meet the objectives of the investigation at this SWMU are:

- Characterization of concentrations of SWMU-related chemicals in surface soil at potential release points from the SWMU (i.e., at the area of highest anticipated concentration)

- Characterization of concentrations of SWMU-related chemicals in subsurface soil at potential release points from the SWMU (i.e., at the area of highest anticipated concentration)

- Characterization of the vertical distribution of concentrations of SWMU-related chemical of concern in soil to address the potential for transport to groundwater at concentrations of concern

4.6.10.2 Data Gaps

Since no previous fieldwork has been conducted for the RFI at this SWMU, the data gaps are identical to the data needs stated above.

4.6.10.3 SWMU Investigative Approach

The goal of the investigation is to satisfy the data needs; i.e., to eliminate the data gaps identified above. Potential release points from this SWMU include leaks in the underground compartments, the connections for the inlet and outlet pipes, possible overflows of the compartments, and spills during oil or sand removal. Soil borings will be drilled near the inlet and outlet pipes (Figure 4-9) to a depth sufficiently below the bottom of the units where potential leaks from the bottom of the units would be detected. Proposed sample locations and numbers are included in the field sampling plan. Surface soil samples (from the soil borings) will be taken to evaluate whether the concentrations of SWMU-related chemicals at the surface (i.e., from potential surface releases) could pose a potential risk to human health or the environment. For borings drilled through pavement, surface soil samples will be collected immediately beneath the pavement. Subsurface soil samples will be collected from the borings to evaluate whether potential subsurface releases could pose human health or environmental risks. The subsurface soil samples collected will also be used to characterize the vertical distribution of contamination, so that the potential impact to groundwater can be addressed.

4.6.11 Oil/Water Separator Near Tank 4095 (SWMU 127)

This section describes the data needs and investigative activities for the oil/water separator at SWMU 127.

SWMU number 127 is a 135-gallon sandtrap that serves the POL refueling truck washrack at Facility 4095 (Figure 4-10). This unit is not an oil/water separator as stated in the RFA

(Kearney, 1987); an oil/water separator did not exist at the time of the RFA visual inspection. The washrack slopes to a centrally located drain that contains the sandtrap. The unit discharged to a leach field located approximately 60 feet east of the washrack. There are no above ground or below ground tanks at Facility 4095. Wash down water from fuel truck cleaning operations contain a biodegradable cleaning compound that consists of 5% by weight ethylene glycol-n-butyl ether. Potential contaminants include JP-4 fuel, grease, and motor oil. This unit has been active since 1977. However, the leach field ceased to function in the late 1980's. An oil/water separator enclosed in a concrete vault was subsequently installed in the washrack's drain pipe in May 1991. The waste water drains to a new leach field located approximately 40 feet southeast of the washrack. The original leach field (now inactive) and sandtrap remain in place.

4.6.11.1 Data Needs

The data needed to meet the objectives of the investigation at this SWMU are:

- Characterization of concentrations of SWMU-related chemicals in surface soil at potential release points from the SWMU (i.e., at the area of highest anticipated concentration)

- Characterization of concentrations of SWMU-related chemicals in subsurface soil at potential release points from the SWMU (i.e., at the area of highest anticipated concentration)

- Characterization of the vertical distribution of concentrations of SWMU-related chemical of concern in soil to address the potential for transport to groundwater at concentrations of concern

4.6.11.2 Data Gaps

Since no previous fieldwork has been conducted for the RFI at this SWMU, the data gaps are identical to the data needs stated above.

4.6.11.3 SWMU Investigative Approach

The goal of the investigation is to satisfy the data needs; i.e., to eliminate the data gaps identified above. Potential release points from this SWMU include leaks in the underground compartments, leaks under the sand trap, and spills during sand removal and pumping. Soil borings will be drilled near the sand trap (Figure 4-10) to a depth sufficiently below the bottom of the unit where potential leaks from the bottom of the unit would be detected. Soil borings will also be drilled in the old and new leach fields. Proposed sample locations and numbers are included in the field sampling plan. Surface soil samples (from the soil borings) will be taken to evaluate whether the concentrations of SWMU-related chemicals at the surface (i.e., from potential surface releases) could pose a potential risk to human health or the environment. For borings drilled through pavement, surface soil samples will be collected immediately beneath the pavement. Subsurface soil samples will be collected from the borings to evalaute whether potential subsurface releases could pose human health or environmental risks. The subsurface soil samples collected will also be used to characterize the vertical distribution of contamination, so that the potential impact to groundwater can be addressed.

4.6.12 Lead Acid Battery Accumulation Point (SWMU 55)

This section describes the data needs and investigative activities for the lead acid battery accumulation point (SWMU 55).

The Lead Acid Battery Accumulation Point is an area where used lead-acid vehicle batteries are stored on pallets in the storage area until a sufficient number are accumulated for sale to a battery recycling company (Figure 4-5). Presently, the area used to store the lead acid batteries is approximately 10 feet by 10 feet. In the past, a larger area (approximately 10 feet by 50 feet) was used. Borings will be placed in the areas of greatest potential contamination. This unit has been in operation since 1965. The area consists of a asphalt apron contiguous with the building parking lot. The pavement slopes to the north and west. The area does not have protection from the elements. The batteries are prepared for storage by securing the vent caps with tape and also by taping the terminals to prevent shorts. The batteries are stored "wet." Contaminants of concern are lead and sulfuric acid.

4.6.12.1 Data Needs

The data needed to meet the objectives of the investigation at this SWMU are:

- Characterization of concentrations of SWMU-related chemicals in surface soil at potential release points from the SWMU (i.e., at the area of highest anticipated concentration)

- Characterization of concentrations of SWMU-related chemicals in subsurface soil at potential release points from the SWMU (i.e., at the area of highest anticipated concentration)

- Characterization of the vertical distribution of concentrations of SWMU-related chemical of concern in soil to address the potential for transport to groundwater at concentrations of concern

4.6.12.2 Data Gaps

Since no previous fieldwork has been conducted for the RFI at this SWMU, the data gaps are identical to the data needs stated above.

4.6.12.3 SWMU Investigative Approach

The goal of the investigation is to satisfy the data needs; i.e., to eliminate the data gaps identified above. Potential release points from this SWMU include cracks in the pavement where contaminants may have been transported to the underlying soils. Soil borings will be drilled at potential release sites as indicated in Figure 4-5. Proposed sample locations and numbers are included in the field sampling plan. Surface soil samples (from the soil borings) will be taken to evaluate whether the concentrations of SWMU-related chemicals at the surface (i.e., from a surface release) could pose a potential risk to human health or the environment. If the boring is located on the concrete pad, the surface soil sample will be taken from immediately beneath the pavement. Subsurface soil samples will be collected from the borings at depths of potential release sites to evaluate whether subsurface releases could pose human health or environmental risks. The subsurface soil samples collected will

also be used to characterize the vertical distribution of contamination, so that the potential impact to groundwater can be addressed.

4.6.13 Civil Engineering Container Storage Area (SWMU 77)

This section describes the data needs and investigative activities at the Civil Engineering Container Storage Area (SWMU 77).

The Civil Engineering Container Area is an open concrete pad (Facility Number 4038) approximately 100 feet by 200 feet long located adjacent to the north property boundary fence of the base (Figure 4-11). An 8-foot fence surrounds the unit. This unit was a passenger terminal for Portair Field during the 1930's. The building was removed in 1942 by the Army. However, historical photographs show the concrete foundation to be vacant until the 1970's, at which time it was utilized for storage.

The Civil Engineering Squadron currently stores supplies and used materials on the concrete. These items include used transformers, street lights and street signs, and heavy equipment parts. Approximately 25 unmarked 55-gallon drums are also stored at this facility, although approximately 100 drums were present during the RFA Visual Site Inspection (Kearney, 1987). Preliminary inspection suggests that the drums contain varying amounts of water, oil, solvents, and asphaltic material. Potential chemicals of concern include waste oil and solvents, aviation fuel, waste paint materials, PCBs and pesticides.

4.6.13.1 <u>Data Needs</u>

The data needed to meet the objectives of the investigation at this SWMU are:

- Characterization of concentrations of SWMU-related chemicals in surface soil at potential release points from the SWMU (i.e., at the area of highest anticipated concentration)

- Characterization of concentrations of SWMU-related chemicals in subsurface soil at potential release points from the SWMU (i.e., at the area of highest anticipated concentration)

- Characterization of the vertical distribution of concentrations of SWMU-related chemical of concern in soil to address the potential for transport to groundwater at concentrations of concern

4.6.13.2 Data Gaps

Since no previous fieldwork has been conducted for the RFI at this SWMU, the data gaps are identical to the data needs stated above.

4.6.13.3 SWMU Investigative Approach

The goal of the investigation is to satisfy the data needs; i.e., to eliminate the data gaps identified above. Potential release points from this SWMU include cracks in the pavement where contaminants may have been transported to the underlying soils. In addition, contaminants may have been transported by surface water runoff to the surrounding soils. Soil borings will be drilled at potential release sites as indicated in Figure 4-11. Proposed sample locations and numbers are included in the field sampling plan. Surface soil samples (from the soil borings) will be taken to evaluate whether the concentrations of SWMU-related chemicals at the surface (i.e., from a surface release) could pose a potential risk to human health or the environment. If the boring is located on the concrete pad, the surface soil sample will be taken from immediately beneath the pavement. Subsurface soil samples will be collected from the borings at depths of potential release sites to evaluate whether subsurface releases could pose human health or environmental risks. The subsurface soil samples collected will also be used to characterize the vertical distribution of contamination, so that the potential impact to groundwater can be addressed. The perimeter borings will be located in areas that appear to receive drainage from the slab.

4.6.14 Wastewater Playa Lake (SWMU 103)

This section describes the data needs and investigative activities at the Wastewater Playa Lake (SWMU 103).

The Wastewater Playa Lake encompasses approximately 13 acres located on the eastern boundary of Cannon AFB (Figure 4-12). The playa receives treated effluent from the

Wastewater Treatment Lagoons. The water level of the playa is maintained at approximately two-thirds total capacity. The playa is contained within the boundary of Cannon AFB; no directly piped discharge of water occurs from the playa; however, the base has contracted for several years with a local farmer, allowing an unlimited amount of water to be withdrawn by pump for irrigation. This unit has been active since 1943. The playa received effluent from an Imhoff wastewater treatment system from 1943 to 1966. The playa has received effluent from the sewage lagoons from 1966 to present. Sanitary and industrial wastewater is treated in the sewage lagoons. Organics, PCBs and pesticides, and metals may have entered the lagoons, and consequently the playa.

4.6.14.1 Data Needs

The data needed to meet the objectives of the investigation at this SWMU are:

- Characterization of concentrations of SWMU-related chemicals in sediment in the lake. Samples will be taken near the influent at the suspected area of highest concentration and at the locations away from the influent.

- Characterization of concentrations of SWMU-related chemicals in surface water in the lake.

- Characterization of the concentrations of SWMU-related chemicals of concern to address the potential for transport to groundwater at concentrations of concern

4.6.14.2 Data Gaps

Since no previous fieldwork has been conducted for the RFI at this SWMU, the data gaps are identical to the data needs stated above.

No soil borings are planned for this phase of the investigation; therefore, characterization of potential contamination in the subsurface soils will not be possible. Thus, the potential for contaminants to be transported to the groundwater may not be fully defined. This pathway may be further evaluated in a subsequent phase of the investigation.

4.6.14.3 SWMU Investigative Approach

The goal of the investigation is to satisfy the data needs; i.e., to eliminate the data gaps identified above. Potential release mechanisms from this SWMU include transport of concern to the underlying soils, and potentially to the groundwater, and direct contact with sediments and surface water. In addition, surface water and sediment samples will be taken to evaluate whether there is a potential for chemicals of concern to leach to groundwater. Proposed sample locations and numbers are included in the field sampling plan. Sediment samples will be taken to evaluate whether the concentrations of SWMU-related chemicals in the sediment could pose a potential risk to human health or the environment. Surface water samples will be taken to evaluate whether the concentration of chemicals of concern in the surface water could pose a potential risk to human health or the environment.

4.7 DATA QUALITY REQUIREMENTS

Data quality requirements define the quality and quantity of data needed to achieve the objectives (principally completion of the risk assessment to evaluate further investigative needs of the SWMUs) of the RFI. Data quality requirements address factors such as sampling plans, designation of critical data, data precision, accuracy, representativeness, comparability, and completeness, detection limits required, and quality assurance/quality control sampling. Quality assurance objectives, which describe the minimum quality of data necessary to achieve the task objectives, are specified in the Sampling and Analysis Plan (FSP and QAPP) for all analytical data. These factors are discussed briefly here and are more thoroughly discussed in the QAPP and the FSP.

4.7.1 Sample Locations and Numbers

The primary objective of this RFI is to evaluate whether hazardous material has been released from a SWMU resulting in an unacceptable risk to human health or the environment. According to the DQO process, sampling locations were selected so that this objective could be met as efficiently as possible. Specific sample locations were selected based on: existing knowledge of wastes and waste handling practices at a SWMU, results of previous investigations, knowledge of potential transport pathways from the SWMU, and potential exposure pathways from the SWMU to receptors. Using these guidelines, sampling locations

were selected so that, with a high level of confidence based on professional judgment, all potential significant releases from a SWMU would be detected and quantified.

4.7.2 Critical Data

Critical data are data that are crucial for decision-making. Since decisions made in the RFI framework (e.g., whether a SWMU requires no further investigation or should be carried into a CMS) are based primarily on the results of the baseline risk assessment, critical data are defined as those data that are necessary for satisfactory completion of the health and environmental assessment.

Critical data may be from special sampling locations or from a selected subset of samples from locations of roughly equal importance. Data from a specific field sample such as a sediment sample immediately downstream of a discharge point, may be designated as critical if it were necessary to know contaminant concentrations at that specific location for source or exposure pathway characterization. In other cases, data from a selected number of any of several field samples (e.g., a subset of all the surface soil samples taken at a site), may be designated as critical when the objective is to estimate mean contaminant concentrations over the area.

Following EPA guidelines (EPA 1990), critical data must be from environmental media representing each major exposure pathway and must be 100 percent complete, that is, valid results must be obtained for all data deemed critical. Sometimes individual results for certain analytes in a sample, which is designated as containing critical data, may be missing or rejected upon data validation. A complete set of critical data may be taken from more than one sample (i.e., if one sample has missing or rejected analytes, data from another comparable sample can be used to complete the critical data set). If the missing or rejected data do not affect the results of the risk assessment (e.g., they are not potential chemicals of concern), they are not considered to be critical data, and the critical data set is still 100 percent complete. If the risk assessment cannot be completed because of missing or rejected data, a recommendation will be made that the project managers determine what corrective action should be taken. Potential chemicals of concern are defined as chemicals that are SWMU-

related (i.e., they are derived from the SWMU and are at concentrations that exceed background levels); and that have EPA-derived toxicity factors (i.e., carcinogenic slope factors or noncarcinogenic RfDs) or that have potential toxicity that can be addressed semiquantitatively (e.g., lead and TPH). Potential chemicals of concern will be derived from the analyte list described in the QAPP. This procedure permits retaining valid data from the original data set and compiling a complete, representative, and valid set of critical data without unnecessary resampling. A discussion of the selection of critical data for the RFI SWMUs is provided below.

4.7.2.1 Critical Data at Oil/Water Separators

The following data have been determined to be critical at each unit at the oil/water separators. That is, complete, representative, and valid sets of data must be collected as indicated. A unit is defined as a oil water separator, a leach field or well, or a sand trap.

- One complete set of data from the surface soil samples, one complete set of data from samples beneath the unit, and one complete set of data from the deepest sampling points.

- One valid SVOC result from a surface sample and the most heavily contaminated sample will be required.

4.7.2.2 Critical Data at the Civil Engineering Storage Area.

The following data have been determined to be critical at the Civil Engineering Storage Area. That is, complete, representative, and valid sets of data must be collected as indicated.

- Three complete sets of data from the surface/near-surface soil, and three complete sets of data from the deepest sampling points.

4.7.2.3 Critical Data at the Lead Battery Storage Area

The following data have been determined to be critical at the Lead Battery Storage Area. That is, complete, representative, and valid sets of data must be collected as indicated.

- Two complete sets of data from the surface soil, and two complete sets of data from the deepest sampling points.

4.7.2.4 Critical Data at the AGE Maintenance Shop

The following data have been determined to be critical at the AGE Maintenance Shop. That is, complete, representative, and valid sets of data must be collected as indicated.

- Two complete sets of data from the surface/near-surface soil, and two complete sets of data from the deepest sampling points.

4.7.2.5 Critical Data at the Playa Lake

The following data have been determined to be critical at the Playa Lake. That is, complete, representative, and valid sets of data must be collected as indicated.

- Two complete sets of data from the impounded water, and two complete sets of data from the sediment samples.

4.7.2.6 PARCC Parameters

As also stated in the QAPP, the PARCC (precision, accuracy, representativeness, completeness, and comparability) parameters are indicators of data quality. Ideally, the end use of the measurement data should define the necessary PARCC parameters. In the ideal situation, numerical precision, accuracy, and completeness goals would be established, and these goals would aid in selecting the measurement methods. However, differences in RFI sites and conditions make this process difficult at best.

Precision measures the reproducibility of measurements under a given set of conditions. Specifically, it is a quantitative measure of the variability of a group of measurements compared to their average value. The overall precision of measurement data is a combination of sampling and analytical factors. Analytical precision is based on historical data from specific analytical methods. Sampling precision is more difficult to quantify because it is unique to each site. For the purposes of risk assessment, precision must be sufficient to

determine if a chemical is above or below the concentration of concern (e.g., MCLs or RBCs) at the point of exposure. Precision becomes more important as results approach the concentrations of concern.

Accuracy measures the bias in a measurement system; it is difficult to measure for the entire data collection activity. Sources of error are the sampling process, field contamination, preservation, handling, sample preparation, and analysis techniques and matrix effects. Sampling accuracy may be assessed by evaluating the results of field and trip blanks, analytical accuracy may be assessed through use of known and unknown (to the laboratory) QC samples, surrogate and matrix spikes. For purposes of risk assessment, accuracy must be sufficient to determine whether a chemical is above the concentration of concern, and as is the case with precision, accuracy is increasingly important near the concentrations of concern.

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter which is most concerned with the proper design of the sampling program. The representativeness criterion is best satisfied by making certain that sampling locations are selected properly and a sufficient number of samples are collected. For this phase of the RFI, the sampling scheme was designed to characterize areas where releases were known or suspected to have occurred. The representativeness of the sampling scheme is assured by the use of existing information concerning the SWMUs such as wastes likely to be present, former waste handling practices, physical characteristics of the SWMU, and professional judgment.

Completeness is defined as the percentage of measurements made which are judged to be valid measurements. The completeness goal is essentially the same for all data uses: that a sufficient amount of valid data be generated. It is important that critical samples are identified and plans made to achieve valid data for them. For this RFI, the completeness goal is 100 percent for critical data. Critical data are defined above in this section. That is, the completeness goal is to produce 100 percent of the data needed to successfully complete the risk assessment.

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. Sample data should be comparable with other measurement data for similar samples and sample conditions. This goal is achieved through using standard techniques to collect and analyze representative samples and reporting analytical results in appropriate units.

4.7.3 Detection Limits

Risk assessment often requires a sample quantitation limit at or below the detection limit provided by routine analytical methods for many chemicals of toxicological concern. The sample quantitation limits vary according to sample medium. The quantitation limits for chemicals in water samples are often far lower than for the same chemicals in soils, because of interferences caused by co-extractable components in the soil. These interferences are most problematic when chemicals are at concentrations near the detection limit. Analytical methods have been selected which will provide the required detection limits. The methods that will be used and their detection limits are discussed in the QAPP.

To select appropriate analytical methods, method detection limits have been compared with analyte-specific concentrations of concern such as MCLs, or risk-based concentrations (RBCs). RBCs are concentrations that under given exposure assumptions, will produce a specified risk. For this discussion, RBCs are concentrations which will cause a carcinogenic risk of 1×10^{-7}, or a noncarcinogenic hazard quotient of 0.1 using EPA's Standard Default Exposure Parameters. According to Guidance for Data Usability in Risk Assessment (EPA 1990), the analytical method detection limit should be no more than 20 percent of the concentration of concern (e.g., MCL, RBC) for a compound.

4.7.4 Quality Assurance/Quality Control Samples

Quality assurance/quality control (QA/QC) samples are used to monitor the quality of analytical data collected, from the perspectives of both field sampling and laboratory analyses. Quality control samples are analyzed by the contracted laboratory as an internal check on field sampling and laboratory analysis performance. For this RFI, QA/QC samples, consisting of field duplicates, trip blanks (for VOCs in water samples), field blanks, and matrix spikes and matrix spike duplicates will be taken at each SWMU for each environmental medium

sampled and each analytical method used. For example, at least one set of QA/QC samples will be taken for VOC analyses in soils and one set for SVOCs in soil, etc. The protocol for taking QA/QC samples is explained in the FSP and the QAPP.

4.8 ARARs

A complete discussion of the project ARARs are included in Appendix C of the Work Plan.

CANNON AIR FORCE BASE
DECISION DIAGRAM FOR SCREENING LEVEL RISK EVALUATION

OBJECTIVE: DETERMINE IF A RELEASE OF SWMU - RELATED CHEMICALS OF CONCERN HAS OCCURRED THAT COULD POSE A POTENTIAL RISK TO HUMAN HEALTH OR THE ENVIRONMENT.

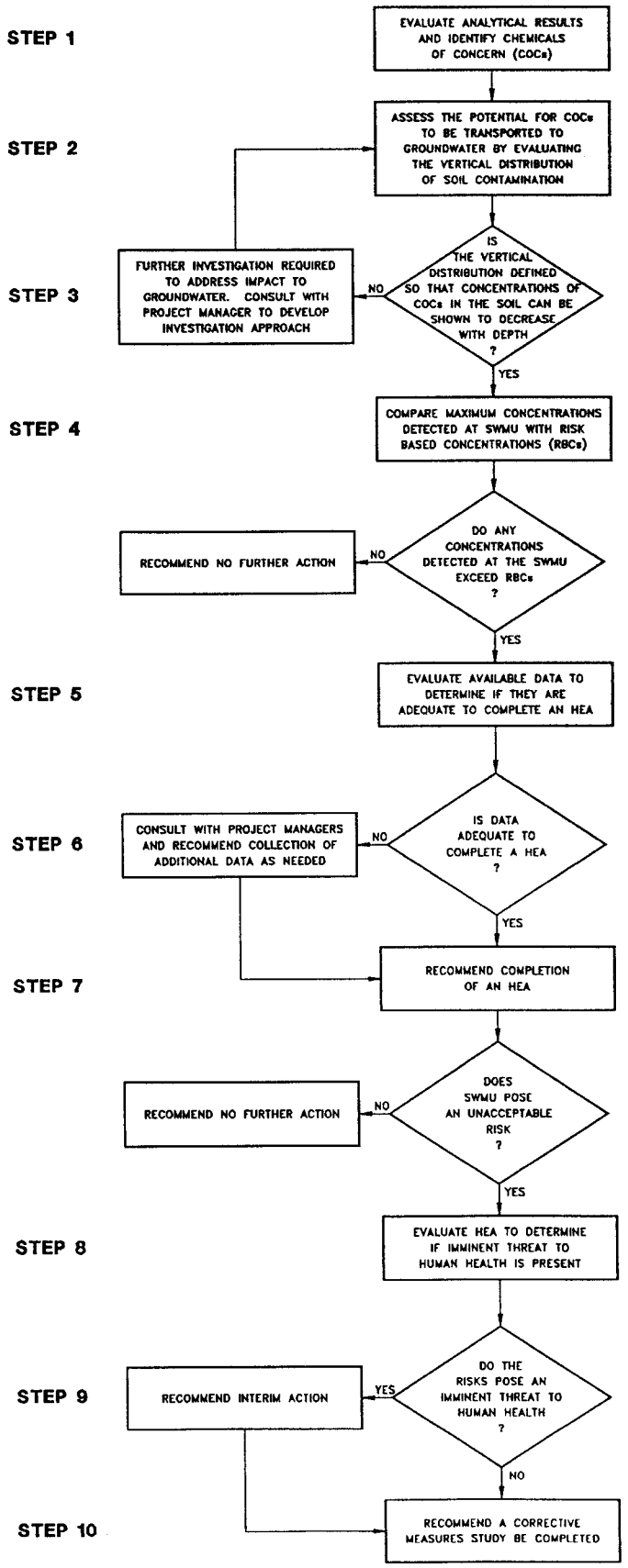


FIGURE 4-1

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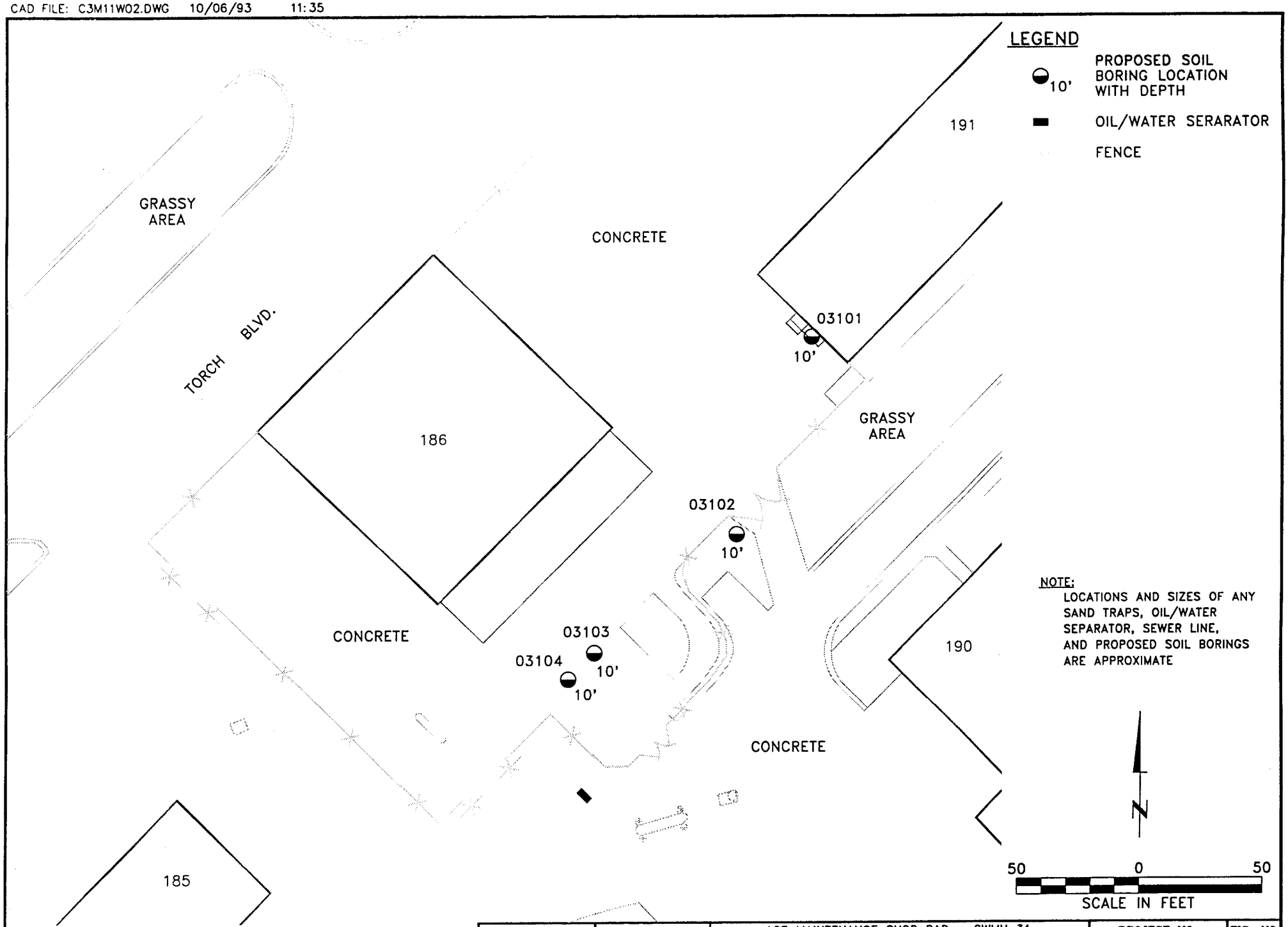
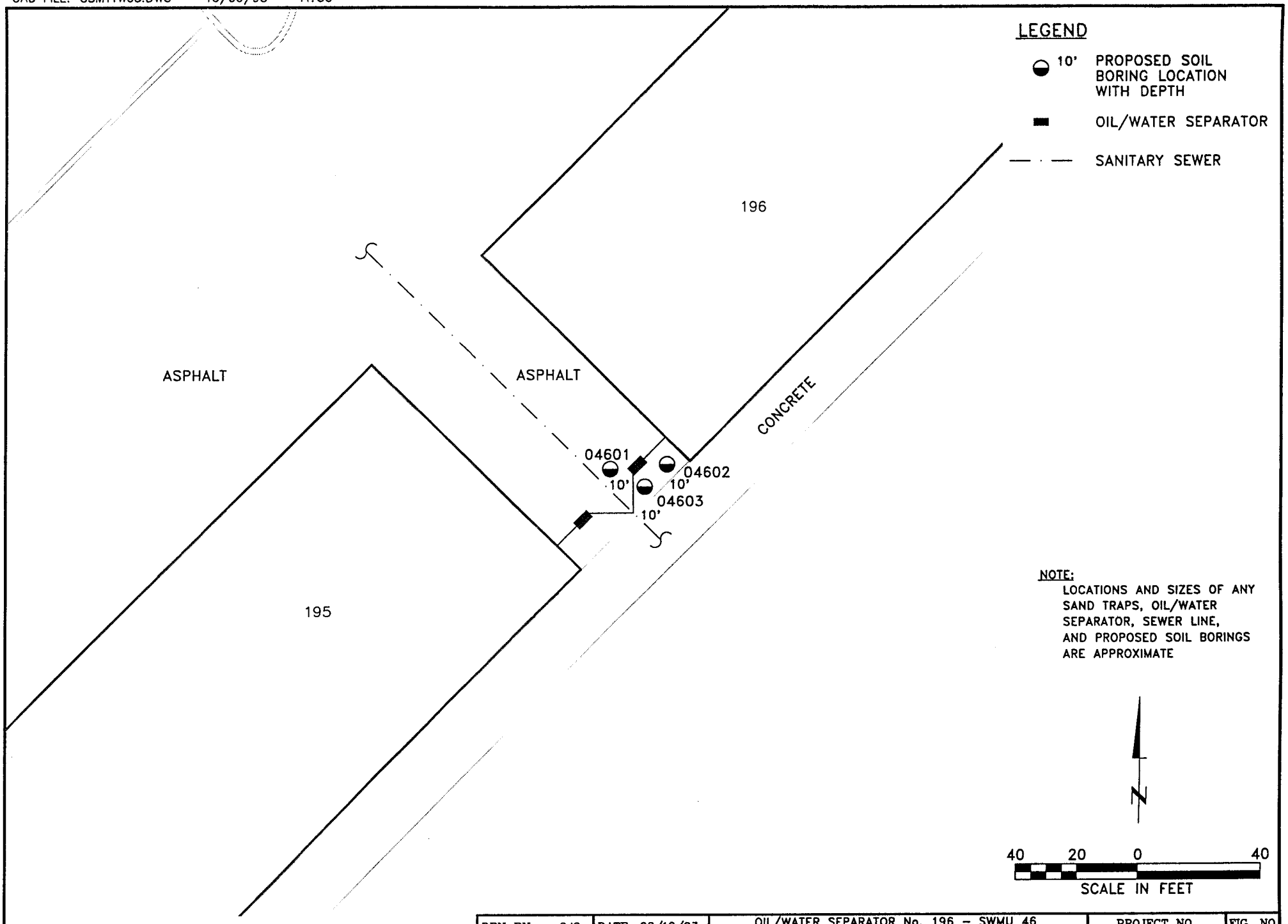
CAD FILE: C3M11W02.DWG 10/06/93 11:35



SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: SCR	DATE: 08/16/93	AGE MAINTENANCE SHOP PAD – SWMU 31 SITE MAP AND PROPOSED SAMPLE LOCATIONS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W
CHK'D BY: .	REVISION: 0		FIG. NO. 4–2

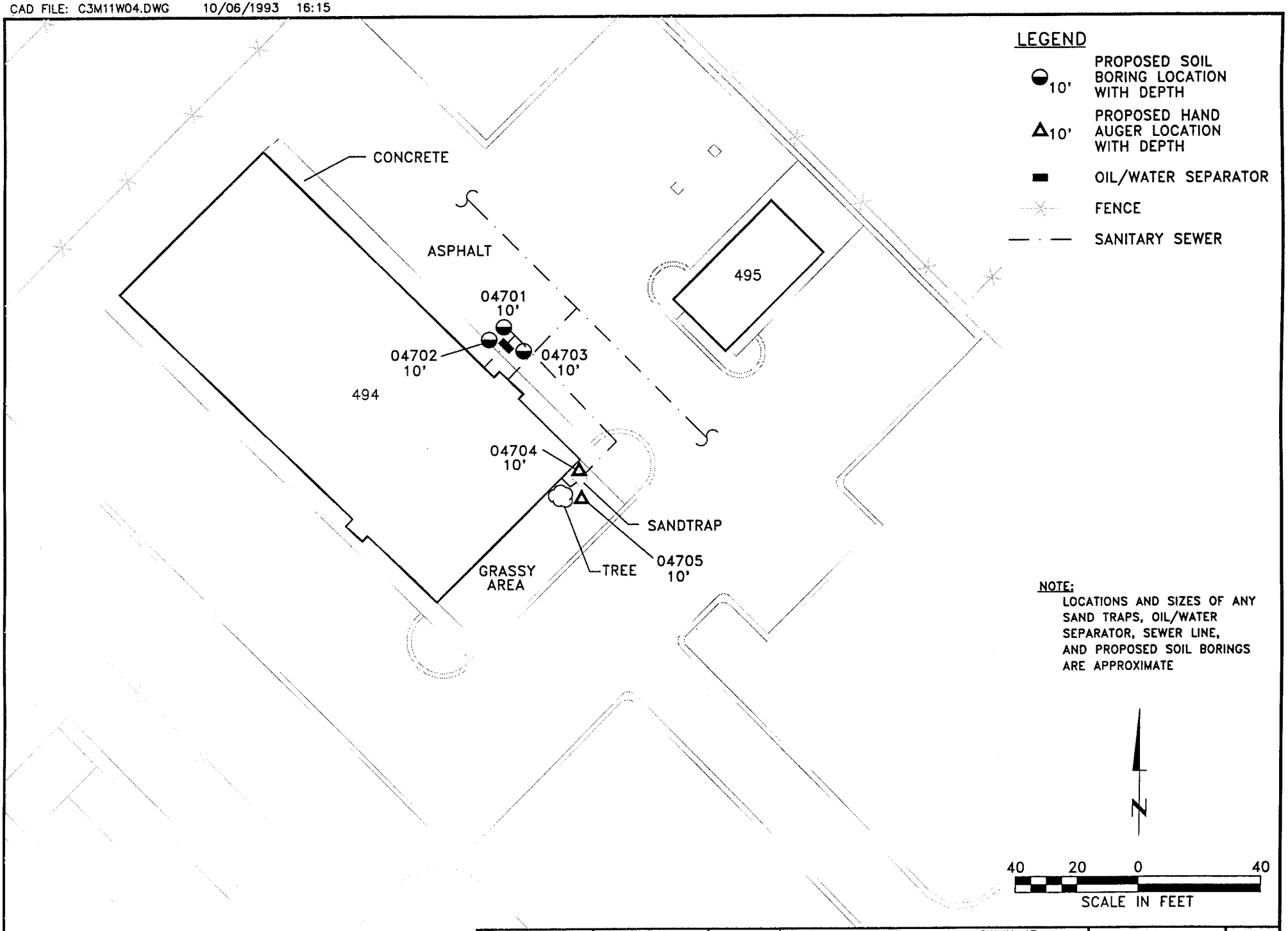
CAD FILE: C3M11W03.DWG 10/06/93 11:50



SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 08/16/93	OIL/WATER SEPARATOR No. 196 – SWMU 46 SITE PLAN AND PROPOSED SAMPLE LOCATIONS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W	FIG. NO. 4-3
CHK'D BY: .	REVISION: 0			

CAD FILE: C3M11W04.DWG 10/06/1993 16:15

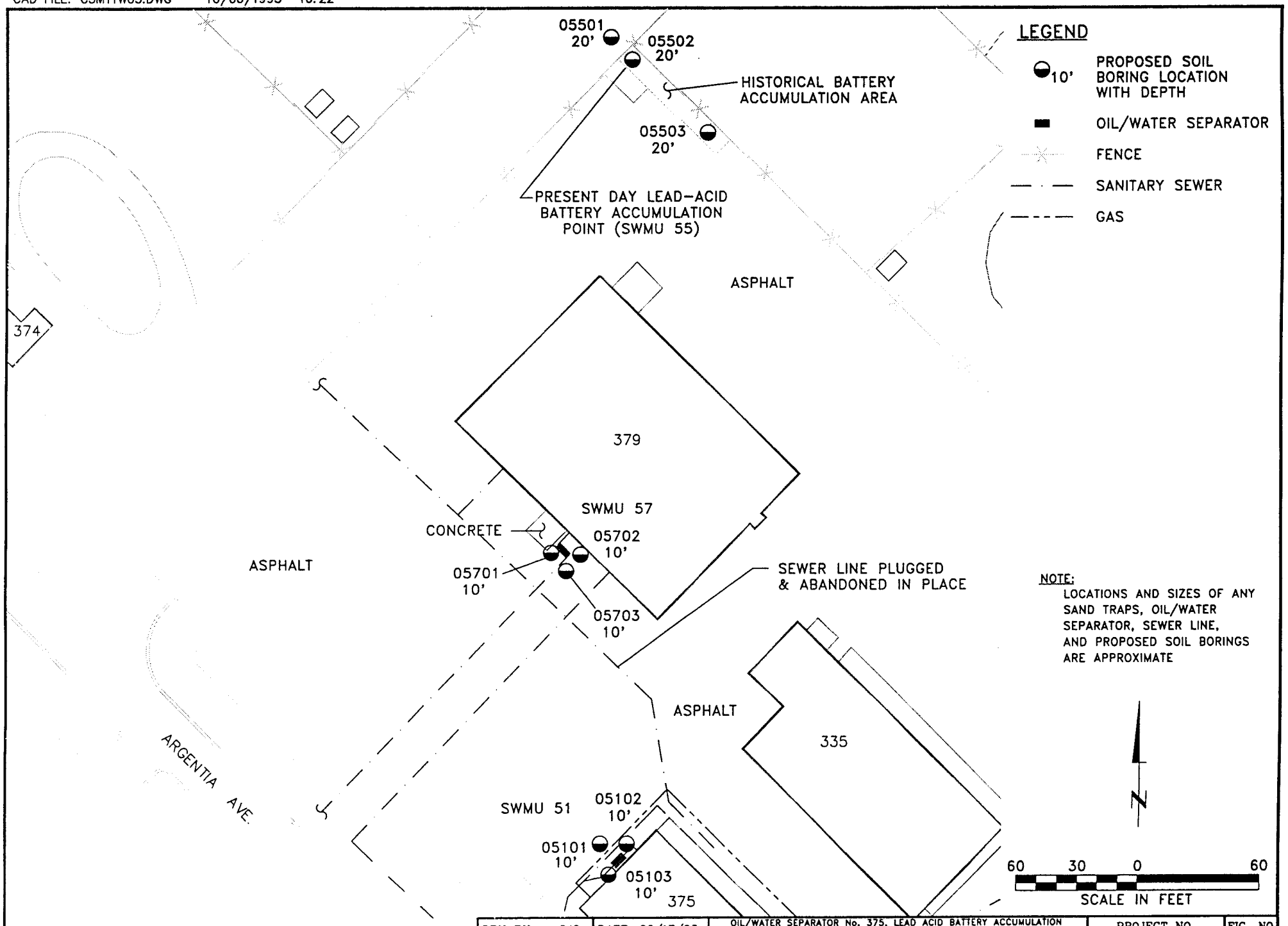


SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 08/17/93	OIL/WATER SEPARATOR No. 494 – SWMU 47 SITE PLAN AND PROPOSED SAMPLE LOCATIONS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W
CHK'D BY: .	REVISION: 0		

FIG. NO. 4–4

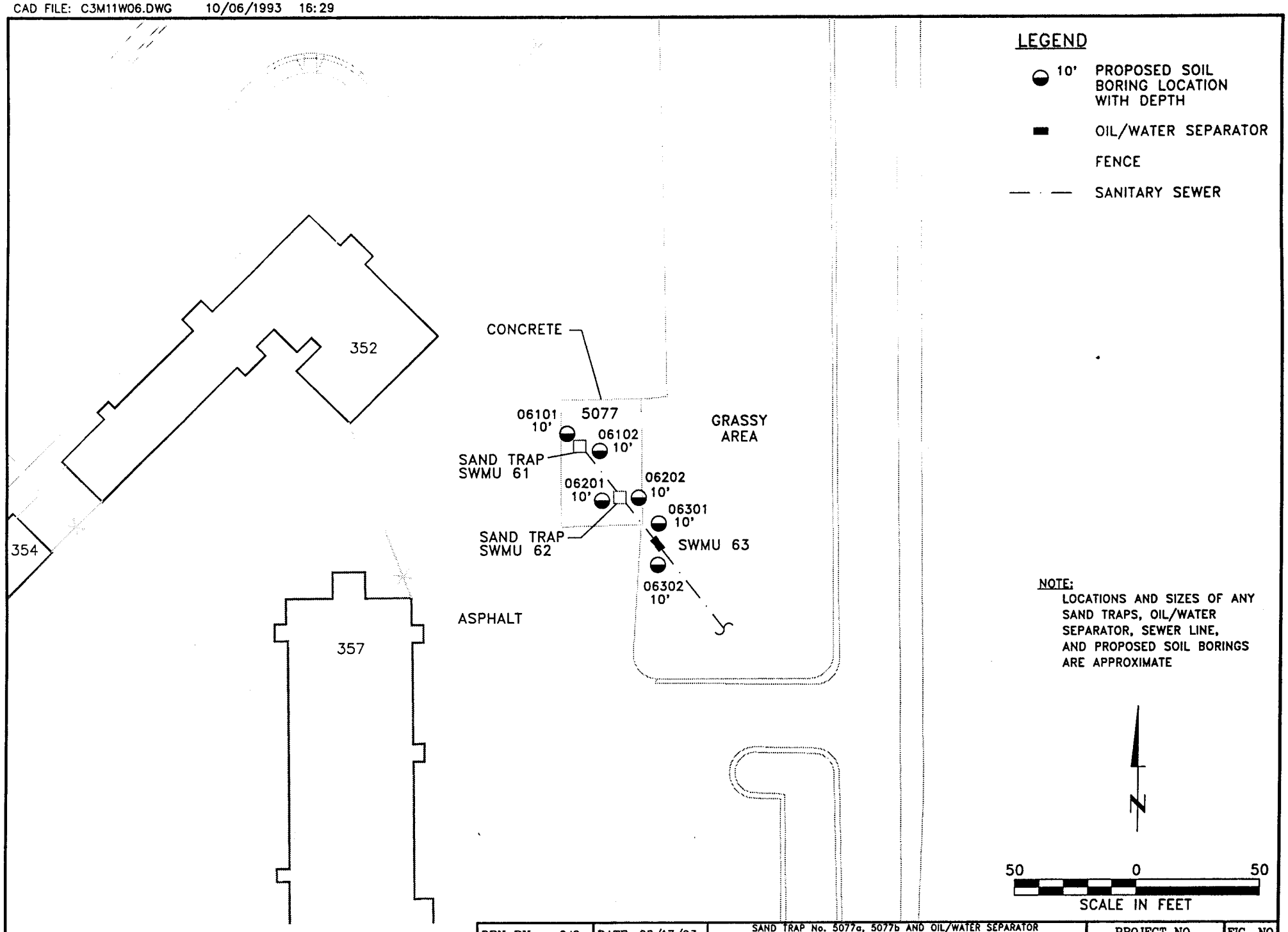
CAD FILE: C3M11W05.DWG 10/06/1993 16:22



SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 08/17/93	OIL/WATER SEPARATOR No. 375, LEAD ACID BATTERY ACCUMULATION POINT AND OIL/WATER SEPARATOR No. 379 - SWMU 51, 55 & 57 SITE PLAN AND PROPOSED SAMPLE LOCATIONS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W
CHK'D BY: .	REVISION: 0		FIG. NO. 4-5

CAD FILE: C3M11W06.DWG 10/06/1993 16:29



SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

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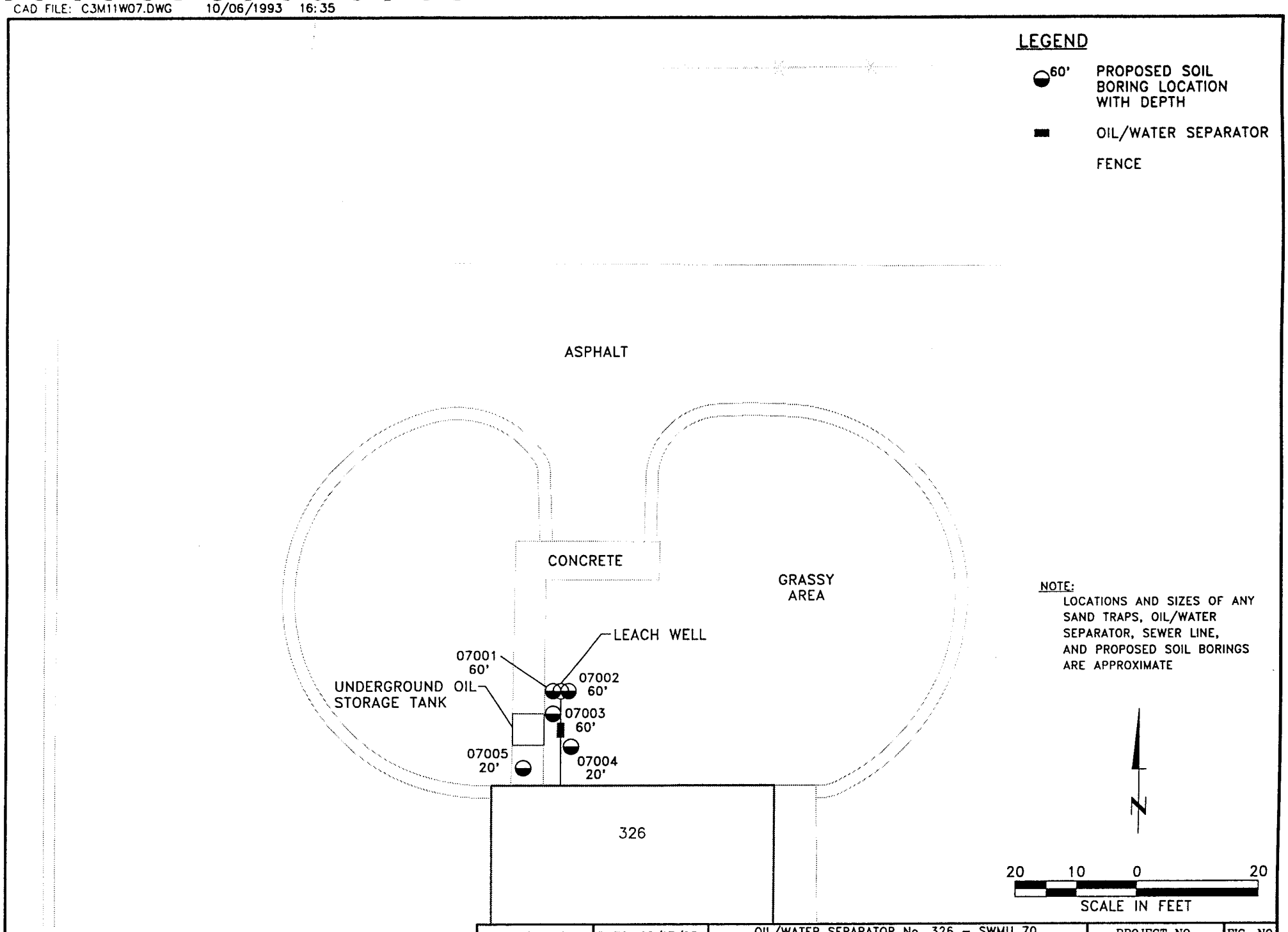
CHK'D BY: .	REVISION: 0		FIG. NO. 4-6

CAD FILE: C3M11W07.DWG 10/06/1993 16:35



SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 08/17/93	OIL/WATER SEPARATOR No. 326 – SWMU 70 SITE PLAN AND PROPOSED SAMPLE LOCATIONS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W
CHK'D BY: .	REVISION: 0		FIG. NO. 4–7

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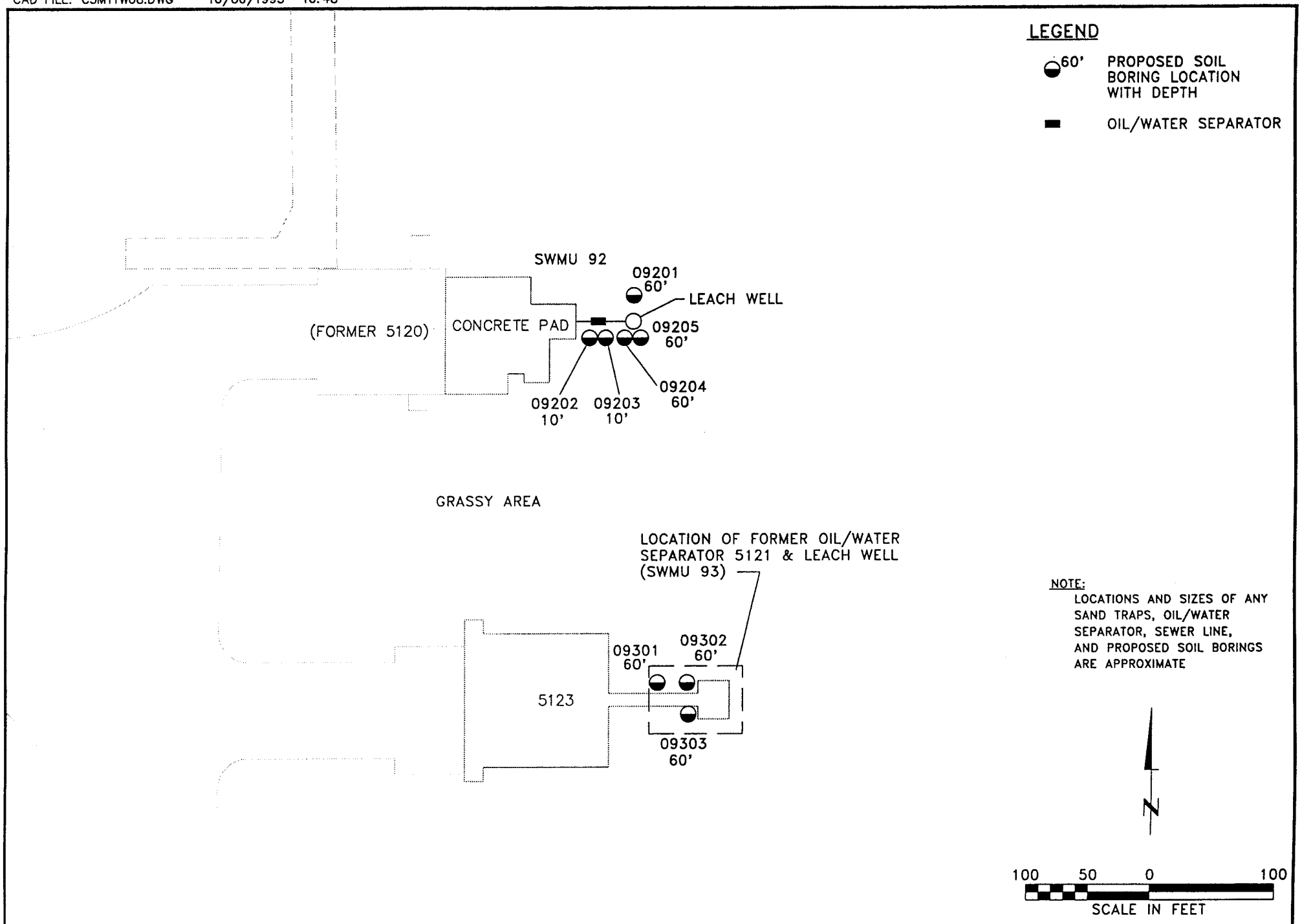
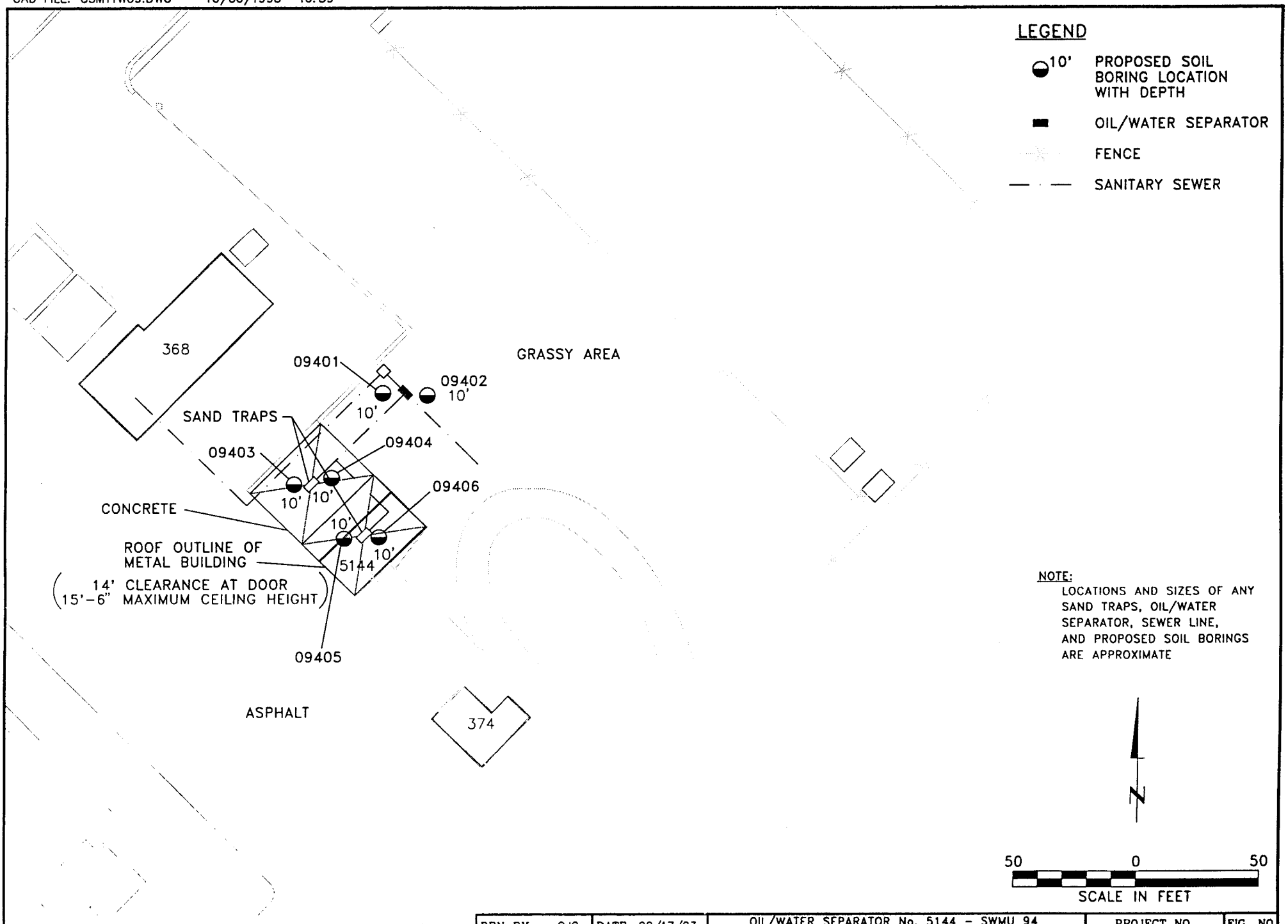


SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 08/17/93	OIL/WATER SEPARATOR No. 5120 & 5121 - SWMU 92 & 93 SITE PLAN AND PROPOSED SAMPLE LOCATIONS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W
CHK'D BY: .	REVISION: 0		FIG. NO. 4-8

CAD FILE: C3M11W09.DWG 10/06/1993 16:59



SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

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CHK'D BY: .	REVISION: 0		FIG. NO. 4-9

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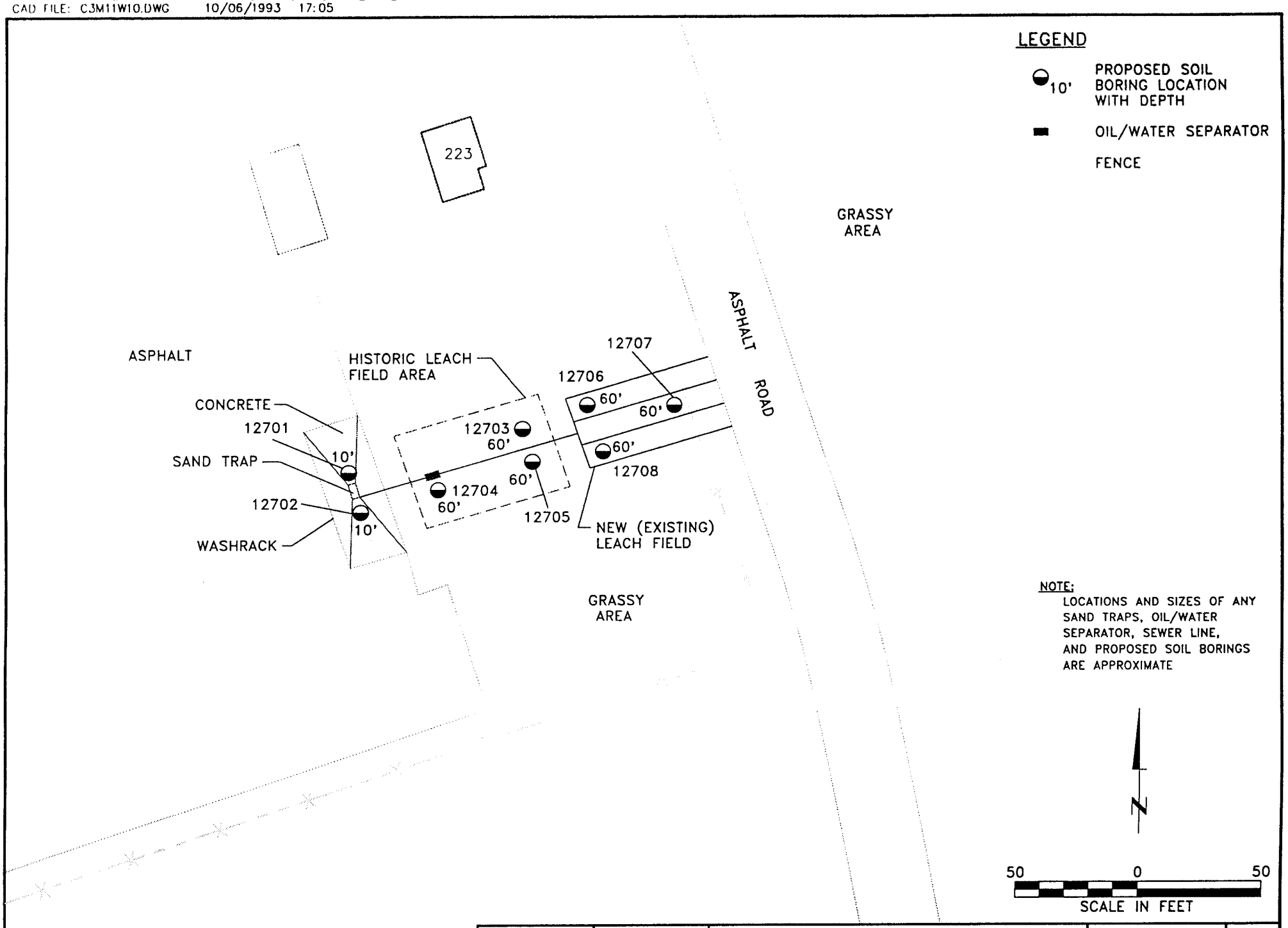

SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 08/17/93	SAND TRAP AT POL WASHRACK – SWMU 127 SITE PLAN AND PROPOSED SAMPLE LOCATIONS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W	FIG. NO. 4–10
CHK'D BY: .	REVISION: 0			

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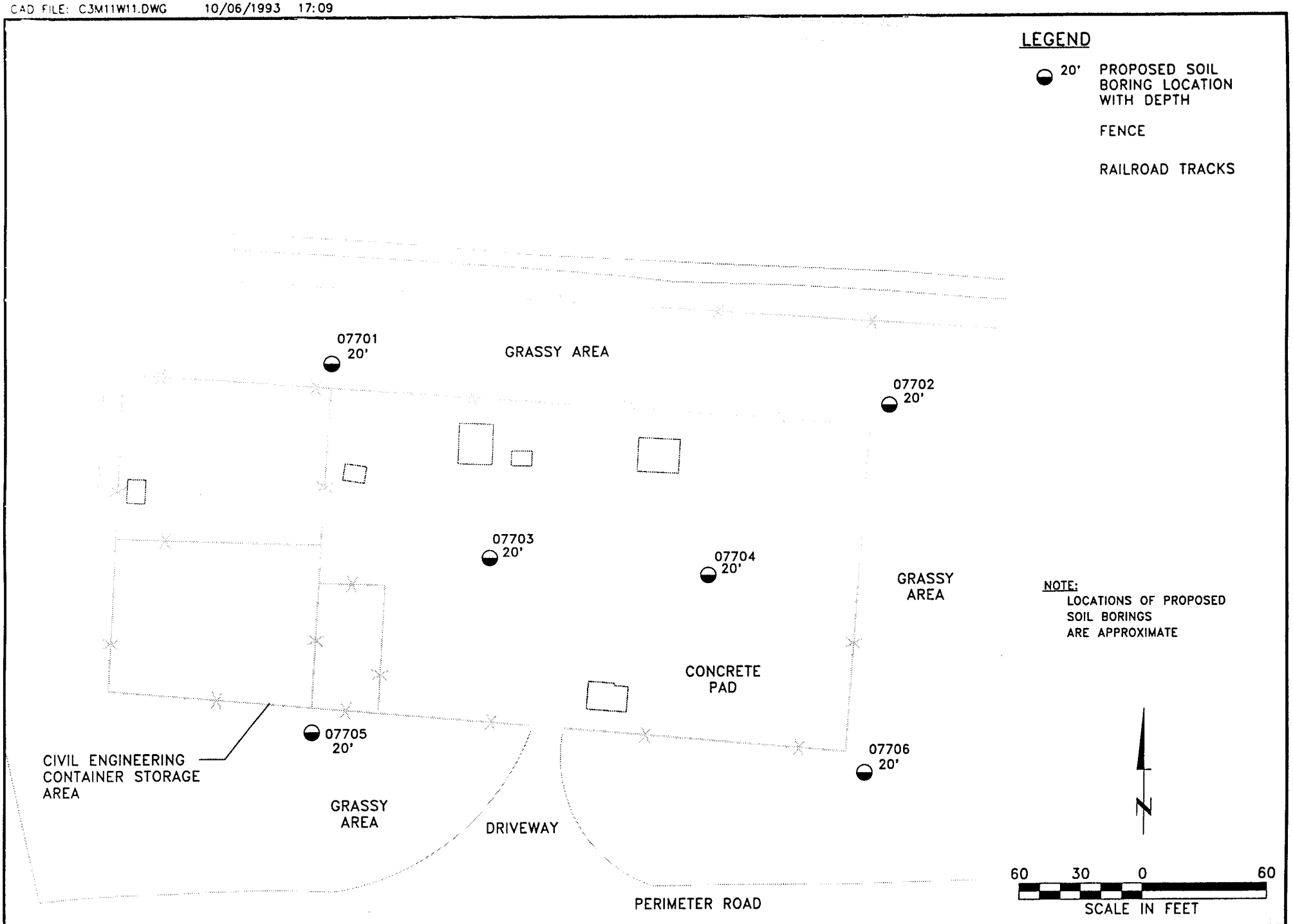

SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 08/17/93	CIVIL ENGINEERING CONTAINER STORAGE AREA – SWMU 77 SITE PLAN AND PROPOSED SAMPLE LOCATIONS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W
CHK'D BY: .	REVISION: 0		FIG. NO. 4–11

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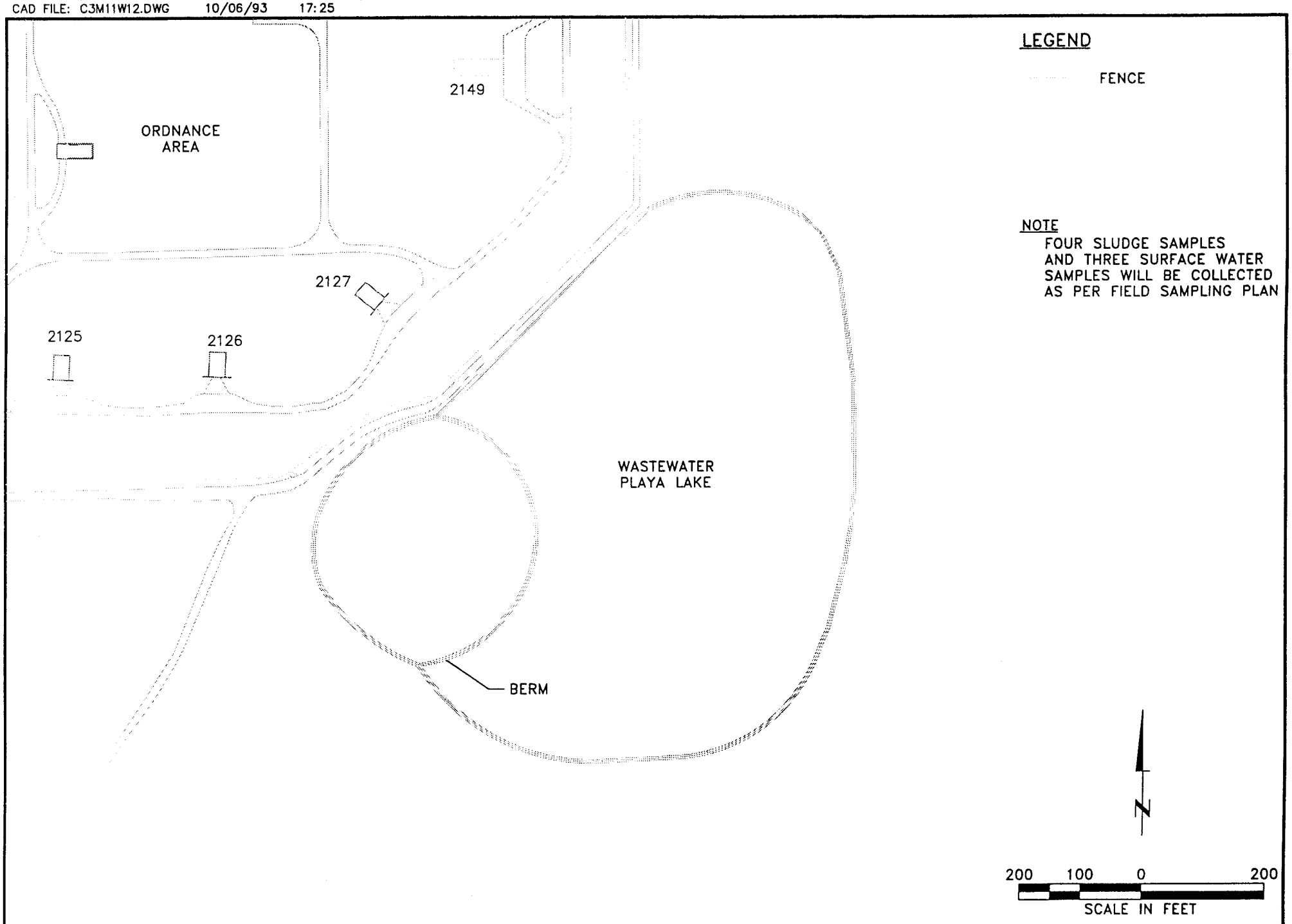

SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 08/17/93	WASTEWATER PLAYA LAKE – SWMU 103 SITE PLAN CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W	FIG. NO. 4-12
CHK'D BY: .	REVISION: 0			

5.0
REMEDIAL INVESTIGATION TASKS

The RFI process involves execution of a series of tasks that have been identified in the project proposal. The RFI tasks are summarized below and described in detail in one or more of the work planning documents and/or the original proposal.

Task 1. Project Planning

This task includes efforts related to initiating the RFI as directed by the regulatory agency. The project planning task is defined as complete when the RFI Work Plan and supplemental plans (i.e., QAPP, FSP and SSHP) are approved and/or accepted for use on the project. The following elements are included in this task:

- Site visit/meeting.

  A site visit will be performed at the start of RFI/SWMU work plan document preparation. The purpose of these visits will be to interview Cannon AFB personnel, obtain additional data/information, and visually assess the SWMUs.

- Obtaining easements/permits/site access.

  It will be necessary to obtain permits for contractor work and site access at Cannon AFB. This will include obtaining vehicle passes, digging/ excavation (utilities clearance) permits. Arrangements for these permits and monitoring will be made with the appropriate Cannon AFB personnel.

- Site reconnaissance and limited field investigation.

  Field investigations will be necessary to facilitate project scoping.

- Site survey/review of topographic maps and existing aerial photographs.

- Existing site maps and photographs will be reviewed during the preparation of SWMU-specific work plans. Additional maps will be prepared with these documents, as necessary.

- Collection and evaluation of existing data.

  The existing data have been summarized in the Field Sampling Plan.

- Identification of data needs and DQOS.

  The DQOs and data needs for the RFI have been identified and presented in Section 4.0 of this Plan and in the Field Sampling Plan.

- Initiation of subcontract procurement.

  Subcontractors will be used to perform several portions of the RFI, including the fieldwork (such as drilling) and the laboratory analyses. Subcontractors will be hired as soon as this RI Work Plan is approved.

- Initiation of coordination with analytical laboratories.

  Coordination with the analytical laboratories will be initiated when this RFI Work Plan is approved.

- Task management.

- Task management is described in Section 6.0 of this plan.

Task 2. Field Investigation

This task involves efforts related to fieldwork in conducting the RFI and includes the procurement of subcontractors related to field efforts. The task begins when any element, as

outlined in the workplan, is approved (in whole or in part) and fieldwork is authorized. Field investigation is defined as complete when the work outlined in the approved field sampling plan is complete and the contractor and subcontractors are demobilized from the field. The following activities are included in this task:

- Procurement of subcontracts.
- Mobilization
- Media sampling
- Source testing
- Geology/hydrogeological investigations
- Site survey/topographic mapping (if not performed in project planning task).
- Field screening/analyses
- Task management and quality control

Field investigations will be performed according to the FSP. Investigations will be performed according to Standard Operating Procedures (SOPs). The SOPs applicable to Cannon AFB field activities are given in the QAPP.

Task 3. Sample Analysis

This task includes chemical analysis of soil samples collected in the field and shipped to the subcontract testing laboratory. Coordination and monitoring of subcontract laboratories activities will be done by the Project Chemist and the Project Manager. Efforts associated with procurement of subcontract laboratory services are included in the premobilization subtask of Task 2 above. Task 3 will be considered complete when data validation has been completed and all deliverables have been received in acceptable form from the subcontract laboratory. The following activities are included in this task:

- Sample management
- Chemical analysis of samples
- Data package preparation and delivery
- Laboratory quality control
- Task management and quality control

Procedures and specifications for sample analysis and validation are given in the QAPP for analytes included in the scope of work. This includes detection limits, precision, accuracy, and recovery limits. If additional analytes are added at a later date, the analytical parameters will be addressed in the QAPP.

Task 4. Sample Location Survey

Each field sampling location will be surveyed by a licensed land surveyor to tie its location into the Base coordinate system in accordance with guidance furnished in the USACE SOS.

Task 5A. Daily Quality Control Reports

The W-C Field Site Manager will be responsible to complete a Daily Quality Control Report each day in accordance with the QAPP and the USACE SOS. These reports will ultimately be summarized as part of the QC Summary Report for the project record. The DQCR is the mechanism for communicating daily QA/QC activities and any observations regarding problems or variations from plan that may have occurred that day. A form is provided (see example in QAPP) to facilitate complete reporting each day.

Task 5B. Data Validation and Evaluation

This task includes validation of all chemical testing data in accordance with the QAPP and analysis of data once it has been validated. The task begins as soon as data from the laboratory is received by the project team, and it is considered to be complete when all of the data from the laboratory has been validated and found to be usable. The following are activities involved:

- Data validation per the QAPP
- Data evaluation
- Data reduction and tabulation
- Task management and quality control
- Task management responsibilities (discussed in Section 6, Project Management, of this Plan).
- Quality control procedures are specified in the QAPP.

The Data Management Plan included as Appendix A to the Work Plan provides guidelines for storing and reporting data collected during the RFI.

Task 5C. Quality Control Summary Report

When data validation is near completion and all the data is available the Quality Control Summary Report will be completed. This report includes a summary of all daily QC reports from the field, all QA/QC reports from the laboratory, and a complete review of the data quality discussing any qualifications or restrictions placed on the use of the data. The Quality Control Summary Report will include Quality Control Summary Tables containing:

- A detailed listing of all blank results
- A detailed listing of all spike results
- A detailed listing of all duplicate results
- All other QC data

This task will be considered complete when the report has been accepted by the USACE.

Task 6. Assessment of Risks

The RFI in the USACE SOS does not specify a baseline risk assessment to be completed as part of the current scope. The current scope calls for a screening of the maximum concentrations of chemicals of concern for each site comparing them to Risk Based Concentrations calculated for each constituent in accordance with RCRA guidance including the proposed Subpart S. This is generally a conservative approach to human health risk assessment to the extent that it can be determined that the maximum concentrations found at each SWMU are representative of the most concentrated area of release that has occurred.

SWMUs that are not screened out by the above process may be included in a future request for a follow-on Baseline Risk Assessment.

Task 7. Reports

This task covers all efforts related to the preparation of an RFI Report of the findings once the data have been evaluated under Tasks 5 and 6. The task covers all draft and final reports as well as task management and quality control. Each subtask will be considered complete when the report document covered by that subtask is submitted. The Final RFI Report subtask will be considered complete when the Final RFI Report has been submitted with all comments of the USACE and EPA satisfactorily addressed. The following are activities included in this task:

- Writing the report
- Reviewing and providing quality control efforts
- Printing and providing quality control efforts
- Holding review meetings
- Revising the report on the basis of agency comments
- Providing task management and control

Task 8. Meetings and Travel

All meetings and travel related to project management are budgeted under this task.

Task 9. Project Management

Project Management is required for all phases of the project to assure a result of the required quality. All project management is budgeted under this task.

6.0
PROJECT MANAGEMENT

Specific project management responsibilities and protocols along with a project organizational structure have been established to manage the planned RFI. The details of project management including a discussion of the above topics are presented in the Project Management Plan (PMP) included in Appendix B.

A detailed schedule for conducting the RFI and transmitting the draft and final RI report is also contained in the PMP as well as budget control procedures.

7.0
REFERENCES

U.S. Environmental Protection Agency (EPA). 1986. User's Guide to the Contract Laboratory Program. EPA, Washington, D.C. December 1986.

U.S. Environmental Protection Agency (EPA). 1987a. "Data Quality Objectives for Remedial Response Activities - Development Process." EPA, Washington, D.C. OSWER Directive 9335.0-7B. EPA/540/G-87/004. March 1987.

U.S. Environmental Protection Agency (EPA). 1987b. "Data Quality Objectives for Remedial Response Activities - Example Scenario: RI/FS Activities at a Site with Contaminated Soils and Groundwater." EPA, Washington, D.C. OSWER Directive 9335.0-7B. EPA/540/G-87/004. March 1987.

U.S. Environmental Protection Agency (EPA). 1988. "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (INTERIM FINAL)." Office of Emergency and Remedial Response, EPA, Washington, D.C. OSWER Directive 9355.3-01. October 1988.

U.S. Environmental Protection Agency (EPA). 1989. RCRA Facility Investigation (RFI) Guidance Interim Final. EPA 530/SW-89-031. EPA, Washington, D.C. May 1989.

U.S. Environmental Protection Agency (EPA). 1990. Federal Register. Corrective Action for Solid Waste Management Units at Hazardous Waste Management Facilities; Proposed Rules (Subpart S). FRL-3403-8; EPA/OSW-FR-90-012.

Installation Restoration Program Phase II - Confirmation/Quantification State I, Cannon AFB, N.M. Vols. I (text) & II (Appendixes A-M), Radian Corporation, Sept. 1986. Final Report for period 9/84-4/85.

Kearney, A.T. 1987. Preliminary Review/VSI Report, RCRA Facility Assessment Cannon Air Force Base. U.S. Environmental Protection Agency, Region VI by A.T. Kearney, Inc., Chicago, Illinois. 1987.

Matthess, George. 1984. Theoretical Background, Hydrogeology, and Practice of Groundwater Protection Zones. Heise, Hanover, West Germany.

Lee Wan Associates, Inc. 1990. RCRA Facility Investigation Work Plan, Alexandria, VA. June 1990.

APPENDIX A
DATA MANAGEMENT PLAN

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FIGURE 3 DATA CORRECTION/CHANGE FORM
FIGURE 4 SUMMARY OF DATABASE QC STEPS COMPLETED

1.0
INTRODUCTION

Data generated at each SWMU site will generally consist of the following categories of information:

- Regional geologic and hydrologic information
- Maps, site plans, sketches
- Field notes - narrative information
- QC reports
- Boring logs
- Sample tracking information
- Chemical analysis results
- Site survey data/coordinates

These data are gathered from various sources during the completion of the project, and they are stored in electronic files and archived as hard copies. This data management plan is primarily directed toward the collection (receipt) and management of the data from chemical testing of the field samples, but all other data is considered in the planning for data management.

The first six categories of data listed above are generally received in either hard copy or computer (word processing or CADD) files. Both the hard copies and the electronic files are kept. Site survey information is integrated, both in hard copy and electronically, into the existing data files when received.

The remainder of this data management plan is devoted to the sample tracking and data management effort related to the development and management of reliable chemical data from the field samples collected.

A critical task of site investigations is the management of the large volume and complexity of the data generated. In order to accomplish this task and ensure that the available data can

be accurately and efficiently reduced into useful information, an automated data management system will be implemented for Cannon AFB data. This system will facilitate report writing, data evaluation, and other means of data output control for important remedial action/design decisions.

An automated database system will be implemented using software developed by W-C. An important aspect of this database system is the interfacing to numerous PC applications, such as WordPerfect, Autocad, Excel, Statgraphics, and Stanford Graphics. The data will be electronically entered, and a quality control check will be completed before and after electronically loading data as described in Section 2.0. The Cannon AFB database will be backed up internally on two hard drive systems using MS-DOS and UNIX, respectively, as well as externally to floppy disk or tape.

2.0
PURPOSE AND SCOPE

The primary purpose of a data management plan is to communicate to users and decision-makers how information will be entered, accessed, reviewed, and used. This procedure is designed to eliminate errors in the database and to provide documentation that corrections have been completed. The process also provides the status of the database directly to the end user.

This data management plan addresses the following issues:

1. Sample documentation
2. Data deliverables
3. Sample tracking
4. Data entry
5. Data proofing
6. Data reporting

A Data Management System (DMS), which includes a sample tracking system and a database management program, must be in place prior to initiation of field activities. The sample tracking portion of the DMS will be capable of meeting the requirements of Section 6.0, and the database management program will be capable of meeting the requirements of Section 7.0. This allows for the sample tracking function and the database management function to be operated independent of location (i.e., field and office). However, it is important that the primary system be updated, either periodically during the project study or at the conclusion of the study, such that only one database provides results to end users. Figure 1 provides an overview of the DMS described in this section.

3.0
RESPONSIBILITIES AND QUALIFICATIONS

3.1 OVERVIEW

The Project Manager is responsible for assuring that chemical data derived from studies at Cannon AFB are managed according to this procedure. The Project Manager will designate qualified project staff to complete this procedure and the required reviews.

The designated project staff are responsible for implementing and carrying out data management activities according to this procedure. They report their progress, and any problems, to the Task Leader or Project Manager. Staff members are responsible for understanding the activities assigned to them and the quality assurance requirements associated with the activities.

All personnel assigned to complete this procedure shall be qualified to perform the portions of the procedure assigned to them. The Project Manager will make the appraisal of qualifications. The Project Manager's appraisal of qualifications will include a comparison of the requirements of the job assignment with the relevant experience and training of the prospective assignee; it will also include a determination of whether future training is required, and, if required, by what method. On-the-job training is an acceptable method, provided such training is received from a person qualified to perform the trainee's assignment and the results of that training are documented.

3.2 PROJECT DATA MANAGER

The Project Data Manager has responsibility for the overall data management program, including systematic updating of data and review of the computerized management system. This person will incorporate the QA guidelines and instruct laboratory, Computer Information Systems (CIS) Administrator, and field personnel in the proper procedures for coding data,

and oversee the operation of the data management system. Authority of the Data Manager includes the following:

- Determine the appropriate QA/QC procedures and document control
- Directly communicate with data generators and users in ensuring procedures for data transmittal and problem resolution
- Coordinate electronic loading, quality control, and database problem resolutions

3.3 COMPUTER-BASED DATA COORDINATOR

A CIS Administrator will ensure that the proper database system is chosen. The proper database system will ensure that data are preserved, retrievable, traceable, and sufficient for future use, and available for response to regulatory, agency, and user requirements.

The CIS Administrator is also responsible for executing the proper procedures for the handling of the computer-based data. He will facilitate electronic loading, quality control checks, and database problem resolution.

3.4 FIELD DATA COORDINATOR

The Field Data Coordinator is responsible for ensuring that all data management procedures are correctly implemented in the field. He/she will be responsible for ensuring that all samples are assigned appropriate site IDs that will be maintained throughout analysis and the reporting of results. He/she will also maintain and review field documentation. The Field Data Coordinator will ensure that all field team members use appropriate sample tags and COC records to clearly identify sample locations, sample matrices, and the requested analyses.

4.0
SAMPLE DOCUMENTATION

Sample identification and documentation will be as described in SOP No. 12. The following are considered key elements in properly documenting and tracking samples.

4.1 FIELD LOGBOOKS

The field logbooks are used to document all samples collected for a project. The field logbooks will contain complete information about each sample as described in SOP No. 12.

To track the number of samples and analyses requested, it is imperative that all samples (whether they are being analyzed for chemical or geotechnical parameters, or not at all) be entered into the field logbooks.

The assignment of QC samples (e.g., field replicates, matrix spikes, matrix spike duplicates) to associated field samples must be designated by the Field Task Manager or designee, in consultation with the Project Quality Assurance/Quality Control (QA/QC) Officer, Database Manager or designee, prior to start of data entry, and will also be documented in the field logbooks. The assignment of QC samples is important for the subsequent evaluation of the sample data quality.

4.2 CHAIN-OF-CUSTODY FORMS

Chain-of-custody (COC) forms are used to document the transport and receipt of samples from the field to the laboratory as specified in SOP No. 12. The COC information is incorporated in the sample tracking system as noted in Section 6.0. For data management purposes, field personnel will designate the preferred sample delivery groups and will indicate the sample delivery group (SDG) number on the COC form. An SDG will consist of 20 samples or less. Following shipment of samples to the laboratory(s), the Field Task Manager or designee will fax copies of the completed COC form(s) to the analytical laboratory, the Data Manager, and the Project QA/QC Officer.

4.3 SAMPLE RECEIPT CONFIRMATION

All laboratories receiving samples from W-C will be required to provide sample receipt confirmation. This confirmation should include a copy of the tabular listing showing the samples entered into the laboratory's data management system by sample delivery group number, the corresponding laboratory ID, and the analyses requested for each sample. The laboratory is required to provide only a tabular listing of the samples received if only a single analysis is requested for each sample. The confirmation will be faxed to the Chemical Task Manager or designee and to the Project Data Manager on the day of sample receipt. The Chemical Task Manager or designee is responsible for checking the confirmation received from the laboratory versus the COC form(s) to determine whether (1) all samples were received by the laboratory, (2) all samples and analyses were correctly entered into the laboratory's data management system, (3) unique field IDs and laboratory IDs were assigned to each sample, and (4) all required samples/analyses were collected and analyzed as specified in the FSP. The Chemical Task Manager or designee will notify the laboratory by phone and/or by fax of any discrepancies observed during the sample confirmation check.

The Data Manager or designee will be responsible for the sample IDs, corresponding laboratory IDs, collection dates, and the test parameters being entered into the Data Management System (see Section 6.0).

5.0
DATA DELIVERABLES

Data deliverable requirements from the laboratory will be determined prior to the start of the fieldwork and should be documented in a contract or contract addendum. Electronic deliverables should be in a W-C-defined format and the laboratory notified that they will be held responsible for ensuring that electronic deliverables will accurately reflect the data reported in hard copy format. A sample of the laboratory's electronic deliverable must be submitted to W-C prior to the initiation of fieldwork so that a proper electronic loader can be tested and data loading problems resolved by the CIS Administrator. As part of the data deliverable requirements, the Project Manager shall designate the W-C personnel to receive the sample data from the laboratory. If the laboratory data are to be sent to the Project Manager or designee, it shall be the Project Manager's responsibility to update the sample tracking system and to forward the data packages to the data reviewer for validation.

6.0
SAMPLE TRACKING AND DATA MANAGEMENT

A major part of managing chemical data is knowing how many samples have been taken, analyses requested, and analysis due dates. In addition, some chemical data may be more urgently needed than others, requiring these data to be prioritized over the rest of the data.

Sample tracking and data management include all forms of data collection and documentation and may include printing sample labels, printing COC forms in the field, checking holding times, and tracking outstanding analyses. A sample tracking system (STS) should be in place prior to the initiation of field sampling activities and may consist of either a simple spreadsheet, such as Excel or Lotus, or a sample tracking program such as the Sample Information Management System (SIMSII) developed by W-C. If a spreadsheet is to be utilized for sample tracking, its format shall be developed and reviewed prior to initiation of the project. The STS should, as a minimum, contain the field sample ID, the laboratory's sample ID, sample matrix, the designated SDG number, the analyses requested, the holding time limits for the analyses, date collected, sample preservation, laboratory performing analyses, assignment of QC samples (e.g., field replicates, rinsates, matrix spikes), and data fields for indicating the following data completion stages:

- Sample data receipt
- SDG data package completeness check
- Data validation/QC review completion per sample per analysis
- Data sent for input into database
- Data entry check completed
- Database proofed against validated data result sheets

The sample COC forms and the laboratory receipt confirmation listings serve as the initial data entry sheets for the STS providing the field sample ID numbers, laboratory IDs, analyses requested, date of collection, SDG number, and laboratory performing the analyses.

The laboratory will submit one analytical data package for each SDG. Upon receipt of the analytical data for an SDG, the data recipient will be responsible for updating the STS to indicate that data were received for the samples contained in the SDG data package, for notifying the Project Manager that data have been received, and for forwarding the data package to the designated data reviewer for validation. If the SDG data package is missing sample results for one or more samples, the laboratory will be notified of the discrepancy.

Following the initial check of the sample data received, the SDG data package will be checked against the required data deliverables for completeness by the data reviewer. If the SDG is complete, the data reviewer will be responsible for updating the STS to indicate that the SDG completeness check was performed. If any discrepancies are noted, the laboratory will be notified and redeliverables requested.

If the SDG is complete, or if the data present are sufficient for validation of the data, the data validation efforts will begin. Following validation of the data for an SDG, assignment of appropriate data qualifiers (if required) and peer review of the data validation, the data reviewer will be responsible for updating the STS to indicate that the data validation has been completed and qualifiers assigned.

Upon receipt of the data, sample results will be controlled by the Data Manager for entry into the database. A separate data transmittal form (Figure 2) will accompany the results from each SDG data package indicating the status of the attached results. The data will be checked for proper sample IDs, methods, and analytes prior to being entered into the database. Upon completion of the data entry, the Database Manager or designee will document the results of the data entry to indicate which sample data were entered into the database and which data were checked. The Project QA/QC Officer will be periodically informed of the status of data entry.

The proofing of the above data fields and data QC form helps to ensure that the proper steps in data management are followed and documented. The Project QA/QC Officer or designee will check a minimum of one SDG per project study to verify that the steps documented as complete were performed (e.g., sample data received, SDG data package complete, data QC performed via Monarch, data entered into database and checked after entry).

7.0
DATA ENTRY

7.1 OVERVIEW

A database management program capable of managing all sample data and generating reports, queries, graphs, and exports of the data should be in place prior to the initiation of field activities. W-C has developed EDGE (Environmental Data Integration and Export) to handle sample data management as a centralized information repository capable of handling all of W-C's chemical and geological/geotechnical information. EDGE has been designed to take advantage of Client/Server architecture. This technology enables a Server to control and distribute data to a large number of Clients. The Servers for this system are the SCO Unix computers, and the clients are desktop PCs running Microsoft Windows™ and EDGE. The Client/Server technology combined with W-C's wide area network enables anyone using EDGE to access data anywhere on the wide area network.

Analytical data can be entered in two ways: (1) manual entry of field and laboratory data from the field logbooks and laboratory data sheets into the data system, and (2) analytical data being downloaded into the database from data disks supplied by the laboratory(s). Electronic deliverables are the preferred method for receipt and entry of laboratory data, making data entry more efficient.

Chemical data results and supporting QC data should be provided whenever possible in electronic format and accompanied by a printed hard copy. This will minimize data entry errors from manual input into the database. The data will be provided by the laboratory in sample delivery groups (SDGs) of 20 samples or less of a similar matrix type, excluding QC samples. W-C will designate the preferred SDGs on the COC forms as described in SOP No. 12.

7.2 QC OF ELECTRONIC SAMPLE DATA

Upon receipt of sample data, the electronic deliverable will be loaded into a Monarch template by the CIS Administrator. After field integrity is checked via Monarch, a copy of the Monarch extract will be given to the Database Manager or designee (preferably a chemist) to check against the laboratory's hard copy. The chemist evaluates completeness and identifies possible problems in sample labeling, analyses requested, and values reported. After the integrity of the electronic deliverable has been established, the DBM informs the CIS Administrator and the data is loaded electronically.

7.3 ENTRY OF ELECTRONIC SAMPLE DATA

After the Monarch check is completed, the CIS Administrator or designee electronically enters the data with a loader which has been tested and debugged using test data received from the laboratory before the initiation of the project. After sample data has been loaded, it is the responsibility of the CIS Administrator to ensure proper loading of all data fields via SQL. Once field integrity has been established, the electronic extract from EDGE is proofed by the DBM or designee to confirm completeness. All methods, detections, and sample IDs are proofed against the laboratory's hard copy.

The Data Manager will determine the current status of the data and a data QC form will be completed to document the status of the data being entered. A status field will be included in any preliminary reports generated from the database. Data entered into the database from a data file provided by the laboratory is considered to be equivalent to single key entry, and 100 percent of the entered data will be proofed using the procedures mentioned above. The laboratory will be notified of any discrepancies found. Qualifiers from the validation process will be added to the database after being compiled by the Database Manager. The DBM will coordinate the assignment of qualifiers into the database with the CIS Administrator.

7.4 CORRECTIONS AND CHANGES TO SAMPLE DATA

It is expected that changes may be required to the data entered into the STS or the database (e.g., cancellation of sample analyses, additions of qualifiers to data). In those instances where changes are required to the database prior to the final QC review, all changes must be accompanied by a Data Correction/Change Form (see Figure 3 for example form) that will detail the changes to be made and document that the changes were completed.

8.0
DATA PROOFING

8.1 GENERAL DISCUSSION

Problems encountered in data management are typically due to inconsistencies or errors in the reporting of the data. The data in the database should be checked electronically and/or manually via database printouts. The data checks should include identifying:

1. Incorrect field sample numbers
2. Duplicate data and samples
3. Improper parameter names
4. Samples with missing data
5. Missing samples
6. Incorrect sample collection data
7. Incorrect units
8. Incorrect qualifiers
9. Missing detection limits, as applicable
10. Number of significant figures reported

It is important that data inconsistencies and errors be identified as soon as possible to allow for corrections of any problems prior to use of the data. All data received from a laboratory should be checked for inconsistencies similar to those listed above.

8.2 DATA ENTRY QC PROCEDURE

Following the sample receipt confirmation, the Field Task Manager or designee will be responsible for either entering the sample IDs, corresponding laboratory IDs, collection dates, and the test parameters directly into the database management program (i.e., sample tracking system and database management system) or providing the data to the Data Manager or designee for entry into the database. The initial sample data entry will be proofed as described in Section 7.2 for electronic entry.

For all corrections, addition of data qualifiers, and other required changes to the database, 100 percent of the changes will be proofed by the Data Manager or designee for potential entry errors.

8.3 DATABASE QC PROCEDURE

The following data QC procedure should be followed for proofing the database to the validated data:

1. The database QC review will be completed on a SDG basis. A hard copy or electronic query of the database, organized by SDG, will be checked by the Project QA/QC Officer or designee against information in the SDG as described below.

2. Clearly mark corrections to the hard copy database report in red ink based on appropriate database change form.

3. Using the laboratory data sheets, check that the W-C sample IDs are correctly listed in the electronic database, and that all samples for the SDG are reported in the electronic database or database hard copy output.

4. Using the laboratory data sheets (Lab Sheets), check that all the analyses requested for each sample are reported on the database hard copy or electronic query.

5. Using the Lab Sheets, check that the units reported on the database hard copy are correctly reported (i.e., check that the analytical matrix is reported correctly) as liters (L) for aqueous samples and kilograms (kg) for solids, and that the power of the unit is correct for the analytical method (i.e., micrograms [μg] or milligrams [mg]).

6. Using the Lab Sheets as a basis, the electronic database values (results and reporting limits) for all analytes for a given sample are checked. Once it has been established that all method-specific analytes have been loaded, all reported values are checked against the hard copy. Errors found are documented and brought to the attention of the DBM for action.

7. For each SDG, any questions or errors are noted concerning the reporting of the data in hard or electronic copy. The Project QA/QC Officer or designee is informed of potential problems found during the proofing procedure.

8. Using a list of qualifiers compiled for each SDG, check that all W-C qualifiers, results, units, and reporting limit changes are correctly reported in the electronic database or database hard copy. All assigned validation qualifiers and all changes to the database will be checked for potential entry errors.

9. For each SDG, a DB QC review form will be attached to properly document the date and initials of persons completing each QC step.

10. Check the corrected output of the database to determine that corrections have been completed (i.e., verify the final hard copy of the database).

11. Following completion of the QC procedure, the Project Manager, in consultation with the Project QA/QC Officer and Data Manager, will change the database reporting status to FINAL.

12. After completing the QC check of the SDGs pertaining to each SWMU, discuss the general findings of the review procedure with the Project QA/QC Officer and the Project Manager. Depending upon the review findings, appropriate modifications to the review procedure may be put into effect.

9.0
DATA REPORTING

To make efficient use of the database to support decisions, it is important for the end user to know the status (i.e., preliminary or final) and quality (i.e., nonvalidated, validated) of the data in the database. This is of primary importance if nonvalidated data have been entered into the database and distributed to project personnel. Therefore, every database report generated will indicate the current status of the database. In addition, until the database is finalized (i.e., all data validated, peer reviewed, and the database QC completed), authorization for access to the database is limited to the Project Manager, Project QA/QC Officer or designee, and the Data Manager or designee. If there is a need for preliminary data by an end user, authorization must be obtained from the Project Manager.

9.1 PRELIMINARY DATABASE REPORTS

For reports generated from the database prior to the database being determined to be final by the Project Manager in consultation with the Project QA/QC Officer and the Data Manager (e.g., nonvalidated data in database), all database reports will include (1) a header indicating that the database is **PRELIMINARY**, and (2) a status line per sample per analysis type (e.g., mercury, methyl mercury, ICP metals, fluoride, chloride, etc.) indicating the current status of the data for that sample. The status lines indicate the following:

- **Data Entered But Not Checked** - Sample results have been entered into the database but the data entry has not been proofed. This may include manual entry of validated or nonvalidated results or entry of nonvalidated results from a data file supplied by the laboratory.

- **Data Entry Checked** - Sample data entered either manually or from a data file have been proofed in accordance with Section 8.0.

- **Data Validated** - Data have been validated, qualifiers assigned, and the validated data entered and proofed.

For **PRELIMINARY** database reports, the reported sample results are subject to change and should be used with caution by the end user.

9.2 FINAL DATABASE REPORTS

When all sample data have been validated, the database QC completed for a given project study, and the database approved as final by the Project Manager in consultation with the Project QA/QC Officer and Data Manager, the header on all database reports generated will indicate **FINAL** and the data status line will be deleted.

All persons receiving copies of the **FINAL** database report(s) for a given task or project will be listed on a distribution list for that database report. Any changes required to the data in the **FINAL** database version for a given project will be made in consultation with the Project Manager. If changes are approved and made to the database, then all individuals on the distribution list for that database report(s) will be sent a notice highlighting the revisions made and a copy of the revised **FINAL** database report(s).

DATA MANAGEMENT SYSTEM

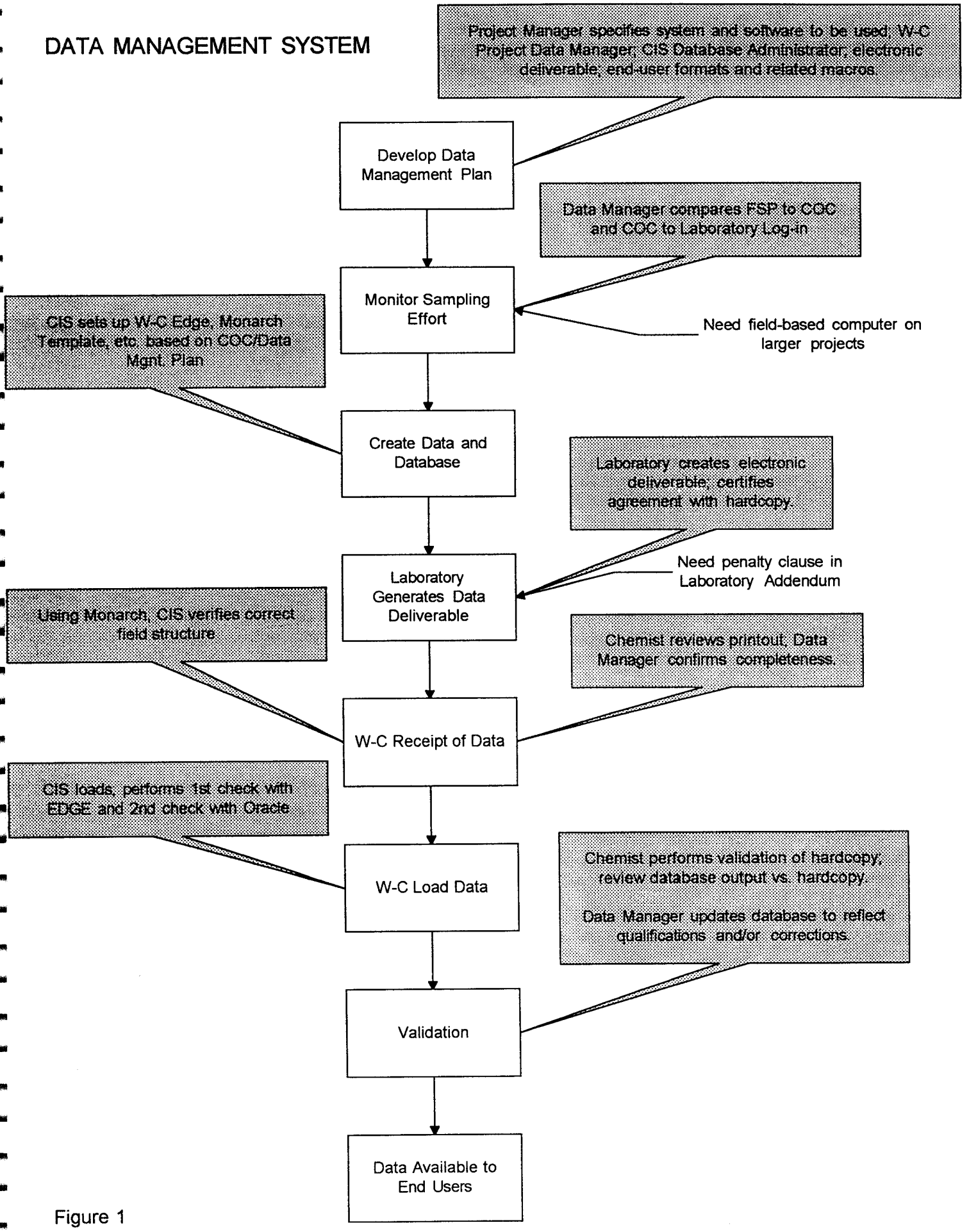

Figure 1

DATA TRANSMITTAL FORM

Data Transmitted

The attached laboratory data for Sample Delivery Group Number _____ contains analytical data for the following analyses:

___ Volatile Organics
___ Semivolatile Organics
___ Pesticides/PCBs
___ ICP Metals
___ GFAA Metals
___ Mercury
___ Cyanide
___ Methyl Mercury
___ Other - _____

The data are reported on a wet/dry weight basis (circle one)

The status of the attached data is:

___ Data Not Validated
___ Data Validated

Data Reviewer _____ Date _____

Data Entry

The status of data entry is as follows:

___ Data entered but entry not proofed
___ Data entered and entry proofed

Data Entry By _____ Date _____

Entry proofed by _____ Date _____

Figure 2

DATA CORRECTION/CHANGE FORM

The following changes and/or corrections to the database are required:

___ Data qualifiers have been assigned to the attached sample data for SDG _____

___ The following sample analyses have been cancelled:

___ Other changes or corrections (describe below):

Changes Requested By _____ Date _____

Changes Made By _____ Date _____

Changes Checked By _____ Date _____

Figure 3

SUMMARY OF DATA BASE QC STEPS COMPLETED FOR SDG ____ , SWMUs ____ PROJECT/Task_____

SWMU	SDG Numbers	Monarch QC	Load into EDGE	EDGE QC	Data Correction Change Form Completed	Data Val Complete	Qualifiers Tabulated	Outlying Parameters Tabulated	Qualifiers Entered into EDGE	Database Integrity Confirmed	Users Receive Data	Data Review Written

FOR THE CELLS ABOVE, INDICATE DATE AND INTIALS AFTER EACH ACTION OR TASK WAS COMPLETED.

X311WDMP.FG4

Figure 4

APPENDIX B
PROJECT MANAGEMENT PLAN

RCRA FACILITY INVESTIGATION

PROJECT MANAGEMENT PLAN

APPENDIX III SWMUs

CANNON AFB, NEW MEXICO

SEPTEMBER 1993

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B1.0
INTRODUCTION

A RCRA Facility Investigation (RFI) will be completed to further evaluate the nature and extent of contamination and human health risks associated with the 16 Appendix III Solid Waste Management Units (SWMU) at Cannon Air Force Base, Clovis, New Mexico. The results of the investigation will be utilized to recommend further studies required to evaluate potential corrective measures alternatives or if warranted a recommendation of "no further action" for each of the SWMUs. The SWMUs to be investigated include:

AGE Maintenance Shop	SWMU 31
Oil/Water Separator #196	SWMU 46
Oil/Water Separator #494	SWMU 47
Oil/Water Separator #375	SWMU 51
Oil/Water Separator #379	SWMU 57
Oil/Water Separator #5077a,b,c	SWMU 61, 62, 63
Oil/Water Separator #326	SWMU 70
Oil/Water Separator #5120	SWMU 92
Oil/Water Separator #5121	SWMU 93
Oil/Water Separator #5144	SWMU 94
Oil/Water Separator #4095	SWMU 127
Lead/Acid Battery Area	SWMU 55
CE Cont. Storage Area	SWMU 77
Wastewater Playa Lake	SWMU 103

Field investigations will include the collection of surface and subsurface soil samples, surface water samples, and sludge samples.

Although there have been some sampling events for soils and surface waters near some of the SWMUs listed above, none of them have been investigated in the past under the U.S. Air Force Installation Restoration Program (IRP). Results of nearby past investigations where available are discussed in the Field Sampling Plan which is submitted along with the Work Plan for the RFI.

This Project Management Plan will be utilized to manage the following RFI tasks:

- Project Planning (including schedule and budget control)
- Field Investigation
- Sample Analysis and Validation
- Data Evaluation
- Risk Assessment (if requested)
- Writing the RFI Reports

The Scope of Work for the above tasks is presented in the RFI Work Plan.

B2.1 RESPONSIBILITIES OF KEY PERSONNEL

The organizational structure and responsibility, defined below and in Figure B2-1, is designed to achieve quality assurance/quality control for site investigation activities at Cannon AFB. Further, the necessary communication and independent review is discussed. Ultimate responsibility for the conduct of the RFI programs at Cannon AFB rests with the installation commander (27 FW/CC), Col. Lance L. Smith. Daily management of RFI activities is vested in the 27 CES-CEV Branch of Civil Engineering and is the responsibility of Mr. Bruce G. Oshita, Chief, Environmental Management Flight. The U.S. Army Corps of Engineers (USACE) (Omaha District) has been contracted to perform the RFI with Mr. Marvin Taylor as the USACE Project Manager. The specific environmental investigations to be performed to satisfactorily characterize the 16 SWMUs will be performed by Woodward-Clyde (W-C) under contract to the USACE.

The following key W-C project personnel are described below:

- Program Manager/Responsible Professional
- Project Manager
- Project QA/QC Officer
- Project Health and Safety Officer
- Task Leaders
- QA/QC Coordinators
- Project Staff
- Site Health and Safety Officer

B2.1.1 Program Manager/Responsible Professional

The Program Manager has overall responsibility to the USACE, Omaha District, for activities on the project and monitoring the Project Manager's activities. The Program Manager has overall responsibility for the development of the QAPP, for monitoring the quality of the

technical and managerial aspects of the project, and for implementing the QAPP and (where necessary) corrective measures. Mr. Ken Nass of W-C will be the Program Manager for this project.

B2.1.2 Project Manager

Mr. Robert (Bob) C. Kuhn of W-C will serve as the Project Manager of this project. The Project Manager has primary responsibility for the completion of all activities on the project. He is responsible to the Program Manager and USACE for the day-to-day control of planning, scheduling, cost control, and implementation of the project, and for the development of the technical reports and other project documents. The Project Manager monitors all project personnel in planning, coordinating, and controlling all technical aspects of the tasks.

B2.1.3 Project QA/QC Officer

The QA/QC Officer reports to the Program Manager and works directly with the Project Manager and other project personnel. Dr. Lance A. Hines of W-C, who will serve as the QA/QC Officer, has the responsibility to monitor and verify that the work is performed in accordance with this plan, the FSP, the SOPs, and other applicable procedures. The QA/QC Officer also has the responsibility to assess the effectiveness of the QA/QC program and to recommend modifications to the program when applicable. The QA/QC Officer is responsible for assuring that personnel assigned to the project are trained and indoctrinated relative to the requirements of the QA/QC Program. He is also responsible for reviewing and verifying the disposition of nonconformance and corrective action reports, and for periodic quality assurance audits. The QA/QC Officer will advise the Project Manager on implementation of the QA/QC program, but the QA/QC functions of the QA/QC Officer and QA/QC representatives are independent of the Project Manager. The QA/QC Officer is responsible for the coordination with the Government Quality Assurance Laboratory which has been designated as the USACE Missouri River Division Laboratory. The QA Officer has the authority to halt work in case of significant problems or nonconformances to the QA plan if such problems or nonconformances are not corrected in a timely manner.

B2.1.4 Project Health and Safety Officer

Mr. Joseph A. Watson of W-C, who will serve as the Project Health and Safety Officer (PHSO), reports to the Program Manager and works directly with the Project Manager and other project personnel. The PHSO has the responsibility to monitor and verify that the work is performed in accordance with the HSP written for site investigations at Cannon AFB. The PHSO will advise the Project manager regarding health and safety issues, but will function independently of the Project Manager. The PHSO will also designate and oversee the activities of the Site Health and Safety Officer.

B2.1.5 Task Leaders

Each Task Leader is responsible to the Project Manager for planning, scheduling, cost control, and completion of assigned project tasks. The Task Leader is responsible for implementing the QA/QC program related to assigned tasks at Cannon AFB. Task leaders for the following RFI tasks are:

Mr. Brian Ruby (W-C)	-	RFI Field Investigation
Dr. John Stansbury (W-C)	-	Risk Assessment/Risk Screening
Mr. Curtis Clowe (W-C)	-	Chemistry

B2.1.6 Project Staff

Each member of the project staff is responsible to the Task Leader and/or Project Manager for completion of assigned project activities. Members of the project staff are responsible for understanding and implementing QA/QC program as it applies to their project activities.

B2.1.7 QA/QC Coordinator

A QA/QC Coordinator(s) may be appointed by the QA/QC Officer to review, monitor, and report on the conformance to QA/QC program requirements for specific project activities or tasks. A QA/QC Coordinator may perform audits and, as QA/QC Coordinator, shall report to the QA/QC Officer. As QA/QC Coordinator, the designated staff member may also perform project-related activities, but may not perform a quality-monitoring function on his

or her own work. As a QA/QC Coordinator, the designated staff member may also advise the task group(s) on QA/QC methods and practices. The QA/QC Coordinator will maintain a record of any assigned quality-monitoring activities and will inform the QA/QC Officer of these monitoring activities.

B2.1.8 Site Health and Safety Officer

The Site Health and Safety Officer (SHSO) monitors all site activities and is responsible for the implementation of and compliance with the Project Health and Safety Plan. The SHSO reports directly to the Project Health and Safety Officer.

B2.2 QUALIFICATIONS OF PERSONNEL

All personnel assigned to the project, including employees and consultants, will be qualified to perform the tasks to which they are assigned.

Appraisal of the qualifications of technical personnel assigned to the project will be made by the Project Manager. The appraisal will include the comparison of the requirements of the job assignment with the relevant experience and training of the prospective assignee; it will also include a determination whether further training is required and, if required, by what method. On-the-job training is an acceptable method, provided such training is provided by a person qualified to perform the trainee's assignment and the results of that training are documented.

All documents concerning qualification appraisal will be stored in the project administrative files.

B2.3 REGULATORY COORDINATION

U.S. EPA Region VI is the lead agency for regulatory oversight of investigation and recommendations regarding the 16 SWMUs discussed in Section 1.0. Mr. Bruce G. Oshita, Chief, Environmental Management Flight for Cannon AFB, will be responsible for overall project coordination with U.S. EPA Region VI including transmittal of all appropriate

documents. At Mr. Oshita's direction USACE and W-C personnel will assist with various aspects of regulatory coordination.

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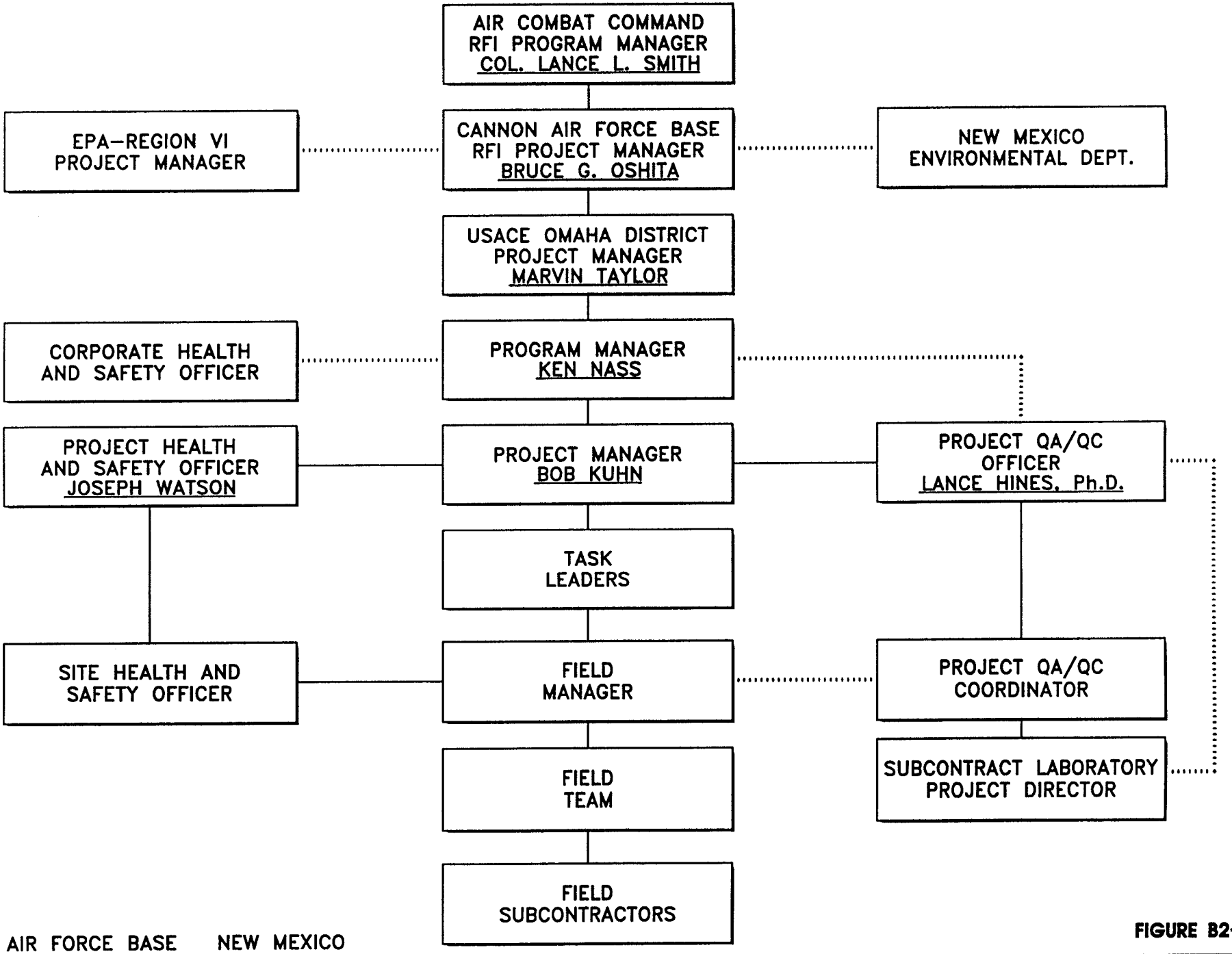
PROJECT ORGANIZATION CHART



CANNON AIR FORCE BASE NEW MEXICO

FIGURE B2-1

B3.0
PROJECT SCHEDULE

The overall RFI project schedule is shown on Figure B3-1. The estimated time duration for each RFI task is also shown. The project is expected to be completed by March 31, 1994 when the Final RFI report is transmitted. This schedule assumes no delays caused by regulatory review or any force majeure.

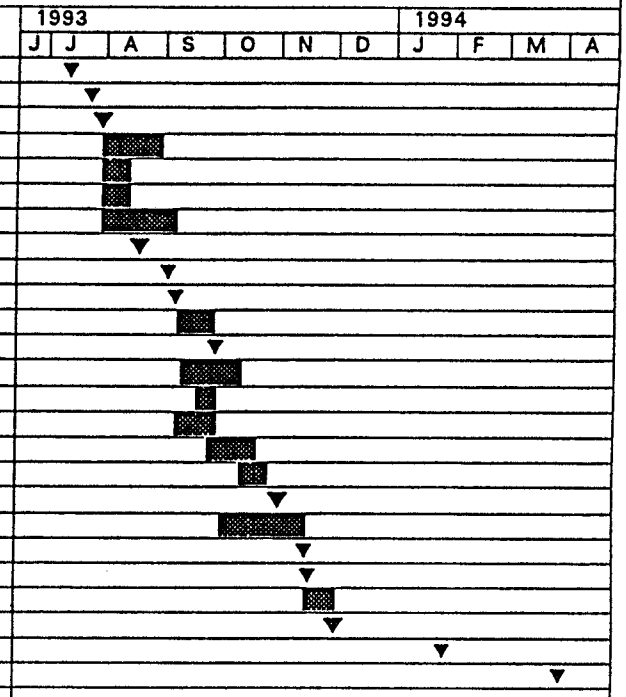
The project schedule assumes that regulatory agency review of and comment (if required) on revised Work Plan documents and the Draft RFI report will take place during the same time period in which Cannon AFB and the USACE personnel are reviewing and commenting on said revised plans and draft reports.

Meetings with regulatory agencies are not shown on the project schedule, however such meetings can be added to the schedule as deemed necessary.

The W-C project manager will be responsible for ensuring that the project remains on schedule except in instances where force majeure or items such as regulatory review time are beyond his/her control. The schedule shown in Figure B3-1 will be updated as necessary as the project progresses.

Cannon AFB New Mexico
Appendix III SWMU's
Project Schedule

Task #	Description	Start	Finish
	Proposal Submitted	07/12/93	
	Negotiations	07/23/93	
	Notice of Award	07/30/93	
1A-1F	Project Work Planning Documents	07/30/93	08/30/93
1G	Review Previous Reports	07/30/93	08/13/93
1H	ARAR's Analysis	07/30/93	08/13/93
1I	Premobilization Planning	07/30/93	09/07/93
	Submit Work Plan	08/19/93	
	Work Plan Approved	09/03/93	
2A	Field Mobilization	09/07/93	
2B	Field Work	09/08/93	09/27/93
2A	Demobilization	09/28/93	
3	Chemical Analysis of Field Samples	09/10/93	10/12/93
4	Sample Location Survey	09/18/93	09/28/93
5A	Daily QC Reports	09/07/93	09/28/93
5B	Data Validation/Data Evaluation	09/24/93	10/20/93
5C	Quality Control Summary Report	10/12/93	10/26/93
	Lab Data Review Meeting	11/01/93	
7A	PreDraft RFI Report Preparation	10/01/93	11/15/93
	Submit PreDraft RFI Report to USACE	11/15/93	
	USACE Comments & PreDraft RFI Meeting	11/17/93	
7B	Draft RFI Report Preparation	11/15/93	12/01/93
	Submit Draft RFI to USACE & EPA	12/01/93	
	Comments on Draft RFI Received	01/28/94	
7C	Final RFI Report to USACE	03/31/94	



NOTE: The Baseline Risk Assessment (BRA) has been deleted from the initial scope, however, we understand USACE intends to request a proposal and estimate for a modified scope to include the BRA at a later date.

Date: 08/20/93

P3M11WFS | Page 1 / 1

Project Finish: 01/20/01

Legend

Critical | Non-Crit. | Summary | Hammock | Early | Subproject

Fig. B3-1 Project Schedule

B4.0
BUDGET TRACKING

The project budget is established on the basis of the price agreed to in the delivery order negotiations and approved by the contracting officer of the USACE. This price is based on a scope of work specified by the USACE and project conditions as represented by the USACE. The W-C Project Manager is responsible to report monthly to the USACE on the completion status of each task in the project. This monthly progress report will also discuss any conditions encountered that are significantly different than represented and agreed to. Variations that require modification to the scope and price of the contract will be discussed and negotiated with the contracting officer prior to any work being done beyond the agreed scope.

B5.1 REPORTING

Progress on the project will be tracked by the W-C project manager, and he will submit a monthly progress report to the USACE. The report will discuss the following:

- Work completed
- Upcoming work
- Problems encountered (including schedule delays)
- Changes in scope
- Meetings attended
- Percent of tasks and overall project complete
- Percent of budget(s) expended

In addition, a daily written Quality Report documenting field quality control (QC) activities, QC deviations, and an evaluation of the quality of sampling will be submitted to the USACE during field operations. The reports discussed above may be transmitted by USACE to other entities as deemed necessary.

B5.2 PROJECT FILES

Explicit data collection, management, and reporting requirements are covered in separate documents (i.e., Field Sampling Plan and Quality Assurance Project Plan).

A complete file of all project data and correspondence, notes and reports will be kept by W-C in the Omaha office. Billing and accounting records will be kept in the main Woodward-Clyde accounting department files in the Denver office.

APPENDIX C
ARARs ANALYSIS

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS IDENTIFICATION AND ANALYSIS FOR APPENDIX III SWMUs CANNON AIR FORCE BASE, NEW MEXICO

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CHEMICAL-SPECIFIC ARARS	3
Chemical-Specific Groundwater and Surface Water ARARs/TBCs	3
Chemical-Specific TBCs for Soil	5
LOCATION-SPECIFIC ARARS	6

TABLE 1 POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs

TABLE 2 POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs GROUNDWATER QUALITY STANDARDS

TABLE 3 POTENTIAL CHEMICAL-SPECIFIC ARARs STATE SURFACE WATER QUALITY STANDARDS

TABLE 4 POTENTIAL CHEMICAL-SPECIFIC CONCENTRATIONS FOR ORGANIC COMPOUNDS IN SOIL -- TBC ACTION LEVELS

TABLE 5 POTENTIAL CHEMICAL-SPECIFIC CONCENTRATIONS FOR INORGANIC COMPOUNDS IN SOIL -- TBC ACTION LEVELS

TABLE 6 SUMMARY OF POTENTIAL LOCATION-SPECIFIC ARARs

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS IDENTIFICATION AND ANALYSIS FOR APPENDIX III SWMUs CANNON AIR FORCE BASE, NEW MEXICO

This document discusses the Applicable or Relevant and Appropriate Requirements (ARARs) that will govern the remedial activities done at Cannon Air Force Base (AFB). Specifically, these ARARs are prepared for the remedial activities at sixteen Appendix III Solid Waste Management Units (SWMUs) at Cannon AFB. Review of these ARARs will highlight SWMU-specific regulatory conditions that might either limit the choice of alternatives or place limits on contaminant concentrations. The ARARs presented in this memorandum are chemical-specific and location-specific. Action-specific ARARs can only be addressed after the field investigation has been concluded and remedial action alternatives are selected.

Cannon AFB must evaluate the SWMUs identified by the USEPA during the RCRA Facility Assessment (RFA) as a condition of their Resource Conservation and Recovery Act (RCRA) Part B permit. The investigations conducted by W-C at Appendix III SWMUs are designed to satisfy RCRA Facility Investigation (RFI) guidance, to characterize the SWMUs, and to develop and implement corrective action measures, if necessary. Under RCRA, alternative remedial or corrective action measures will be evaluated to assess the degree to which they attain or exceed applicable or relevant and appropriate federal and state public health and environmental standards as part of future Corrective Measures Studies (CMS).

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DEFINITION OF ARARs

Cleanup standards for corrective actions must attain a general standard of cleanup that assures protection of human health and the environment, is cost-effective, and uses permanent solutions and alternative treatment technologies or resource recovery technologies to the

maximum extent practicable. In addition, any hazardous substance or pollutant remaining on site is required to meet the level or standard of control established by standards, requirements, criteria, or limitations under any federal environmental law, or any more-stringent standards, requirements, criteria, or limitations promulgated in accordance with a state environmental statute.

A requirement may be either applicable or relevant and appropriate to remedial activities at a site, but not necessarily both. Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances at a site.

If a regulation is not applicable, it may still be relevant and appropriate. The basic considerations are whether the requirement:

(1) regulates or addresses problems or situations sufficiently similar to those encountered at the subject site (i.e., relevance); and

(2) is appropriate to the circumstances of the release or threatened release, such that its use is well suited to the particular site.

Determining whether a requirement is relevant and appropriate is site-specific and must be based on best professional judgment. This judgment is based on a number of factors, including the characteristics of the remedial action, the hazardous substances present at the site, and the physical circumstances of the site and of the release, as compared to the statutory or regulatory requirement. Compliance with all requirements found to be applicable or relevant and appropriate is mandatory unless a waiver is obtained from EPA.

"To be considered" materials (TBCs) are nonpromulgated advisories, proposed rules, criteria, or guidance documents issued by federal or state governments that do not have the status of potential ARARs. However, these advisories and guidance are to be considered when determining protective cleanup levels where no ARAR exists, or where ARARs are not

sufficiently protective of human health and the environment. In these circumstances, TBC values are used to establish cleanup targets.

CHEMICAL-SPECIFIC ARARS

The chemical-specific ARARs and other criteria or guidelines to be considered are presented in Tables 1 through 5. This information is based on standards, guidelines, and criteria found in relevant literature, discussions with appropriate state regulatory agency personnel, and past project experience.

Chemical-specific requirements are based on health or risk-based concentration limits of discharge limitations in environmental media (i.e., water, soil) for specific hazardous chemicals. These requirements may be used to indicate whether remediation is required at a SWMU and/or to set cleanup levels for the chemicals of concern in contaminated media at a SWMU.

Sources for potential target cleanup levels included selected standards, criteria, and guidelines that are typically considered ARARs, as well as recently published guidance and proposed action levels developed under RCRA that should be regarded as "to be considered" (TBC) guidelines. In addition, the State of New Mexico has developed cleanup levels for special wastes and underground storage tank-related remediation, as well as standards for groundwater. A summary of these federal and state regulations, standards, and guidances is presented in Table 1.

Chemical-Specific Groundwater and Surface Water ARARs/TBCs

For groundwater, Maximum Contaminant Levels (MCLs) or non-zero Maximum Contaminant Level Goals (MCLGs) established under the Safe Drinking Water Act (SDWA) are often accepted by regulatory agencies as cleanup levels for groundwater remedial activities,

especially if the groundwater is or could be a drinking water source. Since groundwater in the vicinity of Cannon AFB is classified as a current source of drinking water (Class IIA Groundwaters), the identification of potential target cleanup levels for groundwater samples from Cannon AFB focused on standards, criteria, and guidelines primarily for drinking water. These standards include MCLs and MCLGs, as well as the New Mexico drinking water standards, and are presented in Table 2. Also included are hazardous constituent concentration limits under RCRA Subpart F, which is applicable to releases from RCRA-regulated units. Secondary MCLs established under SDWA are also presented in Table 2, although they are not federally enforceable and should be regarded as TBCs. In addition, the MCLs for several chemicals are not yet in effect and should be considered TBCs. If no value is shown for a potential contaminant in Table 2, there are currently no standards for that contaminant.

Groundwater investigation is not included in the current scope of services provided by W-C at the sixteen Appendix III SWMUs. Groundwater at Cannon AFB is about 250 feet below ground surface, and Cannon AFB generalized geology and climatology indicates that potential adverse impacts to groundwater from SWMUs are not likely to be seen in the short term. However, long-term continuous hydraulic loading (such as that from an unlined lagoon or pond) may aid in the transport of contaminants to groundwater. If the potential for groundwater contamination is indicated during the course of the RFI, further investigation of groundwater as a media of concern may be warranted.

State and federal standards and criteria for surface water quality may be considered applicable to the playa lake included as part of this investigation. The potentially applicable standards are presented in Table 3. The playa lake is not currently used for domestic water supply or as a warm or cold water fishery, but may potentially be used for wildlife or livestock watering and irrigation. These standards are listed in Table 3. The playa lake receives water discharged from two wastewater treatment lagoons within Cannon AFB. These wastewater lagoons have been in operation since 1966 and treat both sanitary and industrial wastewater. A discharge permit from the lagoons to the playa lake has reportedly not been required because the lagoons do not discharge into navigable waters (W-C 1992).

Chemical-Specific TBCs for Soil

There are very few cleanup standards for soil contamination. Cleanup levels are often based on guidance developed from underground storage tank (UST) investigations or, if nonpetroleum wastes are involved, levels are based on site-specific risk assessment, hazardous waste definition, or background levels. Recently, some human health-based criteria for soil and water contaminant levels have been published as guidance for RFIs (referred to as the RFI Guidance), and RCRA-related action levels have been proposed (Tables 4 and 5). However, these criteria were developed specifically for application in RCRA-related activities, although it appears they are being used as proposed ARARs where no other standards exist. These guidelines are presented, therefore, as TBCs rather than as chemical-specific ARARs and represent "potential" cleanup levels only. Actual cleanup levels that may be applied to a particular area will depend on SWMU-specific requirements based in part on the RFI and are subject to final approval by the appropriate regulatory agency or agencies. The RCRA action levels are presented and used for the purposes of this ARARs investigation because there are no other sources of standards or guidance for contaminated soils cleanup levels.

The RFI guidance levels presented in Tables 4 and 5 for cleanup of contaminated soils are based on EPA-derived chronic exposure assumptions and are intended as screening levels at RCRA facilities to determine if a more detailed health risk evaluation is warranted. As previously discussed, they do not necessarily represent a target cleanup level. The proposed RCRA action levels shown in Tables 4 and 5, if exceeded, are intended to trigger a CMS under RCRA. However, because these levels are only proposed, at this time they are not enforceable under RCRA (55 FR 30798, July 27, 1990). The equations used to derive the RFI guidance and RCRA action levels use essentially identical parameters.

Other regulations or requirements that may need "to be considered" included the New Mexico UST Regulations and the New Mexico Special Waste Requirements Regulations. Those regulations set cleanup standards for soils contaminated with petroleum hydrocarbons.

LOCATION-SPECIFIC ARARS

Location-specific ARARs are restrictions placed on the types of activities that may occur in particular locations. Potential location-specific ARARs for Cannon AFB are presented in Table 6 with an explanation as to whether the regulation is applicable or relevant and appropriate and why. The location of a site may be an important characteristic in determining its impact on human health and the environment; thus, individual states may establish location-specific ARARs. These ARARs may restrict or preclude certain remedial actions or may apply only to certain portions of a site. Examples of location-specific ARARs include federal and state requirements for preservation of historic landmarks, endangered species and wetlands protection, and the restrictions on management of hazardous waste in floodplain areas. Although the universe of location-specific ARARs is identified in Table 6, only those regulations that are deemed ARAR for Cannon AFB are discussed below.

Due to the possible presence of both federal- and state-listed threatened/endangered (T/E) species at Cannon AFB, the federal and state Endangered Species Acts are both considered "potentially" applicable. If T/E species are found at a SWMU or at Cannon AFB, these acts would be applicable. In addition, there are bald eagles, peregrine falcons, other raptors and waterfowl, and their habitat within a 50-mile radius of Cannon AFB (Lee Wan and Associates 1990). Both the Migratory Bird Treaty Act and the Bald Eagle Protection Act are considered applicable if any of the species protected by these two acts or their habitats are impacted by remedial actions.

Section 106 of the National Historic Preservation Act, the Historic and Archaeological Data Preservation Act, and the Archaeological Resource Protection Act are also considered "potentially" applicable due to a federal agency having authority over any actions that could impact on historically significant objects, buildings, or structures at the site. Although no buildings, objects, or structures at Cannon AFB have yet been placed on the National Register of Historic Places, the evaluation process is still ongoing. Due to both architectural and archaeological surveys being conducted on Cannon AFB, the State Cultural Properties Act is also considered "potentially" applicable, and negotiations with the State Historic Preservation Office should be renewed prior to any remedial activity.

While there is uncertainty concerning the future definition of wetlands, it is the opinion of the U.S. Fish and Wildlife Service that the playas at the base fall under the current definition of wetland areas under federal wetland delineation guidance (Hagenbuck 1991). The playa lake is one of the areas included under the current RFI at Cannon AFB. Should remedial action be required at the playa lake as a result of the RFI, then the regulations concerning protection and preservation of wetlands would be considered relevant and appropriate and may be considered applicable as well. Coordination with the U.S. Fish and Wildlife Service would need to be initiated prior to any remedial activity. The State of New Mexico does not have its own wetlands regulations at this time.

TABLE 1

POTENTIAL CHEMICAL-SPECIFIC ARARS/TBCs
CANNON AFB, NEW MEXICO

Standard, Requirement, or Criteria	Description	Comment
FEDERAL		
Safe Drinking Water Act (40 USC Sect. 300)		
National Primary Drinking Water Standards [40 CFR Parts 141, 142, (1990, 1991)]	Establishes maximum contaminant levels (MCLs) for specific contaminants which are health-based standards for public drinking water systems.	MCLs are applicable for drinking water at the tap. MCLs are relevant and appropriate for organic and inorganic contamination of groundwater that is or may be used as drinking water.
National Secondary Drinking Water Standards (40 CFR Part 143)	Establishes secondary MCLs which are nonenforceable guidelines for public drinking water systems to protect the aesthetic quality of the water.	Secondary MCLs may be "to be considered" if groundwater is or may be used as a drinking water source.
Maximum Contaminant Level Goals (MCLGs) [PL No. 99-339, 100 Stat. 642 (1986), 40 CFR Parts 141, 142, (1990, 1991)]	Establishes drinking water quality goals at a level at which no adverse health effects may occur with an adequate margin of safety.	MCLGs set above zero levels are relevant and appropriate for existing or potential sources of drinking water. MCLGs may be relevant and appropriate if the risk posed by multiple contaminants or pathways is in excess of 10^{-4}.
Clean Water Act (33 USC Sect 1251-1376)		
Ambient Water Quality Criteria (40 CFR Part 131)	Requires states to establish ambient water quality criteria for surface water based on use classification and the criteria stated under Section 304(a) of the Clean Water Act.	Ambient water quality criteria may be relevant and appropriate if contaminants are released to surface waters. Substantive requirements are found in State laws.

TABLE 1
(Continued)

Standard, Requirement, or Criteria	Description	Comment
Resource, Conservation, and Recovery Act (RCRA)		
Releases from Solid Waste Management Units (40 CFR Part 264)	Subpart F (264.94) gives concentration limits in groundwater for hazardous constituents from a regulated unit.	Applicable if organic or inorganic contamination of groundwater is found at a RCRA regulated unit.
RCRA Facility Investigation Guidance (EPA, 1989)	Guidance levels for cleanup of contaminated soils based on EPA-derived chronic exposure assumptions; intended as screening levels at RCRA facilities to determine if a more detailed health-risk evaluation is warranted.	To be considered if contaminated soils are found.
Proposed RCRA Action Levels (55 FR 30798, 27 July 1990)	Risk-based action levels for contaminants in soil which, if exceeded, would trigger the need for a Corrective Measures Study.	To be considered if contaminated soils are found.
STATE		
New Mexico Water Quality Act, 1978		
New Mexico Drinking Water Regulations (4/16/91)(New Mexico Water Supply Regulations, Sections 202 to 203)	Establishes MCLs and standards and use classifications for sources of drinking water.	State MCLs are applicable or relevant and appropriate to contaminated water if the state MCL is more stringent than federal requirements.
New Mexico Water Quality Regulations, amended through August 17, 1991 (WQCCR Part 3, Sections 100 through 103)	Establishes human health, domestic water supply, and irrigation use standards for ground water protection.	Applicable if remedial activities include discharges onto or below the surface of the ground.
New Mexico Water Quality Standards, as amended through November 12, 1991	Establishes water quality standards and classification and use standards for surface water.	Relevant and appropriate for remedial activities that include point source discharges or discharges into surface waters of the State.

TABLE 1
(Continued)

Standard, Requirement, or Criteria	Description	Comment
New Mexico Hazardous Waste Act 1978		
New Mexico Underground Storage Tank Regulations, amended through July 18, 1991, Section 1209	Sets cleanup levels for soils contaminated with benzene, aromatic hydrocarbons, or petroleum products.	May be "to be considered" if soils are contaminated with benzene, aromatic hydrocarbons, or petroleum products.
New Mexico Solid Waste Regulations		
New Mexico Remedial Action Contingency Plan Regulations, adopted effective January 30, 1992, Part VIII	Establishes remedial action levels and response procedures for releases to groundwater or surface water.	May be applicable to any contaminant releases to groundwater at Cannon AFB.
New Mexico Special Waste Requirements Regulations, adopted effective January 30, 1992, Part VII	Sets disposal levels for soils contaminated with BTEX compounds and total petroleum hydrocarbons. Also sets disposal standards for asbestos waste.	May be applicable to soils contaminated with petroleum hydrocarbons.

TABLE 2

POTENTIAL CHEMICAL-SPECIFIC ARARS/TBCs
GROUNDWATER QUALITY STANDARDS
CANNON AFB, NEW MEXICO

		FEDERAL STANDARDS			STATE STANDARDS NMWQCC Groundwater Quality Standards [e]			
Parameter	Analyte Type	SDWA Maximum Contaminant Level[a]	SDWA Maximum Contaminant Level Goal[a] ARARs/TBCs	RCRA Subpart F Concentration Limit[b] (40 CFR 264.94)	Community Water Supply System [f]	Human Health	Other Standards for Domestic Water Supply	Irrigation Use
pH	Field Parameter	6.5-8.5[d]					6.0-9.0	6.0-9.0
Total Dissolved Solids	Indicator	500,000 μg/L[d]					1,000,000 μg/L	1,000,000 μg/L
Carbonate	Anion							
Chloride	Anion	250,000 μg/L[d]					250,000 μg/L	250,000 μg/L
Fluoride	Anion	4,000 μg/L, 2,000 μg/L[d]	4,000 μg/L		4,000 μg/L	1,600 μg/L		1,600 μg/L
N as Nitrate	Anion	10,000 μg/L	10,000 μg/L		10,000 μg/L	10,000 μg/L		10,000 μg/L
N as Nitrate+Nitrite	Anion	10,000 μg/L	10,000 μg/L					
N as Nitrite	Anion	1,000 μg/L	1,000 μg/L					
Potassium	Anion							
Sulfate	Anion	250,000 μg/L[d]					600,000 μg/L	600,000 μg/L
Aluminum	Metal	0.5 to 200 μg/L[d]						5,000 μg/L
Antimony	Metal	6 μg/L[c]	6 μg/L[c]					
Arsenic	Metal	50 μg/L		50 μg/L	50 μg/L	100 μg/L		100 μg/L
Barium	Metal	2,000 μg/L	2,000 μg/L	1,000 μg/L	1,000 μg/L	1,000 μg/L		1,000 μg/L
Beryllium	Metal	4.0 μg/L[c]	4 μg/L[c]					
Boron	Metal							750 μg/L
Cadmium	Metal	5 μg/L	5 μg/L	10 μg/L	10 μg/L	10 μg/L		10 μg/L
Calcium	Metal							
Chromium	Metal	100 μg/L	100 μg/L	50 μg/L	50 μg/L	50 μg/L		50 μg/L

TABLE 2
(Continued)

Parameter	Analyte Type	FEDERAL STANDARDS: SDWA Maximum Contaminant Level[a]	FEDERAL STANDARDS: SDWA Maximum Contaminant Level Goal[a] ARARs/TBCs	FEDERAL STANDARDS: RCRA Subpart F Concentration Limit[b] (40 CFR 264.94)	STATE STANDARDS NMWQCC Groundwater Quality Standards[e]: Community Water Supply System[f]	STATE STANDARDS NMWQCC Groundwater Quality Standards[e]: Human Health	STATE STANDARDS NMWQCC Groundwater Quality Standards[e]: Other Standards for Domestic Water Supply	STATE STANDARDS NMWQCC Groundwater Quality Standards[e]: Irrigation Use
Cobalt	Metal							50 μg/L
Copper	Metal	1,000 μg/L[*]	1,300 μg/L[d]				1,000 μg/L	1,000 μg/L
		1,300 μg/L[***]						
Cyanide	Metal	200 μg/L[c]	200 μg/L[c]			200 μg/L		200 μg/L
Iron	Metal	300 μg/L[*]					1,000 μg/L	1,000 μg/L
Lead	Metal	50 μg/L	0[d]	50 μg/L	50 μg/L	50 μg/L		50 μg/L
		15 μg/L[***]						
Magnesium	Metal							
Manganese	Metal	50 μg/L[*]					200 μg/L	200 μg/L
Mercury	Metal	2 μg/L	2 μg/L	2 μg/L	2 μg/L	2 μg/L		2 μg/L
Molybdenum	Metal							1,000 μg/L
Nickel	Metal	100 μg/L[c]	100 μg/L[c]					200 μg/L
Selenium	Metal	50 μg/L	50 μg/L	10 μg/L	10 μg/L	50 μg/L		50 μg/L
Silver	Metal	100 μg/L[*]		50 μg/L	50 μg/L	50 μg/L		50 μg/L
Sodium	Metal							
Thallium	Metal	2 μg/L[c]	0.5 μg/L[c]					
Tin	Metal							
Titanium	Metal							
Tungsten	Metal							
Vanadium	Metal							
Zinc	Metal	5,000 μg/L[*]					10,000 μg/L	10,000 μg/L
Gross Alpha	Radionuclide	15 pCi/L			15 pCi/L			

TABLE 2
(Continued)

Parameter	Analyte Type	FEDERAL STANDARDS: SDWA Maximum Contaminant Level[a]	FEDERAL STANDARDS: SDWA Maximum Contaminant Level Goal[a] ARARs/TBCs	FEDERAL STANDARDS: RCRA Subpart F Concentration Limit[b] (40 CFR 264.94)	STATE STANDARDS NMWQCC Groundwater Quality Standards[e]: Community Water Supply System[f]	STATE STANDARDS NMWQCC Groundwater Quality Standards[e]: Human Health	STATE STANDARDS NMWQCC Groundwater Quality Standards[e]: Other Standards for Domestic Water Supply	STATE STANDARDS NMWQCC Groundwater Quality Standards[e]: Irrigation Use
Gross Beta	Radionuclide	4 mrem/yr						
Radium 226+228	Radionuclide	5 pCi/L			5 pCi/L	30 pCi/L		30 pCi/L
Strontium 90	Radionuclide	8 pCi/L			8 pCi/L			
Tritium	Radionuclide	20,000 pCi/L			20,000 pCi/L			
Uranium (total)	Radionuclide					5,000 μg/L		5,000 μg/L
1,1-Dichloroethane	Volatile					25 μg/L		25 μg/L
1,1-Dichloroethene	Volatile	7 μg/L	7 μg/L		7 μg/L	5 μg/L		5 μg/L
1,1,1-Trichloroethane	Volatile	200 μg/L	200 μg/L		200 μg/L	60 μg/L		60 μg/L
1,1,2,2-Tetrachloroethane	Volatile					10 μg/L		10 μg/L
1,1,2,2-Tetrachloroethene	Volatile					20 μg/L		20 μg/L
1,1,2-Trichloroethane	Volatile	5 μg/L[c]	3 μg/L[c]			10 μg/L		10 μg/L
1,1,2-Trichloroethene	Volatile					100 μg/L		100 μg/L
1,2-Dichloroethane	Volatile	5 μg/L	0 μg/L		5 μg/L	10 μg/L		10 μg/L
1,2-Dichloroethene	Volatile							
1,2-Dichloropropane	Volatile	5 μg/L	0 μg/L					
4-Methyl-2-pentanone	Volatile							
Acetone	Volatile							
Benzene	Volatile	5 μg/L	0 μg/L		5 μg/L	10 μg/L		10 μg/L
Bromodichloromethane	Volatile							
Bromoform	Volatile	Tot THM[d] <100 μg/L						
Bromomethane	Volatile							

TABLE 2
(Continued)

Parameter	Analyte Type	FEDERAL STANDARDS: SDWA Maximum Contaminant Level[a]	FEDERAL STANDARDS: SDWA Maximum Contaminant Level Goal[a] ARARs/TBCs	FEDERAL STANDARDS: RCRA Subpart F Concentration Limit[b] (40 CFR 264.94)	STATE STANDARDS NMWQCC Groundwater Quality Standards[e]: Community Water Supply System[f]	STATE STANDARDS NMWQCC Groundwater Quality Standards[e]: Human Health	STATE STANDARDS NMWQCC Groundwater Quality Standards[e]: Other Standards for Domestic Water Supply	STATE STANDARDS NMWQCC Groundwater Quality Standards[e]: Irrigation Use
Carbon Tetrachloride	Volatile	5 μg/L	0 μg/L		5 μg/L	10 μg/L		10 μg/L
Chlorobenzene (mono)	Volatile	100 μg/L	100 μg/L					
Chlorobenzilate	Volatile							
Chloroethane	Volatile							
Chloroform	Volatile	Tot THM** <100 μg/L			Tot THM** 100 μg/L	100 μg/L		100 μg/L
Chloroprene	Volatile							
Chloromethane	Volatile							
Cis-1,2-Dichloroethene	Volatile	70 μg/L	70 μg/L					
Cis-1,3-Dichloropropene	Volatile							
Dibromochloromethane	Volatile	Tot THM** <100 μg/L						
Ethyl Benzene	Volatile	700 μg/L	700 μg/L			750 μg/L		750 μg/L
Methylene Chloride	Volatile	5 μg/L[c]	0 μg/L[c]			100 μg/L		100 μg/L
Styrene	Volatile	100 μg/L	100 μg/L					
Tetrachloroethane	Volatile							
Tetrachloroethene	Volatile	5 μg/L	0 μg/L					
Toluene	Volatile	1,000 μg/L	1,000 μg/L			750 μg/L		
Total Trihalomethanes	Volatile	100 μg/L						
Total Xylenes	Volatile	10,000 μg/L	10,000 μg/L			620 μg/L		620 μg/L
Trans-1,2-Dichloroethene	Volatile	100 μg/L	100 μg/L					
Trans-1,3-Dichloropropene	Volatile							
Trichloroethane	Volatile							

TABLE 2
(Continued)

Parameter	Analyte Type	FEDERAL STANDARDS: SDWA Maximum Contaminant Level[a]	FEDERAL STANDARDS: SDWA Maximum Contaminant Level Goal[a] ARARs/TBCs	FEDERAL STANDARDS: RCRA Subpart F Concentration Limit[b] (40 CFR 264.94)	STATE STANDARDS NMWQCC Groundwater Quality Standards[e]: Community Water Supply System[f]	STATE STANDARDS: Human Health	STATE STANDARDS: Other Standards for Domestic Water Supply	STATE STANDARDS: Irrigation Use
Trichloroethene	Volatile	5 μg/L	0 μg/L		5 μg/L			
Vinyl Acetate	Volatile							
Vinyl Chloride	Volatile	2 μg/L	0 μg/L		2 μg/L	1μg/L		1 μg/L
1,2-Dichlorobenzene (ortho)	Semivolatile	600 μg/L	600 μg/L					
1,3-Dichlorobenzene (meta)	Semivolatile	600 μg/L	600 μg/L					
1,4-Dichlorobenzene (para)	Semivolatile	75 μg/L	75 μg/L		75 μg/L			
1,2,4-Trichlorobenzene	Semivolatile	70 μg/L[c]	70 μg/L[c]					
2-Chloronaphthalene	Semivolatile							
2-Chlorophenol	Semivolatile							
2-Methylnaphthalene	Semivolatile							
2-Nitroaniline	Semivolatile							
2-Nitrophenol	Semivolatile							
2,3,7,8-Tetrachlorodibenzo-p-dioxin	Semivolatile	$3x10^{-8}$[c]	0 μg/L[c]					
2,4-Dichlorophenol	Semivolatile							
2,4-Dichlorophenoxyacetic Acid (2,4-D)	Semivolatile (H)	70 μg/L	70 μg/L	100 μg/L	100 μg/L			
2,4-Dimethylphenol	Semivolatile							
2,4-Dinitrophenol	Semivolatile							
2,4-Dinitrotoluene	Semivolatile							
2,4,5-TP Silvex	Semivolatile (H)	50 μg/L	50 μg/L	10 μg/L	10 μg/L			
2,4,6-Trichlorophenol	Semivolatile							
3-Nitroaniline	Semivolatile							

TABLE 2
(Continued)

Parameter	Analyte Type	FEDERAL STANDARDS: SDWA Maximum Contaminant Level[a]	FEDERAL STANDARDS: SDWA Maximum Contaminant Level Goal[a] ARARs/TBCs	FEDERAL STANDARDS: RCRA Subpart F Concentration Limit[b] (40 CFR 264.94)	STATE STANDARDS NMWQCC Groundwater Quality Standards[e]: Community Water Supply System[f]	STATE STANDARDS NMWQCC Groundwater Quality Standards[e]: Human Health	STATE STANDARDS NMWQCC Groundwater Quality Standards[e]: Other Standards for Domestic Water Supply	STATE STANDARDS NMWQCC Groundwater Quality Standards[e]: Irrigation Use
4-Bromophenyl Phenylether	Semivolatile							
4-Chloroaniline	Semivolatile							
4-Chlorophenyl Phenyl Ether	Semivolatile							
4-Chloro-3-methylphenol	Semivolatile							
4-Nitroaniline	Semivolatile							
4,6-Dinitro-2-methylphenol	Semivolatile							
Acenaphthalene	Semivolatile							
Acrylonitrile	Semivolatile							
Alachlor	Semivolatile	2 μg/L	0 μg/L					
Aldicarb	Semivolatile (P)	3 μg/L	1 μg/L					
Aldicarb Sulfone	Semivolatile (P)	2 μg/L	1 μg/L					
Aldicarb Sulfoxide	Semivolatile (P)	4 μg/L	1 μg/L					
Aldrin	Semivolatile (P)							
Aniline	Semivolatile							
Anthracene	Semivolatile							
Atrazine	Semivolatile	3 μg/L	3 μg/L					
Benzo(a)anthracene	Semivolatile							
Benzo(a)pyrene	Semivolatile	0.2 μg/L[c]	0 μg/L[c]			0.7 μg/L		0.7 μg/L
Benzo(b)fluoranthene	Semivolatile							
Benzo(g,h,i)perylene	Semivolatile							
Benzo(k)fluoranthene	Semivolatile							
Benzyl Alcohol	Semivolatile							

TABLE 2
(Continued)

Parameter	Analyte Type	FEDERAL STANDARDS			STATE STANDARDS NMWQCC Groundwater Quality Standards [e]			
		SDWA Maximum Contaminant Level[a]	SDWA Maximum Contaminant Level Goal[a] ARARs/TBCs	RCRA Subpart F Concentration Limit[b] (40 CFR 264.94)	Community Water Supply System [f]	Human Health	Other Standards for Domestic Water Supply	Irrigation Use
Bis(2-Chloroethoxy)methane	Semivolatile							
Bis(2-Chloroethyl)ether	Semivolatile							
Bis(2-Chloroisopropyl)ether	Semivolatile							
Bis(2-Ethylhexyl)phthalate	Semivolatile							
Butyl Benzylphthalate	Semivolatile							
Carbofuran	Semivolatile (P)	40 μg/L	40 μg/L					
Carbon Disulfide	Semivolatile							
Chlordane	Semivolatile (P)	2 μg/L	0 μg/L					
Chlorophenol	Semivolatile							
DDT	Semivolatile (P)							
DDT metabolite (DDE)	Semivolatile (P)							
DDT metabolite (DDD)	Semivolatile (P)							
Dalapon	Semivolatile (P)	200 μg/L[c]	200 μg/L[c]					
Diallite	Semivolatile							
Dibenzofuran	Semivolatile							
Dibenz(a,h)anthracene	Semivolatile							
Dibromochloropropane	Semivolatile (P)	0.2 μg/L	0 μg/L					
Dichlorobenzene	Semivolatile							
Dichlorobenzidine	Semivolatile							
Dieldrin	Semivolatile (P)							
Di(2-ethylhexyl)adipate	Semivolatile (P)	400 μg/L[c]	400 μg/L[c]					
Diethylphthalate	Semivolatile							

TABLE 2
(Continued)

Parameter	Analyte Type	FEDERAL STANDARDS: SDWA Maximum Contaminant Level[a]	FEDERAL STANDARDS: SDWA Maximum Contaminant Level Goal[a] ARARs/TBCs	FEDERAL STANDARDS: RCRA Subpart F Concentration Limit[b] (40 CFR 264.94)	STATE STANDARDS NMWQCC Groundwater Quality Standards[e]: Community Water Supply System[f]	STATE STANDARDS NMWQCC Groundwater Quality Standards[e]: Human Health	STATE STANDARDS NMWQCC Groundwater Quality Standards[e]: Other Standards for Domestic Water Supply	STATE STANDARDS NMWQCC Groundwater Quality Standards[e]: Irrigation Use
Di(2-ethylhexyl)phthalate	Semivolatile	6.0 μg/L[c]	0 μg/L[c]					
Dimethoate	Semivolatile							
Dimethylphthalate	Semivolatile							
Dinitrotoluene	Semivolatile							
Dinoseb	Semivolatile(H)	7 μg/L[c]	7 μg/L[c]					
Di-n-octylphthalate	Semivolatile							
Diquat	Semivolatile(P)	20 μg/L[c]	20 μg/L[c]					
Endosulfan I	Semivolatile (P)							
Endosulfan II	Semivolatile (P)							
Endosulfan Sulfate	Semivolatile (P)							
Endothall	Semivolatile (P)	100 μg/L	100 μg/L					
Endrin	Semivolatile (P)	2.0 μg/L[c]	2.0 μg/L[c]	0.2 μg/L	0.2 μg/L			
Ethylene Dibromide	Semivolatile	0.05 μg/L	0 μg/L			0.1 μg/L		0.1 μg/L
Fluoranthene	Semivolatile							
Fluorene	Semivolatile							
Glyphosate	Semivolatile(P)	700 μg/L[c]	700 μg/L[c]					
Heptachlor	Semivolatile (P)	0.4 μg/L	0 μg/L					
Heptachlor Epoxide	Semivolatile (P)	0.2 μg/L	0 μg/L					
Hexachlorobenzene	Semivolatile	1.0 μg/L[c]	0 μg/L[c]					
Hexachlorobutadiene	Semivolatile							
Hexachlorocyclohexane, Alpha	Semivolatile (P)							
Hexachlorocyclohexane, Beta	Semivolatile (P)							

TABLE 2
(Continued)

Parameter	Analyte Type	FEDERAL STANDARDS			STATE STANDARDS NMWQCC Groundwater Quality Standards [e]			
		SDWA Maximum Contaminant Level[a]	SDWA Maximum Contaminant Level Goal[a] ARARs/TBCs	RCRA Subpart F Concentration Limit[b] (40 CFR 264.94)	Community Water Supply System [f]	Human Health	Other Standards for Domestic Water Supply	Irrigation Use
Hexachlorocyclohexane, (Lindane)	Semivolatile (P)	0.2 μg/L	0.2 μg/L	4 μg/L	4 μg/L			
Hexachlorocyclohexane, Technical	Semivolatile (P)							
Hexachlorocyclopentadiene	Semivolatile	50 μg/L[c]	50 μg/L[c]					
Hexachloroethane	Semivolatile							
Indeno(1,2,3-cd)pyrene	Semivolatile							
Methoxychlor	Semivolatile (P)	40 μg/L	40 μg/L	100 μg/L	100 μg/L			
Naphthalene	Semivolatile							
Nitrobenzene	Semivolatile							
Nitrophenol	Semivolatile							
Nitrosodibutylamine	Semivolatile							
Nitrosodiethylamine	Semivolatile							
Nitrosodimethylamine	Semivolatile							
Nitrosopyrrolidine	Semivolatile							
N-Nitrosodiphenylamine	Semivolatile							
N-Nitroso-di-n-dipropylamine	Semivolatile							
Oxamyl	Semivolatile(P)	200 μg/L[c]	200 μg/L[c]					
PCBs	PCBs	0.5 μg/L	0 μg/L			1 μg/L		1 μg/L
Pentachlorinated Ethanes	Semivolatile							
Pentachlorophenol	Semivolatile	1 μg/L	0 μg/L					
Phenanthrene	Semivolatile							
Phenol	Semivolatile				5 μg/L		5 μg/L	5 μg/L

TABLE 2
(Continued)

Parameter	Analyte Type	FEDERAL STANDARDS: SDWA Maximum Contaminant Level[a]	FEDERAL STANDARDS: SDWA Maximum Contaminant Level Goal[a] ARARs/TBCs	FEDERAL STANDARDS: RCRA Subpart F Concentration Limit[b] (40 CFR 264.94)	STATE STANDARDS NMWQCC Groundwater Quality Standards[e]: Community Water Supply System[f]	STATE STANDARDS NMWQCC Groundwater Quality Standards[e]: Human Health	STATE STANDARDS NMWQCC Groundwater Quality Standards[e]: Other Standards for Domestic Water Supply	STATE STANDARDS NMWQCC Groundwater Quality Standards[e]: Irrigation Use
Picloram	Semivolatile (H)	500 μg/L	500 μg/L					
Polynuclear Aromatic Hydrocarbons (total PAH)	Semivolatile				30 μg/L	30 μg/L		30 μg/L
Pyrene	Semivolatile							
Simazine	Semivolatile(P)	4 μg/L[c]	4 μg/L[c]					
Trans-1,2-Dichloroethene	Semivolatile	100 μg/L	100 μg/L					
Toxaphene	Semivolatile (P)	3 μg/L	0 μg/L	5 μg/L	5 μg/L			

EXPLANATION OF TABLE

(P) Pesticide (H) Herbicide

* = secondary maximum contaminant level (TBCs)
** = total trihalomethanes: chloroform, bromoform, bromodichloromethane, dibromochloromethane
*** = action levels in no more than 10% of tap samples, 56 FR 26460, 6/7/91, effective 12/7/92

NMWQCC = New Mexico Water Quality Control Commission
RCRA = Resource Conservation and Recovery Act
SDWA = Safe Drinking Water Act
[a] EPA National Primary and Secondary Drinking Water Regulations, 40 CFR 141 and 40 CFR 143 (as of 1/1993)
[b] NCP, 40 CFR 300; NCP Preamble 55 FR 8764; CERCLA Compliance with Other Laws Manual EPA/540/G-89/006, August 1988
[c] EPA National Primary Drinking Water Regulations, 40 CFR 141 and 40 CFR 142, Final Rule (57FR 31776, 7/17/92); Effective date is January 17, 1994, (therefore TBCs) except for endrin, which is effective 8/17/92.
[d] EPA Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper, 40 CFR 141 and 142; effective December 7, 1992 (56 FR 26460, 6/7/91)
[e] NM Water Quality Control Commission, NM Water Quality Regulations, Part 3, Section 3-103, 11/16/1967 amended through August 17, 1991
[f] New Mexico Drinking Water/Water Supply Regulations, adopted April 16, 1991

If no values are shown for a potential contaminant, there are no standards at this time.

TABLE 3

POTENTIAL CHEMICAL-SPECIFIC ARARS
STATE SURFACE WATER QUALITY STANDARDS
CANNON AFB, NEW MEXICO

Parameter	Livestock and Wildlife Watering (mg/L)
Metals	
Aluminum	5
Arsenic	0.02
Barium	
Beryllium	
Boron	5
Cadmium	0.05
Chromium VI	1
Cobalt	1
Copper	0.5
Lead	0.1
Mercury	0.01
Nickel	
Nitrate (as N)	
Selenium	0.05
Selenium, with > 500 mg/L sulfate	
Silver	
Uranium	
Vanadium	0.1
Zinc	25
Other	
Chlordane	
Cyanide	
Radium 226 + 228	30 pCi/L

Source: Water Quality Standards for Interstate and Intrastate Streams in New Mexico, as amended through November 12, 1991.

TABLE 4

POTENTIAL CHEMICAL-SPECIFIC CONCENTRATIONS FOR ORGANIC COMPOUNDS IN SOIL -- TBC ACTION LEVELS CANNON AFB, NEW MEXICO

	RFI Guidance(a) TBCs (mg/kg)	Proposed RCRA Action Level(b) TBCs (mg/kg)	Proposed RCRA Action Level(c) TBCs (mg/kg)	Other TBCs (mg/kg)
Herbicides				
2,4,5-T	-	-	800.00	-
2,4,5-TP (Silvex)	600.00	-	640.00	-
2,4-D	800.00	800.00	800.00	-
2,4-DB	-	-	640.00	-
Dalaphon	-	-	2400.00	-
Dicamba	-	-	2400.00	-
Dichlorprop	-	-	-	-
Dinoseb	80.00	-	80.00	-
MCPA	-	-	40.00	-
MCPP	-	-	80.00	-
Pesticides				
4,4'-DDT	2.10	2.00	2.06	-
4,4'-DDE	2.10	2.00	2.06	-
Aldrin	0.04	0.04	0.04	-
alpha-BHC	-	0.10	0.11	-
alpha-Chlordane	0.54	0.50	0.27	-
Aroclor-1016	0.09	(e)	0.09	-
Aroclor-1221	0.09	(e)	0.09	-
Aroclor-1232	0.09	(e)	0.09	-
Aroclor-1242	0.09	(e)	0.09	-
Aroclor-1248	0.09	(e)	0.09	-
Aroclor-1254	0.09	(e)	0.09	-
Aroclor-1260	0.09	(e)	0.09	-
beta-BHC	-	4.00	0.39	-
delta-BHC	-	-	-	-
Dieldrin	0.04	0.04	0.044	-

TABLE 4

POTENTIAL CHEMICAL-SPECIFIC CONCENTRATIONS FOR ORGANIC COMPOUNDS IN SOIL -- TBC ACTION LEVELS CANNON AFB, NEW MEXICO

	RFI Guidance(a) TBCs (mg/kg)	Proposed RCRA Action Level(b) TBCs (mg/kg)	Proposed RCRA Action Level(c) TBCs (mg/kg)	Other TBCs (mg/kg)
Endosulfan I*	4.00	0.04	-	-
Endosulfan II*	4.00	4.00	-	-
Endrin	20.00	20.00	-	-
Endrin ketone	-	-	-	-
gamma-BHC	20.00	0.50	24	-
gamma-Chlordane	0.54	0.50	0.27	-
Heptachlor	40.00	0.20	0.16	-
Heptachlor epoxide	0.80	0.08	0.077	-
Methoxychlor	-	-	400	-
Toxaphene	0.64	0.60	0.63	-
Semivolatile Organics				
1,2,4-Trichlorobenzene	2000.00	2000.00	800	-
1,2-Dichlorobenzene	-	-	7200	-
1,3-Dichlorobenzene	-	-	-	-
2,2'-Oxybis(1-chloropropane)	-	-	-	-
2,4,5-Trichlorophenol	8000.00	8000.00	8000	-
2,4,6-Trichlorophenol	35.00	40.00	63.6	-
2,4-Dimethylphenol	-	-	1600	-
2,4-Dinitrophenol	200.00	200.00	160	-
2,4-Dinitrotoluene	-	-	160	-
2,6-Dinitrotoluene	-	1.00 (2)	1.02**	-
2-Chloronaphthalene	-	-	-	-
2-Chlorophenol	-	-	400	-
2-Dichlorophenol	-	-	-	-
2-Methylnaphthalene	-	-	-	0.3-220(f)
2-Methylphenol	-	-	-	-
2-Nitroaniline	-	-	-	-

TABLE 4

POTENTIAL CHEMICAL-SPECIFIC CONCENTRATIONS FOR ORGANIC COMPOUNDS IN SOIL -- TBC ACTION LEVELS CANNON AFB, NEW MEXICO

	RFI Guidance(a) TBCs (mg/kg)	Proposed RCRA Action Level(b) TBCs (mg/kg)	Proposed RCRA Action Level(c) TBCs (mg/kg)	Other TBCs (mg/kg)
2-Nitrophenol	-	-	-	-
3-3'-Dichlorobenzidine	-	-	1.56	-
3-Nitroaniline	-	-	-	-
4,6-Dinitro-2-methylphenol	-	-	-	-
4-Bromophenylphenyl ether	-	-	-	-
4-Chloro-3-methylphenol	-	-	-	-
4-Chloroaniline	-	-	320	-
4-Chlorophenylphenyl ether	-	-	-	-
4-Methylphenol	-	-	-	-
4-Nitroaniline	-	-	-	-
4-Nitrophenol	-	-	-	-
Acenaphthene	-	-	4800	-
Acenaphthylene	-	-	-	-
Anthracene	-	-	24,000	-
Benzo(a)anthracene	0.22	-	1.2	0.3-220(f)
Benzo(a)pyrene	0.06	-	0.12	0.3-220(f)
Benzo(b)fluoranthene	-	-	1.2	0.3-220(f)
Benzo(g,h,i)perylene	-	-	-	0.3-220(f)
Benzo(k)fluoranthene	-	-	1.2	0.3-220(f)
Benzoic acid	-	-	32,000	-
Benzyl alcohol	-	-	24,000	-
bis(2-Chloroethyl)ether	0.64	0.60	0.64	-
bis(2-Ethylhexyl)phthalate	83.00	50.00	0.01	0.3-220(f)
Butyl benzyl phthalate	-	20000.00	16,000	0.3-220(f)
Carbazole	-	-	35	-
Chrysene	-	-	12.1	0.3-220(f)
di-n-Butylphthalate	8000.00	8000.00	800,000	-

TABLE 4

POTENTIAL CHEMICAL-SPECIFIC CONCENTRATIONS FOR ORGANIC COMPOUNDS IN SOIL -- TBC ACTION LEVELS CANNON AFB, NEW MEXICO

	RFI Guidance(a) TBCs (mg/kg)	Proposed RCRA Action Level(b) TBCs (mg/kg)	Proposed RCRA Action Level(c) TBCs (mg/kg)	Other TBCs (mg/kg)
di-n-Octylphthalate	-	-	1,600	-
Dibenz(a,h)anthracene	-	-	-	0.3-220(f)
Dibenzofuran	-	-	-	0.3-220(f)
Diethylphthalate	60000.00	60000.00	64,000	-
Dimethylphthalate	-	-	800,000	-
Fluoranthene	-	-	3,200	0.3-220(f)
Fluorene	-	-	3,200	0.3-220(f)
Hexachlorbenzene	0.41	-	0.44	-
Hexachlorobutadiene	90.00	90.00	9.0	-
Hexachlorocyclopentadiene	600.00	-	560	-
Hexachloroethane	500.00	80.00	50	-
Indeno(1,2,3-cd)pyrene	-	-	1.2	0.3-220(f)
Isophorone	-	2000.00	737	-
N-nitroso-di-n-dipropylamine	0.10	0.10	0.1	-
N-nitrosodiphenylamine	-	100.00	0.003	-
Naphthalene	-	-	3,200	0.3-220(f)
Nitrobenzene	40.00	40.00	40	-
Pentachlorophenol	2000.00	2000.00	0.084	-
Phenanthrene	-	-	-	-
Phenol	3000.00	50000.00	48,000	-
Pyrene	-	-	2,400	0.3-220(f)
Volatile Organics				
1,1,1-Trichloroethane	7000.00	7000.00	7,200	-
1,1,2,2-Tetrachloroethane	35.00	40.00	3.5	-
1,1,2-Trichloroethane	120.00	100.00	0.039	-
1,1-Dichlorethane	-	-	8,000	-
1,1-Dichloroethene	12.00	10.00	1.17	-

TABLE 4

POTENTIAL CHEMICAL-SPECIFIC CONCENTRATIONS FOR ORGANIC COMPOUNDS IN SOIL -- TBC ACTION LEVELS CANNON AFB, NEW MEXICO

	RFI Guidance(a) TBCs (mg/kg)	Proposed RCRA Action Level(b) TBCs (mg/kg)	Proposed RCRA Action Level(c) TBCs (mg/kg)	Other TBCs (mg/kg)
1,2-Dichloroethene (total)	-	-	720	-
2-Butanone (MEK)	4000.00	4000.00	48,000	-
2-Hexanone (MnBK)	-	-	-	-
4-Methyl-2-pentanone (MIBK)	4000.00	4000.00	4,000	-
Acetone	8000.00	8000.00	8,000	-
Benzene	24.00	-	24.14	100 (d)
Bromodichloromethane	2000.00	0.50	11.3	-
Bromoform	2000.00	2000.00	88.6	-
Bromomethane	30.00	100.00	112	-
Carbon tetrachloride	5.40	5.00	0.09	-
Carbon disulfide	8000.00	8000.00	8,000	-
Chlorobenzene	2000.00	2000.00	1,600	-
Chloroethane	-	-	-	-
Chloroform	110.00	100.00	115	-
Chloromethane	-	-	54	-
cis-1,3-Dichloropropene	20.00	20.00	24	-
Dibromochloromethane	-	-	8.3	-
Ethylbenzene	8000.00	8000.00	8,000	-
Methylene chloride	93.00	90.00	93.3	-
Styrene	20000.00	20000.00	16,000	-
Tetrachloroethene	-	10.00	13.7	-
Toluene	20000.00	20000.00	16,000	<500 (d)
trans-1,3-Dichloropropene	20.00	20.00	24	-
Trichloroethene	64.00	60.00	63.6	-
Vinyl chloride	-	-	0.37	-
Xylenes (total)	200000.00	200000.00	160,000	-
BTEX***	-	-	-	500 (d)

TABLE 4

POTENTIAL CHEMICAL-SPECIFIC CONCENTRATIONS FOR ORGANIC COMPOUNDS IN SOIL -- TBC ACTION LEVELS CANNON AFB, NEW MEXICO

	RFI Guidance(a) TBCs (mg/kg)	Proposed RCRA Action Level(b) TBCs (mg/kg)	Proposed RCRA Action Level(c) TBCs (mg/kg)	Other TBCs (mg/kg)
Polynuclear Aromatic	-	-	-	<50 (e)
Hydrocarbons (PAHs)	-	-	-	-
Total Petroleum Hydrocarbons (TPH)	-	-	-	<1000 (d)

(a) RCRA Facility Investigation Guidance (EPA 1989a); human health-based criteria for systemic toxicants representing an estimate of the daily exposure an individual can experience without appreciable risk of health effects during a lifetime.

(b) Source: Corrective Action for SWMUs at Hazardous Waste Management Facilities (55 FR 30798, 27 July 1990): these risk-based levels trigger the need for a corrective measure study.

(c) Human health proposed action levels calculated using guidance in 55 FR 30798

(d) New Mexico Environmental Improvement Board, New Mexico Special Waste Requirement Regulations, Adopted effective January 30, 1992

(e) New Mexico Department of Environmental Improvement New Mexico UST Regulations, amended through July 18, 1991.

(f) Range of anthropogenic and naturally occurring PAH concentrations (Blumer 1977, Mallet 1961)

* Value for Endosulfan

*** Benzene, Toluene, Ethylbenzene, and Xylenes

** 2,4 and 2,6-Dinitrotoluene (mixture)

TABLE 5

POTENTIAL CHEMICAL-SPECIFIC CONCENTRATIONS FOR INORGANIC COMPOUNDS IN SOIL -- TBC ACTION LEVELS CANNON AFB, NEW MEXICO

Compound	RFI Guidance[a] (mg/kg)	Proposed RCRA Action Levels[b] (mg/kg)	Proposed RCRA Action Levels[c] (mg/kg)	Other TBCs[d] (mg/kg)	Average Background Concentration[f] (mg/kg)	Range of Background Concentrations[f] (mg/kg)
aluminum	-	-	-	-	5,700	860 - 10,540
antimony	30	30	32	-	6.75	1.33 - 12.2
arsenic	-	80	0.39	-	3.5	0 - 15.5
barium	4,000	4,000	5,600		166	0 - 642
beryllium	0.14	0.2	0.16		0.41	0.09 - 0.73
cadmium	-	40	80	-	1.1	0 - 2.9
calcium	-	-	-	-	69,200	0 - 186,400
chromium III	80,000	-	80,000	-	6.98	1.42 - 12.5
chromium IV	-	400	400	-		
cobalt	-	-	-	-	2.5	0.5 - 4.5
copper	-	3,200	-	-	5.4	0 - 13.0
iron	-	-	-	-	4,780	840 - 8,720
lead	-	-	-	500 - 1,000	712	0 - 25.8
magnesium	-	-	-	-	4,550	0 - 11,750
manganese	-	-	8,000	-	72	0 - 164
mercury	-	20	24	-	0.11	0.9 - 0.13
nickel	2,000	2,000	1,600		5.0	1.0 - 9.0
potassium	-	-	-	-	1,360	148 - 2,572
selenium	-	-	400		8.23	0 - 56.6
silver	200	200	400		1.2	0.2 - 2.2
sodium	-	-	-	-	514	0 - 1,042
thallium[e]	30	6	5.6	-	0.50	0 - 1.2
vanadium	-	-	560	-	14.9	4.50 - 25.3
zinc	-	-	16,000	-	11.3	0.72 - 21.9

[a] RCRA Facility Investigation Guidance (EPA 1989a); human health-based criteria for systemic toxicants representing an estimate of the daily exposure an individual can experience without appreciable risk of health effects during a lifetime.

[b] Source: Corrective Action for SWMUs at Hazardous Waste Management Facilities (55 FR 30798, 27 July 1990). These risk-based levels trigger the need for a corrective action measure study.

[c] Human Health proposed action levels using calculations in 55 FR 30798. Sources of toxicity factors used in calculations include: (1) Integrated Risk Information System (IRIS) and (2) Health Effects Assessment Summary Tables (HEAST) FY1992.

[d] Source: OSWER Directive 9355.4-02.

[e] Values reported are for thallic oxide.

[f] Source: Data collected by W-C during the RFI and RI (1992, 1993) and by Walk, Haydel & Associates for the IRP (1990).

TABLE 6

SUMMARY OF POTENTIAL LOCATION-SPECIFIC ARARS
CANNON AFB, NEW MEXICO

Requirement	Potentially Applicable?	Potentially Relevant and Appropriate?	Comments
Resource Conservation and Recovery Act (RCRA)			
1. New facilities where treatment, storage or disposal of hazardous waste will be conducted is prohibited within 61 meters (200 feet) of a fault displaced in Holocene time [40 CFR 264.18(a)]*	No	No	Treatment, storage and disposal of waste will not be conducted within 61 meters of a fault displaced in Holocene time.
2. New facilities where treatment, storage or disposal of hazardous waste will be conducted is prohibited within the 100-year floodplain. [40 CFR 264.18(b)]*	No	No	Treatment, storage and disposal of waste will not be conducted within the 100-year floodplain of adjacent rivers.
3. Prohibits noncontainerized or bulk liquid hazardous waste placement in salt domes, salt bed formations, and underground mines or caves. [40 CFR 264.18(c)]*	No	No	No action which would place waste in a salt dome or salt bed formation, underground mine or cave is anticipated at this site.
E.O. 11988 Protection of Floodplains			
4. Limits activities in floodplain. Floodplain is defined as "the lowland and relatively flat areas adjoining inland and coastal waters including flood prone areas of off-shore islands, including at a minimum, that area subject to a one percent or greater chance of flooding in any given year." [40 CFR 6, Appendix A and 40 CRF 6.302]	No	No	Remedial activities will not be conducted within any floodplains.

*Adopted by the State of New Mexico and incorporated within Part V of the New Mexico Hazardous Waste Management Regulations.

TABLE 6
(Continued)

Requirement	Potentially Applicable?	Potentially Relevant and Appropriate?	Comments
E.O. 11990 Protection of Wetlands			
5. Minimizes impacts on areas designated as wetlands. [40 CRF 6, Appendix A]	Yes	---	Playas are considered wetlands by the U.S. Fish and Wildlife Service. Construction of facilities or management of property in wetlands must avoid adverse effects, minimize potential harm, and preserve and enhance the wetlands to the extent possible.
Clean Water Act Section 404			
6. Action to prohibit discharge of dredged or fill material into waters of U.S. without permit. [33 USC 1251; 40 CFR 230]	No	No	Dredge and fill permit requirements will not apply as no waters of the U.S. will be impacted by remedial activities on the site.
Army Corps of Engineers General Policies and Permit Regulations			
7. Requires Federal agencies to avoid, to the extent possible, adverse impacts associated with destruction or loss of wetlands. [33 CFR 320-330]	No	No	Not ARAR as the playa lake is not considered a navigable water of the U.S.
Endangered Species Act			
8. Protects endangered species and threatened species and preserves their habitat. [16 USC 1531 et sequence; 50 CFR 200, 50 CFR 402]	Yes	---	Although Walk, Haydel & Associates report in their Remedial Investigation that there are no critical habitats in the immediate vicinity of the site (according to the Wildlife Management Plan for the base), two federally listed endangered species are known to inhabit the area within a 50-mile radius of the site (Lee Wan & Associates, Inc., 6/90).

TABLE 6
(Continued)

Requirement	Potentially Applicable?	Potentially Relevant and Appropriate?	Comments
Bald Eagle Protection Act			
9. Protects all eagle species and restricts activities that may threaten or adversely affect their habitat (16 USC Section 688 et. seq)	Yes	---	If eagle species are found to occur on the base, special protection provisions will need to be coordinated with US Fish and Wildlife Service. Bald eagles are known to inhabit the area within a 50-mile radius of the site (Lee Wan & Associates, Inc., 6/90).
Migratory Bird Treaty Act			
10. Protects migratory, resident, or range habitat of migratory birds including raptors and waterfowl. (16 USC Section 703 et. seq).	Yes	--	Remedial actions cannot threaten or adversely affect the habitats of migratory waterfowl or raptors.
Wilderness Act			
11. Limits activities within an area designed as a wilderness area. [16 USC 1311 et seq.; 50CFR 53.1 et seq.]	No	No	The site is not within a federally-owned area designated as a wilderness area.
12. Limits the type of activities permitted in an area designated as a National Wildlife Refuge system [16 USC 668 et seq.; 50 CFR Part 27]	No	No	The site is not in an area designated as part of the National Wildlife Refuge System (the closest NWRS are over 25 miles from the site).
Fish and Wildlife Coordination Act			
13. Prohibits activities affecting/modifying streams or bodies of water if the activity has a negative impact on fish or wildlife. [16 USC 661 et seq.; 33 CFR Parts 320-330; 40 CFR 6.302]	Yes	--	Applicable to rivers, streams, or playas impacted by remedial activities.

TABLE 6
(Continued)

Requirement	Potentially Applicable?	Potentially Relevant and Appropriate?	Comments
Wild and Scenic Rivers Act			
14. Protects rivers that are designated as wild, scenic or recreational. [16 USC 1271; 40 CFR 6.302(e)]	No	No	No rivers designated as wild, scenic or recreational will be affected by remedial activities.
National Historic Preservation Act (NHPA)			
15. Requires the preservation of historic properties included in or eligible for the National Register of Historic Places and to minimize harm to National Historic Landmarks. [16 USC 470 et seq.; 7 CFR 650; 36 CFR Part 65, Part 800]	Yes	---	Pursuant to Section 106 of NHPA, proposed federal undertaking in any state shall take into consideration the effect of the undertaking on any site, building, structure, or object that is included or eligible for inclusion in the National Register; nothing has been placed on the register to date, but surveys are ongoing. Also applicable if historical sites are discovered during a remedial action or if known historical sites exist near a remedial action site.
The Historic and Archaeological Data Preservation Act of 1974			
16. Establishes procedures to provide for preservation of historical and archaeological data which might be destroyed through alteration of terrain as a result of a federal construction project or a federally licensed activity program (16 USC 469, 40 CFR 6.301(c))	Yes	---	May be available if remedial activities affect historical and/or undiscovered archaeological data of the site.
The Archaeological Resource Protection Act of 1979			
17. Requires a permit for any excavation or removal of archaeological resources form public or Indian lands (16 USC 470aa-47011)	Yes	---	May be applicable if any remedial activity involves removal of archaeological resources; substantive requirements need to be met.

TABLE 6
(Continued)

Requirement	Potentially Applicable?	Potentially Relevant and Appropriate?	Comments
Coastal Zone Management Act			
18. Limits activities affecting the coastal zone, including lands thereunder and adjacent shorelands. [16 USC Section 1451 et sequence]	No	No	The site is not located in the coastal zone management area.
State Regulations			
Endangered Species Act (New Mexico Regulation 682)			
19. Requires coordination with the Department of Game and Fish if activities impact on endangered/ threatened species or their habitat.	Yes	---	As stated above, although Walk, Haydel & Associates report in their Remedial Investigation that there are no significant habitats in the immediate vicinity of the site, state listed threatened/endangered species have been identified at or near the Cannon AFB.
1978 New Mexico State Cultural Properties Act (Sections 18-6-1 through 18-6-17 NMSA 1978)			
20. Provides for the preservation, protection, and enhancement of structures, sites, and objects of historical significance within the State.	Yes	--	Although the Cannon AFB site, including its properties/buildings are not listed on the State Register of Historic Places, coordination with the State Historic Preservation Office is ongoing with respect to the historical and archaeological surveys that have been conducted at the base; State laws closely follow the federal laws.