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RCRA PERMIT PART B NUMBER HW50289 RCRA FACILITY INVESTIGATION REMEDIATION PLAN FOR REMOVAL OF BURIED DRUMS AND UNDERGROUND STORAGE TANK AT SOLID WASTE MANAGEMENT UNIT 24 NAS FORT WORTH TX

5/7/1991

ARMY CORP OF ENGINEERS

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NAVAL AIR STATION FORT WORTH JRB CARSWELL FIELD TEXAS

ADMINISTRATIVE RECORD COVER SHEET

AR File Number 76

CARSWELL AIR FORCE BASE, TEXAS

RCRA Permit Part B Number HW50289

RCRA FACILITY INVESTIGATION/REMEDIATION PLAN REMOVAL OF BURIED DRUMS AND AN UNDERGROUND STORAGE TANK SWMU NO. 24, WASTE BURIAL AREA

7 May 1991

Prepared by:
U.S. Army Corps of Engineers
Fort Worth District

TABLE OF CONTENTS

TABLE OF APPENDICES

TABLE OF FIGURES

RCRA FACILITY INVESTIGATION/REMEDIATION PLAN
REMOVAL OF BURIED DRUMS AND AN UNDERGROUND STORAGE TANK
SWMU NUMBER 24, WASTE BURIAL AREA
CARSWELL AIR FORCE BASE, TEXAS

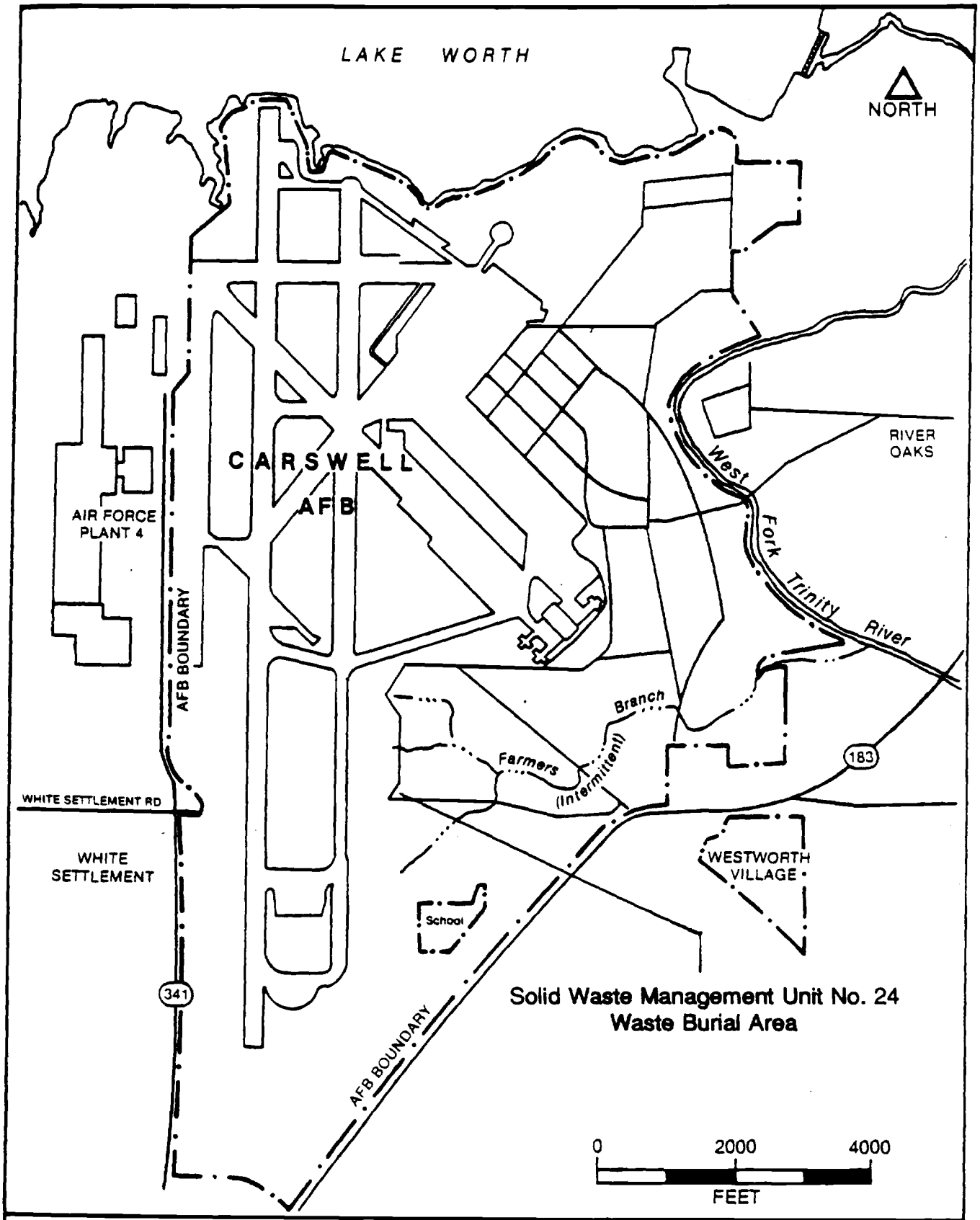
1.0 PURPOSE: This RFI Investigation/Remediation Plan is prepared for SWMU No. 24, Waste Burial Area, in response to the RCRA Permit, Part B, Number HW50289, issued to Carswell Air Force Base (AFB) by the Texas Water Commission (TWC), dated 7 February 1991. This first phase of the total site remediation consists of; 1) excavate and temporarily store approximately 12 buried 55-gallon drums and their contents 2) remove and temporarily store a previously abandoned underground storage tank (UST) and 3) store any soils from the excavations that are determined to be contaminated. The contaminated drums and soil will be permanently disposed of by Carswell AFB under a separate contract in accordance with all applicable TWC, EPA and DOT regulations (49 CRF 100 and 172). The second phase of the remediation consists of placing an imperviable cap on the site, pumping and treating the contaminated groundwater and establishing a groundwater monitoring plan to ensure site remediation is complete. This second phase shall be addressed in a detailed remedial investigation plan which shall be submitted for approval at a later date.

2.0 BACKGROUND: The buried drums and UST are located at the Waste Burial Area, SWMU No. 24, on Carswell AFB. The suspected locations of the drums and UST are shown in the report prepared by Ecology and Environment Inc., (Appendix A). The site is on the southern part of the base and along the eastern edge of the flightline. It is within a secured area and appropriate badges and vehicle passes are required for access.

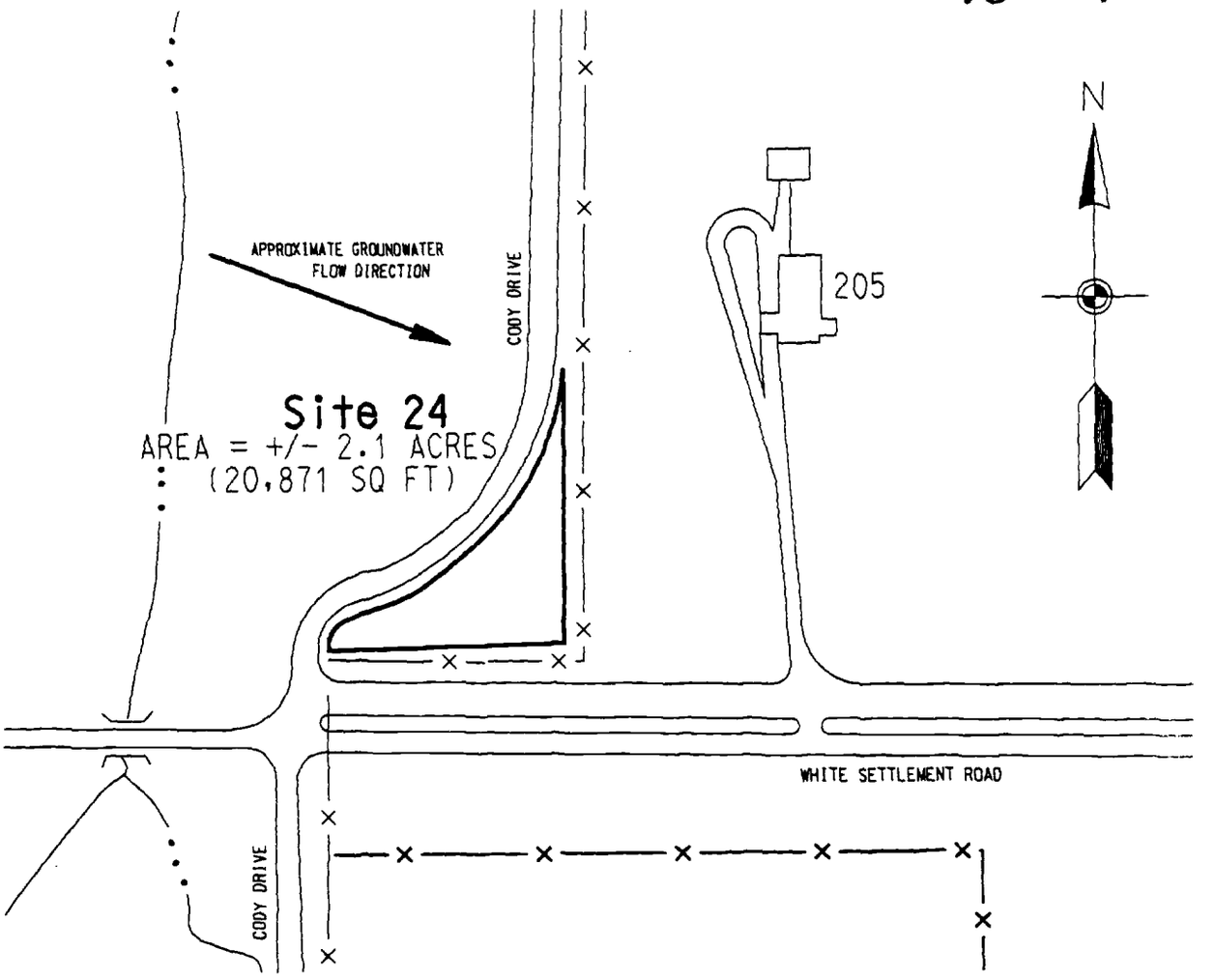
3.0 SITE DESCRIPTION

3.1 TOPOGRAPHY: The Waste Burial Area is located in the southern part of Carswell AFB at the northeast corner of the intersection of White Settlement Road and Cody Drive (Figures 1 and 2). The land surface is virtually flat at an approximate elevation of 620 feet above mean sea level (MSL). There is no visible evidence of the boundaries of the disposal area. Surface drainage is generally to the north to an unnamed tributary of Farmers Branch.

3.2 GEOLOGY: The geologic data developed for the Waste Burial Area resulted primarily from geologic sampling during drilling operations conducted during Radian Corporation's Stage 2 Installation Restoration Program Remedial Investigation. Data gathered from Radian Corporation's Stage 1 Remedial Investigation gathered in 1985



Carswell Air Force Base, Texas
Figure 1



SWMU No. 24, Waste Burial Area
Site Plan
FIGURE 2

included geophysical surveys (EMP and VES), and observations of water levels during and after monitor well installation.

The geologic picture at the Waste Burial Area is based upon an evaluation of drilling logs developed during the installation of three Stage 1 upper zone monitor wells and three Stage 2 soil borings (Figure 3). Upper zone materials consist of surficial deposits of clayey silt with variable amounts of fine sand and gravel, underlain by sand and gravel deposits. The thickness of the upper zone ranges from 31 feet at monitor well 10C to greater than 39 feet at monitor well 10A. Soil borings 10D, 10E and 10F were drilled to 29 feet and did not encounter bedrock. Generally, the surficial clay and silt deposits are 7 to 14 feet thick and the sand and gravel deposits are 19 to greater than 27 feet thick. It was observed that in most borings in the vicinity of the waste burial area, the grain size of the sand and gravel increases with depth. Coarse gravel and cobbles were encountered in borings that reached bedrock at the base of the upper zone.

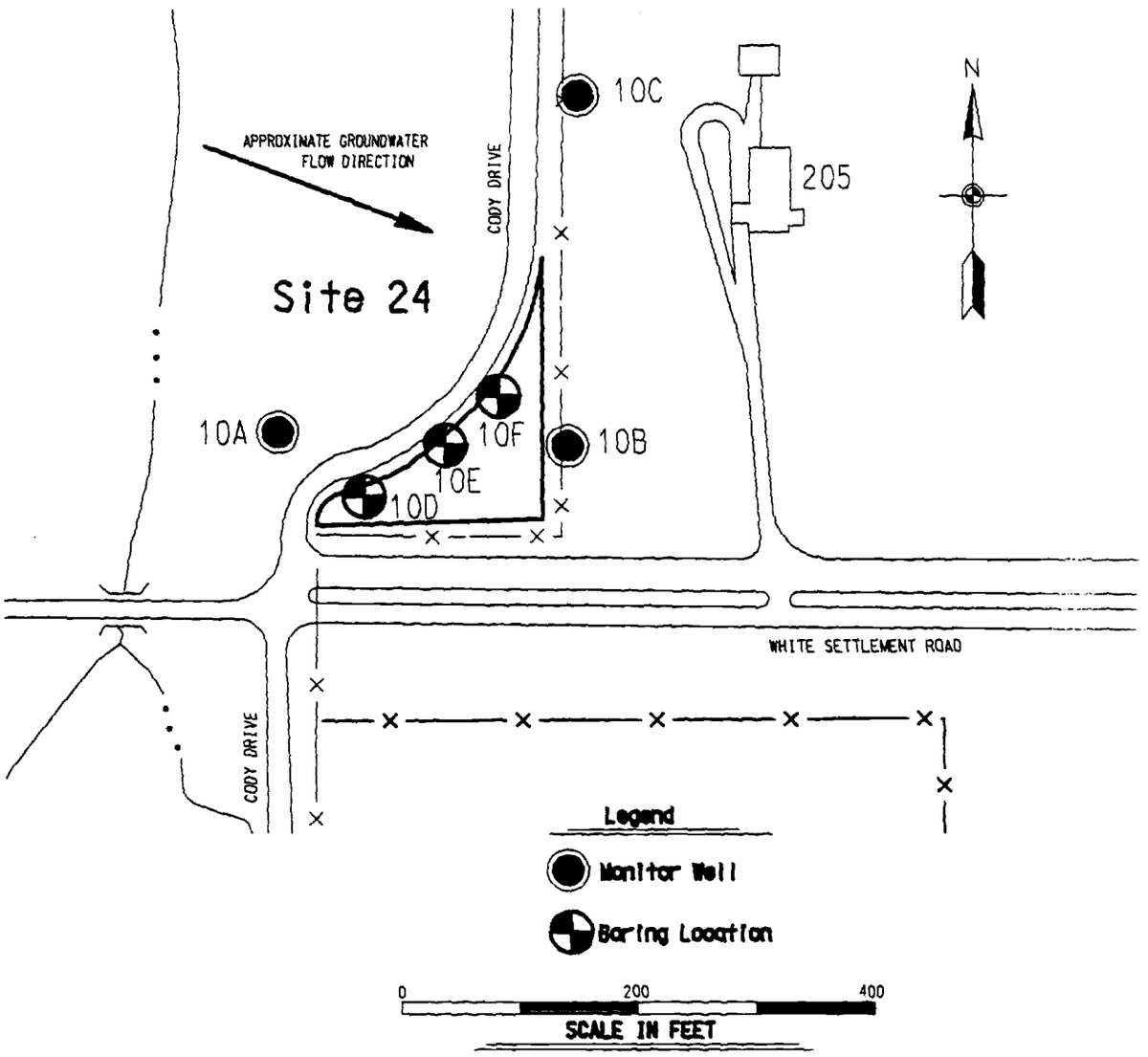
Shale and limestone of the Goodland Formation underlie the upper zone materials. The top of the Goodland occurs at a maximum depth of greater than 39 feet west of the site (at 10A) and at its shallowest depth of 31 feet northeast of the site (at 10C). The contact between the bedrock and the upperzone is generally flat, in contrast to the pronounced slope to the northeast under Landfill 4. A slight bedrock high exists in the vicinity of boring 10B). Generalized hydrogeologic units are depicted in Figure 4.

3.3 HYDROGEOLOGY: Groundwater occurs in the upper zone materials underlying the Waste Burial Area at depths from 20 feet at 10C to 30 feet at 10A. Soil borings 10D, 10E, and 10F all encountered groundwater at 27 feet. Groundwater exists under unconfined (water table) conditions in the upper zone materials.

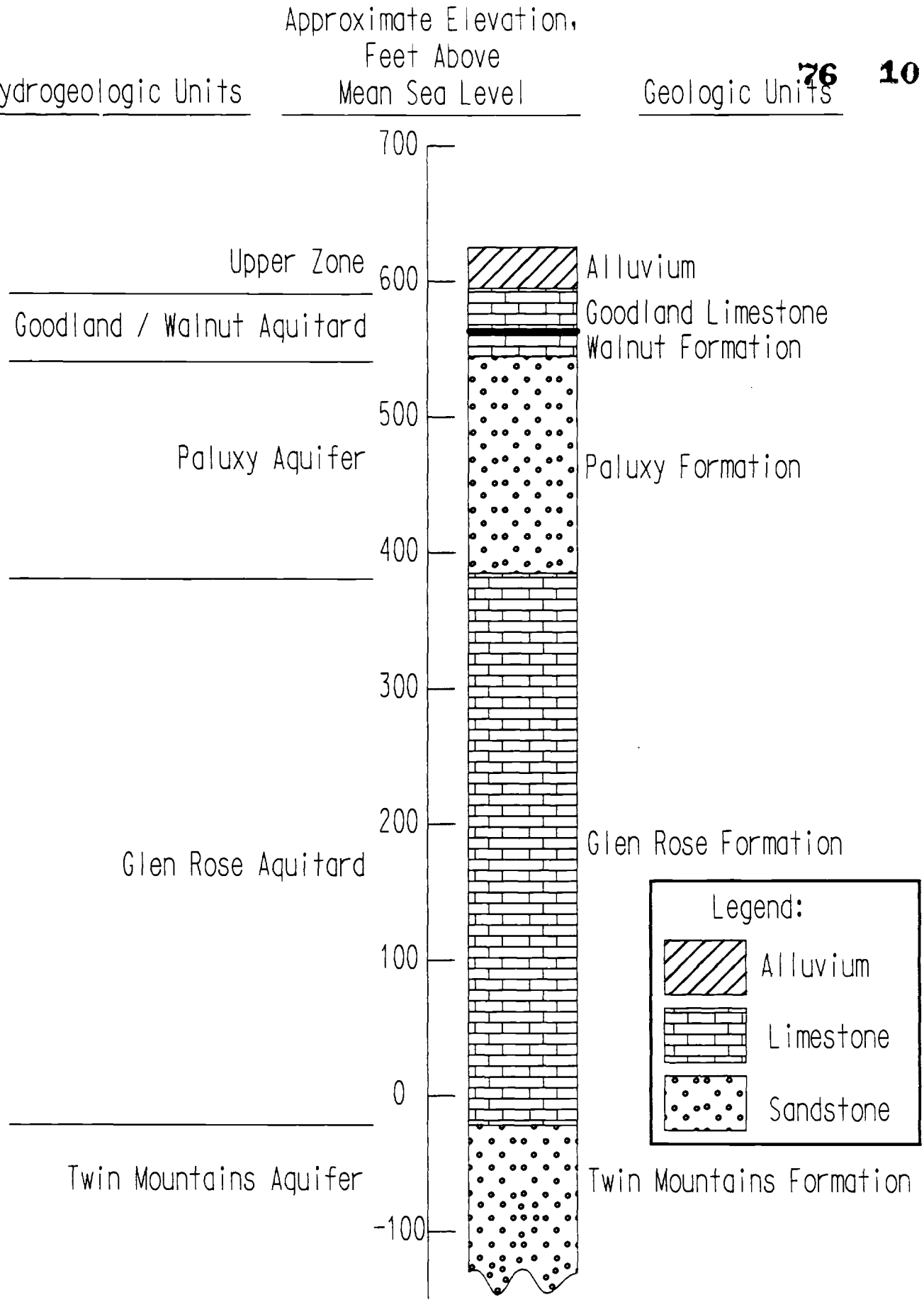
Figure 5 illustrates the potentiometric surface of the water table as determined in March, 1988. Comparison of the potentiometric surface map for the upper zone groundwater and the contour map of the base of the upper zone, figure 6, strongly suggests that the occurrence and direction of movement of groundwater in the upper zone is closely related to the configuration of the bedrock surface. Groundwater flows to the east under a hydraulic gradient of approximately 0.005. apparently not affected by the slight bedrock high in the vicinity of 10B. Groundwater flow velocity in the upper zone is calculated to be approximately 0.2 feet per day. This estimate is derived from a simplification of Darcy's Law:

$$\bar{v} = \frac{k\,i}{\Phi}$$

$\bar{v}$ = average groundwater velocity

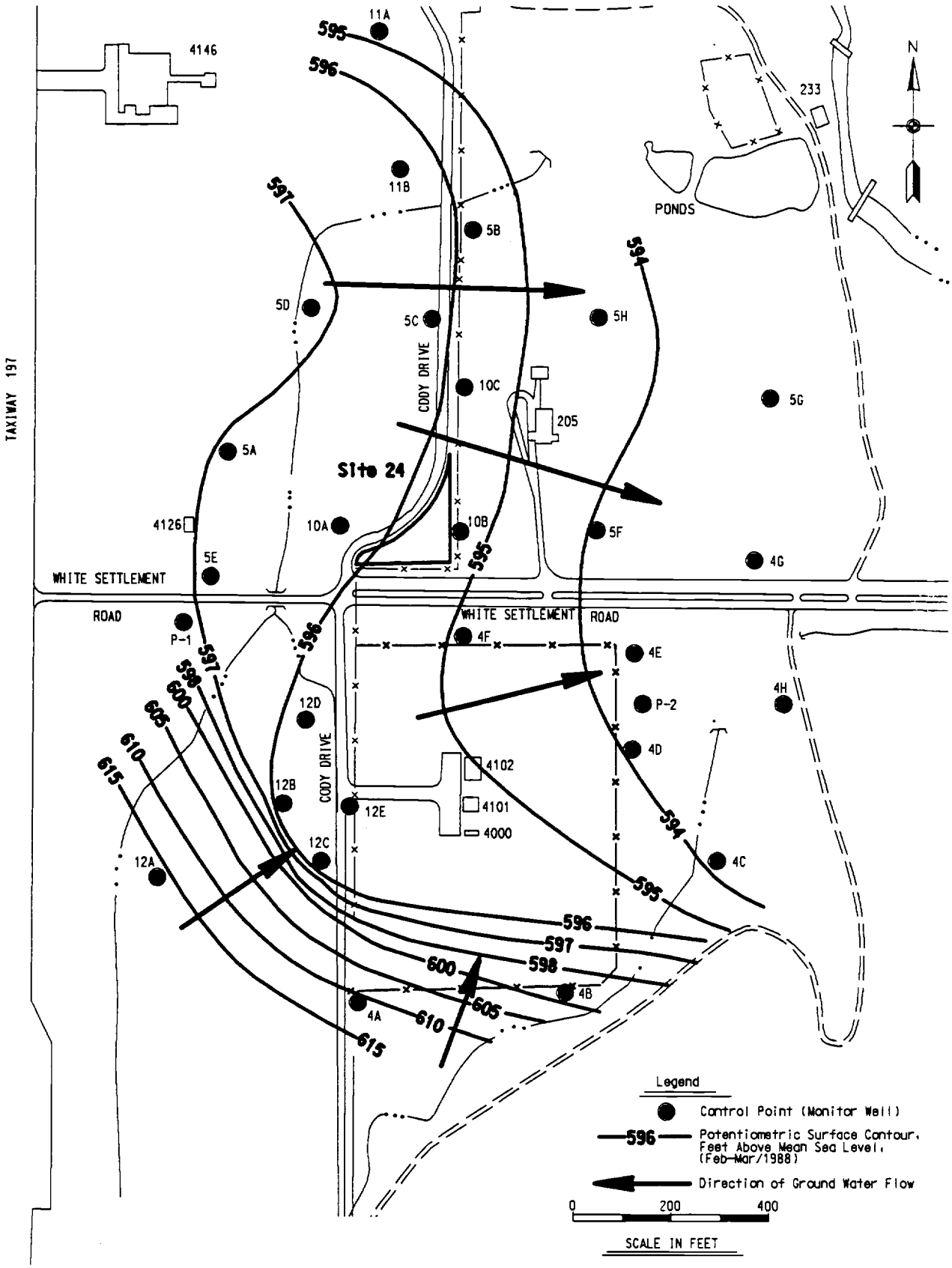


SWMU No. 24, Waste Burial Area
Monitoring Well and Soil Boring Locations
FIGURE 3

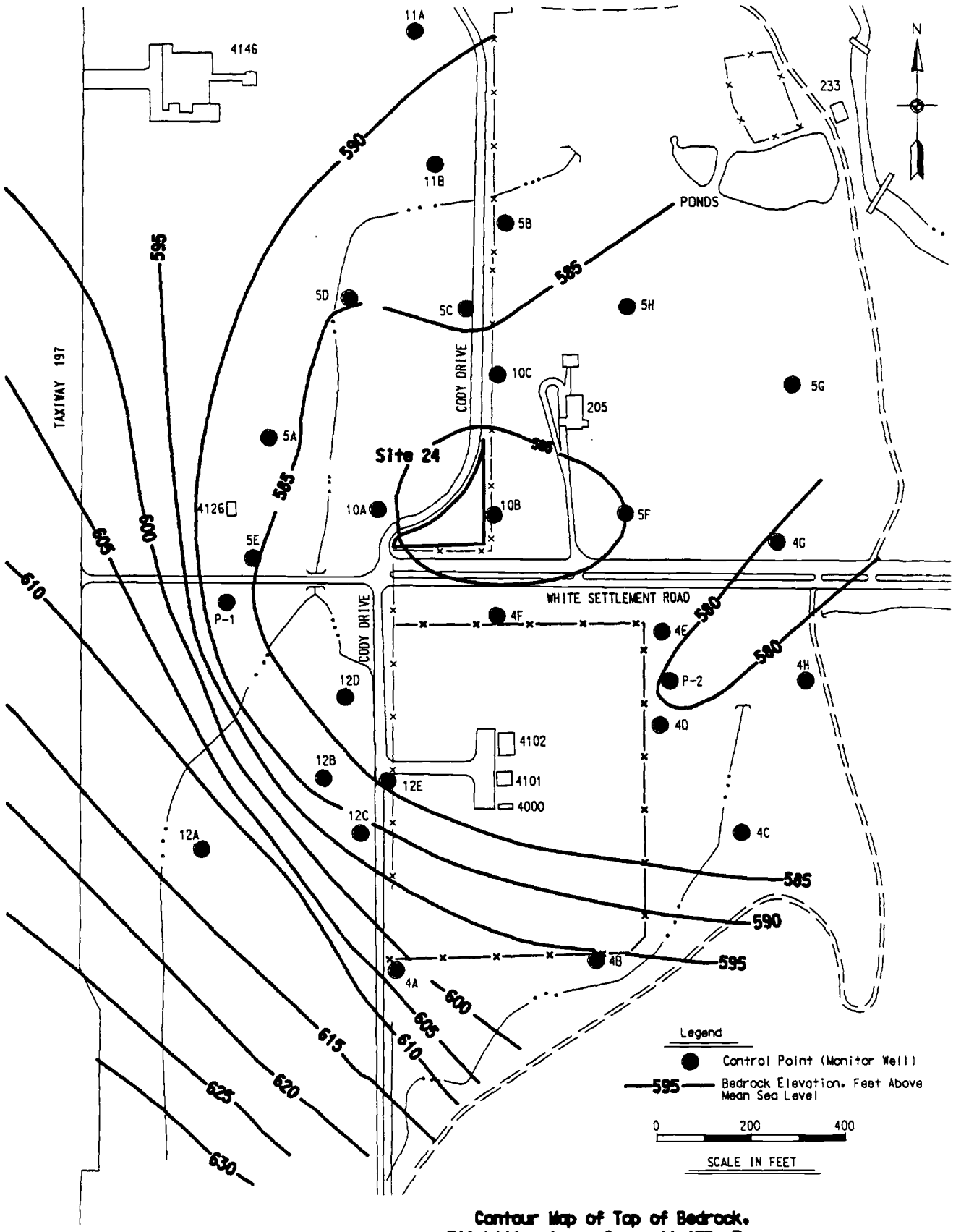


Generalized Hydrogeologic Units at Flightline Area, Carswell AFB, Texas

Figure 4



Potentiometric Surface Map of the Upper Zone, Flightline Area, Carswell AFB, Texas
Figure 5



Contour Map of Top of Bedrock, Flightline Area, Carswell AFB, Texas
Figure 6

k = hydraulic conductivity of upper zone deposits
(average 2.4 x 10-3 cm/sec or 6.8 ft/day
i = hydraulic gradient (0.005) in the upper zone
Φ = estimated porosity of upper zone deposits
(assume 0.20)

4.0 SCOPE: Contractor shall include the following efforts:

4.1 Contractor shall become familiar with all relevant background information as specified in the Government Furnished Materials, these items are described below in paragraph 6.0.

4.2 Contractor shall uncover, drain and remove all buried drums, approximately 12, at SWMU No. 24. It is suspected that the drums contain trichloroethylene (TCE) from previous testing performed on one of the drums (Appendix C). Previously uncovered drums have been badly corroded and leaking. The excavated drums and their contents will be stored in the Base Civil Engineering (CE) Storage Yard, Building 1337.

4.3 Contractor shall uncover, drain (if required) and remove a 5000-gallon UST at SWMU No. 24. The UST was extracted from an unknown location and disposed at site No. 24. The contents of the drum, if any, is unknown. Any remaining liquid in the UST and the UST will be stored in the Base CE Storage Yard, Building 1337.

4.4 The contractor shall utilize soil from a stockpile located on base as a source for additional backfill for the excavations resulting from removal of the UST and buried drums.

5.0 TASKS

5.1 GENERAL SPECIFICATIONS

The contractor will furnish all labor, tools, materials, transportation, laboratory services and equipment to accomplish the above scope.

A. The contractor shall implement all the necessary safety precautions during preparation for and during removal of the drums and UST and during transportation of the drums, drum contents, the UST and the UST contents (if any). A Health and Safety Plan shall be developed in accordance with 29 CFR 1910.120 and EM 385-1-1, US Army Corps of Engineers Safety and Health Requirements Manual. This plan shall define emergency procedures, discuss any hazards that could be encountered during performance of this scope of work, address accident prevention and present appropriate action levels for any contaminant likely to be encountered.

B. All such work shall be accomplished in accordance with federal and state requirements as well as accepted safety standards. The contractor will obtain all applicable permits before beginning any work. The contractor will conduct all work consistent with Carswell AFB Base Fire Marshal requirements.

C. The contractor, subcontractors, and their employees responsible for the drum and tank removal shall be familiar with:

1. All applicable safety rules and regulations.

2. The use of equipment and procedures for vapor-freeing tanks.

D. The contractor shall possess a valid certificate of registration issued by the Texas Water Commission. A copy of this registration shall be included with the proposal to do this work.

5.2 TECHNICAL SPECIFICATIONS FOR TANK REMOVAL: Removal shall be conducted in accordance with the requirements in API Recommended Practice 1604 dated December 1987, Removal and Disposal of Used Underground Petroleum Storage Tanks, except as modified below.

A. The contractor shall initially excavate to the top of the UST, create an opening and remove any liquids or residues inside the UST. The opening in the top of the tank will not be made using flame or spark producing equipment. The liquids and residues shall be stored in an appropriate container. After the liquid is removed, excavate around the UST as required for removal. Excavation around the tank shall be kept to the minimum amount required for removal of the tank.

B. Excavated soils shall be screened by the contactor for volatile organics by using either a Flame Ionizing Device or a Photo Ionizing Device and stockpiled into separate piles based upon either a positive or negative test results. Stockpiles shall be located on-site only at a work area locations designated by the Contracting Officer. The stockpiled soils may be used to backfill the excavation, if they are free of contamination as determined by the Corps of Engineers, Southwestern Division Laboratory. All open excavations shall be protected by barricades and warning signs.

C. Drainage controls shall be provided around the stockpile and open excavation to prevent run-on/run-off contamination. Stockpiled soils shall be enveloped in plastic ("visqueen") liners or equivalent at the end of each work day and at the threat of precipitation. The liner material shall be compatible with TCE and hydrocarbons.

D. After any remaining combustible vapors are removed from the UST and

before removal from the excavation, the contractor shall plug or cap all accessible holes. One plug shall have a 1/8-inch vent hole to prevent the tank from being subjected to excessive differential pressure caused by temperature changes. The tank shall always be positioned with this vent plug on top of the tank during subsequent transport and storage.

E. The contractor shall remove the tank from the excavation and place on a level surface. Use wood blocks or compatible material to prevent movement of the tank after removal and before loading on a truck for transportation. To plug any holes in the tank shell, use screwed (boiler) or equivalent plugs.

F. The contractor shall contain spills or drips to reduce contamination during tank removal.

G. Label the tank after removal from the ground but before removal from the site. Regardless of the condition of the tank, the label shall contain a warning against certain types of reuse. The present vapor state of the tank, including vapor-freeing treatment and date shall also be indicated. The label shall be in letters at least 2 inches high as follows:

NOT VAPOR FREE

NOT SUITABLE FOR STORAGE OF FOOD OR

LIQUIDS INTENDED FOR HUMAN OR ANIMAL CONSUMPTION

DATE OF REMOVAL: (MONTH/DAY/YEAR)

H. The contractor shall remove any flammable vapors by the methods required by state codes. These methods provide a means for temporary vapor-freeing of the tank atmosphere. Since the tank may continue to be a source of flammable vapors even after the vapor-freeing procedures have been implemented, a combustible gas indicator shall be used to assess vapor concentrations in the tank and work area before beginning work. On a daily basis test the tank atmosphere and the excavation area for flammable or combustible vapor concentrations until the tank is purged of all vapors and the tank is moved to Building 1337.

I. Before the tank is removed from the site, the tank atmosphere shall be checked again with a combustible gas indicator to ensure that it does not exceed 20 percent of the lower flammable limit.

J. The contractor will transport the tank from the site after vapor-freeing procedures are completed and within a period of 24 hours after removal. He will also

transport any drums filled with liquids and residues removed from the tank at this time. The contractor will obtain prior approval for longer on-site storage from the Contracting Officer. The tank and the drums containing any liquids and residues removed from the tank will be stored in the CE Storage Yard in an area designated by the Contracting Officer. The tank and drums will be enclosed in a 4 foot high, orange, polyethylene (or polypropylene) safety fence.

K. The tank shall be secured on a truck for transportation to Building 1337 with the 1/8-inch or larger vent hole located at the uppermost point on the tank. The tank and liquid or residue filled drums shall be transported in accordance with all applicable TWC, EPA and DOT regulations (49 CFR 100 and 172).

L. The excavation resulting from tank removal shall be backfilled using materials stockpiled from the excavation of the tank, if the soils are free from contamination as determined by the Corps of Engineers, Southwestern Division Laboratory. Backfill materials required in excess of that available at the site shall be taken from a stockpile located on base. The excavation shall the backfilled to a point 6-inches above original grade at the center of the excavation and slope to drain toward the edges. Backfill material shall be suitable earth or granular material free from organic materials and which can be compacted to the density specified.

1. Backfill material shall be placed and compacted in layers of approximated 12 inches in thickness and smoothed into corners of the backfilled area before the next layer is place. Each layer of backfill shall be compacted to not less than 90 percent of laboratory maximum density with power-driven hand tampers suitable for the material being compacted or by tracking with track or rubber tired equipment.

2. Compaction testing shall be performed by an approved commercial testing laboratory or may be performed by the contractor subject to approval. Field in-place density shall be determined in accordance with ASTM D 1556, D 2167, or D 2922. Not less than two field in-place density tests shall be performed at each tank backfill at the specific location as directed by the Contracting Officer. Laboratory maximum density specified above shall be obtained in accordance with ASTM D 1557, Method D. A laboratory density test shall be performed on each distinctively different type of backfill material or every 3 feet, whichever occurs more frequently.

M. Remove debris and rubbish from the site daily. Do not allow it to accumulate onsite. Remove and transport debris in a manner as to prevent spillage on streets or adjacent areas. Any debris or material spilled or deposited on the streets shall be cleaned up the day the spill occurs. Disposal of all debris and rubbish off base will be the contractors responsibility.

N. Payment for items accomplished under this section will be based on the

number of UST's removed.

5.3 TECHNICAL SPECIFICATIONS FOR REMOVAL OF BURIED DRUMS

A. The contractor shall initially excavate an adequate amount of soil to uncover the top of each buried drum. He will then cut an opening in the top of the drum and remove as much of the liquid remaining in the drum as possible and store it in an appropriate container. The opening in the top of the drum will not be made using flame or spark producing equipment. After the liquid is removed the soils around the drum shall be excavated as required to remove the drum. Excavation around the drums shall be kept to the minimum amount required for removal of the drums.

B. Excavated soils shall be screened for volatile organics using either a Flame Ionizing device or Photo Ionizing Device and stockpiled into two separate piles based upon either a positive or negative results. Stockpiles shall be located on-site only at work area locations designated by the Contracting Officer. The stockpiled soils may be used to backfill the excavation, if they are free of contamination as determined by the Corps of Engineers, Southwestern Division Laboratory. All open excavations shall be protected by barricades and warning signs.

C. Drainage controls shall be provided around the stockpiles and open excavations to prevent run-on/run-off contamination. Stockpiled soils shall be enveloped in plastic ("visqueen") liners or equivalent at the end of each work day and at the threat of precipitation. The liner material shall be compatible with TCE.

D. The contractor shall excavate around each drum to uncover it for removal. Before removal from the excavation, the contractor shall seal all accessible holes. Once the drum is removed from the excavation it shall be placed in an oversized, salvage drum.

E. The contractor shall contain spills or drips to reduce the contamination during removal.

F. The contractor will transport the excavated drums and the containers holding the liquid removed from the excavated drums from the site within a period of 24 hours after removal of the last drum. The contractor will obtain prior approval for longer on-site storage from the Contracting Officer. These will be transported and stored at the CE Storage Yard in an area designated by the Contracting Officer. The drums and containers will be enclosed in a 4 foot high, orange, polyethylene (or polypropylene) safety fence.

G. The drums shall be secured on a truck for transportation to the CE Storage Yard. Drums shall be transported in accordance with all applicable TWC, EPA and DOT regulations (49 CFR 100 and 172).

H. Excavations resulting from removal of the drums shall be backfilled using materials stockpiled from the excavation of the drum, if they are free of contamination as determined by the Corps of Engineers Southwestern Division Laboratory. Backfilling materials required in excess of that available at the site shall be taken from a stockpile located on base. The excavation shall the backfilled to a point 6-inches above original grade at the center of the excavation and slope to drain toward the edges. Backfill material shall be suitable earth or granular material free from organic materials and which can be compacted to the density specified.

1. Backfill material shall be placed and compacted in layers of approximated 12 inches in thickness and smoothed into corners of the backfilled area before the next layer is place. Each layer of backfill shall be compacted to not less than 90 percent of laboratory maximum density with power-driven hand tampers suitable for the material being compacted or by tracking with track or rubber tired equipment.

2. Compaction testing shall be performed by an approved commercial testing laboratory or may be performed by the contractor subject to approval. Field in-place density shall be determined in accordance with ASTM D 1556, D 2167, or D 2922. Not less than two field in-place density tests shall be performed at each tank backfill at the specific location as directed by the contracting officer. Laboratory maximum density specified above shall be obtained in accordance with ASTM D 1557, Method D. A laboratory density test shall be performed on each distinctively different type of backfill material or every three feet, whichever occurs more frequently.

I. Remove debris and rubbish from the site daily. Do not allow it to accumulate onsite. Remove and transport debris in a manner as to prevent spillage on streets or adjacent areas. Any debris or material spilled or deposited on the streets shall be cleaned up the day the spill occurs. Disposal of all debris and rubbish off base will be the contractors responsibility.

J. Payment for items accomplished under this section will be based on the number of drums removed.

5.4 TECHNICAL SPECIFICATIONS FOR HANDLING OF EXCAVATED SOILS

The contractor shall minimize the amount of soils excavated for removal of the UST and the buried drums. The soils shall be stockpiled on site as noted above. The soils will be tested by the Government to determine if they are contaminated. Uncontaminated soils will be used as backfill for the excavations. Contaminated soils shall be placed in clean, steel 55-gallon drums and transported to the CE Storage Yard, Building 1337, as required in paragraph 5.3 G above.

5.5 TESTING

A. SOIL: During excavation soil shall be screened for volatile organics by using either a Flame Ionizing Device of a Photo Ionizing Device and placed on a plastic ("visqueen") surface adjacent to the site. The soil shall be separated and stockpiled based upon the screening as either "contaminated" or "non-contaminated". The "non-contaminated" soil will be allowed to stabilize for a period of not less than 24 hours. After this time soil samples will be drawn per the quality control plan at appendix B. One sample per each fifty cubic yards of soil will be drawn. The soil will be tested for the parameters listed in figure 7 by the Southwestern Division, Corps of Engineers Laboratory.

B. DRUMS: All drums and the UST shall be drained prior to removal from the site. The drums shall be transported to the CE Storage Yard. Prior to disposal, each drum shall be tested to verify the contents being TCE. Samples shall be drawn per the quality control plan at appendix B. Testing shall be conducted by the Southwestern Division, Corps of Engineers Laboratory.

5.6 QUALIFICATIONS OF CONTRACTOR

The contractor and all subcontractors shall certify that they possess the appropriate skills, experience and competence to conduct the work specified herein. The contractor shall comply with all state and federal licensing and certification requirements, if applicable. All work shall be completed in a manner that minimizes the possibility of any threats to human health and safety or the environment.

5.7 APPLICABLE STANDARDS

All work performed under this contract shall be in compliance with all federal and state regulations including, but not limited to, 40 CFR Parts 250, 261, 262, and 280, title 31 TAC Chapters 287, 313 and 334, the Uniform Fire Code, USEPA Publication SW-846 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, and USEPA 1979 Chemical Analyses of Water and Wastes. The work shall also be conducted in accordance with the American Petroleum Institute publications 1604, 1628, 2003, 2015 and 2219, the National Fire Protection Association (NFPA) 329 Recommended Practice of Handling Underground Leakage of Flammable and Combustible Liquids. In addition the Texas Water Commission Guidance Manual for LPST Cleanups in Texas shall be followed as required to remove the tank.

6.0 SPECIAL CONSIDERATION

6.1 All Government furnished materials shall be returned to the Contracting Officer (unless indicated otherwise).

6.2 The contractor shall, without additional expense to the Government, be

SOIL TESTING PARAMETERS

Volatile Organics	EPA Method 8240
Benzene, Toluene, Ethylbenzene, Xylene	EPA Method 8240 or 8020
Metals	
Arsenic	EPA Method 7060
Barium	EPA Method 6010
Cadmium	EPA Method 6010
Chromium	EPA Method 6010
Lead	EPA Method 6010
Mercury	EPA Method 7471
Nickel	EPA Method 6010
Selenium	EPA Method 7740
Silver	EPA Method 6010
Zinc	EPA Method 6010
Oil and Grease	EPA Method 9071
Total Petroleum Hydrocarbons	EPA Method 9071

Figure 7

responsible for obtaining any necessary licenses and permits, and for complying with any Federal, State, and local laws, codes, and regulations applicable to the performance of the work at SWMU No.24.

7.0 SAFETY

The contractor shall implement all the necessary safety precautions during the preparation for and removal of the drums and UST and during the transportation of the drums, drum contents, the UST and the UST contents (if any). A Health and Safety Plan shall be developed in accordance with 29 CFR 1910.120 and EM 385-1-1, US Army Corps of Engineers Safety and Health Requirements manual. This plan shall define emergency procedures, discuss any hazards that could be encountered during the performance of work, address accident prevention and present appropriate action levels for any contaminant likely to be encountered. This Health and Safety plan will be forwarded to TWC.

8.0 SCHEDULE OF WORK: The work shall commence upon receipt of the Notice to Proceed and shall be completed within 60 days. Priority will be given to removing the buried 55-gallon drums. The contractor will provide a work schedule to the contracting officer. This schedule will be forwarded to TWC, District 4, to schedule site inspections as required.

9.0 SITE INSPECTION: The contractor shall prepare a schedule of work and submit it to the contracting officer NLT 5 work days before commencement of work. The schedule of work will be forwarded to TWC to facilitate scheduling site inspections by TWC as required. TWC should contact Mr Frank Grey, CAFB Environmental Coordinator, telephone (817) 782-6265, NLT three working days prior to the inspection to coordinate access to the site. The site is located within the flightline area and access approval must be granted by the base operations division.

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FC7010

Geophysical Survey
Carswell A.F.B.
Fort Worth, Texas

February 1991

Prepared for

U.S. Army Corps of Engineers
Fort Worth District

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INTRODUCTION

Pursuant to a request from the U.S. Army Corps of Engineers, Fort Worth Division, Ecology and Environment, Inc. (E&E) performed a geophysical survey at site 10, a suspected waste burial site at Carswell Air Force Base, Fort Worth, Texas. The nature of the survey was to identify the existence and approximate location of subsurface anomalies, which would indicate the location of suspected buried drums that are thought to contain trichloroethene (TCE).

This report summarizes the field activities, including a description of the geophysical survey and a site map showing the locations of the subsurface anomalies.

SITE DESCRIPTION

The area described as site 10 waste burial site is located in the southern part of Carswell AFB, at the northeast corner of the intersection of White Settlement Road and Cody Drive. It is triangular in shape with dimensions of 200 ft. x 150 ft. x 250 ft., as illustrated in Figure 1.

FIELD INVESTIGATION

E & E technical staff performed the ground-penetrating-radar (GPR) survey on February 11 and the EM-31 conductivity meter survey on February 12, 1991.

The GPR survey was performed with a Geophysical Survey Systems, Inc. Model SIR-3. It provides a continuous profile of the subsurface using high-frequency radio waves to obtain subsurface information. The high-frequency signals are emitted from a transmitter which is pulled along the ground surface. The signals are reflected from various interfaces in the subsurface and are detected by a radar receiver, which is enclosed in the same unit as the transmitter. The information is then passed to a controller and graphic recorder which prints a hard copy of the profile. This allows precision definition of any edges of excavations or metal objects such as tanks, drums or metal utility conduits. However, the actual depth of signal penetration is controlled by various factors, such as the conductivity of the subsurface material and the frequency of the transmitted signal. Consequently, the amount of clay or other highly conductive material may render the subsurface opaque to radar signals, and therefore produce limited results.

The Geonics EM-31 conductivity meter directly measures the average conductivity of the hemisphere below it. The strength of the signal is affected by material at depths of up to 18 feet, but the greatest part of the signal is generated by material in the uppermost 6 to 9 feet. The

EM-31 can also be used in a metal detection mode to further define the results of the conductivity survey.

Upon arrival, the E&E team measured the site as a basis for the site map and to establish a 10 ft. x 10 ft. grid system to facilitate the geophysical survey, data interpretation and anomaly identification. The grid system was established using the existing chainlink fence posts, which are appproximately 10 ft apart, as reference points, with the southeast corner post being designated line 0, station 0. The lines, 0-19, run south to north, originating at the fence posts along the east-west fenceline, and the stations, 0-15,run east to west originating at the fence posts along the south-north fence line. The grid system is provided in Figure 1.

The GPR unit was assembled using the 100 Hz antenna, then employed across the site. After several unsuccessful attempts at obtaining conclusive data with the 100 Hz antenna, a smaller 30 Hz antenna was employed across the same area. Due to the high clay content of the site soils, which inhibited deep radar penetration, the GPR was not useful for determining the location of the suspected buried drums.

On the following day the E&E team returned to the site with an EM-31 conductivity meter to continue the geophysical survey. Initially, the EM-31 was employed in the conductivity mode across the site and data was recorded using the data logger. After the survey results were analyzed by E&E team members, a background level of 50-65 mS/m was established, and any value below background was identified as an anomaly. The results of the survey (Table 1) indicated anomalies along the east border of the site and along the south border parallel to the fenceline. The latter was subsequently determined to be a utility conduit leading to manhole near line 7, station 3. After completing the conductivity survey, the EM-31 was switched to an inphase mode which allows it to be used as a metal detector. This, along with a Fisher TW-6 Mscope pipe and cable locator were used to detect and identify, more specifically, the subsurface anomalies which would indicate buried metal drums. Once the location was identified, survey pin flags were placed around the perimeter of anomalies. Nine locations were identified and marked as areas A through I as illustrated by Figure 1. The anomalies not detected by metal detection could indicate: A TCE contamination plume migrating downgradient, north; or drums buried deeper than the penetration capabilities of the metal detectors.

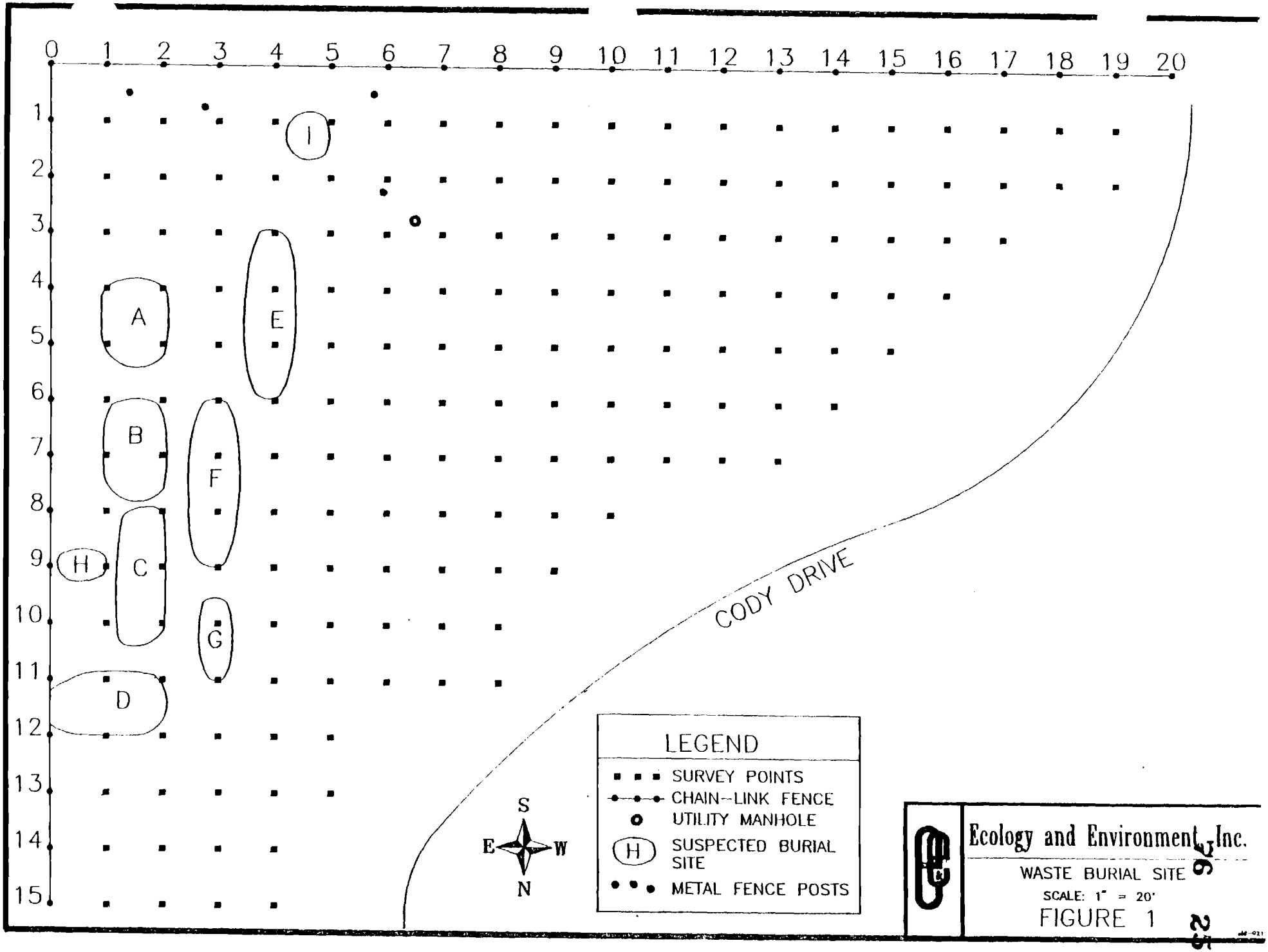
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
I
A
B
C
D
E
F
G
H
CODY DRIVE
S
E
W
N
LEGEND
SURVEY POINTS
CHAIN--LINK FENCE
UTILITY MANHOLE
SUSPECTED BURIAL SITE
METAL FENCE POSTS
Ecology and Environment, Inc.
WASTE BURIAL SITE
SCALE: 1" = 20'
FIGURE 1

TABLE 1

EM-31 CONDUCTIVITY SURVEY RESULTS

	Line																		
Station	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	76.6	78.0	66.2	61.8	65.0	100.6	69.0	79.6	64.2	62.2	62.2	64.0	62.0	61.0	61.6	63.8	64.4	68.6	69.6
2	64.4	59.6	51.2	48.8	56.8	82.4	66.4	68.0	63.2	62.2	61.2	60.1	59.6	59.6	59.2	59.4	59.4	54.0	64.0
3	57.4	51.8	46.6	39.6	46.0	58.2	24.2	35.2	34.8	36.0	34.0	34.0	35.0	35.6	37.0	38.4	39.2		
4	58.0	41.0	42.6	41.4	45.6	53.6	56.8	58.2	57.8	56.4	53.4	59.2	57.8	60.2	62.2				
5	59.0	47.8	43.2	44.4	43.8	53.2	48.6	53.8	52.4	53.2	53.8	58.0	59.4	62.2	62.0				
6	58.0	47.6	36.2	42.0	41.2	48.4	29.4	53.4	47.6	47.8	51.0	55.0	54.6	60.2					
7	60.8	52.0	27.4	44.8	42.0	49.4	32.8	63.8	51.8	51.6	49.8	53.2	59.4						
8	64.6	49.8	35.2	43.8	40.0	46.8	75.2	79.8	52.8	45.8									
9	61.0	48.2	34.6	40.2	38.4	43.2	74.2	60.8	49.8										
10	45.8	47.2	35.6	36.8	35.2	41.4	55.0												
11	49.6	38.0	35.2	37.8	35.4	38.4	44.6												
12	56.6	49.2	41.0	38.2	39.8														
13	60.8	46.2	40.6	40.0	39.8														
14	59.6	47.8	44.0	43.2															
15	60.8	49.8	47.2	46.0															

* CONDUCTIVITY UNITS: mS/m

REFERENCES

Geonics Limited "Theory and Case Histories- Geonics Ground Conductivity Meters (EM 38, EM 31, EM34-3) and Borehole Induction Logger."

Standard Operating Procedure for Overview of Surface Geophysical Techniques used at Hazardous Waste Site Investigations. Ecology and Environment, Inc. SOP- Surface Geophysical Techniques, GEOTECH 5.2. Revised September, 1987.

Standard Operating Procedure for Conducting Ground - Penetrating Radar Surveys at Hazardous Waste Sites. Ecology and Environment, Inc. SOP - Ground-Penetrating Radar, GEOTECH 5.6. Revised January 1990.

U S ARMY CORPS OF ENGINEERS
SOUTHWESTERN DIVISION LABORATORY

Sampling and Analyses Quality Assurance/Quality Control Plan

January 1991

I. Purpose:

The purpose of this QA/QC plan is to describe the quality assurance and quality control procedures followed by the Southwestern Division Laboratory and their contractors when performing analyses of samples from their clients. These procedures are used to ensure that the generation, processing, verification and reporting of the data by the laboratories are reliable, accurate and properly documented.

II. References:

The following references were used in the preparation of this plan:

A. U.S. Environmental Protection Agency, Test Methods for Evaluating Solid Wastes, SW 846, November 1986.

B. American Public Health Association and American Waterworks Association, Standard Methods for the Examination of Water and Wastewater, 16th ed., 1985.

C. U.S. Environmental Protection Agency, Methods for Chemical Analysis of Water and Wastes, EPA - 600/4-79-020, 1979.

D. U.S. Environmental Protection Agency, Handbook for Sample Preparation of Water and Wastewater, EPA - 600/14-82-029, 1982.

E. U.S. Environmental Protection Agency/Corps of Engineers, Procedures for Handling and Chemical Analysis of Sediment and Water Samples, EPA/CE-81-1, 1981.

F. U.S. Army Corps of Engineers, Chemical Data Quality Management for Hazardous Waste Remedial Activities, ER 1110-1-263, March 1990.

G. Forester and Mason, Journal of Forensic Chemistry, Vol. 19, #1, pages 155 to 162, 1974.

III. Sample Collection:

A. Well Sampling:

All groundwater samples shall be taken using a stainless steel or teflon bailer. Each sample container shall be filled directly from the spout or discharge tube. Samples shall be placed in appropriate containers as detailed in Table I. Labels must be affixed to each container with the following information written with permanent ink: well identification, date, required analysis, methods of preservation, sampler's identification.

B. Soil Sampling:

Soil samples shall be taken by augering with a drill rig. Samples shall be collected in glass liter or half-liter wide-mouthed jars with teflon lined caps. Labels must be affixed to each container with the following information written with permanent ink: well or boring identification, depth, date, required analysis, sampler's identification.

C. Sediment Sampling:

Bottom sediment samples shall be taken using a core or grab sampler, depending on which method provides the most representative sample of the site. Samples will be collected either with a glass or stainless steel sampler, mixed in the field and placed in glass liter or half-liter wide-mouthed jars with teflon lined caps. Labels must be affixed to each container with the following information written with permanent ink: location identification, date, depth, required analysis, sampler's identification.

IV. Cleaning Sampling Equipment:

Water samplers used for collecting inorganic samples may be cleaned with non-phosphate detergent followed by rinses with tap water, dilute hydrochloric acid and distilled water. Water samplers used for collecting organic samples shall be cleaned with non-phosphate detergent followed by rinses with tap water, distilled water, pesticide grade hexane and pesticide grade methanol. The last two rinses should be done under a hood or well ventilated conditions. Drilling rigs and core samplers used for soil and sediment sampling shall be steam cleaned after each sampling or boring.

V. Sample Preparation and Preservation:

A. Preservatives:

Preservatives are listed in Table I. All chemical preservatives shall be of reagent grade quality. Preservatives shall be added dropwise from dedicated containers in order to achieve proper pH or concentration at the sampling site. A calibrated pH meter shall be used to check pHs.

B. Refrigeration:

Keep all samples refrigerated or iced down in coolers if space permits; otherwise, refrigerate those samples needing refrigeration as indicated in Table I.

VI. QA Samples:

There shall be a minimum of one QA field split or duplicate sample taken for every ten samples of each matrix type collected. There shall also be a minimum of one blank sample for each matrix type for every ten samples. Field blanks may consist of clean or background soil samples, water from background wells, sample rinsates, or distilled water as appropriate to the sample type.

VII. Documentation:

A. Fieldbook:

A field book shall be kept of all operations and contain the following: well or boring number, date, water level, well evacuation procedure and rate of recharge, sample method, pH and conductivity readings, any unusual conditions noted (odor, color, well damage, etc.) times of collection, preservation and shipment, sampler's name and any information regarding blank samples.

B. Field Data Form:

The field data form includes selected information from the fieldbook relevant to the analyses of the sample; such as, pH, conductivity, unusual odor or color, water level,etc. This form shall be shipped in the cooler.

C. Chain of Custody Form:

The chain of custody form is required to establish possession of the samples from collection to analyses. This form shall be shipped in the cooler with the samples and must be signed by both the sample collector and the sample preparer.

VIII. **Shipment:**

Samples shall be placed in coolers equipped with inserts to hold containers securely. Samples shall be covered with ice and have accompanying documentation sealed in plastic bags inside the coolers. Coolers shall be sealed with straps or tape and have a minimum of two chain of custody seals placed across the opening. Coolers may be shipped by commercial or government carrier and must be received by SWD Laboratory within 24 hours of the time the samples were collected.

Table I

Sampling and Preservation Procedures

Parameter	Container	Preparation
Volatile Organics	Three 40 ml glass vials	Zero headspace, Refrigeration, HCl to pH<2
pH	One 500 ml plastic	Refrigeration
Conductivity	One 500 ml plastic	Refrigeration
Metals	One liter plastic	Nitric Acid to pH<2, Refrigeration
Hex. Chromium	One liter plastic	Refrigeration
Cyanide	One 500 ml plastic	Sodium Hydroxide to pH>12, Refrigeration
Total Organic Halides	One one-liter amber glass	Sulfuric Acid to pH<2, Refrigeration
Total Organic Carbon	One 40 ml glass vial	Sulfuric Acid to pH<2, Refrigeration
Semivolatile Extractable Organics	Two one-liter amber glass	Refrigeration
Pesticides/PCB's	Two one-liter amber glass	Refrigeration
Herbicides	One one-liter amber glass	Refrigeration
Sulfates	One 250 ml plastic	Refrigeration
Fluoride	One 250 ml plastic	Refrigeration
Chloride	One 250 ml plastic	Refrigeration
Nitrate	One 250 ml plastic	Refrigeration
Phenols	One one-liter amber glass	Sulfuric Acid to pH<2, Refrigeration

Total Petroleum Hydrocarbons	One one-liter amber glass	Hydrochloric Acid to pH<2, Refrigeration
Chemical Oxygen Demand	One 500 ml amber glass	Sulfuric Acid to pH<2, Refrigeration
Oil and Grease	One one-liter amber glass	Hydrochloric Acid to pH<2, Refrigeration
Total Solids -- Dissolved Suspended	One 500 ml plastic	Refrigeration
Alkalinity	One 500 ml plastic	Refrigeration
Explosives	Two one-liter amber glass	Refrigeration
Ignitability	One one-liter amber glass	Refrigeration
Corrosivity	One one-liter plastic	Refrigeration
Reactivity	One one-liter plastic	Refrigeration
Gross Alpha, Beta	One one-liter plastic	Nitric Acid to pH <2, Refrigeration
Total Radium	One one-liter plastic	Nitric acid to pH <2, Refrigeration

Note: The above information applies only to water samples. All soil and sediment samples shall be collected into liter or half-liter wide-mouth glass jars with teflon-lined caps and kept refrigerated.

Table II

Analytical Methods

Water Samples

Volatile Organics	EPA Method 8240
pH	EPA Method 9040
Conductivity	EPA Method 120.1
Metals	
Mercury	EPA Method 7470
Arsenic	EPA Method 7060
Selenium	EPA Method 7740
Others	EPA Method 6010
Cyanide	EPA Method 9010
Total Organic Halides	EPA Method 9020
Total Organic Carbon	EPA Method 9060
Semivolatile Organics	EPA Method 8270/8250
Pesticides/PCB's	EPA Method 8080
Herbicides	EPA Method 8150
Sulfates	EPA Method 300.0
Fluoride	EPA Method 300.0
Chloride	EPA Method 300.0
Nitrate/Nitrite	EPA Method 300.0
Phenols	EPA Method 9065
Total Petroleum Hydrocarbons	EPA Method 418.1
Carbon Oxygen Demand	EPA Method 410.1
Oil and Grease	EPA Method 9070
Total Suspended Solids	EPA Method 160.2
Total Dissolved Solids	EPA Method 160.1
Alkalinity	EPA Method 310.1

Soil Samples

Volatile Organics	EPA Method 8240
Benzene, Toluene, Ethylbenzene, Xylene	EPA Method 8240 or 8020
Semivolatile Organics	EPA Method 8270/8250
Pesticides/PCB's	EPA Method 8080
Herbicides	EPA Method 8150
Metals	
Mercury	EPA Method 7471
Arsenic	EPA Method 7060
Selenium	EPA Method 7740
Others	EPA Method 6010
Flashpoint	EPA Method 1010
pH	EPA Method 9045
Oil and Grease	EPA Method 9071
Total Petroleum Hydrocarbons	EPA Method 9071
Conductivity	EPA Method 120.1
Cyanide	EPA Method 9010
Ignitability	EPA Method 1010
Corrosivity	EPA Method 9045
Total Organic Halides	EPA Method 450.1

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Chain-of-Custody Form

Location_____ Date_____

Site_____ Well/Boring Number_____

Number of containers in shipment:

	glass	plastic
liter	_____	_____
vial	_____	_____

Parameters sampled:

pH	_____
Conductivity	_____
Vol. Organics*	_____
Metals**	_____
Cyanide	_____
TOX	_____
Tot. Pet. Hyd.	_____
Ignitability	_____
Pesticides	_____
Other Analyses	_____

*Volatile Organics:
Regular detection limits _____
0.5 ppb detection limits _____

**Metals: (circle desired analyses)

As, Ba. Be, Ca, Cd, Cr, Cu, Fe, Hg, K, Mg, Mn, Na, Ni, Pb, Se,

Ag, Zn, EP Toxicity Prep.

CUSTODY RECORD
Signature and Title

Relinquished By	Received By	Date	Time
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

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Field Data Sheet

Location_____ Date_____

Site_____ Well/Boring Number_____

Casing Diameter_____ Casing Type_____

Rate of Recharge_____

Riser Elevation_____

Depth of Water_____ Time of Measurement_____

Measuring Device_____

Well Purged Dry_____ Continuous Recharge_____

pH Measurements Date_____

_____ Time_____

_____ Meter Type/Model_____

_____

_____

Spec. Conductance, mhos/cm

_____ Time_____

_____ Meter Type/Model_____

_____ Temperature_____

_____

Notes concerning condition of well, odors, color, etc.:

_____

_____

Sampler's Signature_____

IX. Sample Custody:

A. Sample Receiving and Chain-of-Custody Procedures are designed to track the movement of samples from the time they leave the sampling site to the time they are analyzed.

1. All samples are received in a designated area of SWD Laboratory by a sample custodian. Each sample is thoroughly examined to ensure that proper sampling, preservation, packaging and labeling techniques have been employed.

2. Each sample is assigned a unique SWD Laboratory sample number and recorded in a bound log book which includes lab and field sample numbers, date sampled, date arrived to SWD, Corps of Engineer District or client generating sample, location of sampled area, sample description, and list of analyses requested. This information is also maintained on computer files.

3. The Chain-of-Custody is checked for accuracy and signed and dated. Any significant information concerning samples is recorded on the Chain-of-Custody at this time.

B. Sample Storage:

1. Samples are stored at 4C -- checked and recorded daily -- in six 3'x6'x6' stainless steel refrigerators.

2. Samples are stored for a minimum of six weeks after data has been submitted to client.

3. Volatile samples are stored separately in two, 21 cu. ft., refrigerators.

C. Contract Laboratories:

1. Samples which are to be transferred to a contract laboratory are shipped within twenty-four hours of receipt by SWD Laboratory.

2. Samples are shipped in coolers with form- fitting inserts and covered with ice. Coolers are secured with straps and chain-of-custody seals then shipped for next day delivery by commercial carrier.

3. Sample shipment includes samples, chain-of-custody documentation with explicit instructions concerning sample identification, required analyses, turnaround date and sample collection date.

D. Requirements of Contract Laboratories:

1. Contractor must be validated by the Corps of Engineers Missouri River Division Laboratory.

2. Contractor must have minimum duplicity of all major analytical equipment.

3. Contractor must be certified by the Oklahoma Water Resources Board.

X. **Reporting and Recording Data:** Analytical data is reported and recorded in the following manner:

A. All raw data is recorded in bound books and/or computer printout.

B. Written reports are submitted to the client after a project is completed or at regular intervals for long-time projects. Each report contains the following information:

1. Identification of samples by the field number and by the SWD number.

2. Minimum detection limits for each constituent reported.

3. Quality control and quality assurance data such as method blanks, surrogate recoveries, duplicates and spikes applicable to the data set.

4. Analytical results.

5. Date analyzed.

6. Date sample collected and date received by SWD.

7. Method of analyses.

C. Data and information concerning analyses is available by telephone, computer interface or modem, or computer disc.

D. Laboratory Director maintains records of all reports submitted to clients.

E. Environmental Services Section maintains records of all raw data, hard copy of all reports, and computer records of all analytical and quality control data.

XI. Preventative Maintenance: In order to prevent instrument down time and costly instrument repairs, SWD uses the following methods of maintenance:

A. Service maintenance contracts are purchased for all major equipment such as both Perkin Elmer Atomic Absorption Spectrophotometers, the ARL ICAP, the Hewlett-Packard GC/MSD, the Hewlett-Packard GC, the Dohrmann TOX Analyzer, the Waters IC/HPLC and the O. I. TOC Analyzer.

B. Specific operator manuals are used to outline preventative maintenance plans for all equipment.

C. Each instrument has an instrument log book in which the daily performance, preventative maintenance activity, problems, etc. are recorded.

XII. Data Validation: Data validation is accomplished by monitoring the precision and accuracy of quality control data, system audits and by utilizing known and blind standards.

A. Initial Calibration: At the beginning of each day, each instrument is calibrated by standard samples according to the prescribed method. This calibration is verified by an analysis of method blank samples immediately after the calibration procedure and immediately before sample analyses.

1. Standards are either bought or prepared using certified chemicals as specified in the methods.

2. Data from standards are accumulated starting from the lowest concentration and ending with the highest.

3. Calibration is verified by an EPA Quality Control Sample at the rate of at least 10%. Calibration curves are generated using at least three data points.

4. Calibration data is recorded on raw data sheets and kept in bound books and/or computer files.

5. Method blanks are prepared for every twenty samples or less containing appropriate amounts of reagents used in sample preparation. Data from the blank is determined and recorded after calibration. If the method blank is above the required detection limit and/or the lowest analyte is less than ten times the blank concentration, the entire sample set will be reanalyzed.

B. Spiked Sample Analyses: Spiked samples are samples altered by the addition of known amounts of analytes. These samples are analyzed along with actual samples. The percentage of analyte recovery is then calculated to ascertain quality of data.

1. Spiked samples are prepared before sample preparation procedures (digestion, extraction, etc.) and generated at the rate of at least 10% of samples.

2. Individual percent recoveries are calculated as follows:

$$\text{Recovery} = \frac{(SSR - SR) \times 100}{SA}$$

where SSR = Spiked Sample Result
SR = Sample Result
SA = Spike Added

3. Percent recoveries outside the range of 80 to 120% are considered outliers. Spike recoveries are disregarded for samples in which the concentration is four or more times the spike amount.

C. Duplicate Sample Analyses: A second spiked sample is prepared and analyzed as above. The information generated is used as a check on instrument reliability, operator error, chemical problems, etc.

1. The relative percent difference between the spike sample and the spike sample duplicate is calculated as follows:

$$RPD = \frac{(D1 - D2) \times 100}{(D1 + D2)/2}$$

where RPD = Relative Percent Difference
D1 = First Spiked Sample Value
D2 = Second Spiked Sample Value

2. Results of duplicate analyses for samples with concentrations greater than five time the required detection limit shall have RPD of less than twenty percent to be acceptable.

D. Corrective Action: If some, but not all, spiked and/or duplicate spiked samples are found to be outliers, the entire sample set is reanalyzed using the sample extract or digestate. If all the spikes and/or duplicate spiked samples are outliers, the entire sample set shall be reanalyzed starting from the initial step (digestion, extraction, etc.). A thorough investigation of reagents, instrument condition and calibration, and any other factors contributing to the problem of accuracy and precision will be conducted in order to correct any problems.

E. External Quality Assurance Program: SWD Laboratory participates in a QA program provided by the U. S. EPA Environmental Monitoring and Support Laboratory of Cincinnati, Ohio, the certification program by the Oklahoma Water Resource Board, and the U. S. Army Corps of Engineers validation program.

XIII. Procedure for Cleaning Glassware:

A. Trace Metals Analyses:

1. Prior to use, glassware for trace metals analyses is rinsed with pesticide grade hexane.

2. After use, glassware is rinsed with tap water, washed with a Liqui-Nox solution, rinsed twice with tap water, and, finally, rinsed with distilled or deionized water.

3. Stained glassware is cleaned with a strong acid solution, then washed and rinsed as above.

B. Organic Analyses:

1. Prior to use, glassware for organic analyses is rinsed with pesticide grade hexane.

2. After use, glassware is rinsed with tap water, then sonicated for fifteen minutes in a solution of Liqui-Nox in a sonication bath. This is followed with a tap water rinse, two distilled water rinses, and an acetone rinse. After glassware is dry, it is placed in the muffle furnace at 550C for four hours.

3. Stained glassware is cleaned with a strong acid solution after sonication, then washed and rinsed as above.

XVI. Personnel: At the present time the laboratory is staffed by three chemists and two technicians. Two other chemist positions and two technician positions will be opening by the middle of 1991.

Personnel currently on staff and their responsibilities are as follows:

Catherine Hutchins, Chief, Environmental Services Section

1. Provide work assignments and coordinate projects within the Chemistry section
2. Maintain and upgrade QA/QC program
3. Train personnel
4. Purchase equipment, supplies, and materials necessary for maintaining laboratory
5. Consult engineers, geologists and field personnel
6. Evaluate and contract outside laboratories for overflow work
7. Evaluate laboratory data and write reports
8. Prepare Final QA/QC Reports for major projects

Anhmai Tran, Chemist

1. QA/QC manager
2. Chemical analyses using wet methods
3. Chemical analyses using atomic absorption spectroscopy, spectrophotometry, TOC analyzer, ion analyzer, microprocessor, gas chromatography, TOX analyzer
4. Train personnel
5. Evaluate data

Donald Bradshaw, Chemist

1. Safety officer
2. Chemical analyses using wet methods
3. Chemical analyses using atomic absorption spectroscopy, spectrophotometry, TOC analyzer, microprocessor, TOX analyzer, infrared spectrometer
4. Sample tracking manager

Albert Acosta, Lead Technician

1. Computer operations and data management
2. Sample preparation and analyses for trace metals
3. Sample receiving and tracking
4. Chemical analyses using wet methods
5. Chemical analyses using ICP and AA methods.

Franklin Kelly, Technician

1. Sample preparation and analyses for ions
2. Sample receiving
3. Chemical analyses using wet methods

C. Other:

1. Glassware used for phosphate determination is not washed with detergents containing phosphates.

2. Glassware used for ammonia, Kjeldahl nitrogen and nitrate/nitrite is rinsed with ammonia free water.

XIV. Sample Disposal:

A. Samples are stored for a minimum of six weeks after the report is generated. The date a report is issued is put into both the sample log book and the work order book. The sample storage area for completed samples is separate from current samples and inventoried at regular intervals.

B. Hazardous samples are either returned to the client when completed or combined in specially marked containers for proper hazardous disposal.

XV. Safety:

A. Emergency Equipment:

1. The laboratory is equipped with four overhead showers, two eye washers and four fire extinguishers.

2. A Red Cross first aid kit is located on the premises.

3. All safety equipment is checked on a regular basis.

B. Protective Equipment:

1. All personnel are provided with laboratory coats, disposable aprons, gloves, respirators and protective eyewear.

2. All personnel are given a medical examination annually.

C. Ventilation:

1. The laboratory has four ventilation hoods and they are used whenever toxic or flammable materials are used.

FINAL PAGE

ADMINISTRATIVE RECORD

FINAL PAGE

76 4

FINAL PAGE

ADMINISTRATIVE RECORD

FINAL PAGE