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Mr. Ed Horst
New Mexico Environment Department
Toxic Site Bureau
1190 St Francis Drive
P O Box 26110
Santa Fe NM 87502

RE: Draft RCRA Facility Investigation (RFI) Report for 13 Sites with 18 SWMU's

Dear Mr. Horst

Enclosed are two sets of the six volume draft of the reference report which covers a portion of the RFI Phase I requirements. One copy is for you and the other set is for Mr. Dave Morgan of the Groundwater Bureau. Please review this report. If you or Mr. Morgan have any comments, please return them to us by 14 Nov 92.

The sites included in the report are listed below;

| IRP # | SWMU(s) | Description | Samples taken and Work Done | Nature & Extent of Contamination |
|---|---|---|---|---|
| SD-15 | 34 | AGE Drainage Ditch | Surface & Boring | Vol 1a pg, 2-10 |
| WP-14 | 76 | Sludge Weathering Pit | 3 surface samples | Vol 1a pg, 3-5 |
| FT-6 | 78 | CEF Training Area No. 1 | Surface & Boring | Vol 1a pg, 4-6 |
| DP-16 | 81 | Solvent Disposal Site | Surface & Boring | Vol 1a pg, 5-5 |
| SD-11 | 86 90 | Engine Test Cell | Surface & Boring | Vol 1a pg, 6-6 |
| SD-20 | 95 | NE Storm Drainage Area | Surface & Boring | Vol 1a pg, 7-6 |
| SD-17 | 96 | Entomology Rinse Area | 3 Soil borings | Vol 1a pg, 8-5 |
| None | 98 | Sanitary Sewer Line | Video & 32 borings | Vol 1a pg, 9-10 |
| None | 101, 102 | Waste water Lagoons | Sludge & Water | Vol 1a pg, 10-7 |
| FT-7 | 106 | CEF Training Area No. 2 | Surface & Boring | Vol 1a pg, 11-6 |
| FT-8 | 108 | CEF Training Area No. 3 | 4 Soil borings | Vol 1a pg, 12-6 |
| None | 109 | CEF Training Area No. 4 | Surface & Boring | Vol 1a pg, 13-7 |
| LF-5 | 113 | Landfill No. 5 | Groundwater Samples | Vol 1a pg, 14-7 |

Offsite background sites were also studied.

Your cooperation in these matters is greatly appreciated. Please direct any questions to Mr. John Ekhoff or Capt Mac Crawford at (505) 784-4348.

Sincerely

LAWRENCE NYGREN, GM-14
Deputy Base Civil Engineer

6 Atch
1. Book 1 Vol 1a Remedial Investigation Report Executive Summary, Sections 1 through 15
2. Book 2 Vol 1b Remedial Investigation Report Executive Summary, Sections 16 through 21
3. Book 3 Vol II Appendices A & B.
4. Book 4 Vol IIIa Appendix C-1
5. Book 5 Vol IIIb Appendix C-2
6. Book 6 Vol IV Appendix D-1 through D-5

1

# FINAL
# VOLUME Ia
# TEXT: EXECUTIVE SUMMARY
# SECTIONS 1.0 THROUGH 15.0

LIBRARY COPY

REMEDIAL INVESTIGATION
REPORT FOR
18 SOLID WASTE
MANAGEMENT UNITS
CANNON AIR FORCE BASE
CLOVIS, NEW MEXICO

APP. I
SWMUs 34, 74, 78, 81, 86-90, 95
96, 98, 101, 102, 106, 107, 109, 113

Prepared for
U.S. Department of the Army
Corps of Engineers, Omaha District
Omaha, Nebraska
October 19, 1992

Woodward-Clyde

Woodward-Clyde Consultants
101 S. 108th Avenue
Omaha, NE 68154

Project No. 89MC114W

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## EXECUTIVE SUMMARY

A Remedial Investigation (RI) was conducted to evaluate the nature and extent of potential contamination at 18 Solid Waste Management Units (SWMUs) located on the Cannon Air Force Base Installation (Cannon AFB) near Clovis, New Mexico.

A Baseline Risk Assessment (BRA) was performed as part of the RI effort. The RI was carried out to satisfy the requirements of both the U.S. Air Force (USAF) Installation Restoration Program (IRP) which is mandated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as well as the conditions of the Cannon AFB Resource Conservation Recovery Act (RCRA) operating permit.

Woodward-Clyde Consultants (WCC) was contracted by the U.S. Army Corps of Engineers (USACE), Omaha-District to perform the RI. Prior to initiating field activities WCC prepared supplements to the RCRA Facility Investigation (RFI) workplan prepared by Lee Wan and Associates in 1990 for conducting remedial investigation activities at the 18 SWMUs. The WCC Workplan supplements, which were approved by USACE and Cannon AFB, were necessary for performing specific tasks associated with the USACE Scope of Services. The RI was performed in accordance with the requirements of the Lee Wan RFI Workplan as supplemented by WCC.

RI field activities were carried out during October, November and December 1991 and consisted of sampling the following; surface and subsurface soil, groundwater, surface water and sediment.

The SWMUs investigated during the RI were:

- No. 34 — AGE Drainage Ditch (IRP SD-15)
- No. 76 — Sludge Weathering Pit (IRP WP-14)
- No. 78 — Fire Training Area No. 1 (IRP FT-6)
- No. 81 — Solvent Disposal Area (IRP DP-16)
- Nos. 86-90 — Engine Test Cell (IRP SD-11)

- No. 95 — NE Stormwater Drainage (IRP SD-20)
- No. 96 — Old Entomology Ravine (IRP SD-17)
- No. 98 — Sanitary Sewer Line
- Nos. 101, 102 — Wastewater Lagoons
- No. 106 — Fire Training Area No. 2 (IRP FT-7)
- No. 107 — Fire Training Area No. 3 (IRP FT-8)
- No. 109 — Fire Training Area No. 4
- No. 113 — Landfill No. 5 (IRP LF-5)

The SWMUs were identified during a RCRA Facility Assessment (RFA) performed by USEPA in 1987.

Environmental samples were analyzed by Enseco-Rocky Mountain Analytical Laboratory located in Arvada, Colorado. Contract Laboratory Program (CLP) protocol was followed for soil and sediment analyses. The CLP analytical parameter list included:

- Target Compound List (TCL) Volatile Organics
- Semivolatile Organics
- Target Analyte List (TAL) metals
- Pesticides/PCB

Not all of the parameters listed above were analyzed at every SWMU.

Groundwater and surface water samples were analyzed for RCRA Appendix IX constituents. Other non-CLP analyses performed included:

- Total Petroleum Hydrocarbons (TPH)
- Total Organic Carbon (TOC)
- Organic Lead
- Toxicity Characteristic Leading Procedure (TCLP)
- Benzene, toluene, ethylbenzene, xylene (BTEX)

Laboratory analytical data validated by WCC according to procedures specified in the Quality Assurance Project Plan (QAPP) were used in the BRA and the evaluation of nature and extent of potential contamination.

The results of the BRA including ecological risk are discussed after the nature and extent of contamination is presented. The nature and extent of contamination is summarized below by SWMU.

SWMU No. 34 - AGE DRAINAGE DITCH (IRP SD-15)

The AGE drainage ditch has soil contaminated with petroleum hydrocarbons above 100 mg/kg and low levels of PAH compounds from surface to 3 feet bgs in boring 0341. However, petroleum hydrocarbons concentrations decrease from the surface to the total depth of 3 feet at this boring location. The soil at boring 0341 also contains levels of lead and zinc that appear to be above site background and regional levels. The contamination identified appears to be restricted to the area near boring 0341 and does not extend northeast of the culvert where boring 0342 was drilled.

SWMU No. 76 - SLUDGE WEATHERING PIT (IRP WP-14)

The analytical data suggest the possible presence of residual petroleum tank bottom sludge in the pit from a depth of 4 to 6 feet bgs and underlying native soils containing petroleum compounds from a depth of 6 to possibly 18 feet bgs, particularly in the vicinity of borings 0762 and 0763. Ethyl benzene and xylenes were detected at estimated concentrations of 4000 $\mu$g/kg and 7900 $\mu$g/kg, respectively, in boring 0763 at a depth of 8 to 10 feet.

SWMU No. 78 - FIRE TRAINING AREA No. 1 (IRP FT-6)

Organic chemicals of interest in soil at this SWMU consist of the pesticides, 4,4-DDD and 4,4-DDE, and TPH. Analytical data suggest that these chemicals occur in surficial soils throughout the SWMU. It does not appear that soils below 4 to 6 feet have been significantly impacted, although a minor concentration (14 $\mu$g/kg) of 4,4-DDD was reported at 10 to 12 feet in boring 0781. For pesticides, the high soil/water partition

coefficient (EPA 1979) indicates that the compounds are adsorbed on soil particles, thus retarding migration into deeper soils. Lead and zinc appear to be above site background and regional levels in the surficial soils throughout this SWMU.

SWMU No. 81 SOLVENT DISPOSAL AREA (IRP DP-16)

Analytical results indicate that only acetone and toluene were detected above the Laboratory Contract Required Quantitation Limit (LCRQL) in soil at the SWMU. The low concentrations of toluene, less than 17 $\mu$g/kg, detected at the site indicate that toluene is not a chemical of concern at this site. However, even though acetone is a common laboratory contaminant at low concentrations, the elevated levels reported at borings 8101, 8102, 8104, 8107, and 8108 in the western portion of the SWMU (400 ug/kg, 160 ug/kg, 910 ug/kg, 210 ug/kg, and 1300 ug/kg, respectively) may indicate possible contamination from solvent disposal practices. However, based on the results from the two deeper redrill borings completed in that area, it appears that acetone is restricted to the 4 to 6 foot interval . Acetone concentrations in borings 8111 (redrill of 8102) and 8112 (redrill of boring 8107) at the 9 to 9.5 foot interval were non-detect at 2U $\mu$g/kg and 15U $\mu$g/kg, respectively. Therefore, the vertical extent of acetone in the soil in the western portion of the SWMU appears to lie between 4 to 6 feet and does not extend below 9 feet bgs.

SWMU Nos. 86-90 ENGINE TEST CELL (IRP SD-11)

Acetone and toluene were the only volatile organic compounds detected above the LCRQL in soil at this SWMU. It should be noted that toluene was detected at 100 $\mu$g/kg in the background at boring 0865 located west of the SWMU, and all other detections at the SWMU were significantly less than this concentration. It does not appear that toluene is present below 20 feet in borings at this SWMU. Similarly, acetone does not appear to be present at an arbitrary cutoff of 100 $\mu$g/kg below 20 feet at this site.

Surficial soils contained the following metals at concentrations that appear to be above the site background and regional levels: antimony, barium, cadmium, chromium, cobalt, copper, lead, nickel and zinc.

Petroleum hydrocarbons appear to be present from 10 to 20 feet bgs in boring 0861, drilled near the oil/water separator. The lateral extent of petroleum hydrocarbons is uncertain, but is probably limited to the area around the northern side (boring 0861) of the oil/water separator. No petroleum staining was noted southeast of the oil/water separator (boring 0863).

SWMU No. 95 NE STORMWATER DRAINAGE (IRP SD-20)

No volatile organics or semi-volatile organic compounds of concern were found in soil at this SWMU. Only acetone, a common lab contaminant, was detected in three samples (at 2 and 8 feet BGS in boring 0951 and at 2 feet BGS in boring 0952, at concentrations of 22 ug/kg, 17 ug/kg, and 21 ug/kg, respectively). However, hydrocarbon contamination is present in soils at 0951, at the upstream end of the ditch, with diminishing concentrations to the southwest in the direction of flow. TPH contamination is supported by detections at borings 0951 and 0952 which suggest that the TPH contamination may extend laterally throughout the drainage ditch with the highest concentrations near its mouth. This pattern of elevated values is consistent with the main use of the ditch which is to receive water from several oil/water separators and runoff water from the runways. The TPH contamination appears to be surficial (i.e., less than 2 feet bgs).

The metals barium, cadmium, chromium, cobalt, copper iron, lead, nickel, zinc and lead appear to be above site background and regional levels and thus are of potential concern in the surficial soils at this SWMU.

SWMU No. 96 OLD ENTOMOLOGY RINSE AREA (IRP SD-17)

One surface soil sample was collected at the SWMU. Analytical results showed that the pesticides, 4,4-DDE and 4,4-DDT, were reported as estimated values (flagged with J) of 66J and 110J $\mu$g/kg, respectively. The $\alpha$- and $\gamma$-chlordane compounds were reported as estimated values of 16J and 47J $\mu$g/kg, respectively. Heptachlor epoxide was reported as an estimated value of 19J $\mu$g/kg. One groundwater sample was collected from well 96K. In this groundwater sample, six metals were detected above the detection limits for TAL metals; barium, chromium, copper, lead, vanadium, and zinc. All the metals

analyses showed concentrations below the MCL. No PCBs or pesticides were found in the groundwater sample.

SWMU No. 98 SANITARY SEWER LINE

Forty-three soil borings were drilled at this SWMU to evaluate potential contaminant seepage from cracks noted in the Sewer Line during the video camera survey (VCS) performed during the RI. Only five borings encountered moist to very moist conditions below the sewer indicating that a majority of the hairline cracks noted during the VCS have little leakage potential.

Acetone was the only volatile organic detected above the CRQL at this SWMU. In all borings except 9821, the presence of acetone is considered to be due to laboratory contamination. Acetone may be present in the soils at boring 9821, which may indicate past leakage of the sewer at this point. TPH above 100 mg/kg was discovered in only one boring, 9835. At soil boring 9826, cadmium and lead were detected at concentrations that appear to be slightly above site background.

SWMU Nos. 101, 102 WASTEWATER LAGOONS

Sludge, surface water and groundwater samples were collected and analyzed at this SWMU.

The only volatile organics detected above the CRQL in the sludge were acetone and 2-butanone. Phthalates were the only semivolatile organics detected. The actual presence of these compounds in the sludges of the lagoon is questionable since they are common laboratory contaminants. Low levels of pesticides were reported throughout the sludge of both lagoons. Of greater uncertainty is the presence of PCBs, since all detected values were flagged as estimated. Metals in the sludge were consistently above background ranges for soils; however, none of the metals were detected above Toxicity Characteristics (TC) limits for the TCLP analyses.

Groundwater samples were collected from four wells at the SWMU. No analytes other than metals were detected above the reporting limits. Metals analysis revealed the

presence of barium and vanadium in all four groundwater samples. Both metals had concentrations below their MCLs (for barium, 1.0 mg/L; for vanadium, no MCL is established). The concentration of barium ranged from 0.023 mg/L to 0.075 mg/L. The concentration of vanadium ranged from 0.012 mg/L to 0.02 mg/L. The chemical data indicate that groundwater quality does not appear to be impacted by SWMUs 101 and 102.

Three surface water samples were collected from the lagoon. The volatile organics acetone (34 $\mu$g/L), chloroform (5.4 $\mu$g/L) and toluene (5.0 $\mu$g/L) were the only volatile organics detected.

All three sampling locations detected the presence of sulfide. The concentration ranged from 0.19 $\mu$g/L to 3.7 $\mu$g/L.

Six chemicals (five metals and one anion, cyanide) were detected in the surface water at the sewage lagoons in concentrations equal to or greater than EPA Ambient Water Quality Criteria. These chemicals include copper, cyanide, lead, mercury, silver and zinc. No organic chemicals (volatiles, semivolatiles, or pesticides) were found exceeding current available criteria.

SWMU No. 106 FIRE TRAINING AREA No. 2 (IRP FT-7)

Analytical results indicate TPH contamination in the shallow soils at 0 to less than 4 feet and probably does not extent beyond the boundary of the SWMU. Concentrations of lead and chromium in surface soil samples at this SWMU were above site background levels. Concentrations of volatile organics were all below the CRQL for subsurface soil samples. BTEX (140 $\mu$g/kg) and benzene 120 $\mu$g/kg were detected in one surface soil sample.

SWMU No. 107 FIRE TRAINING AREA No. 3 (IRP FT-8)

Lead was detected above site background levels in surface soil samples 1071 and 1074 at concentrations of 151 and 322 mg/kg, respectively. Elevated lead concentrations did

not extend into deeper soils. Chromium was detected infrequently and where detected appears to be present in concentrations similar to site background levels.

TPH, ethyl benzene, toluene, and xylene contamination has occurred at this site to a depth of 32 feet in boring 1074. At depths below 47 feet in boring 1074, and at all depths sampled in the other three borings drilled at the SWMU, these compounds were not detected at levels above the quantitation limit.

SWMU No. 109 FIRE TRAINING AREA No. 4

Xylenes and ethyl benzene occur in the soil from near ground surface to approximately 6 feet at boring 1093 and down to approximately 12 feet at boring 1094. This occurrence correlates well with the fuel staining observed during the field sampling effort near the wings of the mock airplane. Xylenes and ethyl benzene were not detected above the CRQL at other boring locations. No metals were detected at this SWMU in concentrations that appear to be above site background levels.

The lateral extent of ethyl benzene and xylene contamination is not well defined, but is probably confined to the area immediately outside the concrete berm and liner underlying the mock airplane. It appears that volatile organic contamination does not extend deeper than 12 feet bgs based on the results from borings 1093 and 1094. TPH contamination was found at the surface in three boring locations and may be present in other areas of the SWMU where stained soil was observed during the field sampling event. TPH contamination correlated well with the detections of ethyl benzene and xylenes at this site.

SWMU No. 113 LANDFILL No. 5 (IRP LF-5)

Groundwater samples were collected from existing monitoring wells, A, B, C, D, and I. Evaluation of the chemical analyses (Appendix IX constituents) of these samples revealed that no analytes other than metals were detected above the CRQL.

Barium, vanadium, and lead were detected in several samples but at concentrations below drinking water MCLs. Comparison of downgradient water quality to upgradient results indicate that the quality of groundwater has not been affected by the SWMU.

BASELINE RISK ASSESSMENT (BRA)

A BRA was performed by WCC as part of the RI effort. This assessment was performed under the regulatory framework of RCRA and CERCLA. Therefore, the current RCRA and CERCLA guidance was followed to evaluate the human health impact from RCRA facilities and Superfund sites. Under the RCRA guidance, the concentrations of site chemicals were compared with RFI criteria/RCRA proposed action levels which are conservative and not site-specific screening levels. RFI guidance provides that a site-specific risk assessment could be performed when the levels of site chemicals in a particular medium within the facility exceed the RFI criteria/RCRA proposed action levels. The applicable risk assessment guidance under CERCLA was also followed.

A site-specific risk assessment was performed for each Risk Assessment Area (RAA) which is comprised of an individual SWMU or a group of SWMUs which are geographically close, have common or similar chemical release sources, and have potentially overlapping exposure pathways. This resulted in grouping the 18 SWMUs investigated under the RI into 7 RAAs. The results of the risk characterization are summarized below.

The average and reasonable maximum exposure (RME) risks and hazards were estimated for complete exposure pathways at each RAA. Generally, average chemical concentrations in soil and the 95% upper confidence limit (UCL) of the arithmetic mean concentration were used in assessing average and RME intakes, respectively, along with other average or RME intake factors. The total noncarcinogenic hazard indexes were below the EPA's level of concern (1.0) in each RAA evaluated. This was true for individual exposure pathways and combined exposure pathways in each RAA. The total carcinogenic risks for each RAA were also below or within the EPA's target risk range of $1 \times 10^{-4}$ to $1 \times 10^{-6}$. In RAA 1, (Fire Training Areas No. 2, 3 and 4 and Landfill No. 5) the RME cancer risk for the hypothetical future child resident was $1.1 \times 10^{-4}$.

Although this level exceeds the EPA target risk range, the low frequency of detection of COC and raised analytical detection limits due to soil matrix effects probably represent an overestimation of the calculated risks.

With the exception of antimony in RAA 2, (Engine Test Cell) none of the concentrations of chemicals of concern in soil (using the 95% UCL or the maximum measured concentration) exceeded RFI criteria or proposed RCRA action levels. Soil lead levels did not exceed the EPA target cleanup range of 500 to 1,000 mg/kg for lead in soil or the EPA's target blood lead concentration (10 $\mu$g lead/dL of blood) using the Uptake Biokinetic Model. Lead was reported in one groundwater sample from SWMU No. 113 (0.016 mg/L) at concentrations that exceeded the EPA action level (0.015 mg/L) but not the EPA drinking water maximum contaminant levels (MCLs) of (0.050 mg/L) for lead.

The groundwater data collected as part of the RI do not exceed EPA's Maximum Contaminant Levels for drinking water. An examination of the vertical extent of contamination for soils revealed a decrease in concentration at depths below approximately 30 feet. The depth to the water table (Ogallala Aquifer) is approximately 260 feet below ground surface (BGS). After considering the groundwater monitoring well data (one round), the fate and transport properties of site chemicals, and the local geology/hydrogeology, it is believed that the site impact to groundwater is not likely to be significant.

Based on findings of the BRA and comparison of soil data with risk-based RFI criteria/proposed RCRA action levels, it was concluded that potential health impacts to humans from the 18 SWMUs investigated during the RI are not significant.

## ECOLOGICAL RISK ASSESSMENT

An Ecological Risk Assessment (ERA) was performed to evaluate the potential for biota at Cannon Air Force Base to be adversely impacted. The ecological risk assessment focused on the potential for adverse effects on selected indicator species (chemical receptors) from environmental stressors (chemicals of concern) at the site. The

ecological risk assessment followed the guidelines provided by the EPA in "Risk Assessment Guidance for Superfund: Volume II Environmental Evaluation Manual."

During the ERA, the plant and animal species that occur at Cannon AFB and in the nearby vicinity were identified, sensitive species and habitats were described, and indicator species were selected for further evaluation. Ducks were chosen as the principal indicator species for wetland/aquatic ecosystems at Cannon AFB because they are the prevalent species observed at the Playa Lake, and occasionally at the Wastewater Lagoons. For terrestrial habitats, the deer mouse was considered to be the principal indicator species due to their ground-dwelling habit and as a prey item for raptors.

The focus of the ERA was on the exposure of dabbler ducks to chemicals in the wastewater lagoons (SWMU Nos. 101, 102) in water and sediments. Dabbler ducks are present in the area for several months every winter; some individuals may stay the entire year. The ducks principally feed at nearby grain fields and often rest (and feed) at the Playa Lake, which receives water regularly from the lagoons. The Playa Lake is a SWMU which has been identified for investigation in the future as part of the overall RI for Cannon AFB and therefore was not the focus of this ecological risk assessment.

Both water and sediments from the lagoons were found to contain chemical concentrations which could pose some risk to waterfowl and aquatic organisms. Metals were found in the lagoon water at concentrations which exceeded acute (copper, silver, and zinc) and chronic (cyanide, lead, and mercury) AWQC. Hazard Quotients (HQs) were calculated for ducks based on toxicological literature and indicated that metal levels in the water are unlikely to pose any adverse risk. HQs for ducks from incidental ingestion of sediments, however, indicated that mercury and zinc in sediments may pose some risk to waterfowl. No pesticides were detected in the lagoon water. Pesticide concentrations were detected in the lagoon sediments at concentrations which if converted to water concentrations by using partitioning coefficients, exceeded chronic AWQC. Compounds such as dieldrin, endrin, heptachlor, and DDT are especially persistent and stable in anaerobic sewage sludge (EPA 1979). Several of these pesticides have the potential to be acutely toxic to aquatic organisms as well as the potential to bioaccumulate to significant levels through food chains.

The lagoons are not intended for use as wildlife habitat and therefore risks to aquatic organisms such as algae and benthic invertebrates are not of concern. Dabbler ducks, however, are protected migratory waterfowl and are therefore of concern. Based on this ecological risk analysis, there is a small potential for some toxic effects to occur to dabbler ducks which chronically ingest water and sediments from the lagoons. It is also possible that metal and pesticide levels in the lagoon are no higher than those found in other water bodies in the region due to the accumulation of chemicals from surface runoff. Reference concentrations were not available for sediments and water from other sewage lagoons or water bodies in the region.

Concentrations of chemicals in soils at Cannon were also evaluated in terms of potential risk to terrestrial biota. The receptor species of concern are the kites and raptors and small ground-dwelling mammals. Six metals (copper, chromium, cadmium, zinc, cobalt, and lead) and one semi-volatile organic compound (benzo(a)pyrene) were detected in soils at levels which were considered to be above background. Benzo(a)pyrene, because of its relatively low concentration near background levels, was not considered to be a chemical of concern. None of the six metals are thought to bioaccumulate through the food chains to levels where they would pose a risk to kites or raptors. Potential risk from these metals in soil to biota was considered to be greatest through direct exposure of small mammals and other ground-dwelling organisms. Based on the calculation of toxicity values for a mouse from incidental soil ingestion, none of the six metals were considered to pose a risk to small mammal populations.

## RECOMMENDATIONS

Based on the results of the RI, including the baseline risk assessment and ecological risk assessment, the following was recommended:

A **"No Action"** remedial alternative is appropriate for the following SWMUs:

- SWMU No. 34 AGE Drainage Ditch (IRP No. SD-15)
- SWMU No. 76 Sludge Weathering Pit (IRP No. WP-14)
- SWMU No. 78 Fire Department Training Area No. 1 (IRP No. FT-6)
- SWMU No. 81 Solvent Disposal Site (IRP No. SD-20)

- SWMU No. 95 NE Stormwater Drainage Area (IRP No. SD-20)
- SWMU No. 98 Sanitary Sewer Line
- SWMU No. 106 Fire Department Training Area No. 2 (IRP No. FT-7)
- SWMU No. 107 Fire Department Training Area No. 3 (IRP No. FT-8)

**NE Stormwater Drainage Area - SWMU No. 95 (IRP No. SD-20)**

A Stormwater permit application is currently in progress for Cannon AFB to comply with the new regulations contained in 40 CFR parts 122, 123, and 124. In that permit Cannon AFB proposes to monitor effluent in the NE Stormwater Drainage annually during a storm event. The effluent sample will be analyzed for the following parameters:

- Volatile Organic Compounds
- Semi-volatile Organic Compounds
- Pesticides/PCBs
- Metals (antimony, barium, beryllium, cadmium, chromium, copper, lead, silver, thallium, zinc)

It is therefore recommended that this SWMU be listed for no further action under RCRA but continued to be monitored and results be reported under the new stormwater regulations.

Further investigation, monitoring or remedial action is recommended for the following SWMUs at Cannon AFB:

- SWMU Nos. 86-90 Engine Test Cell Area (IRP No. SD-11)
- SWMU No. 96 Old Entomology Rinse Area (IRP No. SD-17)
- SWMU Nos. 101,102 Wastewater Lagoons
- SWMU No. 109 Fire Department Training Area No. 4
- SWMU No. 113 Landfill 5

Based on the RI results, the following presents and discusses recommendations for additional investigations at the above SWMUs.

## Engine Test Cell Area - SWMU Nos. 86-90 (IRP No. SD-11)

The lateral extent of petroleum hydrocarbons found in the soil near the oil/water (o/w) separator (i.e., boring 0863) was not determined during this investigation. However, instead of additional characterization using borings or trenching, Cannon AFB has elected to remove the oil/water separator and surrounding soils contaminated with petroleum hydrocarbons. The following actions are proposed for FY 93 under Project No. 93-8004 for Engine Test Cell Area:

- Removal and disposal of the oil/water separator and associated piping
- Excavation of any soil contaminated with petroleum hydrocarbons and placement in the on-base land farming unit for treatment.
- Collection and laboratory analysis of confirmation samples along the walls and in the bottom of the excavation to verify removal of petroleum hydrocarbon contaminated soil to specified cleanup goals.
- Provide EPA with documentation verifying the removal of the oil/water separator and petroleum hydrocarbon contaminated soil.

## Old Entomology Rinse Area - SWMU No. 96 (IRP No. SD-17)

Results of the surface soil sample collected at the approximate location of the former sink rinse pit and analyzed for PCBs/pesticides suggest that the pesticides 4,4-DDE, 4,4-DDT, heptachlor epoxide, and the $\alpha$- and $\gamma$- chlordane compounds may be present at low estimated concentrations at the surface (66J ug/kg, 110J ug/kg, 19 ug/kg, 16J ug/kg, and 47J u/kg, respectively). Because pesticides have been detected in shallow soil samples (i.e., 2 to 10 feet BGS, and 62 to 63 feet BGS) from previous investigations by Radian (1986) and Walk, Haydel, and Associates (1990), and continued concern of the regulatory agencies, one soil boring will be drilled to a depth of approximately 100 feet BGS at the location of sample 0961. Chemical samples will be collected at 10-foot intervals from surface to total depth in this boring and analyzed for pesticides and PCBs. Following completion of the above work, an addendum to the RI Report will be

provided to the EPA discussing the sampling and analytical results from this boring and recommendations for further action. The above work will be scoped, contracted, and performed in FY 93 under the USAF IRP as weather permits.

**Wastewater Lagoons - SWMU Nos. 101, 102**

This SWMU currently is not regulated under Cannon AFB's RCRA Part B Permit but there continues to be discussion between Cannon AFB, EPA, and NMED to determine under which environmental regulation this unit will be monitored. The analytical results from the sludge samples collected within the Wastewater Lagoons indicated that volatile organic compounds (acetone and 2-butanone), semi-volatile organic compounds (phthalates), pesticides, PCBs, and metals were present. Based on these data, the one upgradient (E) and three downgradient (F, G, H) monitoring wells at this SWMU will be sampled and analyzed, using SW-846 methodologies, annually for volatile organic compounds, metals, pesticides, nitrates, sulfates, and total dissolved solids. This interim monitoring program will continue until the regulatory framework of this unit is resolved. Analytical results will be provided to EPA and NMED on an annual basis.

**Fire Department Training Area No. 4 - SWMU No. 109**

A review of Applicable or Relevant and Appropriate Requirements (ARARs) indicated that the New Mexico Underground Storage Tank (UST) remediation guidelines may be appropriate for SWMU No. 109, Fire Training No. 4. A new fire training facility, Project No. CZQZ-943002, is currently being designed and is scheduled for construction at a new location during FY 94. Until this new facility is built and operational, the current Fire Department Training Area No. 4 will continue to be used. It would not be prudent to proceed with additional site characterization borings until the new facility is active. Therefore, the following actions are recommended for Fire Training Area No. 4 after completion of the new fire training facility in FY 94:

- Drill additional borings around and beneath the mock airplane to evaluate lateral and vertical extent of TPH in soil.

- Drill additional borings at the "tree" and "vehicle burn" area to evaluate lateral and vertical extent of TPH in these areas.

- Analyze soil samples for TPH and BTEX

- Evaluate remedial options for soils exceeding TPH cleanup goals. Analytical results from borings described above will be used to estimate the volume of soil requiring remediation.

- Select a remedial alternative and initiate remedial action.

**Landfill No. 5 - SWMU No. 113**

Evaluation of the monitoring well chemical data indicates the quality of groundwater beneath this SWMU has not been affected by Cell No. 3 (the cell that reportedly received hazardous wastes until mid-1981) at Landfill No. 5. However, since the vadose zone beneath this cell has not been investigated, the nature and extent (lateral and vertical) of any hazardous contamination that may impact the groundwater sometime in the future, has yet to be evaluated. Since the New Mexico Environmental Division regulates the activities at this SWMU, the groundwater monitoring requirements for this unit will be resolved by Cannon AFB and NMED and will not be addressed further in this report.

**Playa Lake**

Even though the Playa Lake was not included in this RI, the Environmental Risk Assessment indicated potential risk to biota, especially ducks, from potential contaminants in the sediment and surface water of the Playa Lake to the east into which Wastewater Lagoon effluent drains. Because of the potential risk, it is recommended that any ecological study conducted at the Playa Lake consider the following:

- Applicability of Ambient Water Quality Criteria to the site
- Evaluation of relevant toxicity information
- Field investigations

- to identify species present and food habits
- collect additional sediment, surface water and biota samples

It is also recommended that if dredging of the sludge in the Wastewater Lagoons is performed in the future, analytical testing be performed to evaluate disposal options.

# 1.0
# INTRODUCTION

## 1.1 PURPOSE AND SCOPE OF REPORT

The purpose of this Remedial Investigation (RI) Report is to present the results of the field activities and subsequent laboratory analyses performed to characterize the nature and extent of contamination (if any) at 18 Solid Waste Management Units (SWMUs) at Cannon Air Force Base (Cannon AFB), Clovis, New Mexico. The information obtained from the field investigation and laboratory analyses was used in the Baseline Risk Assessment which was also completed as part of the overall RI effort for the 18 SWMUs. Woodward-Clyde Consultants (WCC) was contracted by the U.S. Army Corps of Engineers - Omaha District (USACE) to perform the Remedial Investigation described herein. The USACE Scope of Services (SOS) for the Cannon AFB RI is presented in Appendix A. A feasibility study was not called for under the USACE SOS.

The Remedial Investigation was conducted to satisfy requirements of the United States Air Force (USAF) Installation Restoration Program (IRP), as well as the conditions of the Cannon AFB Resource Conservation and Recovery Act (RCRA) operating permit. The activities performed during the RI effort of the 18 SWMUs at Cannon AFB were conducted in accordance with the RI Work Plan documents prepared by WCC for the USACE. The RI Work Plan documents prepared by WCC include the Work Plan (WP) (WCC 1991a) [which includes the Data Management Plan (DMP), Program Management Plan (PMP), and Community Relations Plan (CRP)]; Quality Assurance Project Plan (QAPP) (WCC 1991b); Field Sampling Plan (FSP) (WCC 1991c); and the Site Safety Health Plan (SSHP) (WCC 1991d). The above RI Work Plan documents were prepared as supplements to the RCRA Facility Investigation Work Plan (Volumes I and II) previously prepared and submitted to the USAF by Lee Wan and Associates, Inc. (Lee Wan 1990). WCC modified the work plans submitted by Lee Wan and Associates as necessary for conducting the specific tasks associated with this portion of the overall RI program, as specified in the USACE SOS.

## 1.2 REGULATORY FRAMEWORK

The United States Air Force (USAF), due to its primary mission of defense of the United States, has long been engaged in a wide variety of operations dealing with toxic and hazardous materials. Federal, state, and local governments have developed strict regulations to require that disposers identify the locations and contents of past disposal sites and take action to eliminate hazards in an environmentally responsible manner. The primary federal legislation governing disposal of hazardous waste is the Resource Conservation and Recovery Act (RCRA) of 1987, as amended. Cannon AFB is a recognized RCRA facility. Under Section 6003 of the Act, federal agencies are directed to assist the U.S. Environmental Protection Agency (EPA); under Section 3012, state agencies are required to make the information available to the requesting agencies. To ensure compliance with these hazardous waste regulations, the Department of Defense (DOD) developed the IRP. The current DOD IRP policy is contained in Defense Environmental Quality Program Policy Memorandum (DEQPPM) 81-5, dated December 11, 1981 and implemented by USAF message dated January 21, 1982. DEQPPM 81-5 reissued and amplified all previous directives and memoranda on the IRP. DOD policy is to identify and fully evaluate suspected problems associated with past hazardous contamination and to control hazards to health and welfare that resulted from these past operations. The IRP is the basis for response actions on USAF installations under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1981, commonly known as "Superfund," clarified by Executive Order (EO) 12316. CERCLA (as amended and reauthorized in 1986) is the primary legislation governing remedial action at past hazardous waste disposal sites.

Before 1986, minor differences in the definition of program phases and lines of authority resulted in some confusion between DOD and state and federal regulatory agencies. These difficulties were rectified via passage of the Superfund Amendments and Reauthorization Act (SARA, PL-99-499) of 1986. On January 23, 1987, EO 12580 was issued. EO 12580 effectively revoked EO 12316 and implemented the changes promulgated by SARA. The most important changes affected by SARA included the following:

- Section 120 of SARA provides that federal facilities, including those in the DOD, are subject to all provisions of CERCLA/SARA concerning site assessment, evaluation under the National Contingency Plan (NCP) [40 Code of Federal Regulations (CFR) 300], listing on the National Priorities List (NPL), and removal/remedial actions

- Section 211 of SARA also provides continuing statutory authority for the DOD to conduct its IRP as part of the Defense Environmental Restoration Program (DERP).

- SARA also stipulated that terminology used to describe or otherwise identify actions carried out under the IRP shall be substantially the same as the terminology of the regulations and guidelines issued by the EPA under their Superfund authority.

As a result of SARA, the operational activities of the IRP are currently defined and described as follows:

**Preliminary Assessment (PA).** A records search designated to identify and evaluate past disposal and spill sites that might pose a potential and actual hazard to public health, welfare, or the environment.

**Site Inspection/Remedial Investigation/Feasibility Study.** The Site Inspection (SI) consists of field activities designed to confirm the presence or absence of contamination at the potential sites identified in the PA. The RI consists of field activities designed to quantify and identify the potential contaminant, the extent of the contaminant plume, and the pathways of contaminant migration. The Feasibility Study (FS) consists of the review and screening of remedial alternatives and a detailed evaluation of remaining alternatives with respect to technical feasibility, cost, public health impacts, environmental impacts, and regulatory requirements.

If applicable, a public health evaluation is performed to analyze the collected data. Field tests are required, which may necessitate the installation of monitoring wells or the collection and analysis of water, soil and/or sediment samples. Careful documentation

and quality control procedures, in accordance with CERCLA and SARA guidelines, ensure the validity of data. Hydrogeologic studies are conducted to determine the underlying strata, groundwater flow rates, and direction of contaminant migration. The findings from these studies result in the selection of one or more of the following options:

- **No Further Action**
- **Long-Term Monitoring**
- **Feasibility Study**
- **Remedial Design/Remedial Action (RD/RA)**
- **Immediate Response Alternatives**

The Hazardous and Solid Waste Amendments of 1984 (HSWA) expanded corrective action authorities for permitted RCRA facilities, and required that any permit issued under section 3005(c) of RCRA to a treatment, storage, or disposal facility after November 8, 1984 address corrective action for releases of hazardous wastes or hazardous constituents from any SWMU at the facility.

While RCRA authorizes a general regulatory program to manage all hazardous wastes from "cradle-to-grave" (from generation to ultimate disposal) CERCLA provides authority to respond whenever a release or substantial threat of a release that threatens human health or the environment occurs. CERCLA is the more comprehensive statute, as CERCLA "hazardous substances" encompass RCRA "hazardous wastes" as well as other toxic pollutants regulated by the Clean Air Act, Clean Water Act, and the Toxic Substances Control Act. Thus, all RCRA "hazardous wastes" may trigger CERCLA response actions when released into the environment.

On the whole, the CERCLA response authority has a broader reach than RCRA's corrective action. The RCRA provisions apply only to RCRA-regulated facilities. CERCLA, however, can be utilized to require response work by any potentially responsible party (PRP) at any place where there is a release or potential release. The facility owner or operator implements RCRA corrective action. However, a number of different parties can implement a CERCLA remedial action. The Federal government

and the PRPs could each do a portion of the investigation/remedial work pursuant to a mixed funding settlement agreement.

The RCRA and Superfund programs use different labels but follow roughly parallel procedures in responding to releases (see Table 1-1). In both, the first step after discovery of a release is an examination of available data to ascertain whether an emergency action is warranted. In both, short-term measures are authorized to abate the immediate adverse effects of a release. Once an emergency has been addressed, both programs provide for an investigation and formal study of long-term cleanup options. When these analyses are completed, both provide for formal selection of a remedy.

One of the major procedural differences between the two programs involves ranking. CERCLA requires that site conditions be analyzed according to the Hazard Ranking System and that only NPL sites receive any remedial action funding. Currently, no comparable requirement exists in the RCRA corrective action procedures.

Another difference is in the assessment of risks to human health and the environment. RCRA action levels, used to trigger a Corrective Measures Study, are based on different exposure factors than those are used under CERCLA for duration of exposure. Also, the EPA usually conducts the risk assessment under RCRA, while under CERCLA a PRP can conduct the risk assessment.

This investigation of 18 SWMUs at Cannon AFB was performed to comply with Cannon AFB's RCRA Part B Permit conditions; however, funding is being provided by the USAF IRP. The investigation procedures and subsequent reporting for the evaluation of the nature and extent are similar for both RCRA and CERCLA sites. However, this investigation was tailored toward the more stringent CERCLA guidance, with the exception of the human health risk assessment and environmental evaluation.

## 1.3 REPORT ORGANIZATION

The following subsections of this Introduction briefly present the background information for Cannon AFB as related to the remedial investigation of the 18 SWMUs at Cannon

AFB. Contained in this discussion is a general description of Cannon AFB including historical information and the physical setting of the area. Also contained in this section is a brief description of previous investigations conducted on Cannon AFB preceding this RI effort. Subsection 1.5 presents the RI field investigation objectives and methods used for collecting samples for chemical analysis. Sections 2.0 through 14.0 present the specific information at each SWMU being investigated. Included in each of these subsections is a description of the SWMU, information on the specific field investigation activities at the particular SWMU, and a description of the physical characteristics of the SWMU based on the RI results.

Section 15.0 presents the field investigation activities related to collecting samples at off-site locations to provide background analytical results for comparison to analytical results obtained at the individual SWMUs. Section 16.0 presents a discussion of the Quality Assurance/Quality Control procedures performed during the RI for data collection and chemical analysis of the samples. Sections 17.0 and 18.0 discuss the contaminant fate and transport of chemicals detected as a result of the RI and the results of the baseline risk assessment for human health and the ecological assessment. Section 19.0 presents applicable or relevant and appropriate requirements (ARARs) for evaluating the nature and extent of potential hazardous waste contamination at the SWMUs. Section 20.0 presents the conclusions and recommendations based on the results of the field investigation and baseline risk assessment for each of the 18 SWMUs at Cannon AFB. References for additional documents utilized in conducting the RI and preparing this RI report are contained in Section 21.0.

## 1.4 INSTALLATION BACKGROUND

### 1.4.1 Facility Description

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 located south of the intersection of U.S Highway 84/60 and New Mexico Highway 277. The vicinity map of Cannon AFB is shown on Figure 1-1, and a SWMU location map of Cannon AFB is shown on Figure 1-2. Base facilities include the airfield area with operation, maintenance, and support facilities located primarily northwest of the airfield area. Base

housing is located in the northwest quarter of the base and north of the base, west of New Mexico Highway 277. Additional ancillary base support facilities such as the wastewater lagoons, fire department training area, and munitions storage are located south and east of the airfield.

Off-base facilities include the Melrose Bombing Range and the Conchas Lake Recreation Annex. The Melrose Bombing Range is located approximately 25 miles west of Cannon AFB and occupies an area of approximately 77,190 acres (USAF 1990). Conchas Lake Recreation Area is located approximately 80 miles northwest of Cannon AFB and occupies approximately 27 acres of land (CH2M Hill 1983).

### 1.4.2 Facility History

The following information was obtained from the Installation Restoration Program Records Search document prepared by CH2M Hill for the USAF (CH2M Hill 1983) and the Cannon AFB Area Joint Military Telephone Directory (American Publishers 1991).

Cannon AFB dates back to 1929, when Portair Field was established on the site. Portair field was a civilian passenger terminal for early commercial transcontinental flights. Portair Airfield was renamed Clovis Municipal Airport in the 1930's. In 1942, the Army Corps took control of the civilian airfield, and it became known as the Clovis Army Air Base. The first military unit arrived in June 1942, and base construction began in August of that same year. 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. It was comprised of Air National Guard units from Colorado, Utah, and Wyoming. The 140th flew the P-51 "Mustang" conventional fighter. The airfield was formally reactivated in November 1951 as Clovis Air Force Base. The 140th returned to Air National Guard control at the end

of 1952. In January 1953, the 50th Fighter-Bombing Wing was activated and began flying the F-86 "Sabre" jet fighter. The 50th was transferred overseas in August 1953. In November 1953, the 388th Fighter-Bomber Wing, which also flew F-86s, was activated. The 388th was sent overseas in November 1954 and was relieved at the base by the 312th Fighter-Bomber Group. In December 1954, the 474th Fighter-Bomber Group was transferred to Cannon AFB, and the base became a major training installation for "Sabre" pilots.

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. The first F-100 "Super Sabre" arrived at Cannon AFB in late 1957 and became the principal base aircraft until 1969. 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 F-100 training ended in June 1969 and was replaced with F-111's the following month.

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 a 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. Cannon AFB's 4,000 member work force includes 3,500 military and 500 civil service personnel.

### 1.4.3 Facility Characteristics

#### 1.4.3.1 Physical Geography

Cannon AFB is situated in the Southern High Plains Physiographic Province in the Llano Estacado subprovince (Figure 1-3) (Hawley et al. 1976). 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 (USGS 1985). These are second-order streams. Both streams are very straight, flow southeast, and have rectilinear drainage patterns with short laterals.

### 1.4.3.2 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 39°F to a July high of 78°F. Extreme daily temperatures range from -11°F to 106°F. Average monthly precipitation ranges from 0.4 inches in winter to 2.7 inches in July. The maximum recorded 24-hour rainfall is 4.7 inches, which occurred in August, 1985 (Hale 1992). Rainfall occurs eight or more days per month during the summer precipitation maximum. Mean annual precipitation is approximately 15 inches. The mean annual lake evaporation is 69 inches/yr. Prevailing winds are from the west at an average of 8 mph (USAF 1990).

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 atmospheres (USAF 1990).

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 area in the United States having the most frequent and highest levels of 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.

### 1.4.3.3 Surface Water Hydrology

Cannon AFB is located in the Southern High Plains region. This region is typified by smooth and gently sloping, undulating surface topography on which scattered, normally dry, flat-bottomed depressions are the dominant relief feature. The dominant surface features in the vicinity of Cannon AFB are small temporary lake basins known as playas. A playa located near the southwest corner of Cannon AFB collects the majority of the

stormwater runoff from the Base. Two wastewater lagoons are located on base. These lagoons have a combined surface area of 32 acres and are operated in series. The treated wastewater effluent from the lagoons is channeled into an adjoining playa lake. The effluent to the playa lake is disposed by a combination of evaporation, infiltration and use by a local farmer for irrigation purposes. The wastewater treatment system reportedly does not need a National Pollutant Discharge Elimination System (NPDES) permit since the requirement for a NPDES permit was waived in 1975. Cannon AFB has no permanent surface water features other than the wastewater lagoons and associated playa lake (USAF 1990).

Regional drainage in Curry County is predominantly to the southeast and east. Stream drainage is poorly developed because of the low annual rainfall and the minimal relief. The drainage patterns consist of long shallow valleys (known locally as draws) that extend almost from the western edge of the Southern High Plains to the eastern boundary of the plateau. The valleys or draws eventually drain into one of three major river valley: the Red, the Brazos, or the Colorado River Valleys. Although the draws extend to the river valleys as drainage systems, they seldom contribute actual flow to the rivers except during periods of unusually high rainfall. The bulk of the precipitation is lost to evapotranspiration and infiltration. The playa lakes serve as low-point collection areas for surface runoff in areas not drained by the draws. The playa lakes have no surface outlet, and any water they collect is eventually lost to evaporation and infiltration (USAF 1990).

#### 1.4.3.4 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 United States Department of Agriculture - Soil Conservation Service (USDA-SCS) Comprehensive Soil Classification System. The following summary is based on the Curry County Soil Survey (USDA 1958). Figure 1-4 depicts the various soil types mapped at Cannon AFB. Soil characteristics are briefly described in the following paragraphs.

The most common soil type on the base is the Amarillo fine sandy loam, 0 to 2 percent slope phase (map symbol Ab). 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 color of the surface soil is brown (7.5 YR 5/5, dry) and subsurface soils are reddish-brown (5 YR 4/4, dry) to yellowish-red (15 YR 5/6, dry). The calcic C horizon underlying the Amarillo Fine Sandy loam is white in color. The Amarillo fine sandy loam soil type is present on all relatively flat surfaces at the base but is also found on slopes associated with playas (map symbol Ac). A small area of Amarillo loamy fine sandy 0 to 2 percent slope phase (map symbol Ag) is mapped in the southeast corner of the base.

Clovis fine sandy loams, 0-2 percent slope phase (map symbol Cb) and 2-5 percent slope phase (map symbol Cc), are similar to Amarillo fine sandy loams. Clovis soils are reddish-brown on the surface and in the subsurface, with a white Calcic C horizon. 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 Mb) are found. Mausker fine sandy loams have no B horizons and are very calcareous. Mausker fine sandy loam soils are brown (10 YR 5/3, dry) to light brown (7.15 YR 6/4, dry) at the surface with a pink to reddish-yellow (7.5 YR 7/5, dry) calcic C horizon. Associated with the Mansker fine sandy loam soils around the base Playa Lake are Potter fine sandy loam soils, 0 to 5 percent slope phase (map symbol Pa). This soil typically has a thin A horizon, grayish brown (10 YR 5/2, dry) in color, with no B horizon; similar to Mansker soils. Potter soils are shallow and strongly calcareous, and overlie hard consolidated caliche. 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 (USDA 1958).

### 1.4.3.5 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 Figures 1-5 and 1-6.

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 unconformity having relief of up to several hundred feet (Frye and Leonard 1972).

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 unconformity are deep and trend dominantly east-west. Ogallala thickness may therefore 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. Frye and Leonard (1972) 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. Autogenic and allogenic clays are found as a trace to abundant matrix mineral (Frye, et.al. 1974). Frye, et.al (1974) distinguished five zones 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, especially ionic forms of metals.

Caliche is a major feature of the Ogallala Formation, occurring as nearly continuous to discontinuous layers throughout. 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. Frye, et.al. (1974) gives 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 (Frye and Leonard 1972). 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 is commonly thin or absent below playas.

#### 1.4.3.6 Hydrogeology

The lower portion of the Ogallala Formation is the primary regional aquifer in the site vicinity 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. The Ogallala aquifer has a southeasterly regional gradient of about 10 to 15 feet/mile (Weeks and Gutentag 1981). 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. Water quality is generally good, with dissolved solids ranging from 250 to 500 mg/l (Gutentag et al. 1984) and fluorides ranging from 2.2 to 2.7 mg/l (William Matotan and Associates, Inc. 1985).

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 provide irrigation water only (Figure 1-7).

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 unconformity surface marking the top of the Dockum Group. The local groundwater gradient is southeasterly at 7 to 15 feet/mile (USAF 1990). Figure 1-8 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 205 gpm to 1150 gpm. Specific capacities range from 11.4 gpm/foot to 27.9 gpm/foot (Lee Wan and Associates 1990).

Very rough estimates of hydraulic conductivity were made from aquifer pumping tests in water wells 5 and 9 (Figure 1-7) using the Theis equation. 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 rough approximations.

Hydraulic conductivity values for water wells 5 and 9 were found to be approximately $2.0 \times 10^{-3}$ cm/sec. Calculations for water well 8 result in a hydraulic conductivity of $2.0 \times 10^{-2}$ cm/sec. These estimates appear to be low when compared to published hydraulic conductivity data for sands and gravels (Freeze and Cherry 1979). As reported in Kearney (1987) a groundwater flow velocity of about 150 feet/yr has been estimated for the Ogallala. This is equivalent to a hydraulic conductivity of approximately $1.0 \times 10^{-1}$ cm/sec.

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 indicated that interstitial and interstratified clays are abundant in the Ogallala Formation.

Recharge to the Ogallala is primarily through infiltration of precipitation. Kearney (1987) indicates that the recharge rate may be as much as 1.0 inch/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 the lack of caliche directly below, playas. Caliche is soluble in rainwater and is leached over time to form percolation pathways.

Discharge from the Ogallala Aquifer occurs through well pumping and springs along the eroded margins. Spring discharge is not known to occur on or near Cannon AFB. Domestic and irrigation water wells are common on and around the base, however. The rate of discharge exceeds local recharge. Water levels in the Ogallala have declined steadily from the 1930s to the present. From the 1930s to 1980, a decline of 50 to 100 feet has been observed in the area around Clovis, New Mexico. Luckey, et.al. (1981) states "the largest area of water level decline exceeding 100 feet occurs south of the Canadian River extending from Curry County, New Mexico to Crosby County, Texas."

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.

#### 1.4.3.7 Land Use and Demography

This section will give a broad overview of site-wide land use and demographics, including the general area surrounding Cannon AFB. A more specific description of the demographics and land use occurring at each SWMU is given in later sections of this RI report.

Cannon AFB is located in southern Curry County, approximately seven miles west of the City of Clovis, NM, which is the county seat. 1990 Bureau of Census data reports the population of Curry County and the City of Clovis was 42,207 and 30,954 respectively. In 1990, Cannon AFB had a resident population of approximately 3,800, including military personnel and their dependents (USAF 1991).

The population in the region related to Cannon AFB will increase slightly in 1991 as additional personnel are assigned to the base. Employment at the base will increase by 155 positions (102 military and 53 civilian) because of the transfer to F-111 aircraft (USAF 1991). Population in the region will increase by an estimated 373 persons. Since on-base family housing is typically fully occupied, it is assumed that all of these additional households will reside in local communities.

Currently, 1,841 housing units are controlled by Cannon AFB. Unaccompanied enlisted personnel reside in 830 dormitory units on-base. Military families live in 1,011 units, 250 of which are located off-base. Typically, military family housing (MFH) is maintained at 95 percent occupancy, while 5 percent are undergoing repairs and renovations. Construction of additional military housing units is underway. Two hundred new dormitory units were recently completed and an additional 100 are in the design stage; 350 MFH units are currently under construction off-base under a military/civilian partnership (as per section 801 of PL 98-115). An additional 144 to 200 MFH units are currently being considered under the Military Construction Program (MCP) for FY 93. If approved, they would probably be available to military families by FY 93/3 (USAF 1991).

Major industries by employment in Curry County include the retail trade, government, and services. Cannon AFB is the largest single employer within the county. Base-related employment totalled approximately 4,900 positions, which included approximately 4,000 uniformed military, 460 appropriated fund civilians, and approximately 400 other base civilians (USAF 1991).

Medical services are provided for Cannon AFB personnel and their dependents by two general hospitals in the surrounding communities and by the base hospital. Education of student dependents is provided by the Clovis Municipal School District. A total of 1,735 dependents of Cannon AFB personnel enrolled in Clovis schools during the 1989-1990 school year (USAF 1990).

Land use within Curry County is primarily agricultural. The county has a total land area of 897,000 acres with 837,200 acres designated as farmland; 133,700 acres of this are considered prime farmland (USAF 1990). Lands surrounding Cannon AFB are classified as irrigated farmland of statewide importance. Principal crops include corn, grain, sorghum, wheat, barley, oats, alfalfa, cotton and various vegetables. Cattle ranching occurs throughout the county.

The City of Clovis is the commercial center for eastern New Mexico and western Texas and is one of the primary growth centers in a seventeen-county area. The Clovis planning area boundary extends for a five-mile area around the city. Currently, no land

use or zoning controls restrict the type and amount of construction in the proximity of Cannon AFB.

Within Cannon AFB there are several land uses occurring, including residential, commercial (businesses, offices, commissary, etc.), industrial (facilities associated with base operations), recreational and vacant land. The U.S. Air Force has also designated Compatible Use Zones (CUZs) around Cannon AFB. The CUZs provide recommendations for compatible uses in areas subject to noise and accident hazards. The local communities or county governments are responsible for adopting appropriate land use controls to prevent incompatible development. The county has not passed zoning ordinances controlling development around Cannon AFB. Incompatible land use (in regard to the Air Force's CUZs) has occurred to the northeast of the base, and includes both commercial and residential development.

#### 1.4.3.8 Ecology

Information contained in this section was compiled from maps, photographs,, and literature provided by private, state and federal agencies, and field observations. Additional information was obtained through personal communications with officials from the New Mexico Department of Game and Fish, the U.S. Fish and Wildlife Service, and the New Mexico Natural Heritage Program.

The biotic communities present in the vicinity of Cannon AFB are typical of the High Plains grassland in which it is located. Much of the natural communities are altered, but were formerly open, grass dominated landscapes in which grass formed a nearly continuous, uninterrupted cover. Natural succession led to climax grass-forb associations, however, improper grazing and fire suppression has often interrupted the succession cycle. Grass-forb climax associations have often been replaced by disclimax associations of shrubs (Brown 1982).

These open and exposed plains are subject to high solar radiation and long windy periods. Precipitation is the major factor affecting vegetative development. Common grass species include blue grama (*Bouteloua gracilis*), hairy grama (*Bouteloua hirsuta*), black grama (*Bouteloua eriopoda*), buffalo grass (*Buchloe dactyloides*), galleta (*Hilaria*

*jamesii*), sideoats grama (*Boutelova curtipendula*), little bluestem (*Schizachyrium scoparium*), sand dropseed (*Sporobolus cryptandrus*), western wheatgrass (*Agropyron smithii*), and red three-awns (*Aristida longiseta*). Forbs include asters (*Aster spp.*), kochia (*Kochia scoparia*), and thistles (*Cirsium spp.*). Principal Shrubs include sand sagebrush (*Artemisia filifolia*), soapweed yucca (*Yucca elata*), and broom snakeweed (*Gutierrezia saprothrae*). Several species of trees are found on Cannon AFB, including chinese elm (*Ulmus pamila*), russian olive (*Elaeagnus angustifolia*) and the plains cottonwood (*Populus sargentii*) (USDA 1958, NMSU 1978, CH2M Hill 1983, Brown 1982, USAF 1990). Agricultural crops grown in the vicinity of Cannon AFB include wheat, sorghum and alfalfa.

Grasslands on the High Plains surrounding Cannon AFB support a variety of wildlife, including passerine birds, raptors, waterfowl and shorebirds, and herbivorous mammals. Common passerine species include horned larks (*Eremophila alpestris*), meadowlarks (*Sturnella spp.*), and various sparrows. Common raptors include marsh hawk (*Circus cyaneus*), red-tailed hawks (*Buteo jamaicensis*), burrowing owls (*Spectyto canicularia*) and sharp-skinned hawks (*Accipiter striatus*) (CH2M Hill 1983, NMDG&F 1985). Shorebirds, and waterbirds and migratory waterfowl in general utilize the rivers, playa lakes (playas), and reservoirs of the region.

Playas in eastern New Mexico are important resting, feeding and grouping areas for waterfowl, shorebirds, raptors, songbirds, upland game birds, and many other species of wildlife. There are two playa lakes on Cannon AFB. One of them is located near the intersection of the primary and NW-SE runways and is used as a stormwater retention pond, collecting most of the base runoff. The other playa, known as Playa Lake, receives treated effluent from the base sewage treatment lagoons. Because of this consistent inflow, the Playa Lake has water in it year-round and is used by hundreds of wintering waterfowl, as well as many endemic mammals, amphibians, and reptiles. The Playa Lake is located in a relatively isolated area of the base and is surrounded by a substantial area of vegetated, vacant land, increasing its attractiveness for wildlife. The sewage lagoons themselves provide resting areas for waterfowl.

Waterfowl common to the area include pintails (*Anas acuta*), wigeons (*Anas americana*), mallards (*Anas platyrhynchos*), gadwalls (*Anas strepera*), and shovelers (*Anas clypeata*).

Shorebirds and wading birds such as phalaropes, sandpipers, godwits, and herons are also found in the area (Robertson 1992).

Two National Wildlife Refuges (NWRs) are located within 30 miles of Cannon AFB. The Grulla and Muleshoe NWRs can provide high-quality habitat for many species of migratory ducks, geese and cranes. The most common large mammals in the vicinity of Cannon AFB include pronghorn and coyotes. Both mule and whitetail deer can be found in the area. Small mammals in the area include the black-tailed prairie dog (*Cynomys ludovicianus*), black-tailed jackrabbits (*Lopus californicus*), desert cottontails (*Syluilagus audobornii*) and several species of rodents. A more complete list of bird and mammal species occurring in the vicinity of Cannon AFB is found in Tables 1-2 through 1-4.

There are no known federal threatened or endangered plant or animal species occurring on Cannon AFB (CH2M Hill 1983, USFWS 1987, and USAF 1990). The swift fox (*Vulpes velox*), long-billed curlew (*Numenius americanus*), western snowy plover (*Charadrius alexandrinus nivosis*), ferruginous hawk (*Bueto regalis*), and Texas horned lizard (*Phrynosoma cornutum*), all Category 2 candidate species, may be found in Curry County. Category 2 candidate species are those for which the U.S. Fish and Wildlife Service has information indicating that proposing to list is possibly appropriate, but for which substantial data on biological vulnerability or threats are not currently known to support the immediate preparation of such rules (USFWS 1992).

Federally listed threatened or endangered species occurring within a 50 mile radius of Cannon AFB include the bald eagle (*Haliaeetus leucocephalus*) and the peregrine falcon (*Falco peregrinus*). Bald eagles have been observed in flight over the Melrose Bombing range, approximately 25 miles west of Cannon AFB, but no suitable nesting or roosting sites are found on the base or the immediate surrounding area. The black-footed ferret (*Mustela nigripes*) is a federal endangered species listed as occurring in the area, but is probably extinct in this former range.

The only state-endangered species known to occur in Curry County is the Bairds sparrow (*Ammodramus bairdii*). The Mississippi kite (*Ictinia mississippiensis*) is no longer considered endangered in New Mexico and has been delisted (NMDG&F 1992). The

Bairds sparrow (*Ammodramus bairdii*) occurs mainly during autumn migration in the eastern plains and southern lowlands. Migrants appear as early as the first week of August and move further south by November (USAF 1990). The tall-plains spurge (*Euphorbia strictor*) is a state sensitive plant species which is potentially found in sandy areas and sandy roadsides in the area (NMNHP 1992).

### 1.4.4 Previous Investigations

Prior to this RI at Cannon AFB, past investigations had been performed for the majority of the SWMUs currently being investigated. These previous investigations were conducted under both the USAF IRP program and in relation to Cannon AFB's RCRA permit. The following is a brief description of the previous investigations which have been conducted at Cannon AFB. Additional information on previous investigations at the specific SWMUs investigated by this RI is contained in Sections 2.0 through 14.0 of this RI report.

In 1982-1983, CH2M Hill conducted a records search in support of the USAF IRP program for Cannon AFB. The records search was conducted as Phase I of the IRP for Cannon AFB. This project included a detailed review of pertinent installation records, contact with government agencies, and a site visit. The purpose of this project was to identify and fully evaluate suspected problems associated with past hazardous material disposal sites, control the migration of hazardous contamination from such sites, and control hazards to health and welfare that may have resulted from these past operations. Results of this records search identified several sites on Cannon AFB which warranted further investigation (CH2M Hill 1983).

Based on the Records Search, Radian Corporation conducted a hydrogeological investigation of 16 sites on Cannon AFB to determine if environmental contamination resulted from past waste disposal and materials handling operations. This investigation was part of IRP Phase II of the IRP for Cannon AFB. The sites investigated during this 1984-1985 program included several landfills, fire training areas, fuel handling and spill areas. Results of this investigation documented the presence of oil and grease in the upper soil zone at several sites. Metals analyses indicated that metals were generally at

background levels except for barium and selenium at several sites (Radian 1986). No groundwater contamination was found as a result of this investigation.

As a result of the investigation performed by Radian in 1984-1985, a follow up investigation was performed by Radian at the AGE Drainage Ditch - Site 15, (SWMU 34/IRP No. SD-11) (Figure 1-2). This investigation was conducted to determine whether toxic soils existed and if so, to assist Cannon AFB personnel in disposing the soils in a proper manner in compliance with applicable hazardous waste regulations. Results of this investigation indicated that the AGE Drainage Ditch contained visibly discolored but nonhazardous soils (as defined by 40 CFR 261, Subpart D) (Radian 1987). Recommendations for site restoration were provided to the USACE, Omaha District and Cannon AFB as a result of this investigation.

In 1987, A.T. Kearney, Inc. performed a Preliminary Review and Visual Site Inspection of Cannon AFB for the USEPA Region VI to identify and evaluate solid waste management units and other areas of concern. During that investigation, the potential for releases of hazardous wastes or constituents to the environment was assessed, and where appropriate, the need for further action was identified. That investigation identified 128 SWMUs and 51 other areas of concern (Kearney 1987).

Walk, Haydel & Associates conducted a remedial investigation at four sites (Underground Storage Tank Runoff Area at Fire Department Training Area No. 4, Engine Test Cell Overflow Pit and Leach Field, South Stormwater Collection Point, and Northeast Stormwater Collection Point) at Cannon AFB in 1987. The sites investigated during that investigation were selected for additional investigation based on the results of IRP Phase I and Phase II investigations. Results of that investigation suggested that no adverse impact to public health or the environment is expected based on conditions at each of the four sites (Walk, Haydel & Associates 1990).

In 1988, an Environmental Assessment and Remedial Action Plan was prepared for the Old Entomology Rinse Area - Site 17 (SWMU 78/IRP No. SD-17) (Figure 1-2) by Walk, Haydel & Associates. Their investigation was prompted by findings during the hydrogeologic investigation conducted previously by Radian Corporation. Results of that Environmental Assessment suggested that the site does not pose a significant impact to

the environment and that no remedial action should be required at the Old Entomology Rinse Area (Walk, Haydel & Associates 1988).

## 1.5 FIELD INVESTIGATION OBJECTIVES AND METHODS

### 1.5.1 Field Investigation Objectives

The approach for investigating the 18 SWMUs at Cannon AFB was to review the results of past IRP investigations, identify data needs, and then formulate a sampling plan to collect the necessary data for each SWMU. In general, the SWMU-specific sampling programs were designed to:

- Supplement previous investigations
- Sample all potentially affected media specific to each SWMU
- Collect samples in a safe, efficient, and quality-controlled manner
- Make data collection activities comparable to, and compatible with, previous site data collection activities
- Collect enough acceptable data (i.e., perform the necessary analyses on a sufficient number of samples collected at appropriate locations and/or intervals) to:
    - evaluate the nature and extent of the contamination, if present
    - support the selection of remedial alternatives and remedial design, if necessary
    - identify properties that control contaminant migration
    - perform a baseline risk assessment to determine if the area poses a risk to human health or the environment according to USEPA policy

The rationale for sampling locations, number of samples and analytical parameters was presented in the Field Sampling Plan (FSP), Remedial Investigation, Cannon AFB (WCC 1991c). The FSP was a compilation of the procedures and protocols for conducting the field investigation at Cannon AFB.

Sample locations, frequencies, and analyses were selected for the following purposes:

- Fill in data gaps and/or reconfirm the results from previous investigations
- Evaluate the presence of hazardous waste constituents
- Further characterize the nature and extent of hazardous waste constituents

If contamination was detected or suspected in soil samples collected at the targeted bottom of any soil boring, additional soil sampling was conducted below this depth in either the same boring, or in a boring drilled adjacent (approximately 2 to 5 feet away) to the original boring. Additional soil samples collected were analyzed for the same chemical parameters as the original boring.

### 1.5.2 Field Investigation Methods

This section provides a discussion of the investigation methods (i.e. sampling equipment and procedures, sample designation, and sample handling, documentation, and analysis) used during field activities conducted at Cannon AFB from October 8 through December 20, 1991. The activities at Cannon, as outlined in the Field Sampling Plan (FSP), consisted of drilling 79 soil borings, collecting 41 surface soil, 144 subsurface soil, 8 sludge, 3 surface water, and 10 groundwater samples for chemical analysis, collecting 10 surface soil and 88 subsurface soil samples for geotechnical gradation analysis, and performing 443 geotechnical standard penetration tests (SPT). In addition to this original scope of work, 3 soil borings were drilled deeper than the original target depth and 3 additional soil borings were drilled to further characterize the vertical extent of possible contamination. A total of 17 additional subsurface soil samples were collected for chemical analysis, along with 19 SPTs.

Due to unforeseen capacity problems at the laboratory, holding times principally were missed for volatile organic analysis for samples collected during the field program. In

order to maintain the integrity of the data collected during this investigation, 16 soil borings had to be redrilled for the purpose of re-collecting 16 surface soil, 51 subsurface soil, 7 sludge, 1 surface water, and 1 groundwater sample. Sixty-eight additional SPTs were also collected. The re-drilled soil borings were located approximately 2 to 5 feet away from the original boring. The borings drilled for resampling purposes were sampled at the same intervals as the original borings, with each sample being screened in the field with an organic vapor analyzer (OVA). The surface soil, sludge, and surface water resamples were collected as close to the original sample location as possible. A cross-reference summary list of all of the analytical samples collected during the resampling phase of this field program in given in Table 1-5. A summary of all the analytical and geotechnical analyses performed on samples collected for each SWMU at Cannon is presented in Table 1-6.

In accordance with the QAPP (WCC 1991b), QA/QC samples [field duplicates, ambient blanks, rinsate blanks, trip blanks, matrix spike/matrix spike duplicates (MS/MSD), decontamination water blanks, and USACE (Missouri River Division Laboratory, MRD) and EPA duplicates] were also collected and submitted to the analytical laboratory to provide a means to assess the quality of the data from the field sampling program. A total of 20 field duplicate, 17 ambient blank, 18 rinsate blank, 5 trip blank, 25 MS/MSD, 11 decontamination water, 26 USACE duplicate, and 9 EPA duplicate samples were collected during the original scope of work activities. During the resampling phase of the field program, a total of 14 field duplicate, 9 ambient blank, 10 rinsate blank, 1 trip blank, 15 MS/MSD, 9 decontamination water, and 6 USACE duplicate samples were collected. Table 1-7 summarizes the QA/QC sampling program conducted at each of the SWMUs at Cannon AFB.

#### 1.5.2.1 Sample Equipment and Procedures

The specific procedures for sample collection of the various media (i.e., surface soil, subsurface soil, sludge, surface water, and groundwater) are described in the Standard Operating Procedures (SOPs), which are contained in Appendix A of the QAPP (WCC 1991b).

Before each sampling event, the field manager met with the assigned sampling personnel and reviewed the purpose and objectives of the event. This meeting provided clarification of the sampling event specifics. Topics of discussion and review included:

- Sampling locations, equipment, and requirements
- Number and types of samples
- Sample identification
- Preservation requirements
- Analytical parameters
- Equipment decontamination procedures
- Chain-of-Custody requirements

Surface Soil Analytical and Geotechnical Sample Collection

A WCC geologist or hydrogeologist collected the surface soil samples. All surface soil samples were collected in accordance with QAPP, SOP No. 6 - Surface Soil Sampling (WCC 1991b). A stainless steel hand trowel was used to remove soil from a targeted location to a depth of approximately 0.5 feet below the ground surface (BGS). The volatile organic samples were removed first with as little disturbance as possible, and each sample was screened in the field with an OVA for the presence of any volatile organic vapors. The remaining soil collected was placed in a clean stainless steel bowl and mixed thoroughly with a stainless steel spoon. It was then divided among the sample containers to be filled and placed in a cooler with ice. QA/QC and/or gradation analysis sample containers were also filled from the same mixture.

Subsurface Soil Analytical and Geotechnical Sample Collection

A WCC geologist or hydrogeologist supervised the drilling operations, logged the borings, and collected the surface and subsurface soil samples. All soil borings were drilled, sampled, lithologically logged, and grouted in accordance with QAPP, SOPs No. 7 - Subsurface Drilling and Sampling, No. 8 - Lithologic Descriptions of Subsurface Samples, and No. 9 - Borehole Abandonment (WCC 1991b). Environmental Drilling Company of Tulsa, Oklahoma drilled all soil borings with a truck-mounted auger rig using hollow-stem augers. During the course of the field investigation, five different

auger rigs (a Mobile B-53, two Mobile B-61s, a Failing F-10, and a CME-75) were utilized to complete the drilling phase of the program. Field boring logs which contain the following information were completed for every soil boring drilled as part of the investigation:

- Boring number, location, and elevation
- Drilling agency, equipment, method and driller's name
- Geologist's name and reviewer's name
- Date started and finished
- Completion depth
- Type of samplers used
- Number and depths of analytical and geotechnical samples
- Number of blows per 6 inches, and sample recoveries
- Sample identification numbers and QA/QC samples
- Observations of any contamination or odors
- OVA readings for breathing zone, augers and samples
- Lithologic descriptions and USCS classifications
- Borehole abandonment information
- Downhole water conditions while drilling

All field soil boring logs are contained in Appendix B-1.

A 3-inch outer diameter (OD) stainless steel split spoon sampler was driven 18 to 24 inches below the top of a targeted interval with a 130-pound hammer falling 30 inches. Upon retrieval of the split spoon sampler, the sample was opened slightly and an OVA was used to screen the entire sample for the presence of any volatile organic vapors. If there was a "hit" on the OVA, the volatile organic sample was collected from that interval, otherwise it was collected from the tip, or bottom, of the sampler. The sample was extracted, peeled, and bottled in as short a time as possible. "Peeling" is a process whereby that portion of the sample which was in direct contact with the sampler, as well as the ends of the sample, are removed and discarded. Samples for volatile organic analysis were peeled, bottled, and capped as quickly as possible after the sampler was opened. The remaining soil was placed in a clean stainless steel bowl and mixed thoroughly with a stainless steel spoon. It was then divided among the sample containers

to be filled and placed in a cooler with ice. QA/QC and/or gradation analysis sample containers were also filled from the same mixture.

All SPTs were performed in accordance with ASTM D-1586, while all gradation analyses were performed by Western Laboratories, Torrance, California in accordance with ASTM D-421 and D-422. A steel 2-inch OD or stainless steel 3-inch OD split spoon sampler was driven 18 to 24 inches below the top of a targeted interval with a 130-pound hammer falling 30 inches. The number of hammer blows per 6 inches was recorded. Upon retrieval of the split spoon sampler, the sample was placed into 16-ounce glass jars if gradation analyses were to be performed on the sample.

Sludge Sample Collection

A WCC scientist or geologist collected the sludge samples in accordance with QAPP, SOP No. 5 - Sludge Sampling (WCC 1991b). A motor boat was used to reach the sample locations. A stainless steel Ponar dredge was lowered to the bottom of the lagoon. The closure mechanism was then triggered to collect a sample. The dredge was carefully lifted out of the sludge and brought to the surface. The volatile organic samples were removed first with as little disturbance as possible. The dredge had to be lowered to the bottom of the lagoon several times to obtain a sufficient amount of sample. All of the sludge collected was placed in a clean stainless steel bowl and mixed thoroughly with a stainless steel spoon. It was then divided among the sample containers to be filled and placed in a cooler with ice. QA/QC sample containers were also filled from the same mixture.

Surface Water Sample Collection

A WCC scientist collected the surface water samples in accordance with QAPP, SOP No. 10 - Surface Water Sampling (WCC 1991b). A motor boat was used to reach the sample locations. A sample collection bottle (i.e., clear 40-ml glass, amber 1-liter glass, 250- and 500-ml poly) was lowered to approximately 0.5 feet below the water surface, making sure the top of the bottle was covered until the target sample depth was reached. The bottle was then uncovered and a surface water sample was collected. Once the

bottle was filled, the top was covered again and the sample was brought to the surface and placed in the appropriate sample containers.

Groundwater Sample Collection

A WCC hydrogeologist collected the groundwater samples in accordance with QAPP, SOPs No. 2 - Water Level Measurement, No. 3 - Monitoring Well Sampling Using A Bailer, and No. 4 - Monitoring Well Sampling Using A Dedicated Submersible Pump (WCC 1991b). Prior to sample collection, the wells were evacuated using either a dedicated submersible pump or a PVC hand bailer attached to a tripod. After evacuation, a sample was obtained by either transferring water directly from a nylon/ rubber hose attached to the valve at the well head, or from the bottom of a teflon bailer that had been lowered to the screened interval in the well. Sample bottles were filled with as little aeration as possible in the following order: volatile organics, semivolatile organics, pesticides/polychlorinated biphenyls, herbicides, cyanide, sulfide, total metals, and dissolved metals, which was obtained from the filtering unit after it had been filtered.

All surface soil, subsurface soil boring, sludge, surface water, and groundwater (monitoring well) sample locations were surveyed by Lydick Engineers, of Clovis, New Mexico. A copy of the surveyed locations is contained in Appendix B-2.

The WCC field manager was responsible for ensuring that samples were collected with properly decontaminated equipment. All metal and plastic sampling equipment was decontaminated between sampling events, while the rig, augers, and any other downhole equipment was decontaminated between borings in accordance with QAPP, SOP No. 1 - Equipment Decontamination (WCC 1991b). The decontamination procedures outlined in the SOP are consistent with the most recent EPA guidelines. The procedure for decontaminating metal, PVC, or Teflon sampling equipment consisted of a high pressure steam cleaning, followed by an Alconox wash, a potable water rinse, an isopropanol (methanol for PVC or Teflon equipment) rinse, a hydrochloric (nitric for PVC or Teflon equipment) rinse, and a double deionized water rinse.

### 1.5.2.2 Sample Designation

The sample designation system for all field (analytical and geotechnical) and QA/QC samples was 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) identify the specific sampled location. At Cannon AFB these included surface soil location numbers, subsurface soil boring location numbers, sludge location numbers, surface water location numbers, or groundwater monitoring well location numbers. All sample location numbers were SWMU specific with the first three numbers corresponding to the SWMU number while the fourth number or letter corresponded to the specific soil boring, surface soil, monitoring well, or lagoon location. However, at four SWMUs, Fire Department Training Area No. 1 (SWMU No. 78), Solvent Disposal Site (SWMU No. 81), Engine Test Cell Area (SWMU No. 86), and the Sanitary Sewer Line (SWMU No. 98), there were more than 9 subsurface soil boring and/or surface soil sample locations, so the first two numbers identified the SWMU and the second 2 numbers identified the subsurface soil boring or surface soil sample locations. The last four digits (ZZZZ) were the sample identifier. The first number corresponds to the type of sample collected, specifically, (i.e., 0 for surface or subsurface soil analytical samples, 2 for groundwater analytical samples, 3 for surface water analytical samples, 4 for surface or subsurface soil geotechnical samples, and 5 for sludge analytical samples). 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#34   |
CAN  034  -  0341  -  0000
|    |       |        |
Cannon  SWMU#   Boring #1   Approximate Depth of top of Sample in Feet-BGS
AFB     34
```

During the field investigation, multiple soil samples were often collected from the same borehole as were multiple water samples from the same monitoring well, or lagoon. The last three digits helped to differentiate between these multiple samples. The surface and subsurface soil sample identifier represented the approximate beginning depth at which

the sample was collected. Sludge and surface water samples from a given lagoon were numbered sequentially, as were groundwater samples from a given monitoring well.

All QA/QC samples were 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) identifier. The first two numbers of the QA/QC sample identifier corresponded to a particular SWMU:

- 01 - SWMU No. 34
- 02 - SWMU No. 86
- 03 - SWMU No. 95
- 04 - SWMU No. 101
- 05 - SWMU No. 113
- 06 - SWMU No. 96
- 07 - SWMU No. 76
- 08 - SWMU No. 78
- 09 - SWMU No. 81
- 10 - SWMU No. 106
- 11 - SWMU No. 107
- 12 - SWMU No. 109
- 13 - SWMU No. 98

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

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

The last number corresponded to the sequential number of the particular QA/QC sample type. The only QA/QC sample type which was not identified as above is the Matrix Spike/Matrix Spike Duplicate sample type. These samples were not discrete samples but rather a previously collected analytical sample which was first analyzed and then spiked by the laboratory and reanalyzed. The samples that were chosen for MS/MSD analyses were labeled in the field as MS/MSD samples and were noted as such on the Chain-of-Custody forms. The following is an example of an identification number for a QA/QC Sample:

```
                    SWMU#34     SWMU #34
                       |           |  First Field Duplicate Sample
                       |           |  |
CAN   034   - 0341   - 0161
 |     |       |       |
Cannon SWMU#   Boring #1  Field Duplicate
 AFB   34
```

### 1.5.2.3 Sample Handling, Documentation, and Analysis

All labeling, preservation, handling, shipping, documentation, and tracking for the samples collected at Cannon AFB were performed in accordance with QAPP, SOP No. 12 - Sample Handling, Documentation, and Analysis (WCC 1991b).

All sample labels were filled out with waterproof ink and numbered. Soil, sludge and water sample labels, as well as all sample containers, were supplied by the analytical laboratory. Analytical sample containers were placed in recloseable plastic storage bags and wrapped in protective packing material (i.e., foam liners, bubble packing, styrofoam peanuts). Samples were then placed in trash bags inside a cooler with ice (double bagged using plastic trash bags) for overnight express carrier shipment to the Rocky Mountain Analytical Laboratory, ENSECO, Arvada, Colorado. A completed and signed Chain-of-Custody was placed in each cooler being shipped. A numbered custody seal was placed on the outside lid of each cooler and the coolers were taped shut.

The soil and sludge samples were analyzed for various analytical parameters under the Contract Lab Program (CLP) methods, including Target Compound List Volatile Organic Compounds (TCL VOC), semi-volatile organic compounds (semi-VOC), Target Analyte List (TAL) metals, polychlorinated biphenyls (PCB)/pesticides, benzene, toluene, ethyl benzene, xylene (BTEX), and lead/chromium, as well as SW-846 methods, including total petroleum hydrocarbons (TPH), total organic carbon (TOC), and organic lead (tetraethyl lead). The surface water and groundwater samples were analyzed for Appendix IX constituents listed in 40 CFR 264. These analyses were specified on the Chain-of-Custody.

Geotechnical gradation analysis sample containers were placed in protective packing material (i.e., foam liners, bubble packing, styrofoam peanuts). Samples were then

placed in trash bags inside a cooler for express carrier shipment to Western Laboratories, Torrance, California. A completed and signed Chain-of-Custody was placed in each cooler being shipped. A numbered custody seal was placed on the outside lid of each cooler and the coolers were taped shut.

Gradation (ASTM D-421) and hydrometer (ASTM D-422) analyses were performed on the surface and subsurface soil samples by Western Laboratories of Torrance, California, to determine the particle size distribution of the soil sample. The distribution of particle larger than 0.074 millimeters (i.e. retained on the No. 200 sieve) was determined by sieving, while the distribution of particles smaller than 0.074 millimeters was determined by hydrometer analysis.

Documentation of observations and data acquired in the field provided information on the acquisition of samples and also provided a permanent record of field activities. The observations and data were recorded with waterproof ink in a permanently bound weatherproof field book with consecutively numbered pages. In addition, all pertinent sampling information for every sample collected was recorded on field sampling data sheets. The data sheets for all surface soil, sludge, surface water, and groundwater samples are contained in Appendix B-3. The data sheets for all subsurface soil samples are not included in this appendix because all of the information on the data sheets is also on the field boring logs, which are contained in Appendix B-1. The field sampling data sheets for the subsurface samples are on file in the WCC Denver, Colorado office.

To supplement the information recorded in the field book and field sampling data sheets, A-E daily quality control reports (DQCRs) were also completed for each drill rig and/or sampling crew, in accordance with the USACE SOS. The DQCRs are on file in the WCC Denver, Colorado office.

In addition to the targeted analytical samples collected during the program, field QA/QC samples, including field duplicates, ambient blanks, rinsate blanks, trip blanks, matrix spike/matrix spike duplicates, and decontamination water blanks were collected and submitted to the Rocky Mountain Analytical Laboratory to provide a means of assessing the quality of the data from the field sampling program. The types and frequency of QA/QC samples are presented in the QAPP for the Cannon AFB RI

(WCC 1991b). Field duplicate samples were collected at a minimum frequency of 1 per 10 environmental samples for each media (i.e. surface soil, subsurface soil, sludge, surface water, and groundwater) and analyzed to check for sampling and laboratory reproducibility. Ambient blank samples were collected at a minimum frequency of 1 per SWMU and were analyzed to monitor the potential for volatile organic contamination associated with the site. Rinsate blank samples were collected at a minimum frequency of 1 per SWMU and were analyzed to measure the effectiveness of decontamination procedures and to monitor potential equipment cross-contamination associated with sample collection. Trip blank samples were submitted to the laboratory for volatile organic analysis at a frequency of 1 per SWMU when water samples were collected for volatile organic analysis. Trip blank samples accompanied every cooler containing water samples, however, the directive to the laboratory stated that volatile organic analysis was to be performed on the trip blank accompanying aqueous QA/QC samples only if there was breakage of any sample container. All trip blanks for aqueous field samples were analyzed by the laboratory.

Matrix spike/matrix spike duplicates were collected at a frequency of 1 per 20 environmental samples for each media and analyzed to evaluate the precision and bias of a method in a given sample matrix. Decontamination water blank samples were collected at a frequency of 1 per SWMU and analyzed for volatile organics, except at two SWMUs (Engine Test Cell, SWMU No. 86 and Sludge Weathering Pit, SWMU No. 76) where they were analyzed for the full suit of analytical parameters to evaluate the quality of the potable water obtained during the course of the field work at two different supply locations (the wastewater lagoons and the contractor's area) at the base. All QA/QC samples, except for MS/MSDs, were submitted blind to the laboratory.

In addition to the QA/QC samples described above, duplicate field samples were collected at a frequency of 1 per 10 environmental samples and submitted to the USACE QA laboratory (Missouri River Division Lab) in Omaha, Nebraska and analyzed to aid in evaluating interlaboratory precision as well as consistency of field techniques. PRC Consultants (representatives of the EPA) also collected duplicate subsurface soil and groundwater samples at three SWMUs (Fire Department Training Area No. 1, Wastewater Lagoons, and Landfill No. 5).

## TABLE 1-1

## COMPARISON OF CERCLA AND RCRA PROCESS

| CERCLA Process | RCRA Process |
|---|---|
| Preliminary Assessment/ Site Investigation | RCRA Facility Assessment (Agency-conducted) |
| Hazard Ranking Scoring | N/A |
| National Priorities List | N/A |
| Remedial Investigation | RCRA Facility Investigation |
| Feasibility Study | Corrective Measures Study |
| Record of Decision | Statement of Basis/ Response to Comments |
| Remedial Design/Remedial Action | Corrective Measures Implementation |
| NPL Deletion | N/A |

## TABLE 1-4

## SONG BIRDS IN THE VICINITY OF CANNON AFB

| | |
|---|---|
| American Goldfinch (*Arduelis tristis*) | Loggerhead Shrike (*Lanius ludovicianus*) |
| Barn Swallow (*Hirundo rustica*) | Mac Gallivray's Warbler (*Oporornis tolmiei*) |
| Black-chinned Hummingbird (*Archilochus alexandri*) | Mockingbird (Northern) (*Mimus polyglottos*) |
| Black-throated Gray Warbler (*Dendroica nigrescens*) | Mountain Chickadee (*Parus gambeli*) |
| Brown-headed Cowbird (*Molothrus ater*) | Slate-colored Junco (*Junco hyemalis*) |
| Brown Thrasher (*Toxostoma rufum*) | Red-headed Woodpecker (*Melanerpes erythrocephalus*) |
| Blue Grosbeak (*Guiraca caerulea*) | Northern Flicker (*Colaptes auratus*) |
| Northern Oriole (*Icterus galbula*) | Roadrunner (Greater) (*Geococoyx californianus*) |
| Chipping Sparrow (*Spizella passerina*) | Ruby-crowned Kinglet (*Regulus calendula*) |
| Common Nighthawk (*Chordeiles minor*) | Sage Sparrow (*Amphispiza belli*) |
| Rock Dove (*Columbia livia*) | Savannah Sparrow (*Passerculus sandwichensis*) |
| Eastern Meadowlark (*Sturnella magna*) | Scissor-tailed Flycatcher (*Tyrannus forficatus*) |
| English House Sparrow (*Passer domesticus*) | Song Sparrow (*Melospiza melodia*) |
| Evening Grosbeck (*Coccothraustes vespertinus*) | Summer Tanager (*Piranga rubra*) |
| Hermit Thrush (*Catharus guttatus*) | Tree Sparrow (*Spizella arborea*) |
| Horned Lark (*Eremophila alpestris*) | Western Kingbird (*Tyrannus verticalis*) |
| House Finch (*Carpodacus mexicanus*) | Western Meadowlark (*Sturnella neglecta*) |

**TABLE 1-4**
**(Concluded)**

**SONG BIRDS IN THE VICINITY OF CANNON AFB**

| | |
|---|---|
| Killdeer (*Charadrius vociferus*) | Western Wood Pewee (*Contopus sordidulus*) |
| Ladder-back Woodpecker (*Picoides scalaris*) | White-crowned Sparrow (*Zonotrichia levcophrys*) |
| Lark Bunting (*Calamospiza melancorys*) | White-necked Raven (*Corvus cryptoleucus*) |
| Lark Sparrow (*Chondestes grammacus*) | Wilson's Warbler (*Wilsonia pusilla*) |

Source: NMDGF. 1985.

TABLE 1-5

CROSS-REFERENCE SUMMARY FOR ALL SURFACE SOIL, SUBSURFACE SOIL, SLUDGE, SURFACE WATER, GROUNDWATER, AND QA/QC SAMPLES COLLECTED BY WCC DURING THE RESAMPLING PHASE OF THE FIELD PROGRAM AT CANNON AFB, NEW MEXICO

| ORIGINAL BORING NUMBER | ORIGINAL SAMPLE IDENTIFICATION NUMBER | NEW REDRILL BORING NUMBER | NEW RESAMPLE IDENTIFICATION NUMBER | QA/QC SAMPLES COLLECTED ALONG WITH THE RESAMPLES * | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | MS/MSD | FD | MRD | AB | RB | DW | TB |
| 0341 | CAN034-0341-0000 | 0344 | CAN034-0344-0000 | -0000 MS/MSD | | | | | | |
| 0342 | CAN034-0342-0009 | 0343 | CAN034-0343-0008 | | | | -0152 | -0171 | -0181 | |
| 0781 | CAN078-0781-0000 | 0787 | CAN078-0787-0000 | -0000 MS/MSD | | | -0857 | | -0887 | |
| 0782 | CAN078-0782-0000 | 0788 | CAN078-0788-0000 | | | -0807 | | | | |
| | CAN078-0782-0004 | | CAN078-0788-0004 | | | | | | | |
| | CAN078-0782-0010 | | CAN078-0788-0010 | | -0863 | -0808 | | -0878 | | |
| | CAN078-0782-0020 | | CAN078-0788-0020 | | | | | | | |
| | CAN078-0782-0030 | | CAN078-0788-0030 | | | | | | | |
| | CAN078-0782-0040 | | CAN078-0788-0040 | -0040 MS/MSD | | | | | | |
| | CAN078-0782-0050 | | CAN078-0788-0050 | | | | | | | |
| | CAN078-0782-0060 | | CAN078-0788-0060 | | | | | | | |
| | CAN078-0782-0075 | | CAN078-0788-0075 | | | | | | | |
| | CAN078-0782-0100 | | CAN078-0788-0100 | | | | | | | |
| 0783 | CAN078-0783-0000 | 0789 | CAN078-0789-0000 | | | | | | | |
| 0784 | CAN078-0784-0000 | 7810 | CAN078-7810-0000 | | -0864 | | | | | |
| 0785 | CAN078-0785-0000 | 7811 | CAN078-7811-0000 | | | | | | | |
| 0786 | CAN078-0786-0000 | 7812 | CAN078-7812-0000 | | | | | | | |
| 8106 | CAN081-8106-0000 | 8114 | CAN081-8114-0000 | -0000 MS/MSD | | | -0952 | | -0982 | |
| 8107 | CAN081-8107-0004 | 8113 | CAN081-8113-0004 | -0004 MS/MSD | | | | -0972 | | |
| 0861 | CAN086-0861-0000 | 0867 | CAN086-0867-0000 | | -0268 | | | | | |
| | CAN086-0861-0008 | | CAN086-0867-0008 | | | | | | | |
| 0862 | CAN086-0862-0000 | 0868 | CAN086-0868-0000 | | | -0203 | -0252 | | | |
| | CAN086-0862-0002 | | CAN086-0868-0002 | -0002 MS/MSD | | | | | | |
| | CAN086-0862-0004 | | CAN086-0868-0004 | | -0267 | | | | | |
| 0863 | CAN086-0863-0000 | 0869 | CAN086-0869-0000 | | | | | | | |
| | CAN086-0863-0002 | | CAN086-0869-0002 | | | | | | | |
| | CAN086-0863-0004 | | CAN086-0869-0004 | | | -0204 | | | | |
| | CAN086-0863-0008 | | CAN086-0869-0008 | | -0265 | | | -0272 | -0282 | |
| 0864 | CAN086-0864-0000 | 8610 | CAN086-8610-0000 | -0000 MS/MSD | -0266 | | | | | |
| | CAN086-0864-0002 | | CAN086-8610-0002 | | | | | | | |
| | CAN086-0864-0004 | | CAN086-8610-0004 | | | | | | | |
| 0951 | CAN095-0951-0000 | 0953 | CAN095-0953-0000 | -0000 MS/MSD | | | -0353 | | | |
| | CAN095-0951-0002 | | CAN095-0953-0002 | | | -0302 | | | | |
| | CAN095-0951-0004 | | CAN095-0953-0004 | | | | | | | |
| | CAN095-0951-0008 | | CAN095-0953-0008 | | | | | | | |
| 0952 | CAN095-0952-0002 | 0954 | CAN095-0954-0002 | -0002 MS/MSD | -0364 | | | | | |
| | CAN095-0952-0004 | | CAN095-0954-0004 | | | | | -0373 | | |
| | CAN095-0952-0008 | | CAN095-0954-0008 | | | | | | -0384 | |
| 101N | CAN101-101N-5001 | 101N | CAN101-101N-5009 | | | | | | | |
| | CAN101-101N-5002 | | CAN101-101N-5010 | -5010 MS/MSD | -0463 | | -0452 | -0473 | -0482 | |
| | CAN101-101N-5004 | | CAN101-101N-5011 | | | | | | | |
| 101S | CAN101-101S-5005 | 101S | CAN101-101S-5012 | | | | | | | |
| | CAN101-101S-5006 | | CAN101-101S-5013 | | | | | | | |
| | CAN101-101S-5007 | | CAN101-101S-5014 | | | | | | | |
| | CAN101-101S-5008 | | CAN101-101S-5015 | | | | | | | |
| | CAN101-101S-3001 | | CAN101-101S-3004 | | -0464 | | | | | -0493 |
| 1061 | CAN106-1061-0004 | 1065 | CAN106-1065-0004 | -0004 MS/MSD | | | | -1072 | | |
| 1063 | CAN106-1063-0004 | 1066 | CAN106-1066-0004 | | | | | | | |
| | CAN106-1063-0020 | | CAN106-1066-0020 | | | | -1052 | | | |
| | CAN106-1063-0030 | | CAN106-1066-0030 | | | | | | -1082 | |

TABLE 1-5

CROSS-REFERENCE SUMMARY FOR ALL SURFACE SOIL, SUBSURFACE SOIL, SLUDGE, SURFACE WATER, GROUNDWATER, AND QA/QC SAMPLES COLLECTED BY WCC DURING THE RESAMPLING PHASE OF THE FIELD PROGRAM AT CANNON AFB, NEW MEXICO

| ORIGINAL BORING NUMBER | ORIGINAL SAMPLE IDENTIFICATION NUMBER | NEW REDRILL BORING NUMBER | NEW RESAMPLE IDENTIFICATION NUMBER | QA/QC SAMPLES COLLECTED ALONG WITH THE RESAMPLES * | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | MS/MSD | FD | MRD | AB | RB | DW | TB |
| 1073 | CAN107-1073-0004 | 1076 | CAN107-1076-0004 | | | | | | | |
| | CAN107-1073-0030 | | CAN107-1076-0030 | | -1165 | | | | | |
| 1074 | CAN107-1074-0010 | 1075 | CAN107-1075-0010 | -0010 MS/MSD | | | | | | |
| | CAN107-1074-0010 | | CAN107-1075-0010 | | | | -1152 | -1172 | -1182 | |
| 1091 | CAN109-1091-0010 | 1095 | CAN109-1095-0010 | | | | | | | |
| | CAN109-1091-0020 | | CAN109-1095-0020 | -0020 MS/MSD | | | | | | |
| | CAN109-1091-0030 | | CAN109-1095-0030 | | -1265 | | | -1272 | | |
| | CAN109-1091-0040 | | CAN109-1095-0040 | | | | | | | |
| | CAN109-1091-0050 | | CAN109-1095-0050 | | | | | | -1282 | |
| | CAN109-1091-0060 | | CAN109-1095-0060 | | | | | | | |
| 1092 | CAN109-1092-0000 | 1096 | CAN109-1096-0000 | | -1267 | | | | | |
| | CAN109-1092-0004 | | CAN109-1096-0004 | | | | | | | |
| | CAN109-1092-0010 | | CAN109-1096-0010 | | | | | | | |
| | CAN109-1092-0020 | | CAN109-1096-0020 | | | | | | | |
| | CAN109-1092-0030 | | CAN109-1096-0030 | | | | | | | |
| | CAN109-1092-0040 | | CAN109-1096-0040 | | | | | | | |
| | CAN109-1092-0050 | | CAN109-1096-0050 | | | | | | | |
| | CAN109-1092-0060 | | CAN109-1096-0060 | | | | | | | |
| 1093 | CAN109-1093-0000 | 1097 | CAN109-1097-0000 | | | | | | | |
| | CAN109-1093-0004 | | CAN109-1097-0004 | | | | -1252 | | | |
| | CAN109-1093-0010 | | CAN109-1097-0010 | | -1266 | | | | | |
| | CAN109-1093-0020 | | CAN109-1097-0020 | | | | | | | |
| | CAN109-1093-0040 | | CAN109-1097-0040 | | | | | | | |
| | CAN109-1093-0080 | | CAN109-1097-0080 | | | | | | | |
| 1094 | CAN109-1094-0000 | 1098 | CAN109-1098-0000 | -0000 MS/MSD | | -1201 | | -1273 | | |
| 113I | CAN113-113I-2001 | 113I | CAN113-113I-2002 | -2002 MS/MSD | -0562 | | | | | |

MS/MSD Matrix Spike / Matrix Spike Duplicate
FD Field Duplicate
MRD Missouri River Division Duplicate
AB Ambient Blank
RB Rinsate Blank
DW Decontamination Water Blank
TB Trip Blank

* The identification numbers listed below correspond to the last four digits of the 14 digit sample identification number. The first 10 digits of the QA/QC sample identification number are identical to the first 10 digits of the new sample identification number in the column to the left

# TABLE 1-6

## SUMMARY OF CHEMICAL AND GEOTECHNICAL ANALYSES PERFORMED ON SAMPLES COLLECTED AT CANNON AFB, NEW MEXICO

| SWMU Number | SWMU Name | Sample Matrix | Number of Soil Borings Drilled | Estimated Number of Analytical Samples | Actual Number of Analytical Samples Collected | Analytical Parameters | | | | | | | | | | Geotechnical Parameters | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | Number of Gradation Analyses | | Number of SPTs | |
| | | | | | | TCL VOCs | Semi vols | PCB/ Pest | Metals | TPH | BTEX | TOC | Organic Lead | Lead/ Chromium | Appendix IX | Estimated | Actual | Estimated | Actual |
| 34 | AGE Drainage Ditch | Soil (Subsurface) | 2(1) | 6 | 4(1) | 4(1) | 4 | | 4 | 4 | | | | | | 1 | 1 | 8 | 7(3) |
| | | Soil (Surface) | | 1 | 1(1) | 1(1) | 1 | | 1 | 1 | | | | | | 1 | 0 | | |
| 76 | Sludge Weathering Pit | Soil (Subsurface) | 4 | 9 | 9 | 9 | 9 | | 9 | | | | 9 | | | 3 | 3 | 20 | 43 |
| | | Soil (Surface) | | 2 | 2 | 2 | 2 | | 2 | | | | 2 | | | 1 | 1 | | |
| 78 | Fire Training Area No. 1 | Soil (Subsurface) | 2(1) | 18 | 21(9) | 18(6) | 18 | 18 | 18 | 18(6) | | 11 | | | | 5 | 5 | 44 | 54(9) |
| | | Soil (Surface) | | 6 | 6(6) | 6(4) | 6 | 6 | 6 | 6(5) | | | | | | 1 | 1 | | |
| 81 | Solvent Disposal | Soil (Subsurface) | 10(1)[2] | 10 | 10(1)[3] | 10(1)[3] | | | | | | | | | | 8 | 8[1] | 20 | 30(1) |
| | | Soil (Surface) | | 10 | 10(1) | 10(1) | | | | | | | | | | 2 | 2 | | |
| 86 | Engine Test Cell | Soil (Subsurface) | 5(4)[1] | 15 | 15(8)[4] | 15(8)[4] | | | 15[4] | | | | | | | 3 | 2 | 20 | 25(10)[5] |
| | | Soil (Surface) | | 5 | 5(4) | 5(4) | | | 5 | | | | | | | 2 | 2 | | |
| 95 | NE Stormwater Drainage | Soil (Subsurface) | 2(2) | 6 | 6(6) | 6(5) | 6 | | 6 | 6(3) | | | | | | 1 | 1 | 8 | 10(6) |
| | | Soil (Surface) | | 1 | 1(1) | 1(1) | 1(2) | | 1 | 1 | | | | | | 1 | 1 | | |
| 96 | Old Entomology Rinse | Soil (Surface) | | 1 | 1 | | | 1 | | | | | | | | 1 | 1 | | |
| | | Water (Groundwater) | | 1 | 1 | | | 1 | 1 | | | | | | | | | | |
| 98 | Sanitary Sewer Line | Soil (Subsurface) | 42 | 50 | 44 | 44 | | | 50 | 42 | | | | | | 44 | 44 | 200 | 88 |
| 101 | Wastewater Lagoons | Sludge[2] | | 8 | 8(7) | 8(7) | 8 | 8 | 8 | | | 2 | | | | 2 | 0 | | |
| | | Water (Surface) | | 3 | 3(1) | (1) | | | | | | | | | 3 | | | | |
| | | Water (Groundwater) | | 4 | 4 | | | | | | | | | | 4 | | | | |
| 106 | Fire Training Area No. 2 | Soil (Subsurface) | 4(2) | 16 | 16(4) | 16(4) | | | | 16 | | | | 16 | | 7 | 7 | 32 | 52(5) |
| | | Soil (Surface) | | 4 | 4 | | | | | 4 | 4 | | | 4 | | 1 | 1 | | |
| 107 | Fire Training Area No. 3 | Soil (Subsurface) | 4(2) | 16 | 16(4)[3] | 19(4) | | | | 19 | | | | 19 | | 7 | 7 | 32 | 53(11)[5] |
| | | Soil (Surface) | | 4 | 4 | | | | | 4 | 4 | | | 4 | | 1 | 0 | | |
| 109 | Fire Training Area No. 4 | Soil (Subsurface) | 4(3) | 28 | 28(18)[7] | 35(14) | | | | 35(2) | | 6(6) | | 35 | | 7 | 9 | 56 | 81(23)[9] |
| | | Soil (Surface) | | 4 | 4(3) | 4(2) | | | | 4(2) | | | | 4 | | 1 | 1 | | |
| 113 | Landfill No. 5 | Water (Groundwater) | | 7 | 5(1) | (1) | | | | | | | | | 5 | | | | |
| OFS | Offsite Background Sites | Soil (Surface) | | 3 | 3 | | | 3 | 3 | | | | | | | | | | |

[1] The number in parenthesis corresponds to the number of redrills and resamples collected due to laboratory missed holding times on the original sample. The number in brackets corresponds to the number of redrills and resamples collected to determine the depth of contamination.
[2] TCLP was run on two sludge samples.

# TABLE 1-7

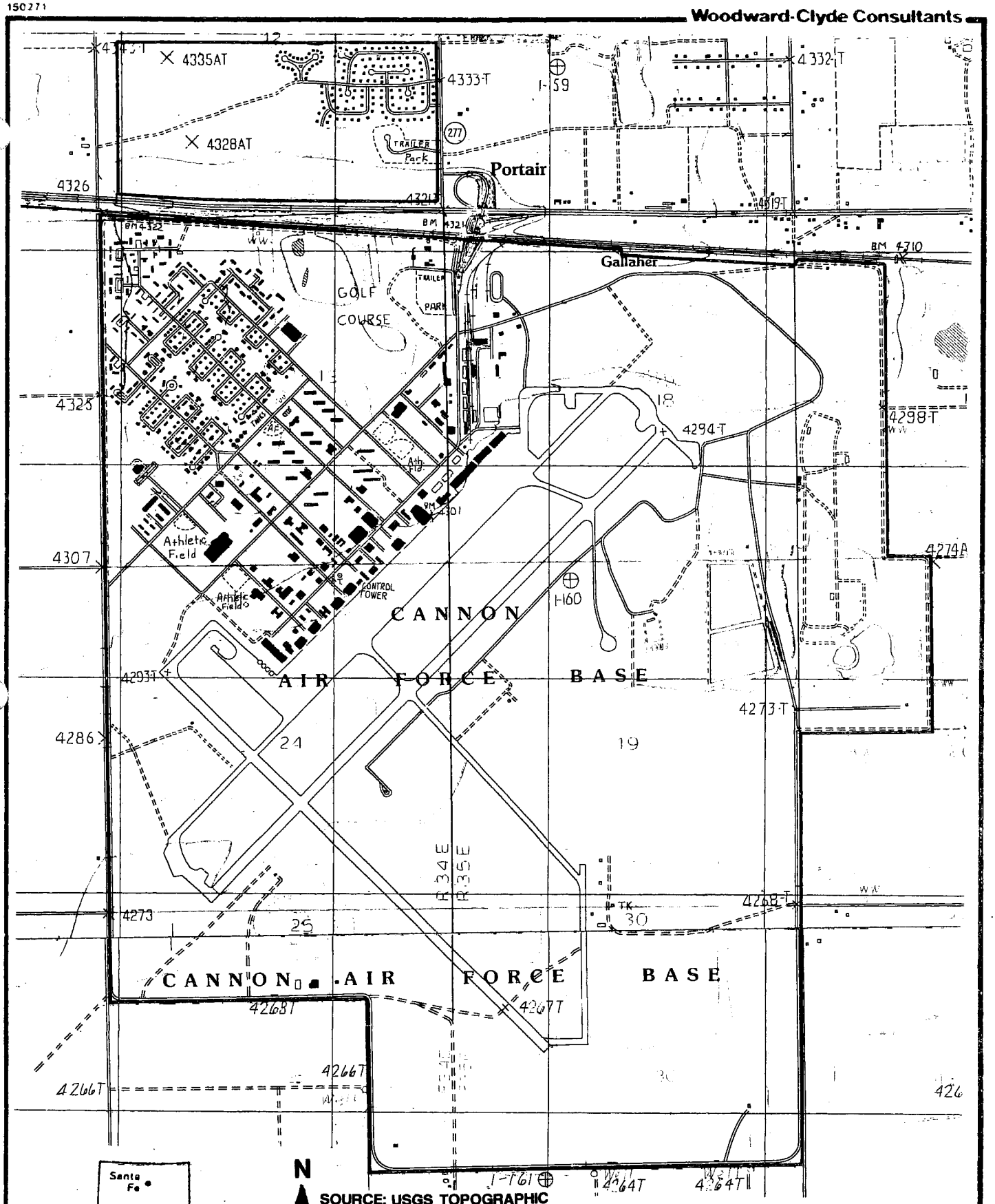
## SUMMARY OF ALL ANALYTICAL AND QA/QC SAMPLES COLLECTED AT CANNON AFB, NEW MEXICO

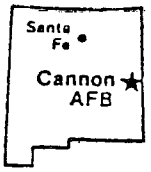
| SWMU Number | SWMU Name | Sample Matrix | Number of Soil Borings Drilled | Estimated Number of Analytical Samples | Actual Number of Analytical Samples Collected | Number of QA/QC Samples Collected | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Field Duplicates | | Ambient Blanks | | Rinsate Blanks | | Trip Blanks | | Matrix Spike/Dups | | Decon Water Blanks | | MRD Duplicates | | EPA Duplicates | |
| | | | | | | Esti-mated | Actual | Esti-mated | Actual | Esti-mated | Actual | Esti-mated | Actual | Esti-mated | Actual | Esti-mated | Actual | Esti-mated | Actual | Esti-mated | Actual |
| 34 | AGE Drainage Ditch | Soil (Subsurface) | 2(1) | 6 | 4(1) | 1 | 1 | 1 | 1(1) | 1 | 2(1) | | | 1 | 1 | 1 | 1(1) | 1 | 1 | | |
| | | Soil (Surface) | | 1 | 1(1) | | | | | | | | | 1 | 1(1) | | | | | | |
| 76 | Sludge Weathering Pit | Soil (Subsurface) | 4 | 9 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | | | 1 | 1 | 1 | 1 | 1 | 1 | | |
| | | Soil (Surface) | | 2 | 2 | 1 | 1 | | | | | | | 1 | 1 | | | | | | |
| 78 | Fire Training Area No. 1 | Soil (Subsurface) | 2(1) | 18 | 21(9) | 1 | 1(1) | 1 | 1 | 1 | 1(1) | | | 1 | 1(1) | 1 | 1 | 1 | 1(1) | | 4 |
| | | Soil (Surface) | | 6 | 6(6) | 1 | 1(1) | | (1) | | | | | 1 | (1) | | (1) | 1 | 1(1) | | |
| 81 | Solvent Disposal | Soil (Subsurface) | 10(1)[2] | 10 | 10(1)[3] | 1 | 1 | | | | (1) | | | 1 | 1(1) | | | 1 | 1 | | |
| | | Soil (Surface) | | 10 | 10(1) | 1 | 1 | 1 | 1(1) | 1 | 1 | | | 1 | 1(1) | 1 | (1) | 1 | 1 | | |
| 86 | Engine Test Cell | Soil (Subsurface) | 5(4)[1] | 15 | 15(8)[4] | 2 | 2(2) | 1 | 1 | | (1) | | | 1 | 1(1) | 1 | 1(1) | | (1) | | |
| | | Soil (Surface) | | 5 | 5(4) | 2 | 2(2) | | (1) | 1 | 1 | | | 1 | 1(1) | | | 2 | 2(1)[1] | | |
| 95 | NE Stormwater Drainage | Soil (Subsurface) | 2(2) | 6 | 6(6) | 1 | (1) | 1 | 1 | 1 | 1(1) | | | 1 | (1) | | | 1 | 1(1) | | |
| | | Soil (Surface) | | 1 | 1(1) | | | | (1) | | | | | 1 | (1) | 1 | 1(1) | | | | |
| 96 | Old Entomology Rinse | Soil (Surface) | | 1 | 1 | | | | | | | | | 1 | 1 | | | | | | |
| | | Water (Groundwater) | | 1 | 1 | 1 | 1 | | | 1 | 1 | | | 1 | 1 | | | 1 | 1 | | |
| 98 | Sanitary Sewer Line | Soil (Subsurface) | 42 | 50 | 44 | 5 | 5 | 5 | 5 | 5 | 5 | | | 4 | 4 | 1 | 1 | 5 | 5 | | |
| 101 | Wastewater Lagoons | Sludge[2] | | 8 | 8(7) | 1 | 1(1) | | (1) | 1 | 1(1) | | | 1 | 1(1) | | (1) | | | | |
| | | Water (Surface) | | 3 | 3(1) | 1 | 1(1) | 1 | 1 | | | | 3(1) | 1 | 1 | | | | | | |
| | | Water (Groundwater) | | 4 | 4 | 1 | 1 | 1 | 1 | | | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | | 2 |
| 106 | Fire Training Area No. 2 | Soil (Subsurface) | 4(2) | 16 | 16(4) | 2 | 2 | 1 | 1(1) | 1 | 1(1) | | | 1 | 1(1) | 1 | 1(1) | 1 | 1 | | |
| | | Soil (Surface) | | 4 | 4 | 1 | 1 | | | | | | | 1 | 1 | | | 1 | 1 | | |
| 107 | Fire Training Area No. 3 | Soil (Subsurface) | 4(2) | 16 | 16(4)[3] | 2 | 1(1) | 1 | 1(1) | 1 | 1(1) | | | 1 | 1(1) | 1 | 1(1) | 1 | 1 | | |
| | | Soil (Surface) | | 4 | 4 | 1 | 1 | | | | | | | 1 | 1 | | | 1 | 1 | | |
| 109 | Fire Training Area No. 4 | Soil (Subsurface) | 4(3) | 28 | 28(18)[7] | 3 | 3(2) | 1 | 1(1) | 1 | 1(1) | | | 1 | 1(1) | 1 | 1(1) | 1 | 1(1) | | |
| | | Soil (Surface) | | 4 | 4(3) | 1 | 1(1) | | | | (1) | | | 1 | 1(1) | | | 2 | 2[1] | | |
| 113 | Landfill No. 5 | Water (Groundwater) | | 7 | 5(1) | 1 | 1(1) | 1 | 1 | 1 | 1 | 1 | | 1 | 1(1) | | | 1 | 1 | | 3 |
| OFS | Offsite Background Sites | Soil (Surface) | | 3 | 3 | | | | | | | | | | | | | | | | |

[1] The number in parenthesis corresponds to the number of redrills and resamples collected due to laboratory missed holding times on the original sample. The number in brackets corresponds to the number of redrills and resamples collected to determine the depth of contamination.
[2] TCLP was run on two sludge samples.

150271

Woodward-Clyde Consultants




NEW MEXICO

N

SOURCE: USGS TOPOGRAPHIC QUADRANGLE MAPS, PORTAIR AND OASIS STATE PARK, 1985

0 1/2 1 2

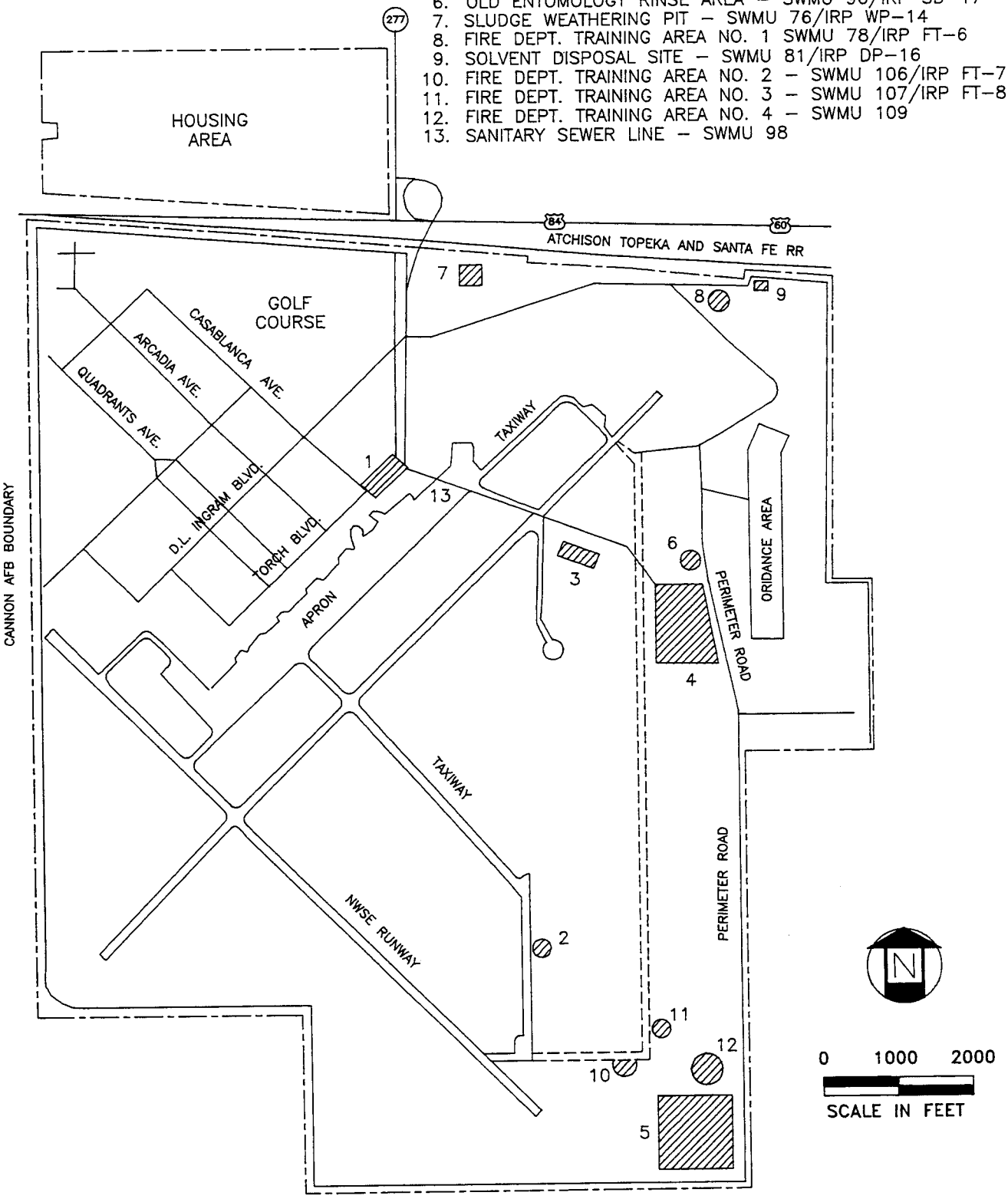
SCALE IN MILES

| | |
|---|---|
| Job No. : 89MC114W | GENERAL VICINITY MAP |
| Prepared by : D.A.K. | CANNON AFB, NEW MEXICO |
| Date : 7/9/92 | |

FIG. 1-1

EXPLANATION

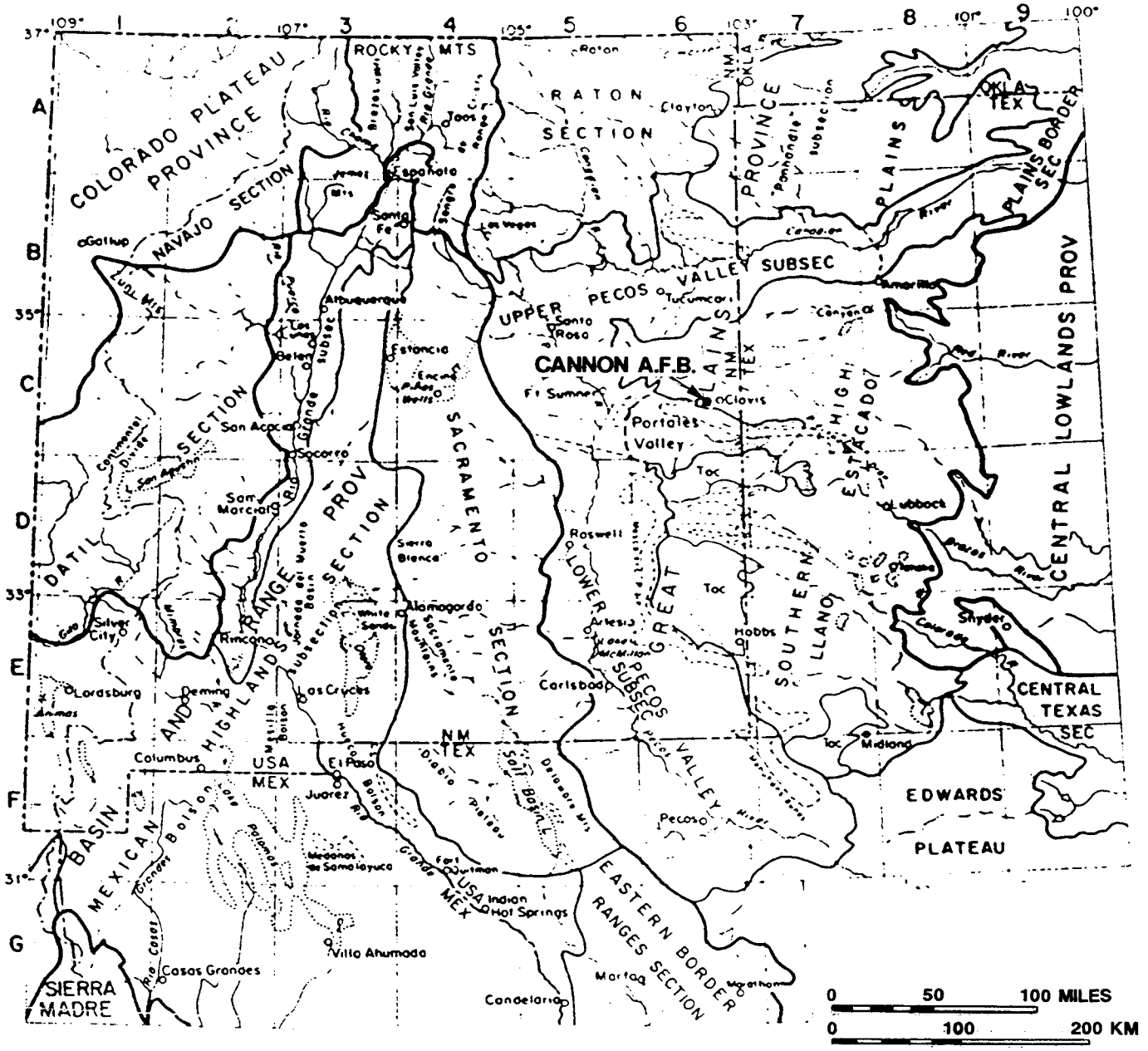
1. AGE DRAINAGE DITCH – SWMU 34/IRP SD–15
2. ENGINE TEST CELL AREA – SWMU 86–90/IRP SD–11
3. NE STORMWATER DRAINAGE AREA – SWMU 95/IRP SD–20
4. WASTEWATER LAGOONS – SWMU 101,102
5. LANDFILL NO. 5 – SWMU 113/IRP LF–5
6. OLD ENTOMOLOGY RINSE AREA – SWMU 96/IRP SD–17
7. SLUDGE WEATHERING PIT – SWMU 76/IRP WP–14
8. FIRE DEPT. TRAINING AREA NO. 1 SWMU 78/IRP FT–6
9. SOLVENT DISPOSAL SITE – SWMU 81/IRP DP–16
10. FIRE DEPT. TRAINING AREA NO. 2 – SWMU 106/IRP FT–7
11. FIRE DEPT. TRAINING AREA NO. 3 – SWMU 107/IRP FT–8
12. FIRE DEPT. TRAINING AREA NO. 4 – SWMU 109
13. SANITARY SEWER LINE – SWMU 98




| | |
|---|---|
| Job No. : 89MC114W | SWMU LOCATION MAP |
| Prepared by : D.A.K. | CANNON AFB, NM |
| Date : 2/6/92 | |

C114003A

FIG. 1–2

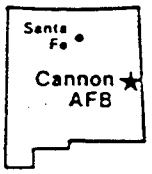



UPPER QUATERNARY EOLION SAND SHEETS WITH DUNE FIELDS

DEPRESSIONS OCUPIED BY UPPER PLEISTOCENE "FLUVIAL" LAKES

Toc — RELICT OGALLA CAPROCK SURFACE

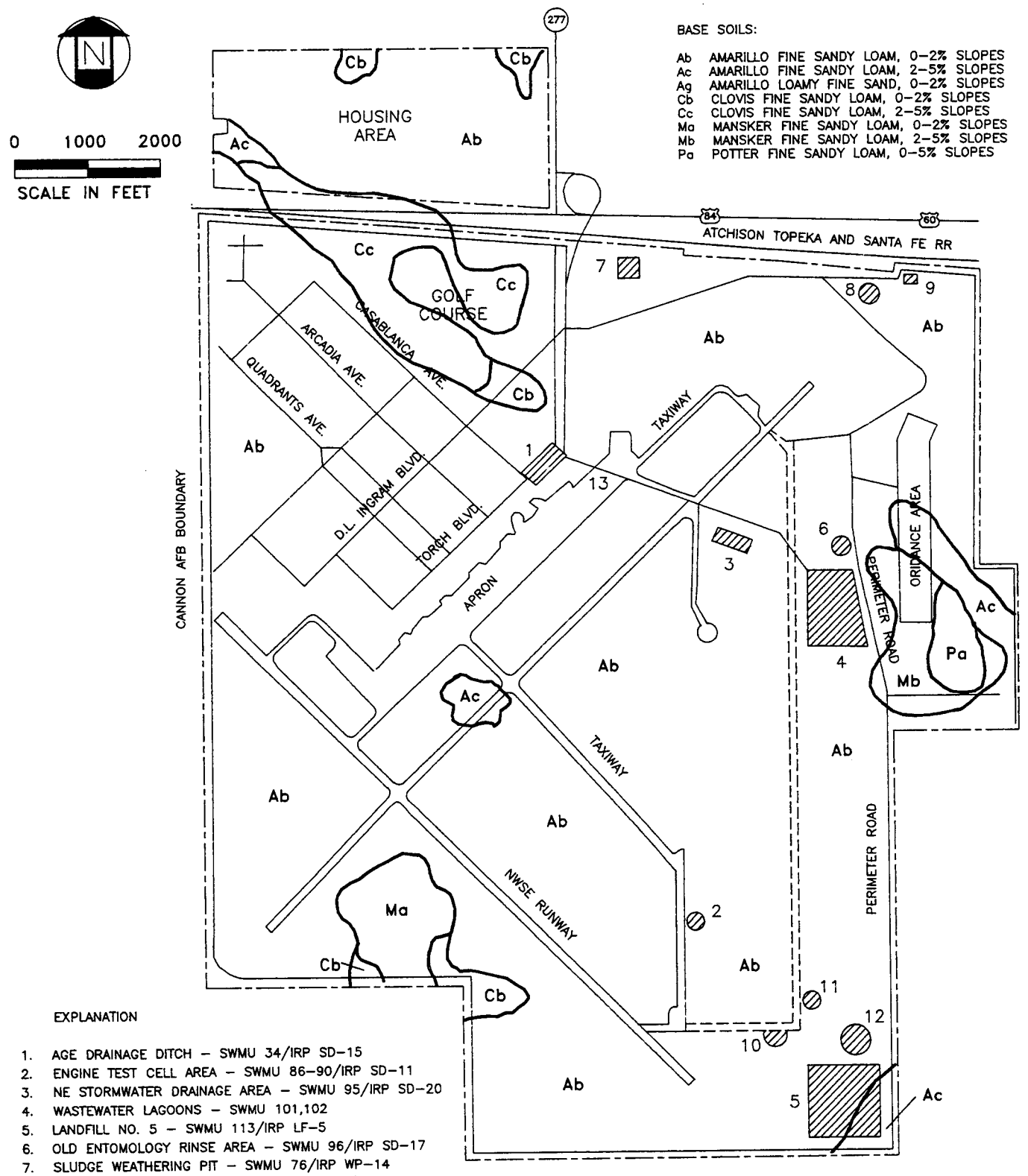
SOURCE: QUATERNARY STRATIGRAPHY IN THE BASIN & RANGE AND GREAT PLAINS PROVINCES NEW MEXICO & WEST TEXAS; HAWLEY, BACKMAN, MANLEY.




NEW MEXICO

| | |
|---|---|
| Job No. : 89MC114W | GEOMORPHIC PROVINCE MAP |
| Prepared by : L.L.G. | CANNON AFB, N.M. |
| Date : 2/18/92 | |

FIG. 1-3




BASE SOILS:

| | |
|---|---|
| Ab | AMARILLO FINE SANDY LOAM, 0–2% SLOPES |
| Ac | AMARILLO FINE SANDY LOAM, 2–5% SLOPES |
| Ag | AMARILLO LOAMY FINE SAND, 0–2% SLOPES |
| Cb | CLOVIS FINE SANDY LOAM, 0–2% SLOPES |
| Cc | CLOVIS FINE SANDY LOAM, 2–5% SLOPES |
| Ma | MANSKER FINE SANDY LOAM, 0–2% SLOPES |
| Mb | MANSKER FINE SANDY LOAM, 2–5% SLOPES |
| Pa | POTTER FINE SANDY LOAM, 0–5% SLOPES |

EXPLANATION

1. AGE DRAINAGE DITCH – SWMU 34/IRP SD–15
2. ENGINE TEST CELL AREA – SWMU 86–90/IRP SD–11
3. NE STORMWATER DRAINAGE AREA – SWMU 95/IRP SD–20
4. WASTEWATER LAGOONS – SWMU 101,102
5. LANDFILL NO. 5 – SWMU 113/IRP LF–5
6. OLD ENTOMOLOGY RINSE AREA – SWMU 96/IRP SD–17
7. SLUDGE WEATHERING PIT – SWMU 76/IRP WP–14
8. FIRE DEPT. TRAINING AREA NO. 1 SWMU 78/IRP FT–1
9. SOLVENT DISPOLAL SITE – SWMU 81/IRP DP–16
10. FIRE DEPT. TRAINING AREA NO. 2 – SWMU 106/IRP FT–7
11. FIRE DEPT. TRAINING AREA NO. 3 – SWMU 107/IRP FT–8
12. FIRE DEPT. TRAINING AREA NO. 4 – SWMU 109
13. SANITARY SEWER LINE – SWMU 98

SOURCE: USDA–S.C.S., SOIL SURVEY OF CURRY COUNTY N.M., 1958

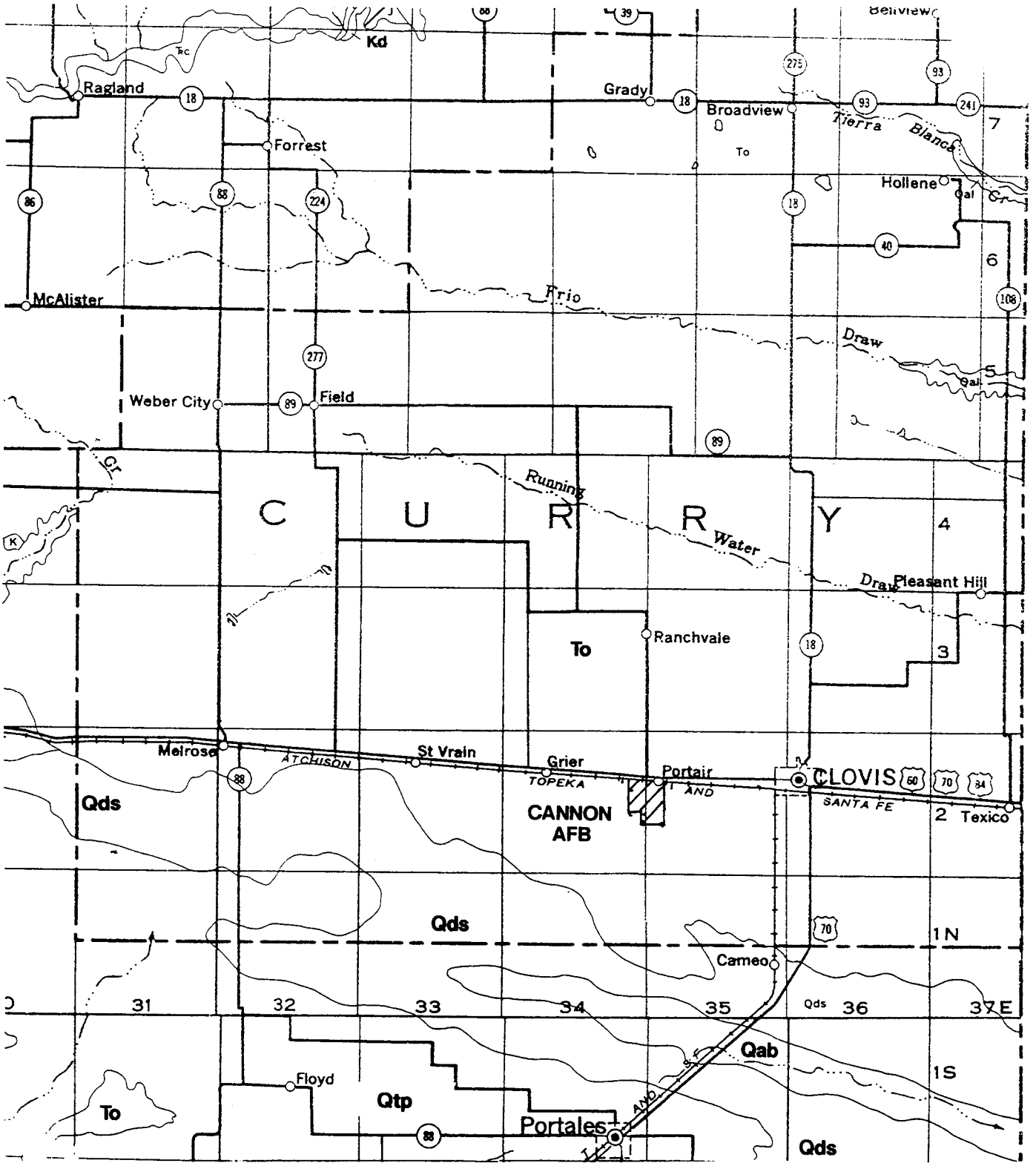
| | |
|---|---|
| Job No. : 89MC114W | DISTRIBUTION OF SOILS, BY TYPE |
| Prepared by : D.A.K. | CANNON AFB, NEW MEXICO |
| Date : 2/6/92 | |

C1140021

FIG. 1–4

150271

Woodward-Clyde Consultants

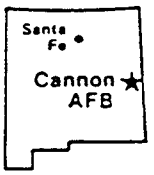



LEGEND

| | |
|---|---|
| QTp | GRAVEL, SAND & CALICHE |
| Qds | DUNE SAND |
| Qab | ALLUVIUM |
| To | OGALLALA FORMATION |

N

0 2.5 5 10
SCALE IN MILES




NEW MEXICO

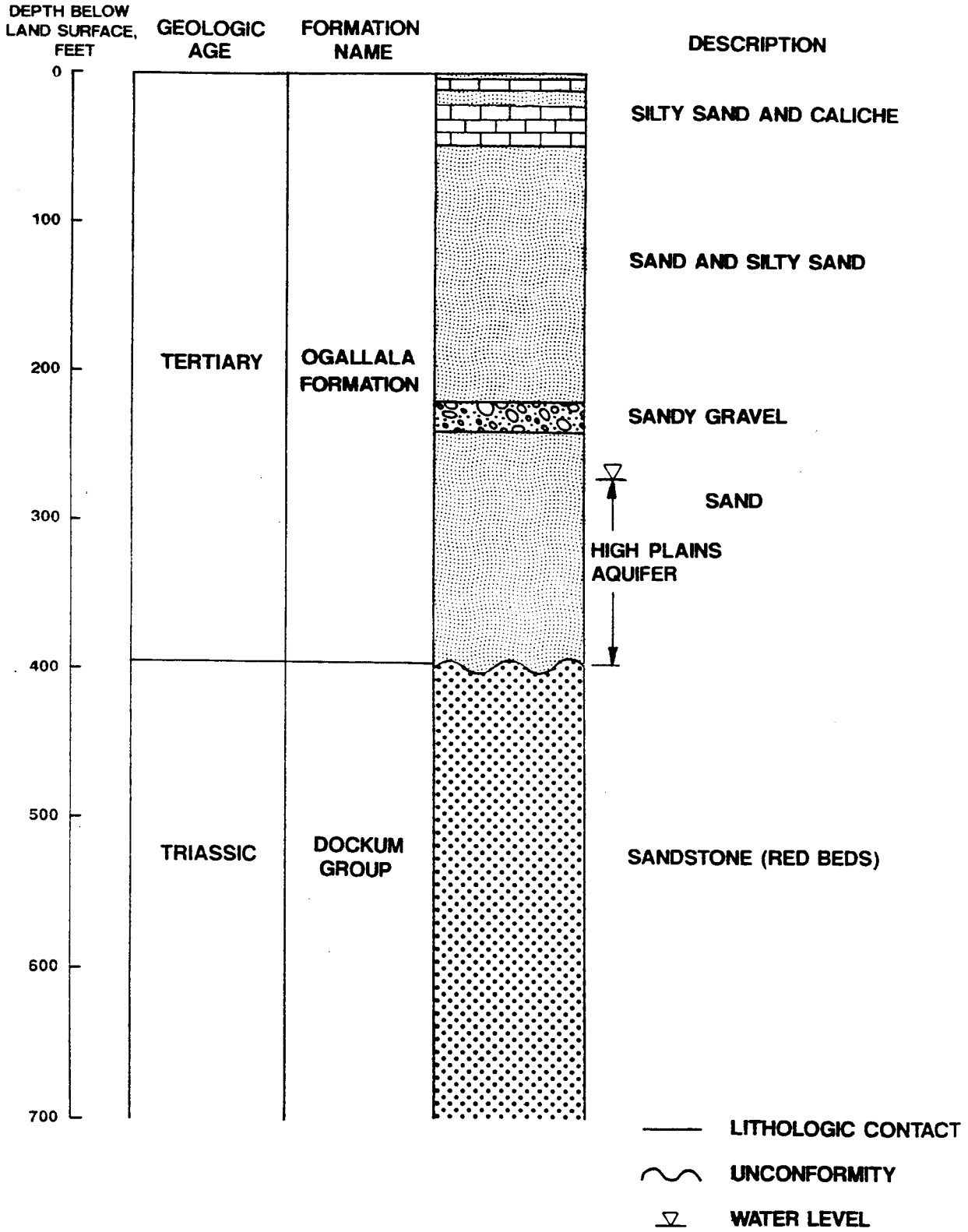
SOURCE: U.S.G.S. GEOLOGIC MAP OF NORTHERN N.M., 1962

| | |
|---|---|
| Job No. : 89MC114W | GENERALIZED GEOLOGIC MAP CANNON AFB, N.M. |
| Prepared by : L.L.G. | |
| Date : 2/18/92 | |

FIG. 1-5

150271

Woodward-Clyde Consultants



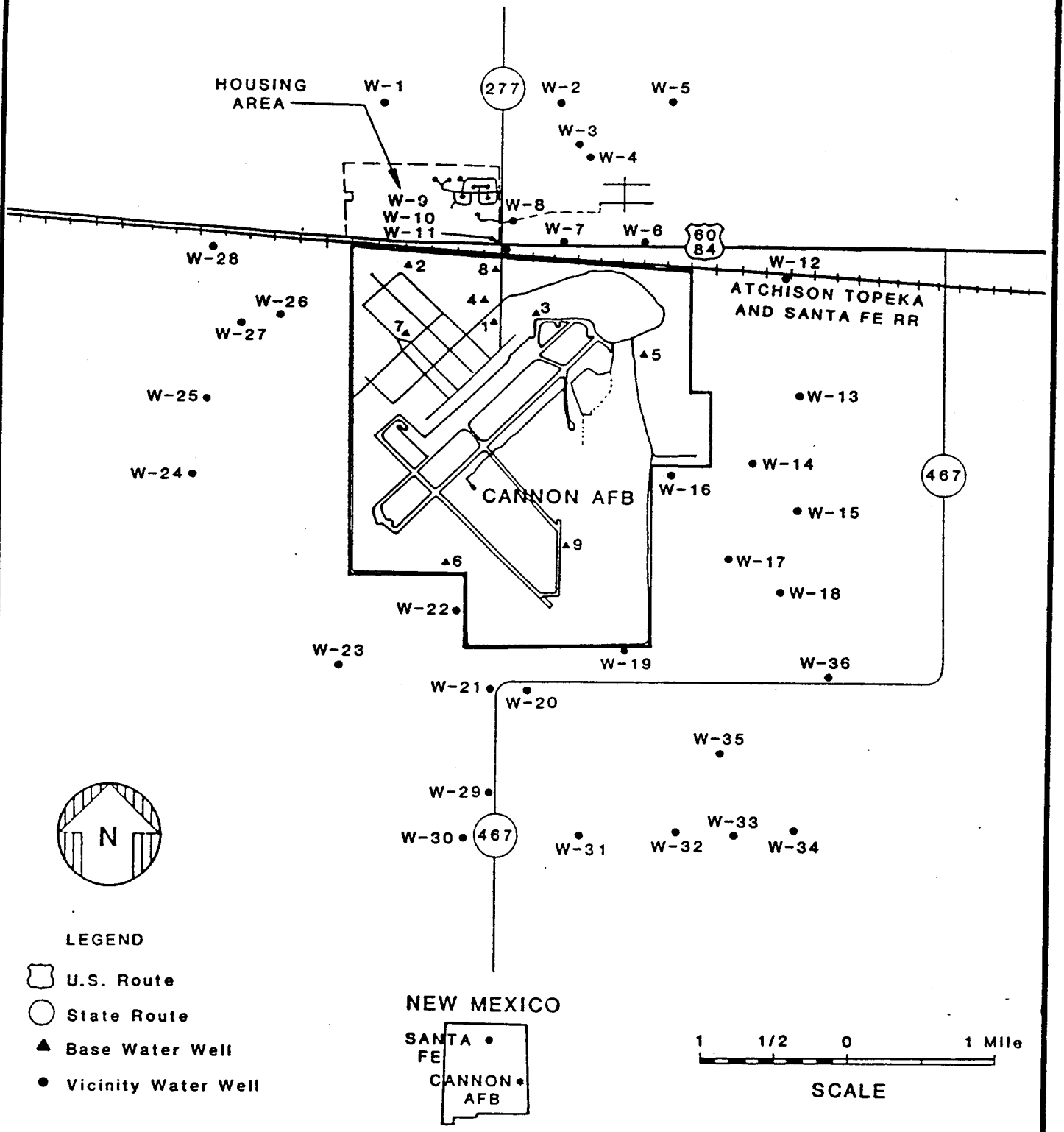

MODIFIED FROM GUTENTAG ET.AL., 1984

| | |
|---|---|
| Job No. : 89C114W | GENERALIZED GEOLOGIC COLUMN OF CANNON AFB, N.M. |
| Prepared by : L.L.G. | |
| Date : 2/18/92 | |

FIG. 1-6

136236

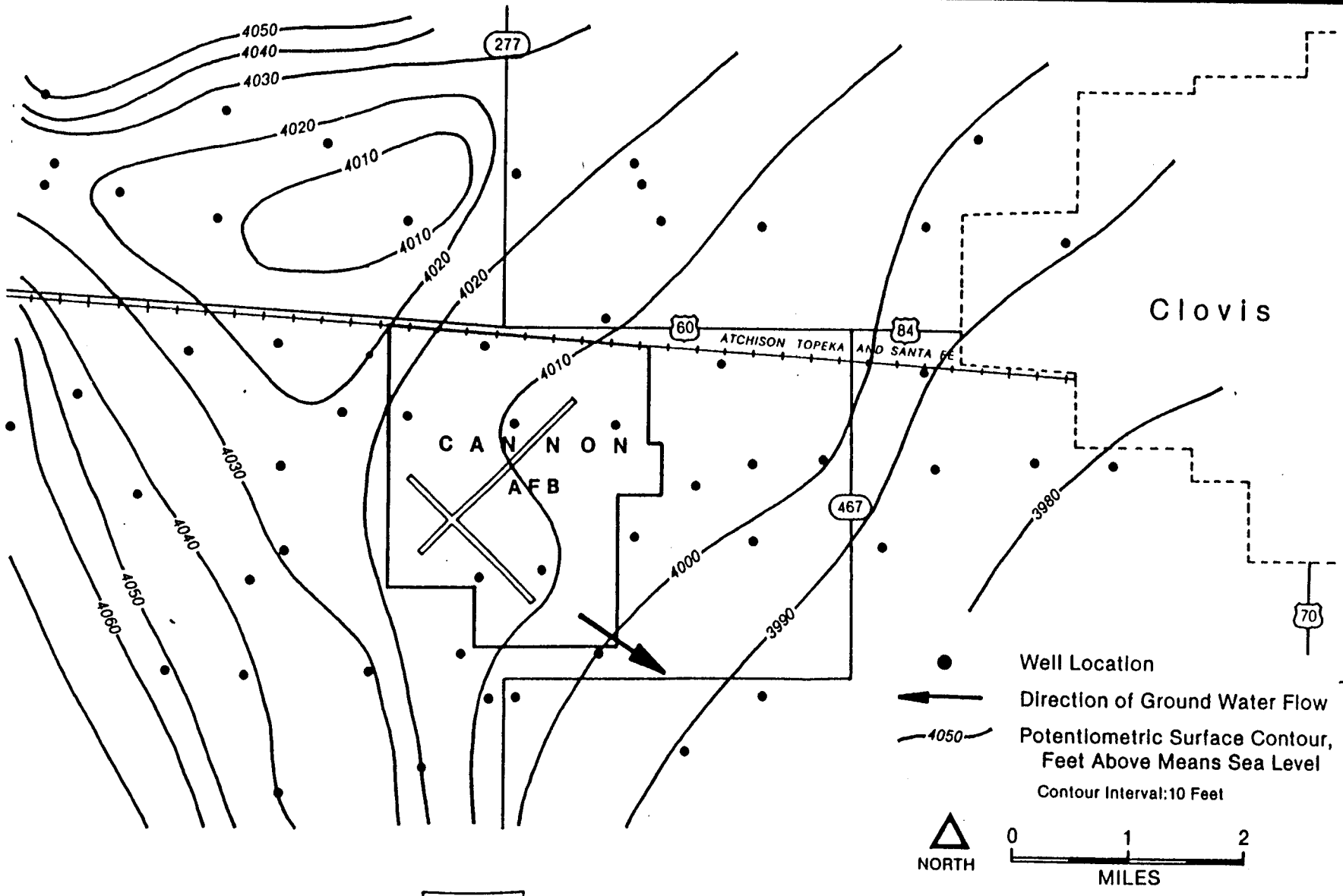
Woodward-Clyde Consultants




BASE MAP ADAPTED FROM: FINAL REPORT, IRP PHASE II

| | |
|---|---|
| Job No. : 89MC114W | WATER WELL LOCATIONS ON AND NEAR CANNON AFB, NM |
| Prepared by : J.T.A. | |
| Date : 2/18/92 | |

FIG. 1-7



GROUNDWATER ELEVATION IN THE VICINITY OF CANNON AFB, NEW MEXICO - JANUARY-FEBRUARY 1982

BASE MAP ADAPTED FROM: FINAL REPORT, IRP PHASE II

Woodward-Clyde Consultants

136236

| | |
|---|---|
| Job No. : | 89MC114W |
| Prepared by : | J.T.A. |
| Date : | 2/18/92 |

ALTITUDE AND CONFIGURATION OF WATER TABLE, VICINITY OF CANNON AFB, NM

FIG. 1-8

# 2.0
# AGE DRAINAGE DITCH (SWMU NO. 34/IRP NO. SD-15)

## 2.1 SWMU DESCRIPTION

### 2.1.1 Setting

The AGE Drainage Ditch originates on the flightline side of AGE Facility Building No. 186, and runs parallel to Facilities Buildings Nos. 191, 192, and 193, terminating on base at a culvert inlet near Argentina Avenue (Figure 2-1). Surface runoff water flows under Argentina Avenue via a culvert, to a storm water ditch which routes storm water to the NE storm water drainage ditch.

The AGE Drainage Ditch is about 1,200 feet long, 12 feet wide, and 1 foot deep at its deepest point. The side slopes are vegetated with grass above the active channel along the majority of the ditch area However, directly behind the southeast portion of Building 190, the ditch has been regraded due to construction activities associated with construction of this building. At this time no vegetation is present in this area. The ditch is bounded by the Building 191 loading dock, located approximately 16 feet northwest of the ditch bank, and the Building 190 parking curb, 15 feet southeast of the ditch bank.

### 2.1.2 History of Use

The AGE drainage ditch is reportedly man-made as a result of settled earth that followed removal of railroad tracks in the late 1960s. The ditch has functioned as a surface runoff drainage facility since that time.

Historically, most runoff originating from the parking area near former Building 189 (located southeast of the AGE Drainage Ditch) was contained by the parking lot curb, except in one place where the curb was broken. Building 189 and the curbing along the ditch have been demolished and replaced by a new building, number 190. The curbing now has storm water inlets into the AGE Drainage Ditch. The area where the curbing

was broken and the parking lot drainage inlets permit runoff to drain a portion of the parking area.

Field personnel during the WCC 1991 field investigation observed runoff from the asphalt and concrete storage areas around Building 186 into the ditch during rainy days. Occasional minor spillage of grease and oil occurs on the storage area during routine maintenance and repairing of equipment.

### 2.1.3 Past Investigations

During 1984-1985, a Phase II IRP investigation was conducted by Radian Corporation (Radian 1986) at the AGE Drainage Ditch. Two soil borings (15A and 15B) were drilled in the AGE Drainage Ditch adjacent to Building 191 to depths of 50.5 and 52.5 feet, respectively (Figure 2-1). Three samples were collected form borehole 15A and four samples were collected from borehole 15B and analyzed for oil and grease, lead, and purgeable organic compounds.

No purgeable organic compounds were detected in the samples, and oil and grease was detected in one sample (15B-1) at 99 mg/kg. However, the duplicate sample analysis did not detect any elevated oil and grease, and the conclusion was made that the oil and grease detected in sample 15B-1 may be due to natural organic interference. Elevated levels of lead relative to the site average were found in soil sample 15B-1 (35 mg/kg). (Radian 1986). Analytical results for borings 15A and 15B are contained in Table 2-1.

In March 1987, a follow-up soil removal investigation was conducted by Radian Corporation (Radian 1987) at the AGE Drainage Ditch based on results of the Phase II investigation discussed above. This investigation was conducted to determine whether toxic soils existed and, if so, to assist Cannon AFB in the proper removal and disposal of the soils. The investigation consisted of hand-augering 15 shallow boreholes in the most discolored portion of the ditch to a depth of 2 feet (Figure 2-1). Soil samples were collected at depths of 0-1 feet and 1-2 feet, and analyzed for total lead, petroleum hydrocarbons, EP-toxicity, metals, and purgeable organic compounds. A total of 22 samples were submitted for analysis with results shown in Tables 2-2 and 2-3. Total lead and petroleum hydrocarbon levels in the upper 0.5 foot of soil exceeded background

concentrations when compared to a sample collected outside of the AGE Drainage Ditch. The elevated levels of lead and petroleum hydrocarbons were reported to correlate with visible soil discoloration observed during augering (Radian 1986).

Results of EP-toxicity analysis of the shallow soils collected during the 1987 Radian investigation which contained elevated levels of lead revealed extremely low or nondetectable levels of RCRA metals as regulated by 40 CRF Subpart D. Based on this information, the soils were defined as non-hazardous. No purgeable organic compounds were reported in the shallow soil samples, with the exception of methylene chloride in three samples. The methylene chloride was reported to be contributed to laboratory contamination during the extraction procedures.

As recommended in the Phase IV-A investigation report, the drainage ditch soil was tilled in October 1988. This tilling provided aeration to the soil aiding microbial degradation of contaminants and providing better conditions for renewed vegetation growth.

### 2.1.4 Land Use and Demography

The AGE Drainage Ditch is located in a heavily used portion of Cannon AFB. Several buildings border the drainage ditch. The buildings include the AGE maintenance facility building No. 186, the squadron mobility building No. 191, equipment maintenance building No. 190, and the aircraft maintenance building No. 194. The primary activities in this area is aircraft and equipment maintenance. The concrete parking apron where aircraft are often parked is located immediately southeast of the maintenance buildings.

Base personnel cross the ditch once or twice a day using it as a shortcut. A few vehicles a day use the road that runs parallel to the ditch and personnel in building 191 often sit on the loading docks, which are adjacent to the ditch, and eat their lunch.

## 2.2 FIELD INVESTIGATION

This section provides a discussion of the field activities conducted by WCC at the AGE Drainage Ditch from October 22 through 24, 1991 and from December 8 through 10,

1991. The activities at this SWMU, as outlined in the FSP (WCC 1991c), consisted of collecting 1 surface soil sample for chemical analysis, drilling 2 soil borings, and collecting 4 subsurface soil samples for chemical analysis and 1 subsurface soil sample for gradation analysis. The resampling phase of the field program, which became necessary due to laboratory missed holding times, consisted of recollecting 1 surface soil sample for chemical analysis, redrilling 1 soil boring, and recollecting 1 subsurface soil sample for chemical analysis.

Table 2-4 summarizes the drilling and sampling methods, along with sampling frequency conducted at each soil boring and surface sample location during the 1991 WCC investigation. A complete record of all surface soil, subsurface soil, and associated QA/QC samples collected at the AGE Drainage Ditch is presented in Table 2-5. The locations of the surface soil samples and soil borings are shown on Figure 2-1.

### 2.2.1 Sampling Objectives

The objective of additional sampling at the AGE Drainage Ditch was to provide additional information regarding the downward migration of potential hazardous contaminants near the two surface water drainage inlets. These two locations are considered to be more representative of site conditions than the borings located further downstream during the previous investigation and both locations appeared to exhibit staining at the surface. The data collected at these two soil boring locations were used to further evaluate the extent of potential contamination, if present, and to judge the effectiveness of the soil tilling in reducing contaminant levels. The results were also used to perform a baseline risk assessment to determine if the area poses a risk to human health or the environment. The data may also be utilized to evaluate remedial actions if necessary. Presently, there does not appear to be any substantial risk to the groundwater, so no hydrogeologic investigation was planned or conducted.

### 2.2.2 Surface Soil Investigation

One surface soil sample was collected from 0 to 0.5 feet below ground surface (BGS) near boring 0341 at the southwest end of the drainage ditch. This sample was collected

using a stainless steel hand trowel and analyzed for TCL VOCs, semi-VOCs, TAL metals, and TPH.

During the resampling phase, one additional surface soil sample, 0344 (a resample of the surface soil sample from boring 0341), located approximately 1 foot southwest of the original surface sample location, was collected because the laboratory missed the holding time for the TCL VOC analysis on the original sample. This sample was analyzed for TCL VOCs only.

### 2.2.3 Subsurface Soil/Vadose Zone Investigation

Two soil borings, 0341 and 0342, were drilled to depths of 3 and 11 feet BGS, respectively, at the southwest end of the AGE Drainage Ditch. Each soil boring was sampled continuously and described lithologically from the split spoon samples obtained during drilling. Subsurface soil samples for chemical analysis were collected at 1 foot BGS in boring 0341 and at 1.5, 5, and 9 feet BGS in boring 0342 for a total of four subsurface soil samples. The subsurface analytical samples were collected with stainless steel split spoons and analyzed for TCL VOCs, semi-VOCs, TAL metals and TPH. One subsurface sample was collected at 9 feet BGS in boring 0342 for geotechnical gradation analysis.

During the resampling phase, one additional soil boring, 0343 (a redrill of boring 0342), located approximately 5 feet south of the original soil boring, was drilled to a depth of 10 feet BGS and sampled at the same intervals where analytical subsurface soil samples were collected in the original boring. One additional subsurface soil sample was collected at 8 feet BGS because the laboratory missed the holding time for the TCL VOC analysis on the original sample. This sample was analyzed for TCL VOCs only.

## 2.3 PHYSICAL CHARACTERISTICS

This section provides a discussion of the surface water hydrology, soil, geology and hydrogeology at the AGE Drainage Ditch based on a review of information from previous investigations and the detailed lithologic descriptions of split spoon samples and gradation analysis results from the 1991 WCC investigation.

### 2.3.1 Surface Water Hydrology

The uppermost surface water inlet to the AGE Drainage Ditch is a drop-inlet structure located near the northwest corner of Building 184. Reportedly, flow from the drop-inlet does not flow into the AGE Drainage Ditch due to blockage or lack of a connecting drain pipe to other portions of the drainage ditch. Runoff from the aircraft parking apron, JP-4 fuel station, and fuel cart parking areas is routed to this inlet structure and into a 12-inch culvert.

Open channel flow occurs over a short distance downstream of the washrack before being routed through a second 12-inch culvert underneath an access road. The second 12-inch culvert crosses the AGE Facility Building 186 access road and empties into the AGE Drainage Ditch again.

Several sources of runoff to the AGE Drainage Ditch exist downslope of the culvert. Surface runoff from the AGE Building 186 asphalt parking area is routed into a small, 1-foot wide runoff ditch that empties into the AGE Drainage Ditch. During rainfall events, road runoff from Torch Boulevard, northwest of the AGE Drainage Ditch flows through portals in a concrete retaining wall and enters the ditch via the AGE Building 186 parking lot.

Historically, most runoff originating from the parking area near former Building 189 (located southeast of the AGE Drainage Ditch) was contained by the parking lot curb, except in one place where the curb was broken. Building 189 and the curbing along the ditch have been demolished and replaced by Building 190. The curbing now has storm water inlets into the AGE Drainage Ditch. The area where the curbing was broken and the parking lot drainage inlets now permit runoff to drain a portion of the parking area, thereby supplying the AGE Drainage Ditch with another source of runoff.

The AGE Drainage Ditch terminates at Argentia Avenue at a culvert inlet. Surface runoff water flows under Argentia Avenue via a culvert, to a storm water ditch that routes storm water flow into a drop inlet that flows under the flightline to the NE storm water drainage area. No other runoff from the AGE Drainage Ditch is routed to other receiving waters or sanitary sewer systems. All surface water entering the AGE

Drainage Ditch is the result of rainfall and runoff from impervious flat areas such as the aircraft parking apron and other parking/road areas described above. Generally, all parking surfaces and curbing are constructed of asphalt.

### 2.3.2 Soil

The soils underlying the southwest end of the AGE Drainage Ditch area consist of sandy loam and loamy sand of the Amarillo Soil Group. The soils consist primarily of fine-grained, well sorted, silty, clayey, unconsolidated red-brown sands. The sands are generally moist to slightly moist at depth, due in part to the constant drainage, pooling, and infiltration of surface runoff in the area. The total thickness of the soil zone is approximately 3 to 5 feet.

### 2.3.3 Geology

The near surface (upper 11 feet) stratigraphy at the AGE Drainage Ditch consists of Tertiary Miocene to Pliocene fluvial deposits of the Ogallala Formation. Stratigraphic correlations of the various fluvial deposits between borings is based primarily on the split spoon lithologic samples collected during drilling.

The SWMU is underlain by Ogallala fluvial deposits consisting primarily of well sorted sand. The total thickness of these Ogallala deposits beneath the SWMU is not presently known, but based on regional information, may be as thick as 390 feet. The fluvial deposits shown on the boring logs from 4289 to 4296 feet mean sea level (MSL) consist of very fine- to fine-grained, well sorted, silty, calcareous red-brown sands (Appendix B-1). These sands are comprised predominantly of subangular quartz grains with varying amounts of silt, calcium carbonate, and clay. One gradation analysis was performed on a sample collected within this unit at 9 feet BGS in boring 0342. The results indicate that this sample was comprised of approximately 46 percent sand, 18 percent silt, and 36 percent calcium carbonate and/or clay-sized material. The thickness of this unit is unknown at present due to the fact that the unit was not fully penetrated. Approximately 3 to 5 feet of native topsoil exists above this unit. No groundwater was encountered during the drilling of these borings.

## 2.4 INTRODUCTION TO NATURE AND EXTENT OF CONTAMINATION

**The following introductory paragraphs on Concentrations of Major Elements and Soils for subsection 2.4 apply to subsections 2.5 and 3.4 through 14.4. The information is not repeated in those subsections for purposes of brevity.**

The purpose of this section is to summarize the nature and extent of contamination identified at 18 SWMUs at Cannon Air Force Base. This section focuses on those media which, by the distribution and nature of contamination, may be of potential concern from a public health, environmental, or regulatory standpoint. The risk assessment and the ecological assessment (Section 18.0) identify these concerns where they exist.

This discussion is limited to the environmental media that were sampled in each of the SWMUs. For purposes of clarity, a definition of contamination is warranted. For this discussion, contamination is used to describe soil or groundwater that contains detectable concentrations of chemical compounds that do not occur naturally in the environment or that may be present at concentrations that exceed site background levels, as described below. The risk assessment and the ecological assessment performed as part of the RI will define the potential risk to public health and the environment and were primary considerations, along with ARARs, in determining whether or not remediation or additional investigations are warranted.

The two media of concern at Cannon AFB are soil and groundwater. Soil is the primary medium of investigation performed at the site. Potential impacts to groundwater may not be as significant since the Ogallala aquifer lies at approximately 250 feet. In the SWMUs where there are existing monitoring wells, groundwater sampling was performed. Surface water features are limited to one SWMU, the wastewater lagoons.

### Concentrations of Major Elements

Soil samples from seven SWMUs were analyzed for the major elements (calcium, potassium, and sodium). Minimum, maximum, and mean values for these inorganics are listed in Table 2-6 by SWMU. Also listed is the common range of these elements found in soils (Lindsay 1979). All detected values were within the common ranges found in

soils of this region. In general, calcium occurs at higher concentrations in the soil because of the calcareous nature of soil (e.g., caliche).

The highest maximum values reported in soil samples were: calcium at 231,000 mg/kg at the Engine Test Cell area; potassium at 2,770 mg/kg at the Sanitary Sewer Line; and sodium at 6,410 mg/kg at the NE Stormwater Drainage site.

## Soils

This section describes the background levels of the chemicals in soil at the 18 SWMUs at Cannon Air Force Base. Information is also provided for comparison with metals levels in soils for this region (USGS 1985) (Table 2-7).

Three offsite background site (OFS) samples were collected during the RI and analyzed for metals, PCBs, and pesticides to obtain information on levels for these chemicals in soils near Cannon AFB. Specifically, results from analysis of the OFS soil samples were used to obtain average background levels for metals in soils at Cannon AFB. However, one of the samples (OFS-3) yielded detectable levels of PCBs and pesticides, so that the data for metals from this sample were not used in defining background levels. In addition, fourteen soil samples collected from along the sanitary sewer line having the following criteria, suggesting that these samples have not been impacted by base activities, were included in defining background levels of metals at Cannon AFB.

- Metals concentrations were within levels for this region.
- No detectable levels of organics were present in the samples.
- No visible indications of soil discoloration were present at the boring location.
- Subsurface samples were not moist or saturated.
- The average concentrations of the detected metals and the standard deviations were utilized to give a concentration range representative of the soil naturally occurring near Cannon AFB.

Table 2-7 summarizes the metals content of the background soil samples, and their reported concentrations, along with a range of concentrations for the site.

Several definitions are required in order to describe the different levels of chemical contamination. Metals at elevated concentrations are detected at levels greater than the 95th percentile of the range (mean + 2 standard deviation). For example, the mean concentration of lead in the background soil is 5.2 mg/kg, and the 95th percentile would be 8.62 mg/kg.

For the organics, it is assumed that any chemical found at measurable quantities will be considered to be above background levels. Note that if a chemical was detected to be present, but below the reporting limit, the results are qualified as estimated (J). If these chemicals are, upon professional judgment, considered to be normal laboratory contaminants (e.g., acetone, methylene chloride), they are not considered chemicals of interest. However, if those reported chemicals are related to compounds found at measurable quantities above reporting limits, their presence will be discussed in the text.

The sampling program for each SWMU has been described in previous sections of this RI. The following subsections make reference to the previous sections which are pertinent to that particular SWMU. It should be noted that in most SWMUs, some borings had to be redrilled and resampled due to laboratory-missed holding times, particularly for volatile analysis. In the following discussions, the redrilled borings will be listed and referred to as the original boring number.

## 2.5 NATURE AND EXTENT OF CONTAMINATION

One surface sample and one subsurface sample at a depth of 1 foot was collected at boring 0341. Three subsurface samples at depths of 1.5, 5, and 9 feet were collected at boring 0342 (Figure 2-1). Evaluation of the chemical analyses (TCL VOCs, semi-VOCs, TAL metals, TPH) of these samples has been used as a basis for characterizing the nature and extent of contamination.

None of the target analyte list of volatile organic compounds were detected at concentrations above Contract Required Quantitation Limits (CRQL) in samples from SWMU No. 34. This is consistent with the initial Phase II IRP investigation conducted onsite during 1984 and 1985, which did not yield detectable levels of purgeable organic compounds above detection limits (Table 2-1). In the samples, collected from borings

0341 and 0342, cyanide was indicated in the instrumental readout, but it was not above reporting limits to report quantitative values.

None of the target semi-volatile organic compounds were found above the CRQL in any of the samples. However, polynuclear aromatic hydrocarbon (PAH) compounds were detected at low levels (between instrument detection limits and reporting limits) in both samples from boring 0341 (surface and subsurface soil sample). As shown in Table 2-8, the compounds detected, phenanthrene, anthracene, benzo(a)anthracene, benzo(a)pyrene, fluoranthene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, benzo(g,h,i)perylene, indeno(1,2,3-cd)pyrene, and dibenzo(a,h)anthracene, are all high molecular weight PAH compounds typically associated with the heavy distillate oil fraction or asphalt. Given that the ditch drains a large portion of the parking lot, it is possible that the source of these compounds may be the asphalt. Since elevated levels of total petroleum hydrocarbons (TPH) were found in boring 0341 (see Table 2-9), the PAH compounds are probably the constituents of residual petroleum products.

The results for metals analysis in surface and subsurface soil shown in Table 2-10 indicate that several metals were detected at levels above background. Cadmium was detected in the surface soil sample at boring location 0341 at 1.3 mg/kg. Chromium was detected at 12.3 mg/kg in the surface soil sample at boring location 0341, and at concentrations of 10.4 mg/kg and 10.5 mg/kg at a depth of 1 foot bgs in boring 0341 and 0342, respectively. These values are above background levels at Cannon AFB, but are below the level of chromium commonly found in soils of this region of New Mexico, as shown in Table 2-7. Copper was detected at 1 foot bgs in soil boring 0341 at a concentration of 20.7 mg/kg. This value is slightly above both the background and the level found in soils of the region; however, it is not a metal of concern at this SWMU. Iron was detected at 8920 mg/kg at 1 foot bgs in boring 0342. This also may be naturally occurring, even though it is above background levels for iron in soils at Cannon AFB.

From the metals analysis, lead was detected at concentrations above background in boring 0341 at a concentration of 40.7 and 38.1 mg/kg at the surface and at 1 foot depth, respectively (Table 2-10). The concentrations of lead in the soil samples from boring 0341 appear to be, in general, higher than that found in samples from boring 0342.

Given boring 0341 was drilled near to the vehicle wash rack facility, it is possible that high levels of lead are due to the previous activities (possible use of leaded gasoline) in this area. As the ditch flows northeast, the levels of lead that occur here in the soil appear to be similar to background levels. During the initial Phase II IRP investigation, higher levels of lead were found in the subsurface soil (4-5.5 feet bgs) in boring 15B (Figure 2-1) than that in soil at deeper levels in that boring and in boring 15A. Likewise, the 1987 investigation (Radian 1987) showed that lead was higher than background levels in the surface soil through most of the drainage ditch investigated (see Table 2-2). The samples from boring 0342 at depths greater than 1.5 feet do not indicate lead concentrations above background. Therefore, it is likely that most of the elevated lead is associated with only the top 1 foot of soil. This is consistent with the high levels of oil and grease that were also found during the 1987 investigation in only the top 1 foot of soil. The vertical extent of elevated lead in the vicinity of boring 0341 below the upper 1 foot is presently unknown, since the boring could not be drilled deeper than 3 feet bgs due to the presence of utilities (i.e., high voltage underground lines).

Manganese and nickel were detected at concentrations of 173 mg/kg and 9.2 mg/kg at 1 foot in boring 0341. These values were above background concentration for the site but were within the range for soils of the region. Therefore, these metals are not considered to be contaminants at this SWMU. Selenium was detected in the surface soil at boring 0341 at 2.2(J) mg/kg. This value is above both background and selenium concentration in soils of this region; however, since this value is estimated, selenium may actually be present at values below this concentration and is possibly naturally occurring. Zinc was detected at boring location 0341 at an estimated value of 237(J) mg/kg and 60.3 mg/kg in the surface soil sample and 1 foot bgs. Zinc was also detected at 22 mg/kg in the 1 foot sample in boring 0342. These values were above the background zinc concentration range for the site and above that found in soils of this region of the southwestern United States.

Analysis for total petroleum hydrocarbons (TPH) from sample location 0341 indicated elevated concentrations (1180 and 397 mg/kg) at the ground surface and 1 foot bgs, respectively (Table 2-9). This was supported by the reported presence of tentatively identified compounds (TICs) and the presence of polynuclear aromatic hydrocarbons in

the semi-volatile analysis. (Tentatively identified compounds are identified in the gas chromatogram and the mass spectrum, but not quantified because they are not target analytes. Their identities are somewhat subjective and are based on comparison of their mass spectrum to that from a computer library search.) A variety of high molecular weight saturated hydrocarbons were detected at 0341 at 1 foot bgs.

The subsurface samples from boring 0342 yielded nondetectable levels of TPH. Comparison of the analytical results of boring 0342 (1.5-3 ft bgs sample) with that of boring 1 (0-1 ft bgs sample) in Radian's 1987 investigation (the two geographically closest borings) show poor correlation. Boring 1 (Radian 1987) had previously indicated elevated levels of TPH of 200 mg/kg, while the present investigation indicates levels of less than 45 mg/kg. This change in concentration suggests that the tilling activities previously conducted were effective in reducing the TPH levels by increased aeration and biodegradation in the top 1 foot of soil.

In summary, the AGE drainage ditch appears to have soil contaminated with petroleum hydrocarbons above 100 mg/kg and low levels of PAH compounds from surface to 3 feet bgs in boring 0341. However, petroleum hydrocarbons concentrations do decrease from the surface to the total depth of the boring at this location. The soil at boring 0341 also contains lead and zinc above background levels (Table 7-5). The vertical extent of elevated lead and zinc is presently unknown, since the boring did not extend beyond 3 feet bgs. The contamination identified at boring 0341 does not appear to extend east of the culvert.

# TABLE 2-1

## ANALYTICAL RESULTS OF SOIL SAMPLES COLLECTED BY RADIAN AT AGE DRAINAGE DITCH SWMU NO. 34/IRP NO. SD-15 CANNON AFB, NEW MEXICO

| Sample Number | Sample Depth (Ft-BGS) | Oil and Grease (mg/kg) | Lead (mg/kg) | Purgeable Organic Compounds (EPA 8010/8020) (ug/kg) |
|---|---|---|---|---|
| 15A-1 | 3.0-4.1 | <10 | 5.8 | ND |
| 15A-2 | 8.5-9.5 | <10 | 2.4 | ND |
| 15A-3 | 47.5-50.0 | <10 | 0.93 | ND |
| 15B-1 | 4.0-5.5 | 99 | 35 | ND |
| 15B-1a[1] | 4.0-5.5 | <10 | 69 | ND |
| 15B-2 | 9.0-10.5 | <10 | 2.7 | ND |
| 15B-3 | 52.5-54.0 | <10 | 1.2 | ND |

ND = Not detected
Ft-BGS = Feet below ground surface
mg/kg = Milligrams per kilogram
ug/kg = Micrograms per kilogram

[1] duplicate analysis

Source: Final Report, IRP Phase II (Radian 1986)

# TABLE 2-2

## TOTAL PETROLEUM HYDROCARBON AND TOTAL LEAD CONCENTRATIONS IN SOIL SAMPLES COLLECTED BY RADIAN AT AGE DRAINAGE DITCH SWMU NO. 34/IRP NO. SD-15 CANNON AFB, NEW MEXICO

| Sample Number | Sample Depth (Ft-BGS) | TPH[1] (mg/kg) | | Total Lead[2] (mg/kg) | |
|---|---|---|---|---|---|
| 1-1[3] | 0-1 | 200 | (5.0) | 110 | (.30) |
| 1-2 | 1-2 | ND | (5.0) | 8.6 | (.30) |
| 2-1[3] | 0-1 | 120 | (5.0) | 500 | (.30) |
| 2-2 | 1-2 | ND | (4.0) | 6.6 | (.30) |
| 2-2 (dup) | 1-2 | NA | | 6.8 | (.30) |
| 3-1[3] | 0-1 | 540 | (5.0) | 120 | (.30) |
| 4-1 | 0-1 | 280 | (5.0) | 26 | (.30) |
| 5-1 | 0-.6 | 57 | (5.0) | 67 | (.30) |
| 5-2 | .6-1.5 | ND | (4.0) | 5.6 | (.30) |
| 6-1 | 0-.75 | 15[4] | (5.0) | 25 | (.30) |
| 6-2 | .75-1.4 | ND | (4.0) | 8.2 | (.30) |
| 6-2 (dup) | .75-1.4 | ND | (5.0) | 8.4 | (.30) |
| 7-1 | 0-.6 | ND | (5.0) | 62 | (.30) |
| 8-1 | 0-.6 | 120 | (5.0) | 32 | (.30) |
| 9-1 | 0-.6 | 120 | (5.0) | 32 | (.30) |
| 9-2 | .6-1.3 | ND | (5.0) | 7.6 | (.30) |
| 10-1 | 0-.9 | 910 | (5.0) | 62 | (.30) |
| 11-1[3] | 0-.6 | 280 | (5.0) | 80 | (.30) |
| 12-1[3] | 0-.6 | 320 | (5.0) | 90 | (.30) |
| 13-1 | 0-.6 | 150 | (5.0) | 35 | (.30) |

**TABLE 2-2**
**(Concluded)**

| Sample Number | Sample Depth (Ft-BGS) | TPH[1] (mg/kg) | | Total Lead[2] (mg/kg) | |
|---|---|---|---|---|---|
| 13-2 | .6-2.0 | ND | (5.0) | 16 | (.30) |
| 15-1 | 0-1.0 | 120 | (5.0) | 55 | (.30) |
| 20-1 | 0-.75 | 75 | (5.0) | 45 | (.30) |
| Background | 0-.75 | 300/ND[5] | (5.0) | 13.9 | (.30) |

ND = Not detected at specified detection limit
NA = Not Analyzed
Ft-BGS = Feet below ground surface
( ) = Detection limit
dup = Duplicate sample
mg/kg = Milligrams per kilogram

1 Infrared Spectrophotometry, EPA Method 418.1
2 Flame Atomic Absorption Spectrophotometry, Method SW-846 3050
3 EP-Toxicity analyses run due to high total lead value detected. Results of EP-Toxicity analyses shown in Table 2-3.
4 Value less than five times detection limit.
5 False positive value due to vaporization of acetone bottle resulting in contamination of background sample. Rerun of background sample revealed <5 mg/kg when analyzed.

Source: Soil Removal Investigation Report (Radian 1987)

## TABLE 2-3

## EP-TOXICITY ANALYTICAL RESULTS IN SOIL SAMPLES COLLECTED BY RADIAN AT AGE DRAINAGE DITCH, SWMU NO. 34/IRP NO. SD-15 CANNON AFB, NEW MEXICO

| Analytical Parameters/ (Technique) | Sample Number [Date Sampled] 1-1 [03/30/87] | 2-1 [03/30/87] | 3-1 [03/30/87] | 11-1 [03/30/87] | 12-1 [03/30/87] | 12-1 (dup) [03/30/87] | Background [03/30/87] |
|---|---|---|---|---|---|---|---|
| EP-Toxicity Metals (mg/L) | | | | | | | |
| Silver (ICPES) | ND (.007) | ND (.007) | ND (.007) | ND (.007) | ND (.007) | ND (.007) | ND (.007) |
| Arsenic (Flame AA) | .004 (.004) | .004 (.004) | ND (.004) | .004 (.004) | ND (.004) | ND (.004) | ND (.004) |
| Barium (ICPES) | 1.3 (.009) | 1.4 (.009) | 1.3 (.009) | 1.7 (.009) | 1.7 (.009) | 1.6 (.009) | 0.6 (.009) |
| Cadmium (ICPES) | .02 (.003) | .02 (.003) | .02 (.003) | .04 (.003) | .04 (.003) | .04 (.003) | ND (.004) |
| Chromium (ICPES) | ND (.007) | .01 (.01) | ND (.007) | ND (.007) | ND (.007) | ND (.007) | ND (.007) |
| Mercury (Cold Vapor AA) | ND (.0005) | ND (.0005) | ND (.0005) | ND (.0005) | ND (.0005) | ND (.0005) | ND (.0005) |
| Lead (ICPES) | ND (.042) | ND (.042) | .06 (.042) | ND (.042) | ND (.042) | ND (.042) | ND (.042) |
| Selenium (Hydride AA) | ND (.004) | ND (.004) | ND (.004) | ND (.004) | ND (.004) | ND (.004) | ND (.004) |

ICPES = Inductively Coupled Plasma (Atomic) Emission Spectrometry
AA = Atomic Absorption Spectrophotometry
ND = Not detected at specified detection limit
( ) = Detection limit

Source: Soil Removal Investigation Report (Radian 1987)

TABLE 2-4

SUMMARY OF SURFACE SOIL SAMPLING, BOREHOLE DRILLING, AND BOREHOLE SAMPLING CONDUCTED BY WCC AT AGE DRAINAGE DITCH, SWMU NO. 34 / IRP NO. SD-15 , CANNON AFB, NEW MEXICO

| BORING NUMBER | DRILLING/ SAMPLING METHOD | DRILL RIG USED | BOREHOLE DIAMETER (In) | DRILLING/ SAMPLING DEPTH INTERVALS (Ft-BGS) | BOREHOLE SAMPLING FREQUENCY | DATE(S) DRILLED/ SAMPLED | NUMBER OF ANALYTICAL SOIL SAMPLES COLLECTED | NUMBER OF ANALYTICAL QA/QC SAMPLES COLLECTED | NUMBER OF SPT SOIL SAMPLES COLLECTED | NUMBER OF GRADATION ANALYSIS SAMPLES COLLECTED | GROUND ELEVATION (Ft-MSL) | TOTAL DEPTH OF BOREHOLE (Ft-BGS) | DATE BOREHOLE GROUTED |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0341 | HT | NA | NA | 0 to 0.5 | NA | 10-24-91 | 1 | 1 | NA | 0 | 4300.28 | 3 | 12-10-91 |
| | HSA | B-61B | 7.5 | 0 to 3 | Continous | 12-08-91 | 1 | 4 | 2 | 0 | | | |
| (0344)* | HT | NA | NA | 0 to 0.5 | NA | 12-10-91 | 1 | 1 | 0 | 0 | 4300.15 | 0.5 | NA |
| 0342 | HSA | B-53 | 6.5 | 0 to 11 | Continous | 10-22-91 | 3 | 3 | 5 | 1 | 4300.07 | 11 | 10-22-91 |
| (0343)* | HSA | B-61B | 7.5 | 0 to 10 | 1.5' Intervals | 12-08-91 | 1 | 3 | 3 | 0 | 4300.00 | 10 | 12-10-91 |

| | | | |
|---|---|---|---|
| In | Inches | B-53 | Mobile B-53 Auger Drill Rig with 6" OD / 3.75" ID Augers and 6.5" Bullet Bit |
| Ft-BGS | Feet Below Ground Surface | B-61A | Mobile B-61 Auger Drill Rig with 6" OD / 3.75" ID Augers and 6.5" or 6.25" Bullet Bit |
| Ft-MSL | Feet Mean Sea Level | B-61B | Mobile B-61 Auger Drill Rig with 7.25" OD / 4.25" ID Augers and 7.5" Bullet Bit |
| SPT | Standard Penetration Test | F-10 | Failing F-10 Auger Drill Rig with 8.25" OD / 4.25" ID Augers and 8.5" Bullet Bit |
| HSA | Hollow Stem Auger | CME-75 | Central Mine Equipment CME-75 Auger Drill Rig with 7.75" OD / 4.25" ID Augers and 8.0" Bullet Bit |
| HT | Hand Trowel, Surface Sample | OD | Outer Diameter |
| NA | Not Applicable, Surface Sample | ID | Inner Diameter |
| NS | Not Sampled | | |

( )* The borings that are shaded and in parentheses correspond to either a redrill or surface resample of the previous boring or surface sample due to laboratory missed holding times. These borings or surface resamples were drilled or collected approximately 1 to 5 feet away from the original boring or surface sample location.

**Woodward-Clyde Consultants**

TABLE 2-5

SUMMARY OF SURFACE SOIL, SUBSURFACE SOIL, AND QA/QC SAMPLES COLLECTED BY WCC AT AGE DRAINAGE DITCH, SWMU NO. 34 / IRP NO. SD-15, CANNON AFB, NEW MEXICO

| BORING NUMBER | DEPTH INTERVAL (Ft-BGS) | SAMPLE IDENTIFICATION NUMBER | SAMPLE TYPE | QA/QC SAMPLES | SAMPLE MATRIX | DATE SAMPLED | TIME SAMPLED | OVA ON SAMPLE (ppm) | ANALYTICAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|---|
| 0341 | 0 to 0.5 | CAN034-0341-0000 | A | MS/MSD | Soil | 10-24-91 | 1555 | 0 | VOC,SV,M,TPH |
| | 0 to 1 | CAN034-0341-4000 | SPT | | Soil | 12-08-91 | 1425 | | |
| | 1 to 3 | CAN034-0341-0001 | A/SPT | | Soil | 12-08-91 | 1430 | 0 | VOC,SV,M,TPH |
| | | CAN034-0341-0101 | A | MRD | Soil | 12-08-91 | 1430 | 0 | VOC,SV,M,TPH |
| | | CAN034-0341-0151 | A | AB | Water | 12-08-91 | 1500 | | VOC |
| | | CAN034-0341-0181 | A | DW | Water | 12-08-91 | 1510 | | VOC |
| | | CAN034-0341-0172 | A | RB | Water | 12-08-91 | 1640 | | VOC,SV,M,TPH |
| (0344)* | 0 to 0.5 | CAN034-0344-0000 | A | MS/MSD | Soil | 12-10-91 | 1120 | 0 | VOC |
| 0342 | 1.5 to 3 | CAN034-0342-0001 | A/SPT | | Soil | 10-22-91 | 1050 | 0 | VOC,SV,M,TPH |
| | | CAN034-0342-0161 | A | FD | Soil | 10-22-91 | 1050 | 0 | VOC,SV,M,TPH |
| | 3 to 5 | CAN034-0342-4003 | SPT | | Soil | 10-22-91 | 1055 | | |
| | 5 to 7 | CAN034-0342-0005 | A/SPT | MS/MSD | Soil | 10-22-91 | 1130 | 0 | VOC,SV,M,TPH |
| | 7 to 9 | CAN034-0342-4007 | SPT | | Soil | 10-22-91 | 1135 | | |
| | 9 to 11 | CAN034-0342-0009 | A/SPT | | Soil | 10-22-91 | 1220 | 0 | VOC,SV,M,TPH |
| | | CAN034-0342-4009 | GA | | Soil | 10-22-91 | 1220 | | |
| | | CAN034-0342-0171 | A | RB | Water | 10-22-91 | 1415 | | VOC,SV,M,TPH |
| (0343)* | 1.5 to 3.5 | CAN034-0343-4001 | SPT | | Soil | 12-08-91 | 1320 | 0 | |
| | 5 to 7 | CAN034-0343-4005 | SPT | | Soil | 12-08-91 | 1335 | 0 | |
| | 8 to 10 | CAN034-0343-0008 | A/SPT | | Soil | 12-08-91 | 1345 | 0 | VOC |
| | | CAN034-0343-0152 | A | AB | Water | 12-08-91 | 1405 | | VOC |
| | | CAN034-0343-0171 | A | RB | Water | 12-08-91 | 1415 | | VOC |
| | | CAN034-0343-0181 | A | DW | Water | 12-08-91 | 1445 | | VOC |

| | | | | | |
|---|---|---|---|---|---|
| Ft-BGS | Feet Below Ground Surface | FD | Field Duplicate | SV | Semi Volatile Organic Compounds |
| OVA | Organic Vapor Analyzer Reading | MRD | Missouri River Division Duplicate | M | Metals (TAL) |
| ppm | Parts per Million | AB | Ambient Blank | TPH | Total Petroleum Hydrocarbons |
| A | Analytical | RB | Rinsate Blank | BTEX | Benzene, Toluene, Ethylbenzene, Xylene |
| SPT | Standard Penetration Test | DW | Decontamination Water Blank | | |
| GA | Gradation Analysis | TB | Trip Blank | TOC | Total Organic Carbon |
| L | Lithology | VOC | Volatile Organic Compounds (TCL) | OL | Organic Lead |
| MS/MSD | Matrix Spike / Matrix Spike Duplicate | PCB | Polychlorinated Biphenols, Pesticides | Pb/Cr | Lead / Chromium |
| | | TCL | Target Compound List | TAL | Target Analyte List |

( )* The borings that are shaded and in parentheses correspond to either a redrill or surface resample of the previous boring or surface sample due to laboratory missed holding times. These borings or surface resamples were drilled or collected approximately 1 to 5 feet away from the original boring or surface sample.

## TABLE 2-6

## MINIMUM, MAXIMUM AND MEAN CONCENTRATIONS OF MAJOR ELEMENTS MEASURED IN SOIL SAMPLES COLLECTED BY WCC AT VARIOUS SWMUs CANNON AFB, CLOVIS, NEW MEXICO

| | Common Range for Soils[1] (mg/kg) | Age Drainage Ditch SWMU No. 34 (mg/kg) | | | Sludge Weathering Pit SWMU No. 76 (mg/kg) | | | Fire Training Area No. 1 SWMU No. 78 (mg/kg) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Min. | Max. | Mean | Min. | Max. | Mean | Min. | Max. | Mean |
| Calcium | 7,000-500,000 | 39,200 | 122,000 | 70,000 | 2,600 | 219,000 | 123,000 | 832 | 151,000 | 40,000 |
| Potassium | 400-30,000 | 860 | 2,140 | 1,500 | 592 | 1,830 | 1,300 | 253 | 2,570 | 1,200 |
| Sodium | 750-7,500 | 319 | 319 | 320 | 304 | 361 | 330 | ND | ND | ND |

| | Engine Test Cell SWMU Nos. 86-90 (mg/kg) | | | NE Stormwater Drainage SWMU No. 95 (mg/kg) | | | Sanitary Sewer Line SWMU No. 98 (mg/kg) | | | Offsite Background OFS (mg/kg) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Min. | Max. | Mean | Min. | Max. | Mean | Min. | Max. | Mean | Min. | Max. | Mean |
| Calcium | 2,000 | 231,000 | 59,000 | 88,900 | 223,000 | 142,000 | 4,900 | 29,600 | 120,000 | 1910 | 2,840 | 2,300 |
| Potassium | 803 | 2,250 | 1,600 | 448 | 2,030 | 1,200 | 823 | 2,770 | 1,600 | 1,730 | 1,930 | 1,800 |
| Sodium | ND | ND | ND | 1,170 | 6,410 | 2,900 | 330 | 532 | 410 | ND | ND | ND |

mg/kg = Milligrams per kilogram
ND = Not detected above the reporting limit.
[1] Source: Lindsay, W.L., 1979. Chemical Equilibria in Soils. John Wiley and Sons, N.Y., N.Y.

# TABLE 2-7

## BACKGROUND ELEMENTAL CONCENTRATIONS (1) IN SOIL SAMPLES COLLECTED BY WCC AT OFFSITE AREAS AND ALONG THE SANITARY SEWER LINE CANNON AFB, NEW MEXICO

| Boring No. | OFS-1 | OFS-2 | 9805 | 9805 | 9807 | 9819 | 9823 | 9826 | 9827 | 9828 | 9829 | 9834 | 9836 | 9841 | 9842 | 9843 | Mean | Std. | Statistical | Levels in |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth (Ft-BGS) | 0 | 0 | 11 | 14 | 11 | 12 | 14 | 15 | 17 | 14 | 16 | 10 | 10 | 06 | 07 | 08 | x | Dev. | Range(2) | Clovis, NM Region (4) |
| ELEMENT | | | | | | | | | | | | | | | | | | | | |
| Aluminum | 8670 | 8830 | 4910 | 8240 | 9370 | 5490 | 8810 | 8810 | 4280 | 4610 | 5120 | 5180 | 7790 | 6000 | 4000 | 4030 | 6508.75 | 1969.04 | 2571-10447 | 5,000 |
| Antimony | 5 | 5 | 5.1 | 5.2 | 5.2 | 5.5 | 5.3 | 5.2 | 5.1 | 5.2 | 5.3 | 5.1 | 5.1 | 5.1 | 5.2 | 4.9 | 5.16 | 0.14 | 4.88-5.44 | <1 |
| Arsenic | 1.8 | 1.9 | 1.1 | 1.4 | 1.8 | 0.95 | 1.3 | 1.3 | 0.67 | 0.7 | 0.85 | 1 | 0.76 | 1.2 | 1 | 1.3 | 1.19 | 0.38 | 0.43-1.95 | 6.5 |
| Barium | 67.2 | 62.3 | 140 | 1200 | 351 | 856 | 136 | 79.1 | 111 | 70.4 | 231 | 241 | 14.9 | 442 | 67.1 | 334 | 275.19 | 313.99 | 0-903 | 500 |
| Beryllium | 0.49 | 0.44 | 0.44 | 0.64 | 0.46 | 0.47 | 0.47 | 0.45 | 0.45 | 0.45 | 0.46 | 0.54 | 0.77 | 0.56 | 0.45 | 0.43 | 0.50 | 0.09 | 0.32-0.68 | 1-2 |
| Cadmium | 0.87 | 0.87 | 0.88 | 0.91 | 0.91 | 0.95 | 0.93 | 1.1 | 0.89 | 0.9 | 0.92 | 0.89 | 0.89 | 0.89 | 0.91 | 0.86 | 0.91 | 0.05 | 0.81-1.01 | --- |
| Calcium | 2220 | 1910 | 101000 | 40600 | 62100 | 154000 | 121000 | 57700 | 78500 | 51800 | 157000 | 89800 | 4900 | 124000 | 131000 | 172000 | 84345.63 | 54358.32 | 0-193062. | 790-1800 |
| Chromium | 8.6 | 8.7 | 5.1 | 7.6 | 8.3 | 4.6 | 5.7 | 6.3 | 4 | 4.5 | 4.1 | 4.8 | 8 | 6.2 | 4.5 | 4.8 | 5.99 | 1.66 | 2.67-9.31 | 30 |
| Cobalt | 2.7 | 2.7 | 2 | 3.9 | 3.3 | 1.4 | 3.2 | 3 | 1.3 | 2.5 | 2.5 | 3.1 | 3 | 3.1 | 3.3 | 2.5 | 2.72 | 0.67 | 1.38-4.06 | 3-7 |
| Copper | 18.3 | 15.3 | 6.6 | 6.8 | 9.3 | 4 | 7.2 | 9.2 | 2.8 | 4.1 | 4.4 | 7.7 | 5.4 | 7 | 6.5 | 7 | 7.60 | 3.92 | 0.00-15.44 | 20 |
| Iron | 7860 | 8010 | 3720 | 6390 | 7240 | 2750 | 5240 | 5950 | 3940 | 5390 | 4540 | 4600 | 7960 | 5900 | 4040 | 3930 | 5466.25 | 1613.57 | 2239-8693 | 100-1500 |
| Lead | 5.7 | 10 | 3.5 | 6.5 | 5.8 | 1.5 | 5.6 | 4.2 | 3.9 | 5.3 | 4.1 | 4.5 | 5.8 | 5.8 | 5.6 | 5.4 | 5.20 | 1.72 | 1.76-8.64 | 15 |
| Magnesium | 1390 | 1410 | 2460 | 4410 | 4420 | 18300 | 5580 | 3950 | 3830 | 3030 | 4300 | 4420 | 4080 | 3070 | 2680 | 2830 | 4385.00 | 3758.93 | 0-11903 | 200-500 |
| Manganese | 150 | 172 | 63.2 | 128 | 138 | 24.9 | 64.1 | 80.8 | 43.3 | 91 | 85.7 | 97.7 | 71.4 | 99.2 | 54.4 | 62.4 | 89.13 | 39.12 | 10.69-167 | 500 |
| Mercury | 0.11 | 0.11 | 0.11 | 0.11 | 0.11 | 0.12 | 0.12 | 0.11 | 0.11 | 0.11 | 0.11 | 0.11 | 0.11 | 0.11 | 0.11 | 0.11 | 0.11 | 0.00 | ----(3) | 0.32 |
| Nickel | 6.9 | 6.7 | 3.8 | 6.9 | 8.2 | 4.5 | 5 | 5.7 | 4.4 | 5.8 | 5.8 | 7.9 | 7.5 | 6.3 | 5.9 | 5.2 | 6.03 | 1.23 | 3.57-8.49 | 15 |
| Potassium | 1760 | 1930 | 1150 | 1890 | 2100 | 986 | 2060 | 2080 | 1300 | 1360 | 1570 | 1710 | 2770 | 1410 | 1020 | 866 | 1622.63 | 495.14 | 632-2613 | 1600 |
| Selenium | 0.22 | 0.22 | 0.22 | 0.23 | 0.23 | 0.24 | 2.3 | 0.22 | 0.22 | 0.23 | 0.23 | 0.22 | 0.22 | 0.22 | 0.23 | 0.21 | 0.35 | 0.50 | 0-1.35 | 0.15-0.30 |
| Silver | 0.87 | 0.87 | 0.88 | 0.91 | 0.91 | 0.95 | 0.93 | 0.9 | 0.89 | 0.9 | 0.92 | 0.89 | 0.89 | 0.89 | 0.91 | 0.86 | 0.90 | 0.02 | 0.86-0.94 | --- |
| Sodium | 286 | 288 | 290 | 384 | 301 | 313 | 307 | 297 | 295 | 297 | 302 | 295 | 615 | 295 | 532 | 452 | 346.81 | 96.47 | 154-540 | 700 |
| Thallium | 0.22 | 0.22 | 0.22 | 0.23 | 0.23 | 0.24 | 0.23 | 0.22 | 0.22 | 0.23 | 0.23 | 0.22 | 0.22 | 0.22 | 0.23 | 0.21 | 0.22 | 0.01 | 0.20-0.24 | --- |
| Vanadium | 17.7 | 17.6 | 8.5 | 19.5 | 20.5 | 23.6 | 16.3 | 17.6 | 16.2 | 19.7 | 16.4 | 20.5 | 28.3 | 19.5 | 13.5 | 12.6 | 18.00 | 4.37 | 9.26-26.74 | 30-70 |
| Zinc | 18.6 | 21.4 | 10.3 | 17.4 | 19.5 | 5.5 | 13.3 | 14.4 | 7.9 | 11.6 | 11.3 | 10.7 | 16.4 | 13.4 | 9.9 | 9.6 | 13.20 | 4.31 | 4.58-21.82 | 45 |

--- = No value given

Ft-BGS = Feet below ground surface

(1) All concentrations are in milligrams per kilogram (mg/kg)

(2) The range was established as (+) or (-) two standard deviations from the mean.

(3) No range could be calculated.

(4) USGS 1984

## TABLE 2-8

## POLYNUCLEAR AROMATIC HYDROCARBON (PAH) CONCENTRATIONS[1] IN SOIL SAMPLES COLLECTED BY WCC AT AGE DRAINAGE DITCH

## SWMU NO. 34/IRP NO. SD-15
## CANNON AFB, NEW MEXICO

| Compound | Boring 0341 Sample Depth (Ft-BGS) | | Boring 0342 Sample Depth (Ft-BGS) | | |
|---|---|---|---|---|---|
| | 0-0.5 | 1-3 | 1.5-3 | 5-7 | 9-11 |
| Phenanthrene | 200J | 370J | 380U | 370U | 370U |
| Fluoroanthene | 400J | 840 | 380U | 370U | 370U |
| Pyrene | 270J | 600 | 380U | 370U | 370U |
| Anthracene | 710U | 100J | 380U | 370U | 370U |
| Chrysene | 200J | 370J | 380U | 370U | 370U |
| Benzo(a)anthracene | 160J | 340J | 380U | 370U | 370U |
| Benzo(a)pyrene | 200J | 310J | 380U | 370U | 370U |
| Benzo(b)fluoranthene | 400J | 520 | 380U | 370U | 370U |
| Benzo(k)fluoranthene | 710U | 200J | 380U | 370U | 370U |
| Dibenzo(a,h)anthracene | 710U | 53J | 380U | 370U | 370U |
| Benzo(g,h,i)perylene | 300J | 400U | 380U | 370U | 370U |
| Indeno(1,2,3-cd)pyrene | 240J | 250J | 380U | 370U | 370U |

Ft-BGS = Feet below ground surface
J = Estimated value
U = Not detected
[1] All concentrations are in micrograms per kilogram ($\mu$g/kg).

TABLE 2-9

TOTAL PETROLEUM HYDROCARBON CONCENTRATIONS IN SOIL SAMPLES
COLLECTED BY WCC AT
AGE DRAINAGE DITCH

SWMU NO. 34/IRP NO. SD-15
CANNON AFB, NEW MEXICO

| Boring Number | Sample Depth (Ft-BGS) | TPH (mg/kg) |
|---|---|---|
| 0341 | 0 - 0.5 | 1180 |
| | 1 - 3.0 | 397 |
| 0342 | 1.5 - 3 | 45.1 U |
| | 5 - 7 | 44.6 U |
| | 9 - 11 | 44.9 U |

U = Not detected
Ft-BGS = Feet below ground surface
mg/kg = Milligrams per kilogram

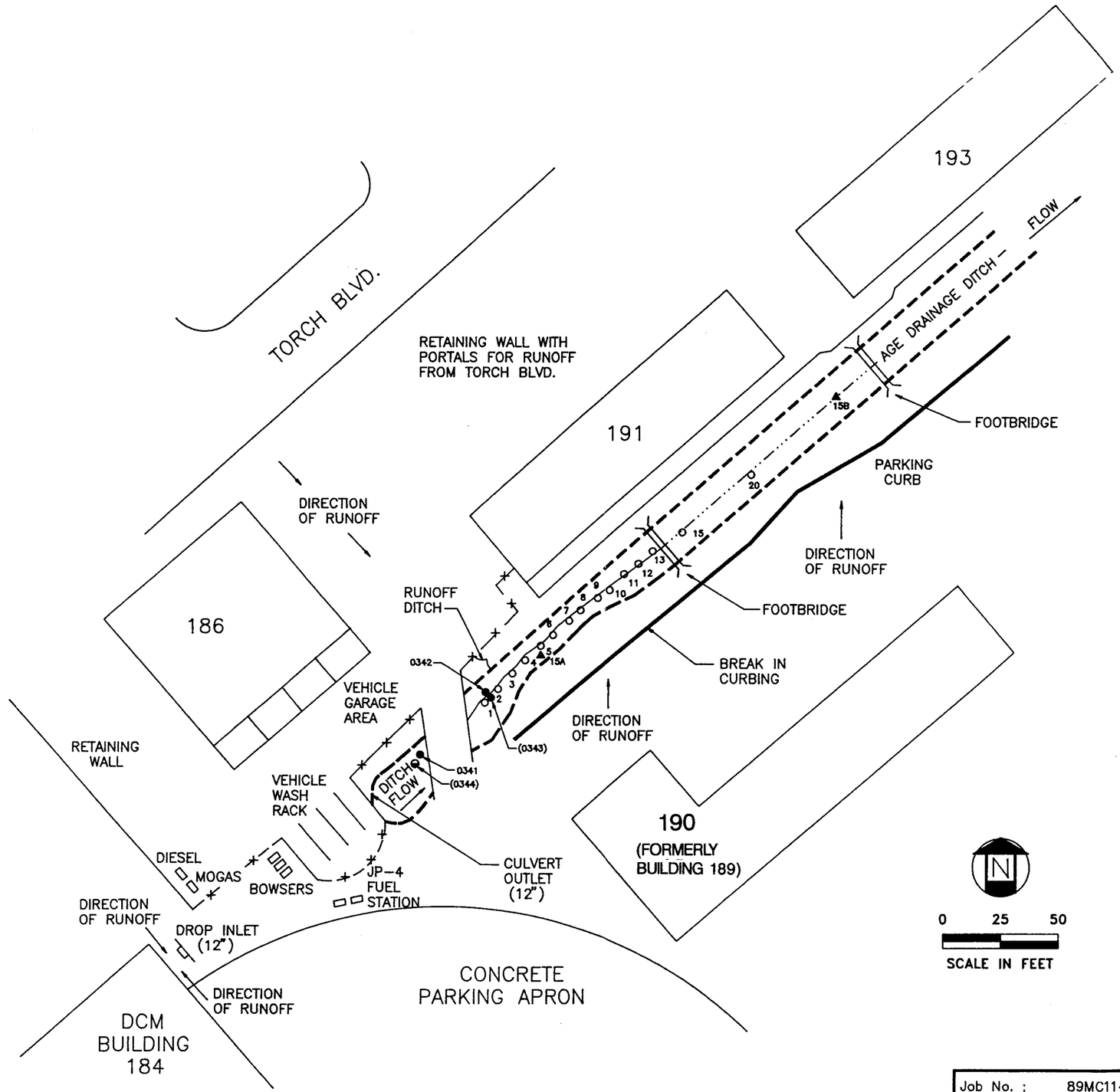
## TABLE 2-10

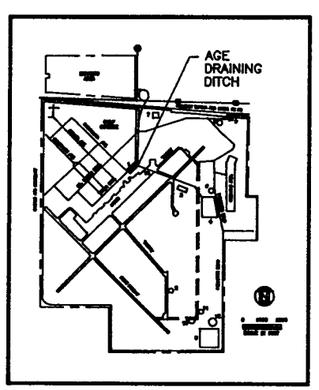
## METAL CONCENTRATIONS[1] IN SOIL SAMPLES COLLECTED BY WCC AT AGE DRAINAGE DITCH SWMU NO. 34/IRP NO. SD-15 CANNON AFB, NEW MEXICO

| | Boring 0341 Sample Depth (Ft-BGS) | | Boring 0342 Sample Depth (Ft-BGS) | | Background[2] |
|---|---|---|---|---|---|
| Element | 0-0.5 | 1-3 | 1.5-3 | 5-7 | ($\bar{x}$ + 2$\sigma$) |
| Aluminum | 4040 | 8230 | 12500 | 9170 | 2571-10447 |
| Antimony | 5UJ | 5.5 UJ | 5.2UJ | 5.2UJ | 4.88-5.4 |
| Arsenic | 1.6J | 2.8 J | 2J | 2J | 0.43-1.95 |
| Barium | 148J | 161 J | 94.8 | 163J | 0-903 |
| Beryllium | 0.43U | 0.48 U | 0.55J | 0.49J | 0.32-0.68 |
| Cadmium | 1.3 | 0.96 U | 0.9U | 0.91U | 0.81-1.01 |
| Calcium | 39200 | 49100 | 69700 | 122000 | 0-193062 |
| Chromium | 12.3 | 10.4 | 10.5 | 8.1 | 2.67-9.31 |
| Cobalt | 2.8J | 2.8 J | 4.2J | 3.5J | 1.38-4.06 |
| Copper | 15 | 20.7 | 14U | 10.8U | 0.00-15.44 |
| Iron | 4680J | 6710 J | 8920 | 6450 | 2239-8683 |
| Lead | 40.7 | 38.1 | 6.5 | 5.1 | 1.76-8.64 |
| Magnesium | 1530 | 2330 | 2810 | 3320 | 0-11903 |
| Manganese | 83.9 | 173 J | 120 | 83.4J | 10.88-167 |
| Mercury | 0.11U | 0.12 U | 0.11U | 0.11U | -- - -- |
| Nickel | 7.5U | 7.1 J | 9.2 | 7.1J | 3.57-8.49 |
| Potassium | 860J | 1570 | 2140 | 1520 | 632-2613 |
| Selenium | 2.2J | - R | -R | -R | 0.00-1.35 |
| Silver | 0.87U | 0.96 U | 0.9U | 0.91U | 0.86-0.94 |
| Sodium | 319J | 316 U | 298U | 299U | 154-540 |
| Thallium | 0.22UJ | 0.24 UJ | 0.23UJ | 0.23UJ | 0.20-0.24 |
| Vanadium | 11.8 | 16 | 18.1 | 19.1 | 9.26-26.74 |
| Zinc | 237J | 60.3J | 22 | 16.8J | 4.58-21.82 |

UJ = Estimated as non-detect at instrument detection limit
J = Estimated value
U = Not detected
-R = Rejected
-- - -- = No range could be calculated
Ft-BGS = Feet below ground surface

[1] All concentrations are in milligrams per kilogram (mg/kg).
[2] Background range calculated from values in Table 2-7.




N

0 25 50

SCALE IN FEET

LEGEND

- ▲ 15B — RADIAN 1984–1985 FIELD INVESTIGATION SOIL BORING LOCATION
- ○ 15 — RADIAN 1987 FIELD INVESTIGATION SOIL BORING LOCATION
- ● 0342 — WCC 1991 FIELD INVESTIGATION SOIL BORING LOCATION
- ◒ 0341 — WCC 1991 FIELD INVESTIGATION SURFACE SOIL SAMPLE LOCATION
- - - - SWMU BOUNDARY
- 190 — BUILDING NUMBER

NOTE: THE NUMBERS IN PARENTHESIS CORRESPOND TO REDRILLS/RESAMPLES OF THE ORIGINAL BORING/SAMPLE

| | |
|---|---|
| Job No. : | 89MC114W |
| Prepared by : | D.A.K. |
| Date : | 2/10/92 |

LOCATION OF SOIL BORINGS AT AGE DRAINAGE DITCH

SWMU NO. 34/IRP NO. SD-15

CANNON AFB, NEW MEXICO

FIG. 2–1

C1140010

# 3.0
# SLUDGE WEATHERING PIT (SWMU NO. 76/IRP NO. WP-14)

## 3.1 SWMU DESCRIPTION

### 3.1.1 Setting

The sludge weathering pit is located near Building 396 on the north part of the base and was used for weathering sludge from leaded gas tanks (Figure 3-1). After the sludge was judged to be weathered, it was removed to a landfill for final disposition (USAF 1990).

### 3.1.2 History of Use

This site was used in the 1960s and 1970s for the weathering of fuel tank sludges. The quantities of sludges weathered at the site or how often it was used is not known. However, the quantities of sludge are estimated to be small based on conversations with base personnel. The pit was last used in 1980, at which time it was filled with soil and left to revegetate (USAF 1990).

### 3.1.3 Past Investigations

The pit is a well defined area with a depressed ground surface covered with native vegetation. A low, subtle berm surrounds the pit. A soil sample was analyzed in 1981 for lead, and extractable oil and grease. Results for lead were negative and the analysis for oil and grease indicated 0.012 g/kg (CH2M Hill 1983).

### 3.1.4 Land Use and Demography

The sludge weathering pit is located in an open field that is not currently being used. However, the pit is located adjacent to the east side of the POL bulk storage area where fuels are stored. Ground maintenance contractors mow the pit area once per month for approximately 5 to 10 minutes, for 6 months of the year.

## 3.2 FIELD INVESTIGATION

This section provides a discussion of the field activities conducted by WCC at the Sludge Weathering Pit from October 21 through 29, 1991. The activities at this SWMU, as outlined in the FSP (WCC 1991c), consisted of collecting 2 surface soil samples for chemical analysis, 1 surface soil sample for gradation analysis, drilling 4 soil borings, collecting 9 subsurface soil samples for chemical analysis and 3 subsurface soil samples for gradation analysis.

Table 3-1 summarizes the drilling and sampling methods, along with sampling frequency conducted at each soil boring and surface sample location during the 1991 WCC investigation. A complete record of all surface soil, subsurface soil, and associated QA/QC samples collected at the Sludge Weathering Pit is presented in Table 3-2. The locations of the surface soil samples and soil borings are shown on Figure 3-1.

### 3.2.1 Sampling Objectives

The objective of sampling at the Sludge Weathering Pit was to evaluate the nature and extent of potential hazardous contaminants that may be present. The sampling intervals were located to provide a cross-sectional profile of the sludge weathering pit. The data collected at these boring locations were used to further evaluate the extent of potential contamination, if present, and to perform a baseline risk assessment to determine if the area poses a risk to human health or the environment. The data may also be utilized to evaluate remedial actions if necessary. Presently, there does not appear to be any substantial risk to the groundwater, so no hydrogeologic investigation was planned or conducted.

### 3.2.2 Surface Soil Investigation

Three surface soil samples were collected from 0 to 0.5 feet BGS near borings 0760, 0762, and 0763. All three samples were collected using a stainless steel hand trowel. The samples from borings 0762 and 0763 were analyzed for TCL VOCs, semi-VOCs, TAL metals, and organic lead. Geotechnical gradation analysis was performed on one sample from boring 0760.

### 3.2.3 Subsurface Soil/Vadose Zone Investigation

One soil boring, 0760, was initially drilled near the center of the pit to determine the pit bottom/native soil interface. This boring was drilled to a depth of 19 feet BGS, and sampled continuously. All soil borings were described lithologically from the split spoon samples obtained during drilling. The bottom of the pit was estimated to be between 6 and 7 feet BGS. All field personnel involved in the drilling of this soil boring were suited up in Level C personal protective equipment (PPE). A total of four air samples (one ambient air blank, three real-time samples) were collected using continuous flow pumps during the drilling of this boring and analyzed for tetraethyl lead. The results of the analyses were non-detect for tetraethyl lead. Based on these results, the remaining three soil borings were drilled in Level D PPE.

The three other borings, 0761, 0762, 0763, were drilled to depths of 27, 33, and 24 feet BGS, respectively. All soil borings were sampled continuously from surface to 20 feet BGS and at 5-foot intervals from 20 feet BGS to total depth. The split spoons were described lithologically. Subsurface soil samples for chemical analysis were collected at 4, 10, and 25 feet BGS in boring 0761; at 8, 14, and 31 feet BGS in boring 0762; and at 8, 18, and 22 feet BGS in boring 0763 for a total of nine subsurface soil samples. The subsurface analytical samples were collected with stainless steel split spoons and analyzed for TCL VOCs, semi-VOCs, TAL metals and organic lead. Three subsurface soil samples were collected at 2 feet BGS in boring 0761; at 8 feet BGS in boring 0762; and at 14 feet in boring 0763 for geotechnical gradation analysis.

## 3.3 PHYSICAL CHARACTERISTICS

This section provides a discussion of the soil, geology and hydrogeology at the Sludge Weathering Pit based on the detailed lithologic descriptions of split spoon samples and gradation analysis results from the 1991 WCC investigation.

### 3.3.1 Soil

The soils underlying the Sludge Weathering Pit were not characterized because the material encountered during the drilling of the four soil borings was determined to be backfill used to fill in the pit after it was closed in 1980.

### 3.3.2 Geology

The near surface (upper 33 feet) stratigraphy at the Sludge Weathering Pit consists of Tertiary Miocene to Pliocene fluvial deposits of the Ogallala Formation. Geologic cross-section A-A' (Figure 3-2) was constructed using the lithologic borings from the 1991 WCC field investigation. This cross-section runs northwest-southeast (see Figure 3-1 for the cross-section location). Stratigraphic correlations of the various fluvial deposits between borings is based primarily on the split spoon lithologic samples collected during drilling.

The SWMU is underlain by Ogallala fluvial deposits consisting primarily of well sorted sand, with scattered thin (1 to 4 feet thick) layers of caliche. The total thickness of these Ogallala deposits beneath the SWMU is not presently known, but based on regional information, may be as thick as 390 feet.

It would appear from the geologic cross-section and the lithologic descriptions (Appendix B-1) that two fairly distinct sand, sand/caliche units are present beneath the SWMU to a depth of 33 feet. The lower fluvial deposits shown on the cross-section from 4283 to 4285 feet MSL consist of very fine- to medium-grained, moderately sorted, unconsolidated light red-brown sands. These sands are comprised predominantly of subangular to subrounded quartz grains and are relatively clean (i.e., little or no silt/clay sized particles). This unit was only encountered in boring 0762 at approximately 31 feet BGS. The thickness of this unit cannot be determined at present due to the fact that the unit was not fully penetrated.

The upper fluvial deposits shown on the geologic cross-section from 4285 to 4310 feet MSL consist of very fine- to fine-grained, well sorted, silty, calcareous light to pale brown sands. These sands are comprised predominantly of subangular to subrounded quartz

grains with varying amounts of silt. Occasionally, these sands are moderately to well cemented with calcium carbonate. Thin layers of light to medium brown, silty, sandy caliche are scattered throughout this unit. In all four soil borings, the upper 5 to 8 feet of this unit was heavily stained medium to dark gray, with most of the unit between 5 and 19 feet BGS also appearing to be contaminated with petroleum residues based on OVA readings and visual and odor observations. Two gradation analyses were performed on samples collected within this unit, one from the caliche at 8 feet BGS in boring 0762 and one from the sand at 14 feet BGS in boring 0763. The results indicate that the caliche sample was comprised of approximately 45 percent calcium carbonate and/or clay-sized material, 32 percent sand, and 23 percent silt, while the sand sample was comprised of approximately 60 percent sand, 26 percent silt, and 14 percent calcium carbonated and/or clay-sized material. Based on the cross-section, the thickness of this unit is approximately 25 feet at boring 0762. Approximately 6 feet of backfill exists above this unit. No groundwater was encountered during the drilling of these borings.

### 3.4 NATURE AND EXTENT OF CONTAMINATION

Two surface soil samples, 0762 and 0763, and nine subsurface soil samples from borings 0761, 0762, and 0763, were collected (Figure 3-1). Evaluation of the chemical analyses (TCL VOCs, semi-VOCs, TAL metals, organic lead) of these samples has been used as a basis for characterizing the nature and extent of hazardous contaminants that may be present.

Target analyte list volatile organic compounds and semi-volatile organic compounds were not detected above the CRQL in surface and subsurface samples from SWMU No. 76. Acetone was reported by the lab to be present in one sample in boring 0763 at a depth of 18 feet at a concentration of 210 $\mu$g/kg. However, the absence of detectable acetone in other samples from the same boring and the low concentration of acetone indicates acetone probably occurred from laboratory contamination.

Ethyl benzene and xylenes were also reported at estimated concentrations of 4000J and 7900J $\mu$g/kg, respectively, in boring 0763 at 8 to 10 feet bgs, but both compounds were below the laboratory reporting limits of 27,000 $\mu$g/kg for that sample, and hence the reported concentrations are uncertain (Table 3-3). The reporting limits for TCL volatile

and semi-volatile organic analyses were raised in samples 0761 (4 to 6 feet bgs), 0762 (8 to 10 feet bgs), and 0763 (8 to 10 feet bgs) because of the sample dilution necessitated due to the presence of non-target compounds (Table 3-3). Tentatively identified compounds (TICs) from VOC and semi-VOC analyses of the above samples revealed a variety of medium molecular weight saturated and unsaturated hydrocarbons. The surface samples collected from borings 0762 and 0763 did not have to be diluted for the analysis.

For the subsurface samples at greater than 10 feet bgs, the TIC report indicated very few hydrocarbons and at low enough levels that the samples did not require dilution. Ethyl benzene and xylenes were not detected above the CRQL in any of the borings below the 10-foot depth. The presence of non-target compounds at shallow depths may be due to the residual petroleum sludge at the bottom of the pit, estimated to be at a depth of approximately 6 feet bgs (see Section 3.2.3).

The results for metals analysis of the two surface soil samples collected at boring locations 0762 and 0763 generally indicate that metals were detected at or below background concentrations (Table 3-4). The metals beryllium, chromium, cobalt, iron, lead, manganese, and zinc, were detected above site background, levels, but below concentrations in soils of this region.

Results for metals analysis of subsurface samples shown in Table 3-4 indicate that the metals were detected below background concentrations. Barium was detected above background levels at 1060 mg/kg in boring 0761 at 18 feet bgs; however, barium was also detected at concentrations below background in all other samples at this SWMU. This suggests that this value is either an anomaly or reflects the natural variability of barium in the soils due to variability of sand and caliche layers. Mercury was detected above the site background range in two samples from boring 0761 at concentrations of 0.13 and 0.85 mg/kg at 4 and 25 feet bgs respectively; however, no mercury was detected at the 10-foot depth in the same boring. Silver was detected at low concentrations (1J to 1.5J mg/kg in two samples from boring 0761, and 1 sample from boring 0762). The values for silver are near background levels for soil at Cannon AFB, and are estimated values; therefore, it is not considered to be a contaminant of concern at the SWMU.

Organic lead was analyzed in all of the samples because of the known history of the site where leaded gas tank sludges were initially treated (Table 3-4). However, there is no indication that organic lead is at levels of concern at this site. Since organic lead is highly unstable under normal conditions because of its rapid oxidation rates, it is not unusual that organic lead is found only at low levels. However, inorganic lead, an oxidation product of organic lead, was also detected at concentrations below site background levels found in soils of this region.

In summary, the analytical data suggest the possible presence of residual petroleum tank bottom sludge in the pit from a depth of 4 to 6 feet bgs and underlying native soils containing petroleum compounds from a depth of 6 to possibly 18 feet bgs, particularly in the vicinity of borings 0762 and 0763. Ethyl benzene and xylenes were detected at estimated concentrations of 4000 $\mu$g/kg and 7900 $\mu$g/kg, respectively, in boring 0763 at a depth of 8 to 10 feet.

Ethyl benzene and xylene may also be present in samples from 4 to 6 feet in boring 0761 and 8 to 10 feet in boring 0762 but may be masked by high detection due to laboratory dilution of samples because of non-target compounds.

Mercury appears to be the only metal of concern at this SWMU, with concentrations of 0.13 mg/kg at 4 feet bgs and 0.85 mg/kg at 25 feet bgs in soil boring 0761.

TABLE 3-1

SUMMARY OF SURFACE SOIL SAMPLING, BOREHOLE DRILLING, AND BOREHOLE SAMPLING CONDUCTED BY WCC AT SLUDGE WEATHERING PIT, SWMU NO. 76 / IRP NO. WP-14, CANNON AFB, NEW MEXICO

| BORING NUMBER | DRILLING/ SAMPLING METHOD | DRILL RIG USED | BOREHOLE DIAMETER (In) | DRILLING/ SAMPLING DEPTH INTERVALS (Ft-BGS) | BOREHOLE SAMPLING FREQUENCY | DATE(S) DRILLED/ SAMPLED | NUMBER OF ANALYTICAL SOIL SAMPLES COLLECTED | NUMBER OF ANALYTICAL QA/QC SAMPLES COLLECTED | NUMBER OF SPT SOIL SAMPLES COLLECTED | NUMBER OF GRADATION ANALYSIS SAMPLES COLLECTED | GROUND ELEVATION (Ft-MSL) | TOTAL DEPTH OF BOREHOLE (Ft-BGS) | DATE BOREHOLE GROUTED |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0760 | HSA | B-53 | 6.5 | 0 to 19 | Continuous | 10-21-91 | 0 (3) | 0 (1) | 9 | 1 | 4316.05 | 19 | 10-21-91 |
| 0761 | HSA | B-61A | 6.5 | 0 to 20 | Continuous | 10-28-91 | 2 | 1 | 10 | 1 | 4316.08 | 27 | 10-30-91 |
| | | | | 20 to 27 | 5' Intervals | 10-28-91 | 1 | 1 | 1 | 0 | | | |
| 0762 | HT | NA | NA | 0 to 0.5 | NA | 10-23-91 | 1 | 0 | NA | 0 | 4316.02 | 33 | 10-30-91 |
| | HSA | B-61A | 6.5 | 0 to 19 | Continuous | 10-28-91 | 2 | 1 | 10 | 1 | | | |
| | | | | 19 to 33 | 5' Intervals | 10-28-91 to 10-29-91 | 1 | 1 | 2 | 0 | | | |
| 0763 | HT | NA | NA | 0 to 0.5 | NA | 10-23-91 | 1 | 2 | NA | 0 | 4315.87 | 24 | 10-30-91 |
| | HSA | B-61A | 6.5 | 0 to 20 | Continuous | 10-29-91 | 2 | 1 | 10 | 1 | | | |
| | | | | 20 to 24 | 5' Intervals | 10-29-91 | 1 | 0 | 1 | 0 | | | |

| | |
|---|---|
| In | Inches |
| Ft-BGS | Feet Below Ground Surface |
| Ft-MSL | Feet Mean Sea Level |
| SPT | Standard Penetration Test |
| HSA | Hollow Stem Auger |
| HT | Hand Trowel, Surface Sample |
| NA | Not Applicable, Surface Sample |
| NS | Not Sampled |

| | |
|---|---|
| B-53 | Mobile B-53 Auger Drill Rig with 6" OD / 3.75" ID Augers and 6.5" Bullet Bit |
| B-61A | Mobile B-61 Auger Drill Rig with 6" OD / 3.75" ID Augers and 6.5" or 6.25" Bullet Bit |
| B-61B | Mobile B-61 Auger Drill Rig with 7.25" OD / 4.25" ID Augers and 7.5" Bullet Bit |
| F-10 | Failing F-10 Auger Drill Rig with 6.25" OD / 4.25" ID Augers and 6.5" Bullet Bit |
| CME-75 | Central Mine Equipment CME-75 Auger Drill Rig with 7.75" OD / 4.25" ID Augers and 8.0" Bullet Bit |
| OD | Outer Diameter |
| ID | Inner Diameter |

TABLE 3-2

SUMMARY OF SURFACE SOIL, SUBSURFACE SOIL, AND QA/QC SAMPLES COLLECTED BY WCC AT SLUDGE WEATHERING PIT, SWMU NO. 76 / IRP NO. WP-14, CANNON AFB, NEW MEXICO

| BORING NUMBER | DEPTH INTERVAL (Ft-BGS) | SAMPLE IDENTIFICATION NUMBER | SAMPLE TYPE | QA/QC SAMPLES | SAMPLE MATRIX | DATE SAMPLED | TIME SAMPLED | OVA ON SAMPLE (ppm) | ANALYTICAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|---|
| 0760 | 0 to 0.5 | CAN076-0760-6000 | A | AB | Air | 10-21-91 | 0900 | | OL |
| | | CAN076-0760-4000 | GA | | Soil | 10-21-91 | 1035 | | |
| | 0 to 2 | CAN076-0760-4000 | SPT | | Soil | 10-21-91 | 1035 | | |
| | 2 to 4 | CAN076-0760-4002 | SPT | | Soil | 10-21-91 | 1040 | | |
| | 4 to 6 | CAN076-0760-4004 | SPT | | Soil | 10-21-91 | 1055 | 0 | |
| | 0 to 6 | CAN076-0760-6002 | A | | Air | 10-21-91 | 1048 | | OL |
| | 7 to 9 | CAN076-0760-4007 | SPT | | Soil | 10-21-91 | 1107 | 0 | |
| | 9 to 11 | CAN076-0760-4009 | SPT | | Soil | 10-21-91 | 1130 | 22 | |
| | 12 to 12.5 | CAN076-0760-4012 | SPT | | Soil | 10-21-91 | 1150 | 0 | |
| | 6 to 12.5 | CAN076-0760-6001 | A | | Air | 10-21-91 | 1150 | | OL |
| | 13 to 14.5 | CAN076-0760-4013 | SPT | | Soil | 10-21-91 | 1215 | 0 | |
| | 15 to 17 | CAN076-0760-4015 | SPT | | Soil | 10-21-91 | 1245 | | |
| | 17 to 19 | CAN076-0760-4017 | SPT | | Soil | 10-21-91 | 1400 | 0 | |
| | 12.5 to 19 | CAN076-0760-6003 | A | | Air | 10-21-91 | 1425 | | OL |
| 0761 | 0 to 2 | CAN076-0761-4000 | SPT | | Soil | 10-28-91 | 0820 | | |
| | 2 to 4 | CAN076-0761-4002 | SPT/GA | | Soil | 10-28-91 | 0825 | | |
| | 4 to 6 | CAN076-0761-0004 | A/SPT | | Soil | 10-28-91 | 0835 | 0 | VOC,SV,M,OL |
| | | CAN076-0761-0701 | A | MRD | Soil | 10-28-91 | 0835 | 0 | VOC,SV,M,OL |
| | 6 to 8 | CAN076-0761-4006 | SPT | | Soil | 10-28-91 | 0850 | | |
| | 8 to 10 | CAN076-0761-4008 | SPT | | Soil | 10-28-91 | 0930 | 0 | |
| | 10 to 12 | CAN076-0761-0010 | A/SPT | | Soil | 10-28-91 | 0945 | 0 | VOC,SV,M,OL |
| | 12 to 14 | CAN076-0761-4012 | SPT | | Soil | 10-28-91 | 0955 | | |
| | 14 to 16 | CAN076-0761-4014 | SPT | | Soil | 10-28-91 | 1015 | 0 | |
| | 16 to 18 | CAN076-0761-4016 | SPT | | Soil | 10-28-91 | 1030 | 5 | |
| | 18 to 20 | CAN076-0761-4018 | SPT | | Soil | 10-28-91 | 1040 | 0 | |
| | 25 to 27 | CAN076-0761-0025 | A/SPT | | Soil | 10-28-91 | 1115 | 0 | VOC,SV,M,OL |
| | | CAN076-0761-0781 | A | DW | Water | 10-28-91 | 1610 | | VOC,SV,M,PCB, TPH,TOC,OL |
| | | CAN076-0761-0751 | A | AB | Water | 10-29-91 | 1315 | | VOC |
| 0762 | 0 to 0.5 | CAN076-0762-0000 | A | | Soil | 10-23-91 | 1710 | | VOC,SV,M,OL |
| | 0 to 2 | CAN076-0762-4000 | SPT | | Soil | 10-28-91 | 1400 | | |
| | 2 to 4 | CAN076-0762-4002 | SPT | | Soil | 10-28-91 | 1405 | | |
| | 4 to 6 | CAN076-0762-4004 | SPT | | Soil | 10-28-91 | 1415 | 29 | |
| | 6 to 8 | CAN076-0762-4006 | SPT | | Soil | 10-28-91 | 1430 | 39 | |
| | 8 to 10 | CAN076-0762-0008 | A/SPT | MS/MSD | Soil | 10-28-91 | 1450 | 180 | VOC,SV,M,OL |
| | | CAN076-0762-4008 | GA | | Soil | 10-28-91 | 1450 | | |
| | 10 to 12 | CAN076-0762-4010 | SPT | | Soil | 10-28-91 | 1505 | 0 | |
| | 12 to 14 | CAN076-0762-4012 | SPT | | Soil | 10-28-91 | 1520 | 0 | |
| | 14 to 16 | CAN076-0762-0014 | A/SPT | | Soil | 10-28-91 | 1535 | 17 | VOC,SV,M,OL |
| | 16 to 18 | CAN076-0762-4016 | SPT | | Soil | 10-28-91 | 1545 | 0 | |
| | 18 to 18.3 | CAN076-0762-4018 | SPT | | Soil | 10-28-91 | 1600 | | |
| | 25 to 25.5 | CAN076-0762-4025 | SPT | | Soil | 10-28-91 | 1630 | | |
| | 31 to 33 | CAN076-0762-0031 | A/SPT | | Soil | 10-29-91 | 1345 | 0 | VOC,SV,M,OL |
| | | CAN076-0762-0771 | A | RB | Water | 10-29-91 | 1505 | | VOC,SV,M,OL |
| 0763 | 0 to 0.5 | CAN076-0763-0000 | A | MS/MSD | Soil | 10-23-91 | 1650 | | |
| | | CAN076-0763-0762 | A | FD | Soil | 10-23-91 | 1700 | | |
| | 0 to 2 | CAN076-0763-4000 | SPT | | Soil | 10-29-91 | 1720 | 8 | VOC,SV,M,OL |
| | 2 to 4 | CAN076-0763-4002 | SPT | | Soil | 10-29-91 | 1750 | 0 | VOC,SV,M,OL |
| | 4 to 6 | CAN076-0763-4004 | SPT | | Soil | 10-29-91 | | | |
| | 6 to 6.5 | CAN076-0763-4006 | SPT | | Soil | 10-29-91 | | | |
| | 8 to 10 | CAN076-0763-0008 | A/SPT | | Soil | 10-29-91 | | | |
| | | CAN076-0763-0761 | A | FD | Soil | 10-29-91 | | | |
| | 10 to 10.8 | CAN076-0763-4010 | SPT | | Soil | 10-29-91 | | | |

TABLE 3-2

SUMMARY OF SURFACE SOIL, SUBSURFACE SOIL, AND QA/QC SAMPLES COLLECTED AT SLUDGE WEATHERING PIT,

| BORING NUMBER | DEPTH INTERVAL (Ft-BGS) | SAMPLE IDENTIFICATION NUMBER | SAMPLE TYPE | QA/QC SAMPLES | SAMPLE MATRIX | DATE SAMPLED | TIME SAMPLED | OVA ON SAMPLE (ppm) | ANALYTICAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|---|
| 0763 | 12 to 12.2 | CAN076-0763-4012 | SPT | | Soil | 10-29-91 | | | |
| | 14 to 16 | CAN076-0763-4014 | SPT/GA | | Soil | 10-29-91 | 1650 | | |
| | 16 to 18 | CAN076-0763-4016 | SPT | | Soil | 10-29-91 | 1700 | | |
| | 18 to 20 | CAN076-0763-0018 | A/SPT | | Soil | 10-29-91 | 1720 | 8 | VOC,SV,M,OL |
| | 22 to 24 | CAN-076-0763-0022 | A/SPT | | Soil | 10-29-91 | 1750 | 0 | VOC,M,OL |

| | | | | | |
|---|---|---|---|---|---|
| Ft-BGS | Feet Below Ground Surface | FD | Field Duplicate | SV | Semi Volatile Organic Compounds |
| OVA | Organic Vapor Analyzer Reading | MRD | Missouri River Division Duplicate | M | Metals (TAL) |
| ppm | Parts per Million | AB | Ambient Blank | TPH | Total Petroleum Hydrocarbons |
| A | Analytical | RB | Rinsate Blank | BTEX | Benzene, Toluene, Ethylbenzene, Xylene |
| SPT | Standard Penetration Test | DW | Decontamination Water Blank | | |
| GA | Gradation Analysis | TB | Trip Blank | TOC | Total Organic Carbon |
| L | Lithology | VOC | Volatile Organic Compounds (TCL) | OL | Organic Lead |
| MS/MSD | Matrix Spike / Matrix Spike Duplicate | PCB | Polychlorinated Biphenols, Pesticides | Pb/Cr | Lead / Chromium |
| | | TCL | Target Compound List | TAL | Target Analyte List |

## TABLE 3-3

## ETHYL BENZENE AND XYLENES CONCENTRATIONS IN SOIL SAMPLES COLLECTED BY WCC AT SLUDGE WEATHERING PIT

## SWMU NO. 76/IRP NO. WP-14
## CANNON AFB, NEW MEXICO

| Boring Number | Sample Depth (Ft-BGS) | Ethyl Benzene 1060000 (µg/kg) | Xylenes 132000 (µg/kg) |
|---|---|---|---|
| 0761 | 4 - 6 | 29,000 U | 29,000 U |
| | 10 - 12 | 11 U | 11 U |
| | 25 - 27 | 12 U | 12 U |
| 0762 | 0 - 0.5 | 3 J | 11 U |
| | 8 - 10 | 7,300 U | 7,300 U |
| | 14 - 16 | 12 U | 12 U |
| | 31 - 33 | 11 U | 11 U |
| 0763 | 0 - 0.5 | 11 U | 11 U |
| | 8 - 10 | 4,000 J | 7,900 J |
| | 18 - 20 | 11 U | 11 U |
| | 22 - 24 | 12 UJ | 12 UJ |

J = Estimated value
U = Not detected
UJ = Estimated as non-detect at the CRQL
Ft-BGS = Feet below ground surface

# TABLE 3-4

## METAL CONCENTRATIONS[1] IN SOIL SAMPLES COLLECTED BY WCC AT SLUDGE WEATHERING PIT SWMU NO. 76/IRP NO. WP-14 CANNON AFB, NEW MEXICO

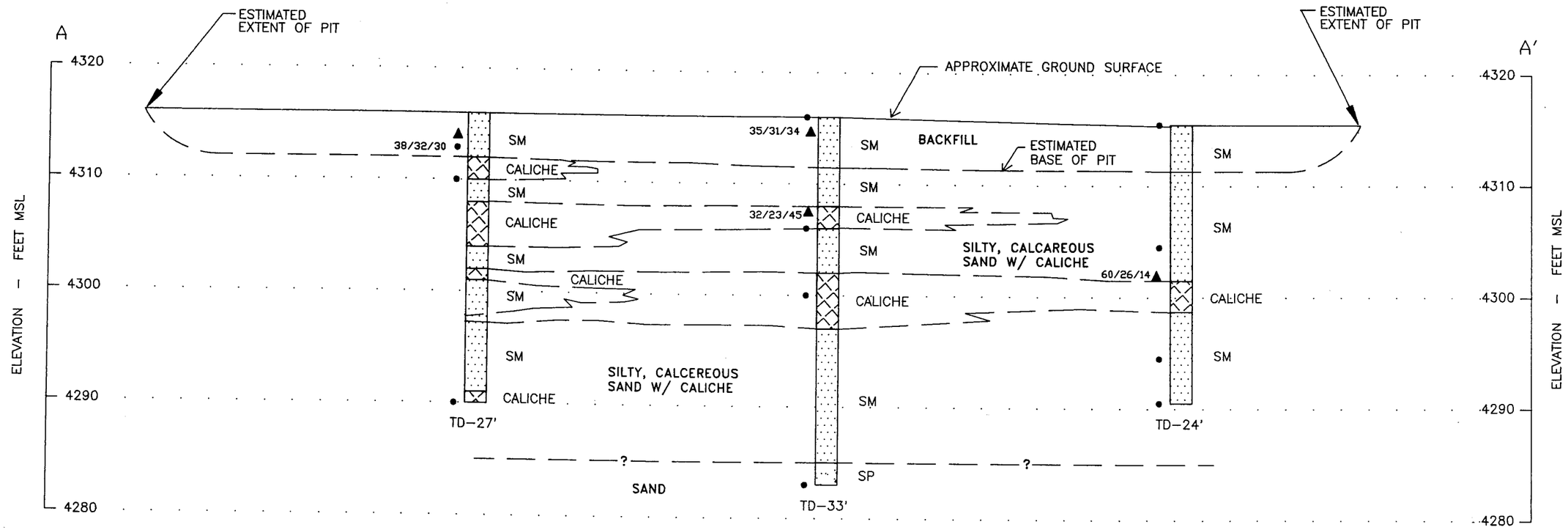
| | Boring 0761 Sample Depth (Ft-BGS) | | | Boring 0762 Sample Depth (Ft-BGS) | | | | Boring 0763 Sample Depth (Ft-BGS) | | | | Background[2] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Element | 4 | 10 | 25 | 0 | 8 | 14 | 31 | 0 | 8 | 18 | 22 | ($\bar{x}$ + 2 $\sigma$) |
| Aluminum | 8440J | 6990J | 6190J | 8440 | 3820 | 5380J | 5220J | 9310 | 5770J | 3530J | 6140J | 2571-10447 |
| Antimony | 5.4U | 5.2U | 5.4U | -R | 5.3U | 5.3U | 4.9U | -R | 5.5U | 5.8U | 5.2U | 4.88-5.4 |
| Arsenic | 1.9U | 1.2J | 0.92J | 1.8J | 1.9J | 1.1J | 0.6J | 1.8J | 1.6J | 0.63J | 0.59J | 0.43-1.95 |
| Barium | 151J | 92.6 | 42.5J | 82.6 | 374 | 77.5 | 61.2 | 86.6 | 680 | 1060 | 78.1 | 0-903 |
| Beryllium | 0.52J | 0.51J | 0.47U | 0.82J | 0.47U | 0.46U | 0.43U | 0.72J | 0.48U | 0.5U | 0.45U | 0.32-0.68 |
| Cadmium | 0.94U | 0.91U | 0.94U | 0.85J | 0.93U | 0.93U | 0.86U | 0.88U | 0.96U | 1U | 0.91U | 0.81-1.01 |
| Calcium | 164000 | 121000 | 113000 | 2600 | 210000 | 211000 | 38000 | 2850 | 219000J | 160000 | 111000 | 0-193062 |
| Chromium | 7 | 6.1 | 5.5 | 9.4 | 3.8 | 4.5 | 6 | 10 | 4.6 | 3.6 | 6.2 | 2.67-9.31 |
| Cobalt | 3J | 2.3J | 2.1J | 4.6J | 2.5J | 1.7J | 1.5J | 4.6J | 3.5J | 1.5J | 1.9J | 1.38-4.06 |
| Copper | 16.2 | 6.7 | 11.2 | 11 | 8.7 | 6.7 | 4.4U | 13.7 | 5.1U | 3.4U | 3.5U | 0.00-15.44 |
| Iron | 6140 | 5520 | 3770 | 8740 | 2990 | 3300 | 4150 | 9300 | 3830J | 2150 | 3880 | 2239-8683 |
| Lead | 4.9 | 4.2 | 2.2 | 9.6 | 2.3 | 2.6 | 1.6 | 12.6 | 2.6 | 1.6 | 2.4 | 1.76-8.64 |
| Lead, organic | 1.2UJ | 1.1UJ | 1.1UJ | 1.1UJ | 1.2UJ | 1.2UJ | 1.1UJ | 1.1UJ | 1.2UJ | 1.1UJ | 1.2UJ | NA |
| Magnesium | 2560 | 3540 | 11800 | 1570 | 3800 | 7880 | 9590 | 1660 | 5470 | 8940 | 8400 | 0-11903 |
| Manganese | 80.9 | 65.4 | 36.8 | 226 | 29.2 | 41.1 | 35.9 | 223 | 43.2 | 18 | 38.2 | 10.88-167 |
| Mercury | 0.13 | 0.11U | 0.85 | 0.11U | 0.12U | 0.12U | 0.11U | 0.11U | 0.12U | 0.13U | 0.11U | -- - -- |
| Nickel | 7.8J | 6.2J | 5.9J | 8.4J | 7J | 5.4J | 4.4J | 8.4J | 8.3J | 5.6J | 5.3J | 3.57-8.49 |

# TABLE 3-4
# (Concluded)

| | Boring 0761 Sample Depth (Ft-BGS) | | | Boring 0762 Sample Depth (Ft-BGS) | | | | Boring 0763 Sample Depth (Ft-BGS) | | | | Background[2] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Element | 4 | 10 | 25 | 0 | 8 | 14 | 31 | 0 | 8 | 18 | 22 | ($\bar{x}$ + 2 $\sigma$) |
| Potassium | 1510J | 1570J | 1070J | 1810 | 951J | 1030J | 1240 | 1830 | 1470 | 592J | 1130J | 632-2613 |
| Selenium | 0.23UJ | 0.23UJ | 0.24UJ | 0.21U | 0.23UJ | 0.23UJ | 0.21UJ | 0.22U | 2.4UJ | 0.25UJ | 2.3UJ | 0.00-1.35 |
| Silver | 1J | 0.91U | 1.2J | 0.85U | 1.1J | 0.93U | 0.86U | 0.88U | 0.96U | 1U | 0.91U | 0.86-0.94 |
| Sodium | 309U | 299U | 312J | 280U | 307U | 307U | 304J | 289U | 315U | 330U | 361J | 154-540 |
| Thallium | 0.23UJ | 0.23UJ | 0.24UJ | 0.21UJ | 0.23UJ | 0.23UJ | 0.21UJ | 0.22UJ | 0.24UJ | 0.25UJ | 0.23UJ | 0.20-0.24 |
| Vanadium | 16.3 | 14.4 | 11.2J | 20 | 10 | 11.8 | 13.3 | 19.8 | 15.5 | 16.9 | 16.4 | 9.26-26.74 |
| Zinc | 15 | 12.6 | 7.7 | 22.2J | 7.9 | 9.2 | 10.9 | 24.9 | 15 | 9.3 | 10.2 | 4.58-21.82 |

UJ = Estimated as non-detect at the instrument detection limit
J = Estimated value
U = Not detected
-R = Rejected
-- - -- = No range could be calculated
Ft-BGS = Feet below ground surface
NA = Not analyzed in background samples

[1] All concentrations are in milligrams per kilogram (mg/kg).
[2] Background range calculated from values in Table 2-7.




LEGEND

| | | |
|---|---|---|
| MSL | – | MEAN SEA LEVEL |
| TD | – | TOTAL DEPTH IN FEET BGS |
| SM,SP,GW ML,GP | – | UNIFIED SOIL CLASSIFICATION SYSTEM ABREVIATIONS |
| BGS | – | BELOW GROUND SURFACE |
| • | – | ANALYTICAL SAMPLE INTERVAL |

60/26/14 ▲ – GRADATION ANALYSIS SAMPLE INTERVAL THE THREE NUMBERS REPRESENT THE APPROXIMATE PERCENTAGES OF SAND–, SILT– AND CLAY– SIZED MATERIAL RESPECTIVELY

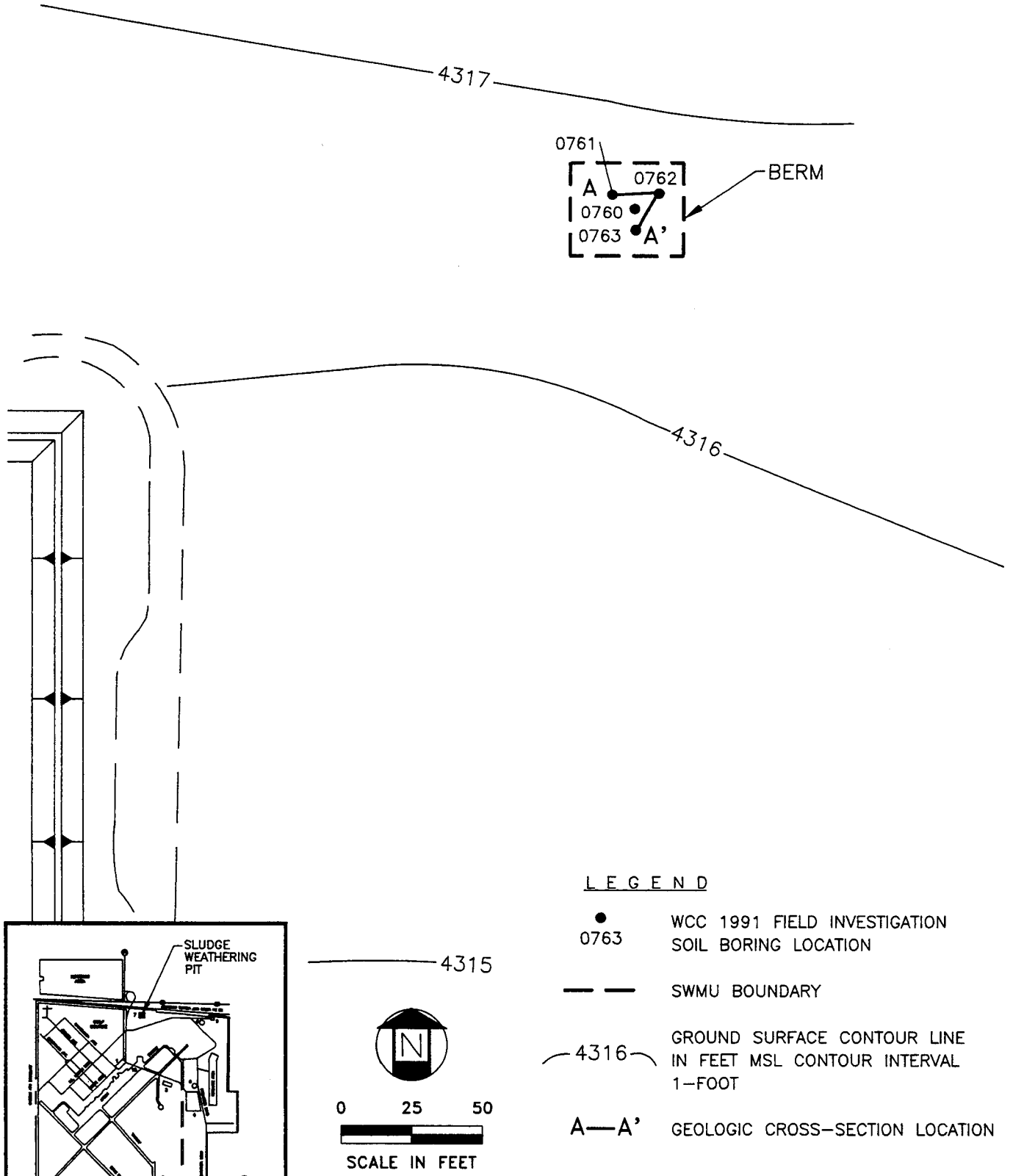
NOTE: THE LOCATION OF THIS CROSS–SECTION IS ON FIG. 3–1

0 5 10
HORIZONTAL SCALE IN FEET
VERTICAL EXAGGERATION = 0.5X

| | |
|---|---|
| Job No. : 89MC114W | GEOLOGIC CROSS SECTION A–A' SLUDGE WEATHERING PIT |
| Prepared by : LLG | SWMU NO. 76/IRP NO. WP-14 |
| Date : 2/3/92 | CANNON AFB NEW MEXICO |

SWMU–76

FIG. 3–2




| | |
|---|---|
| Job No. : | 89MC114W |
| Prepared by : | D.A.K. |
| Date : | 2/5/92 |

LOCATION OF SOIL BORINGS AT SLUDGE WEATHERING PIT

**SWMU NO. 76/IRP NO. WP-14**

CANNON AFB, NEW MEXICO

C1140001

FIG. 3-1

# 4.0
# FIRE DEPARTMENT TRAINING AREA NO.1 (SWMU NO. 78/IRP NO. FT-6)

## 4.1 SWMU DESCRIPTION

### 4.1.1 Setting

The Fire Department Training Area No. 1 is located in the northeast comer of the base, south of the railroad tracks and northeast of Perimeter Road (Figure 4-1). The facility now appears as an open field covered with prairie grass. The general configuration of the fire training area can be discerned since vegetative cover is more sparse than the surrounding surface. Additionally, there is abundant aluminum slag on the ground surface.

### 4.1.2 History of Use

The site was used to conduct fire department training exercises from 1959 to 1968. Approximately 300 gallons of waste oils, recovered fuels, and spent solvents were used to create training fires at the site during each exercise, twice per month (USAF 1990). In some instances, the ground may have been presaturated with water prior to pouring the waste products onto the ground.

### 4.1.3 Past Investigations

During 1985, two deep soil borings (6A and 6B) were drilled by Radian Corporation in the area to evaluate the extent of potential contamination and to define subsurface conditions. Soil analysis results shown in Table 4-1 indicate the presence of oil and grease, and lead at this SWMU (Radian 1986).

It was found that these soil borings did not describe the potential vertical extent of contaminant migration since a "no detection" depth was reached. Likewise, the horizontal extent was not adequately defined in that there are no staked locations or surveyor's notes to show where the 1985 borings were located.

### 4.1.4 Land Use Demography

Fire training Area No. 1 is located in an open field which is currently vacant and not in use. Ground maintenance contractors mow the area once per month for approximately 5 to 10 minutes, for 6 months of the year.

## 4.2 FIELD INVESTIGATION

This section provides a discussion of the field activities conducted by WCC at Fire Department Training Area No. 1 from October 12 through 14, 1991 and from December 7 through 16, 1991. The activities at this SWMU, as outlined in the FSP (WCC 1991c), consisted of collecting 6 surface soil samples for chemical analysis, 1 surface soil sample for gradation analysis, drilling 2 soil borings, and collecting 21 subsurface soil samples for chemical analysis and 5 subsurface soil samples for gradation analysis. The resampling phase of the field program, which became necessary due to laboratory missed holding times, consisted of recollecting 6 surface soil samples for chemical analysis, redrilling 1 soil boring, and recollecting 9 subsurface soil samples for chemical analysis.

Table 4-2 summarizes the drilling and sampling methods, along with sampling frequency conducted at each soil boring and surface sample location during the 1991 WCC investigation. A complete record of all surface soil, subsurface soil, and associated QA/QC samples collected at Fire Department Training Area No. 1 is presented in Table 4-3. The locations of the surface soil samples and soil borings are shown on Figure 4-1.

### 4.2.1 Sampling Objectives

The objective of sampling at Fire Department Training Area No. 1 was to evaluate the nature and extent of potential hazardous contaminants that may be present. The surface soil and subsurface soil sampling programs were designed to supplement previous investigations. The data collected at these two soil boring and four surface soil sample locations were used to further evaluate the extent of potential contamination, if present, and to perform a baseline risk assessment to determine if the area poses a risk to human

health or the environment. The data may also be utilized to evaluate remedial actions if necessary. Presently, there does not appear to be any substantial risk to the groundwater, so no hydrogeologic investigation was planned or conducted.

### 4.2.2 Surface Soil Investigation

Six surface soil samples were collected from 0 to 0.5 feet BGS near soil borings 0781 and 0782, at surface soil locations 0783, 0784, and 0785 within the S boundary, and at surface soil location 0786, outside of the SWMU boundary. These samples were located in areas with sparse vegetation, noticeable debris, or visual staining. These samples were collected using a stainless steel hand trowel and analyzed for TCL VOCS, semi-VOCs, TAL metals, PCBS, pesticides, and TPH. In addition, the sample from boring 0781 was used for geotechnical gradation analysis.

During the resampling phase, six additional surface soil samples, 0787, 0788, 0789, 7810, 7811, and 7812 (resamples of the surface soil samples from soil borings 0781 and 0782, and surface soil locations 0783, 0784, 0785, and 0786), located approximately 1 to 3 feet away from the original soil boring/surface soil sample locations, were collected because the laboratory missed holding times for the TCL VOC and/or TPH analyses on the original samples. These samples were analyzed for TCL VOCs and/or TPH, depending on which holding times were missed for each sample.

### 4.2.3 Subsurface Soil/Vadose Zone Investigation

Two soil borings, 0781 and 0782, were drilled to depths of 101.5 and 102 BGS, respectively, in areas of sparse vegetation within the SWMU boundary. Each soil boring was sampled continuously to a depth of 20 feet BGS and at 5-foot intervals from 20 feet BGS to total depth. All soil borings were described lithologically from the split spoon samples obtained during drilling. Subsurface samples for chemical analysis were collected at 4, 10, 20, 30, 40, 50, 60, 70, 75, 80, 90, and 100 feet BGS in boring 078 1; and at 4, 10, 20, 30, 40, 50, 60, 75, and 100 feet BGS in boring 0782 for a total of 21 subsurface soil samples. The subsurface analytical samples were collected with stainless steel split spoons and analyzed for TCL VOCS, semi-VOCs, TAL metals, PCBS, pesticides, and TPH, with the exception of the samples collected at 80 and 90 feet BGS

in boring 0781, which were only analyzed for total organic carbon (TOC). In addition to these analyses, nine of the samples collected at 4, 10, 20, 30, 40, 50, 50, 70, and 75 feet BGS in boring 0781 were also analyzed for TOC. Five subsurface samples were collected at 35 and 75 feet BGS in boring 078 1, and at 14, 55, and 90 feet BGS in boring 0782 for geotechnical gradation analysis.

During the resampling phase, one additional soil boring, 0788 (a redrill of boring 0782), located approximately 5 feet northwest of the original boring, was drilled to a depth of 102 feet BGS and sampled at the same intervals where analytical subsurface soil samples were collected in the original boring. Nine additional subsurface soil analytical samples were collected at 4, 10, 20, 30, 40, 50, 60, 75, and 100 feet BGS because the laboratory missed holding times for the TCL VOC and/or TPH analyses on the original samples. These samples were analyzed for TCL VOCs and/or TPH, depending on which holding times were missed on each sample.

## 4.3 PHYSICAL CHARACTERISTICS

This section provides a discussion of the soil, geology and hydrogeology at Fire Department Training Area No. 1 based on the detailed lithologic descriptions of split spoon samples and gradation analysis results from the 1991 WCC investigation, and the review of lithologic boring logs from the previous 1984-1985 Radian field investigation.

### 4.3.1 Soil

The soils underlying the Fire Department Training Area No. 1 area consist of sandy loam and loamy sand of the Amarillo Soil Group with a total thickness of approximately 4 feet. The soils consist primarily of fine-grained, well sorted, silty, clayey, unconsolidated orange to brown-orange to brown sands. The sands are generally dry to slightly moist at depth. One gradation analysis was performed on a sample collected within this unit at 0.5 feet BGS in boring 0781. The results indicate that this soil sample was comprised of approximately 59 percent sand, 22 percent silt, and 19 percent clay.

### 4.3.2 Geology

The near surface (upper 102 feet) stratigraphy at Fire Department Training Area No. 1 consists of Tertiary Miocene to Pliocene fluvial deposits of the Ogallala Formation. Geologic cross-section B-B' (Figure 4-2) was constructed using information from the lithologic boring logs of the 1991 WCC field investigation along with one boring log, 6B, from the 1984-1985 Radian field investigation. This cross-section runs southwest-northeast (see Figure 4-1 for the cross-section location). Stratigraphic correlations of the various fluvial deposits between borings is based primarily on the split spoon lithologic samples collected during drilling.

The SWMU is underlain by Ogallala fluvial deposits consisting primarily of well sorted sand, with scattered thin (1 to 11 feet thick) layers of caliche. The total thickness of these Ogallala deposits beneath the SWMU is not presently known, but based on regional information, may be as thick as 390 feet.

It would appear from the geologic cross-section and the lithologic descriptions (Appendix B-1) that three fairly distinct sand, sand/caliche units are present beneath the SWMU to a depth of 102 feet. The lowermost fluvial deposits shown on the geologic cross-section from 4218 to 4246 feet MSL consist of fine- to medium-grained, well sorted, unconsolidated fight to medium orange sand deposits. These sand deposits are comprised predominantly of subrounded to subangular quartz grains with minor amounts (3-5% each) of orange and dark colored grains. These sands are relatively clean (i.e., little or no silt/clay sized particles). Overall, these sands are non-calcareous, however, there are occasional thin layers and pockets of calcareous sands. Two gradation analyses were performed on samples collected within this unit at 75 feet BGS in boring 0781 and at 90 feet BGS in boring 0782. The results indicate that these two samples were comprised of approximately 89 to 92 percent sand, 2 to 4 percent silt, and 6 to 7 percent clay. This unit was encountered in both of the WCC borings at approximately 70 feet BGS. The thickness of this unit is unknown at present due to the fact that the unit was not fully penetrated, but is at least 32 feet thick at this SWMU.

The middle fluvial deposits shown on the geologic cross-section from 4246 to 4260 feet MSL consist of fine-grained, well sorted, slightly silty, pale orange to orange sands.

These sands are comprised predominantly of subangular to subrounded quartz grains with minor amounts (1-5%) of dark colored grains. These sands are non-calcareous and become siltier toward the northeast near boring 0781. One gradation analysis was performed on a sample collected within this unit at 55 feet BGS in boring 0782. The results indicate that this sample was comprised of approximately 86 percent sand, 7 percent silt, and 7 percent clay. This unit was encountered between 52 feet BGS in boring 0782 and 56 feet BGS in boring 0781. Based on the cross-section, the thickness of this unit ranges from approximately 13 feet thick in 0781 to 18 feet thick in 0782.

The upper fluvial deposits shown on the geologic cross-section from 4260 to 4312 feet MSL consist of fine-grained, well sorted, silty, calcareous, medium to pale orange to tan-orange sands. These sands are comprised predominantly of subangular to subrounded quartz grains with varying amounts of silt and calcium carbonate. Occasionally, these sands are moderately to well cemented with calcium carbonate. Thin layers (ranging from a few inches to several feet in thickness) and small pockets or nodules of tan-orange, silty, sandy, clayey caliche are scattered throughout this unit. Two gradation analyses were performed on samples collected within this unit at 35 feet BGS in boring 0781 and at 14 feet BGS in boring 0782. The results indicate that these samples were comprised of approximately 52 to 70 percent sand, 16 to 24 percent silt, and 14 to 24 percent calcium carbonate and/or clay-sized material. Based on the cross-section, the thickness of this unit ranges from 48 feet thick in 0782 to 52 feet thick in 0781. Approximately 4 feet of native topsoil exists above this unit. No groundwater was encountered during the drilling of these borings.

## 4.4 NATURE AND EXTENT OF CONTAMINATION

Six surface samples, five within the SWMU boundary (0781 through 0785) and one outside the SWMU boundary (0786), were collected in order to evaluate the lateral extent of contamination. Subsurface samples were collected from two soil borings, 0781 and 0782, at 10-foot intervals between 4 and 100 feet bgs (Figure 4-1). Evaluation of the chemical analyses (TCL VOCS, semi-VOCs, TAL metals, PCBs/pesticides, TPH) of these samples has been used to characterize the nature and extent of contamination.

None of the target analyte list volatile organic compounds, except acetone, were detected above the CRQL in surface and subsurface samples from SWMU No. 78. Acetone was detected in five samples from boring 0788 (resample of boring 0782) at depths of 10, 50, 60, 75, and 100 feet, at concentrations of 35, 370, 100, 94, and 93 jag/kg, respectively. The occurrence of acetone as previously discussed is probably laboratory contamination.

None of the target analyte list of semi-volatile organic compounds except phthalate, was detected above the CRQL in surface and subsurface samples from SWMU No. 78. Bis(2ethylhexyl) phthalate was detected at a concentration of 460 mg/kg in the surface sample from boring 0781. Di-n-butylphthalate was detected at an estimated concentration (flagged with a J) in five samples from boring 0782 (10, 20, 50, 60, and 75 feet bgs). The concentration range was 36J to 85J $\mu$g/kg. Phthalates were not detected at the 4, 30, 40, and 100 feet depths.

Phthalates are common plasticizers and, as with acetone, occur ubiquitously as laboratory contaminants. Therefore, phthalates are not considered a chemical of concern at this site.

The pesticide 4,4-DDD was detected in all surface samples inside the SWMU boundary but not in surface sample 0786 outside of the SWMU (Table 4-4 and Figure 4-4). Concentrations of 2000 and 660 mg/kg were present at sample locations 0783 and 0784, respectively. Concentrations of 150, 91, and 160 Kg/kg were present at sample locations 0781) 0782, and 0785, respectively. In the subsurface, 4,4-DDD was detected at depths up to 12 feet in boring 0781, but was not found in boring 0782 deeper than the surface sample. The pesticide 4,4-DDE was also detected in surface samples at locations 0781, 0784, and 0785 at a concentration of 57J (estimated), 58J (estimated), and 110 $\mu$g/kg, respectively (Table 4-4). It is possible that the pesticides were present in fuel mixtures used for past fire training exercises or pesticides were applied at the SWMU to ward off pests during the active life of this fire training area.

Total petroleum hydrocarbon (TPH) concentration of surface soil samples 0781 through 0785 were at elevated levels ranging from 980 to 4080 mg/kg (Table 4-5). A TPH concentration of 95 mg/kg was also detected at 4 feet bgs in boring 0781. Tentatively identified compounds from semi-volatile organic compounds analyses of surface samples

0781 through 0785 consisted of a variety of high molecular weight unsaturated hydrocarbons, oxygenated, and polynuclear aromatic hydrocarbons. The TICs provide a estimation of possible TPH components at this site.

All five surface soil samples, 0781 through 0785, collected within the SWMU boundary indicated high concentrations of cadmium, chromium, copper, lead, and zinc above site background levels (Table 4-6). At soil sample location 0786, located outside the SWMU boundary, lead and chromium were also detected at levels above background soil conditions at Cannon AFB. Chromium was detected within the SWMU boundary at concentrations ranging from 39.6 mg/kg at soil boring location 0781 to 13.4 mg/kg at soil sample location 0784, while the surface soil sample at location 0786 (outside the SWMU) had a chromium concentration of 12.1 mg/kg. However, the above results are below values for chromium common in soils of this area (Table 2-7) and therefore is not a metal of concern at this SWMU. Lead and zinc were detected in surface soil samples at concentrations ranging from 194 mg/kg to 529 mg/kg and 126 mg/kg to 829 mg/kg, respectively, within the S boundary. The soil sample collected outside the SWMU boundary had a lead concentration of 25.6 mg/kg and an estimated zinc concentration of 33.3 mg/kg. These results suggest that lead and zinc are potential metals of concern in the surface soil at this SWMU.

In addition, iron and manganese were detected in surface soil samples at boring locations 0781 and 0782 at concentrations above background levels; however, these metals were also detected at above background concentrations at boring location 0786, outside of the SWMU boundary, and therefore may reflect natural soil conditions in this area. Aluminum-4 arsenic, and nickel were detected at estimated concentrations in the surface soil at several of the boring locations within and outside the SWMU boundary. These three metals are estimated concentrations, and at values below that which is naturally occurring in soils in this area of New Mexico, and are not considered to be of concern at this site.

In general, metals in subsurface soil samples down to 30 feet bgs were detected at concentrations approaching background levels (Table 4-7). However, of potential concern is the detection of lead at 4 feet bgs of 16.3 mg/kg in boring 0781 and at 20 feet bgs of 25.0 mg/kg in boring 0782. At depths greater than 40 feet, no metals were

detected at concentrations above background. Figure 4-3 illustrates the vertical extent of lead in subsurface soils on a cross-sectional diagram. The results of the present investigation are consistent with the initial Phase H IRP investigation of 1985. The analytical results of the past study (see Table 4-1) indicated a concentration range of 1.8 mg/kg to 28 mg/kg for lead down to a depth of 48 feet bgs (Radian boring 6B).

In summary, organic chemicals of concern at this SWMU consist of the pesticides, 4,4-DDD and 4,4-DDE, and TPH. Analytical data suggest that these chemicals of concern occur in surficial soils throughout the SWMU. It does not appear that soils below 4 to 6 feet have been significantly impacted, although a minor concentration (14 /Ag/kg) of 4,4-DDD was reported at 10 to 12 feet in boring 0781. For pesticides, the high soil/water partition coefficient (EPA 1979) indicates that the compounds are retained on soil particles, thus retarding migration into deeper soils. Lead and zinc are potential metals of concern in the surficial soils throuyghout this SWMU. In addition, lead is also of potential concern at depths of 4 feet and 20 feet bgs in borings 0781 and 0782, respectively.

# TABLE 4-1

## ANALYTICAL RESULTS OF SOIL SAMPLES COLLECTED BY RADIAN AT FIRE DEPARTMENT TRAINING AREA NO. 1 SWMU NO. 78/IRP NO. FT-6 CANNON AFB, NEW MEXICO

| Sample Number | Sample Depth (Ft-BGS) | Oil and Grease (mg/kg) | Lead (mg/kg) | Purgeable Organic Compounds (EPA 8010/8020) (ug/kg) |
|---|---|---|---|---|
| 6A-1 | 3.8-4.8 | 2000 | 4.5 | ND |
| 6A-2 | 9.6-10.6 | 2800 | 3.2 | ND |
| 6A-3 | 47.5-48.6 | 1700 | 28 | ND |
| 6B-1 | 3.5-4.5 | 520 | 3.8 | ND |
| 6B-2 | 9.5-10.5 | 140 | 23 | ND |
| 6B-3 | 47.5-48.0 | 310 | 1.8 | ND |

Ft-BGS = Feet below ground surface
mg/kg = Milligrams per kilogram
ug/kg = Micrograms per kilogram
ND = Not detected

Source: Final Report, IRP Phase II (Radian 1986)

TABLE 4-2

SUMMARY OF SURFACE SOIL SAMPLING, BOREHOLE DRILLING, AND BOREHOLE SAMPLING CONDUCTED BY WCC AT FIRE DEPARTMENT TRAINING AREA NO. 1, SWMU NO. 78 / IRP NO. FT-6, CANNON AFB, NEW MEXICO

| BORING NUMBER | DRILLING/ SAMPLING METHOD | DRILL RIG USED | BOREHOLE DIAMETER (in) | DRILLING/ SAMPLING DEPTH INTERVALS (Ft-BGS) | BOREHOLE SAMPLING FREQUENCY | DATE(S) DRILLED/ SAMPLED | NUMBER OF ANALYTICAL SOIL SAMPLES COLLECTED | NUMBER OF ANALYTICAL QA/QC SAMPLES COLLECTED | NUMBER OF SPT SOIL SAMPLES COLLECTED | NUMBER OF GRADATION ANALYSIS SAMPLES COLLECTED | GROUND ELEVATION (Ft-MSL) | TOTAL DEPTH OF BOREHOLE (Ft-BGS) | DATE BOREHOLE GROUTED |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0781 | HT | NA | NA | 0 to 0.5 | NA | 10-12-91 to 10-13-91 | 1 | 1 | NA | 1 | 4316.83 | 101.5 | 10-13-91 |
| | HSA | F-10 | 8.5 | 0 to 22 | Continuous | 10-12-91 | 3 | 2 | 11 | 0 | | | |
| | | | | 22 to 101.5 | 5' Intervals | 10-12-91 to 10-13-91 | 9 | 1 | 16 | 2 | | | |
| (0787)* | HT | NA | NA | 0 to 0.5 | NA | 12-16-91 | 1 | 3 | NA | 0 | 4316.91 | 0.5 | NA |
| 0782 | HT | NA | NA | 0 to 0.5 | NA | 10-13-91 | 1 | 0 | NA | 0 | 4316.75 | 102 | 10-14-91 |
| | HSA | F-10 | 8.5 | 0 to 21.5 | Continuous | 10-13-91 | 3 | 2 | 11 | 1 | | | |
| | | | | 21.5 to 102 | 5' Intervals | 10-13-91 to 10-14-91 | 6 | 0 | 16 | 2 | | | |
| (0788)* | HT | NA | NA | 0 to 0.5 | NA | 12-07-91 | 1 | 1 | NA | 0 | 4316.71 | 102 | 12-09-91 |
| | HSA | CME-7 | 8.0 | 0 to 12 | 5' Intervals | 12-07-91 | 2 | 3 | 2 | 0 | | | |
| | | | | 12 to 102 | 10' Intervals | 12-07-91 | 7 | 1 | 7 | 0 | | | |
| 0783 | HT | NA | NA | 0 to 0.5 | NA | 10-12-91 | 1 | 1 | NA | 0 | 4316.71 | 0.5 | NA |
| (0789)* | HT | NA | NA | 0 to 0.5 | NA | 12-16-91 | 1 | 0 | NA | 0 | 4316.60 | 0.5 | NA |
| 0784 | HT | NA | NA | 0 to 0.5 | NA | 10-13-91 | 1 | 0 | NA | 0 | 4316.60 | 0.5 | NA |
| (7810)* | HT | NA | NA | 0 to 0.5 | NA | 12-16-91 | 1 | 1 | NA | 0 | 4316.55 | 0.5 | NA |
| 0785 | HT | NA | NA | 0 to 0.5 | NA | 10-13-91 | 1 | 0 | NA | 0 | 4316.55 | 0.5 | NA |
| (7811)* | HT | NA | NA | 0 to 0.5 | NA | 12-16-91 | 1 | 0 | NA | 0 | 4316.59 | 0.5 | NA |
| 0786 | HT | NA | NA | 0 to 0.5 | NA | 10-13-91 | 1 | 0 | NA | 0 | 4316.87 | 0.5 | NA |
| (7812)* | HT | NA | NA | 0 to 0.5 | NA | 12-16-91 | 1 | 0 | NA | 0 | 4316.98 | 0.5 | NA |

| | | | |
|---|---|---|---|
| In | Inches | B-53 | Mobile B-53 Auger Drill Rig with 6" OD / 3.75" ID Augers and 6.5" Bullet Bit |
| Ft-BGS | Feet Below Ground Surface | B-61A | Mobile B-61 Auger Drill Rig with 6" OD / 3.75" ID Augers and 6.5" or 6.25" Bullet Bit |
| Ft-MSL | Feet Mean Sea Level | B-61B | Mobile B-61 Auger Drill Rig with 7.25" OD / 4.25" ID Augers and 7.5" Bullet Bit |
| SPT | Standard Penetration Test | F-10 | Failing F-10 Auger Drill Rig with 8.25" OD / 4.25" ID Augers and 8.5" Bullet Bit |
| HSA | Hollow Stem Auger | CME-75 | Central Mine Equipment CME-75 Auger Drill Rig with 7.75" OD / 4.25" ID Augers and 8.0" Bullet Bit |
| HT | Hand Trowel, Surface Sample | OD | Outer Diameter |
| NA | Not Applicable, Surface Sample | ID | Inner Diameter |
| NS | Not Sampled | | |

( )* The borings that are shaded and in parentheses correspond to either a redrill or surface resample of the previous boring or surface sample due to laboratory missed holding times. These borings or surface resamples were drilled or collected approximately 1 to 5 feet away from the original boring or surface sample location.

TABLE 4-3

SUMMARY OF SURFACE SOIL, SUBSURFACE SOIL, AND QA/QC SAMPLES COLLECTED BY WCC AT FIRE DEPARTMENT TRAINING AREA NO. 1, SWMU NO. 78 / IRP NO. FT-6, CANNON AFB, NEW MEXICO

| BORING NUMBER | DEPTH INTERVAL (Ft-BGS) | SAMPLE IDENTIFICATION NUMBER | SAMPLE TYPE | QA/QC SAMPLES | SAMPLE MATRIX | DATE SAMPLED | TIME SAMPLED | OVA ON SAMPLE (ppm) | ANALYTICAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|---|
| 0781 | 0 to 0.5 | CAN078-0781-0000 | A | | Soil | 10-13-91 | 0945 | 0 | VOC,SV,M,PCB,TPH |
| | | CAN078-0781-0801 | A | MRD | Soil | 10-13-91 | 0945 | 0 | VOC,SV,M,PCB,TPH |
| | | CAN078-0781-4000 | GA | | Soil | 10-12-91 | 1330 | 0 | |
| | 0 to 2 | CAN078-0781-4000 | SPT | | Soil | 10-12-91 | 1330 | | |
| | 2 to 4 | CAN078-0781-4002 | SPT | | Soil | 10-12-91 | 1335 | | |
| | | CAN078-0781-0881 | A | DW | Water | 10-12-91 | 1335 | | VOC |
| | 4 to 6 | CAN078-0781-0004 | A/SPT | EPA | Soil | 10-12-91 | 1345 | 0 | VOC,SV,M,PCB,TPH |
| | 6 to 8 | CAN078-0781-4006 | SPT | | Soil | 10-12-91 | 1400 | | |
| | 8 to 10 | CAN078-0781-4008 | SPT | | Soil | 10-12-91 | 1408 | | |
| | 10 to 12 | CAN078-0781-0010 | A/SPT | MS/MSD | Soil | 10-12-91 | 1417 | 0 | VOC,SV,M,PCB,TPH,TOC |
| | 12 to 14 | CAN078-0781-4012 | SPT | | Soil | 10-12-91 | 1436 | | |
| | 14 to 16 | CAN078-0781-4014 | SPT | | Soil | 10-12-91 | 1441 | | |
| | 16 to 18 | CAN078-0781-4016 | SPT | | Soil | 10-12-91 | 1458 | | |
| | 18 to 20 | CAN078-0781-4018 | SPT | | Soil | 10-12-91 | 1510 | | |
| | 20 to 22 | CAN078-0781-0020 | A/SPT | EPA | Soil | 10-12-91 | 1525 | 0.6 | VOC,SV,M,PCB,TPH,TOC |
| | 25 to 25.6 | CAN078-0781-4025 | SPT | | Soil | 10-12-91 | 1542 | | |
| | 30 to 30.5 | CAN078-0781-0030 | A/SPT | | Soil | 10-12-91 | 1605 | 0 | VOC,SV,M,PCB,TPH,TOC |
| | 35 to 36 | CAN078-0781-4035 | SPT/GA | | Soil | 10-12-91 | 1640 | | |
| | 40 to 41.5 | CAN078-0781-0040 | A/SPT | EPA | Soil | 10-12-91 | 1700 | 0 | VOC,SV,M,PCB,TPH,TOC |
| | 45 to 47 | CAN078-0781-4045 | SPT | | Soil | 10-12-91 | 1733 | | |
| | 50 to 51 | CAN078-0781-0050 | A/SPT | | Soil | 10-12-91 | 1815 | 0 | VOC,SV,M,PCB,TPH,TOC |
| | 55 to 57 | CAN078-0781-4055 | SPT | | Soil | 10-12-91 | 1920 | | |
| | 60 to 62 | CAN078-0781-0060 | A/SPT | | Soil | 10-12-91 | 2000 | 8 | VOC,SV,M,PCB,TPH,TOC |
| | 65 to 67 | CAN078-0781-4065 | SPT | | Soil | 10-12-91 | 2015 | | |
| | 70 to 72 | CAN078-0781-0070 | A/SPT | | Soil | 10-12-91 | 2035 | 0 | TOC |
| | 75 to 77 | CAN078-0781-0075 | A/SPT | | Soil | 10-13-91 | 0730 | 0 | VOC,SV,M,PCB,TPH,TOC |
| | | CAN078-0781-4075 | GA | | Soil | 10-13-91 | 0730 | | |
| | 80 to 81 | CAN078-0781-0080 | A/SPT | | Soil | 10-13-91 | 0830 | 0 | TOC |
| | 85 to 87 | CAN078-0781-4085 | SPT | | Soil | 10-13-91 | 0850 | | |
| | 90 to 92 | CAN078-0781-0090 | A/SPT | | Soil | 10-13-91 | 0920 | 0 | TOC |
| | 95 to 97 | CAN078-0781-4095 | SPT | | Soil | 10-13-91 | 0945 | | |
| | | CAN078-0781-0851 | A | AB | Water | 10-13-91 | 0955 | | |
| | 100 to 101. | CAN078-0781-0100 | A/SPT | | Soil | 10-13-91 | 1050 | 0 | VOC,SV,M,PCB,TPH |
| (0787)* | 0 to 0.5 | CAN078-0787-0000 | A | MS/MSD | Soil | 12-16-91 | 0915 | 0 | VOC |
| | | CAN078-0787-0857 | A | AB | Water | 12-16-91 | 0920 | | VOC |
| | | CAN078-0787-0887 | A | DW | Water | 12-16-91 | 0925 | | VOC |
| 0782 | 0 to 0.5 | CAN078-0782-0000 | A | | Soil | 10-13-91 | 0830 | 0 | VOC,SV,M,PCB,TPH |
| | 0 to 2 | CAN078-0782-4000 | SPT | | Soil | 10-13-91 | 1415 | | |
| | 2 to 4 | CAN078-0782-4002 | SPT | | Soil | 10-13-91 | 1422 | | |
| | 4 to 6 | CAN078-0782-0004 | A/SPT | EPA | Soil | 10-13-91 | 1430 | 0 | VOC,SV,M,PCB,TPH |
| | 6 to 8 | CAN078-0782-4006 | SPT | | Soil | 10-13-91 | 1500 | | |
| | 8 to 10 | CAN078-0782-4008 | SPT | | Soil | 10-13-91 | 1505 | | |
| | 10 to 12 | CAN078-0782-0010 | A/SPT | | Soil | 10-13-91 | 1515 | 0 | VOC,SV,M,PCB,TPH |
| | | CAN078-0782-0861 | A | FD | Soil | 10-13-91 | 1500 | 0 | VOC,SV,M,PCB,TPH |
| | | CAN078-0782-0802 | A | MRD | Soil | 10-13-91 | 1515 | 0 | VOC,SV,M,PCB,TPH |
| | 12 to 14 | CAN078-0782-4012 | SPT | | Soil | 10-13-91 | 1530 | | |
| | 14 to 16 | CAN078-0782-4014 | SPT/GA | | Soil | 10-13-91 | 1545 | | |
| | 16 to 18 | CAN078-0782-4016 | SPT | | Soil | 10-13-91 | 1600 | | |
| | 18 to 20 | CAN078-0782-4018 | SPT | | Soil | 10-13-91 | 1620 | | |
| | 20 to 21.5 | CAN078-0782-0020 | A/SPT | | Soil | 10-13-91 | 1635 | 0 | VOC,SV,M,PCB,TPH |
| | 25 to 27 | CAN078-0782-4025 | SPT | | Soil | 10-13-91 | 1640 | | |
| | 30 to 31 | CAN078-0782-0030 | A/SPT | | Soil | 10-13-91 | 1700 | 0 | VOC,SV,M,PCB,TPH |
| | 35 to 36 | CAN078-0782-4035 | SPT | | Soil | 10-13-91 | 1730 | | |
| | 40 to 42 | CAN078-0782-0040 | A/SPT | | Soil | 10-13-91 | 1800 | 0 | VOC,SV,M,PCB,TPH |
| | | CAN078-0782-0871 | A | RB | Water | 10-13-91 | 1810 | | VOC,SV,M,PCB,TPH |
| | 45 to 47 | CAN078-0782-4045 | SPT | | Soil | 10-13-91 | 1815 | | |

TABLE 4-3

SUMMARY OF SURFACE SOIL, SUBSURFACE SOIL, AND QA/QC SAMPLES COLLECTED BY WCC AT FIRE DEPARTMENT TRAINING AREA NO. 1, SWMU NO. 78 / IRP NO. FT-6, CANNON AFB, NEW MEXICO

| BORING NUMBER | DEPTH INTERVAL (Ft-BGS) | SAMPLE IDENTIFICATION NUMBER | SAMPLE TYPE | QA/QC SAMPLES | SAMPLE MATRIX | DATE SAMPLED | TIME SAMPLED | OVA ON SAMPLE (ppm) | ANALYTICAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|---|
| 0782 | 50 to 51 | CAN078-0782-0050 | A/SPT | | Soil | 10-13-91 | 1830 | 0 | VOC,SV,M,PCB,TPH |
| | 55 to 57 | CAN078-0782-4055 | SPT/GA | | Soil | 10-13-91 | 1845 | | |
| | 60 to 62 | CAN078-0782-0060 | A/SPT | | Soil | 10-13-91 | 1920 | 0 | VOC,SV,M,PCB,TPH |
| | 65 to 67 | CAN078-0782-4065 | SPT | | Soil | 10-14-91 | 0545 | | |
| | 70 to 72 | CAN078-0782-4070 | SPT | | Soil | 10-14-91 | 0600 | | |
| | 75 to 76.5 | CAN078-0782-0075 | A/SPT | | Soil | 10-14-91 | 0700 | 0 | VOC,SV,M,PCB,TPH |
| | 80 to 82 | CAN078-0782-4080 | SPT | | Soil | 10-14-91 | 0715 | | |
| | 85 to 86 | CAN078-0782-4085 | SPT | | Soil | 10-14-91 | 0735 | | |
| | 90 to 91.5 | CAN078-0782-4090 | SPT/GA | | Soil | 10-14-91 | 0800 | | |
| | 95 to 97 | CAN078-0782-4095 | SPT | | Soil | 10-14-91 | 0830 | | |
| | 100 to 102 | CAN078-0782-0100 | A/SPT | | Soil | 10-14-91 | 0925 | 0 | VOC,SV,M,PCB,TPH |
| (0788)* | 0 to 0.5 | CAN078-0788-0000 | A | | Soil | 12-07-91 | 1350 | 0 | VOC,TPH |
| | | CAN078-0788-0807 | A | MRD | Soil | 12-07-91 | 1350 | 0 | VOC,TPH |
| | 4 to 6 | CAN078-0788-0004 | A/SPT | | Soil | 12-07-91 | 1605 | 0 | VOC |
| | 10 to 12 | CAN078-0788-0010 | A/SPT | | Soil | 12-07-91 | 1630 | 0 | VOC,TPH |
| | | CAN078-0788-0808 | A | MRD | Soil | 12-07-91 | 1630 | 0 | VOC,TPH |
| | | CAN078-0788-0863 | A | FD | Soil | 12-07-91 | 1645 | 0 | VOC,TPH |
| | | CAN078-0788-0878 | A | RB | Water | 12-07-91 | 1655 | | VOC,TPH |
| | 20 to 21.5 | CAN078-0788-0020 | A/SPT | | Soil | 12-07-91 | 1700 | 0 | TPH |
| | 30 to 31 | CAN078-0788-0030 | A/SPT | | Soil | 12-08-91 | 0650 | 0.8 | TPH |
| | 40 to 42 | CAN078-0788-0040 | A/SPT | MS/MSD | Soil | 12-08-91 | 0735 | 0 | TPH |
| | 50 to 51 | CAN078-0788-0050 | A/SPT | | Soil | 12-08-91 | 0840 | 0 | VOC,TPH |
| | 60 to 62 | CAN078-0788-0060 | A/SPT | | Soil | 12-08-91 | 0940 | 0 | VOC,TPH |
| | 75 to 76.5 | CAN078-0788-0075 | A/SPT | | Soil | 12-08-91 | 1030 | 0 | VOC |
| | 100 to 102 | CAN078-0788-0100 | A/SPT | | Soil | 12-08-91 | 1200 | 0 | VOC |
| 0783 | 0 to 0.5 | CAN078-0783-0000 | A | | Soil | 10-12-91 | 1820 | 0 | SV,M,PCB,TPH |
| | | CAN078-0783-0862 | A | FD | Soil | 10-12-91 | 1820 | 0 | SV,M,PCB,TPH |
| (0789)* | 0 to 0.5 | CAN078-0789-0000 | A | | Soil | 12-16-91 | 0930 | 0 | TPH |
| 0784 | 0 to 0.5 | CAN078-0784-0000 | A | | Soil | 10-13-91 | 1035 | 0 | VOC,SV,M,PCB,TPH |
| (7810)* | 0 to 0.5 | CAN078-7810-0000 | A | | Soil | 12-16-91 | 0940 | 0 | VOC,TPH |
| | | CAN078-7810-0864 | A | FD | Soil | 12-16-91 | 0950 | 0 | VOC,TPH |
| 0785 | 0 to 0.5 | CAN078-0785-0000 | A | | Soil | 10-13-91 | 1055 | 0 | VOC,SV,M,PCB,TPH |
| (7811)* | 0 to 0.5 | CAN078-7811-0000 | A | | Soil | 12-16-91 | 1005 | 0 | VOC,TPH |
| 0786 | 0 to 0.5 | CAN078-0786-0000 | A | | Soil | 10-13-91 | 1015 | 0 | VOC,SV,M,PCB,TPH |
| (7812)* | 0 to 0.5 | CAN078-7812-0000 | A | | Soil | 12-16-91 | 1015 | 0 | TPH |

| | | | | | |
|---|---|---|---|---|---|
| Ft-BGS | Feet Below Ground Surface | FD | Field Duplicate | SV | Semi Volatile Organic Compounds |
| OVA | Organic Vapor Analyzer Reading | MRD | Missouri River Division Duplicate | M | Metals (TAL) |
| ppm | Parts per Million | AB | Ambient Blank | TPH | Total Petroleum Hydrocarbons |
| A | Analytical | RB | Rinsate Blank | BTEX | Benzene, Toluene, Ethylbenzene, Xylene |
| SPT | Standard Penetration Test | DW | Decontamination Water Blank | | |
| GA | Gradation Analysis | TB | Trip Blank | TOC | Total Organic Carbon |
| L | Lithology | VOC | Volatile Organic Compounds (TCL) | OL | Organic Lead |
| MS/MSD | Matrix Spike / Matrix Spike Duplicate | PCB | Polychlorinated Biphenols, Pesticides | Pb/Cr | Lead / Chromium |
| | | TCL | Target Compound List | TAL | Target Analyte List |

( )* The borings that are shaded and in parentheses correspond to either a redrill or surface resample of the previous boring or surface sample due to laboratory missed holding times. These borings or surface resamples were drilled or collected approximately 1 to 5 feet away from the original boring or surface sample.

# TABLE 4-4

## PESTICIDE CONCENTRATIONS IN SOIL SAMPLES COLLECTED BY WCC AT FIRE DEPARTMENT TRAINING AREA NO. 1

## SWMU NO. 78/IRP NO. FT-6
## CANNON AFB, NEW MEXICO

| Boring Number | Sample Depth (Ft-BGS) | 4,4-DDD (μg/kg) | 4,4-DDE (μg/kg) |
|---|---|---|---|
| 0781 | 0-0.5 | 150 | 57J |
| | 4-6 | 23 | 3.7U |
| | 10-12 | 14 | 3.6U |
| | 20-22 | 3.7U | 3.7U |
| | All samples below 22 feet | Not detected above CRQL | Not detected above CRQL |
| 0782 | 0-0.5 | 91 | 14U |
| | 4-6 | 3.5UJ | 3.5UJ |
| | 10-12 | 3.7UJ | 3.7UJ |
| | 20-22 | 3.7UJ | 3.7U |
| | All samples below 22 feet | Not detected above CRQL | Not detected above CRQL |
| 0783 | 0-0.5 | 2,000 | 330U |
| 0784 | 0-0.5 | 660 | 58J |
| 0785 | 0-0.5 | 160 | 110 |
| 0786 | 0-0.5 | 4.3U | 1.1J |

J = Estimated value
U = Not detected at CRQL
UJ = Estimated as non-detect at the CRQL
Ft-BGS = Feet below ground surface
ug/kg = Micrograms per kilogram

## TABLE 4-5

## TOTAL PETROLEUM HYDROCARBON CONCENTRATIONS IN SOIL SAMPLES COLLECTED BY WCC AT FIRE DEPARTMENT TRAINING AREA NO. 1

### SWMU NO. 78/IRP NO. FT-6
### CANNON AFB, NEW MEXICO

| Boring Number (Redrill Boring Number) | Sampling Depth (Ft-BGS) | TPH (mg/kg) |
|---|---|---|
| 0781 (0787) | 0-0.5 | 2,200 |
| | 4-6 | 95 |
| | All samples deeper than 6 feet | ND |
| 0782 (0788) | 0-0.5 | (1,970) |
| | 4-6 | 42.2U |
| | All samples deeper than 6 feet | ND |
| 0783 (0789) | 0-0.5 | (4,080) |
| 0784 (7810) | 0-0.5 | (980) |
| 0785 (7811) | 0-0.5 | (12,500J) |
| 0786 (7812) | 0-0.5 | (45.5U) |

Ft-BGS = Feet below ground surface
mg/kg = Milligrams per kilogram
ND = Not detected
J = Estimated value
U = Not detected
( ) = The values in parentheses are results from samples collected from the redrill borings due to laboratory missed holding times

## TABLE 4-6

## METAL CONCENTRATIONS[1] IN SURFACE SOIL SAMPLES COLLECTED BY WCC AT FIRE DEPARTMENT TRAINING AREA NO. 1 SWMU NO. 78/IRP NO. FT-6 CANNON AFB, NEW MEXICO

| Element | Boring Number | | | | | | Background[2] ($\bar{x} + 2\sigma$) |
|---|---|---|---|---|---|---|---|
| | 0781 | 0782 | 0783 | 0784 | 0785 | 0786 | |
| Aluminum | 26000J | 10700J | 10200J | 9110J | 14200J | 13900J | 2571-10447 |
| Antimony | -R | -R | -R | -R | -R | 6.1R | 4.81-5.44 |
| Arsenic | 1.9J | 2J | 1.8J | 1.6J | 1.7J | 2.5J | 0.43-1.95 |
| Barium | 165J | 142J | 115J | 132J | 220J | 83.5J | 0-903 |
| Beryllium | 0.44U | 0.49J | 0.41U | 0.53J | 0.42U | 0.53U | 0.32-0.68 |
| Cadmium | 21.6 | 10.5 | 3.3 | 7.7 | 4.1 | 1.1U | 0.81-1.01 |
| Calcium | 2540 | 1950 | 1450 | 1290 | 832J | 12200 | 0-193062 |
| Chromium | 39.6 | 16.7 | 14.2 | 13.4 | 29.1 | 12.1 | 2.67-9.31 |
| Cobalt | 2J | 4J | 3.3J | 2.5J | 1.9J | 4.5J | 1.38-4.06 |
| Copper | 710 | 112 | 52 | 84.7 | 385 | 13U | 0.00-15.44 |
| Iron | 7100 | 9230 | 8950 | 7500 | 6580 | 11400 | 2239-8683 |
| Lead | 336 | 292 | 194 | 271 | 529 | 25.6 | 1.76-8.64 |
| Magnesium | 1170 | 1410 | 1390 | 1290 | 968J | 2020 | 0-11903 |
| Manganese | 225 | 171 | 99.5 | 74.6 | 51.1 | 198 | 10.89-167 |

**TABLE 4-6**
**(Concluded)**

| Element | Boring Number | | | | | | Background[2] ($\bar{x} + 2\sigma$) |
|---|---|---|---|---|---|---|---|
| | 0781 | 0782 | 0783 | 0784 | 0785 | 0786 | |
| Mercury | 0.11U | 0.11 | 0.12 | 0.1U | 0.1U | 0.13U | -- - -- |
| Nickel | 8.8J | 7.8J | 6.8J | 5.6J | 5.9J | 8.8J | 3.57-8.49 |
| Potassium | 1450 | 1900J | 1880J | 1710J | 1110J | 2570J | 632-2613 |
| Selenium | 0.22UJ | 0.22UJ | 0.2UJ | 0.2UJ | 0.21UJ | 0.27UJ | 0.00-1.35 |
| Silver | 0.88U | 0.87U | 0.81U | 0.81U | 0.83U | 1.1U | 0.86-0.94 |
| Sodium | 289U | 288U | 268U | 269U | 275U | 352U | 154-540 |
| Thallium | 0.22UJ | 0.22UJ | 0.2UJ | 0.2UJ | 0.21UJ | 0.27UJ | 0.20-0.24 |
| Vanadium | 14.4 | 18.7 | 19.2 | 15.4 | 14.1 | 24.3 | 9.26-26.74 |
| Zinc | 829 | 214 | 126 | 154 | 614 | 33.3J | 4.58-21.82 |

UJ = Estimated as non-detect at the instrument detection limit
J = Estimated value
U = Not detected
-R = Rejected
-- - -- = No range could be calculated

[1] All concentrations are in milligrams per kilogram (mg/kg)
[2] Background range calculated from values in Table 2-7

# TABLE 4-7

## METAL CONCENTRATIONS[1] IN SOIL SAMPLES COLLECTED BY WCC FROM BORINGS 0781 AND 0782 AT FIRE DEPARTMENT TRAINING AREA NO. 1 SWMU NO. 78/IRP NO. FT-6 CANNON AFB, NEW MEXICO

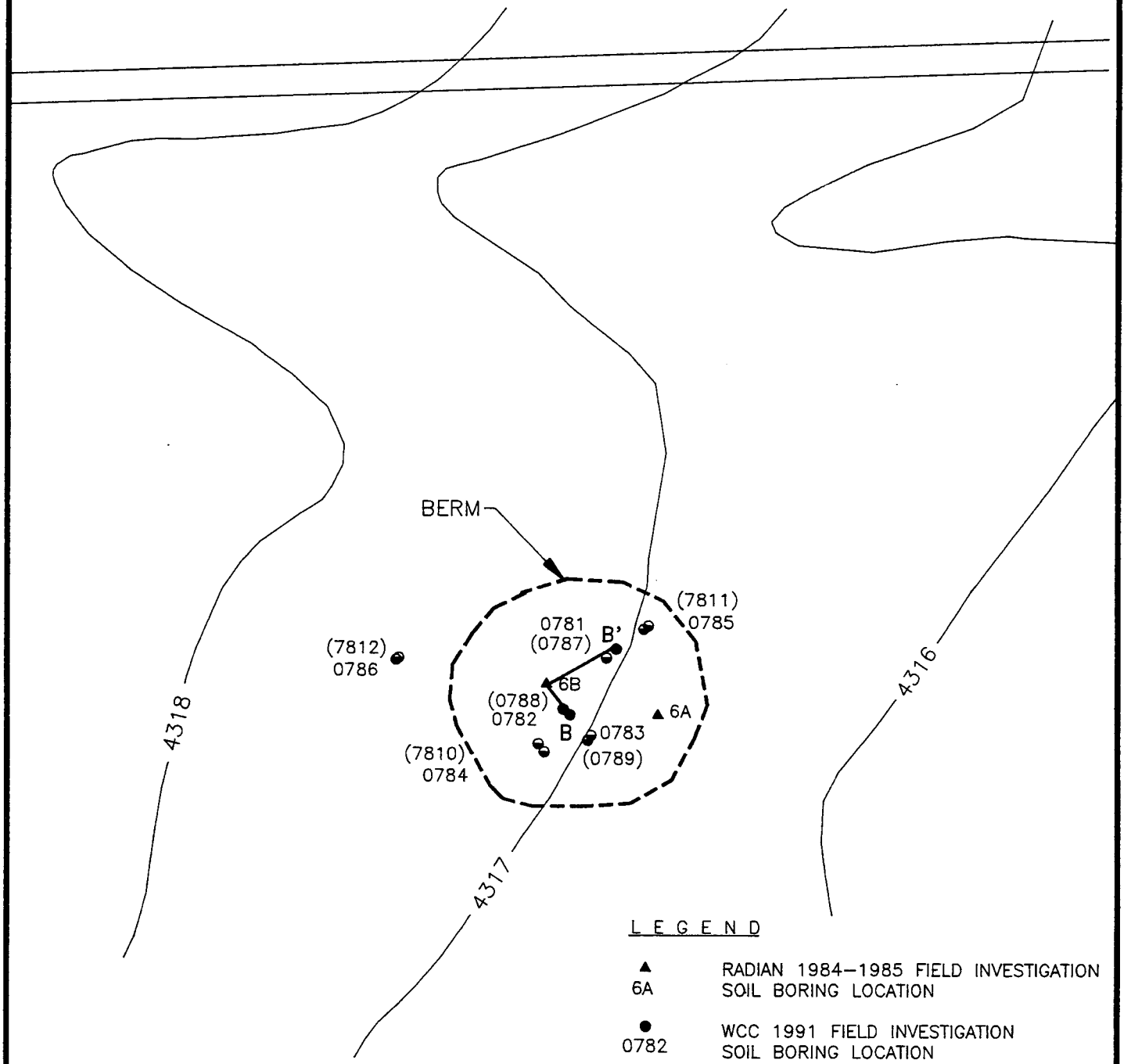
| Element | Boring 0781 Depth (Ft-BGS) | | | | | | | | | | Boring 0782 Depth (Ft-BGS) | | | | | | | | | | Back-ground[2] ($\bar{x}$ + 2 $\sigma$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 4 | 10 | 20 | 30 | 40 | 50 | 60 | 75 | 100 | 0 | 4 | 10 | 20 | 30 | 40 | 50 | 60 | 75 | 100 | |
| Aluminum | 26000J | 13200J | 10500J | 6460J | 6340J | 4860J | 4790J | 1940J | 1660J | 1410J | 10700J | 6240J | 6570J | 7940J | 9530J | 3950J | 4490J | 2190J | 1420J | 1350J | 2571-10447 |
| Antimony | -R | -R | -R | -R | -R | -R | -R | -R | -R | -R | -R | -R | -R | -R | -R | -R | -R | -R | -R | -R | 4.88-5.44 |
| Arsenic | 1.9J | 2.7 | 2.1J | 2J | 1J | 0.76J | 0.79J | 0.77J | 0.67J | -.69J | 2J | 1.8J | 1.3J | 1.9J | 1.6J | 0.83J | 0.73J | 0.89J | 0.67J | 0.85J | 0.43-1.95 |
| Barium | 165J | 111J | 392J | 60.3J | 70J | 52.5J | 19.1J | 6.7J | 15.6J | 27.5J | 142J | 158J | 101J | 498J | 61.2J | 13.4J | 66.4J | 12.4J | 36.1J | 13.3J | 0-903 |
| Beryllium | 0.44U | 0.59J | 0.5J | 0.44U | 0.47U | 0.42U | 0.43U | 0.41U | 0.42U | 0.41U | 0.49J | 0.42U | 0.44U | 0.45U | 0.46U | 0.42U | 0.43U | 0.43U | 0.42U | 0.41U | 0.32-0.68 |
| Cadmium | 21.6 | 0.9U | 0.9U | 0.88U | 0.94U | 0.85U | 0.85U | 0.83U | 0.84U | 0.81U | 10.5 | 0.84U | 0.89U | 0.9U | 0.91U | 0.85U | 0.85U | 0.85U | 0.84U | 0.83U | 0.81-1.01 |
| Calcium | 2540 | 27400 | 73500 | 43800 | 132000 | 38900 | 29600 | 5920 | 8390 | 3350 | 1950 | 96400 | 151000 | 98100 | 109000 | 13700 | 36600 | 6950 | 49500 | 5780 | 0-193062 |
| Chromium | 39.6 | 11.3 | 8.1 | 5.3 | 9.9 | 3.7 | 4.2 | 1.9J | 2.1 | 1.6J | 16.7 | 5.8 | 5.6 | 10.4 | 8 | 3.3 | 4.6 | 2J | 3.5 | 1.3J | 2.67-9.31 |
| Cobalt | 2J | 5.3J | 3.6J | 2J | 1.6J | 1.1J | 1.4J | 1U | 1U | 1U | 4J | 2.2J | 2.2J | 1.7J | 1.7J | 1.1J | 1.1J | 1.1U | 1.1U | 1U | 1.38-4.06 |
| Copper | 710 | 12.6 | 7 | 4.3J | 5.7J | 3J | 5.1J | 3.1J | 2.7J | 2.3J | 112 | 8.9 | 6 | 5.9 | 4.6J | 2.7J | 3.3J | 3.7J | 2.5J | 3.2J | 0.00-15.44 |
| Iron | 7100 | 11300 | 7880 | 4750 | 3340 | 3540 | 3650 | 1710 | 1900 | 2000 | 9230 | 5060 | 4660 | 5140 | 4820 | 3120 | 3320 | 1800 | 1470 | 2000 | 2239-8683 |
| Lead | 336 | 16.3 | 6.1 | 5 | 2.6 | 2.5 | 4.2 | 2 | 1.8 | 1.4 | 292 | 6.8 | 3.8 | 25 | 3.1 | 2.7 | 3.6 | 2.2 | 3 | 2.8 | 1.76-8.64 |
| Magnesium | 1170 | 2640 | 4370 | 4220 | 20700 | 5010 | 6430 | 1640 | 1100 | 827J | 1410 | 2490 | 4290 | 4900 | 18800 | 3610 | 5180 | 2510 | 1200 | 823J | 0-11903 |
| Manganese | 225 | 214 | 153 | 73.1 | 42 | 34.5 | 52.1 | 17.2 | 20.3 | 29.5 | 171 | 66 | 55.5 | 59.4 | 33.6 | 58.6 | 43 | 18.8 | 22.5 | 30.5 | 10.89-167 |
| Mercury | 0.11U | 0.11U | 0.11U | 0.11U | 0.12U | 0.11U | 0.11U | 0.1U | 0.1U | 0.1U | 0.11 | 0.11U | 0.11U | 0.11U | 0.11U | 0.11U | 0.11U | 0.11U | 0.11U | 0.1U | ---- |
| Nickel | 8.8J | 11.6 | 8.8J | 6.2J | 6.1J | 3.5J | 4.4J | 2.1J | 2.2J | 1.4U | 7.8J | 5.8J | 7.4J | 5.9J | 6.1J | 3.5J | 4J | 2.3J | 1.5U | 1.8J | 3.57-8.49 |
| Potassium | 1450 | 2070J | 1890 | 1650 | 1020J | 1020J | 996J | 366J | 313J | 277J | 1900J | 1110 | 1420 | 1520 | 1600 | 841J | 864J | 369J | 253J | 261J | 632-2613 |
| Selenium | 0.22UJ | 0.23UJ | 0.22UJ | 0.22UJ | 0.24UJ | 0.21UJ | 0.21UJ | 0.21UJ | 0.21UJ | 0.2UJ | 0.22UJ | 0.21UJ | 0.22UJ | 0.23UJ | 0.23UJ | 0.21UJ | 0.21UJ | 0.21UJ | 0.21UJ | 0.21UJ | 0.00-1.35 |
| Silver | 0.88U | 0.9U | 0.9U | 0.88U | 0.94U | 0.85U | 0.85U | 0.83U | 0.84U | 0.81U | 0.87U | 0.84U | 0.89U | 0.9U | 0.91U | 0.85U | 0.85U | 0.85U | 0.84U | 0.83U | 0.86-0.94 |
| Sodium | 289U | 299U | 296U | 292U | 312U | 280U | 282U | 274U | 276U | 269U | 288U | 278U | 294U | 298U | 301U | 280U | 282U | 281U | 278U | 274U | 154-540 |

# TABLE 4-7
# (Concluded)

| Element | Boring 0781 Depth (Ft-BGS) | | | | | | | | | | Boring 0782 Depth (Ft-BGS) | | | | | | | | | | Back-ground[2] ($\bar{x}$ + 2 $\sigma$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 4 | 10 | 20 | 30 | 40 | 50 | 60 | 75 | 100 | 0 | 4 | 10 | 20 | 30 | 40 | 50 | 60 | 75 | 100 | |
| Thallium | 0.22UJ | 0.23UJ | 0.22UJ | 0.22UJ | 0.24UJ | 0.21UJ | 0.21UJ | 0.21UJ | 0.21UJ | 0.2UJ | 0.22UJ | 0.21UJ | 0.22UJ | 0.23UJ | 0.23UJ | 0.21UJ | 0.21UJ | 0.21UJ | 0.21UJ | 0.21UJ | 0.20-0.24 |
| Vanadium | 14.4 | 23.4 | 25 | 18.1 | 19.7 | 10.1J | 15.8 | 7.5J | 5.1J | 5.2J | 18.7 | 16.4 | 15.2 | 19.7 | 27.1 | 9.4J | 12.8 | 9.2J | 4.7J | 4.9J | 9.26-26.74 |
| Zinc | 829 | 33.7 | 21.4 | 12.4 | 9.2 | 9.7 | 9.9 | 4.8 | 4.7 | 5 | 214 | 18 | 13.7 | 13.7 | 11.3 | 7.9 | 9.7 | 5.8 | 4.2 | 5 | 4.58-21.82 |

UJ = Estimated as non-detect at the instrument detection limit
J = Estimated value
U = Not detected
-R = Rejected
-- - -- = No range could be calculated
Ft-BGS = Feet below ground surface

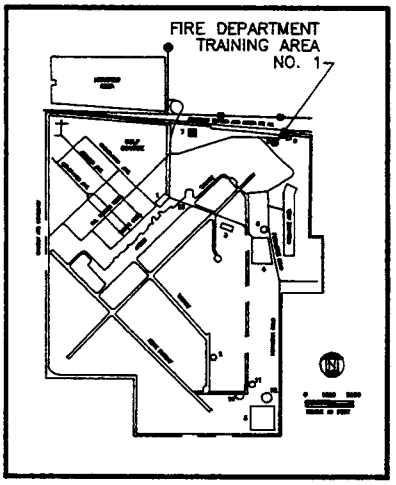
[1] All concentrations are in milligrams per kilogram (mg/kg)
[2] Background range calculated from values in Table 2-7

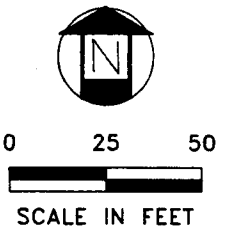



LEGEND

| | |
|---|---|
| ▲ 6A | RADIAN 1984–1985 FIELD INVESTIGATION SOIL BORING LOCATION |
| ● 0782 | WCC 1991 FIELD INVESTIGATION SOIL BORING LOCATION |
| ◒ 0784 | WCC 1991 FIELD INVESTIGATION SURFACE SOIL SAMPLE LOCATION |
| - - - - | SWMU BOUNDARY |
| 4316 | GROUND SURFACE CONTOUR LINE IN FEET MSL CONTOUR INTERVAL = 1 FOOT |
| B — B' | GEOLOGIC CROSS-SECTION LOCATION |

NOTE: THE NUMBERS IN PARENTHESIS CORRESPOND TO REDRILLS/RESAMPLES OF THE ORIGINAL BORING/SAMPLE



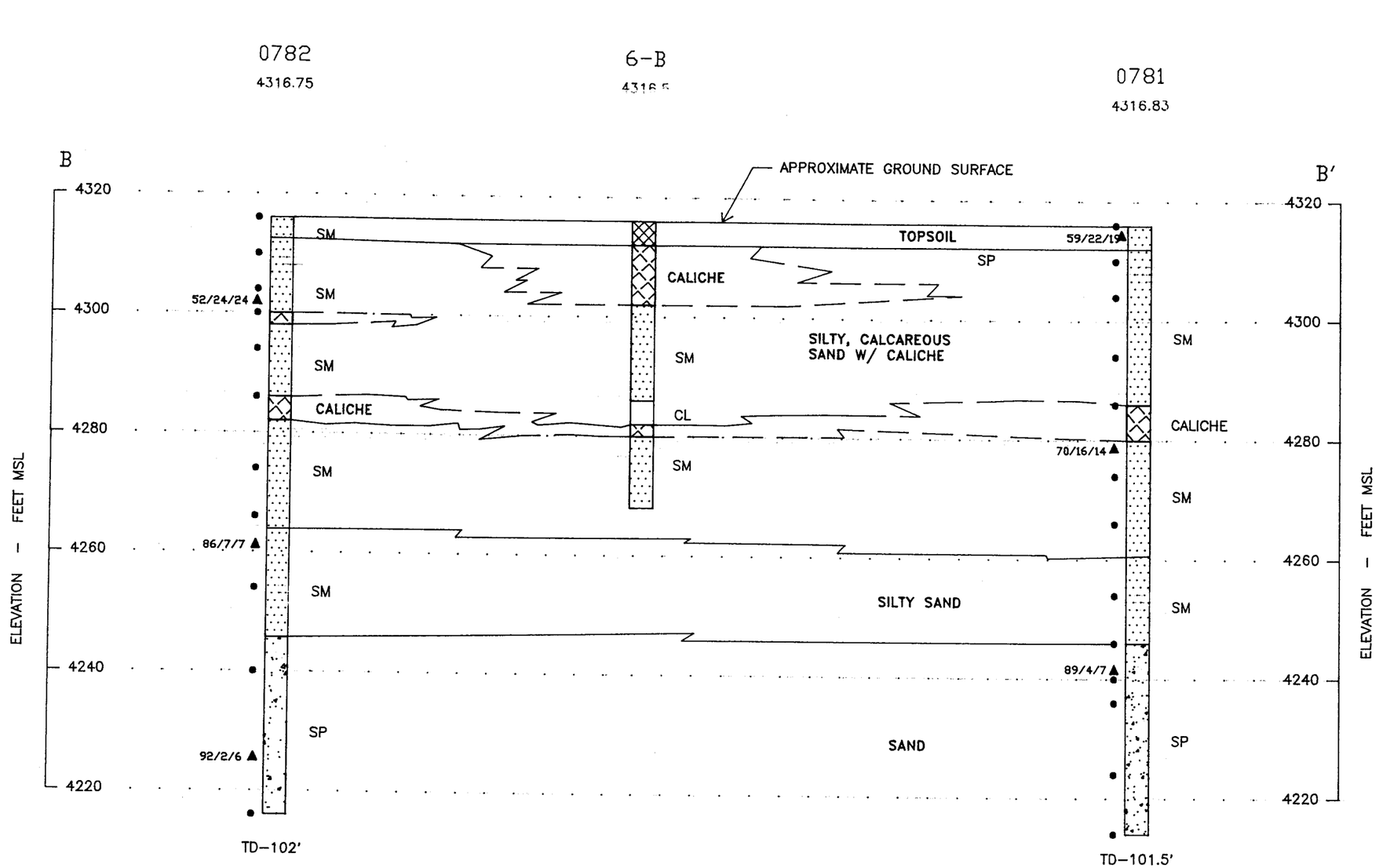




| | |
|---|---|
| Job No. : | 89MC114W |
| Prepared by : | D.A.K. |
| Date : | 2/10/92 |

LOCATION OF SOIL BORINGS AND SURFACE SOIL SAMPLES AT FIRE DEPARTMENT TRAINING AREA NO. 1
SWMU NO. 78/IRP FT-6
CANNON AFB, NEW MEXICO

C1140006

FIG. 4-1




LEGEND

MSL – MEAN SEA LEVEL
TD – TOTAL DEPTH IN FEET BGS
SM,SP,GW ML,GP – UNIFIED SOIL CLASSIFICATION SYSTEM ABBREVIATIONS
BGS – BELOW GROUND SURFACE

• – ANALYTICAL SAMPLE INTERVAL

86/7/7 ▲ – GRADATION ANALYSIS SAMPLE INTERVAL THE THREE NUMBERS REPRESENT THE APPROXIMATE PERCENTAGES OF SAND,– SILT– AND CLAY– SIZED MATERIAL RESPECTIVELY

BORINGS 0781, 0782 WCC (OCT 91)
BORING 6B RADIAN (NOV 84)
(BORING APPROXIMATELY LOCATED)

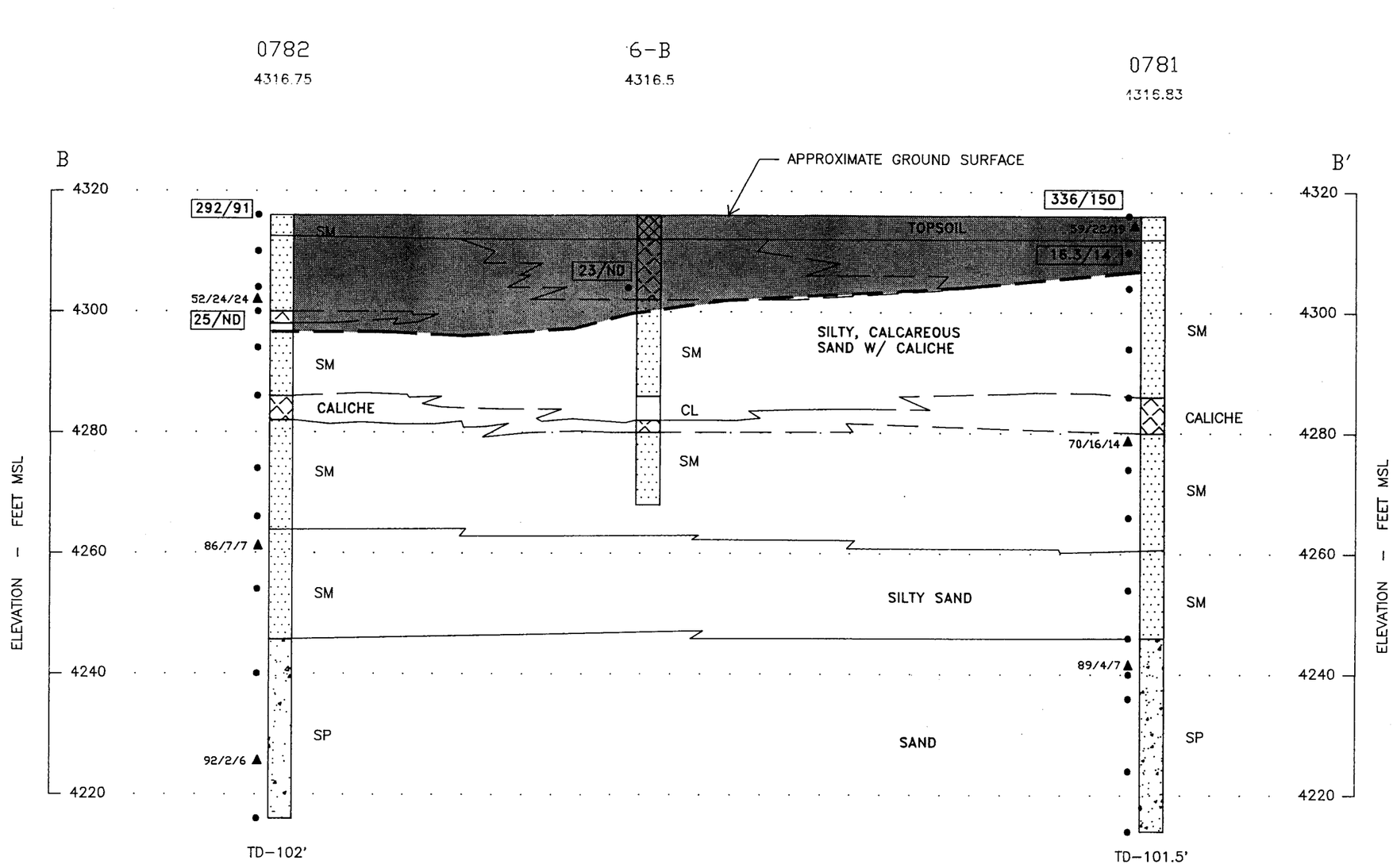
NOTE: THE LOCATION OF THIS CROSS-SECTION IS SHOWN ON FIG. 4-1

0 5 10
HORIZONTAL SCALE IN FEET
VERTICAL EXAGGERATION = 0.25X

| | |
|---|---|
| Job No. : 89MC114W | GEOLOGIC CROSS SECTION B-B' FIRE DEPT. TRAINING AREA NO.1 SWMU NO.78/IRP NO. FT-6 CANNON AFB NEW MEXICO |
| Prepared by : LLG | |
| Date : 2/3/92 | |

FIG. 4-2

SWMU-7




LEGEND

| | | |
|---|---|---|
| MSL | – | MEAN SEA LEVEL |
| TD | – | TOTAL DEPTH IN FEET BGS |
| SM,SP,GW | | UNIFIED SOIL CLASSIFICATION |
| ML,GP | | SYSTEM ABBREVIATIONS |
| BGS | – | BELOW GROUND SURFACE |

BORINGS 0781, 0782 WCC (OCT 91)
BORING 6B RADIAN (NOV 84)
(BORING APPROXIMATELY LOCATED)

NOTE: THE LOCATION OF THIS CROSS-SECTION IS SHOWN ON FIG. 4-1

292/ND — ANALYTICAL SAMPLE INTERVAL THE NUMBER REPRESENTS ANALYTICAL RESULTS FOR LEAD AND 4,4,DDD RESPECTIVELY (mg/kg)

— — APPROXIMATE VERTICAL EXTENT OF LEAD AND 4,4,DDD IN SOIL

86/7/7 ▲ — GRADATION ANALYSIS SAMPLE INTERVAL THE THREE NUMBERS REPRESENT THE APPROXIMATE PERCENTAGES OF SAND,- SILT- AND CLAY- SIZED MATERIAL RESPECTIVELY

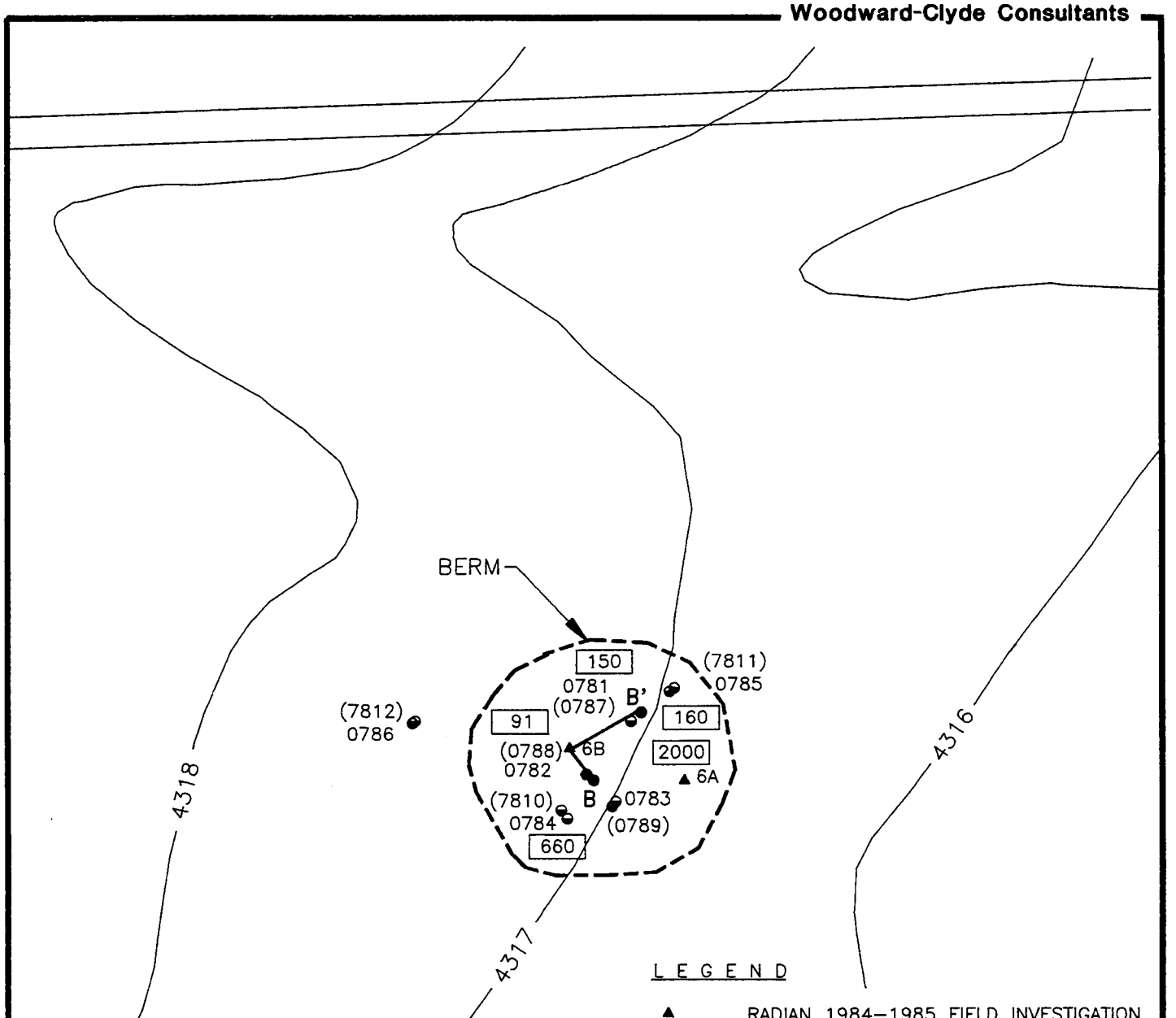
ND — NOT DETECTED

0 5 10
HORIZONTAL SCALE IN FEET
VERTICAL EXAGGERATION = 0.25X

| | |
|---|---|
| Job No. : 89MC114W | VERTICAL EXTENT OF LEAD AND 4,4,DDD IN SOIL, FIRE DEPT. TRAINING AREA NO.1 SWMU NO. 78/IRP NO. FT-6 CANNON AFB NEW MEXICO |
| Prepared by : LLG | |
| Date : 2/3/92 | |

SWMU-78

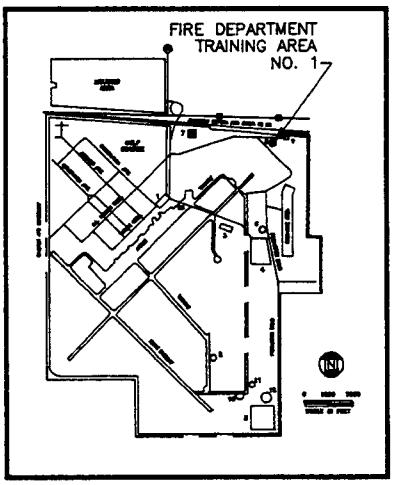
FIG. 4-3




LEGEND

| | |
|---|---|
| ▲ 6A | RADIAN 1984–1985 FIELD INVESTIGATION SOIL BORING LOCATION |
| ● 0782 | WCC 1991 FIELD INVESTIGATION SOIL BORING LOCATION |
| 2000 | PESTICIDE 4,4,DDD LEVEL IN SOIL (mg/kg) |
| ◒ 0784 | WCC 1991 FIELD INVESTIGATION SURFACE SOIL SAMPLE LOCATION |
| - - - - | SWMU BOUNDARY |
| 4316 | GROUND SURFACE CONTOUR LINE IN FEET MSL CONTOUR INTERVAL = 1 FOOT |
| B — B' | GEOLOGIC CROSS-SECTION LOCATION |

NOTE: THE NUMBERS IN PARENTHESIS CORRESPOND TO REDRILLS/RESAMPLES OF THE ORIGINAL BORING/SAMPLE




N

0 25 50

SCALE IN FEET

| | |
|---|---|
| Job No. : | 89MC114W |
| Prepared by : | D.A.K. |
| Date : | 2/10/92 |

4,4,DDD LEVELS IN SURFACE SOIL
DEPARTMENT TRAINING AREA NO. 1

SWMU NO. 78/IRP FT-6
CANNON AFB, NEW MEXICO

C1140023

FIG. 4-4

# 5.0
# SOLVENT DISPOSAL SITE (SWMU NO. 81/IRP NO. DP-16)

## 5.1 SWMU DESCRIPTION

### 5.1.1 Setting

The Solvent Disposal Site is located on the northeast part of the base between Landfill No. 2 and Fire Training Area No. 1 (Figure 5-1). The site is in an open field covered with prairie grass.

### 5.1.2 History of Use

This unit was first identified in 1983 by CH2M Hill as containing two drums, labeled "Trichloroethylene", on the ground, opened, and positioned so as to drain into a shallow surrounding pit. Each drum had rust holes in the top, suggesting they had been there for several years (CH2M Hill 1983).

### 5.1.3 Past Investigations

Although the unit was first identified in 1983, it was not permanently marked. During the RFA in 1987, there was apparently no evidence of the site. The site was recently located by USAF personnel for the WCC RI effort, although no visual indications of the site location were observed.

### 5.1.4 Land Use and Demography

The solvent disposal area is located in an open field adjacent to Fire Training Area No. 1. The land here is not currently being used. Ground maintenance contractors mow the area once per month for approximately 5 to 10 minutes, for 6 months of the year.

## 5.2 FIELD INVESTIGATION

This section provides a discussion of the field activities conducted by WCC at the Solvent Disposal Site from October 11 through 12, 1991, November 6 through 7, 1991, and from November 24 through December 16, 1991. The activities at this SWMU, as outlined in the FSP (WCC 1991c), consisted of collecting 10 surface soil samples for chemical analysis, 2 surface soil samples for gradation analysis, drilling 10 soil borings, collecting 8 subsurface soil samples for chemical analysis and 8 subsurface soil samples for gradation analysis. Based on elevated OVA readings detected from the soil samples collected at the targeted bottom of two soil borings, it was decided to drill 2 additional borings approximately 5 feet deeper than the original borings to evaluate the potential vertical extent of contamination. A total of 3 additional subsurface soil samples for chemical analysis and 1 subsurface soil sample for gradation analysis were collected. The resampling phase of the field program, which became necessary due to laboratory missed holding times, consisted of recollecting 1 surface soil sample for chemical analysis, redrilling 1 soil boring, and recollecting 1 subsurface soil sample for chemical analysis.

Table 5-1 summarizes the drilling and sampling methods, along with sampling frequency conducted at each soil boring and surface sample location during the 1991 WCC investigation. A complete record of all surface soil, subsurface soil, and associated QA/QC samples collected at the Solvent Disposal Site is presented in Table 5-2. The locations of the surface samples and soil borings are shown on Figure 5-1.

### 5.2.1 Sampling Objectives

The objective of sampling at the Solvent Disposal Site was to evaluate the nature and extent of potential hazardous contaminants that may be present in the soil. The soil borings were located at 10 nodal sampling locations based on a 10-foot by 10-foot grid system. The grid was laid out over the SWMU as a 4-by-4 grid square, for a total effective area of coverage of 160 square feet (40 feet by 40 feet). Initially, nine sampling locations were located, with the tenth location being located near a boring which showed elevated OVA readings. These sample locations were designed to allow for a systematic sampling approach in the area surrounding and including the reported location of the

solvent spill at this SWMU. The data collected at these boring locations were used to further evaluate the extent of potential contamination, if present, and to perform a baseline risk assessment to determine if the area poses a risk to human health or the environment. The data may also be utilized to evaluate remedial actions if necessary. Presently, there does not appear to be any substantial risk to the groundwater, so no hydrogeologic investigation was planned or conducted.

### 5.2.2 Surface Soil Investigation

Ten surface soil samples were collected from 0 to 0.5 feet below ground surface (BGS) near borings 8101 through 8110. These samples were collected using a stainless steel hand trowel and analyzed for TCL VOCs. In addition, two samples, one from boring 8101 and one from boring 8106, were sent out for geotechnical gradation analysis.

During the resampling phase, one additional surface soil sample, 8114 (a resample of the surface soil sample from boring 8106), located approximately 1 foot south of the original surface sample location, was collected because the laboratory missed the holding time for the TCL VOC analysis on the original sample. This sample was analyzed for TCL VOCs.

### 5.2.3 Subsurface Soil/Vadose Zone Investigation

Ten soil borings, 8101 through 8110, were drilled to a depth of 6 feet BGS at the Solvent Disposal Site at the 10 nodal sampling locations discussed above. Each soil boring was sampled continuously and described lithologically from the split spoon samples obtained during drilling. Subsurface samples for chemical analysis were collected at 4 feet BGS in all borings for a total of ten subsurface soil samples. The subsurface analytical samples were collected with stainless steel split spoons and analyzed for TCL VOCs. Eight subsurface samples were collected for geotechnical gradation analysis. Four of the samples were collected at 2 feet BGS in borings 8102, 8104, 8107, and 8109, while the other four samples were collected at 4 feet BGS in borings 8103, 8105, 8108, and 8110.

Based on elevated OVA readings of the subsurface soil samples collected in borings 8102 and 8107, two additional soil borings, 8111 (a deeper redrill of boring 8102),

located approximately 1 foot southeast of the original soil boring, and 8112 (a deeper redrill of boring 8107), located approximately 1 foot northeast of the original boring, were drilled to a depth of 9.5 and 9.4 feet BGS, respectively, and sampled continuously. Three additional subsurface soil samples were collected at 5 and 9 feet BGS in boring 8111, and at 5 feet BGS in boring 8112, to evaluate the vertical extent of potential contamination below the depth of the original borings. These samples were analyzed for TCL VOCs. One additional geotechnical gradation analysis sample was collected at 5 feet BGS in boring 8112.

During the resampling phase, one additional soil boring, 8113 (a redrill of boring 8107), located approximately 2 feet north of the original boring, was drilled to a depth of 6 feet BGS. One additional sample was collected at the same interval where the analytical subsurface soil sample was collected in the original boring (4 feet BGS) because the laboratory missed the holding time for the TCL VOC analysis on the original sample. This sample was analyzed for TCL VOCs.

## 5.3 PHYSICAL CHARACTERISTICS

This section provides a discussion of the soil, geology and hydrogeology at the Solvent Disposal Site based on a review of the detailed lithologic descriptions of split spoon samples and gradation analysis results from the 1991 WCC investigation.

### 5.3.1 Soil

The soils underlying the Solvent Disposal Site consist of sandy loam and loamy sand of the Amarillo Soil Group . The soils consist primarily of fine-grained, well sorted, silty, clayey, unconsolidated orange-red to brown-red to brown sands. The sands are generally slightly moist with trace amounts of clay. Six gradation analyses were performed on soil samples collected within unit at 0.5 feet BGS in borings 8101 and 8106, and at 2 feet BGS in borings 8102, 8104, 8107, and 8109. The results indicate that the soil samples collected at 0.5 feet BGS were comprised of approximately 57 to 58 percent sand, 25 percent silt, and 17 to 18 percent clay, while the soil samples collected at 2 feet BGS were comprised of approximately 33 to 36 percent sand, 30 to 33 percent silt, and 31 to 36 percent clay. The total thickness of the soil zone is approximately 2 to 5 feet.

### 5.3.2 Geology

The near surface (upper 9.5 feet) stratigraphy at the Solvent Disposal Site consists of Tertiary Miocene to Pliocene fluvial deposits of the Ogallala Formation. Stratigraphic correlations of the various fluvial deposits between borings is based primarily on the split spoon lithologic samples collected during drilling.

The SWMU is underlain by Ogallala fluvial deposits consisting primarily of well sorted sand. The total thickness of these Ogallala deposits beneath the SWMU is not presently known, but based on regional information, may be as thick as 390 feet. The fluvial deposits shown on the boring logs from 4304 to 4310 feet MSL consist of fine- to very fine-grained, well sorted, silty, calcareous medium to light orange and brown sands (Appendix B-1). These sands are comprised predominantly of subangular to subrounded quartz grains with varying amounts of silt, calcium carbonate, and very minor amounts of clay. Scattered throughout this unit is tan to tan-orange caliche pockets or nodules. Five gradation analyses were performed on samples collected within this unit at 4 feet BGS in borings 8103, 8105, 8108, and 8110, and at 5 feet BGS in boring 8112. The results indicated that these samples were comprised of approximately 30 to 45 percent sand, 17 to 19 percent silt, and 38 to 51 percent calcium carbonate and /or clay-sized material. The thickness of this unit is unknown at present due to the fact that the unit was not fully penetrated. Approximately 2 to 5 feet of native topsoil exists above this unit. No groundwater was encountered during the drilling of these borings.

## 5.4 NATURE AND EXTENT OF CONTAMINATION

Surface and subsurface soil samples were collected from each of ten soil borings, 8101 through 8110, and two redrill soil borings, 8111 and 8112 (Figure 5-1). Evaluation of the chemical analyses (TCL VOCs) of these samples has been used to describe the nature and extent of contamination.

Due to the history of the site, all samples were analyzed for Target Compound List volatile organic compounds. Acetone and toluene were the only target compounds detected above the CRQL and their concentrations are summarized in Table 5-3.

Toluene was present in a concentration of 13-17 μg/kg at the surface in borings 8102, 8104, 8105, and 8110, but was not present above the CRQL in any of the subsurface samples. Acetone was reported as present in concentrations ranging from 30 to 910 μg/kg at 4 to 6 feet bgs at all ten boring locations.

The reporting limits for TCL volatile organic analyses were raised in samples 8101 (4 to 6 feet bgs), 8102 (4 to 6 feet bgs), 8104 (4 to 6 feet bgs), and 8108 (0 to 0.5 feet bgs) because of the sample dilution necessary due to target compounds. The concentration of acetone usually exceeded the calibration range and therefore, the samples were reanalyzed at dilution.

In summary, analytical results indicate that only acetone and toluene were detected at the SWMU above the CRQL. Acetone, which is a common laboratory contaminant, can be dismissed as a chemical concern at low concentrations in several borings. However, the elevated acetone concentrations at borings 8101, 8102, 8104, 8107, and 8108 (400 μg/kg, 160 μg/kg, 910 μg/kg, 210 μg/kg, and 1300 μg/kg, respectively) may indicate possible contamination from solvent disposal practices. Elevated acetone concentrations occur in the western portion of the SWMU at the 4 to 6 foot interval in borings 8101, 8102, 8104, 8107, and 8108 (Figure 5-1). However, based on the results from the two deeper redrill borings completed in that area, it appears that acetone is restricted to the 4 to 6 foot interval. Acetone concentrations in borings 8111 (redrill of 8102) and 8112 (redrill of boring 8107) at the 9 to 9.5 foot interval were non-detect at 22U μg/kg and 15U μg/kg, respectively. Therefore, the vertical extent of acetone in the soil in the western portion of the SWMU appears to lie between 4 to 6 feet and does not extend below 9 feet bgs. The low concentrations of toluene (i.e., less than 17 μg/kg) detected at the site indicate that toluene is not a chemical of concern.

TABLE 5-1

SUMMARY OF SURFACE SOIL SAMPLING, BOREHOLE DRILLING, AND BOREHOLE SAMPLING CONDUCTED BY WCC AT SOLVENT DISPOSAL SITE, SWMU NO. 81 / IRP NO. DP-16, CANNON AFB, NEW MEXICO

| BORING NUMBER | DRILLING/ SAMPLING METHOD | DRILL RIG USED | BOREHOLE DIAMETER (In) | DRILLING/ SAMPLING DEPTH INTERVALS (Ft-BGS) | BOREHOLE SAMPLING FREQUENCY | DATE(S) DRILLED/ SAMPLED | NUMBER OF ANALYTICAL SOIL SAMPLES COLLECTED | NUMBER OF ANALYTICAL QA/QC SAMPLES COLLECTED | NUMBER OF SPT SOIL SAMPLES COLLECTED | NUMBER OF GRADATION ANALYSIS SAMPLES COLLECTED | GROUND ELEVATION (Ft-MSL) | TOTAL DEPTH OF BOREHOLE (Ft-BGS) | DATE BOREHOLE GROUTED |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8101 | HT | NA | NA | 0 to 0.5 | NA | 10-11-91 | 1 | 1 | NA | 1 | 4314.40 | 6 | 10-12-91 |
| | HSA | B-53 | 6.5 | 0 to 6 | Continuous | 10-12-91 | 1 | 0 | 3 | 0 | | | |
| 8102 | HT | NA | NA | 0 to 0.5 | NA | 10-11-91 | 1 | 1 | NA | 0 | 4314.49 | 6 | 10-12-91 |
| | HSA | B-53 | 6.5 | 0 to 6 | Continuous | 10-12-91 | 1 | 0 | 3 | 1 | | | |
| [8111]* | HSA | B-61A | 6.5 | 0 to 9.5 | Continuous | 11-06-91 | 2 | 0 | 0 | 0 | 4314.42 | 9.5 | 11-07-91 |
| 8103 | HT | NA | NA | 0 to 0.5 | NA | 10-11-91 | 1 | 0 | NA | 0 | 4314.32 | 6 | 10-12-91 |
| | HSA | B-53 | 6.5 | 0 to 6 | Continuous | 10-12-91 | 1 | 1 | 3 | 1 | | | |
| 8104 | HT | NA | NA | 0 to 0.5 | NA | 10-11-91 | 1 | 0 | NA | 0 | 4314.57 | 6 | 10-12-91 |
| | HSA | B-53 | 6.5 | 0 to 6 | Continuous | 10-12-91 | 1 | 1 | 3 | 1 | | | |
| 8105 | HT | NA | NA | 0 to 0.5 | NA | 10-11-91 | 1 | 1 | NA | 0 | 4314.43 | 6 | 10-12-91 |
| | HSA | B-53 | 6.5 | 0 to 6 | Continuous | 10-12-91 | 1 | 0 | 3 | 1 | | | |
| 8106 | HT | NA | NA | 0 to 0.5 | NA | 10-11-91 | 1 | 1 | NA | 1 | 4314.40 | 6 | 10-12-91 |
| | HSA | B-53 | 6.5 | 0 to 6 | Continuous | 10-12-91 | 1 | 0 | 3 | 0 | | | |
| (8114)* | HT | NA | NA | 0 to 0.5 | NA | 12-18-91 | 1 | 2 | NA | 0 | 4314.33 | 0.5 | NA |
| 8107 | HT | NA | NA | 0 to 0.5 | NA | 10-11-91 | 1 | 1 | NA | 0 | 4314.49 | 6 | 10-12-91 |
| | HSA | B-53 | 6.5 | 0 to 6 | Continuous | 10-12-91 | 1 | 0 | 3 | 1 | | | |
| [8112]* | HSA | B-61A | 6.5 | 0 to 9.4 | Continuous | 11-07-91 | 2 | 0 | 0 | 1 | 4314.62 | 9.4 | 11-07-91 |
| (8113)* | HSA | B-61A | 6.5 | 0 to 6 | 5' Interval | 11-24-91 | 1 | 1 | 1 | 0 | 4314.62 | 6 | 11-07-91 |
| 8108 | HT | NA | NA | 0 to 0.5 | NA | 10-11-91 | 1 | 0 | NA | 0 | 4314.51 | 6 | 10-12-91 |
| | HSA | B-53 | 6.5 | 0 to 6 | Continuous | 10-12-91 | 1 | 1 | 3 | 1 | | | |
| 8109 | HT | NA | NA | 0 to 0.5 | NA | 10-11-91 | 1 | 0 | NA | 0 | 4314.37 | 6 | 10-12-91 |
| | HSA | B-53 | 6.5 | 0 to 6 | Continuous | 10-12-91 | 1 | 0 | 3 | 1 | | | |
| 8110 | HT | NA | NA | 0 to 0.5 | NA | 10-11-91 | 1 | 1 | NA | 0 | 4314.45 | 6 | 10-12-91 |
| | HSA | B-53 | 6.5 | 0 to 6 | Continuous | 10-12-91 | 1 | 0 | 3 | 1 | | | |

26
- 2 replicates
24

TABLE 5-1

SUMMARY OF SURFACE SOIL SAMPLING, BOREHOLE DRILLING, AND BOREHOLE SAMPLING CONDUCTED BY WCC AT SOLVENT DISPOSAL SITE, SWMU NO. 61 / IRP NO. DP-16, CANNON AFB, NEW MEXICO

| | | | |
|---|---|---|---|
| In | Inches | B-53 | Mobile B-53 Auger Drill Rig with 6" OD / 3.75" ID Augers and 6.5" Bullet Bit |
| Ft-BGS | Feet Below Ground Surface | B-61A | Mobile B-61 Auger Drill Rig with 6" OD / 3.75" ID Augers and 6.5" or 6.25" Bullet Bit |
| Ft-MSL | Feet Mean Sea Level | B-61B | Mobile B-61 Auger Drill Rig with 7.25" OD / 4.25" ID Augers and 7.5" Bullet Bit |
| SPT | Standard Penetration Test | F-10 | Failing F-10 Auger Drill Rig with 8.25" OD / 4.25" ID Augers and 8.5" Bullet Bit |
| HSA | Hollow Stem Auger | CME-75 | Central Mine Equipment CME-75 Auger Drill Rig with 7.75" OD / 4.25" ID Augers and 8.0" Bullet Bit |
| HT | Hand Trowel, Surface Sample | OD | Outer Diameter |
| NA | Not Applicable, Surface Sample | ID | Inner Diameter |
| NS | Not Sampled | | |

[ ]* The borings that are shaded and in brackets correspond to a deeper redrill of the previous boring based on elevated OVA readings and/or odors detected from the soil sample collected at the targeted bottom of the original boring. These borings were drilled approximately 1 to 5 feet away from the original boring.

( )* The borings that are shaded and in parentheses correspond to either a redrill or surface resample of the previous boring or surface sample due to laboratory missed holding times. These borings or surface resamples were drilled or collected approximately 1 to 5 feet away from the original boring or surface sample.

TABLE 5-2

SUMMARY OF SURFACE SOIL, SUBSURFACE SOIL, AND QA/QC SAMPLES COLLECTED BY WCC AT SOLVENT DISPOSAL SITE, SWMU NO. 81 / IRP NO. DP-16, CANNON AFB, NEW MEXICO

| BORING NUMBER | DEPTH INTERVAL (Ft-BGS) | SAMPLE IDENTIFICATION NUMBER | SAMPLE TYPE | QA/QC SAMPLES | SAMPLE MATRIX | DATE SAMPLED | TIME SAMPLED | OVA ON SAMPLE (ppm) | ANALYTICAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|---|
| 8101 | 0 to 0.5 | CAN081-8101-0000 | A | | Soil | 10-11-91 | 1843 | 0 | VOC |
| | | CAN081-8101-0901 | A | MRD | Soil | 10-11-91 | 1843 | 0 | VOC |
| | | CAN081-8101-4000 | GA | | Soil | 10-11-91 | 1845 | 0 | |
| | 0 to 2 | CAN081-8101-4000 | SPT | | Soil | 10-12-91 | 0825 | | |
| | 2 to 4 | CAN081-8101-4002 | SPT | | Soil | 10-12-91 | 0835 | | |
| | 4 to 6 | CAN081-8101-0004 | A/SPT | | Soil | 10-12-91 | 0845 | 0 | VOC |
| 8102 | 0 to 0.5 | CAN081-8102-0000 | A | | Soil | 10-11-91 | 1851 | 0 | VOC |
| | | CAN081-8102-0981 | A | DW | Water | 10-11-91 | 1853 | | VOC |
| | 0 to 2 | CAN081-8102-4000 | SPT | | Soil | 10-12-91 | 0900 | | |
| | 2 to 4 | CAN081-8102-4002 | SPT/GA | | Soil | 10-12-91 | 0910 | | |
| | 4 to 6 | CAN081-8102-0004 | A/SPT | | Soil | 10-12-91 | 0925 | 11.3 | VOC |
| [8111]* | 0 to 5 | CAN081-8111-4000 | L | | Soil | 11-06-91 | 1555 | 0 | |
| | 5 to 9 | CAN081-8111-0005 | L | | Soil | 11-06-91 | 1630 | 0 | |
| | 9 to 9.5 | CAN081-8111-0009 | A | | Soil | 11-06-91 | 1655 | 0 | VOC |
| 8103 | 0 to 0.5 | CAN081-8103-0000 | A | | Soil | 10-11-91 | 1855 | 0 | VOC |
| | 0 to 2 | CAN081-8103-4000 | SPT | | Soil | 10-12-91 | 0940 | | |
| | 2 to 4 | CAN081-8103-4002 | SPT | | Soil | 10-12-91 | 0945 | | |
| | 4 to 6 | CAN081-8103-0004 | A/SPT | | Soil | 10-12-91 | 1000 | 0 | VOC |
| | | CAN081-8103-0902 | A | MRD | Soil | 10-12-91 | 1000 | 0 | VOC |
| | | CAN081-8103-4004 | GA | | Soil | 10-12-91 | 1000 | 0 | |
| 8104 | 0 to 0.5 | CAN081-8104-0000 | A | | Soil | 10-11-91 | 1858 | 0 | VOC |
| | 0 to 2 | CAN081-8104-4000 | SPT | | Soil | 10-12-91 | 1015 | | |
| | 2 to 4 | CAN081-8104-4002 | SPT/GA | | Soil | 10-12-91 | 1025 | | |
| | 4 to 6 | CAN081-8104-0004 | A/SPT | MS/MSD | Soil | 10-12-91 | 1035 | 2.1 | VOC |
| 8105 | 0 to 0.5 | CAN081-8105-0000 | A | | Soil | 10-11-91 | 1902 | 0 | VOC |
| | | CAN081-8105-0962 | A | FD | Soil | 10-11-91 | 1930 | 0 | VOC |
| | 0 to 2 | CAN081-8105-4000 | SPT | | Soil | 10-12-91 | 1050 | | |
| | 2 to 4 | CAN081-8105-4002 | SPT | | Soil | 10-12-91 | 1105 | | |
| | 4 to 6 | CAN081-8105-0004 | A/SPT | | Soil | 10-12-91 | 1110 | 0.1 | VOC |
| | | CAN081-8105-4004 | GA | | Soil | 10-12-91 | 1110 | 0.1 | |
| 8106 | 0 to 0.5 | CAN081-8106-0000 | A | | Soil | 10-11-91 | 1907 | 0 | VOC |
| | | CAN081-8106-0951 | A | AB | Water | 10-11-91 | 1910 | | VOC |
| | | CAN081-8106-4000 | GA | | Soil | 10-11-91 | 1918 | 0 | |
| | 0 to 2 | CAN081-8106-4000 | SPT | | Soil | 10-12-91 | 1130 | | |
| | 2 to 4 | CAN081-8106-4002 | SPT | | Soil | 10-12-91 | 1140 | | |
| | 4 to 6 | CAN081-8106-0004 | A/SPT | | Soil | 10-12-91 | 1155 | 0 | VOC |
| (8114)* | 0 to 0.5 | CAN081-8114-0000 | A | MS/MSD | Soil | 12-16-91 | 1030 | 0 | VOC |
| | | CAN081-8114-0952 | A | AB | Water | 12-16-91 | 1035 | | VOC |
| | | CAN081-8114-0982 | A | DW | Water | 12-16-91 | 1040 | | VOC |
| 8107 | 0 to 0.5 | CAN081-8107-0000 | A | | Soil | 10-11-91 | 1910 | 0 | VOC |
| | | CAN081-8107-0971 | A | RB | Water | 10-11-91 | 1925 | | VOC |
| | 0 to 2 | CAN081-8107-4000 | SPT | | Soil | 10-12-91 | 1220 | | |
| | 2 to 4 | CAN081-8107-4002 | SPT/GA | | Soil | 10-12-91 | 1225 | | |
| | 4 to 6 | CAN081-8107-0004 | A/SPT | | Soil | 10-12-91 | 1240 | 10 | VOC |
| [8112]* | 0 to 5 | CAN081-8112-0000 | A | | Soil | 11-07-91 | 0730 | 0 | VOC |
| | 5 to 9 | CAN081-8112-4005 | L | | Soil | 11-07-91 | 0825 | 0 | |
| | 9 to 9.4 | CAN081-8112-0005 | A | | Soil | 11-07-91 | 0845 | 0 | VOC |
| | | CAN081-8112-4005 | GA | | Soil | 11-07-91 | 0845 | 0 | |
| (8113)* | 4 to 6 | CAN081-8113-0004 | A/SPT | MS/MSD | Soil | 12-16-91 | 1100 | 0 | VOC |
| | | CAN081-8113-0972 | A | RB | Water | 12-16-91 | 1145 | | VOC |

TABLE 5-2

SUMMARY OF SURFACE SOIL, SUBSURFACE SOIL, AND QA/QC SAMPLES COLLECTED BY WCC AT SOLVENT DISPOSAL SITE, SWMU NO. 81 / IRP NO. DP-16, CANNON AFB, NEW MEXICO

| BORING NUMBER | DEPTH INTERVAL (Ft-BGS) | SAMPLE IDENTIFICATION NUMBER | SAMPLE TYPE | QA/QC SAMPLES | SAMPLE MATRIX | DATE SAMPLED | TIME SAMPLED | OVA ON SAMPLE (ppm) | ANALYTICAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|---|
| 8108 | 0 to 0.5 | CAN081-8108-0000 | A | | Soil | 10-11-91 | 1915 | 0 | VOC |
| | 0 to 2 | CAN081-8108-4000 | SPT | | Soil | 10-12-91 | 1300 | 0 | |
| | 2 to 4 | CAN081-8108-4002 | SPT | | Soil | 10-12-91 | 1315 | 0 | |
| | 4 to 6 | CAN081-8108-0004 | A/SPT | | Soil | 10-12-91 | 1325 | 0 | VOC |
| | | CAN081-8108-0961 | A | FD | Soil | 10-12-91 | 1325 | 0 | VOC |
| | | CAN081-8108-4004 | GA | | Soil | 10-12-91 | 1325 | 0 | |
| 8109 | 0 to 0.5 | CAN081-8109-0000 | A | | Soil | 10-11-91 | 1920 | 0 | VOC |
| | 0 to 2 | CAN081-8109-4000 | SPT | | Soil | 10-12-91 | 1335 | 0 | |
| | 2 to 4 | CAN081-8109-4002 | SPT/GA | | Soil | 10-12-91 | 1355 | 0 | |
| | 4 to 6 | CAN081-8109-0004 | A/SPT | | Soil | 10-12-91 | 1410 | 0 | VOC |
| 8110 | 0 to 0.5 | CAN081-8110-0000 | A | MS/MSD | Soil | 10-11-91 | 1930 | 0 | VOC |
| | 0 to 2 | CAN081-8110-4000 | SPT | | Soil | 10-12-91 | 1430 | 0 | |
| | 2 to 4 | CAN081-8110-4002 | SPT | | Soil | 10-12-91 | 1435 | 0 | |
| | 4 to 6 | CAN081-8110-0004 | A/SPT | | Soil | 10-12-91 | 1445 | 0 | VOC |
| | | CAN081-8110-4004 | GA | | Soil | 10-12-91 | 1445 | 0 | |

| | | | | | |
|---|---|---|---|---|---|
| Ft-BGS | Feet Below Ground Surface | FD | Field Duplicate | SV | Semi Volatile Organic Compounds |
| OVA | Organic Vapor Analyzer Reading | MRD | Missouri River Division Duplicate | M | Metals (TAL) |
| ppm | Parts per Million | AB | Ambient Blank | TPH | Total Petroleum Hydrocarbons |
| A | Analytical | RB | Rinsate Blank | BTEX | Benzene, Toluene, Ethylbenzene, Xylene |
| SPT | Standard Penetration Test | DW | Decontamination Water Blank | | |
| GA | Gradation Analysis | TB | Trip Blank | TOC | Total Organic Carbon |
| L | Lithology | VOC | Volatile Organic Compounds (TCL) | OL | Organic Lead |
| MS/MSD | Matrix Spike / Matrix Spike Duplicate | PCB | Polychlorinated Biphenols, Pesticides | Pb/Cr | Lead / Chromium |
| | | TCL | Target Compound List | TAL | Target Analyte List |

[ ]* The borings that are shaded and in brackets correspond to a deeper redrill of the previous boring based on elevated OVA readings and/or odors detected from the soil sample collected at the targeted bottom of the original boring. These borings were drilled approximately 1 to 5 feet away from the original boring.

( )* The borings that are shaded and in parentheses correspond to either a redrill or surface resample of the previous boring or surface sample due to laboratory missed holding times. These borings or surface resamples were drilled or collected approximately 1 to 5 feet away from the original boring or surface sample.

## TABLE 5-3

## VOLATILE ORGANIC COMPOUND CONCENTRATIONS IN SOIL SAMPLES COLLECTED BY WCC AT SOLVENT DISPOSAL SITE

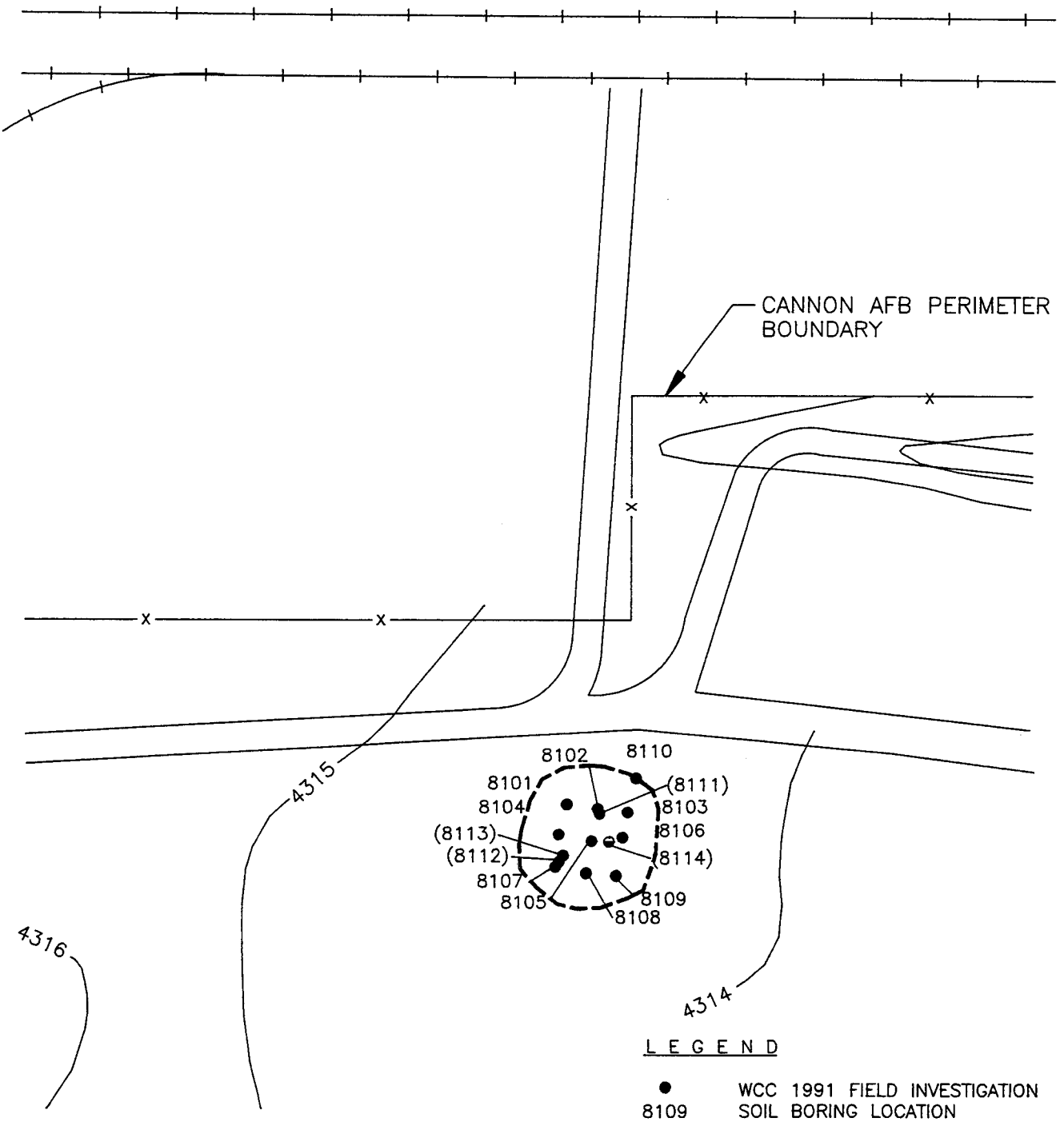
## SWMU NO. 81/IRP NO. DP-16
## CANNON AFB, NEW MEXICO

| Boring Number (Redrill Boring Number) | Sample Depth (Ft-BGS) | Acetone (ug/kg) | Toluene (ug/kg) | 1,1,1 TCA (ug/kg) | Ethyl Benzene (ug/kg) | TCE (ug/kg) | Xylenes (ug/kg) | 2-Butanone (ug/kg) |
|---|---|---|---|---|---|---|---|---|
| 8101 | 0-0.5 | 10U | 10J | 2J | 1J | 2J | 3J | 10U |
| | 4-6 | 400 | 21U | 2J | 21U | 21U | 21U | 1J |
| 8102 | 0-0.5 | 30J | 17 | 2J | 2J | 2J | 6J | 1J |
| [8111] | 4-6 | 160 | 54U | 54U | 54U | 54U | 54U | 54U |
| | 9-9.5 | [22U] | [11U] | [11U] | [11U] | [11U] | [11U] | [11U] |
| 8103 | 0-0.5 | 2J | 8J | 11U | 11U | 1J | 3J | 11U |
| | 4-6 | 90 | 10U | 10U | 10U | 10U | 10U | 10U |
| 8104 | 0-0.5 | 2J | 13 | 2J | 10U | 2J | 3J | 10U |
| | 4-6 | 910 | 53U | 53U | 534 | 53U | 53U | 53U |
| 8105 | 0-0.5 | 11U | 14 | 2J | 2J | 2J | 5J | 11U |
| | 4-6 | 190 | 11U | 11U | 11U | 11U | 11U | 11U |
| 8106 | 0-0.5 | (4J) | (11U) | (11U) | (11U) | (11U) | (11U) | (11U) |
| (8114) | 4-6 | 130 | 10U | 10U | 10U | 10U | 10U | 10U |
| 8107 | 0-0.5 | [16U] | [11U] | [11U] | [11U] | [11U] | [11U] | [11U] |
| [8112] | 4-6 | (210) | (11U) | (11U) | (11U) | (11U) | (11U) | (11U) |
| (8113) | 9-9.4 | [15U] | [11U] | [11U] | [11U] | [11U] | [11U] | [3J] |

**TABLE 5-3**
**(Concluded)**

| Boring Number (Redrill Boring Number) | Sample Depth (Ft-BGS) | Acetone (ug/kg) | Toluene (ug/kg) | 1,1,1 TCA (ug/kg) | Ethyl Benzene (ug/kg) | TCE (ug/kg) | Xylenes (ug/kg) | 2-Butanone (ug/kg) |
|---|---|---|---|---|---|---|---|---|
| 8108 | 0-0.5 | 1300 | 1J | 11U | 11U | 11U | 11U | 11U |
| | 4-6 | 57 | 11U | 11U | 11U | 11U | 11U | 11U |
| 8109 | 0-0.5 | 11U | 3J | 11U | 11U | 11U | 11U | 11U |
| | 4-6 | 140 | 10U | 10U | 10U | 10U | 10U | 10U |
| 8110 | 0-0.5 | 11UJ | 13 | 2J | 1J | 2J | 4J | 11UJ |
| | 4-6 | 150 | 11U | 11U | 11U | 11U | 11U | 11U |

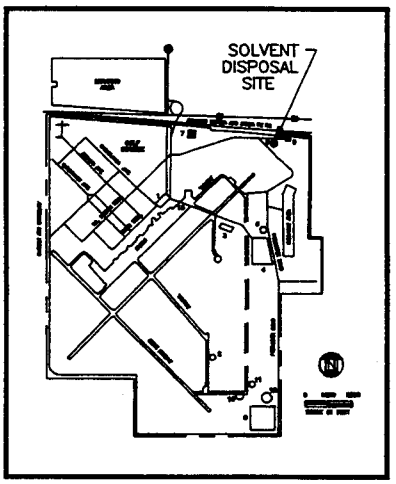
Ft-BGS = Feet below ground surface
ug/kg = Micrograms per kilogram
J = Estimated concentration
U = Not detected
UJ = Estimated as non-detect at the CRQL
[ ] = The values in brackets are results from samples collected from the deeper redrill borings.
( ) = The values in parentheses are results from samples collected from the redrill borings due to laboratory missed holding times.

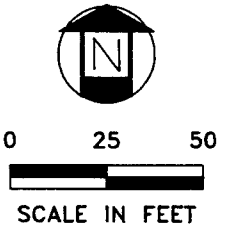



LEGEND

| | |
|---|---|
| ● 8109 | WCC 1991 FIELD INVESTIGATION SOIL BORING LOCATION |
| ◒ (8114) | WCC 1991 FIELD INVESTIGATION SURFACE SOIL SAMPLE LOCATION |
| - - - - - | APPROXIMATE SWMU BOUNDARY |
| 4316 | GROUND SURFACE CONTOUR LINE IN FEET MSL CONTOUR INTERVAL = 1 FOOT |

NOTE: THE NUMBERS IN PARENTHESES CORRESPOND TO REDRILLS/RESAMPLES OF THE ORIGINAL BORING/SAMPLE




| | |
|---|---|
| Job No. : | 89MC114W |
| Prepared by : | D.A.K. |
| Date : | 2/10/92 |

LOCATION OF SOIL BORINGS AT SOLVENT DISPOSAL SITE

**SWMU NO. 81/IRP NO. DP-16**

CANNON AFB, NEW MEXICO

C1140005

FIG. 5–1

# 6.0
# ENGINE TEST CELL AREA (SWMU NOS. 86-90/IRP NO. SD-11)

## 6.1 SWMU DESCRIPTION

### 6.1.1 Setting

This unit was an enclosed tank with dimensions of approximately 50 feet by 10 feet by 20 feet high. The cell rested on a concrete slab located near a taxiway in the southeast part of Cannon AFB. Aircraft engines were cleaned with steam (Figure 6-1). It has also been reported that when engines were tested, water was sprayed on the exhaust to buffer the noise. Today, all physical structures used to secure the engine for cleaning and testing have been removed, leaving only a concrete pad.

### 6.1.2 History of Use

The unit was active from 1965 to 1988, during which effluent was handled in several ways. Initially, it was discharged only to an overflow pit (SWMU No. 87). Then an oil/water separator (SWMU No. 90) was added with discharge to a leach field (SWMU No. 88). Finally, the effluent was routed through the oil/water separator to an evaporation pond (SWMU No. 89). The evaporation pond was constructed in the area of the former leach field. These separate units received potential contaminants from a single operation: the steam cleaning and testing of aircraft engines. Potential contaminants of concern are the same for all units.

### 6.1.3 Past Investigations

During 1984-1985, a Phase II IRP investigation was conducted by Radian Corporation at the Engine Test Cell Area. Two boreholes were drilled to depths of 35 and 50 feet, respectively (Figure 6-1). One borehole (11B) was located within the leachfield and another (11A) was located in a depression which had collected overflow from the oil/water separator. Five soil samples taken from the borehole were analyzed for purgeable halocarbons and aromatics, oil and grease, and lead. Only lead was found at

detectable levels; however, no sample had a lead concentration exceeding 5 ug/g (ppm) (Table 6-1). (Radian 1986)

A Phase IV IRP investigation was conducted in 1989 (Walk, Haydel, and Associates 1990). Four boreholes (Figure 6-1), one on each side of the evaporation pond, were drilled to a depth of 30 feet. A fifth borehole was drilled to a depth of 60 feet adjacent to the oil/water separator. A total of 45 soil samples were analyzed for VOCs, base/neutral extractables, and total metals using EPA SW 846 methodologies. Results shown in Table 6-2 indicate very low levels of phenol, 2,2'-methylene bis [6- (1,1-dimethylethyl)-4-ethyl-] or antioxidant 425 in boreholes B-1 and B-4 at concentrations below 1 ppm. Silver was the only metal detected at levels exceeding background (Table 6-3). (Walk, Haydel and Associates 1990) However, the distribution of silver was considered by Lee Wan and Associates (1990) to be naturally occurring.

Based on the findings of Phase II and Phase IV investigations, only the area of the Engine Test Cell remained to be investigated. Staining on the pad indicates that rinse waters may have existed beneath the walls of the test cell.

### 6.1.4 Land Use and Demography

The Engine Test Cell Area is located in a sparsely populated portion of the base. The area's primary function is to test jet engines. The structures present are an office building (No. 2330), a large warehouse, and facilities to test jet engines north of the area.

There are 30 to 40 workers in the area for 8 hours per day. Building 2330 north of the test cell is occupied daily and the large warehouses south of the test cell are sporadically occupied. People are estimated to be in the abandoned area approximately 1 to 2 hours per week.

## 6.2 FIELD INVESTIGATION

This section provides a discussion of the field activities conducted by WCC at the Engine Test Cell Area from October 10 through 11, 1991, and on November 6 and 24, 1991.

The activities at this SWMU, as outlined in the FSP (WCC 1991c), consisted of collecting 5 surface soil samples for chemical analysis, 2 surface soil samples for gradation analysis, drilling 5 soil borings, and collecting 15 subsurface soil samples for chemical analysis and 2 subsurface soil samples for gradation analysis. Based on elevated OVA readings and odors detected from the soil sample collected at the targeted bottom of one soil boring, it was decided to drill 1 additional soil boring approximately 15 feet deeper than the original boring to evaluate the potential vertical extent of contamination. A total of 4 additional subsurface soil samples for chemical analysis were collected. The resampling phase of the field program, which became necessary due to laboratory missed holding times, consisted of recollecting 4 surfacce soil samples for chemical analysis, redrilling 4 soil borings, and recollecting 8 subsurface soil samples for chemical analysis.

Table 6-4 summarizes the drilling and sampling methods, along with sampling frequency conducted at each soil boring and surface sample location during the 1991 WCC investigation. A complete record of all surface soil, subsurface soil, and associated QA/QC samples collected at the Engine Test Cell area is presented in Table 6-5. The locations of the surface samples and soil borings are shown on Figure 6-1.

### 6.2.1 Sampling Objectives

The objective of sampling in the area of the Engine Test Cell was to evaluate the nature and extent of potential hazardous contaminants that may be present. The surface soil and subsurface soil sampling programs were designed to supplement previous investigations by performing soil sampling in those areas not previously sampled. The data collected at these boring locations were used to further evaluate the extent of potential contamination, if present, and to perform a baseline risk assessment to determine if the area poses a risk to human health or the environment. The data may also be utilized to evaluate remedial actions if necessary. Presently, there does not appear to be any substantial risk to the groundwater, so no hydrogeologic investigation was planned or conducted.

### 6.2.2 Surface Soil Investigation

Five surface soil samples were collected from 0 to 0.5 feet BGS near soil borings 0861 through 0865. These samples were collected using a stainless steel hand trowel and analyzed for TCL VOCs and TAL metals. Geotechnical gradation analysis was performed on two samples from borings 0861 and 0865.

During the resampling phase, four additional surface soil samples, 0867 through 8610 (resamples of the surface soil samples from soil borings 0861 through 0864), located approximately 1 to 3 feet away from the original soil boring/surface soil sample locations, were collected because the laboratory missed holding times for the TCL VOC analysis on the original samples. These samples were analyzed for TCL VOCs only.

### 6.2.3 Subsurface Soil/Vadose Zone Investigation

Five soil borings, 0861 through 0865, were drilled to depths of 10 feet BGS near the Engine Test pad and the old oil/water separator. Each soil boring was sampled continuously and described lithologically from the split spoon samples obtained during drilling. Subsurface samples for chemical analysis were collected at 2, 4, and 8 feet BGS in all borings for a total of fifteen subsurface soil samples. The subsurface analytical samples were collected with stainless steel split spoons and analyzed for TCL VOCs and TAL metals. Two subsurface samples for geotechnical gradation analysis were collected at 8 feet BGS in boring 0862 and at 2 feet BGS in boring 0863.

Based on elevated OVA readings as well as visual evidence of contamination in the soils at boring 0861, one additional soil boring, 0866, located approximately 2 feet north of the original boring, was drilled to a depth of 25 feet BGS and sampled at approximately 5-foot intervals below 10 feet BGS, the total depth of the original boring. Four additional subsurface soil samples were collected at 10, 13, 18, and 23 feet BGS for chemical analysis to evaluate the vertical extent of any contamination below the depth of the original boring. These samples were analyzed for TCL VOCs and TAL metals.

During the resampling phase, four additional soil borings, 0867 through 8610 (redrills of borings 0861 through 0864), located 1 to 3 feet away from the original soil boring, were

drilled to depths of 10, 6, 10, and 6 feet BGS, respectively, and sampled at the same intervals where analytical subsurface soil samples were collected in the original borings. Eight additional subsurface soil samples were collected at 8 feet BGS in boring 0867, at 2 and 4 feet BGS in boring 0868, at 2, 4, and 8 feet BGS in boring 0869, and at 2 and 4 feet BGS in boring 8610 because the laboratory missed holding times for the TCL VOC analysis on the original samples. These samples were analyzed for TCL VOCs only.

## 6.3 PHYSICAL CHARACTERISTICS

This section provides a discussion of the soil, geology and hydrogeology at the Engine Test Cell Area based on the detailed lithologic descriptions of split spoon samples and gradation analysis results from the 1991 WCC investigation, and the review of lithologic boring logs from the previous 1987 Walk, Haydel, and Associates field investigation.

### 6.3.1 Soil

The soils underlying the Engine Test Cell Area consist of sandy loam and loamy sand of the Amarillo Soil Group with a total thickness of approximately 2 to 3 feet. The soils consist primarily of very fine- to fine-grained, well sorted, silty, calcareous, clayey, unconsolidated brown sands. The sands are generally dry to slightly moist at depth. Three gradation analyses were performed on samples collected from within unit at 0.5 feet BGS in borings 0861 and 0865, and at 3 feet BGS in boring 0863. The results indicate that these soil samples were comprised of approximately 57 to 63 percent sand, 16 to 20 percent silt, and 20 to 23 percent clay.

### 6.3.2 Geology

The near surface (upper 30 feet) stratigraphy at the Engine Test Cell Area consists of Tertiary Miocene to Pliocene fluvial deposits of the Ogallala Formation. Geologic cross-section C-C' (Figure 6-2) was constructed using information on the lithologic boring logs from the 1991 WCC field investigation along with one boring log , B-1, from the 1987 Walk, Haydel, and Associates field investigation. This cross-section runs west-east (see Figure 6-1 for the cross-section location). Stratigraphic correlations of the various fluvial

deposits between borings is based primarily on the split spoon lithologic samples collected during drilling.

The SWMU is underlain by Ogallala fluvial deposits consisting primarily of well sorted sand, with scattered thin (1 to 10 feet thick) layers of caliche. The total thickness of these Ogallala deposits beneath the SWMU is not presently known, but based on regional information, may be as thick as 390 feet.

It would appear from the geologic cross-section and the lithologic descriptions (Appendix B-1) that only one sand, sand/caliche unit is present beneath the SWMU to a depth of 30 feet. The fluvial deposits shown on the geologic cross-section from 4238 to 4266 feet MSL consist of fine- to very fine-grained, well sorted, silty, calcareous light to medium brown and red-brown sands. These sands are comprised predominantly of subrounded to subangular quartz grains with varying amounts of silt and calcium carbonate. Occasionally, these sands are moderately to well cemented with calcium carbonate. Thin layers (ranging from a few inches to several feet in thickness) and small pockets or nodules of pale brown, silty, sandy, clayey caliche are scattered throughout this unit. One gradation analysis was performed on a sample collected within this unit at 8 feet BGS in boring 0862. The results indicate that this sample was comprised of approximately 44 percent sand, 24 percent silt, and 32 percent calcium carbonate and/or clay-sized material. The thickness of this unit is unknown at present due to the fact that the unit was not fully penetrated. Approximately 2 to 3 feet of native topsoil exists above this unit. No groundwater was encountered during the drilling of these borings.

## 6.4 NATURE AND EXTENT OF CONTAMINATION

Five soil borings, 0861 through 0865, were drilled, and surface and subsurface samples were collected from each boring (Figure 6-1). Evaluation of the chemical analyses (TCL VOCs, TAL metals) of these samples provided the basis for characterizing the nature and extent of contamination.

None of the target analyte list of volatile organic compounds, except acetone and toluene, were detected above the CRQL in surface and subsurface soil samples at the SWMU. The concentrations for acetone and toluene are summarized in Table 6-6.

Toluene was present in two surface samples, 0863 and 0865, at concentrations of 29 and 100 $\mu$g/kg, respectively. Acetone was detected above the CRQL in only one surface sample (i.e., sample 0864 at 17 $\mu$g/kg). Acetone was detected in nearly all subsurface samples at all five boring locations with concentrations ranging from 68 $\mu$g/kg to 5700 $\mu$g/kg.

The reporting limits for TCL volatile organic analyses were raised in samples 0862 (1 to 3 feet bgs and 8 to 10 feet bgs), 0864 (4 to 6 feet bgs), and 0865 (1 to 2 feet bgs) because of the sample dilution necessitated due to high concentrations of target compounds, particularly acetone. The concentration of acetone usually exceeded the calibration range and therefore, the samples were reanalyzed at dilution. In samples 0861 (8 to 10 feet bgs and 18 to 20 feet bgs), the reporting limits were raised due to the presence of non-target compounds. Tentatively identified compounds (TICs) from VOC analyses indicated that a variety of saturated and polynuclear aromatic hydrocarbons may be present. The presence of hydrocarbons is supported by the OVA readings and observed staining obtained from samples in this boring during the field sampling event.

A variety of metals were detected in soil borings 0861 through 0865. Vanadium was detected at concentrations of 18-25 mg/kg, slightly higher than background levels. However, the distribution of vanadium was uniform throughout surface and subsurface samples and therefore, could be considered to be naturally occurring. Heavy metals detected at elevated levels are antimony, barium, cadmium, chromium, cobalt, copper, lead, manganese, nickel, and zinc. The reported concentrations are summarized in Table 6-7. Other metals, including iron, aluminum, potassium, and mercury were detected infrequently and at concentrations near or below site background or regional levels.

In summary, acetone and toluene were the only volatile organic compounds detected above the CRQL at this SWMU. It should be noted that toluene was detected at 100 $\mu$g/kg in the background boring 0865 located west of the SWMU, and all other detections at the SWMU were significantly less than this concentration. With raised detection limits for certain samples, toluene may be present up to the detection limits shown on Table 6-6 for samples 0861-0018, 0861-0008, 0863-0004, 0864-0004, and 0865-0002. For example, toluene may be present in sample 0861-0018 up to a concentration of 2800 $\mu$g/kg. It does not appear that toluene is present below 20 feet

in boring 0861; 6 feet in boring 0863, and 4 feet in boring 0865. Toluene may be present below 10 feet (i.e., depth of boring) at location 0862. Similarly, acetone does not appear to be present at an arbitrary cutoff of 100 $\mu$g/kg below 20 feet at boring 0861; 6 feet at boring 0863; 6 feet at boring 0864; and 6 feet at boring 0865. Acetone in concentrations greater than 100 $\mu$g/kg may extend deeper than 10 feet (i.e., total depth of boring) at location 0862. The results of the risk assessment will be important in establishing whether or not toluene or acetone pose an unacceptable risk at this SWMU.

Petroleum hydrocarbons appear to be present from 10 to 20 feet bgs in boring 0861, drilled near the oil/water separator. The lateral extent of petroleum hydrocarbons is not known to a great degree of certainty, but is probably limited to the boring 0861 area around the northern side of the oil/water separator. No petroleum staining was noted in boring 0863, located southeast of the oil/water separator.

Metals concentrations above background were detected in the upper four feet in all borings at this SWMU, with the higher concentrations generally being present in surface soil. Borings 0861 and 0863, located near the oil/water separator, showed lower concentrations of heavy metals in surface samples compared to borings 0862 and 0864, located near the concrete pad of the former engine test cell. Boring 0865, located west of the entrance road to the engine test cell area, indicates lower levels of metal concentrations compared to the other borings.

The analytical results of the present investigation do not compare well with the analytical results of boring B1 of the previous Phase IV IRP investigation in 1989 (Figure 6-1). A low concentration of Antioxidant 425 [2.2' methylenebis (6-t-butyl-4-ethylphenol)] was reported by Walk, Haydel and Associates (1990) as a tentatively identified compound in the base treated organic analysis. Silver was the only metal detected above background levels, which was considered by Walk, Haydel and Associates (1990) to be naturally occurring.

# TABLE 6-1

## ANALYTICAL RESULTS OF SOIL SAMPLES COLLECTED BY RADIAN AT ENGINE TEST CELL AREA

## SWMU NOS. 86-90/IRP NO. SD-11
## CANNON AFB, NEW MEXICO

| Sample Number | Sample Depth (Ft-BGS) | Oil and Grease (mg/kg) | Lead (mg/kg) | Purgeable Organic Compounds (EPA 8010/8020) (ug/kg) |
|---|---|---|---|---|
| 11A-1 | 1.0-2.0 | ND | 1.5 | ND |
| 11A-2 | 5.0-7.0 | ND | 4.0 | ND |
| QA-1[1] | 5.0-7.0 | ND | 4.3 | ND |
| 11B-1 | 2.0-4.0 | ND | 4.8 | ND |
| 11B-2 | 5.5-7.0 | ND | 2.0 | ND |
| 11B-3 | 46.5-47.5 | ND | 2.0 | ND |

ND = not detected
Ft-BGS = Feet below ground surface
mg/kg = Milligrams per kilogram
ug/kg = Micrograms per kiligram

[1] duplicate of 11A-2

Source: Final Report, IRP Phase II (Radian 1986)

## TABLE 6-2

## ORGANIC COMPOUND CONCENTRATIONS[1] IN SOIL SAMPLES COLLECTED BY RADIAN AT ENGINE TEST CELL AREA

### SWMU NOS. 86-90/IRP NO. SD-11
### CANNON AFB, NEW MEXICO

| Sample Depth (Ft-BGS) | Compound | Boring Number | | | | |
|---|---|---|---|---|---|---|
| | | B1 | B2 | B3 | B4 | B5 |
| 0-1.5 | Acetone | | | | | 340 |
| 2.5-4.0 | Acetone | | | | | 214 |
| 5-6.5 | Antioxidant-425[2] | 400 | | | | |
| 7.5-9 | Acetone | | | | | 209 |
| | Antioxidant-425[2] | | | | 790 | |
| 10-11.5 | Acetone | | | | | 158 |
| 15-16.5 | | | | | | |
| 20-21.5 | | | | | | NS |
| 25-26.5 | | | | | | NS |
| 30-31.5 | | | | AR | | |
| 45-46.5 | | NS | NS | NS | NS | |
| 60-61.5 | Bis (2-ethylhexyl) phthalate | | | | | 640[3] |

NS = No sample collected in accordance with scope of services/sampling plan
AR = Auger refusal prevented completion to 30 feet.

[1] All concentrations are in micrograms per kilogram (ug/kg)
[2] Phenol, 2,2'-Methylene Bis (6-(1,1-Dimethylethyl)-4-Ethyl-)
[3] Detected in rinsate at 640 ug/L.

Source: Final Report, Phase II IRP (Radian 1986)

## TABLE 6-3

## SILVER CONCENTRATIONS[1] IN SOIL SAMPLES COLLECTED BY WALK, HAYDEL, AND ASSOCIATES AT ENGINE TEST CELL AREA

### SWMU NOS. 86-90/IRP NO. SD-11
### CANNON AFB, NEW MEXICO

| Sample Depth (Ft-BGS) | Boring Number | | | | |
|---|---|---|---|---|---|
| | B1 | B2 | B3 | B4 | B5 |
| 0-1.5 | 6 | | | 7.3 | 7.6 |
| 2.5-4 | | | 7.3 | 12.2 | 12.6 |
| 5-6.5 | | 5.3 | | 6.2 | |
| 7.5-9 | | | 4.3 | | 7.8 |
| 10-11.5 | 19 | | 4.1 | 4.2 | 6.4 |
| 15-16.5 | 19 | 5.3 | 4.7 | 7.7 | 5.8 |
| 20-21.5 | 6 | 6.1 | | | NS |
| 25-26.5 | 9 | | | | NS |
| 30-31.5 | 11 | 8.2 | AR | 4.1 | 8.6 |
| 45-46.5 | NS | NS | NS | NS | |
| 60-61.5 | NS | NS | NS | NS | |

NS = No sample collected in accordance with Scope of Services/Sampling Plan

AR = Auger refusal prevented completion to 30 feet.

[1] All concentrations are in milligrams per kilogram (mg/kg)

Source: Final Report, RPT Phase IV-A - New Addition (Walk, Haydel & Associates, Inc. 1990)

TABLE 6-4

SUMMARY OF SURFACE SOIL SAMPLING, BOREHOLE DRILLING, AND BOREHOLE SAMPLING CONDUCTED BY WCC AT ENGINE TEST CELL AREA, SWMU NOS. 86 - 90 / IRP NO. SD-11, CANNON AFB, NEW MEXICO

| BORING NUMBER | DRILLING/ SAMPLING METHOD | DRILL RIG USED | BOREHOLE DIAMETER (In) | DRILLING/ SAMPLING DEPTH INTERVALS (Ft-BGS) | BOREHOLE SAMPLING FREQUENCY | DATE(S) DRILLED/ SAMPLED | NUMBER OF ANALYTICAL SOIL SAMPLES COLLECTED | NUMBER OF ANALYTICAL QA/QC SAMPLES COLLECTED | NUMBER OF SPT SOIL SAMPLES COLLECTED | NUMBER OF GRADATION ANALYSIS SAMPLES COLLECTED | GROUND ELEVATION (Ft-MSL) | TOTAL DEPTH OF BOREHOLE (Ft-BGS) | DATE BOREHOLE GROUTED |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0861 | HT | NA | NA | 0 to 0.5 | NA | 10-10-91 | 1 | 1 | NA | 1 | 4268.92 | 10 | 10-10-91 |
| | HSA | B-53 | 6.5 | 0 to 10 | Continuous | 10-10-91 | 3 | 1 | 5 | 0 | | | |
| [0866]* | HSA | B-61A | 6.5 | 0 to 9 | Continuous | 11-06-91 | 2 | 1 | 0 | 0 | 4268.80 | 25 | 11-06-91 |
| | | | | 9 to 25 | 5' Intervals | 11-06-91 | 4 | 0 | 4 | 0 | | | |
| (0867)* | HT | NA | NA | 0 to 0.5 | NA | 11-24-91 | 1 | 1 | NA | 0 | 4268.85 | 10 | 11-25-91 |
| | HSA | B-61A | 6.5 | 0 to 10 | 2' Intervals | 11-24-91 | 1 | 0 | 3 | 0 | | | |
| 0862 | HT | NA | NA | 0 to 0.5 | NA | 10-10-91 | 1 | 1 | NA | 0 | 4268.96 | 10 | 10-10-91 |
| | HSA | B-53 | 6.5 | 0 to 10 | Continuous | 10-10-91 | 3 | 3 | 5 | 1 | | | |
| (0868)* | HT | NA | NA | 0 to 0.5 | NA | 11-24-91 | 1 | 2 | NA | 0 | 4268.71 | 6 | 11-25-91 |
| | HSA | B-61A | 6.5 | 0 to 6 | 2' Intervals | 11-24-91 | 2 | 1 | 2 | 0 | | | |
| 0863 | HT | NA | NA | 0 to 0.5 | NA | 10-10-91 | 1 | 2 | NA | 0 | 4268.70 | 10 | 10-10-91 |
| | HSA | B-53 | 6.5 | 0 to 10 | Continuous | 10-10-91 | 3 | 1 | 5 | 1 | | | |
| (0869)* | HT | NA | NA | 0 to 0.5 | NA | 11-24-91 | 1 | 0 | NA | 0 | 4268.84 | 10 | 11-25-91 |
| | HSA | B-61A | 6.5 | 0 to 10 | 2' Intervals | 11-24-91 | 3 | 4 | 3 | 0 | | | |
| 0864 | HT | NA | NA | 0 to 0.5 | NA | 10-10-91 | 1 | 1 | NA | 0 | 4268.95 | 10 | 10-10-91 |
| | HSA | B-53 | 6.5 | 0 to 10 | Continuous | 10-10-91 | 3 | 0 | 5 | 1 | | | |
| (8610)* | HT | NA | NA | 0 to 0.5 | NA | 11-24-91 | 1 | 2 | NA | 0 | 4269.05 | 6 | 11-25-91 |
| | HSA | B-61A | 6.5 | 0 to 6 | 2' Intervals | 11-24-91 | 2 | 0 | 2 | 0 | | | |
| 0865 | HT | NA | NA | 0 to 0.5 | NA | 10-11-91 | 1 | 1 | NA | 1 | 4269.19 | 10 | 10-11-91 |
| | HSA | B-53 | 6.5 | 0 to 10 | Continuous | 10-11-91 | 3 | 0 | 5 | 0 | | | |

| | | | |
|---|---|---|---|
| In | Inches | B-53 | Mobile B-53 Auger Drill Rig with 6" OD / 3.75" ID Augers and 6.5" Bullet Bit |
| Ft-BGS | Feet Below Ground Surface | B-61A | Mobile B-61 Auger Drill Rig with 6" OD / 3.75" ID Augers and 6.5" or 6.25" Bullet Bit |
| Ft-MSL | Feet Mean Sea Level | B-61B | Mobile B-61 Auger Drill Rig with 7.25" OD / 4.25" ID Augers and 7.5" Bullet Bit |
| SPT | Standard Penetration Test | F-10 | Failing F-10 Auger Drill Rig with 8.25" OD / 4.25" ID Augers and 8.5" Bullet Bit |
| HSA | Hollow Stem Auger | CME-75 | Central Mine Equipment CME-75 Auger Drill Rig with 7.75" OD / 4.25" ID Augers and 8.0" Bullet Bit |
| HT | Hand Trowel, Surface Sample | OD | Outer Diameter |
| NA | Not Applicable, Surface Sample | ID | Inner Diameter |
| NS | Not Sampled | | |

[ ]* The borings that are shaded and in brackets correspond to a deeper redrill of the previous boring based on elevated OVA readings and/or odors detected from the soil sample collected at the targeted bottom of the original boring. These borings were drilled approximately 1 to 5 feet away from the original boring.

( )* The borings that are shaded and in parentheses correspond to either a redrill or surface resample of the previous boring or surface sample due to laboratory missed holding times. These borings or surface resamples were drilled or collected approximately 1 to 5 feet away from the original boring or surface sample.

TABLE 6-5

SUMMARY OF SURFACE SOIL, SUBSURFACE SOIL, AND QA/QC SAMPLES COLLECTED BY WCC AT ENGINE TEST CELL AREA, SWMU NOS. 86 - 90 / IRP NO. SD-11, CANNON AFB, NEW MEXICO

| BORING NUMBER | DEPTH INTERVAL (Ft-BGS) | SAMPLE IDENTIFICATION NUMBER | SAMPLE TYPE | QA/QC SAMPLES | SAMPLE MATRIX | DATE SAMPLED | TIME SAMPLED | OVA ON SAMPLE (ppm) | ANALYTICAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|---|
| 0861 | 0 to 0.5 | CAN086-0861-0000 | A | | Soil | 10-10-91 | 1100 | 0 | VOC,M |
| | | CAN086-0861-0263 | A | FD | Soil | 10-10-91 | 1100 | | VOC,M |
| | | CAN086-0861-4000 | GA | | Soil | 10-10-91 | 1100 | | |
| | 0 to 2 | CAN086-0861-4000 | SPT | | Soil | 10-10-91 | 0930 | | |
| | 2 to 4 | CAN086-0861-0002 | A/SPT | | Soil | 10-10-91 | 0945 | 11 | VOC,M |
| | 4 to 6 | CAN086-0861-0004 | A/SPT | | Soil | 10-10-91 | 1005 | 19 | VOC,M |
| | 6 to 8 | CAN086-0861-4006 | SPT | | Soil | 10-10-91 | 1015 | | |
| | 8 to 10 | CAN086-0861-0008 | A/SPT | | Soil | 10-10-91 | 1025 | 21 | VOC,M |
| | | CAN086-0861-0281 | A | DW | Water | 10-11-91 | 0730 | | VOC,SV,M,PCB, TPH,TOC |
| [0866]* | 0 to 4 | CAN086-0866-0000 | A | | Soil | 11-06-91 | 0930 | 0 | VOC,M |
| | | CAN086-0866-0203 | A | MRD | Soil | 11-06-91 | 0930 | 0 | VOC,M |
| | 4 to 9 | CAN086-0866-0004 | A/SPT | | Soil | 11-06-91 | 1010 | 360 | VOC,M |
| | 10 to 12 | CAN086-0866-0010 | A/SPT | | Soil | 11-06-91 | 1040 | 0 | VOC,M |
| | 13 to 15 | CAN086-0866-0013 | A/SPT | | Soil | 11-06-91 | 1120 | 0 | VOC,M |
| | 18 to 20 | CAN086-0866-0018 | A/SPT | | Soil | 11-06-91 | 1255 | 12 | VOC,M |
| | 23 to 25 | CAN086-0866-0023 | A/SPT | | Soil | 11-06-91 | 1335 | 0 | VOC,M |
| (0867)* | 0 to 0.5 | CAN086-0867-0000 | A | | Soil | 11-24-91 | 1225 | 0 | VOC |
| | | CAN086-0867-0268 | A | FD | Soil | 11-24-91 | 1235 | 0 | VOC |
| | 2 to 4 | CAN086-0867-4002 | SPT | | Soil | 11-24-91 | 1225 | 0 | VOC |
| | 4 to 6 | CAN086-0867-4004 | SPT | | Soil | 11-24-91 | 1235 | 0 | VOC |
| | 8 to 10 | CAN086-0867-0008 | A/SPT | | Soil | 11-24-91 | 1245 | 0 | VOC |
| 0862 | 0 to 0.5 | CAN086-0862-0000 | A | | Soil | 10-10-91 | 1100 | 0 | VOC,M |
| | | CAN086-0862-0201 | A | MRD | Soil | 10-11-91 | 1020 | 0 | VOC,M |
| | 0 to 2 | CAN086-0862-4000 | SPT | | Soil | 10-10-91 | 1115 | | |
| | 2 to 4 | CAN086-0862-0002 | A/SPT | MS/MSD | Soil | 10-10-91 | 1130 | 22 | VOC,M |
| | 4 to 6 | CAN086-0862-0004 | A/SPT | | Soil | 10-10-91 | 1200 | 0 | VOC,M |
| | | CAN086-0862-0261 | A | FD | Soil | 10-10-91 | 1150 | 0 | VOC,M |
| | 6 to 8 | CAN086-0862-4006 | SPT | | Soil | 10-10-91 | 1208 | | |
| | 8 to 10 | CAN086-0862-0008 | A/SPT | | Soil | 10-10-91 | 1215 | 0 | VOC |
| | | CAN086-0862-0251 | A | AB | Water | 10-10-91 | 1700 | | VOC |
| | | CAN086-0862-4008 | GA | | Soil | 10-10-91 | 1220 | 0 | |
| (0868)* | 0 to 0.5 | CAN086-0868-0000 | A | | Soil | 11-24-91 | 1245 | 0 | VOC |
| | | CAN086-0868-0203 | A | MRD | Soil | 11-24-91 | 1245 | 0 | VOC |
| | | CAN086-0868-0252 | A | AB | Water | 11-24-91 | 1250 | | VOC |
| | 2 to 4 | CAN086-0868-0002 | A/SPT | MS/MSD | Soil | 11-24-91 | 1325 | 10 | VOC |
| | 4 to 6 | CAN086-0868-0004 | A/SPT | | Soil | 11-24-91 | 1340 | 0 | VOC |
| | | CAN086-0868-0267 | A | FD | Soil | 11-24-91 | 1330 | 0 | VOC |
| 0863 | 0 to 0.5 | CAN086-0863-0000 | A | MS/MSD | Soil | 10-10-91 | 1435 | 0 | VOC,M |
| | | CAN086-0863-0202 | A | MRD | Soil | 10-11-91 | 1030 | 0 | VOC,M |
| | 0 to 2 | CAN086-0863-4000 | SPT | | Soil | 10-10-91 | 1445 | 0 | |
| | 2 to 4 | CAN086-0863-0002 | A/SPT | | Soil | 10-10-91 | 1500 | 0 | VOC,M |
| | | CAN086-0863-4002 | GA | | Soil | 10-10-91 | 1500 | | |
| | 4 to 6 | CAN086-0863-0004 | A/SPT | | Soil | 10-10-91 | 1525 | 0 | VOC,M |
| | 6 to 8 | CAN086-0863-4006 | SPT | | Soil | 10-10-91 | 1540 | 0 | |
| | 8 to 10 | CAN086-0863-0008 | A/SPT | | Soil | 10-10-91 | 1550 | 0 | VOC,M |
| | | CAN086-0863-0262 | A | FD | Soil | 10-10-91 | 1546 | 0 | VOC,M |
| (0869)* | 0 to 0.5 | CAN086-0869-0000 | A | | Soil | 11-24-91 | 1315 | 0 | VOC |
| | 2 to 4 | CAN086-0869-0002 | A/SPT | | Soil | 11-24-91 | 1425 | 36 | VOC |
| | 4 to 6 | CAN086-0869-0004 | A/SPT | | Soil | 11-24-91 | 1435 | 0 | VOC |
| | | CAN086-0869-0204 | A | MRD | Soil | 11-24-91 | 1435 | 0 | VOC |
| | 8 to 10 | CAN086-0869-0008 | A/SPT | | Soil | 11-24-91 | 1500 | 60 | VOC |
| | | CAN086-0869-0265 | A | FD | Soil | 11-24-91 | 1510 | 60 | VOC |
| | | CAN086-0869-0272 | A | RB | Water | 11-24-91 | 1525 | | VOC |
| | | CAN086-0869-0282 | A | DW | Water | 11-24-91 | 1530 | | VOC |

TABLE 6-5

SUMMARY OF SURFACE SOIL, SUBSURFACE SOIL, AND QA/QC SAMPLES COLLECTED BY WCC AT ENGINE TEST CELL AREA, SWMU NOS. 86 - 90 / IRP NO. SD-11, CANNON AFB, NEW MEXICO

| BORING NUMBER | DEPTH INTERVAL (Ft-BGS) | SAMPLE IDENTIFICATION NUMBER | SAMPLE TYPE | QA/QC SAMPLES | SAMPLE MATRIX | DATE SAMPLED | TIME SAMPLED | OVA ON SAMPLE (ppm) | ANALYTICAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|---|
| 0864 | 0 to 0.5 | CAN086-0864-0000 | A | | Soil | 10-10-91 | 1620 | 0 | VOC,M |
| | | CAN086-0864-0264 | A | FD | Soil | 10-10-91 | 1620 | 0 | VOC,M |
| | 0 to 2 | CAN086-0864-4000 | SPT | | Soil | 10-10-91 | 1640 | | |
| | 2 to 4 | CAN086-0864-0002 | A/SPT | | Soil | 10-10-91 | 1630 | 0 | VOC,M |
| | 4 to 6 | CAN086-0864-0004 | A/SPT | | Soil | 10-10-91 | 1700 | 0 | VOC,M |
| | 6 to 8 | CAN086-0864-4006 | SPT | | Soil | 10-10-91 | 1705 | 0 | |
| | 8 to 10 | CAN086-0864-0008 | A/SPT | | Soil | 10-10-91 | 1715 | 0 | VOC,M |
| (8610)* | 0 to 0.5 | CAN086-8610-0000 | A | MS/MSD | Soil | 11-24-91 | 1300 | 0 | VOC |
| | | CAN086-8610-0266 | A | FD | Soil | 11-24-91 | 1300 | 0 | VOC |
| | 2 to 4 | CAN086-8610-0002 | A/SPT | | Soil | 11-24-91 | 1535 | 0 | VOC |
| | 4 to 6 | CAN086-8610-0004 | A/SPT | | Soil | 11-24-91 | 1545 | 6 | VOC |
| 0865 | 0 to 0.5 | CAN086-0865-0271 | A | RB | Water | 10-11-91 | 0900 | | VOC,M |
| | | CAN086-0865-0000 | A | | Soil | 10-11-91 | 0925 | 0 | VOC,M |
| | | CAN086-0865-4000 | GA | | Soil | 10-11-91 | 0925 | 0 | |
| | 0 to 2 | CAN086-0865-4000 | SPT | | Soil | 10-11-91 | 0930 | | |
| | 2 to 4 | CAN086-0865-0002 | A/SPT | | Soil | 10-11-91 | 1005 | 0 | VOC,M |
| | 4 to 6 | CAN086-0865-0004 | A/SPT | | Soil | 10-11-91 | 1435 | 0 | VOC,M |
| | 6 to 8 | CAN086-0865-4006 | SPT | | Soil | 10-11-91 | 1445 | | |
| | 8 to 10 | CAN086-0865-0008 | A/SPT | | Soil | 10-11-91 | 1500 | 0 | VOC,M |

| | | | | | |
|---|---|---|---|---|---|
| Ft-BGS | Feet Below Ground Surface | FD | Field Duplicate | SV | Semi Volatile Organic Compounds |
| OVA | Organic Vapor Analyzer Reading | MRD | Missouri River Division Duplicate | M | Metals (TAL) |
| ppm | Parts per Million | AB | Ambient Blank | TPH | Total Petroleum Hydrocarbons |
| A | Analytical | RB | Rinsate Blank | BTEX | Benzene, Toluene, Ethylbenzene, Xylene |
| SPT | Standard Penetration Test | DW | Decontamination Water Blank | | |
| GA | Gradation Analysis | TB | Trip Blank | TOC | Total Organic Carbon |
| L | Lithology | VOC | Volatile Organic Compounds (TCL) | OL | Organic Lead |
| MS/MSD | Matrix Spike / Matrix Spike Duplicate | PCB | Polychlorinated Biphenols, Pesticides | Pb/Cr | Lead / Chromium |
| | | TCL | Target Compound List | TAL | Target Analyte List |

[ ]* The borings that are shaded and in brackets correspond to a deeper redrill of the previous boring based on elevated OVA readings and/or odors detected from the soil sample collected at the targeted bottom of the original boring. These borings were drilled approximately 1 to 5 feet away from the original boring.

( )* The borings that are shaded and in parentheses correspond to either a redrill or surface resample of the previous boring or surface sample due to laboratory missed holding times. These borings or surface resamples were drilled or collected approximately 1 to 5 feet away from the original boring or surface sample.

# TABLE6-6

## ACETONE AND TOLUENE CONCENTRATIONS IN SOIL SAMPLES COLLECTED BY WCC AT ENGINE TEST CELL AREA

## SWMU NOS. 86-90/IRP NO. SD-11
## CANNON AFB, NEW MEXICO

252000

| Boring Number (Redrill Boring Number) | Sample Depth (Ft-BGS) | 2310000 Acetone (ug/kg) | Toluene (ug/kg) |
|---|---|---|---|
| 0861 | 0-0.5 | (11U) | (2J) |
| [0866] | 2-4 | 10J | 12U |
| (0867) | 4-6 | 21J | 11U |
| | 8-10 | (270U) | (6J) |
| | 13-15 | [13U] | [11U] |
| | 18-20 | [5700] | [2800U] |
| | 23-25 | [13J] | [2J] |
| 0862 | 0-0.5 | (35U) | (4J) |
| (0868) | 2-4 | (660) | (33J) |
| | 4-6 | (220) | (11U) |
| | 8-10 | 1300 | 1100U |
| 0863 | 0-0.5 | (3J) | (2J) |
| (8669) | 2-4 | (1100J) | (55U) |
| | 4-6 | (2100J) | (1400U) |
| | 8-10 | (390UJ) | (8J) |
| 0864 | 0-0.5 | (17J) | (2J) |
| (8610) | 2-4 | (68) | (1J) |
| | 4-6 | (290) | (3J) |
| | 8-10 | 98 | 26U |
| 0865 | 0-0.5 | 8J | 100 |
| | 2-4 | 7700U | 1400U |
| | 4-6 | 330J | 12U |
| | 8-10 | 91 | 11U |

**TABLE 6-6**
**(Concluded)**

| | | |
|---|---|---|
| Ft-BGS | = | Feet below ground surface |
| ug/kg | = | Micrograms per kilogram |
| U | = | Not detected |
| J | = | Estimated value |
| UJ | = | Estimated as non-detect at the CRQL |
| [ ] | = | The values in brackets are results from samples collected from the deeper redrill borings. |
| ( ) | = | The values in parentheses are results from samples collected form the redrill borings due to laboratory missed holding times. |

## TABLE 6-7

## HEAVY METAL CONCENTRATIONS[1] IN SOIL SAMPLES COLLECTED BY WCC AT ENGINE TEST CELL AREA

## SWMU NOS. 86-90/IRP NO. SD-11
## CANNON AFB, NEW MEXICO

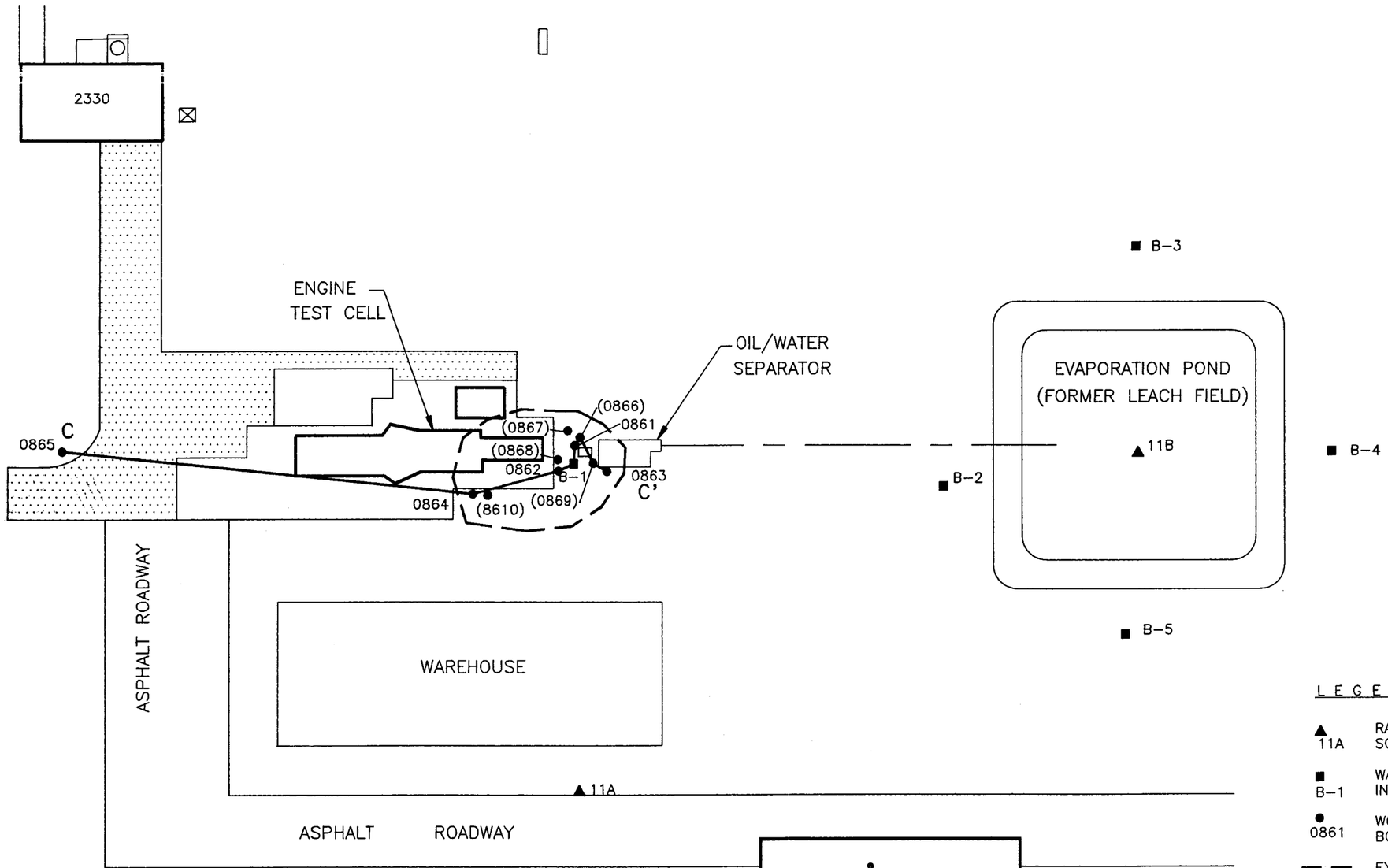
| Boring Number | Sample Depth (Ft-BGS) | 31.3 Antimony | 15600 Barium | 39 Cadmium | 234 Chromium | 1520 Cobalt | 3130 Copper | 400 Lead | 3590 Manganese | 1560 Nickel | 23500 Zinc |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0861 | 0-0.5 | 5.4UJ | 1,950 | 2.3 | 11.1 | 4.1J | 9.8 | 48.1J | 752 | 7.7J | 1,320 |
| | 2-4 | 5.1UJ | 147 | 1.9J | 9.8 | 3.9J | 46.8 | 32.7 | 152 | 7.8J | 41.1 |
| | 4-6 | 5.4UJ | 154 | 0.94UJ | 11.7 | 5.0J | 10.4 | 12.9 | 132 | 11.4 | 25.6 |
| | 8-10 | 5.2UJ | 298 | 0.9UJ | 5.3 | 2.4J | 3U | 5.1 | 64.5 | 6.5J | 11.1U |
| 0862 | 0-0.5 | 2.3J | 390 | 4.9 | 67.8 | 18.7 | 56.4 | 236J | 383 | 103 | 3,000 |
| | 2-4 | 5.2UJ | 128 | 0.9U | 10 | 5.1J | 10 | 8.5 | 293 | 9.5 | 51.9 |
| | 4-6 | 5UJ | 78.1 | 0.88UJ | 9.7 | 4.1J | 7.5 | 5.3 | 86.3 | 9 | 19U |
| 0863 | 0-0.5 | 4.7UJ | 207 | 1.6 | 14.6 | 4.4J | 14.5 | 13.5J | 187 | 10.5 | 249J |
| | 2-4 | 5.7UJ | 80.6 | 0.99U | 11.4 | 5.1J | 8.5 | 7.9 | 219 | 9.7J | 26.2 |
| | 4-6 | 5.1UJ | 49.9 | 0.88U | 8.9 | 3.9J | 7 | 6.3 | 131 | 8.2J | 17.6U |
| | 8-10 | 5.2UJ | 96.1 | 0.9U | 6.9 | 3.3J | 6.9 | 4.2 | 97.5 | 5.4J | 14.7 |
| 0864 | 0-0.5 | 87.4J | 503 | 8.8 | 113 | 15.2J | 470J | 224 | 229 | 54.4J | 2,900J |
| | 2-4 | 5.3UJ | 82.8 | 0.92U | 12 | 5.6J | 8.7 | 9.8 | 219 | 10.1 | 37.8 |
| | 4-6 | 5.2UJ | 88 | 0.91U | 10.1 | 3.8J | 7.9 | 4.3 | 110 | 8.8J | 19.9U |
| | 8-10 | 5.4UJ | 65.4 | 0.94UJ | 8.3 | 3.5J | 7.4 | 6.5 | 123 | 8.8J | 18.6 |

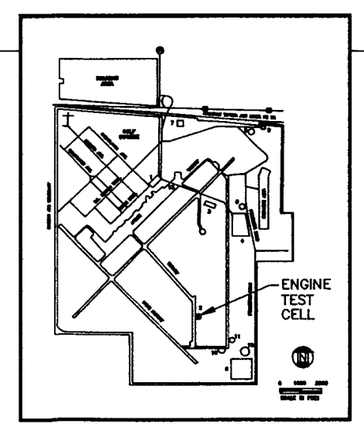
## TABLE 6-7
## (Concluded)

| Boring Number | Sample Depth (Ft-BGS) | Antimony | Barium | Cadmium | Chromium | Cobalt | Copper | Lead | Manganese | Nickel | Zinc |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0865 | 0-0.5 | 4.9UJ | 126 | 0.85U | 12 | 2.8J | 8.9J | 13.2J | 210 | 6.9J | 49.4J |
| | 2-4 | 5.3UJ | 214 | 0.93UJ | 8.8 | 3.8J | 7.4U | 7.3 | 148 | 8.5J | 20.9 |
| | 4-6 | 5.4UJ | 71.7 | 0.93UJ | 11.5 | 3.5J | 8.2U | 7.1 | 111 | 11.2 | 23.7 |
| | 8-10 | 5.4UJ | 87 | 0.95UJ | 7.7 | 3.4J | 6.5U | 6 | 86.7 | 7.7J | 16.5 |
| | Background[2] $\bar{x} + 2\sigma$ | 4.88-5.44 | 0-903 | 0.81-1.01 | 2.67-9.31 | 1.38-4.06 | 0.00-15.44 | 1.76-8.64 | 10.89-167 | 3.57-8.49 | 4.58-21.82 |

Ft-BGS = Feet below ground surface
UJ = Estimated as non-detect at the instrument detection limit
J = Estimated value
U = Not detected

1 All concentrations are in milligrams per kilogram (mg/kg)
2 Background range calculated from values in Table 2-7




N

0 25 50

SCALE IN FEET

LEGEND

| | |
|---|---|
| ▲ 11A | RADIAN 1984–1985 FIELD INVESTIGATION SOIL BORING LOCATION |
| ■ B–1 | WALK, HAYDLE & ASSOCIATES 1987 FIELD INVESTIGATION SOIL BORING LOCATION |
| ● 0861 | WCC 1991 FIELD INVESTIGATION SOIL BORING LOCATION |
| — — | EXTENT OF WCC 1991 INVESTIGATION |
| 2330 | BUILDING NUMBER |
| C—C' | GEOLOGIC CROSS–SECTION LOCATION |

NOTE:

THE NUMBERS IN PARENTHESIS CORRESPOND TO REDRILLS/RESAMPLES OF THE ORIGINAL BORING /SAMPLE

| | |
|---|---|
| Job No. : | 89MC114W |
| Prepared by : | D.A.K. |
| Date : | 2/5/92 |

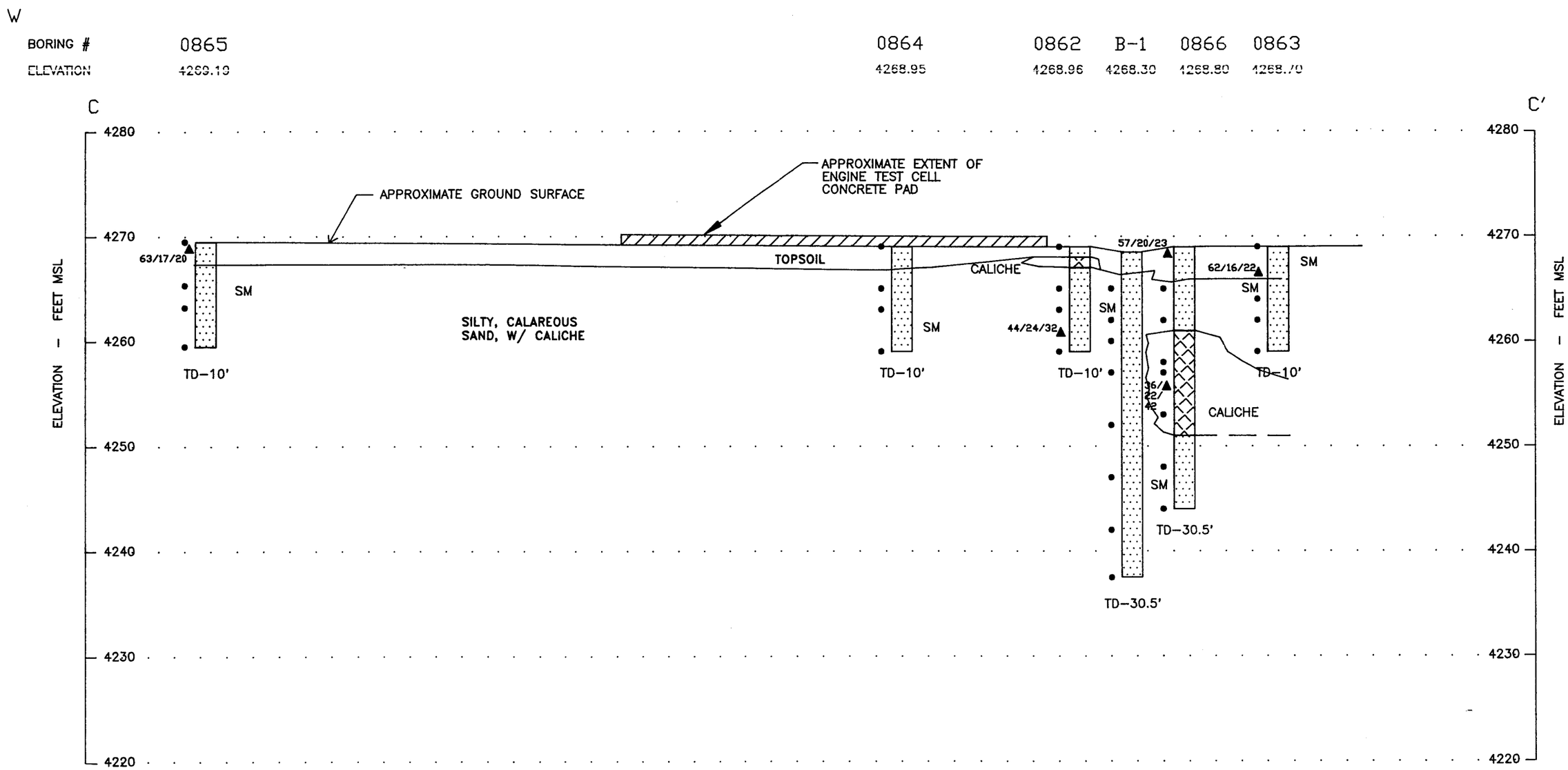
LOCATION OF SOIL BORINGS AT ENGINE TEST CELL AREA

SWMU NOS. 86-90/IRP NO. SD-11

CANNON AFB, NEW MEXICO

C1140002

FIG. 6–1




LEGEND

| | | | |
|---|---|---|---|
| MSL | – | MEAN SEA LEVEL | BORINGS 0862, 0863, 0864, 0865, 0860 WCC (OCT 91) |
| TD | – | TOTAL DEPTH IN FEET BGS | BORING B-1 WHA INC. (DEC 87) |
| SM,SP,GW ML,GP | – | UNIFIED SOIL CLASSIFICATION SYSTEM ABBREVIATIONS | (NOTE: BORING 0866 SAMPLING DATA FROM 0 TO 10' TAKEN FROM REDRILL BORING 0867) |
| BGS | – | BELOW GROUND SURFACE | NOTE: THE LOCATION OF THIS CROSS-SECTION IS SHOWN ON FIG. 6-1 |
| • | – | ANALYTICAL SAMPLE INTERVAL | |
| ▲ 63/17/20 | – | GRADATION ANALYSIS SAMPLE INTERVAL THE THREE NUMBERS REPRESENT THE APPROXIMATE PERCENTAGES OF SAND-, SILT- AND CLAY- SIZED MATERIAL RESPECTIVELY | |

0 25 50

HORIZONTAL SCALE IN FEET
VERTICAL EXAGGERATION = 2.5X

| | |
|---|---|
| Job No. : 89MC114W | GEOLOGIC CROSS SECTION C-C' ENGINE TEST CELL AREA |
| Prepared by : LLG | SWMU NOS. 86-90/IRP NO. SD-11 |
| Date : 2/3/92 | CANNON AFB NEW MEXICO |

SWMU-86-

FIG. 6-2

# 7.0
# NE STORMWATER DRAINAGE AREA (SWMU NO. 95)

## 7.1 SWMU DESCRIPTION

### 7.1.1 Setting

This unit is an open drain which receives water from several oil/water separators and runoff water from runways and storm water drains in the east-central portion of the base (Figure 7-1). The ditch, about 40 feet wide, begins near the end of the northeast Runway 4/22 and extends under a road to a field. The northwest end of the ditch is marked by a concrete culvert and is surrounded by heavy vegetation.

### 7.1.2 History of Use

The ditch started receiving runoff from the runways in 1953. The oil/water separators presumably began discharging to the area when they were installed in 1969 (USAF 1990).

### 7.1.3 Past Investigations

A remedial investigation was conducted by Walk, Haydel and Associates at this site under the Installation Restoration Program. Eleven soil borings were installed in and near the mouth of the drainage ditch. Detectable levels of long-chain organics were detected within the upper 3 feet of sediment and oil at the mouth of the drainage ditch (Lee Wan and Associates 1990b) (Table 7-1). Barium and selenium were present at concentrations above background (Table 7-2). However, these metals are naturally occurring in soils and sediments, and are known to accumulate in soils in arid climates. Lee Wan and Associates (1990b) attribute barium and selenium to natural sources. Review of other IRP data, as well as data from other sources, suggests that the concentrations of these metals in soils may be highly variable within a small area (Walk, Haydel and Associates 1990).

Due to the very low quantities of organic contaminants present, and in consideration of the lack of migration once the organics enter the soil, Walk, Haydel, and Associates (1990) concluded that "no adverse impact to health or the environment" was expected from site conditions.

### 7.1.4 Land Use and Demography

The NE stormwater drainage ditch is the only facility in use at this location. No buildings or other structures exist in this area. The primary facility near this site is the active northeast-southwest runway located northwest of the unit.

Since this SWMU is in a remote part of the base, it is not frequented by base personnel. The vegetation is not mowed as other portions of the base are mowed. Three or four vehicles per day use a northeast-southwest road that crosses the southeastern end of the ditch.

## 7.2 FIELD INVESTIGATION

This section provides a discussion of the field activities conducted by WCC at the NE Stormwater Drainage Area from October 14 through 15, 1991, and from December 7 through 8, 1991. The activities at this SWMU, as outlined in the FSP (WCC 1991c), consisted of collecting 1 surface soil sample for chemical analysis, 1 surface soil sample for gradation analysis, drilling 2 soil borings, and collecting 6 subsurface soil samples for chemical analysis and 1 subsurface soil sample for gradation analysis. The resampling phase of the field program, which became necessary due to laboratory missed holding times, consisted of recollecting 1 surface soil sample for chemical analysis, redrilling 2 soil borings, and recollecting 6 subsurface soil samples for chemical analysis.

Table 7-3 summarizes the drilling and sampling methods, along with sampling frequency conducted at each soil boring and surface sample location during the 1991 WCC investigation. A complete record of all surface soil, subsurface soil, and associated QA/QC samples collected at the NE Stormwater Drainage area is presented in Table 7-4. The locations of the surface samples and soil borings are shown on Figure 7-1.

### 7.2.1 Sampling Objectives

The objective of sampling in the NE Stormwater Drainage Area was to provide additional information regarding the nature and extent of potential hazardous contaminants near the upstream end of ditch. The surface soil and subsurface soil sampling programs were designed to supplement previous investigations by performing soil sampling in those areas and depths not previously sampled. The data collected at these boring locations were used to further evaluate the extent of potential contamination, if present, and to perform a baseline risk assessment to determine if the area poses a risk to human health or the environment. The data may also be utilized to evaluate remedial actions if necessary. Presently, there does not appear to be any substantial risk to the groundwater, so no hydrogeologic investigation was planned or conducted.

### 7.2.2 Surface Soil Investigation

Two surface soil samples were collected from 0 to 0.5 feet BGS near soil borings 0951 and 0952. These samples were collected using a stainless steel hand trowel and analyzed for TCL VOCs, semi-VOCs, TAL metals, and TPH. Geotechnical gradation analysis was performed on one sample from boring 0951.

During the resampling phase, one additional surface soil sample, 0953 (a resample of the surface soil sample from soil boring 0951), located approximately 3 feet away from the original soil boring/surface soil sample location, was collected because the laboratory missed the holding time for the TCL VOC analysis on the original sample. This sample was analyzed for TCL VOCs only.

### 7.2.3 Subsurface Soil/Vadose Zone Investigation

Two soil borings, 0951 and 0952, were drilled to depths of 10 feet BGS at the norhtwest end of the NE Stormwater Drainage Area, near the culvert east of the runway and near the confluence of the two drainages, respectively. Each soil boring was sampled continuously and described lithologically from the split spoon samples obtained during drilling. Subsurface samples for chemical analysis were collected at 2, 4, and 8 feet BGS

in both borings for a total of six subsurface soil samples. The subsurface analytical samples were collected with stainless steel split spoons and analyzed for TCL VOCs, semi-VOCs, TAL metals, and TPH. One subsurface sample for geotechnical gradation analysis was collected at 6 feet BGS in boring 0952.

During the resampling phase, two additional soil borings, 0953 and 0954 (redrills of borings 0951 and 0952), located approximately 3 to 4 feet west-northwest (upstream) of the original borings, were drilled to depths of 10 feet BGS and sampled at the same intervals where analytical subsurface soil samples were collected in the original borings. Six additional subsurface soil samples were collected at 2, 4, and 8 feet BGS in each boring because the laboratory missed holding times for the TCL VOC, semi-VOC and TPH analyses on the original samples. These samples were analyzed for TCL VOCs, and/or semi-VOCs, and/or TPH, depending on which holding times were missed on each sample.

## 7.3 PHYSICAL CHARACTERISTICS

This section provides a discussion of the soil, geology and hydrogeology at the NE Stormwater Drainage Area based on the detailed lithologic descriptions of split spoon samples and gradation analysis results from the 1991 WCC investigation, and the review of lithologic boring logs from the previous 1987 Walk, Haydel and Associates field investigation.

### 7.3.1 Soil

The soils underlying the NE Stormwater Drainage Area consist of sandy loam and loamy sand of the Amarillo Soil Group. The soils consist primarily of very fine- to fine-grained, well sorted, silty, clayey, light brown sands. The sands are generally wet to very moist at depth, due to the constant drainage, pooling, and infiltration of the two drainages. One gradation analysis was performed on a sample collected within this unit at 0.5 feet BGS in boring 0951. The results indicate that this soil sample was comprised of approximately 48 percent sand, 23 percent silt, and 29 percent clay. The upper 2 to 3 feet of this soil unit is stained black to dark gray. The total thickness of the soil zone is approximately 4 to 5 feet.

### 7.3.2 Geology

The near surface (upper 61 feet) stratigraphy at the NE Stormwater Drainage Area consists of Tertiary Miocene to Pliocene fluvial deposits of the Ogallala Formation. Geologic cross-section D-D' (Figure 7-2) was constructed using information on the lithologic boring logs from the 1991 WCC field investigation along with one boring log, B-1, from the 1987 Radian field investigation. This cross-section runs northwest-southeast (see Figure 7-1 for the cross-section location). Stratigraphic correlations of the various fluvial deposits between borings is based primarily on the split spoon lithologic samples collected during drilling.

The SWMU is underlain by Ogallala fluvial deposits consisting primarily of well sorted sand. The total thickness of these Ogallala deposits beneath the SWMU is not presently known, but based on regional information, may be as thick as 390 feet.

It would appear from the geologic cross-section and the lithologic descriptions that two fairly distinct sand units are present beneath the SWMU to a depth of 61 feet BGS (4220 feet MSL). The lower fluvial deposits shown on the geologic cross-section from 4220 to 4237 feet MSL consist of fine-grained, well sorted, light to medium orange sands. These sands are comprised predominantly of subrounded to subangular quartz grains with varying amounts of calcareous nodules. These sands are also relatively clean. This unit was only encountered in boring B-1 at approximately 44 feet BGS. The thickness of this unit is unknown at present due to the fact that the unit was not fully penetrated.

The upper fluvial deposits shown on the geologic cross-section from 4237 to 4281 feet MSL consist of very fine- to fine-grained, well sorted, silty, calcareous light to pale brown sands. These sands are comprised predominantly of subangular quartz grains with slight to moderate amounts of silt and calcium carbonate. One gradation analysis was performed on a sample collected within this unit at 6 feet BGS in boring 0952. The results indicate that this sample was comprised of approximately 51 percent sand, 15 percent silt, and 34 percent calcium carbonate and/or clay-sized material. Based on the cross-section, the thickness of this unit probably ranges from 40 to 41 feet thick. Approximately 4 to 5 feet of native topsoil exists above this unit. No groundwater was encountered during the drilling of these borings.

## 7.4 NATURE AND EXTENT OF CONTAMINATION

One surface and three subsurface soil samples were collected from two soil borings, 0951 and 0952 (Figure 7-1). Evaluation of the chemical analyses (TCL VOCs, semi-VOCs, TAL metals, TPH) of these samples has been used as the basis to characterize the nature and extent of contamination.

None of the target analyte list of volatile and semi-volatile organic compounds, except acetone, were detected above the CRQL (adjusted for sample size or dilutions) in samples from SWMU No. 95. Acetone was detected infrequently and in low concentrations (i.e., in boring 0951 at 2 and 8 feet BGS and in boring 0952 at 2 feet BGS at concentrations of 22 ug/kg, 17 ug/kg, and 21 ug/kg, respectively). The highest concentration was an estimated value of 140J $\mu$g/kg (Table 7-5). Its reported presence most likely results from laboratory contamination.

In addition to acetone, three volatile organic compounds (2-butanone, methylene chloride, toluene) and three semi-volatile organic compounds (2-methylnaphthalene, bis(2-ethylhexyl phthalate, butyl benzyl phthalate) were detected in six samples (Table 7-5) at estimated concentrations ranging from 2J ug/kg to 1700J ug/kg. Since all of these compounds, except for 2-methylnaphthalene, are common lab comtaminants they can be dismissed as chemicals of concern at low concentrations. 2-methylnaphthalene, detected at an estimated concentration of 1300J ug/kg in the surface soil sample at boring 0951, may be associated with the total petroleum hydrocarbons and TICs detected in that sample as discussed below.

Total petroleum hydrocarbon concentrations of surface soil samples 0951 and 0952 were at levels of 1260 and 285 mg/kg, respectively (Table 7-5). Tentatively identified compounds for the semi-VOC analysis consisted of a variety of medium molecular weight saturated hydrocarbons for the two surface soil samples. In addition, the reporting limits for those two samples were raised because of the sample dilution necessary due to the TICs. TPH was not detected in samples collected below 2 feet.

A variety of metals were detected in surface samples 0951 and 0952 (Table 7-6). At surface sample location 0951, the concentration of heavy metals described below

exceeded background levels. The metals of potential concern and their concentrations were barium (3820 mg/kg), cadmium (1.8 mg/kg), chromium (115J mg/kg), cobalt (12.6 mg/kg), copper (59 mg/kg), iron (41,200 mg/kg), lead (147 mg/kg), mercury (0.38 mg/kg), nickel (49.1 mg/kg), and zinc (467J mg/kg). At surface sample location 0952, lead (31.6 mg/kg) and zinc (62.6 mg/kg) were detected in concentrations exceeding background levels. In deeper subsurface soil samples, the heavy metals concentrations were below or near background levels in soils at Cannon AFB.

In summary, no volatile or semi-volatile organic compounds of concern were found at this SWMU. However, hydrocarbon contamination is present in soils around boring 0951, at the upstream end of the ditch, with diminishing concentrations to the southwest in the direction of flow. TPH contamination is supported by detections at borings 0951 and 0952 and the occurrence of long-chain saturated hydrocarbon concentrations ranging from 49 to 73 mg/kg for boring B1 of the previous Phase IV IRP investigation conducted in 1989. This suggests that the TPH contamination may extend laterally throughout the drainage ditch with the highest concentrations near its mouth. This pattern of elevated values is consistent with the main use of the ditch which is to receive water from several oil-water separators and runoff water from the runways. The TPH contamination appears to be surficial (i.e., less than 2 feet bgs).

Only the heavy metals described above are of potential concern in the surficial soils at this SWMU. No heavy metals of concern were identified in the subsurface samples.

# TABLE 7-1

## ORGANIC COMPOUND CONCENTRATIONS[1] IN SOIL SAMPLES COLLECTED BY WALK, HAYDEL AND ASSOCIATES AT NE STORMWATER DRAINAGE AREA

## SWMU NO. 95/IRP NO. SD-20
## CANNON AFB, NEW MEXICO

| Sample Depth (Ft-BGS) | Compound | Boring Number | |
|---|---|---|---|
| | | B1 | B8 |
| 0-1 | 2,5,9-Trimethyl-decane | 73,000 | 340 |
| | 7-Methyl-tridecane | 56,000 | |
| | 2,7,10-Trimethyl-dodecane | 60,000 | |
| | 2,6-Dimethyl-heptadecane | 49,000 | |
| | 2,6,7-Trimethyl-decane | 73,000 | |
| | Ethylbenzene | | 37 |
| | Total Xylene | | 70 |
| 2-3 | 4-Propyl-heptane | 52,000 | |
| | 2,5,9-Trimethyl-decane | 70,000 | |
| | 7-methyl-tridecane | 74,000 | |
| | 2,7,10-Trimethyl-dodecane | 37,000 | |
| | 2,6-Dimethyl-heptadecane | 70,000 | |

Ft-BGS = Feet below ground surface
[1] All concentrations are in micrograms per kilogram ($\mu$g/kg)

Source: Final Report, IRP Phase IV (Walk, Haydel and Associates Inc. 1990)

## TABLE 7-2

## SELENIUM AND BARIUM CONCENTRATIONS[1] IN SOIL SAMPLES COLLECTED BY WALK, HAYDEL AND ASSOCIATES AT NE STORMWATER DRAINAGE AREA

## SWMU NO. 95/IRP NO. SD-20
## CANNON AFB, NEW MEXICO

| Sample Depth (Ft-BGS) | Boring Number | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | B1 | B2 | B3 | B4 | B5 | B6 | B7 | B8 | B9 | B10 | B11 |
| 0-1 | | | 149.1 | 61.8 | | NS | NS | NS | NS | NS | NS |
| 0-1.5 | NS | NS | NS | NS | NS | 80.2 | | 54.2 | 105 | 153.9 | 68.2 |
| 2-3 | 174.1 | 150.6 | 131.3 (1,499) | | | NS | NS | NS | NS | NS | NS |
| 2.5-4 | NS | NS | NS | NS | NS | 162.3 | | 94.9 (4,294.6) | 175.2 | 149.4 | 94.6 |
| 4-5 | 185.9 | 149.7 | 273 | 71.4 | 68.9 | NS | NS | NS | NS | NS | NS |
| 5-6.5 | NS | NS | NS | NS | NS | 120.6 | 53.3 | | 75.3 | 174.4 | 76.6 |
| 7.5-9 | NS | NS | NS | NS | NS | | 81.2 | 78.6 | 129.5 | 140.8 | 57.1 |
| 10-11.5 | NS | NS | NS | NS | NS | 124.7 | | | 132.4 | | |
| 15-16.5 | NS | NS | NS | NS | NS | 142.1 | | 75.8 | | 74.1 | |
| 20-21.5 | NS | NS | NS | NS | NS | 138.6 | | | 130.5 | 106.8 | NS |
| 25-26.5 | NS | NS | NS | NS | NS | 100.6 | 111.2 | | 106.2 | 83.3 | NS |
| 30-31.5 | NS | NS | NS | NS | NS | | 101.2 | | 106.3 | | |
| 45-46.5 | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | |
| 60-61.5 | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | |

**TABLE 7-2**
**(Concluded)**

Ft-BGS = Feet Below ground surface
NS = Sample not collected in accordance with Scope of Services/Sampling Plan
( ) = The values in parentheses are for barium, all other values are for selenium

[1] All concentrations are in milligrams per kilogram (mg/kg)

Source: Final Report, IRP Phase IV (Walk, Haydel and Associates, Inc. 1990)

TABLE 7-3

SUMMARY OF SURFACE SOIL SAMPLING, BOREHOLE DRILLING, AND BOREHOLE SAMPLING CONDUCTED BY WCC AT NE STORMWATER DRAINAGE AREA, SWMU NO. 95 / IRP NO. SD-20, CANNON AFB, NEW MEXICO

| BORING NUMBER | DRILLING/ SAMPLING METHOD | DRILL RIG USED | BOREHOLE DIAMETER (In) | DRILLING/ SAMPLING DEPTH INTERVALS (Ft-BGS) | BOREHOLE SAMPLING FREQUENCY | DATE(S) DRILLED/ SAMPLED | NUMBER OF ANALYTICAL SOIL SAMPLES COLLECTED | NUMBER OF ANALYTICAL QA/QC SAMPLES COLLECTED | NUMBER OF SPT SOIL SAMPLES COLLECTED | NUMBER OF GRADATION ANALYSIS SAMPLES COLLECTED | GROUND ELEVATION (Ft-MSL) | TOTAL DEPTH OF BOREHOLE (Ft-BGS) | DATE BOREHOLE GROUTED |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0951 | HT | NA | NA | 0 to 0.5 | NA | 10-14-91 | 1 | 0 | NA | 1 | 4279.86 | 10 | 10-15-91 |
| | HSA | B-53 | 6.5 | 0 to 10 | Continuous | 10-15-91 | 3 | 3 | 5 | 0 | | | |
| (0953)* | HT | NA | NA | 0 to 0.5 | NA | 12-07-91 | 1 | 2 | NA | 0 | 4278.51 | 10 | 12-10-91 |
| | HSA | B-61B | 7.5 | 0 to 10 | 2' Intervals | 12-07-91 | 3 | 1 | 3 | 0 | | | |
| 0952 | HT | NA | NA | 0 to 0.5 | NA | 10-14-91 | 1 | 0 | NA | 0 | 4280.08 | 10 | 10-15-91 |
| | HSA | B-53 | 6.5 | 0 to 10 | Continuous | 10-15-91 | 3 | 1 | 5 | 1 | | | |
| (0954)* | HSA | B-61B | 7.5 | 0 to 10 | 2' Intervals | 12-08-91 | 3 | 4 | 3 | 0 | 4278.35 | 10 | 12-10-91 |

| | | | |
|---|---|---|---|
| In | Inches | B-53 | Mobile B-53 Auger Drill Rig with 6" OD / 3.75" ID Augers and 6.5" Bullet Bit |
| Ft-BGS | Feet Below Ground Surface | B-61A | Mobile B-61 Auger Drill Rig with 6" OD / 3.75" ID Augers and 6.5" or 6.25" Bullet Bit |
| Ft-MSL | Feet Mean Sea Level | B-61B | Mobile B-61 Auger Drill Rig with 7.25" OD / 4.25" ID Augers and 7.5" Bullet Bit |
| SPT | Standard Penetration Test | F-10 | Failing F-10 Auger Drill Rig with 8.25" OD / 4.25" ID Augers and 8.5" Bullet Bit |
| HSA | Hollow Stem Auger | CME-75 | Central Mine Equipment CME-75 Auger Drill Rig with 7.75" OD / 4.25" ID Augers and 8.0" Bullet Bit |
| HT | Hand Trowel, Surface Sample | OD | Outer Diameter |
| NA | Not Applicable, Surface Sample | ID | Inner Diameter |
| NS | Not Sampled | | |

( )* The borings that are shaded and in parentheses correspond to either a redrill or surface resample of the previous boring or surface sample due to laboratory missed holding times. These borings or surface resamples were drilled or collected approximately 1 to 5 feet away from the original boring or surface sample location.

TABLE 7-4

SUMMARY OF SURFACE SOIL, SUBSURFACE SOIL, AND QA/QC SAMPLES COLLECTED BT WCC AT NE STORMWATER DRAINAGE AREA, SWMU NO. 95 / IRP NO. SD-20, CANNON AFB, NEW MEXICO

| BORING NUMBER | DEPTH INTERVAL (Ft-BGS) | SAMPLE IDENTIFICATION NUMBER | SAMPLE TYPE | QA/QC SAMPLES | SAMPLE MATRIX | DATE SAMPLED | TIME SAMPLED | OVA ON SAMPLE (ppm) | ANALYTICAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|---|
| 0951 | 0 to 0.5 | CAN095-0951-0000 | A | | Soil | 10-14-91 | 1615 | 0 | VOC,SV,M,TPH |
| | | CAN095-0951-4000 | GA | | Soil | 10-14-91 | 1615 | | |
| | 0 to 2 | CAN095-0951-4000 | SPT | | Soil | 10-15-91 | 1145 | | |
| | 2 to 4 | CAN095-0951-0002 | A/SPT | | Soil | 10-15-91 | 1155 | 41 | VOC,SV,M,TPH |
| | | CAN095-0951-0301 | A | MRD | Soil | 10-15-91 | 1215 | 41 | VOC,SV,M,TPH |
| | 4 to 6 | CAN095-0951-0004 | A/SPT | | Soil | 10-15-91 | 1215 | 0 | VOC,SV,M,TPH |
| | 6 to 8 | CAN095-0951-4006 | SPT | | Soil | 10-15-91 | 1230 | | |
| | 8 to 10 | CAN095-0951-0008 | A/SPT | | Soil | 10-15-91 | 1255 | 0 | VOC,SV,M,TPH |
| | | CAN095-0951-0371 | A | RB | Water | 10-15-91 | 1415 | | VOC |
| | | CAN095-0951-0351 | A | AB | Water | 10-15-91 | 1420 | | VOC |
| (0953)* | 0 to 0.5 | CAN095-0953-0000 | A | MS/MSD | Soil | 12-07-91 | 1000 | 0 | VOC |
| | | CAN095-0953-0353 | A | AB | Water | 12-07-91 | 1025 | | VOC |
| | 2 to 4 | CAN095-0953-0002 | A/SPT | | Soil | 12-07-91 | 1340 | 0 | VOC,TPH |
| | | CAN095-0953-0302 | A | MRD | Soil | 12-07-91 | 1340 | 0 | VOC,TPH |
| | 4 to 6 | CAN095-0953-0004 | A/SPT | | Soil | 12-07-91 | 1355 | 0 | TPH |
| | 8 to 10 | CAN095-0953-0008 | A/SPT | | Soil | 12-07-91 | 1405 | 0 | TPH,SV |
| 0952 | 0 to 0.5 | CAN095-0952-0000 | A | | Soil | 10-14-91 | 1600 | 0 | VOC,SV,M,TPH |
| | 0 to 2 | CAN095-0952-4000 | SPT | | Soil | 10-15-91 | 0830 | | |
| | 2 to 4 | CAN095-0952-0002 | A/SPT | | Soil | 10-15-91 | 0840 | 0 | VOC,SV,M,TPH |
| | 4 to 6 | CAN095-0952-0004 | A/SPT | | Soil | 10-15-91 | 0855 | 0 | VOC,SV,M,TPH |
| | 6 to 8 | CAN095-0952-4006 | GA/SPT | | Soil | 10-15-91 | 0910 | | |
| | 8 to 10 | CAN095-0952-0008 | A/SPT | | Soil | 10-15-91 | 0920 | 0 | VOC,SV,M,TPH |
| | | CAN095-0952-0381 | A | DW | Water | 10-15-91 | 0930 | | VOC |
| (0954)* | 2 to 4 | CAN095-0954-0002 | A/SPT | MS/MSD | Soil | 12-08-91 | 0905 | 0 | VOC,SV,TPH |
| | | CAN095-0954-0364 | A | FD | Soil | 12-08-91 | 0915 | 0 | VOC,SV,TPH |
| | 4 to 6 | CAN095-0954-0004 | A/SPT | | Soil | 12-08-91 | 0930 | 0 | TPH |
| | | CAN095-0954-0373 | A | RB | Water | 12-08-91 | 1025 | | VOC,SV,TPH |
| | 8 to 10 | CAN095-0954-0008 | A/SPT | | Soil | 12-08-91 | 1030 | 0 | VOC |
| | | CAN095-0954-0384 | A | DW | Water | 12-08-91 | 1050 | | VOC |

| | | | | | |
|---|---|---|---|---|---|
| Ft-BGS | Feet Below Ground Surface | FD | Field Duplicate | SV | Semi Volatile Organic Compounds |
| OVA | Organic Vapor Analyzer Reading | MRD | Missouri River Division Duplicate | M | Metals (TAL) |
| ppm | Parts per Million | AB | Ambient Blank | TPH | Total Petroleum Hydrocarbons |
| A | Analytical | RB | Rinsate Blank | BTEX | Benzene, Toluene, Ethylbenzene, Xylene |
| SPT | Standard Penetration Test | DW | Decontamination Water Blank | | |
| GA | Gradation Analysis | TB | Trip Blank | TOC | Total Organic Carbon |
| L | Lithology | VOC | Volatile Organic Compounds (TCL) | OL | Organic Lead |
| MS/MSD | Matrix Spike / Matrix Spike Duplicate | PCB | Polychlorinated Biphenols, Pesticides | Pb/Cr | Lead / Chromium |
| | | TCL | Target Compound List | TAL | Target Analyte List |

( )* The borings that are shaded and in parentheses correspond to either a redrill or surface resample of the previous boring or surface sample due to laboratory missed holding times. These borings or surface resamples were drilled or collected approximately 1 to 5 feet away from the original boring or surface sample.

## TABLE 7-5

## TOTAL PETROLEUM HYDROCARBON, VOLATILE AND SEMI-VOLATILE ORGANIC COMPOUND CONCENTRATIONS IN SOIL SAMPLES COLLECTED BY WCC AT NE STORMWATER DRAINAGE AREA

## SWMU NO. 95/IRP NO. SD-20
## CANNON AFB, NEW MEXICO

| | | | Volatile Organics[1] | | | | Semi-Volatile Organics[1] | | |
|---|---|---|---|---|---|---|---|---|---|
| Boring Number (Redrill Boring Number) | Sample Depth (Ft-BGS) | TPH (mg/kg) | Acetone (ug/kg) | 2-Butanone (ug/kg) | Methylene Chloride (ug/kg) | Toluene (ug/kg) | 2-Methyl naphthalene (ug/kg) | bis(2-Ethylhexyl) phthalate (ug/kg) | Butyl benzyl phthalate (ug/kg) |
| 0951 (0953) | 0 to 0.5 | 1260 | (140J) | (23J) | (57UJ) | (57U) | 1300J | 1700J | 7500U |
| | 2 - 4 | (48.5U) | (22) | (12U) | (2J) | (12U) | 390U | 350J | 390U |
| | 4 - 6 | (46.4U) | 11J | 11U | 11U | 11U | 380U | 380U | 380U |
| | 8 - 10 | (46.5U) | 17 | 11U | 11U | 11U | (380U) | (45J) | (240J) |
| 0952 (0954) | 0 - 0.5 | 285 | 12U | 12UJ | 12U | 3J | 8200U | 8200U | 8200U |
| | 2 - 4 | (49U) | (21) | (12J) | (3J) | (12U) | (400U) | (400U) | (120J) |
| | 4 - 6 | (49.9U) | 37U | 12U | 12U | 12U | 410U | 410U | 410U |
| | 8 - 10 | 48.5U | (12UJ) | (12UJ) | (2UJ) | (12UJ) | 400U | 190J | 400U |

**TABLE 7-5**
**(Concluded)**

| | | |
|---|---|---|
| Ft-BGS | = | Feet below ground surface |
| mg/kg | = | Milligrams per kilogram |
| ug/kg | = | Micrograms per kilogram |
| U | = | Not detected |
| J | = | Estimated value |
| UJ | = | Estimated as non-detect at the CRQL |
| ( ) | = | The values in parentheses are results from samples collected from the redrill borings due to laboratory missed holding times. |

[1] Only the volatile and semi-volatile organic compounds listed were detected (or estimated) in soil samples. All values are in ug/kg (micrograms per kilogram). All other volatile and semi-volatile organic compounds were not detected. For a complete list of all VOCs and Semi-VOCs concentrations see Appendix C-1, Analytical Database Printout.

## TABLE 7-6

## METAL CONCENTRATIONS[1] IN SOIL SAMPLES COLLECTED BY WCC AT NE STORMWATER DRAINAGE AREA SWMU NO. 95/IRP NO. SD-20 CANNON AFB, NEW MEXICO

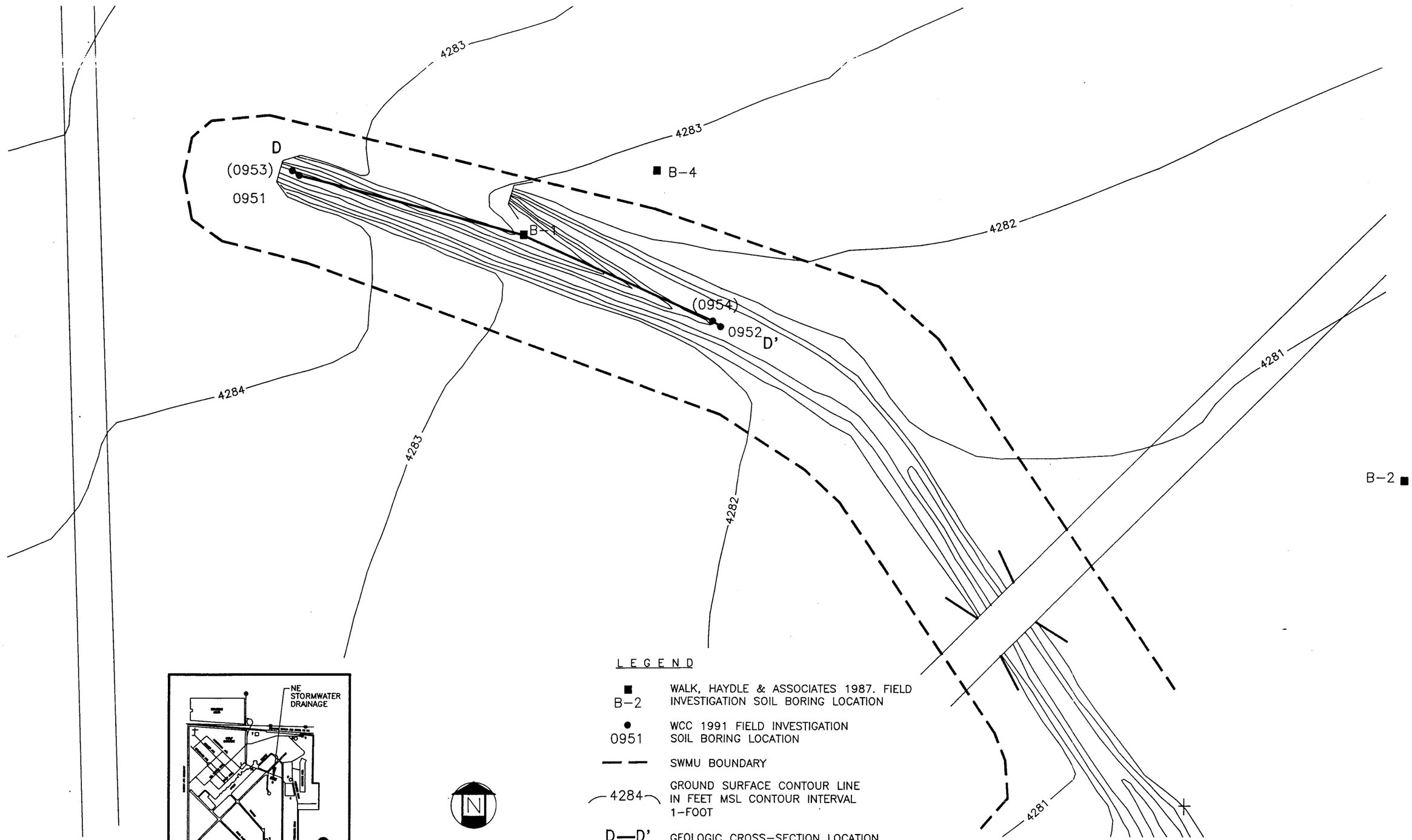
| Element | Boring 0951 Sample Depth (Ft-BGS) | | | | Boring 0952 Sample Depth (Ft-BGS) | | | | Background[2] $\bar{x} + 2\sigma$ |
|---|---|---|---|---|---|---|---|---|---|
| | 0-0.5 | 2-4 | 4-6 | 8-10 | 0-0.5 | 2-4 | 4-6 | 8-10 | |
| Aluminum | 2180 | 4560 | 9840 | 7840 | 6320 | 4160 | 4760 | 5240 | 2571-10447 |
| Antimony | 5.1UJ | 5.4UJ | 5.2UJ | 5.2UJ | 5.8UJ | 5.6UJ | 5.6UJ | 5.5UJ | 4.81-5.44 |
| Arsenic | 3.9 | 1.5J | 2.3 | 1.3J | 2.2J | 1.9J | 1.8J | 1.9J | 0.43-1.95 |
| Barium | 3820 | 255 | 188 | 50.9 | 184 | 74.3 | 82.7 | 239 | 0-903 |
| Beryllium | 0.44U | 0.47U | 0.54J | 0.54J | 0.51U | 0.48U | 0.49U | 0.48U | 0.32-0.68 |
| Cadmium | 1.8 | 0.94U | 0.91U | 0.9U | 1U | 0.97U | 0.97U | 0.97U | 0.81-1.01 |
| Calcium | 144000 | 223000 | 88900 | 109000 | 137000 | 146000 | 127000 | 160000 | 0-193062 |
| Chromium | 115J | 4.2 | 7.6 | 6.6 | 26.8J | 4.4J | 4.3J | 4.4J | 2.67-9.31 |
| Cobalt | 12.6 | 2.7J | 4.3J | 3J | 3.5J | 1.5J | 2.4J | 3.1J | 1.38-4.06 |
| Copper | 59 | 4.3U | 6.1U | 4.5U | 14U | 4.7U | 4U | 4.3U | 0.00-15.44 |
| Iron | 41200 | 2660 | 6530 | 4730 | 6310 | 3810 | 3880 | 3800 | 2239-8683 |
| Lead | 147 | 1.6 | 4.8 | 3.1 | 31.6 | 3.6 | 3.3 | 2.9 | 1.76-8.64 |
| Magnesium | 2740 | 3910 | 4500 | 4340 | 2610 | 2360 | 2290 | 3450 | 0-11903 |
| Manganese | 443 | 115 | 103 | 57.2 | 165 | 106 | 99.9 | 113 | 10.89-167 |

**TABLE 7-6**
**(Concluded)**

| Element | Boring 0951 Sample Depth (Ft-BGS) | | | | Boring 0952 Sample Depth (Ft-BGS) | | | | Background[2] $\bar{x} + 2\sigma$ |
|---|---|---|---|---|---|---|---|---|---|
| | 0-0.5 | 2-4 | 4-6 | 8-10 | 0-0.5 | 2-4 | 4-6 | 8-10 | |
| Mercury | 0.38 | 0.12U | 0.11U | 0.11U | 0.13U | 0.12U | 0.12U | 0.12U | -- - -- |
| Nickel | 49.1 | 5.6J | 9.6 | 6.8J | 8.1J | 4.7J | 4.6J | 4.9J | 3.57-8.49 |
| Potassium | 448J | 814J | 2030 | 1680 | 1130J | 982J | 1110J | 1110J | 632-2613 |
| Selenium | 0.22UJ | 2.3UJ | 2.3UJ | 2.2UJ | 2.5UJ | 2.4UJ | 2.4UJ | 2.4UJ | 0.00-1.35 |
| Silver | 0.88U | 1J | 0.91U | 0.9U | 1U | 0.97U | 0.97U | 0.97U | 0.86-0.94 |
| Sodium | 6410 | 5570 | 3140 | 1170 | 1850 | 1410 | 1800 | 1420 | 154-540 |
| Thallium | 0.22UJ | 2.3UJ | 2.3UJ | 0.22UJ | 0.25UJ | 0.24U | 0.24U | 0.24UJ | 0.20-0.24 |
| Vanadium | 15.5 | 9.4J | 20.7 | 14.3 | 13.8 | 12.5 | 11.5J | 11.6J | 9.26-26.74 |
| Zinc | 467J | 7.6 | 17.4 | 11.3 | 62.6J | 9 | 8.8 | 9.3J | 4.58-21.82 |

Ft-BGS = Feet below ground surface
UJ = Estimated as non detect at the instrument detection limit
J = Estimated value
U = Not detected
-- - -- = No range could be calculated

[1] All concentrations are in milligrams per kilogram (mg/kg)
[2] Background range calculated from values in Table 2-7




| | |
|---|---|
| Job No. : | 89MC114W |
| Prepared by : | D.A.K. |
| Date : | 2/10/92 |

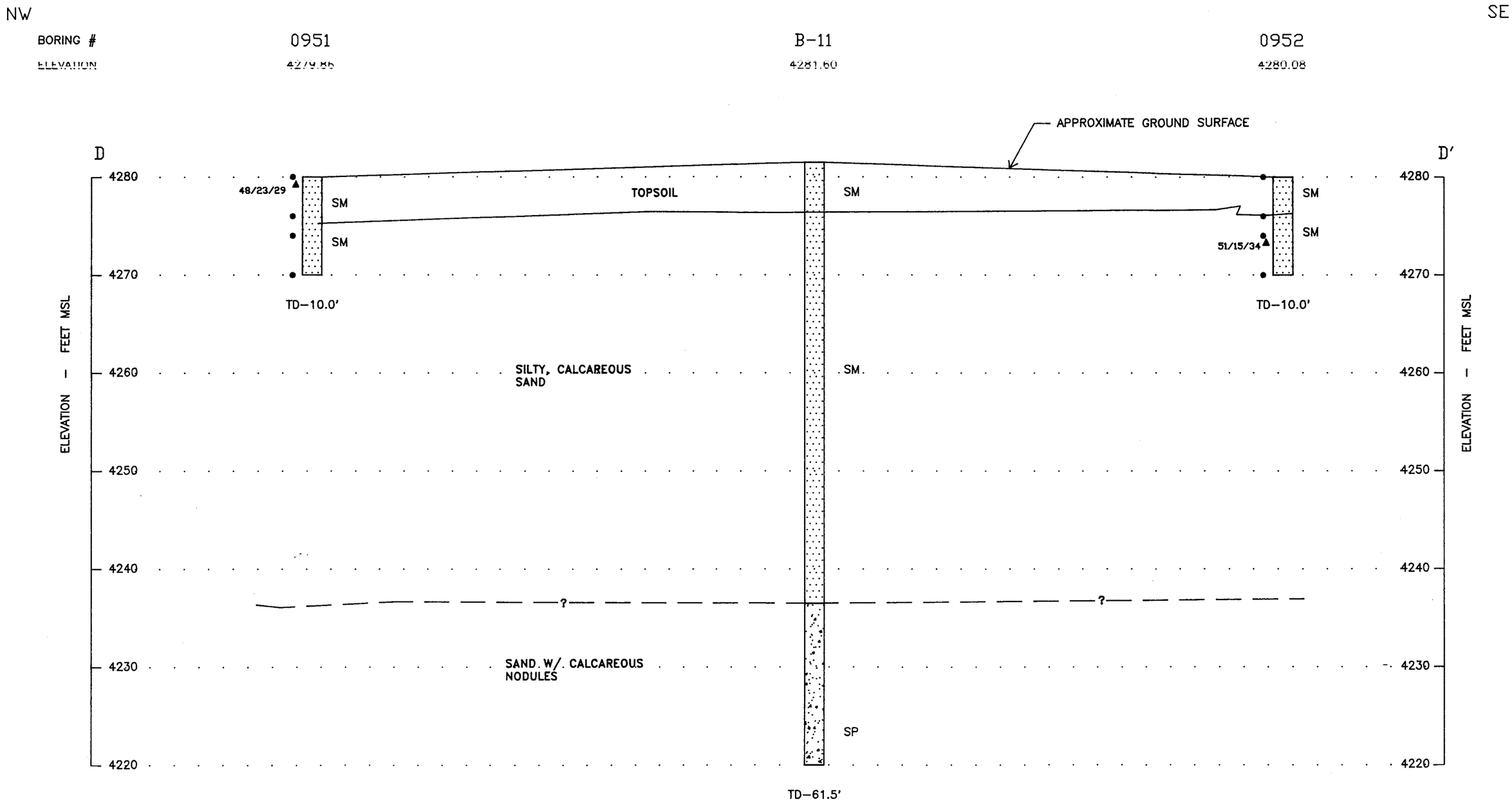
LOCATION OF SOIL BORINGS AT NE STORMWATER DRAINAGE AREA

SWMU NO. 95/IRP NO. SD-20

CANNON AFB, NEW MEXICO

C1140008

FIG. 7-1




LEGEND

| | | |
|---|---|---|
| MSL | – | MEAN SEA LEVEL |
| TD | – | TOTAL DEPTH IN FEET BGS |
| SM,SP,GW ML,GP | – | UNIFIED SOIL CLASSIFICATION SYSTEM ABBREVIATIONS |
| BGS | – | BELOW GROUND SURFACE |
| • | – | ANALYTICAL SAMPLE INTERVAL |

BORINGS 0951, 0952 WCC (91)
BORING B11 RADIAN
(BORINGS APPROXIMATELY LOCATED)
(ELEVATIONS ESTIMATED)
NOTE: THE LOCATION OF THIS CROSS-SECTION IS SHOWN ON FIG. 7-1

48/23/29 ▲ – GRADATION ANALYSIS SAMPLE INTERVAL. THE THREE NUMBERS REPRESENT THE APPROXIMATE PERCENTAGES OF SAND-, SILT-, AND CLAY- SIZED MATERIAL RESPECTIVELY

| | |
|---|---|
| Job No. : | 89MC114W |
| Prepared by : | LLG |
| Date : | 2/3/92 |

GEOLOGIC CROSS SECTION D-D'
NE STORMWATER DRAINAGE AREA
SWMU NO. 95/IRP NO. SD-20
CANNON AFB NEW MEXICO

SWMU-95

FIG. 7-2

# 8.0
# OLD ENTOMOLOGY RINSE AREA (SWMU NO. 96/IRP NO. SD-17)

## 8.1 SWMU DESCRIPTION

### 8.1.1 Setting

The Old Entomology Rinse Area (ERA) was located behind pesticide storage Building 2160 which was abandoned during October 1983, and demolished in September 1984 (Figure 8-1). The location is on the east-central part of the base north of the wastewater lagoons and west of perimeter road. During its use, pesticide and herbicide application equipment and containers were rinsed in a sink in Building 2160. The sink drained to a 3-feet-square and 2-feet-deep open pit in the rear of the building. The bottom of the pit was open to the soil (USAF 1990).

### 8.1.2 History of Use

Start-up on this unit is suspected to have been in 1968, although it could have been earlier.

### 8.1.3 Past Investigations

Three soil borings (17A, B, and C) were drilled by Radian Corporation to depths of 62.5, 63.0 and 58.0 feet, respectively (Figure 8-1). Ten soil samples were collected and analyzed for arsenic, mercury, herbicides, pesticides, and purgeable halocarbons and aromatics (Table 8-1). No organophosphate pesticides, purgeable halocarbons or aromatics were detected in the samples. Low total organic carbon (TOC) concentrations and metal concentrations within normal soil ranges were detected. Analytical results from boring 17A indicated the presence of the herbicide 2, 4-D at depths of 5-10 feet and at 63 feet, and the presence of minor concentrations of pesticides at depths of 2-4 feet. Boring 17C contained 0.406 ppm 2,4-D at a depth of 62 feet.

In November and December 1986, Walk, Haydel and Associates conducted a Phase IV-A investigation involving soil borings, surface sediments, sewage lagoon sediment and water, and groundwater sampling and analyses.

Eight soil borings were drilled by Walk, Haydel and Associates during the Phase IV investigation of the ERA. Also, one 356-foot-deep monitoring well was installed downgradient of the ERA (Figure 8-1). The borings were sampled at designated intervals from 0 to 10 feet, and at 10-foot intervals from 10 to 50 feet. Four of the deeper borings (total depth = 100 feet) were also sampled every 10 feet from 50 to 100 feet. The pesticides 4,4-DDE, 4,4-DDD, 4,4-DDT and chlordane were present at almost all boring locations at the 0.5-foot sample depth, with concentrations decreasing with depth (Table 8-1). The highest concentration detected was 2.6 ppm in boring B1 at a depth of 0.5 feet BGS. Most borings only showed contamination to a depth of 1.0 foot, except for boring B8, located near the open pit adjacent to building 2160. This boring showed pesticides to a depth of 6.0 feet. No herbicides were detected in any of the samples collected during this investigation. Based on this data, Walk, Haydel and Associates concluded the conditions at this site were not conducive to downward contaminant migration.

### 8.1.4 Land Use and Demography

Current use of the land around this SWMU is minimal. The closest facility to this unit is the wastewater lagoons, which are about 150 feet to the south. The area is fenced and has a locked gate. Two workers pass through the area daily to check the wastewater lagoons pump station.

## 8.2 FIELD INVESTIGATION

This section provides a discussion of the field activities conducted by WCC at the Old Entomology Rinse Area on October 24, 1991 and on November 13, 1991. The activities at this SWMU, as outlined in the FSP (WCC 1991c), consisted of collecting 1 surface soil sample for chemical analysis, 1 surface soil sample for gradation analysis, measuring the static water level, evacuating and sampling 1 monitoring well, and collecting 1 groundwater sample for chemical analysis. The groundwater sampling was conducted

in accordance with SOPs No.2 - Water Level Measurement and No. 3 - Monitoring Well Sampling Using a Bailer contained in the QAPP (WCC 1991b). The monitoring well was evacuated with a 3-inch OD PVC bailer attached to a nylon rope using a tripod well sampler. The actual groundwater sample was collected with a 1.6-inch OD Teflon bailer attached to a nylon rope.

Table 8-2 summarizes the surface soil sampling, while a summary of the monitoring well evacuation and sampling during the 1991 WCC investigation is provided in Table 8-3. A complete record of all surface soil, groundwater, and associated QA/QC samples collected at the Old Entomology Rinse Area is presented in Table 8-4. The locations of the surface soil sample and monitoring well are shown on Figure 8-1.

### 8.2.1 Sampling Objectives

The objective of additional sampling in the area of the Old Entomology Rinse Area is to provide additional information regarding the nature and extent of potential hazardous contaminants in the surface soil near the site of the old 2160 building and in the groundwater downgradient of that building for risk assessment purposes. The data collected at these boring locations were used to further evaluate the extent of potential contamination, if present, and to perform a baseline risk assessment to determine if the area poses a risk to human health or the environment. The data may also be utilized to evaluate remedial actions if necessary.

### 8.2.2 Surface Soil Investigation

One surface soil sample, 0961, was collected from 0 to 0.5 feet BGS at the approximate location of the sink rinse pit behind building 2160. This sample was collected using a stainless steel hand trowel and analyzed for PCBs and pesticides. Geotechnical gradation analysis was also performed on this sample.

### 8.2.3 Groundwater Investigation

One monitoring well, 096K, was evacuated and sampled. Prior to any well evacuation or sampling activity, the static water level (SWL) and total depth to the bottom of the

casing was measured. The groundwater level and monitoring well casing depths were recorded to the nearest hundredth of a foot using an electrical water level indicator (well sounder). This information, along with the inside diameter of the well casing, was used to calculate the volume of water in the well casing under static conditions. The volume of water in the well casing was approximately 16 gallons.

During the evacuation process, the field parameters pH, specific conductance, temperature, and color of the removed groundwater were monitored and recorded. Almost two well casing volumes (31 gallons) were evacuated from the well before it was bailed dry. Based on the stable field parameters that were observed at this well, (i.e. pH and specific conductance varied by less than 10 percent) it was determined that all of the stagnant water in the well casing had been removed. The SWL in the well was allowed to recover to approximately 90 percent before it was sampled. One groundwater analytical sample was collected and analyzed for PCBs, pesticides, and total metals.

## 8.3 PHYSICAL CHARACTERISTICS

This section provides a discussion of the soil and hydrogeology at the Old Entomology Rinse Area based on the lithologic description of the surface soil sample and gradation analysis results from the 1991 WCC investigation, and the review of lithologic boring logs from the previous 1988 Walk, Haydel and Associates field investigation (Walk, Haydel and Associates 1990).

### 8.3.1 Soil

The soils underlying the Old Entomology Rinse Area consist of sandy loam and loamy sand of the Amarillo Soil Group. The soils consist primarily of fine-grained, well sorted, silty, clayey, brown sands. The sands are dry to slightly moist at depth. One gradation analysis was performed on a sample collected from this soil unit at 0.5 feet BGS in boring 0961. The results indicate that this soil sample was comprised of approximately 53 percent sand, 23 percent silt, and 34 percent clay. The total thickness of the soil zone is approximately 4 to 5 feet.

### 8.3.2 Hydrogeology

The hydrostratigraphy at the Old Entomology Rinse Area consists of Tertiary Miocene to Pliocene fluvial deposits of the Ogallala Formation. Based on information contained in the field boring log for well 096K (Walk, Haydel, and Associates, Inc. 1988), the SWMU is underlain by Ogallala fluvial deposits consisting of well to moderately sorted sand, with scattered layers of caliche in the upper 65 feet. The total thickness of these deposits appears to be approximately 350 feet.

Based on the SWL measured by WCC and the information contained on the field boring log for monitoring well 096K, the first water-bearing zone encountered in well 096K from 4064 to 3924 feet MSL consists of fine-grained, silty, occasionally calcareous, partially cemented, tan to brown sand. This unit was encountered at approximately 210 feet BGS and appears to be 140 feet thick at this location. Based on the lithologic descriptions, this water-bearing zone represents the water table aquifer beneath the SWMU and occurs under unconfined conditions. The depth to the top of the water table measured on November 8, 1991 was approximately 270.42 feet BGS. The static water level elevation was 4003.88 feet MSL.

Using the SWL measurement at well 096K, along with SWL measurements from the four monitoring wells at the wastewater lagoons, 101E, 101F, 101G, and 101H, a groundwater potentiometric surface contour map was constructed using the three-point method for estimating groundwater flow direction with visual contour adjustments (Figure 8-2). This map shows the groundwater flow to be in a southeasterly direction. Based on the potentiometeric surface contour map, the hydraulic gradient beneath this SWMU is approximately 0.001 ft/ft.

## 8.4 NATURE AND EXTENT OF CONTAMINATION

### 8.4.1 Soils

One surface soil sample, 0961, was collected at the approximate location of the sink rinse pit, southwest of former building 2160 (Figure 8-1). Due to the history of this site,

the sample was collected primarily for risk assessment purposes and analyzed only for PCBs/pesticides.

The pesticides, 4,4-DDE and 4,4-DDT, were reported as estimated values (flagged with J) of 66J and 110J $\mu$g/kg, respectively (Table 8-5). The $\alpha$- and $\gamma$-chlordane compounds were reported as estimated values of 16J and 47J $\mu$g/kg, respectively. Heptachlor epoxide was reported as an estimated value of 19J $\mu$g/kg. The concentrations of PCBs were reported as non-detects below the CRQL.

A comparison of the above analytical results with those of borings B4 and B8 of past investigations (Final Report, IRP Phase IV-A) shows that the estimated values of the pesticides described above are far below the detected range of 1.2-1.5 mg/kg for 4,4-DDE, 1.6-2.0 mg/kg for 4,4-DDT, and 0.3-0.5 mg/kg for chlordane, for shallow soil at B4 and B8. Heptachlor epoxide had not been previously reported as detected. The conclusion from this analysis is that the surficial soil at boring 0961 contains levels of pesticides much lower than that detected in past investigations for soils southeast of former building 2160.

### 8.4.2 Groundwater

One groundwater sample was collected from the existing monitoring well, 096K, located downgradient from the Old Entomology Rinse Area. The location of the well is shown on Figure 8-2 and a description of the sampling event is discussed in Section 8.2.3. Evaluation of the chemical analysis (TAL metals, PCBs/pesticides) of this sample, 096K, has been used to describe the nature of contamination.

Six metals were detected above the detection limits for TAL metals: barium, chromium, copper, lead, vanadium, and zinc. Table 8-6 summarizes the reported concentrations for the detected metals and compares them with established maximum contaminant levels (MCL) for groundwater quality standards. All the metals had concentrations below the MCL.

No PCBs or pesticides were found in the groundwater sample 096K.

These analytical results confirm that the groundwater at well K was not impacted by metals or PCBs/pesticides resulting from activities at the old entomology rinse site.

## TABLE 8-1

## PESTICIDE CONCENTRATIONS[1] IN SOIL SAMPLES COLLECTED BY WALK, HAYDEL AND ASSOCIATES AT OLD ENTOMOLOGY RINSE AREA

## SWMU NO. 96/IRP NO. SD-17
## CANNON AFB, NEW MEXICO

| Sample Depth (Ft-BGS) | Compound | Boring Number | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 17A | 17C | B1 | B3 | B4 | B5 | B6 | B7 | B8 |
| 0.5 | 4,4 - DDD | | | 0.3 | | 0.5 | | 0.2 | | 0.4 |
| | 4,4 - DDE | | | 2.6 | 0.5 | 1.5 | 0.1 | 1.3 | 0.5 | 1.2 |
| | 4,4 - DDT | | | 0.9 | 0.2 | 2.0 | 0.1 | 0.8 | 0.7 | 1.6 |
| | Chlordane | | | 0.7 | 0.1 | 0.5 | 0.3 | 1.0 | 0.5 | 0.3 |
| 1.0 | 4,4 - DDE | | | 0.1 | | | | | 0.3 | |
| | 4,4 - DDT | | | | | 0.1 | | | 0.2 | |
| | Chlordane | | | | | | 0.2 | | 0.2 | |
| 2.0 - 4.0 | 4,4 - DDD | | .007[2] | | | | | | | |
| | 4,4 - DDE | | .025[2] | | | | | | | |
| | 4,4 - DDT | | .029[2] | | | | | | | |
| | Dieldrin | .000002 | | | | | | | | |
| | Toxaphene | .000221 | | | | | | | | |
| 5.0 - 6.0 | 2,4 - D | .283 | | | | | | | | |
| | 4,4 - DDD | | | | | | | | | 0.3 |
| | 4,4 - DDE | | | | | | | | | 0.9 |

**TABLE 8-1**
**(Concluded)**

| Sample Depth (Ft-BGS) | Compound | Boring Number | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 17A | 17C | B1 | B3 | B4 | B5 | B6 | B7 | B8 |
| | 4,4 - DDT | | | | | | | | | 1.3 |
| | Chlordane | | | | | | | | | 0.2 |
| 7.5 - 9.5 | 2,4 - D | .059 | | | | | | | | |
| 61.5 - 62.0 | 2,4 - D | | .406 | | | | | | | |
| | 4,4 - DDT | | .008[2] | | | | | | | |
| 62.5 - 63.0 | 2,4 - D | 3.41 | | | | | | | | |

Ft-BGS = Feet below ground surface

[1] All concentrations are in milligrams per kilogram (mg/kg)
[2] Below detection limit

Source: Final Report, IRP Phase IV-A (Walk, Haydel & Associates Inc. 1990)

TABLE 8-2

SUMMARY OF SURFACE SOIL SAMPLING CONDUCTED BY WCC AT OLD ENTOMOLOGY RINSE AREA,
SWMU NO. 96 / IRP NO. SD-17, CANNON AFB, NEW MEXICO

| BORING NUMBER | DRILLING/ SAMPLING METHOD | DRILL RIG USED | BOREHOLE DIAMETER (In) | DRILLING/ SAMPLING DEPTH INTERVALS (Ft-BGS) | BOREHOLE SAMPLING FREQUENCY | DATE(S) DRILLED/ SAMPLED | NUMBER OF ANALYTICAL SOIL SAMPLES COLLECTED | NUMBER OF ANALYTICAL QA/QC SAMPLES COLLECTED | NUMBER OF SPT SOIL SAMPLES COLLECTED | NUMBER OF GRADATION ANALYSIS SAMPLES COLLECTED | GROUND ELEVATION (Ft-MSL) | TOTAL DEPTH OF BOREHOLE (Ft-BGS) | DATE BOREHOLE GROUTED |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0961 | HT | NA | NA | 0 to 0.5 | NA | 10-24-91 | 1 | 1 | NA | 1 | 4279.32 | 0.5 | NA |

| | |
|---|---|
| In | Inches |
| Ft-BGS | Feet Below Ground Surface |
| Ft-MSL | Feet Mean Sea Level |
| SPT | Standard Penetration Test |
| HSA | Hollow Stem Auger |
| HT | Hand Trowel, Surface Sample |
| NA | Not Applicable, Surface Sample |
| NS | Not Sampled |
| B-53 | Mobile B-53 Auger Drill Rig with 6" OD / 3.75" ID Augers and 6.5" Bullet Bit |
| B-61A | Mobile B-61 Auger Drill Rig with 6" OD / 3.75" ID Augers and 6.5" or 6.25" Bullet Bit |
| B-61B | Mobile B-61 Auger Drill Rig with 7.25" OD / 4.25" ID Augers and 7.5" Bullet Bit |
| F-10 | Failing F-10 Auger Drill Rig with 8.25" OD / 4.25" ID Augers and 8.5" Bullet Bit |
| CME-75 | Central Mine Equipment CME-75 Auger Drill Rig with 7.75" OD / 4.25" ID Augers and 8.0" Bullet Bit |
| OD | Outer Diameter |
| ID | Inner Diameter |

TABLE 8-3

SUMMARY OF MONITORING WELL EVACUATION AND SAMPLING CONDUCTED BY WCC AT OLD ENTOMOLOGY RINSE AREA, SWMU NO. 96 / IRP NO. SD-17, CANNON AFB, NEW MEXICO

| MONITORING WELL NUMBER | DATE INSTALLED | DRILLING METHOD | SCREENED INTERVAL (Ft-BGS) | SCREEN SLOT SIZE (In) | GRAVEL PACK INTERVAL (Ft-BGS) | BENTONITE SEAL INTERVAL (Ft-BGS) | GROUND SURFACE ELEVATION (Ft-MSL) | MEASURING POINT ELEVATION (Ft-MSL) | DATE(S) EVACUATED/ SAMPLED | EVACUATION AND SAMPLING METHOD | INITIAL SWL (Ft-BTOC) (Ft-MSL) | TOTAL DEPTH OF WELL (Ft-BGS) | WELL CASING DIAMETER (In) | WELL VOLUME UNDER STATIC CONDITIONS (GALLONS) | VOLUME OF WATER EVACUATED (GALLONS) | FINAL SWL (Ft-BTOC) (Ft-MSL) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 096K | 11-24-86 | WR | 267-287 | 0.010 | 200-356 | 195-200 | 4274.30 | 4277.48 | 11-13-91 | Hand Bailing | 273.60<br>4003.88 | 300.00 | 4.0 | 15.71 | 31 | 277.40<br>4000.08 |

Ft-BGS Feet Below Ground Surface
In Inches
Ft-MSL Feet Mean Sea Level
Ft-BTOC Feet Below Top of Casing
SWL Static Water Level
WR Wash Rotary

TABLE 8-4

SUMMARY OF SURFACE SOIL, GROUNDWATER, AND QA/QC SAMPLES COLLECTED BY WCC AT OLD ENTOMOLOGY RINSE AREA, SWMU NO. 96 / IRP NO. SD-17, CANNON AFB, NEW MEXICO

| BORING/ WELL NUMBER | DEPTH INTERVAL (Ft-BGS) | SAMPLE IDENTIFICATION NUMBER | SAMPLE TYPE | QA/QC SAMPLES | SAMPLE MATRIX | DATE SAMPLED | TIME SAMPLED | OVA ON SAMPLE (ppm) | ANALYTICAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|---|
| 0961 | 0 to 0.5 | CAN096-0961-0000 | A | MS/MSD | Soil | 10-24-91 | 1645 | 0 | PCB |
| | | CAN096-0961-4000 | GA | | Soil | 10-24-91 | 1645 | 0 | |
| 096K | | CAN096-096K-2001 | A | MS/MSD | Water | 11-13-91 | 1700 | | PCB,M |
| | | CAN096-096K-0661 | A | FD | Water | 11-13-91 | 1600 | | PCB,M |
| | | CAN096-096K-0671 | A | RB | Water | 11-13-91 | 1800 | | PCB,M |
| | | CAN096-096K-0601 | A | MRD | Water | 11-13-91 | 1700 | | PCB,M |

| | | | | | |
|---|---|---|---|---|---|
| Ft-BGS | Feet Below Ground Surface | FD | Field Duplicate | SV | Semi Volatile Organic Compounds |
| OVA | Organic Vapor Analyzer Reading | MRD | Missouri River Division Duplicate | M | Metals (TAL) |
| ppm | Parts per Million | AB | Ambient Blank | TPH | Total Petroleum Hydrocarbons |
| A | Analytical | RB | Rinsate Blank | BTEX | Benzene, Toluene, Ethylbenzene, Xylene |
| SPT | Standard Penetration Test | DW | Decontamination Water Blank | | |
| GA | Gradation Analysis | TB | Trip Blank | TOC | Total Organic Carbon |
| L | Lithology | VOC | Volatile Organic Compounds (TCL) | OL | Organic Lead |
| MS/MSD | Matrix Spike / Matrix Spike Duplicate | PCB | Polychlorinated Biphenols, Pesticides | Pb/Cr | Lead / Chromium |
| | | TCL | Target Compound List | TAL | Target Analyte List |

## TABLE 8-5

## PCB/PESTICIDE CONCENTRATIONS IN THE SURFACE SOIL SAMPLE COLLECTED BY WCC AT OLD ENTOMOLOGY RINSE AREA

### SWMU NO. 96/IRP NO. SD-17
### CANNON AFB, NEW MEXICO

| Boring Number | Sample Depth (Ft-BGS) | Compound | Concentration ($\mu$g/kg) |
|---|---|---|---|
| 0961 | 0 - 0.5 | 4,4-DDD | 14 UJ |
| | | 4,4-DDE | 66 J |
| | | 4,4-DDT | 110 J |
| | | Aldrin | 7.4 UJ |
| | | Dieldrin | 14 UJ |
| | | Endosulfan I | 7.4 UJ |
| | | Endosulfan II | 14 UJ |
| | | Endosulfan Sulfate | 14 UJ |
| | | Endrin | 14 UJ |
| | | Endrin Aldehyde | 14 UJ |
| | | Endrin Ketone | 14 UJ |
| | | Heptachlor | 7.4 UJ |
| | | Heptachlor Epoxide | 19 J |
| | | Methoxychlor | 74 UJ |
| | | PCB 1016 | 140 UJ |
| | | PCB 1221 | 290 UJ |
| | | PCB 1232 | 140 UJ |
| | | PCB 1242 | 140 UJ |
| | | PCB 1248 | 140 UJ |
| | | PCB 1254 | 140 UJ |
| | | PCB 1260 | 140 UJ |
| | | Toxaphene | 740 UJ |
| | | alpha-BHC | 7.4 UJ |
| | | alpha-Chlordane | 16 J |
| | | beta-BHC | 7.4 UJ |
| | | delta-BHC | 7.4 UJ |
| | | gamma-BHC | 7.4 UJ |
| | | gamma-Chlordane | 47 J |

Ft-BGS = Feet below ground surface
J = Estimated value
UJ = Estimated as non-detect at the CRQL

## TABLE 8-6

## METAL CONCENTRATIONS[1] IN THE GROUNDWATER SAMPLE COLLECTED BY WCC AT OLD ENTOMOLOGY RINSE AREA SWMU NO. 96/IRP NO. SD-17 CANNON AFB, NEW MEXICO

| Element | Well 96K | MCL[2] |
|---|---|---|
| Antimony | 0.06 U | 0.01/0.005 |
| Arsenic | 0.0047 J | 0.05 |
| Barium | 0.66 | 1.0 |
| Beryllium | 0.002 U | 0.01[3] |
| Cadmium | 0.005 U | 0.005[3] |
| Chromium | 0.034 U | 0.1 |
| Cobalt | 0.01 U | * |
| Copper | 0.15 | 1.0[4] |
| Lead | 0.034 J | 0.05[5] |
| Mercury | 0.0002 U | 0.002 |
| Nickel | 0.029 J | 1.0[3] |
| Selenium | 0.02 U | 0.05[5] |
| Silver | 0.003 U | 1.0[4] |
| Thallium | 0.01 U | 0.022/0.001[3] |
| Tin | 0.1 U | * |
| Vanadium | 0.035 | * |
| Zinc | 0.049 | 5.0[4] |

MCL = Maximum contaminant level
J = Estimated value
U = Not detected
1 All concentrations are in milligrams per liter (mg/L)
2 Primary MCL in effect as of July 30, 1992
3 Proposed primary MCL
4 Secondary MCL in effect as of July 30, 1992
5 Effective until 12/7/92, at which time action level of 0.015 mg/L becomes effective.
* No primary or secondary MCL or proposed MCL as of March 1992

## Stewart, Patricia, NMENV

**From:** Jeffrey_Voelker@URSCorp.com
**Sent:** Thursday, July 22, 2010 2:46 PM
**To:** Hanson, Hugh G CIV USAF AFSOC 27 SOCES/CEAN; Stewart, Patricia, NMENV
**Cc:** Tony_Sedlacek@URSCorp.com
**Subject:** Fw: SWMU 96 and SWMU 81
**Attachments:** Revised Tables 6,7,10 and 11 CAC Proposal June 2010.xls; Table D-15 revised 21JUL10.xls

Mr. Hanson and Ms. Stewart,

Please see the responses to Ms. Stewart's questions regarding SWMUs 96 and 81 in Tony's email below.

Thanks,

Jeff Voelker

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----- Forwarded by Jeffrey Voelker/Omaha/URSCorp on 07/22/2010 03:12 PM -----

**Tony Sedlacek/Omaha/URSCorp**
07/22/2010 03:10 PM

To Jeffrey Voelker/Omaha/URSCorp@URSCORP
cc
Subject Re: Fw: SWMU 96 and SWMU 81

General Note: URS apologizes for an inconsistencies in the Appendix D and CAC Proposal Tables. Tables D-15, 10 and 11 compile data from multiple investigations completed at SWMUs 96. Similarly, Tables 6 and 7 include data from multiple sampling efforts at SWMU 81. The tables were manually generated using data presented in historical reports. Compiling the data using the historical reports has proven to be a challenge when trying to determine accurate sampling dates, units for reported results, and matching the text to tables. The Cannon AFB administrative record was utilized to verify results.

Below is a summary of URS' responses to Ms. Stewart's comments, which were provided via multiple emails.

## SWMU 96

(1) According to my copy of the Woodward-Clyde Remedial Investigation Report for 18 SWMUs, values for 4,4-DDD, 4,4-DDE and 4,4-DDT in samples 17C-1-2 and 17C-3-61 were below detection limits. The values should, therefore, be replaced with "<" and noted with a UJ qualifier.

> The values for 4,4-DDD, 4,4-DDE and 4,4-DDT in samples 17C-1-2 and 17C-3-61 will be replaced with < and UJ qualifiers will be added in Table D-15. The max and frequency were also updated in Tables 10 and 11 of the CAC Proposal (URS 2010).

(2) Toxaphene is missing from the revised Table D-15. According to my copy of the Woodward-Clyde Remedial Investigation Report for 18 SWMUs, it was detected in one sample.

> Toxaphene results were added to Table D-15 for all samples that Toxaphene analysis was requested.

(3) After all potentially missing data are identified, please verify the maximum detected concentrations and the frequency detected for all
analytes in Tables 10 and 11 in the latest CAC Proposal. I think there will be a lot of changes in Tables 10 and 11.

The max and frequencies were updated in Tables 10 and 11 of the CAC Proposal (URS 2010)based on data added to Table D-15.

There are data for barium, copper, nickel, vanadium and zinc for some, but not all, of the three soil borings sampled in 1984; 17A, 17B and
17C. However, Table D-15 in the Woodward-Clyde Remedial Investigation Report for 18 SWMUs has no data for these metals in these soil borings, only arsenic and mercury.

Upon further review of the analytical data summaries in Appendix A of the Radian IRP Phase II Report (Radian 1986) for samples collected from soil borings 17A, 17B and 17C. Analytical data for barium, copper, nickel and zinc were included in the analytical data summaries for samples collected from soil borings 17A and 17B. These metals were not discussed in the Radian report as requested analytes for analyses, only arsenic and mercury were discussed as requested analyses for SWMU 96. These metals were initially included in Table D-15 for completeness. The laboratory may have analyzed and reported these metals in error; therefore they were not included in the Radian report. Based on the lack of evidence that these additional metals were required for SMWU 96 and were not included or discussed in the Radian 1986 report they have been removed from Table D-15.

(1) The Woodward-Clyde Remedial Investigation Report for 18 SWMUs (October 1992)indicated that 10 samples were taken from 3 soil borings
(17A, 17B and 17D) in November 1984. Only 9 samples are listed in Table D-15. I think that 17B-63 is missing. Can the results be found and included in the table?

The Radian IRP Phase II Report (Radian 1986) report was reviewed to try to locate any potential missing data. The boring logs indicate that the following samples were collected from the three soil borings: SB17A-1, SB17A-2, SB17A-3, SB17A-4, SB17B-1, SB17B-2, SB-17C-1, SB-17C-2 and SB-17C-3. Based on the boring logs, 9 samples were collected from the 3 soil borings. The boring log for SB17B indicated that there was no sample recovery because of the consolidated nature of the material in the 61- to 63-foot sample interval. The report text indicated that 10 samples including one QA duplicate sample were collected from SWMU 96. Table 4-18 of the 1986 Radian report shows 10 samples with the last sample in the table with a 17B-2a sample ID. The "a" in the sample identification was never defined. Therefore, based on the lack of evidence that the 17B-2a was an investigative sample and the "a" identifier may have represented the field duplicate, this data was not included in Table D-15. Based on Table 4-18 of the Radian report and Radian report text, the field duplicate may have been included as the 10th sample.

(2) Also reported in The Woodward-Clyde Remedial Investigation Report for 18 SWMUs, 8 borings were advanced in November and December 1986. The revised Table D-15 indicates that samples B8-0.5 through B8-50 were collected on December 10, 2009. I believe that should be December 10, 1986.

The date December 10, 2009 has been updated to December 10, 1986 for samples B8-0.5 through B8-50 in Table D-15.

(3) I think that the data and dates for the 8 soil borings could be presented a little better. For example; samples B1-05. B1-1, B1-2, B1-5 and B1-10 were collected on November 30, 1986, then B1-20, B1-30, B1-40, B1-50, B1-60, B1-70, B1-80, B1-90 and B1-100 were sampled the next day, December 1, 1986. However, the samples B1-61 and B1-62 are placed in the table below B1-100 with unknown November 1986 dates. I strongly suspect that B1-61 and B1-62 were collected on December 1 when drilling resumed in the B1 boring to depths below 10 feet bgs. Sample sets B3-61 and B3-62, B5-61 and B5-62 and B7-61 and B7-62 and B8-61 and B8-62 are similar. I strongly doubt that the 61 and 62 ft samples were collected on days other than when the 50 ft bgs samples were collected. I think that data for the 61 ft and 62 ft increments should be shown a logical depth sequence with the 10 ft increment samples (between the 60 ft and 70 ft increments), with logical assumptions on the collection dates, and include a footnote that the exact dates are assumed, but not confirmed.

Samples collected from sample borings at depths of 61 and 62 feet have been moved to after the 50-foot sample depths in Table D-15. The footnote for the associated 61- and 62-foot samples has been amended to state *"The exact date is assumed, but not confirmed."*

(4) Can you check and see if results for B5-50 and B7-50 increments are available? They are missing, but maybe the samples weren't analyzed for some reason.

The sample results for B5-50 and B7-50 have been added to Table D-15.

(5) Results for analyses for alpha-chlordane and gamma-chlordane should be indicated in only 1 row, the 0961-0 sample collected on October 24, 1991. It is the only one analyzed for the two metabolites of chlordane. All of the other pesticide analyses were for only the parent compound, chlordane, not the two alpha and gamma metabolites.

The results for alpha-chlordane and gamma-chlrodane have been included in one row in Table D-15.

These changes have also been made to Table 10 and 11 of the CAC Proposals.

## SWMU 81

Please look at Table 7 (data for SWMU 81) in the June 2010 version of the CAC Proposals for 2,4,6,10,50, et al. The total number of surface and subsurface samples is 25. In the previous version (March 2010) Table 7 indicates 22 surface and subsurface samples. I reviewed the RFI for 21 SWMUs (October 2007) and the Remedial Investigation Report for 18 SWMUs (October 1992). The explanations of redrills and replacements for samples that weren't analyzed within the holding period are confusing. However, there are data for only 22 samples in both reports. I also found some discrepancy in the frequency of detections in Table 7 combined surface and subsurface comparisons). I don't come up with the same number of detections.

Do you have data for more than 22 samples? If so, I would like a copy of the report that has the additional data.

The correct number of surface and subsurface soil samples collected at SWMU 81 is 22. These quantities were verified based on the text in Section 5 of the 1992 Woodard-Clyde RI for 18 SWMUs Report. With the redrills due to missed holding times and elevated OVA readings it is difficult to determine the correct number of samples. Based on reading through the text and looking at Appendix D tables presented in the 1992 RI for 18 SWMUs Report we have determined that the correct number is 22. Soil borings 8101, 8103, 8104, 8105, 8108, 8109 and 8110 did not have any redrills completed and 0- to 0.5- and 4- to 6-foot samples were collected from each of these borings for a total of **14** samples. Soil boring 8106 was sampled at 0-0.5 and 4-6 feet originally. The 0- to 0.5-foot sample was unaffected but the 4-6 feet sample was recollected from a redrilled boring (8114) due to missed holding time in the original boring (8106). The VOC data from the 4-6 feet sample interval from the redrill boring (8114) was reported in place of the VOC data from the original boring (8106). This brings the total to **16** samples. Based on an elevated OVA reading from the 4- to 6-foot subsurface sample collected from boring 8102, an additional soil boring (8111) was a deeper redrill of soil boring 8102. Two additional soil samples at depths of 5 and 9 feet were collected from the deeper redrilled soil boring (8111) and analyzed for VOCs. This brings the total to **19** samples, including the 0-0.5 surface soil sample from the original boring (8102). Also due to an elevated OVA reading in the 4- to 5-foot sample in boring 8107, an additional soil boring (8112) was a deeper redrill of soil boring 8107. One additional soil sample at a depth of 5 feet was collected and analyzed for VOCs. An additional redrill soil boring (8113) of soil boring 8107 was completed due to missed holding times in the original soil boring 8107. A 4-foot sample was collected and analyzed for VOCs. The samples collected from soil boring associated with 8107 are as follows: 0- to 0.5-foot sample from the original soil boring 8107, a 9-foot sample from the deeper redrilled boring 8112 due to elevated OVA readings, and a 4-foot sample from redrilled boring 8113 due to missed hold times from the original sample (8107). This bring the grand total to **22** samples. There were some discrepancies between the Section 5 text and tables in the Woodward-Clyde RI for 18 SWMUs. I have included a table summarizing the borings and sample depths for clarity.

| Soil Boring: | Sample depth: |
|---|---|
| B101 | 0-0.5 |
| | 4-6 |
| | |
| B102 | 0-0.5 |
| B111 (redrill elevated OVA) | 4-6 |
| | 9-9.5 |
| | |
| B103 | 0-0.5 |
| | 4-6 |
| | |
| B104 | 0-0.5 |
| | 4-6 |
| | |
| B105 | 0-0.5 |
| | 4-6 |
| | |
| B106 | 0-0.5 |
| B114 (redrill due to missed holding time) | 4-6 |
| | |
| B107 | 0-0.5 |
| B112 (redrill elevated OVA) | 4-6 |
| B113 (redrill due to missed holding time) | 9-9.4 |
| | |
| B108 | 0-0.5 |
| | 4-6 |
| | |
| B109 | 0-0.5 |
| | 4-6 |
| | |
| B110 | 0-0.5 |
| | 4-6 |

Tables 6 and 7 in the 2010 CAC Proposals were amended based on the correct number of samples.

*(See attached file: Revised Tables 6,7,10 and 11 CAC Proposal June 2010.xls)*

*(See attached file: Table D-15 revised 21JUL10.xls)*

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# TABLE D-15
# SWMU 96 DATA SET TABLE
# CANNON AFB, NEW MEXICO

| SITE | | SWMU 96 | | | SWMU 96 | | | SWMU 96 | | | SWMU 96 | | | SWMU 96 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ANALYTE | | alpha Chlordane | | | gamma Chlordane | | | Chlordane | | | Dieldrin | | | 2,4-D | | |
| UNITS | | mg/kg | | | mg/kg | | | mg/kg | | | mg/kg | | | mg/kg | | |
| | Date Collected | Result | RL | Qual | Result | RL | Qual | Result | RL | Qual | Result | RL | Qual | Result | RL | Qual |
| 0961-0 | October 24, 1991 | | | | | | | 6.30E-02 | | J | < | | UJ | | | |
| 0962-10 | November 9, 1993 | < | | U | < | | U | < | | U | < | | U | < | | U |
| 0962-20 | November 9, 1993 | < | | U | < | | U | < | | U | < | | U | < | | U |
| 0962-30 | November 9, 1993 | < | | U | < | | U | < | | U | < | | U | < | | U |
| 0962-40 | November 9, 1993 | < | | U | < | | U | < | | U | < | | U | < | | U |
| 0962-50 | November 9, 1993 | < | | U | < | | U | < | | U | < | | U | < | | U |
| 0962-60 | November 9, 1993 | < | | U | < | | U | < | | U | < | | U | < | | U |
| 0962-70 | November 9, 1993 | < | | U | < | | U | < | | U | < | | U | < | | U |
| 0962-80 | November 9, 1993 | < | | U | < | | U | < | | U | < | | U | < | | U |
| 0962-90 | November 9, 1993 | < | | U | < | | U | < | | U | < | | U | < | | U |
| 0962-100 | November 9, 1993 | < | | U | < | | U | < | | U | < | | U | < | | U |
| 096K ** | November 13, 1991 | < | | U | < | | U | < | | U | < | | U | | | |
| 17A-1-2 | November 27, 1984 | < | | U | < | | U | < | | U | 2.00E-06 | | | < | | U |
| 17A-2-5 | November 27, 1984 | < | | U | < | | U | < | | U | < | | U | 2.83E-01 | | |
| 17A-3-7.5 | November 27, 1984 | < | | U | < | | U | < | | U | < | | U | 5.90E-02 | | |
| 17A-4-62 | November 27, 1984 | < | | U | < | | U | < | | U | < | | U | 3.41E+00 | | |
| 17B-1-4 | November 28, 1984 | < | | U | < | | U | < | | U | < | | U | < | | U |
| 17B-2-9 | November 28, 1984 | < | | U | < | | U | < | | U | < | | U | < | | U |
| 17C-1-2 | January 14, 1985 | < | | U | < | | U | < | | U | < | | U | < | | U |
| 17C-2-9 | January 14, 1985 | < | | U | < | | U | < | | U | < | | U | < | | U |
| 17C-3-61 | January 14, 1985 | < | | U | < | | U | < | | U | < | | U | 4.06E-01 | | |
| B1-0.5 | November 30, 1986 | < | | U | < | | U | 7.00E-01 | | | < | | U | < | | U |
| B1-1 | November 30, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B1-2 | November 30, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B1-5 | November 30, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B1-10 | November 30, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B1-20 | December 1, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B1-30 | December 1, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B1-40 | December 1, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B1-50 | December 1, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B1-60 | December 1, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B1-61 | December 1, 1986* | < | | U | < | | U | | | | < | | U | < | | U |
| B1-62 | December 1, 1986* | < | | U | < | | U | | | | < | | U | < | | U |
| B1-70 | December 1, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B1-80 | December 1, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B1-90 | December 1, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B1-100 | December 1, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B2-0.5 | December 2, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B2-1 | December 2, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B2-2 | December 2, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B2-5 | December 2, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B2-10 | December 2, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B2-20 | December 2, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B2-30 | December 2, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B2-40 | December 3, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B2-50 | December 3, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B2-60 | December 3, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B2-70 | December 3, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B2-80 | December 3, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B2-90 | December 3, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B2-100 | December 3, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B3-0.5 | December 4, 1986 | < | | U | < | | U | 1.00E-01 | | | < | | U | < | | U |
| B3-1 | December 4, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B3-2 | December 4, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B3-5 | December 4, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B3-10 | December 4, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B3-20 | December 4, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B3-30 | December 4, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B3-40 | December 4, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B3-50 | December 4, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B3-60 | December 4, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B3-61 | December 5, 1986* | < | | U | < | | U | | | | < | | U | < | | U |
| B3-62 | December 5, 1986* | < | | U | < | | U | | | | < | | U | < | | U |
| B3-70 | December 5, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B3-80 | December 5, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B3-90 | December 5, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B3-100 | December 5, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |

# TABLE D-15
# SWMU 96 DATA SET TABLE
# CANNON AFB, NEW MEXICO

| SITE | | SWMU 96 | | | SWMU 96 | | | SWMU 96 | | | SWMU 96 | | | SWMU 96 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ANALYTE | | alpha Chlordane | | | gamma Chlordane | | | Chlordane | | | Dieldrin | | | 2,4-D | | |
| UNITS | | mg/kg | | | mg/kg | | | mg/kg | | | mg/kg | | | mg/kg | | |
| | Date Collected | Result | RL | Qual | Result | RL | Qual | Result | RL | Qual | Result | RL | Qual | Result | RL | Qual |
| B4-0.5 | December 6, 1986 | < | | U | < | | U | 5.00E-01 | | | < | | U | < | | U |
| B4-1 | December 6, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B4-2 | December 6, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B4-5 | December 6, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B4-10 | December 6, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B4-20 | December 6, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B4-30 | December 6, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B4-40 | December 6, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B4-50 | December 6, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B4-61 | December 6, 1986* | < | | U | < | | U | | | | < | | U | < | | U |
| B4-62 | December 6, 1986* | < | | U | < | | U | | | | < | | U | < | | U |
| B5-0.5 | December 7, 1986 | < | | U | < | | U | 3.00E-01 | | | < | | U | < | | U |
| B5-1 | December 7, 1986 | < | | U | < | | U | 2.00E-01 | | | < | | U | < | | U |
| B5-2 | December 7, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B5-5 | December 7, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B5-10 | December 7, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B5-20 | December 7, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B5-30 | December 7, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B5-40 | December 7, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B5-50 | December 7, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B5-60 | December 7, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B5-61 | December 8, 1986* | < | | U | < | | U | | | | < | | U | < | | U |
| B5-62 | December 8, 1986* | < | | U | < | | U | | | | < | | U | < | | U |
| B5-70 | December 8, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B5-80 | December 8, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B5-90 | December 8, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B5-100 | December 8, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B6-0.5 | December 9, 1986 | < | | U | < | | U | 1.00E+00 | | | < | | U | < | | U |
| B6-1 | December 9, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B6-2 | December 9, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B6-5 | December 9, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B6-10 | December 9, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B6-20 | December 9, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B6-30 | December 9, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B6-40 | December 9, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B6-50 | December 9, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B6-61 | December 9, 1986* | < | | U | < | | U | | | | < | | U | < | | U |
| B6-62 | December 9, 1986* | < | | U | < | | U | | | | < | | U | < | | U |
| B7-0.5 | December 9, 1986 | < | | U | < | | U | 5.00E-01 | | | < | | U | < | | U |
| B7-1 | December 9, 1986 | < | | U | < | | U | 2.00E-01 | | | < | | U | < | | U |
| B7-2 | December 9, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B7-5 | December 9, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B7-10 | December 9, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B7-20 | December 9, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B7-30 | December 9, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B7-40 | December 9, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B7-50 | December 9, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B7-61 | December 9, 1986* | < | | U | < | | U | | | | < | | U | < | | U |
| B7-62 | December 9, 1986* | < | | U | < | | U | | | | < | | U | < | | U |
| B8-0.5 | December 10, 1986 | < | | U | < | | U | 3.00E-01 | | | < | | U | < | | U |
| B8-1 | December 10, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B8-2 | December 10, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B8-5 | December 10, 1986 | < | | U | < | | U | 2.00E-01 | | | < | | U | < | | U |
| B8-10 | December 10, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B8-20 | December 10, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B8-30 | December 10, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B8-40 | December 10, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B8-50 | December 10, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U |
| B8-61 | December 10, 1986* | < | | U | < | | U | | | | < | | U | < | | U |
| B8-62 | December 10, 1986* | < | | U | < | | U | | | | < | | U | < | | U |

Notes: *The exact date is assumed, but not confirmed.
** Results are for aqueous samples and units are in mg/L
Shading indicates samples deeper than 10 feet below ground surface that were not used for screening.
mg/kg = Milligram per kilogram
Qual = Qualifier
RL = Reporting Limit
SWMU = Solid Waste Management Unit
U = Nondetect
UJ = Estimated Nondetect

# TABLE D-15
# SWMU 96 DATA SET TABLE
# CANNON AFB, NEW MEXICO

| E | | SWMU 96 | | | SWMU 96 | | | SWMU 96 | | | SWMU 96 | | | SWMU 96 | | | SWMU 96 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ANALYTE | | 4,4-DDD | | | 4,4-DDE | | | 4,4-DDT | | | Heptachlor epoxide | | | Toxaphene | | | Arsenic | | |
| UNITS | | mg/kg | | | mg/kg | | | mg/kg | | | mg/kg | | | mg/kg | | | mg/kg | | |
| | Date Collected | Result | RL | Qual | Result | RL | Qual | Result | RL | Qual | Result | RL | Qual | Result | RL | Qual | Result | RL | Qual |
| 0961-0 | October 24, 1991 | < | | UJ | 6.60E-02 | | J | 1.10E-01 | | J | 1.90E-02 | | J | | | | | | |
| 0962-10 | November 9, 1993 | < | | U | < | | U | < | | UJ | < | | U | | | | 2.10E+00 | | |
| 0962-20 | November 9, 1993 | < | | U | < | | U | < | | UJ | < | | U | | | | 2.30E+00 | | |
| 0962-30 | November 9, 1993 | < | | U | < | | U | < | | UJ | < | | U | | | | 1.10E+00 | | |
| 0962-40 | November 9, 1993 | < | | U | < | | U | < | | UJ | < | | U | | | | 7.10E-01 | | |
| 0962-50 | November 9, 1993 | < | | U | < | | U | < | | UJ | < | | U | | | | 5.40E-01 | | |
| 0962-60 | November 9, 1993 | < | | U | < | | U | < | | UJ | < | | U | | | | 4.00E-01 | | |
| 0962-70 | November 9, 1993 | < | | U | < | | U | < | | UJ | < | | U | | | | 4.90E-01 | | |
| 0962-80 | November 9, 1993 | < | | U | < | | U | < | | UJ | < | | U | | | | 6.70E-01 | | |
| 0962-90 | November 9, 1993 | < | | U | < | | U | < | | UJ | < | | U | | | | 8.60E-01 | | |
| 0962-100 | November 9, 1993 | < | | U | < | | U | < | | UJ | < | | U | | | | 8.50E-01 | | |
| 096K ** | November 13, 1991 | < | | U | < | | U | < | | U | < | | U | | | | 4.70E-03 | | J |
| 17A-1-2 | November 27, 1984 | < | | U | < | | U | < | | U | < | | U | 2.10E-04 | | | 4.10E+00 | | |
| 17A-2-5 | November 27, 1984 | < | | U | < | | U | < | | U | < | | U | < | | U | 2.30E+00 | | |
| 17A-3-7.5 | November 27, 1984 | < | | U | < | | U | < | | U | < | | U | < | | U | 1.40E+00 | | |
| 17A-4-62 | November 27, 1984 | < | | U | < | | U | < | | U | < | | U | < | | U | < | | U |
| 17B-1-4 | November 28, 1984 | < | | U | < | | U | < | | U | < | | U | < | | U | 1.80E+00 | | |
| 17B-2-9 | November 28, 1984 | < | | U | < | | U | < | | U | < | | U | < | | U | 5.60E+00 | | |
| 17C-1-2 | January 14, 1985 | < | | UJ | < | | UJ | < | | UJ | < | | U | < | | U | 1.60E+00 | | |
| 17C-2-9 | January 14, 1985 | < | | U | < | | U | < | | UJ | < | | U | < | | U | 1.20E+00 | | |
| 17C-3-61 | January 14, 1985 | < | | U | < | | U | < | | UJ | < | | U | < | | U | 2.00E+00 | | |
| B1-0.5 | November 30, 1986 | 3.00E-01 | | | 2.60E+00 | | | 9.00E-01 | | | < | | U | < | | U | | | |
| B1-1 | November 30, 1986 | < | | U | 1.00E-01 | | | < | | U | < | | U | < | | U | | | |
| B1-2 | November 30, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B1-5 | November 30, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B1-10 | November 30, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B1-20 | December 1, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B1-30 | December 1, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B1-40 | December 1, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B1-50 | December 1, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B1-60 | December 1, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B1-61 | December 1, 1986* | < | | U | < | | U | | | | | | | < | | U | | | |
| 52 | December 1, 1986* | < | | U | < | | U | | | | | | | < | | U | | | |
| 70 | December 1, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B1-80 | December 1, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B1-90 | December 1, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B1-100 | December 1, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B2-0.5 | December 2, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B2-1 | December 2, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B2-2 | December 2, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B2-5 | December 2, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B2-10 | December 2, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B2-20 | December 2, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B2-30 | December 2, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B2-40 | December 3, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B2-50 | December 3, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B2-60 | December 3, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B2-70 | December 3, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B2-80 | December 3, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B2-90 | December 3, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B2-100 | December 3, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B3-0.5 | December 4, 1986 | < | | U | 3.00E-01 | | | 2.00E-01 | | | < | | U | < | | U | | | |
| B3-1 | December 4, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B3-2 | December 4, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B3-5 | December 4, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B3-10 | December 4, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B3-20 | December 4, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B3-30 | December 4, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B3-40 | December 4, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B3-50 | December 4, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B3-60 | December 4, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B3-61 | December 5, 1986* | < | | U | < | | U | | | | | | | < | | U | | | |
| B3-62 | December 5, 1986* | < | | U | < | | U | | | | | | | < | | U | | | |
| B3-70 | December 5, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B3-80 | December 5, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B3-90 | December 5, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B3-100 | December 5, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |

# TABLE D-15
# SWMU 96 DATA SET TABLE
# CANNON AFB, NEW MEXICO

| SITE | | SWMU 96 | | | SWMU 96 | | | SWMU 96 | | | SWMU 96 | | | SWMU 96 | | | SWMU 96 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ANALYTE | | 4,4-DDD | | | 4,4-DDE | | | 4,4-DDT | | | Heptachlor epoxide | | | Toxaphene | | | Arsenic | | |
| UNITS | | mg/kg | | | mg/kg | | | mg/kg | | | mg/kg | | | mg/kg | | | mg/kg | | |
| | Date Collected | Result | RL | Qual | Result | RL | Qual | Result | RL | Qual | Result | RL | Qual | Result | RL | Qual | Result | RL | Qual |
| B4-0.5 | December 6, 1986 | 5.00E-01 | | | 1.50E+00 | | | 2.00E+00 | | | < | | U | < | | U | | | |
| B4-1 | December 6, 1986 | < | | U | < | | U | 1.00E-01 | | | < | | U | < | | U | | | |
| B4-2 | December 6, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B4-5 | December 6, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B4-10 | December 6, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B4-20 | December 6, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B4-30 | December 6, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B4-40 | December 6, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B4-50 | December 6, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B4-61 | December 6, 1986* | < | | U | < | | U | | | | | | | < | | U | | | |
| B4-62 | December 6, 1986* | < | | U | < | | U | | | | | | | < | | U | | | |
| B5-0.5 | December 7, 1986 | < | | U | 1.00E-01 | | | 1.00E-01 | | | < | | U | < | | U | | | |
| B5-1 | December 7, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B5-2 | December 7, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B5-5 | December 7, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B5-10 | December 7, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B5-20 | December 7, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B5-30 | December 7, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B5-40 | December 7, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B5-50 | December 7, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B5-60 | December 7, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B5-61 | December 8, 1986* | < | | U | | | | | | | | | | < | | U | | | |
| B5-62 | December 8, 1986* | < | | U | | | | | | | | | | < | | U | | | |
| B5-70 | December 8, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B5-80 | December 8, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B5-90 | December 8, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B5-100 | December 8, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B6-0.5 | December 9, 1986 | 2.00E-01 | | | 1.30E+00 | | | 8.00E-01 | | | < | | U | < | | U | | | |
| B6-1 | December 9, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B6-2 | December 9, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B6-5 | December 9, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B6-10 | December 9, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B6-20 | December 9, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B6-30 | December 9, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B6-40 | December 9, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B6-50 | December 9, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B6-61 | December 9, 1986* | < | | U | | | | | | | | | | < | | U | | | |
| B6-62 | December 9, 1986* | < | | U | | | | | | | | | | < | | U | | | |
| B7-0.5 | December 9, 1986 | < | | U | 5.00E-01 | | | 7.00E-01 | | | < | | U | < | | U | | | |
| B7-1 | December 9, 1986 | < | | U | 3.00E-01 | | | 2.00E-01 | | | < | | U | < | | U | | | |
| B7-2 | December 9, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B7-5 | December 9, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B7-10 | December 9, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B7-20 | December 9, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B7-30 | December 9, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B7-40 | December 9, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B7-50 | December 9, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B7-61 | December 9, 1986* | < | | U | | | | | | | | | | < | | U | | | |
| B7-62 | December 9, 1986* | < | | U | | | | | | | | | | < | | U | | | |
| B8-0.5 | December 10, 1986 | 4.00E-01 | | | 1.20E+00 | | | 1.60E+00 | | | < | | U | < | | U | | | |
| B8-1 | December 10, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B8-2 | December 10, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B8-5 | December 10, 1986 | 3.00E-01 | | | 9.00E-01 | | | 1.30E+00 | | | < | | U | < | | U | | | |
| B8-10 | December 10, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B8-20 | December 10, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B8-30 | December 10, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B8-40 | December 10, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B8-50 | December 10, 1986 | < | | U | < | | U | < | | U | < | | U | < | | U | | | |
| B8-61 | December 10, 1986* | < | | U | | | | | | | | | | | | | | | |
| B8-62 | December 10, 1986* | < | | U | | | | | | | | | | | | | | | |

Notes: *The exact date is assumed, but not confirmed.
** Results are for aqueous samples and units are in mg/L
Shading indicates samples deeper than 10 feet below ground surface that were not used for screening.
mg/kg = Milligram per kilogram
Qual = Qualifier
RL = Reporting Limit
SWMU = Solid Waste Management Unit
U = Nondetect
UJ = Estimated Nondetect

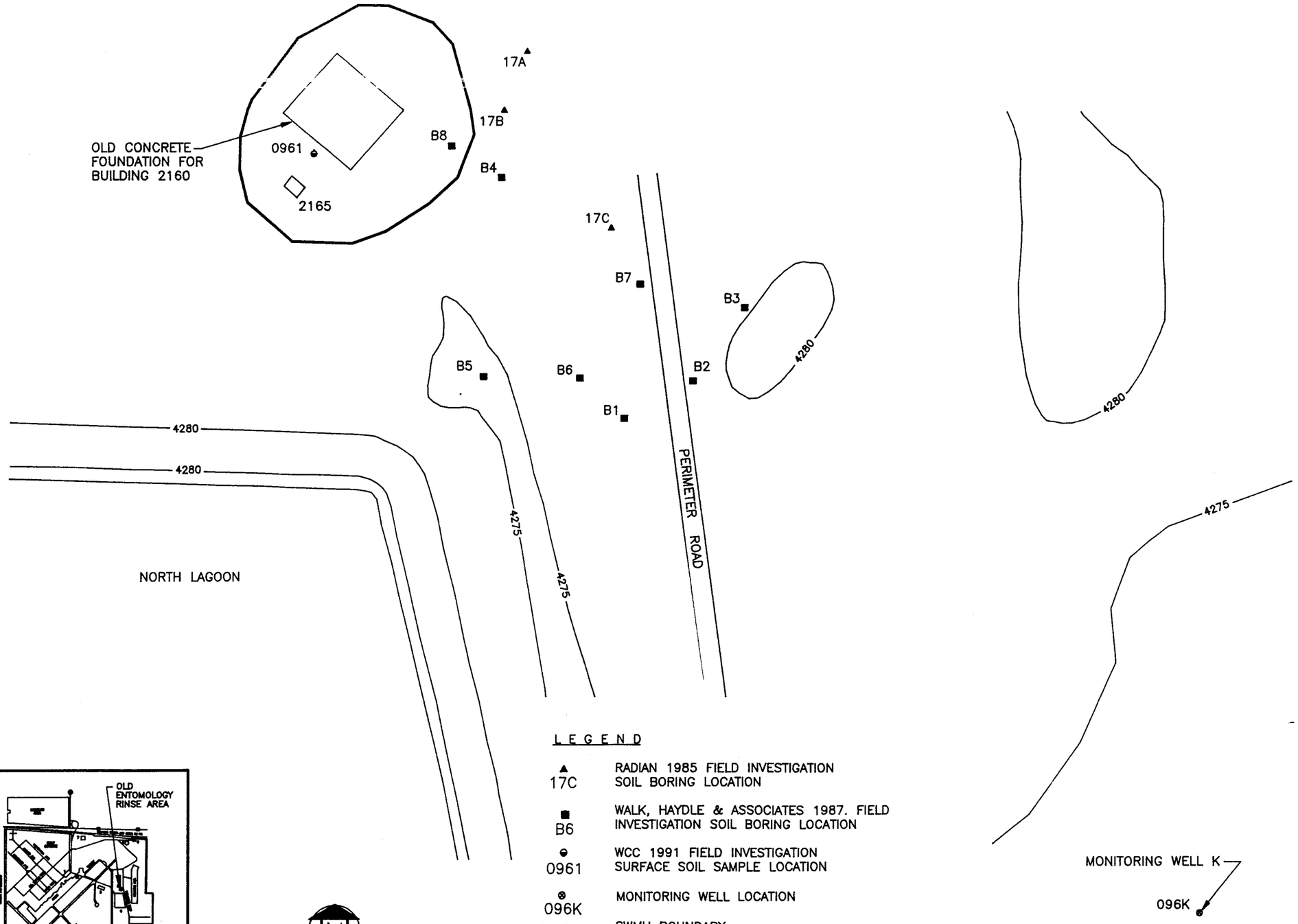
# TABLE D-15
# SWMU 96 DATA SET TABLE
# CANNON AFB, NEW MEXICO

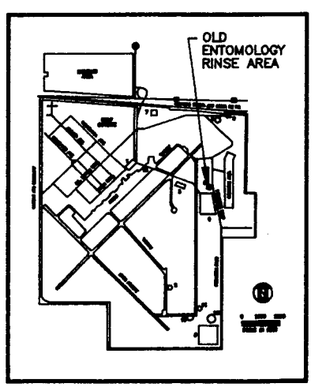
| E<br>ANALYTE<br>UNITS | | SWMU 96<br>Mercury<br>mg/kg | | | SWMU 96<br>Barium<br>mg/kg | | | SWMU 96<br>Copper<br>mg/kg | | | SWMU 96<br>Nickel<br>mg/kg | | | SWMU 96<br>Vanadium<br>mg/kg | | | SWMU 96<br>Zinc<br>mg/kg | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Date Collected | Result | RL | Qual | Result | RL | Qual | Result | RL | Qual | Result | RL | Qual | Result | RL | Qual | Result | RL | Qual |
| 0961-0 | October 24, 1991 | | | | | | | | | | | | | | | | | | |
| 0962-10 | November 9, 1993 | < | | U | 6.80E+01 | | J | 7.2E+00 | | | 6.10E+00 | | | 1.68E+01 | | | < | | U |
| 0962-20 | November 9, 1993 | < | | U | 8.91E+01 | | J | 4.5E+00 | | | 8.20E+00 | | | 2.04E+01 | | | < | | U |
| 0962-30 | November 9, 1993 | < | | U | 1.50E+01 | | J | 3.00E+00 | | | 3.40E+00 | | | 1.31E+01 | | | < | | U |
| 0962-40 | November 9, 1993 | < | | U | 2.90E+01 | | J | 1.30E+00 | | | 2.00E+00 | | | 7.00E+00 | | | < | | U |
| 0962-50 | November 9, 1993 | < | | U | 4.58E+01 | | J | 2.00E+00 | | | 2.60E+00 | | | 9.60E+00 | | | < | | U |
| 0962-60 | November 9, 1993 | < | | U | 1.12E+01 | | J | 1.30E+00 | | | 1.20E+00 | | | 6.00E+00 | | | < | | U |
| 0962-70 | November 9, 1993 | < | | U | 6.18E+01 | | J | 1.40E+00 | | | 1.60E+00 | | | 6.60E+00 | | | < | | U |
| 0962-80 | November 9, 1993 | < | | U | 1.78E+01 | | J | 1.90E+00 | | | 1.70E+00 | | | 7.80E+00 | | | < | | U |
| 0962-90 | November 9, 1993 | < | | U | 1.85E+01 | | J | 1.80E+00 | | | 1.70E+00 | | | 7.10E+00 | | | < | | U |
| 0962-100 | November 9, 1993 | < | | U | 3.26E+01 | | J | 1.80E+00 | | | 2.30E+00 | | | 8.20E+00 | | | < | | U |
| 096K ** | November 13, 1991 | < | | U | 6.60E-01 | | | 1.50E-01 | | | 2.90E-02 | | J | 3.50E-02 | | | 4.90E-02 | | |
| 17A-1-2 | November 27, 1984 | 9.00E-02 | | | | | | | | | | | | | | | | | |
| 17A-2-5 | November 27, 1984 | 1.00E-01 | | | | | | | | | | | | | | | | | |
| 17A-3-7.5 | November 27, 1984 | 1.00E-01 | | | | | | | | | | | | | | | | | |
| 17A-4-62 | November 27, 1984 | 4.00E-02 | | | | | | | | | | | | | | | | | |
| 17B-1-4 | November 28, 1984 | 8.00E-02 | | | | | | | | | | | | | | | | | |
| 17B-2-9 | November 28, 1984 | 2.40E-01 | | | | | | | | | | | | | | | | | |
| 17C-1-2 | January 14, 1985 | 7.00E-02 | | | | | | | | | | | | | | | | | |
| 17C-2-9 | January 14, 1985 | 8.00E-02 | | | | | | | | | | | | | | | | | |
| 17C-3-61 | January 14, 1985 | 1.00E-01 | | | | | | | | | | | | | | | | | |
| B1-0.5 | November 30, 1986 | | | | | | | | | | | | | | | | | | |
| B1-1 | November 30, 1986 | | | | | | | | | | | | | | | | | | |
| B1-2 | November 30, 1986 | | | | | | | | | | | | | | | | | | |
| B1-5 | November 30, 1986 | | | | | | | | | | | | | | | | | | |
| B1-10 | November 30, 1986 | | | | | | | | | | | | | | | | | | |
| B1-20 | December 1, 1986 | | | | | | | | | | | | | | | | | | |
| B1-30 | December 1, 1986 | | | | | | | | | | | | | | | | | | |
| B1-40 | December 1, 1986 | | | | | | | | | | | | | | | | | | |
| B1-50 | December 1, 1986 | | | | | | | | | | | | | | | | | | |
| B1-60 | December 1, 1986 | | | | | | | | | | | | | | | | | | |
| B1-61 | December 1, 1986* | | | | | | | | | | | | | | | | | | |
| 52 | December 1, 1986* | | | | | | | | | | | | | | | | | | |
| 70 | December 1, 1986 | | | | | | | | | | | | | | | | | | |
| B1-80 | December 1, 1986 | | | | | | | | | | | | | | | | | | |
| B1-90 | December 1, 1986 | | | | | | | | | | | | | | | | | | |
| B1-100 | December 1, 1986 | | | | | | | | | | | | | | | | | | |
| B2-0.5 | December 2, 1986 | | | | | | | | | | | | | | | | | | |
| B2-1 | December 2, 1986 | | | | | | | | | | | | | | | | | | |
| B2-2 | December 2, 1986 | | | | | | | | | | | | | | | | | | |
| B2-5 | December 2, 1986 | | | | | | | | | | | | | | | | | | |
| B2-10 | December 2, 1986 | | | | | | | | | | | | | | | | | | |
| B2-20 | December 2, 1986 | | | | | | | | | | | | | | | | | | |
| B2-30 | December 2, 1986 | | | | | | | | | | | | | | | | | | |
| B2-40 | December 3, 1986 | | | | | | | | | | | | | | | | | | |
| B2-50 | December 3, 1986 | | | | | | | | | | | | | | | | | | |
| B2-60 | December 3, 1986 | | | | | | | | | | | | | | | | | | |
| B2-70 | December 3, 1986 | | | | | | | | | | | | | | | | | | |
| B2-80 | December 3, 1986 | | | | | | | | | | | | | | | | | | |
| B2-90 | December 3, 1986 | | | | | | | | | | | | | | | | | | |
| B2-100 | December 3, 1986 | | | | | | | | | | | | | | | | | | |
| B3-0.5 | December 4, 1986 | | | | | | | | | | | | | | | | | | |
| B3-1 | December 4, 1986 | | | | | | | | | | | | | | | | | | |
| B3-2 | December 4, 1986 | | | | | | | | | | | | | | | | | | |
| B3-5 | December 4, 1986 | | | | | | | | | | | | | | | | | | |
| B3-10 | December 4, 1986 | | | | | | | | | | | | | | | | | | |
| B3-20 | December 4, 1986 | | | | | | | | | | | | | | | | | | |
| B3-30 | December 4, 1986 | | | | | | | | | | | | | | | | | | |
| B3-40 | December 4, 1986 | | | | | | | | | | | | | | | | | | |
| B3-50 | December 4, 1986 | | | | | | | | | | | | | | | | | | |
| B3-60 | December 4, 1986 | | | | | | | | | | | | | | | | | | |
| B3-61 | December 5, 1986* | | | | | | | | | | | | | | | | | | |
| B3-62 | December 5, 1986* | | | | | | | | | | | | | | | | | | |
| B3-70 | December 5, 1986 | | | | | | | | | | | | | | | | | | |
| B3-80 | December 5, 1986 | | | | | | | | | | | | | | | | | | |
| B3-90 | December 5, 1986 | | | | | | | | | | | | | | | | | | |
| B3-100 | December 5, 1986 | | | | | | | | | | | | | | | | | | |

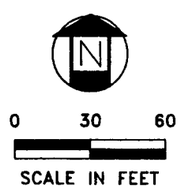
# TABLE D-15
# SWMU 96 DATA SET TABLE
# CANNON AFB, NEW MEXICO

| SITE | | SWMU 96 | | | SWMU 96 | | | SWMU 96 | | | SWMU 96 | | | SWMU 96 | | | SWMU 96 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ANALYTE | | Mercury | | | Barium | | | Copper | | | Nickel | | | Vanadium | | | Zinc | | |
| UNITS | | mg/kg | | | mg/kg | | | mg/kg | | | mg/kg | | | mg/kg | | | mg/kg | | |
| | Date Collected | Result | RL | Qual | Result | RL | Qual | Result | RL | Qual | Result | RL | Qual | Result | RL | Qual | Result | RL | Qual |
| B4-0.5 | December 6, 1986 | | | | | | | | | | | | | | | | | | |
| B4-1 | December 6, 1986 | | | | | | | | | | | | | | | | | | |
| B4-2 | December 6, 1986 | | | | | | | | | | | | | | | | | | |
| B4-5 | December 6, 1986 | | | | | | | | | | | | | | | | | | |
| B4-10 | December 6, 1986 | | | | | | | | | | | | | | | | | | |
| B4-20 | December 6, 1986 | | | | | | | | | | | | | | | | | | |
| B4-30 | December 6, 1986 | | | | | | | | | | | | | | | | | | |
| B4-40 | December 6, 1986 | | | | | | | | | | | | | | | | | | |
| B4-50 | December 6, 1986 | | | | | | | | | | | | | | | | | | |
| B4-61 | December 6, 1986* | | | | | | | | | | | | | | | | | | |
| B4-62 | December 6, 1986* | | | | | | | | | | | | | | | | | | |
| B5-0.5 | December 7, 1986 | | | | | | | | | | | | | | | | | | |
| B5-1 | December 7, 1986 | | | | | | | | | | | | | | | | | | |
| B5-2 | December 7, 1986 | | | | | | | | | | | | | | | | | | |
| B5-5 | December 7, 1986 | | | | | | | | | | | | | | | | | | |
| B5-10 | December 7, 1986 | | | | | | | | | | | | | | | | | | |
| B5-20 | December 7, 1986 | | | | | | | | | | | | | | | | | | |
| B5-30 | December 7, 1986 | | | | | | | | | | | | | | | | | | |
| B5-40 | December 7, 1986 | | | | | | | | | | | | | | | | | | |
| B5-50 | December 7, 1986 | | | | | | | | | | | | | | | | | | |
| B5-60 | December 7, 1986 | | | | | | | | | | | | | | | | | | |
| B5-61 | December 8, 1986* | | | | | | | | | | | | | | | | | | |
| B5-62 | December 8, 1986* | | | | | | | | | | | | | | | | | | |
| B5-70 | December 8, 1986 | | | | | | | | | | | | | | | | | | |
| B5-80 | December 8, 1986 | | | | | | | | | | | | | | | | | | |
| B5-90 | December 8, 1986 | | | | | | | | | | | | | | | | | | |
| B5-100 | December 8, 1986 | | | | | | | | | | | | | | | | | | |
| B6-0.5 | December 9, 1986 | | | | | | | | | | | | | | | | | | |
| B6-1 | December 9, 1986 | | | | | | | | | | | | | | | | | | |
| B6-2 | December 9, 1986 | | | | | | | | | | | | | | | | | | |
| B6-5 | December 9, 1986 | | | | | | | | | | | | | | | | | | |
| B6-10 | December 9, 1986 | | | | | | | | | | | | | | | | | | |
| B6-20 | December 9, 1986 | | | | | | | | | | | | | | | | | | |
| B6-30 | December 9, 1986 | | | | | | | | | | | | | | | | | | |
| B6-40 | December 9, 1986 | | | | | | | | | | | | | | | | | | |
| B6-50 | December 9, 1986 | | | | | | | | | | | | | | | | | | |
| B6-61 | December 9, 1986* | | | | | | | | | | | | | | | | | | |
| B6-62 | December 9, 1986* | | | | | | | | | | | | | | | | | | |
| B7-0.5 | December 9, 1986 | | | | | | | | | | | | | | | | | | |
| B7-1 | December 9, 1986 | | | | | | | | | | | | | | | | | | |
| B7-2 | December 9, 1986 | | | | | | | | | | | | | | | | | | |
| B7-5 | December 9, 1986 | | | | | | | | | | | | | | | | | | |
| B7-10 | December 9, 1986 | | | | | | | | | | | | | | | | | | |
| B7-20 | December 9, 1986 | | | | | | | | | | | | | | | | | | |
| B7-30 | December 9, 1986 | | | | | | | | | | | | | | | | | | |
| B7-40 | December 9, 1986 | | | | | | | | | | | | | | | | | | |
| B7-50 | December 9, 1986 | | | | | | | | | | | | | | | | | | |
| B7-61 | December 9, 1986* | | | | | | | | | | | | | | | | | | |
| B7-62 | December 9, 1986* | | | | | | | | | | | | | | | | | | |
| B8-0.5 | December 10, 1986 | | | | | | | | | | | | | | | | | | |
| B8-1 | December 10, 1986 | | | | | | | | | | | | | | | | | | |
| B8-2 | December 10, 1986 | | | | | | | | | | | | | | | | | | |
| B8-5 | December 10, 1986 | | | | | | | | | | | | | | | | | | |
| B8-10 | December 10, 1986 | | | | | | | | | | | | | | | | | | |
| B8-20 | December 10, 1986 | | | | | | | | | | | | | | | | | | |
| B8-30 | December 10, 1986 | | | | | | | | | | | | | | | | | | |
| B8-40 | December 10, 1986 | | | | | | | | | | | | | | | | | | |
| B8-50 | December 10, 1986 | | | | | | | | | | | | | | | | | | |
| B8-61 | December 10, 1986* | | | | | | | | | | | | | | | | | | |
| B8-62 | December 10, 1986* | | | | | | | | | | | | | | | | | | |

Notes: *The exact date is assumed, but not confirmed.
** Results are for aqueous samples and units are in mg/L
Shading indicates samples deeper than 10 feet below ground surface that were not used for screening.
mg/kg = Milligram per kilogram
Qual = Qualifier
RL = Reporting Limit
SWMU = Solid Waste Management Unit
U = Nondetect
UJ = Estimated Nondetect



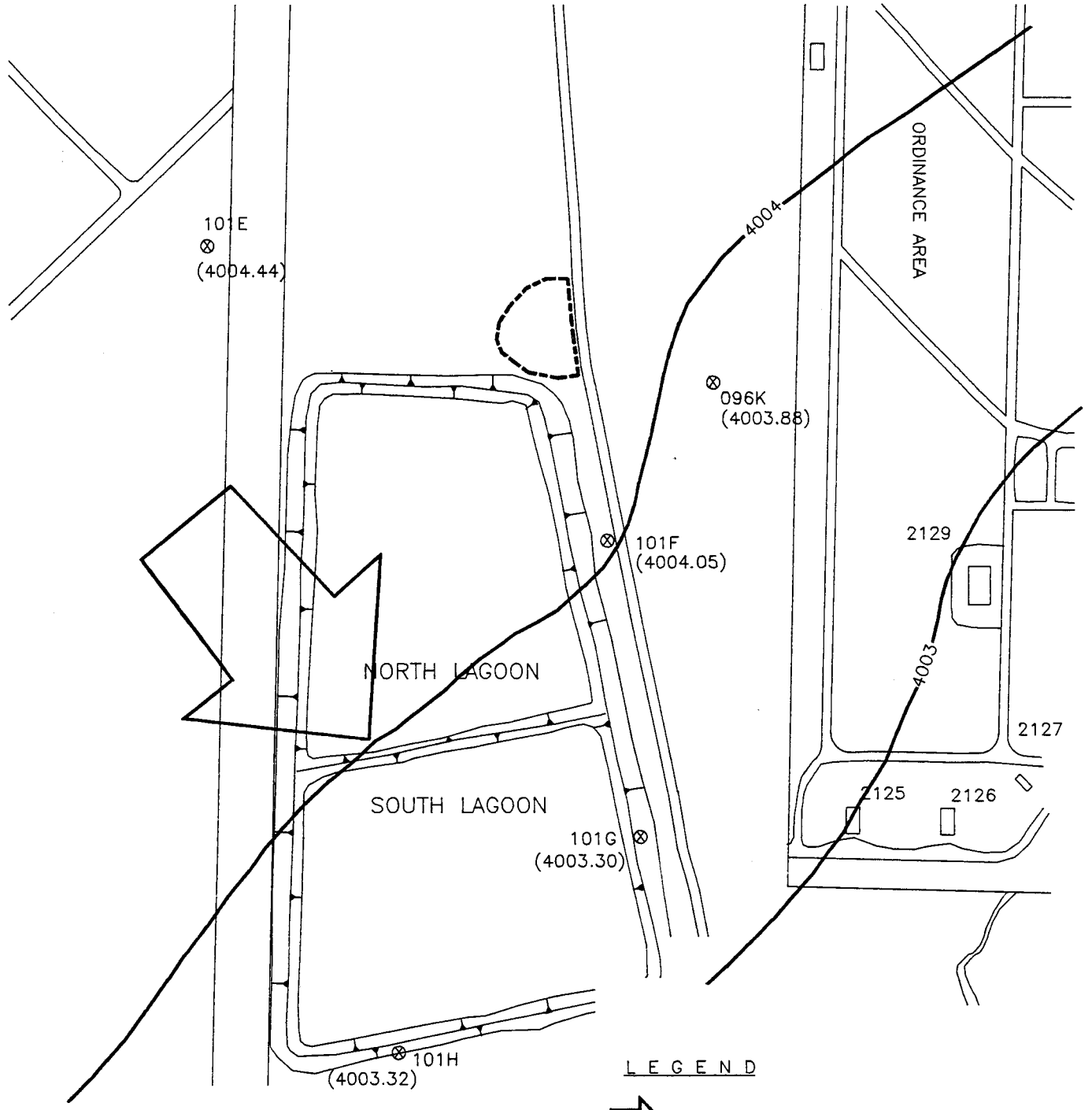

LEGEND

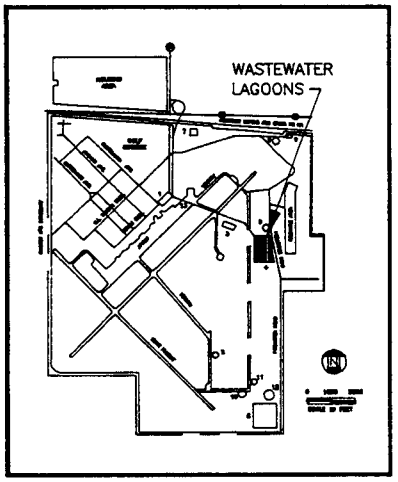
| | |
|---|---|
| ▲ 17C | RADIAN 1985 FIELD INVESTIGATION SOIL BORING LOCATION |
| ■ B6 | WALK, HAYDLE & ASSOCIATES 1987. FIELD INVESTIGATION SOIL BORING LOCATION |
| ◒ 0961 | WCC 1991 FIELD INVESTIGATION SURFACE SOIL SAMPLE LOCATION |
| ⊗ 096K | MONITORING WELL LOCATION |
| —— | SWMU BOUNDARY |
| —4280— | GROUND SURFACE CONTOUR LINE IN FEET MSL CONTOUR INTERVAL = 5 FEET |
| 2165 | BUILDING NUMBER |

| | |
|---|---|
| Job No. : 89MC114W | LOCATION OF SURFACE SOIL SAMPLES, SOIL BORINGS AND MONITORING WELL AT ENTOMOLOGY RINSE AREA SWMU NO. 96 CANNON AFB, NEW MEXICO |
| Prepared by : D.A.K. | |
| Date : 2/18/92 | |

C1140015

FIG. 8–1




N

0 200 400

SCALE IN FEET

LEGEND

GROUNDWATER FLOW DIRECTION

101G MONITORING WELL LOCATION

SWMU BOUNDARY

4003 POTENTIOMETRIC SURFACE CONTOUR LINE IN FEET MEAN SEA LEVEL

2125 BUILDING NUMBER

NOTE: THE NUMBER IS PARENTHESIS IS THE STATIC WATER LEVEL IN FEET MEAN SEA LEVEL MEASURED ON NOV. 8,1991

| | |
|---|---|
| Job No. : 89MC114W | POTENTIOMETRIC SURFACE CONTOUR MAP AT OLD ENTOMOLOGY RINSE AREA |
| Prepared by : D.A.K. | SWMU NO.96/IRP NO. SD-17 |
| Date : 2/17/92 | CANNON AFB, NEW MEXICO |

C1140019

FIG. 8-2

# 9.0
# SANITARY SEWER LINE (SWMU NO. 98)

## 9.1 SWMU DESCRIPTION

### 9.1.1 Setting

The underground sewer lines located throughout Cannon AFB are used to transport sanitary wastewater to the wastewater lagoons. The sewer lines are constructed of polyvinyl chloride (PVC) in the housing area and clay tile in the main base area, with diameters ranging from 8 inches for the PVC lines to 15 inches for the clay tile.

The sanitary sewer system consists of a northeast flowing trunk line laid along Torch Boulevard in the aircraft maintenance area, with a small south flowing branch along Torch Boulevard near the main base entrance. A secondary southeast flowing sewer line enters the main trunk line along Torch Boulevard at Argentina Avenue to enter a transmission line flowing east across the runways to the sewage treatment plant (Figure 9-1). Only the main and south branch trunk lines, and the east flowing transmission lines, could have received hazardous wastes. Secondary branch lines flowing northeast to join the main trunk line receive only domestic sewage.

### 9.1.2 History of Use

The sewage line system has been in operation since approximately 1943. The average daily flow is 0.4 million gallons per day (mgd). There has been no indication of significant line losses.

### 9.1.3 Past Investigation

No previous investigations have been conducted for the sanitary sewer lines.

### 9.1.4 Land Use and Demography

Land use along the sanitary sewer line can be divided into three use areas. The first area is where the line runs along the length of Torch Boulevard. This is characteristically the busiest area of Cannon AFB. The northern section of Torch Boulevard near the main gate is lined with supply buildings on the east side and base civil engineering buildings on the west. The main sewer trunk line flows along the northeast-southwest portion of Torch Boulevard. Athletic facilities, equipment maintenance shops, tactical fighter squadron headquarters base operations, and various other base support facilities are located along this section of Torch Boulevard.

The second use area is where the sewer line branches off the main trunk at Torch Boulevard and Argentina Avenue and flows southeast. The line flows through the aircraft maintenance area then through the flight apron and taxiway to the runway. The line then flows under the main northeast-southwest runway to the wastewater lagoons. This area southeast of the runway is the third use area and is characterized by open fields with no existing buildings or structures.

Even though the sewer line runs through a heavily populated portion of the base, people normally are not in contact with the line as it is buried between 5 and 17 feet below ground surface. On occasion when a sewer line repair is needed, 3 to 4 construction workers may come in contact with the line.

## 9.2 FIELD INVESTIGATION

This section provides a discussion of the field activities conducted by WCC at the Sanitary Sewer Line from November 8 through 26, 1991. The activities at this SWMU, as outlined in the FSP (Woodward-Clyde Consultants 1991C), consisted of video camera surveying over 8900 feet of sanitary sewer line, drilling 42 soil borings, and collecting 44 subsurface soil samples for chemical analysis and collecting 34 subsurface soil samples and 8 surface soil samples for gradation analysis.

A WCC scientist supervised the video camera surveying operations, which were conducted by Cook Construction Company of Albuquerque, New Mexico.

A summary of the sewer line segments and footages that were surveyed is presented in Table 9-1. Table 9-2 summarizes the drilling and sampling methods, along with sampling frequency conducted at each soil boring and surface soil gradation analysis sample location during the 1991 WCC investigation. A complete record of all surface soil, subsurface soil, and asssociated QA/QC samples collected at the Sanitary Sewer Line is presented in Table 9-3. Due to the size of the area under investigation, the locations of the surface samples and soil borings are shown on four separate figures (Figure 9-1 - North Torch Boulevard, Figure 9-2 - South Torch Boulevard, Figure 9-3 - Taxiway B, and Figure 9-4 - East of the Main Runway).

### 9.2.1 Sampling Objectives

The objective of conducting the video camera survey of the Sanitary Sewer Line was to identify locations where the sewer line may have leaked, potentially allowing a release of hazardous contaminants into the subsurface soil. The objective of sampling at the Sanitary Sewer Line was to evaluate the nature and extent of potential hazardous contaminants that may be present at locations identified during the video camera survey and record searches of repairs done on the line. The data collected at forty-two boring locations were used to evaluate the extent of potential contamination, if present, and to perform a baseline risk assessment to determine if the area poses a risk to human health or the environment. The data may also be utilized to evaluate remedial actions if necessary. Presently, there does not appear to be any substantial risk to the groundwater, so no hydrogeologic investigation was planned or conducted.

### 9.2.2 Video Camera Survey

A video camera survey of three major sanitary sewer trunk lines was conducted at Cannon AFB in October 1991. Two of the sewer lines surveyed were located along Torch Boulevard, from near the east lift station toward the main entrance of the Base. The third trunk line surveyed was the main sewer line on the Base into which all other sewer lines emptied. This line originated at the intersection of the two Torch Boulevard lines, passed underneath taxiway B and the main northeast-southwest runway areas, and emptied into the wastewater lagoons. The camera survey of these lines was undertaken to identify locations of current sewer line breaks and potential leaks.

Cleaning and closed circuit television (CCTV) inspection of approximately 8,500 feet of sanitary sewer line was subcontracted to Cook Construction Company (CCC). All cleaning and CCTV inspection was performed per the standards set by the National Association of Sewer Service Companies', "Recommended Specifications For Sewer Collection System Rehabilitation," Fifth Edition (pertinent sections are contained in Appendix B-4).

Cleaning the sewer lines consisted of removing foreign materials from the lines and restoring the sewer to a minimum of approximately 95 percent of the original carrying capacity. Equipment used for cleaning consisted of a Vactor 200 Series vacuum cleaning truck equipped with high-velocity jet (hydrocleaning) equipment. The hose was fitted with a high-velocity nozzle capable of producing a scouring action from 15 to 45 degrees in all sewer lines. The Vactor truck carried its own water tank, auxiliary engines, pumps, and hydraulically driven hose reel. Lines were cleaned by running the Vactor's hose up the sewer line to the next manhole and drawing the hose slowly back to the truck with the high velocity water scouring the line. The jet-stream of water from the hose pushed the debris in front of it until it reached the manhole where the truck was positioned. The Vactor then vacuumed up the pile of debris and stored it in its tanks until it was unloaded into the north wastewater lagoon.

After the line was cleaned, television inspection and videotaping of the manholes and sewer lines was accomplished using a radial view camera designed and constructed for sewer line inspection. The camera lens swivelled to allow a view of the sides and top of the pipe, in addition to the normal view of the pipe's bottom and sides. Audio comments concerning sewer line conditions were included for each sewer line segment of videotape. Table 9-1 sets forth the location of the sewer line videotaped, the particular segment of the line (manhole to manhole), the footage of the segment, the date the segment was videotaped, and the method of survey.

Videotaping was accomplished by pulling the camera through the sewer line from manhole to manhole. A hydro truck, stationed at the next manhole downstream of the TV van, pumped water through its hose to force the hose to the upstream position for attachment to the camera. The camera, connected to the TV van by means of a heavy cable, was then hooked to the hydro's hose. A varied amount of water was then allowed

to spray out from the hose as it was winched back to the downstream position, pulling the camera behind it. This stream of water reflected the lights from the camera and allowed for greater illumination of the sewer line for videotaping.

It was necessary to clean and videotape from both ends of the sewer line segment on segments of line exceeding 500 feet in length as the hoses and camera cable used by CCC were only 500 feet long. Segments from manhole #202A to manhole #203 and from manhole #203 to manhole #203A were greater than 500 feet in length and required cleaning and videotaping from both ends. In addition, because the hydro truck's hose was not long enough to reach the camera from the downstream manhole, another means of moving the camera through the sewer line had to be employed. This was accomplished through the use of a self-propelled tractor mechanism (called a transporter) that carried the camera through the sewer lines on its flat bed. The transporter was used at both ends of these long sewer line sections to carry the camera a maximum of 500 feet into the line. As the segment from manhole #202A to manhole #203 was actually 1,430 feet in length, only approximately 1,000 feet of the line was able to be videotaped, leaving approximately 430 feet under the runway that was not video surveyed.

Television inspection logs were kept by CCC that recorded the locations of sewer connections, broken pipe, roots, cracks, and other discernable features. Video tapes taken of the sewer lines supplied a visual and audio record of problem areas in the lines.

WCC was provided with videotape copies of all CCTV inspections, copies of all television inspection logs, and engineering reports from CCC summarizing all findings. WCC reviewed all videotapes, inspection logs, and engineering reports to identify exfiltration points needing further investigation.

Upon completion of the video camera survey, the tapes and field notes were reviewed to determine locations for soil borings. Several criteria, including but not restricted to the presence of radial or linear cracks below the historic water flow line, evidence of replaced sections of pipe, the presence of holes or crumbling, and the protrusion of roots, were evaluated in locating soil borings. Forty-three locations were originally proposed: borings 9801 through 9843. However, one boring, 9811, was not drilled

because of its location on one of the taxiways for the main runway. The report from Cook Construction Company is contained in Appendix B-4. The video tapes are on file at the WCC Denver, Colorado office.

The vitrified clay pipe in general appeared to be in fair condition. However, there were several joints that have separated, displaced or become misaligned, probably due to line settlement. This has allowed roots to grow into the sewer lines. At two locations, pieces of pipe were missing near the top of the sewer line. In addition, minor longitudinal and radial cracks observed at the joints could cause disintegration of the pipe in the future. The section of concrete pipe appeared to in satisfactory condition, however some joint deterioration has allowed roots to grow into the sewer line.

### 9.2.3 Surface Soil Investigation

Eight surface soil samples were collected from 0 to 0.5 feet BGS near soil borings 9801, 9802, 9806, 9808, 9815, 9816, 9831, and 9836. These samples were collected using a stainless steel hand trowel with only geotechnical gradation analysis being performed. No surface soil analytical sampling was conducted due to the fact that the source of potential contamination is the sewer line itself, which is located between 5 and 17 feet BGS.

### 9.2.4 Subsurface Soil/Vadose Zone Investigation

Forty-two soil borings were drilled to depths ranging from 8 to 29 feet BGS. The depth of each boring was determined by drilling approximately 5 feet below the estimated depth of the sewer line at that particular location. The depth of the sewer line at each boring location was estimated using the known ground surface elevations at the manhole covers at either side of the boring location, the measured depth of the sewer line inlet at those manholes, and the ground surface elevation at the boring site. The sewer line gradiant was calculated between the two manholes, and the distance to the boring was used to estimate the depth of the sewer line. Four soil borings, 9801 through 9804, were drilled along North Torch Boulevard (Figure 9-1) to depths ranging from 16 to 22.5 feet BGS. Fourteen soil borings, 9805 through 9809 and 9821 through 9829, were drilled along South Torch Boulevard (Figure 9-2) to depths ranging from 9.7 to 29 feet BGS.

Twelve soil borings, 9810, 9812 through 9820, 9830, and 9831, were drilled along Taxiway B west of the main runway to depths ranging from 11 to 17.5 feet BGS. Thirteen soil borings, 9832 through 9843, were drilled east of the main runway (Figure 9-4) to depths ranging from 8 to 14 feet BGS.

For each soil boring, sampling was continuous from the surface to the estimated depth of the sewer line using a 5-foot continuous split barrel inside the lead hollow-stem auger. Below the estimated depth of the sewer line, sampling was continuous using stainless steel split spoons for approximately 4 to 6 feet. In one boring, 9821, sampling was at 5-foot intervals below approximately 20 feet BGS. Due to physical constraints, nine soil borings had to be sampled continuously using the 5-foot continuous split barrel only with, or without, poly butyrate liners. All soil borings were lithologically described.

Subsurface samples for chemical analysis were collected below the estimated depth of the sewer at various depths depending on the OVA readings taken or visual observations made during sample collection. Samples were collected based on the presence of contamination detected with an OVA or from visual observations, or at approximately 5 feet below the estimated depth of the sewer line if no contamination was suspected. Table 9-2 gives the sampling depths for all sampling conducted in each boring. A total of forty-four subsurface soil samples (one from each boring with 2 additional from boring 9821) were collected. Thirty-four subsurface samples for geotechnical gradation analysis were collected at various depths in 34 borings. The subsurface analytical samples were collected with stainless steel split spoons, 5-foot continuous split barrels with poly butyrate liners (9802, 9817, 9818, 9819, 9820, 9830, and 9831) and 5-foot continuous split barrels without liners (9842 and 9843) and analyzed for TCL VOCs, TAL metals, and TPH.

Three soil borings, 9803, 9808, and 9817, had to be redrilled and resampled due to problems with sample collection (i.e. poly butyrate liners were not used in borings 9803 and 9817, while no sample was collected in boring 9808 because the sewer line was broken during drilling before reaching the target depth. The subsurface soil samples collected for chemical aanalysis replaced the original samples, so no additional subsurface soil analytical samples were collected.

## 9.3 PHYSICAL CHARACTERISTICS

This section provides a discussion of the soil, geology and hydrogeology at the Sanitary Sewer Line based on the detailed lithologic descriptions of split spoon samples and gradation analysis results from the 1991 WCC investigation.

### 9.3.1 Soil

The soils underlying the Sanitary Sewer Line area consist of sandy loam and loamy sand of the Amarillo Soil Group. The soils consist primarily of very fine- to fine-grained, well sorted, silty, clayey, unconsolidated medium to dark red-brown to brown-orange to orange sands. The sands are comprised predominantly of subangular to angular quartz grains. The sands are generally dry to slightly moist at depth. Eleven gradation analyses were performed on samples collected within this unit from all four areas of the SWMU. The results indicate that the soil samples from North and South Torch Boulevard and east of the main runway were comprised of approximately 41 to 62 percent sand, 18 to 29 percent silt, and 15 to 36 percent clay, while the samples from Taxiway B were comprised of approximately 32 to 37 percent sand, 30 to 39 percent silt, and 24 to 37 percent clay. The thickness of the topsoil varies along the sewer line, ranging from 4 to 8 feet thick along North Torch Boulevard, from 2 to 8 feet thick along South Torch Boulevard, from 0 to 5 feet thick along Taxiway B, and from 2 to 6 feet thick east of the main runway.

### 9.3.2 Geology

The near surface (upper 29 feet) stratigraphy at the Sanitary Sewer Line consists of Tertiary Miocene to Pliocene fluvial deposits of the Ogallala Formation. Four geologic cross-sections, E-E', F-F', G-G', and H-H' (Figures 9-5 through 9-8), were constructed using information on the lithologic boring logs from the 1991 WCC field investigation. Cross-section E-E', located along North Torch Boulevard, runs north-south, while cross-section F-F', located along South Torch Boulevard, runs northwest-southeast. Both cross-sections G-G', located along Taxiway B, and H-H', located east of the main runway, run west-east. The locations of these cross-sections are shown on Figures 9-1 through 9-4, respectively. Stratigraphic correlations of the various fluvial deposits

between borings is based primarily on the split spoon lithologic samples collected during drilling.

The SWMU is underlain by Ogallala fluvial deposits consisting primarily of well to moderately sorted sand, with scattered thin to moderately thick (2 to 14 feet thick) layers of caliche. The total thickness of these Ogallala deposits beneath the SWMU is not presently known, but based on regional information, may be as thick as 390 feet.

It would appear from the geologic cross-sections and the lithologic descriptions (Appendix B-1) that only one distinct sand, sand/caliche unit is present beneath the SWMU to a depth of 29 feet. This unit appears to be fairly homogeneous lithologically throughout the investigation area.

The fluvial deposits shown on geologic cross-section E-E' from 4285 to 4303 feet MSL, geologic cross-section F-F' from 4271 to 4298 feet MSL, geologic cross-section G-G' from 4272 to 4294 feet MSL, and geologic cross-section H-H' from 4269 to 4292 feet MSL consist of fine- to very fine-grained, well sorted, silty, calcareous, medium to pale orange and pale brown to medium red-brown sands. These sands are comprised predominantly of subangular to angular quartz grains with varying amounts of silt and calcium carbonate. Occasionally these sands are moderately to well cemented with calcium carbonate. Thin to moderately thick layers (ranging from a few inches to several feet in thickness) and small pockets or nodules of tan-orange to pale orange, silty, sandy, clayey caliche are scattered throughout this unit. These caliche layers appeared to thicken in the area of borings 9827 and 9828 along South Torch Boulevard (Figure 9-6) and in most of the borings all along Taxiway B (Figure 9-7). Chert nodules or silica replaced caliche was found in a few borings along Taxiway B, and North and South Torch Boulevard. Thirty-two gradation analyses were performed on samples collected within this unit, eight from the caliche and twenty-four from the sands. The results indicate that the caliche samples were comprised of approximately 36 to 51 percent calcium carbonate and/or clay-sized material, 28 to 35 percent sand, and 19 to 29 percent silt, while the sand samples were comprised of approximately 35 to 74 percent sand, 18 to 31 percent silt, and 11 to 38 percent calcium carbonate and/or clay-sized material. The thickness of this unit is unknown at present due to the fact that the unit was not fully penetrated, but is at least 22 feet thick at this SWMU. Approximately 2

to 8 feet of native topsoil exists above this unit. No groundwater was encountered during the drilling of these borings, however, at five soil boring locations (9819, 9820, 9821, 9830, and 9833), the soils appeared to be moist to very moist at depths below the estimated sewer line depths.

## 9.4 NATURE AND EXTENT OF CONTAMINATION

Forty-two soil borings, 9801 through 9810 and 9812 through 9843, were drilled, and subsurface samples were collected approximately 5 feet from below the estimated depth of the sewer line (Figures 9-1, 9-2, 9-3, and 9-4). Evaluation of the chemical analyses (TCL VOCs, TAL metals, TPH) of the samples provides the basis for characterizing the nature and extent of contamination resulting from potential leakage of the sewer line.

None of the target analyte list of volatile organic compounds except acetone, were detected above the CRQL in samples for SWMU No. 98. Acetone was detected in borings 9808 at 8 feet bgs (230 $\mu$g/kg); 9817 at 8 feet bgs (33 $\mu$g/kg); 9821 at 9, 17, and 23 feet bgs (7800, 2200, and 200 $\mu$g/kg, respectively); 9831 at 7 feet bgs (78 $\mu$g/kg); and 9837 at 11 feet bgs (94 $\mu$g/kg). The concentration of detectable acetone is low except in boring 9821, which had acetone present between 9-23 feet bgs. In addition, two of the samples from boring 9821 (9 and 17 feet bgs) had raised reporting limits because of the sample dilution necessary due to the presence of acetone. Aside from the samples at boring 9821, the occurrence of acetone is considered to be due to laboratory contamination. The acetone found at boring 9821 may indicate past leakage from a crack in the sewer line at this location.

Total petroleum hydrocarbons were encountered in only one boring, 9835, at a depth of 10 feet at a concentration of 338 mg/kg. TPH was not detected above the reporting limit in any of the other borings.

Boring 9803 indicated the presence of cadmium and lead at low concentrations of 1.3 and 8.9 mg/kg, respectively, at a depth of 12 feet. Boring 9826 indicated the presence of cadmium at a concentration of 1.1 mg/kg at 15 feet bgs. Boring 9830 indicated the presence of cadmium and cyanide at concentrations of 1.3 and 2.6 mg/kg, respectively, at a depth of 6 feet. The above discussed metal concentrations are not of concern at this

SWMU since they are only slightly above site background and are near or below levels found in soils of this region (Table 7-2). Except for the above discussed borings, no other metals were detected exceeding background levels in any of the other soil borings.

In summary, acetone was the only volatile organic detected above the CRQL at this SWMU. In all borings except 9821, the presence of acetone is considered to be due to laboratory contamination. Acetone may be present in the soils at boring 9821, which may indicate past leakage of the sewer at this point. The results of the risk assessment will be critical in establishing whether additional investigation is warranted in the vicinity of boring 9821. TPH above 100 mg/kg was discovered in only one boring, 9835. At two borings, 9803 and 9826, cadmium and lead were detected at concentrations slightly above site background; however, they are not metals of concern at this SWMU.

# TABLE 9-1

## SUMMARY OF VIDEO CAMERA SURVEY OF SANITARY SEWER LINES SWMU NO. 98, CANNON AFB, NEW MEXICO

| Sewer Line Location | Sewer Line Segment | Footage Taped | Date(s) Surveyed | Method of Survey |
|---|---|---|---|---|
| North Torch Blvd. | MH #192 to MH #195 | 539 | 10-16-91 | CCTV |
| North Torch Blvd. | MH #195 to MH #196 | 263 | 10-17-91 | CCTV |
| North Torch Blvd. | MH #196 to MH #197 | 401 | 10-17-91 | CCTV |
| North Torch Blvd. | MH #197 to MH #198 | 397 | 10-17-91 | CCTV |
| North Torch Blvd. | MH #198 to MH #198A | 147 | 10-18-91 | CCTV |
| North Torch Blvd. | MH #198A to MH #199 | 142.8 | 10-18-91 | CCTV |
| South Torch Blvd. | MH #113A to MH #113 | 61.8 | 10-19-91 | CCTV |
| South Torch Blvd. | MH #113A to MH #118 | 331 | 10-19-91 | CCTV |
| South Torch Blvd. | MH #118 to MH #121 | 243 | 10-19-91 | CCTV |
| South Torch Blvd. | MH #121 to MH #122 | 178 | 10-19-91 | CCTV |
| South Torch Blvd. | MH #122 to MH #138 | 204 | 10-22-91 | CCTV |
| South Torch Blvd. | MH #138 to MH #139 | 266 | 10-22-91 | CCTV |
| South Torch Blvd. | MH #139 to MH #148 | 372 | 10-22-91 | CCTV |
| South Torch Blvd. | MH #148 to MH #156 | 410 | 10-22-91 | CCTV |
| South Torch Blvd. | MH #156 to MH #159 | 383.8 | 10-24-91 | CCTV |
| South Torch Blvd. | MH #159 to MH #199 | 332 | 10-24-91 | CCTV |
| West of Taxiway A | MH #199 to MH #200 | 215.4 | 10-18-91 | CCTV |
| West of Taxiway A | MH #200 to MH #200A | 86 | 10-18-91 | CCTV |
| West of Taxiway A to red-line security area | MH #200A to MH #201 | 292 | 10-20-91 | CCTV |
| Red-line security area to Taxiway A | MH #201 to MH #202 | 596 | 10-20-91 | CCTV |
| Taxiway A to west of Runway | MH #202 to MH #202A | 396 | 10-20-91 | CCTV |
| West of Runway to east of (under) Runway | MH #202A to MH #203 | 994.4 (actual distance of 1430 feet) | 10-27-91 | CCTV with tractor |
| East of Runway to Lagoons | MH #203 to MH #203A | 715 | 10-27-91 | CCTV with tractor |
| East of Runway to Lagoons | MH #203A to MH #204 | 503 | 10-25-91 | CCTV |
| East of Runway to Lagoons | MH #204 to MH #205 | 457 | 10-26-91 | CCTV |

MH = Manhole CCTV = Closed Circuit Television inspection

TABLE 9-2

SUMMARY OF SURFACE SOIL SAMPLING, BOREHOLE DRILLING, AND BOREHOLE SAMPLING CONDUCTED BY WCC AT SANITARY SEWER LINE, SWMU NO. 98 , CANNON AFB, NEW MEXICO

| BORING NUMBER | DRILLING/ SAMPLING METHOD | DRILL RIG USED | BOREHOLE DIAMETER (In) | DRILLING/ SAMPLING DEPTH INTERVALS (Ft-BGS) | BOREHOLE SAMPLING FREQUENCY | DATE(S) DRILLED/ SAMPLED | NUMBER OF ANALYTICAL SOIL SAMPLES COLLECTED | NUMBER OF ANALYTICAL QA/QC SAMPLES COLLECTED | NUMBER OF SPT SOIL SAMPLES COLLECTED | NUMBER OF GRADATION ANALYSIS SAMPLES COLLECTED | GROUND ELEVATION (Ft-MSL) | TOTAL DEPTH OF BOREHOLE (Ft-BGS) | DATE BOREHOLE GROUTED |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9801 | HT | NA | NA | 0 to 0.5 | NA | 11-18-91 | 0 | 0 | NA | 1 | 4308.12 | 22.5 | 11-19-91 |
| | HSA | B-61A | 6.5 | 0 to 22.5 | Continuous | 11-18-91 | 1 | 1 | 3 | 0 | | | |
| 9802 | HT | NA | NA | 0 to 0.5 | NA | 11-19-91 | 0 | 0 | NA | 1 | 4307.26 | 22 | 11-19-91 |
| | HSA | B-61A | 6.5 | 0 to 22 | Continuous | 11-19-91 | 1 | 0 | 0 | 0 | | | |
| 9803 | HSA | B-61A | 6.5 | 0 to 15 | Continuous | 11-08-91 | 0 | 0 | 0 | 0 | | | 11-08-91 |
| (9803)* | HSA | B-61A | 6.5 | 0 to 10 | NS | 11-23-91 | NS | NS | NS | NS | 4303.44 | 14 | 11-23-91 |
| | | | | 10 to 14 | Continuous | 11-23-91 | 1 | 2 | 2 | 1 | | | |
| 9804 | HSA | B-61A | 6.25 | 0 to 5 | NS | 11-23-91 | NS | NS | NS | NS | 4301.93 | 16 | 11-23-91 |
| | | | | 5 to 10 | Continuous | 11-23-91 | 0 | 0 | 0 | 1 | | | |
| | | | | 10 to 12 | NS | 11-23-91 | NS | NS | NS | NS | | | |
| | | | | 12 to 16 | Continuous | 11-23-91 | 1 | 0 | 2 | 0 | | | |
| 9805 | HSA | B-61A | 6.25 | 0 to 13 | Continuous | 11-13-91 | 1 | 2 | 3 | 1 | 4298.52 | 13 | 11-13-91 |
| 9806 | HT | NA | NA | 0 to 0.5 | NA | 11-12-91 | 0 | 0 | NA | 1 | 4299.04 | 18 | 11-13-91 |
| | HSA | B-61A | 6.5 | 0 to 8 | NS | 11-12-91 | NS | NS | NS | NS | | | |
| | | | | 8 to 10 | Continuous | 11-12-91 | 0 | 0 | 0 | 0 | | | |
| | | | | 10 to 13 | NS | 11-12-91 | NS | NS | NS | NS | | | |
| | | | | 13 to 18 | Continuous | 11-12-91 | 1 | 0 | 3 | 0 | | | |
| 9807 | HSA | B-61A | 6.5 | 0 to 13 | Continuous | 11-13-91 | 1 | 0 | 2 | 1 | 4299.29 | 13 | 11-13-91 |
| 9808 | HSA | B-61A | 6.5 | 0 to 10 | Continuous | 11-08-91 | 0 | 0 | 1 | 0 | | 10 | 11-08-91 |
| (9808)* | HT | NA | NA | 0 to 0.5 | NA | 11-26-91 | 0 | 0 | NA | 1 | 4300.06 | 9.7 | 11-13-91 |
| | HSA | B-61A | 6.5 | 0 to 8 | NS | 11-12-91 | NS | NS | NS | NS | | | |
| | | | | 8 to 9.7 | Continuous | 11-12-91 | 1 | 0 | 1 | 0 | | | |
| 9809 | HSA | B-61A | 6.5 | 0 to 16 | Continuous | 11-13-91 | 1 | 0 | 3 | 1 | 4300.40 | 16 | 11-13-91 |
| 9810 | HSA | B-61A | 6.5 | 0 to 3 | NS | 11-25-91 | NS | NS | NS | NS | 4297.55 | 17 | 11-25-91 |
| | | | | 3 to 17 | Continuous | 11-25-91 | 1 | 0 | 2 | 1 | | | |
| 9812 | HSA | B-61A | 6.5 | 0 to 15 | Continuous | 11-09-91 | 1 | 1 | 3 | 1 | 4292.03 | 15 | 11-14-91 |
| 9813 | HSA | B-61A | 6.5 | 0 to 10 | 5' Intervals | 11-10-91 | 0 | 0 | 0 | 0 | 4290.41 | 15 | 11-14-91 |

TABLE 9-2

SUMMARY OF SURFACE SOIL SAMPLING, BOREHOLE DRILLING, AND BOREHOLE SAMPLING CONDUCTED BY WCC AT SANITARY SEWER LINE, SWMU NO. 98 , CANNON AFB, NEW MEXICO

| BORING NUMBER | DRILLING/ SAMPLING METHOD | DRILL RIG USED | BOREHOLE DIAMETER (In) | DRILLING/ SAMPLING DEPTH INTERVALS (Ft-BGS) | BOREHOLE SAMPLING FREQUENCY | DATE(S) DRILLED/ SAMPLED | NUMBER OF ANALYTICAL SOIL SAMPLES COLLECTED | NUMBER OF ANALYTICAL QA/QC SAMPLES COLLECTED | NUMBER OF SPT SOIL SAMPLES COLLECTED | NUMBER OF GRADATION ANALYSIS SAMPLES COLLECTED | GROUND ELEVATION (Ft-MSL) | TOTAL DEPTH OF BOREHOLE (Ft-BGS) | DATE BOREHOLE GROUTED |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9813 | HSA | B-61A | 6.5 | 10 to 15 | Continuous | 11-10-91 | 1 | 1 | 4 | 1 | | | |
| 9814 | HSA | B-61A | 6.5 | 0 to 4 | Continuous | 11-10-91 | 0 | 0 | 0 | 0 | 4289.77 | 15.5 | 11-14-91 |
| | | | | 4 to 10.5 | NS | 11-10-91 | NS | NS | NS | NS | | | |
| | | | | 10.5 to 11.5 | Continuous | 11-10-91 | 0 | 0 | 1 | 0 | | | |
| | | | | 11.5 to 13.5 | NS | 11-10-91 | NS | NS | NS | NS | | | |
| | | | | 13.5 to 15.5 | Continuous | 11-10-91 | 1 | 0 | 1 | 1 | | | |
| 9815 | HT | NA | NA | 0 to 0.5 | NA | 11-26-91 | 0 | 0 | NA | 1 | 4288.35 | 10 | 11-14-91 |
| | HSA | B-61A | 6.5 | 0 to 10 | Continuous | 11-10-91 | 1 | 1 | 3 | 0 | | | |
| 9816 | HT | NA | NA | 0 to 0.5 | NA | 11-26-91 | 0 | 0 | NA | 1 | 4288.20 | 11 | 11-14-91 |
| | HSA | B-61A | 6.5 | 0 to 11 | Continuous | 11-10-91 | 1 | 0 | 3 | 0 | | | |
| 9817 | HSA | B-61A | 6.5 | 0 to 14 | Continuous | 11-11-91 | 0 | 0 | 0 | 0 | | | 11-14-91 |
| (9817)* | HSA | B-61A | 6.5 | 0 to 9 | NS | 11-21-91 | NS | NS | NS | NS | 4288.56 | 14 | 11-22-91 |
| | | | | 9 to 14 | Continuous | 11-21-91 | 1 | 1 | 0 | 1 | | | |
| 9818 | HSA | B-61A | 6.5 | 0 to 3.5 | Continuous | 11-21-91 | 0 | 0 | 0 | 0 | 4289.54 | 14.5 | 11-22-91 |
| | | | | 3.5 to 5 | NS | 11-21-91 | NS | NS | NS | NS | | | |
| | | | | 5 to 9 | Continuous | 11-21-91 | 0 | 0 | 0 | 0 | | | |
| | | | | 9 to 11.5 | NS | 11-21-91 | NS | NS | NS | NS | | | |
| | | | | 11.5 to 14.5 | Continuous | 11-21-91 | 1 | 1 | 0 | 1 | | | |
| 9819 | HSA | B-61A | 6.5 | 0 to 17.5 | Continuous | 11-22-91 | 1 | 0 | 0 | 1 | 4289.73 | 17.5 | 11-22-91 |
| 9820 | HSA | B-61A | 6.5 | 0 to 11 | Continuous | 11-22-91 | 1 | 1 | 0 | 1 | 4289.67 | 11 | 11-22-91 |
| 9821 | HSA | B-61A | 6.5 | 0 to 5 | NS | 11-20-91 | NS | NS | NS | NS | 4300.53 | 29 | 11-21-91 |
| | | | | 5 to 19 | Continuous | 11-20-91 to 11-21-91 | 2 | 2 | 5 | 1 | | | |
| | | | | 19 to 29 | 5' Intervals | 11-21-91 | 1 | 0 | 3 | 0 | | | |
| 9822 | HSA | B-61B | 7.5 | 0 to 16 | Continuous | 11-22-91 | 1 | 0 | 3 | 1 | 4300.80 | 16 | 11-22-91 |
| 9823 | HSA | B-61B | 7.5 | 0 to 16 | Continuous | 11-21-91 | 1 | 1 | 3 | 1 | 4301.43 | 16 | 11-21-91 |
| 9824 | HSA | B-61B | 7.5 | 0 to 16 | Continuous | 11-22-91 | 1 | 1 | 3 | 1 | 4302.60 | 16 | 11-22-91 |

TABLE 9-2

SUMMARY OF SURFACE SOIL SAMPLING, BOREHOLE DRILLING, AND BOREHOLE SAMPLING CONDUCTED BY WCC AT SANITARY SEWER LINE, SWMU NO. 98 , CANNON AFB, NEW MEXICO

| BORING NUMBER | DRILLING/ SAMPLING METHOD | DRILL RIG USED | BOREHOLE DIAMETER (In) | DRILLING/ SAMPLING DEPTH INTERVALS (Ft-BGS) | BOREHOLE SAMPLING FREQUENCY | DATE(S) DRILLED/ SAMPLED | NUMBER OF ANALYTICAL SOIL SAMPLES COLLECTED | NUMBER OF ANALYTICAL QA/QC SAMPLES COLLECTED | NUMBER OF SPT SOIL SAMPLES COLLECTED | NUMBER OF GRADATION ANALYSIS SAMPLES COLLECTED | GROUND ELEVATION (Ft-MSL) | TOTAL DEPTH OF BOREHOLE (Ft-BGS) | DATE BOREHOLE GROUTED |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9825 | HSA | B-61B | 7.5 | 0 to 16 | Continuous | 11-22-91 | 1 | 1 | 3 | 1 | 4302.61 | 16 | 11-22-91 |
| 9826 | HSA | B-61A | 6.5 | 0 to 3 | NS | 11-26-91 | NS | NS | NS | NS | 4302.59 | 17 | 11-26-91 |
| | | | | 3 to 17 | Continuous | 11-26-91 | 1 | 1 | 2 | 1 | | | |
| 9827 | HSA | B-61A | 6.5 | 0 to 1.5 | NS | 11-21-91 | NS | NS | NS | NS | 4302.87 | 19 | 11-20-91 |
| | | | | 1.5 to 19 | Continuous | 11-21-91 | 1 | 1 | 4 | 1 | | | |
| 9828 | HSA | B-61A | 6.5 | 0 to 18 | Continuous | 11-20-91 | 1 | 0 | 2 | 1 | 4302.79 | 18 | 11-20-91 |
| 9829 | HSA | B-61A | 6.5 | 0 to 18 | Continuous | 11-19-91 | 1 | 0 | 2 | 1 | 4302.26 | 18 | 11-20-91 |
| 9830 | HSA | B-61A | 6.5 | 0 to 11 | Continuous | 11-22-91 | 1 | 0 | 0 | 1 | 4290.71 | 11 | 11-23-91 |
| 9831 | HT | NA | NA | 0 to 0.5 | NA | 11-22-91 | 0 | 0 | 0 | 1 | 4289.79 | 12 | 11-23-91 |
| | HSA | B-61A | 6.5 | 0 to 4 | Continuous | 11-22-91 | 0 | 0 | 0 | 0 | | | |
| | | | | 4 to 5 | NS | 11-22-91 | NS | NS | NS | NS | | | |
| | | | | 5 to 12 | Continuous | 11-22-91 | 1 | 0 | 0 | 0 | | | |
| 9832 | HSA | B-61B | 7.5 | 0 to 14 | Continuous | 11-21-91 | 1 | 2 | 3 | 1 | 4287.34 | 14 | 11-21-91 |
| 9833 | HSA | B-61B | 7.5 | 0 to 12 | Continuous | 11-20-91 | 1 | 1 | 2 | 1 | 4284.92 | 12 | 11-21-91 |
| 9834 | HSA | B-61B | 7.5 | 0 to 12 | Continuous | 11-20-91 | 1 | 0 | 2 | 1 | 4283.97 | 12 | 11-21-91 |
| 9835 | HSA | B-61B | 7.5 | 0 to 12 | Continuous | 11-20-91 | 1 | 0 | 2 | 1 | 4283.95 | 12 | 11-21-91 |
| 9836 | HT | NA | NA | 0 to 0.5 | NA | 11-20-91 | 0 | 0 | 0 | 1 | 4283.37 | 12 | 11-21-91 |
| | HSA | B-61B | 7.5 | 0 to 12 | Continuous | 11-20-91 | 1 | 0 | 2 | 0 | | | |
| 9837 | HSA | B-61B | 7.5 | 0 to 13 | Continuous | 11-20-91 | 1 | 1 | 2 | 1 | 4282.47 | 13 | 11-21-91 |
| 9838 | HSA | B-61B | 7.5 | 0 to 11 | Continuous | 11-25-91 | 1 | 1 | 2 | 1 | 4284.53 | 11 | 11-26-91 |
| 9839 | HSA | B-61B | 7.5 | 0 to 11 | Continuous | 11-25-91 | 1 | 0 | 2 | 1 | 4284.08 | 11 | 11-26-91 |
| 9840 | HSA | B-61B | 7.5 | 0 to 11 | Continuous | 11-19-91 | 1 | 1 | 2 | 1 | 4281.03 | 11 | 11-21-91 |

TABLE 9-2

SUMMARY OF SURFACE SOIL SAMPLING, BOREHOLE DRILLING, AND BOREHOLE SAMPLING CONDUCTED BY WCC AT SANITARY SEWER LINE, SWMU NO. 98 , CANNON AFB, NEW MEXICO

| BORING NUMBER | DRILLING/ SAMPLING METHOD | DRILL RIG USED | BOREHOLE DIAMETER (In) | DRILLING/ SAMPLING DEPTH INTERVALS (Ft-BGS) | BOREHOLE SAMPLING FREQUENCY | DATE(S) DRILLED/ SAMPLED | NUMBER OF ANALYTICAL SOIL SAMPLES COLLECTED | NUMBER OF ANALYTICAL QA/QC SAMPLES COLLECTED | NUMBER OF SPT SOIL SAMPLES COLLECTED | NUMBER OF GRADATION ANALYSIS SAMPLES COLLECTED | GROUND ELEVATION (Ft-MSL) | TOTAL DEPTH OF BOREHOLE (Ft-BGS) | DATE BOREHOLE GROUTED |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9841 | HSA | B-61B | 7.5 | 0 to 8 | Continuous | 11-19-91 | 1 | 0 | 2 | 1 | 4281.28 | 8 | 11-21-91 |
| 9842 | HSA | B-61B | 7.5 | 0 to 8 | Continuous | 11-19-91 | 1 | 0 | 0 | 1 | 4281.35 | 8 | 11-21-91 |
| 9843 | HSA | B-61B | 7.5 | 0 to 9 | Continuous | 11-19-91 | 1 | 1 | 0 | 1 | 4281.25 | 9 | 11-21-91 |

| | | | |
|---|---|---|---|
| In | Inches | B-53 | Mobile B-53 Auger Drill Rig with 6" OD / 3.75" ID Augers and 6.5" Bullet Bit |
| Ft-BGS | Feet Below Ground Surface | B-61A | Mobile B-61 Auger Drill Rig with 6" OD / 3.75" ID Augers and 6.5" or 6.25" Bullet Bit |
| Ft-MSL | Feet Mean Sea Level | B-61B | Mobile B-61 Auger Drill Rig with 7.25" OD / 4.25" ID Augers and 7.5" Bullet Bit |
| SPT | Standard Penetration Test | F-10 | Failing F-10 Auger Drill Rig with 8.25" OD / 4.25" ID Augers and 8.5" Bullet Bit |
| HSA | Hollow Stem Auger | CME-75 | Central Mine Equipment CME-75 Auger Drill Rig with 7.75" OD / 4.25" ID Augers and 8.0" Bullet Bit |
| HT | Hand Trowel, Surface Sample | OD | Outer Diameter |
| NA | Not Applicable, Surface Sample | ID | Inner Diameter |
| NS | Not Sampled | | |

( )* The borings that are shaded and in parentheses correspond to a redrill of the previous boring due to sample collection difficulties. These borings were drilled approximately 1 to 5 away from the original boring.

TABLE 9-3

SUMMARY OF SURFACE SOIL, SUBSURFACE SOIL, AND QA/QC SAMPLES COLLECTED BY WCC AT SANITARY SEWER LINE, SWMU NO. 98 , CANNON AFB, NEW MEXICO

| BORING NUMBER | DEPTH INTERVAL (Ft-BGS) | SAMPLE IDENTIFICATION NUMBER | SAMPLE TYPE | QA/QC SAMPLES | SAMPLE MATRIX | DATE SAMPLED | TIME SAMPLED | OVA ON SAMPLE (ppm) | ANALYTICAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|---|
| 9801 | 0 to 0.5 | CAN098-9801-4000 | GA | | Soil | 11-18-91 | 1605 | 0 | |
| | 0 to 4 | CAN098-9801-4000 | L | | Soil | 11-18-91 | 1055 | | |
| | 4 to 9 | CAN098-9801-4004 | L | | Soil | 11-18-91 | 1110 | 0 | |
| | 9 to 14 | CAN098-9801-4009 | L | | Soil | 11-18-91 | 1130 | 0 | |
| | 14 to 16.5 | CAN098-9801-4014 | L | | Soil | 11-18-91 | 1145 | 0 | |
| | 16.5 to 18.5 | CAN098-9801-4016 | SPT | | Soil | 11-18-91 | 1210 | 0 | |
| | 18.5 to 20.5 | CAN098-9801-4018 | SPT | | Soil | 11-18-91 | 1240 | 0 | |
| | 20.5 to 22.5 | CAN098-9801-0020 | A/SPT | MS/MSD | Soil | 11-18-91 | 1305 | 0 | VOC,M,TPH |
| 9802 | 0 to 0.5 | CAN098-9802-4000 | GA | | Soil | 11-19-91 | 1115 | 0 | |
| | 0 to 4 | CAN098-9802-4000 | L | | Soil | 11-19-91 | 1115 | 0 | |
| | 4 to 9 | CAN098-9802-4004 | L | | Soil | 11-19-91 | 0740 | 0 | |
| | 9 to 10 | CAN098-9802-4009 | L | | Soil | 11-19-91 | 0750 | 0 | |
| | 12 to 17 | CAN098-9802-4012 | L | | Soil | 11-19-91 | 0815 | 0 | |
| | 17 to 22 | CAN098-9802-0017 | A/L | | Soil | 11-19-91 | 0850 | 0 | |
| 9803 | 1 to 5 | CAN098-9803-4001 | L | | Soil | 11-08-91 | 1315 | 0 | |
| | 5 to 10 | CAN098-9803-4005 | L | | Soil | 11-08-91 | 1330 | 0 | |
| | 10 to 15 | CAN098-9803-4010 | L | | Soil | 11-08-91 | 1355 | 0 | |
| (9803)* | 10 to 12 | CAN098-9803-4010 | SPT/GA | | Soil | 11-23-91 | 0935 | 0 | |
| | 12 to 14 | CAN098-9803-0012 | A/SPT | | Soil | 11-23-91 | 0940 | 0 | VOC,M,TPH |
| | | CAN098-9803-1302 | A | MRD | Soil | 11-23-91 | 0940 | 0 | VOC,M,TPH |
| | | CAN098-9803-1373 | A | RB | Water | 11-23-91 | 1205 | | VOC,M,TPH |
| 9804 | 5 to 6 | CAN098-9804-4005 | L | | Soil | 11-23-91 | 1005 | | |
| | 6 to 10 | CAN098-9804-4006 | L/GA | | Soil | 11-23-91 | 1330 | 0 | |
| | 12 to 14 | CAN098-9804-4012 | SPT | | Soil | 11-23-91 | 1355 | 0 | |
| | 14 to 16 | CAN098-9804-0014 | A/SPT | | Soil | 11-23-91 | 1405 | 0 | VOC,M,TPH |
| 9805 | 2 to 7 | CAN098-9805-4002 | L | | Soil | 11-13-91 | 1055 | | |
| | 7 to 9 | CAN098-9805-4007 | SPT/GA | | Soil | 11-13-91 | 1110 | 0 | |
| | 9 to 11 | CAN098-9805-4009 | SPT | | Soil | 11-13-91 | 1120 | 0 | |
| | 11 to 13 | CAN098-9805-0011 | A/SPT | | Soil | 11-13-91 | 1135 | 0 | VOC,M,TPH |
| | | CAN098-9805-1362 | A | FD | Soil | 11-13-91 | 1145 | 0 | VOC,M,TPH |
| | | CAN098-9805-1352 | A | AB | Water | 11-13-91 | 1210 | | VOC |
| 9806 | 0 to 0.5 | CAN098-9806-4000 | GA | | Soil | 11-23-91 | 1600 | | |
| | 8 to 10 | CAN098-9806-4008 | L | | Soil | 11-12-91 | 1615 | | |
| | 13 to 15 | CAN098-9806-4013 | SPT | | Soil | 11-12-91 | 1625 | 0 | |
| | 15 to 17 | CAN098-9806-4015 | SPT | | Soil | 11-12-91 | 1645 | 0 | |
| | 17 to 18 | CAN098-9806-0017 | A/SPT | | Soil | 11-12-91 | 1655 | 0 | VOC,M,TPH |
| 9807 | 0 to 4 | CAN098-9807-4000 | L | | Soil | 11-13-91 | 0815 | | |
| | 4 to 8 | CAN098-9807-4004 | L | | Soil | 11-13-91 | 0825 | 0 | |
| | 8 to 9.5 | CAN098-9807-4008 | SPT | | Soil | 11-13-91 | 0835 | 0 | |
| | 11 to 13 | CAN098-9807-0011 | A/SPT | | Soil | 11-13-91 | 0850 | 0 | VOC,M,TPH |
| | | CAN098-9807-4011 | GA | | Soil | 11-13-91 | 0850 | 0 | |
| 9808 | 0 to 4 | CAN098-9808-4000 | L | | Soil | 11-08-91 | 1005 | | |
| | 4 to 8 | CAN098-9808-4004 | L | | Soil | 11-08-91 | 1010 | | |
| | 8 to 10 | CAN098-9808-4008 | SPT | | Soil | 11-08-91 | 1020 | | |
| (9808)* | 0 to 0.5 | CAN098-9808-4000 | GA | | Soil | 11-26-91 | 1245 | | |
| | 8 to 9.7 | CAN098-9808-0008 | A/SPT | | Soil | 11-12-91 | 0850 | 60 | VOC,M,TPH |
| 9809 | 1 to 5 | CAN098-9809-4000 | L | | Soil | 11-13-91 | 1355 | | |
| | 5 to 10 | CAN098-9809-4005 | L | | Soil | 11-13-91 | 1400 | | |

TABLE 9-3

SUMMARY OF SURFACE SOIL, SUBSURFACE SOIL, AND QA/QC SAMPLES COLLECTED BY WCC AT SANITARY SEWER LINE, SWMU NO. 98 , CANNON AFB, NEW MEXICO

| BORING NUMBER | DEPTH INTERVAL (Ft-BGS) | SAMPLE IDENTIFICATION NUMBER | SAMPLE TYPE | QA/QC SAMPLES | SAMPLE MATRIX | DATE SAMPLED | TIME SAMPLED | OVA ON SAMPLE (ppm) | ANALYTICAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|---|
| 9809 | 10 to 12 | CAN098-9809-4010 | SPT/GA | | Soil | 11-13-91 | 1410 | 0 | |
| | 12 to 14 | CAN098-9809-4012 | SPT | | Soil | 11-13-91 | 1415 | 0 | |
| | 14 to 16 | CAN098-9809-0014 | A/SPT | | Soil | 11-13-91 | 1425 | 0 | VOC,M,TPH |
| 9810 | 3 to 8 | CAN098-9810-4003 | L | | Soil | 11-25-91 | 1525 | 0 | |
| | 8 to 13 | CAN098-9810-4008 | L | | Soil | 11-25-91 | 1530 | | |
| | 13 to 15 | CAN098-9810-4013 | SPT | | Soil | 11-25-91 | 1535 | 0 | |
| | 15 to 17 | CAN098-9810-0015 | A/SPT | | Soil | 11-25-91 | 1545 | 0 | VOC,M,TPH |
| | | CAN098-9810-4015 | GA | | Soil | 11-25-91 | 1545 | 0 | |
| 9812 | 0 to 5 | CAN098-9812-4000 | L | | Soil | 11-09-91 | 1320 | | |
| | 5 to 9.5 | CAN098-9812-4005 | L | | Soil | 11-09-91 | 1340 | | |
| | 10 to 12 | CAN098-9812-4010 | SPT | | Soil | 11-09-91 | 1510 | 0 | |
| | 12 to 13 | CAN098-9812-4012 | SPT | | Soil | 11-09-91 | 1535 | | |
| | 13 to 15 | CAN098-9812-0013 | A/SPT | | Soil | 11-09-91 | 1550 | 0 | VOC,M,TPH |
| | | CAN098-9812-4013 | GA | | Soil | 11-09-91 | 1550 | 0 | |
| | | CAN098-9812-1371 | A | RB | Water | 11-09-91 | 1630 | | VOC,M,TPH |
| 9813 | 0 to 2 | CAN098-9813-4000 | L | | Soil | 11-10-91 | 0820 | | |
| | 5 to 6 | CAN098-9813-4005 | L | | Soil | 11-10-91 | 0845 | | |
| | 10 to 11.7 | CAN098-9813-4010 | SPT | | Soil | 11-10-91 | 0850 | 0 | |
| | 12 to 12.5 | CAN098-9813-4012 | SPT | | Soil | 11-10-91 | 0925 | | |
| | 12.5 to 13 | CAN098-9813-4012 | SPT | | Soil | 11-10-91 | 0940 | 24 | |
| | 13 to 15 | CAN098-9813-0013 | A/SPT | | Soil | 11-10-91 | 1005 | 0 | VOC,M,TPH |
| | | CAN098-9813-4013 | GA | | Soil | 11-10-91 | 1005 | 0 | |
| | | CAN098-9813-1351 | A | AB | Water | 11-10-91 | 1105 | | VOC |
| 9814 | 0 to 4 | CAN098-9814-4000 | L | | Soil | 11-10-91 | 1145 | | |
| | 10.5 to 11.5 | CAN098-9814-4010 | SPT | | Soil | 11-10-91 | 1215 | 0 | |
| | 13.5 to 15.5 | CAN098-9814-0013 | A/SPT | | Soil | 11-10-91 | 1255 | 0 | VOC,M,TPH |
| | | CAN098-9814-4013 | GA | | Soil | 11-10-91 | 1255 | 0 | |
| 9815 | 0 to 0.5 | CAN098-9815-4000 | GA | | Soil | 11-26-91 | 1235 | | |
| | 0 to 5 | CAN098-9815-4000 | L | | Soil | 11-10-91 | 1425 | | |
| | 5 to 7 | CAN098-9815-0005 | A/SPT | | Soil | 11-10-91 | 1440 | 110 | VOC,M,TPH |
| | | CAN098-9815-1361 | A | FD | Soil | 11-10-91 | 1440 | 110 | VOC,M,TPH |
| | 7 to 9 | CAN098-9815-4007 | SPT | | Soil | 11-10-91 | 1455 | 0 | |
| | 9 to 10 | CAN098-9815-4009 | SPT | | Soil | 11-10-91 | 1515 | 0 | |
| 9816 | 0 to 0.5 | CAN098-9816-4000 | GA | | Soil | 11-26-91 | 1230 | | |
| | 0 to 5 | CAN098-9816-4000 | L | | Soil | 11-10-91 | 1550 | | |
| | 5 to 7 | CAN098-9816-0005 | A/SPT | | Soil | 11-10-91 | 1600 | 64 | VOC,M,TPH |
| | 7 to 9 | CAN098-9816-4007 | SPT | | Soil | 11-10-91 | 1615 | 0 | |
| | 9 to 11 | CAN098-9816-4009 | SPT | | Soil | 11-10-91 | 1630 | 0 | |
| 9817 | 0 to 4 | CAN098-9817-4000 | L | | Soil | 11-11-91 | 0910 | 0 | |
| | 4 to 9 | CAN098-9817-4004 | L | | Soil | 11-11-91 | 0930 | 0 | |
| | 9 to 14 | CAN098-9817-4009 | L | | Soil | 11-11-91 | 1025 | 0 | |
| (9817)* | 9 to 14 | CAN098-9817-0009 | A | | Soil | 11-21-91 | 1435 | 0 | VOC,M,TPH |
| | | CAN098-9817-4009 | GA | | Soil | 11-21-91 | 1435 | 0 | |
| | | CAN098-9817-1353 | A | AB | Water | 11-21-91 | 1500 | | VOC |
| 9818 | 0 to 3.5 | CAN098-9818-4000 | L | | Soil | 11-21-91 | 1530 | | |
| | 5 to 9 | CAN098-9818-4005 | L | | Soil | 11-21-91 | 1615 | 0 | |
| | 11.5 to 14.5 | CAN098-9818-0011 | A/L | | Soil | 11-21-91 | 1650 | 0 | VOC,M,TPH |
| | | CAN098-9818-1301 | A | MRD | Soil | 11-21-91 | 1650 | 0 | VOC,M,TPH |
| | | CAN098-9818-4011 | GA | | Soil | 11-21-91 | 1650 | 0 | |

TABLE 9-3

SUMMARY OF SURFACE SOIL, SUBSURFACE SOIL, AND QA/QC SAMPLES COLLECTED BY WCC AT SANITARY SEWER LINE, SWMU NO. 98 , CANNON AFB, NEW MEXICO

| BORING NUMBER | DEPTH INTERVAL (Ft-BGS) | SAMPLE IDENTIFICATION NUMBER | SAMPLE TYPE | QA/QC SAMPLES | SAMPLE MATRIX | DATE SAMPLED | TIME SAMPLED | OVA ON SAMPLE (ppm) | ANALYTICAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|---|
| 9819 | 0 to 4 | CAN098-9819-4000 | L | | Soil | 11-22-91 | 0955 | 0 | |
| | 4 to 9 | CAN098-9819-4004 | L | | Soil | 11-22-91 | 1015 | 0 | |
| | 9 to 12 | CAN098-9819-4009 | L | | Soil | 11-22-91 | 1030 | 0 | |
| | 12 to 14 | CAN098-9819-0012 | A/L | | Soil | 11-22-91 | 1055 | 6 | VOC,M,TPH |
| | | CAN098-9819-4012 | GA | | Soil | 11-22-91 | 1055 | 6 | |
| | 14 to 17.5 | CAN098-9819-4014 | L | | Soil | 11-22-91 | 1125 | 0 | |
| 9820 | 0 to 3.5 | CAN098-9820-4000 | L | | Soil | 11-22-91 | 1205 | | |
| | 4 to 6 | CAN098-9820-4004 | L | | Soil | 11-22-91 | 1330 | | |
| | 6 to 11 | CAN098-9820-0006 | A/L | | Soil | 11-22-91 | 1345 | 0 | VOC,M,TPH |
| | | CAN098-9820-1363 | A | FD | Soil | 11-22-91 | 1345 | 0 | VOC,M,TPH |
| | | CAN098-9820-4006 | GA | | Soil | 11-22-91 | 1345 | 0 | |
| 9821 | 5 to 9 | CAN098-9821-4005 | L/GA | | Soil | 11-20-91 | 1555 | 0 | |
| | 9 to 11 | CAN098-9821-0009 | A/SPT | MS/MSD | Soil | 11-20-91 | 1605 | 68 | VOC,M,TPH |
| | 11 to 13 | CAN098-9821-4011 | SPT | | Soil | 11-20-91 | 1615 | 54 | |
| | 13 to 15 | CAN098-9821-4013 | SPT | | Soil | 11-20-91 | 1645 | 20 | |
| | 15 to 17 | CAN098-9821-4015 | SPT | | Soil | 11-20-91 | 1700 | 20 | |
| | | CAN098-9821-1372 | A | RB | Water | 11-21-91 | 0715 | | VOC,M,TPH |
| | 17 to 19 | CAN098-9821-0017 | A/SPT | | Soil | 11-21-91 | 0815 | 12 | VOC,M,TPH |
| | 22 to 22.5 | CAN098-9821-4022 | SPT | | Soil | 11-21-91 | 0850 | | |
| | 23 to 24 | CAN098-9821-0023 | A/SPT | | Soil | 11-21-91 | 0920 | 8 | VOC,M,TPH |
| | 28 to 29 | CAN098-9821-4028 | SPT | | Soil | 11-21-91 | 1000 | 0 | |
| 9822 | 0 to 5 | CAN098-9822-4000 | L | | Soil | 11-22-91 | 1125 | 0 | |
| | 3 to 4 | CAN098-9822-4003 | GA | | Soil | 11-22-91 | 1125 | 0 | |
| | 5 to 10 | CAN098-9822-4005 | L | | Soil | 11-22-91 | 1200 | 0 | |
| | 10 to 12 | CAN098-9822-4010 | SPT | | Soil | 11-22-91 | 1210 | 0 | |
| | 12 to 14 | CAN098-9822-4012 | SPT | | Soil | 11-22-91 | 1220 | 0 | |
| | 14 to 16 | CAN098-9822-0014 | A/SPT | | Soil | 11-22-91 | 1240 | 0 | VOC,M,TPH |
| 9823 | 0 to 5 | CAN098-9823-4000 | L | | Soil | 11-21-91 | 1505 | | |
| | 5 to 10 | CAN098-9823-4005 | L | | Soil | 11-21-91 | 1510 | 0 | |
| | 10 to 12 | CAN098-9823-4010 | SPT | | Soil | 11-21-91 | 1515 | 0 | |
| | 12 to 14 | CAN098-9823-4012 | SPT/GA | | Soil | 11-21-91 | 1520 | 0 | |
| | 14 to 16 | CAN098-9823-0014 | A/SPT | MS/MSD | Soil | 11-21-91 | 1530 | 0.2 | VOC,M,TPH |
| 9824 | 0 to 5 | CAN098-9824-4000 | L | | Soil | 11-22-91 | 0755 | 0 | |
| | 5 to 10 | CAN098-9824-4005 | L | | Soil | 11-22-91 | 0805 | 0 | |
| | 7 to 8 | CAN098-9824-4007 | GA | | Soil | 11-22-91 | 0805 | 0 | |
| | 10 to 12 | CAN098-9824-4010 | SPT | | Soil | 11-22-91 | 0810 | 0 | |
| | 12 to 14 | CAN098-9824-4012 | SPT | | Soil | 11-22-91 | 0820 | 0 | |
| | 14 to 16 | CAN098-9824-0014 | A/SPT | | Soil | 11-22-91 | 0835 | 0 | VOC,M,TPH |
| | | CAN098-9824-1354 | A | AB | Water | 11-22-91 | 0850 | | VOC |
| 9825 | 0 to 5 | CAN098-9825-4000 | L | | Soil | 11-22-91 | 0935 | 0 | |
| | 5 to 10 | CAN098-9825-4005 | L | | Soil | 11-22-91 | 0940 | 0 | |
| | 10 to 12 | CAN098-9825-4010 | SPT/GA | | Soil | 11-22-91 | 0945 | 0 | |
| | 12 to 14 | CAN098-9825-4012 | SPT | | Soil | 11-22-91 | 0950 | 0 | |
| | 14 to 16 | CAN098-9825-0014 | A/SPT | | Soil | 11-22-91 | 1000 | 0.2 | VOC,M,TPH |
| | | CAN098-9825-1304 | A | MRD | Soil | 11-22-91 | 1000 | 0.2 | VOC,M,TPH |
| 9826 | 3 to 8 | CAN098-9826-4003 | L | | Soil | 11-26-91 | 0815 | 0 | |
| | 8 to 13 | CAN098-9826-4008 | L | | Soil | 11-26-91 | 0835 | 0 | |
| | 13 to 15 | CAN098-9826-4013 | SPT | | Soil | 11-26-91 | 0845 | 0 | |
| | 15 to 17 | CAN098-9826-0015 | A/SPT | | Soil | 11-26-91 | 0855 | 0 | VOC,M,TPH |
| | | CAN098-9826-4015 | GA | | Soil | 11-26-91 | 0855 | 0 | |

TABLE 9-3

SUMMARY OF SURFACE SOIL, SUBSURFACE SOIL, AND QA/QC SAMPLES COLLECTED BY WCC AT SANITARY SEWER LINE, SWMU NO. 98 , CANNON AFB, NEW MEXICO

| BORING NUMBER | DEPTH INTERVAL (Ft-BGS) | SAMPLE IDENTIFICATION NUMBER | SAMPLE TYPE | QA/QC SAMPLES | SAMPLE MATRIX | DATE SAMPLED | TIME SAMPLED | OVA ON SAMPLE (ppm) | ANALYTICAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|---|
| 9826 | 15 to 17 | CAN098-9826-1374 | A | RB | Water | 11-26-91 | 1045 | | VOC,M,TPH |
| 9827 | 1.5 to 6.5 | CAN098-9827-4001 | L | | Soil | 11-19-91 | 1335 | | |
| | 6.5 to 11.5 | CAN098-9827-4006 | L | | Soil | 11-19-91 | 1405 | 0 | |
| | 11.5 to 13 | CAN098-9827-4011 | SPT | | Soil | 11-19-91 | 1415 | 0 | |
| | 13 to 15 | CAN098-9827-4013 | SPT | | Soil | 11-19-91 | 1425 | 0 | |
| | 15 to 17 | CAN098-9827-4015 | SPT/GA | | Soil | 11-19-91 | 1445 | 0 | |
| | 17 to 19 | CAN098-9827-0017 | A/SPT | | Soil | 11-19-91 | 1500 | 0 | VOC,M,TPH |
| | | CAN098-9827-1363 | A | FD | Soil | 11-19-91 | 1510 | 0 | VOC,M,TPH |
| 9828 | 0.8 to 4.2 | CAN098-9828-4000 | L | | Soil | 11-20-91 | 0855 | | |
| | 4.2 to 9 | CAN098-9828-4004 | L | | Soil | 11-20-91 | 0910 | 0 | |
| | 9 to 14 | CAN098-9828-4009 | L | | Soil | 11-20-91 | 0915 | 0 | |
| | 14 to 16 | CAN098-9828-0014 | A/SPT | | Soil | 11-20-91 | 0920 | 2 | VOC,M,TPH |
| | 16 to 18 | CAN098-9828-4016 | SPT/GA | | Soil | 11-20-91 | 0945 | | |
| 9829 | 0.8 to 4.2 | CAN098-9829-4000 | L | | Soil | 11-19-91 | 1635 | 0 | |
| | 4.2 to 9.2 | CAN098-9829-4004 | L | | Soil | 11-19-91 | 1645 | 0 | |
| | 9.2 to 14 | CAN098-9829-4009 | L | | Soil | 11-19-91 | 1655 | 0 | |
| | 14 to 16 | CAN098-9829-4014 | SPT/GA | | Soil | 11-19-91 | 1710 | 0 | |
| | 16 to 18 | CAN098-9829-0016 | A/SPT | | Soil | 11-19-91 | 1720 | 0 | VOC,M,TPH |
| 9830 | 0 to 3.5 | CAN098-9830-4000 | L | | Soil | 11-22-91 | 1455 | | |
| | 3.5 to 6 | CAN098-9830-4003 | L | | Soil | 11-22-91 | 1510 | 0 | |
| | 6 to 11 | CAN098-9830-0006 | A/L | | Soil | 11-22-91 | 1545 | 0 | VOC,M,TPH |
| | | CAN098-9830-4006 | GA | | Soil | 11-22-91 | 1545 | 0 | |
| 9831 | 0 to 0.5 | CAN098-9831-4000 | GA | | Soil | 11-22-91 | 1615 | | |
| | 0 to 4 | CAN098-9831-4000 | L | | Soil | 11-22-91 | 1615 | | |
| | 5 to 7 | CAN098-9831-4005 | L | | Soil | 11-22-91 | 1715 | 0 | |
| | 7 to 12 | CAN098-9831-0007 | A/L | | Soil | 11-22-91 | 1730 | 0 | VOC,M,TPH |
| 9832 | 0 to 4 | CAN098-9832-4000 | L | | Soil | 11-21-91 | 0730 | 0 | |
| | 4 to 8 | CAN098-9832-4004 | L | | Soil | 11-21-91 | 0740 | 0 | |
| | 8 to 10 | CAN098-9832-4008 | SPT | | Soil | 11-21-91 | 0745 | 0 | |
| | 10 to 12 | CAN098-9832-4012 | SPT | | Soil | 11-21-91 | 0750 | 0 | |
| | 12 to 14 | CAN098-9832-0012 | A/SPT | | Soil | 11-21-91 | 0800 | 0.2 | VOC,M,TPH |
| | | CAN098-9832-4012 | GA | | Soil | 11-21-91 | 0800 | 0.2 | |
| | | CAN098-9832-1355 | A | AB | Water | 11-21-91 | 0900 | | VOC |
| | | CAN098-9832-1381 | A | DW | Water | 11-21-91 | 1000 | | VOC |
| 9833 | 0 to 4 | CAN098-9833-4000 | L | | Soil | 11-20-91 | 1555 | 0 | |
| | 4 to 8 | CAN098-9833-4004 | L | | Soil | 11-20-91 | 1610 | 0 | |
| | 6 to 7 | CAN098-9833-4006 | GA | | Soil | 11-20-91 | 1610 | 0 | |
| | 8 to 10 | CAN098-9833-4008 | SPT | | Soil | 11-20-91 | 1615 | 0 | |
| | 10 to 12 | CAN098-9833-0010 | A/SPT | | Soil | 11-20-91 | 1620 | 0 | VOC,M,TPH |
| | | CAN098-9833-1375 | A | RB | Water | 11-20-91 | 1730 | | VOC,M,TPH |
| 9834 | 0 to 4 | CAN098-9834-4000 | L | | Soil | 11-20-91 | 1430 | 0 | |
| | 4 to 8 | CAN098-9834-4004 | L | | Soil | 11-20-91 | 1435 | 0 | |
| | 8 to 10 | CAN098-9834-4008 | SPT | | Soil | 11-20-91 | 1445 | 0 | |
| | 10 to 12 | CAN098-9834-0010 | A/SPT | | Soil | 11-20-91 | 1500 | 0 | VOC,M,TPH |
| | | CAN098-9834-4010 | GA | | Soil | 11-20-91 | 1500 | 0 | |
| 9835 | 0 to 4 | CAN098-9835-4000 | L | | Soil | 11-20-91 | 1225 | 0 | |
| | 4 to 8 | CAN098-9835-4004 | L | | Soil | 11-20-91 | 1235 | 0 | |
| | 4 to 5 | CAN098-9835-4004 | GA | | Soil | 11-20-91 | 1235 | 0 | |

TABLE 9-3

SUMMARY OF SURFACE SOIL, SUBSURFACE SOIL, AND QA/QC SAMPLES COLLECTED BY WCC AT SANITARY SEWER LINE, SWMU NO. 98 , CANNON AFB, NEW MEXICO

| BORING NUMBER | DEPTH INTERVAL (Ft-BGS) | SAMPLE IDENTIFICATION NUMBER | SAMPLE TYPE | QA/QC SAMPLES | SAMPLE MATRIX | DATE SAMPLED | TIME SAMPLED | OVA ON SAMPLE (ppm) | ANALYTICAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|---|
| 9835 | 8 to 10 | CAN098-9835-4008 | SPT | | Soil | 11-20-91 | 1240 | 0 | |
| | 10 to 12 | CAN098-9835-0010 | A/SPT | | Soil | 11-20-91 | 1245 | 0 | VOC,M,TPH |
| 9836 | 0 to 0.5 | CAN098-9836-4000 | GA | | Soil | 11-20-91 | 1110 | 0 | |
| | 0 to 4 | CAN098-9836-4000 | L | | Soil | 11-20-91 | 1110 | 0 | |
| | 4 to 8 | CAN098-9836-4004 | L | | Soil | 11-20-91 | 1120 | 0 | |
| | 8 to 10 | CAN098-9836-4008 | SPT | | Soil | 11-20-91 | 1125 | 0 | |
| | 10 to 12 | CAN098-9836-0010 | A/SPT | | Soil | 11-20-91 | 1135 | 0 | VOC,M,TPH |
| 9837 | 0 to 4 | CAN098-9837-4000 | L | | Soil | 11-20-91 | 0755 | 0 | |
| | 4 to 9 | CAN098-9837-4004 | L | | Soil | 11-20-91 | 0810 | 0.1 | |
| | 9 to 11 | CAN098-9837-4009 | SPT/GA | | Soil | 11-20-91 | 0825 | 0 | |
| | 11 to 13 | CAN098-9837-0011 | A/SPT | MS/MSD | Soil | 11-20-91 | 0845 | 5 | VOC,M,TPH |
| 9838 | 0.5 to 4 | CAN098-9838-4000 | L | | Soil | 11-25-91 | 1650 | 0 | |
| | 3 to 4 | CAN098-9838-4003 | GA | | Soil | 11-25-91 | 1650 | 0 | |
| | 4 to 7 | CAN098-9838-4004 | L | | Soil | 11-25-91 | 1655 | 0 | |
| | 7 to 9 | CAN098-9838-4007 | SPT | | Soil | 11-25-91 | 1700 | 0 | |
| | 9 to 11 | CAN098-9838-0009 | A/SPT | | Soil | 11-25-91 | 1715 | 0 | VOC,M,TPH |
| | | CAN098-9838-1304 | A | MRD | Soil | 11-25-91 | 1715 | 0 | VOC,M,TPH |
| 9839 | 0.5 to 4 | CAN098-9839-4000 | L | | Soil | 11-25-91 | 1550 | 0 | |
| | 4 to 7 | CAN098-9839-4004 | L | | Soil | 11-25-91 | 1600 | 0 | |
| | 5 to 6 | CAN098-9839-4005 | GA | | Soil | 11-25-91 | 1600 | 0 | |
| | 7 to 9 | CAN098-9839-4007 | SPT | | Soil | 11-25-91 | 1605 | 0 | |
| | 9 to 11 | CAN098-9839-0009 | A/SPT | | Soil | 11-25-91 | 1615 | 0 | VOC,M,TPH |
| 9840 | 0 to 4 | CAN098-9840-4000 | L | | Soil | 11-19-91 | 1515 | 0 | |
| | 4 to 7 | CAN098-9840-4004 | L | | Soil | 11-19-91 | 1525 | 0 | |
| | 5 to 6 | CAN098-9840-4005 | GA | | Soil | 11-19-91 | 1525 | 0 | |
| | 7 to 9 | CAN098-9840-4007 | SPT | | Soil | 11-19-91 | 1545 | 0 | |
| | 9 to 11 | CAN098-9840-0009 | A/SPT | | Soil | 11-19-91 | 1600 | 0.8 | VOC,M,TPH |
| | | CAN098-9840-1365 | A | FD | Soil | 11-19-91 | 1630 | 0.8 | VOC,M,TPH |
| 9841 | 0 to 4 | CAN098-9841-4000 | L | | Soil | 11-19-91 | 1355 | 0 | |
| | 1 to 2 | CAN098-9841-4001 | GA | | Soil | 11-19-91 | 1355 | 0 | |
| | 4 to 6 | CAN098-9841-4004 | SPT | | Soil | 11-19-91 | 1410 | 0 | |
| | 6 to 8 | CAN098-9841-0006 | A/SPT | | Soil | 11-19-91 | 1420 | 0 | VOC,M,TPH |
| 9842 | 0 to 4 | CAN098-9842-4000 | L | | Soil | 11-19-91 | 1310 | 0 | |
| | 4 to 8 | CAN098-9842-4004 | L | | Soil | 11-19-91 | 1320 | 0 | |
| | 7 to 8 | CAN098-9842-0007 | A | | Soil | 11-19-91 | 1320 | 0 | VOC,M,TPH |
| | | CAN098-9842-4007 | GA | | Soil | 11-19-91 | 1320 | 0 | |
| 9843 | 0 to 4 | CAN098-9843-4000 | L | | Soil | 11-19-91 | 1110 | 0 | |
| | 3 to 4 | CAN098-9843-4003 | GA | | Soil | 11-19-91 | 1110 | 0 | |
| | 4 to 9 | CAN098-9843-4004 | L | | Soil | 11-19-91 | 1125 | 0 | |
| | 8 to 9 | CAN098-9843-0008 | A | | Soil | 11-19-91 | 1125 | 0 | VOC,M,TPH |
| | | CAN098-9843-1305 | A | MRD | Soil | 11-19-91 | 1125 | 0 | VOC,M,TPH |

TABLE 9-3

SUMMARY OF SURFACE SOIL, SUBSURFACE SOIL, AND QA/QC SAMPLES COLLECTED BY WCC AT SANITARY SEWER LINE, SWMU NO. 98 , CANNON AFB, NEW MEXICO

| | | | | | |
|---|---|---|---|---|---|
| Ft-BGS | Feet Below Ground Surface | FD | Field Duplicate | SV | Semi Volatile Organic Compounds |
| OVA | Organic Vapor Analyzer Reading | MRD | Missouri River Division Duplicate | M | Metals (TAL) |
| ppm | Parts per Million | AB | Ambient Blank | TPH | Total Petroleum Hydrocarbons |
| A | Analytical | RB | Rinsate Blank | BTEX | Benzene, Toluene, Ethylbenzene, Xylene |
| SPT | Standard Penetration Test | DW | Decontamination Water Blank | | |
| GA | Gradation Analysis | TB | Trip Blank | TOC | Total Organic Carbon |
| L | Lithology | VOC | Volatile Organic Compounds (TCL) | OL | Organic Lead |
| MS/MSD | Matrix Spike / Matrix Spike Duplicate | PCB | Polychlorinated Biphenols, Pesticides | Pb/Cr | Lead / Chromium |
| | | TCL | Target Compound List | TAL | Target Analyte List |

( )* The borings that are shaded and in parentheses correspond to a redrill of the previous boring due to sample collection difficulties. These borings were drilled approximately 1 to 5 feet away from the original boring or surface sample.

# TABLE 9-4
# METAL CONCENTRATIONS (1) IN SOIL SAMPLES COLLECTED BY WCC AT SANITARY SEWER LINE SWMU NO. 98, CANNON AFB, NEW MEXICO

| Boring Number | Sample Depth (Ft-BGS) | Element | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Aluminum | | Antimony | | Arsenic | | Barium | | Beryllium | | Cadmium | | Calcium | | Chromium | |
| 9801 | 20 | 7090 | J | 5.3 | UJ | 1.4 | J | 561 | J | 0.72 | J | 0.91 | U | 36300 | J | 7 | |
| 9802 | 17 | 5800 | J | 5.2 | UJ | 1.1 | J | 485 | J | 0.49 | J | 0.91 | U | 36000 | J | 5.9 | |
| 9803 | 12 | 9630 | | 5.3 | UJ | 2.4 | J | 173 | J | 0.46 | U | 1.3 | | 118000 | | 6.3 | |
| 9804 | 14 | 7080 | | 5.4 | UJ | 1.5 | J | 109 | J | 0.47 | U | 0.94 | U | 156000 | | 5.5 | |
| 9806 | 17 | 6220 | | 4.9 | UJ | 1.5 | J | 57.3 | | 0.47 | J | 0.85 | U | 52200 | J | 5 | |
| 9808 | 8 | 5990 | | 5.2 | UJ | 2 | J | 1060 | | 0.45 | U | 0.9 | U | 159000 | J | 5 | |
| 9810 | 15 | 11100 | | 5.3 | UJ | 1.6 | J | 49.9 | J | 0.46 | U | 0.92 | U | 66700 | | 8.4 | |
| 9812 | 13 | 4670 | | 5.5 | UJ | 1.3 | J | 1310 | J | 0.48 | U | 0.96 | U | 212000 | | 3.8 | |
| 9813 | 13 | 5460 | | 5.3 | UJ | 1.5 | J | 861 | J | 0.47 | U | 0.93 | U | 195000 | | 4.3 | |
| 9814 | 13 | 7620 | | 5.2 | UJ | 1.9 | J | 148 | J | 0.45 | U | 0.9 | U | 109000 | | 5.3 | |
| 9815 | 5 | 7870 | | 5.3 | UJ | 2.2 | J | 1560 | J | 0.46 | U | 0.92 | U | 86000 | | 6 | |
| 9816 | 5 | 6280 | | 5 | UJ | 1.6 | J | 386 | J | 0.44 | U | 0.88 | U | 57300 | | 5.5 | |
| 9817 | 9 | 11500 | | 5.2 | UJ | 1.7 | J | 159 | | 0.45 | U | 0.9 | U | 135000 | | 7.3 | |
| 9818 | 11 | 4720 | | 5.3 | UJ | 1.1 | J | 3480 | | 0.46 | U | 0.92 | U | 216000 | | 3.1 | |
| 9820 | 6 | 6150 | | 5 | U | 1.3 | J | 151 | | 0.44 | U | 0.87 | U | 90000 | | 4.9 | |
| 9821 | 9 | 4800 | | 5.2 | UJ | 1.1 | J | 158 | J | 0.45 | U | 0.91 | U | 116000 | J | 4.5 | |
| 9821 | 17 | 4770 | | 5.3 | UJ | 0.58 | J | 70.7 | | 0.46 | U | 0.92 | U | 197000 | J | 4.8 | |
| 9821 | 23 | 7060 | | 5.5 | UJ | 0.71 | J | 120 | | 0.48 | U | 0.95 | U | 87800 | J | 4.5 | |
| 9822 | 14 | 6400 | | 5.5 | UJ | 0.76 | J | 123 | J | 0.48 | U | 0.95 | U | 198000 | | 4.7 | |
| 9824 | 14 | 8130 | | 5.2 | UJ | 1.5 | J | 338 | J | 0.46 | U | 0.91 | U | 102000 | | 6.4 | |
| 9830 | 6 | 5400 | | 5.3 | UJ | 1.3 | J | 570 | J | 0.46 | U | 1.3 | | 178000 | | 4.1 | |
| 9831 | 7 | 6750 | | 5.3 | UJ | 1.5 | J | 525 | J | 0.46 | U | 0.92 | U | 177000 | | 4.6 | |
| 9832 | 12 | 4450 | | 5.4 | UJ | 1.6 | J | 406 | J | 0.49 | J | 0.93 | U | 195000 | J | 3.6 | |
| 9833 | 10 | 5500 | | 5.6 | UJ | 1.4 | J | 398 | J | 0.5 | J | 0.97 | U | 114000 | J | 5.4 | |
| 9835 | 10 | 5330 | | 5.2 | J | 1.1 | J | 151 | J | 0.45 | U | 0.9 | U | 114000 | | 5.3 | |
| 9837 | 11 | 5460 | | 5.3 | J | 1.1 | J | 1040 | J | 0.46 | U | 0.92 | U | 72400 | | 6.1 | |
| 9838 | 9 | 6200 | | 10.3 | UJ | 1.9 | J | 1830 | J | 0.9 | U | 1.8 | U | 246000 | | 2.6 | J |
| 9839 | 9 | 8820 | | 5.1 | UJ | 1.7 | J | 325 | J | 0.44 | U | 0.89 | U | 102000 | | 6.7 | |
| 9840 | 9 | 4030 | | 5.3 | J | 1.4 | J | 121 | J | 0.46 | U | 0.92 | U | 148000 | | 3.9 | |

# TABLE 9–4
# (Continued)

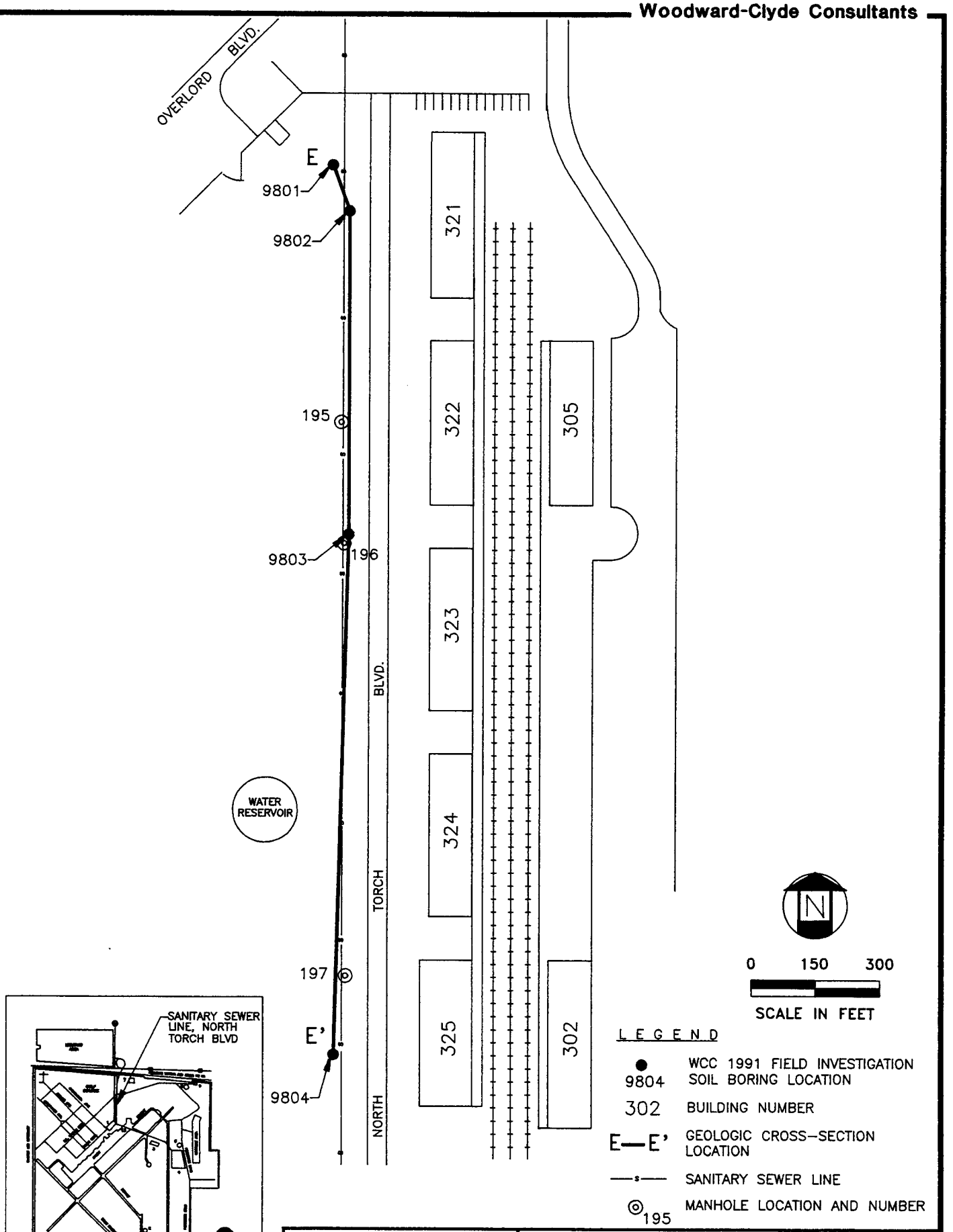
| Boring Number | Sample Depth (Ft-BGS) | Element | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cobalt | | Copper | | Iron | | Lead | | Manganese | | Magnesium | Mercury | | Nickel | | |
| 9801 | 20 | 3.2 | J | 8.5 | U | 7030 | J | 6.4 | | 133 | | 3610 | 0.11 | U | 7.2 | J | |
| 9802 | 17 | 3.1 | J | 7.5 | U | 6580 | J | 5.5 | | 110 | | 3340 | 0.11 | U | 6.2 | J | |
| 9803 | 12 | 3 | J | 4.1 | J | 6330 | | 8.9 | | 82 | | 5320 | 0.12 | U | 6.5 | J | |
| 9804 | 14 | 3 | J | 6.7 | | 3670 | | 2.7 | | 29.5 | | 7890 | 0.12 | U | 6.5 | J | |
| 9806 | 17 | 3.1 | J | 4.9 | J | 4880 | | 5 | J | 110 | | 2980 | 0.11 | U | 5.5 | J | |
| 9808 | 8 | 2.7 | J | 5.9 | U | 4220 | | 3 | J | 51.6 | | 2990 | 0.11 | U | 5.2 | J | |
| 9810 | 15 | 3.2 | J | 9.8 | U | 7560 | | 4.8 | | 126 | | 4270 | 0.11 | U | 6.8 | J | |
| 9812 | 13 | 1.2 | U | 3.2 | U | 2250 | | 1.4 | | 16.7 | | 20900 | 0.12 | U | 4.5 | J | |
| 9813 | 13 | 1.5 | J | 4.1 | U | 2800 | | 3.8 | | 25.7 | | 21100 | 0.12 | U | 4.8 | J | |
| 9814 | 13 | 2.3 | J | 3 | U | 4560 | | 2.7 | | 59.4 | | 7930 | 0.11 | U | 5.9 | J | |
| 9815 | 5 | 3.5 | J | 6.4 | U | 6280 | | 4.6 | | 126 | | 3480 | 0.11 | U | 7.1 | J | |
| 9816 | 5 | 3.5 | J | 4.5 | U | 4950 | | 4 | | 92.7 | | 2870 | 0.11 | U | 5.2 | J | |
| 9817 | 9 | 3.1 | J | 12 | | 6860 | | 5.8 | | 94.1 | | 5410 | 0.11 | U | 6.8 | J | |
| 9818 | 11 | 1.3 | J | 8 | | 2330 | | 1.3 | | 18.1 | | 12800 | 0.12 | U | 3.3 | J | |
| 9820 | 6 | 2.3 | J | 3.5 | J | 4370 | | 4.5 | | 73.1 | | 2950 | 0.11 | U | 4.3 | J | |
| 9821 | 9 | 2.7 | J | 5.5 | U | 4830 | J | 4.9 | J | 76.7 | J | 2820 | 0.11 | U | 7.5 | J | |
| 9821 | 17 | 2.4 | J | 3.8 | U | 2940 | | 2.4 | J | 32.9 | | 8870 | 0.12 | U | 5.2 | J | |
| 9821 | 23 | 2 | J | 5.9 | U | 3890 | | 1.1 | J | 28.9 | | 35300 | 0.12 | U | 7 | J | |
| 9822 | 14 | 1.2 | U | 3.5 | J | 3160 | | 2 | J | 24.1 | | 12800 | 0.12 | U | 3.6 | J | |
| 9824 | 14 | 4.2 | J | 5 | J | 5470 | | 6.1 | J | 115 | | 4510 | 0.11 | U | 6.4 | J | |
| 9830 | 6 | 1.8 | J | 2.2 | J | 3290 | | 2.8 | | 33.7 | | 3170 | 0.12 | U | 3.7 | J | |
| 9831 | 7 | 2.9 | J | 3.1 | J | 4080 | | 3.1 | | 67.9 | | 4350 | 0.11 | U | 5.3 | J | |
| 9832 | 12 | 2.2 | J | 4.3 | U | 2840 | | 3.6 | J | 28.9 | | 4930 | 0.12 | U | 5.3 | J | |
| 9833 | 10 | 2.8 | J | 6 | U | 4640 | | 3.7 | J | 47.3 | | 4810 | 0.12 | U | 6.7 | J | |
| 9835 | 10 | 3.6 | J | 4.7 | J | 5080 | | 4.3 | | 69.7 | | 3850 | 0.11 | U | 6.8 | J | |
| 9837 | 11 | 2.9 | J | 5.1 | J | 5660 | | 5.1 | | 108 | | 3130 | 0.11 | U | 6.2 | J | |
| 9838 | 9 | 3 | J | 7.5 | U | 3590 | | 2.7 | | 43.8 | | 4900 | 0.11 | U | 5.5 | J | |
| 9839 | 9 | 3 | J | 12.7 | | 5970 | | 4 | | 76.7 | | 4010 | 0.11 | U | 7.1 | J | |
| 9840 | 9 | 2.4 | J | 6.8 | | 3700 | | 3.8 | | 55.2 | | 3560 | 0.11 | U | 6.4 | J | |

# TABLE 9-4
# (Concluded)

| Boring Number | Sample Depth (Ft-BGS) | Element | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Potassium | | Selenium | | Silver | | Sodium | | Thallium | | Vanadium | | Zinc | |
| 9801 | 20 | 2340 | | 0.23 | UJ | 0.91 | U | 301 | U | 0.23 | UJ | 21.4 | | 16.8 | |
| 9802 | 17 | 1800 | | 0.23 | UJ | 0.91 | U | 300 | U | 0.23 | UJ | 19.6 | | 16 | |
| 9803 | 12 | 2530 | | 2.3 | UJ | 0.93 | U | 306 | U | 0.23 | UJ | 20.3 | | 16.1 | |
| 9804 | 14 | 1060 | J | 0.24 | UJ | 0.94 | U | 350 | J | 2.4 | UJ | 17.6 | | 7.6 | |
| 9806 | 17 | 1690 | | 0.21 | UJ | 0.85 | U | 282 | U | 0.21 | UJ | 15.4 | | 12.6 | |
| 9808 | 8 | 1160 | | 0.23 | UJ | 0.9 | U | 297 | U | 0.23 | UJ | 16.9 | | 11.5 | |
| 9810 | 15 | 2630 | | 2.3 | UJ | 0.92 | U | 302 | U | 0.23 | UJ | 17.7 | | 19.5 | |
| 9812 | 13 | 861 | J | 2.4 | UJ | 0.96 | U | 317 | U | 0.24 | UJ | 18.5 | | 6.6 | U |
| 9813 | 13 | 1010 | J | 2.3 | UJ | 0.93 | U | 307 | U | 0.23 | UJ | 18.6 | | 8.8 | |
| 9814 | 13 | 1720 | | 2.2 | UJ | 0.9 | U | 296 | U | 0.22 | UJ | 23.3 | | 12 | |
| 9815 | 5 | 1770 | | 2.3 | UJ | 0.92 | U | 303 | U | 2.3 | UJ | 20.2 | | 18 | |
| 9816 | 5 | 1530 | | 2.2 | UJ | 0.88 | U | 290 | U | 0.22 | UJ | 17.2 | | 13.6 | |
| 9817 | 9 | 2700 | | 0.22 | UJ | 0.9 | U | 297 | U | 2.2 | UJ | 20.2 | | 17.4 | |
| 9818 | 11 | 824 | J | 0.23 | UJ | 0.92 | U | 304 | U | 0.23 | UJ | 20 | | 4.3 | J |
| 9820 | 6 | 1680 | | 2.2 | UJ | 0.87 | U | 287 | U | 0.22 | UJ | 13.2 | | 10.4 | |
| 9821 | 9 | 1090 | J | 0.23 | UJ | 1 | J | 330 | J | 0.23 | UJ | 23 | | 12.8 | U |
| 9821 | 17 | 823 | J | 0.23 | UJ | 0.92 | U | 305 | U | 0.23 | UJ | 18.2 | | 6.8 | U |
| 9821 | 23 | 1120 | J | 0.24 | U | 0.95 | U | 314 | U | 0.24 | UJ | 23.3 | | 7.2 | U |
| 9822 | 14 | 1200 | | 2.4 | UJ | 0.95 | U | 315 | U | 2.4 | UJ | 13.1 | | 6.6 | |
| 9824 | 14 | 2220 | | 2.3 | UJ | 0.91 | U | 300 | U | 0.23 | UJ | 14.7 | | 14.2 | |
| 9830 | 6 | 1350 | | 2.3 | UJ | 0.92 | U | 304 | U | 0.23 | UJ | 9.9 | J | 8.3 | |
| 9831 | 7 | 1630 | | 2.3 | UJ | 0.92 | U | 302 | U | 2.3 | UJ | 13.6 | | 10 | |
| 9832 | 12 | 1400 | | 0.23 | UJ | 0.94 | J | 427 | J | 2.3 | UJ | 13.7 | | 6.8 | U |
| 9833 | 10 | 1800 | | 0.24 | UJ | 0.97 | U | 371 | J | 0.24 | UJ | 18.8 | | 11 | U |
| 9835 | 10 | 1620 | | 0.22 | UJ | 0.9 | U | 297 | U | 0.22 | J | 16.7 | | 12.1 | |
| 9837 | 11 | 1590 | | 0.23 | UJ | 0.92 | U | 303 | U | 0.23 | J | 18.7 | | 12.7 | |
| 9838 | 9 | 1440 | J | 0.22 | UJ | 1.8 | U | 591 | U | 2.2 | UJ | 13.2 | J | 9.4 | U |
| 9839 | 9 | 2210 | | 2.2 | UJ | 0.89 | U | 294 | U | 0.22 | UJ | 16.2 | | 14.1 | |
| 9840 | 9 | 1460 | | 0.23 | UJ | 0.92 | U | 303 | U | 0.23 | J | 15.2 | | 12.4 | |

Ft-BGS = Feet below ground surface
U = Not detected
J = Estimated value
UJ = Estimated as non-detect at the CRQL
(1) All concentrations are in milligrams per kilogram (mg/kg)

Woodward-Clyde Consultants



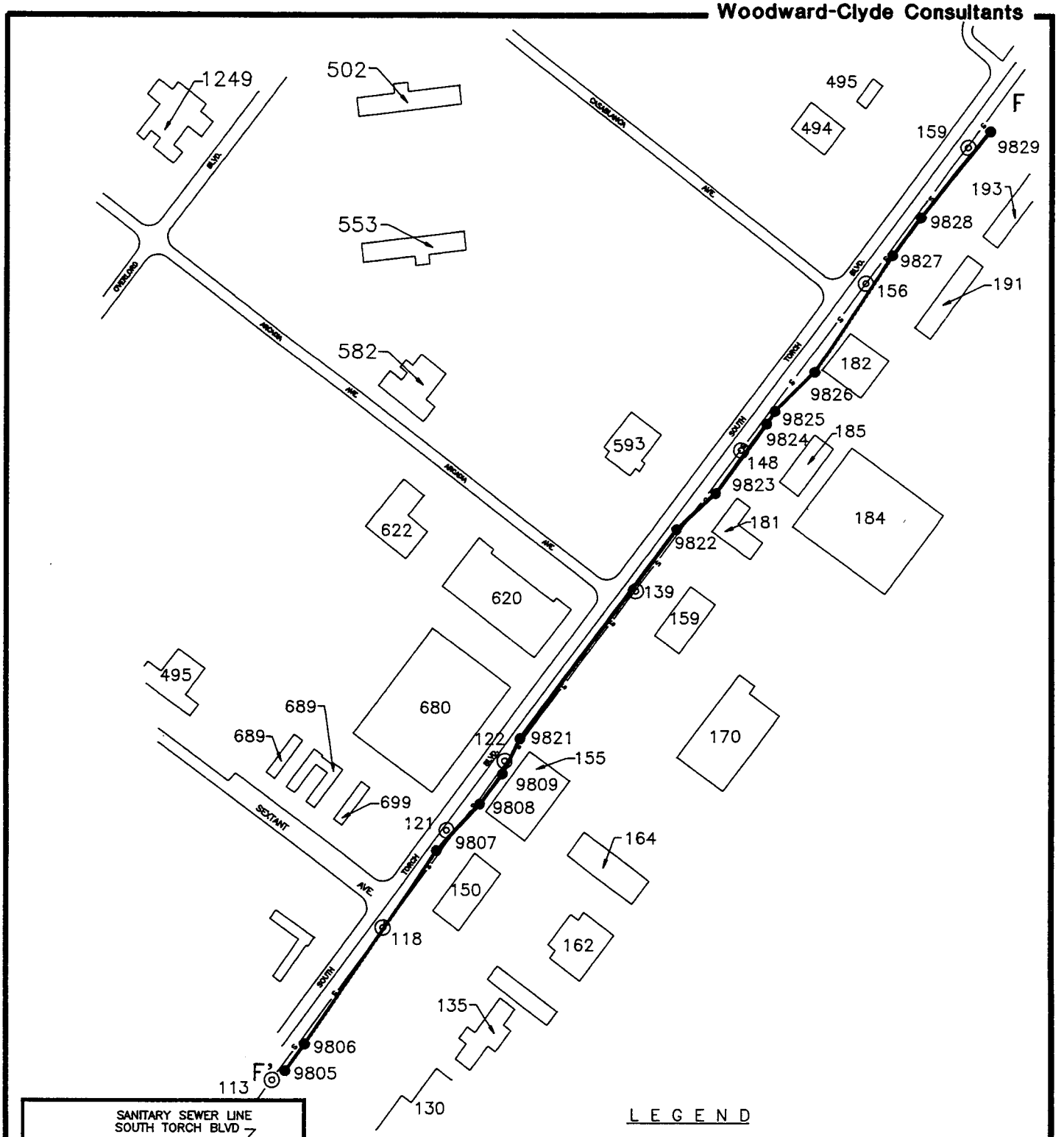

| | |
|---|---|
| Job No. : | 89MC114W |
| Prepared by : | D.A.K. |
| Date : | 2/11/92 |

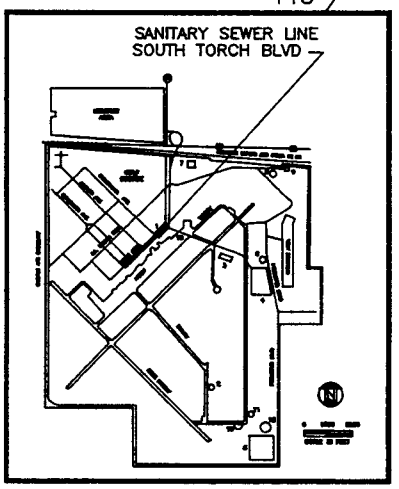
LOCATION OF SOIL BORINGS AT SANITARY SEWER LINE, NORTH TORCH BLVD.
SWMU NO. 98
CANNON AFB, NEW MEXICO

C1140011

FIG. 9-1

Woodward-Clyde Consultants



0 150 300

SCALE IN FEET

LEGEND

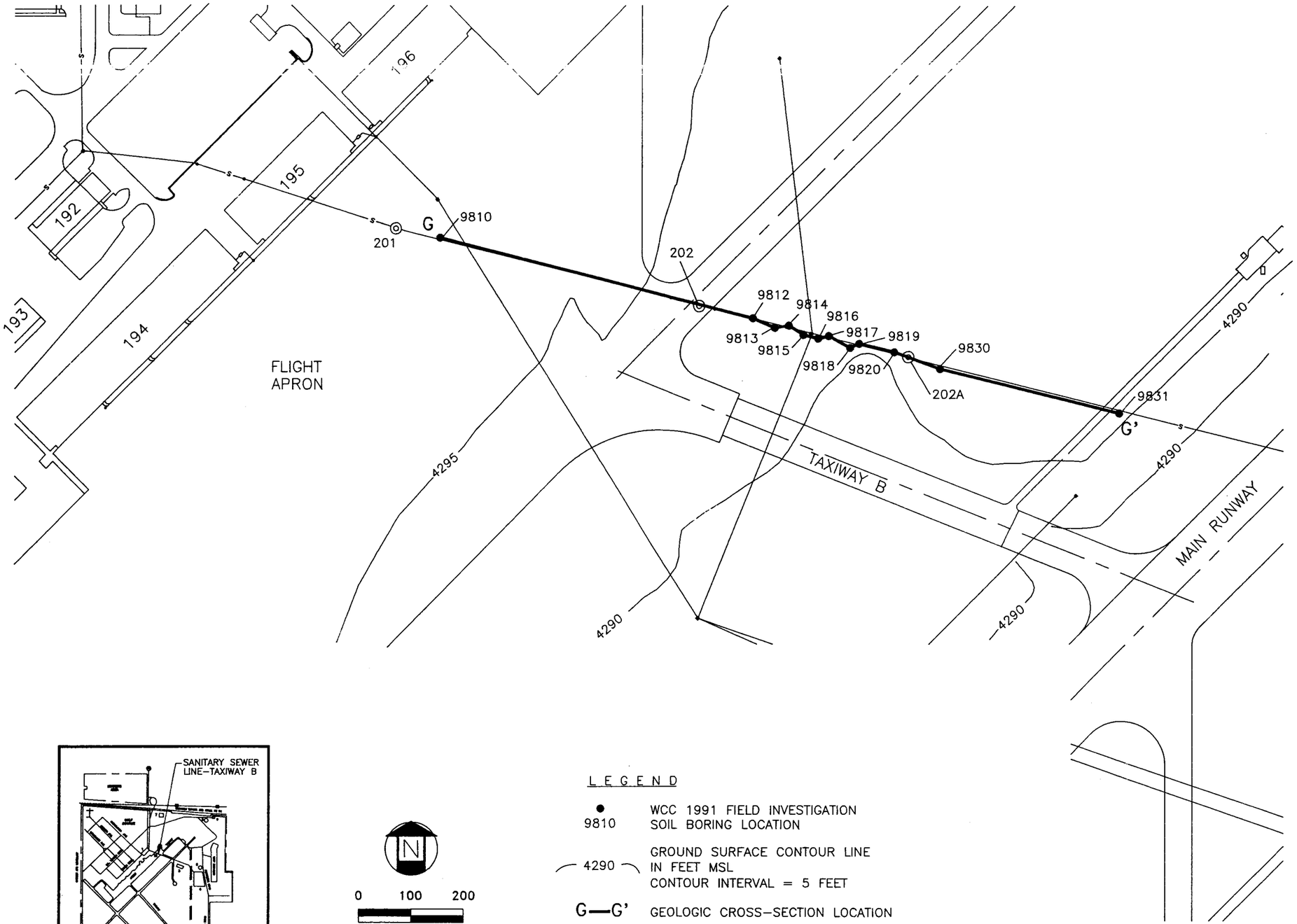
| | |
|---|---|
| ● 9807 | WCC 1991 FIELD INVESTIGATION SOIL BORING LOCATION |
| 130 | BUILDING NUMBER |
| F — F' | GEOLOGIC CROSS-SECTION LOCATION |
| —s— | SANITARY SEWER LINE |
| ◎113 | MANHOLE LOCATION AND NUMBER |

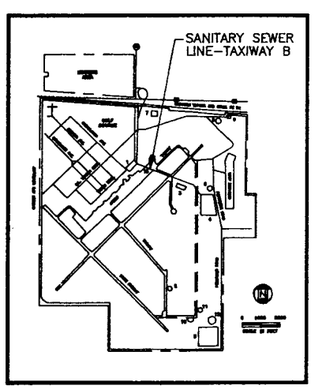
| | |
|---|---|
| Job No. : | 89MC114W |
| Prepared by : | D.A.K. |
| Date : | 2/11/92 |

LOCATION OF SOIL BORINGS AT SANITARY SEWER LINE, SOUTH TORCH BLVD.
SWMU NO. 98
CANNON AFB, NEW MEXICO

C1140012

FIG. 9-2




N

0 100 200

SCALE IN FEET

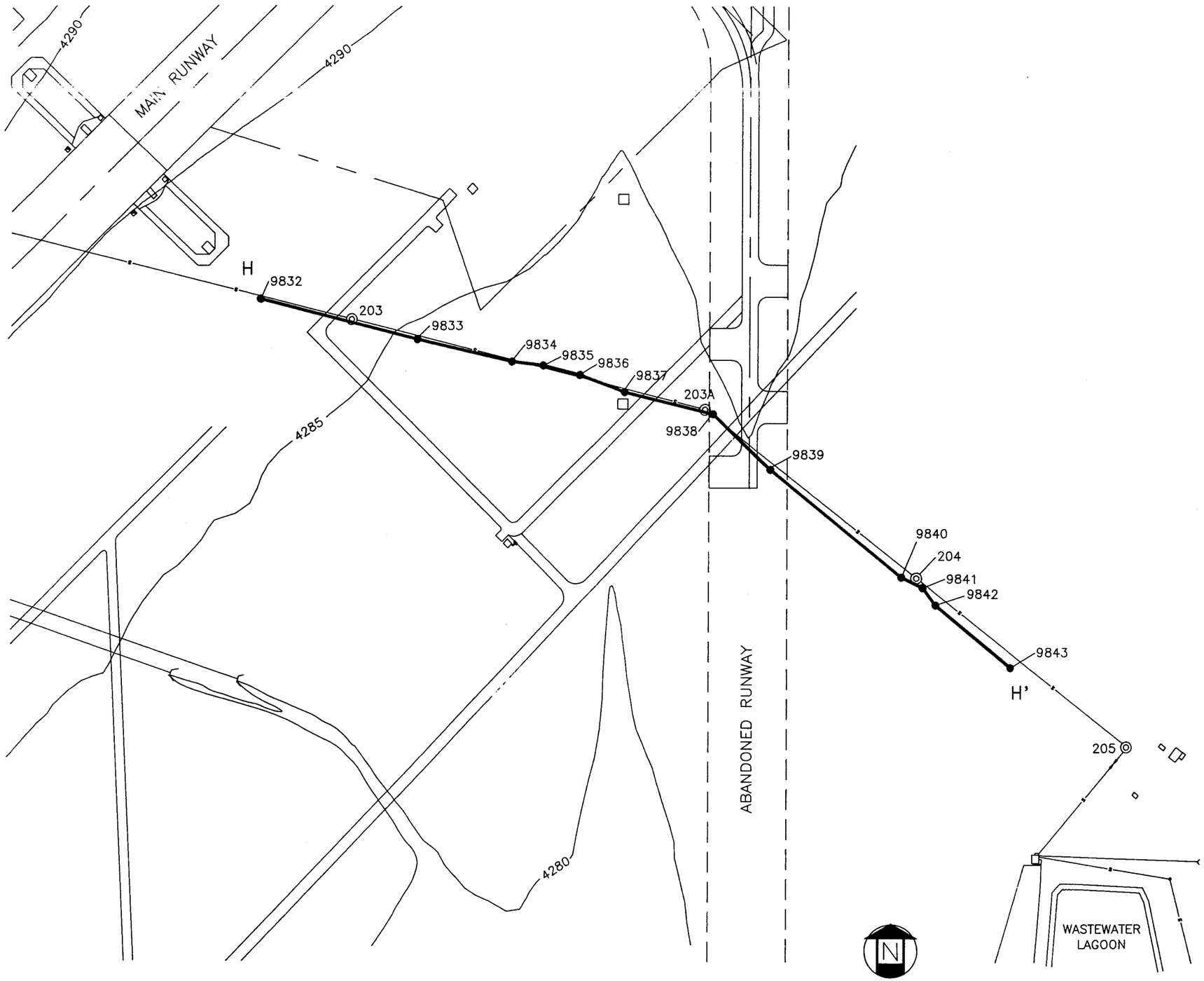
LEGEND

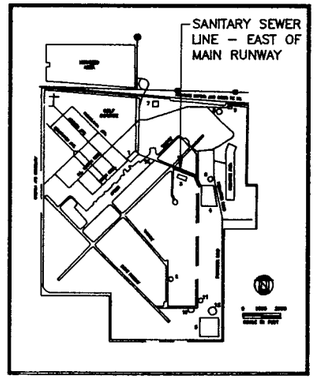
| | |
|---|---|
| ● 9810 | WCC 1991 FIELD INVESTIGATION SOIL BORING LOCATION |
| 4290 | GROUND SURFACE CONTOUR LINE IN FEET MSL CONTOUR INTERVAL = 5 FEET |
| G—G' | GEOLOGIC CROSS–SECTION LOCATION |
| —s— | SANITARY SEWER LINE |
| 193 | BUILDING NUMBER |
| ◎ 202 | MANHOLE LOCATION AND NUMBER |

| | |
|---|---|
| Job No. : 89MC114W | LOCATION OF SOIL BORINGS AT SANITARY SEWER LINE – TAXIWAY B SWMU NO. 98 CANNON AFB, NEW MEXICO |
| Prepared by : D.A.K. | |
| Date : 2/19/92 | |

C1140016

FIG. 9–3



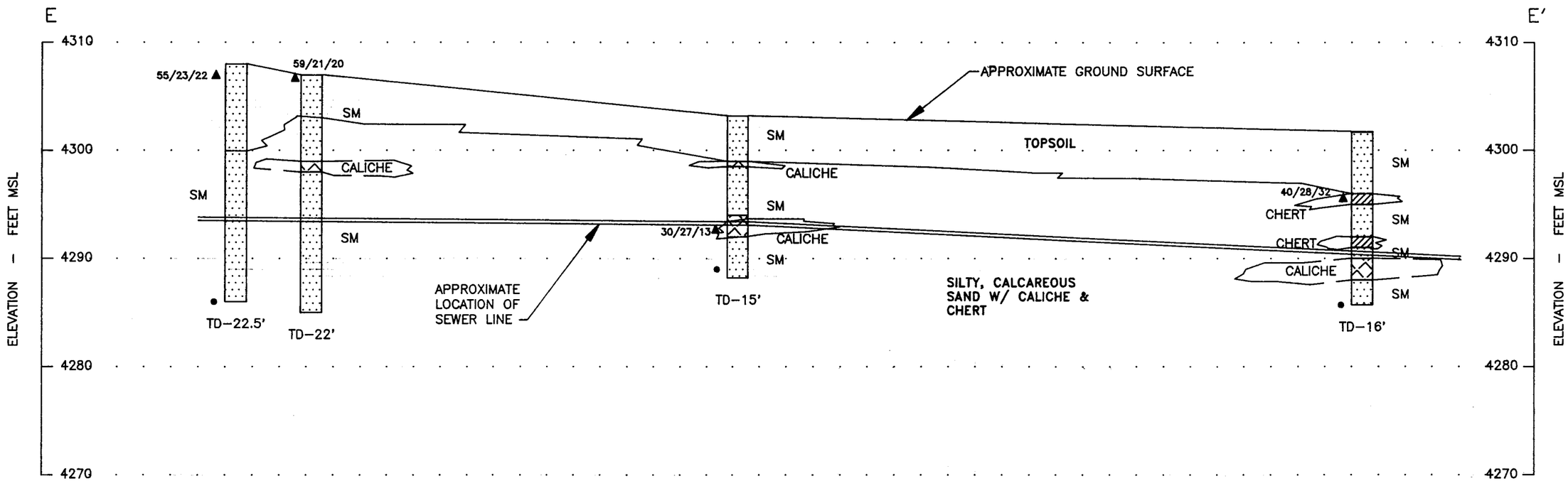

LEGEND

- ● WCC 1991 FIELD INVESTIGATION SOIL BORING LOCATION
- 4290 GROUND SURFACE CONTOUR LINE IN FEET MSL CONTOUR INTERVAL = 5 FEET
- H—H' GEOLOGIC CROSS-SECTION LOCATION
- SANITARY SEWER LINE
- ◎ 205 MANHOLE LOCATION AND NUMBER

| | |
|---|---|
| Job No. : 89MC114W | LOCATION OF SOIL BORINGS AT SANITARY SEWER LINE – EAST OF MAIN RUNWAY SWMU NO. 98 CANNON AFB, NEW MEXICO |
| Prepared by : D.A.K. | |
| Date : 2/19/92 | |

C1140017

FIG. 9–4




LEGEND

| | | |
|---|---|---|
| MSL | – | MEAN SEA LEVEL |
| TD | – | TOTAL DEPTH IN FEET BGS |
| SM,SP,GW ML,GP | – | UNIFIED SOIL CLASSIFICATION SYSTEM ABBREVIATIONS |
| BGS | – | BELOW GROUND SURFACE |
| • | – | ANALYTICAL SAMPLE INTERVAL |

BORINGS 9801, 9802, 9803, 9804
WCC (NOV 91)

NOTE: THE LOCATION OF THIS CROSS-SECTION IS SHOWN ON FIG. 9-1

30/27/13 ▲ – GRADATION ANALYSIS SAMPLE INTERVAL. THE THREE NUMBERS REPRESENT THE APPROXIMATE PERCENTAGES OF SAND-, SILT- AND CLAY- SIZED MATERIAL RESPECTIVELY

0 100 200

HORIZONTAL SCALE IN FEET
VERTICAL EXAGGERATION = 20X

| | |
|---|---|
| Job No. : | 89MC114W |
| Prepared by : | LLG |
| Date : | 2/3/92 |

GEOLOGIC CROSS SECTION E-E'
SANITARY SEWER LINE-NORTH TORCH BLVD SWMU NO. 98
CANNON AFB NEW MEXICO

SWMU-98

FIG. 9-5

**TO VIEW THE MAP AND/OR MAPS WITH THIS DOCUMENT, PLEASE CALL THE HAZARDOUS WASTE BUREAU AT 505-476-6000 TO MAKE AN APPOINTMENT**

# 10.0
# WASTEWATER LAGOONS (SWMU NOS. 101, 102)

## 10.1 SWMU DESCRIPTION

### 10.1.1 Setting

The lagoons are located on the east-central part of the base between an old north-south abandoned runway and perimeter road. This SWMU consists of two unlined surface impoundments which have been in use since 1966 (Figure 10-1). The lagoons operate in series and have a total surface area of 32 acres. They are constructed with unlined earth bottoms and concrete-lined banks. The average depth of water is 3.5 feet with a maximum of 4.5 feet. The lagoons are separated by a 12-foot-wide levee.

### 10.1.2 History of Use

The wastewater lagoons have been in operation since 1966. Combined sanitary and industrial wastewater is treated in the lagoons.

The wastewater treatment system does not have an NPDES permit because the lagoons do not discharge into navigable waters. The discharge goes to a playa which is contained within the boundary of Cannon AFB.

The sewage lagoons are inspected weekly and after storms to ensure dike integrity.

### 10.1.3 Past Investigations

One upgradient and three downgradient monitoring wells have been installed around the sewage lagoons (Figure 10-1). These wells are sampled quarterly with only field parameters (i.e. temperature, pH, and conductivity) being analyzed.

### 10.1.4 Land Use and Demography

The main function of this facility is to treat sewage from the sanitary sewer line. The area has no other present use. Perimeter Road on the eastern side of the lagoons is the only road in this part of the base that leads to the south gate.

Two workers once a day check the pump station on the north side of the lagoons, and once a week two workers drive around the perimeter of the lagoons inspecting the banks and dike. The only access to the lagoons is through a locked gate in the entomology rinse area (USAF 1990).

## 10.2 FIELD INVESTIGATION

This section provides a discussion of the field activities conducted by WCC at the Wastewater Lagoons from October 15 through 16, 1991, from November 9 through 13, 1991 and on December 17, 1991. The activities at this SWMU, as outlined in the FSP (WCC 1991c), consisted of the collecting 8 sludge samples for chemical analysis, 3 surface water samples for chemical analysis, measuring the static water level, evacuating, and sampling 4 monitoring wells, and collecting 4 groundwater samples for chemical analysis. The resampling phase of the field program, which became necessary due to laboratory missed holding times, consisted of recollecting 7 sludge samples for chemical analysis and 1 surface water sample for chemical analysis. The groundwater sampling was conducted in accordance with SOPs No. 2 - Water Level Measurement and No. 4 - Monitoring Well Sampling Using a Dedicated Submersible Pump contained in the QAPP (WCC 1991b).

All sludge and surface water samples were located by placing wooden stakes along the north and west shorelines of each lagoon at predetermined grid location distances. A motor boat was used to reach the various sample locations and was anchored in place at each location until all sampling was completed. The sludge samples were collected using a stainless steel Ponar dredge. The dredge was lowered to the bottom of the lagoon (approximately 3 to 4 feet below the lagoon surface (BLS) and allowed to settle. The closure mechanism was triggered to collect a sample. The surface water samples were collected by lowering a sample bottle to approximately 0.5 feet BLS, making sure

the top of the bottle was covered until the target sample depth was reached. The bottle was then uncovered and a surface water sample was collected. Once the bottle was filled, the top was covered again, and the sample was brought to the surface and placed in the appropriate sample containers. The sample collection bottles used to actually collect the surface water sample were of the same type that were subsequently filled and sent to the laboratory for the various analyses requested (i.e. clear 40 ml bottles for VOCs, amber 1 liter bottles for semi-VOCs, etc.).

The monitoring wells were purged using the dedicated submersible pump previously installed in each well. All purge water was pumped into either a dedicated 750-gallon poly tank or 55-gallon steel drums to be stored for later disposal. Following well purging and stabilization of field parameters, the required groundwater samples were collected.

Table 10-1 summarizes the sludge and surface water sampling methods conducted at each sample location, while a summary of the monitoring well purging and sampling during the 1991 WCC investigation is provided in Table 10-2. A complete record of all sludge, surface water, groundwater and associated QA/QC samples collected at the Wastewater Lagoons is presented in Table 10-3. The locations of the sludge and surface water samples along with the monitoring wells are shown on Figure 10-1.

### 10.2.1 Sampling Objectives

The objective of sludge, surface water, and additional groundwater sampling at the Wastewater Lagoons was to provide information regarding the nature and extent of potential hazardous contaminants that may be present in the wastewater sludge, the treated wastewater within the lagoons, and the groundwater downgradient of the SWMU. The groundwater sampling program was designed to supplement previous investigations. The data collected at these sludge, surface water, and monitoring well locations were used to further evaluate the extent of potential contamination, if present, and to perform a baseline risk assessment to determine if the area poses a risk to human health or the environment. The data may also be utilized to evaluate remedial actions if necessary.

### 10.2.2 Sediment Investigation

Eight sludge samples, four from the north lagoon, 5001 through 5004, and four from the south lagoon, 5005 through 5008, were initially collected from 3 to 4 feet BLS at four randomly generated nodal sampling locations. These samples were collected using a stainless steel Ponar dredge and analyzed for TCL VOCs, semi-VOCs, TAL metals, PCBs, and pesticides. In addition, two samples, 5002 and 5005, were analyzed for TOC, and two samples, 5003 and 5007, were analyzed for the TCLP parameter list contained in Table 4-16 in the QAPP (WCC 1991b).

During the resampling phase, seven additional sludge samples, three from the north lagoon, 5009 through 5011 (resamples of sludge samples 5001, 5002, and 5004), and four from the south lagoon, 5012 through 5015 (resamples of sludge samples 5005 through 5008), located at approximately the same locations of the original samples, were collected because the laboratory missed holding times for the TCL VOC analysis on the original samples. These samples were analyzed for TCL VOCs only.

### 10.2.3 Surface Water Investigation

Three surface water samples, one from the center of the south lagoon, 3001, one from the center of the north lagoon, 3002, and one near the wastewater flow splitting pool, 3003, were initially collected. These samples were analyzed for Appendix IX constituents listed in 40 CFR 264.

During the resampling phase, one additional surface water sample, 3004 (resample of surface water sample 3001), from the center of the south lagoon was collected because the laboratory missed the holding time for the TCL VOC analysis on the original sample. This sample was analyzed for TCL VOCs only.

### 10.2.4 Groundwater Investigation

Four monitoring wells, 101E, 101F, 101G, and 101H, were purged and sampled. Prior to any well purging or sampling activity, the SWL and total depth to the bottom of the casing were measured in each monitoring well. The groundwater levels and monitoring

well casing depths were recorded to the nearest hundredth of a foot using an electrical water level indicator (well sounder). This information, along with the inside diameter of the well casings, was used to calculate the volume of water in each well casing under static conditions. The volume of water in the well casings ranged between approximately 41.5 to 44.9 gallons in wells 101E through 101H (4-inch diameter wells). Based on these calculations, approximately 5 to 7 well casing volumes were purged from each well (235 gallons from well 101E, 300 gallons from well 101F, 335 gallons from well 101G, and 260 gallons from well 101H).

During the purging process, the field parameters pH, specific conductance, temperature, and color of the removed groundwater were monitored and recorded. In all monitoring wells, the field parameters appeared to be stable (i.e. pH and specific conductance varied by less than 10 percent) from the first purge sample collected to the final field parameter sampled collected with the analytical sample (see the field sampling data sheets for groundwater samples contained in Appendix A-2). Based on these field parameters it was determined that all of the stagnant water in the well casings had been removed. The SWL in all wells recovered to the original level almost instantaneously after shutting the pump off.

Four groundwater analytical samples were collected and analyzed for Appendix IX constituents listed in 40 CFR 264. In addition, the samples from wells 101E and 101G were also analyzed for total metals.

## 10.3 PHYSICAL CHARACTERISTICS

This section provides a discussion of the sediment, surface water hydrology, and hydrogeology at the Wastewater Lagoons based on the review of information on the field sampling data sheets and observations made while sampling during the 1991 WCC investigation, and the review of lithologic boring logs from the previous 1988 Walk, Haydel and Associates field investigation.

### 10.3.1 Sediment

The sediment at the bottom of the lagoons consists predominantly of silt and clay sized particles which have settled out of suspension from the wastewater. These sediments appear to be a greenish black soupy mixture containing approximately 70 to 80 percent free liquid. The thickness of the sediments were measured at each of the eight sludge sampling locations, 5001 through 5008, in the two lagoons. The total thickness of the these sediments appeared to be fairly consistent between each location as well as between lagoons, measuring approximately 2.3 feet in thickness.

### 10.3.2 Surface Water Hydrology

The Wastewater Lagoons consist of two unlined surface impoundments that work in series and have a total surface area of 32 acres. They are constructed with unlined earth bottoms and concrete-lined banks. The average depth of the water is approximately 3.5 feet, with a maximum depth of 4.5 feet. The lagoons are separated by a 12-foot wide levee.

The wastewater treatment system does not have a NPDES permit because the lagoons do not discharge into navigable waters. The discharge goes to a playa lake which is contained within the boundary of Cannon AFB. Periodically, the water in the playa lake is used to irrigate crops. Water not taken up by the plants or evapotranspired, eventually percolates into the subsurface.

The surface water appeared to be a green to sometimes black liquid that contained a high amount (i.e. visually estimated to be approximately 1000 milligrams per liter) of suspended solids. The surface water had an almost chunky appearance at times.

### 10.3.3 Hydrogeology

Information concerning the construction of the monitoring wells or lithology of the monitor well borings is unavailable at this time, so the hydrogeology at the Wastewater Lagoons can only be inferred from information contained in the field boring log for monitor well 096K (Walk, Haydel, and Associates, Inc. 1988) at the Old Entomology

Rinse area. This presumption is justifiable due to the close proximity of this well to the wastewater lagoons, and because of the fairly homogeneous nature of the Ogallala Formation in this area. The hydrostratigraphy at this SWMU consists of Tertiary Miocene to Pliocene fluvial deposits of the Ogallala Formation and is underlain by deposits consisting of well to moderately sorted sands, with scattered layers of caliche in the upper 65 feet. The total thickness of these deposits appears to be approximately 350 feet.

Based on the SWLs measured by WCC and the field boring log, the first water bearing zone encountered in well 096K from 3924 to 4064 feet MSL consists of fine-grained, silty, occasionally calcareous, partially cemented, tan to brown sand. This unit was encountered at approximately 210 feet BGS and appears to be 140 feet thick at this location. Based on the lithologic descriptions, this water-bearing zone represents the water table aquifer beneath the SWMU and occurs under unconfined conditions. The depth to the top of the water table in the four monitoring wells surrounding the lagoons and at the well at the Old Entomology Rinse area measured on November 8, 1991, ranged from approximately 272.25 feet BGS at well 101F to 276.67 feet BGS at well 101E. The static water level elevations ranged from 4003.30 feet MSL at well 101G to 4004.44 feet MSL at well 101E.

Utilizing the SWL measurements at wells 101E through 101H and well 096K, a groundwater potentiometric surface contour map was constructed combining the three-point method for estimating groundwater flow direction with visual contour adjustments (Figure 10-2). This map shows the groundwater flow to be in a southeasterly direction. Based on the potentiometric surface contour map, the hydraulic gradient beneath this SWMU ranged from approximately 0.0004 ft/ft in the northwest portion between wells 101E and 101F to 0.0010 ft/ft in the southeast portion of the SWMU.

## 10.4 NATURE AND EXTENT OF CONTAMINATION

### 10.4.1 Soils

Eight sludge samples, four from SWMU No. 101 (the north impoundment), 5001 through 5004, and four from SWMU No. 102 (the south impoundment), 5005 through 5008, were

collected (Figure 10-1). Evaluation of the chemical analysis (TCL VOCs, semi-VOCs, TAL metals, PCBs/pesticides) of these samples provides the basis for characterizing the nature and extent of contamination at this SWMU.

A variety of organic compounds were identified as being present in sludge samples taken from both the north and south wastewater lagoons. Table 10-4 summarizes the reported concentrations of volatile and semi-volatile organic compounds detected from the wastewater lagoons. The volatile organic compounds detected were acetone and 2-butanone, and the semi-volatile compound, bis(2-ethylhexyl) phthalate was also detected. Acetone is predominant in the south lagoon, while low levels of 2-butanone exist in the north lagoon. Bis (2-ethylhexyl) phthalate is distributed through both lagoons. The four samples from the south lagoon, 5005 through 5008, also had raised reporting limits because of the sample dilution necessitated due to the presence of acetone. The presence of 2-butanone at the low levels in these samples is probably attributable to laboratory contamination since it is a common laboratory contaminant and was detected in 14 of the method blanks analyzed during this project.

Metals analysis of the sludge indicated that barium, chromium, copper, selenium, silver, and zinc exceeded background levels for soils at the site. Table 10-5 summarizes the detected metals content at each sediment (sludge) sampling location and their reported concentrations. Concentration values flagged with a J are reported as an estimated value. It is important to recognize in the comparison in Table 10-5 that the analytical results from the wastewater lagoons are from sludge samples while the background levels are established from on-site samples.

Table 10-6 summarizes the reported concentrations of PCBs/pesticides detected in sludges of the wastewater lagoons. The pesticides, 4,4-DDD, 4,4-DDE, both $\alpha$- and $\gamma$-chlordane, and PCB 1254 were detected (including estimated concentrations) in the sludge from both lagoons. The above compounds were detected at low concentrations and at the same order of magnitude, indicating a rather uniform distribution throughout the lagoon with no apparent "hot spots." It is likely that the low levels of PCB and pesticide in the wastewater lagoon sludge are accumulations over time from various base activities conducted in the past and transferred to the lagoon through the sanitary sewer.

Samples CAN101-101N-5003 and CAN101-101S-5007 were also analyzed by the TCLP method to evaluate the leachability of detected chemicals. Table 10-7 summarizes the analytical results with the maximum contaminant level established by 40 CFR 261.24 for the toxicity characteristic (TC Limit) using TCLP. It should be noted that none of the chemicals exceeded the TC limit. It should be noted that the sample values are not matrix spike recovery corrected as would normally be done to compare TC limits. However, all matrix spike recoveries were within validation guidelines limits, and the sample values are all sufficiently below TC limits that the corrected values would also meet all TC limits.

In summary, the only volatile organics detected above the CRQL in the sludge were acetone and 2-butanone. Phthalates were the only semi-volatile organics detected. The actual presence of these compounds in the sludges of the lagoon is questionable since they are common laboratory contaminants. Low levels of pesticides were reported throughout the sludge of both lagoons. Results of the field sampling estimated the sludge to be approximately 2 feet thick. Of greater uncertainty is the presence of PCBs, since all detected values were flagged as estimated. Metals in the sludge were consistently above background ranges for soils; however, none of the metals were detected above TC limits for the TCLP analyses.

### 10.4.2 Groundwater

Four groundwater samples were collected from existing monitoring wells, E, F, G, and H. The location of the wells is shown on Figure 10-1 and a description of the sampling event is discussed in Section 10.2.4. Wells F, G, and H are located downgradient from the SWMUs and well E is located upgradient. Evaluation of the chemical analyses (Appendix IX constituents in 40 CFR 264) of these samples provides the basis for characterizing the nature and extent of contamination.

No analytes other than metals were detected above the reporting limits.

Metals analysis shown in Table 10-8 revealed the presence of barium and vanadium in all four groundwater samples. Both metals had concentrations below their MCLs (for barium, 1.0 mg/L; for vanadium, no MCL is established). The concentration of barium

ranged from 0.023 mg/L to 0.075 mg/L. The concentration of vanadium ranged from 0.012 mg/L to 0.02 mg/L. Copper was also detected in one groundwater sample, 101G, at a concentration of 0.029 mg/L, well below its secondary MCL of 1.0 mg/L.

Evaluation of the chemical data indicates the quality of groundwater is not impacted by SWMUs 101 and 102.

### 10.4.3 Surface Water

Three surface water samples, one from the center of the south lagoon, 3001, one from the center of the north lagoon, 3002, and one near the wastewater flow splitting pool, 3003, were collected. The location of the samples are shown in Figure 10-1. Evaluation of the chemical analyses (Appendix IX constituents in 40 CFR 264) of these samples has been used to describe the nature and extent of contamination.

The content of detected metals varied according to the location of the specific sample. Table 10-9 summarizes the reported concentrations for the detected metals for each sampling location and compares them with established EPA Ambient Water Quality Criteria for surface water. The largest number of detected metals, 6, was in sample location 3003, near the wastewater flow splitting pool. These chemicals include copper, cyanide, lead, mercury, silver, and zinc.

All three sampling locations detected the presence of sulfide. The concentration ranged from 0.19 mg/L to 3.7 mg/L.

TABLE 10-1

SUMMARY OF LAGOON SLUDGE AND SURFACE WATER SAMPLING CONDUCTED BY WCC AT WASTEWATER LAGOONS, SWMU NOS. 101, 102, CANNON AFB, NEW MEXICO

| LAGOON NUMBER | SAMPLE TYPE | SAMPLING METHOD USED | SAMPLING DEPTH INTERVALS (Ft-BLS) | DATE(S) SAMPLED | NUMBER OF ANALYTICAL SLUDGE SAMPLES COLLECTED | NUMBER OF ANALYTICAL QA/QC SAMPLES COLLECTED | NUMBER OF ANALYTICAL SURFACE WATER SAMPLES COLLECTED | NUMBER OF ANALYTICAL QA/QC SAMPLES COLLECTED | LAGOON SURFACE ELEVATION (Ft-MSL) |
|---|---|---|---|---|---|---|---|---|---|
| 101N | Sludge | Ponar Dredge | 3 to 4 | 10-15-91 | 4 | 2 | NA | NA | 4281.00 |
| | Water(S) | Submersible Bottle | 0 to 0.5 | 10-16-91 | NA | NA | 2 | 4 | 4281.00 |
| (101N)* | Sludge | Ponar Dredge | 3 to 4 | 12-17-91 | 3 | 5 | NA | NA | 4281.00 |
| 101S | Sludge | Ponar Dredge | 3 to 4 | 10-16-91 | 2 | 0 | NA | NA | 4281.00 |
| | Sludge | Ponar Dredge | 3 to 4 | 11-10-91 | 2 | 1 | NA | NA | 4281.00 |
| | Water(S) | Submersible Bottle | 0 to 0.5 | 10-16-91 | NA | NA | 1 | 2 | 4281.00 |
| (101S)* | Sludge | Ponar Dredge | 3 to 4 | 12-17-91 | 4 | 0 | NA | NA | 4281.00 |
| | Water(S) | Submersible Bottle | 0 to 0.5 | 12-17-91 | NA | NA | 1 | 2 | 4281.00 |

Ft-BLS Feet Below Lagoon Surface
Ft-MSL Feet Mean Sea Level
(S) Surface Water Sample
NA Not Applicable

( )* The samples that are shaded and in parentheses are resamples of the previous lagoon sludge or surface water sample due to laboratory missed holding times. These samples were collected as close to the original sampling location as possible.

TABLE 10-2

SUMMARY OF MONITORING WELL PURGING AND SAMPLING CONDUCTED BY WCC AT WASTEWATER LAGOONS, SWMU NOS. 101,102 , CANNON AFB, NEW MEXICO

| MONITORING WELL NUMBER | DATE INSTALLED | DRILLING METHOD | SCREENED INTERVAL (Ft-BGS) | SCREEN SLOT SIZE (In) | GRAVEL PACK INTERVAL (Ft-BGS) | BENTONITE SEAL INTERVAL (Ft-BGS) | GROUND SURFACE ELEVATION (Ft-MSL) | MEASURING POINT ELEVATION (Ft-MSL) | DATE(S) EVACUATED/ SAMPLED | EVACUATION AND SAMPLING METHOD | INITIAL SWL (Ft-BTOC) (Ft-MSL) | TOTAL DEPTH OF WELL (Ft-BGS) | WELL CASING DIAMETER (In) | WELL VOLUME UNDER STATIC CONDITIONS (GALLONS) | VOLUME OF WATER EVACUATED (GALLONS) | FINAL SWL (Ft-BTOC) (Ft-MSL) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 101E | 11-11-85 | MR | 355-370 | 0.010 | 350-373 | 348-350 | 4281.11 | 4283.06 | 11-11-91 | Submersible Pump | 278.62<br>4004.44 | 373.00 | 4.0 | 61.61 | 210 | 278.66<br>4004.40 |
| 101F | 11-19-85 | MR | 355-370 | 0.010 | 350-375 | 348-350 | 4276.30 | 4279.29 | 12-16-91 | Submersible Pump | 275.24<br>4004.05 | 375.00 | 4.0 | 65.12 | 225 | 275.21<br>4004.08 |
| 101G | 11-06-85 | MR | 357-372 | 0.010 | 355-372 | 353-355 | 4277.81 | 4280.02 | 11-09-91 | Submersible Pump | 276.72<br>4003.30 | 372.00 | 4.0 | 62.20 | 225 | 277.36<br>4002.66 |
| 101H | 11-18-85 | MR | 356-371 | 0.010 | 354-376 | 352-354 | 4277.33 | 4279.50 | 11-09-91 | Submersible Pump | 276.30<br>4003.20 | 376.00 | 4.0 | 65.08 | 216 | 276.30<br>4003.20 |

Ft-BGS Feet Below Ground Surface
In Inches
Ft-MSL Feet Mean Sea Level
Ft-BTOC Feet Below Top of Casing
SWL Static Water Level
MR Mud Rotary

**Woodward-Clyde Consultants**

TABLE 10-3

SUMMARY OF LAGOON SLUDGE, SURFACE WATER, GROUNDWATER, AND QA/QC SAMPLES
COLLECTED BY WCC AT WASTEWATER LAGOONS, SWMU NOS. 101,102, CANNON AFB, NEW MEXICO

| LAGOON/ WELL NUMBER | DEPTH INTERVAL (Ft-BLS) | SAMPLE IDENTIFICATION NUMBER | SAMPLE TYPE | QA/QC SAMPLES | SAMPLE MATRIX | DATE SAMPLED | TIME SAMPLED | OVA ON SAMPLE (ppm) | ANALYTICAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|---|
| 101N | 3 to 4 | CAN101-101N-5001 | A | MS/MSD | Sludge | 10-15-91 | 1630 | | VOC,SV,M,PCB |
| | | CAN101-101N-0461 | A | FD | Sludge | 10-15-91 | 1630 | | VOC,SV,M,PCB |
| | 3 to 4 | (CAN101-101N-5009)* | A | | Sludge | 12-17-91 | 1130 | | VOC |
| | 3 to 4 | CAN101-101N-5002 | A | | Sludge | 10-15-91 | 1726 | | VOC,SV,M,PCB,TOC |
| | 3 to 4 | (CAN101-101N-5010)* | A | MS/MSD | Sludge | 12-17-91 | 1250 | | VOC |
| | | (CAN101-101N-0463)* | A | FD | Sludge | 12-17-91 | 1245 | | VOC |
| | | (CAN101-101N-0452)* | A | AB | Water | 12-17-91 | 1255 | | VOC |
| | | (CAN101-101N-0473)* | A | RB | Water | 12-17-91 | 1305 | | VOC |
| | | (CAN101-101N-0482)* | A | DW | Water | 12-17-91 | 1315 | | VOC |
| | 3 to 4 | CAN101-101N-5003 | A | | Sludge | 10-15-91 | 1813 | | SV,M,PCB,TCLP |
| | 3 to 4 | CAN101-101N-5004 | A | | Sludge | 10-15-91 | 1836 | | VOC,SV,M,PCB |
| | 3 to 4 | (CAN101-101N-5011)* | A | | Sludge | 12-17-91 | 1215 | | VOC |
| | 0 to 0.5 | CAN101-101N-3002 | A | | Water(S) | 10-16-91 | 0935 | | Appendix IX |
| | | CAN101-101N-0451 | A | AB | Water | 10-16-91 | 0953 | | VOC |
| | | CAN101-101N-0492 | A | TB | Water | 10-16-91 | 0953 | | VOC |
| | 0 to 0.5 | CAN101-101N-3003 | A | MS/MSD | Water(S) | 10-16-91 | 1145 | | Appendix IX |
| | | CAN101-101N-0492 | A | TB | Water | 10-16-91 | 1145 | | VOC |
| 101S | 3 to 4 | CAN101-101S-5005 | A | | Sludge | 10-16-91 | 1726 | | VOC,SV,M,PCB,TOC |
| | 3 to 4 | (CAN101-101N-5012)* | A | | Sludge | 12-17-91 | 1520 | | VOC |
| | 3 to 4 | CAN101-101S-5006 | A | | Sludge | 10-16-91 | 1748 | | VOC,SV,M,PCB |
| | 3 to 4 | (CAN101-101N-5013)* | A | | Sludge | 12-17-91 | 1530 | | VOC |
| | 3 to 4 | CAN101-101S-5007 | A | | Sludge | 10-16-91 | 1810 | | VOC |
| | 3 to 4 | CAN101-101S-5007 | A | | Sludge | 11-10-91 | 1415 | | SV,M,PCB,TCLP |
| | 3 to 4 | (CAN101-101N-5014)* | A | | Sludge | 12-17-91 | 1600 | | VOC |
| | 3 to 4 | CAN101-101S-5008 | A | | Sludge | 11-10-91 | 1500 | | VOC,SV,M,PCB |
| | | CAN101-101S-0471 | A | RB | Water | 11-10-91 | 1325 | | VOC,SV,M,PCB |
| | 3 to 4 | (CAN101-101N-5015)* | A | | Sludge | 12-17-91 | 1545 | | VOC |
| | 0 to 0.5 | CAN101-101S-3001 | A | | Water(S) | 10-16-91 | 1615 | | Appendix IX |
| | | CAN101-101S-0462 | A | FD | Water(S) | 10-16-91 | 1615 | | Appendix IX |
| | | CAN101-101S-0492 | A | TB | Water | 10-16-91 | 1615 | | VOC |
| | 0 to 0.5 | (CAN101-101S-3004)* | A | | Water(S) | 12-17-91 | 1455 | | VOC |
| | | (CAN101-101S-0464)* | A | FD | Water(S) | 12-17-91 | 1500 | | VOC |
| | | (CAN101-101S-0493)* | A | TB | Water | 12-17-91 | 1600 | | VOC |
| 101E | | CAN101-101E-2001 | A | | Water(G) | 11-11-91 | 1200 | | Appendix IX |
| | | CAN101-101E-0481 | A | DW | Water | 11-13-91 | 1000 | | VOC |
| 101F | | CAN101-101F-2001 | A | | Water(G) | 12-17-91 | 1420 | | Appendix IX |
| | | CAN101-101F-0493 | A | TB | Water | 12-17-91 | 1430 | | VOC |
| 101G | | CAN101-101G-2001 | A | MS/MSD/EPA | Water(G) | 11-09-91 | 0915 | | Appendix IX |
| | | CAN101-101G-0463 | A | FD | Water(G) | 11-09-91 | 0800 | | Appendix IX |
| | | CAN101-101G-0402 | A | MRD | Water(G) | 11-09-91 | 0915 | | Appendix IX |
| | | CAN101-101G-0491 | A | TB | Water | 11-09-91 | 0915 | | VOC |
| 101H | | CAN101-101H-2001 | A | EPA | Water(G) | 11-09-91 | 1630 | | Appendix IX |
| | | CAN101-101H-0452 | A | AB | Water | 11-09-91 | 1400 | | VOC |

TABLE 10-3

SUMMARY OF LAGOON SLUDGE, SURFACE WATER, GROUNDWATER, AND QA/QC SAMPLES
COLLECTED BY WCC AT WASTEWATER LAGOONS, SWMU NOS. 101,102, CANNON AFB, NEW MEXICO

| | | | | | |
|---|---|---|---|---|---|
| Ft-BLS | Feet Below Lagoon Surface | FD | Field Duplicate | SV | Semi Volatile Organic Compounds |
| OVA | Organic Vapor Analyzer Reading | MRD | Missouri River Division Duplicate | M | Metals (TAL) |
| ppm | Parts per Million | AB | Ambient Blank | TPH | Total Petroleum Hydrocarbons |
| A | Analytical | RB | Rinsate Blank | BTEX | Benzene, Toluene, Ethylbenzene, Xylene |
| SPT | Standard Penetration Test | DW | Decontamination Water Blank | | |
| GA | Gradation Analysis | TB | Trip Blank | TOC | Total Organic Carbon |
| L | Lithology | VOC | Volatile Organic Compounds (TCL) | OL | Organic Lead |
| MS/MSD | Matrix Spike / Matrix Spike Duplicate | PCB | Polychlorinated Biphenols, Pesticides | Pb/Cr | Lead / Chromium |
| | | TCL | Target Compound List | TAL | Target Analyte List |
| (G) | Groundwater Sample | (S) | Surface Water Sample | | |

( )* The samples that are shaded and in parenthese are resamples of the previous lagoon sludge or surface water sample due to laboratory missed holding times. These samples were collected as close to the original sampling location as possible.

## TABLE 10-4

## VOLATILE AND SEMI-VOLATILE ORGANIC COMPOUND CONCENTRATIONS IN SLUDGE SAMPLES COLLECTED BY WCC AT WASTEWATER LAGOONS

### SWMU NOS. 101, 102
### CANNON AFB, NEW MEXICO

| | Volatiles | | Semi-Volatiles |
|---|---|---|---|
| Sample Number (Resample Number) | Acetone (ug/kg) | 2-Butanone (ug/kg) | bis(2-ethylhexyl) phthalate (ug/kg) |
| CAN101-101N-5001 (5009) | (610) | (410) | 19,000J |
| -5002 (5010) | (620) | (93U) | 340,000J |
| -5003 | NA | NA | 38,000 |
| -5004 (5011) | (1,300J) | (160U) | 24,000 |
| CAN101-101S-5005 (5012) | (6,900J) | (8900U) | 150,000J |
| -5006 (5013) | (14,000) | (6000U) | 31,000J |
| -5007 (5014) | (12,000) | (3900U) | 6,100U |
| -5008 (5015) | (17,000) | (9600U) | 16,000UJ |

ug/kg = Micrograms per kilogram
U = Not detected
J = Estimated value
UJ = Estimated as non-detect at the CRQL
( ) = The values in parentheses are results from samples collected from the redrill borings due to laboratory missed holding times
NA = Not analyzed; original sample exceeded holding times and no resample was collected

## TABLE 10-5

## ELEVATED METALS CONCENTRATIONS[1] IN SLUDGE SAMPLES COLLECTED BY WCC AT WASTEWATER LAGOONS

## SWMU NOS. 101, 102
## CANNON AFB, NEW MEXICO

| Sample Number | Calcium | Barium | Cadmium | Chromium | Copper | Selenium | Silver | Vanadium | Zinc |
|---|---|---|---|---|---|---|---|---|---|
| CAN101-101N-5001 | 49,800 | 309J | U | 39.8 | 213 | 8.7J | 54 | 75J | 388 |
| -5002 | 34,300 | 295J | U | 41.5 | 346 | 6.5J | 61 | 53J | 502 |
| -5003 | 20,900 | 260 | 5.1 | 28.7 | 111 | 6.6 | 35 | 45 | 251 |
| -5004 | 15,500 | 230 | 3.4J | 28.0 | 98 | 1.2J | 31 | 45 | 212 |
| CAN101-101S-5005 | 54,300 | 528J | U | 51.0J | 312 | 35.3 | 97 | 98J | 580 |
| -5006 | 58,600 | 342J | U | 34.5 | 168 | 13.8J | 55 | 76J | 330 |
| -5007 | 42,900 | 382J | U | 19.2J | 208 | 11.5 | 61 | 60J | 450 |
| -5008 | 35,700 | 635 | U | 32.6 | 289 | 15.6 | 83 | 77J | 672 |
| Background[2] ($x- + 2\sigma$) | 0-193062 | 0-903 | 0.81-1.01 | 2.67-9.31 | 0.00-15.44 | 0-1.35 | 0.86-0.94 | 9.26-26.74 | 4.58-21.82 |

U = Not detected
J = Estimated value

[1] All concentrations are in milligrams per kilogram (mg/kg).
[2] Background range calculated from values in Table 2-7

## TABLE 10-6

## PCB/PESTICIDE CONCENTRATIONS[1] IN SLUDGE SAMPLES COLLECTED BY WCC AT WASTEWATER LAGOONS

## SWMU NOS. 101, 102
## CANNON AFB, NEW MEXICO

| Sample Number | Pesticides | | | | PCBs |
|---|---|---|---|---|---|
| | 4,4-DDD | 4,4-DDE | ∞-Chlordane | γChlordane | PCB 1254 |
| CAN101-101N-50001 | 55UJ | 55UJ | 28UJ | 28UJ | 550U |
| -5002 | 11J | 15UJ | 7.7UJ | 4J | 82J |
| -5003 | 19J | 63 | 31 | 42J | 300J |
| -5004 | 53 | 55 | 31 | 45 | 270J |
| CAN101-101S-5005 | 66U | 90 | 23J | 34U | 490J |
| -5006 | 30U | 26J | 15 | 15U | 300U |
| -5007 | 16 | 43 | 7.8J | 8.2UJ | 220J |

U = Not detected
J = Estimated value
UJ = Estimated as non-detect at the CRQL

[1] All concentrations are in micrograms per kilogram ($\mu$g/kg)

# TABLE 10-7

## TCLP RESULTS[1] FOR SLUDGE SAMPLES COLLECTED BY WCC AT WASTEWATER LAGOONS

## SWMU NOS. 101, 102
## CANNON AFB, NEW MEXICO

| Compound | Sample Number | | TC Limit[2] |
|---|---|---|---|
| | CAN101-101N-5003 | CAN101-101S-5007 | |
| 1,1-Dichloroethene | 0.025U | 0.025U | 0.7 |
| 1,1-Dichloroethane | 0.025U | 0.025U | 0.5 |
| 1,4-Dichlorobenzene | 0.05U | 0.05UJ | 7.5 |
| 2,4,5-TP (Silvex) | 0.001U | 0.001U | 1.0 |
| 2,4,5-Trichlorophenol | 0.0066 | 0.25UJ | 400.0 |
| 2,4,6-Trichlorophenol | 0.05U | 0.05UJ | 2.0 |
| 2,4-D | 0.005U | 0.005U | 10.0 |
| 2,4-Dinitrotoluene | 0.05U | 0.05UJ | 0.13 |
| 2-Butanone | 0.05U | 0.05U | 200.0 |
| 2-Methylphenol | 0.05U | 0.05UJ | 200.0 |
| 3/4-Methylphenol | 0.0064 | 0.05UJ | 200.0 |
| Arsenic | 1.0U | 1.0U | 5.0 |
| Barium | 0.25 | 1.2 | 100.0 |
| Benzene | 0.025U | 0.025U | 0.5 |
| Cadmium | 0.0075J | 0.05U | 1.0 |
| Carbon Tetrachloride | 0.025U | 0.025U | 0.5 |
| Chlordane | 0.005U | 0.005U | 0.03 |
| Chlorobenzene | 0.025U | 0.025U | 100.0 |
| Chloroform | 0.025U | 0.025U | 6.0 |
| Chromium | 0.038J | 0.1U | 5.0 |
| Endrin | 0.001U | 0.001U | 0.02 |

**TABLE 10-7**
**(Concluded)**

| Compound | Sample Number | | TC Limit[2] |
|---|---|---|---|
| | CAN101-101N-5003 | CAN101-101S-5007 | |
| Hexachlor (and its epoxide) | 0.0005U | 0.0005U | 0.008 |
| Hexachlorobenzene | 0.05U | 0.05UJ | 0.13 |
| Hexachlorobutadiene | 0.05U | 0.05UJ | 0.5 |
| Hexachloroethane | 0.05U | 0.05UJ | 3.0 |
| Lead | 0.5U | 0.5U | 5.0 |
| Mercury | 0.002U | 0.002U | 0.2 |
| Methoxychlor | 0.005U | 0.005U | 10.0 |
| Nitrobenzene | 0.05U | 0.05UJ | 2.0 |
| Pentachlorophenol | 0.0078J | 0.25UJ | 100.0 |
| Pyridine | 0.1U | 0.1UJ | 5.0 |
| Selenium | 0.05U | 0.1UJ | 1.0 |
| Silver | 0.017J | 0.1UJ | 5.0 |
| Tetrachloroethene | 0.025U | 0.0071J | 0.7 |
| Toxaphene | 0.05U | 0.05U | 0.5 |
| Trichloroethene | 0.025U | 0.025U | 0.5 |
| Vinyl Chloride | 0.05U | 0.05U | 0.2 |
| gamma-BHC (Lindane) | 0.0005U | 0.0005U | 0.4 |

U = Not detected.
J = Estimated value
UJ = Estimated as non-detect at the CRQL

[1] All concentrations are in milligrams per liter (mg/L)
[2] TC Limit as established by 40 CFR 261.24 for the Toxicity Characteristic Rule

## TABLE 10-8

## DISSOLVED METALS CONCENTRATIONS[1] IN GROUNDWATER SAMPLES COLLECTED BY WCC AT WASTEWATER LAGOONS

### SWMU NOS. 101, 102
### CANNON AFB, NEW MEXICO

| Element | (mg/L) NMED | (mg/L) EPA | Upgradient Well 101E (mg/L) TAP | Downgradient Well 101F | Well 101G | Well 101H | MCL[2] |
|---|---|---|---|---|---|---|---|
| Antimony | — | 6 | 0.06 U | 0.06 U | 0.06 U | 0.06 U | 0.01/0.005[3] |
| Arsenic | 0.1 | 0.01 | 0.005 U | 0.005 U | 0.005 U | 0.005 U | 0.05 |
| Barium | 1.0 | 2 | 0.022 J | 0.075 | 0.026 J | 0.026 J | 1.0 |
| Beryllium | — | 0.004 | 0.002 U | 0.002 U | 0.002 U | 0.002 U | 0.01[3] |
| Cadmium | 0.01 | 0.005 | 0.005 U | 0.005 U | 0.005 U | 0.005 U | 0.005[3] |
| Chromium | 0.05 | 0.1 | 0.01 U | 0.01 U | 0.01 U | 0.01 U | 0.1 |
| Cobalt | — | — | 0.01 U | 0.01 U | 0.01 U | 0.01 U | * |
| Copper | — | 0.739 | 0.02 U 0.739 | 0.02 U | 0.02 U | 0.02 U | 1.0[4] |
| Lead | 0.05 | 0.015 | 0.005 U | 0.005 U | 0.005 U | 0.005 U | 0.05 |
| Mercury | 0.002 | / | 0.0002 U | 0.0002 U | 0.0002 U | 0.0002 U | 0.002 |
| Nickel | — | 0.10 | 0.04 U | 0.04 U | 0.0045 J | 0.04 U | 1.0[3] |
| Selenium | 0.05 | 0.05 | 0.01 UJ | 0.025 U | 0.0082 J | 0.024 J | 0.05 |
| Silver | 0.05 | | 0.01 U 0.13 | 0.01 U | 0.01 U | 0.01 U | 0.1[4] |

**TABLE 10-8**
**(Concluded)**

| Element | | | Upgradient Well 101E | Downgradient Well 101F | Downgradient Well 101G | Downgradient Well 101H | MCL[2] |
|---|---|---|---|---|---|---|---|
| Thallium | NMED — | EPA 0.002 | 0.01 UJ | 0.05 UJ | 0.02 UJ | 0.01 UJ | 0.022/0.001[3] |
| Tin | — | — | 0.1 U | 0.1 U | 0.1 U | 0.1 U | * |
| Vanadium | | | 0.02 | 0.012 | 0.012 | 0.016 | * |
| Zinc | 10 | | 0.0041 J 0.037 | 0.011 J | 0.0075 U | 0.02 U | 5.0[4] |

MCL = Maximum contaminant level
UJ = Estimated as non-detect at the CRQL
J = Estimated value
U = Not detected

[1] All concentrations are in milligrams per liter (mg/L)
[2] Primary MCL in effect as of July 30, 1992
[3] Proposed primary MCL
[4] Secondary MCL in effect as of July 30, 1992
* No primary or secondary MCL or proposed MCL as of March 1992

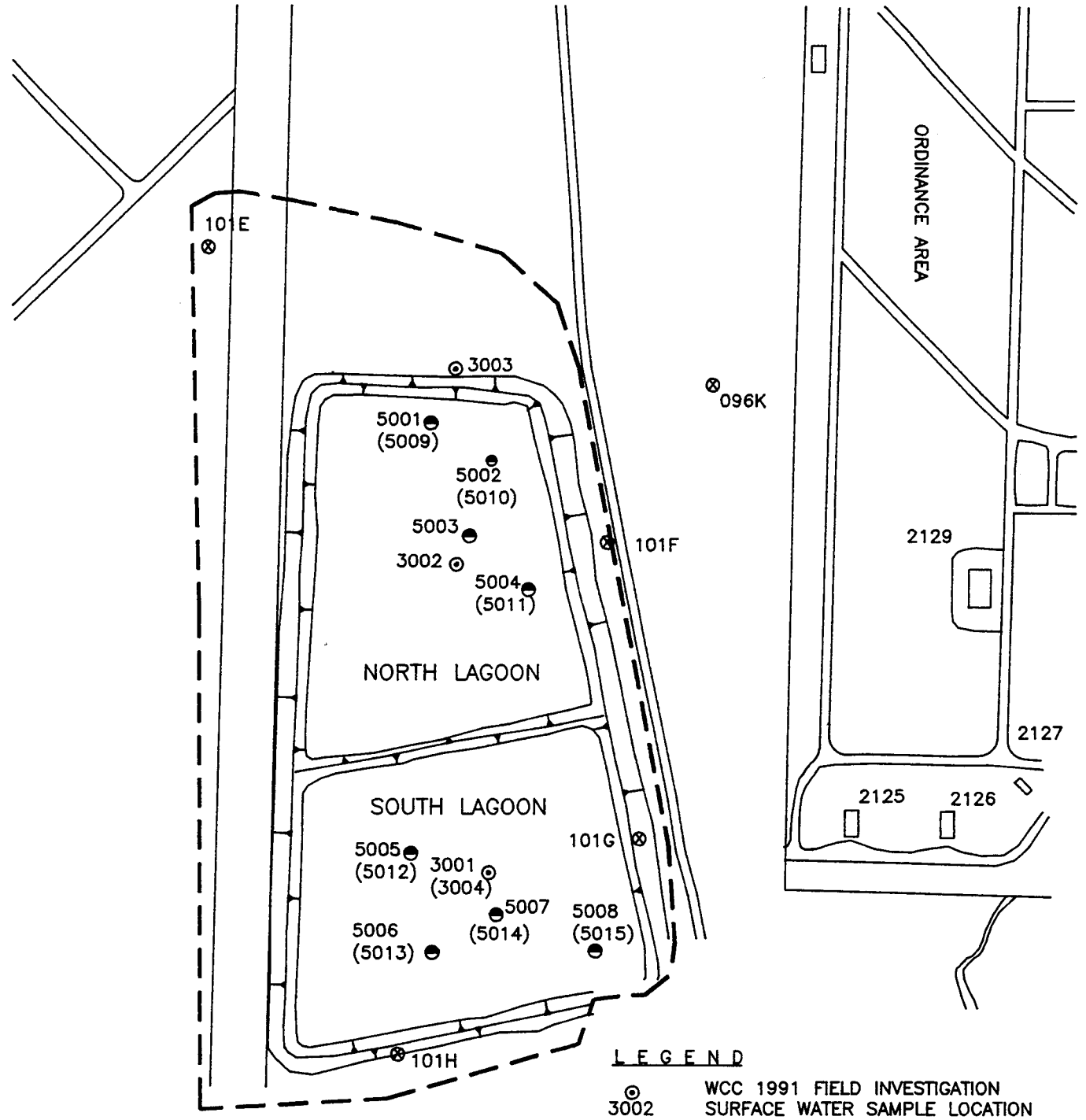
# TABLE 10-9

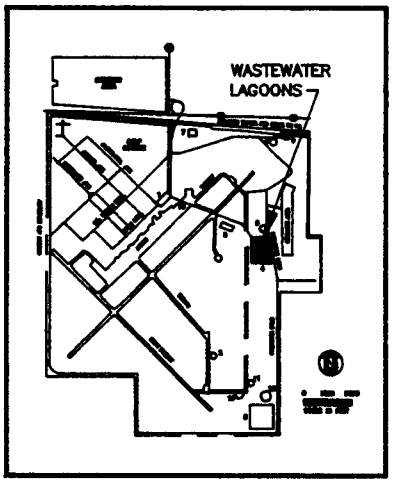
## COMPARISON OF THE CONCENTRATIONS OF DETECTED METALS TO MCLs IN SURFACE WATER SAMPLES COLLECTED BY WCC AT WASTEWATER LAGOONS

## SWMU NOS. 101, 102
## CANNON AFB, NEW MEXICO

| | | | AWQC for Protection of Aquatic Life | | Attainable or Designated Uses | |
|---|---|---|---|---|---|---|
| Sample Number | Element | Concentration (mg/L) | Acute | Chronic Value | Irrigation | Livestock & Wildlife Watering |
| CAN101-101N-3001 | Barium | 0.059 | * | * | * | * |
| | Lead | 0.032 | .082 | .0032 | 5.0 | .1 |
| CAN101-101N-3002 | Barium | 0.11 | * | * | * | * |
| | Copper | 0.02 | 0.18 | .012 | .2 | .5 |
| | Zinc | 0.032 | .120 | .110 | 2.0 | 25.0 |
| CAN101-101N-3003 | Barium | 0.1 | * | * | * | * |
| | Copper | 0.051 | .018 | .012 | .2 | .5 |
| | Lead | 0.0071 | .082 | .0032 | 5.0 | .1 |
| | Mercury | 0.0011 | .0024 | .000012 | * | .010 |
| | Silver | 0.04J | .0041 | .00012 | * | * |
| | Vanadium | 0.038 | * | * | .1 | .1 |
| | Zinc | 0.12 | .120 | .110 | 2.0 | 25.0 |

MCL = Maximum contaminant level
mg/L = Milligrams per liter
J = Estimated value
* = No standard for this metal




N

0 200 400

SCALE IN FEET

LEGEND

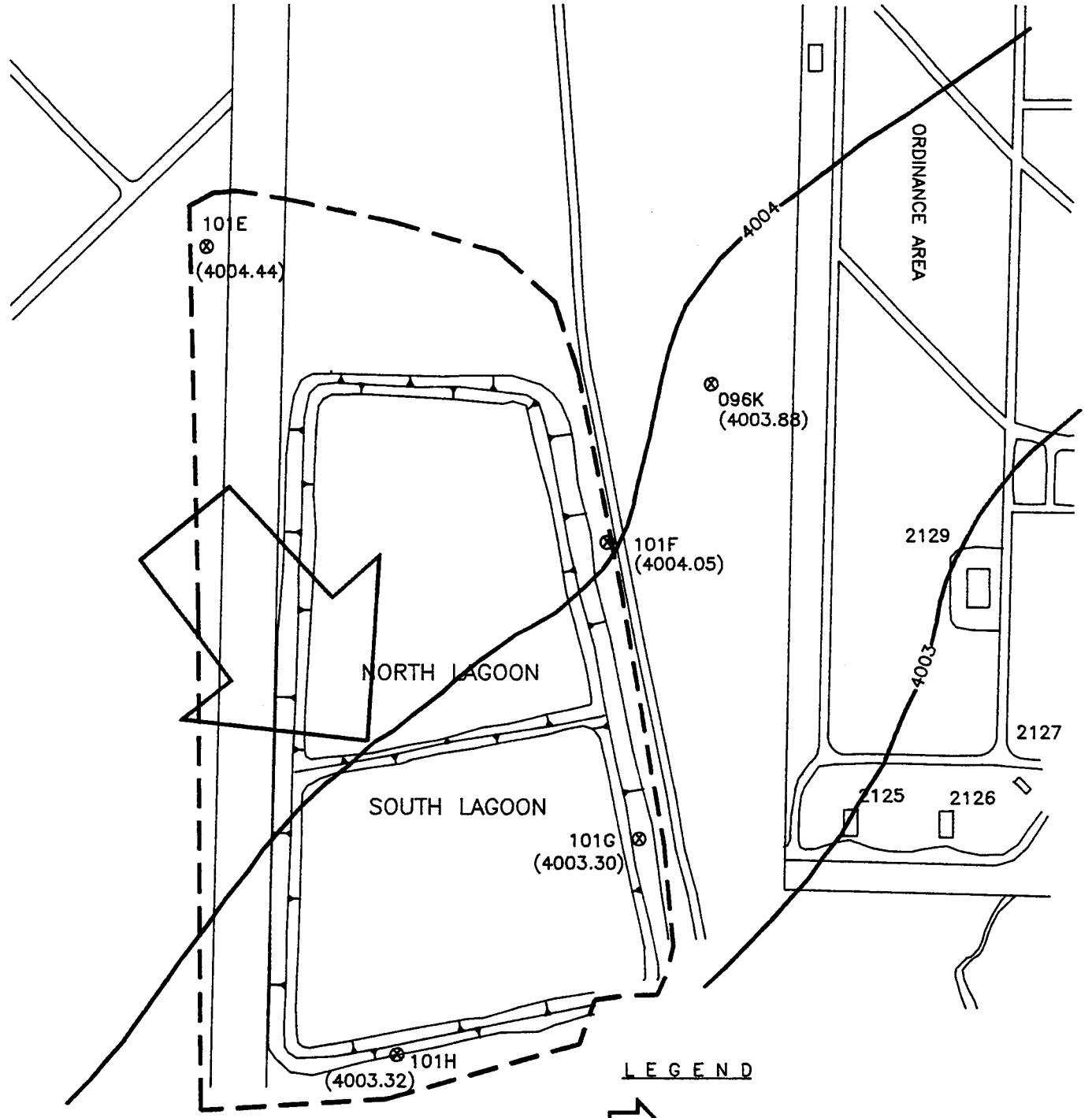
| | |
|---|---|
| 3002 | WCC 1991 FIELD INVESTIGATION SURFACE WATER SAMPLE LOCATION |
| 5005 | WCC 1991 FIELD INVESTIGATION SLUDGE SAMPLE LOCATION |
| 101G | MONITORING WELL LOCATION |
| — — | SWMU BOUNDARY |
| 2129 | BUILDING NUMBER |

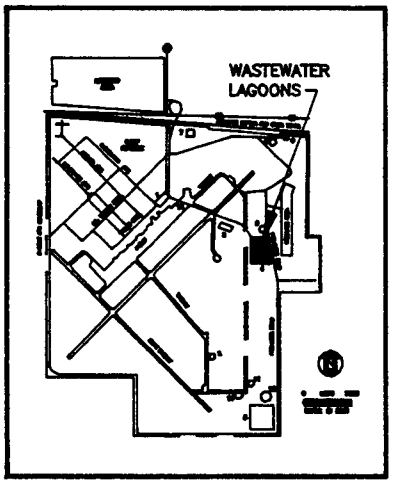
NOTE: THE NUMBERS IN PARENTHESIS CORRESPOND TO REDRILLS/RESAMPLES OF THE ORIGINAL BORING/SAMPLE

| | |
|---|---|
| Job No. : 89MC114W | LOCATION OF SLUDGE/SURFACE WATER SAMPLES AND MONITORING WELLS AT WASTEWATER LAGOONS SWMU NOS.101,102 CANNON AFB, NEW MEXICO |
| Prepared by : D.A.K. | |
| Date : 2/17/92 | |

C1140014

FIG. 10–1




N

0 200 400

SCALE IN FEET

LEGEND

GROUNDWATER FLOW DIRECTION

101G MONITORING WELL LOCATION

SWMU BOUNDARY

4003 POTENTIOMETRIC SURFACE CONTOUR LINE IN FEET MEAN SEA LEVEL

2125 BUILDING NUMBER

NOTE: THE NUMBER IN PARENTHESIS IS THE STATIC WATER LEVEL IN FEET MEAN SEA LEVEL MEASURED ON NOV. 8,1991

| | |
|---|---|
| Job No. : 89MC114W | POTENTIOMETER SURFACE CONTOUR MAP AT WASTEWATER LAGOONS |
| Prepared by : D.A.K. | SWMU NOS.101,102 |
| Date : 2/17/92 | CANNON AFB, NEW MEXICO |

C1140018

FIG. 10–2

# 11.0
# FIRE DEPARTMENT TRAINING AREA NO. 2 (SWMU NO. 106/IRP NO. FT-7)

## 11.1 SWMU DESCRIPTION

### 11.1.1 Setting

This SWMU is located in the southeast corner of the base bounded on the north by an east-west paved road and west of an old abandoned north-south runway. The unit consists of two small round depressions in the land surface that is sparsely vegetated and measures approximately 250 feet across (Figure 11-1).

### 11.1.2 History of Use

Fire Training Area No. 2 was used from 1968 to 1974 to provide fire extinguishing experience for base personnel. The ground was saturated with water and unused JP-4 fuel was introduced to create fires. Approximately 300 gallons of fuel was burned at each exercise, which occurred about eight times per year (USAF 1990).

### 11.1.3 Past Investigations

During 1984, Radian Corporation drilled one deep soil boring (Boring No. 7) on the west side of the lowest point of the area. Results of soil sample analyses, shown in Table 11-1, indicate the presence of oil and grease, and lead at this SWMU (Radian 1986).

### 11.1.4 Land Use and Demography

This unit is located in an open grass-covered field. The area is currently not in use. Due to the remoteness and inactivity of this SWMU, no personnel use the area.

## 11.2 FIELD INVESTIGATION

This section provides a discussion of the field activities conducted by WCC at Fire Department Training Area No. 2 from October 23 through 26, 1991 and on December 5, 1991. The activities at this SWMU, as outlined in the FSP (WCC 1991c), consisted of collecting 4 surface soil samples for chemical analysis, 1 surface soil sample for gradation analysis, drilling 4 soil borings, and collecting 16 subsurface soil samples for chemical analysis and 7 subsurface soil samples for gradation analysis. The resampling phase of the field program, which became necessary due to laboratory missed holding times, consisted of redrilling 2 soil borings and recollecting 4 subsurface soil samples for chemical analysis.

Table 11-2 summarizes the drilling and sampling methods, along with sampling frequency conducted at each soil boring and surface soil sample location during the 1991 WCC investigation. A complete record of all surface soil, subsurface soil, and associated QA/QC samples collected at Fire Department Training Area No. 2 is presented in Table 11-3. The locations of the surface samples and soil borings are shown on Figure 11-1.

### 11.2.1 Sampling Objectives

The objective of sampling at Fire Department Training Area No. 2 was to evaluate the nature and extent of potential hazardous contaminants that may be present. The surface soil and subsurface soil sampling programs were designed to supplement previous investigations. The data collected at these boring locations were used to further evaluate the extent of potential contamination, if present, and to perform a baseline risk assessment to determine if the area poses a risk to human health or the environment. The data may also be utilized to evaluate remedial actions if necessary. Presently, there does not appear to be any substantial risk to the groundwater, so no hydrogeologic investigation was planned or conducted.

### 11.2.2 Surface Soil Investigation

Four surface soil samples were collected from 0 to 0.5 feet BGS near soil borings 1061 through 1064. These samples were collected using a stainless steel hand trowel and analyzed for BTEX, TPH, and lead/chromium. In addition, the sample from boring 1091 was sent out for geotechnical gradation analysis.

### 11.2.3 Subsurface Soil/Vadose Zone Investigation

Four soil borings, 1061 through 1064, were drilled to depths of 32, 31, 32, and 32 feet BGS, respectively, two in each of the lobe-type depressions within the SWMU. Boring 1061 was located as close as possible to Radian's 1984-1985 field investigation boring 7. Each soil boring was sampled continuously to a depth of 20 feet BGS and at 5-foot intervals from 20 feet BGS to total depth. All soil borings were described lithologically from the split spoon samples obtained during drilling. Subsurface samples for chemical analysis were collected at 4, 10, 20, and 30 feet BGS in borings 1061, 1063, and 1064, and at 6, 10, 20, and 30 feet BGS in boring 1062 for a total of sixteen subsurface soil samples. The subsurface analytical samples were collected with stainless steel split spoons and analyzed for TCL VOCs, TPH, and lead/chromium. Seven subsurface samples for geotechnical gradation analysis were collected at 14 feet BGS in boring 1061, at 2 and 18 feet BGS in boring 1062, at 4 and 25 feet BGS in boring 1063, and at 8 and 30 feet BGS in boring 1064.

During the resampling phase, two additional soil borings, 1065 and 1066 (redrills of borings 1061 and 1063), located approximately 2 feet east and 3 feet southeast, respectively, from the original borings, were drilled to depths of 6 and 32 feet BGS, respectively, and sampled at the same intervals where analytical subsurface soil samples were collected in the original boring. Four additional subsurface soil samples were collected at 4 feet BGS in boring 1065 and at 4, 20, and 30 feet BGS in boring 1066 because the laboratory missed holding times for the TCL VOC analyses on the original samples. These samples were analyzed for TCL VOCs only.

## 11.3 PHYSICAL CHARACTERISTICS

This section provides a discussion of the soil, geology and hydrogeology at Fire Department Training Area No. 2 based on the detailed lithologic descriptions of split spoon samples and gradation analysis results from the 1991 WCC investigation, and the review of the lithologic boring logs from the previous 1984-1985 Radian field investigation.

### 11.3.1 Soil

The soils underlying the Fire Department Training Area No. 2 area consist of sandy loam and loamy sand of the Amarillo Soil Group. The soils consist primarily of very fine- to fine-grained, well sorted, silty, clayey, unconsolidated red-brown sands. The sands are comprised predominantly of subangular quartz grains. One gradation analysis was performed on a sample collected within this unit at 0.5 feet BGS in boring 1061. The results indicate that this soil sample was comprised of approximately 44 percent sand, 28 percent silt, and 28 percent clay. The sands are generally dry to slightly moist at depth with a thickness ranging between 1 to 4 feet.

### 11.3.2 Geology

The near surface (upper 58 feet) stratigraphy at Fire Department Training Area No. 2 consists of Tertiary Miocene to Pliocene fluvial deposits of the Ogallala Formation. Geologic cross-section J-J' (Figure 11-2) was constructed using information on the lithologic boring logs from the 1991 WCC field investigation along with one boring log, 7, from the 1984-1985 Radian field investigation. This cross-section runs west-east (see Figure 11-1 for the cross-section location). Stratigraphic correlations of the various fluvial deposits between borings is based primarily on the split spoon lithologic samples collected during drilling.

The SWMU is underlain by Ogallala fluvial deposits consisting primarily of well to moderately sorted sand, with prominent (4 to 12 feet thick) layers of caliche. The total thickness of these Ogallala deposits beneath the SWMU is not presently known, but based on regional information, may be as thick as 390 feet.

It would appear from the geologic cross-section and the lithologic descriptions (Appendix B-1) that one, and possibly two, distinct sand, sand/caliche units are present beneath the SWMU to a depth of 58 feet. The lower fluvial deposits shown on the geologic cross-section from 4202 to 4221 feet MSL consist of medium-grained, moderately sorted, light to medium orange sands. These sands are comprised predominantly of quartz grains, with varying amounts of silt and clay. Occasionally, there are hard caliche pockets throughout. This unit was only encountered in the Radian boring 7 at approximately 40 feet BGS. The thickness of this unit is unknown at present due to the fact that the unit was not fully penetrated, but is at least 19 feet thick at this SWMU.

The upper fluvial deposits shown on the geologic cross-section from 4221 to 4260 feet MSL consist of fine- to very fine-grained, well sorted, silty, calcareous, medium to light red-brown to pale brown sands. These sands are comprised predominantly of subangular to angular quartz grains with varying amounts of silt and calcium carbonate. Occasionally, these sands are moderately to well cemented with calcium carbonate. Prominent layers (ranging from 4 to 12 feet in thickness) and small pockets or nodules of light red-brown to pale brown, silty, sandy, clayey caliche are scattered throughout this unit.

Six gradation analyses were performed on samples collected within this unit, two from the caliche at 2 feet BGS in boring 1062 and at 4 feet BGS in boring 1063, and four from the sands at 14 feet BGS in boring 1061, 18 feet BGS in boring 1062, 25 feet BGS in boring 1063, and 8 feet BGS in boring 1064. The results indicate that the caliche samples were comprised of approximately 48 to 57 percent calcium carbonate and/or clay-sized material, 23 to 33 percent sand, and 19 to 20 percent silt, while the sand samples were comprised of approximately 43 to 67 percent sand, 13 to 21 percent silt, and 20 to 36 percent calcium carbonate and/or clay-sized material. Based on the cross-section the thickness of this unit probably ranges from 38 to 40 feet thick based on boring 7.

Near the base of this unit, a very fine- to fine-grained, well sorted, calcareous red-brown sand layer was encountered in borings 1063 and 1064 at approximately 4231 feet MSL (30 feet BGS). This sand is comprised predominantly od subangular quartz grains with very minor amounts of silt. One gradation analysis was performed on a sample collected

within this layer at 30 feet BGS in boring 1064. The results indicate that this sand sample was comprised of approximately 73 percent sand, 14 percent silt, and 13 percent calcium carbonate and/or clay-sized material. Approximately 1 to 4 feet of native topsoil exists above this unit. No groundwater was encountered during the drilling of these borings.

## 11.4 NATURE AND EXTENT OF CONTAMINATION

One surface and four subsurface soil samples were collected from each of four soil borings, 1061 through 1064 (Figure 11-1). Evaluation of the chemical analyses (TCL VOCs, chromium/lead, TPH, BTEX) on these samples provides the basis for characterizing the nature and extent of contamination.

Subsurface soil samples were analyzed for volatile organic compounds. Acetone was detected infrequently and in low concentrations. Its presence can be attributed to laboratory contamination. BTEX analysis indicated the presence of toluene at 140 $\mu$g/kg in surface sample 1061 and benzene at 170 $\mu$g/kg in surface sample 1064. Levels of TCL VOCs were below the CRQL for all subsurface samples.

Chromium and lead were detected above site background in all surface soil samples. Chromium was present in concentrations of 19.2, 11.4, 8.9, and 9.8 mg/kg for surface soil samples at borings 1061, 1062, 1063, and 1064, respectively. Lead was present in concentrations of 31.4, 11J, 41.0, and 10.3 mg/kg for surface soil at borings 1061, 1062, 1063, and 1064, respectively. The concentrations of chromium and lead in the subsurface samples were near or below site background levels for soil at Cannon AFB, with the exception of the samples collected at 10 feet bgs in borings 1061 and 1063. These two samples indicated chromium at concentrations of 11.4 mg/kg and 10.9 mg/kg, respectively. Table 11-4 summarizes the concentrations for chromium and lead at this SWMU.

Total petroleum hydrocarbon concentrations of surface soil samples 1061 through 1064 ranged from 49.6 mg/kg to 232 mg/kg (Table 11-5). TPH and BTEX were non-detectable in all subsurface samples.

In summary, the extent of soil with TPH contamination is limited to the shallow soils at 0 to less than 4 feet and probably does not extent beyond the boundary of the SWMU, which is shown on Figure 11-1. Concentrations of lead and chromium in surface soil samples at this SWMU were above site background levels. Lead and chromium in subsurface samples were below site background levels with the exception of chromium at 11.4 mg/kg at 10 feet bgs in boring 1061 and 109 mg/kg at 10 feet bgs in boring 1063.

The surface soil and subsurface soil sample analyses also complement the results of previous investigations. Soil boring 1061 is located close to Radian's 1984-1985 field investigation boring 7. Results of the soil sample analysis for boring 1061 is consistent with the previous conclusion that lead is present in low concentrations of 3-4 mg/kg (Table 11-1) and purgeable organic compounds are non-detectable at depths below ground surface. Radian's previous investigation also detected oil and grease at depths greater than 50 feet in boring 7. However, the TPH results from the present investigation do not confirm the presence of petroleum hydrocarbons at this depth.

# TABLE 11-1

## ANALYTICAL RESULTS OF SOIL SAMPLES COLLECTED BY RADIAN AT FIRE DEPARTMENT TRAINING AREA NO. 2

## SWMU NO. 106/IRP NO. FT-7
## CANNON AFB, NEW MEXICO

| Sample Number | Sample Depth (Ft-BGS) | Oil and Grease (mg/kg) | Lead (mg/kg) | Purgeable Organic Compounds (EPA 8010/8020) (μg/kg) |
|---|---|---|---|---|
| 7-1 | 1.0-2.5 | 1000 | 3.1 | ND |
| 7-2 | 5.0-6.0 | 3400 | 3.9 | ND |
| 7-3 | 57.4-58.0 | 8600 (80) | 3.9 | NA |

Ft-BGS = Feet below ground surface
mg/kg = Milligrams per kilogram
μg/kg = Micrograms per kilogram
( ) = Re-analysis using infrared methods
ND = Not detected
NA = Not analyzed, sample discarded

Source: Final Report, IRP Phase II (Radian 1986)

TABLE 11-2

SUMMARY OF SURFACE SOIL SAMPLING, BOREHOLE DRILLING, AND BOREHOLE SAMPLING CONDUCTED BY WCC AT FIRE DEPARTMENT TRAINING AREA NO. 2, SWMU NO. 106 / IRP NO. FT-7, CANNON AFB, NEW MEXICO

| BORING NUMBER | DRILLING/ SAMPLING METHOD | DRILL RIG USED | BOREHOLE DIAMETER (In) | DRILLING/ SAMPLING DEPTH INTERVALS (Ft-BGS) | BOREHOLE SAMPLING FREQUENCY | DATE(S) DRILLED/ SAMPLED | NUMBER OF ANALYTICAL SOIL SAMPLES COLLECTED | NUMBER OF ANALYTICAL QA/QC SAMPLES COLLECTED | NUMBER OF SPT SOIL SAMPLES COLLECTED | NUMBER OF GRADATION ANALYSIS SAMPLES COLLECTED | GROUND ELEVATION (Ft-MSL) | TOTAL DEPTH OF BOREHOLE (Ft-BGS) | DATE BOREHOLE GROUTED |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1061 | HT | NA | NA | 0 to 0.5 | NA | 10-23-91 | 1 | 1 | NA | 1 | 4261.27 | 32 | 10-23-91 |
| | HSA | B-53 | 6.5 | 0 to 22 | Continuous | 10-23-91 | 3 | 2 | 11 | 1 | | | |
| | | | | 22 to 32 | 5' Intervals | 10-23-91 | 1 | 1 | 2 | 0 | | | |
| (1065)* | HSA | B-61B | 7.5 | 0 to 6 | 5' Intervals | 12-05-91 | 1 | 2 | 1 | 0 | 4261.44 | 6 | 12-10-91 |
| 1062 | HT | NA | NA | 0 to 0.5 | NA | 10-23-91 | 1 | 1 | NA | 0 | 4261.20 | 31 | 10-27-91 |
| | HSA | B-53 | 6.5 | 0 to 22 | Continuous | 10-23-91 to 10-24-91 | 3 | 1 | 11 | 2 | | | |
| | | | | 22 to 31 | 5' Intervals | 10-24-91 to 10-25-91 | 1 | 0 | 2 | 0 | | | |
| 1063 | HT | NA | NA | 0 to 0.5 | NA | 10-23-91 | 1 | 1 | NA | 0 | 4261.69 | 32 | 10-27-91 |
| | HSA | B-61A | 6.5 | 0 to 22 | Continuous | 10-25-91 | 3 | 1 | 11 | 1 | | | |
| | | | | 22 to 32 | 5' Intervals | 10-25-91 to 10-26-91 | 1 | 0 | 2 | 1 | | | |
| (1066)* | HSA | B-61B | 7.5 | 0 to 6 | 5' Intervals | 12-05-91 | 1 | 0 | 1 | 0 | 4261.84 | 32 | 12-10-91 |
| | | | | 6 to 32 | 10' Intervals | 12-05-91 | 2 | 2 | 3 | 0 | | | |
| 1064 | HT | NA | NA | 0 to 0.5 | NA | 10-23-91 | 1 | 0 | NA | 0 | 4261.61 | 32 | 10-27-91 |
| | HSA | B-61A | 6.5 | 0 to 22 | Continuous | 10-26-91 | 3 | 1 | 11 | 1 | | | |
| | | | | 22 to 32 | 5' Intervals | 10-26-91 | 1 | 1 | 2 | 1 | | | |

| | | | |
|---|---|---|---|
| In | Inches | B-53 | Mobile B-53 Auger Drill Rig with 6" OD / 3.75" ID Augers and 6.5" Bullet Bit |
| Ft-BGS | Feet Below Ground Surface | B-61A | Mobile B-61 Auger Drill Rig with 6" OD / 3.75" ID Augers and 6.5" or 6.25" Bullet Bit |
| Ft-MSL | Feet Mean Sea Level | B-61B | Mobile B-61 Auger Drill Rig with 7.25" OD / 4.25" ID Augers and 7.5" Bullet Bit |
| SPT | Standard Penetration Test | F-10 | Failing F-10 Auger Drill Rig with 8.25" OD / 4.25" ID Augers and 8.5" Bullet Bit |
| HSA | Hollow Stem Auger | CME-75 | Central Mine Equipment CME-75 Auger Drill Rig with 7.75" OD / 4.25" ID Augers and 8.0" Bullet Bit |
| HT | Hand Trowel, Surface Sample | OD | Outer Diameter |
| NA | Not Applicable, Surface Sample | ID | Inner Diameter |
| NS | Not Sampled | | |

( )* The borings that are shaded and in parentheses correspond to either a redrill or surface resample of the previous boring or surface sample due to laboratory missed holding times. These borings or surface resamples were drilled or collected approximately 1 to 5 feet away from the original boring or surface sample.

TABLE 11-3

SUMMARY OF SURFACE SOIL, SUBSURFACE SOIL, AND QA/QC SAMPLES COLLECTED BY WCC AT FIRE DEPARTMENT TRAINING AREA NO. 2, SWMU NO. 106 / IRP NO. FT-7, CANNON AFB, NEW MEXICO

| BORING NUMBER | DEPTH INTERVAL (Ft-BGS) | SAMPLE IDENTIFICATION NUMBER | SAMPLE TYPE | QA/QC SAMPLES | SAMPLE MATRIX | DATE SAMPLED | TIME SAMPLED | OVA ON SAMPLE (ppm) | ANALYTICAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|---|
| 1061 | 0 to 0.5 | CAN106-1061-0000 | A | | Soil | 10-23-91 | 0755 | 0 | BTEX,TPH,Pb/Cr |
| | | CAN106-1061-1063 | A | FD | Soil | 10-23-91 | 0755 | 0 | BTEX,TPH,Pb/Cr |
| | | CAN106-1061-4000 | GA | | Soil | 10-23-91 | 0755 | 0 | |
| | 0 to 2 | CAN106-1061-4000 | SPT | | Soil | 10-23-91 | 0807 | 0 | |
| | 2 to 4 | CAN106-1061-4002 | SPT | | Soil | 10-23-91 | 0820 | | |
| | 4 to 6 | CAN106-1061-0004 | A/SPT | MS/MSD | Soil | 10-23-91 | 0830 | 0 | VOC,TPH,Pb/Cr |
| | 6 to 8 | CAN106-1061-4006 | SPT | | Soil | 10-23-91 | 0845 | 0 | |
| | 8 to 10 | CAN106-1061-4008 | SPT | | Soil | 10-23-91 | 0855 | 0 | |
| | 10 to 12 | CAN106-1061-0010 | A/SPT | | Soil | 10-23-91 | 0915 | 0 | VOC,TPH,Pb/Cr |
| | | CAN106-1061-1061 | A | FD | Soil | 10-23-91 | 0915 | 0 | VOC,TPH,Pb/Cr |
| | 12 to 14 | CAN106-1061-4012 | SPT | | Soil | 10-23-91 | 0925 | 0 | |
| | 14 to 16 | CAN106-1061-4014 | SPT/GA | | Soil | 10-23-91 | 0940 | 0 | |
| | 16 to 18 | CAN106-1061-4016 | SPT | | Soil | 10-23-91 | 1000 | 0 | |
| | 18 to 20 | CAN106-1061-4018 | SPT | | Soil | 10-23-91 | 1035 | 0 | |
| | 20 to 22 | CAN106-1061-0020 | A/SPT | | Soil | 10-23-91 | 1110 | 0 | VOC,TPH,Pb/Cr |
| | 25 to 27 | CAN106-1061-4025 | SPT | | Soil | 10-23-91 | 1135 | 0 | |
| | 30 to 32 | CAN106-1061-0030 | A/SPT | | Soil | 10-23-91 | 1230 | 0 | VOC,TPH,Pb/Cr |
| | | CAN106-1061-1071 | A | RB | Water | 10-23-91 | 1350 | | VOC,TPH,Pb/Cr |
| (1065)* | 4 to 6 | CAN106-1065-0004 | A/SPT | MS/MSD | Soil | 12-05-91 | 1340 | 0 | VOC |
| | | CAN106-1065-1072 | A | RB | Water | 12-05-91 | 1405 | | VOC |
| 1062 | 0 to 0.5 | CAN106-1062-0000 | A | | Soil | 10-23-91 | 1345 | 0 | BTEX,TPH,Pb/Cr |
| | | CAN106-1062-1001 | A | MRD | Soil | 10-23-91 | 1345 | 0 | BTEX,TPH,Pb/Cr |
| | 0 to 2 | CAN106-1062-4000 | SPT | | Soil | 10-23-91 | 1610 | 0 | |
| | 2 to 4 | CAN106-1062-4002 | SPT/GA | | Soil | 10-23-91 | 1620 | 0 | |
| | 4 to 6 | CAN106-1062-4004 | SPT | | Soil | 10-23-91 | 1630 | 0 | |
| | 6 to 8 | CAN106-1062-0006 | A/SPT | | Soil | 10-23-91 | 1645 | 0 | VOC,TPH,Pb/Cr |
| | 8 to 10 | CAN106-1062-4008 | SPT | | Soil | 10-23-91 | 1700 | 0 | |
| | 10 to 12 | CAN106-1062-0010 | A/SPT | | Soil | 10-23-91 | 1715 | 0 | VOC,TPH,Pb/Cr |
| | 12 to 13.5 | CAN106-1062-4012 | SPT | | Soil | 10-23-91 | 1725 | | |
| | 14 to 15.5 | CAN106-1062-4014 | SPT | | Soil | 10-24-91 | 0820 | 0 | |
| | 16 to 17.5 | CAN106-1062-4016 | SPT | | Soil | 10-24-91 | 0850 | 0 | |
| | 18 to 19 | CAN106-1062-4018 | SPT/GA | | Soil | 10-24-91 | 0910 | | |
| | 20 to 22 | CAN106-1062-0020 | A/SPT | | Soil | 10-24-91 | 1005 | 0 | VOC,TPH,Pb/Cr |
| | | CAN106-1062-1062 | A | FD | Soil | 10-24-91 | 1005 | 0 | VOC,TPH,Pb/Cr |
| | 25 to 26 | CAN106-1062-4025 | SPT | | Soil | 10-24-91 | 1055 | 0 | |
| | 30 to 31 | CAN106-1062-0030 | A/SPT | | Soil | 10-25-91 | 0823 | 0 | VOC,TPH,Pb/Cr |
| 1063 | 0 to 0.5 | CAN106-1063-0000 | A | MS/MSD | Soil | 10-23-91 | 1415 | 0 | BTEX,TPH,Pb/Cr |
| | 0 to 2 | CAN106-1063-4000 | SPT | | Soil | 10-25-91 | 1110 | | |
| | 2 to 4 | CAN106-1063-4002 | SPT | | Soil | 10-25-91 | 1120 | | |
| | 4 to 6 | CAN106-1063-0004 | A/SPT | | Soil | 10-25-91 | 1130 | 0 | VOC,TPH,Pb/Cr |
| | | CAN106-1063-4004 | GA | | Soil | 10-25-91 | 1130 | 0 | |
| | 6 to 8 | CAN106-1063-4006 | SPT | | Soil | 10-25-91 | 1143 | 0 | |
| | 8 to 10 | CAN106-1063-4008 | SPT | | Soil | 10-25-91 | 1315 | | |
| | 10 to 12 | CAN106-1063-0010 | A/SPT | | Soil | 10-25-91 | 1325 | | VOC,TPH,Pb/Cr |
| | 12 to 14 | CAN106-1063-4012 | SPT | | Soil | 10-25-91 | 1340 | | |
| | 14 to 16 | CAN106-1063-4014 | SPT | | Soil | 10-25-91 | 1400 | | |
| | 16 to 18 | CAN106-1063-4016 | SPT | | Soil | 10-25-91 | 1425 | | |
| | | CAN106-1063-1051 | A | AB | Water | 10-25-91 | 1625 | | VOC |
| | 18 to 20 | CAN106-1063-4018 | SPT | | Soil | 10-25-91 | 1740 | | |
| | 20 to 22 | CAN106-1063-0020 | A/SPT | | Soil | 10-25-91 | 1820 | | VOC,TPH,Pb/Cr |
| | 25 to 27 | CAN106-1063-4025 | SPT/GA | | Soil | 10-26-91 | 0815 | | |
| | 30 to 32 | CAN106-1063-0030 | A/SPT | | Soil | 10-26-91 | 0925 | 0 | VOC,TPH,Pb/Cr |
| (1066)* | 4 to 6 | CAN106-1066-0004 | A/SPT | | Soil | 12-05-91 | 1005 | 0 | VOC |
| | 10 to 12 | CAN106-1066-4010 | SPT | | Soil | 12-05-91 | 1030 | 0 | VOC |
| | 20 to 22 | CAN106-1066-0020 | A/SPT | | Soil | 12-05-91 | 1050 | 0 | VOC |

TABLE 11-3

SUMMARY OF SURFACE SOIL, SUBSURFACE SOIL, AND QA/QC SAMPLES COLLECTED BY WCC AT FIRE DEPARTMENT TRAINING AREA NO. 2, SWMU NO. 106 / IRP NO. FT-7, CANNON AFB, NEW MEXICO

| BORING NUMBER | DEPTH INTERVAL (Ft-BGS) | SAMPLE IDENTIFICATION NUMBER | SAMPLE TYPE | QA/QC SAMPLES | SAMPLE MATRIX | DATE SAMPLED | TIME SAMPLED | OVA ON SAMPLE (ppm) | ANALYTICAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|---|
| (1066)* | 20 to 22 | CAN106-1066-1052 | A | AB | Water | 12-05-91 | 1115 | | VOC |
| | 30 to 32 | CAN106-1066-0030 | A/SPT | | Soil | 12-05-91 | 1130 | 0 | VOC |
| | | CAN106-1066-1082 | A | DW | Water | 12-05-91 | 1155 | | VOC |
| 1064 | 0 to 0.5 | CAN106-1064-0000 | A | | Soil | 10-23-91 | 1430 | 0 | BTEX,TPH,Pb/Cr |
| | 0 to 2 | CAN106-1064-4000 | SPT | | Soil | 10-26-91 | 1205 | | |
| | 2 to 4 | CAN106-1064-4002 | SPT | | Soil | 10-26-91 | 1215 | | |
| | 4 to 6 | CAN106-1064-0004 | A/SPT | | Soil | 10-26-91 | 1235 | 0 | VOC,TPH,Pb/Cr |
| | 6 to 8 | CAN106-1064-4006 | SPT | | Soil | 10-26-91 | 1240 | | |
| | 8 to 10 | CAN106-1064-4008 | SPT/GA | | Soil | 10-26-91 | 1245 | | |
| | 10 to 12 | CAN106-1064-0010 | A/SPT | | Soil | 10-26-91 | 1305 | 0 | VOC,TPH,Pb/Cr |
| | 12 to 14 | CAN106-1064-4012 | SPT | | Soil | 10-26-91 | 1315 | 0 | |
| | 14 to 15 | CAN106-1064-4014 | SPT | | Soil | 10-26-91 | 1330 | 0 | |
| | 16 to 18 | CAN106-1064-4016 | SPT | | Soil | 10-26-91 | 1350 | | |
| | 18 to 19 | CAN106-1064-4018 | SPT | | Soil | 10-26-91 | 1410 | | |
| | 20 to 22 | CAN106-1064-0020 | A/SPT | | Soil | 10-26-91 | 1420 | 0 | VOC,TPH,Pb/Cr |
| | | CAN106-1064-1002 | A | MRD | Soil | 10-26-91 | 1420 | 0 | VOC,TPH,Pb/Cr |
| | 25 to 26 | CAN106-1064-4025 | SPT | | Soil | 10-26-91 | 1445 | | |
| | 30 to 32 | CAN106-1064-0030 | A/SPT | | Soil | 10-26-91 | 1520 | 0 | VOC,TPH,Pb/Cr |
| | | CAN106-1064-4030 | GA | | Soil | 10-26-91 | 1520 | 0 | |
| | | CAN106-1064-1081 | A | DW | Water | 10-26-91 | 1600 | | VOC |

| | | | | | |
|---|---|---|---|---|---|
| Ft-BGS | Feet Below Ground Surface | FD | Field Duplicate | SV | Semi Volatile Organic Compounds |
| OVA | Organic Vapor Analyzer Reading | MRD | Missouri River Division Duplicate | M | Metals (TAL) |
| ppm | Parts per Million | AB | Ambient Blank | TPH | Total Petroleum Hydrocarbons |
| A | Analytical | RB | Rinsate Blank | BTEX | Benzene, Toluene, Ethylbenzene, Xylene |
| SPT | Standard Penetration Test | DW | Decontamination Water Blank | | |
| GA | Gradation Analysis | TB | Trip Blank | TOC | Total Organic Carbon |
| L | Lithology | VOC | Volatile Organic Compounds (TCL) | OL | Organic Lead |
| MS/MSD | Matrix Spike / Matrix Spike Duplicate | PCB | Polychlorinated Biphenols, Pesticides | Pb/Cr | Lead / Chromium |
| | | TCL | Target Compound List | TAL | Target Analyte List |

( )* The borings that are shaded and in parentheses correspond to either a redrill or surface resample of the previous boring or surface sample due to laboratory missed holding times. These borings or surface resamples were drilled or collected approximately 1 to 5 feet away from the original boring or surface sample.

# TABLE 11-4

## CHROMIUM AND LEAD CONCENTRATIONS IN SOIL SAMPLES COLLECTED BY WCC AT FIRE DEPARTMENT TRAINING AREA NO. 2

## SWMU NO. 106/IRP NO. FT-7
## CANNON AFB, NEW MEXICO

| Sample | Sample Depth (Ft-BGS) | Chromium[1] (mg/kg) | Lead[2] (mg/kg) |
|---|---|---|---|
| 1061 | 0 - 0.5 | 19.2 | 31.4 |
| | 4 | 5.6 | 4.5 |
| | 10 | 11.4 | 7.4 |
| | 20 | 4.3 | 2.6 |
| | 30 | 6.2 | 3.2 |
| 1062 | 0 - 0.5 | 11.4 | 11.1J |
| | 6 | 3.4 | 3.0 |
| | 10 | 6.3 | 5.8 |
| | 20 | 2.9 | 1.0 |
| | 30 | 3.6 | 2.4 |
| 1063 | 0 - 0.5 | 8.9 | 41.0 |
| | 4 | 4.0 | 3.8 |
| | 10 | 10.9 | 8.8 |
| | 20 | 6.4 | 3.2 |
| | 30 | 4.7 | 1.8 |
| 1064 | 0 - 0.5 | 9.8 | 10.3 |
| | 4 | 6.7 | 3.5 |
| | 10 | 8.1 | 5.8 |
| | 20 | 4.6 | 2.4 |
| | 30 | 7.6 | 3.9 |

Ft-BGS = Feet below ground surface
mg/kg = Milligrams per kilogram
J = Estimated value

1 Background range for chromium is 2.67 to 9.31 mg/kg (see Table 2-7).
2 Background range for lead is 1.76 to 8.64 mg/kg (see Table 2-7).

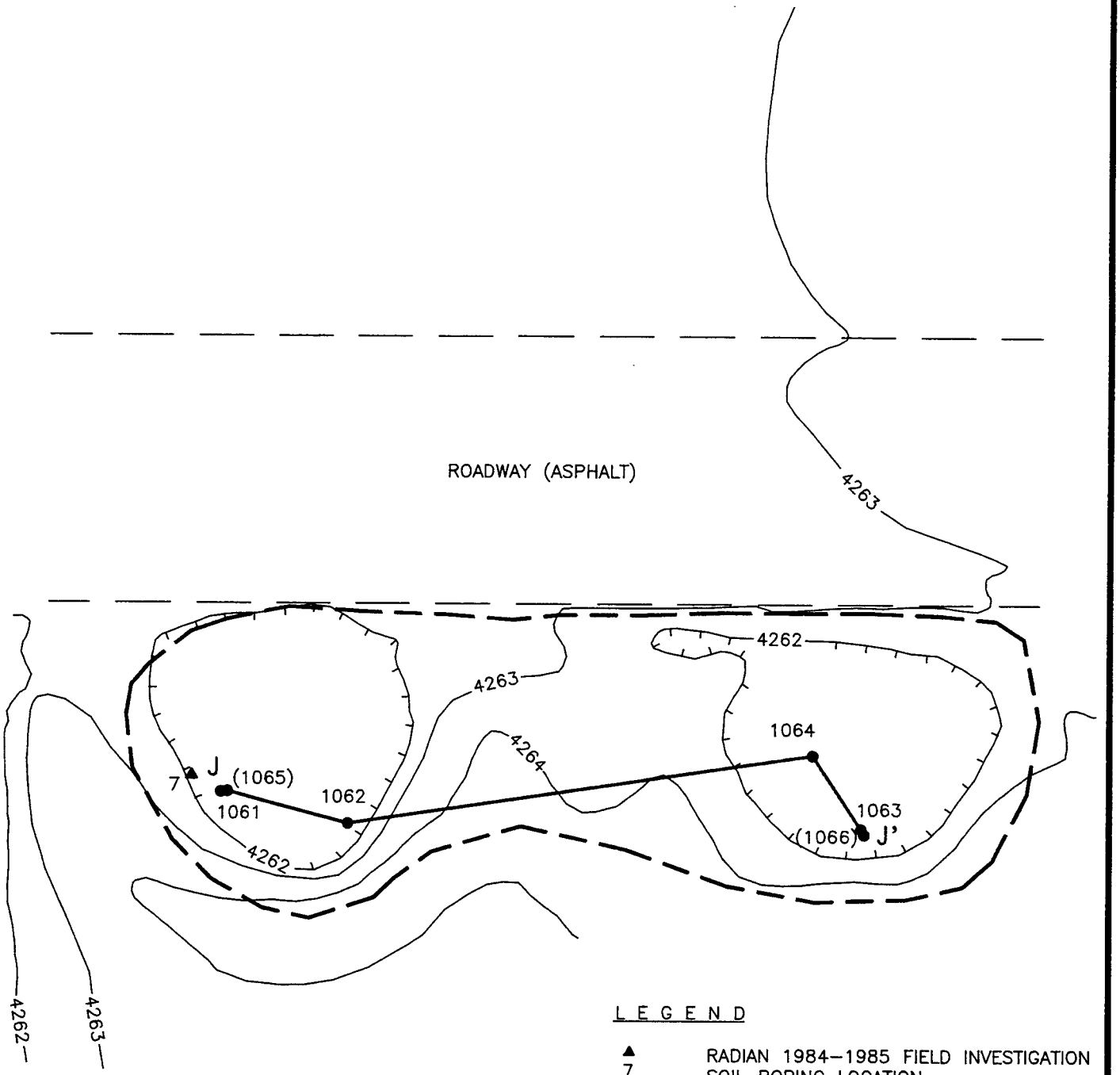
# TABLE 11-5

## TOTAL PETROLEUM HYDROCARBON CONCENTRATIONS IN SOIL SAMPLES COLLECT BY WCC AT FIRE DEPARTMENT TRAINING AREA NO. 2

## SWMU NO. 106/IRP NO. FT-7
## CANNON AFB, NEW MEXICO

| Boring Number (Redrill Boring Number) | Sample Depth (Ft-BGS) | TPH (mg/kg) |
|---|---|---|
| 1061 | 0-0.5 | 102 |
| (1065) | 4-6 | 45.1U |
| | 10-12 | 47U |
| | 20-22 | 44.5U |
| | 30-32 | 45.4U |
| 1062 | 0-0.5 | 177 |
| | 6-8 | 45.6U |
| | 10-12 | 45.6U |
| | 20-22 | 44.9U |
| | 30-32 | 44.4U |
| 1063 | 0-0.5 | 232 |
| (1066) | 4-6 | 44.1U |
| | 10-12 | 45.4U |
| | 20-22 | 42.9U |
| | 30-32 | 44.2U |
| 1064 | 0-0.5 | 49.6 |
| | 4-6 | 45.6U |
| | 10-12 | 44.1U |
| | 20-22 | 44U |
| | 30-32 | 44.2U |

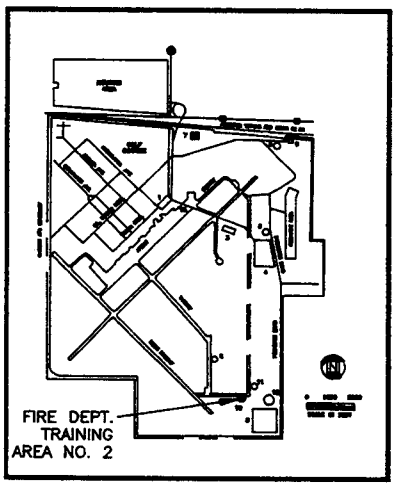
Ft-BGS = Feet below ground surface
mg/kg = Milligrams per kilogram
U = Not detected at the reporting limit

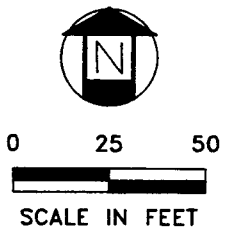



LEGEND

| | |
|---|---|
| ▲ 7 | RADIAN 1984–1985 FIELD INVESTIGATION SOIL BORING LOCATION |
| ● 1063 | WCC 1991 FIELD INVESTIGATION SOIL BORING LOCATION |
| — — | SWMU BOUNDARY |
| 4263 | GROUND SURFACE CONTOUR LINE IN FEET MSL CONTOUR INTERVAL = 1 FOOT |
| J — J' | GEOLOGIC CROSS–SECTION LOCATION |

NOTE: THE NUMBERS IN PARENTHESIS CORRESPOND TO REDRILLS/RESAMPLES OF THE ORIGINAL BORING/SAMPLE



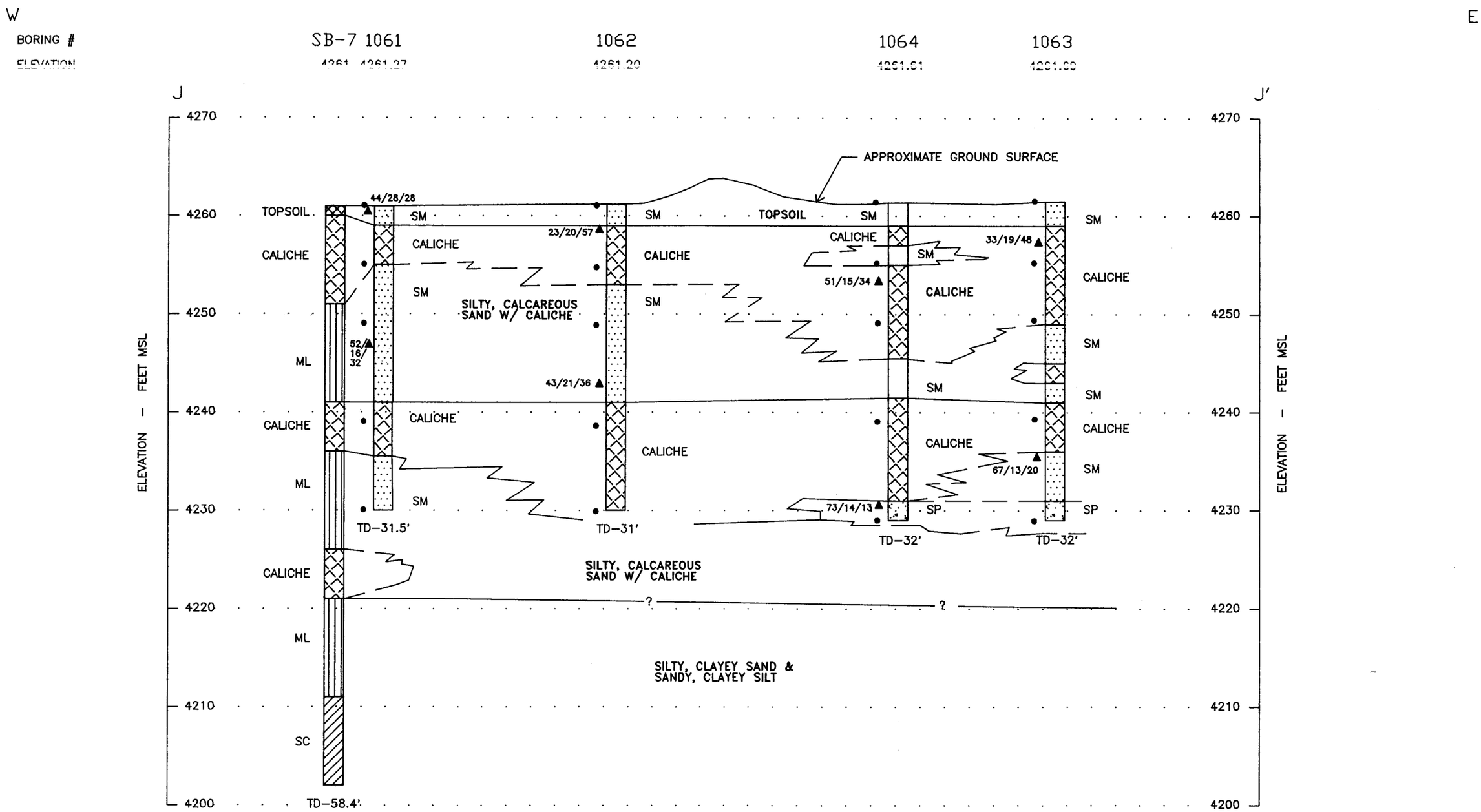




| | |
|---|---|
| Job No. : | 89MC114W |
| Prepared by : | D.A.K. |
| Date : | 2/10/92 |

LOCATION OF SOIL BORINGS AT FIRE DEPARTMENT TRAINING AREA NO. 2
SWMU NO. 106/IRP NO. FT-7
CANNON AFB, NEW MEXICO

C1140004

FIG. 11–1




LEGEND

| | | |
|---|---|---|
| MSL | – | MEAN SEA LEVEL |
| TD | – | TOTAL DEPTH IN FEET BGS |
| SM,SP,GW ML,GP | – | UNIFIED SOIL CLASSIFICATION SYSTEM ABBREVIATIONS |
| BGS | – | BELOW GROUND SURFACE |
| • | – | ANALYTICAL SAMPLE INTERVAL |

BORINGS 1062, 1062, 1063, 1064 WCC (OCT 91) (BORING APPROXIMATELY LOCATED)

NOTE: THE LOCATION OF THIS CROSS-SECTION IS SHOWN ON FIG. 11-1

43/21/36 ▲ – GRADATION ANALYSIS SAMPLE INTERVAL. THE THREE NUMBERS REPRESENT THE APPROXIMATE PERCENTAGES OF SAND-, SILT-, AND CLAY-, SIZED MATERIAL RESPECTIVELY

| | |
|---|---|
| Job No. : | 89MC114W |
| Prepared by : | LLG |
| Date : | 2/3/92 |

GEOLOGIC CROSS SECTION J-J'
FIRE DEPT. TRAINING AREA NO.2
SWMU NO. 106/IRP NO. FT-7
CANNON AFB NEW MEXICO

SWMU-106

FIG. 11-2

# 12.0
# FIRE DEPARTMENT TRAINING AREA NO. 3 (SWMU NO. 107/IRP NO. FT-8)

## 12.1 SWMU DESCRIPTION

### 12.1.1 Setting

This SWMU was an unlined surface area located in the southeastern part of Cannon AFB (Figure 12-1). It is immediately adjacent to an abandoned north-south runway. The area is in a half moon shape about 100 feet in length and is surrounded by a low berm (less than one foot high).

The area has little vegetation on it and the southwest corner has a small wooden storage unit open on one side containing various empty pails. The ground in this corner of the site, which is partially covered with gravel, is also littered with empty plastic containers, pails and a large empty aircraft fuel tank.

### 12.1.2 History of Use

This unit was in operation during the same time period as Fire Training Area No. 2, which was between 1968 and 1974. Approximately 300 gallons of unused JP-4 fuel was used to create fires. Exercises occurred about 8 times per year (USAF 1990).

### 12.1.3 Past Investigations

A deep soil boring (Boring No. 8) was drilled in this area in 1984 by Radian Corporation. The sample results shown in Table 12-1 indicate the presence of oil and grease, and lead at this SWMU.

### 12.1.4 Land Use and Demography

Although fires are no longer conducted at Fire Training Area No. 3, the area continues to have activities associated with the adjacent explosive ordinance site. The explosive

ordinance site, which is approximately 1800 feet in diameter, has always been used for ammunition disposal and training operations. Currently, this ammunition facility is used for practice only, with no detonations taking place. Approximately 5 people used this area for one to two hours per month.

## 12.2 FIELD INVESTIGATION

This section provides a discussion of the field activities conducted by WCC at Fire Department Training Area No. 3 from October 8 through 26, 1991 and from December 6 through 10, 1991. The activities at this SWMU, as outlined in the FSP (WCC 1991c), consisted of collecting 4 surface soil samples for chemical analysis, drilling 4 soil borings, and collecting 16 subsurface soil samples for chemical analysis and 7 subsurface soil samples for gradation analysis. Based on elevated OVA readings and odors detected from the soil sample collected at the targeted bottom of one soil boring, it was decided to drill this boring approximately 37 feet deeper than originally planned to evaluate the vertical extent of potential contamination. A total of 3 additional subsurface soil samples for chemical analysis were collected. The resampling phase of the field, which became necessary due to laboratory missed holding times, consisted of redrilling 2 soil borings and recollecting 4 subsurface soil samples for chemical analysis.

Table 12-2 summarizes the drilling and sampling methods, along with sampling frequency conducted at each soil boring and surface sample location. A complete record of all surface soil, subsurface soil, and QA/QC samples collected at Fire Department Training Area No. 3 is presented in Table 12-3. The locations of the surface samples and soil borings are shown on Figure 12-1.

### 12.2.1 Sampling Objectives

The objective of sampling at Fire Department Training Area No. 3 was to evaluate the nature and extent of potential hazardous contaminants that may be present. The surface soil and subsurface soil sampling programs were designed to supplement previous investigations. The data collected at these boring locations were used to further evaluate the extent of potential contamination, if present, and to perform a baseline risk assessment to determine if the area poses a risk to human health or the environment.

The data may also be utilized to evaluate remedial actions if necessary. Presently, there does not appear to be any substantial risk to the groundwater, so no hydrogeologic investigation was planned or conducted.

### 12.2.2 Surface Soil Investigation

Four surface soil samples were collected from 0 to 0.5 feet BGS near soil borings 1071 through 1074. These samples were collected using a stainless steel hand trowel and analyzed for BTEX, TPH, and lead/chromium.

### 12.2.3 Subsurface Soil/Vadose Zone Investigation

Four soil borings, 1071 through 1074, were drilled to depths of 31. 31, 31, and 67.1 feet BGS, respectively, in either low lying areas or areas of visible staining or residue within the SWMU boundary. Boring 1071 was located as close as possible to Radian's 1984-1985 field investigation boring 8. The exact location of boring 8 could not be determined by WCC during the 1991 investigation. Each soil boring was sampled continuously to a depth of 20 feet BGS and at 5-foot intervals from 20 feet BGS to total depth. All soil borings were described lithologically from the split spoon samples obtained during drilling. Subsurface samples for chemical analysis were collected at 5, 10, 20 and 29.5 feet BGS in boring 1071; at 4, 10, 20, and 30 feet BGS in borings 1072 and 1073; and at 4, 10, 20, 30, 45, 50, and 60 feet BGS in boring 1074 for a total of nineteen subsurface soil samples. The subsurface analytical samples were collected with stainless steel split spoons and analyzed for TCL VOCs, TPH, and lead/chromium. Seven subsurface samples for geotechnical gradation analysis were collected at 13.5 feet BGS in boring 1071, at 2 and 18 feet BGS in boring 1072, at 6 and 25 feet BGS in boring 1073, and at 8 and 30 feet BGS in boring 1074.

During the resampling phase, two additional soil borings, 1075 and 1076 (redrills of borings 1074 and 1073), located approximately 5 and 2 feet north of the original borings, respectively, were drilled to depths of 52 and 31.1 feet BGS, respectively. These soil borings were sampled at the same intervals where analytical subsurface soil samples were collected in the original boring. Four additional subsurface soil samples were collected at 10 and 50 feet BGS in boring 1075, and at 4 and 30.3 feet BGS in boring 1076

because the laboratory missed holding times for the TCL VOC analysis on the original samples. These samples were analyzed for TCL VOCs only.

## 12.3 PHYSICAL CHARACTERISTICS

This section provides a discussion of the soil, geology and hydrogeology at Fire Department Training Area No. 3 based on the detailed lithologic descriptions of split spoon samples and gradation analysis results from the 1991 WCC investigation, and the review of lithologic boring logs from the previous 1984-1985 Radian field investigation.

### 12.3.1 Soil

The soils underlying the Fire Department Training Area No. 3 area consist of sandy loam and loamy sand of the Amarillo Soil Group. The soils consist primarily of fine-grained, well sorted, silty, clayey, unconsolidated light brown and gray-brown to red-brown and brown-orange sands. The sands are comprised predominantly of subangular to subrounded quartz grains. These soils appear to be stained dark gray in boring 1074. The sands are generally dry to slightly moist at depth with a thickness ranging between 3 to 4 feet. One gradation analysis was performed on a sample collected within this unit at 2 feet BGS in boring 1072. The results indicate that this soil sample was comprised of approximately 56 percent sand, 14 percent silt, and 30 percent clay. The upper one foot in borings 1071, 1072, and 1073 are calcareous with pockets or nodules of caliche, which suggest that this may not be native material.

### 12.3.2 Geology

The near surface (upper 67 feet) stratigraphy at Fire Department Training Area No. 3 consists of Tertiary Miocene to Pliocene fluvial deposits of the Ogallala Formation. Geologic cross-section K-K' (Figure 12-2) was constructed using information on the lithologic boring logs from the 1991 WCC field investigation along with one boring log, 8, from the 1984-1985 Radian field investigation. These cross-sections run northwest-southeast and north-south, respectively (see Figure 12-1 for the cross-section locations). Stratigraphic correlations of the various fluvial deposits between borings is based primarily on the split spoon lithologic samples collected during drilling.

The SWMU is underlain by Ogallala fluvial deposits consisting primarily of well to moderately sorted sand, with scattered thin (1 to 12 feet thick) layers of caliche. The total thickness of these Ogallala deposits beneath the SWMU is not presently known, but based on regional information, may be as thick as 390 feet.

It would appear from the geologic cross-section and the lithologic descriptions (Appendix B-1) that three fairly distinct sand, sand/caliche units are present beneath the SWMU to a depth of 67 feet. The lowermost fluvial deposits shown on the geologic cross-section from 4197 to 4210 feet MSL consist of fine- to medium-grained, well sorted, unconsolidated orange sands. These sands are comprised predominantly of subrounded quartz grains with very minor amounts (1-2%) of black grains. These sands are relatively clean (i.e., little or no silt/clay sized particles). These sands are non-calcareous. This unit was encountered in boring 1074 at 55 feet BGS. The thickness of this unit is unknown at present due to the fact that the unit was not fully penetrated, but is at least 12 feet thick at this SWMU.

The middle fluvial deposits shown on the geologic cross-section from 4210 to 4230 feet MSL consist of fine-grained, well sorted, silty, orange to pale orange sands. These sands are comprised predominantly of subangular to subrounded quartz grains with very minor amounts (1-3%) of black and dark colored grains. These sands are silty and slightly clayey with varying amounts of calcium carbonate Occasionally, these sands have scattered small pockets or nodules of tan-orange to pale orange caliche and calcium carbonate cemented sands. One gradation analysis was performed on a sample collected within this unit at 30 feet BGS in boring 1074. The results indicate that this sample was comprised of approximately 70 percent sand, 11 percent silt, and 19 percent calcium carbonate and/or clay-sized material. This unit was encountered at approximately 30 feet BGS in borings 8 and 1074. Based on the cross-section, the thickness of this unit ranges from approximately 25 feet thick in boring 1074 to 27 feet thick in boring 8. This unit may be contaminated with petroleum residue in boring 1074, based on OVA readings and odor observations. The lithologies from Radian's boring 8 appear to show more silt than sand. Based on the fact that no thick silt deposits were not encountered in any of the WCC borings, nor were silts identified in any of the gradation analyses performed, it may be assumed that these silt deposits are probably very fine-grained, silty sand deposits.

The upper fluvial deposits shown on the geologic cross-section from 4230 to 4262 feet MSL consist of fine-grained, well sorted, silty, calcareous, medium to pale orange to tan-orange sands. These sands are comprised predominantly of subangular to subrounded quartz grains with slight to moderate amounts of silt and calcium carbonate. Occasionally, these sands are moderately cemented with calcium carbonate. Abundant thin layers (ranging from a few inches to several feet in thickness) and small pockets or nodules of tan-orange to pale orange, silty, sandy, clayey caliche are scattered throughout this unit. Five gradation analyses were performed on samples collected within this unit, two from the caliche at 6 feet BGS in boring 1073 and 8 feet BGS in boring 1074, and three from the sands at 13 feet BGS in boring 1071, 18 feet BGS in boring 1072, and 25 feet BGS in boring 1073. The results indicate that the caliche samples were comprised of approximately 43 to 49 percent calcium carbonate and/or clay-sized material, 32 to 33 percent sand, and 18 to 25 percent silt, while the sand samples were comprised of approximately 54 to 57 percent sand, 13 to 18 percent silt, and 27 to 32 percent calcium carbonate and/or clay-sized material. Based on the cross-section the thickness of this unit is approximately 26 feet thick in borings 8 and 1074. This entire unit in boring 1074 appeared to be contaminated with petroleum residue, based on OVA readings, visual staining, and odor observations. Approximately 3 to 4 feet of native topsoil exists above this unit. No groundwater was encountered during the drilling of these borings.

## 12.4 NATURE AND EXTENT OF CONTAMINATION

Surface and subsurface soil samples were collected from four soil borings, 1071 through 1074 (Figure 12-1). Evaluation of the chemical analyses (TCL VOCs, chromium/lead, TPH, BTEX) of these samples has been used to describe the nature and extent of contamination at this SWMU.

Except for the BTEX analysis discussed later, no other volatile organic compounds except acetone, were detected above the CRQL in subsurface soil samples. Acetone was detected in two samples from boring 1073 at depths of 4 and 30 feet, and from boring 1074 at a depth of 50 feet. However, the absence of detectable acetone in other samples at different depths from the same borings indicates acetone is probably related to laboratory contamination.

Xylenes were detected at boring 1074 between 4 and 32 feet bgs at concentrations of 94 to 4.9 mg/kg. At the next sampling interval at 45 to 47 feet bgs, xylenes were not detected above the quantitation limit (Figure 12-3) (Table 12-4). These results are supported by VOC analysis of TICs which indicated the possible presence of a variety of xylene derivatives. Xylenes were not detected above the quantitation limit in the three remaining borings. Ethyl benzene was detected in samples from boring 1074 at 4, 10, and 20 feet bgs at an estimated concentration of 13J and 15J, and a concentration of 5.8 mg/kg, respectively. Ethyl benzene may also be present at the 30-32 foot interval since the detection limit has been raised to 14 mg/kg (Table 12-4). Ethyl benzene was not detected above the quantitation limit in the other borings. Toluene was detected in samples from boring 1073 at the surface and in boring 1074 at 4, 20, and 62 feet bgs at estimated concentrations of 0.073J mg/kg, 6.9J mg/kg, 2.7J mg/kg, and 0.004J mg/kg, respectively. Toluene was not detected above the quatitation limits in any of the borings. The detection of xylenes, ethyl benzene, and toluene at boring 1074 is consistent with residual fuel constituents from previous fire training exercises. Benzene was not detected above the CRQL (adjusted for sample size and dilutions) in any of the soil samples.

Total petroleum hydrocarbon concentrations in the four surface soil samples ranged from 963 mg/kg to 6080 mg/kg, with the highest concentration at boring 1073 (Figure 12-3) (Table 2-6). High concentrations were also detected in subsurface soil down to 4 feet bgs in boring 1071 and down to 32 feet bgs at boring 1074. A cross-sectional diagram (Figure 12-3) depicts the distribution of TPH at the SWMU. VOC analysis of TICs in boring 1074 reported a variety of medium molecular weight saturated and unsaturated hydrocarbons. These TICs were reported in boring 1074 from 0 to 30 feet bgs. In addition, the reporting limits for TCL volatile organic analyses were raised in the samples with TICs because of the sample dilution necessitated due to the non-target compounds. This identification compares well with the probable existence of residual fuel constituents from previous on-site activities.

Lead was detected in surface soil samples 1071 and 1074 at concentrations of 151 and 322 mg/kg, respectively (Table 12-5). The vertical extent of contamination did not extend into deeper soils. Chromium was detected infrequently and in concentrations comparable to site background levels.

In summary, Figures 12-4 and 12-5 illustrate the vertical extent of TPH and ethyl benzene and xylenes contamination at this site. Migration of total petroleum hydrocarbons along with ethyl benzene and xylenes has occurred to a depth of 32 feet in boring 1074. These compounds were not detected above the quantitation limit below 47 feet in this boring.

# TABLE 12-1

## ANALYTICAL RESULTS OF SOIL SAMPLES COLLECTED BY RADIAN AT FIRE DEPARTMENT TRAINING AREA NO. 3

## SWMU NO. 107/IRP NO. FT-8
## CANNON AFB, NEW MEXICO

| Sample Number | Sample Depth (Ft-BGS) | Oil and Grease (mg/kg) | Lead (mg/kg) | Purgeable Organic Compounds (EPA 8010/8020) ($\mu$g/kg) |
|---|---|---|---|---|
| 8-1 | 1.5-2.0 | 1700 | 3.7 | ND |
| 8-2 | 7.5-9.5 | 3800 | 2.9 | ND |
| 8-3 | 59.8-61.5 | 2600 | 1.7 | ND |

Ft-BGS = Feet below ground surface
mg/kg = Milligrams per kilogram
$\mu$g/kg = Micrograms per kilogram
ND = Not detected

Source: Final Report, IRP Phase II (Radian 1986)

TABLE 12-2

SUMMARY OF SURFACE SOIL SAMPLING, BOREHOLE DRILLING, AND BOREHOLE SAMPLING CONDUCTED BY WCC AT FIRE DEPARTMENT TRAINING AREA NO. 3, SWMU NO. 107 / IRP NO. FT-8, CANNON AFB, NEW MEXICO

| BORING NUMBER | DRILLING/ SAMPLING METHOD | DRILL RIG USED | BOREHOLE DIAMETER (In) | DRILLING/ SAMPLING DEPTH INTERVALS (Ft-BGS) | BOREHOLE SAMPLING FREQUENCY | DATE(S) DRILLED/ SAMPLED | NUMBER OF ANALYTICAL SOIL SAMPLES COLLECTED | NUMBER OF ANALYTICAL QA/QC SAMPLES COLLECTED | NUMBER OF SPT SOIL SAMPLES COLLECTED | NUMBER OF GRADATION ANALYSIS SAMPLES COLLECTED | GROUND ELEVATION (Ft-MSL) | TOTAL DEPTH OF BOREHOLE (Ft-BGS) | DATE BOREHOLE GROUTED |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1071 | HT | NA | NA | 0 to 0.5 | NA | 10-11-91 | 1 | 1 | NA | 0 | 4265.48 | 31 | 10-09-91 |
| | HSA | B-53 | 6.5 | 0 to 21 | Continuous | 10-08-91 | 3 | 2 | 11 | 1 | | | |
| | | | | 21 to 31 | 5' Intervals | 10-09-91 | 1 | 0 | 3 | 0 | | | |
| 1072 | HT | NA | NA | 0 to 0.5 | NA | 10-23-91 | 1 | 1 | NA | 0 | 4265.80 | 32 | 10-27-91 |
| | HSA | F-10 | 7.25 | 0 to 22 | Continuous | 10-24-91 | 3 | 1 | 11 | 2 | | | |
| | | | | 22 to 31 | 5' Intervals | 10-25-91 | 1 | 0 | 2 | 0 | | | |
| 1073 | HT | NA | NA | 0 to 0.5 | NA | 10-23-91 | 1 | 1 | NA | 0 | 4265.66 | 31 | 10-27-91 |
| | HSA | F-10 | 7.25 | 0 to 22 | Continuous | 10-25-91 | 3 | 1 | 11 | 1 | | | |
| | | | | 22 to 31 | 5' Intervals | 10-25-91 | 1 | 0 | 2 | 1 | | | |
| (1076)* | HSA | B-61B | 7.5 | 0 to 12 | 5' Intervals | 12-06-91 | 1 | 0 | 2 | 0 | 4265.66 | 31.1 | 12-07-91 |
| | | | | 12 to 52 | 10' Intervals | 12-06-91 | 1 | 1 | 3 | 0 | | | |
| 1073 | HT | NA | NA | 0 to 0.5 | NA | 10-23-91 | 1 | 0 | NA | 0 | 4265.85 | 67.1 | 10-26-91 |
| | HSA | F-10 | 7.25 | 0 to 22 | Continuous | 10-25-91 | 3 | 1 | 11 | 1 | | | |
| | | | | 22 to 52 | 5' Intervals | 10-25-91 to 10-26-91 | 3 | 1 | 5 | 1 | | | |
| | | | | 52 to 67.1 | 10' Intervals | 10-26-91 | 1 | 0 | 2 | 0 | | | |
| (1076)* | HSA | CME-7 | 8.0 | 0 to 12 | 5' Intervals | 12-10-91 | 1 | 1 | 2 | 0 | 4265.85 | 52 | 12-10-91 |
| | | | | 12 to 52 | 10' Intervals | 12-10-91 | 1 | 3 | 3 | 0 | | | |

| | | | |
|---|---|---|---|
| In | Inches | B-53 | Mobile B-53 Auger Drill Rig with 6" OD / 3.75" ID Augers and 6.5" Bullet Bit |
| Ft-BGS | Feet Below Ground Surface | B-61A | Mobile B-61 Auger Drill Rig with 6" OD / 3.75" ID Augers and 6.5" or 6.25" Bullet Bit |
| Ft-MSL | Feet Mean Sea Level | B-61B | Mobile B-61 Auger Drill Rig with 7.25" OD / 4.25" ID Augers and 7.5" Bullet Bit |
| SPT | Standard Penetration Test | F-10 | Failing F-10 Auger Drill Rig with 8.25" OD / 4.25" ID Augers and 8.5" Bullet Bit |
| HSA | Hollow Stem Auger | CME-75 | Central Mine Equipment CME-75 Auger Drill Rig with 7.75" OD / 4.25" ID Augers and 8.0" Bullet Bit |
| HT | Hand Trowel, Surface Sample | OD | Outer Diameter |
| NA | Not Applicable, Surface Sample | ID | Inner Diameter |
| NS | Not Sampled | | |

( )* The borings that are shaded and in parentheses correspond to either a redrill or surface resample of the previous boring or surface sample due to laboratory missed holding times. These borings or surface resamples were drilled or collected approximately 1 to 5 feet away from the original boring or surface sample location.

TABLE 12-3

SUMMARY OF SURFACE SOIL, SUBSURFACE SOIL, AND QA/QC SAMPLES COLLECTED BY WCC AT FIRE DEPARTMENT TRAINING AREA NO. 3, SWMU NO. 107 / IRP NO. FT-8 , CANNON AFB, NEW MEXICO

| BORING NUMBER | DEPTH INTERVAL (Ft-BGS) | SAMPLE IDENTIFICATION NUMBER | SAMPLE TYPE | QA/QC SAMPLES | SAMPLE MATRIX | DATE SAMPLED | TIME SAMPLED | OVA ON SAMPLE (ppm) | ANALYTICAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|---|
| 1071 | 0 to 0.5 | CAN107-1071-0000 | A | | Soil | 10-11-91 | 1145 | 0 | BTEX,TPH,Pb/Cr |
| | | CAN107-1071-1073 | A | FD | Soil | 10-11-91 | 1145 | 0 | BTEX,TPH,Pb/Cr |
| | 0.5 to 2 | CAN107-1071-4000 | SPT | | Soil | 10-08-91 | 1400 | 0 | |
| | 2 to 3.5 | CAN107-1071-4002 | SPT | | Soil | 10-08-91 | 1405 | | |
| | 3.5 to 5 | CAN107-1071-4003 | SPT | | Soil | 10-08-91 | 1410 | | |
| | 5 to 6.5 | CAN107-1071-0005 | A/SPT | MS/MSD | Soil | 10-08-91 | 1415 | 0 | VOC,TPH,Pb/Cr |
| | | CAN107-1071-1071 | A | RB | Water | 10-08-91 | 1420 | | VOC,TPH,Pb/Cr |
| | 6.5 to 8.5 | CAN107-1071-4006 | SPT | | Soil | 10-08-91 | 1430 | | |
| | 8.5 to 10 | CAN107-1071-4008 | SPT | | Soil | 10-08-91 | 1510 | | |
| | 10 to 11.5 | CAN107-1071-0010 | A/SPT | | Soil | 10-08-91 | 1525 | 0 | VOC,TPH,Pb/Cr |
| | 11.5 to 13.5 | CAN107-1071-4011 | SPT | | Soil | 10-08-91 | 1540 | | |
| | 13.5 to 15 | CAN107-1071-4013 | SPT/GA | | Soil | 10-08-91 | 1600 | | |
| | 17 to 18.5 | CAN107-1071-4017 | SPT | | Soil | 10-08-91 | 1700 | | |
| | 20 to 21 | CAN107-1071-0020 | A/SPT | | Soil | 10-08-91 | 1850 | 0 | VOC,TPH,Pb/Cr |
| | 23.5 to 25 | CAN107-1071-4023 | SPT | | Soil | 10-09-91 | 0825 | | |
| | 28.5 to 29.5 | CAN107-1071-4028 | SPT | | Soil | 10-09-91 | 1130 | | |
| | 29.5 to 31 | CAN107-1071-0030 | A/SPT | | Soil | 10-09-91 | 1145 | 0 | VOC,TPH,Pb/Cr |
| 1072 | 0 to 0.5 | CAN107-1072-0000 | A | | Soil | 10-23-91 | 1450 | 0 | BTEX,TPH,Pb/Cr |
| | | CAN107-1072-1101 | A | MRD | Soil | 10-23-91 | 1450 | 0 | BTEX,TPH,Pb/Cr |
| | 0 to 2 | CAN107-1072-4000 | SPT | | Soil | 10-24-91 | 1620 | | |
| | 2 to 4 | CAN107-1072-4002 | SPT/GA | | Soil | 10-24-91 | 1625 | | |
| | 4 to 6 | CAN107-1072-0004 | A/SPT | | Soil | 10-24-91 | 1650 | 0 | VOC,TPH,Pb/Cr |
| | 6 to 8 | CAN107-1072-4006 | SPT | | Soil | 10-24-91 | 1705 | | |
| | 8 to 10 | CAN107-1072-4008 | SPT | | Soil | 10-24-91 | 1715 | | |
| | 10 to 12 | CAN107-1072-0010 | A/SPT | | Soil | 10-24-91 | 1725 | 6 | VOC,TPH,Pb/Cr |
| | 12 to 14 | CAN107-1072-4012 | SPT | | Soil | 10-24-91 | 1730 | | |
| | 14 to 16 | CAN107-1072-4014 | SPT | | Soil | 10-24-91 | 1745 | | |
| | 16 to 18 | CAN107-1072-4016 | SPT | | Soil | 10-24-91 | 1805 | | |
| | 18 to 20 | CAN107-1072-4018 | SPT/GA | | Soil | 10-24-91 | 1815 | | |
| | 20 to 22 | CAN107-1072-0020 | A/SPT | | Soil | 10-24-91 | 1830 | 0 | VOC,TPH,Pb/Cr |
| | | CAN107-1072-1162 | A | FD | Soil | 10-24-91 | 1900 | 0 | VOC,TPH,Pb/Cr |
| | 25 to 27 | CAN107-1072-4025 | SPT | | Soil | 10-25-91 | 0815 | | |
| | 30 to 31 | CAN107-1072-0030 | A/SPT | | Soil | 10-25-91 | 0845 | 0 | VOC,TPH,Pb/Cr |
| 1073 | 0 to 0.5 | CAN107-1073-0000 | A | MS/MSD | Soil | 10-23-91 | 1510 | 0 | BTEX,TPH,Pb/Cr |
| | 0 to 2 | CAN107-1073-4000 | SPT | | Soil | 10-25-91 | 1000 | | |
| | 2 to 4 | CAN107-1073-4002 | SPT | | Soil | 10-25-91 | 1015 | | |
| | 4 to 6 | CAN107-1073-0004 | A/SPT | | Soil | 10-25-91 | 1020 | 1.1 | VOC,TPH,Pb/Cr |
| | 6 to 8 | CAN107-1073-4006 | SPT/GA | | Soil | 10-25-91 | 1035 | | |
| | 8 to 10 | CAN107-1073-4008 | SPT | | Soil | 10-25-91 | 1040 | | |
| | 10 to 12 | CAN107-1073-0010 | A/SPT | | Soil | 10-25-91 | 1050 | 0 | VOC,TPH,Pb/Cr |
| | 12 to 14 | CAN107-1073-4012 | SPT | | Soil | 10-25-91 | 1100 | | |
| | 14 to 16 | CAN107-1073-4014 | SPT | | Soil | 10-25-91 | 1110 | | |
| | 16 to 18 | CAN107-1073-4016 | SPT | | Soil | 10-25-91 | 1120 | | |
| | | CAN107-1073-1151 | A | AB | Water | 10-25-91 | 1120 | | VOC |
| | 18 to 20 | CAN107-1073-4018 | SPT | | Soil | 10-25-91 | 1130 | | |
| | 20 to 22 | CAN107-1073-0020 | A/SPT | | Soil | 10-25-91 | 1145 | 0 | VOC,TPH,Pb/Cr |
| | 25 to 26.5 | CAN107-1073-4025 | SPT/GA | | Soil | 10-25-91 | 1200 | | |
| | 30 to 31 | CAN107-1073-0030 | A/SPT | | Soil | 10-25-91 | 1220 | 0 | VOC,TPH,Pb/Cr |
| (1076)* | 4 to 6 | CAN107-1076-0004 | A/SPT | | Soil | 12-06-91 | 0800 | 0 | VOC |
| | 10 to 12 | CAN107-1076-4010 | SPT | | Soil | 12-06-91 | 0825 | 0 | |
| | 20 to 21.5 | CAN107-1076-4020 | SPT | | Soil | 12-06-91 | 0845 | 0 | |
| | 30 to 30.3 | CAN107-1076-4030 | SPT | | Soil | 12-06-91 | 0910 | 0 | |
| | 30.3 to 31.1 | CAN107-1076-0030 | A/SPT | | Soil | 12-06-91 | 0935 | 0 | VOC |
| | | CAN107-1076-1165 | A | FD | Soil | 12-06-91 | 0945 | 0 | VOC |

TABLE 12-3

SUMMARY OF SURFACE SOIL, SUBSURFACE SOIL, AND QA/QC SAMPLES COLLECTED BY WCC AT FIRE DEPARTMENT TRAINING AREA NO. 3, SWMU NO. 107 / IRP NO. FT-8 , CANNON AFB, NEW MEXICO

| BORING NUMBER | DEPTH INTERVAL (Ft-BGS) | SAMPLE IDENTIFICATION NUMBER | SAMPLE TYPE | QA/QC SAMPLES | SAMPLE MATRIX | DATE SAMPLED | TIME SAMPLED | OVA ON SAMPLE (ppm) | ANALYTICAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|---|
| 1074 | 0 to 0.5 | CAN107-1074-0000 | A | | Soil | 10-23-91 | 1530 | 13 | BTEX,TPH,Pb/Cr |
| | 0 to 2 | CAN107-1074-4000 | SPT | | Soil | 10-25-91 | 1455 | 3.2 | |
| | 2 to 4 | CAN107-1074-4002 | SPT | | Soil | 10-25-91 | 1500 | 35 | |
| | 4 to 6 | CAN107-1074-0004 | A/SPT | | Soil | 10-25-91 | 1505 | 240 | VOC,TPH,Pb/Cr |
| | 6 to 8 | CAN107-1074-4006 | SPT | | Soil | 10-25-91 | 1510 | 45 | |
| | 8 to 10 | CAN107-1074-4008 | SPT/GA | | Soil | 10-25-91 | 1525 | 63 | |
| | 10 to 12 | CAN107-1074-0010 | A/SPT | | Soil | 10-25-91 | 1550 | 38 | VOC,TPH,Pb/Cr |
| | 12 to 14 | CAN107-1074-4012 | SPT | | Soil | 10-25-91 | 1555 | 47 | |
| | 14 to 16 | CAN107-1074-4014 | SPT | | Soil | 10-25-91 | 1605 | 13 | |
| | 16 to 18 | CAN107-1074-4016 | SPT | | Soil | 10-25-91 | 1615 | 8 | |
| | 18 to 20 | CAN107-1074-4018 | SPT | | Soil | 10-25-91 | 1625 | 21 | |
| | 20 to 22 | CAN107-1074-0020 | A/SPT | | Soil | 10-25-91 | 1640 | 17 | VOC,TPH,Pb/Cr |
| | | CAN107-1074-1101 | A | MRD | Soil | 10-25-91 | 1640 | 17 | VOC,TPH,Pb/Cr |
| | 25 to 27 | CAN107-1074-4025 | SPT | | Soil | 10-25-91 | 1700 | 18 | |
| | 30 to 32 | CAN107-1074-0030 | A/SPT | | Soil | 10-25-91 | 1725 | 11 | VOC,TPH,Pb/Cr |
| | | CAN107-1074-4030 | GA | | Soil | 10-25-91 | 1725 | 11 | |
| | 35 to 37 | CAN107-1074-4035 | SPT | | Soil | 10-25-91 | 1810 | 16 | |
| | | CAN107-1074-1181 | A | DW | Water | 10-26-91 | 0900 | | VOC |
| | 45 to 47 | CAN107-1074-0045 | A/SPT | | Soil | 10-26-91 | 1525 | 3 | VOC,TPH,Pb/Cr |
| | 50 to 52 | CAN107-1074-0050 | A/SPT | | Soil | 10-26-91 | 1610 | 3.2 | VOC,TPH,Pb/Cr |
| | 60 to 62 | CAN107-1074-0060 | A/SPT | | Soil | 10-26-91 | 1655 | 0.1 | VOC,TPH,Pb/Cr |
| | 67 to 67.1 | CAN107-1074-4067 | SPT | | Soil | 10-26-91 | 1800 | 0 | |
| (1075)* | 4 to 6 | CAN107-1075-4004 | SPT | | Soil | 12-10-91 | 0840 | 16 | |
| | 10 to 12 | CAN107-1075-0010 | A/SPT | MS/MSD | Soil | 12-10-91 | 0905 | 29 | VOC |
| | 20 to 22 | CAN107-1075-4020 | SPT | | Soil | 12-10-91 | 0950 | 29 | |
| | 30 to 32 | CAN107-1075-4030 | SPT | | Soil | 12-10-91 | 1020 | 160 | |
| | 40 to 42 | CAN107-1075-4040 | SPT | | Soil | 12-10-91 | 1100 | 0 | |
| | 50 to 52 | CAN107-1075-0050 | A/SPT | | Soil | 12-10-91 | 1140 | 0 | VOC |
| | | CAN107-1075-1152 | A | AB | Water | 12-10-91 | 1120 | | VOC |
| | | CAN107-1075-1182 | A | DW | Water | 12-10-91 | 1200 | | VOC |
| | | CAN107-1075-1172 | A | RB | Water | 12-10-91 | 1215 | | VOC |

| | | | | | |
|---|---|---|---|---|---|
| Ft-BGS | Feet Below Ground Surface | FD | Field Duplicate | SV | Semi Volatile Organic Compounds |
| OVA | Organic Vapor Analyzer Reading | MRD | Missouri River Division Duplicate | M | Metals (TAL) |
| ppm | Parts per Million | AB | Ambient Blank | TPH | Total Petroleum Hydrocarbons |
| A | Analytical | RB | Rinsate Blank | BTEX | Benzene, Toluene, Ethylbenzene, Xylene |
| SPT | Standard Penetration Test | DW | Decontamination Water Blank | TOC | Total Organic Carbon |
| GA | Gradation Analysis | TB | Trip Blank | OL | Organic Lead |
| L | Lithology | VOC | Volatile Organic Compounds (TCL) | Pb/Cr | Lead / Chromium |
| MS/MSD | Matrix Spike / Matrix Spike Duplicate | PCB | Polychlorinated Biphenols, Pesticides | TAL | Target Analyte List |
| | | TCL | Target Compound List | | |

( )* The borings that are shaded and in parentheses correspond to either a redrill or surface resample of the previous boring or surface sample due to laboratory missed holding times. These borings or surface resamples were drilled or collected approximately 1 to 5 feet away from the original boring

# TABLE 12-4

## TOTAL PETROLEUM HYDROCARBON, ETHYL BENZENE, XYLENES, BENZENE, AND TOLUENE CONCENTRATIONS IN SOIL SAMPLES COLLECT BY WCC AT FIRE DEPARTMENT TRAINING AREA NO. 3

## SWMU NO. 107/1RP NO. FT-8
## CANNON AFB, NEW MEXICO

| Boring Number (Redrill Boring Number) | Sample Depth (Ft-BGS) | TPH (mg/kg) | Ethyl Benzene (ug/kg) | Xylene (ug/kg) | Benzene (ug/kg) | Toluene (ug/kg) |
|---|---|---|---|---|---|---|
| 1071 | 0-0.5 | 2870 | 52U | 52U | 1100U | 1100U |
| | 5-7 | 74.2 | 11U | 11U | 11U | 11U |
| | 10-12 | 43.8U | 11U | 11U | 11U | 11U |
| | 20-22 | 44.6U | 11U | 11U | 11U | 11U |
| | 30-32 | 43.5U | 11U | 11U | 11U | 11U |
| 1072 | 0-0.5 | 963 | 54U | 54U | 54U | 54UJ |
| | 4-6 | 46.4U | 11U | 11U | 11U | 11U |
| | 10-12 | 44.1U | 11U | 11U | 11U | 11U |
| | 20-22 | 43.5U | 54U | 54U | 54U | 54U |
| | 30-32 | 43U | 27U | 27U | 27U | 27U |
| 1073 | 0-0.5 | 6080 | 53U | 53U | 53U | 73J |
| (1076) | 4-6 | 46.3U | (11U) | (11U) | (11U) | (11U) |
| | 10-12 | 43.7U | 11U | 11U | 11U | 11U |
| | 20-22 | 44.6U | 11U | 11U | 11U | 11U |
| | 30-32 | 43.9U | (27U) | (27U) | (27U) | (27U) |
| 1074 | 0-0.5 | 3610 | 55U | 55U | 55U | 55UJ |
| (1075) | 4-6 | 18300 | 13000J | 94000 | 29000U | 6900J |
| | 10-12 | 9220 | (15000J) | (87000) | (36000U) | (36000U) |
| | 20-22 | 11500 | 5800 | 28000 | 2700U | 2700J |
| | 30-32 | 4710 | 14000U | 4900J | 14000U | 14000U |
| | 45-47 | 41.9 | 11U | 11U | 11U | 11U |
| | 50-52 | 43U | (11U) | (11U) | (11U) | (11U) |
| | 60-62 | 41.9U | 11U | 11U | 11U | 4J |

**TABLE 12-4**
**(Concluded)**

| | | |
|---|---|---|
| Ft-BGS | = | Feet below ground surface |
| mg/kg | = | Milligrams per kilogram |
| ug/kg | = | Micrograms per kilogram |
| U | = | Not detected |
| J | = | Estimated value |
| UJ | = | Estimate as non-detect at the CRQL |
| ( ) | = | The values in parentheses are results from samples collected from the redrill borings due to laboratory missed holding times. |

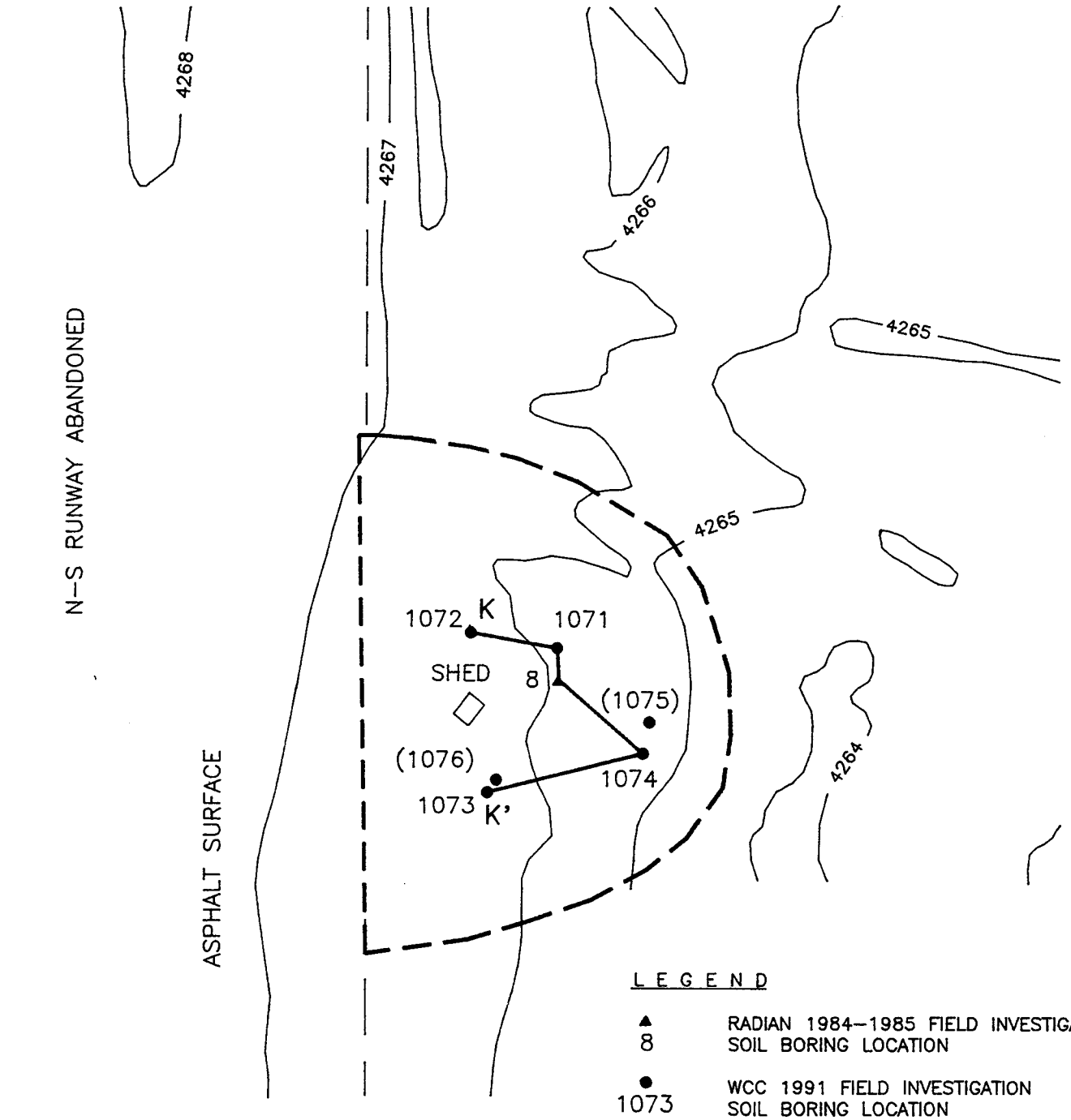
# TABLE 12-5

## CHROMIUM AND LEAD CONCENTRATIONS IN SOIL SAMPLES COLLECTED BY WCC AT FIRE DEPARTMENT TRAINING AREA NO. 3

## SWMU NO. 107/IRP NO. FT-8
## CANNON AFB, NEW MEXICO

| Boring Number | Sample Depth (Ft-BGS) | Chromium[1] (mg/kg) | Lead[2] (mg/kg) |
|---|---|---|---|
| 1071 | 0 - 0.5 | 5.1 | 151 |
| | 5 | 5.7 | 3.3 |
| | 10 | 7.7 | 4.8 |
| | 20 | 5.6 | 2.1 |
| | 30 | 6.4 | 3.8 |
| 1072 | 0 - 0.5 | 3.5 | 6.4 J |
| | 4 | 3.3 | 2.1 |
| | 10 | 5.0 | 5.3 |
| | 20 | 4.9 | 2.7 |
| | 30 | 10.3 | 1.6 |
| 1073 | 0 - 0.5 | 3.2 | 8.7 |
| | 4 | 6.1 | 2.9 |
| | 10 | 8.2 | 4.8 |
| | 20 | 7.3 | 4.1 |
| | 30 | 4.8 | 1.9 |
| 1074 | 0 - 0.5 | 11.1 | 322 |
| | 4 | 5.7 | 10.4 |
| | 10 | 5.2 | 5.8 |
| | 20 | 7.3 | 3.7 |
| | 30 | 8.3 | 3.6 |
| | 45 | 4.4 | 1.8 |
| | 50 | 5.2 | 1.5 |
| | 60 | 2.7 | 0.73 |

Ft-BGS = Feet below ground surface
mg/kg = Milligrams per kilogram
J = Estimated value
[1] Background range for chromium is 2.67 to 9.31 mg/kg (see Table 2-7).
[2] Background range for lead is 1.76 to 8.64 mg/kg (see Table 2-7).




LEGEND

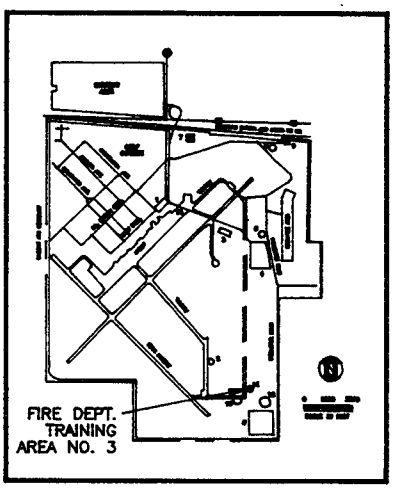
| | |
|---|---|
| ▲ 8 | RADIAN 1984–1985 FIELD INVESTIGATION SOIL BORING LOCATION |
| ● 1073 | WCC 1991 FIELD INVESTIGATION SOIL BORING LOCATION |
| — — | SWMU BOUNDARY |
| 4265 | GROUND SURFACE CONTOUR LINE IN FEET MSL CONTOUR INTERVAL = 1 FOOT |
| K—K' | GEOLOGIC CROSS-SECTION LOCATION |

N

0 25 50

SCALE IN FEET

NOTE: THE NUMBERS IN PARENTHESIS CORRESPOND TO REDRILLS/RESAMPLES OF THE ORIGINAL BORING/SAMPLE

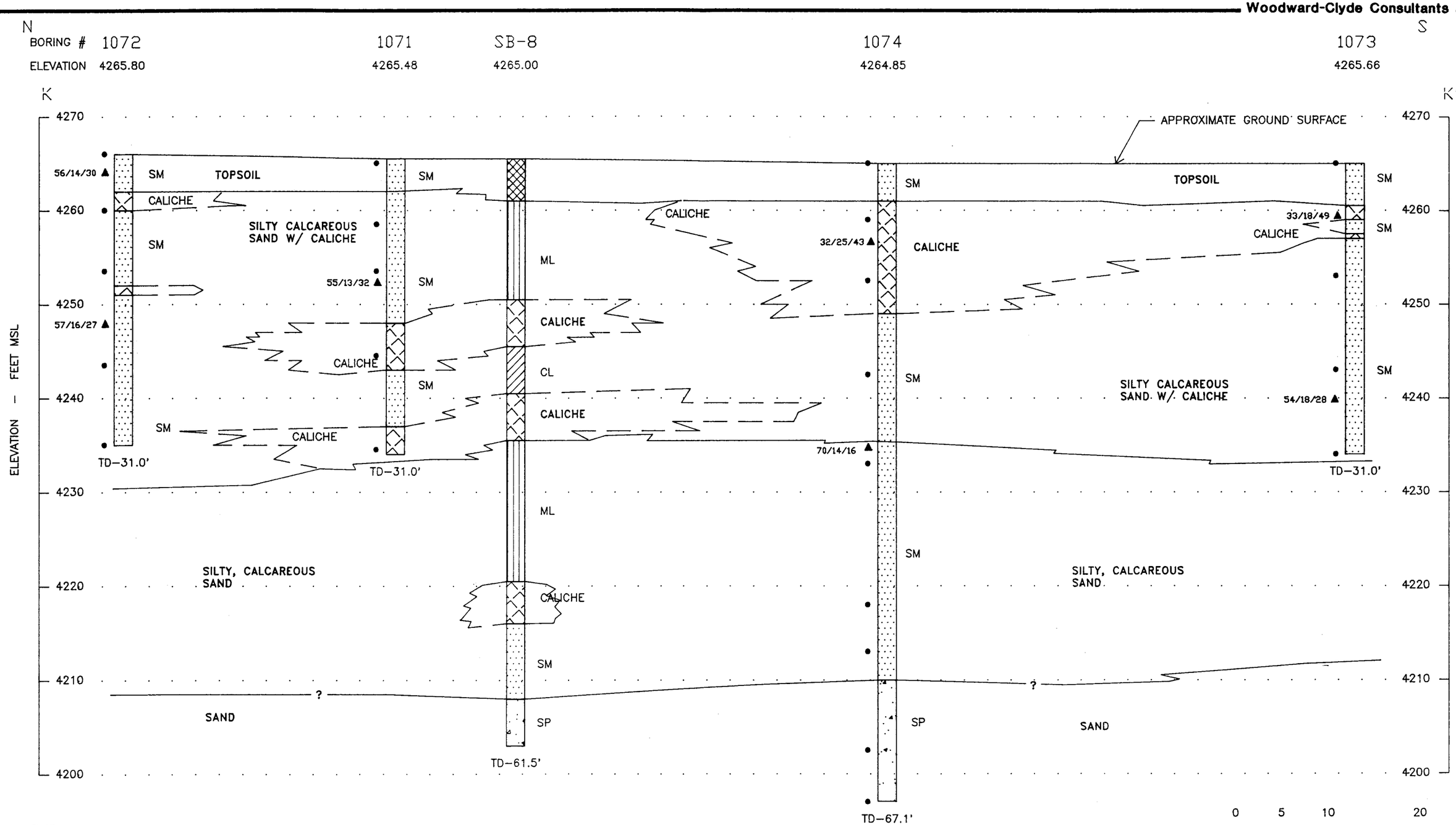



| | |
|---|---|
| Job No. : | 89MC114W |
| Prepared by : | D.A.K. |
| Date : | 2/10/92 |

LOCATION OF SOIL BORINGS AT FIRE DEPARTMENT TRAINING AREA NO. 3
SWMU NO. 107/IRP NO. FT-8
CANNON AFB, NEW MEXICO

C1140007

FIG. 12–1




LEGEND

MSL – MEAN SEA LEVEL
TD – TOTAL DEPTH IN FEET BGS
SM,SP,GW ML,GP – UNIFIED SOIL CLASSIFICATION SYSTEM ABBREVIATIONS
BGS – BELOW GROUND SURFACE
• – ANALYTICAL SAMPLE INTERVAL

BORINGS 1071, 1072, 1073, 1704 WCC (OCT 91) (BORINGS APPROXIMATELY LOCATED)
(BORING APPROXIMATELY LOCATED)

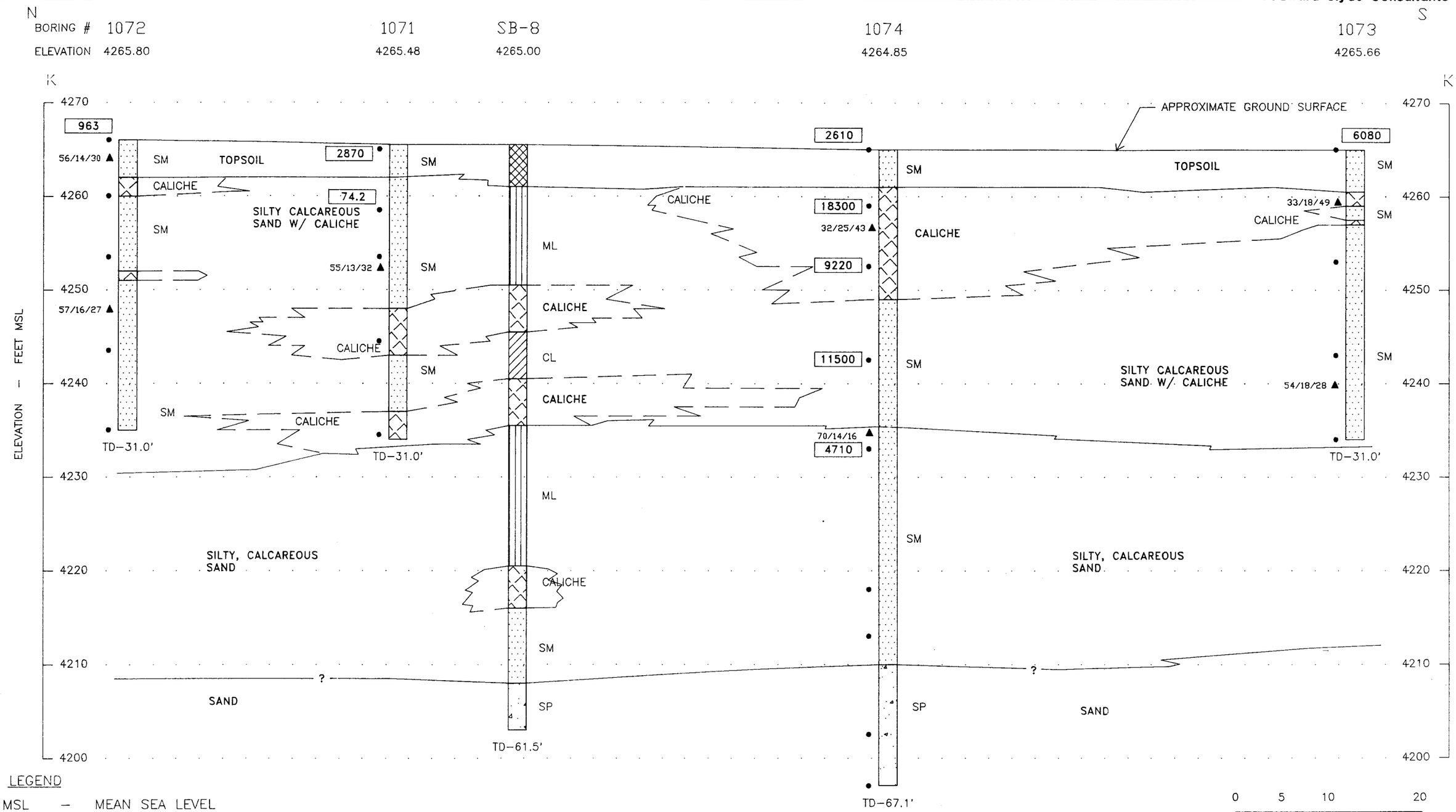
NOTE: THE LOCATION OF THIS CROSS-SECTION IS SHOWN ON FIG. 12-1

70/14/16
▲ – GRADATION ANALYSIS SAMPLE INTERVAL. THE THREE NUMBERS REPRESENT THE APPROXIMATE PERCENTAGES OF SAND-, SILT- AND CLAY- SIZED MATERIAL RESPECTIVELY

| | |
|---|---|
| Job No. : 89MC114W | GEOLOGIC CROSS SECTION K-K' FIRE DEPT. TRAINING AREA NO.3 |
| Prepared by : LLG | SWMU NO. 107/IRP NO. FT-8 |
| Date : 2/3/92 | CANNON AFB NEW MEXICO |

SWMU-107

FIG. 12-2




LEGEND

MSL – MEAN SEA LEVEL
TD – TOTAL DEPTH IN FEET BGS
SM,SP,GW UNIFIED SOIL CLASSIFICATION
ML,GP SYSTEM ABBREVIATIONS
BGS – BELOW GROUND SURFACE

2870 • – THE BOXED NUMBER REPRESENTS ANALYTICAL RESULTS IN mg/kg FOR TOTAL PETROLEUM HYDROCARBONS

BORINGS 1071, 1072, 1073, 1704 WCC (OCT 91) (BORINGS APPROXIMATELY LOCATED)
(BORING APPROXIMATELY LOCATED)

NOTE: THE LOCATION OF THIS CROSS-SECTION IS SHOWN ON FIG. 12-1

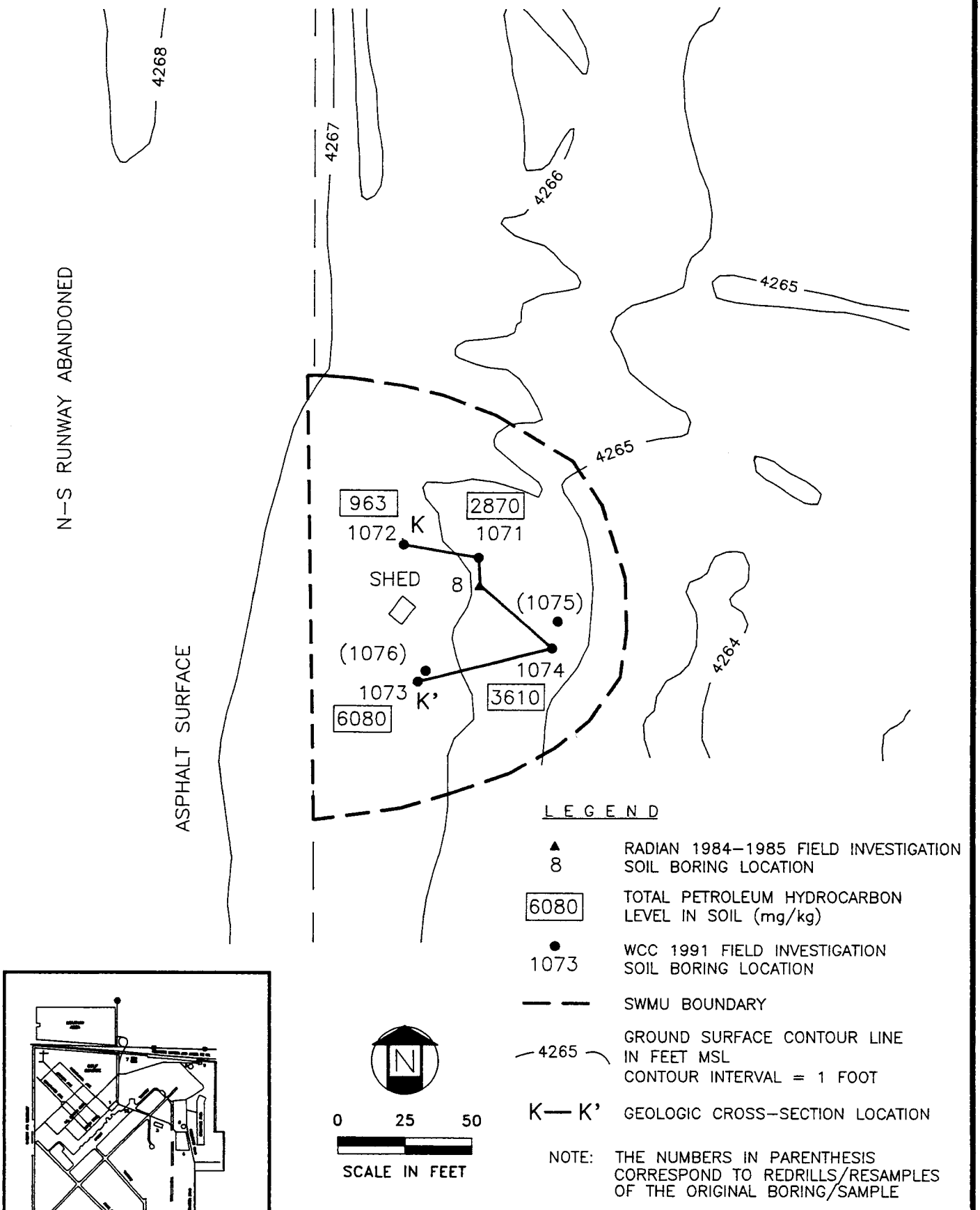
70/14/16
▲ – GRADATION ANALYSIS SAMPLE INTERVAL. THE THREE NUMBERS REPRESENT THE APPROXIMATE PERCENTAGES OF SAND-, SILT- AND CLAY- SIZED MATERIAL RESPECTIVELY

| | |
|---|---|
| Job No. : | 89MC114W |
| Prepared by : | LLG |
| Date : | 2/3/92 |

VERTICAL EXTENT OF TPH IN SOIL
FIRE DEPT. TRAINING AREA NO.3
SWMU NO. 107/IRP NO. FT-8
CANNON AFB NEW MEXICO

SWMU107B

FIG. 12-4




| | |
|---|---|
| Job No. : | 89MC114W |
| Prepared by : | D.A.K. |
| Date : | 2/10/92 |

TPH LEVELS IN SURFACE SOIL AT FIRE DEPARTMENT TRAINING AREA NO. 3

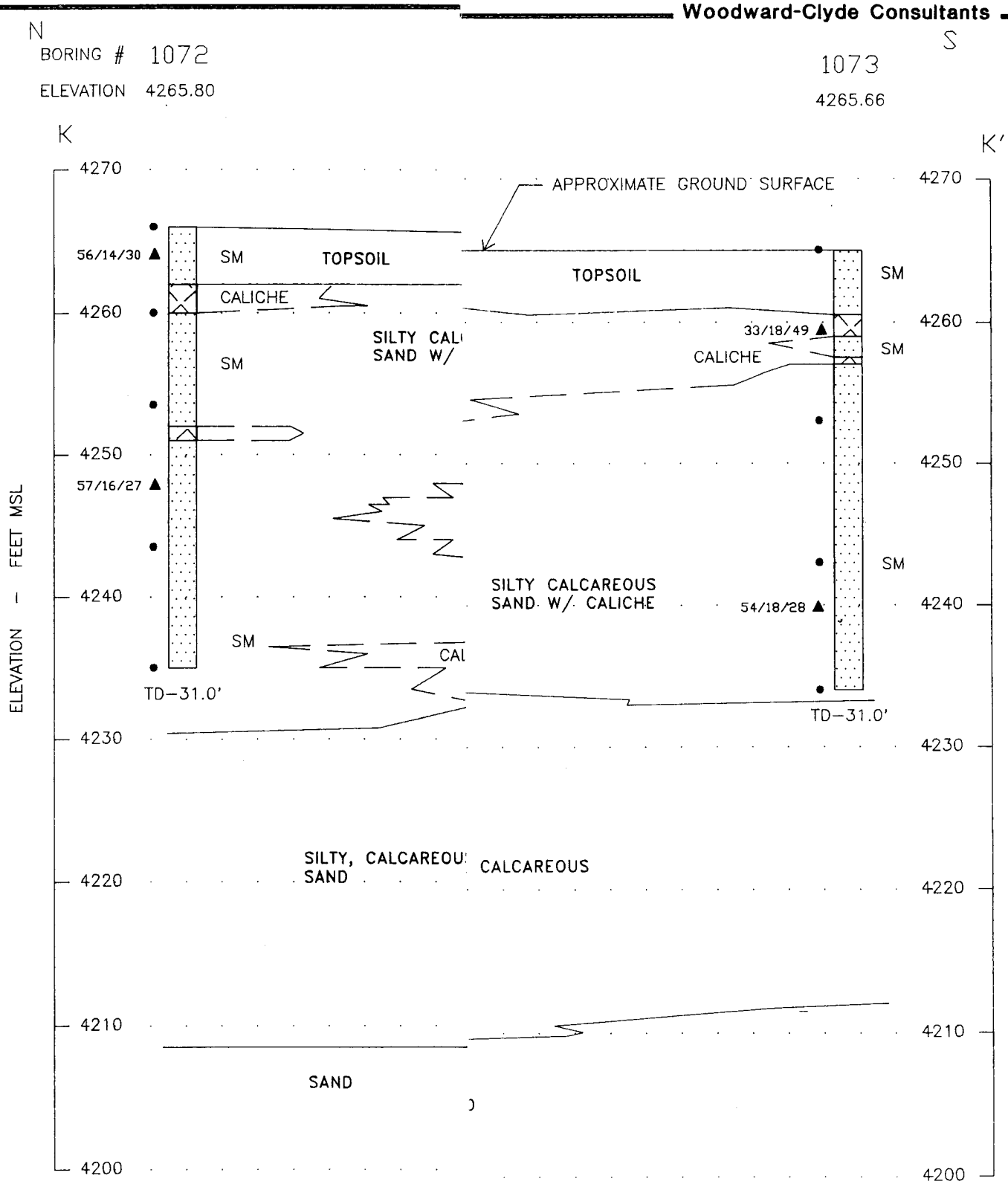
SWMU NO. 107/IRP NO. FT-8

CANNON AFB, NEW MEXICO

C1140024

FIG. 12-3

Woodward-Clyde Consultants




LEGEND

| | | |
|---|---|---|
| MSL | – | MEAN SEA LEVEL |
| TD | – | TOTAL DEPTH IN FEET BGS |
| SM,SP,GW | | UNIFIED SOIL CLASSIFICATION |
| ML,GP | | SYSTEM ABBREVIATIONS |
| BGS | – | BELOW GROUND SURFACE |
| ND | – | NOT DETECTED |

5.8/

0 5 10 20

HORIZONTAL SCALE IN FEET
VERTICAL EXAGGERATION = 1X

:C114W

/92

ETHYL BENZENE AND XYLENES IN SOIL
FIRE DEPT. TRAINING AREA NO.3
SWMU NO. 107/IRP NO. FT-8
CANNON AFB NEW MEXICO

SWMU107A

FIG. 12-5

# 13.0
# FIRE DEPARTMENT TRAINING AREA NO. 4 (SWMU NO. 109)

## 13.1 SWMU DESCRIPTION

### 13.1.1 Setting

Fire Training Area No. 4 is situated in the southeast corner of the base near former Fire Training Areas 2 and 3, which have been previously discussed (Figure 13-1).

This unit is active and used on the average 10 to 12 times a year for fire training exercises. The larger surface area that comprises the training area is unlined and ringed with a small berm and security fence. Immediately below a mock airplane is a concrete "pan" which has internal drainage features such that excess fuel/water is drained to an oil/water separator. A recent addition to the site is a decommissioned airplane which is located about 100 feet northeast of the mock airplane.

### 13.1.2 History of Use

This unit was reportedly used as a fuel truck cleaning area between 1961 and 1974. In 1974, it was activated as a fire department training area. The site has had configuration changes over the years such that some former integral parts are also included in this RI. These include an underground waste oil tank, an unlined pit, and an oil/water separator. During some, but not all exercises, the ground was saturated with water. Runoff was initially directed to an unlined pit but more recently to the oil/water separator (USAF 1990).

The underground waste oil tank has been removed from the ground. Soil from around the tank is being land farmed on a plot adjacent to the site access gate. To prevent any downward migration of contaminants, the land-farmed soil was placed on top of heavy gauge plastic per agreement with the New Mexico Environmental Improvement Division (USAF 1990).

The oil/water separator was allegedly built on the site of the former unlined pit. No visible evidence of the pit was observed during a March 1990 review of the site.

### 13.1.3 Past Investigations

Sample results obtained in 1985 from two deep soil borings drilled by Radian Corporation (Borings Nos. 9A and 9B) shown in Table 13-1 indicate the presence of oil and grease, and lead at this SWMU.

In January 1988, nine borings were drilled by Walk, Haydel and Associates in the runoff and underground fuel storage tank area to depths ranging from 5 to 100 feet. Analytical results contained in Tables 13-2 through 13-7 indicated the presence of constituents of JP-4 (ethylbenzene, benzene, toluene and xylene) above background in the soils in the vicinity of the underground tank to a depth of 60 feet. Concentrations declined rapidly between 60 and 100 feet. No organics were detected in the runoff area. Arsenic, selenium, barium, cadmium and silver were detected in soils at the site. Only arsenic and barium were detected in concentrations above those typically found in soils (Walk, Haydel and Associates 1990).

### 13.1.4 Land Use and Demography

Fire Training Area No. 4 is an active fire training unit and is located adjacent to Landfill No. 5, which is an active landfill. The area is situated in an open field with no other current use. This fire training area is used for training 20 personnel for approximately 5 hours per month.

## 13.2 FIELD INVESTIGATION

This section provides a discussion of the field activities conducted by WCC at Fire Department Training Area No. 4 from October 8 through 30, 1991 and from November 23 through December 16, 1991. The activities at this SWMU, as outlined in the FSP (WCC 1991c), consisted of collecting 4 surface soil samples for chemical analysis, 1 surface soil sample for gradation analysis, drilling 4 soil borings, and collecting 28 subsurface soil samples for chemical analysis and 7 subsurface soil samples for gradation

analysis. Based on elevated OVA readings and odors detected from soil samples collected at the targeted bottom of two soil borings, it was decided to drill these two borings approximately 30 to 40 feet deeper than originally planned to evaluate the vertical extent of potential contamination. A total of 7 additional subsurface soil samples for chemical analysis were collected. The resampling phase of the field program, which became necessary due to laboratory missed holding times, consisted of recollecting 3 surface soil samples for chemical analysis, redrilling 3 soil borings, and recollecting 18 subsurface soil samples for chemical analysis.

Table 13-8 summarizes the drilling and sampling methods, along with sampling frequency conducted at each soil boring and surface soil location during the 1991 WCC investigation. A complete record of all surface soil, subsurface soil, and associated QA/QC samples collected at Fire Department Training Area No. 4 is presented in Table 13-9. The locations of the surface samples and soil borings are shown on Figure 13-1.

### 13.2.1 Sampling Objectives

The objective of sampling at Fire Department Training Area No. 4 was to evaluate the nature and extent of potential hazardous contaminants that may be present. The surface soil and subsurface soil sampling programs were designed to supplement previous investigations. The data collected at these boring locations were used to further evaluate the extent of potential contamination, if present, and to perform a baseline risk assessment to determine if the area poses a risk to human health or the environment. The data may also be utilized to evaluate remedial actions if necessary. Presently, there does not appear to be any substantial risk to the groundwater, so no hydrogeologic investigation was planned or conducted.

### 13.2.2 Surface Soil Investigation

Four surface soil samples were collected from 0 to 0.5 feet BGS near soil borings 1091 through 1094. These samples were collected using a stainless steel hand trowel and analyzed for TCL VOCs, TPH, and lead/chromium. Geotechnical gradation analysis was also performed on the sample from boring 1091.

During the resampling phase, three additional surface soil samples, 1096, 1097, and 1098 (resamples of the surface soil samples from soil borings 1092, 1093, and 1094) located approximately 1 to 3 feet away from the original soil boring/surface soil sample locations, were collected because the laboratory missed holding times for the TCL VOC and/or TPH analyses on the original samples. These samples were analyzed for TCL VOCs and/or TPH, depending on which holding times were missed for each sample.

### 13.2.3 Subsurface Soil/Vadose Zone Investigation

Four soil borings, 1091 through 1094, were drilled to depths of 61, 62, 100, and 92 feet BGS, respectively, near the oil/water separator, and in either low lying areas or areas of visible staining or residue within the SWMU boundary. Each soil boring was sampled continuously to a depth of 20 feet BGS and at 5-foot intervals from 20 feet BGS to total depth. All soil borings were described lithologically from the split spoon samples obtained during drilling. Subsurface samples for chemical analysis were collected at 4, 10, 20, 30, 40, 50, and 60 feet BGS in borings 1091 and 1092; at 4, 10, 20, 30, 40, 50, 60, 70, 80, 90 and 98 feet BGS in boring 1093; and at 4, 10, 20, 30, 40, 50, 60, 70, 80 and 90 feet BGS in boring 1094 for a total of thirty-five subsurface soil samples. The subsurface analytical samples were collected with stainless steel split spoons and analyzed for TCL VOCs, TPH, and lead/chromium. In addition to these analyses, six of the samples collected at 10, 20, 30, 40, 50, 50, and 60 feet BGS in boring 1091 were also analyzed for TOC. Nine subsurface samples for geotechnical gradation analysis were collected at 28.5 feet BGS in boring 1091, at 2 and 35 feet BGS in boring 1092, at 12, 45 and 90 feet BGS in boring 1093, and at 18, 55 and 80 feet BGS in boring 1094.

During the resampling phase, three additional soil borings, 1095, 1096, and 1097 (redrills of borings 1091, 1092, and 1093), located approximately 3 to 5 feet away from the original boring, were drilled to a depth of 61, 62, and 92 feet BGS, respectively, and sampled at the same intervals where analytical subsurface soil samples were collected in the original boring. Eighteen additional subsurface soil samples were collected at 10, 20, 30, 40, 50, and 60 feet BGS in boring 1095; at 4, 10, 20, 30, 40, 50, and 60 feet BGS in boring 1096; and at 4, 10, 20, 40, and 80 feet BGS in boring 1097 because the laboratory missed holding times for the TCL VOC, and/or TPH, and/or TOC analyses

on the original samples. These samples were analyzed for TCL VOCs, and/or TPH, and/or TOC, depending on which holding times were missed on each sample.

## 13.3 PHYSICAL CHARACTERISTICS

This section provides a discussion of the soil, geology and hydrogeology at Fire Department Training Area No. 4 based on the detailed lithologic descriptions of split spoon samples and gradation analysis results from the 1991 WCC investigation, and the review of lithologic boring logs from the previous 1984-1985 Radian field investigation.

### 13.3.1 Soil

The soils underlying the Fire Department Training Area No. 4 area consist of sandy loam and loamy sand of the Amarillo Soil Group. The soils consist primarily of fine-grained, well sorted, silty, clayey, unconsolidated red-brown to brown-red sands. The sands are comprised predominantly of subangular to subrounded quartz grains. Two gradation analyses were performed on samples collected within this unit at 0.5 feet BGS in boring 1091 and 2 feet BGS in boring 1092. The results indicate that these soil samples were comprised of approximately 60 to 68 percent sand, 14 to 17 percent silt, and 18 to 23 percent clay. The sands are generally dry to slightly moist at depth with a thickness ranging between 3 to 6 feet. These soils were stained brown-gray to dark gray in boring 1093 and 1094.

### 13.3.2 Geology

The near surface (upper 100 feet) stratigraphy at Fire Department Training Area No. 4 consists of Tertiary Miocene to Pliocene fluvial deposits of the Ogallala Formation. Two geologic cross-sections, L-L' (Figure 13-2) and M-M' (Figure 13-3), were constructed using information on the lithologic boring logs from the 1991 WCC field investigation along with one boring log, 9A, from the 1984-1985 Radian field investigation. These cross-sections run northwest-southeast and north-south, respectively (see Figure 13-1 for the cross-section locations). Stratigraphic correlations of the various fluvial deposits between borings is based primarily on the split spoon lithologic samples collected during drilling.

The SWMU is underlain by Ogallala fluvial deposits consisting primarily of well to moderately sorted sand, with scattered thin (1 to 6 feet thick) layers of caliche. The total thickness of these Ogallala deposits beneath the SWMU is not presently known, but based on regional information, may be as thick as 390 feet.

It would appear from the geologic cross-sections and the lithologic descriptions (Appendix B-1) that three fairly distinct sand, sand/caliche units are present beneath the SWMU to a depth of 100 feet. The lowermost fluvial deposits shown on the geologic cross-sections from 4165 to 4190 feet MSL consist of fine- to medium-grained, well sorted, unconsolidated light to medium orange sands. These sands are comprised predominantly of subrounded to subangular quartz grains with minor amounts (3-5% each) of orange and dark colored grains. These sands are relatively clean (i.e., little or no silt/clay sized particles). Overall, these sands are non-calcareous, however, there are occasional thin layers and pockets of calcareous sands. Two gradation analyses were performed on samples collected within this unit at 80 feet BGS in boring 1094 and 90 feet BGS in boring 1093. The results indicate that these samples were comprised of approximately 74 to 82 percent sand, 7 to 13 percent silt, and 11 to 13 percent clay and/or calcium carbonate. This unit was encountered in borings 1093 and 1094 at 75 and 79 feet BGS, respectively. The thickness of this unit is unknown at present due to the fact that the unit was not fully penetrated, but is at least 25 feet thick at this SWMU.

The middle fluvial deposits shown on the geologic cross-sections from 4190 to 4222 feet MSL consist of fine-grained, well sorted, slightly silty, pale orange to orange sands. These sands are comprised predominantly of subangular to subrounded quartz grains with minor amounts (1-5%) of dark colored grains. These sands are slightly calcareous with occasion small pockets of tan-orange to pale orange caliche and scattered calcium carbonate cemented sands. Two gradation analyses were performed on samples collected within this unit at 45 feet BGS in boring 1093 and 55 feet BGS in boring 1094. The results indicate that these samples were comprised of approximately 71 to 78 percent sand, 15 to 16 percent silt, and 7 to 13 percent calcium carbonate and/or clay-sized material. This unit was encountered between at approximately 40 to 45 feet BGS in all four borings. Based on the cross-sections, the thickness of this unit ranges from approximately 32 feet thick in 1093 to 36 feet thick in 1094. This unit may be contaminated with petroleum residue, based on OVA readings and odor observations.

The upper fluvial deposits shown on the geologic cross-sections from 4222 to 4260 feet MSL consist of fine-grained, well sorted, silty, calcareous, medium to pale orange to tan-orange sands. These sands are comprised predominantly of subangular to subrounded quartz grains with varying amounts of silt and calcium carbonate. Occasionally, these sands are moderately to well cemented with calcium carbonate. Thin layers (ranging from a few inches to several feet in thickness) and small pockets or nodules of tan-orange to pale orange, silty, sandy, clayey caliche are scattered throughout this unit.

Four gradation analyses were performed on samples collected within this unit at 28 feet BGS in boring 1091, 35 feet BGS in boring 1092, 12 feet BGS in boring 1093, and 18 feet BGS in boring 1094. The results indicate that these samples were comprised of approximately 43 to 66 percent sand, 13 to 26 percent silt, and 21 to 42 percent calcium carbonate and/or clay-sized material. Based on the cross-sections, the thickness of this unit ranges from approximately 38 feet thick in borings 1091, 1092, and 1094 to 39 feet thick in boring 1093. The upper 15 feet of this unit in borings 1093 and 1094 appeared to be contaminated with petroleum residue, based on OVA readings and odor observations. Approximately 3 to 6 feet of native topsoil exists above this unit. No groundwater was encountered during the drilling of these borings.

## 13.4 NATURE AND EXTENT OF CONTAMINATION

Surface and subsurface samples have been collected from four soil borings, 1091 through 1094 (Figure 13-1). Evaluation of the chemical analyses (TCL VOCs, chromium/lead, TPH) of these samples has been used to describe the nature and extent of contamination.

Aside from acetone, xylenes and ethyl benzene were the only volatile organic compounds detected above the CRQL. Ethyl benzene and xylene concentrations are summarized in Table 13-10. Xylenes were found predominantly at 4 feet bgs in boring 1093 and at 4 and 10 feet bgs in boring 1094 at concentrations of 4.1, 290, and 6.7J mg/kg, respectively. At boring 1094, xylenes were not detected above the CRQL below 22 feet bgs nor below 12 feet at boring 1093. Ethyl benzene was also detected in boring 1074 at 4 feet bgs at an estimated value of 19 mg/kg and may be present at the 10-12 foot depth because of raised detection limits. TICs from VOC analysis indicate the possible

presence of xylene derivatives in boring 1094 and 1093 at the depths described above for xylenes and ethyl benzene detections. This identification of xylenes and ethyl benzene compares well with the existence of residual fuel constituents from fire training exercises.

The reporting limits for TCL volatile organic analyses were raised in samples 1093 (4 feet bgs) and 1094 (4 and 10 feet bgs) because of the sample dilution necessary due to target and non-target compounds. The concentration of xylenes usually exceeded the calibration range and, therefore, the samples were reanalyzed at dilution. In addition, there was also the presence of TICs, as previously discussed.

Total petroleum hydrocarbon concentrations of surface soil samples 1091, 1093, and 1094 were 273, 38,500, and 13,600 mg/kg, respectively (Figure 13-4) (Table 13-10). The vertical extent of TPH contamination extends from ground surface to approximately 5 feet bgs for boring 1091. TPH contamination in boring 1094 extends from the surface to approximately 20 feet bgs. Elevated levels of TPH in boring 1093 were detected from ground surface to approximately 6 feet bgs. The TPH concentrations of 215 mg/kg and 203 mg/kg found at 50-52 feet and 60-62 feet bgs, respectively, in boring 1093 are anomalous since TPH was not detected in samples immediately above and below this depth. Figure 13-5 illustrates the occurrence of TPH at this site. VOC analysis reported tentatively identified compounds (TICs) which were a variety of medium to high molecular weight saturated hydrocarbons. These TICs were present at boring 1094 from 0 to 10 feet bgs and at boring 1093 at 4 feet bgs. This identification compares well with the probable existence of residual fuel constituents from on-site fire training exercises.

All surface and subsurface soil samples were analyzed for chromium and lead (Table 13-11). Only one sample for lead, the surface sample at boring 1093, indicated a metal concentration above significantly background soils at the site at 19.6J mg/kg. However, since this result is an estimated value, it is not considered as a concern at this site.

In summary, xylenes and ethyl benzene occur in the soil from near ground surface to approximately 6 feet at boring 1093 and down to approximately 12 feet at boring 1094. This occurrence correlates well with the fuel staining observed during the field sampling effort near the wings of the mock airplane. Xylenes and ethyl benzene were not detected above the CRQL at other boring locations. With no exception of concentration

of 19.6 Ims/kg in one surface soil sample, metals were detected at concentrations above background levels at this SWMU.

The lateral extent of ethyl benzene and xylene contamination is not well defined, but is probably confined to the area immediately outside the concrete berm and liner underlying the mock airplane. It appears that volatile organic contamination does not extend deeper than 10 feet bgs based on the results from borings 1093 and 1094. TPH contamination was found at the surface in three boring locations and may be present in other areas of the SWMU where stained soil was observed during the field sampling event. Vertically, TPH contamination correlated well with the detections of ethyl benzene and xylenes.

## TABLE 13-1

## ANALYTICAL RESULTS OF SOIL SAMPLES COLLECTED BY RADIAN AT FIRE DEPARTMENT TRAINING AREA NO. 4

## SWMU NO. 109
## CANNON AFB, NEW MEXICO

| Sample Number | Sample Depth (Ft-BGS) | Oil and Grease (mg/kg) | Lead (mg/kg) | Purgeable Organic Compounds (EPA 8010/8020) ($\mu$g/kg) |
|---|---|---|---|---|
| 9A-1 | 5.5-7.0 | ND | 4.1 | ND |
| 9A-2 | 10.5-11.5 | 110 | 39.0 | ND |
| 9A-2A[1] | 10.5-11.5 | 280 | 5.3 | ND |
| 9B-1 | 4.0-5.5 | ND | 4.5 | ND |
| 9B-2 | 9.0-10.5 | ND | 3.7 | ND |
| 9B-3 | 43.0-45.0 | 37 | 1.3 | ND |

Ft-BGS = Feet below ground surface
mg/kg = Milligrams per kilogram
$\mu$g/kg = Micrograms per kilogram
ND = Not detected

[1] duplicate analysis of 9A-2

Source: Final Report, IRP Phase II (Radian 1986)

## TABLE 13-2

## VOLATILE ORGANIC COMPOUND CONCENTRATIONS[1] IN SOIL SAMPLES COLLECTED BY WALK, HAYDEL AND ASSOCIATES AT FIRE DEPARTMENT TRAINING AREA NO. 4

### SWMU NO. 109
### CANNON AFB, NEW MEXICO

| Sample Depth (Ft-BGS) | Compound | Boring Number | | |
|---|---|---|---|---|
| | | B1 | B3 | B10 |
| 0-1.5 | Benzene | NA | NS | 1,060 |
| | Toluene | NA | NS | 762 |
| | Total Xylene | NA | NS | 6,940 |
| 2.5-4 | Benzene | 2,030 | NS | 2,140 |
| | Ethylbenzene | 1,790 | NS | 2,550 |
| | Toluene | 9,870 | NS | 14,600 |
| | Xylene | 10,900 | NS | 18,800 |
| 5-6.5 | Benzene | 4,560 | NS | 4,860 |
| | Ethylbenzene | 14,200 | NS | 2,020 |
| | Toluene | 2,870 | NS | 18,700 |
| | Xylene | 12,300 | NS | 10,400 |
| 7.5-9 | Ethylbenzene | NSR | NS | 2,150 |
| | Toluene | NSR | NS | 36,700 |
| | Xylene | NSR | NS | 6,880 |
| 10-11.5 | Benzene | 4,400 | 2,700 | 4,810 |
| | Ethylbenzene | 6,690 | 1,300 | 7,400 |
| | Toluene | 39,100 | 54,000 | 38,400 |
| | Xylene | 18,400 | 57,000 | 17,300 |
| 20-21.5 | Benzene | 15,200 | NS | NS |
| | Ethylbenzene | 6,220 | NS | NS |
| | Toluene | 64,000 | NS | NS |
| | Xylene | 12,500 | NS | NS |
| 25-26.5 | Benzene | 2,670 | NS | NS |
| | Ethylbenzene | 6,200 | NS | NS |
| | Toluene | 15,300 | NS | NS |
| | Xylene | 7,870 | NS | NS |

**TABLE 13-2**
**(Concluded)**

| Sample Depth (Ft-BGS) | Compound | Boring Number | | |
|---|---|---|---|---|
| | | B1 | B3 | B10 |
| 30-31.5 | Benzene | 3,130 | 4,200 | 5,740 |
| | Ethylbenzene | 9,340 | 14,000 | 8,740 |
| | Toluene | 22,200 | 57,000 | 38,700 |
| | Xylene | 19,000 | 17,000 | 11,200 |
| 45-46.5 | Benzene | NS | 2,800 | 5,890 |
| | Ethylbenzene | NS | 11,000 | 24,400 |
| | Toluene | NS | 48,000 | 32,200 |
| | Xylene | NS | 10,000 | 66,200 |
| 55-56.5 | Ethylbenzene | NS | NS | 56,200 |
| | Toluene | NS | NS | 51,200 |
| | Xylene | NS | NS | 173,000 |
| 60-61.5 | Benzene | NS | 4,200 | NS |
| | Ethylbenzene | NS | 14,000 | NS |
| | Toluene | NS | 51,000 | NS |
| | Xylene | NS | 20,000 | NS |
| 85-86.5 | Ethylbenzene | NS | 620 | NS |
| | Toluene | NS | 310 | NS |
| | Xylene | NS | 1,700 | NS |
| 100-101.5 | Toluene | NS | 280 | NS |
| | Xylene | NS | 1,500 | NS |
| Spent Mud | Benzene | NS | 8,600 | NS |
| | Ethylbenzene | NS | 3,500 | NS |
| | Toluene | NS | 31,000 | NS |
| | Total Xylene | NS | 93,800 | NS |

Ft-BGS = Feet below ground surface
NS = Sample not collected/analyzed in accordance with Scope of Services/Sampling Plan
NA = Sample not analyzed by laboratory
NSR = No sample recovered from this interval. Split spoon contained only wood.

[1] All concentrations are in micrograms per kilogram (ug/kg)

Source: Final Report, IRP Phase IV (Walk, Haydel and Associates Inc. 1990)

**TABLE 13-3**
**ARSENIC CONCENTRATIONS[1] IN SOIL SAMPLES COLLECTED BY WALK, HAYDEL AND ASSOCIATES AT FIRE DEPARTMENT TRAINING AREA NO. 4**
**SWMU NO. 109**
**CANNON AFB, NEW MEXICO**

| Sample Depth (Ft-BGS) | Boring Number | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | B1 | B3 | B4 | B5 | B6 | B7 | B8 | B9 | B10 |
| 0-1.5 | NA | NS | | | | | 51.1 | | |
| 2.5-4 | | NS | | | NS | NS | NS | | |
| 5-6.5 | | NS | | | NS | NS | NS | | |
| 7.5-9 | NSR | NS | | | NS | NS | NS | (94.4) | |
| 10-11.5 | | NS | | | NS | NS | NS | (86) | |
| 15-16.5 | | | | | | (114.5) | (96.6) | 50.7 | |
| 20-21.5 | | NS | | | NS | NS | NS | NS | NS |
| 25-26.5 | | NS | | | NS | NS | NS | NS | NS |
| 30-31.5 | | | | | | 53.3 | (88.1) | (152.5) | |
| 45-46.5 | NS | | NS | NS | | 51.9 | ISR | 52.3 | |
| 55-56.5 | NS | NS | NS | NS | NS | NS | NS | NS | |
| 60-61.5 | NS | | NS | NS | | | | | AR |
| 75-76.5 | NS | ISR | NS | NS | | ISR | | NS | NS |
| 85-86.5 | NS | | NS | NS | NS | NS | NS | NS | NS |
| 90-91.5 | NS | NS | NS | NS | | | | NS | NS |
| 100-101.5 | NS | ISR | NS | NS | | | | NS | NS |

NS = No sample collected in accordance with Scope of Services/Sampling Plan
( ) = Above concentrations typical of soils
NA = Sample not analyzed by laboratory
NSR = No sample recovered from this interval. Split spoon contained only wood.
ISR = Insufficient sample recovered for analysis.
AR = Auger refusal prevented completion at 60 feet. Collected sample at 55 feet.
Ft-BGS = Feet below ground surface
[1] All concentrations are in milligrams per kilogram (mg/kg)
Source: Final Report, IRP Phase IV (Walk, Haydel and Associates Inc. 1990)

## TABLE 13-4

## BARIUM CONCENTRATIONS[1] IN SOIL SAMPLES COLLECTED BY WALK, HAYDEL AND ASSOCIATES AT FIRE DEPARTMENT TRAINING AREA NO. 4 SWMU NO. 109 CANNON AFB, NEW MEXICO

| Sample Depth (Ft-BGS) | Boring Number | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | B1 | B3 | B4 | B5 | B6 | B7 | B8 | B9 | B10 |
| 0-1.5 | NA | | | | | | | | |
| 2.5-4 | | NS | | 676.9 | NS | NS | NS | | |
| 5-6.5 | | NS | | | NS | NS | NS | 857.2 | |
| 7.5-9 | NSR | NS | | | NS | NS | NS | | |
| 10-11.5 | | NS | | | NS | NS | NS | | |
| 15-16.5 | | | | | | | | | |
| 20-21.5 | | NS | | | NS | NS | NS | NS | NS |
| 25-26.5 | | NS | | | NS | NS | NS | NS | NS |
| 30-31.5 | | | | | | | | | 1713.5 |
| 45-46.5 | NS | | NS | NS | | 1074.4 | ISR | | |
| 55-56.5 | NS | NS | NS | NS | NS | NS | NS | NS | |
| 60-61.5 | NS | | NS | NS | | | | | AR |
| 75-76.5 | NS | ISR | NS | NS | | ISR | | NS | NS |
| 85-86.5 | NS | | NS | NS | NS | NS | | NS | NS |
| 90-91.5 | NS | NS | NS | NS | | | | NS | NS |
| 100-101.5 | NS | ISR | NS | NS | | | | NS | NS |

NS = No sample collected in accordance with Scope of Services/Sampling Plan
NA = Sample not analyzed by laboratory
NSR = No sample recovered from this interval. Split spoon contained only wood.
ISR = Insufficient sample recovered for analysis.
AR = Auger refusal prevented completion at 60 feet. Collected sample at 55 feet.
Ft-BGS = Feet below ground
[1] All concentrations are in milligrams per kilogram (mg/kg)
Source: Final Report, IRP Phase IV (Walk, Haydel and Associates Inc. 1990)

**TABLE 13-5**
**CADMIUM CONCENTRATIONS[1] IN SOIL SAMPLES COLLECTED BY WALK, HAYDEL AND ASSOCIATES AT FIRE DEPARTMENT TRAINING AREA NO. 4**
**SWMU NO. 109**
**CANNON AFB, NEW MEXICO**

| Sample Depth (Ft-BGS) | Boring Number | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | B1 | B3 | B4 | B5 | B6 | B7 | B8 | B9 | B10 |
| 0-1.5 | NA | | | | | | | 9 | |
| 2.5-4 | 7.8 | NS | | | NS | NS | NS | | |
| 5-6.5 | 8.2 | NS | | 9.7 | NS | NS | NS | 9.1 | |
| 7.5-9 | NSR | NS | | (11.2) | NS | NS | NS | | |
| 10-11.5 | | NS | 9 | 8.5 | NS | NS | NS | | |
| 15-16.5 | 9.2 | 8.8 | 8.5 | (12.7) | | | | | |
| 20-21.5 | | NS | | 8 | NS | NS | NS | NS | NS |
| 25-26.5 | | NS | | 9.2 | NS | NS | NS | NS | NS |
| 30-31.5 | | | | | | | | | 1713.5 |
| 45-46.5 | NS | | NS | NS | | | ISR | | |
| 55-56.5 | NS | NS | NS | NS | NS | NS | NS | NS | |
| 60-61.5 | NS | | NS | NS | | | | | AR |
| 75-76.5 | NS | ISR | NS | NS | | ISR | | NS | NS |
| 85-86.5 | NS | | NS | NS | NS | NS | NS | NS | NS |
| 90-91.5 | NS | NS | NS | NS | | | | NS | NS |
| 100-101.5 | NS | ISR | NS | NS | | | | NS | NS |

NS = No sample collected in accordance with Scope of Services/Sampling Plan
( ) = Above concentrations typical of soils
NA = Sample not analyzed by laboratory
NSR = No sample recovered from this interval. Split spoon contained only wood.
ISR = Insufficient sample recovered for analysis.
AR = Auger refusal prevented completion at 60 feet. Collected sample at 55 feet.
Ft-BGS = Feet below ground surface
[1] All concentrations are in milligrams per kilogram (mg/kg)
Source: Final Report, IRP Phase IV (Walk, Haydel and Associates Inc. 1990)

**TABLE 13-6**
**SELENIUM CONCENTRATIONS[1] IN SOIL SAMPLES COLLECTED BY WALK, HAYDEL AND ASSOCIATES AT FIRE DEPARTMENT TRAINING AREA NO. 4**
**SWMU NO. 109**
**CANNON AFB, NEW MEXICO**

| Sample Depth (Ft-BGS) | Boring Number | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | B1 | B3 | B4 | B5 | B6 | B7 | B8 | B9 | B10 |
| 0-1.5 | NA | NS | | | | 85 | 67 | | |
| 2.5-4 | | NS | | | NS | NS | NS | | |
| 5-6.5 | | NS | | | NS | NS | NS | | |
| 7.5-9 | NSR | NS | | | NS | NS | NS | 154.8 | |
| 10-11.5 | | NS | | | NS | NS | NS | 134.6 | |
| 15-16.5 | | | | | | 166.8 | 193.6 | 151.4 | |
| 20-21.5 | | NS | | | NS | NS | NS | NS | NS |
| 25-26.5 | | NS | | | NS | NS | NS | NS | NS |
| 30-31.5 | | | | | | 104.9 | 112.3 | 198.4 | |
| 45-46.5 | NS | | NS | NS | | 85 | ISR | | |
| 55-56.5 | NS | NS | NS | NS | NS | NS | NS | NS | |
| 60-61.5 | NS | | NS | NS | | 80.1 | 64.5 | | AR |
| 75-76.5 | NS | ISR | NS | NS | | ISR | 57.7 | NS | NS |
| 85-86.5 | NS | | NS | NS | NS | NS | NS | NS | NS |
| 90-91.5 | NS | NS | NS | NS | | | 80.6 | NS | NS |
| 100-101.5 | NS | ISR | NS | NS | | 57.1 | | NS | NS |

NS = No sample collected in accordance with Scope of Services/Sampling Plan
NA = Sample not analyzed by laboratory
NSR = No sample recovered from this interval. Split spoon contained only wood.
ISR = Insufficient sample recovered for analysis.
AR = Auger refusal prevented completion at 60 feet. Collected sample at 55 feet.
Ft-BGS = Feet below ground surface
[1] All concentrations are in milligrams per kilogram (mg/kg)
Source: Final Report, IRP Phase IV (Walk, Haydel and Associates Inc. 1990)

**TABLE 13-7**
**SILVER CONCENTRATIONS[1] IN SOIL SAMPLES COLLECTED BY WALK, HAYDEL AND ASSOCIATES AT FIRE DEPARTMENT TRAINING AREA NO. 4**
**SWMU NO. 109**
**CANNON AFB, NEW MEXICO**

| Sample Depth (Ft-BGS) | Boring Number | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | B1 | B3 | B4 | B5 | B6 | B7 | B8 | B9 | B10 |
| 0-1.5 | NA | NS | 5.4 | | 18.7 | | | | 7.3 |
| 2.5-4 | 6.7 | NS | 7.4 | 16.4 | NS | NS | NS | | |
| 5-6.5 | 10.4 | NS | 20.7 | 17.4 | NS | NS | NS | | |
| 7.5-9 | NSR | NS | 13.3 | 13.6 | NS | NS | NS | 154.8 | |
| 10-11.5 | 10.1 | NS | 15.4 | 9 | NS | NS | NS | 134.6 | |
| 15-16.5 | 6.2 | 8.6 | 6.2 | 13.5 | 13.4 | | | | 5.2 |
| 20-21.5 | 15.5 | NS | 10.1 | 18.5 | NS | NS | NS | NS | NS |
| 25-26.5 | 16.1 | NS | 8.4 | 9.8 | NS | NS | NS | NS | NS |
| 30-31.5 | 7.4 | 12.3 | 19.2 | 10.1 | 4.3 | | | | 6.0 |
| 45-46.5 | NS | 4.1 | NS | NS | 4.7 | | ISR | | 6.9 |
| 55-56.5 | NS | NS | NS | NS | NS | NS | NS | NS | 5.7 |
| 60-61.5 | NS | | NS | NS | 5.1 | | | | AR |
| 75-76.5 | NS | ISR | NS | NS | 5.1 | ISR | | NS | NS |
| 85-86.5 | NS | | NS | NS | NS | NS | NS | NS | NS |
| 90-91.5 | NS | NS | NS | NS | | | | NS | NS |
| 100-101.5 | NS | ISR | NS | NS | 13.7 | | | NS | NS |

NS = No sample collected in accordance with Scope of Services/Sampling Plan
NA = Sample not analyzed by laboratory
NSR = No sample recovered from this interval. Split spoon contained only wood.
ISR = Insufficient sample recovered for analysis.
AR = Auger refusal prevented completion at 60 feet. Collected sample at 55 feet.
Ft-BGS = Feet below ground surface
[1] All concentrations are in milligrams per kilogram (mg/kg)
Source: Final Report, IRP Phase IV (Walk, Haydel and Associates, Inc. 1990)

TABLE 13-8

SUMMARY OF SURFACE SOIL SAMPLING, BOREHOLE DRILLING, AND BOREHOLE SAMPLING CONDUCTED BY WCC AT FIRE DEPARTMENT TRAINING AREA NO. 4, SWMU NO. 109 , CANNON AFB, NEW MEXICO

| BORING NUMBER | DRILLING/ SAMPLING METHOD | DRILL RIG USED | BOREHOLE DIAMETER (In) | DRILLING/ SAMPLING DEPTH INTERVALS (Ft-BGS) | BOREHOLE SAMPLING FREQUENCY | DATE(S) DRILLED/ SAMPLED | NUMBER OF ANALYTICAL SOIL SAMPLES COLLECTED | NUMBER OF ANALYTICAL QA/QC SAMPLES COLLECTED | NUMBER OF SPT SOIL SAMPLES COLLECTED | NUMBER OF GRADATION ANALYSIS SAMPLES COLLECTED | GROUND ELEVATION (Ft-MSL) | TOTAL DEPTH OF BOREHOLE (Ft-BGS) | DATE BOREHOLE GROUTED |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1091 | HT | NA | NA | 0 to 0.5 | NA | 10-08-91 | 1 | 1 | NA | 1 | 4265.46 | 61 | 10-09-91 |
| | HSA | F-10 | 8.5 | 0 to 22 | Continuous | 10-08-91 | 3 | 2 | 13 | 0 | | | |
| | | | | 22 to 61 | 5' Intervals | 10-08-91 to 10-09-91 | 4 | 1 | 10 | 1 | | | |
| (1095)* | HSA | CME-7 | 8.0 | 0 to 12 | 5' Intervals | 12-09-91 | 1 | 0 | 2 | 0 | 4265.44 | 61 | 12-09-91 |
| | | | | 12 to 61 | 10' Intervals | 12-09-91 | 5 | 4 | 5 | 0 | | | |
| 1092 | HT | NA | NA | 0 to 0.5 | NA | 10-10-91 | 1 | 1 | NA | 0 | 4264.49 | 62 | 10-11-91 |
| | HSA | F-10 | 8.5 | 0 to 22 | Continuous | 10-10-91 | 3 | 0 | 11 | 1 | | | |
| | | | | 22 to 62 | 5' Intervals | 10-10-91 | 4 | 1 | 8 | 1 | | | |
| (1096)* | HT | NA | NA | 0 to 0.5 | NA | 12-09-91 | 1 | 1 | NA | 0 | 4264.50 | 62 | 12-09-91 |
| | HSA | B-61B | 7.5 | 0 to 12 | 5' Intervals | 12-09-91 | 2 | 0 | 2 | 0 | | | |
| | | | | 12 to 62 | 10' Intervals | 12-09-91 | 5 | 0 | 5 | 0 | | | |
| 1093 | HT | NA | NA | 0 to 0.5 | NA | 10-15-91 | 1 | 2 | NA | 0 | 4265.24 | 100 | 10-27-91 |
| | HSA | F-10 | 8.5 | 0 to 22 | Continuous | 10-15-91 | 3 | 1 | 11 | 1 | | | |
| | | | | 22 to 62 | 5' Intervals | 10-16-91 | 4 | 0 | 8 | 1 | | | |
| | | | | 62 to 82 | 5' Intervals | 10-21-91 to 10-22-91 | 2 | 0 | 4 | 0 | | | |
| | | | | 82 to 100 | 10' Intervals | 10-22-91 | 2 | 0 | 3 | 1 | | | |
| (1097)* | HT | NA | NA | 0 to 0.5 | NA | 12-05-91 | 1 | 0 | NA | 0 | 4265.33 | 82 | 12-07-91 |
| | HSA | CME-7 | 8.0 | 0 to 12 | 5' Intervals | 12-05-91 | 2 | 2 | 2 | 0 | | | |
| | | | | 12 to 82 | 10' Intervals | 12-05-91 to 12-06-91 | 3 | 0 | 7 | 0 | | | |
| 1094 | HT | NA | NA | 0 to 0.5 | NA | 10-15-91 | 1 | 0 | NA | 0 | 4265.25 | 92 | 10-29-91 |
| | HSA | F-10 | 8.5 | 0 to 22 | Continuous | 10-27-91 to 10-28-91 | 3 | 2 | 11 | 1 | | | |
| | | | | 22 to 62 | 5' Intervals | 10-28-91 | 4 | 0 | 8 | 1 | | | |
| | | | | 62 to 92 | 10' Intervals | 10-28-91 to 10-29-91 | 3 | 2 | 4 | 1 | | | |
| (1098)* | HT | NA | NA | 0 to 0.5 | NA | 12-16-91 | 1 | 3 | NA | 0 | 4265.07 | 0.5 | NA |

| | | | |
|---|---|---|---|
| In | Inches | B-53 | Mobile B-53 Auger Drill Rig with 6" OD / 3.75" ID Augers and 6.5" Bullet Bit |
| Ft-BGS | Feet Below Ground Surface | B-61A | Mobile B-61 Auger Drill Rig with 6" OD / 3.75" ID Augers and 6.5" or 6.25" Bullet Bit |
| Ft-MSL | Feet Mean Sea Level | B-61B | Mobile B-61 Auger Drill Rig with 7.25" OD / 4.25" ID Augers and 7.5" Bullet Bit |
| SPT | Standard Penetration Test | F-10 | Failing F-10 Auger Drill Rig with 8.25" OD / 4.25" ID Augers and 8.5" Bullet Bit |
| HSA | Hollow Stem Auger | CME-75 | Central Mine Equipment CME-75 Auger Drill Rig with 7.75" OD / 4.25" ID Augers and 8.0" Bullet Bit |
| HT | Hand Trowel, Surface Sample | OD | Outer Diameter |
| NA | Not Applicable, Surface Sample | ID | Inner Diameter |
| NS | Not Sampled | | |

( )* The borings that are shaded and in parentheses correspond to either a redrill or surface resample of the previous boring or surface sample due to laboratory missed holding times. These borings or surface resamples were drilled or collected approximately 1 to 5 feet away from the original boring or surface sample location.

TABLE 13-9

SUMMARY OF SURFACE SOIL, SUBSURFACE SOIL, AND QA/QC SAMPLES COLLECTED BY WCC AT FIRE DEPARTMENT TRAINING AREA NO. 4, SWMU NO. 109, CANNON AFB, NEW MEXICO

| BORING NUMBER | DEPTH INTERVAL (Ft-BGS) | SAMPLE IDENTIFICATION NUMBER | SAMPLE TYPE | QA/QC SAMPLES | SAMPLE MATRIX | DATE SAMPLED | TIME SAMPLED | OVA ON SAMPLE (ppm) | ANALYTICAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|---|
| 1091 | 0.25 to 0.5 | CAN109-1091-0000 | A | | Soil | 10-08-91 | 1500 | 0 | VOC,TPH,Pb/Cr |
| | | CAN109-1091-1201 | A | MRD | Soil | 10-08-91 | 1545 | 0 | VOC,TPH,Pb/Cr |
| | | CAN109-1091-4000 | GA | | Soil | 10-08-91 | 1545 | 0 | |
| | 0.25 to 1.75 | CAN109-1091-4000 | SPT | | Soil | 10-08-91 | 1545 | | |
| | 1.75 to 3.25 | CAN109-1091-4001 | SPT | | Soil | 10-08-91 | 1600 | | |
| | 3.25 to 4.75 | CAN109-1091-4003 | SPT | | Soil | 10-08-91 | 1610 | | |
| | 5 to 7 | CAN109-1091-0005 | A/SPT | | Soil | 10-08-91 | 1615 | 0 | VOC,TPH,Pb/Cr |
| | | CAN109-1091-1271 | A | RB | Water | 10-08-91 | 1635 | | VOC,TPH,Pb/Cr |
| | 7 to 8.5 | CAN109-1091-4007 | SPT | | Soil | 10-08-91 | 1620 | | |
| | 8.5 to 10 | CAN109-1091-4008 | SPT | | Soil | 10-08-91 | 1625 | | |
| | 10 to 12 | CAN109-1091-0010 | A/SPT | | Soil | 10-08-91 | 1700 | 0 | VOC,TPH,Pb/Cr,TOC |
| | 12 to 13.5 | CAN109-1091-4012 | SPT | | Soil | 10-08-91 | 1705 | | |
| | 13.5 to 15 | CAN109-1091-4013 | SPT | | Soil | 10-08-91 | 1710 | | |
| | 15 to 17 | CAN109-1091-4015 | SPT | | Soil | 10-08-91 | 1715 | | |
| | 17 to 18.5 | CAN109-1091-4017 | SPT | | Soil | 10-08-91 | 1720 | | |
| | 18.5 to 20 | CAN109-1091-4018 | SPT | | Soil | 10-08-91 | 1730 | | |
| | 20 to 22 | CAN109-1091-0020 | A/SPT | MS/MSD | Soil | 10-08-91 | 1755 | 6 | VOC,TPH,Pb/Cr,TOC |
| | 23.5 to 25 | CAN109-1091-4023 | SPT | | Soil | 10-08-91 | 1815 | | |
| | 28.5 to 30 | CAN109-1091-4028 | SPT/GA | | Soil | 10-09-91 | 0800 | | |
| | 30 to 32 | CAN109-1091-0030 | A/SPT | | Soil | 10-09-91 | 0820 | 0 | VOC,TPH,Pb/Cr,TOC |
| | | CAN109-1091-1261 | A | FD | Soil | 10-09-91 | 0840 | 0 | VOC,TPH,Pb/Cr,TOC |
| | 33.5 to 35 | CAN109-1091-4033 | SPT | | Soil | 10-09-91 | 0845 | | |
| | 38.5 to 40 | CAN109-1091-4038 | SPT | | Soil | 10-09-91 | 1050 | | |
| | 40 to 41 | CAN109-1091-0040 | A/SPT | | Soil | 10-09-91 | 1115 | 22 | VOC,TPH,Pb/Cr,TOC |
| | 45 to 46.5 | CAN109-1091-4045 | SPT | | Soil | 10-09-91 | 1215 | | |
| | 50 to 51.5 | CAN109-1091-0050 | A/SPT | | Soil | 10-09-91 | 1230 | 74 | VOC,TPH,Pb/Cr,TOC |
| | 55 to 56.5 | CAN109-1091-4055 | SPT | | Soil | 10-09-91 | 1305 | | |
| | 60 to 61 | CAN109-1091-0060 | A/SPT | | Soil | 10-09-91 | 1400 | 0 | VOC,TPH,Pb/Cr,TOC |
| (1095)* | 5 to 7 | CAN109-1095-4005 | SPT | | Soil | 12-09-91 | 0855 | 0 | |
| | 10 to 12 | CAN109-1095-0010 | A/SPT | | Soil | 12-09-91 | 0915 | 0 | TOC |
| | 20 to 22 | CAN109-1095-0020 | A/SPT | MS/MSD | Soil | 12-09-91 | 0935 | 0.5 | TOC |
| | 30 to 32 | CAN109-1095-0030 | A/SPT | | Soil | 12-09-91 | 1010 | 4.2 | VOC,TOC |
| | | CAN109-1095-1265 | A | FD | Soil | 12-09-91 | 1025 | 4.2 | VOC,TOC |
| | | CAN109-1095-1272 | A | RB | Water | 12-09-91 | 1040 | | VOC,TOC |
| | 40 to 41 | CAN109-1095-0040 | A/SPT | | Soil | 12-09-91 | 1115 | 2.6 | VOC,TOC |
| | 50 to 51.5 | CAN109-1095-0050 | A/SPT | | Soil | 12-09-91 | 1155 | 1.8 | VOC,TOC |
| | | CAN109-1095-1282 | A | DW | Water | 12-09-91 | 1230 | | VOC |
| | 60 to 61 | CAN109-1095-0060 | A/SPT | | Soil | 12-09-91 | 1240 | 0 | VOC,TOC |
| 1092 | 0 to 0.5 | CAN109-1092-0000 | A | | Soil | 10-10-91 | 1345 | 0 | VOC,TPH,Pb/Cr |
| | | CAN109-1092-1264 | A | FD | Soil | 10-10-91 | 1400 | 0 | VOC,TPH,Pb/Cr |
| | 0 to 2 | CAN109-1092-4000 | SPT | | Soil | 10-10-91 | 0930 | | |
| | 2 to 4 | CAN109-1092-4002 | SPT/GA | | Soil | 10-10-91 | 0932 | | |
| | 4 to 6 | CAN109-1092-0004 | A/SPT | | Soil | 10-10-91 | 1000 | 0 | VOC,TPH,Pb/Cr |
| | 6 to 8 | CAN109-1092-4006 | SPT | | Soil | 10-10-91 | 1005 | | |
| | 8 to 10 | CAN109-1092-4008 | SPT | | Soil | 10-10-91 | 1010 | | |
| | 10 to 12 | CAN109-1092-0010 | A/SPT | | Soil | 10-10-91 | 1015 | 0 | VOC,TPH,Pb/Cr |
| | 12 to 14 | CAN109-1092-4012 | SPT | | Soil | 10-10-91 | 1020 | | |
| | 14 to 16 | CAN109-1092-4014 | SPT | | Soil | 10-10-91 | 1025 | | |
| | 16 to 18 | CAN109-1092-4016 | SPT | | Soil | 10-10-91 | 1040 | | |
| | 18 to 20 | CAN109-1092-4018 | SPT | | Soil | 10-10-91 | 1050 | | |
| | 20 to 22 | CAN109-1092-0020 | A/SPT | | Soil | 10-10-91 | 1115 | 58 | VOC,TPH,Pb/Cr |
| | 25 to 26.5 | CAN109-1092-4025 | SPT | | Soil | 10-10-91 | 1130 | | |
| | 30 to 32 | CAN109-1092-0030 | A/SPT | | Soil | 10-10-91 | 1200 | 0 | VOC,TPH,Pb/Cr |
| | 35 to 37 | CAN109-1092-4035 | SPT/GA | | Soil | 10-10-91 | 1230 | | |
| | 40 to 41.5 | CAN109-1092-0040 | A/SPT | | Soil | 10-10-91 | 1315 | 58 | VOC,TPH,Pb/Cr |
| | 45 to 47 | CAN109-1092-4045 | SPT | | Soil | 10-10-91 | 1415 | | |

TABLE 13-9

SUMMARY OF SURFACE SOIL, SUBSURFACE SOIL, AND QA/QC SAMPLES COLLECTED BY WCC AT FIRE DEPARTMENT TRAINING AREA NO. 4, SWMU NO. 109, CANNON AFB, NEW MEXICO

| BORING NUMBER | DEPTH INTERVAL (Ft-BGS) | SAMPLE IDENTIFICATION NUMBER | SAMPLE TYPE | QA/QC SAMPLES | SAMPLE MATRIX | DATE SAMPLED | TIME SAMPLED | OVA ON SAMPLE (ppm) | ANALYTICAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|---|
| 1092 | 50 to 52 | CAN109-1092-0050 | A/SPT | | Soil | 10-10-91 | 1515 | 68 | VOC,TPH,Pb/Cr |
| | | CAN109-1092-1251 | A | AB | Water | 10-10-91 | 1525 | | VOC |
| | 55 to 57 | CAN109-1092-4055 | SPT | | Soil | 10-10-91 | 1535 | | |
| | 60 to 62 | CAN109-1092-0060 | A/SPT | | Soil | 10-10-91 | 1630 | 2.1 | VOC,TPH,Pb/Cr |
| (1096)* | 0 to 0.5 | CAN109-1096-0000 | A | | Soil | 11-23-91 | 1400 | 0 | VOC |
| | | CAN109-1096-1267 | A | FD | Soil | 11-23-91 | 1415 | 0 | VOC |
| | 4 to 6 | CAN109-1096-0004 | A/SPT | | Soil | 11-23-91 | 1450 | 0 | VOC |
| | 10 to 12 | CAN109-1096-0010 | A/SPT | | Soil | 11-23-91 | 1505 | 0 | VOC |
| | 20 to 22 | CAN109-1096-0020 | A/SPT | | Soil | 11-23-91 | 1530 | 20 | VOC |
| | 30 to 32 | CAN109-1096-0030 | A/SPT | | Soil | 11-23-91 | 1625 | 0 | VOC |
| | 40 to 41.5 | CAN109-1096-0040 | A/SPT | | Soil | 11-23-91 | 1715 | 10 | VOC |
| | 50 to 52 | CAN109-1096-0050 | A/SPT | | Soil | 11-24-91 | 0930 | 10 | VOC |
| | 60 to 62 | CAN109-1096-0060 | A/SPT | | Soil | 11-24-91 | 1110 | 0 | VOC |
| 1093 | 0 to 0.5 | CAN109-1093-0000 | A | MS/MSD | Soil | 10-15-91 | 1150 | 35 | VOC,TPH,Pb/Cr |
| | | CAN109-1093-1202 | A | MRD | Soil | 10-15-91 | 1150 | 35 | VOC,TPH,Pb/Cr |
| | 0 to 2 | CAN109-1093-4000 | SPT | | Soil | 10-15-91 | 1700 | 35 | |
| | 2 to 4 | CAN109-1093-4002 | SPT | | Soil | 10-15-91 | 1710 | 14 | |
| | 4 to 6 | CAN109-1093-0004 | A/SPT | | Soil | 10-15-91 | 1745 | 10.5 | VOC,TPH,Pb/Cr |
| | | CAN109-1093-1262 | A | FD | Soil | 10-15-91 | 1800 | 10.5 | VOC,TPH,Pb/Cr |
| | 6 to 8 | CAN109-1093-4006 | SPT | | Soil | 10-15-91 | 1800 | 12 | |
| | 8 to 10 | CAN109-1093-4008 | SPT | | Soil | 10-15-91 | 1805 | 17 | |
| | 10 to 12 | CAN109-1093-0010 | A/SPT | | Soil | 10-15-91 | 1820 | 22 | VOC,TPH,Pb/Cr |
| | 12 to 14 | CAN109-1093-4012 | SPT/GA | | Soil | 10-15-91 | 1830 | 8 | |
| | 14 to 16 | CAN109-1093-4014 | SPT | | Soil | 10-15-91 | 1835 | 31 | |
| | 16 to 18 | CAN109-1093-4016 | SPT | | Soil | 10-15-91 | 1855 | 0.8 | |
| | 18 to 20 | CAN109-1093-4018 | SPT | | Soil | 10-15-91 | 1900 | 0.2 | |
| | 20 to 22 | CAN109-1093-0020 | A/SPT | | Soil | 10-15-91 | 1920 | 0 | VOC,TPH,Pb/Cr |
| | 25 to 27 | CAN109-1093-4025 | SPT | | Soil | 10-16-91 | 0725 | 0 | |
| | 30 to 32 | CAN109-1093-0030 | A/SPT | | Soil | 10-16-91 | 0755 | 0 | VOC,TPH,Pb/Cr |
| | 35 to 37 | CAN109-1093-4035 | SPT | | Soil | 10-16-91 | 0825 | 0 | |
| | 40 to 42 | CAN109-1093-0040 | A/SPT | | Soil | 10-16-91 | 0850 | 4.8 | VOC,TPH,Pb/Cr |
| | 45 to 47 | CAN109-1093-4045 | SPTGA | | Soil | 10-16-91 | 0915 | 0 | |
| | 50 to 52 | CAN109-1093-0050 | A/SPT | | Soil | 10-16-91 | 1000 | 1.1 | VOC,TPH,Pb/Cr |
| | 55 to 56.5 | CAN109-1093-4055 | SPT | | Soil | 10-16-91 | 1030 | 0 | |
| | 60 to 62 | CAN109-1093-0060 | A/SPT | | Soil | 10-16-91 | 1100 | 0.6 | VOC,TPH,Pb/Cr |
| | 65 to 66 | CAN109-1093-4065 | SPT | | Soil | 10-21-91 | 1625 | 7.1 | |
| | 70 to 72 | CAN109-1093-0070 | A/SPT | | Soil | 10-21-91 | 1710 | 11 | VOC,TPH,Pb/Cr |
| | 75 to 75.5 | CAN109-1093-4075 | SPT | | Soil | 10-22-91 | 0835 | 0.2 | |
| | 80 to 82 | CAN109-1093-0080 | A/SPT | | Soil | 10-22-91 | 0945 | 5.1 | VOC,TPH,Pb/Cr |
| | 90 to 92 | CAN109-1093-0090 | A/SPT | | Soil | 10-22-91 | 1220 | 1.1 | VOC,TPH,Pb/Cr |
| | | CAN109-1093-4090 | SPT/GA | | Soil | 10-22-91 | 1220 | 1.1 | |
| | 98 to 100 | CAN109-1093-0098 | A/SPT | | Soil | 10-22-91 | 1320 | 0 | VOC,TPH,Pb/Cr |
| (1097)* | 0 to 0.5 | CAN109-1097-0000 | A | | Soil | 12-05-91 | 1130 | 30 | TPH |
| | 4 to 6 | CAN109-1097-0004 | A/SPT | | Soil | 12-05-91 | 1200 | 16 | VOC |
| | | CAN109-1097-1252 | A | AB | Water | 12-05-91 | 1210 | | VOC |
| | 10 to 12 | CAN109-1097-0010 | A/SPT | | Soil | 12-05-91 | 1245 | 14 | TPH |
| | | CAN109-1097-1266 | A | FD | Soil | 12-05-91 | 1225 | 14 | TPH |
| | 20 to 22 | CAN109-1097-0020 | A/SPT | | Soil | 12-05-91 | 1345 | 0 | TPH |
| | 30 to 32 | CAN109-1097-4030 | SPT | | Soil | 12-06-91 | 1320 | 1.1 | |
| | 40 to 42 | CAN109-1097-0040 | A/SPT | | Soil | 12-06-91 | 1350 | 2.4 | VOC |
| | 50 to 52 | CAN109-1097-4050 | SPT | | Soil | 12-06-91 | 1455 | 8.2 | |
| | 60 to 62 | CAN109-1097-4060 | SPT | | Soil | 12-06-91 | 1540 | 2.4 | |
| | 70 to 72 | CAN109-1097-4070 | SPT | | Soil | 12-06-91 | 1625 | 17 | |
| | 80 to 82 | CAN109-1097-0080 | A/SPT | | Soil | 12-06-91 | 1710 | 11.2 | VOC |

TABLE 13-9

SUMMARY OF SURFACE SOIL, SUBSURFACE SOIL, AND QA/QC SAMPLES COLLECTED BY WCC AT FIRE DEPARTMENT TRAINING AREA NO. 4, SWMU NO. 109, CANNON AFB, NEW MEXICO

| BORING NUMBER | DEPTH INTERVAL (Ft-BGS) | SAMPLE IDENTIFICATION NUMBER | SAMPLE TYPE | QA/QC SAMPLES | SAMPLE MATRIX | DATE SAMPLED | TIME SAMPLED | OVA ON SAMPLE (ppm) | ANALYTICAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|---|
| 1094 | 0 to 0.5 | CAN109-1094-0000 | A | | Soil | 10-15-91 | 1220 | 35 | VOC,TPH,Pb/Cr |
| | 0 to 2 | CAN109-1094-4000 | SPT | | Soil | 10-27-91 | 1545 | 20 | |
| | 2 to 4 | CAN109-1094-4002 | SPT | | Soil | 10-27-91 | 1555 | 70 | |
| | 4 to 6 | CAN109-1094-0004 | A/SPT | | Soil | 10-27-91 | 1605 | 36 | VOC,TPH,Pb/Cr |
| | 6 to 8 | CAN109-1094-4006 | SPT | | Soil | 10-27-91 | 1610 | 73 | |
| | 8 to 10 | CAN109-1094-4008 | SPT | | Soil | 10-27-91 | 1625 | 92 | |
| | 10 to 12 | CAN109-1094-0010 | A/SPT | | Soil | 10-27-91 | 1640 | 110 | VOC,TPH,Pb/Cr |
| | 12 to 14 | CAN109-1094-4012 | SPT | | Soil | 10-27-91 | 1650 | 32 | |
| | 14 to 16 | CAN109-1094-4014 | SPT | | Soil | 10-27-91 | 1655 | 24 | |
| | 16 to 18 | CAN109-1094-4016 | SPT | | Soil | 10-27-91 | 1710 | 3.6 | |
| | 18 to 20 | CAN109-1094-4018 | SPT/GA | | Soil | 10-27-91 | 1720 | 24 | |
| | 20 to 22 | CAN109-1094-0020 | A/SPT | | Soil | 10-28-91 | 0845 | 3.3 | VOC,TPH,Pb/Cr |
| | | CAN109-1094-1203 | A | MRD | Soil | 10-28-91 | 0845 | 3.3 | VOC,TPH,Pb/Cr |
| | | CAN109-1094-1263 | A | FD | Soil | 10-28-91 | 0915 | 3.3 | VOC,TPH,Pb/Cr |
| | 25 to 27 | CAN109-1094-4025 | SPT | | Soil | 10-28-91 | 0915 | 0.2 | |
| | 30 to 31 | CAN109-1094-0030 | A/SPT | | Soil | 10-28-91 | 0930 | 0.2 | VOC,TPH,Pb/Cr |
| | 35 to 37 | CAN109-1094-4035 | SPT | | Soil | 10-28-91 | 1005 | 0 | |
| | 40 to 41.5 | CAN109-1094-0040 | A/SPT | | Soil | 10-28-91 | 1040 | 0 | VOC,TPH,Pb/Cr |
| | 45 to 47 | CAN109-1094-4045 | SPT | | Soil | 10-28-91 | 1130 | 8 | |
| | 50 to 52 | CAN109-1094-0050 | A/SPT | | Soil | 10-28-91 | 1210 | 2.8 | VOC,TPH,Pb/Cr |
| | 55 to 57 | CAN109-1094-4055 | SPT/GA | | Soil | 10-28-91 | 1350 | 1.1 | |
| | 60 to 62 | CAN109-1094-0060 | A/SPT | | Soil | 10-28-91 | 1445 | 5.1 | VOC,TPH,Pb/Cr |
| | 70 to 72 | CAN109-1094-0070 | A/SPT | | Soil | 10-28-91 | 1525 | 6.2 | VOC,TPH,Pb/Cr |
| | 80 to 82 | CAN109-1094-0080 | A/SPT | | Soil | 10-28-91 | 1700 | 7.8 | VOC,TPH,Pb/Cr |
| | | CAN109-1094-1204 | A | MRD | Soil | 10-28-91 | 1700 | 7.8 | VOC,TPH,Pb/Cr |
| | | CAN109-1094-4080 | GA | | Soil | 10-28-91 | 1700 | 7.8 | |
| | 90 to 92 | CAN109-1094-0090 | A/SPT | | Soil | 10-29-91 | 0845 | 0 | VOC,TPH,Pb/Cr |
| | | CAN109-1094-1281 | A | DW | Water | 10-30-91 | 1000 | | VOC |
| (1098)* | 0 to 0.5 | CAN109-1098-0000 | A | MS/MSD | Soil | 12-16-91 | 1100 | 21 | VOC,TPH |
| | | CAN109-1098-1201 | A | MRD | Soil | 12-16-91 | 1100 | 21 | VOC,TPH |
| | | CAN109-1098-1273 | A | RB | Water | 12-16-91 | 1115 | | VOC,TPH |

| | | | | | |
|---|---|---|---|---|---|
| Ft-BGS | Feet Below Ground Surface | FD | Field Duplicate | SV | Semi Volatile Organic Compounds |
| OVA | Organic Vapor Analyzer Reading | MRD | Missouri River Division Duplicate | M | Metals (TAL) |
| ppm | Parts per Million | AB | Ambient Blank | TPH | Total Petroleum Hydrocarbons |
| A | Analytical | RB | Rinsate Blank | BTEX | Benzene, Toluene, Ethylbenzene, Xylene |
| SPT | Standard Penetration Test | DW | Decontamination Water Blank | | |
| GA | Gradation Analysis | TB | Trip Blank | TOC | Total Organic Carbon |
| L | Lithology | VOC | Volatile Organic Compounds (TCL) | OL | Organic Lead |
| MS/MSD | Matrix Spike / Matrix Spike Duplicate | PCB | Polychlorinated Biphenols, Pesticides | Pb/Cr | Lead / Chromium |
| | | TCL | Target Compound List | TAL | Target Analyte List |

( )* The borings that are shaded and in parentheses correspond to either a redrill or surface resample of the previous boring or surface sample due to laboratory missed holding times. These borings or surface resamples were drilled or collected approximately 1 to 5 feet away from the original boring or surface sample.

# TABLE 13-10

## TOTAL PETROLEUM HYDROCARBON, ETHYL BENZENE AND XYLENES CONCENTRATIONS IN SOIL SAMPLES COLLECTED BY WCC AT FIRE DEPARTMENT TRAINING AREA NO. 4

## SWMU NO. 109
## CANNON AFB, NEW MEXICO

| Boring Number (Redrill Boring Number) | Sampling Depth (Ft-BGS) | TPH (mg/kg) | Xylenes (μg/kg) | Ethyl Benzene (μg/kg) |
|---|---|---|---|---|
| 1091 | 0-0.5 | 27.3 | 2 J | 11 UJ |
| (1095) | 5-7 | 56.6 | 11 U | 11 U |
| | 10-12 | 45.1 U | 11 U | 11 U |
| | 20-22 | 45.7 U | 12 U | 12 U |
| | 30-32 | 44.5 U | (55 U) | (55 U) |
| | 40-42 | 46.3 U | (57 U) | (57 U) |
| | 50-52 | 43.9 U | (11 U) | (11 U) |
| | 60-62 | 42.6 U | (11 U) | (11 U) |
| 1092 (1096) | 0-60 | Not detected above CRQL | (Not detected above CRQL) | (Not detected above CRQL) |
| 1093 | 0-0.5 | (38500) | 8J | 19 U |
| (1097) | 4-6 | 12900 | (4100) | (1200 U) |
| | 10-12 | (45 U) | 11 U | 11 U |
| | 20-22 | (46.6 U) | 12 U | 12 U |
| | 30-32 | 44 U | 11 U | 11 U |
| | 40-42 | 45.6 U | (11 U) | (11 U) |
| | 50-52 | 215 | 11 U | 11 U |
| | 60-62 | 203 | 10 U | 10 U |
| | 70-72 | 42.8 U | 11 UJ | 11 UJ |
| | 80-82 | 41.8 U | (11 U) | (11 U) |
| | 90-92 | 40.6 U | 10 UJ | 10 UJ |
| | 98-100 | 41.2 U | 10 UJ | 10 UJ |

**TABLE 13-10**
**(Concluded)**

| Boring Number (Redrill Boring Number) | Sampling Depth (Ft-BGS) | TPH (mg/kg) | Xylenes (μg/kg) | Ethyl Benzene (μg/kg) |
|---|---|---|---|---|
| 1094 | 0-0.5 | (13600) | (11 U) | (11 U) |
| (1098) | 4-6 | 8300 | 290,000 | 19,000 J |
| | 10-12 | 1870 | 6,700 J | 28,000 U |
| | 20-22 | 46.7 | 12 U | 12 U |
| | 30-32 | 44 U | 11 U | 11 U |
| | 40-42 | 44.1 U | 11 U | 11 U |
| | 50-52 | 42.7 U | 10 U | 10 U |
| | 60-62 | 43.2 U | 10 U | 10 U |
| | 70-72 | 43 U | 11 U | 11 U |
| | 80-82 | 42.2 U | 11 U | 11 U |
| | 90-92 | 42.1 U | 11 U | 11 U |

Ft-BGS = Feet below ground surface
mg/kg = Milligrams per kilogram
ug/kg = Micrograms per kilogram
U = Not detected
J = Estimated value
UJ = Estimated as non-detect at the CRQL
( ) = The values in parentheses are results from samples collected from the redrill borings due to laboratory missed holding times.

# TABLE 13-11

## CHROMIUM AND LEAD CONCENTRATIONS IN SOIL SAMPLES COLLECTED BY WCC AT FIRE DEPARTMENT TRAINING AREA NO. 4

## SWMU NO. 109
## CANNON AFB, NEW MEXICO

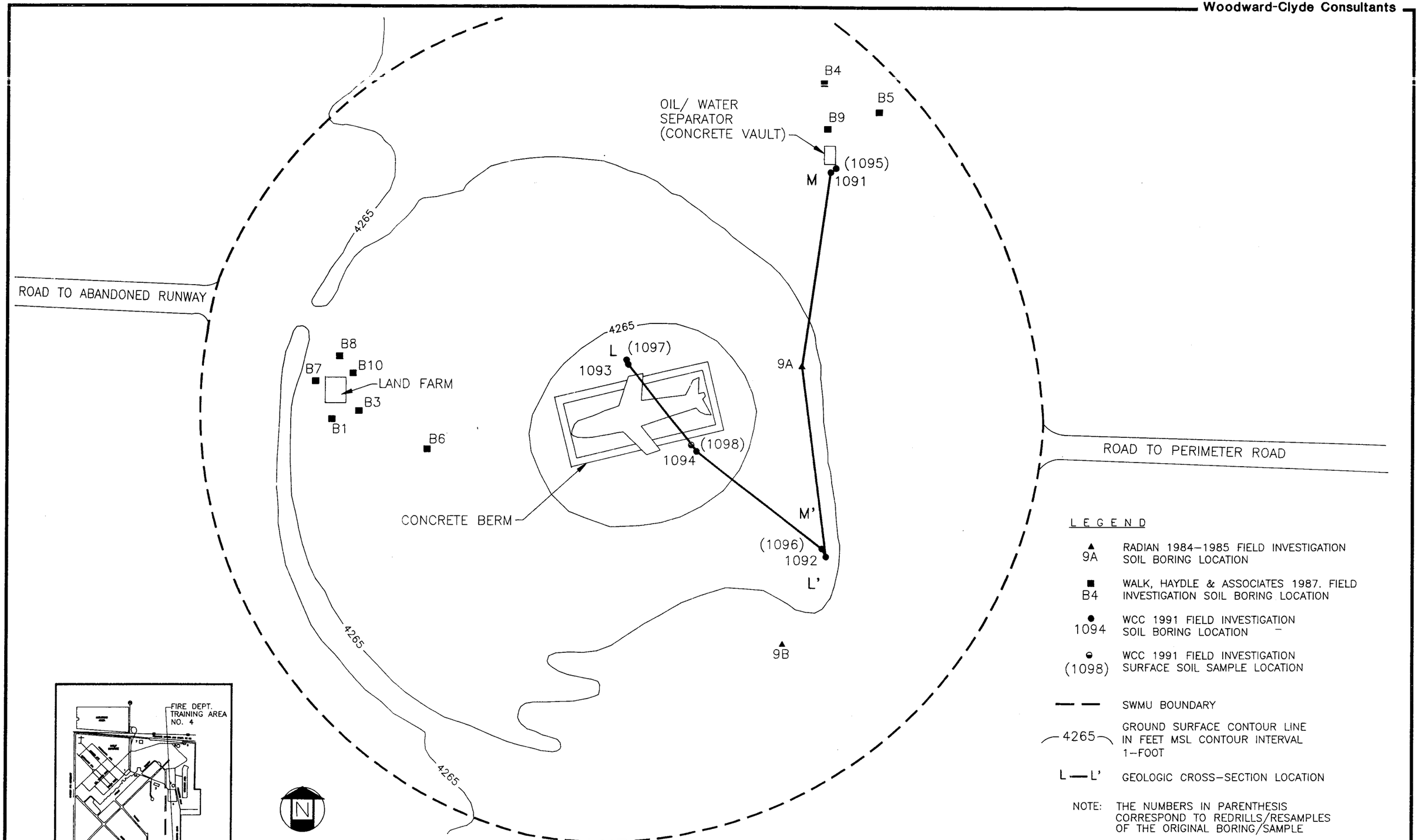
| Boring Number | Sample Depth (Ft-BGS) | Chromium (mg/kg) | Lead (mg/kg) |
|---|---|---|---|
| 1091 | 0 - 0.5 | 10 | 6.4 |
| | 5 | 6.4 | 4.8 |
| | 10 | 4.5 | 4.2 |
| | 20 | 8.8 | 6.6 |
| | 30 | 7.8 | 3.7 |
| | 40 | 6.6 | 2.2 |
| | 50 | 3.6 | 2.5 |
| | 60 | 6.1 | 2.3 |
| 1092 | 0-0.5 | 9.3 | 6.8 |
| | 4 | 7.4 | 4.7 |
| | 10 | 7.5 | 4.7 |
| | 20 | 8.1 | 3.8 |
| | 30 | 7.7 | 3.0 |
| | 40 | 4.9 | 2.2 |
| | 50 | 4.5 | 2.3 |
| | 60 | 4.5 | 2.1 |
| 1093 | 0-0.5 | 6.5 | 19.6 J |
| | 4 | 7.3 | 6.3 |
| | 10 | 6.8 | 5.0 |
| | 20 | 6.6 | 2.6 |
| | 30 | 5.5 | 3.1 |
| | 40 | 6.8 | 2.1 |
| | 50 | 3.3 | 2.4 |
| | 60 | 4.2 | 1.9 |
| | 70 | 1.4 | 0.9 |
| | 80 | 2.6 | 1.5 |
| | 90 | 1.4 | 0.9 |
| | 98 | 1.1 J | 0.87 |

**TABLE 13-11**
**(Concluded)**

| Boring Number | Sample Depth (Ft-BGS) | Chromium (mg/kg) | Lead (mg/kg) |
|---|---|---|---|
| 1094 | 0 - 0.5 | 4.8 | 2.5 |
| | 4 | 5.8 | 6.5 |
| | 10 | 8.3 | 6.4 |
| | 20 | 10.5 | 5.3 |
| | 30 | 7.0 | 2.1 |
| | 40 | 7.4 | 2.4 |
| | 50 | 3.9 | 1.5 |
| | 60 | 4.1 | 1.6 |
| | 70 | 4.2 | 1.8 |
| | 80 | 9.1 | 2.1 |
| | 90 | 2.8 | 0.98 |

Ft-BGS = Feet below ground surface
mg/kg = Milligrams per kilogram
J = Estimated value

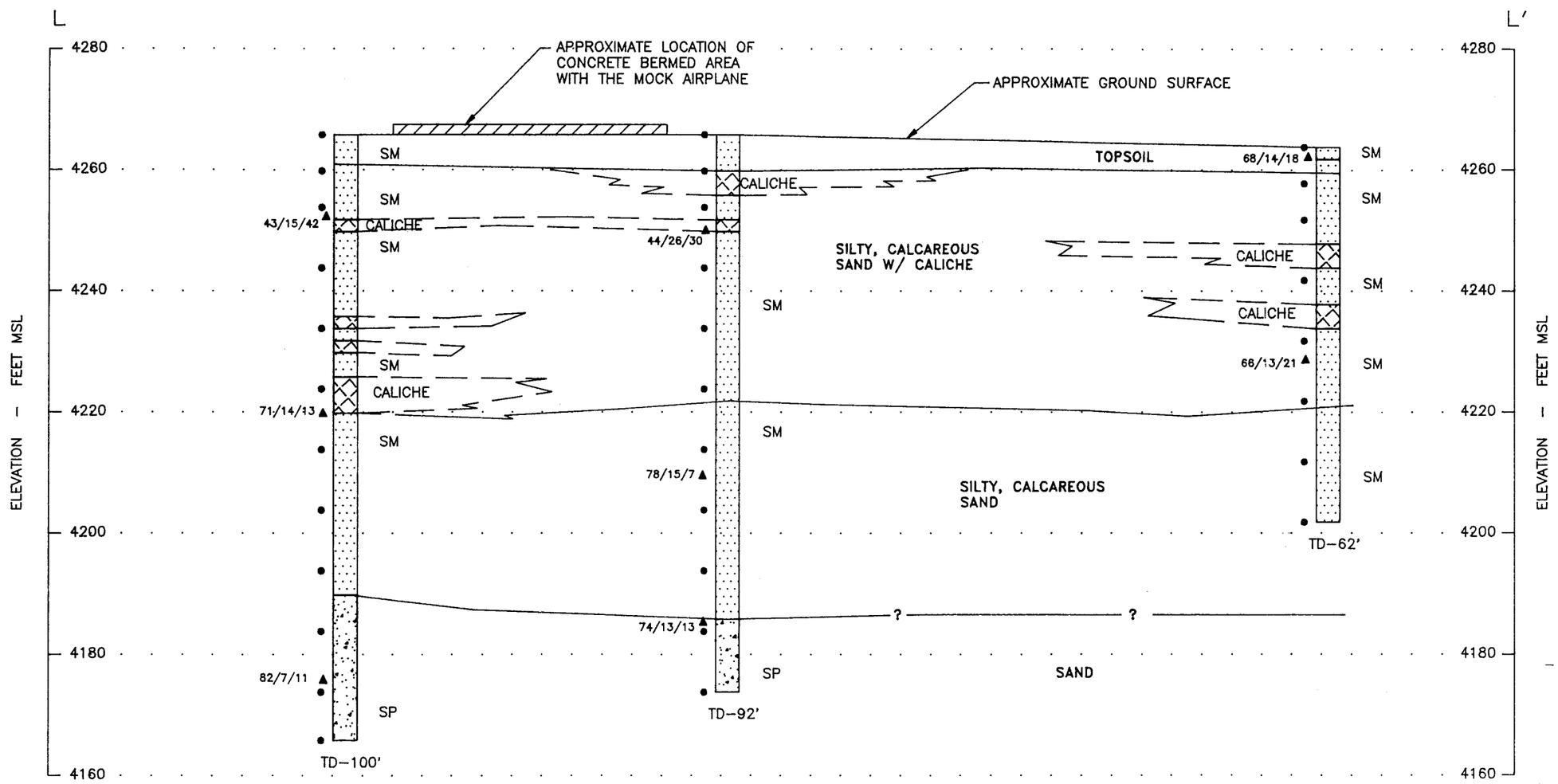
[1] Background range for chromium is 2.97 to 9.31 mg/kg (see Table 2-7).
[2] Background range for lead is 17.6 to 8.64 mg/kg (see Table 2-7).




| | |
|---|---|
| Job No. : 89MC114W | LOCATION OF SOIL BORINGS AT FIRE DEPARTMENT TRAINING AREA NO.4 |
| Prepared by : D.A.K. | SWMU NO. 109 |
| Date : 2/18/92 | CANNON AFB, NEW MEXICO |

C1140009

FIG. 13–1




LEGEND

| | | |
|---|---|---|
| MSL | – | MEAN SEA LEVEL |
| TD | – | TOTAL DEPTH IN FEET BGS |
| SM,SP,GW ML,GP | | UNIFIED SOIL CLASSIFICATION SYSTEM ABBREVIATIONS |
| BGS | – | BELOW GROUND SURFACE |
| • | – | ANALYTICAL SAMPLE INTERVAL |

BORINGS 1092, 1093, 1094 WCC (OCT 91)

NOTE: THE LOCATION OF THIS CROSS-SECTION IS SHOWN ON FIG. 13-1

35/31/34 ▲ – GRADATION ANALYSIS SAMPLE INTERVAL. THE THREE NUMBERS REPRESENT THE APPROXIMATE PERCENTAGES OF SAND-, SILT- AND CLAY- SIZED MATERIAL RESPECTIVELY

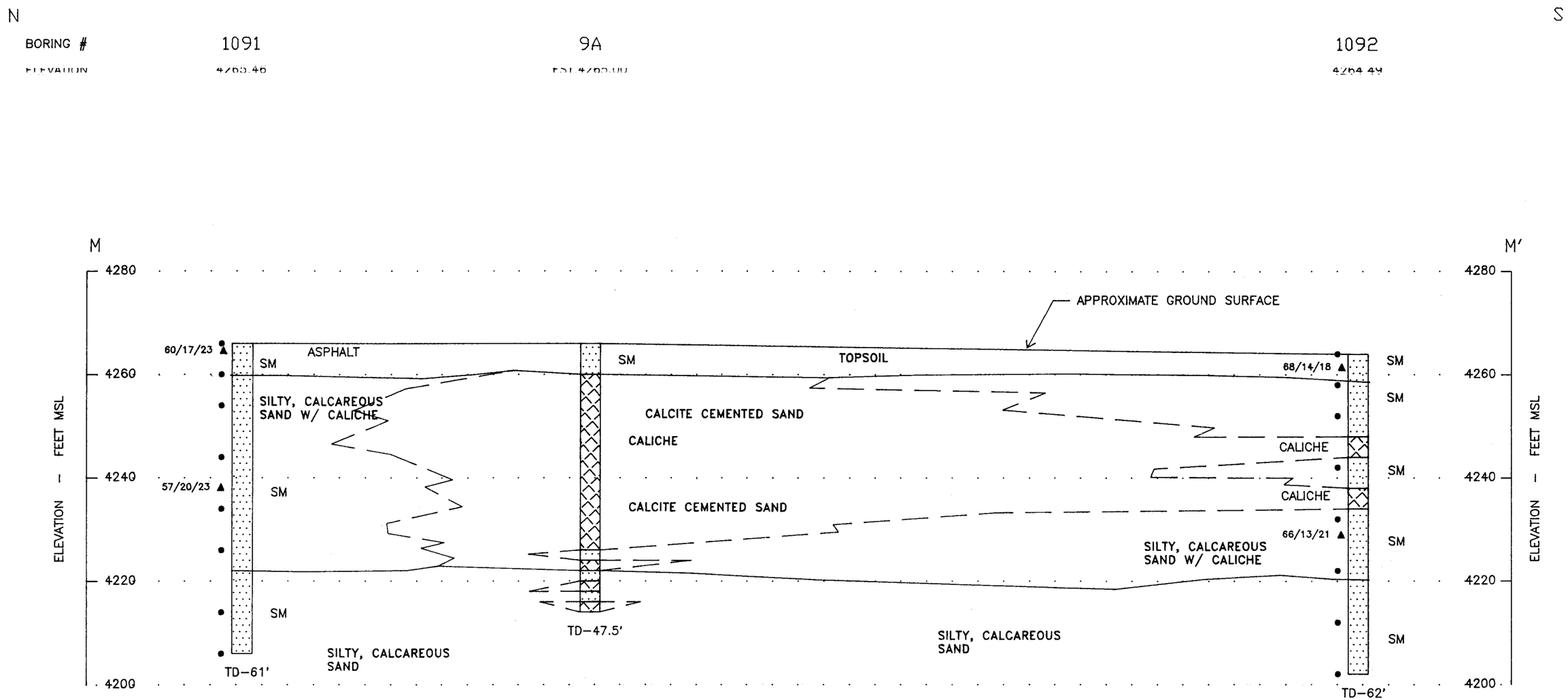
0 10 20 40

HORIZONTAL SCALE IN FEET
VERTICAL EXAGGERATION = 1X

| | |
|---|---|
| Job No. : 89MC114W | GEOLOGIC CROSS SECTION L–L' FIRE DEPT. TRAINING AREA NO.4 SWMU NO. 109 CANNON AFB NEW MEXICO |
| Prepared by : LLG | |
| Date : 2/3/92 | |

SWMU–109

FIG. 13–2




LEGEND

| | | |
|---|---|---|
| MSL | – | MEAN SEA LEVEL |
| TD | – | TOTAL DEPTH IN FEET BGS |
| SM,SP,GW ML,GP | – | UNIFIED SOIL CLASSIFICATION SYSTEM ABBREVIATIONS |
| BGS | – | BELOW GROUND SURFACE |
| • | – | ANALYTICAL SAMPLE INTERVAL |

BORINGS 1091, 1092 WCC (OCT 91)
BORINGS 9A RADIAN (JAN 85)
(BORINGS APPROXIMATELY LOCATED)

NOTE: THE LOCATION OF THIS CROSS–SECTION IS SHOWN ON FIG. 13–1

57/20/23 ▲ – GRADATION ANALYSIS SAMPLE INTERVAL. THE THREE NUMBERS REPRESENT THE APPROXIMATE PERCENTAGES OF SAND–, SILT– AND CLAY– SIZED MATERIAL RESPECTIVELY

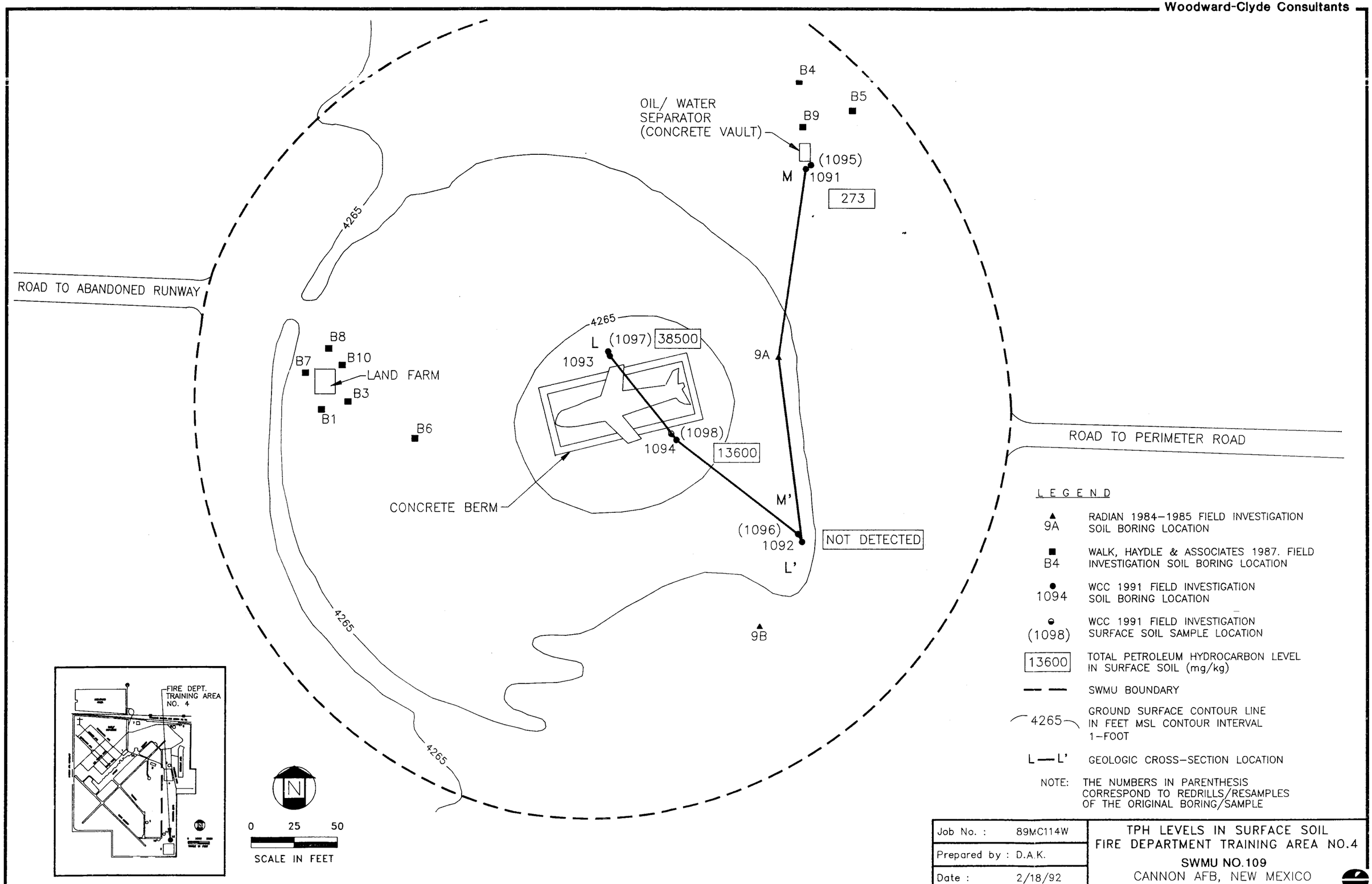
0 10 20 40

HORIZONTAL SCALE IN FEET
VERTICAL EXAGGERATION = 1X

| | |
|---|---|
| Job No. : 89MC114W | GEOLOGIC CROSS SECTION M–M' FIRE DEPT. TRAINING AREA NO.4 SWMU NO. 109 CANNON AFB NEW MEXICO |
| Prepared by : LLG | |
| Date : 2/3/92 | |

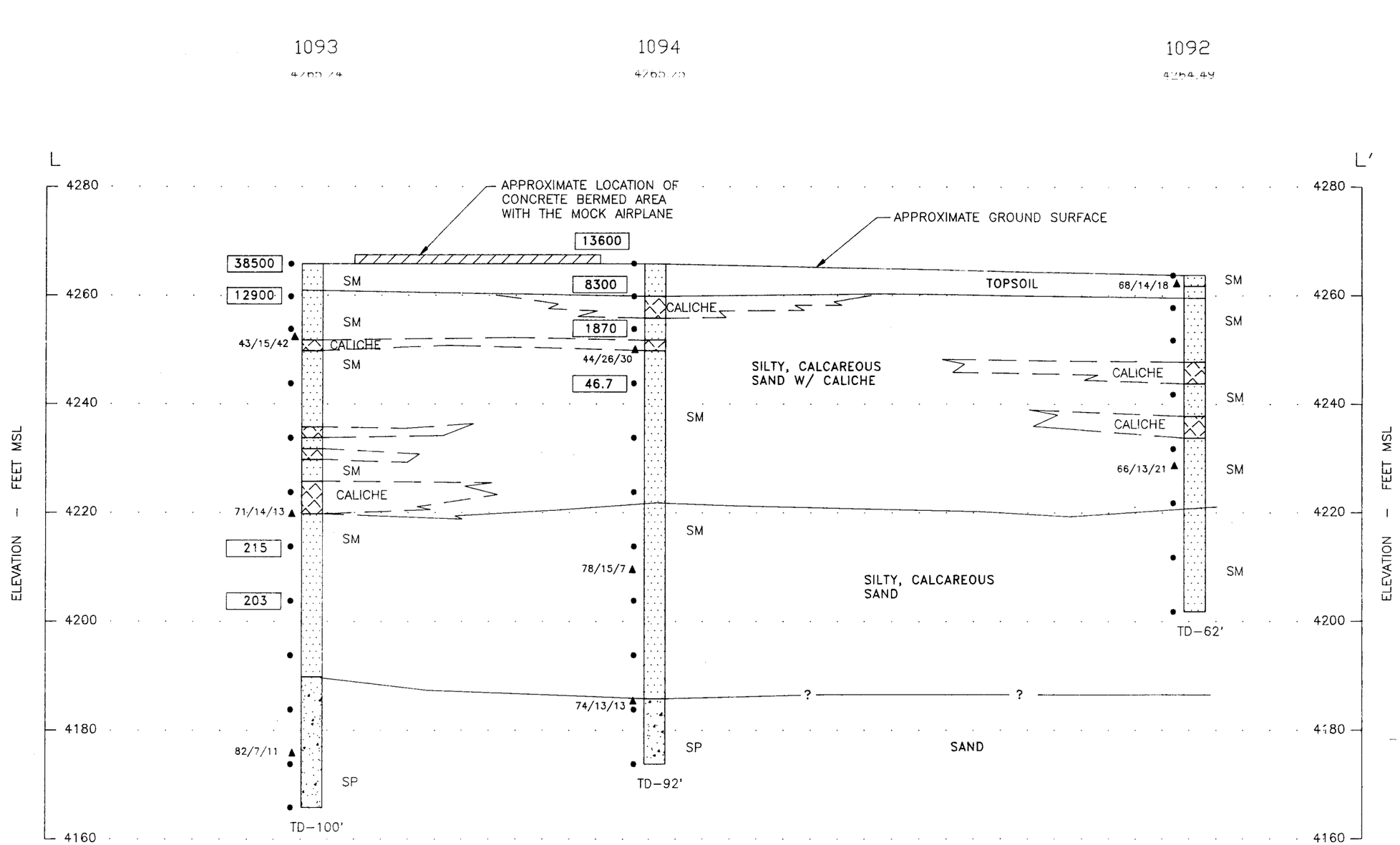
SWMU109A

FIG. 13–3




C1140025

FIG. 13-4




LEGEND

MSL – MEAN SEA LEVEL
TD – TOTAL DEPTH IN FEET BGS
SM,SP,GW ML,GP – UNIFIED SOIL CLASSIFICATION SYSTEM ABBREVIATIONS
BGS – BELOW GROUND SURFACE

38500 • – THE BOXED NUMBER REPRESENTS ANALYTICAL RESULTS IN mg/kg FOR TOTAL PETROLEUM HYDROCARBONS

BORINGS 1092, 1093, 1094 WCC (OCT 91)

NOTE: THE LOCATION OF THIS CROSS-SECTION IS SHOWN ON FIG. 13-1

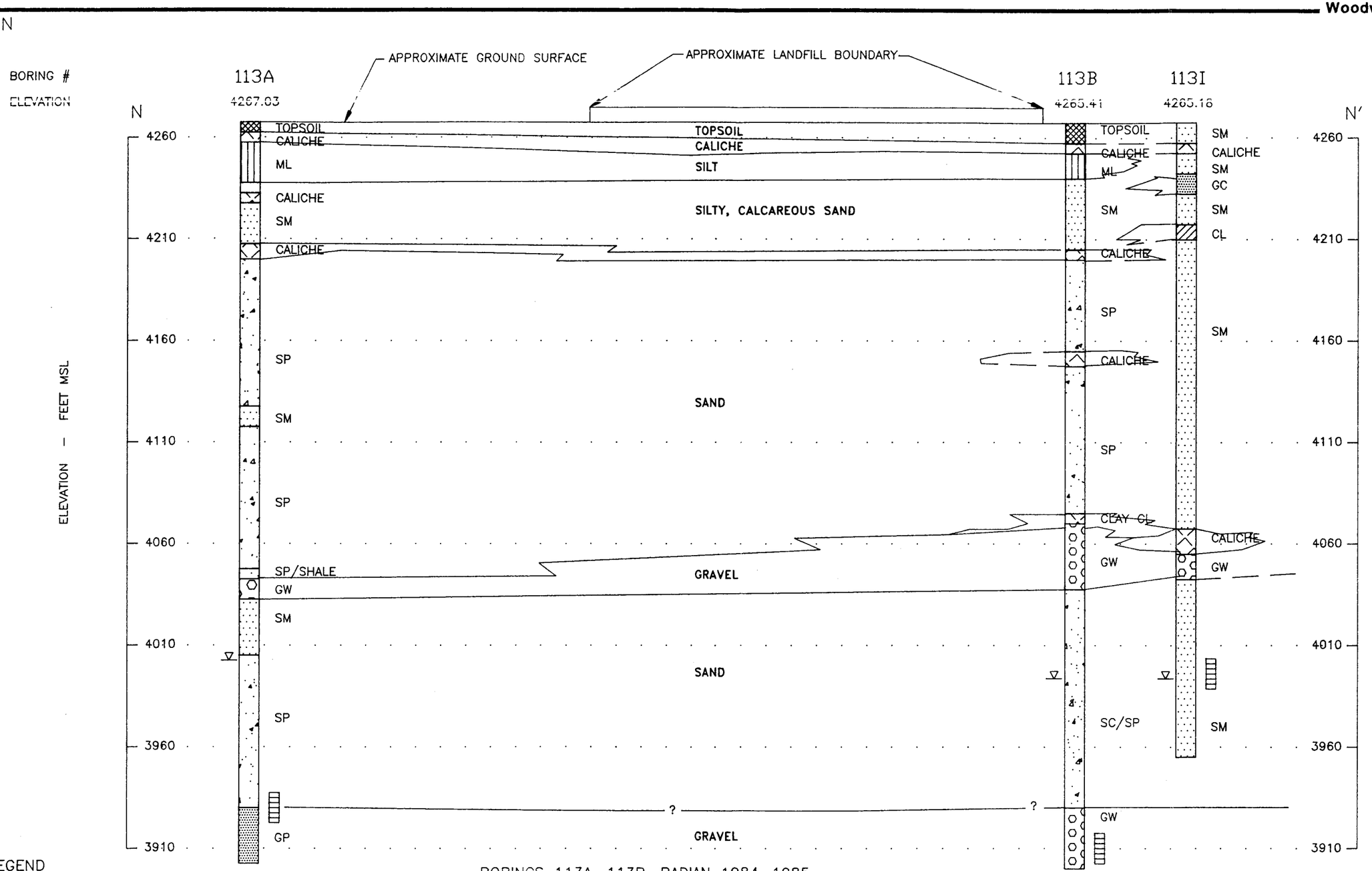
35/31/34 ▲ – GRADATION ANALYSIS SAMPLE INTERVAL. THE THREE NUMBERS REPRESENT THE APPROXIMATE PERCENTAGES OF SAND-, SILT- AND CLAY- SIZED MATERIAL RESPECTIVELY

0 10 20 40
HORIZONTAL SCALE IN FEET
VERTICAL EXAGGERATION = 1X

| | |
|---|---|
| Job No. : 89MC114W | VERTICAL EXTENT OF TPH IN SOIL FIRE DEPT. TRAINING AREA NO.4 SWMU NO.109 CANNON AFB NEW MEXICO |
| Prepared by : LLG | |
| Date : 2/3/92 | |

SWMU109B

FIG. 13-5




LEGEND

| | | |
|---|---|---|
| MSL | – | MEAN SEA LEVEL |
| TD | – | TOTAL DEPTH IN FEET BGS |
| SM,SP,GW | | UNIFIED SOIL CLASSIFICATION |
| ML,GP | | SYSTEM ABBREVIATIONS |
| BGS | – | BELOW GROUND SURFACE |
| ▤ | – | SCREENED INTERVAL |
| ▽ | – | STATIC WATER LEVEL IN MONITORING WELL MEASURED ON 11–8–91 |

BORINGS 113A, 113B, RADIAN 1984–1985
BORING 113I RADIAN 1988

NOTE: THE LOCATION OF THIS CROSS–SECTION IS SHOWN ON FIG. 14–1

0 150 300 600

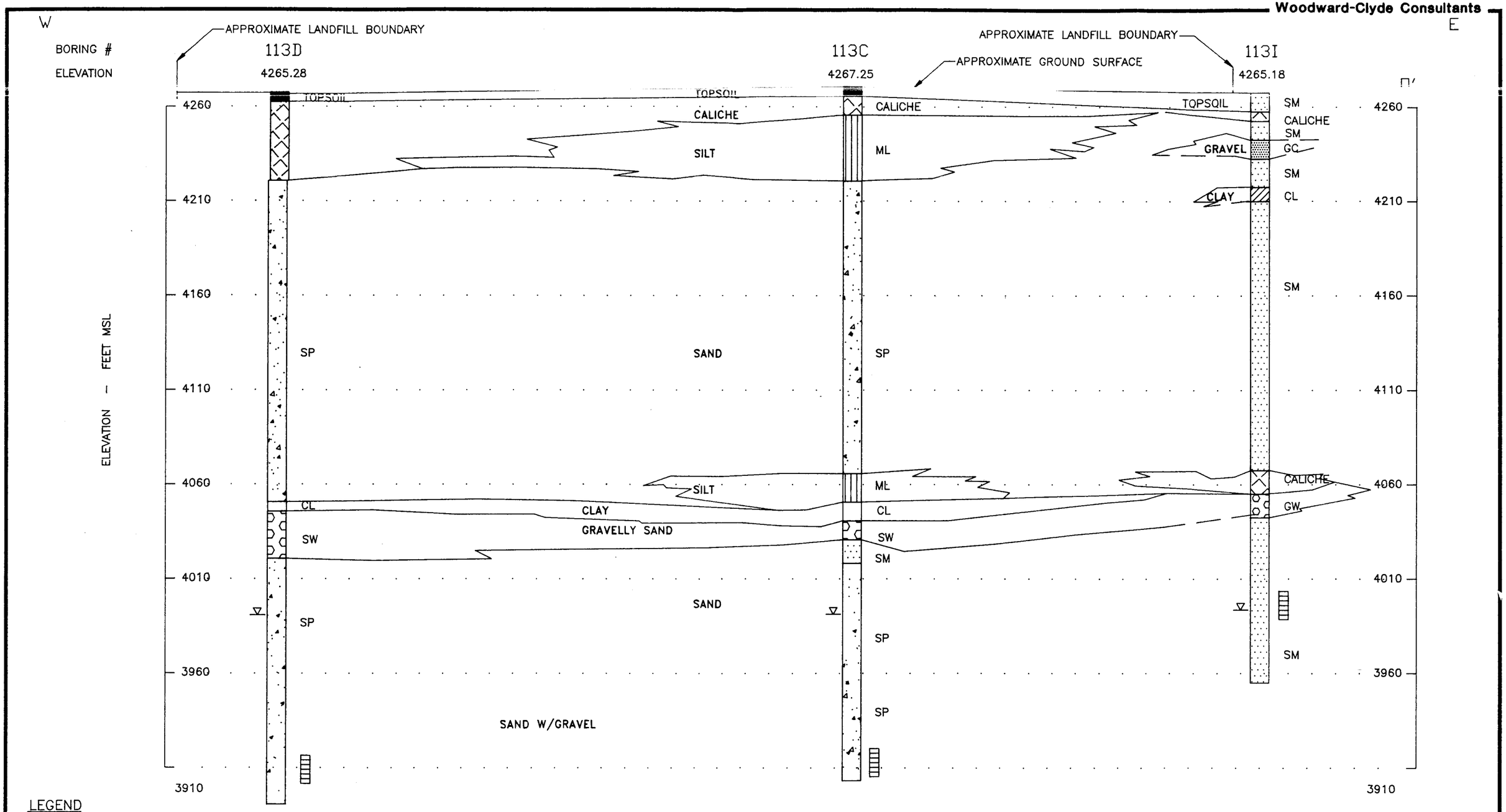
HORIZONTAL SCALE IN FEET
VERTICAL EXAGGERATION = 6X

| | |
|---|---|
| Job No. : 89MC114W | GEOLOGIC CROSS SECTION N–N' LANDFILL NO. 5 |
| Prepared by : LLG | SWMU NO. 113/IRP NO. LF-5 |
| Date : 2/3/92 | CANNON AFB NEW MEXICO |

SWMU–113

FIG. 14–2

Woodward-Clyde Consultants




LEGEND

| | | |
|---|---|---|
| MSL | – | MEAN SEA LEVEL |
| TD | – | TOTAL DEPTH IN FEET BGS |
| SM,SP,GW | | UNIFIED SOIL CLASSIFICATION |
| ML,GP | | SYSTEM ABBREVIATIONS |
| BGS | – | BELOW GROUND SURFACE |
| | – | SCREENED INTERVAL |
| | – | STATIC WATER LEVEL IN MONITORING WELL MEASURED ON 11–8–91 |

BORINGS 113D, 113C RADIAN 1984–1985
BORING 113I RADIAN 1988

NOTE: THE LOCATION OF THIS CROSS–SECTION IS SHOWN ON FIG. 14–1

0 150 300 600

HORIZONTAL SCALE IN FEET
VERTICAL EXAGGERATION = 6X

| | |
|---|---|
| Job No. : 89MC114W | GEOLOGIC CROSS SECTION 0–0' LANDFILL NO. 5 |
| Prepared by : LLG | SWMU NO. 113/IRP NO. LF-5 |
| Date : 2/3/92 | CANNON AFB NEW MEXICO |

SWMU113B

FIG. 14–3

# 14.0
# LANDFILL NO. 5 (SWMU NO. 113/IRP NO. LF-5)

## 14.1 SWMU DESCRIPTION

### 14.1.1 Setting

This SWMU is an active landfill located in the southeastern corner of the base, occupying about 30 acres (Figure 14-1). It is 200 feet from the boundary fence and bordered on the north by Fire Training Area No. 4.

### 14.1.2 History of Use

This unit began operation in 1968. Cell No. 3, which is closed, is RCRA regulated because, until mid-1981, this cell received hazardous waste. Until the cell was closed in 1983, it did not receive additional hazardous waste. Closure consisted of placing an impermeable cap over Cell No. 3, in accordance with NMEID and EPA requirements. Additional groundwater monitoring wells were installed to meet RCRA release detection monitoring requirements (Radian 1986).

Waste materials received at this landfill included domestic solid waste, waste oils, and solvents; paint, paint remover, and thinners; pesticide containers; and various empty cans and drums. Until mid-1981, approximately 5 to 10 drums per month of waste oils and solvents were disposed (Radian 1986).

### 14.1.3 Past Investigations

The landfill continues in operation, with the current cell receiving only tree limbs and construction debris. Cell No. 3 has been permanently closed with a cap, separate fencing for security, and a series of monitoring wells to detect contaminant migration.

### 14.1.4 Land Use and Demography

This landfill and Fire Training Area No. 4, which is used to train base personnel in extinguishing fires, are the only facilities currently being used in this remote corner of the base.

Periodically, workers dispose of non-hazardous materials for about 5 hours per year. In addition, one person conducts quarterly sampling of the monitoring wells for about 5 to 10 hours per quarter.

## 14.2 FIELD INVESTIGATION

This section provides a discussion of the field activities conducted by WCC at Landfill No. 5 from November 10 through 13, 1991 and on December 17, 1991. The activities at this SWMU, as outlined in the FSP (WCC 1991c), consisted of measuring the static water level, evacuating, and sampling 5 monitoring wells, and collecting 5 groundwater samples for chemical analysis. The resampling phase of the field program, which became necessary due to laboratory missed holding times, consisted of recollecting 1 groundwater sample for chemical analysis. The groundwater sampling was conducted in accordance with SOPs No. 2 - Water Level Measurement and No. 4 - Monitoring Well Sampling Using a Dedicated Submersible Pump contained in the QAPP (WCC 1991b).

The monitoring wells were purged using the dedicated submersible pump previously installed in each well. All purge water was pumped into either a dedicated 750-gallon poly tank or 55-gallon steel drums to be stored for later disposal. Following well purging and stabilization of field parameters, the required groundwater samples were collected.

Table 14-1 summarizes the purging and sampling conducted at each monitoring well. A complete record of all groundwater and associated QA/QC samples collected at Landfill No. 5 is presented in Table 14-2. The locations of the monitoring wells are shown on Figure 14-1.

### 14.2.1 Sampling Objectives

The objective of groundwater sampling from the monitoring wells surrounding Landfill No. 5 was to provide additional information regarding the nature and extent of potential hazardous contaminants in the groundwater upgradient and downgradient of the SWMU. The groundwater sampling program was designed to supplement previous investigations. The data collected at these monitoring well locations were used to further evaluate the extent of potential contamination, if present, and to perform a baseline risk assessment to determine if the area poses a risk to human health or the environment. The data may also be utilized to evaluate remedial actions if necessary.

### 14.2.2 Groundwater Investigation

Five monitoring wells, 113A, 113B, 113C, 113D, and 113I, were purged and sampled. Prior to any well purging or sampling activity, the SWL and total depth to the bottom of the casing were measured in each monitoring well. The groundwater levels and monitoring well casing depths were recorded to the nearest hundredth of a foot using an electrical water level indicator (well sounder). This information, along with the inside diameter of the well casings, was used to calculate the volume of water in each well casing under static conditions. The volume of water in the well casings ranged between approximately 5.4 to 8.6 gallons in wells 113A through 113D (4-inch diameter wells) to approximately 24.5 gallons in well 113I (6-inch diameter well). Based on these calculations, approximately 10 well casing volumes were purged from wells 113A through 113D (80 gallons from well 113A, 105 gallons from well 113B, 60 gallons from well 113C, and 70 gallons from well 113D), and approximately 7 well casing volumes from well 113I (180 gallons).

Upon subsequent review of monitoring well construction records, it was determined that the total depth measured in the field actually corresponded to the depth of the dedicated submersible pumps installed in wells 113A through 113D. The pumps in these wells were installed approximately 48 to 67 feet above the top of the screened interval (approximately 63 to 82 feet above the actual bottom of the well casing, based on a 15-foot section of screen). Using this information, the volume of standing water in the well casings ranged from approximately 45.6 gallons in well 113A to 54.9 gallons in well 113B,

and approximately 30.6 gallons in well 113I. Based on these recalculated well casing volumes, the actual number of well volumes purged from each monitoring well decreased. The actual well casing volumes purged from each monitoring well were recalculated to be 1.8 volumes from well 113A, 1.9 volumes from 113B, 1.1 volumes from well 113C, 1.3 volumes from well 113D, and 5.9 volumes from well 113I.

During the purging process, the field parameters pH, specific conductance, temperature, and color of the removed groundwater were monitored and recorded. In all monitoring wells, the field parameters appeared to be stable (i.e. pH and specific conductance varied by less than 10 percent) from the first purge sample collected to the final field parameter sampled collected with the analytical sample (see the field sampling data sheets for groundwater samples contained in Appendix A-2). Based on these field parameters, it was determined that all of the stagnant water in the well casings had been removed even though 5 well casing volumes had not been purged as called for in the QAPP. The SWL in all wells recovered to the original level almost instantaneously after shutting the pump off.

Five groundwater analytical samples were collected and analyzed for Appendix IX constituents listed in 40 CFR 264. In addition, the samples from wells 113A, 113B, and 113I were also analyzed for total metals.

During the resampling phase, one additional groundwater sample was collected from well 113I because the laboratory missed the holding time for the TCL VOC analysis on the original sample. This samples was analyzed for TCL VOCs only.

## 14.3 PHYSICAL CHARACTERISTICS

This section provides a discussion of the geology and hydrogeology at Landfill No. 5 based on the review of lithologic boring logs from the previous 1984-1985, and 1988 Radian field investigations.

### 14.3.1 Geology

The stratigraphy (upper 365 feet) at Landfill No. 5 consists of Tertiary Miocene to Pliocene fluvial deposits of the Ogallala Formation. Two hydrogeologic cross-sections, N-N' (Figure 14-2) and O-O' (Figure 14-3), were constructed using information contained in the four monitor well lithologic boring logs from the 1984-1985 Radian field investigation and one of the two monitor well lithologic boring logs from the 1988 Radian field investigation. These cross-sections run north-south and west-east, respectively (see Figure 14-1 for the cross-section locations). Stratigraphic correlations of the various fluvial deposits between borings is based primarily on the lithologic samples collected during drilling.

The SWMU is underlain by Ogallala fluvial deposits consisting primarily of well to moderately sorted sand, moderately to poorly sorted gravels, with scattered relatively thin (5 to 25 feet thick) layers silt, clay, and caliche. The total thickness of these Ogallala deposits beneath the SWMU is not presently known, but based on the cross-sections is at least 365 feet thick.

It would appear from the geologic cross-sections and the lithologic descriptions that four or five fairly distinct sand, gravel, or sand/caliche units are present beneath the SWMU to a depth of 365 feet. The lowermost fluvial deposits shown on the hydrogeologic cross-sections from 3890 to 3930 feet MSL consist of coarse-grained, moderately sorted, moderately to well cemented brown sands and sandy, well cemented brown gravels. These sands are comprised predominantly of quartz grains. The gravels are comprised predominantly of quartz and olivine pebbles, along with shale and other lithic fragments. Both the sands and gravels are relatively clean (i.e. little or no silt/clay sized particles). This unit was encountered in most borings at approximately 325 to 335 feet BGS. The thickness of this unit is unknown at present due to the fact that the unit was not fully penetrated.

The next fluvial deposits shown on the hydrogeologic cross-sections from 3930 to 4030 feet MSL consist of medium- to coarse-grained, moderate to poorly sorted, slightly silty, light brown to tan-brown sands. These sands are comprised predominantly of subangular to subrounded quartz grains with minor amounts (1-5%) of dark colored grains. Overall,

these sands are non-calcareous, however, there are occasional thin layers and pockets of calcareous sands. This unit was encountered in all borings at approximately 250 to 260 feet BGS. Based on the cross-sections, the thickness of this unit ranges from approximately 100 to 115 feet thick.

Above this unit shown on the hydrogeologic cross-sections from 4030 to 4060 feet MSL is a relatively thin (10 to 30 feet thick) deposit of poorly sorted, unconsolidated to slightly consolidated, gray sands and gravels. These sands and gravels are comprised predominantly of angular to subrounded quartz and chert grains/pebbles, and lithic fragments. This unit was encountered in all borings at approximately 195 to 225 feet BGS. Based on the cross-sections, the thickness of this unit ranges from approximately 5 to 30 feet thick. Resting on top of this unit in the southern portion of this SWMU are relatively thin clay and silt deposits ranging from approximately 5 to 25 feet in thickness.

The next fluvial deposits shown on the hydrogeologic cross-sections from 4060 to 4220 feet MSL consist of fine- to medium-grained, well to moderately sorted, unconsolidated light to medium brown sands. These sands are comprised predominantly of subrounded quartz grains with minor amounts of orange and dark colored grains. These sands are relatively clean (i.e. little or no silt/clay sized particles). Overall, these sands are non-calcareous, however, there are occasional thin layers and pockets of calcareous sands and scattered caliche nodules. This unit was encountered in all borings at approximately 45 to 65 feet BGS. The thickness of this unit ranges from approximately 150 to 165 feet thick.

The upper fluvial deposits shown on the hydrogeologic cross-sections from 4220 to 4265 feet MSL consist of fine-grained, well sorted, silty, calcareous, medium to light brown sands and sandy silts. The sands are comprised predominantly of subangular to subrounded quartz grains with slight to moderate amounts of silt and calcium carbonate. Occasionally these sands are moderately to well cemented with calcium carbonate. The silts are also calcareous. Thin to moderately thick layers (ranging from a few inches to over 30 feet) and small nodules of light brown to white caliche are scattered throughout this unit. Based on the cross-sections the thickness of this unit ranges from approximately 40 to 60 feet. Above this unit is approximately 4 to 5 feet of native topsoil.

### 14.3.2 Hydrogeology

The hydrostratigraphy at Landfill No. 5 consists of Tertiary Miocene to Pliocene fluvial deposits of the Ogallala Formation. Based on information contained in the field boring logs for wells 113A through 113D, 113I, and 113J (Radian 1986, 1988), and the hydrogeologic cross-sections, the SWMU is underlain by Ogallala fluvial deposits consisting of well to moderately sorted sand, with scattered layers of caliche in the upper 65 feet. The total thickness of these deposits appears to be at least 365 feet.

Based on the SWLs measured by WCC and the field boring logs, the first water bearing zone encountered in each well from 3890 to 3940 feet MSL consists of fine- to coarse-grained, moderately to well sorted, occasionally silty and gravelly, unconsolidated, tan to brown sands and moderately to poorly sorted, moderately to well cemented brown gravels. This unit was encountered at approximately 325 to 340 feet BGS and appears to be at least 30 to 35 feet thick at this location. Based on the lithologic descriptions, this water-bearing zone represents the water table aquifer beneath the SWMU and occurs under semi-confined conditions. The depth to the top of the water table in the five monitoring wells measured on November 8, 1991, ranged from approximately 264.42 feet BGS at well 113A to 269.18 feet BGS at well 113C. The static water level elevations ranged from 3995.17 feet MSL at well 113I to 4000.60 feet MSL at well 113A.

Utilizing the SWL measurement at the five wells, a groundwater potentiometric surface contour map was constructed combining the three-point method for estimating groundwater flow direction visual contour adjustments (Figure 14-4). This map shows the groundwater flow to be in a southeast-easterly direction. Based on the potentiometric surface contour map, the hydraulic gradient beneath this SWMU is approximately 0.0025 ft/ft.

## 14.4 NATURE AND EXTENT OF CONTAMINATION

Five groundwater samples were collected from existing monitoring wells, A, B, C, D, and I. The location of each of the wells is shown on Figure 14-1 and a description of the sampling event is discussed in Section 14.2.2. Four of the wells, B, C, D, and I, are located downgradient from the landfill and well A is located upgradient. Evaluation of

the chemical analyses (Appendix IX constituents in 40 CFR 264) of these samples has been used to describe the nature and extent of contamination.

No analytes other than metals were detected above the CRQL.

Metals analysis shown in Table 14-3 revealed the presence of barium and vanadium in all five groundwater samples. Both metals had concentrations below their MCLs (for barium, 1.0 mg/L; for vanadium, no MCL is established). The concentration of barium was approximately 0.029 mg/L. The concentration of vanadium ranged from 0.023 mg/L to 0.036 mg/L. Lead was detected in one groundwater sample, 113 B, at a concentration of 0.016 mg/L, well below its MCL of 0.05 mg/L. This MCL is effective only until December 7, 1992, at which time the MCL for lead will be abolished and replaced by an action level of 0.015 mg/L. However, it should be noted that this action level is for samples taken at the tap for public drinking water systems (56 FR 26460, 6/7/91).

Evaluation of the chemical data indicates the quality of groundwater has not been affected by SWMU No. 113.

TABLE 14-1

SUMMARY OF MONITORING WELL EVACUATION AND SAMPLING CONDUCTED BY WCC AT LANDFILL NO. 5,
SWMU NO. 113 / IRP NO. LF-5, CANNON AFB, NEW MEXICO

| MONITORING WELL NUMBER | DATE INSTALLED | DRILLING METHOD | SCREENED INTERVAL (Ft-BGS) | SCREEN SLOT SIZE (In) | GRAVEL PACK INTERVAL (Ft-BGS) | BENTONITE SEAL INTERVAL (Ft-BGS) | GROUND SURFACE ELEVATION (Ft-MSL) | MEASURING POINT ELEVATION (Ft-MSL) | DATE(S) EVACUATED/ SAMPLED | EVACUATION AND SAMPLING METHOD | INITIAL SWL (Ft-BTOC) (Ft-MSL) | TOTAL DEPTH OF WELL (Ft-BGS) | WELL CASING DIAMETER (In) | WELL VOLUME UNDER STATIC CONDITIONS (GALLONS) | VOLUME OF WATER EVACUATED (GALLONS) | FINAL SWL (Ft-BTOC) (Ft-MSL) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 113A | 01-07-85 | MR | 328-343 | 0.010 | 325-343 | 323-325 | 4265.02 | 4267.05 | 11-11-91 | Submersible Pump | 266.45<br>4000.60 | 343.00 | 4.0 | 45.55 | 80 | 266.55<br>4000.50 |
| 113B | 11-30-84 | MR | 347-362 | 0.010 | 342-362 | 340-342 | 4263.31 | 4265.41 | 11-10-91 | Submersible Pump | 269.80<br>3995.61 | 362.00 | 4.0 | 54.87 | 105 | 269.83<br>3995.58 |
| 113C | 01-11-85 | MR | 347-362 | 0.010 | 344-362 | 342-344 | 4265.03 | 4267.25 | 11-10-91 | Submersible Pump | 271.40<br>3995.85 | 362.00 | 4.0 | 53.92 | 60 | 271.40<br>3995.85 |
| 113D | 12-16-84 | MR | 342-357 | 0.010 | 337-357 | 335-337 | 4263.30 | 4265.28 | 11-10-91 | Submersible Pump | 268.02<br>3997.26 | 357.00 | 4.0 | 52.95 | 70 | 268.04<br>3997.24 |
| 113I | 12-16-84 | MR | 273-293 | 0.020 | 255-305 | 245-255 | 4262.84 | 4265.18 | 11-10-91 | Submersible Pump | 270.01<br>3995.17 | 293.00 | 6.0 | 30.58 | 180 | 270.41<br>3994.77 |
| | | | | | | | | | 12-17-91 | Submersible Pump | 270.00<br>3995.18 | 293.00 | 6.0 | 30.60 | 200 | 270.07<br>3995.11 |

| | |
|---|---|
| Ft-BGS | Feet Below Ground Surface |
| In | Inches |
| Ft-MSL | Feet Mean Sea Level |
| Ft-BTOC | Feet Below Top of Casing |
| SWL | Static Water Level |
| MR | Mud Rotary |

TABLE 14-2

SUMMARY OF GROUNDWATER AND QA/QC SAMPLES COLLECTED BY WCC AT LANDFILL NO. 5, SWMU NO. 113 / IRP NO. LF-5, CANNON AFB, NEW MEXICO

| WELL NUMBER | DEPTH INTERVAL (Ft-BGS) | SAMPLE IDENTIFICATION NUMBER | SAMPLE TYPE | QA/QC SAMPLES | SAMPLE MATRIX | DATE SAMPLED | TIME SAMPLED | OVA ON SAMPLE (ppm) | ANALYTICAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|---|
| 113A | | CAN113-113A-2001 | A | | Water(G) | 11-11-91 | 1645 | | Appendix IX |
| | | CAN113-113A-0571 | A | RB | Water | 11-13-91 | 1100 | | Appendix IX |
| 113B | | CAN113-113B-2001 | A | EPA | Water(G) | 11-10-91 | 1030 | | Appendix IX |
| | | CAN113-113B-0561 | A | FD | Water(G) | 11-10-91 | 1000 | | Appendix IX |
| 113C | | CAN113-113C-2001 | A | EPA | Water(G) | 11-10-91 | 0730 | | Appendix IX |
| | | CAN113-113C-0501 | A | MRD | Water(G) | 11-10-91 | 0730 | | Appendix IX |
| 113D | | CAN113-113D-2001 | A | MS/MSD | Water(G) | 11-10-91 | 1640 | | Appendix IX |
| 113I | | CAN113-113I-2001 | A | EPA | Water(G) | 11-10-91 | 1330 | | Appendix IX |
| | | CAN113-113I-0551 | A | AB | Water | 11-10-91 | 1430 | | VOC |
| | | (CAN113-113I-2002)* | A | MS/MSD | Water(G) | 12-17-91 | 1120 | | VOC |
| | | (CAN113-113I-0562)* | A | FD | Water(G) | 12-17-91 | 1130 | | VOC |

| | | | | | |
|---|---|---|---|---|---|
| Ft-BGS | Feet Below Ground Surface | FD | Field Duplicate | SV | Semi Volatile Organic Compounds |
| OVA | Organic Vapor Analyzer Reading | MRD | Missouri River Division Duplicate | M | Metals (TAL) |
| ppm | Parts per Million | AB | Ambient Blank | TPH | Total Petroleum Hydrocarbons |
| A | Analytical | RB | Rinsate Blank | BTEX | Benzene, Toluene, Ethylbenzene, Xylene |
| SPT | Standard Penetration Test | DW | Decontamination Water Blank | | |
| GA | Gradation Analysis | TB | Trip Blank | TOC | Total Organic Carbon |
| L | Lithology | VOC | Volatile Organic Compounds (TCL) | OL | Organic Lead |
| MS/MSD | Matrix Spike / Matrix Spike Duplicate | PCB | Polychlorinated Biphenols, Pesticide | Pb/Cr | Lead / Chromium |
| | | TCL | Target Compound List | TAL | Target Analyte List |
| (G) | Groundwater Sample | | | | |

()* The samples that are shaded and in parentheses are resamples of the previous monitoring well sample due to laboratory missed holding times.

## TABLE 14-3

## DISSOLVED METALS CONCENTRATIONS[1] IN GROUNDWATER SAMPLES COLLECTED BY WCC AT LANDFILL NO. 5

## SWMU NO. 113/IRP. NO. LF-5
## CANNON AFB, NEW MEXICO

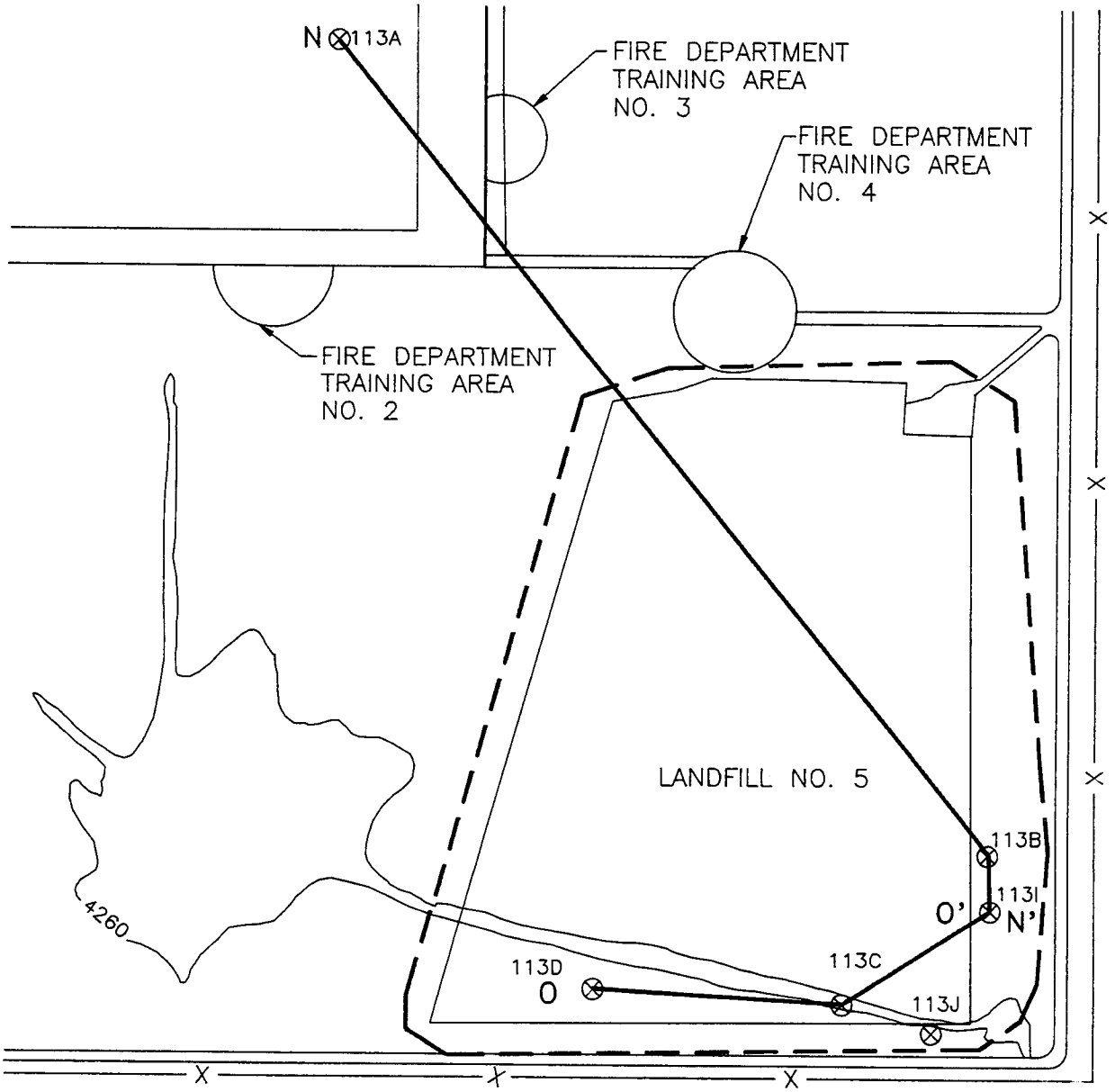
| Element | Upgradient | Downgradient | | | | MCL[2] |
|---|---|---|---|---|---|---|
| | Well 113A | Well 113B | Well 113C | Well 113D | Well 113I | |
| Antimony | 0.06 U | 0.06 U | 0.06 U | 0.06 U | 0.06 U | 0.01/0.005[3] |
| Arsenic | 0.005 U | 0.005 U | 0.005 U | 0.0039 J | 0.0033 J | 0.051 |
| Barium | 0.029 J | 0.026 J | 0.022 J | 0.029 J | 0.03 J | 1.0 |
| Beryllium | 0.002 U | 0.002 U | 0.002 U | 0.002 U | 0.002 U | 0.01[3] |
| Cadmium | 0.005 U | 0.005 U | 0.005 U | 0.005 U | 0.005 U | 0.005[3] |
| Chromium | 0.01 U | 0.01 U | 0.01 U | 0.01 U | 0.01 U | 0.01 |
| Cobalt | 0.01 U | 0.01 U | 0.01 U | 0.01 U | 0.01 U | * |
| Copper | 0.02 U | 0.02 U | 0.02 U | 0.02 U | 0.02 U | 1.0[4] |
| Lead | 0.005 U | 0.005 U | 0.005 U | 0.005 U | 0.005 U | 0.05 |
| Mercury | 0.0002 U | 0.0002 U | 0.0002 U | 0.0002 U | 0.0002 U | 0.002 |
| Nickel | 0.04 U | 0.04 U | 0.04 U | 0.04 U | 0.04 U | 1.0[3] |
| Selenium | 0.0049 J | 0.01 UJ | 0.01 UJ | 0.0047 UJ | 0.0047 UJ | 0.05 |
| Silver | 0.01 U | 0.01 U | 0.01 U | 0.01 U | 0.01 U | 1.0[4] |
| Thallium | 0.01 UJ | 0.01 UJ | 0.01 UJ | 0.01 UJ | 0.01 UJ | 0.022/0.001[3] |

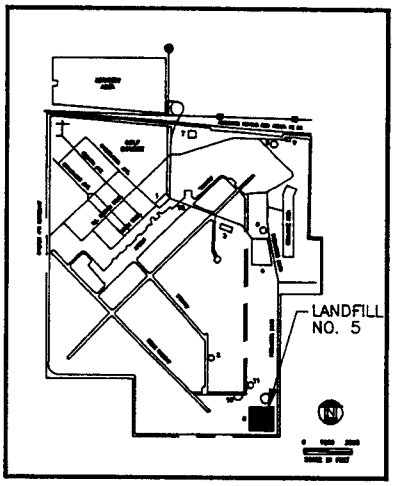
**TABLE 14-3**
**(Concluded)**

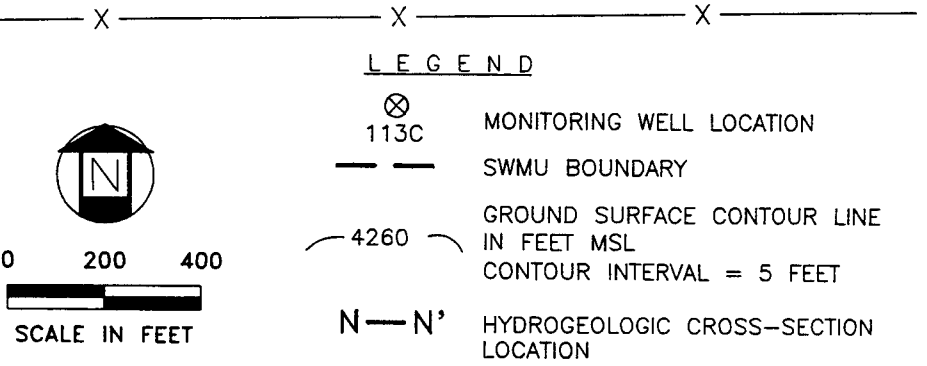
| Element | Upgradient | Downgradient | | | | MCL[2] |
|---|---|---|---|---|---|---|
| | Well 113A | Well 113B | Well 113C | Well 113D | Well 113I | |
| Tin | 0.1 U | 0.1 U | 0.1 U | 0.1 U | 0.1 U | * |
| Vanadium | 0.031 | 0.017 | 0.026 | 0.036 | 0.027 | * |
| Zinc | 0.0049 J | 0.02 U | 0.02 U | 0.02 U | 0.0059 U | 5.0 |

MCL = Maximum contaminant level
UJ = Estimated as non-detect at the CRQL
J = Estimated value
U = Not detected

[1] All concentrations are in milligrams per liter (mg/L)
[2] Primary MCL in effect as of July 30, 1992
[3] Proposed primary MCL
[4] Secondary MCL in effect as of July 30, 1992
* No primary or secondary MCL or proposed MCL as of March 1992




| | |
|---|---|
| Job No. : | 89MC114W |
| Prepared by : | D.A.K. |
| Date : | 2/14/92 |

LOCATION OF MONITORING WELLS AT LANDFILL NO. 5

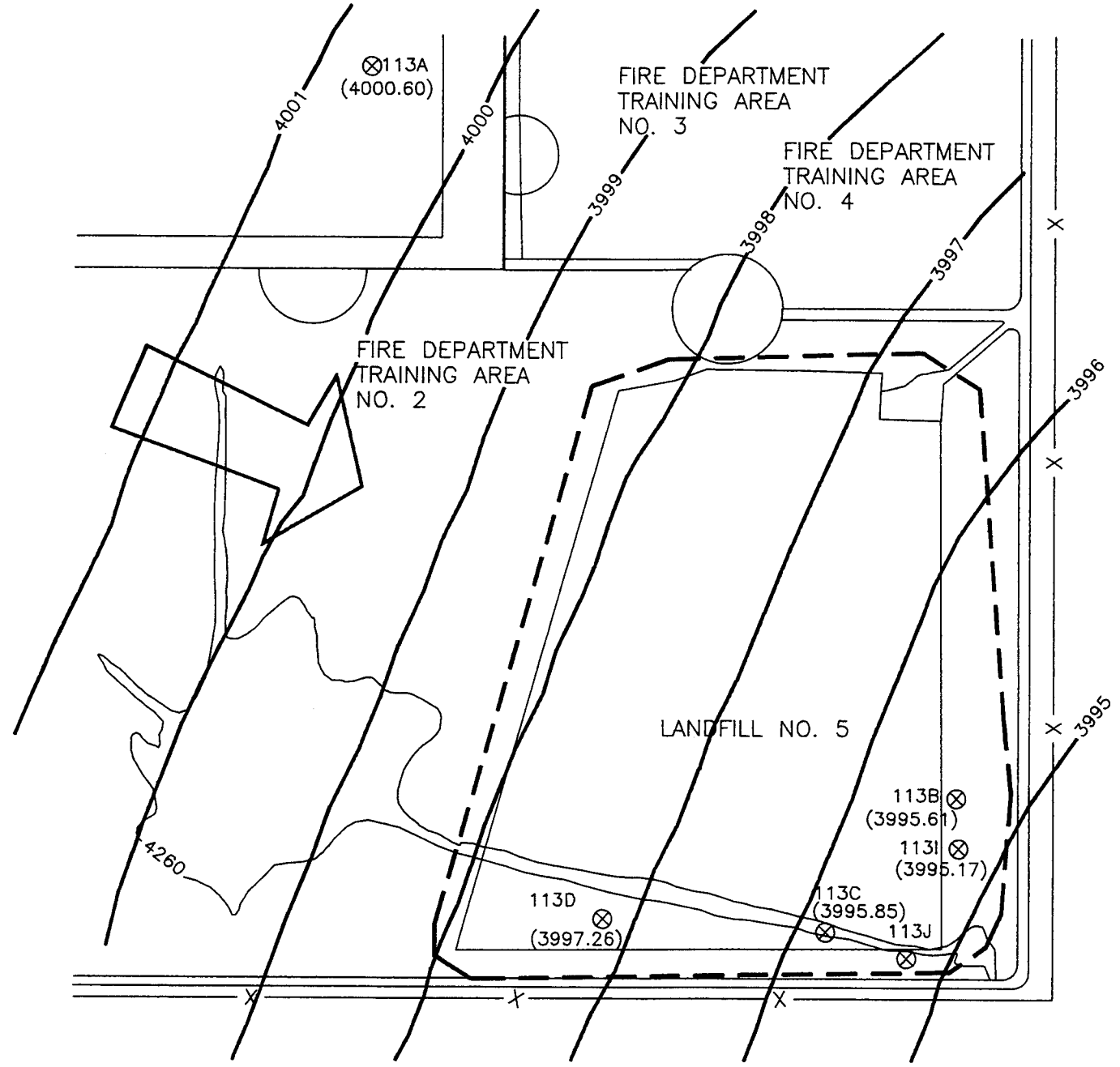
**SWMU NO. 113/IRP NO. LF-5**

CANNON AFB, NEW MEXICO

C1140013

FIG. 14–1

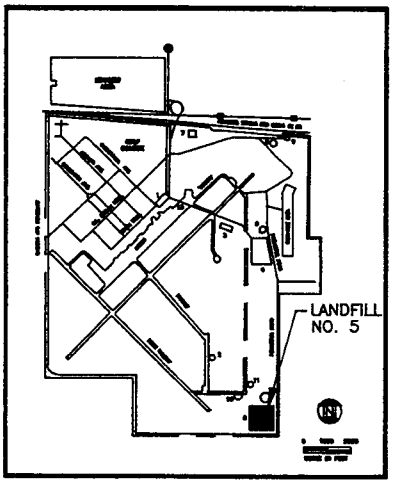
Woodward-Clyde Consultants




LEGEND

| | |
|---|---|
| ⊗ 113C | MONITORING WELL LOCATION |
| — X — | SWMU BOUNDARY |
| 4260 | GROUND SURFACE CONTOUR LINE IN FEET MSL CONTOUR INTERVAL = 5 FEET |
| —3995— | POTENTIOMETRIC SURFACE CONTOUR LINE IN FEET MEAN SEA LEVEL |
| ⇨ | GROUNDWATER FLOW DIRECTION |

NOTE: THE NUMBER IN PARENTHESIS IS THE STATIC WATER LEVEL IN FEET MEAN SEA LEVEL MEASURED ON NOV. 8, 1991




N

0 200 400

SCALE IN FEET

| | |
|---|---|
| Job No. : | 89MC114W |
| Prepared by : | D.A.K. |
| Date : | 2/14/92 |

POTENTIOMETRIC SURFACE CONTOUR MAP AT LANDFILL NO. 5
SWMU NO. 113/IRP NO. LF-5
CANNON AFB, NEW MEXICO

C1140020

FIG. 14-4

# 15.0
# OFFSITE BACKGROUND SITES

## 15.1 OFFSITE DESCRIPTIONS

### 15.1.1 Setting

The locations for the background surface soil samples were selected based on information from Cannon AFB personnel concerning the current and past use of land located on and adjacent to the base. The three sampling locations chosen were located northwest of the main gate and behind the officers mess. The offsite locations are located in areas of similar soil type as is found over the majority of the base. A description of this soil is provided in Section 15.3. These areas were believed to represent background soil conditions based on the lack of any known construction activity or base operations in the immediate vicinity of these locations.

The first two surface soil sample locations, OFS1 and OFS2, were located off base in a field west of the Chavez Housing Area, adjacent to Cannon AFB, just north of Highway 60 & 84 and west of Highway 277. The third surface soil sample location, OFS3, was located on base in an open field behind the Officer's Club on Octagon Street, in the west-central portion of Cannon AFB. The three offsite soil sample locations are shown on Figure 15-1.

### 15.1.2 History of Use

All three offsite areas appeared to be undisturbed open fields, indicating that no base operations had taken place in the past.

### 15.1.3 Land Use and Demography

Current use of the land around these background sites is minimal. The closest facility to the first two locations in the housing area are single family homes approximately 200 feet east of sample location OFS1 and approximately 400 feet north of sample location

OFS2. The closest facility to the third sample location, OFS3, is the Officer's Club, which is approximately 180 feet east of the sample location. None of these background sample locations appeared to be near high pedestrian traffic areas.

## 15.2 FIELD INVESTIGATION

This section provides a discussion of the field activities conducted by WCC at the Offsite Background Sites on December 10, 1991. The activities at these sites, as outlined in the FSP (WCC 1991c), consisted of collecting 3 surface soil sample for chemical analysis.

Table 15-1 summarizes the surface soil sampling conducted during the 1991 WCC investigation. A complete record of all surface soil samples collected at the Offsite Background Sites is presented in Table 15-2. The locations of the surface soil samples are shown on Figure 15-1.

### 15.2.1 Sampling Objectives

The objective of sampling at the Offsite Background Sites was to provide information regarding the ambient anthropogenic levels of metals, PCBs, and pesticides in the surface soils near Cannon AFB that are not site related. The data collected at these surface sample locations were utilized in the baseline risk assessments which were performed for each SWMU to evaluate whether the area poses a risk to human health or the environment.

### 15.2.2 Surface Soil Investigation

Three surface soil samples, OFS1, OFS2, and OFS3, were collected from 0 to 0.5 feet BGS at three offsite locations, two in the Chavez Housing Area off base and one behind the Officer's Club on base. These samples were collected using a stainless steel hand trowel and analyzed for TAL metals, PCBs and pesticides.

## 15.3 PHYSICAL CHARACTERISTICS

This section provides a discussion of the soil at the Offsite Background Sites based on the lithologic description of the surface soil samples from the 1991 WCC investigation.

The soils underlying the Offsite Background Sites consist of sandy loam and loamy sand of the Amarillo Soil Group. The soils consist primarily of fine-grained, well sorted, silty, clayey, brown-orange to red-brown sands. The sands are dry to slightly moist. The total thickness of the soil zone is unknown at present due to the fact that the zone was not fully penetrated, but based on information collected at the SWMUs on base, this soil zone probably ranges from 2 to 5 feet in thickness.

TABLE 15-1

SUMMARY OF SURFACE SOIL SAMPLING CONDUCTED BY WCC AT THREE OFFSITE LOCATIONS, CANNON AFB, NEW MEXICO

| BORING NUMBER | DRILLING/ SAMPLING METHOD | DRILL RIG USED | BOREHOLE DIAMETER (In) | DRILLING/ SAMPLING DEPTH INTERVALS (Ft-BGS) | BOREHOLE SAMPLING FREQUENCY | DATE(S) DRILLED/ SAMPLED | NUMBER OF ANALYTICAL SOIL SAMPLES COLLECTED | NUMBER OF ANALYTICAL QA/QC SAMPLES COLLECTED | NUMBER OF SPT SOIL SAMPLES COLLECTED | NUMBER OF GRADATION ANALYSIS SAMPLES COLLECTED | GROUND ELEVATION (Ft-MSL) | TOTAL DEPTH OF BOREHOLE (Ft-BGS) | DATE BOREHOLE GROUTED |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OFS1 | HT | NA | NA | 0 to 0.5 | NA | 12-10-91 | 1 | 0 | NA | 0 | 4326.40 | 0.5 | NA |
| OFS2 | HT | NA | NA | 0 to 0.5 | NA | 12-10-91 | 1 | 0 | NA | 0 | 4315.33 | 0.5 | NA |
| OFS3 | HT | NA | NA | 0 to 0.5 | NA | 12-10-91 | 1 | 0 | NA | 0 | 4316.88 | 0.5 | NA |

| | |
|---|---|
| In | Inches |
| Ft-BGS | Feet Below Ground Surface |
| Ft-MSL | Feet Mean Sea Level |
| SPT | Standard Penetration Test |
| HSA | Hollow Stem Auger |
| HT | Hand Trowel, Surface Sample |
| NA | Not Applicable, Surface Sample |
| NS | Not Sampled |

| | |
|---|---|
| B-53 | Mobile B-53 Auger Drill Rig with 6" OD / 3.75" ID Augers and 6.5" Bullet Bit |
| B-61A | Mobile B-61 Auger Drill Rig with 6" OD / 3.75" ID Augers and 6.5" or 6.25" Bullet Bit |
| B-61B | Mobile B-61 Auger Drill Rig with 7.25" OD / 4.25" ID Augers and 7.5" Bullet Bit |
| F-10 | Failing F-10 Auger Drill Rig with 8.25" OD / 4.25" ID Augers and 8.5" Bullet Bit |
| CME-75 | Central Mine Equipment CME-75 Auger Drill Rig with 7.75" OD / 4.25" ID Augers and 8.0" Bullet Bit |
| OD | Outer Diameter |
| ID | Inner Diameter |

TABLE 15-2

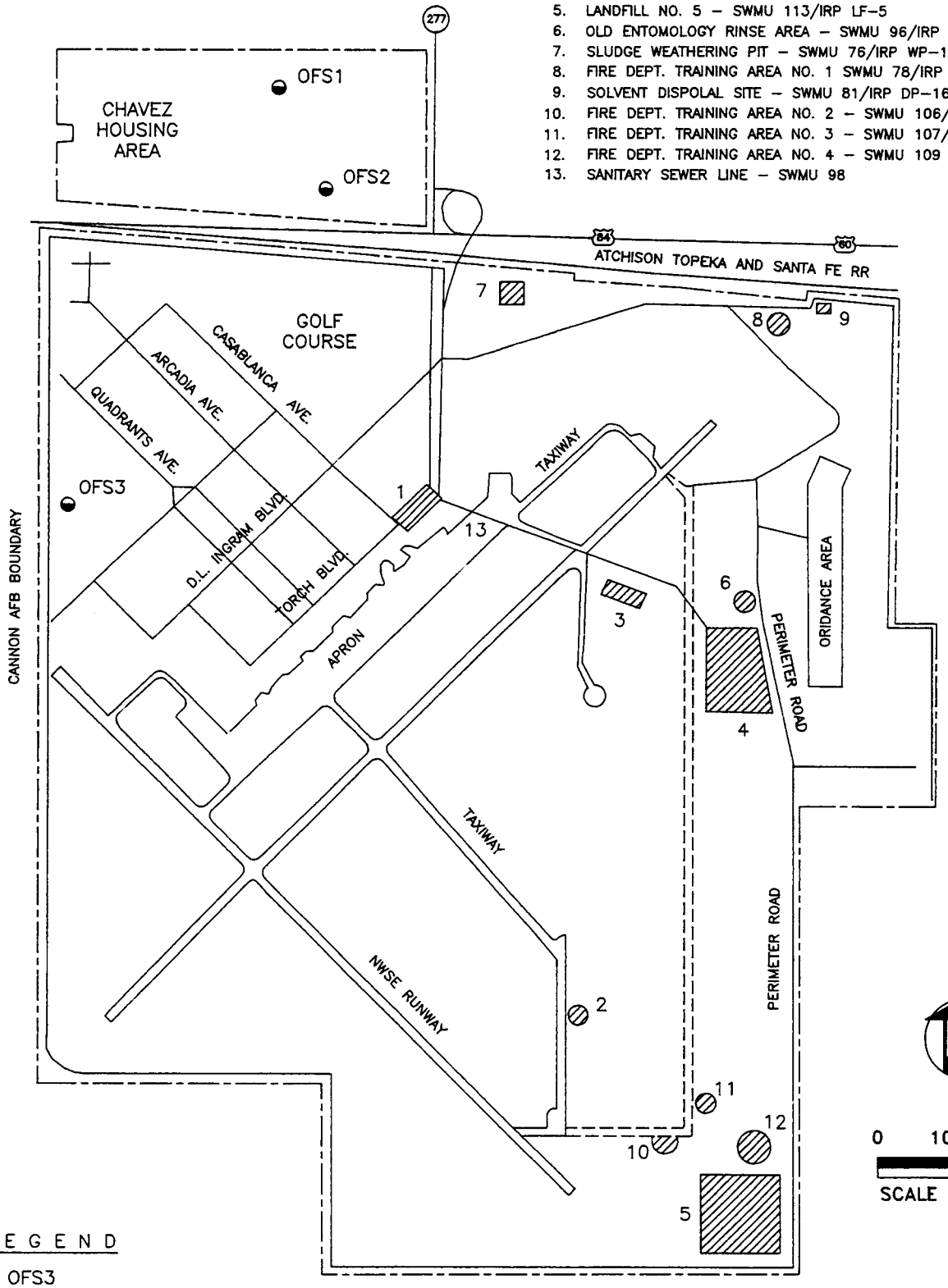
SUMMARY OF SURFACE SOIL AND QA/QC SAMPLES COLLECTED BY WCC AT THREE OFFSITE LOCATIONS, CANNON AFB, NEW MEXICO

| BORING NUMBER | DEPTH INTERVAL (Ft-BGS) | SAMPLE IDENTIFICATION NUMBER | SAMPLE TYPE | QA/QC SAMPLES | SAMPLE MATRIX | DATE SAMPLED | TIME SAMPLED | OVA ON SAMPLE (ppm) | ANALYTICAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|---|
| OFS1 | 0 to 0.5 | CANOFS-OFS1-0000 | A | | Soil | 12-10-91 | 0950 | 0 | PCB,M |
| OFS2 | 0 to 0.5 | CANOFS-OFS2-0000 | A | | Soil | 12-10-91 | 1010 | 0 | PCB,M |
| OFS3 | 0 to 0.5 | CANOFS-OFS3-0000 | A | | Soil | 12-10-91 | 1050 | 0 | PCB,M |

| | | | | | |
|---|---|---|---|---|---|
| Ft-BGS | Feet Below Ground Surface | FD | Field Duplicate | SV | Semi Volatile Organic Compounds |
| OVA | Organic Vapor Analyzer Reading | MRD | Missouri River Division Duplicate | M | Metals (TAL) |
| ppm | Parts per Million | AB | Ambient Blank | TPH | Total Petroleum Hydrocarbons |
| A | Analytical | RB | Rinsate Blank | BTEX | Benzene, Toluene, Ethylbenzene, Xylene |
| SPT | Standard Penetration Test | DW | Decontamination Water Blank | TOC | Total Organic Carbon |
| GA | Gradation Analysis | TB | Trip Blank | OL | Organic Lead |
| L | Lithology | VOC | Volatile Organic Compounds (TCL) | Pb/Cr | Lead / Chromium |
| MS/MSD | Matrix Spike / Matrix Spike Duplicate | PCB | Polychlorinated Biphenols, Pesticides | TAL | Target Analyte List |
| | | TCL | Target Compound List | | |

EXPLANATION

1. AGE DRAINAGE DITCH – SWMU 34/IRP SD–15
2. ENGINE TEST CELL AREA – SWMU 86–90/IRP SD–11
3. NE STORMWATER DRAINAGE AREA – SWMU 95/IRP SD–20
4. WASTEWATER LAGOONS – SWMU 101,102
5. LANDFILL NO. 5 – SWMU 113/IRP LF–5
6. OLD ENTOMOLOGY RINSE AREA – SWMU 96/IRP SD–17
7. SLUDGE WEATHERING PIT – SWMU 76/IRP WP–14
8. FIRE DEPT. TRAINING AREA NO. 1 SWMU 78/IRP FT–6
9. SOLVENT DISPOLAL SITE – SWMU 81/IRP DP–16
10. FIRE DEPT. TRAINING AREA NO. 2 – SWMU 106/IRP FT–7
11. FIRE DEPT. TRAINING AREA NO. 3 – SWMU 107/IRP FT–8
12. FIRE DEPT. TRAINING AREA NO. 4 – SWMU 109
13. SANITARY SEWER LINE – SWMU 98




LEGEND

OFS3
WCC 1991 FIELD INVESTIGATION SURFACE SOIL SAMPLE LOCATION

| | |
|---|---|
| Job No. : | 89MC114W |
| Prepared by : | D.A.K. |
| Date : | 3/20/92 |

LOCATION OF SURFACE SOIL SAMPLES AT THE OFFSITE BACKGROUND SITES

CANNON AFB, NEW MEXICO

C1140022

FIG. 15–1

(1)

# FINAL
# VOLUME Ib
# TEXT: SECTIONS 16.0 THROUGH 21.0

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REMEDIAL INVESTIGATION
REPORT FOR
18 SOLID WASTE
MANAGEMENT UNITS
CANNON AIR FORCE BASE
CLOVIS, NEW MEXICO

APP. I
SWMUs 34, 76, 78, 81, 86-90, 95, 96, 98
101, 102, 106, 107, 109, 113,

Prepared for
U.S. Department of the Army
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Woodward-Clyde

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Project No. 89MC114W

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# 16.0
# QUALITY ASSURANCE/QUALITY CONTROL OF DATA

## 16.1 INTRODUCTION

This section summarizes quality assurance procedures related to field and laboratory data and the results of quality control samples taken during the RI at 18 SWMUs on Cannon AFB near Clovis, New Mexico. A copy of the analytical results data base is contained in Appendix C-1.

Details of data quality objectives for the overall project are discussed in Volume I of the QAPP for the RI (WCC 1991b). The QAPP provides the documentation and procedures making up the RI quality assurance program and SOPs Volume II for sampling and data validation procedures.

Quality assurance objectives are usually expressed in terms of accuracy or bias, precision, completeness, representativeness, and comparability. A brief definition of each of these terms is as follows:

| | |
|---|---|
| Accuracy | Nearness of a measurement or the mean ($\bar{x}$) of a set of measurements to the true value. Accuracy is evaluated by the percent recovery of sample spikes, analysis of laboratory control samples, and reference materials. |
| Comparability | A measure of the confidence with which one data set can be compared with another. |
| Completeness | A measure of the amount of valid sample data obtained from the measurement system compared to the amount of sample data analyzed. Valid results are those results which meet or exceed quality control criteria and satisfy quality assurance objectives. |

| | |
|---|---|
| Precision | Precision is the agreement between a set of replicate measurements without assumption or knowledge of the true value. Precision is evaluated as the relative percent difference or relative standard deviation for replicate or split samples. |
| Representativeness | The degree to which a single measurement is indicative of the characteristics of a larger sample or area or the degree to which data represents field conditions. |

Target ranges for the quality assurance objectives are presented in the QAPP for analytical testing and field measurements.

Variances from the quality assurance objectives result in the implementation of appropriate corrective measures and an assessment of the impact on the usability of the data in the decision-making process.

As used in this section, quality control (QC) refers to activities which provide methods for checking, verifying, or quantifying the data against established standards.

## 16.2 SPECIFIC TYPES OF QA/QC ACTIVITIES

Specific QA activities required by the QAPP include the following:

- Adherence to sampling and reporting procedures outlined in the SOPs for the RI Work Plan (WCC 1991a)
- Audits of field procedures, including a minimum of one systems audit on field performance
- Collection and analysis of QC samples

### 16.2.1 QC Samples

Field duplicates, ambient blanks, rinsate blanks, decontamination water blanks and trip blanks were collected and submitted to the analytical laboratory to provide a means of assessing the quality of the data resulting from the field sampling program. Field duplicate samples were analyzed to check for sampling and laboratory reproducibility and to evaluate whether analytical results were representative of the sample analyzed. Trip blank samples were analyzed to check for procedural contamination, cross-contamination, and laboratory contamination during shipment and storage of aqueous samples. Ambient blanks were used to evaluate contamination as a result of airborne chemicals. Decontamination water blanks were utilized to evaluate contamination that might be introduced during decontamination activities and to evaluate contaminants contained in the water, used for ambient and rinsate blanks. The rinsate blanks were used as a measure of contamination of samples from the sampling equipment.

Matrix spike and laboratory control samples were analyzed to measure the accuracy of the analysis on site samples and on laboratory standards to evaluate if recoveries falling outside acceptance windows were attributable to sample matrix interferences rather than laboratory analytical errors. The TCLP analyses performed in the RI were not designed to be utilized for demonstration of compliance to RCRA Toxicity Characteristic (TC) Criteria. As such, the analytical results have not been matrix spike corrected as specified in the TC Rule, but rather are utilized to evaluate the accuracy of the TCLP analyses on site samples. Laboratory duplicates for inorganic analysis and matrix spike duplicates for organic analytes were analyzed to evaluate laboratory reproducibility or precision. Surrogate recovery results were utilized to evaluate the accuracy of analytical measurement on a sample-specific basis. Method blank data were used to evaluate the laboratory contamination during analysis.

The analytical spike (post-digestion spike) is utilized only in the graphite furnace automatic absorption analyses for metals. Analytical spike recoveries on each sample were used to determine whether results needed to be quantified through the method of standard additions (MSA). Specific QC sample descriptions and minimum frequency requirements are given in Section 10.0 of the QAPP.

## 16.3 RESULTS OF QAPP-REQUIRED ACTIVITIES

### 16.3.1 Field Audits

Quality assurance (QA) field audits were conducted, documented, and reported in accordance with the quality assurance/quality control (QA/QC) requirements presented in Sections 10.0, 11.0, 14.0, and 15.0 of the QAPP.

Field audits were conducted during a three-day period from October 14-16, 1991a. Field audits were conducted to evaluate conformance of field practices with the SOPs. The following SOPs were audited:

Audit Date: October 14, 1991a:

- SOP No. 1, Equipment Decontamination
- SOP No. 7, Subsurface Drilling and Sampling
- SOP No. 8, Lithologic Description of Subsurface Samples
- SOP No. 9, Borehole Abandonment
- SOP No. 12, Sample Handling, Documentation and Analysis

Audit Date: October 15, 1991a:

- SOP No. 5, Sludge Sampling

Audit Date: October 16, 1991a:

- SOP No. 10, Surface Water Sampling

Results of these field audits were satisfactory and summaries are maintained in project files.

### 16.3.2 Laboratory Audits

In addition to the USACE certification, Enseco-Rocky Mountain Analytical Laboratories (RMAL) has been audited and approved by WCC. For this project, two onsite laboratory visits were conducted by WCC on December 5 and 11, 1991. The focus of the laboratory visits was to evaluate the effectiveness of the laboratory in handling sample load and throughput for soil matrix samples for analysis of volatiles by GC/MS.

There were two findings from the laboratory visits:

- The laboratory could improve their operations with more effective communication between the group leader(s), project manager(s), and analysts

- Greater involvement on the part of the QA officer is warranted

The audit summaries are maintained in the project files.

## 16.4 DATA VALIDATION

The analytical data generated by the laboratory were reviewed for accuracy, precision, completeness, representativeness, and comparability. The data validation process for this project consisted of data generation, reduction, and two levels of review, the first by the analytical laboratory (Rocky Mountain Analytical Laboratory) and the second through an independent data review by WCC. Details of the analytical laboratory data review are described in Section 9.0 of the QAPP.

Laboratory analytical data packages received a second level of validation or review by a designee of the Woodward-Clyde Consultants QA/QC Officer whose function is to provide an independent review of the data package. Laboratory results were reviewed and data qualified, if required.

### 16.4.1 Full Data Validation

Ten percent of the data underwent full validation as described in SOP No. 13 Data Validation and QC Review of Analytical Laboratory Data Packages (WCC 1991a). Criteria that were evaluated under full validation that were not evaluated as part of the QC review are discussed below by analysis. In general, the information described below is useful because common laboratory problems were identified during the full data validation that would not be evaluated under the QC review. (Note that copies of complete full data validation and QC review reports are reproduced in Appendix C-2.)

In the following discussion, data that may have required qualification under more than one validation criteria are included within the total number of data qualified under each criterion.

#### 16.4.1.1 Volatiles

Calibrations

The percent difference between the response factors from the initial calibration and those found for the continuing calibration was greater than the QA objective of 25 percent in 19 of 27 samples. Analytes commonly found to be outside the 25 percent control limit included methylene chloride, acetone, 2-butanone and 2-hexanone. In addition, the relative standard deviation of response factors for initial calibration for acetone exceeded the QA objective of 30 percent in 19 of the 27 samples that were validated. Associated data were qualified as estimated "J" (for detects) or estimated nondetect "UJ" (for nondetects).

Internal Standard Performance

Generally, the internal standard areas and retention times for the sample were within the QC limits established by the corresponding continuing calibration. Internal standards were found to be outside the lower QC control limits in 5 of the 27 samples which underwent full validation. In these cases, associated data were qualified "J" for detects and "UJ" for non-detects based on these results.

Tentatively Identified Compounds (TIC)

In 14 of 27 cases, the TIC identifications were supported with mass spectral evidence meeting validation criteria. In two cases, TIC's were rejected "R" based on associated blank contamination. In eleven instances, TIC identifications were rejected because they were identified as various siloxanes, common column bleed materials and as such are not considered a true sample constituent under validation guidelines.

Target Compound Identification

All TCL identifications were supported with mass spectral evidence that met the validation criteria.

Quantitation and Reported Detection Limits

Quantitation and detection limits were verified as having been properly calculated. Evaluation of the effect of raised detection limits on the useability of the data is provided within the data interpretation sections.

System Performance

System performance was considered satisfactory for all validated data.

Holding Times and Percent Moisture

Two samples were qualified either "J" (for detects) or "UJ" (for nondetects) for exceeding holding times. Two samples were qualified "J" (for detects) or "UJ" (for nondetects) based on excessive moisture contents. One sample contained moisture of greater than 50 percent and one of greater than 94 percent.

### 16.4.1.2 Semivolatiles

Calibrations

The percent difference between the response factors from the initial calibration and those found for the continuing calibration was greater than the QA objective of 25 percent in 13 out of 14 cases. Analytes commonly cited included 2-methylphenol, 2,4,6-trichlorophenol, 3,3-dichlorobenzidine and 4-nitrophenol. Associated data which exceeded the control limits were qualified appropriately with estimated "J" (for detects) or estimated nondetects "UJ" (for non-detects).

Tentatively Identified Compounds

Identification of TIC compounds in 7 of 14 samples were rejected "R" for being present in the corresponding method blank. In addition all compounds including TICs for one sample were qualified as estimated based on a 94 percent moisture content.

Additional Criteria

GC/MS instrument performance, internal standard performance, target compound identification, quantitation and reported detection limits and system performance were also evaluated as part of the full validation procedure for semivolatiles and determined to be acceptable for the 14 samples validated.

### 16.4.1.3 Inorganics

Calibration

Nine of the twenty-one samples reviewed for GFAA analyses had initial calibration correlation coefficients for thallium below 0.995. These samples were qualified as estimated.

Furnace Atomic Absorption QC

Fifteen of the twenty-two samples reviewed had post digestion spike recoveries outside the 85 to 115 percent control limits. These samples were qualified as estimated. Common missed analytes were selenium, thallium and arsenic.

ICP Serial Dilution

Fourteen of the twenty-two samples reviewed had more than the 10 percent limit difference between the original analytical result and that from the diluted sample. These samples were qualified as estimated. Common analytes exceeding the limit were barium, calcium, iron, zinc, aluminum, manganese and potassium.

Sample Result Verification

No problems were noted.

**16.4.1.4 Pesticides/PCBs.**

Instrument Performance

No problems were indicated in the seven samples validated.

Calibration

No problems were indicated in the seven samples validated.

Target Compound Identification

No problems were indicated in the seven samples validated.

Compound Quantitation and Reported Detection Limits

One of the seven samples for percent difference (%D) between initial calibration response factors and those from the continuing calibration exceeded 25 percent for the two analytes 4,4'-DDE and 4,4'-DDT. Results for these two compounds were qualified as estimated.

### 16.4.1.5 Additional Analyses

Ten percent of the samples analyzed for the following analytes also underwent full validation as described in SOP No. 13 and Revision No. 1 of the QAPP Addendum (WCC 1992).

- Lead/chromium
- Benzene, toluene, ethyl benzene, xylene (BTEX)
- TPH
- TOC
- Organic lead
- RCRA Appendix IX
- TCLP

No problems were indicated for these analyses with the following exceptions:

Pb/Cr

One sample analyzed for lead was analyzed by ICP rather than GFAA, and the associated lead result qualified as estimated.

Appendix IX

In all three samples undergoing full validation, the relative response factor (RRF) from the initial calibration was less than the control limit for 1,4-dioxane and these associated dioxane results were qualified. The percent difference in response factors between the initial calibration and the continuing calibration for two of the samples was greater than

25 percent for trichlorofluoromethane, acetone, 2-butanone and 2-hexanone. Based on these associated results, the samples were qualified as "J" or "UJ" for the analytes listed above.

### 16.4.2 Quality Control Review

For this project, quality control review (QCR) has been defined by WCC as the evaluation of analytical data with respect to the following:

- Holding times
- Method blanks
- Laboratory control samples
- Laboratory duplicate sample
- MS/MSD
- Surrogate compound percent recoveries
- Field duplicate results
- Overall assessment of data for a case
- Completeness of sample deliverable package

In addition, if the laboratory narrative indicated a problem, the effect on the quality of the associated data was evaluated and the results qualified accordingly. The QC review of the data followed procedures outlined in SOP No. 13 and Revision No. 1 to the QAPP and was performed on all the analytical data.

A brief description of additional parameters evaluated during the review but not specified in SOP No. 13 are described below. Results of the evaluation of specific items are provided if significant problems were encountered.

#### 16.4.2.1 Holding Times

During the original analysis, the laboratory experienced problems with surrogate recoveries and internal standard areas. Samples that were affected by these problems were reextracted and reanalyzed outside holding times.

concentrations with an absolute value greater than the CRDL and less than 2 times the CRDL are deemed to be acceptable, but other blank data needs to be evaluated to assess the extent of the interference problem. If no other negative concentrations were reported for any other blanks, the interference was considered to be an isolated case, and no qualification was considered necessary. Only a few blank samples were reported with negative concentrations. No blanks exceeded the 2 times CRDL criteria.

#### 16.4.2.3 Field Duplicates For All Parameters Except CLP Metals

Although there is no specific guidance in the Functional Guidelines or the QAPP for evaluating the field duplicate samples, control limits of 50 percent relative percentage difference (RPD) for aqueous samples and 100 percent RPD for non-aqueous samples were implemented if the analyte concentration was greater than 5 times the reporting or quantitation limit. For analyte concentrations less than or equal to 5 times the reporting or quantitation limit, control limits of ± 3X (where X is the reporting or quantitation limit) were utilized. All non-aqueous samples are homogenized except for volatile organic analysis (VOA) samples, which are collocated. The reporting limit or quantitation limit will be used for non-detects (ND) or below detection limit (BDL). If results for analytes in the field duplicates did not agree within these limits, an estimated "J" data qualifier was assigned to the results for this analyte in all associated samples.

#### 16.4.2.4 Field Duplicates for CLP Metals

Although there is no specific guidance in the Functional Guidelines or the QAPP for evaluating the field duplicate samples, control limits of 50 percent RPD for aqueous samples and 100 percent for non-aqueous samples were implemented, if the analyte concentration was greater than 10 times the IDL. For analyte concentrations less than or equal to 10 times the IDL, control limits of ± 3X (where X is the IDL) were utilized. If results for analytes in the field duplicates did not agree within these limits, an estimated (J) qualifier was assigned to the results for this analyte in all associated samples.

## 16.5 SUMMARY

As summarized above and discussed in detail in the full validation reports in Appendix C-2, conformance to accuracy, precision, and the representativeness of an analytical value to the sample analyzed were evaluated for all sample results, and qualification or rejection of sample data were performed in accordance with specified guidelines and criteria. The analytical data, as qualified, presented in this report have been found to meet the quality assurance objectives for this project as specified in the validation and quality control review protocols.

Comparability expresses the confidence with which one data set can be compared to another. Data are comparable when siting consideration, collection techniques, and measurement procedures; methods and reporting are equivalent for the samples within sample set. Throughout this investigation, SOPs for the field activities were implemented, and EPA-approved standards methods were used for analysis and reporting. Consequently, within each data set, results are comparable to one another as well as to other data sets for this investigation.

Completeness, calculated as the ratio of acceptable results (unqualified and estimate "J") to the total number of analytical results requested on samples submitted for analysis, was 99.98 percent. This satisfies the completeness goal of 90 percent specified in the QAPP.

The full validation of 10 percent of all sample data is intended to be used as a guide to general laboratory performance on the site sample analyses and to identify problems which may not have been observed in the quality control review of the rest of the data. As summarized in Section 16.4.2.2, several analytes were found to occur commonly in a significant number of laboratory blanks. As such, the presence of low levels of methylene chloride, acetone, 2-butanone, 2-hexanone, 4-methyl-1,2-pentanone, di-n-butyl phthalate, bis(2-ethylhexyl)phthalate, 4-nitrophenol, and di-n-octyl phthalate in environmental samples is probably a result of laboratory contamination and should not be considered to be an indication of the presence of these analytes in the environmental samples.

In addition, the full validation reports indicate that the laboratory routinely failed to meet quality assurance objectives for calibration for the following analytes: methylene chloride, acetone, 2-butanone, 2-hexanone, 4-nitrophenol, 2-methylphenol, 2,4,6-trichlorophenol, and 3,3'-dichlorobenzidine. It is possible that the calibration problems for many of these analytes is related to variable amounts of laboratory contamination during calibration. Because the calibration problems for these analytes occurred with some regularity, analytical values for these analytes in all environmental samples should be considered of lower reliability than the other unqualified analytical results.

For the CLP-metals analyses, the full validation indicated sufficient difficulties in the GFAA analyses for selenium, thallium, and arsenic so that the analytical values for these analytes in all environmental samples should also be considered of lower reliability than other, unqualified analytical results.

# 17.0
# CONTAMINANT FATE AND TRANSPORT

This section discusses the remedial investigation in terms of fate and transport for the chemicals of concern preliminarily identified for the risk assessment (Section 18.0). This section draws upon the nature and extent subsection in Sections 2.0 through 14.0 discussion to examine potential pathways and to assess the fate and transport of potential contaminants identified at Cannon AFB. The fate and transport discussion, together with nature and extent, provides a basis for detailed examination of pathways, a key component of the risk assessment.

The fate and transport section reviews those potential pathways (e.g., air, surface water, groundwater) that may have relevance to Cannon AFB. Using these chemicals of concern, the physical and chemical properties are presented and their importance to transport mechanisms is discussed. This discussion is generalized because of the lack of site-specific fate and transport data, the collection of which, was beyond the scope of this investigation. In the absence of site-specific data, the discussion does supply useful insights on possible transport behavior and likely chemical persistence which can be used in the subsequent pathway analysis performed in the risk assessment.

The fate and transport assessment is specific to the chemicals of concern identified within particular media at Cannon AFB. Given the limited nature and similarity of the chemicals of concern, they are discussed as classes of contaminants for the entire base and not on a site- or SWMU-, specific basis. Where appropriate, fate and transport of chemicals of concern and media particular to individual areas within the base will be discussed.

This section first presents briefly the transport mechanisms identified for the base. Next, the physical and chemical properties which control fate and transport will be presented. Finally, the mobility and/or persistence of the chemicals of concern in those specific media will be assessed. The chemicals of concern include metals and organic compounds, principally volatiles and pesticides (Table 17-1).

## 17.1 POTENTIAL CONTAMINANT TRANSPORT MECHANISMS

Chemicals released at Cannon AFB could potentially move into the adjacent environment by several transport mechanisms, or pathways. These mechanisms include (1) air - volatilization of organics and movement within soil gas or the atmosphere, and wind transport of metals and/or organics on- or off-site; (2) surface water runoff; (3) groundwater - infiltration of water through the subsurface to the water table then its movement via groundwater flow. Each of these potential mechanisms is briefly discussed in this section.

### 17.1.1 Air

The air mechanism includes water or soil volatilization, and wind transport. Volatilization is a process by which an organic compound is transferred from soil or water, into soil gas and/or the atmosphere. Volatilization will influence the migration of volatile organics identified at Cannon AFB, however, it will have much less, or no, impact on most pesticide compounds detected and will not influence the metals detected. The focus of this transport mechanism is on the upward migration and dispersion of soil gases into the atmosphere. The wind component will affect metals adsorbed to dust particles, as well as organics which may also be absorbed to dust particles or dispersed in the atmosphere. Air transport could potentially modify organic concentrations associated with surface soils, subsurface soils within the unsaturated zone and possibly the saturated zone, as well as surface water bodies on site (e.g., wastewater lagoons). The degree to which metal or organic concentrations will be modified will depend upon the physico-chemical properties of the specific chemical of concern.

As previously discussed (Section 1.4.3.2), dust is frequently present, given the semiarid climate and gusty winds in the area of Cannon AFB. The prevailing winds are from the west and average about 3 mph, however during the summer the prevailing winds are from the south and average about 2 mph. No atmospheric air quality monitoring or sampling was undertaken during this investigation. Personal protection air quality monitoring was completed at the Sludge Weathering Pit for tetraethyl lead which was not detected during the initial site investigation activities.

### 17.1.2 Surface Water

Potential contaminants, both metals and organics, can be transported in surface waters via adsorption on soil particles, or in solution during storm events. The metals and organics transported in storm runoff, either in solution or adsorbed to sediments, may be redeposited elsewhere, infiltrate into the subsurface, or be carried into a surface water body. During this transport, some of the more volatile organics may be lost to the atmosphere. The degree to which chemicals of concern are adsorbed, put into solution, or lost to the atmosphere, will depend on their particular physico-chemical properties.

With one exception, there are no natural perennial surface water features on or near the base. Storm runoff from Cannon AFB is directed into the playa lake located in the southwest corner of the base. Effluent from the wastewater lagoons which is directed into a playa to the east, via a pipeline, does represent a perennial surface water feature at Cannon AFB. The playas have no surface water outlets and all water within them is lost through either evaporation or infiltration (Section 1.4.3.3). The mean annual precipitation for the site is about 16 inches per year, most of which falls during the summer months of July and August when eight or more days of rainfall may occur. The annual evaportranspiration rate is about 71 inches per year.

Three surface water samples were collected from the base wastewater lagoons and analyzed for Appendix IX parameters. Eight sludge samples were also collected from the lagoons and analyzed for TCL VOCs, SVOCs, PCBs, pesticides, metals and one sample was collected for TOC. No storm event water or sediment samples were collected during this investigation. Surface and subsurface soil sampling was undertaken at 13 SWMUs and 315 soil samples were collected. Most samples were analyzed for TCL VOCs and metals, a smaller number of the samples were analyzed for SVOCs, pesticides, and TPH, while a few were analyzed for lead and chromium, and BTEX compounds (Table 1-6).

### 17.1.3 Groundwater

As previously discussed (Section 1.4.3.5), the Ogallala, or Great Plains, Aquifer underlies Cannon AFB and locally may be unconfined or semi-confined. It consists of gravels,

sands, silts and clays which vary from 360 to 415 feet in thickness at Cannon AFB. Caliche is a major feature of the Ogallala Aquifer in the area and may vary from 5 to 25 feet in thickness. The predominant clays within the Ogallala are smectites and attapulgite. The Ogallala Aquifer has a saturated thickness of about 95 to 145 feet which is strongly influenced by the configuration of the erosional unconformity underlying the Ogallala Aquifer. Based on the monitoring wells at the three SWMUs considered during this investigation, the unsaturated thickness ranges from 210 to about 325 feet BGS. The recharge rate for the Ogallala Aquifer has been estimated at 1 inch/year (Kearney 1987) and is attributable to the low annual rainfall coupled with the high annual evaportranspiration rate. The hydraulic gradient is toward the southeast at 7 to 15 feet/mile.

Dissolution of metals and organics through the leaching of contaminated surface, or near surface, soils by infiltrating water is considered the principal means by which contaminants can enter the site groundwater. This infiltrating water will originate either from precipitation, probably during storm events, the wastewater lagoons, or playas on site. In the near surface, adsorption of chemicals of concern may play a role in retarding downward mobilization. However, facilitated transport of contaminants through dissolution may not be a significant means for contaminants to reach groundwater given the unconsolidated nature and thickness of the unsaturated zone as well as the potential for adsorption. For organics which enter the unsaturated zone via infiltration, volatilization within the thick unsaturated zone may limit the concentrations of any dissolved volatile organics before they reach the water table.

Groundwater from the Ogallala Aquifer is the sole source of water for the base which is supplied by nine wells. These wells have capacities of 200 to 765 gpm (gallons per minute) and are installed from 357 to 415 feet BGS (USAF 1991). In 1984 these wells were producing at an average daily rate of 1.3 million gallons (Matotan and Associates 1985). About 25 percent of this water was used for irrigation during the peak summer demand. No groundwater quality data for these base wells were collected during this investigation.

As part of this investigation, ten existing monitoring wells were sampled in three areas of Cannon AFB (i.e., Old Entomology Rinse Area - SWMU 96, Wastewater Lagoons - SWMUs 101 and 102, and Landfill 5 - SWMU 113). Appendix IX parameters were analyzed in samples from the five wells at Landfill 5, Appendix IX VOCs were analyzed in samples from the four wells adjacent to the Wastewater Lagoons, and TAL metals and PCBs were analyzed in a sample from the well at the Old Entomology Rinse Area. All parameters detected in these samples were at, or below current MCL values. No organics were detected in the groundwaters at these three areas above the reporting limits. In all wells sampled, some metals were detected in the groundwater but the concentrations were all below the current MCL values. In most cases where metals were detected, they were present at estimated concentrations below the method detection limit. Based on the metal and organic data collected at the three SWMUs and the nature and extent discussion, groundwater does not appear to be a pathway for contaminant transport. As a result of these data, no groundwater contaminant transport modeling was undertaken for this investigation.

## 17.2 PHYSICAL AND CHEMICAL PROPERTIES

This section provides some discussion of the physical and chemical properties of the chemicals of concern which directly affect their fate and transport. These properties are summarized in Table 17-2. In the absence of site-specific data, this discussion provides useful insights on transport mechanisms which can help in the Risk Assessment Pathway Analysis.

### 17.2.1 Volatilization

Volatilization will affect the volatile organic concentrations in both water and soil. Organics influenced by this process will be transferred into a gaseous phase, soil gas and/or the atmosphere. Assuming that a free non-aqueous phase does not exist, volatilization will be principally controlled by a chemical's solubility, vapor pressure, Henry's Law constant, and adsorption. Water content of a soil, temperature, and atmospheric conditions (i.e., wind and sunlight) may also influence volatilization from a soil (Lyman et al. 1990).

Volatilization is a complex process that is dependent upon very site-specific conditions. Nevertheless, some appreciation of an organic chemical's volatility can be made by considering the Henry's Law constant and vapor pressure values. Henry's Law constant is directly proportional to a chemical's vapor pressure and molecular weight and inversely proportional to its water solubility and temperature. Henry's Law constant values > $10^{-3}$ atm-$m^3$/mol (cubic meters of atmosphere per mole) are considered to have a high volatility while those with values < $10^{-7}$ atm-$m^3$/mol are less volatile than water and will tend to concentrate in water as it evaporates (Lyman et al. 1990). Dragun (1988) and Olsen and Davis (1990) suggest comparable though slightly different values for high and low volatility. According to Ney (1990), organic vapor pressures of > $10^{-2}$ mm Hg (milliliters of mercury) are indicative of high volatility while values of < $10^{-6}$ mm Hg suggests low volatility.

### 17.2.2 Aqueous Solubility

Solubility is one of the most important factors influencing the fate and transport of metals and organic chemicals. For metals in solution, their solubility will be controlled by the solution Eh-pH relationships; number, concentrations, solubility product, etc. of ion complexes in solution; aqueous major ion chemistry; etc. Dissolved metal fate and transport will depend upon a number of very site-specific factors whose collection and/or calculation were beyond the scope of this investigation. Water solubility of organics is typically considered with respect to the $K_{ow}$ (octanol/water partition coefficient). The $K_{ow}$ value is defined as "... the ratio of a chemical's concentration in the octanol phase to its concentration in the aqueous phase of a two-phase system." (Lyman et al. 1990). Other factors which can affect an organic's solubility include adsorption, volatilization, and presence of organic carbon. According to Lyman et al. (1990), values of $K_{ow}$ > 10,000 indicates the organic is very hydrophobic and would have a low water solubility, high soil/sediment adsorption coefficients, lower mobility, and higher potential to bioaccumulate. Conversely, values of $K_{ow}$ < 10 suggest high solubilities and greater mobility, but small soil/sediment adsorption coefficients, and decreased potential for bioaccumulation.

### 17.2.3 Adsorption

Adsorption is also an important factor which influences the fate and transport of both metals and organics. Typically, adsorption is expressed in terms of an adsorption coefficient and it can be defined as the ratio to which a metal or organic chemical partitions itself between the solid and solution phases. This can apply to water-saturated or unsaturated soils, storm water, sediment, or aquifer materials. Adsorption is often referred to in terms of the soil-water distribution coefficient - $K_d$, or distribution coefficient. $K_d$ is defined as the ratio of concentration adsorbed on soil surfaces to the concentration in water. For organics, $K_d$ is has been strongly correlated with the fraction of total organic carbon in the solid matrix ($f_{oc}$) and which has been used to define the organic carbon partition coefficient - $K_{oc}$ (Olsen and Davis 1990). It is defined as the ratio of $K_d$ to $f_{oc}$ (i.e., chemical adsorbed per unit weight of organic carbon (oc) in the soil/sediment/aquifer to the concentration of the chemical in solution at equilibrium). This correlation appears to hold over a wide range of organic carbon content values (i.e., 0.1 to 2 percent TOC) as reported by Lyman et al. (1990). For organics, a critical fraction of organic carbon can be defined (i.e., < 0.1 percent TOC), below which inorganic clay surface reactions dominate the adsorption process (Olsen and Davis 1990). A qualitative assessment of chemical mobility based on $K_d$ values has been made by Dragun (1988) as follows: > 10 immobile, 2 to 10 low mobility, 0.5 to 2 intermediate mobility, 0.1 to 0.5 mobile, and < 0.1 very mobile. According to Adams (1972), $K_{oc}$ values can range from 1 to $10^7$; the higher the value, the less mobile the organic.

### 17.2.4 Biodegradation

Biodegradation, including biotransformation, occurs via microorganisms that may be either attached to the soil, or present in the soil pores, or in solution. Factors affecting biodegradation rates include: composition and size of the microbial population; presence of a suitable and available substrate (i.e., energy source); soil acidity and alkalinity; soil temperature and moisture; presence of essential inorganic elements; chemical concentration; oxygen availability; and adsorption (Dragun 1988). Typically, biodegradation rates are measured in half-lives which are defined as the time required for microbial degradation to reduce a chemical concentration by half. Biodegradation is typically associated with organics and not metals. Although for some metals (e.g.,

iron, sulfur) microorganisms do play a significant role in controlling reaction rates, the affects of such microbially mediated reactions appears to be less well understood than for organics. Half-lives are cited only for organics.

Frequently, the half-lives cited for organics can vary greatly. This variation is likely due to reductions below optimum in at least one of the above referenced factors which can thereby control the reaction rate (Dragun 1988).

### 17.2.5 Other Physical and Chemical Properties

The four processes previously discussed in this section probably represent the most important controls on the fate and transport of chemicals of concern at Cannon AFB. A more detailed assessment of fate and transport properties and processes was beyond the scope of this investigation. However, it is important to recognize that other properties or processes also exist which could contribute to contaminant mobility and fate. These properties and processes include bioconcentration, complexation, dehydrohalogenation, diffusion, hydrolysis, oxidation, photolysis, precipitation, reduction, and solubility in solvents. These alternatives were not discussed because, individually, they are not considered to be as significant as the volatilization, aqueous solubility, adsorption, and biodegradation processes. Subsequently, no site-specific data for those properties/processes were collected during this investigation.

## 17.3 CONTAMINANT PERSISTENCE

Within a particular medium, physical, chemical, and biological processes will affect the persistence of a chemical of concern. Using the information on potential pathways and physical and chemical properties, together with the existing nature and extent information for the Cannon AFB site (sections 2.0 through 14.0), the persistence of metals, volatile organics, and pesticides is discussed. Generalizations are drawn from these preceding information sources, as well as site geologic and hydrogeologic features, in an attempt to provide qualitative information on fate and transport for the classes of chemicals identified in the absence of site-specific information.

The organics detected on site have been broadly classified as either volatile organics or pesticides. For the purposes of this discussion, all compounds that are not classed as pesticides are considered volatile organics, which is typically the case. The volatile organics and pesticides of concern identified in Table 17-1 were typically associated with either soils collected from various SWMUs, or sediment samples from SWMUs 101 and 102.

### 17.3.1 Metals

The metals which are considered to be chemicals of concern based on the risk assessment are listed in Table 17-1. In most cases these metals are associated with soil concentrations and not groundwater, although some metals of concern were detected in both media. Current site data do not provide information that would allow one to quantitatively estimate their mobility in surface waters or the subsurface. However, one can expect metal complexes in soil or water to form reaction products that get incorporated into soil minerals; precipitate as oxide or hydroxide minerals; or form coating on minerals (Dragun 1988). It is expected that most of the metals will be assimilated into oxide, hydroxide, or oxyhydroxide complexes within the soil or water. Based on existing site information, several generalizations can be made as follows:

1) Within this area of the Ogallala Formation, the predominant clay minerals are montmorillonites and attapulgite (i.e., palygorskite is a Mica Group clay mineral) according to Frye et al. (1974). The cation exchange capacity (CEC) for montomorillonite clays are generally quite high and range from 80 to 150 meq/100 g - milliequivalents per 100 grams (Dragun 1988) while the CEC values for the attapulgite will be probably less than 50 meq/100 g. Based on grain size information collected during this investigation, the clay content of the surficial material ranges from 20 to 70 percent and typically is greater than 30 percent. However, United States Department of Agriculture (USDA) data for Curry County where Cannon AFB is located, reports CEC values of about 5 to 21 meq/100 g for the surface soils reportedly present at the base (USDA 1958). Thus, the degree to which CEC will control metals migration is not clear.

2) For the metal concentrations in soils, there is generally a trend of decreasing concentration with depth. This trend is exemplified by the boring sample results from the Sludge Weathering Pit (boring nos. 0761 and 0762 - Table 3-4); Fire Department Training Area 1 (boring nos. 0781 and 0782); the Engine Test Cell Area; and Fire Training Areas 2, 3, and 4. The decrease in concentrations below the soil surface which typically occurs within the first 5 to 10 feet, are the most dramatic.

3) In a number of instances, the metal concentrations will remain consistent from surface to total depth (e.g., boring no. 0781 - cadmium, mercury, and silver) and are thought to represent background concentrations. (Section 2.4.1). Occasionally, a metal concentration increases slightly at some depth below ground surface and for that sample interval reverses the trend of decreasing concentration. Such trend changes may result from variations in the site stratigraphy (e.g., presence of caliche, sudden changes in the percentage of silt/clay) where soil chemistry and/or infiltrating water chemistry could be expected to change.

4) Previous work at most of these SWMUs indicated a similar trend of decreasing soil metal concentrations with depth, or beyond a particular depth, a generally consistent metal concentration in the subsurface materials sampled (Radian 1986, Volume 1, Section 4).

5) Air quality modeling was undertaken for the risk assessment and those results are discussed in Section 18.0 for particular SWMUs and metals of concern. The fate and transport implications of this modeling work, for metals which are associated with fugitive dust, are discussed in Section 18.4, Exposure Assessment.

### 17.3.2 Volatile Organics

Based on the properties presented in Table 17-2 data and the site specific factors that limit migration, the volatile chemicals of concern detected at Cannon AFB probably will not be persistent. This conclusion is based on several points as follows:

1) The limited concentrations of volatile organics detected during this investigation within the soil and/or sediment.

2) Where detected in the soil, volatile concentrations typically decreased with depth and, in most cases, were non-detect at depths of about 20 feet BGS (Section 2.4.1).

3) The vapor pressure and Henry's Law constant data both indicate a high volatility for these chemicals of concern; accordingly, it is anticipated that volatilization within the thick unsaturated zone will play a major role in reducing their soil concentrations. The vapor pressures range from 6 (TCA) to 360 (carbon disulfide) mm Hg while the Henry's Law values extend from $3.8 \times 10^{-4}$ (TCA) to $5.38 \times 10^{-2}$ (carbon disulfide) atm-$m^3$ /mole (Table 18-2).

4) According to Dragun (1988) field-observed biodegradation rates for some of the volatile organics in soil-groundwater systems suggests relatively rapid half-lives (i.e., less then 365 days) for most of the volatile chemicals of concern. According to Dragun, n-alkanes, n-alkylaromatics, and aromatic hydrocarbons in the $C_5$ to $C_{22}$ class are biodegradable, although the biodegradation rate decreases as the number of Cl atoms increases within the molecule.

5) The volatiles found on site generally have high water solubilities with values ranging from 160 (xylene) to 1,000,000 (acetone) mg/L (these high solubilities are reflected in the range of log $K_{ow}$values, -0.24 (acetone) to 3.2 (xylene) ml/g. Given the low average rate of recharge, for most SWMUs little infiltrating water is available to dissolve any volatile organics that may be present in the soil. Dragun (1988) also indicates that water soluble chemicals are more likely to be biodegraded than less soluble compounds. Given the 210 to 325 foot thickness of the unsaturated zone, and the low recharge rate, it is likely that both volatilization and biodegradation will be primary factors controlling the impact on site groundwaters.

6) Results of previous investigations at these SWMUs detected no purgeable organics based on EPA 8010 and 8020 analyses of soil samples (Radian 1986, Volume 1, Section 4).

7) Groundwater data collected during this investigation did not detect volatiles (Section 14.4). Previous groundwater work at Landfill 5 did not indicate the presence of volatile organics based on EPA 601 and 602 analyses (Radian 1986, Volume 1, Section 4.2.5). Radian did detect trichlorofluoromethane (freon) in one sample which was considered to be a laboratory artifact.

8) Air quality modeling was undertaken for the risk assessment and those results are discussed in Section 18.0 for particular SWMUs and volatiles of concern. The fate and transport implications of this modeling work, for volatiles which are associated with soil gas releases, are discussed in Section 18.4, Exposure Assessment.

### 17.3.3 Pesticides

A number of pesticides have been identified as chemicals of concern (Table 17-1). Carbazole is included in this group for discussion purposes although carbazole is a semi-volatile. Soil samples were collected at an off-site location (OFS-3), Fire Department Training Area 1 (SWMU 78) and the Old Entomology Rinse Area (SWMU 96) and analyzed for pesticides. Sediment samples were collected from the Wastewater Lagoons (SWMUs 101 and 102) and also analyzed for pesticides. Based on information on nature and extent of contamination and Table 17-2, the pesticides detected may be persistent but their transport potential is considered to be limited. This is based on several factors as follows:

1) Where detected, pesticides appear to be concentrated at the soil surface. Data collected during this investigation from two vertical profiles at Fire Training Area 1 clearly show decreasing concentrations of pesticides with depth. No pesticides were detected below a depth of 22 feet BGS (Section 4.4). Results of Radian's previous site investigation of pesticides

in the Old Entomology Rinse Area indicated that pesticides were generally restricted to the surface soils, although in one case DDT was detected 58 feet BGS (Radian 1986, Volume 1, Section 4.2.15).

2) It is likely that vertical transport in the Fire Training Area 1 was significantly influenced by application of water and solvents/waste oils/fuels at this site during fire training exercises. IARC (1974) indicates that DDE is soluble in most solvents which would help account for its enhanced mobility and its presence at depth. At other sites where recharge was not artificially increased, or potential opportunities for enhanced solubility (i.e., transport) do not exist, vertical concentrations should be expected to typically decrease within the near surface (i.e., within a depth of about 20 feet BGS).

3) The limited mobility of the pesticides is supported by the high log $K_{ow}$values reported in Table 18-2 (i.e., heptachlor epoxide - 3.65 to DDT - 6.44). Organics with log $K_{ow}$values greater then 4 are considered to be very hydrophobic, have low water solubilities, high soil/sediment adsorption coefficients, and lower mobility (Lyman et al 1990). Table 17-2 data indicate that the solubilities for these pesticides in less than 2 mg/L and is 2 to 5 orders of magnitude lower than for the volatile chemicals of concern. No specific information is available for carbazole, but it is generally expected to behave in a similar manner.

4) Ten TOC soil samples from Fire Training Area 1 and six TOC soil samples from Fire Training Area 4 were collected from one boring in each Area. These TOC samples were typically collected at depth intervals of 10 feet. With one exception, all the TOC data were qualified during the data validation process due to presence of TOC in the blank and cannot be used for estimation of $K_d$ values. In one case (Area 1, from a depth of 75 feet BGS), an estimated TOC concentration of 0.33 percent was reported for the medium to fine sand. Using the Table 17-2 $K_{oc}$ minimum and maximum values, and assuming a $f_{oc}$ value of 0.0033 is representative,

estimated $K_d$ values were calculated. This yielded $K_d$ values of about 69 for heptachlor epoxide and 3,300 for DDE. Based on this single result and Dragun (1988), all of the pesticides would be considered immobile (i.e., they all have $K_d$'s > 10).

5) A single TOC analysis on a Wastewater Lagoon sediment sample produced a value of 13.13 percent. This produces an $f_{oc}$ value of 0.13 and the $K_d$ values calculated would range from about 2,700 to 130,000 for heptachlor epoxide and DDE, respectively. Based on the single result and Dragun (1988), all the pesticides associated with the sediment samples would be considered immobile.

6) The absence of any pesticides in the groundwater and surface water (i.e., Wastewater Lagoon) samples suggests the pesticides are not being dissolved and/or transported in groundwater or surface water.

## 17.4 FATE AND TRANSPORT SUMMARY

Metal, and volatile and pesticide organic chemicals of concern have been identified at Cannon AFB. Within the air pathway, the fate and transport of metals from the soils shows no evidence of a health risk (Section 18.0). Movement of metals within the Ogallala Formation from soil or sediment has been determined to be limited to the near surface based on results of both WCC's current and Radian's previous subsurface investigations. However, insufficient site-specific information exists to quantify the subsurface or aqueous mobility of the metals of concern. Volatile chemicals of concern do not represent a health risk based on air quality modeling of soil gas releases. Within site surface waters, groundwater, or the subsurface, both volatilization and biodegradation are expected to be responsible for considerable reductions in volatile concentrations. Based on existing data from the three SWMUs assessed by this investigation, there is no indication that these volatiles are transported into the Ogallala Aquifer, the ultimate receptor of all on-site surface water. Similarly, there is no evidence pesticides are being transported into the Ogallala Aquifer by infiltration of either precipitation through the soil, or surface water. Limited soil and sediment TOC data suggest the pesticides will be highly adsorbed. The pesticides are expected to be

relatively persistent within the soils or sediments, based on their high adsorption and low aqueous solubility, volatilization rates, and biodegradation half-lives.

# TABLE 17-1

## CHEMICALS OF CONCERN

| | |
|---|---|
| **METALS** | Antimony |
| | Barium |
| | Cadmium |
| | Chromium |
| | Cobalt |
| | Copper |
| | Lead |
| | Mercury |
| | Nickel |
| | Selenium |
| | Silver |
| | Thallium |
| | Vanadium |
| | Zinc |
| **ORGANICS** | Acetone |
| | Benzene |
| | Carbon disulfide |
| | Carbazole |
| | Chlordane |
| | Chloromethane |
| | DDD |
| | DDT |
| | DDE |
| | Ethylbenzene |
| | Heptachlor expoxide |
| | Toluene |
| | TCA |
| | TCE |
| | PCE |
| | Xylene |

# TABLE 17-2

## PHYSICAL AND CHEMICAL PROPERTIES OF ORGANIC CHEMICALS OF CONCERN

| Chemical | Molecular Formula | Molecular Weight (g/mole) | Water Solubility (mg/L) | Vapor Pressure mmHg | Henry's Law Constant (atm-m$^3$/mole) | Log $K_{ow}$ | Log $K_{oc}$ | Biodegradation Rate (days) |
|---|---|---|---|---|---|---|---|---|
| Acetone | $C_3H_6O$ | 58 | 1,000,000[1] | 266[2] | 3.97 x $10^{-5}$[3] | -0.24[4] | 0.34[1] | NA |
| Benzene | $C_6H_6$ | 78 | 1,696[5] | 95.2[6] | 5.38 x $10^{-3}$[7] | 2.11[8] | 1.69[9] | 48-110[10,11] |
| Carbon disulfide | $CS_2$ | 76 | 2,300 @ 22°C[12] | 360[13] | 1.33 x $10^{-2}$[13] | 1.84[4] | 2.28-2.55[14] | NA |
| Carbazole | $C_{12}HqN$ | 167 | Insoluble[15] | NA | NA | NA | NA | NA |
| Chlorodane | $C_{10}H_6C_{;8}$ | 410 | 1.85[16] | 1x$10^{-6}$ @ 20°C[17] | 4.8 x $10^{-5}$[18] | 6.0[19] | 5.15 & 5.57[20] | >7[21] |
| Chloromethane (Methyl Chloride) | $CH_2Cl$ | 85 | 7,400[22] | 3,756 @ 20°C[23] | 6.6 x $10^{-3}$[24] | 0.9[25] | 1.4[26] | NA |
| DDD | $C_{14}H_{10}Cl_4$ | 320 | 0.02 - 0.09[13] | 1.02x$10^{-6}$ @ 30°C[27] | 2.16 x $10^{-5}$[13] | 6.02[14] | 4.64[14] | >7[21] |
| DDE | $C_{14}H_8Cl_4$ | 319 | 0.12[28] | 6.49 X $10^{-6}$ @ 30°C[27] | 2.34 x $10^{-5}$[13] | 5.77[14] | 6.0[29] | >7[21] |
| DDT | $C_{14}H_9Cl_5$ | 354 | 0.025[28] | 1 x $10^{-7}$[30] | 5.2 x $10^{-5}$[37] | 6.16 - 6.44[31] | 5.14[32] | >7[21] |
| Ethylbenzene | $C_8H_{10}$ | 106 | 187[33] | 7.08 @ 20°C[34] | 6.6 X $10^{-3}$[24] | 3.13[35] | 1.98[9] | 37[10] |
| Heptachlor epoxide | $C_{10}H_5Cl_7O$ | 389 | 0.2[28] | 2.6 x $10^{-6}$ @ 20°C[36] | 3.2 X $10^{-5}$[18] | 3.65[13] | 4.32[14] | >7[21] |
| Tetracholoroethane | $C_2H_2Cl_4$ | 168 | 2,970[38] | 6[17] | 3.8 x $10^{-4}$[24] | 2.56[25] | 2.07[39] | 300[40] |
| Trichloroethane | $C_2H_3Cl_3$ | 133 | 720[39] | 124[43] | 1.3 x $10^{-2}$[39] | 2.18[25] | 2.18[39] | 300[40] |
| Trichloroethylene | $C_2HCl_3$ | 131 | 1,100[12] | 72.6[44] | 9.1 x $10^{-3}$[24] | 3.03[41] | 2.10[39] | 7 - 300[21,40] |
| Toluene | $C_7H_8$ | 92 | 580[5] | 22 @ 20°C[12] | 6.7 x $10^{-3}$[24] | 2.65[41] | 2.18[42] | 37 - 39[10,11] |
| Xylene (o) | $C_8H_{10}$ | 106 | 175[30] | 6.6[30] | 5.0 x $10^{-3}$[24] | 3.16[45] | 2.11[9] | 11 -32[10,11] |
| (m) | | | 160[46] | 8.29[47] | 7.0 x $10^{-3}$[24] | 3.20[4] | 3.20[9] | 15 -37[10,11] |
| (p) | | | 180[38] | 8.76[47] | 7.1 x $10^{-3}$[24] | 3.18[41] | 2.31[9] | 17 - 37[10,11] |

# TABLE 17-2
# (Concluded)

Notes: All values at 25°C where noted in reference and/or unless otherwise specified
All references from Montgomery and Welkom 1990, except 10, 11, 21, and 40, from Dragun 1988; and 1 and as follows:

| | |
|---|---|
| 1 | USEPA 1986 |
| 2 | NIOSH 1987 |
| 3 | Hine and Mookerjee 1975 |
| 4 | Leo, Hansch, and Elkins 1971 |
| 5 | Keely, Hoffpauir, and Meriwether 1988 |
| 6 | Mackay and Leinonen 1975 |
| 7 | Jury, Spencer, and Farmer 1984 |
| 8 | Mackay 1982 |
| 9 | Abdul, Gibson, and Rai 1987 |
| 10 | Zoeteman, DeGreef, and Brinkmann 1981 |
| 11 | Barker and Patrick 1985 |
| 12 | Verschueren 1983 |
| 13 | USEPA 1980 |
| 14 | Kenaga and Goring 1980 |
| 15 | Budavari et al 1989 |
| 16 | Weil, Dure, and Quentin 1974 |
| 17 | American Conference of Governmental Industrial Hygienists 1986 |
| 18 | Warner, Cohen, and Ireland 1987 |
| 19 | Travis and Arms 1988 |
| 20 | Chin, Peven, and Weber 1988 |
| 21 | Tabak, Quave, Mashni, and Barth 1981 |
| 22 | Lyman, Reehl, and Rosenblatt 1982 |
| 23 | McConnell, Ferguson, and Pearson 1975 |
| 24 | Pankow and Rosen 1988 |
| 25 | Mills et al 1985 |
| 26 | Chiou, Peters, and Freed 1979 |
| 27 | Spencer and Cliath 1972 |
| 28 | Biggar and Riggs 1974 |
| 29 | Oliver and Charlton 1984 |
| 30 | Mackay and Wolkoff 1973 |
| 31 | Brooke, Dobbs, and Williams 1986 |
| 32 | Schwarzenbach and Westall 1981 |
| 33 | Miller et al 1985 |
| 34 | Burris and MacIntyre 1986 |
| 35 | Yalkowsky, Valvani, and Mackay 1983 |
| 36 | IARC 1974 |
| 37 | Jury, Spencer, and Farmer 1983 |
| 38 | Banerjee, Yalkowsky, and Valvani 1980 |
| 39 | Schwille 1988 |
| 40 | Roberts, Schreiner, and Hopkins 1982 |
| 41 | Tewari et al 1982 |
| 42 | Garbarini and Lion 1986 |
| 43 | Neely and Blau 1985 |
| 44 | Klopffer et al 1982 |
| 45 | Hodson and Williams 1988 |
| 46 | Riddick, Bunger, and Sakano 1986 |
| 47 | Bohon and Claussen 1951 |

# 18.0
# BASELINE RISK ASSESSMENT

## 18.1 INTRODUCTION

This section describes the procedures and results for assessing potential human health impacts associated with 18 SWMUs at Cannon AFB under the baseline (i.e., no further remedial action) conditions. These conditions encompass current and future land use scenarios. The baseline risk assessment (BRA) examines site-specific pathways by which environmental or human receptors may be exposed to chemicals released at each SWMU. For those exposure pathways judged to be complete, the risks to human health are characterized in terms of carcinogenic risk and noncarcinogenic hazards. The results of the risk characterization are presented along with the uncertainties and limitations associated with the assumptions that were used to perform the BRA. As an integral part of the Remedial Investigation (RI) process under CERCLA and RCRA, the objectives of the BRA are to:

- Identify current and future receptors which may be exposed to site chemicals
- Establish the conceptual site models for individual or groups of SWMUs that identify potential exposure pathways
- Perform qualitative, and where appropriate, quantitative estimation of risks and hazards
- Present the findings of the BRA and the associated uncertainties
- Provide risk management information for decision makers regarding follow-up actions, if necessary, at individual or groups of SWMUs
- Provide health-based information for the establishment of remediation goals and the Feasibility Study (FS), if needed

### 18.1.1 Overview and Scope of Risk Assessment

The BRA was performed in accordance with the RI Work Plan (WCC 1991a), using validated chemical data collected by Woodward-Clyde Consultants (WCC) under the RI. Surficial and subsurface soil sample were collected on-site and from background locations and 18 SWMUs. In addition, groundwater data were collected from groundwater monitoring wells previously installed at Landfill No. 5 (SWMU No. 113) the wastewater lagoons (SWMU Nos. 101 and 102), and the Old Entomology Rinse Area (SWMU No. 96).

The BRA estimated the potential carcinogenic risk and noncarcinogenic hazard for receptor populations that would be expected to receive the greatest degree of exposure under baseline (no-action) conditions. These populations included current and future on-site maintenance workers, future on-site construction workers, and future residential adults and children (at SWMUs where residential construction was considered feasible). Other possible receptors identified, but not quantitatively evaluated, were occasional trespassers or visitors and off-site residents or workers. Risks to these individuals are expected to be insignificant because of infrequent exposures and should be below those hazards and risks estimated for on-site workers and on-site future residents.

The media evaluated included soils, air, and groundwater. The soil data suggest the potential release of chemicals at some of the SWMUs. However, the groundwater data do not indicate the presence of contamination above the Maximum Contaminant Levels (MCLs) established by the EPA under the Safe Drinking Water Act. An examination of the vertical extent of contamination for soils in the vicinity of the groundwater monitoring wells revealed a general decrease in soil chemical concentrations at depths below 30 feet. The Ogallala Aquifer is over 260 feet deep (Tables 10-2 and 14-1). After considering the groundwater monitoring well data, the fate and transport properties of chemicals detected in soil samples, and the local geology/hydrogeology, it was judged that the groundwater exposure pathway is not likely to be a significant route of human exposure and potential risks and hazards associated with groundwater use were not quantitatively evaluated in this BRA. The groundwater exposure pathway should be re-evaluated as additional groundwater data become available, or at the time of the

installation's five-year review and/or in the event of any required future permit modifications.

### 18.1.2 Approach

The Cannon RI was performed under the regulatory framework of RCRA and CERCLA (Section 1.2). Accordingly, WCC followed current RCRA and CERCLA guidance to evaluate the human health impact from RCRA facilities and Superfund sites. Under the RCRA guidance, the concentrations of site chemicals were compared with RFI criteria and proposed RCRA action levels, which are conservative, and non-site-specific screening levels. Specific guidance pertaining to RFIs is described in the RCRA Facility Investigation Guidance, Volume I (EPA 1989a). This guidance indicates that a site-specific risk assessment may be performed when the levels of site chemicals in a particular medium exceed the RFI criteria.

As required by the Cannon AFB RI Work Plan, a site-specific risk assessment was performed for each Risk Assessment Area (RAA) which is comprised of an individual SWMU or a group of SWMUs that are geographically close, have common or similar chemical release sources, and have potentially overlapping exposure pathways. Table 18-1 presents the SWMUs included in each RAA.

In performing the BRA, the following risk assessment guidance under CERCLA was followed:

- Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (EPA 1989b)
- Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors" (EPA 1991a)
- Superfund Exposure Assessment Manual (EPA 1988a)
- Exposure Factors Handbook (EPA 1989c)

- Health Effects Assessment Summary Tables (HEAST) (EPA 1991b)
- EPA Integrated Risk Information System (IRIS) (EPA 1992a)

EPA-derived toxicity values were also used to update the RFI criteria/proposed RCRA action levels. Other EPA and State of New Mexico guidance was followed and referenced, as appropriate.

The following steps were performed for the Cannon BRA.

- Select chemicals of concern (COCs)
- Evaluate data and compare data for each COC with RFI criteria/proposed RCRA action levels
- Assess toxicity of chemicals of concern
- Identify human receptor populations
- Evaluate potential exposure pathways
- Estimate chemical intakes for human receptors
- Characterize risks and hazards

Because the process of assessing human health risks requires the use of professional judgment and the application of exposure assumptions, a summary of uncertainties and limitations inherent in the BRA are also presented in this section.

### 18.1.3 Data Evaluation/Selection of Chemicals of Concern

The purpose of data evaluation is to examine the adequacy of available data for use in a BRA. The data were carefully reviewed with regard to the quantitation limits attained during the chemical analyses, laboratory quality assurance measures (precision, accuracy,

representativeness, completeness, and comparability), and the overall quality of the data. During this data validation process, a number of laboratory contaminants were identified (Section 16.5)[1]. Validated soil and groundwater data were compiled for each RAA. The arithmetic mean and 95 percent upper confidence limit (UCL) of the arithmetic mean concentrations were calculated. Chemicals of concern were identified based on the criteria described in Section 18-2. These criteria involve the comparison of compiled site data with background concentrations and the elimination of laboratory contaminants identified by the data validation process. Also eliminated were chemicals for which detected concentrations were highly uncertain, as well as chemicals with extremely low mammalian toxicities or compounds considered trace elements, if present at non-toxic concentrations. Chemicals without EPA toxicity values were excluded from the quantitative estimation of risk but were evaluated qualitatively for potential human health and environmental risks. Section 18-2 provides detailed information on how the potential chemicals of concern were selected for each RAA. Exposure point concentrations, based on soil data collected during the RI, were then compared to the RFI criteria/proposed RCRA action levels. Chemicals that exceeded the RFI criteria/proposed RCRA action levels were identified.

### 18.1.4 Toxicity Assessment

The sources of toxicity information for the chemicals of concern were the EPA IRIS database (EPA 1992a), HEAST (EPA 1991b), and the Agency for Toxic Substances and Disease Registry (ATSDR) toxicological profiles. USEPA-verified toxicity values (reference doses [RfDs] for noncarcinogens and slope factors [SFs] for carcinogens) were used in quantitatively estimating risks. Summaries of toxicity and fate/transport properties for the key contaminants of concern (compounds which contribute significantly to the overall risk within each RAA) are presented as toxicity profiles in Appendix D-4.

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[1] The identified laboratory contaminants pertinent to the BRA are 2-butanone (methyl ethyl ketone), 2-hexanone, acetone, methylene chloride, phthalate esters (di-n-butylphthalate, di-n-octylphthalate, and bis(2-ethylhexyl)phthalate.

### 18.1.5 Exposure Assessment

The purpose of the exposure assessment is to estimate the current or potential daily intake of site chemicals by the human receptors. Exposure variables and input values applicable to the site were used to estimate the reasonable maximum exposure (RME) to humans under current and future exposure scenarios. Plausible exposure pathways associated with the primary source (soils) and secondary source (air and groundwater) were discussed. Where appropriate, mathematical modeling was performed to estimate the environmental concentrations of chemicals of concern in ambient air at each RAA. Conceptual site models were prepared for each RAA addressing the plausibility of various chemical release and transport mechanisms, and exposure routes from chemical source(s) to the receptors (Section 18.4).

In the BRA, WCC calculated the baseline risks and hazards posed to humans by each RAA for the exposure pathways of incidental soil ingestion, dermal contact, inhalation of airborne particulates, and inhalation of volatilized organic chemicals. A combination of reasonable maximum and average exposure assumptions were used to estimate the daily intake of site chemicals from these exposure pathways. To conservatively estimate the exposure point concentration for airborne particulate and volatilized organic chemicals within an RAA, WCC used the mean and the 95% UCL of the arithmetic mean concentration of the chemical in soil to model the average and upperbound ambient air concentrations for that chemical. The modeled fugitive dust concentrations within each RAA were assumed to be inhalable (i.e., suspended particulates of aerodynamic size between 0 to 10 micrometers in diameter [$PM_{10}$]). The chemical composition of the airborne particulates was assumed to be the same as that in the soil.

### 18.1.6 Risk Characterization and Uncertainty Analysis

The potential noncarcinogenic hazards and carcinogenic risks were estimated by comparing the average daily intake to an established reference dose (noncarcinogenic effects) or by multiplying the average daily intake by the slope factor (carcinogenic effects). The noncarcinogenic hazards for individual chemicals and exposure pathways were summed to derive an overall hazard index. Similarly, carcinogenic risks were summed across chemical exposure pathways to derive a total carcinogenic risk. A hazard

index and an estimation of total carcinogenic risk were estimated for each RAA. A discussion of the uncertainties follows the quantitative risk characterization. The purpose of the uncertainty discussion is to allow appropriate interpretation of the estimated hazards and risks. The section emphasizes the concept of RME and the uncertainties in the toxicity and exposure data for the site chemicals.

Due to the lack of EPA-verified critical toxicity values for lead, the potential impact of lead from site soils was evaluated by comparing the soil concentrations with the current guidance for establishing soil lead cleanup levels at Superfund sites. The lead levels in site soils for Cannon AFB were compared to levels of 500 to 1,000 mg/kg, which are the concentrations of lead in soil that the USEPA's Office of Solid Waste and Remedial Response recommends as acceptable cleanup levels (EPA 1990a). The EPA also recommends the use of the Uptake Biokinetic (UBK) Model to predict site-specific lead cleanup levels based on estimated blood lead concentrations in children (EPA 1989). A preliminary analysis of potential blood lead concentrations in children was run using the UBK model and the highest 95% UCL concentration for lead detected in soil samples (411 mg/kg) and the maximum concentration detected in groundwater samples (0.034 mg/L) collected as input to the UBK model. The UBK analysis predicted that 95% of the children would have blood lead levels below 10 $\mu$g/dL. On this basis, lead detected in soil and groundwater samples from SWMUs investigated at Cannon AFB is within currently recommended EPA guideline concentrations.

### 18.1.7 Organization of the Risk Assessment

This report is organized into the following sections:

- Section 18.1 provides an overview and scope of the BRA

- This section evaluates data for chemicals detected at each SWMU and also presents the potential select chemicals of concern to be used in the risk characterization. Section 18.2 also compares the data for the chemicals of concern with available RFI criteria and proposed RCRA action levels.

- Section 18.3 provides general information concerning the toxicity values used to estimate risks and hazards quantitatively. This section also describes the methods used to calculate cancer risks and non-cancer hazards.

- Section 18.4 presents exposure information for each RAA including RAA-specific conceptual site models, the exposure assumptions used, and the methodology on how to calculate chemical intakes. The modeling techniques for estimating ambient concentrations of volatilized organic compounds and airborne particulates within each RAA are also described in this section.

- Section 18.5 describes the risk characterization for each RAA.

- Section 18.6 presents ecological risk assessment.

- Section 18.7 presents the overall results of the human health risk assessment performed for each RAA, a summary of the ecological risk assessment, and an evaluation of uncertainties.

All risk calculations, performed using WCC's ASSESS© software, are presented in Appendix D-3. Tables for toxicity values, chemicals of concern, input values for parameters in each complete exposure pathway, and a summary of quantitative risk estimates are presented at the end of this section.

## 18.2 DATA EVALUATION

### 18.2.1 General

This section presents the criteria used for the selection of the chemicals of concern (COCs) for each RAA. The rationale for their selection is also presented. The COCs are chemicals potentially related to previous activities regarding the use, reclamation, waste disposal, and management of products or substances containing the chemicals. Chemical data for the COCs at each RAA were used to characterize risks. This section

also describes the process by which validated data (Section 16.0) collected in the RI are compiled to generate potential exposure point concentrations for the selected COCs for comparison with the medium-specific RFI criteria/proposed RCRA action levels.

### 18.2.2 Selection of Chemicals of Concern

COCs for each SWMU were selected from the chemicals detected at the SWMU. Detected chemicals were evaluated by chemical group (i.e., volatile organic compounds, semi-volatile organic compounds, pesticides, and metals) for their detection frequencies, data certainty, data comparability, and concentrations. SWMU-specific information, such as facility history and the results of previous investigation activities at the SWMUs, was also considered. This section describes criteria used to select the COCs. A summary of the selection process for the COCs at each RAA is provided under this section.

The selection criteria are as follows:

- Those metals for which 95% UCL concentrations in soil exceed the background soil concentrations and literature values for regional soils will be selected

- Those chemicals for which 95% UCL concentrations in the downgradient wells exceed the upgradient well concentrations will be selected

- Laboratory contaminants identified by the data validation process will be excluded

- Chemicals which were detected with a low level of confidence will be excluded, if such exclusion is consistent with background information concerning the site

- Chemicals with low mammalian toxicities will be excluded

- Chemicals without EPA toxicity values were excluded from the quantitative estimation of risk but were evaluated qualitatively for potential human health and environmental risks[2]

Validated soil data were compiled for each RAA. The surficial soil data, and the combined surficial soil and subsurface soil data (from 0 to 10 feet BGS, the reasonable maximum excavated depth for an RAA of area greater than one-half acre) were used as the primary data sets for evaluation. For each data set, the arithmetic mean and the 95% UCL of the arithmetic mean concentration were calculated. These concentrations were then compared to the background concentrations. To be conservative, detected values above the reporting limits (i.e., validated data without a qualifier), estimated values below the reporting limits (i.e., validated data qualified J), estimated reporting limits (i.e., non-detects qualified as UJ), and half of the reporting limit (for chemicals that were not detected in one sample but detected in other samples within the data set, qualified as U) were used in the data set. Chemicals that were not detected in any samples within a given RAA were excluded from further evaluation.

Metals are naturally occurring elements in soils. To differentiate whether the detected metal concentrations were related to site activities, the 95% UCL concentrations were compared with the regional background concentrations as well as those calculated from the combined off-site and on-site background soil samples (Table 2-7). Polycyclic aromatic hydrocarbons (PAHs) could come from many anthropogenic sources, including petroleum-derived products such as asphalt and the combustion of fossil fuels. As described Section 18-3, ambient naturally occurring or non-site related (i.e., anthropogenic) PAH concentrations documented in published literature were compared with the levels of PAHs found in SWMU No. 34 (RAA6). Published ambient PAH concentrations are presented in Table 18-2.

In the data validation process, a number of volatile and semivolatile organic compounds were detected in Cannon SWMU samples, as well as method blanks, at relatively high

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[2] Aluminum has no toxicity values and the chemicals with low mammalian toxicities are copper, iron, magnesium. The latter compounds are essential nutritional elements and are frequently used as food contact surfaces or in medicine.

frequencies (Section 16.5). These chemicals were judged as laboratory contaminants and were excluded from the COC list if their concentrations were low. The list of potential laboratory contaminants are:

- 2-butanone
- 2-hexanone
- 4-methyl-2-pentanone
- acetone
- 4-nitrophenol
- methylene chloride
- bis(2-ethylhexyl)phthalate
- di-n-butylphthalate
- di-n-octylphthalate

With the exception of acetone in RAA2 and RAA4, where concentrations in soils were elevated, the above compounds were not included in the COC list for the risk characterization.

Chemicals with low mammalian toxicities were excluded from the COC list. These metals include copper, iron, and magnesium. These metals are essential nutritional elements, and are typically used as food contact surfaces or in medicine. Because of their relatively low toxicity, these compounds were excluded as COCs if detected at relatively low concentrations. Aluminum and lead have no toxicity values. Aluminum concentrations in soil and groundwater were not elevated above background concentrations. Even though lead was included as a COC for some RAAs, lead was not included in the quantitative estimation of risk due to the lack of EPA-published toxicity values. Lead was evaluated for its potential human health and environmental risks by comparing detected lead concentrations with EPA guidelines, criteria, or standards.

Table 18-3 presents detected chemicals for each RAA (excluding laboratory contaminants) and the frequency of detection for each compound. Table 18-4 through Table 18-11 provides a summary of the COC selection for each RAA. Each table presents the chemicals detected at the RAA; chemicals eliminated from consideration

as COCs, the rationale for their elimination; and the final list of COCs. The selected COCs were used in the BRA performed for each RAA.

#### 18.2.2.1 Chemicals of Concern in RAA1

Located at the southeast corner of the base, RAA1 is comprised of inactive fire training department areas (SWMU Nos. 106 and 107), a current fire training area (SWMU No. 109), and Landfill 5 (SWMU No. 113). Reportedly, fuel, waste oils, and solvents were burned for fire training purposes in the fire training areas. Landfill 5 is fenced and only receives tree limbs and construction debris. The hazardous waste portion (Cell 3) is closed with a permanent cap and is currently inactive. Wastes received at this landfill included domestic solid waste, waste oils, and solvents; paint, paint remover, and thinners; pesticide containers; and various empty cans and drums. Based on soil data from the fire training areas, the COCs are: benzene, toluene, xylenes, trichloroethylene (TCE), ethylbenzene, chromium, and lead (Table 18-4).

Within the potential depth of excavation (from 0 to 10 feet), benzene and TCE were both detected at low frequencies.[3] Benzene was detected once in 37 samples at a concentration of 0.17 mg/kg; trichloroethene was detected once in 29 samples at an estimated concentration of 0.001 mg/kg. Despite the low frequencies of detection, these compounds were included because they could have been constituents of fuel, waste oil, or solvent. Soil lead levels, at 322 mg/kg and 100 mg/kg for the maximum and 95% UCL concentrations, respectively, were higher than the site and regional background concentrations of 8.6 mg/kg and 15 mg/kg, respectively.

A total of five groundwater monitoring wells were previously installed in this RAA (four in the SWMU No. 113 area and one north of SWMU No. 106). All data were comparable. The detectable levels of arsenic in two downgradient wells were below the CRDL and the estimated values for arsenic in the upgradient well. All chemicals detected in the monitoring well samples were below the drinking water MCLs. Therefore, no potential groundwater COCs were selected for this RAA.

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[3] The 10 feet excavation depth was generally considered the depth for the foundation or basement. During excavation, it was assumed that the subsurface soil was spread on site, allowing the chemicals in the subsurface soil to be accessible to humans for direct contact exposures.

### 18.2.2.2 Chemicals of Concern in RAA2

Located in the southeast quadrant of the base and northeast of RAA1, RAA2 comprises the former aircraft engine steam cleaning and testing areas (Engine Test Cell Area, SWMU Nos. 86 to 90). During the period of operation (1965 to 1988), washdown water containing lubricating and synthetic oils, residual JP-4 fuel, and dirt were discharged on land via an overflow pit, an oil-water separator, a leach field, and an evaporation pond. The soil data indicate that this area has detectable levels of volatile organic compounds and elevated levels of metals above the site and regional background concentrations. The COCs are acetone, ethylbenzene, tetrachloroethylene, or perchloroethylene (PCE), 1,1,1-trichloroethane (TCA), TCE, toluene, xylenes, antimony, barium, cadmium, chromium, cobalt, nickel, lead, and zinc (Table 18-6)[4].

Between the depths of 0 to 10 feet, most of the volatile organic compounds detected were at low concentrations (below CRDL) and detection frequencies: ethylbenzene (1/25), TCE (3/25), TCA (1/25), PCE (1/25), and xylenes (3/25). Antimony was detected in surficial soils next to the concrete pad. No groundwater data was available for the identification of COCs. However, it is expected that the low mobility of metals and the low infiltration rate in this region substantially reduce the potential for groundwater impacts at this RAA. No consistent trend of increased chemical concentrations with depth was observed for organic COCs in soil (Appendix D-1).

### 18.2.2.3 Chemicals of Concern in RAA3

RAA3 includes the Northeast Stormwater Drainage Area (SWMU 95), the Old Entomology Rinse Area (SWMU No. 96), and the two wastewater lagoons (SWMU No. 101 and 102). This RAA is located in the northeast quadrant of the base.

SWMU No. 95 is active and receives stormwater runoff, and water discharges from oil-water separators and cleaning facilities. The runoff and discharges may contain oily waste and alkaline aircraft cleaning compounds. Elevated levels of metals above the site

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[4] The detected chromium was assumed to be trivalent chromium, since it is likely that chromium exists in a stable and lower valency state in the natural environment (ATSDR 1989).

and regional background concentrations were found in the mouth (northwest end) of the drainage area. SWMU No. 96 once housed a pesticide storage building where pesticide and herbicide application equipment and containers were rinsed in a sink. This rinse water was discharged to a small shallow pit behind the building. Detectable levels of pesticides were found at this SWMU. The COCs for these two SWMUs are: toluene, barium, cadmium, chromium, cobalt, lead, mercury, nickel, zinc, DDE, DDT, chlordane, and heptachlor epoxide (Table 18-7).[5]

Toluene was detected below the CRDL at a frequency of 1/8 samples between depths of 0 to 10 feet. Elevated levels of lead and zinc appear to be prevalent throughout the surficial soil of the Northeast Stormwater Drainage Area.

SWMU Nos. 101 and 102 are enclosed by a fence. Sediment data from these lagoons indicate elevated levels of metals and detectable levels of semivolatile organic compounds including pesticides and PCBs. The COCs for these two SWMUs are: cadmium, chromium, lead, mercury, nickel, selenium, silver, zinc, bis(2-ethylhexyl)phthalate (BEHP), DDD, DDE, chlordane, and PCBs. All other pesticides and PCBs were detected at very low frequencies, below the CRDL (Appendix D-1). Although selected as COCs, the above compounds are not likely to pose a significant impact to humans due to the lack of direct exposure pathways (i.e., incidental ingestion, dermal contact, or inhalation of particulates emanating from the sediment). Chemicals detected in sediments were evaluated further in the environmental risk assessment (Section 18-6).

A total of five groundwater monitoring wells were sampled in RAA3 (four in the SWMU Nos. 101 and 102 area and one southeast of SWMU No. 96). A comparison of SWMU Nos. 101 and 102 downgradient well data with upgradient well (Well 101E) data was performed. With the exception of barium and selenium, no observable differences existed among the chemical concentrations in the upgradient and downgradient wells at SWMU Nos. 101 and 102. The detectable levels of selenium were highly uncertain since they were below the CRDL and below the (estimated) concentration of selenium in the

[5] As discussed in Section 19.3, EPA-published toxicity values are not available for lead. The primary toxicological concern for lead is neurotoxicity in infants and young children. No toxicity values are available for cobalt, for which the primary toxicological concern appears to be skin or respiratory tract sensitization.

upgradient well. All detected chemicals in the monitoring well samples were below the drinking water MCLs and no potential groundwater COCs were selected for this RAA.

#### 18.2.2.4 Chemicals of Concern in RAA4

Located at the northeast corner of the base, RAA4 is comprised of an inactive fire department training area (SWMU No. 78) and a former solvent disposal area (SWMU No. 81). Reportedly, waste oils, recovered fuels, and spent solvents were burned at SWMU No. 78 during fire department training exercises from 1959 to 1968. At SWMU No. 81, two empty drums labeled as trichloroethylene were previously identified. The contents of these drums, however, are unknown and the drums were never verified as having contained TCE at that location. Volatile organic compounds and pesticides, as well as elevated levels of metals (above site and regional background concentrations) were detected in this RAA (Table 2-7). The COCs for these two SWMUs are: acetone, ethylbenzene, tetrachloroethylene or perchloroethylene (PCE), TCA, TCE, toluene, xylenes, DDD, DDE, DDT, cadmium, lead, and zinc (Table 18-8).

Acetone did not appear to be a laboratory contaminant as judged from the concentrations and multiple depths at which acetone was detected. Several volatile organic chemicals were detected at low frequencies between soil depths of 0 to 10 feet BGS and at concentrations below the CRDL: ethylbenzene (6/34), PCE (4/34), and TCA (7/34). These compounds appeared to be confined primarily to surficial soils. Chlordane was detected once at level well below the CRDL and was estimated at levels only twice the reporting limits for non-detects in the off-site background soil samples (Appendix D-1). Therefore, chlordane was not selected as a COC for this RAA.

No groundwater data were available for the identification of COCs. However, it is expected that the low mobility of metals and the low infiltration rate in this region substantially reduce the potential groundwater impacts at this RAA. No consistent trend of increased chemical concentration with depth was observed for organic COCs in soil (Appendix D-1).

Similar results were obtained for surface water samples collected from the lagoons. No organic compounds were detected in these samples and metals detected were below

drinking water MCLs. Potential exposure pathways associated with surface water were judged to be incomplete and, therefore, no COCs were selected for wastewater in the lagoons (see Section 18.4.4).

#### 18.2.2.5 Chemicals of Concern in RAA5

Located near the intersection between the north-south cardinal and the northern perimeter of the base, RAA5 is a former sludge weathering pit for a leaded gasoline tank (SWMU No. 76). The pit has been covered and is overgrown with native vegetation. Soil data collected in the RI indicate the presence of elevated levels of lead, and estimated high levels of ethylbenzene and xylenes. Although toluene was detected at a low frequency between the soil depths of 0 to 10 feet BGS and was below the CRDL, it was included as a COC since it a constituent of gasoline. The COCs for this RAA are: lead, ethylbenzene, toluene, and xylenes (Table 18-9). No groundwater data were available for this RAA. However, it is expected that the low mobility of metals and the low infiltration rate in this region substantially reduce the potential for groundwater impacts at this RAA. No consistent trend of increasing chemical concentrations with depth was observed for organic COCs in soil (Appendix D-1).

#### 18.2.2.6 Chemicals of Concern in RAA6

Located in a heavily used portion of Cannon AFB (originating on the flightline side of AGE Facility and terminating on base at a culvert inlet near Argentina Avenue), the AGE ditch (SWMU No. 34) receives runoff from the Aircraft Parking Apron, JP-4 Fuel Station, discharges from the washrack area, and minor spillage of grease and oil from the storage area. Soil data collected in the RI indicate the presence of volatile organic compounds and metals (Appendix D-1). Elevated levels of lead, selenium, and zinc were observed when compared to site and regional background concentrations (Table 2-7). Toluene, PCE, and TCA were detected below the CRDL. PAHs were detected at less than 1 mg/kg, which is lower or comparable to background concentrations in the literature (Table 18-2). Carbazole was detected once among five samples collected between the soil depths of 0 to 10 feet. The estimated concentration was four times below the reporting limits in the other four (non-detect) samples, suggesting that the confidence level for detection of this compound is low. Therefore, carbazole was

eliminated from the COC list. The COCs for this RAA are: toluene, lead, selenium, and zinc (Table 18-10).

No groundwater data were available for this RAA. However, it is expected that the low mobility of metals and the low infiltration rate in this region substantially reduce the potential for groundwater impacts at this RAA. No organic analytes were detected in the subsurface soil (Appendix D-1).

#### 18.2.2.7 Chemicals of Concern in RAA7

RAA7 is comprised of sanitary sewer lines that run along North Torch Boulevard (north-south direction), South Torch Boulevard (southwest-northeast direction), and parallel to Taxiway B toward the Main Runway (northwest-southeast direction) (Figure 9-3). Sanitary wastewater is carried to the wastewater lagoons through these sewer lines. Potential chemical constituents in wastewater include oils, greases, JP-4 fuel, residual paints, and solvents. Subsurface soil data to the depth of 23 feet BGS indicate that barium was detected above the site and regional background levels (Table 2-7). Detectable concentrations of acetone and toluene were also found at various depths near the sewer lines. Acetone did not appear to be a laboratory contaminant, based on the concentrations and depth at which acetone was detected. The COCs for this RAA are: barium, acetone, and toluene (Table 18-11). No groundwater data were available for the identification of COCs and no significant potential for groundwater impacts were expected based on the concentrations detected and the depth to groundwater.

### 18.2.3 Data Comparison with Proposed RCRA Action Levels/RFI Criteria

RCRA corrective action is triggered by release of hazardous waste or constituents from a facility managing hazardous waste. The RCRA corrective action process involves the RCRA Facility Assessment (RFA), followed by the RCRA Facility Investigation (RFI), the Corrective Measures Study (CMS), and finally Corrective Measures Implementation (CMI) (EPA 1986b). At any point during the process, interim corrective measures may be required to protect human health and the environment. The RFA is conducted by the regulatory agency, primarily to determine if any releases of hazardous wastes or hazardous constituents from the facility have occurred.

If the RFA determines a release from the facility warrants further investigation, the regulatory agency will require the facility owner or operator to conduct an RFI. The RFI will identify the nature and extent of the release. If the agency determines cleanup is likely to be necessary, a CMS will be conducted to evaluate potential remedies. The owner or operator will implement corrective measures under the oversight of the regulatory agency.

The RFI criteria and proposed corrective action levels are not cleanup standards, but are highly conservative screening values used to assess whether a CMS is warranted for a RCRA facility investigation. The RFI criteria were published in the Interim Final RFI Guidance (EPA 1989a) and the proposed RCRA corrective action levels were outlined in the proposed corrective action rule (55 FR 30798; July 27, 1990). The criteria and proposed action levels are not regulatory standards.

For each COC in a medium (soil or groundwater) within a SWMU, the maximum detected chemical concentration or the 95% UCL of the arithmetic mean, whichever was lower, was compared to the corresponding RFI criterion and RCRA proposed corrective action levels for that chemical. To accurately compare these values, the RfDs and SFs used to derive the criteria and action levels were reviewed to determine if the values were current. The sources for these RfDs and SFs were the EPA's IRIS (EPA 1992a) and the EPA's Health Effects Summary Tables (HEAST, EPA 1991b). If any RfDs or SFs were not current, the updated values were used to re-calculate criteria and action levels. Table 16-2 presents the equations used to derive the action levels and RFI criteria, as well as EPA's exposure input parameters such as body weight, soil ingestion rate, and other assumptions. EPA uses a $1x10^{-6}$ risk for Class A and B carcinogens and $1x10^{-5}$ risk for Class C in the calculation of these values. Table 18-15 explains EPA's carcinogenic weight-of-evidence classification scheme.

In accordance with the proposed corrective action rule and the RFI Guidance, chemical concentrations in Cannon AFB groundwater samples were compared to the MCLs or action levels promulgated under the Safe Drinking Water Act (SDWA). The sources of drinking water standards were EPA's Drinking Water Regulations and Health Advisories (EPA 1991c) and the EPA's Office of Groundwater and Drinking Water Phase II Final

Rule (57 FR 3526; January 30, 1991). Thus, MCLs were used as RFI criteria/proposed RCRA action levels in accordance with EPA guidance.

Surface water samples were only collected at SWMU Nos. 101 and 102, the wastewater treatment lagoons. The water from the lagoons is not intended for human consumption and there is no aquatic life in the lagoons suitable for human consumption. Despite this fact, the quality of the lagoon water, according to the RFI guidance, was conservatively assessed by comparing the chemical concentrations in the lagoon water with the ambient water quality standards promulgated under the Clean Water Act (CWA), MCLs, or RCRA proposed action levels (55 FR 30818 to 30819 and EPA 1989a). If applicable regulatory values were not available for certain detected chemicals, the regulatory values were calculated using the methodology described in the RFI guidance (Table 18-12).

The RFI Guidance and the proposed corrective action rule do not discuss action levels for chemicals in sediment. Instead, the RFI Guidance states that interim corrective measures and/or a CMS may be necessary if any potentially bioaccumulative contaminants are detected by biomonitoring in the "species of interest" (EPA 1989a). Corrective action levels for sediments are being developed and, according to the EPA, "Until sediment corrective action levels are established, the implementing agency will decide on a case-by-case basis whether to require a CMS" (55 FR 30819; July 27, 1990). Therefore, the sludge (sediment) data collected from the wastewater lagoons were assessed qualitatively and were not compared with any potential sediment criteria.

Calculation of corrective action levels and RFI criteria is similar, although the corrective action level equations allow more for site variations (Table 18-12). When determining corrective action levels for carcinogens, for example, the assumed lifetime is 70 years and the exposure duration is determined by site characteristics. Lifetime and exposure duration are not, however, part of the RFI criteria carcinogen formulas. This results in a conservative value based on the assumption that receptors would be exposed to a chemical for their entire lifetime. The proposed corrective action equations also take into account the absorption rates of chemicals, although in the proposed rule, the "absorption factor" (the ratio of the amount of chemical absorbed to the amount of the chemical ingested or inhaled) is assumed to be one. Although the RFI criteria and proposed RCRA corrective action levels are calculated using different equations, the

RFI criteria and action level for a given chemical are the same, due to the use of EPA standard default exposure assumptions (Tables 18-13 and 18-14).

For metals in soil, the Cannon AFB background concentrations statistical range described in Section 2.5 (Table 2-7) was used as the background range. For PAHs such as benzo(a)pyrene in soil, the background PAH concentrations published by ATSDR and in the literature (for an environmental setting similar to that of the Cannon AFB) were used for comparison to evaluate whether any exceedances beyond the regulatory values were significant (Table 18-2).

Cannon AFB groundwater background concentrations, established by the upgradient groundwater monitoring well data, were compared with the statistical mean concentrations in downgradient well samples. The comparison, although based on limited groundwater data, provides additional information for any potential exceedances of regulatory concern.

#### 18.2.3.1 AGE Drainage Ditch (SWMU No. 34)

The AGE Drainage Ditch is in RAA6. The COCs identified in this RAA were: toluene, lead, selenium and zinc. Toluene, selenium, and zinc soil data were compared with the RFI soil criteria/proposed RCRA soil action levels. None of these compounds exceeded the criteria/action levels. Since EPA does not have published critical toxicity values (i.e., RfDs or SFs) for lead, no RFI criteria/proposed RCRA action levels are available for comparison. Due to the lack of groundwater monitoring well data, no groundwater COCs were identified for this SWMU for comparison with the RFI groundwater criteria/ proposed RCRA action levels (MCLs).

#### 18.2.3.2 Sludge Weathering Pit (SWMU No. 76)

The Sludge Weathering Pit is in RAA5. The COCs identified in this RAA were: toluene, ethylbenzene, xylene, and lead. Ethylbenzene and xylene data were compared with the RFI soil criteria/proposed RCRA action levels. None of these compounds exceeded the criteria/action levels. Since EPA does not have published critical toxicity values for lead, no criteria/action levels were available for comparison. Due to the lack

of groundwater monitoring well data, no groundwater COCs were identified for this SWMU for comparison with the RFI criteria/proposed RCRA action levels (MCLs).

#### 18.2.3.3 Fire Department Training Area No. 1 (SWMU No. 78)

The Fire Department Training Area No. 1 is in RAA4. The COCs identified in this RAA were: acetone, ethylbenzene, PCE, TCA, TCE, toluene, xylene, DDD, DDE, DDT, cadmium, lead and zinc. Ethylbenzene and PCE were not detected above the reporting limits at this SWMU. The other COC data (with the exception of lead) were compared with the RFI soil criteria/proposed RCRA action levels. None of these compounds exceeded the applicable criteria/action levels. Since EPA does not have published toxicity values for lead, no comparison was made. Due to the lack of groundwater monitoring well data, no groundwater COCs were identified for this SWMU for comparison with the RFI groundwater criteria/proposed RCRA action levels (MCLs).

#### 18.2.3.4 Solvent Disposal Site (SWMU No. 81)

The Solvent Disposal Site is also in RAA4. The COCs identified in this RAA are: acetone, ethylbenzene, PCE, TCA, TCE, toluene, xylenes, DDD, DDE, and DDT, cadmium, lead, and zinc. Soil samples taken at this SWMU were not analyzed for semivolatile organic compounds and metals. Acetone, TCA, TCE, toluene and xylene data were compared with the RFI soil criteria/RCRA proposed soil action levels. None of these compounds exceeded the applicable criteria/action levels. Due to the lack of groundwater monitoring well data, no groundwater COCs have been identified for this SWMU for comparison with the RFI groundwater criteria/proposed RCRA action levels (MCLs).

#### 18.2.3.5 Engine Test Cell Area (SWMU Nos. 86, 87, 88, 89, and 90)

All SWMUs within the Engine Test Cell Area are in RAA2. The COCs identified in this RAA are: acetone, ethylbenzene, perchloroethylene (PCE), 1,1,1-trichloroethane (TCA), TCE, toluene, xylene, antimony, barium, cadmium, chromium, cobalt, nickel, lead and zinc. The COC surface and surface/subsurface data (except for cobalt and lead)

were compared with the RFI soil criteria/proposed RCRA soil action levels. None, with the exception of antimony, exceeded the applicable criteria/action levels. High concentrations of antimony were found in the surface soil at borehole location 0864, at the edge of the remaining concrete pad of the test cell area. Since EPA does not have published toxicity values for cobalt and lead, no RFI criteria/proposed RCRA action levels were conducted. Due to the lack of groundwater monitoring well data, no groundwater COCs were identified for comparison.

#### 18.2.3.6 Northeast Storm Drainage Area (SWMU No. 95)

The Northeast Storm Drainage Area is in RAA3. The COCs identified in this RAA are: toluene, barium, cadmium, chromium, cobalt, lead, mercury, nickel, zinc, DDE, DDT, chlordane, and heptachlor epoxide. DDE, DDT, chlordane, and heptachlor epoxide were not detected above the reporting limits at this SWMU. The COC data (with the exception of cobalt and lead) were compared with the RFI soil criteria/proposed RCRA soil action levels. None of these compounds exceeded the applicable criteria/action levels. Since EPA does not have published toxicity values for cobalt and lead, no RFI criteria/proposed RCRA action levels were available for comparison. Due to the lack of groundwater monitoring well data, no groundwater COCs were identified for comparison.

#### 18.2.3.7 Old Entomology Rinse Area (SWMU No. 96)

The Old Entomology Rinse Area is also in RAA3. The COCs identified in this RAA are: toluene, barium, cadmium, chromium, cobalt, lead, mercury, nickel, zinc, DDE, DDT, chlordane, and heptachlor epoxide. One surface soil sample was taken from this area and was analyzed for pesticides and PCBs. No chemical characterization data for volatile organic chemicals or metals were collected in the RI. DDE, DDT, chlordane and heptachlor surface soil data were compared with the RFI soil criteria/RCRA proposed soil action levels. None of these compounds exceeded the applicable criteria/ action levels. No potential groundwater COCs were established for this RAA (Section 18.2.2). Comparison of potential COC concentrations in downgradient wells with the RFI groundwater criteria/proposed RCRA action levels (MCLs) was therefore

not performed. None of the detected metals in the downgradient wells exceeded the EPA's MCLs.

#### 18.2.3.8 Sanitary Sewer Line (SWMU No. 98)

The Sanitary Sewer Line is in RAA7. The COCs identified in this RAA were acetone, toluene, and barium. The COC data were compared with the RFI soil criteria/RCRA proposed soil action levels. None of these compounds exceeded the applicable criteria/ action levels. Due to the lack of groundwater monitoring well data, no groundwater COCs were identified for comparison with the RFI groundwater criteria/proposed RCRA action levels (MCLs).

#### 18.2.3.9 Wastewater Lagoons (SWMU Nos. 101, 102)

The wastewater lagoons are in RAA3. The COCs identified in the sediment samples from the lagoons in this RAA were: cadmium, chromium, lead, mercury, nickel, selenium, silver, zinc, bis(2-ethylhexyl)phthalate, DDD, DDE, chlordane, and PCBs. No RFI sediment criteria/proposed RCRA sediment action levels were available to compare with the concentrations of the COCs in the lagoon sediment. The lagoon sediment is not readily accessible to base personnel. With the wastewater atop the sediment and the restricted access imposed by the security fence, the chemicals in the sediment are not expected to pose a human health threat by direct contact (ingestion and dermal contact) or by inhalation of fugitive sediment. No organic compounds were detected in groundwater samples from this SWMU and none of the detected metals in the downgradient wells exceeded MCLs. Therefore, no potential groundwater COCs were established for this RAA.

#### 18.2.3.10 Fire Department Training Area No. 2 (SWMU No. 106)

The Fire Department Training Area No. 2 is in RAA1. The COCs identified in this RAA are: benzene, ethylbenzene, toluene, xylene, trichloroethene (TCE), chromium, and lead. The COC data (except for lead) were compared with the RFI soil criteria/ proposed RCRA soil action levels. None of these compounds exceeded the applicable

criteria/action levels. Since EPA does not have published toxicity values for lead, no RFI criteria/proposed RCRA action levels were available for comparison.

The COC downgradient well concentrations were not compared with the RFI groundwater criteria/proposed RCRA action levels (Section 18.2.2). None of the detected chemicals in the downgradient wells exceeded MCLs.

#### 18.2.3.11 Fire Department Training Area No. 3 (SWMU No. 107)

The Fire Department Training Area No. 3 is in RAA1. The COCs identified in this RAA are: benzene, ethylbenzene, toluene, xylene, trichloroethene (TCE), chromium, and lead. The same conclusions reached for Fire Department Training Area No. 2 apply here. No chemicals detected at SWMU No. 107 exceeded RFI criteria.

#### 18.2.3.12 Fire Department Training Area No. 4 (SWMU No. 109)

The Fire Department Training Area No. 4 is in RAA1. The COCs identified in this RAA are: benzene, ethylbenzene, toluene, xylene, trichloroethene (TCE), chromium, and lead. The same conclusions reached for Fire Department Training Area No. 2 apply here. No chemicals detected at SWMU No. 109 exceeded RFI criteria.

#### 18.2.3.13 Landfill No. 5 (SWMU No. 113)

Landfill No. 5 is in RAA1. Groundwater was the only medium sampled at SWMU No. 113. Downgradient well concentrations were not compared with the RFI groundwater criteria/proposed RCRA action levels since no COCs were identified. None of the detected chemicals in the downgradient wells exceeded the MCLs.

In summary, antimony concentrations in one surface soil sample at SWMU No. 86 exceeded the RFI criteria/proposed RCRA action level for soil. Lead was reported in one groundwater sample from SWMU No. 96 (0.034 mg/L) and in one groundwater sample from SWMU No. 113 (0.016 mg/L) at concentrations that exceeded the proposed RCRA action level/RFI criteria (0.015 mg/L) but not the EPA drinking water standard (MCL) for lead (0.050 mg/L).

## 18.3 TOXICITY ASSESSMENT

The purpose of the toxicity assessment is to evaluate the toxicity of site-related chemicals of concern and to identify an estimate of the dose-response relationship for each of these chemicals. Chemicals of concern at Cannon Air Force Base were identified by the application of a concentration-toxicity screen. The information obtained in the toxicity assessment is combined with estimated chemical intakes calculated as part of the exposure assessment to estimate the potential excess lifetime cancer risks and potential noncarcinogenic health hazards.

Noncarcinogenic responses are generally characterized by a threshold, a certain minimum intake of substance, below which the likelihood of adverse deleterious effects is expected to be low or nonexistent. A threshold effect can be best described as a non-graded response. Exposure to a range of chemical concentrations can be tolerated by an organism, with essentially no change of expression of adverse effects, until protective mechanisms of the organism are overwhelmed. Carcinogenic responses are assumed to have no threshold. That assumption means that there is some finite cancer risk no matter how small the dose.

The two principal indexes of toxicity are the reference dose (RfD) for noncarcinogenic effects and slope factor (SF) for carcinogens. These values, for chemicals for which adequate scientific dose-response data are available, are derived by the EPA for the most commonly occurring chemicals and the most toxic chemicals generally associated with chemical releases to the environment. An RfD is the intake or dose per unit of body weight per day (mg/kg-day) that is unlikely to result in toxic effects to human populations, including sensitive subgroups (e.g., the very young or old). The RfD allows for the existence of a threshold dose.

The SF is used to estimate an upper-bound probability of an individual developing cancer as a result of exposure to a potential carcinogen. Carcinogens with EPA-derived slope factors are also given an EPA weight-of-evidence classification, whereby potential carcinogens are grouped depending on the quality and quantity of carcinogenic potency data for a given chemical. Table 18-15 presents the EPA weight-of-evidence

classification system. Available RfDs and SFs for each chemical of concern are presented in Table 18-16.

### 18.3.1 Toxicity Information for Noncarcinogenic Effects

Substances that produce noncarcinogenic effects are generally thought to have a threshold dose below which there are no observable adverse health effects. In developing a toxicity value for noncarcinogenic effects, the approach is to identify this threshold dose or no-observed-adverse-effect level (NOAEL) through studies with experimental animals. A NOAEL is an experimentally determined highest dose at which there was no statistically or biologically significant effect of concern, often called the "critical toxic effect." For certain substances, only a LOAEL, or "lowest-observed-adverse-effect level," has been determined. This is the lowest dose of a substance that produces either a statistically or biologically significant indication of the critical toxic effect. The NOAEL or the LOAEL may be used to calculate the RfD of a particular chemical.

RfDs are generally calculated by dividing the NOAEL (or LOAEL) by uncertainty factors, which generally range from 10 to 1000. For example, uncertainties include variations in the sensitivity of individuals within a population and the extrapolation of data from experimental animals to humans. The RfD is expressed in units of milligrams of chemical per kilogram of body weight-per-day (mg/kg-day) for oral exposure and in milligrams of chemical per cubic meter of air-per-day ($mg/m^3$-day) for inhalation exposure. A body weight of 70 kg and a respiration rate of 20 $m^3$/day are generally used to convert the reference air concentration ($mg/m^3$) to a dose (i.e., $mg/m^3$-day). The methodology for deriving RfDs is more fully described in the EPA's current human health risk assessment guidance (EPA 1989b).

The majority of current toxicological knowledge of chemicals comes from experiments with laboratory animals. Experimental animal data have historically been relied upon by regulatory agencies and other expert groups to assess the hazards of human chemical exposures. Although this reliance has been generally supported by empirical observations, there are known interspecies differences in chemical absorption, metabolism, excretion, and toxic responses. There are also uncertainties concerning the

relevance of animal studies using exposure routes that differ from the human exposure routes under consideration. Additionally, the extrapolation of results of short-term or subchronic animal studies to long-term exposures in humans has inherent uncertainty.

Despite the many limitations of experimental animal data, such information is essential for chemical toxicity assessment, especially in the absence of human epidemiological evidence. The uncertainty factors used in the derivation of RfDs are intended to compensate for data limitations and any synergistic effects. Synergistic effects may occur when a combination of chemicals has a greater-than-additive effect. This approach is conservative by design and is meant to avoid the underestimation of protective RfD values.

The EPA has developed various types of RfDs depending on the exposure route (ingestion or inhalation), the critical effect, and the length of exposure being evaluated (chronic or subchronic). The EPA bases the RfD on the most sensitive animal species tested (i.e., the species that experiences adverse effects at the lowest dose).

The EPA defines a chronic RfD as an estimate of a daily exposure level for the human population that is unlikely to result in deleterious effects during a lifetime (70 years, according to EPA guidance). A chronic RfD is used to evaluate the potential noncarcinogenic hazards associated with long-term chemical exposures (7 years to a lifetime).

Subchronic RfDs have been developed to characterize potential noncarcinogenic hazards associated with short-term chemical exposures. The EPA defines subchronic exposure as periods ranging from 2 weeks to 7 years (EPA 1989b). Subchronic RfDs tend to be higher, generally by an order of magnitude, than chronic RfDs because of the shorter exposure duration.

Chronic and subchronic RfDs for the chemicals of concern are shown in Table 18-16. For the ingestion route, the RfD for the administered dose assumes 100 percent absorption by the gastrointestinal tract unless otherwise noted. For the inhalation route, 100 percent of a chemical that is inhaled and retained by the lungs is assumed to be absorbed into the bloodstream unless otherwise noted. Both assumptions enhance the

conservatism of the risk assessment. RfDs have also been developed from many of the carcinogens to account for their noncarcinogenic effects.

### 18.3.2 Toxicity Information for Carcinogenic Effects

In estimating the potential risk posed by potential carcinogens, it is the common practice of the EPA and other regulatory agencies to assume that any exposure level is associated with a finite probability, however minute, of producing a carcinogenic response. EPA assumes that a small number of molecular events can evoke changes in a single cell that can lead to uncontrolled cellular proliferation. This mechanism for carcinogenicity is referred to as "non-threshold" since there is theoretically no level of exposure for such a substance that does not pose a small, though finite, probability of producing a carcinogenic response. The EPA uses an evaluation process in which the substance is assigned a weight-of-evidence classification. This describes the likelihood, based on scientific evidence, that the substance is a human carcinogen. A slope factor is then calculated that defines quantitatively the relationship between average lifetime dose and carcinogenic risk.

The slope factors are based primarily upon the results of animal studies. There is uncertainty whether animal carcinogens are also human carcinogens. While many chemical substances are carcinogenic in one or more animal species, only a small number of chemical substances are known to be human carcinogens. The EPA assumes that humans are as sensitive to all animal carcinogens as the most sensitive animal species. This policy decision is designed to prevent underestimating risk, and introduces the potential to overestimate carcinogenic risk.

A number of mathematical models and procedures have been developed to extrapolate from carcinogenic responses observed at high doses in experimental animals to responses expected at low doses in humans. The EPA uses a linearized multistage model for low-dose extrapolation. This conservative mathematical model is based on the multi-stage theory of carcinogenesis wherein the response is assumed to be linear at low doses. The EPA further calculates the upper 95th percent confidence limit of the slope of the resulting dose-response curve. This SF value, expressed in units of $(mg/kg\text{-}day)^{-1}$, is used to convert the average daily intake of chemical, normalized over a lifetime, directly to

a cancer risk. This represents an estimation of an upper-bound incremental lifetime probability that an individual will develop cancer as a result of exposure to a potential carcinogen. This model provides a conservative estimate of cancer risk at low doses, and is likely to overestimate the actual cancer risk. The EPA acknowledges that actual slope factors are likely to be between zero and the estimate provided by the linearized multistage model (EPA 1989b). The slope factors and weight-of-evidence classifications for the chemicals of concern are also included in Table 18-16.

Although EPA has not established slope factors for most PAHs, their slope factors may be estimated using the SF for benzo(a)pyrene (BaP) and relative potency estimates. The (BaP) slope factor is 5.8 $(mg/kg/day)^{-1}$ (personal communication with Glen Rice; ECAO, Cincinnati, Ohio; March 10, 1992). To calculate slope factors for other PAHs, relative potency estimates for the other PAHs were multiplied by the BaP slope factor (Clement Associates 1988). PAH relative cancer potency estimates are listed in Table 18-19.

### 18.3.3 Hazard Index for Noncarcinogenic Hazards

Potential noncarcinogenic health hazards, expressed as the hazard quotient and hazard index, are calculated in a similar manner. The calculations of chronic and subchronic hazard quotients and hazard indexes are performed identically (shown schematically below). The hazard quotient (HQ) applies to individual chemicals, whereas the hazard index (HI) applies to the sum of potential noncarcinogenic health effects for chemicals of concern in a given exposure scenario.

| Chemical Concentration (mg/kg-day) | Intake Factor (kg/kg-day) | Daily Intake (mg/kg-day) | RfD (mg/kg-day) | Hazard Quotient |
|---|---|---|---|---|
| A | B | C | D | E |

in which

$$\text{Hazard Quotient(E)} = \frac{\text{Daily Intake(C)}}{\text{RfD(D)}}$$

$$\text{Daily Intake(C)} = \text{Intake Factor(A)} \times \text{Chemical Concentration(B)}$$

The hazard quotient is calculated by dividing the daily intake (Column C) by the reference dose (Column D). The daily intake (Column C) is obtained by multiplying the chemical concentration within a given medium (Column A) by the intake factor (Column B).

The individual chemical hazard quotients are summed over all the chemicals evaluated, to provide a hazard index for a given exposure scenario. The total (cumulative) hazard index for a given receptor population is obtained by combining the hazard indexes for each exposure pathway contributing to the exposure of that population. The total hazard index for multiple pathways is calculated as follows:

Total Exposure Hazard Index = Hazard Index (exposure $pathway_1$)+ Hazard Index (exposure $pathway_2$) + ...Hazard Index (exposure $pathway_i$).

Computations of hazard quotients and hazard indexes were also performed using WCC's ASSESS© risk assessment computer application software. Use of the RfD assumes that there is a level of intake (the RfD) below which it is unlikely that even sensitive individuals (i.e., the very young and old) will experience adverse health effects over a lifetime of exposure. If the average daily intake exceeds the RfD (that is, if the hazard quotient exceeds 1.0), the cause for concern for potential adverse health effects increases. The hazard quotient does not represent a statistical probability of an effect occurring but is a conservative indicator of whether there is cause for concern for a particular chemical's systemic effects. An HQ above 1.0 may indicate the need for further site-specific analyses for that particular chemical to verify data previously obtained and then used in the risk assessment. For multiple chemical exposures, the total HI might exceed 1.0 even if no single chemical intake exceeds its RfD. If the total HI is less than 1.0, cumulative exposures to the chemicals of concern at the site are judged unlikely to result in an adverse effect. If the sum is greater than 1.0, a more detailed and critical evaluation of the risks, including consideration of specific target organs affected and the mechanisms of toxic action for each chemical of concern, is required to ascertain if the cumulative exposure would in fact be likely to harm exposed individuals.

The assumption of additive effects reflected in the cumulative HI is most properly applied to substances that induce the same effect by the same mechanism. Consequently, application of the equation to a mixture of substances that are not expected to induce the same type of effects could overestimate the potential for adverse health effect. The HI provides an approximate measure of potential toxicity, but it is conservative and dependent on the quality of the experimental evidence. Since the HI does not define dose-response relationships, its numerical value cannot be construed as a direct estimate of risk (EPA 1989b), but only an indirect indicator of potential noncarcinogenic health hazards.

### 18.3.4 Carcinogenic Risk

Carcinogenic risk is defined as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen. The numerical estimate of excess lifetime cancer risk is calculated by multiplying the chronic (lifetime) daily intake (CI) by the risk per unit dose of carcinogenic or carcinogenic slope factor as follows:

$$\text{Cancer Risk} = \text{CI} \times \text{SF}$$

where

| | | |
|---|---|---|
| Risk | = | likelihood of developing cancer from lifetime exposure (70 years) expressed as unitless probability |
| CI | = | daily chemical intake of a substance averaged over a lifetime (mg/kg-day) |
| SF | = | slope factor $(\text{mg/kg-day})^{-1}$ |

The EPA slope factors are upper 95th percentile confidence limits of the probability of "response" per unit intake of chemical over a lifetime. Slope factors are based on results from studies performed with experimental animals or on epidemiological studies in humans. A linear nonthreshold mathematical model for low-dose extrapolation, the linearized multistage model, is used to calculate the value of the slope factor. The EPA

states that carcinogenic risks estimated using this approach are upper-bound estimates and that actual risks may be lower and could, in fact, be zero.

EPA guidance for evaluating potential cancer risk from simultaneous exposure to several carcinogens assumes that incremental cancer risks are additive. The concept that cancer risks are additive is based on a number of assumptions. If these assumptions are incorrect, over or underestimation of the actual risk could result (EPA 1989b). The cancer risk is estimated as follows:

$$Risk_T = \Sigma Risk_i$$

where

$Risk_T$ = total cancer risk
$Risk_i$ = the risk estimate for the $_i$th toxicant
(these individual risks are then summed to derive $Risk_T$)

EPA policy must be considered in order to interpret the significance of the cancer risk estimates. In the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300), EPA states that: "For known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper-bound lifetime cancer risk to an individual of between $10^{-4}$ and $10^{-6}$." The Agency further states, in the preamble to the NCP, that the $10^{-6}$ risk level be used as a point of departure for establishing remediation goals for the risks from constituents at Superfund sites. Recent EPA guidance indicates that if the estimated total cancer risk based on maximum exposure conditions is $10^{-4}$ or less, further action at the site is generally not warranted unless there are adverse environmental impacts or drinking water standards are exceeded (MCLs or MCL Goals) (40 CFR 141 and 143).

Carcinogenic Risk Calculation

The parameters presented below represent the format utilized in the calculation of potential carcinogenic risks:

| Chemical Concentration (mg/kg) A | Intake Factor (kg/kg-day) B | Lifetime Daily Intake (mg/kg-day) C | Slope Factor $(mg/kg\text{-}day)^{-1}$ D | Cancer Risk E |
|---|---|---|---|---|

in which

Lifetime Daily Intake(C) = Chemical Concentration(A) x Intake Factor(B)
Cancer Risk(E) = Slope Factor (D) x Lifetime Daily Intake(C)

The cancer risk is calculated by multiplying the lifetime daily intake (Column C) by the slope factor (Column D). The lifetime daily intake (Column C) is obtained by multiplying the intake factor (Column B) by the chemical concentration in media (Column A).

The cancer risks are summed over all of the chemicals evaluated for each exposure pathway. To determine the total carcinogenic risk for a given receptor population, the cancer risks for each exposure pathway contributing to the exposure of that population are summed. The total (cumulative) carcinogenic risk is calculated as follows:

Total Exposure Cancer Risk = Risk (exposure $pathway_1$) + Risk (exposure $pathway_2$)... + Risk (exposure $pathway_i$)

These computations are performed by Woodward-Clyde's ASSESS© risk assessment software.

### 18.3.5 Evaluation of Potential Lead Exposure to Children

Childhood lead poisoning is manifested by anemia, abdominal pain, and central nervous system effects. As an enzymatic poison, lead affects susceptible developing tissues rather than tissues with a stable metabolism. Therefore, subclinical forms of lead poisoning are most dangerous to children as its effects emerge without associated symptoms that bring the victim to medical attention. In the acute clinical form of lead poisoning, signs and symptoms are thought to reflect both the direct effect of high blood concentrations of lead (greater than 80-100 $\mu g/dL$) and subsequent severe alterations in porphyrin

synthesis. Signs and symptoms include anemia, abdominal pain, lethargy, anorexia, ataxia, and slurred speech. In more severe cases, convulsions, coma, and possible death are usually due to severe generalized cerebral edema and renal failure. Almost always associated with this syndrome is a high exposure to environmental lead (usually paint chips or house dust with high levels of lead), pica (the ingestion of non-food substances), and malnutrition (iron, calcium, and zinc deficiency).

The EPA withdrew the established RfD for lead in late 1989 because of the uncertainty concerning a safe threshold value or RfD. The Office of Solid Waste and Emergency Response (OSWER) provided a Directive (#9355.4-02) entitled "Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites" which recommends a residential soil lead cleanup level of 500 to 1000 ppm (EPA 1990a). OSWER Directive #9355.4-02A was a follow-up document reiterating that the former Directive was only interim guidance and not an enforceable regulation.

OSWER Directive #9355.4-02 identifies the EPA Integrated Uptake/Biokinetic (UBK) Model as the best available approach to use as a risk assessment tool to predict blood lead levels of the most sensitive populations (i.e., infants and children 6 months to 7 years old) who are potentially exposed to lead in air, dust, drinking water, soil, and lead-based paint). The recently published statement by the Centers for Disease Control indicates that the goal of all lead poisoning prevention activities should be to reduce children's blood lead levels below 10 $\mu$g lead/dL blood (CDC 1991).

Infants and children (ages 6 months to 7 years) have been identified as the populations most vulnerable to lead exposure. Children absorb a greater fraction of an oral dose of lead than adults, and a child's developing nervous system is more sensitive to lead. In addition, children are known to digest more dirt (EPA defines dirt as soil and dust) by mouthing behavior than adults. Considerable controversy remains regarding the biological significant of some of the effects attributed to chronic, low level lead exposure and the blood levels at which they occur. However, the EPA has stated a blood level of 10 $\mu$g/dL is a "level of concern" based on studies correlating this blood level with measurable physiological effects (EPA 1991d). A level of concern is not the same as a threshold, however. A level of concern represents a blood level that warrants the attention of a regulatory body (medical or governmental) and does not imply that

toxicological effects occur at lower exposures (Davis 1990 as cited in EPA 1991d). In the 1991 CDC statement of lead poisoning in children, the 10 $\mu$g/dL level is used as trigger for a community-wide educational program. Case management or medical intervention are based on higher blood levels in individual children.

Multi-media exposures and the lack of empirical evidence for a threshold for lead in infants and young children make it difficult to establish meaningful oral and inhalation reference doses (RfDs) for lead. On the other hand, blood lead levels provide an important index of risk because most toxicity endpoints associated with lead exposure can be correlated with blood lead levels. The EPA UBK Model accounts for multi-media exposures and provides a method for predicting blood lead levels in potentially exposed populations. Using the maximum concentration for lead in groundwater samples collected for this RI (0.034 mg/L) and the highest 95% UCL concentration for soil lead among all RAAs (411 mg/kg), the predicted blood lead level for 95% of the population (children 6 months to 7 years of life) was less than 10 $\mu$g/dL.

## 18.4 EXPOSURE ASSESSMENT

### 18.4.1 Introduction

The objective of this exposure assessment is to assess and evaluate human receptors that are potentially exposed to site chemicals, the manner by which exposure occurs or is likely to occur, and the amount of chemical intake resulting from such exposure. To meet these objectives, the exposure assessment identifies populations that are likely to be exposed to site-related chemicals, the various media in which site chemicals are found or transported, the exposure routes, and the estimated magnitude, frequency, and duration of the exposures. The exposure assessment also addresses the physical and chemical properties of the chemicals of concern that may facilitate their movement through the environment and their uptake by humans via the complete exposure pathways. The exposure scenarios evaluated are those for "baseline" conditions, which are exposures that would be expected to occur at present, and "future use" conditions under which it is assumed that no-further remedial action has been implemented to reduce the potential exposure point concentrations and the degree of human exposure

to site-related chemicals. The exposure scenarios examined therefore include both current and hypothetical future land use scenarios at Cannon AFB.

To guide the exposure assessment, the EPA's Superfund RI/FS guidance recommends the development of a Conceptual Site Model (CSM). A CSM was developed for each RAA. The CSM evaluates the sources of potential chemical release and transport and identifies potential receptor populations and the routes by which they may be exposed. Based on the CSM, estimates of exposure point concentrations for chemicals of concern were compiled with the validated analytical data from the appropriate environmental media. In the case of inhalation of volatilized organic compounds or fugitive dust containing COCs, predictive air modeling was performed. With the intake equations provided by the Risk Assessment Guidance for Superfund, chemical intakes for each complete, significant exposure pathway were estimated. The results of the exposure assessment are pathway-specific chemical intakes of identified chemicals of concern. These chemical intakes were used in conjunction with chemical-specific toxicity factors to characterize risks.

A summary of the remaining sections of the exposure assessment is provided below. Section 18.4.1 provides descriptive site information pertinent to the exposure assessment. Section 18.4.2 describes the potential receptor populations and activities that may lead to exposure to site chemicals, and Section 18.4.3 presents a general description of the conceptual site model, which examines all major exposure pathways. Section 18.4.4 explains the methods used to estimate chemical intakes. The concept of average and reasonable maximum exposure (RME), consistent with the current EPA policy, is also presented in this section. Specific information on the CSM, exposure pathways, and receptors for each RAA is provided in the remaining sections.

#### 18.4.1.1 Site Description

The following sections describe the physical setting, hydrogeology, and demographics of Cannon Air Force Base and the surrounding area as they pertain to the human health risk assessment. Human populations potentially exposed to chemicals of concern that may be released from each RAA (receptor populations) are then identified.

Physical Setting

Cannon AFB comprises 4,320 acres of land and is located in Curry County in east central New Mexico. The site is located approximately 7 miles west of the city of Clovis and is just south of U.S. Highway 60-84 in a farming and ranching area. The vicinity map of Cannon AFB and the site map, identifying all SWMUs investigated in the RI was presented in Figure 1-2 in Section 1.4.

Situated in the Southern High Plains Physiographic Province in the Llano Estacado subprovince, Cannon AFB rests on nearly flat terrain. Elevations range from 4,250 to 4,350 feet above mean sea level (msl) in the vicinity of the base. No streams exist on or near Cannon AFB. The nearest streams are Running Water Draw and Frio Draw, 10 and 20 miles, respectively, north of the base. Blowouts are broad shallow depressions which form as the result of wind erosion. 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 which have no external drainage. Without recharge, playa lakes persist for only a few days or weeks.

Climate

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 1990). Average monthly precipitation ranges from 1 cm (0.4 inches) in winter to 6.9 cm (2.7 inches) in July (WCC 1991a). 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. 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 1990a). Prevailing winds are from the west at an average of 5 km/hr (3.1 mph) during fall, winter, and spring. During the summer, winds blow from the south at an average of 3.7 km/hr (2.3 mph).

Dust may be entrained into the atmosphere in this region of the country because of gusty winds and the semi-arid 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 (averaging 5 km/hr).

Hydrogeological Conditions and Evaluations

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. The lower portion of the Ogallala Formation is the primary regional aquifer for both potable and irrigation water. No deeper aquifers are used 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 the Dockum Group formations, which serve as the basal confining layer. The Ogallala is a water table (unconfined) aquifer (Lee Wan and Associates 1990). At Cannon AFB, the Ogallala Aquifer begins at approximately 240 feet below ground surface and has an average saturated thickness of 120 feet, based on mid-1960s data. The local groundwater gradient is southeasterly at 7.5 feet/mile (Lee Wan and Associates 1990). Yields in tests at Cannon AFB water wells have ranged from 776 liters per minute (205 gallons per minute) to 4353 liters per minute (1150 gallons per minute).

Recharge to the Ogallala is primarily through precipitation. Recharge rates range from 0.5 inch/year to 1.0 inch/year. Due to the high evapotranspiration and low precipitation rates, 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 dominant uses of groundwater in the Cannon AFB area are for drinking and irrigation. Discharge of groundwater to surface water does not occur on or near Cannon AFB. The rate of discharge exceeds recharge. Water levels in the Ogallala have

declined steadily from the 1930s to the present, with a decline of 50 to 100 feet observed in the area around Clovis, New Mexico for the period from 1930 to 1980.

Numerous wells are located near Cannon AFB, most of which provide only irrigation water (Table 18-18). Nine wells are located on Cannon AFB for domestic and occupational use (Table 18-19) (Walk, Haydel and Associates 1990). The locations of domestic and commercial groundwater wells on and in the vicinity of Cannon AFB were presented in Figure 1-7 of the RI.

As part of this investigation, ten existing monitoring wells were sampled in three areas of Cannon AFB (i.e., Old Entomology Rinse Area - SWMU No. 96; Wastewater Lagoons - SWMU Nos. 101 and 102; and Landfill No. 5 - SWMU No. 113). Appendix IX parameters were analyzed in the five wells at Landfill No. 5, Appendix IX VOCs were analyzed in the four wells adjacent to the Wastewater Lagoons, and TAL metals and PCGs were analyzed in the well at the Old Entomology Rinse Area. All parameters detected in these samples were within current MCL values. No organics were detected in the groundwaters at these three areas above the reporting limits. In all wells samples, some metals were detected in the groundwater, but in all cases, the concentrations were below the MCL values. In most cases where metals were detected, they were present at estimated concentrations below the detection level. Based on these metals and organic data, no chemicals of concern were considered to be present in the groundwater. Therefore, groundwater is not regarded as a pathway for contaminant transport. The fate and transport of potential contaminants in groundwater, as well as other media, is discussed in Section 17.0.

Site Land Use and Demographics

This section describes land use and the populations that might be exposed to chemicals potentially released from the facility. The purposes of this section are (1) to identify potential human receptor populations and (2) to provide a basis for identifying exposure pathways to be further detailed in the exposure assessment. Cannon AFB is mainly surrounded by irrigated farmland and grassland. Major crops produced in the area are wheat, sorghum, sugar beets, corn, cotton, alfalfa, barley, and peanuts. The land is also used for beef and dairy cattle grazing. Sorghum, used for livestock feed, and peanuts

are grown nearby. Winter wheat grown in the area is used for human food, livestock feed, or for cattle grazing.

As a military installation, the use of Cannon AFB is highly specialized and land use cannot be significantly altered (i.e., converted to private commercial or residential use) without the approval of the U.S. Congress and the Secretary of Defense. Cannon AFB has been in operation since 1965, fulfilling the primary mission of serving as a home base for an F-111 tactical fighter wing and providing training of combat units for tactical organizations worldwide. Approximately 70 aircraft are assigned to the base. As of July, 1989, Cannon AFB's total work force consisted of approximately 3,500 military and 500 civilian personnel. For security and safety reasons, ingress and egress to the base is restricted. Except for authorized maintenance workers or base personnel, individuals generally do not enter the air field areas, where most of the SWMUs are located.

Most of the buildings on Cannon AFB are located in the corner of the base northwest of the NE-SW runway. As of July of the 1989 calendar year, 761 of the residential buildings on the base were family homes and 10 were large dormitories for "unaccompanied personnel." Also as of July of the 1989 calendar year, 830 military personnel lived in the base dormitories and 1,011 in the base family housing. These population figures do not include spouses and other dependents (USAF 1990). Depending on the length of tour, military personnel occupy a transient status. Very rarely will the military personnel be permanently assigned to the base. Civilian personnel such as clerks and maintenance workers do not live on base.

#### 18.4.1.2 Potential Receptor Populations

Receptor populations selected for evaluation in the human health risk assessment at Cannon Air Force Base are current and future SWMU workers, and future, hypothetical adult and child residents who may reside at a previously located SWMU or within RAA. Currently, general-duty workers who work at or adjacent to a given RAA are assumed to be the most likely human receptors. In addition, construction workers at the RAA may also be exposed in the future. The hypothetical residential receptors, assumed to live at current RAAs, represent the population with the upperbound exposure. The presence of such future-use receptors is highly unlikely and evaluation of future

hypothetical residents is, therefore, conservative since commercial or industrial land use is the most likely future land use scenario associated with Cannon AFB.

Human populations on and near the site were evaluated to assess their likelihood of exposure to site-related chemicals of concern. In general, the RAAs are located away from the residential areas and population density areas on base. Access to the SWMUs is generally restricted to on-base workers. EPA guidance does not require an exhaustive assessment of every potential receptor and exposure scenario in a BRA. Rather, the exposure scenarios judged to be reasonable and conservative should be examined, along with an assessment of any associated uncertainty (EPA 1989b; EPA 1992b). The receptor populations quantitatively evaluated in the BRA are those most likely to be exposed and have potentially the greatest degree of exposure to site-related chemicals. Potential risks to populations not evaluated in this risk assessment are expected to be much lower. A brief summary of potentially exposed receptor populations for the RAAs being investigated at Cannon AFB is presented below. The identification of those receptor populations with the greatest potential degree of chemical exposure at each RAA and the identification of exposure points concentrations for these receptor populations is presented in later sections. Table 18-20 presents the rationale for the selection of receptor populations and exposure scenarios.

Sensitive receptors within the study area are those who might be particularly susceptible to chemical exposure. They may include infants, the elderly, or individuals with chronic health problems. Sensitive receptor locations generally include hospitals, convalescent homes, schools, and day care centers. The sensitive receptors identified for this risk assessment were children who may live within the RAA in the future. Potential health risks to children were evaluated for each residential receptor location selected for quantitative risk evaluation.

Potential human receptors for the current and future exposure scenarios are:

<u>Current Exposure Scenario</u>

- Maintenance worker (on-site and off-site)
- Residential child (off-site/out of the RAA)

- Residential adult (off-site/out of RAA)
- Trespassers or visitors (on-site and off-site)

Future Exposure Scenario

- Maintenance (general-duty) worker (on-site and off-site)
- Construction worker (on-site)
- Residential child (on-site)
- Residential adult (on-site)
- Trespassers or visitors (on-site)

The above receptors, identified as possible receptors, may include off-site and on-site residents, on-site workers near the SWMUs, on-site excavation/sewer maintenance workers, off-site farm and cattle workers, and on-site visitors and trespassers. On-site receptors include humans physically located within a SWMU. Off-site trespassers are not expected to trespass as frequently as on-site trespassers because base access is restricted. Receptors included in the quantitative estimation of potential health risks were the SWMU workers, including on-site sewer maintenance workers (baseline and future use/no action) and on-site adult and child residents (hypothetical future use/no action). Trespassers and on-site and off-site residents/workers were not included in the quantitative risk assessment because their exposure frequencies and durations of exposure would be lower than for the future residents and workers within the RAA. Their potential exposure to site chemicals would therefore be considerably less than the potential exposure to on-site workers or future residents. In other words, the potential exposure and risks for workers (current and future), as well as future residents within the RAAs, is expected to be greater than the potential risk to other on-site or off-site receptors.

Future, hypothetical residents and construction workers were not automatically assumed for all RAAs. With the exception of RAA7 (SWMU No. 98, Sanitary Sewer Line), excavation (construction of residential homes) is assumed to be plausible in the future for RAAs of adequate size and configuration. An area of one-half acre, the area in which on-site workers are most likely to be exposed on a continuous basis, was used to evaluate the likelihood of future construction at each RAA (Neptune et al., 1990). This

area, referred to as an exposure unit, is an area where people working in or visiting the site would be expected to receive exposures to site-related chemicals (Neptune et al., 1990). This is also a reasonable size of land on which residential homes are likely to be constructed. Areas less than 0.5 acre were considered to be too small for workers, or subsequent future residents to be consistently exposed to chemicals of concern for the duration or frequency of time assumed for their respective exposure pathways. RAAs with areas less than one-half of an acre were therefore not evaluated for future construction or residential land use. The RAAs with more than one-half acre are RAA1, RAA3, RAA6, and RAA7.

The wastewater lagoons (SWMU Nos. 101 and 102) and Landfill No. 5 (SWMU No. 113) are not expected to be disturbed without extensive construction planning and modification of the existing piping, structures, and conveyances. Such changes would require regulatory approval for permitted closure. The areas covering SWMU Nos. 101, 102, and 113 were therefore not included in the one-half acre areal comparison.

Residents and construction workers were considered plausible receptors for the Fire Training Areas (SWMU Nos. 106, 107, and 109) in RAA1. The Northeast Drainage Ditch (RAA3), RAA6 and RAA7 are long and narrow bands of land. In these areas, it was assumed that excavation for general maintenance or repair of underground structures, such as the sewer lines, was plausible. Future use residents and construction worker receptors were also considered plausible for RAA3. Construction workers were assumed to be the only plausible receptors at the Northeast Drainage Ditch Area. A more detailed description of the receptor and exposure pathways for each RAA is presented in the final subsection of this exposure assessment.

The assumption that hypothetical residents are exposed to chemical concentrations at each RAA is a conservative approach to assessing potential health risks and ensures that potential health risks are not underestimated. The on-site residential receptors are not likely to be present in the foreseeable future since Cannon AFB is a military installation and land use and access are highly restricted. Risk estimates calculated for future residents are used for general information only and should not be used for development of remedial action alternatives or target cleanup levels, nor should these risk estimates be construed as indicators of probable future site risks or hazards.

### 18.4.1.3 Conceptual Site Model (CSM)

The CSM is an important tool for planning and implementing human health and environmental risk assessments. Development of the CSM is recommended under the EPA RI/FS guidance (EPA 1988b). The CSM discusses chemical release sources and transport media, potential human receptors, exposure points, and intake mechanisms for each risk assessment scenario. The CSM provides a framework for evaluating potential risks associated with the site, aids in the identification of data gaps, and assists in the identification of appropriate preliminary remediation goals. In conjunction with the CSM, the physical and chemical fate and transport properties of site-related chemicals, as well as available environmental data, are also critical to the exposure assessment.

The 18 SWMU Nos. at Cannon AFB are grouped into 7 RAAs. Exposure pathways and receptors for each RAA are designated in Figures 18-1 through 18-8. In these figures, a solid circle represents a significant complete exposure pathway, an open circle represents a pathway in which chemical intakes are considered to be relatively insignificant in comparison to other exposure pathways, and an "I" designates an incomplete pathway.

An exposure pathway describes the means by which release, transport, and intake by receptor populations of site-related chemicals of concern occurs. An exposure pathway consists of five 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)
- Human receptors located at these points

- A human intake mechanism (e.g., inhalation or ingestion) at the point of exposure

All five elements must be present for an exposure pathway to be complete and for chemical exposure to occur.

Exposure to site chemicals in groundwater may occur, for example, directly via groundwater ingestion from a downgradient well. This potential exposure pathway for on-site receptors is judged to be incomplete for the following reasons:

- Data from groundwater monitoring wells located around potential waste sources (Wastewater Treatment Lagoons and Landfill No. 5) indicated that all detected chemicals were below the Maximum Contaminant Levels (MCLs) under the Safe Drinking Water Act. According to base personnel, historic groundwater data have not exceeded drinking water MCLs in these monitoring wells (Personal communication, May 5, 1992, Lt. Norman Hepner, Cannon AFB Bioenvironmental Engineer).

- Volatile or semi-volatile organic chemicals were not detected in groundwater samples. Volatile organic compounds in soil are expected to volatilize and escape as fugitive emissions before they are able to leach to groundwater. The potential inhalation of volatile organic chemicals of concern was quantitatively evaluated in this BRA.

- Chemical concentration profiles in soil borings did not indicate increasing chemical concentrations at depths below approximately 30 feet. The depth to groundwater is approximately 240 feet BGS. Most of the SWMs evaluated have been in existence for more than 20 years, suggesting that extensive migration of chemicals in subsurface soils has not occurred.

- Site geology (the presence of clay and Caliche (calcium carbonate) layer within the vadose zone) impedes the mobility of metals.

- Semivolatile organic compounds such as pesticides are not sufficiently mobile to impact the underlying Ogallala Aquifer, which is approximately 240 feet BGS.

- A groundwater monitoring program is currently in place and is scheduled to continue.

Since the hypothetical scenario of consumption of COCs in groundwater is not plausible, the potential risks and hazards associated with groundwater were not quantified in this BRA.

Without exposure, there can be no risk. Potential exposure pathways were evaluated for all potential chemical sources within each RAA. Complete, significant exposure pathways were quantitatively assessed by estimating chemical intakes and calculating potential carcinogenic risks and noncarcinogenic health hazards. Incomplete exposure pathways do not result in actual human exposure or potential risk, therefore, they were not included in the quantitative risk assessment process. The quantitative estimation of risks and hazards was performed only for site chemicals with available EPA toxicity values. Site-related chemicals without toxicity values were evaluated qualitatively in this BRA.

The potential sources of chemical emissions from the site are presented in Figures 18-1 to 18-8. The primary source is generally waste or discarded commercial chemical products discharged or spilled on land; the secondary sources refer to other media such as subsurface soil, surface water runoff, or biota impacted by the primary source. Site chemicals in these media or sources may be transported away from the primary source, impacting other environments that may act as tertiary sources for the site chemicals. Fugitive dusts or volatilized chemical constituents emanating from the primary or secondary sources may impact the ambient air and may be transported away from the source. The distinction among primary, secondary, and tertiary sources is not always clear, and there are cases where the sources can be viewed as both primary and secondary. The key factor to the development and understanding of the CSM is to identify the exposure pathway through which a site chemical is likely to be available for uptake by the receptor.

An exposure point is defined as a location of potential contact between a receptor and a medium that contains site-related chemicals. The objective of selecting exposure points is to identify locations where receptor populations may be potentially exposed to chemicals of concern in the environmental transport media. Chemicals in environmental media may be taken into the body via inhalation, ingestion, or dermal absorption. Each exposure pathway was evaluated for the potential for human intake. Potential human exposure pathways for each of the RAA are presented in Sections 18.4.2 through 18.4.8 (see also Figures 18-1 through 18-8). In general, the primary exposure pathways for each RAA are soil ingestion, dermal absorption, and fugitive dust and VOC inhalation. It was assumed that for the dermal absorption pathway, metals are not significantly absorbed through the skin (EPA 1989b). Thus, metals were not considered chemicals of concern for the dermal absorption pathway.

#### 18.4.1.4 Quantification of Exposure

Following development of the CSM, the next step in the exposure assessment is to quantify the magnitude, frequency, and duration of exposure for the defined receptor populations. This step is conducted in two stages: (1) measurement and/or estimation of exposure point concentrations, and (2) estimation of intake for each of the exposure pathways considered in the risk characterization. Exposure point concentrations are derived from measured chemical data or from modeling. Some general considerations in quantifying exposure are presented in this section as an overview of the process and how it relates to the risk assessment. These principles are then applied to the risk assessment for each RAA. Input values for parameters pertinent to individual exposure pathways for each RAA are presented in Appendix D-3.

Average and Reasonable Maximum Exposures

Exposure to a chemical is described in terms of intake, which is expressed in units of milligrams of chemical per kilogram of body weight per day (mg/kg-day). The magnitude of exposure to a chemical (or intake) is a function of a number of variables, including exposure point concentration and variables that describe intake (e.g., contact rate, exposure frequency and duration, and body weight). Each of these variables can be described by a range of values. For purposes of this assessment, two measures of

chemical intake are estimated: average exposure and reasonable maximum exposure (RME).

The average exposure is estimated using the arithmetic average of the exposure point concentration and exposure variables that represent central values or best estimates of exposure for an individual, given normal activity patterns. The RME has been estimated using guidance provided in EPA's Risk Assessment Guidance for Superfund (EPA 1989b) and supporting guidance documents. The reasonable maximum exposure is estimated by selecting intake parameters so that the combination of these variables results in the maximum exposure that can reasonably be expected to occur. The intent of the RME is to estimate a conservative, above-average chemical intake that is still within the range of possible exposures. The EPA recommends that the 95 percent upper confidence limit (UCL) of the arithmetic average be used as the chemical exposure point concentration when calculating the RME. In cases where the maximum concentration is lower than the 95% UCL concentration, the maximum was used in the chemical intake calculation to provide a more reasonable estimate of the exposure point concentration (EPA 1989b).

Estimating Chemical Intake

The general equation for calculating intake in terms of mg/kg-day is:

$$\text{Intake} = \frac{\text{chemical concentration x contact rate x exposure frequency x exposure duration}}{\text{body weight x averaging time}}$$

The units for the above equation are expressed as: intake (mg/kg-day); chemical concentration (mg/weight or volume); contact rate (weight or volume/day); exposure frequency (days/year); exposure duration (years); body weight (kg); and averaging time (days).

The contact rate depends on the exposure route and is equivalent, for example, to the volume of water ingested or air inhaled per day. Exposure frequency and exposure duration are site-specific. Body weight is assumed to be 70 kg for adults. Child body

weight is calculated using a time-weighted average. The averaging time, expressed in days, is used to calculate average daily intake. For noncarcinogenic chemicals, chronic intakes are calculated by averaging over the period of exposure (exposure duration multiplied by 365 days) to yield an average daily intake. For carcinogens, intakes are calculated by averaging the total cumulative dose over an assumed lifetime of 70 years, yielding a lifetime average daily intake. Different averaging times are used for carcinogens and noncarcinogens because it is thought that their effects occur through different mechanisms. In essence, exposure to low doses of a carcinogen over an extended duration (7 years or more) is assumed to be cumulative. The approach for carcinogens is based on the current scientific opinion that a high dose received over a short period of time (as conducted in chronic studies in experimental animals) is equivalent in the dose-response rate to a corresponding low dose spread over a lifetime. Therefore, the intake of a carcinogen, for whatever duration, is averaged over a 70-year lifetime.

Omitting the chemical concentration from the intake equation yields an intake factor, which is constant for each exposure pathway and receptor. The general intake factor equation is:

$$\text{Intake Factor} = \frac{\text{contact rate x exposure frequency x exposure duration}}{\text{body weight x averaging time}}$$

The intake factor can be multiplied by the concentration of each chemical to obtain the pathway-specific intake of that chemical. Intake factors are calculated separately for each potentially exposed receptor and exposure pathway. They were calculated to facilitate the presentation of exposure calculations in the risk characterization section of this report. Supporting documentation for the calculation of intake factors appears in Appendix D-3.

General Exposure Assumptions

Several exposure parameters, such as body weight and averaging times, have general application in all intake estimations, regardless of pathway. These general assumptions, as well as pathway-specific assumptions, are detailed in the sections below and were used as guidelines in estimating exposure and intake in this BRA. For residents, average duration of exposure to potentially contaminated media is 9 years, which is the national median time in a single residence (EPA 1989c). Reasonable maximum duration of exposure of residents to potentially contaminated soils is 30 years, the national upper-bound (90th percentile) time at one residence (EPA 1989c).

The average exposure duration for workers was also assumed to be 9 years, based on the median time at a residence. The reasonable maximum value used was 25 years, which is the 95th-percentile value for time worked at a particular location (EPA 1991a). Under the RME exposure assumption, full time workers within an RAA were assumed to be at the area 8 hours per day, 250 days per year (EPA 1991a) unless site-specific information was provided. This allows for two weeks of vacation per year. Workers were assumed to not take sick leave in addition to vacation time, which is a conservative assumption. Data concerning the frequency and duration of exposure, for workers in each RAA, were obtained from interviews with Cannon AFB personnel.

The average value used for the amount of time residents spend at their homes is 274 days per year (75% of the time). The RME value used for the amount of time residents their homes is 350 days per year, which assumes residents take 2 weeks of vacation per year away from home (EPA 1991a). Resident receptors were assumed to be at the SWMU for 16 hours per day in the average case, and 24 hours per day in the RME case.

The average adult body weight is 70 kg (EPA 1989c). To estimate exposures to children over the course of 9 years, a time-weighted average body weight of 18 kg is used for the average duration of exposure. Likewise, to estimate a 30-year (reasonable maximum) exposure beginning in infancy, a time-weighted average body weight of 48 kg is used. The weighted averages were calculated based on EPA's Exposure Factors Handbook (EPA 1989c). Body weight data and weighted averages are presented in Table 18-21.

The averaging time for noncarcinogenic effects is the total number of days over which the exposure occurs. Averaging time for carcinogenic effects is 70 years (25,550 days) in the average and RME scenarios (EPA 1989b).

Inhalation Assumptions

Uptake of chemicals of concern through inhalation is a function of the volume of air inhaled per day, the exposure frequency and duration, pulmonary deposition, and ciliary clearance of inhaled contaminants. The specific inhalation rates were based on the assumed average level of activity during the exposure period; these values are specific to each receptor population. The following assumptions are used to estimate exposure to chemicals of concern through the inhalation route:

- Of the particles inhaled, it is assumed that 75 percent are deposited in the lung and the remainder is exhaled (Hawley 1985).

- Of the particles deposited in the lung, 62.5 percent are cleared by ciliary action; 37.5 percent remain in the lung and are absorbed (MRI 1985). Thus, approximately 25 percent of chemicals adsorbed to particulates are inhaled into the lungs.

The volume of air inhaled daily by residents was assumed to be 15 $m^3$/day (0.63 $m^3$/hr) for the average and RME scenarios (EPA 1991a). Because the ratio of inhalation volume to body size remains relatively constant over a lifetime, identical inhalation rates for the child receptor were assumed. Cannon AFB SWMU workers were assumed to inhale 20 $m^3$/day (0.83 $m^3$/hr) of air in both the average case and the reasonable maximum case (EPA 1991a). With the daily use of power tools by maintenance or construction workers, this inhalation rate is reasonable and in accordance with the EPA's Standard Default Exposure Factors supplemental guidance (EPA 1991a). Construction workers were assumed to inhale 20 $m^3$/day (0.83 $m^3$/hr) in the average case and 30 $m^3$/day (1.25 $m^3$/hr) in the RME case. For inhalation of fugitive dust, it was assumed that the ground surface was frozen or snow-covered for approximately 36 days per year (DOC 1986). Thus, chemical intake via particulate inhalation was reduced by a fraction of 0.9 (90% of the total particulate intake without frozen or snow-covered ground).

Ambient Air Concentration Calculation

Fugitive dust emissions were estimated for RAAs using a wind erosion model. Emission rates for volatilized organic compounds were estimated using a steady-state diffusion model. Chemical emissions were assumed to be transported by wind within the conservative mixing height of the simplified box model. Meteorological data in the Cannon AFB area were used in the air modeling when available and applicable. The potential human receptors were assumed to be in the immediate area of the RAA (i.e., inside the box). The exposure point concentration, based on the air modeling techniques described above, used average and 95% UCL concentrations in soil. The airborne particulates or fugitive dust within the RAA were conservatively assumed to be inhalable (i.e., suspended particulates of aerodynamic size between 0 to 10 micrometers [$PM_{10}$]) and the chemical concentration of the airborne particulates was assumed to be the same as that in the soil within the RAA. Indoor and outdoor air concentrations were assumed to be the same, which is a conservative assumption for indoor air. It is assumed that no respiratory protection was worn under any of the exposure scenarios evaluated. A summary of the air modeling approach used in this BRA and the supporting documentation of the calculations performed is presented in Appendix D-2.

Soil Ingestion Assumptions

Uptake of chemicals of concern via incidental ingestion of soil and house dust is a function of the rate of ingestion, the fraction of ingested soil or dust that is contaminated, and the frequency and duration of exposure. Children between the ages of 1 and 5 years are believed to exhibit greater hand-to-mouth behavior and, therefore, to ingest greater amounts of soil and house dust than adults. For this risk assessment, the assumed most likely soil/dust ingestion rate for a child is 50 mg/day although there is significant peer reviewed literature that supports lower ingestion rates (Calabrese et al. 1989, 1990). The RME value used for child soil ingestion is 50 mg/day for the average case and 200 mg/day for the RME case.

Adult residents and SWMU workers were assumed to accidentally ingest 10 milligrams of soil per day in the average case (EPA 1989c) and 50 milligrams of soil per day in the reasonable maximum case (EPA 1991a). It is also assumed for workers that normal

industrial hygiene practices that limit eating and smoking while working are not in place. This results in a conservative estimate of worker soil ingestion, which generally occurs by hand-to-mouth transfer of soil.

Details regarding potential exposure pathways are listed below for each RAA being evaluated. Site-specific background information on each SWMU, unless otherwise referenced, was provided by Mr. Bruce Hale (Personal communication, Bruce Hale; October 30, 1991).

### 18.4.2 Risk Assessment Area 1

Risk Assessment Area 1 consists of three fire training areas (SWMU Nos. 106, 107, and 109), and Landfill No. 5 (SWMU No. 113). The conceptual site model (CSM) for RAA1 is presented in Figure 18-1. SWMU No. 109 (Fire Training Area [FTA] No. 4) and SWMU No. 107 (FTA-3) remain active, whereas SWMU No. 106 (FTA-2) is inactive. SWMU No. 109 was used for fuel truck cleaning for approximately 13 years and has been used for fire training for approximately 16 years. Located in an open field, SWMU No. 109 is a training area for about 20 people for approximately 5 hours per month. SWMU No. 109 includes an oil/water separator, and it historically contained a waste oil tank (which was removed) and an unlined pit used to collect surface runoff.

Previous reports indicate that in SWMU Nos. 106 and 107, unused JP-4 fuel was used to create fires from 1968 to 1974 ($CH_2M$ Hill 1983). These SWMUs are in a relatively uninhabited area in the southeast corner of the base, between an abandoned taxiway and the boundary fence. SWMU No. 106 is currently not in use and is located in an open grass-covered field. Due to the remoteness and inactivity of this SWMU, personnel generally do not visit this site. SWMU No. 107 is used for explosive ordinance disposal practice by 5 workers for approximately 1 hour per month (Personal communication, Jim Richards; March 1992).

SWMU No. 113 (Landfill No. 5) is inactive and is also located in the southeastern corner of the base. It occupies approximately 30 acres. The entire landfill is surrounded by a fence. According to records, waste materials formerly received at the landfill include domestic solid waste, waste oils, solvents, paint, paint thinner and remover,

pesticide containers, and empty cans and drums (Radian 1986). The waste was covered with fill and the surface of the landfill is currently vegetated. One cell of the landfill, Cell 3, used to receive hazardous waste but it is currently inactive and has been covered with fill material. Landfill No. 5 is scheduled to be capped and closed in accordance with EPA and New Mexico Environmental Improvement Department (NMEID) requirements. Five groundwater monitoring wells are located along the east and south boundaries of this landfill. Workers monitor these wells quarterly or semi-annually, spending approximately 5 to 10 hours per quarter in the area.

#### 18.4.2.1 Exposure Pathways

The primary chemical sources in this RAA include fuel spills to the soil during fire training and chemicals potentially released to the soil. The hazardous waste cell of the landfill is covered with fill and the entire landfill is fenced, which effectively prevents current and future direct contact of site chemicals by humans or the generation of fugitive emissions in the form of dust/particulates or volatilized site chemicals. Dust generation is further inhibited by vegetation covering the landfill. The primary release mechanism is mixing and infiltration of chemicals into soils. A secondary release mechanism from the soil includes the potential leaching of chemicals to groundwater. This is not expected to be a significant release mechanism because the landfill has been covered with fill and no chemicals have been detected in downgradient monitoring wells surrounding the landfill. Construction is not expected in the landfill area due to soil instability and potential flammable gas generation.

The fire training areas (FTAs) are larger than half an acre. Therefore, the potential for soil excavation and residential home construction in the future is plausible. Direct contact with soils containing chemicals may result in potentially significant exposure via ingestion or dermal absorption. Such pathways may be particularly important in children, who are expected to exhibit mouthing behavior between the ages of approximately 1 and 6 years (EPA 1989c). A high frequency of contact with soils by children is not expected under current conditions due to the location of these SWMUs and access limitations. Workers in the vicinity of these SWMUs are the most likely to come into contact with soil from these areas. Chemicals can be released from the FTAs

into the air via volatilization or via fugitive dust emissions, resulting in potential exposures via inhalation.

Secondary release mechanisms from soil in the FTA areas include leaching of chemicals to groundwater (GW), stormwater runoff to surface water (SW), direct contact with subsurface soils, fugitive VOC and dust emissions, and intrusive actions such as site excavation and construction. As a result of intrusive actions, ingestion or dermal absorption via direct contact with chemicals in surface and subsurface soils may occur. Disturbance of soil may result in the generation of fugitive dust, and release of volatile organic chemical (VOC) emissions into the air, providing a complete exposure pathway by inhalation.

Stormwater runoff may result in migration of chemicals from soil to surface water and from surface water to groundwater. Potential exposure routes for surface water include ingestion, direct contact (dermal absorption), and inhalation of fugitive VOC emissions from surface water. These pathways are not expected to be complete due to the intermittent nature of on-site surface water runoff.

Potential exposure to chemicals in groundwater may occur via ingestion, inhalation, or dermal absorption from showering, bathing, or other domestic uses of groundwater. The groundwater gradient in this area is to the southeast. For reasons described in Section 18.4.1.3, the groundwater exposure pathway is judged to be incomplete.

Uptake of chemicals from groundwater used for irrigation of crops, and subsequent ingestion of crops by humans or biota, is another potential exposure pathway. These pathways are judged to be incomplete because no chemicals were detected in groundwater at concentrations exceeding MCLs or RCRA criteria. Because of their low concentrations and solubilities, metals present in the groundwater used for irrigation are expected to be bound with the oxides of iron and aluminum in the natural soils (Table 2-7). Humic acid and other organic matter in soils chelate with metals, with resulting complexes that are less likely to be absorbed into plants because of their molecular size (Walsh et al. 1977). If plant uptake occurs, most heavy metals are held in the root cells, and only minute quantities, if any, are expected to be translocated to shoots of crop plants (Chaney 1985).

Atmospheric deposition of airborne particulates on edible crops located off-site (or within the RAA under the future exposure scenario) is possible due to land use in the area. This exposure pathway is not expected to be significant based on the concentration of chemicals detected in soils from this RAA. Fugitive dust inhalation by workers is expected to result in greater levels of chemical intake. If the results of risk characterization from the inhalation routes for workers and future residents in this RAA are acceptable, it is likely that indirect exposure, via ingestion of food crops, is also insignificant. Food crops are normally processed and washed before they are consumed. These processing activities substantially reduce the amount of particulates deposited on the food crops. Exposure of site chemicals to humans, via ingestion through the food chain, is possible. However, this exposure pathway is judged to be insignificant because of the expected distribution and metabolism of COCs in plants or animals. VOCs are expected to be metabolized rapidly in animals, and are expected to be metabolized and volatilize (through cuticle and stoma cells) in plants. Lead may accumulate in organ meat and bone, which are not normally consumed by the average American.

Human receptors with the greatest potential for contacting chemicals from the media are identified in the CSM for RAA1 (Figure 18-1). They include adult general-duty workers and future construction workers, and future residents in the FTAs. There are currently no residential areas directly adjacent to this RAA. The RAA is larger than one-half acre in size, and future construction or soil-intrusive action was assumed. Under the future no action residential exposure scenario, adult and child residents were assumed to dwell within the RAA. Based on currently available information, the most important potential exposure routes include inhalation of fugitive VOCs or dust, and direct contact with soil resulting in ingestion and dermal absorption of chemicals in soil. The receptors, exposure pathways and data sources for exposure point concentrations identified for quantitative risk characterization for this RAA are summarized in Figure 18-1.

#### 18.4.2.2 Exposure Assumptions

The general exposure assumptions used for the calculation of average daily intake were presented in Section 18.4.1.5. Factors used to calculate intake include both the average and RME exposure time (ET) in hours/day, exposure frequency (EF) in days/year, and

duration of exposure (ED) in years. Other exposure parameters such as soil ingestion rates, inhalation rates, and body weight were also presented. This section provides RAA-specific exposure information for the calculation of intakes under the current or average exposure conditions. Based on interviews with the base personnel, input values for ET, EF, and ED are presented below for the human receptors most likely to be exposed to site related chemicals at RAA1:

Current Receptor: FTA Instructor (*ingestion, dermal contact, inhalation)
ET: 5 hours/day*
EF: 12 days/year*
ED: 9 years

Other future receptors are general-duty workers, construction workers, and residents. All exposure assumptions (average and RME) for RAA1 are presented in Appendix D-3.

#### 18.4.2.3 Exposure Point Concentrations

For current and future general-duty workers, the chemical data collected as part of this RI, for each SWMU in RAA1, was combined and used to calculate the exposure point concentrations. Concentrations of COCs in soil were used to assess risk and hazard from incidental soil ingestion and dermal contact. In assessing the average risk and hazard from these routes of exposure for the on-site worker under baseline and future use conditions, the COC's average concentration in surficial soil was used. In assessing the upperbound or RME risk and hazard for the same routes of exposure and receptors, the 95% UCL of the COC's arithmetic mean concentration in surficial soil was used. The ambient concentrations of airborne particulates and gaseous emission within the RAA were needed to assess the risk and hazard from the inhalation route of exposure for these receptors. This model was described previously and in Appendix D-2. The average and RME airborne particulate chemical concentrations were predicted using the average and 95% UCL of the arithmetic mean surface soil concentrations, respectively. The average and upperbound concentrations of volatilized organic chemicals were predicted using the average and 95% UCL of the arithmetic mean soil concentrations, respectively, from depths 0 to 10 feet in the modeling equation.

For the future construction workers and residents, the exposure point concentration of a COC in soil was used to assess risk and hazard from incidental soil ingestion and dermal contact. In assessing the average risk and hazard between these routes of exposure, the COC's average concentration in surface and subsurface soil from depths between 0 to 10 feet was used. This was based on the assumption that the soil between these depths could be exposed during excavation activities. In assessing the RME risk and hazard from these routes of exposure, the 95% UCL of the COC's arithmetic mean concentration in surface and subsurface soil between depths 0 to 10 feet was used. The ambient concentrations of airborne particulates and gaseous emission within the RAA were calculated in order to assess the risk and hazard from the inhalation route of exposure for these receptors. The average and upperbound airborne particulate concentration were predicted by a wind erosion equation and the simplified box model, as described previously. The average and upperbound concentrations of volatilized organic chemicals were predicted by the same methodology and were numerically the same as those predicted for the current and future general-duty workers. Appendixes D-1 and D-2 present the exposure point concentrations for RAA1.

### 18.4.3 Risk Assessment Area 2

Risk Assessment Area 2 (RAA2) consists of SWMU Nos. 86, 87, 88, 89, and 90, which are known and referred to collectively as the Engine Test Cell Area. The CSM for this RAA is presented in Figure 18-2. This area, located approximately 500 meters northwest of RAA1, was used to steam clean aircraft engines from 1965 to 1988, but are no longer in use. Effluent "washdown water," which typically contained lubricating and synthetic oils, grease, dirt, and jet fuel, was initially discharged from the engine test cell (SWMU No. 86) to an unlined overflow pit (SWMU No. 87). An oil/water separator (SWMU No. 90) was added at a later date to recover jet fuel. Effluent from the oil/water separator was discharged to a leach field (SWMU No. 88) and was later discharged to an evaporation pond with concrete sides and a clay bottom (SWMU No. 89). The exact dates of which these various modifications occurred were not available. A portion of this area is currently covered with a concrete pad.

Based on interviews with base personnel, workers are estimated to be in the abandoned area for approximately 1 to 2 hours per week. In the nearby active buildings, 30 to 40

workers are in the area for a maximum of 8 hours per day. These buildings (SWMU Nos. 93 and 94), are located to the north of the Engine Test Cell Area.

#### 18.4.3.1 Exposure Pathways

The primary chemical sources in this RAA include lubricating and synthetic oils and residual JP-4 fuel. The primary release mechanisms for RAA2 include discharge of effluent as surface water to the soil, fugitive VOC or dust emissions, and direct contact with chemicals in soil. Chemicals may further migrate from soil via surface water runoff and subsequent percolation to groundwater. Chemicals can also be released into the air via volatilization or via fugitive dust emissions resulting in potential inhalation exposures. This inhalation exposure can occur directly from the primary source on an average day of a general-duty worker due to wind erosion of surface soil or chemical volatilization from surface and subsurface soil.

RAA2 is less than one-half acre in size. Therefore, the potential for major soil excavation and construction of residential homes within this RAA is low. Workers in the vicinity of these SWMUs are currently the most likely receptors to come into contact with soil from these areas. Adult general-duty workers are expected to be the most significant receptor population under current and future exposure conditions. The most important potential exposure routes for RAA2 are the same as those described above for RAA1. These include inhalation of fugitive VOCs or dust, direct contact with soil resulting in ingestion, and dermal absorption of chemicals of concern in soil.

Secondary release mechanisms from soil in SWMU Nos. 86, 87, 88, 89, and 90, include leaching of chemicals to groundwater, stormwater runoff to surface water, direct contact with subsurface soils, and fugitive VOC and dust emissions. The likelihood of intrusive action is low because of its small size. Stormwater runoff may result in migration of chemicals from soil to surface water and from surface water to groundwater. Potential exposure routes for surface water include ingestion, direct contact (dermal absorption), and inhalation of fugitive VOC emissions from surface water. These pathways are not expected to be complete due to the intermittent nature of on-site surface water runoff.

Potential exposure to chemicals in groundwater was judged to be incomplete because of the relatively small volume of chemically-impacted soil contained within this RAA. The RI data indicated that the VOC concentrations were primarily contained within depths ranging from 0 to 8 feet BGS, tending to decrease at greater depths. The depth to groundwater is approximately 240 feet BGS.

The food chain crop exposure pathway is not likely to be significant based on the evaluation of the same pathway for RAA1. Volatile organic chemicals and metals were identified as COCs for this RAA, although uptake of chemicals by plants is not likely to be significant because of the low concentrations VOCs and metals within the root zone (with the exception of zinc) (Section 18.6 evaluates potential environmental risks associated with site chemicals). Atmospheric deposition of airborne particulates on edible food in part of the off-site food chain crop is also possible due to land use in the area. However, this exposure pathway is judged to be insignificant in comparison to other potential exposure pathways, as described for RAA1.

Human receptors with the greatest potential for contacting chemicals from the media are identified in the CSM for RAA2 (Figure 18-2). They include adult general duty workers in the vicinity of these SWMUs. There are currently no residential areas directly adjacent to this RAA and it is not likely that future residential homes will be built in this area. Based on currently available information, the most important potential exposure routes include inhalation of fugitive VOCs or dust, and direct contact with soil resulting in the potential ingestion and dermal absorption of chemicals in soil. The receptors, exposure pathways, and data sources for exposure point concentrations identified for quantitative risk characterization for this RAA are summarized in Table 18-2.

#### 18.4.3.2 Exposure Assumptions

The general exposure assumptions used for the calculation of average and RME daily chemical intakes were presented in Section 18.4.1.5. This section provides RAA-specific exposure information for the calculation of chemical intakes. Based on interviews with base personnel, input values for ET, EF, and ED are presented below for the human receptors most likely to be exposed to RAA2:

Current Receptor: Ground Maintenance Worker (*soil ingestion, dermal contact)
Building 2330 Worker (**inhalation)
ET: 0.5 hours/day*; up to 8 hours/day**
EF: 50 days/year*; 250 days/year**
ED: 9 years

A summary of intake parameters for receptors evaluated in RAA2 is presented in Appendix D-3.

#### 18.4.3.3 Exposure Point Concentrations

Chemical data collected in RAA2 was combined and used to calculate the exposure point concentration of COCs. The exposure point concentrations were calculated using the same methodology described in Section 18.4.2.4. Since intrusive action is not likely, all exposure point concentrations were based on surficial soil data for assessing the risks and hazards from the exposure routes of incidental soil ingestion, dermal contact, and inhalation of airborne particulates. Appendixes D-1 and D-2 present the exposure point concentrations for RAA2.

### 18.4.4 Risk Assessment Area 3

Risk Assessment Area 3 includes the northeast stormwater drainage area (SWMU No. 95), the Old Entomology Rinse Area (SWMU No. 96), and the wastewater lagoons (SWMU Nos. 101 and 102). The conceptual site model for this RAA is depicted in Figures 18-3 and 18-4. The northeast stormwater drainage area (SWMU No. 95) is currently active, receiving water from several oil/water separators and runoff from the nearby tarmac. The ditch is approximately 40 feet wide and 800 feet long. It extends from the northeast end of Runway 4/22 southeast towards the wastewater lagoons. The grass around the area is mowed once per month for 6 months of the year.

The Old Entomology Rinse Area consists of a small building used to rinse pesticide containers and pesticide application equipment. This rinse water was drained directly to an unlined pit. The building containing the rinse area was abandoned in 1983 and demolished in 1984. Pesticides historically used at Cannon AFB include dieldrin,

toxaphene, 2,4-D, and DDT. SWMU No. 96 is adjacent to the lagoons, and workers going to the lagoons usually pass through this area.

The wastewater lagoons (SWMU Nos. 101 and 102) consist of two unlined ponds in series that have a total surface area of approximately 32 acres. The lagoons have an average depth of approximately 3.5 feet, are separated by a 12-foot wide levee, and are encircled by a fence. Access to the lagoons is restricted by a locked gate. These units have been active since 1966 and continue to be used, receiving sanitary and industrial wastewater from the sewer. Pesticides, metals, PCBs and VOCs may have entered into the lagoons. Discharge from the lagoons empties into a nearby playa (Playa Lake). Two groundwater monitoring wells are located on the east and one on the south side of the lagoons.

The wastewater is treated using natural aeration and settling. Wastewater is in a pond for approximately 40 days before being discharged into a nearby playa lake. Surface water and sediment samples were taken at SWMU Nos. 101 and 102. Water from the playa lake is used for irrigation of a nearby farmer's land at a rate of 1,152,000 gallons per day or 51,840,000 gallons per season (45 days per year). The crops irrigated with playa lake water are wheat and corn grown for animal feed (Personal communication, Mr. Merrill; [the farmer who pumps the water], February 24, 1992). Two maintenance workers work at the lagoons for approximately 1 to 2 hours per day.

#### 18.4.4.1 Exposure Pathways

The primary chemical sources in this RAA include oily waste, alkaline aircraft cleaning compounds, pesticides and herbicides. Release mechanisms from soil in SWMU Nos. 95, 96, 101, and 102 include leaching of chemicals to groundwater, storm water runoff to surface water, and direct contact with soils, fugitive VOC and dust emissions.

Potential exposure pathways for SWMU Nos. 95 and 96, presented in Figure 18-3, are similar to those presented for the FTAs in RAA1. Pathways with the most potential for significant exposures include the inhalation of fugitive VOCs or dust, and direct contact with soil resulting in potential ingestion or dermal absorption of chemicals of concern. SWMU Nos. 95 and 96 are larger than one-half acre. Accordingly, intrusive action or

construction were considered plausible for these two areas. Future construction workers and residents were assumed in these areas. Despite this assumption, it should be noted that construction of residential homes in the Northeast Drainage Ditch Area (SWMU No. 96) is highly unlikely. SWMU No. 95 is a natural drainage ditch and it would require a major earthmoving endeavor to divert the natural runoff pattern in order to allow construction of residential homes.

Wastewater in the lagoons was sampled and analyzed (Table 14-3). Metals were the only compounds detected and their levels were below the MCLs. Thus, incidental ingestion of surface water in the lagoons is not considered a significant exposure pathway. Dermal absorption of chemicals in surface water is also not considered a viable exposure pathway since only metals were detected in surface water samples and metals are not readily absorbed through the skin (EPA 1989b). Potential environmental impacts associated with the wastewater in the lagoons and discharge to Playa Lake are assessed in Section 18.6.

Sediment in the wastewater lagoons could be a potential chemical sources in this RAA, although there is no potential for direct contact with sediment/sewage sludge, since it is piped underwater directly into the lagoon. In addition, TCLP testing of chemicals in sediment samples indicated that none of the detected chemicals in sediment exceeded TCLP criteria. The lagoons are fenced, and the only access to the lagoon is through the Old Entomology Rinse Area by way of a locked gate. Thus, the potential exposure pathways for incidental ingestion, dermal contact, and inhalation of fugitive dust from the sediment in the wastewater lagoon were not considered complete (Figure 18-4).

As discussed previously, the human exposure pathways for food chain crops or biomagnification is judged to be insignificant.

Human receptors with the greatest potential for contacting chemicals from the media are identified in the CSM for RAA3 (Figures 18-3 and 18-4) and include adult general-duty workers. There are currently no residential areas directly adjacent to this RAA. The RAA is more than one-half acre in size, therefore, future construction or intrusive action was assumed. Based on currently available information, the most important potential exposure pathways include inhalation of fugitive VOCs or dust, and direct contact with

soil, resulting in ingestion and dermal absorption of chemicals in soil. The receptors, exposure pathways, and data sources for exposure point concentrations identified for quantitative risk characterization for this RAA are summarized in Table 18-20.

#### 18.4.4.2 Exposure Assumptions

This section provides site-specific exposure information for the calculation of chemical intakes under the average and RME exposure conditions. Based on interviews with the base personnel and EPA guidance, input values for ET, EF, and ED are presented below for the human receptors most likely to be exposed at RAA3:

Current Receptor:

Maintenance Worker Passing Through Ditch or Rinse Area (*soil ingestion, dermal contact)
Lagoon Maintenance Worker (**inhalation)

ET: 0.5 hours/day*; 1 hours/day**
EF: 250 days/year**
ED: 9 years

#### 18.4.4.3 Exposure Point Concentrations

The exposure point concentrations were calculated using the same methodology described for RAA1. Since intrusive action is likely for the Northeast Drainage Ditch and the Old Entomology Rinse Area, the exposure point concentrations for the future construction worker and residents were based on both surface and subsurface soil data. These data were used to assess the risks and hazards from incidental soil ingestion, dermal contact, and inhalation of airborne particulates. Appendixes D-1 and D-2 present the exposure point concentrations for RAA3.

### 18.4.5 Risk Assessment Area 4

RAA4 is comprised of Fire Training Area 1 (SWMU No. 78) and the Solvent Disposal Area (SWMU No. 81). SWMU No. 78 is located in the northeast corner of the base, just south of the Atchinson Topeka and Santa Fe Railroad. This area was active from 1959 to 1968, during which approximately 300 gallons of waste oils, recovered fuels, and spent solvents were used to create training fires, twice a month at this location, during each exercise. SWMU No. 81 is located approximately 400 feet to the east of SWMU No. 78 and about 100 feet south of the base perimeter road. This unit, first identified in 1983, contained two drums labeled "trichloroethylene", which were on the ground, opened, and positioned so as to drain into a shallow surrounding pit.

#### 18.4.5.1 Exposure Pathways

The primary chemical sources in this RAA include waste oils, recovered fuels, and spent solvents such as trichloroethylene. Release mechanisms from soil in SWMU Nos. 78 and 81 include leaching of chemicals to groundwater, stormwater runoff to surface water, and direct contact with subsurface soils. Chemicals can also be released into the air via volatilization or via fugitive dust emissions resulting in potential inhalation exposures. A ground maintenance or a general-duty worker in the area may be exposed to surficial soil via ingestion and dermal contact. This person may also be exposed to fugitive dust or particulates from wind erosion of surface soil, or volatilized chemicals emitted from surface and subsurface soils.

Stormwater runoff may result in migration of chemicals from soil to surface water and from surface water to groundwater. Potential exposure routes for surface water include ingestion, direct contact (dermal absorption), and inhalation of fugitive VOC emissions from surface water. These pathways are considered to be incomplete due to the intermittent nature of on-site surface water runoff.

RAA4 is less than one-half acre. Therefore, the potential for major soil excavation and construction of residential homes within this RAA is low. The most important potential exposure routes for RAA4 are the same as those described above for RAA2. These include inhalation of fugitive VOCs or dust, direct contact with soil resulting in ingestion,

and dermal absorption of chemicals in soil. Workers in the vicinity of these SWMUs are currently more likely to come into contact with soil from these areas than are base residents. Adult general-duty workers are expected to be the most significant receptor population under current and future exposure conditions. Contractors (ground maintenance) mow the vegetation covering SWMU Nos. 78 and 81 once per month (for approximately 5 to 10 minutes), 6 months of the year.

As discussed in Section 18.4, the exposure pathways for food chain crops or biomagnification is judged to be insignificant and incomplete.

Human receptors with the greatest potential for contacting chemicals from the media are identified in the CSM for RAA4 (Figure 18-5). There are currently no residential areas directly adjacent to this RAA. Because the RAA is less than one-half acre in size, future construction or intrusive action was not assumed. Based on currently available information, the most important potential exposure pathways include inhalation of fugitive VOCs or dust, and direct contact with soil, resulting in ingestion and dermal absorption of chemicals in soil. The receptors, exposure pathways, and data sources for exposure point concentrations identified for quantitative risk characterization for this RAA are summarized in Table 18-20.

#### 18.4.5.2 Exposure Assumptions

The general exposure assumptions used for the calculation of daily chemical intakes were presented in Section 18.4. This section provides site-specific exposure information for the calculation of intake under the current or average exposure conditions. Input values for ET, EF, and ED are presented below for the human receptors most likely to be exposed at RAA4:

Current Receptor: Ground Maintenance Worker (soil ingestion*, dermal contact, inhalation)

ET: 0.5 hours/day*
EF: 6 days/year
ED: 9 years

#### 18.4.5.3 Exposure Point Concentrations

The exposure point concentrations were calculated using the same methodology described for the other RAAs. Since intrusive action is not likely, exposure point concentrations were based on surficial soil data for assessing the risks and hazards from the exposure routes of incidental soil ingestion, dermal contact, and inhalation of airborne particulates. Appendixes D-1 and D-2 present the exposure point concentrations for RAA4.

### 18.4.6 Risk Assessment Area 5

Risk Assessment Area 5 contains only one SWMU, a sludge weathering pit (SWMU No. 76) located along the northern boundary of the base, approximately 2800 feet west of SWMU No. 78 (FTA-1). SWMU No. 76 covers approximately 200 square feet. The sludge weathering pit has been covered with fill material and is no longer active.

#### 18.4.6.1 Exposure Pathways

The primary chemical sources in this RAA include volatile organic compounds, semi-volatile organic compounds, and metals. Potential sources of these contaminants are waste fuels, oils, and tetraethyl lead. Release mechanisms from soil in SWMU No. 76 include leaching of VOCs to groundwater and direct contact with subsurface soils. Fugitive dust emissions of COCs in surface soil and transport of chemicals via stormwater runoff are not expected because the pit was filled in 1980.

Potential exposure pathways for SWMU No. 76 are presented in the CSM for RAA5 (Figure 18-6). One potentially significant exposure pathway could be the inhalation of fugitive VOCs emanating from subsurface soil. The rate of fugitive VOC emissions was judged to be low unless intrusive activities are conducted at this location, which is unlikely because of its small size (less than one-half acre) and proximity to the railroad. Appendix D-1 presents surficial soil data for this RAA. Volatile organic compounds were not detected in surficial soil and the level of metals were comparable to site and regional background levels. Another potential exposure pathway would involve the leaching of chemicals and subsequent ingestion of groundwater (see Figure 18-6). A well

is located approximately 1200 feet south of this SWMU. Potential exposure to chemicals in groundwater is judged to be insignificant because of the relatively small volume of chemically-impacted soil contained within this RAA. The RI data indicated that VOCs were not detected beyond a depth of approximately 10 feet BGS.

There is a low potential for human exposure to chemical constituents associated with this RAA. All exposure pathways evaluated were judged to be either incomplete, insignificant, or not applicable with the exception of the VOC inhalation pathway. Human receptors for this exposure pathway were identified as adult general-duty or ground maintenance workers. Contractors (ground maintenance) mow the pit area once per month (for approximately 5 to 10 minutes), 6 months of the year. Potential exposures via this pathway are expected to be low because of the anticipated low ambient VOC concentrations and the short durations of exposure.

#### 18.4.6.2 Exposure Assumptions

Input values for ET, EF, and ED are presented below for the human receptors most likely to be exposed at RAA5:

Current Receptor: Ground Maintenance Worker (soil ingestion*, dermal contact, inhalation)

ET: 0.5 hours/day*
EF: 6 days/year
ED: 9 years

#### 18.4.6.3 Exposure Point Concentrations

The exposure point concentrations were derived using the summarized chemical data collected from this SWMU directly or calculated using the air modeling methodology described in Section 18.4. Since intrusive action is not likely, and the surficial soil is backfill, no risks or hazards for incidental soil ingestion, particulate inhalation, or dermal contact were estimated. Appendixes D-1 and D-2 present the exposure point concentrations for RAA5.

### 18.4.7 Risk Assessment Area 6

RAA6 contains one SWMU (SWMU No. 34), defined as the AGE drainage ditch. The CSM for RAA6 appears as Figure 18-7. The AGE drainage ditch originates on the flightline side of AGE Facility Building No. 186, and runs parallel to Facilities Building Nos. 191, 192, and 193, terminating on base in an open field near Argentina Avenue. People cross the ditch once or twice per day, using it as a shortcut.

The ditch is reportedly man-made, resulting from soil settling that followed the removal of railroad tracks in the late 1960s. The AGE drainage ditch is about 1200 feet long, 12 feet wide, and 1 to 2 feet deep. The side slopes are vegetated with grass above the active channel. The ditch is bounded by the Building 191 loading dock, located 16 feet northwest of the ditch bank, and the Building 189 parking curb, 15 feet southeast of the ditch bank. The ditch drains to a culvert, then to a stormwater ditch which reroutes stormwater to the northeast stormwater drainage ditch. Surface runoff from the northeast end of the aircraft apron and from streets in the vicinity drain into the AGE ditch. A vehicle garage, wash rack, oil/water separator, several fuel storage tanks, and fueling stations are located in this area, which includes SWMU Nos. 31, 38, 39, 46, 48, 49, 50, 51, 55, 57, 77, 95, and 124. The ditch empties into an open field near Argentina Avenue, terminating at that point. Flow in the AGE ditch is intermittent. Surface water drainage from the ditch either evaporates or is absorbed into the soil at that location. The ditch was tilled in October 1988 to facilitate bioremediation.

#### 18.4.7.1 Exposure Pathways

The CSM for RAA6 (Figure 18-7) depicts potential exposure pathways and receptors. The primary source of chemicals in the AGE ditch is surface runoff from the nearby aircraft tarmac, refueling station, vehicle maintenance facilities, and adjacent streets. Chemicals may be transported to soil and surface water in the AGE ditch. Fugitive emissions of volatile chemicals are not expected to be significant from surface runoff. VOCs were detected at a low frequencies and concentrations (Table 18-3). Potential exposures associated with chemicals in surface water include dermal contact and those associated with biota (i.e., ingestion, direct contact, and uptake by plants). Chemicals in soil may serve as a secondary source, potentially releasing chemicals to surface water

runoff, groundwater, and fugitive dust. Such releases to surface water may result in dermal contact in humans and potential exposures to biota, as described above.

Exposures to groundwater may include ingestion, inhalation, and dermal contact. This exposure pathway, however, was judged to be incomplete based on a review of the RI data. Metal exceedances above background soil concentrations were relatively small, and the levels of VOCs and semivolatile organic compounds detected in surface and subsurface soils were also low (Appendix D-1). Despite the fact that a road is running parallel to the ditch, the amount of fugitive dust emissions is not expected to be high, due to heavy vegetation above the active channel. Chemical intakes may also occur via direct dermal contact or via incidental ingestion of soil, particularly during intrusive activities, such as tilling or excavation of soil in the AGE ditch.

As discussed in Section 18.4, the exposure pathways for food chain crops or biomagnification is judged to be insignificant and incomplete. Biota found in the ditch, if any, are not expected to be suitable for human consumption.

Base personnel cross the ditch once or twice a day, using it as a shortcut. Every day, a few vehicles use the road that runs parallel to the ditch, and personnel in Building 191 often sit on the loading docks (adjacent to the ditch) and eat their lunch.

Human receptors with the greatest potential for contacting chemicals from the media are identified in the CSM for this RAA (Figure 18-7). They include adult general-duty workers and construction workers. There are currently no residential areas directly adjacent to this RAA. The RAA is more than one-half acre in size. Therefore, future soil intrusive action was assumed. Future residential exposure is unlikely because of the shape of this RAA and its location in a natural topographical low area. Based on currently available information, the most important potential exposure routes include inhalation of fugitive VOCs or dust, and direct contact with soil, resulting in ingestion and dermal absorption of chemicals in soil. These pathways were judged to be complete under the baseline conditions and future intrusive activities. The receptors, exposure pathways, and data sources for exposure point concentrations identified for quantitative risk characterization for this RAA are summarized in Table 18-20.

#### 18.4.7.2 Exposure Assumptions

The general exposure assumptions used for the calculation of average daily intake were presented in Section 18.4. Based on interviews with the base personnel and EPA guidance, input values for ET, EF, and ED are presented below for the human receptors most likely to be exposed at RAA6:

Current Receptor: General Duty Worker in Building 191 (soil ingestion*, dermal contact); (inhalation**)

ET: 1 hours/day*; 8 hours/day**
EF: 190 days/year
ED: 9 years

#### 18.4.7.3 Exposure Point Concentrations

Since part of the ditch 6was tilled and mixed, the chemical data collected as part of this RI, from depths of 0 to 10 feet BGS, were used to assess the current and future risks and hazards to general-duty workers. The same exposure point concentrations were used to calculate air emissions of VOCs, employing the air modeling methodology described previously. Since intrusive action is also likely, the same combined surface and subsurface soil concentrations of the COCs were used to estimate chemical intakes for incidental soil ingestion and dermal contact. Appendixes D-1 and D-2 present the exposure point concentrations for RAA6.

### 18.4.8 Risk Assessment Area 7

RAA7 is the sanitary sewer line for Cannon AFB (SWMU No. 98). It has been in operation for several decades, receiving sanitary and industrial wastewater. Potential sources of chemicals in the sewer line include laboratory sink drainage and effluent from several oil/water separators. The CSM for this SWMU is presented in Figure 18-8. The sanitary sewer line is buried 5 to 17 feet BGS.

#### 18.4.8.1 Exposure Pathways

The RI data indicate that the sewer line is, or was, leaking. Leakage of chemicals from the sewer line appeared to impact subsurface soils surrounding the line. Such a scenario could result in potential exposures via direct contact with soils during repair activities. No data were available to assess whether the groundwater was impacted. Maintenance workers are the receptor population most likely to come into direct contact with wastewater in the sewer. However, such occurrences would be infrequent since sewer maintenance is not conducted regularly (Personal communication, Jim Richards; March 1992).

The primary chemical sources in this RAA include oils, greases, JP-4 fuel, residual paints, and solvents in the sewer wastewater. Release mechanisms from soil in SWMU No. 98 include leaching of VOCs to groundwater, stormwater runoff to surface water, and direct contact with subsurface soils. Fugitive dust emissions from surface soil are not expected because SWMU No. 98 is buried. Although emission of VOCs from this RAA is plausible, the quantities are expected to be minute. The highest concentration of VOC detected was acetone, at a concentration of 7.8 ppm (at the depth of 8 feet BGS) (Appendix D-1). The sanitary sewer line is not expected to impact biota since it is buried and located in an industrial part of the base.

Human receptors with the greatest potential for contacting chemicals from the media are identified in the CSM for this RAA (Figure 18-8). They are future adult construction workers performing sewer repair activities. Although RAA7 occupies an area larger than one-half acre, the future residential exposure scenario is not likely because of the shape of this RAA. Based on currently available information, the most important potential exposure routes include inhalation of fugitive VOCs or dust, and direct contact with soil, resulting in ingestion and dermal absorption of chemicals in soil. These pathways were judged to be complete under the baseline conditions and future intrusive activities. The receptors, exposure pathways, and data sources for exposure point concentrations identified for quantitative risk characterization for this RAA are summarized in Table 18-20.

#### 18.4.8.2 Exposure Assumptions

General exposure assumptions used for the calculation of average daily intake were presented in Section 18.4. This section provides site-specific exposure information for the calculation of intake in the human receptors most likely to be exposed at RAA7.

For future sewer maintenance worker exposures, it was assumed that one repair event spans from 20 to 40 working days, during the potential worker exposure period of 25 years.

#### 18.4.8.3 Exposure Point Concentrations

As part of this RI, the chemical data collected for SWMU No. 98, from depths of 0 to 23 feet (the full RI data set), were used to assess the future risks and hazards to the sewer repair workers due to incidental soil ingestion and dermal contact. The same exposure point concentrations were used to calculate air emissions of VOCs using the air modeling methodology described previously. Appendixes D-1 and D-2 present the exposure point concentrations for RAA7.

## 18.5 RISK CHARACTERIZATION

### 18.5.1 Introduction

In the risk characterization, the information from the toxicity assessment (SFs and RfDs) and the exposure assessment (chemical intakes for potentially exposed populations) were integrated to arrive at quantitative estimates of carcinogenic risks and noncarcinogenic hazards. The methodologies used for calculating carcinogenic risks and noncarcinogenic hazards associated with exposure to the chemicals of concern were presented in Sections 18.3.4 and 18.3.5, respectively. This section presents the findings of quantitative estimation of noncarcinogenic hazards and carcinogenic risks for receptors identified at each RAA. Lead was identified as a chemical of concern for some RAAs. Due to the lack of EPA-published toxicity values, the impact of lead on humans was assessed qualitatively. Section 18.3.6 provides a discussion of potential lead exposure to children.

The results of this risk characterization provide a basis for evaluating potential health risks to workers and hypothetical future residents within each of the RAAs.

### 18.5.2 Risk Characterization Results

Carcinogenic risks and noncarcinogenic health hazards were estimated for each risk assessment scenario, exposure pathway, and chemical of concern using the chemical intake factors and exposure point concentrations presented in Section 18.4 in conjunction with the risk characterization methods described above. Documentation from Woodward-Clyde's ASSESS© risk assessment software, showing the values used for calculation of carcinogenic risks and noncarcinogenic hazard indexes, is presented in Appendix D-3. Blank pages in the ASSESS© printout indicate that calculations were not performed because of the lack of EPA-published toxicity values. For example, lead does not have toxicity values for all routes of exposure, therefore, risk and hazard were not calculated for lead for all routes of exposure. Zinc and selenium do not have RfDs for the inhalation route, therefore, no hazard estimates were calculated for the inhalation of airborne particulates containing only selenium and zinc.

#### 18.5.2.1 Risk Characterization - RAA1

The chemicals of concern (COCs) identified in this RAA were lead, benzene, toluene, TCE and total xylenes. With the exception of lead, which does not have EPA-published toxicity values, all chemicals were included in the estimation of carcinogenic risks and non-carcinogenic hazards for workers (general duty and construction) and future residents (adult and child) for RAA1. The exposure pathways of incidental soil ingestion, dermal contact, and inhalation of volatile organic compounds and fugitive particulates were assumed to be the major and complete pathways. Workers in the Landfill 5 area were assumed to be exposed to fugitive dust and volatilized organic chemicals from the FTAs only, since capping of the hazardous waste cell and effectively eliminated the incidental soil ingestion and dermal contact exposure pathways. Future workers who perform intrusive actions and hypothetical future residents who may dwell on the FTAs were assumed to be exposed to COCs via the dermal contact, incidental ingestion, and inhalation routes of exposure. Hazards and risks were combined across exposure pathways and are summarized below.

Noncarcinogenic Hazards

Noncarcinogenic hazards for all receptors considered in RAA1 are presented in Table 18-22. For both the average and reasonable maximum exposure scenarios, the total HIs did not exceed EPA's "level of concern" of unity (1.0) for noncarcinogenic effects. The RME HI for the assumed future child resident and adult resident were at least an order of magnitude higher than the HIs for other receptors. It is worth noting that an HI is not a probability of an individual suffering an adverse health effect. Rather, the HI is an exposure-to-toxicity ratio that expresses a level of concern that increases as this ratio surpasses one (i.e., if the estimated intake of a chemical of concern exceeds the EPA-established acceptable daily intake or RfD).

The exposure pathway contributing the most to the total HI for both the average and RME exposure scenarios was the inhalation of VOCs, making up almost all of the total noncarcinogenic hazard. This was true for each receptor evaluated. Total xylenes presented the majority of these noncarcinogenic hazards for this exposure pathway.

Carcinogenic Risks

Carcinogenic risks are also presented in Table 18-22. The total carcinogenic risk (i.e., the risks for all pathways combined) for average and RME exposures for each of the receptors evaluated were within the EPA's target risk range of 1.0E-04 to 1.0E-06 (EPA 1991), with the exception of total RME cancer risk for the future hypothetical child resident (1.1E-04). The exposure pathway and chemical(s) contributing the majority of the cancer risk was the inhalation of VOCs. In this case, benzene contributed at least 80% of this risk, regardless of exposure scenario (i.e., average or RME). However, the chemicals contributing to the estimated risks were detected at extremely low frequencies (1/29 for TCE and 1/37 for benzene). The highest values for these chemicals were based on non-detects and the detection limits ranged from approximately 30 to 60 mg/kg. Thus, the corresponding risk estimates are probably artifacts based on matrix effects associated with the soils analyses (see Appendix D-1). In addition, the fugitive VOC model that was used to estimate airborne VOC concentrations did not take into account biodegradation of benzene or trichloroethylene (TCE), which would tend to

decrease fugitive VOC concentrations over time. Thus, the estimated ambient VOC concentrations would probably not be sustained over the entire exposure duration.

Lead as a Potential Hazard/Risk

Lead in RAA1 was measured in soil and in groundwater and modeling was performed to estimate an ambient air concentration of lead in fugitive dust. The surface soil and groundwater lead 95% UCL concentrations for RAA1 were 100.4 mg/kg and 0.011 mg/L, respectively (Appendix D-1). The groundwater lead is below the current action level (0.015 mg/L) and MCL (0.050 mg/L) for lead in drinking water. Surface soil lead concentrations were well below current EPA interim guidance, which has established soil lead cleanup levels of 500 to 1000 mg/kg at Superfund sites (EPA 1991f).

Air modeling was performed to estimate lead concentrations in ambient air under the baseline, intrusive action, and future residential exposure conditions. The predicted baseline average and RME lead air concentrations were 0.008 $\mu g/m^3$ and 0.017 $\mu g/m^3$, respectively. The predicted average and RME lead air concentrations for the intrusive action and future use (residential) scenarios were .006, .011, .0056, and .0099 $\mu g/m^3$, respectively. The estimated concentrations for the above three exposure conditions were below the EPA UBK model's default value of 0.200 $\mu g/m^3$, which is considered by the EPA to be the average (1988) background urban air concentration for lead in the U.S. (EPA 1991e).

### 18.5.2.2 Risk Characterization - RAA2

The COCs identified in this RAA were metals and volatile organic chemicals. With the exception of lead which does not have any EPA-published toxicity values, and cobalt and zinc which do not have inhalation toxicity values, all COCs were included in the estimation of risks and hazards for this RAA. Carcinogenic risks and noncarcinogenic hazards were estimated for workers who infrequently assembled on-site (for direct contact exposures) and regularly worked adjacent to the site in the new engine test cell and part storage areas. Future intrusive action (construction) or residential scenarios

were not judged to be plausible for RAA2 because it is smaller than one-half acre (see Section 18.4).

The exposure pathways of incidental soil ingestion, dermal absorption, and inhalation of volatile organic compounds and fugitive dust were assumed to be the complete exposure pathways for current and future workers. Workers were assumed to be exposed to site-related chemicals via dermal contact and incidental ingestion routes whenever they assemble in the old engine test cell area. These workers were assumed to be exposed to site-related chemicals in the form of fugitive dust (metals) and VOCs via the inhalation route whenever they work in the new engine test cell area. The levels of exposure for current and future workers were judged to be the same. Hazards and risks were combined across exposure pathways for all site-related chemicals. The results are summarized below.

Noncarcinogenic Hazards

Noncarcinogenic hazards for all receptors considered in RAA2 are presented in Table 18-23. for both the average exposure and the reasonable maximum exposure (RME), subchronic and chronic hazard indexes (HI) are shown for each receptor. For the average and RME exposure scenario for each receptor, the total HIs did not exceed EPA's level of concern of unity (1.0) for noncarcinogenic effects.

The exposure pathway contributing the most to the total HI for both the average and RME exposure scenarios is the inhalation of fugitive dust or airborne particulates, making up almost all (>98%) of the total noncarcinogenic hazard. Chromium was the primary COC for this exposure pathway.

Carcinogenic Risks

Carcinogenic risks are also presented in Table 18-23. The total carcinogenic risks (i.e., risks for all pathways combined), for the average and RME exposures were 1.5E-08 and 1.9E-07, respectively. These risks are within the EPA's target risk range of 1.0E-04 to 1.0E-06 for a Superfund site (EPA 1989b). The exposure pathway contributing the

majority of the cancer risk was the inhalation of particulates. Cadmium and nickel contributed about equally to these carcinogenic risks.

Lead as a Potential Hazard/Risk

The maximum level of soil lead detected in RAA2 was 224 mg/kg (qualified as an estimated value). The EPA UBK model is not applicable to this RAA since residential exposure is not likely to occur. The 95% UCL concentration for lead in surface soil at RAA2 was 215 mg/kg (Appendix D-1). Both the maximum and 95% UCL soil lead concentrations were well below the current EPA interim guidance for soil lead cleanup levels (500 to 1000 mg/kg) at Superfund sites (EPA 1991f).

Air modeling was performed to determine the lead concentrations in ambient air. For the average and RME exposures, the estimated ambient concentrations of lead were 0.017 $\mu g/m^3$ and 0.034 $\mu g/m^3$, respectively. Both of these concentrations were below the EPA background concentration of 0.200 $\mu g/m^3$ (EPA 1991e).

### 18.5.2.3 Risk Characterization - RAA3

Noncarcinogenic hazard indexes (HIs) and carcinogenic health risks were calculated for a current and future maintenance worker, a future construction worker, and hypothetical adult and child residents. These receptors were assumed to be exposed to chemicals at RAA 3 via soil ingestion, dermal contact with soil, inhalation of VOCs, and inhalation of particulates. The risks and HIs calculated for each receptor are described below and are summarized in Table 18-24.

Current and Future Maintenance Worker

Current and future maintenance workers were assumed to be routinely exposed to site chemicals for 9 or 25 years. The total hazard index calculated for noncarcinogenic health effects due to cumulative exposures to soil via ingestion, dermal contact, and inhalation of VOCs and particulates is 3.4E-02 and 1.6E-01 in the average and RME conditions, respectively. Both hazard indexes are below the EPA level of concern (1.0), which indicates that the potential for adverse health effects is minimal.

The lifetime excess cancer risk to current and future maintenance workers under the assumed exposure conditions is 1.2E-09 and 2.6E-08 in the average and RME cases, respectively. Inhalation of particulates is the chief contributor to the risk estimates. These levels are at or below the target risk range of 1E-06 to 1E-04 for exposure to chemicals released from RAA 3.

Future Construction Worker

The future construction worker was assumed to be exposed to RAA chemicals 8 hours a day, 20 days per year and 40 days per year for the average and RME exposure scenarios, respectively. The total hazard index calculated for noncarcinogenic health effects due to cumulative exposures to soil via ingestion, dermal contact, and inhalation of VOCs and particulates is 3.6E-03 and 3.0E-02 in the average and RME conditions, respectively. Both hazard indexes are below the EPA level of concern (1.0), which indicates that no adverse health effects are to be anticipated for this receptor.

The lifetime excess cancer risk to future construction workers under the assumed exposure conditions is 2.3E-10 and 1.1E-9 in the average and RME cases, respectively. Soil ingestion is the chief contributor to the risk estimates. These levels are at or below the target risk range of 1 E-06 to 1E-04 for exposure to chemicals released from RAA 3.

Future Adult and Child Resident

Hypothetical future adult and child residents were assumed to be routinely exposed to site chemicals for 9 or 30 years. For the future adult resident, the total hazard index calculated for noncarcinogenic health effects due to cumulative exposures to soil via ingestion, dermal contact, and inhalation of VOCs and particulates is 1.8E-01 and 5.6E-01 in the average and RME conditions, respectively. Average and RME hazard indexes calculated for the future child resident were 7.2E-01 and 8.8E-01, respectively. Hazard indexes for these two hypothetical future residents are below the EPA level of concern (1.0).

The lifetime excess cancer risk to hypothetical future adult and child residents under the assumed exposure conditions is 8.6E-09 and 2.2E-7 for the hypothetical adult resident and 4.5E-08 and 5.1E-07 for the hypothetical child resident in the average and RME cases, respectively. For the average exposure scenario, inhalation of particulates is the chief contributor to the risk estimates, while the RME scenario has soil ingestion as the primary contributor to the risk estimates. These levels are at or below the target risk range of 1 E-06 to 1E-04 for exposure to chemicals released from RAA 3.

Lead as a Potential Hazard/Risk

The maximum level of soil lead detected in RAA 3 was 147 mg/kg in surficial soil (Appendix D-1), well below the current EPA interim guidance for soil lead cleanup levels (500 to 1,000 mg/kg) (EPA 1991f).

Air modeling was performed to determine the lead concentrations in ambient air. For the average and RME exposures under the baseline, intrusive action and future use scenarios, the estimated ambient concentrations of lead (Appendix D-2) were below the EPA's background value of 0.200 $\mu g/m^3$ (EPA 1991e).

#### 18.5.2.4 Risk Characterization - RAA4

The COCs identified in this RAA were metals, volatile organic chemicals, and pesticides. Carcinogenic risks and noncarcinogenic hazards were estimated for current and future workers who perform general-duty or ground maintenance functions in the SWMUs within RAA 4. Future intrusive action or residential scenarios were not judged to be plausible for RAA 4, because it is smaller than one-half acre (Section 18.4).

Exposure pathways evaluated were of incidental soil ingestion, dermal contact, and inhalation of volatile organic compounds and fugitive dust for current and future workers. The results are summarized below.

Noncarcinogenic Hazards

Noncarcinogenic hazards for all receptors considered in RAA4 are presented in Table 18-25. For both the average exposure and the reasonable maximum exposure (RME), subchronic and chronic hazard indexes (HI) are shown for each receptor. For the average and RME exposure scenarios, the total HIs did not exceed EPA's level of concern of unity (1.0) for noncarcinogenic effects.

The exposure pathway contributing the most to the total HI for both the average and RME exposure scenarios is incidental ingestion of site soil, making up almost all (>80%) of the total noncarcinogenic hazard. Cadmium was the primary COC for this exposure pathway.

Carcinogenic Risks

Carcinogenic risks are also presented in Table 18-25. The total carcinogenic risk (i.e., risks for all pathways combined), for the average and RME exposures for workers were 1.7E-11 and 8.9E-10 respectively. These risks are within the EPA's target risk range (1.0E-04 to 1.0E-06) for a Superfund site (EPA 1989b). The primary exposure pathway contributing the majority of the cancer risk was inhalation of particulates. 4, 4'-DDD contributed significantly (i.e., >75%) to this carcinogenic risk.

Lead as a Potential Hazard/Risk

The maximum level of soil lead detected in RAA4 was 529 mg/kg in surficial soil. The EPA UBK model is not applicable to this RAA since residential exposure is not likely to occur. The surface soil lead 95% UCL concentration for RAA4 was 411 mg/kg (Appendix D-1), well below the current EPA interim guidance for residential soil lead cleanup levels (500 to 1000 mg/kg) (EPA 1991f).

Air modeling was performed to determine the lead concentrations in ambient air. For the average and RME exposures, the estimated ambient concentrations of lead were 0.015 $\mu g/m^3$ and 0.048 $\mu g/m^3$, respectively. Both of these concentrations were below the EPA's background value of 0.200 $\mu g/m^3$ (EPA 1991e).

### 18.5.2.5 Risk Characterization - RAA5

The COCs identified in this RAA were lead, ethylbenzene, toluene, and xylenes. Since lead does not have EPA-verified toxicity values, the quantitative evaluation of human health impact from exposure to chemicals at RAA 5 was based on ethylbenzene, toluene, and xylenes. These compounds are noncarcinogens. RAA 5, a former sludge weathering pit covered with clean fill, is less than one-half acre and is grass-covered. Therefore, future intrusive action, construction, or residential activities were not judged to be plausible for scenarios for RAA 5. Noncarcinogenic hazards were estimated for current and future workers who perform general duty or ground maintenance functions in this SWMU or risk assessment area (Section 18.4).

The potential exposure pathway was judged to be inhalation of volatile organic compounds for current and future workers. Since the SWMU was filled and there is little likelihood of intrusive action at this SWMU, exposure to site-related chemicals via dermal contact and incidental soil ingestion exposure pathways was not evaluated quantitatively. Workers at RAA 5 were assumed to be exposed to volatilized organic chemicals by inhalation. A box model was used to estimate ambient VOC exposure point concentrations. No groundwater data were collected for RAA 5. However, this exposure pathway was judged to be relatively insignificant since site-chemicals were not detected at depths beyond 10 feet BGS (Section 18.4). Risk characterization results for the inhalation pathway are summarized below.

Noncarcinogenic Hazards

Noncarcinogenic hazards for current and future workers at RAA 5 are presented in Table 18-26. HIs and hazard quotients for subchronic and chronic exposure to site-related chemicals are presented for workers under the average and reasonable maximum exposure (RME) scenarios. For the average exposure scenario, total HIs also did not exceed the EPA level of concern (1.0) for noncarcinogenic effects. Although the HIs for RME exposure were over eight times greater than the HIs for average exposure, the RME HIs did not exceed the EPA level of concern.

The chemical that contributed most to the noncarcinogenic hazard among the COCs for the inhalation pathway was xylene. However, xylene was only detected in two out of six soil samples collected at this SWMU.

Carcinogenic Hazards

Calculated carcinogenic risks were absent (or zero), due to the absence of carcinogenic chemicals identified as chemicals of concern for this RAA.

Lead as a Potential Hazard/Risk

The maximum level of soil lead detected in this RAA was 12.6 mg/kg in surficial soil. The EPA UBK model is not applicable to this RAA since residential exposure is not likely to occur. The estimated (RME) ambient air concentration for lead was 0.0012 $\mu g/m^3$, well below the EPA-estimated background concentration ($0.20 \mu g/m^3$) (EPA 1991e). The surface soil lead 95% UCL concentrations for RAA 5 was 12.6 mg/kg. Both the maximum and 95% UCL soil lead concentrations were comparable to background lead concentrations (Table 2-7) and well below the current EPA interim guidance establishing the residential soil lead cleanup levels at Superfund sites (500 to 100 mg/kg) (EPA 1989b).

### 18.5.2.6 Risk Characterization - RAA6

The chemicals of concern (COCs) identified were lead, toluene, selenium, and zinc. With the exception of lead, all COCs are noncarcinogens. Noncarcinogenic hazards were estimated for workers (general duty and construction) for RAA6. Although the area is greater than one-half acre, the ditch serves to conduit runoff from nearby buildings and a parking lot. Therefore, it is unlikely that the ditch will become a residential area. The ditch was tilled in 1988 to enhance bioremediation. Thus, surface and subsurface soil data were combined to estimate exposure point concentrations. The exposure pathways of incidental soil ingestion, dermal contact, and inhalation of volatile organic compounds and fugitive particulates were assumed to be complete for the above identified receptors (Section 18.4). Hazards were combined across exposure pathways for all site-related chemicals. The results are summarized below.

Noncarcinogenic Hazards

Noncarcinogenic hazards for all receptors considered in RAA6 are presented in Table 18-27. For both the average exposure and the reasonable maximum exposure (RME), all HIs and hazard quotients represent chronic exposure to the site-related chemicals. For the average exposure scenario for each receptor, the total HIs did not exceed EPA's level of concern (1.0) for noncarcinogenic effects. Under the RME scenario, both HIs are well below (by more than three orders of magnitude) the EPA level of concern.

The most significant exposure pathway for both the average and RME exposure scenarios was the soil ingestion of COCs, in soil, which contributed to almost all of the total noncarcinogenic hazard index. Metals were the primary COCs for this exposure pathway.

Carcinogenic Hazards

As shown in Table 18-27, calculated carcinogenic risks were absent (or zero), due to the absence of carcinogenic chemicals identified as chemicals of concern for this RAA.

Lead as a Potential Hazard/Risk

Lead in RAA6 was measured in soil and modeling was performed to estimate ambient air concentrations. The 95% UCL of the arithmetic mean soil concentration of lead in surface and subsurface soils for RAA6 is about 4.6 mg/kg (Appendix D-1), which is higher than the maximum detected value of 8.9 ppm. The maximum detected concentration was selected as the exposure point concentration (EPA 1989b). These soil lead levels are below the site and regional background concentrations of 9 to 15 mg/kg; this level is many times below the current EPA interim guidance for soil lead cleanup levels of 500 to 1000 mg/kg at Superfund sites (EPA 1991f).

Air modeling was performed to estimate air lead concentrations in order to assess the hazard from the inhalation route of exposure under the baseline and intrusive action

scenarios. For each of these scenarios, the RME lead air concentrations modeled from the soil lead concentrations in surface and combined surface/subsurface soils were the same (41 ppm). The predicted ambient lead concentrations (RME) for the baseline and intrusive action scenarios were 0.043 $\mu g/m^3$ and 0.0148 $\mu g/m^3$, respectively. Both of these concentrations were below the EPA UBK model's default (background) value of 0.200 $\mu g/m^3$ (EPA 1991e).

### 18.5.2.7 Risk Characterization - RAA7

The COCs identified for RAA7 were barium, acetone, and toluene. These COCs are noncarcinogens. Since acetone does not have a inhalation toxicity value (reference concentration, RfC), it was not evaluated for noncarcinogenic effects from inhalation exposure.

RAA7 is comprised of three trunks of buried sewer lines. Exposure to COCs in this RAA is plausible during intrusive or construction activities. Although the area is greater than one-half acre, it is unlikely that this long stretch of land will be converted for residential use. This RAA is expected to continue to serve as a conduit for wastewater from the base to the wastewater treatment lagoons. Thus, receptors evaluated for exposure to site chemicals were future workers performing construction or intrusive work. The exposure pathways of incidental soil ingestion, dermal contact, and inhalation of volatile organic compounds and fugitive particulates were assumed to be complete for the future construction worker (Section 18.4). Hazard indexes were combined across exposure pathways for all COCs chemicals. The results are summarized below.

Noncarcinogenic Hazards

Noncarcinogenic hazards for all receptors considered in RAA7 are presented in Table 18-28. For the average exposure scenario, the total HI did not exceed the EPA level of concern (1.0) for noncarcinogenic effects. Although the total HI for RME exposure was over four times the HI for average exposure, the RME HI also did not exceed the EPA level of concern. The pathway-specific RME HIs were one or more orders of magnitude below unity. The results of this hazard evaluation indicate that inhalation of barium contributes most to the estimated hazard index, relative to the

other exposure pathways. Nevertheless, the hazard index is within acceptable limits and many times below the concern level.

## 18.6 ECOLOGICAL RISK ASSESSMENT

### 18.6.1 Introduction

The purpose of this ecological risk assessment was to evaluate the potential for biota at Cannon Air Force Base to be adversely impacted. The ecological risk assessment focuses on the potential for adverse effects on selected indicator species (chemical receptors) from environmental stressors (chemicals of concern) at the site. The ecological risk assessment follows the guidelines provided by the EPA (1989d) in "Risk Assessment Guidance for Superfund: Volume II Environmental Evaluation Manual."

Presented in this report are the assumptions used and the conclusions reached regarding the potential for wildlife impacts at Cannon. Also included are descriptions of the site ecology and chemicals of concern.

### 18.6.2 Identification of Potential Receptors

In this subsection, the plant and animal species (biota) that occur at Cannon and in the nearby vicinity are identified, sensitive species and habitats are described, and an indicator species is selected for further evaluation. Some of the information contained in this subsection was obtained during a site visit on October 30, 1991.

A description of the general ecology of the area is given in Section 1.4.3.8. Located on what was formerly agricultural land, the natural communities associated with a High Plains grassland have been highly modified. Industrial and other land uses have disturbed much of the base; however, some species typical of the southern High Plains (i.e., grama grasses and western wheatgrass) can still be found within the study area.

There are 18 SWMUs, located on 13 different sites, that are being evaluated as part of in this Remedial Investigation (RI). The sewage treatment lagoons are the only water bodies; the other SWMUs have habitats that range from industrial/disturbed areas to

grassland/shrub type. For the most part, the SWMUs offer limited habitat for wildlife. The SWMUs are mostly flat, open areas. Many are on disturbed sites where the vegetation is kept mowed to a fairly short height. Common receptors would include insects and small rodents, with birds of prey being at the top of the food chain. Table 18-29 lists the SWMUs, their habitats, and the receptors that could typically be found in each habitat type.

Playa Lake, which is located approsimately 1000 feet east of the lagoons, is briefly discussed in this ecological risk assessment since it receives effluent from the sewage lagoons and it is the principle site of wildlife activity on Cannon AFB. Playa Lake is a SWMU which has been identified for investigation in the future as part of the overall RI for Cannon AFB. Playa Lake has water in it year-round and thus attracts migratory waterfowl and shorebirds, small mammals, reptiles, and amphibians. Playa Lake provides some wetland habitat mixed in with open, grassy and weedy mesic areas surrounding the lake.

#### 18.6.2.1 Migratory Fowl

Waterfowl have been identified as the predominant wildlife population at Cannon. Most of the ducks on Cannon AFB can be classified as belonging to the prairie dabbler group. The U.S. Army Corps of Engineers manual for wetland evaluation (USACE 1987) describes the prairie dabbler ducks as having similar food preferences. Pintails, wigeons, gadwalls, shovelers, and mallards are the primary species observed at both of the sewage lagoons (SWMU Nos. 101, 102) and, more commonly, at Playa Lake. Although other classes of ducks and birds may be present, the dabbler ducks were considered to be wildlife of special concern for aquatic/wetland ecosystems at this site due to their conspicuous abundance, food habits, and potential exposure to chemicals in water and sediment at the lagoons.

Migration corridors through the Central Flyway bring ducks into the Clovis area by late October. They reach their greatest numbers by mid-November (Robertson 1992). Many continue on through eastern New Mexico to wintering grounds along the Gulf Coast of Texas and Mexico, but others will spend at least some of the winter in the Clovis area. The amount of time spent in the area is dependent on many factors, but weather plays

a major role. In mild winters, the lagoons, Playa Lake and the other lakes around Clovis can stay free of ice and ducks may stay most of the winter (approximately 3-4 months). During colder winters, most of the ducks will leave when the lakes freeze over, usually by early January. In this case, the ducks would not spend more than one and a half to two months at the lake at Cannon or the other lakes around Clovis. Typically, the majority of ducks will leave the area by early to mid-March.

During their winter stay in the Clovis area, ducks do not use one water body exclusively, but spend time at several different locations, including the lagoons and Playa Lake at Cannon and Santa Fe Lake, south of Clovis. The primary food source for ducks at Cannon seems to be the waste grain on the surrounding farm fields. Both ducks and geese feed on the waste grain (mostly corn, wheat, and sorghum) and are also attracted to the winter wheat grown in the area (Robertson 1992). The sewage lagoons are used by waterfowl primarily as a resting area where very little, if any, feeding takes place, due to the lack of aquatic vegetation or other food sources. The exposure pathway for chemicals in the sewage lagoons would be generally limited to water which the ducks could be drinking. Ducks in the lagoon may also be exposed to chemicals in the sediments through incidental ingestion. Playa Lake presents a more natural environment near the lagoons and does provide some food sources for ducks. Dabbler ducks feed primarily on the seeds and succulent stems and leaves of aquatic and marsh plants in the lake.

#### 18.6.2.2 Predatory Species

Raptors are at the top of many food chains at Cannon AFB. Many different species can be found in the area including northern harriers, American kestrels, Mississippi kites, sharp-shinned hawks, ferruginous hawks, and great-horned owls.

The ferruginous hawk is a federal Category 2 candidate species. Category 2 species are those species for which listing as threatened or endangered is possibly appropriate, but more information is needed before such action is taken. Ferruginous hawks are known to occur in Curry County and could possibly be found in the area around Cannon AFB. They may be winter migrants or year-round residents. It is one of the largest and most powerful of the buteos, with a wingspan of up to 56 inches. Prey species include prairie

dogs, gophers, rabbits, and mice, but they will occasionally eat snakes, lizards, and insects. While ferruginous hawks may occasionally feed at the base, they are unlikely to remain as residents as there is very little, if any, suitable nesting habitat on the base itself.

The Mississippi kite had been classified as a state protected species, but has recently been delisted (NMDG&F 1992). In recent years it has been expanding its range in New Mexico and has established itself in several areas of the state. Mississippi kites have been present on the golf course at Cannon AFB. Unlike many migratory North American birds that are in their winter range when in New Mexico, the Mississippi kite is in its summer range when in the Clovis area. Its winter range is in Paraguay and Argentina - it migrates north in flocks in the spring and arrives in the U.S. sometime in March-May. Pairs appear to be mated upon arrival, and several pairs have been observed defending their territory around the Cannon golf course. Prey species are primarily large insects caught in flight (including grasshoppers, cicadas, crickets, dragonflies, and beetles), but they will occasionally eat small snakes and lizards. Raptors were considered important potential receptors for the terrestrial ecosystems.

#### 18.6.2.3 Other Populations

Most of the SWMUs offer very little habitat for wildlife. Vegetation is primarily limited to mixed, non-native grass species and weeds, which are often kept short by mowing. These areas are generally open and flat, without trees or shrubs, and are often close to human activity. Consequently, both species abundance and diversity are low. Playa Lake does provide habitat for waterfowl, endemic amphibians, and small mammals. Landfill No. 5, in the southeast corner of the base (SWMU No. 113), does have a few trees and shrubs and provides a slightly better habitat for wildlife than most of the other SWMUs. Besides the receptors already discussed, small mammals such as mice and gophers would be the most common receptors in this type of habitat.

The plains pocket gopher and the deer mouse can be found on Cannon AFB. The pocket gopher is a medium-sized burrowing rodent that spends most of its life underground. Its presence on Cannon AFB is indicated by the characteristic gopher

mounds (piles of soil which have been brought to the surface from their underground burrows). Tunnels at plant root levels serve as feeding areas, with the gophers' food consisting mostly of roots and tubers. Deer mice are widely distributed throughout the study area. They are omnivorous rodents, eating primarily seeds, grains, and insects.

Game species occur infrequently at Cannon AFB. The pronghorn antelope can occasionally be found in the area, but any exposure to possible contaminants would generally be limited to a few individual antelope, on a very irregular basis. The Bairds sparrow is the only state endangered species known to occur in Curry County. Its presence or absence on Cannon AFB is not known. This sparrow can be found in a variety of grassland habitats including the shortgrass habitats found on Cannon AFB. This sparrow migrates to the eastern plains of New Mexico. Migrants arrive in the fall as early as the first week of August, but most have moved further south by November. In the spring, the species has seldom been observed. Food consumed by the sparrow consists mainly of grass seeds and insects.

#### 18.6.2.4 Indicator Species

It is not feasible to assess impacts to every species potentially affected by exposure to chemicals of potential concern at a site. A common approach to resolve this problem in ecological risk assessments is to select "indicator species" or species groups for detailed evaluation and to assume that impacts to these indicators are representative of potential impacts on other species at the site. The selection of indicator species is driven by a number of factors including the potential for exposure, the frequency of occurrence of the species, the relative sensitivity of the species or group, the availability of toxicity data, and the role of the species or group in the food web. Given these considerations, ducks were chosen as the principle indicator species for wetland/aquatic ecosystems at Cannon. Ducks account for the majority of the wildlife observed at Cannon, and they are the prevalent species observed at the wastewater treatment lagoons and the nearby Playa Lake. Fish and other aquatic organisms at the lagoons were not designated as indicator species, because the lagoons, as water bodies, are not designated for the protection of aquatic life.

For terrestrial habitats, the deer mouse was considered to be the principal indicator species due to its ground-dwelling habit and as a prey item for raptors. Kites were also considered to be an important species to evaluate for potential impacts given their recent status as a state protected species.

### 18.6.3 Potential Exposure Pathways

This subsection evaluates the source media and potential exposure pathways by which environmental receptors may be exposed to chemicals of potential concern at Cannon. Exposure pathways define the migration routes that chemicals may take from sources to exposure points. Each potential exposure pathway is described in terms of the transport media and chemicals involved, the potential ecological receptors, and the potential uptake of chemicals by those receptors. Potential pathways are evaluated for significance and completeness.

An exposure pathway consists of four necessary elements:

- a source mechanism of chemical release to the environment
- an environmental transport medium for the released chemical
- a point of potential ecological contact with the contaminated medium
- an ecological uptake route (intake of contaminated media) at the point of exposure.

All four elements must be present for an exposure pathway to be complete. Incomplete exposure pathways do not result in ecological exposures and are thus not included in the risk assessment.

Exposure pathways to ecological receptors at Cannon were considered to be limited. Only three environmental transport media were considered significant with respect to potential ecological receptor exposure: i.e., soil, surface water, and sediments. The transport pathways for chemicals of concern from a source to these three media are

similar to those shown in Figures 18-3 and 18-4 of the human health conceptual site model.

Surface waters and sediments in the lagoon provide the principal exposure media of concern at Cannon. For this evaluation, ducks were assumed to spend some time in the wastewater treatment lagoon area both resting and feeding. Most of their time may actually be spent at Playa Lake and in nearby grain fields, with only a small amount of time spent at the lagoons resting.

Surface soil is another important media for potential exposure to chemicals by ecological receptors. Terrestrial species that would be exposed to chemicals in the soil either directly through soil ingestion or indirectly through vegetation ingestion include small mammals and soil invertebrates. Hawks and kites and other non-ground-dwelling species could also be exposed to soil chemicals indirectly through ingestion of insects or small herbivores/carnivores. Due to the lack of ecological soil criteria, the assessment of potential impacts to terrestrial wildlife from exposure to chemicals in soil is largely qualitative in this risk assessment.

Potential exposures to chemicals in the air are not evaluated for ecological receptors because toxicity and exposure information are very limited. Potential exposures to chemicals in groundwater were also not evaluated because no exposure pathways for groundwater to ecological receptors were identified. The significance of the three principal exposure routes (i.e., ingestion, inhalation, and dermal absorption) are discussed in subsection 18.6.7 with respect to the selected chemicals of concern.

### 18.6.4 Chemicals of Concern

Chemicals of concern were selected by comparing concentrations of chemicals in water, sediment, and soil to background concentrations and reference concentrations where available. Chemicals of concern were different for each of the three media. The following subsections discuss the selection process and results for each of the three media.

### 18.6.4.1 Water

To identify the chemicals of concern for water, four surface water samples were collected from the wastewater treatment lagoons (SWMU Nos. 101, 102). The samples were analyzed for metals, volatile organics, semivolatile organics and pesticides. From the concentrations detected, the average concentrations and the upper 95% confidence intervals were calculated. For samples where the concentration was less than the detection limit, 50% of the detection limit was used for calculating the upper 95% confidence limit. In some of the cases, only one sample had a concentration greater than the detection limit. In these cases, the highest concentration detected was noted. No background samples were collected, so a comparison to background concentrations could not be completed. Table 18-30 presents the highest detections in the water and sediment samples, and includes the federal and state water criteria.

To identify the potential chemicals of concern in water from the lagoons, the highest concentrations detected in the samples were compared to state and federal water quality criteria. The criteria that were used included the national Ambient Water Quality Criteria (AWQC) and the New Mexico Water Quality Criteria.

Six chemicals (five metals and one anion, cyanide) were detected in the surface water at the sewage lagoons in concentrations equal to or greater than either state or federal water quality criteria. These chemicals include copper, cyanide, lead, mercury, silver and zinc. No organic chemicals (volatiles, semivolatiles, or pesticides) were found at concentrations exceeding current available criteria. The AWQC include an "acute" criteria which, if even briefly exceeded, would pose an adverse risk to the most sensitive organism. The AWQC also include a "chronic" criteria which, if exceeded over a portion of the organism's life, may pose a risk. Information on the relationships between chemicals of concern and adverse effects comes from several sources, including: Ambient Water Quality Criteria (EPA 1980-1985); Quality Criteria for Water (EPA 1986c); Wildlife Toxicology (Peterle 1991); Mining and the Freshwater Environment (Kelly 1988); and the available scientific literature.

Copper, silver, and zinc have maximum detected values above the freshwater acute criteria, as established by the EPA. The acute and chronic water quality criteria values

were obtained using a hardness value of 100 mg/L (as $CaCO_3$) and using waters that had an average Total Organic Carbon (TOC) of 2-3 mg/L. For many chemicals, toxicity decreases as hardness and TOC increases; therefore, AWQC are typically adjusted upward for waters significantly higher in TOC and hardness. Hardness and TOC values for the lagoon water were not available. However, hardness values from groundwater wells on the base had values from 200 to 300 mg/L. This would indicate that the reference AWQC used in this evaluation are likely to be conservative.

#### 18.6.4.2 Sediments

Eight sediment samples were collected from the lagoon and were used to identify chemicals of concern. No standardized criteria or background sediment values are available against which to compare sediment concentrations from the lagoons. Sediment concentrations for metals were thus initially compared to Cannon AFB background soil concentrations and EPA Threshold Sediment Concentrations (Fitchko 1989) (Table 18-31). EPA's Threshold Sediment Concentrations are based on AWQC that are converted to sediment criteria using partitioning coefficients, a 4% TOC value, and the following equation.

$$\text{Concentration}_{(water)} = \text{Concentration}_{(sediment)} / (F_{oc} * K_{oc})$$

where: $F_{oc}$ = Fraction of organic carbon in sediment (%)
$K_{oc}$ = Sediment absorption coefficient (L/kg sediment)

Since the lagoon sediment TOC was 13.3% (CAN101-101S-5005), these criteria are considered very conservative. EPA provides these sediment concentrations as guidance values for pesticides; the equilibrium partitioning of chemicals between sedimentary organic matter and interstitial water should only be applied to nonpolar, nonionic organic chemicals, and not metals.

To provide a further screening of sediment values for organic chemicals measured in the lagoon sediments, sediment concentrations were converted to water concentrations using available sediment-water partition coefficients from Chapman (1989) (see Table 18-32). The fraction of organic carbon was based on measured TOC values in sediment of

13.3% (CAN101-101S-5005). The resultant values for water were then compared to EPA acute and chronic AWQC (Table 18-33).

Most of the metals values in sediments exceeded Cannon soils background concentrations. Copper, lead, and mercury had values that exceeded the EPA Threshold Sediment Concentrations. Because copper, lead, and mercury are considered to be chemicals of concern in water, they were thus also selected as principal chemicals of concern for sediments.

Sediment values for most of the organic pesticides that were partitioned to water, exceeded AWQC and RFI (1989a) criteria for carcinogens in water. Sediment concentrations for lindane and DDT also exceeded EPA Threshold Concentrations. Based on this initial screen, all of the organic pesticides in sediment were considered to be potential chemicals of concern to waterfowl which frequent the lagoons.

Bis(2-ethylhexyl)phthalate was not considered further as a chemical of concern in this screening assessment because it is not likely to be toxic to ducks or mammals at concentrations less than 1,000 ppm (detected at 340 ppm) nor likely to be more toxic than those pesticides and metals found in the lagoon sediments. Bis(2-ethylhexyl)phthalate is also not likely to biomagnify.

#### 18.6.4.3 Soils

For soils, maximum or UCL concentrations (whichever value was lower) were compared to reference values (i.e., off site and Cannon AFB background concentrations). Table 18-34 lists those SWMU locations and analytical results where reference values were exceeded. A number of soil concentrations which exceeded Cannon background values may still be in the normal range of soils concentrations. Included on Table 18-30 are chemical values which are considered to be in a normal range for the southwest (see Table 2-7) and for the United States (Bowen 1979; USGS 1984).

Based on the data presented in Table 18-34 a number of metals were eliminated from further consideration, as their levels were within background or normal ranges. These metals included aluminum, iron, arsenic, manganese, nickel, and mercury. Values for

barium, selenium, silver, and beryllium were also considered to be within the normal range for this area. The remaining seven metals (cadmium, chromium, cobalt, copper, lead, zinc, antimony) had concentrations exceeding Cannon and southwest background concentrations, or normal ranges for soils in the U.S. Values that exceeded background ranges for Cannon and the southwest, and that were near or outside the U.S. normal range for soils, were considered to be of greatest potential concern (i.e., zinc and cadmium). Antimony was eliminated from further consideration as the one value that was elevated above Cannon background and the normal range in U.S. soils, and also had a "U" qualifier, indicating this value was a "nondetect." Based on this analysis, metals in addition to zinc and cadmium that are considered to be of concern are copper, chromium, cobalt, and lead.

Only one value (0.12 ppm) for organic chemicals, benzo(a)pyrene, slightly exceeded the reference value (0.2 ppm). Benzo(a)pyrene, because of its low concentration relative to the reference (background) value (see Human Risk Assessment), was not considered to be a chemical of concern to soil biota.

### 18.6.5 Exposure Evaluation

For this ecological risk assessment, ducks were determined to be an important receptor to metals in water; therefore, the duck-water source-receptor pathway was selected as the principal exposure pathway of concern, based on the known metal concentrations in water. A further quantitative evaluation of the potential toxic hazards to waterfowl from water ingestion of metals was conducted. Where toxicity information was available, the incidental ingestion of metals in sediments was also considered.

While a number of pesticides were identified in the sediments of the lagoons, it is not known whether the dabbler ducks are actually exposed to these sediments through feeding or incidental ingestion. Further quantitative evaluation of the pesticide-sediment-duck pathway was not conducted since actual exposure and background concentrations are unknown, and adequate characterization of potential risk from all the detected pesticides would require considerable additional research. This report recognizes, however, that pesticides in the lagoon sediments pose a potential risk to waterfowl if chronically ingested, and concentrations for several of the chemicals (e.g.,

heptachlor and toxaphene) may be acutely toxic to aquatic life. A brief qualitative discussion of organochlorine pesticide toxicity to mallards is presented in subsection 18.6.7.5.

A number of metals were selected as potential chemicals of concern in soils. These metals are of most concern to ground-dwelling organisms. None of the selected metals of concern is considered to pose a risk to higher trophic level organisms in terrestrial ecosystems, such as raptors. Unlike in aquatic ecosystems, where there is considerable potential for bioconcentration and bioaccumulation of metals, the potential for bioaccumulation of metals in higher trophic levels in terrestrial ecosystems is not generally thought to be significant. A general discussion is presented in subsection 18.6.7.6 on the potential risk posed to biota from the metals in soils at Cannon.

### 18.6.6 Toxicity Information for Metals of Potential Concern in Lagoon Water and Sediments

The following toxicity evaluation focuses on the chemical and biological properties of the metals of concern detected in the water and sediments of the sewage lagoons. Most of the information presented was obtained from the AWQC documents published by the EPA from 1980 to 1985.

The AWQC were derived using statistical analysis of toxicity data from several species. The species used for establishing the AWQC are primarily aquatic. These species include fish, invertebrates, and other organisms that may spend their entire life cycle in an aquatic environment. These organisms are likely to experience a greater intake of the chemicals in the water than those species that derive only a portion of their diet from aquatic sources and are only occasionally immersed in the water.

Dabbling ducks spend only a portion of their time in the water and have a very different physiology than fish or invertebrates. It was necessary, therefore, to identify criteria that are more relevant to ducks. To accomplish this, a review of the literature was conducted to identify toxic concentrations of the chemicals of concern that had been administered to ducks or other similar birds. The intent was to identify "no observable adverse effect levels" (NOAELs) for the chemicals of concern. Where these could not be identified,

the "lowest observable adverse effect levels" (LOAELs), lowest toxic dose (TDLO), lowest lethal doses (LDLO), or $LD_{50}$s (concentrations resulting in death of 50% of the population) were noted. The identified concentrations were converted to screening intake values (SIVs) to assess the potential impacts of the chemicals to the duck populations at Cannon. SIVs represent concentrations that ducks could intake without experiencing toxicological effects. For cases where a NOAEL was identified, that value was used. If a LOAEL or TDLO was identified, the value was divided by a safety factor of 10 to yield the SIV. If an LDLO was the best value identified, that value was divided by a safety factor of 100 to yield the SIV. If an $LD_{50}$ was identified, the value was divided by a safety factor of 1000 to yield the SIV. The ducks' actual intake of the chemicals is compared to the SIV to assess if there is the potential for a significant risk. The values identified for ducks and other birds are listed in Table 18-35.

Many studies present toxicity data as a dietary level, in ppm. To convert this value to a dose, the dietary level was multiplied by the food consumption, and the product is divided by the organism's body weight:

$$\text{dose}_{(food)}(\text{mg/kg-BW/day}) = \frac{\text{dietary level (mg/kg-food) * consumption (kg-food/day)}}{\text{body weight (BW) (kg)}}$$

where: consumption/BW is the conversion factor from dietary level to dose

Parameters used in the calculation of toxicity doses for the mallard were as follows:

weight = 1.11 kg (Teres 1991)
food consumption = 0.058 kg/day (Nagy 1987)
water intake = 0.063 L/day (Calder and Braun 1983)
% sediment intake = 0.029 kg/day (Goodman and Fisher 1962)

Food consumption was based on weight using the following allometric equation from Nagy (1987):

Food Intake (kg/day) = 0.0582 [(Wt-kg)^0.0651]

Water intake was based on weight using the following allometric equation from Calder and Braun (1983):

Water Intake (L/day) = 0.059 [(Wt-kg)^0.67]

Sediment intake was very conservatively estimated at 50 percent of the food intake (Goodman and Fisher 1962).

Based on the above equations and parameters, a conversion factor of 0.057 can be used to calculate SIVs (mg/kg-BW/day) for water dose, and a conversion factor of 0.056 can be used to calculate SIVs (mg/kg-BW/day) for food dose when data in the literature are presented as dietary level (ppm).

### 18.6.6.1 Copper

General Toxicity

The AWQC for copper show a freshwater acute value of 18-46 $\mu$g/L and a final chronic value of 12 $\mu$g/L. Copper was detected in only one of the three surface water samples collected at the Cannon sewage treatment lagoons. The concentration of copper detected in the one sample was 51 $\mu$g/L, which exceeds both the chronic and acute criteria. Concentrations of copper of 1 to 10 $\mu$g/L are usually reported for unpolluted surface waters of the United States.

Although copper is a required element, it can become toxic at elevated levels. It is especially toxic to many aquatic species. Elevated copper concentrations in water are particularly toxic to many species of algae, crustaceans, annelids, cyrinids, and salmonids. Adverse effects caused by exposure to toxic levels of copper vary between species, and occasionally between different sexes of the same species, but generally include growth inhibition, reduction in C and $N_2$ fixation, and death (if the dose is high enough).

Copper toxicity decreases as both hardness and TOC increase. It can act synergistically with other common contaminants such as ammonia, cadmium, mercury, and zinc to produce an increased toxic effect on fish. Many higher organisms can conserve copper

when it is deficient and excrete it when an excess amount enters the body. However, continued ingestion of copper, in excess of dietary requirements, will lead to some accumulation in tissues, particularly the liver and kidneys. Excess copper accumulation can lead to copper toxicosis and cell damage.

Copper is one of the most common contaminants associated with discharges and sludges generated by sewage treatment plants. Copper has been widely used as an algicide and herbicide for the control of many aquatic plants. It is known as an inhibitor of photosynthesis and plant growth. Concentrations from 1 to 8,000 $\mu$g/L have been shown to inhibit plant growth. Several of these values are near or below the chronic values for fish and invertebrate species, but most are much higher. Protection of animal species appears to offer adequate protection of plant species.

Bioconcentration factors (BCFs) in fresh water range from 0 for the bluegill to 2,000 for the alga, Chlorella regularis. The potential for bioaccumulation or bioconcentration of copper is high for the following biota: mammals, birds, fish, algae, lower animals, and higher plants. Studies on waterfowl have indicated that zinc and copper have the highest accumulation of the heavy metals (Gochfeld and Burger 1987).

Toxicity to Birds

The minimum lethal dose of copper for bird species varies from 300 to 1550 mg/kg body weight, depending on the form of copper fed. Mallards have been shown to tolerate 29 mg/kg body weight of copper (NAS 1977). Symptoms of copper poisoning include reduced weight gain, weakness, lethargy, and eventually anemia or death.

### 18.6.6.2 Cyanide

General Toxicity

Data on the toxicity of cyanide are expressed as free cyanide, which is the sum of cyanide present as HCN and CN- (expressed as CN). The EPA AWQC for cyanide show an acute value of 22 $\mu$g/L and a chronic value of 5.2 $\mu$g/L. The maximum concentration of cyanide detected in surface water at the sewage lagoons was 11 $\mu$g/L,

which exceeds the chronic criteria, but not the acute criteria. Toxicity of cyanide increases with the reduction of dissolved oxygen below the saturation level. Temperature can also affect toxicity of this substance. In fish, hardness has not been observed as affecting acute toxicity of cyanide. The long-term survival and growth of various freshwater fish species were observed to be substantially reduced at free cyanide concentrations of 20-50 $\mu$g/L.

A long-term survival, a partial, and a life-cycle test with brook trout and fathead minnows gave chronic toxic values of 13.6, 7.8, and 16.4 $\mu$g/L, respectively. Chronic toxic values for two freshwater invertebrate species were 18-3 and 34 $\mu$g/L. Adverse effects include incipient inhibition, reduction in growth and reproduction, liver damage, reduced increases in size, and death. At lethal levels, cyanide is primarily a respiratory poison and is one of the most rapidly effective toxicants known (NRCC 1982). $LC_{50}$ values for snails, Daphnia, isopods, amphipods, stoneflys, and midges were all well above the maximum detected concentration in the sewage lagoon water at Cannon.

Freshwater plants show a wide range of sensitivities to cyanide. Green alga exhibited a toxic effect at 75 $\mu$g/L, and duckweed showed a decrease in potassium uptake at 26,000 $\mu$g/L. Adverse effects of cyanide are unlikely at concentrations which do not cause chronic effects on most freshwater species.

Studies have indicated that cyanides are not bioaccumulated in the food chain. Volatilization and biotransformation appear to be the primary processes controlling the aquatic fate of cyanide.

Toxicity to Birds

No information was identified regarding the toxicity of cyanide to birds. For the purposes of this evaluation, data from rat studies were used to approximate toxic values for birds. Ducks and rats are warm-blooded and primarily terrestrial species, unlike fish which are cold-blooded and aquatic.

### 18.6.6.3 Lead

General Toxicity

The EPA AWQC for lead are 3.2 $\mu$g/L for chronic exposure and 82 $\mu$g/L for acute exposure, with a hardness of 100 mg/L. EPA has determined that an unstressed ecosystem can recover from a pollution event, where the concentration of lead exceeds criteria, in an average of three years. The maximum concentration of lead detected in the Cannon wastewater lagoons was 7.1 $\mu$g/L, which exceeds the AWQC criteria for chronic exposure, but not for acute exposure. The two other samples were nondetect for lead (with detection limits of 5 and 2.5 mg/L).

Lead occurs in many different forms, each with different levels of toxicity. Different species also exhibit different sensitivities to lead. Increasing hardness decreases the acute and chronic toxicity of lead. In fish, effects of lead poisoning include growth reduction, reduced respiration, and reproductive impairment. Absorbed lead concentrates primarily in the bones of mammals and birds. Of the soft tissues, the kidneys are the primary targets.

Lead bioconcentration was studied in four species of invertebrates, resulting in a range of bioconcentration factors from 499 to 1700. Two fish species were also examined, yielding bioconcentration factors of 42 and 45. A bioconcentration value has not been established, however, because no maximum permissible tissue concentration is available for lead.

Toxicity to Birds

Several studies have been conducted on the toxicity of lead to ducks. Many of these studies have focused on lead shot because of the concern over using lead shot in hunting. Scheuhammer (1987) reviewed research that had been conducted on lead toxicity in birds. The important contributing factor to lead toxicity, discussed in the article, was the presence of calcium in the diet. A calcium deficiency greatly increased the toxicity of lead. Additionally, it was observed that female birds, particularly egg-laying birds, accumulated lead into their tissues at a greater rate than non-egg-laying females or

males. The hypothesis is that much of the body's calcium is incorporated into the egg shells, reducing the available calcium in the bird's tissues, resulting in greater lead accumulation.

Several studies, with lead as an additive to the diet, were conducted using different species of birds. It was found that levels of lead below 100 ppm usually caused few reproductive effects in birds. Quail, however, were found to be especially sensitive with 10 ppm in the diet, reducing plasma calcium levels and egg production. A concentration of 200 ppm was required to produce similar effects in chickens (Scheuhammer 1987).

The symptoms of lead poisoning in birds include green, watery feces, muscular paralysis, and lethargy (Pain 1989). Dietary lead is usually not manifested in the feathers. High levels of lead in the feathers is usually due to dermal contact with lead.

#### 18.6.6.4 Mercury

General Toxicity

Derivation of water quality criteria for mercury is complicated by the fact that mercury can exist in the natural environment in several different states. In addition, mercury can be converted to an organic and highly toxic methylmercury form under reducing conditions. Bacteria common to most natural waters are capable of converting many mercury compounds to methylmercury.

The AWQC for mercury show an acute value of 2.4 $\mu$g/L and a chronic value of 0.012 $\mu$g/L. The maximum detected concentration of mercury in the sewage lagoons was 1.1 $\mu$g/L, less than the acute value, but greater than the chronic value. Acute toxicity values are available for three classes of mercury compounds: mercury (II), methylmercury, and other mercury compounds.

Available data indicate that methylmercury is the most chronically toxic of the tested mercury compounds. The methyl group gives it a greater affinity for organic material; therefore, it is easily accumulated into biological tissues. Methylmercury is the form of mercury present in most fish tissue and is the most readily accumulated and retained

form of mercury in other aquatic biota. Bacteria common to most natural waters have been shown to be capable of converting many mercury compounds to methylmercury; therefore, virtually any mercury compound entering the water may become a bioaccumulation hazard if conditions are favorable for biomethylation (EPA 1979).

Freshwater plants show a wide range of sensitivities to mercury. Some freshwater plants can tolerate concentrations of approximately 1,000 $\mu$g/L of mercury (II), while others have shown toxic effects at concentrations less than 5 $\mu$g/L. Although many plants are relatively insensitive to mercury (II) and sensitive to methylmercury, they appear to be less sensitive to methylmercury than freshwater animals. Meeting the standards for animals would protect most freshwater plants.

Mercury is strongly bioaccumulated. It is acquired by organisms through direct contact in air and/or water and through the food chain. Upon entering an aqueous system, virtually any mercurial compound can be microbically converted to methylmercury. Mercury is strongly adsorbed to organic and inorganic particulates resulting in strong partitioning of mercury into suspended and bed sediments. Bioconcentration factors for mercury (II) range up to 4,994 for the flathead minnow.

Adverse effects of mercury include reduced growth and reproductive impairment in animals, and reduced photosynthesis in plants.

Toxicity to Birds

Several studies have shown effects of mercury on ducks. At estimated dietary mercury concentrations of 0.1 ppm in food, reduced hatching success and reduced juvenile survival have been reported in ducks. Other studies have shown that chronic exposure of ducks to inorganic mercury yields significant reproductive problems such as delayed testicular development, reduced number of mating attempts, reduced hatching success, and early mortality in hatchlings (Scheuhammer 1987). Female mallards, fed 0.5 ppb of mercury for three generations, laid more eggs outside nest boxes, had lower clutches, and raised fewer young (Gochfeld and Burger 1987).

Breeding mallards were dosed with 3 ppm of dietary methylmercury for 21 days. During this time, their general health seemed unaffected; however, significant reproductive effects occurred. These effects included reduced egg output, reduced hatching success, and increased early mortality in hatchlings (Scheuhammer 1987).

**18.6.6.5 Silver**

General Toxicity

The AWQC for silver is 4.1 $\mu$g/L for acute exposure and 0.12 $\mu$g/L for chronic exposure, based on a hardness of 100 mg/L. The maximum concentration of silver detected in the lagoon waters at Cannon AFB was 40 $\mu$g/L and the average concentration was 15 $\mu$g/L, with an upper 95% confidence level of 51 $\mu$g/L. All three concentrations exceeded both the acute and chronic standards. The water standard for humans is 50 $\mu$g/L.

Silver is usually found in low concentrations in aquatic environments. Silver can exist in many forms, ranging from monovalent silver ions, which can exist in solution, to adsorbed silver on sediment. However, most silver compounds have a low solubility in water. Sorption of silver appears to be dependent on pH and salinity. High organic content appears to increase the sorbtion of silver.

Silver, in minute amounts, is very toxic to fish. The primary toxic mechanism in fish is probably interference with gas exchange by the gills (Gough et al. 1979). The majority of information on the toxicity of silver in the aquatic environment has been derived from studies with freshwater fish and with four species of freshwater invertebrates. The toxicity of silver has been found to decrease with an increase in water hardness. Acute toxicity of silver is also related to chloride ion concentration. Silver toxicity appears to decrease with increasing chloride content, but there is insufficient data from which to establish a criteria relating the two.

A study with Daphnia Magna determined that the presence of food reduced the toxicity of silver.

Bioconcentration data for silver have been established by examining three insect species which were exposed to silver nitrate. The bioconcentration factors ranged from 15 to 240. A bioconcentration factor of less than 1 was established for bluegills. Activated sludge organisms accumulate silver with a factor of $10^3$ to $10^4$. The bioaccumulation of silver is dependent upon what it is complexed to. Silver bioaccumulation from biogenic carbonates and synthetic calcites was found to be greater than silver uptake from iron oxides or detrital organic compounds (Terhaar et al. 1977).

Toxicity to Birds

No information was identified discussing the toxicity of silver to birds. Therefore, data from rat studies were used for assessing the risk of silver to ducks. Neither rats nor birds possess gills, which are the primary mechanism for silver toxicity in fish.

**18.6.6.6 Zinc**

General Toxicity

EPA AWQC for zinc are 110 $\mu$g/l for chronic exposure and 120 $\mu$g/l for an acute exposure, both are based on a hardness of 100 mg/l. The highest concentration of zinc detected in the sewage lagoons was 120 $\mu$g/L and the average concentration was 55 $\mu$g/l, with an upper 95% confidence level of 151 $\mu$g/L. These concentrations are greater than, but very similar to, both the acute and chronic standards.

Zinc can occur in both suspended and dissolved forms. The pH of the water affects adsorption: if the pH exceeds 7, zinc is removed from solution (adsorbed); if the pH is less than 6, zinc is almost completely dissolved. Zinc is also desorbed as salinity increases. Generally, most of the zinc in aquatic environments is partitioned into the sediments. Increasing hardness decreases the acute toxicity of zinc, as the calcium or magnesium outcompetes the zinc binding. However, on the chronic scale, hardness does not appear to impact the toxicity of zinc (determined in a saltwater species of fish). Studies with Daphnia magna and with Daphnia pulex showed that toxicity increased with an increase in temperature.

Most aquatic plants appear to be insensitive to zinc. However, zinc concentrations ranging from 30 to 21,600 $\mu$g/l have been shown to reduce the growth of some plant species, with algae being more sensitive than macrophytes. Bioconcentration factors for freshwater fish range from 51 to 432, and for freshwater invertebrates from 107 to 1130, according to AWQC. Chapman et al. (1968) determined bioconcentration factors of 1000 for freshwater fish, 4000 for freshwater plants, and 40,000 for freshwater invertebrates. Zinc is generally incorporated into organs and bones of fish. Data on bioconcentration suggests that concentrations of zinc that do not harm freshwater species, will not harm the consumers of aquatic organisms.

There is some data to show a behavioral avoidance of zinc-contaminated waters. This data has not been substantiated. However, it indicates that if there is a choice to avoid zinc-contaminated areas, and if such avoidance does not significantly alter normal territorial or migratory urges, fish may attempt to avoid zinc-contaminated areas.

Toxicity to Birds

Gasaway and Buss (1972) examined the effects of adding zinc to the diets of mallard ducks. Four different concentrations of zinc were incorporated into the ducks' food for 60 days. The lowest concentration of zinc was 3000 ppm. A control group received similar food, with no added zinc. It was noted that the ducks' food consumption decreased in relation to the amount of zinc that had been added to the food. As a result, the weight of the ducks decreased with increasing doses of zinc. The control ducks gained weight initially, then fluctuated. The zinc-fed ducks experienced a notable paralysis in their legs, some very soon after being fed the zinc. The paralysis reached the point of immobilizing the ducks. Diarrhea also appeared correlated with the dietary zinc.

After 45 days, only 12 ducks being fed the zinc-supplemented diet were living (out of 24 zinc-fed ducks which began the study). After 60 days, only 2 ducks (being fed the lowest dose of zinc) remained. After 34 days, the ducks' blood was studied, revealing a reduction in the amount of hemoglobin. However, the two ducks that survived for 60 days did not show a reduction in the amount of hemoglobin. Additional data correlated the amount of hemoglobin to the number of red blood cells. Several organs in the zinc-

fed ducks were noted to be reduced. A significant increase was noted in the concentration of zinc in all zinc-fed duck tissues examined.

### 18.6.7 Risk Characterization

Section 18.6.6 described the additional assumptions and information used for calculating the risk due to chemicals in the surface waters at Cannon. As there is no formal method for assessing environmental risk, the risk characterization followed a similar procedure as that outlined in Risk Assessment Guidance for Superfund, Volume I, Human Health (EPA 1989b). Three routes of exposure are typically considered in human health risk assessments: inhalation, dermal adsorption, and ingestion. The EPA document describes the calculation of Hazard Quotients (HQs) to estimate the potential for risk. The HQs for these routes for all chemicals are summed to achieve a total HI.

The individual and combined HQs give an indication of the overall risk the ducks are experiencing at Cannon, as a result of the chemicals present at the site. The HQ is a ratio of the estimated dose they are obtaining to a dose they can tolerate with no adverse effects (the screening intake value or NOAEL). If this ratio is less than 1, it indicates that the ducks can tolerate more than is being taken in and are not likely to be experiencing a significant health risk. If the HI is greater than 1, the ducks are potentially being exposed to higher amounts than they can tolerate without adverse effects. There would be the potential for a risk, due to that chemical. The following subsections discuss the calculations and potential risks of each chemical.

It should be noted that the metals of concern do interact. These interactions can either increase or reduce the overall risk. These interactions and their impact on overall risk, were not evaluated.

#### 18.6.7.1 <u>Inhalation</u>

Most of the chemicals of concern at Cannon AFB are metals which are generally non-volatile and, therefore, would produce a minimal inhalation exposure. The exception is mercury which, in metallic form, is volatile at room temperature. Mercury was detected in one of two water samples from the wastewater treatment area. Since this mercury

was in a dilute solution, it is not likely to produce an inhalation risk from volatilization. Soil sampling revealed no visible patches of metallic mercury. The analytical results for mercury were < 0.5 mg/kg soil, suggesting that mercury is not a soil contaminant at the site. If metallic mercury was present in the soil at Cannon, then there would be an increased potential for an inhalation risk.

At acidic pH, cyanide can be present in a volatile form, as cyanide gas, which would present an inhalation risk. Given the conditions in the lagoons, it is very unlikely that cyanide gas is present. Therefore, it is not likely that there would be an inhalation risk from cyanide.

The other potential for inhalation risk would be inhalation of water spray. As the ducks land or dive, water could be sprayed and inhaled. Similarly, the wind could create a mist of water that could be inhaled. Given the relatively low concentrations present in the water and the low exposure time for such "spraying" events, this route of exposure is also unlikely to be significant.

#### 18.6.7.2 Dermal Absorption

Ducks spend only a portion of their lives in the water. While they are in the water, only approximately half of their body is actually in contact with the water. Their feathers prevent direct contact of the water to the skin, so the only portions of their skin that are actually in contact with the water are their feet and legs. The skin of the feet and legs of the duck is similar to human skin. Both have protective layers which function to impede the absorption of foreign materials.

When in ionic or elemental forms, metals are generally not readily absorbed into the skin. Absorption generally occurs only when a metal is in an organic form. As the concentrations of metals are relatively low, and the portions in organic form are even lower, the potential for dermal absorption is very low.

Cyanide does have a potential for dermal absorption. Data from human studies indicate that this absorption is slow. Cyanide is also detoxified by mammals and possibly birds, and is therefore of little concern in small doses. As the ducks spend a limited amount

of time in the contaminated waters, it is not likely that a significant amount of cyanide would be absorbed.

Intake of both the metals and cyanide from the waters at Cannon is much more significant by ingestion, rather than by dermal contact. Therefore, risks due to dermal adsorption were not considered in this evaluation.

### 18.6.7.3 Ingestion

There are two routes of ingestion of chemicals by ducks at Cannon. Ducks can ingest chemicals in the water when drinking. They can also ingest water and sediments as they feed along lake bottoms. The ducks at Cannon are generally dabbling ducks that sift through lake sediments in search of food. Any contamination that is adsorbed to the sediment can be ingested while feeding. Calculations of potential health risks due to both routes of ingestion are presented in Table 18-36. These two routes of exposure can occur simultaneously and can produce an additive risk. Therefore the calculated HQs for the two routes are summed to create a total HQ for each metal.

The chemical properties of most metals suggest that they would be primarily adsorbed to the sediment at the bottom of the sewage treatment waters, rather than dissolved in solution. Therefore, the primary route of metal intake should be from ingesting sediment materials, rather than from drinking the water.

A value of 50% of total food intake was used to estimate sediment intake in the mallard. This value is very uncertain. An additional value of 10% was factored onto the sediment intake value to account for matrix effects (i.e., the low bioavailability and low absorption of chemicals from sediment particles). In experimental studies, the dose given is usually provided in a matrix form that maximizes availability. The 10% value was considered conservative because the bioavailability for most of the metals in sediments is thought to be more on the order of 2% to 5%.

### 18.6.7.4 Metals in Lagoon Water and Sediments

Copper

Mallards have been shown to tolerate a daily dosage of 29 mg/kg-BW of copper (NAS 1977). Therefore, this concentration was used as the SIV for calculating the risk due to copper. Based on this SIV and the calculated dose of 2.89E-03 mg/kg-BW, the HQ for water was 1.0 E-04 and the HQ for sediment was 3.3E-02. The combined HQ was 3.0E-02, which suggests that copper in the lagoons does not pose a significant risk to the ducks.

Copper is particularly toxic to aquatic life. Copper levels below 1 ppm in water can be toxic to fish (NRC 1980). The mean, maximum, and upper confidence level concentrations measured in the lagoon water exceed the chronic and acute AWQC. Should these same concentrations occur in a water body, it is likely that aquatic life (algae and invertebrates) would be impacted.

Cyanide

No literature specific to birds was identified that addressed the toxic effects of cyanide. The only value that was identified was the $LD_{50}$ for the mouse, which is 3 mg/kg-BW/day (USDHHS 1987). To obtain an approximate NOAEL from an $LD_{50}$, the $LD_{50}$ value was divided by 1000, yielding a screening value of 0.003 mg/kg/day. This value was used as the SIV to calculate the cyanide risk for the ducks. The concentration of cyanide used was 0.011 mg/L in water. Cyanide was not detected in the sediment; therefore, the calculated combined HQ for cyanide is was 0.21. As this value is less than 1, it suggests that cyanide at the site does not pose a significant risk.

Only one concentration of cyanide was measured in the lagoon (water Sample CAN101-101S-3001). Cyanide at the level measured in water (11 ppb) may have some chronic impacts on small fish, such as fathead minnows, should they be present.

Lead

Several studies were conducted with lead as an additive to the diet of different species of birds. It was found that dietary levels of lead below 100 ppm usually caused few reproductive effects in birds. Quail, however, were found to be especially sensitive with 10 ppm in the diet producing reductions in plasma calcium levels and egg production. A dietary concentration of 200 ppm was required to produce similar effects in chickens (Scheuhammer 1987).

Given this data, a dietary dose of 75 ppm was conservatively selected to represent a NOAEL for waterfowl. In mallards, this corresponds to a dose value of 4.2 mg/kg-BW/day for food or water ingestion. Using these data, the calculated HQ for water is 1.0E-04 and the HQ for sediment is 0.104. The combined HQ of 0.104 indicates that lead does not appear to present a significant risk to the ducks at Cannon.

The maximum concentration for lead in water slightly exceeded the chronic AWQC. At such a concentration, there is the potential for adverse impacts to some aquatic life from chronic exposure.

Mercury

The studies described in subsection 18.6.6.4 showed considerable range in the toxicity value for mercury. Breeding mallards were dosed with 3 ppm of dietary methylmercury for 21 days. Based on the three studies discussed in this subsection (Table 18-35), the median SIV (0.0057 mg/kg-BW/day) was selected as the most appropriate value by which to calculate the HQ. Actual mercury concentrations in the water at Cannon are uncertain and were based on the results from two water samples, only one of which yielded a detectable concentration of total mercury.

The calculated HQ for mercury ingestion by drinking the water was 0.01 and the HQ for ingesting sediments was 3.97. The overall water and sediment ingestion HQ was 3.98. Ducks exposed to these concentrations of mercury could potentially be at risk if mercury were largely in the form of methylmercury. This, however, is not likely to be the case as methylmercury is not the common form found in the environment. Calculation of this

HQ does not take into account, however, biomagnification of mercury through food chains which can be significant if the ducks are consuming aquatic organisms such as algae and invertebrates. Bioconcentration factors for mercury range from $10^3$ for freshwater plants and fish to $10^5$ for freshwater invertebrates (EPA 1979). While data used in this evaluation are not sufficient to draw strong conclusions, mercury may warrant further consideration as a potential hazard, principally in the lagoon sediments.

The maximum concentration for mercury in the lagoon waters exceeded the chronic AWQC. Due to the high bioaccumulation potential for mercury, it is possible that aquatic life would be impacted if chronically exposed. Higher trophic level organisms such as fish and invertebrates would be the most impacted. If waterfowl were to ingest such organisms, the potential for risk would be increased.

Silver

Data specific to silver and ducks were not identified in the literature. Therefore, an $LD_{10}$ value for the rat of 330 mg/kg/day was selected (USDHHS 1987). Dividing this value by 100 yielded a SIV of 3.3 mg/kg/day. The calculated HQ for water ingestion was 7.0E-04 and the calculated HQ for sediment ingestion was 8.2E-02. Based on the combined HQ of 8.0E-02, silver is not likely to pose a risk to ducks at Cannon.

All three silver concentrations exceeded the acute and chronic AWQC. Small fish or minnow and other aquatic life, if present, would likely be impacted given these concentrations.

Zinc

Gasaway and Buss (1972) administered zinc in the food supply to mallards. The concentrations administered were 3,000; 6,000; 9,000; and 12,000 ppm dietary levels. All ducks significantly reduced their food intake and displayed evidence of toxicosis. In the three higher-dose groups, all ducks died. In the group given 3,000 ppm, two ducks were still living by the end of the study (six ducks began the study in each group). This concentration corresponds to a lethal dose low ($LD_{10}$).

Little information is available on concentrations of zinc that would correspond to NOAELs or LOAELs. Therefore, the SIV was estimated using results from the above study. A dietary level of 3,000 ppm corresponds to a mallard dose of 168 mg/kg-BW/day. This value was divided by 100 to establish a SIV of 1.68 mg/kg-BW/day. This value seems intuitively low since zinc is an essential mineral and is relatively non-toxic. However, due to a lack of more precise data, this is the value that was used in the risk calculations.

Using a SIV of 1.68 yielded an HQ of 0.004 for water ingestion and HQ of 1.12 for sediment ingestion. The combined HQ of 1.12 suggests that there may be a slight potential for risk to ducks from zinc, due largely to the ingestion of sediments. As the SIV was based on a 60-day study, ducks would have to consume sediments daily for 60 days for similar effects to potentially occur.

For zinc, the highest detection and the upper 95% confidence limit values are very near to the AWQC. The AWQC of 110 and 120 $\mu$g/l for chronic and acute exposures to zinc, respectively, were based on data from organisms that live in the water and derive their entire diet from the contaminated water. These organisms would likely be more sensitive to changes in their environment (such as contamination) than species that use the water only part of the time. Given this information, it seems unlikely that zinc would actually pose a significant health risk to the ducks, but may pose a risk to aquatic-dwelling organisms.

Concentrations of zinc were close to, and in some cases exceeded, the acute and chronic AWQC. It is not known at these concentrations of zinc whether aquatic plant and animal communities are likely to be impacted. There is some evidence to indicate that at these concentrations, aquatic plant growth may be reduced.

### 18.6.7.5 Organic Chemicals in Lagoon Sediments

A number of organochlorine pesticides were detected in the lagoon sediments. These chemicals are typically associated with adverse impacts on waterfowl in the form of eggshell thinning. The quantity of sediments that ducks may actually ingest from the lagoons is unknown. Information on all the detected pesticides is also not readily

accessible in the scientific literature. Toxicity information on a number of these pesticides indicated that chronic exposure to the sediments may result in adverse impacts, particularly if all the chemicals listed in Table 18-33 are present.

Available information (ESE 1989) for several of the pesticides affecting mallards (or other birds as indicated) included the following toxicity information:

DDT

$LD_{50}$ acute (oral) = 2,240 mg/kg-BW
$LD_{10}$ = 50 mg/kg-BW
$LD_{10}$ = 30 ppm dietary (1.7 mg/kg-BW)

Chlordane

$LD_{50}$ acute = 150 ppm dietary (starlings)

Heptachlor

$LC_{50}$ acute (oral) = 92-480 ppm dietary (4.8-25.08 mg/kg-BW)
$LC_{50}$ chronic (oral) = 50 ppm dietary (2.6 mg/kg-BW)

Endrin

$L_0$ acute (oral) = 1.19 mg/kg-BW

Dieldrin

$L_0$ acute (oral) = 6.9 mg/kg-BW (grouse)

As shown on Table 18-32, maximum concentrations in sediments for the listed chemicals ranged from 0.017 mg/kg (aldrin and heptachlor) to 1.7 mg/kg for toxaphene. At these concentrations, the corresponding dose values for mallards would be approximately 4.74E-05 to 4.74E-03 mg/kg-BW (i.e., sed. intake x sed. conc. x matrix effect/BW).

Acute toxic dose concentrations, as listed above for mallards, range from 1.19 mg/kg-BW (endrin) to 2,240 mg/kg-BW (DDT). If safety factors are applied to these values to convert the lethal doses to "no effect" levels, the range becomes 1.1E-03 mg/kg-BW to 2.2 mg/kg-BW. This comparison indicates that dose ingestion values are, on the whole, likely to be less, but may be within the range of toxic values for these pesticides. Chronic exposure to these sediment values may present a hazard, as may the ingestion of other aquatic organisms, due to the large bioaccumulation values associated with most of these pesticides.

Bioconcentration factors for dieldrin, in various aquatic organisms, range from $10^2$ to $10^4$, indicating a moderate to significant potential for bioaccumulation (EPA 1979). Various studies have found that bioconcentration factors for DDT range up to $10^6$ in aquatic systems (EPA 1979). Bioconcentration factors for endrin have been shown to range from $10^3$ to $10^4$ in aquatic systems (EPA 1979). Heptachlor also shows strong tendencies for bioaccumulation, with bioconcentration factors on the order of $10^4$ for several organisms (EPA 1979). Sorption of toxaphene on biota is rapid, and significant uptake can occur with bioconcentration factors ranging up to $10^4$ (EPA 1979). The potential for bioaccumulation of the PCBs is the greatest, as bioaccumulation factors are usually on the order of $10^4$ to $10^6$. PCBs can be passed along the food chain; however, biomagnification is apparently not the controlling factor in attaining the levels found in aquatic organisms. Scura and Theilacker (1977) found that the partition coefficient for each organism in an aquatic food chain determines the ultimate levels and not the food chain itself.

In general, aquatic invertebrate and fish species are highly sensitive to the organochlorine pesticides. When partitioned to water, most pesticide concentrations in sediments exceeded chronic AWQC. This would indicate that there is a potential for adverse impacts to occur to benthic-dwelling aquatic biota. Ducks may also be at risk from ingesting sediments as well as aquatic organisms. Ducks that reside year-round at Cannon and frequent the lagoons would be at the greatest risk for adverse impacts.

### 18.6.7.6 Metals in Soil

Criteria are not available to readily evaluate the potential toxicity of metals in soils to biota. Plants, in particular, are generally able to tolerate relatively high levels of many metals in soil. Concentrations above 0.1% for most heavy metals in soil are generally considered likely to have some phytotoxic impacts on the plant communities present (Gough et al. 1979). Plant bioaccumulation factors for most metals tend to be low (<100), so biomagnification through plants to upper trophic levels is generally not considered a major concern. Metals in the rhizosphere are often complexed by root exudate and soil humus. Some metals at elevated levels may be more likely to present a risk to detritivores (decomposers) and lower trophic-level organisms (i.e., soil invertebrates). Data on toxicity of metals to soil organisms are not readily available, however.

For this evaluation, small mammals were considered to be the terrestrial receptor of concern. Given that bioabsorption and bioaccumulation of metals by plants is low, ingestion of plants was not considered an important intake route. The incidental ingestion of soil by small mammals was considered to the primary route of exposure to soil chemicals. Metals of potential concern in soil are zinc, cadmium, copper, chromium, cobalt, and lead. Maximum concentrations (mg/kg) detected for these metals are as follows:

zinc = 2,840 mg/kg (SWMU Nos. 86-90)
cadmium = 14.2 mg/kg (SWMU No. 78)
copper = 449 mg/kg (SWMU No. 78)
chromium = 115 mg/kg (SWMU No. 95)
cobalt = 16 mg/kg (SWMU Nos. 86-90)
lead = 411 mg/kg (SWMU No. 78)

Using a mouse weight of 0.025 kg (USDHHS 1987), a food intake of 0.003 kg (USDHHS 1987), and an estimated incidental soil ingestion value of 6.0E-05 kg (i.e., 2% of food intake) (Garten 1980), the following dose values can be calculated for chemical intake through incidental soil ingestion (i.e., soil intake x soil conc./BW):

zinc = 6.8 mg/kg-BW
cadmium = 0.03 mg/kg-BW
copper = 1.07 mg/kg-BW
chromium = 0.28 mg/kg-BW
cobalt = 0.04 mg/kg-BW
lead = 0.99 mg/kg-BW

NRC (1980) provides the following maximum dietary tolerance levels for domestic species. By converting the dietary levels to dose values for a mouse, using the above parameter values for weight and food intake, the SWMU dose values can be compared to the screening or "safe" dose values as follows (i.e. food intake x food conc./BW):

zinc = 300 - 1000 ppm (36 - 120 mg/kg-BW)
cadmium = 0.5 ppm (0.06 mg/kg-BW)
copper = 300 ppm (rabbits) (36 mg/kg-BW)
chromium = 1000 ppm (as chloride) (120 mg/kg-BW)
cobalt = 10 ppm (1.2 mg/kg-BW)
lead = 30 ppm (3.6 mg/kg-BW)

Based on this screening comparison, it would appear that the only metal that may be close to presenting some risk to small mammals through incidental soil ingestion is cadmium (i.e., exposure dose of 0.03 versus a safe dose of 0.06). To exceed the safe dose, based on incidental ingestion of soil by the mouse, soil concentrations would have to exceed 25 ppm. Absorption of cadmium in rats has been shown to be 0.3 to 2.5 percent of a single oral dose (NRC 1980). This preceding screening evaluation did not take into account the matrix effects of soil, which can lessen the bioavailability and absorption of the metals. As most soil values are below the 25 ppm concentration, cadmium in soils is not considered to present a risk to small mammals.

The preceding analysis does not take into the account the multitude of factors which can affect the toxicity and potential interactions of metals in soils. This analysis was solely intended to provide a simple screening of the potential toxicity of soil concentrations to biota of concern at Cannon. Based on this screening analysis, it would appear that metal concentrations in soils at Cannon are not likely to pose a risk to terrestrial biota. The

elevated concentration of zinc (2840 ppm) at SWMU Nos. 86-90 could potentially have some phytotoxic effect on the immediate plant community; however, SWMU Nos. 86-90 is an essentially unvegetated, disturbed, industrial area, where such concentrations and potential impacts are not of concern. Concentrations of zinc at the other SWMUs were well below 1000 ppm and, therefore, of no concern.

### 18.6.8 Conclusions

The calculated HQs give an indication of the potential risk to ducks and other biota due to chemical exposure at the site. This conclusion is based on limited data and is intended for screening purposes only. HQs or a total Hazard Index greater than 1 indicate a need for further information, such as additional information on potential exposure, toxic reference doses, or additional sampling. As these calculations do not provide definitive indications of risk, they are not intended for use as remediation criteria.

The focus of this ecological risk assessment was on the exposure of dabbler ducks to chemicals in the lagoon (SWMU Nos. 101, 102) in water and sediments. Dabbler ducks are present in the area for several months every winter; some individuals may stay the entire year. The ducks principally feed at nearby grain fields and often rest (and feed) at the Playa Lake, which receives water regularly from the lagoons. Both water and sediments from the lagoons were found to contain chemical concentrations which could pose some risk to waterfowl and aquatic organisms, based on a comparison to EPA AWQC. Calculation of HQs for ducks, from ingestion of the water, indicated that chemical levels in the water are not likely to pose any risk to the ducks. Calculation of the HQ, however, does not take into account the bioaccumulation potential of chemicals. In the case of mercury, although the HQ was below 1, the bioaccumulation potential for mercury is significant, and ducks could be at risk from ingesting aquatic organisms if present in the lagoons. Copper, silver, and zinc were found in the lagoon water at levels which exceeded acute AWQC, and cyanide, lead, and mercury values in lagoon water exceeded chronic AWQC levels. Based on these exceedances, aquatic life forms in the lagoons may be adversely impacted.

The HQs for mercury and zinc from incidental ingestion of sediments was slightly greater than 1. This indicates that there may be the potential for adverse impacts to occur to ducks if they ingested lagoon sediments. The dose value on which the mercury HQ was calculated was based on toxicity experiments using methylmercury, which is significantly more toxic than the inorganic form. The chemical form of mercury found in lagoon sediments is not known; however, assuming that all the mercury measured was methylmercury, makes the evaluation conservative. The HQ evaluation for zinc is also likely to be conservative because the SIV was based on a single laboratory study where mallards were fed high levels of zinc daily, for 60 days.

Sediments from the lagoons were found to contain a number of pesticides at concentrations which, if ingested, could pose potential risk to the ducks. Compounds such as dieldrin, heptachlor, endrin, and DDT are especially persistent and stable in anaerobic sewage sludge (EPA 1979). Each of these chemicals has the potential to bioaccumulate to significant levels in aquatic organisms as well as biomagnify in higher trophic level organisms. The quantity of sediments and aquatic organisms that ducks ingest at the lagoons is unknown. Given the potential toxicity of organochlorine pesticides and their tendency to bioaccumulate and biomagnify, it is possible that ducks that frequent the lagoons may be at risk.

Concentrations of chemicals in soils at Cannon were also evaluated in terms of potential risk to biota. The receptor species of most concern are the kites and raptors and small ground-dwelling mammals. Six metals (copper, chromium, cadmium, zinc, cobalt, and lead) were detected in soils at levels which were considered to be above background. Benzo(a)pyrene, because of its relatively low concentration near background, was not considered to be a chemical of concern. None of the six metals are known to bioaccumulate through the food chains to levels where they would pose a risk to the kites or raptors. Risk from the metals to biota was therefore considered to be greater through the direct exposure of small mammals and other ground-dwelling organisms.

Dose values were calculated for a mouse, based on the incidental ingestion of these metals from soil. These calculated dose values were compared to tolerance values for domestic animals (NRC 1980). As tolerance values for domestic animals were established on toxicity studies which included a range of organisms, including rodents,

these values were considered adequate for screening purposes. None of the calculated incidental soil ingestion dose values exceeded the calculated tolerance dose levels. Cadmium was the closest, with a soil ingestion value of 0.3 mg/kg-BW and a tolerance value of 0.6 mg/kg-BW. As the value used to calculate the soil ingestion dose was a maximum value (14.2 ppm), and most soil concentrations were well below this value, the potential for risk was considered negligible. Also, the effects of the soil matrix, which lessen the bioavailability and absorption potential of the metals, reduce the potential for risk even further.

### 18.6.9 Uncertainties and Limitations

It is necessary to make assumptions for any risk assessment. Identification of assumptions and subsequent uncertainties and their impact on estimated risks helps to place the risk estimates in perspective. A range of possible assumptions exist which can be used to represent any given uncertainty. Realistic assumptions are generally those about which a significant amount of information is known, or assumptions which have a low level of uncertainty.

In the absence of adequate information, the approach used in this ecological risk assessment was to make conservative assumptions whenever possible, to ensure that risks are not underestimated. Assumptions were made in the compilation of environmental media data, in the exposure evaluation and development of toxicity screening values, and in the risk characterization. When many conservative assumptions are used to develop an overall assessment of risk, the sum of the effect may result in an overly conservative appraisal of risk. The actual incremental risks are likely to be lower and may actually be zero. The major assumptions are those which tend to overestimate or underestimate risks. These assumptions are presented below with some discussion of their uncertainty, conservativeness, or impact on risk.

#### 18.6.9.1 <u>Factors Which May Overstate Risk</u>

A number of very conservative assumptions were made in this evaluation. The Hazard Quotient/Hazard Index method involves input parameters, each of which is known imprecisely. The combined effects from the uncertainty in each of the parameters and

assumptions used may overstate the risk to the environment. Specific factors that may overstate risk include: assumed environmental concentrations; screening intake values; and water, food, and sediment/soil intake parameters.

Environmental Concentrations

The HQ calculations were based on a very limited number of samples, in many cases ranging from nondetects to criteria exceedances for the same chemical, media, and location (e.g., pesticides in lagoon sediments). Considerable uncertainty is therefore associated with values used in the analyses. Also, maximum and upper confidence limit values were generally used rather than mean values to provide a conservative assessment of risk in this screening evaluation. For pesticides and metals, maximum concentrations were used and were higher than the (often only one) value that was detected. Water and sediment concentrations were collected only from the lagoons and not from Playa Lake, which is not a SWMU in this RI. Actual risks to the ducks from chemicals in the lagoons may be negligible as most of the ducks are only at Cannon for a few months, which would reduce overall risk to the duck populations. Reference concentrations for metals and pesticides in sediments were not available. Pesticide and mercury levels in sediments from other lakes in the area may be as high or higher than those found in the lagoons.

Sediment/Water Equilibrium Partitioning Approach

The sediment/water equilibrium partitioning approach was used to evaluate the potential toxicity of lagoon sediments as no standardized sediment quality criteria are available. Use of this approach to evaluate sediment toxicity entails a number of assumptions that can lead to either an overestimation or underestimation of risk. The equilibrium-partitioning approach incorporates the EPA AWQC together with a correction factor for the effects of organic carbon. Distribution coefficients for individual nonpolar organic chemicals are used to establish chemical concentrations in sediments that, at equilibrium, will yield concentrations in the interstitial water that are equivalent to the water quality criteria.

It was necessary to evaluate sediment quality in addition to surface water quality at the lagoons because: 1) various toxic chemicals found in only trace amounts or not detected in the water column can accumulate in sediments to elevated levels, and 2) benthic and benthic-feeding organisms (e.g., dabbler ducks) can be exposed to sediments. None of the pesticides that were detected in the lagoon sediments were detected in surface water samples. However, when partitioning coefficients were applied to convert the sediment concentrations to water concentrations, chronic AWQC were generally exceeded.

The sediment/water equilibrium partitioning approach is based on several assumptions (Chapman 1989): 1) that partitioning between sediments and interstitial waters can be explained largely on the basis of organic carbon content of the sediments; 2) that water criteria bioassay tests used to establish AWQC provide useful information relevant to sediments; 3) that equilibrium partitioning is the only significant pathway from sediments to biota, 4) that sediment ingestion by organisms is not a route of contaminant exposure; 5) that equilibrium steady state conditions exist in aquatic systems, particularly between the solid and aqueous phases, and can be estimated from sorption constants in the interstitial water; and 6) that available partition coefficients, which are based on sorption experiments with relatively low sediment/water ratios, are applicable to the site's sedimentary environment in which very high sediment/water ratios may occur.

Application of chronic EPA AWQC to Cannon surface water values (as partitioned from sediments) and the use of detection limits that meet chronic criteria levels may not be appropriate depending on the basis for the establishment of the AWQC. EPA AWQC chronic values are frequently below the detection levels used for surface water, particularly for those chemicals with large bioconcentration factors such as the organochlorine pesticides. The detection level at Cannon for PCBs (Arachlor) in water, for example, is 1 $\mu$g/L and the chronic AWQC is 0.014 $\mu$g/L. The chronic criteria for PCBs (0.014 $\mu$g/L), however, is based on the lowest maximum permissible tissue concentration for mink (0.64 mg/kg) divided by the geometric mean (45,000) of whole-body bioconcentration values for salmonoids. Because neither mink nor salmonoids are found at Cannon, the chronic AWQC for PCBs is not applicable and use of a lower detection level may not be appropriate.

The principal use of the sediment-partitioning approach is as a screening tool for potential ecological risk rather than a determination of actual ecological risk. Local conditions may allow site-specific water quality criteria to be higher than national criteria. Use of higher criteria would require a more thorough characterization of site-specific ecological conditions and an assessment of site-specific toxicity information.

Toxicity Screening Values

The screening intake values (SIVs) used for calculating Hazard Quotients (HQs) are a source of considerable uncertainty. No satisfactory system for deriving extrapolation or safety factors for chemicals in ducks or rodents is available from toxicity literature. The approach used in this ecological assessment to derive screening dose values was based on the method used by EPA in deriving human reference doses (RfDs). Toxicity dose values for wildlife, derived from the literature, were divided by a value representing what is considered to be a conservative safety factor in order to obtain the screening intake values. Only a limited number of toxicity dose values could be compiled in the available time frame. The resulting screening values are considered to represent conservative estimates of the daily dose in mg/kg-BW/day to individual receptors. At these levels, deleterious effects to that population are unlikely. This approach differs slightly from that used to derive a human RfD, where the RfD is routinely derived to protect the most sensitive subgroups of a population. If there were endangered or threatened species at Cannon, where loss of an individual could significantly impact the population of that species, additional uncertainty factors would have been applied in the derivation of the screening intake values.

Many of the toxicity studies used did not actually reveal a NOAEL, but rather revealed LOAELs, $LD_{10}$'s or $L_0$'s. From these values, safety factors of 10, 100, or 1000, respectively were used to approximate NOAEL values. These safety factors incorporate significant uncertainty, tending to overestimate the potential for risk. Also, the values that were obtained from the literature tended to be based on laboratory-raised ducks. Laboratory-raised ducks are generally more sensitive to environmental stressors than wild animals.

Food and Sediment/Soil Intake Parameters

Food, water, and sediment intake parameters were derived from allometric equations based on the work of Nagy (1987), Calder (1983), Goodman and Fisher (1962), and Garten (1980). Confidence intervals for these modeled parameters reflect a considerable degree of uncertainty in these values. Actual food habits and intake values for food, water, and sediment intake by ducks and mice are unknown. By assuming that ducks consume food and sediments at the site, a conservative evaluation of potential risk was made. Ducks at Cannon may feed entirely at nearby grain fields and avoid significant sediment exposure at the lagoons.

A matrix effects value of 10% as applied to account for the low bioavailability of chemicals from sediment, soil, or food matrices. Laboratory dose studies typically supply the chemical in a readily absorbed carrier substance. The $LD_{50}$ studies are usually designed to promote maximum exposure (absorption) because less of the chemical is complexed with dietary material. The $LD_{10}$ (lethal dose low) dietary studies probably give a better indication of the real toxicity effects of the chemical tested. Absorption values for wildlife species are more likely to be in the 2% to 5% range.

### 18.6.9.2 Factors Which May Understate Risk

Factors which may understate risk include the assumptions that the receptor species evaluated are representative of the site, that the screening values account for all types of effects, and that the analysis of individual effects indicates ecosystem health.

Receptor Species

The scope of this evaluation was limited to consideration of ducks, raptors, and small mammals (mice). It is possible that receptors that were not considered in this assessment may potentially be at risk. Potential adverse impacts on ecosystem functioning were also not considered in this evaluation.

Toxicity Screening Values

Toxicity screening intake values (SIVs) were derived through the application of safety factors. Final SIVs were not modified to account for extrapolation from the laboratory organisms to the wild organisms or to reflect uncertainty associated with phylogenic effects. For this evaluation, it was conservatively assumed that laboratory organisms are much more susceptible to the chemical concentrations than wildlife.

A 10% matrix effect was applied to account for low bioavailability and bioabsorption of metals from soil and chemicals from sediments. Other factors, such as pH, could increase bioavailability and bioabsorption.

Hazard Quotients/Hazard Indices

The Hazard Index may underestimate risk in those cases where the metals and organic chemicals may have an additive and synergistic effect with one another. The potential for toxic effects to occur when there are combinations of a number of chemical concentrations detected cannot readily determined, based on information available in the literature. A number of chemicals considered in this evaluation have a significant potential to bioaccumulate at higher trophic levels (e.g., mercury and the pesticides). HQs generally cannot take into account the effects of bioaccumulation. The HQ for sediment ingestion by ducks indicated that consumption of mercury may pose a risk. The ingestion of mercury in sediments, in addition to the ingestion of mercury in food and water, would add more risk. The ingestion of mercury, in addition to the ingestion of a number of the organochlorine pesticides, poses significant risk to the duck. These aspects were not incorporated into this risk assessment.

Population Level Effects

Most toxicity data are based on individual or small group effects. This approach assumes that individual/small group level effects are valid surrogates for ecosystem health and that injury to the basic components can decrease the ecosystem's stability, functional integrity, quality, and/or likelihood of survival. This approach to risk

assessment does not adequately account for other ecosystem effects such as predator-prey relationships, community metabolism, or structural shifts.

## 18.7 SUMMARY

### 18.7.1 Human Health Risk Assessment

This section summarizes the findings of a baseline human health risk assessment (BRA) conducted by Woodward-Clyde Consultants (WCC) for the Cannon AFB. The SWMUs that were evaluated as part of this RI were divided into 7 risk assessment areas (RAAs). Definition of these RAAs was based on consideration of the chemical sources, overlapping exposure pathways, potential receptors, and the geographic proximity of the SWMUs. This risk assessment used conservative assumptions of exposure and toxicity to characterize potential health risks so that risks would not be underestimated. Thus, the actual risks that may occur at each RAA may be lower than presented. A summary of the uncertainties and limitations associated with the assumptions used in this risk assessment is presented in the following section.

The BRA used validated soil and groundwater data collected as part of the RI to identify and select chemicals of concern (COCs) for the quantitative characterization of risk. These data and predicted ambient air concentrations, based on measured soil concentrations and a conservative emission and dispersion box model, were used to estimate chemical intakes for baseline and hypothetical future use human receptors. Measured soil and groundwater concentrations were also compared with the RCRA Facility Investigation (RFI) criteria and proposed RCRA action levels, which were revised to reflect current EPA-published toxicity values.

The BRA examined site-specific exposure pathways for each RAA. Exposure pathways consist of: a source of potential chemical release, transport of chemicals within or between media, an exposure point corresponding to a potential human receptor, and a mechanism of chemical by the receptor. The potential carcinogenic risks and noncarcinogenic hazards were quantified for exposure pathways judged to be significant and complete. Since lead does not have EPA-verified toxicity values, measured and modeled lead levels were compared with EPA-published target cleanup levels or other

guidelines or standards. Results of the risk characterization were presented in Sections 18.5 and summarized in Tables 18-22 to 18-28.

The receptors evaluated in the exposure assessment were: maintenance workers under current and future exposure scenarios, child and adult residents under a hypothetical future exposure scenario, and construction workers under a future use, intrusive action scenario. Other possible receptors (occasional trespassers or visitors, and off-site residents or workers) were not evaluated since the risks to these individuals are expected to be below those hazards and risks estimated for on-site workers and on-site future residents. Unless indicated in the exposure assessment for a given RAA, surface soils data were used to evaluate baseline and future use maintenance workers. For future workers, excavation was judged to be plausible at some RAAs. Surface and subsurface soils data combined from depths of 0 to 10 feet to evaluate exposure pathways for construction workers. The criterion for judging whether a RAA may be converted to future residential use was based on the area, geometry and other RAA-specific factors. An area of one-half acre or more was considered a plausible exposure unit based on EPA guidance (Neptune et al., 1990). It was judged that intrusive actions were plausible for: RAA 1 (Fire Training Areas 2, 3, and 4), RAA 3 (Northeast Storm Drainage and Old Entomology Rinse Area), RAA 6 (AGE Drainage Ditch), and RAA 7 (Sanitary Sewer Line). Future hypothetical residential use was evaluated using surface and subsurface soils data combined from depths of 0 to 10 feet. The use of these data assumed that soil mixing would occur during construction of residences. Potential risks to hypothetical future residents were evaluated for RAAs 1 and RAA 3 although future use corresponding to these SWMUs at Cannon AFB will most likely be commercial or industrial.

The average and reasonable maximum exposure (RME) risks and hazards were estimated for complete exposure pathways at each RAA. Generally, average chemical concentrations in soil and the 95% upper confidence limit (UCL) of the arithmetic mean concentration were used in assessing average and RME intakes, respectively, along with other average or RME intake factors. The total noncarcinogenic hazard indexes were below the EPA's level of concern (1.0) in each RAA evaluated. This was true for individual exposure pathways and combined exposure pathways in each RAA. The total carcinogenic risks were also below or within the EPA's target risk range of 1E-4 to

1E-6. In RAA 1, the RME cancer risk for the hypothetical future child resident was 1.1E-04. Although this level exceeds the EPA target risk range, the COCs associated with that risk, benzene and trichloroethylene, were detected at extremely low frequencies (1/37 and 1/29, respectively) and had high detection limit values in samples that were reported as non-detects. The results may therefore represent an overestimation of the calculated risks.

With the exception of antimony in RAA 2, none of the concentrations of chemicals of concern in soil (using the 95% UCL or the maximum measured concentration) exceeded RFI criteria or proposed RCRA action levels. Soil lead levels did not exceed the EPA target cleanup range of 500 to 1,000 mg/kg for lead in soil. In addition, a screening calculation was performed for lead using the EPA's Uptake Biokinetic Model. The highest 95% UCL lead level among the surface soil samples collected for this RI (411 mg/kg), in combination with the maximum groundwater level measured in this RI data set (0.034 mg/L), indicated that 95% of the sensitive population (i.e., children) would be predicted to have blood lead concentrations less than 10 $\mu$g/dL, which is consistent with EPA's guideline level.

The groundwater data collected as part of the RI do not indicate exceedances of EPA's Maximum Contaminant Levels. An examination of the vertical extent of contamination for soils revealed a decrease in concentration at depths below approximately 30 feet. The Ogallala aquifer is approximately 260 feet BGS. After considering the groundwater monitoring well data (one round), the fate and transport properties of site chemicals, and the local geology/hydrogeology, it is judged that the site impact to groundwater is not likely to be significant.

Based on findings of the BRA and comparison of soil data with risk-based RFI criteria/proposed RCRA action levels, it is concluded that potential health impacts to humans are insignificant using the assumptions presented in this section. A summary of the inherent limitations and assumptions used in this evaluation is presented in the following section.

### 18.7.2 Uncertainties and Limitations in the Risk Assessment Methodology

The EPA guidance for risk assessment provides a systematic means for organizing, analyzing, and presenting information on the nature and magnitude of potential risks to public health and the environment posed by chemical exposures. Despite the advanced state of the current methodology, uncertainties and limitations are inherent in the risk assessment process. The quality of available data, incomplete information about existing conditions and future circumstances, as well as other factors discussed below, contribute to these uncertainties and limitations. This section discusses the following sources of uncertainties and limitations associated with this risk assessment:

- Data collection and evaluation
- Exposure assessment
- Toxicity assessment
- Risk characterization

The assumptions used in this risk assessment were conservative and therefore tend to overestimate risk. Conservative assumptions were used to avoid underestimating actual risks. Thus, the majority of the uncertain fees discussed below are factors that tend to overestimate risks.

#### 18.7.2.1 Data Collection and Evaluation

Data Collection

Data used in the human health risk assessment were collected during the remedial investigation. The data collected during the RI are subject to uncertainty associated with sampling and analysis.

Sampling

In the risk assessment, it was assumed that the samples collected were representative of conditions to which various populations may be exposed. However, the collected samples may not be perfectly representative due to biases in sampling and the random

variability of samples. In general, sampling was biased toward areas of known and suspected elevated chemical concentrations, which will lead to an overestimation of risk when these results are assumed to represent a larger area (e.g., when samples from an area of concentrated chemicals are used to characterize exposure over a large area). In addition, the environmental media sampled are not homogeneous. Random variability of the media sampled may result in the samples collected either over or underestimating the actual risks.

Analysis

Samples were analyzed using Contract Laboratory Program (CLP) procedures, and were subjected to review, to obtain data suitable for decision-making. However, it should be understood that sample analysis is subject to uncertainties associated with precision and accuracy, and uncertainties associated with the detection of chemicals at low concentrations. Analytical precision and accuracy are evaluated through laboratory QA programs. Uncertainties associated with precision and accuracy of analysis are generally random errors which may lead to over or underestimation of risks. These errors are typically of low magnitude (well below an order of magnitude) compared to other sources of uncertainty in the risk assessment.

Due to the limits of analytical methodologies and the complexity of matrixes for environmental samples, some chemicals present in low concentrations in samples may not be detected, leading to a possible underestimation of risk. However, it is also possible that the chemicals were indeed in trace amount and, therefore, not detected.

Another uncertainty relates to the estimated values. According to EPA's guidelines on data useability for risk assessment (EPA 1990b), estimated values (data coded "J") were included in the estimation of exposure point concentrations. The J qualifier was assigned, by the laboratory, to reported values for a variety of reasons (Section 16.4.1):

- The percent difference between the response factors from the initial calibration and those found for the continuing calibration was greater than the QA objective of 25%

- Holding time or moisture content was excessive
- Initial calibration of correlation coefficients was below 0.995
- For analysis of metals by the Inductively Coupled Plasma (ICP) method, more than a 10 percent difference exists between the original analytical result and the dilute sample
- Detection of a chemical concentration is above the instrument detection limit, but not above the contract-required detection limit

Data Evaluation

In compiling data for use in the risk assessment, arithmetic mean and 95 percentile upper confidence limits (UCL) were compiled on the arithmetic mean concentrations of chemicals detected in each medium. It was assumed that a chemical not detected in a given sample was actually present at one-half of its detection limit, if that chemical was present in any sample in a given medium within the RAA. This assumption is conservative and may lead to overestimation of risk, particularly for those chemicals reported at low frequencies or low concentrations (Table 18-3). The arithmetic mean concentration was used to evaluate average exposures, an assumption which may over or underestimate risk. In estimating RME exposures, the 95% UCL concentrations were used, which likely results in an overestimation of potential risk.

### 18.7.2.2 Exposure Assessment

The exposure assessment is based on a series of assumptions concerning concentrations of chemicals to which humans are exposed (exposure point concentrations) and patterns of behavior leading to exposure or intake of chemicals (exposure scenarios).

Exposure Point Concentrations

For the most part, the arithmetic mean and 95% UCL chemical concentrations found in on-site soil were used as exposure point concentrations. It was conservatively assumed that chemical concentrations observed at the SWMUs will remain unchanged over time. The potential reduction in chemical concentrations by migration, degradation, and attenuation were not considered. These processes would reduce the chemical concentrations present at the evaluated SWMUs during the assumed exposure periods considered in the risk assessment. The use of existing chemical concentrations and exposure periods projected into the future may result in an overestimation of potential health risks.

For airborne exposure to volatile organic compounds, a conservative box model was used to estimate airborne concentrations. This model overestimates potential exposure point concentrations in the following ways.

- The model uses a method that assumes internal gas generation by landfills. This would increase the overall fugitive VOC gas emissions estimates from the site. In other words, dispersion and deposition were not considered for the emitted gases, and the gases were assumed to be nonreactive.

- The model does not allow for reduction of fugitive VOC gases being emitted from a landfill due to the assumption of minimum soil cover over the landfill and cap. In other words, no control efficiency was assumed.

- The model assumes a steady-state release of gases over time. In reality, the release of gases over time decreases as the production of gas decreases.

- The model assumes the worst-case average wind speed for construction workers (intrusive action). This is a conservative assumption which overestimates actual wind speed.

- In estimating the windblown particulate concentrations, all chemicals present in the soil were assumed to be attached to the particulates.

- The windblown particulates were assumed to be the $PM_{10}$ fraction, and all such particulates were assumed inhalable.

Exposure Assumptions

The exposure assessment relied on assumptions of a wide variety of scenarios for potential human exposure. Assumptions used were based upon:

- Site-specific information

- EPA risk assessment guidance (EPA 1989b and EPA 1991a), and the Exposure Factors Handbook (EPA 1989c)

- Professional judgement

Although professional judgment was employed in assessing exposure for RME scenarios, many input factors in the calculation of intakes were based on conservative EPA guidance. The hypothetical future residential exposure scenario is highly conservative and the resulting risks and hazards are likely to be overestimated. The specialized use of Cannon AFB cannot easily be changed without the approval from Congress and the Secretary of Defense.

The average case scenarios represent assumptions that are considered central values or realistically conservative estimates for the exposed population. However, even the average case scenarios assume individuals are exposed on a regular basis over a long period of time, which is an assumption that likely overestimates actual exposures. The future residential exposure scenarios are developed to provide an upperbound risk estimate. The RME scenarios are based on combinations of conservative assumptions for all variables related to exposure, and thus are likely to overestimate potential risks, possibly by a large amount (one or more orders of magnitude).

Assumptions concerning most of the generic (nonsite-specific) variables used in estimating chemical intakes are based on data collected for human populations, and thus are subject to limited uncertainty. These include variables such as body weight, ingestion rate, breathing rate, etc. There is great uncertainty associated with assumptions concerning soil ingestion rates and absorption of chemicals from complex matrixes (such as soil) into the body. In some cases, published information for one chemical has been assumed to be representative of other chemicals. These assumptions may lead to over or underestimation of risk. The general approach used in this assessment was to use conservative assumptions for intake variables in the absence of strong scientific data, thus minimizing the possibility that risks could be underestimated.

Although a fraction ingested variable has been used based on exposure time (amount of time a given receptor spent in an RAA), this variable is also place or activity-dependent. Both of these factors have been overestimated, leading to an overestimation of exposure and risk. Since exposure point concentrations for a particular chemical are not uniform throughout the RAA (see frequency of detection in Table 18-3), the fraction ingestion should be much smaller than those assumed in this BRA.

A matrix effects variable was also used in the calculation of intake factors that lends full bioavailability of chemicals in soil and air. This results in an overestimation of exposure and risk.

#### 18.7.2.3 Toxicity Assessment

In the quantitative characterization of carcinogenic risks and hazards to human receptors, the EPA-published RfDs and SFs were used in this BRA. EPA based its toxicity values on available scientific information, which is generally insufficient to provide a thorough understanding of all the toxic properties of chemicals to which humans are potentially exposed. Consequently, varying degrees of uncertainty surround the assessment of adverse health effects in exposed populations. To address this uncertainty, EPA has conservatively incorporated uncertainty factors in the derivation of toxicity values. The application of uncertainty factors in the RfD, and use of the 95th UCL value for the slope factor, is biased toward the calculation of conservative risks. EPA acknowledged this fact in the Federal Register Notice concerning the availability

of toxicity values in IRIS: "In general, risk values such as those on IRIS, cannot be used to predict the actual [sic] incidences of human disease or the type of effects chemical exposures may have on humans. This is due to the numerous uncertainties involved in risk assessment, including those associated with extrapolations from animal data to humans and from high experimental doses to lower environmental exposures" (53 FR 20163, 2 June 1988).

Sources of uncertainty related directly to toxicity data include:

- Use of dose-response data from experiments on homogeneous, sensitive animal populations to predict effects in heterogeneous human populations with a wide range of sensitivities

- Extrapolation of data from: (1) high-dose animal studies to low-dose human exposures, (2) acute or subchronic exposure to chronic exposure, and (3) one exposure route to another (e.g., from ingestion to inhalation or dermal absorption)

- Use of single-chemical test data that do not account for multiple exposures or synergistic and antagonistic responses

- Absence of generally accepted toxicity values for certain chemicals

- Use of sensitive subpopulations (e.g., the very young and old)

Interspecies Extrapolation (Use of Animal Studies)

The majority of our toxicological knowledge of chemicals comes from experiments with laboratory animals due to the limited studies available on humans. Experimental animal data have historically been relied upon by regulatory agencies and other expert groups to assess the hazards and safety of human exposure to chemicals. Even though this practice has generally been supported by empirical observations, there are known interspecies differences in chemical absorption, metabolism, excretion, and toxic response. There are also uncertainties concerning the relevance of animal studies using

exposure routes that differ from human exposure routes. In addition, there is inherent uncertainty due to the frequent necessity to extrapolate results of short-term or subchronic animal studies to humans exposed over a lifetime.

Although animal experimental data have many limitations, they are widely believed to be a necessary part of toxicity assessment, especially in the absence of human epidemiological evidence. Use of animal data for human health assessment may under or overestimate potential human health risk. In order to account for this uncertainty, EPA generally applies uncertainty factors ranging from 10 to 1,000 to the results of studies in sensitive animal populations to develop toxicity values to be used in human health evaluations. This conservative approach is likely to overestimate potential human health risks.

There is uncertainty whether animal carcinogens are also carcinogenic in humans. While many chemical substances are carcinogenic in one or more animal species, only a small number of chemical substances are known to be human carcinogens. The fact that some chemicals are carcinogenic in some animals but not in others raises the possibility that not all animal carcinogens are human carcinogens. EPA assumes that humans are as sensitive to all carcinogens as the most sensitive animal test species. This policy decision is designed to prevent the underestimation of risk, increasing the likelihood that the potential carcinogenic risk will be overestimated.

Dose Extrapolation

Toxicity testing is generally performed using high doses over a relatively short period of time, while environmental exposures are usually low doses over a relatively long period of time. Extrapolating from high doses to low doses has considerable uncertainty. For noncarcinogenic chemicals, little or no toxic effect may occur below a threshold value, due to the body's natural detoxifying mechanisms. However, because of uncertainty associated with dose extrapolation, EPA often bases the RfD for noncarcinogenic effects on the most sensitive animal species test data available (i.e., the species which experiences adverse effects at the lowest dose). This risk assessment has incorporated EPA-verified RfD values that were derived in this manner. The use of these

conservatively derived RfD values is likely to overestimate the potential health impact of noncarcinogenic chemicals at the site.

The model used by EPA to determine slope factors for carcinogens is a linearized multistage model, which provides a conservative estimate of cancer risk at low doses and is likely to overestimate the actual slope factor. EPA acknowledges that the actual slope factor is likely to be between zero and this estimate. Inadequate knowledge of the validity and accuracy of this model, however, increases uncertainty and the tendency to overestimate cancer risks.

Dose Additivity

Synergistic effects are those in which the net effect of the simultaneous action of two or more toxic agents is greater than the sum of their individual effects. For example, synergistic effects have been documented for the effects of asbestos exposure and smoking. Antagonistic effects are those in which the net effect of exposure to two or more agents is less than the sum of their individual effects. Data concerning combined effects of complex mixtures of chemicals are generally lacking. In the absence of such data, the approach recommended by EPA for evaluating the health impact of chemical mixtures assumes dose additivity (EPA 1989b). This approach does not account for potential synergism, antagonism, or differences in target organ specificity and mechanism of action. This approach may over or underestimate the potential human health impact.

Absence of Generally Accepted Toxicity Values

For some chemicals, available data do not support development of generally accepted toxicity values (RfDs or slope factors). The absence of toxicity values for some chemicals may lead to an underestimation of risk. For most chemicals without toxicity values detected at the SWMUs, there is a limited potential for significant underestimation of risk due to low concentration, low frequency of detection, or consideration of other structurally-related chemicals in the assessment.

Use of Data For Sensitive Populations

In many cases, toxicity values are based on results observed during exposure to sensitive subpopulations (in animal or human studies). For example, one study has reported the toxicity of cobalt to heavy beer drinkers at doses well below values demonstrated to be safe in other studies. Use of data from such sensitive subpopulations may have little bearing on actual exposures considered in the risk assessment and thus lead to significant overestimation of risk.

#### 18.7.2.4 Risk Characterization

Because there are uncertainties in each step of the risk assessment process, these uncertainties are often magnified in the final risk characterization. The final quantitative estimates of risk may be one or several orders of magnitude different from the potential risk associated with a given exposure. In an attempt to minimize the consequences of uncertainty, and in the absence of strong scientific data, EPA guidance typically relies on use of conservative estimates of hazards and risk. The overall result is that estimates presented in this report are much more likely to overestimate the potential risk rather than to underestimate it.

The assessment has been prepared in a manner consistent with that currently used in the consulting community and agency guidance. It is likely that risk assessment methods, and data identifying and quantifying the toxicity of chemicals will improve with time. Currently unsuspected hazards may be identified at a later date. This assessment was based upon available data, using currently available risk assessment methods.

### 18.7.3 Ecological Risk Assessment

The focus of this ecological risk assessment was on the exposure of dabbler ducks to chemicals in water and sediments in the lagoons (SWMU Nos. 101, 102) and the exposure of small mammals to chemicals in soils at the Base. Dabbler ducks are present in the area for several months every winter; some individuals may stay the entire year. The ducks principally feed at nearby grain fields and rest (and feed) at the Playa Lake,

which receives water regularly from the lagoons. The Playa Lake is a SWMU which has been identified for investigation in the future as part of the overall RI for Cannon AFB.

Both water and sediments from the lagoons were found to contain chemical concentrations that could pose some risk to waterfowl and aquatic organisms. Metals were found in the lagoon water at concentrations that exceeded acute (copper, silver, and zinc) and chronic (cyanide, lead, and mercury) AWQC. Hazard Quotients (HQs) were calculated for ducks based on toxicological literature and indicated that metal levels in the water are unlikely to pose any adverse risk. HQs for ducks from incidental ingestion of sediments, however, indicated that mercury and zinc in sediments may pose some risk to waterfowl. No pesticides were detected in the lagoon water. Pesticide concentrations were detected in the lagoon sediments at concentrations that if converted to water concentrations by using partitioning coefficients exceeded chronic AWQC. Compounds such as dieldrin, endrin, heptachlor, and DDT are especially persistent and stable in anaerobic sewage sludge (EPA 1979). Several of these pesticides have the potential to be acutely toxic to aquatic organisms as well as the potential to bioaccumulate to significant levels through food chains.

The lagoons are not intended for use as wildlife habitat and therefore risks to aquatic organisms such as algae and benthic invertebrates are not of concern. Dabbler ducks, however, are protected migratory waterfowl and are therefore of concern. Based on this ecological risk analysis, there is a small potential for some toxic effects to occur to dabbler ducks which chronically ingest water and sediments from the lagoons. It is also possible that metal and pesticide levels in the lagoon are no higher than those found in other water bodies in the region due to the accumulation of chemicals from surface runoff. Reference concentrations were not available for sediments and water from other sewage lagoons or water bodies in the region.

Concentrations of chemicals in soils at Cannon were also evaluated in terms of potential risk to terrestrial biota. The receptor species of concern are the kites and raptors and small ground-dwelling mammals. Six metals (copper, chromium, cadmium, zinc, cobalt, and lead) and one semi-volatile organic compound (benzo(a)pyrene) were detected in soils at levels which were considered to be above background. Benzo(a)pyrene, because of its relatively low concentration at near background levels was not considered to be

a chemical of concern. None of the six metals are thought to bioaccumulate through the food chains to levels where they would pose a risk to kites or raptors. Potential risk from these metals in soil to biota was considered to be greatest through direct exposure of small mammals and other ground-dwelling organisms. Based on the calculation of toxicity values for a mouse from incidental soil ingestion, none of the six metals were considered to pose a risk to small mammal populations.

A number of uncertainties were incorporated into the ecological risk assessment. The limitations of this study and factors that contribute to the overestimation or underestimation of risk are presented in Subsection 18.6.9.

## TABLE 18-1

## DESCRIPTION OF RISK ASSESSMENT AREAS (RAAs)

| RAA # | SWMU # | SWMU Description | IRP Site Number | Potential Chemical Sources | Status |
|---|---|---|---|---|---|
| 1 | 106 | Fire Training Area 2 | FT-7 | JP-4 fuel | Inactive |
| | 107 | Fire Training Area 3 | FT-8 | JP-4 fuel | Inactive |
| | 109 | Fire Training Area 4 | LF-5 | JP-4 fuel | Active |
| | 113 | Landfill 5 | | Solid waste, waste oils, solvents, paints, pesticides | Active |
| 2 | 86 | Engine Test Cell Area | SD-11 | POLs | Active |
| | 87 | Engine Test Cell Area | SD-11 | POLs | Active |
| | 88 | Engine Test Cell Area | SD-11 | POLs | Active |
| | 89 | Engine Test Cell Area | SD-11 | POLs | Active |
| | 90 | Engine Test Cell Area | SD-11 | POLs | Active |
| 3 | 95 | Northeast Storm Drainage Area | SD-20 | Solvents, waste oils | Active |
| | 96 | Old Entomology Rinse Area | SD-17 | Pesticides | Active |
| | 101 | Wastewater Lagoon | | Multiple | Active |
| | 102 | Wastewater Lagoon | | Multiple | Active |
| 4 | 78 | Fire Training Area 1 | FT-6 | JP-4 fuel | Inactive |
| | 81 | Solvent Disposal Area | DP-16 | Chlorinated solvents | Inactive |
| 5 | 76 | Sludge Weathering Pit | WP-14 | AVGAS and JP-4 sludge | Inactive |
| 6 | 34 | AGE Drainage Ditch | SD-15 | POLs, JP-4 fuel | Active |
| 7 | 98 | Sanitary Sewer Line | | Multiple | Active |

# TABLE 18-2

## BACKGROUND SOIL CONCENTRATIONS OF POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)

| Compound | Concentration (mg/kg) | | |
|---|---|---|---|
| | Rural Soil | Agricultural Soil | Urban Soil |
| Acenaphthene | 0.002 | 0.006 | |
| Acenaphthylene | | 0.005 | |
| Anthracene | | 0.011 - 0.013 | |
| Benzo(a)anthracene | 0.005 - 0.020 | 0.056 - 0.110 | 0.169 - 59 |
| Benzo(a)pyrene | 0.002 - 1 | 0.005 - 0.900 | 0.165 - 0.220 |
| Benzo(b)fluoranthene | 0.020 - 0.030 | 0.058 - 0.220 | 15 - 62 |
| Benzo(e)pyrene | | 0.053 - 0.130 | 0.060 - 14 |
| Benzo(g,h,i)perylene | 0.010 - 0.070 | 0.066 | 0.900 - 47 |
| Benzo(k)fluoranthene | 0.010 - 0.110 | 0.058 - 0.250 | 0.300 - 26 |
| Chrysene | 0.038 | 0.078 - 0.120 | 0.251 - 0.640 |
| Fluoranthene | 0.0003 - 0.040 | 0.120 - 0.210 | 0.200 - 166 |
| Fluorene | | 0.010 | |
| Indeno(1,2.3-cd)pyrene | 0.010 - 0.015 | 0.063 - 0.100 | 8 - 61 |
| Phenanthrene | 0.030 | 0.048 - 0.140 | |
| Pyrene | 0.001 - 0.020 | 0.099 - 0.150 | 0.145 - 147 |

Sources:

Butler et al. (1984)
Edwards (1983)
IARC (1973)
Jones et al. (1987)
Vogt et al. (1987)
White and Vanderslice (1980)
Windsor and Hites (1979)

## TABLE 18-3

## FREQUENCY OF DETECTIONS FOR CHEMICALS OF CONCERN
## CANNON AFB

| RAA:Medium | Benzene | Ethylbenzene | Toluene | Xylene | TCE | Acetone | TCA | PCE | DDD | DDT | DDE | alpha-Chlordane | gamma-Chlordane | Heptachlor Epoxide | Carbazole | Ba | Cd | Cr | Co | Hg | Ni | Th | Sb | Se | Pb | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1:S | 1/13 | -- | 6/13 | 2/12 | 1/5 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 12/12 | -- |
| 1:S/SS | 1/37 | -- | 8/37 | 9/37 | 1/29 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 36/36 | -- |
| 2:S | -- | 1/6 | 6/6 | 3/6 | 3/6 | 3/9 | 1/6 | 1/6 | -- | -- | -- | -- | -- | -- | -- | 5/5 | 4/5 | 5/5 | 5/5 | -- | 5/5 | -- | 2/5 | -- | 5/5 | 5/5 |
| 2:S/SS | -- | 1/25 | 11/25 | 3/25 | 3/25 | 17/34 | 1/25 | 1/25 | -- | -- | -- | -- | -- | -- | -- | 20/20 | 5/20 | 20/20 | 20/20 | -- | 20/20 | -- | 2/20 | -- | 20/20 | 14/20 |
| 3:S | -- | -- | 1/2 | -- | -- | -- | -- | -- | -- | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | -- | 1/1 | 1/1 | 2/2 | 2/2 | 1/2 | 2/2 | -- | -- | -- | 2/2 | 2/2 |
| 3:S/SS | -- | -- | 1/8 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 8/8 | 1/8 | 8/8 | 8/8 | 1/8 | 8/8 | -- | -- | -- | 8/8 | 8/8 |
| 4:S | -- | 5/15 | 9/16 | 9/16 | 9/16 | 7/21 | 6/16 | 4/15 | 5/6 | 0/6 | 4/6 | 1/0 | 1/6 | -- | -- | -- | 5/6 | -- | -- | -- | -- | -- | -- | -- | 6/6 | 6/6 |
| 4:S/SS | -- | 6/34 | 12/34 | 10/34 | 27/54 | 7/34 | 4/34 | 7/25 | 1/25 | 1/25 | 4/25 | 1/25 | 1/25 | -- | -- | -- | 5/24 | -- | -- | -- | -- | -- | -- | -- | 24/24 | 24/24 |
| 5:S | -- | -- | 1/2 | -- | 1/6 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 2/2 | -- |
| 5:S/SS | -- | 1/6 | 2/11 | -- | 2/6 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 11/11 | -- |
| 6:S | -- | -- | 2/2 | -- | -- | -- | 1/2 | 1/2 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1/1 | 1/1 | 1/1 |
| 6:S/SS | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1/5 | -- | -- | -- | -- | -- | -- | -- | -- | 0/0 | 4/4 | 4/4 |
| 7:S | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 7:S/SS | -- | -- | 5/25 | -- | -- | 14/43 | -- | -- | -- | -- | -- | -- | -- | -- | -- | 43/43 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |

TCE - trichloroethylene
TCA - trichloroethane
PCE - perchloroethylene (or tetrachloroethylene)

- = not analyzed for or not detected
NA = not applicable (surface soil was not sampled at RAA 7)
S = surface soil
S/SS = combined surface/subsurface soil

## TABLE 18-4

## SELECTION OF CHEMICALS OF CONCERN
## RAA1 (SWMUs 106, 107, 109, 113)

| Media | Soils |
|---|---|
| Chemicals Detected | Chromium (Cr), lead (Pb), benzene, toluene, acetone, methylene chloride, trichloroethylene (TCE), total xylenes, MEK, 2-hexanone, ethylbenzene |
| Chemicals Discarded: | Acetone, methylene chloride, MEK, 2-hexanone, (lab contaminants) |
| Chemicals of Concern: | Cr, Pb, benzene, toluene, TCE, xylene, ethylbenzene |
| Exceeded RFI Criteria: | None |
| Exposure Scenario: | For fire training areas - intrusive action > ½ acre (worker/residents soil ingestion, dermal contact and inhalation of VOCs and particulates plus potential groundwater ingestion) |
| | Landfill - None, landfill has been capped. Groundwater monitoring (ongoing). No direct contact. |

## TABLE 18-5

## SELECTION OF CHEMICALS OF CONCERN
## RAA1 (LANDFILL 5, SWMU 113)

| Medium: | Groundwater |
|---|---|
| Chemicals Detected: | Arsenic (As), barium (Ba), copper (Cu), lead (Pb), nickel (Ni), selenium (Se), vanadium (V), zinc (Zn), Di-n-butylphthalate |
| Chemicals Discarded: | As (within upgradient range)<br>V, Se, Ba (similar to background)<br>Zn, Cu (not detected in downgradient wells)<br>Ni (estimated at below detection limits of upgradient well)<br>Lab contaminant - Di-n-butylphthalate |
| Chemicals of Concern: | None |
| Exceeded RFI Criteria: | Pb (0.016 mg/l) higher than upgradient wells, within the analytical range of proposed public water supply action level for lead (0.015 mg/l). |
| Exposure Scenario: | Groundwater ingestion pathway is plausible, but existing data are limited and do not indicate contamination. This pathway will be reassessed when additional data are available. |

*Lower than site background but > regional background.
**Lower than regional and/or comparable to site background.
***Lower than site regional background.
+Low toxicity chemicals.

## TABLE 18-6

## SELECTION OF CHEMICALS OF CONCERN
## RAA2 (SWMUs 86 - 90)

| Media | Soils |
|---|---|
| Chemicals Detected: | Aluminum (Al), silver (Ag), arsenic (As), barium (Ba), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), iron (Fe), lead (Pb), magnesium (Mg), antimony (Sb), manganese (Mn), mercury (Hg), nickel (Ni), vanadium (V), zinc (Zn), 1,1,1-trichloroethane (TCA), 2-butanone, acetone, ethylbenzene, methylene chloride, perchloroethylene (PCE), toluene, trichloroethylene (TCE), total xylenes |
| Chemicals Discarded: | *Al |
| | **As, Mn, Hg, Ag, V |
| | ***Be |
| | +Fe, Mg, Cu |
| | Lab contaminants - MEK (2-butanone), methylene chloride |
| Chemicals of Concern: | Sb, Ba, Cd, Cr, Co, Pb, Ni, Zn, TCA, ethylbenzene, PCE, toluene, TCE, xylene, acetone |
| Exceeded RFI Criteria: | Sb |
| Exposure Scenario: | Worker - dermal contact, inhalation of VOCs/dust, ingestion of soil |

*Lower than site background but > regional background.
**Lower than regional and/or comparable to site background.
***Lower than site regional background.
+Low toxicity chemicals.

## TABLE 18-7
## SELECTION OF CHEMICALS OF CONCERN
## RAA3 (SWMUs 95, 96, 101, 102)

| Media | Soils/Sediment |
|---|---|
| Chemicals Detected: | Aluminum (Al), arsenic (As), barium (Ba), beryllium (Be), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), iron (Fe), lead (Pb), magnesium (Mg), manganese (Mn), mercury (Hg†), nickel (Ni), silver (Ag), vanadium (V), zinc (Zn), selenium (Se†), MEK, acetone*, methylene chloride, toluene, carbon disulfide ($CS_2$), chloromethane, chloride, DDT, DDE, chlordane, heptachlor epoxide, 2 methylnaphthalene, BEHP†, PCBs† |
| | Chloromethane - below reporting limits of nondetects. |
| Chemicals Discarded: | Cd - comparable to background |
| | +Al, Cu, Fe, Mg, Chloride |
| | **As, Be, Mn, 2-Methylnaphthalene |
| | Lab contaminants - MEK, Acetone, Methylene chloride, $CS_2$, BEHP, Butylbenzyl Phthalate (2 hits at 2, 8 ft; not surficial soil) |
| Chemicals of Concern: | |
| SWMU Nos. 95, 96 only: | DDE, DDT, chlordane, heptachlor epoxide, toluene |
| | Cd, Co, Hg, Ba, Cr, Pb, Ni, Zn |
| SWMU Nos. 101, 102 only*: | Cd, Cr, Pb, Hg, Ni, Se, Ag, Zn, BEHP, DDD, DDE, chlordane, PCBs |
| Exceeded RFI Criteria (Soil): | None |
| Exposure Scenario: | SWMU Nos. 95 & 96, < ½ acre, therefore no intrusive construction and future residential scenario is unlikely; complete exposure paths include maintenance worker soil ingestion, dermal contact and inhalation of VOCs/particulates. |

†High in sludge only
*Chemicals detected in sediment
**Lower than site background and/or comparable to
+Low toxicity chemicals
BEHP - bis(2-ethylhexyl)phthalate

## TABLE 18-8

## SELECTION OF CHEMICALS OF CONCERN
## RAA4 (SWMUs 78, 81)

| Medium | Soils (SWMU 81 - VOC analytes only) |
|---|---|
| Chemicals Detected: | Aluminum (Al), arsenic (As), barium (Ba), beryllium (Be), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), iron (Fe), lead (Pb), magnesium (Mg), manganese (Mn), mercury (Hg), nickel (Ni), vanadium (V), zinc (Zn), BEHP, di-n-butylphthalate (Di-n-BP), DDD, DDE, DDT, Chlordane, Methoxychlor†, trichloroethane (TCA), MEK, Acetone, Vinyl Chloride††, ethylbenzene, methylene chloride, PCE, toluene, trichloroethylene (TCE), xylene |
| Chemicals Discarded: | **As, Cr |
| | +Cu, Fe, Mg |
| | ***Ba, Be, Co, Mn, Hg, Ni, V, Al |
| | Lab contaminants - BEHP, Di-n-BP, MEK, and methylene chloride |
| Chemicals of Concern: | Cd, Pb, Zn, DDD, DDE, DDT, TCA, ethylbenzene, PCE, toluene, TCE, xylene, acetone |
| Exceed RFI Criteria: | None |
| Exposure Scenario: | Area < ½ acre- future residential scenario unlikely current and future worker; No groundwater data available. |

Legend:
†Methoxychlor was detected at the extremely low value of 0.009 (estimated below DL.) at 100 ft.
††Vinyl Chloride (1/49) with concentration of 0.11 mg/kg is considered an outlier.
*Lower than site background but > regional background.
**Lower than regional and/or comparable to site background.
***Lower than site regional background.
+Low toxicity chemicals.

## TABLE 18-9

## SELECTION OF CHEMICALS OF CONCERN
## RAA5 (SWMU 76)

| Medium | Soils |
|---|---|
| Chemicals Detected: | Aluminum (Al), arsenic (As), barium (Ba), beryllium (Be), chromium (Cr), cobalt (Co), copper (Cu), iron (Fe), lead (Pb), magnesium (Mg), manganese (Mn), mercury (Hg), nickel (Ni), silver (Ag), vanadium (V), zinc (Zn), BEHP, Di-n-BP, toluene, 2-hexanone, acetone, ethylbenzene, total xylenes, methylene chloride |
| | *Cu, Fe, Mg |
| | **Ba, Be, Co, Mn, Hg, Ni, Ag, V, Zn, Al |
| Chemicals Discarded: | ***As, Cr |
| | Lab contaminants: BEHP, Di-n-BP, 2-hexanone, acetone, methylene chloride |
| Chemicals of Concern: | Pb, ethylbenzene, xylene, toluene |
| Exceeded RFI Criteria: | None |
| Exposure Scenario: | Area < ½ acre; residential scenario not expected; (current and future) general duty work soil ingestion, dermal contact and inhalation of VOCs and particulates; industrial setting former weathering pit (sludge) already covered. |

*Low toxicity chemicals
**At regional background concentrations
***At site background concentrations

## TABLE 18-10

## SELECTION OF CHEMICALS OF CONCERN
## RAA6 (SWMU 34)

| Media | Soils |
|---|---|
| Chemicals Detected: | Aluminum (Al), arsenic (As), barium (Ba), beryllium (Be), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), iron (Fe), lead (Pb), magnesium (Mg), manganese (Mn), nickel (Ni), selenium (Se), vanadium (V), zinc (Zn), trichloroethane (TCA), acetone, tetrachloroethylene (PCE), toluene, BEHP, PAHs, carbazole |
| Chemicals Discarded: | TCA, PCE, carbazole - low confidence chemicals |
| | *Cu, Fe, Mg |
| | **As, Ba, Cd, Cr, Co, Ni, Al |
| | ***Be, Mn, V |
| | Lab contaminants: Acetone, BEHP PAHs -- national background levels |
| Chemicals of Concern: | Pb, Se, Zn, toluene |
| Exceeded RFI Criteria: | None |
| Exposure Scenario: | Area > ½ acre, residential scenario plausible but not likely due to add geometry; current and future worker (maintenance); intrusive work is feasible |
| | Data: use 0-10' subsurface soil data as surface soil data, insufficient; ditch has been plowed over to enhance chemical biodegradation. |

Legend:
*Lower than site background but > regional background.
**Lower than regional and/or comparable to site background.
***Lower than site regional background.
+Low toxicity chemicals.

## TABLE 18-11

## SELECTION OF CHEMICALS OF CONCERN
## RAA7 (SWMU 98)

| Media | Soils |
|---|---|
| Chemicals Detected: | Aluminum (Al), antimony (Sb), arsenic (As), barium (Ba), beryllium (Be), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), iron (Fe), lead (Pb), magnesium (Mg), manganese (Mn), nickel (Ni), thallium (Th), silver (Ag), vanadium (V), zinc (Zn), MEK, acetone, methylene chloride, toluene |
| Chemicals Discarded: | *Sb |
| | ***As, Be, Cd, Cr, Co, Pb, Ni, Ag, V, Zn, Al |
| | **Mn, Th |
| | +Cu, Fe, Mg |
| | Lab contaminants: MEK, methylene chloride |
| Chemicals of Concern: | Ba, toluene, acetone |
| Exceed RFI Criteria: | None |
| Exposure Scenario: | Intrusive (worker) no surficial soil data |
| | 0-23 ft bgs soil data |
| | Area > ½ acres, no residential construction is feasible due to narrow width; sewage maintenance worker is the plausible scenario |

Legend:
*Lower than site background but > regional background.
**Lower than regional and/or comparable to site background.
***Lower than site regional background.
+Low toxicity chemicals.

# TABLE 18-12

## CALCULATION OF ACTION LEVELS AND RFI CRITERIA

| | Proposed RCRA Corrective Action Rule | | | | RCRA Facility Investigation Guidance Document | |
|---|---|---|---|---|---|---|
| | Systemic Toxicants | Carcinogens | | | Systemic Toxicants | Carcinogens |
| General Equations | $C_m$=[RfDxW]/[IxA]<br>where:<br>$C_m$ = action level in medium (units are medium-dependent);<br>RfD = reference dose (mg/kg/day);<br>W = body weight (kg);<br>I = intake assumption (units are medium-dependent); and<br>A = absorption factor[1] (dimensionless). | $C_m$=[RxWxLT]/[CSFxIxAxED]<br>where:<br>$C_m$ = action level in medium (units are medium-dependent);<br>R = assumed risk level (dimensionless) ($10^{-4}$ for class A & B; $10^{-5}$ for class C carcinogens);<br>W = body weight (kg);<br>LT = assumed lifetime (years);<br>CSF = carcinogenic slope factor $(mg/kg/day)^{-1}$<br>I = intake assumption (units are medium-dependent);<br>A = absorption factor[1] (dimensionless); and<br>ED = exposure duration (years). | | General Equations | $C_i$=(RfD)x(W/I)<br>where:<br>$C_i$ = criterion concentration for constituent of interest (units are medium-dependent)<br>RfD = reference dose (mg/kg/day)<br>I = ingestion rate (units are medium-dependent)<br>W = body weight (kg) | $C_i$=($R/q_1$*)x(W/I)<br>where:<br>$C_i$ = criterion concentration for constituent of interest (units are medium-dependent)<br>R = specified risk level ($10^{-6}$ for Class A and B; $10^{-5}$ for Class C carcinogens)<br>$q_1$* = carcinogen slope factor $(mg/kg/day)^{-1}$<br>W = body weight (kg)<br>I = intake amount for a given period (units are medium-dependent) |
| Air | $C_a$ is the action level in air, in $\mu g/m^3$.<br>$C_a$ = (RfD x 70 kg x 1000 $\mu g/mg$)/(20 $m^3$/day x 1) | $C_a$ is the action level in air, in $\mu g/m^3$.<br>$C_a$ = (R x 70 kg x 70 years x 1000 $\mu g/mg$)/(CSF x 20$m^3$/day x 1 x ED) | | Air | $C_a$ is the criterion concentration in air, in $\mu g/m^3$.<br>$C_a$ = (RfD x 1000$\mu g/mg$) x [70kg/(20$m^3$/day)] | $C_a$ is the criterion concentration in air, in $\mu g/m^3$.<br>$C_a$ = ($R/q_1$*) x [70 kg/(20$m^3$/day)] x(1000 $\mu g/mg$) |
| Water | $C_w$ is the action level in water, in mg/L.<br>$C_w$ = (RfD x 70 kg)/(2L/day x 1) | $C_w$ is the action level in water, in mg/L.<br>$C_w$ = (R x 70 kg x 70 years)/(CSF x 2L/day x 1 x ED) | | Water | $C_w$ is the criterion concentration in water, in $\mu g/L$.<br>$C_w$ = (RfD x 1000$\mu g/mg$) x [70 kg/(2L/day)] | $C_w$ is the criterion concentration in water, in $\mu g/L$.<br>$C_w$ = ($R/q_1$*) x [70 kg/(2L/day)] x (1000 $\mu g/mg$) |

## TABLE 18-12
## (Concluded)

| | Proposed RCRA Corrective Action Rule | | | | RCRA Facility Investigation Guidance Document | |
|---|---|---|---|---|---|---|
| | Systemic Toxicants | Carcinogens | | | Systemic Toxicants | Carcinogens |
| Soil | $C_s$ is the action level in soil, in mg/kg.<br>$C_s$ = (RfD x 16 kg[2] x 1000 g/kg)/(0.2 g/day x 1) | $C_s$ is the action level in soil, in mg/kg.<br>$C_s$ = (R x 70 kg x 70 years x 1000 g/kg)/(CSF x 0.1 g/day x 1 x ED) | | Air | $C_s$ is the criterion concentration in soil, in mg/kg.<br>$C_s$ = (RfD x 1000 mg/g) x [16 kg[2]/(0.2 g/day)] | $C_s$ is the criterion concentration in soil, in mg/kg.<br>$C_s$ = $C_s = (R/q_1^*)$ x [70 kg/(0.1g/day)] x (1000 g/kg) |

(1) Assumed to be 1, based upon the assumption that the human absorption rate will be the same as the rate in the study upon which the RfD or CSF was developed.
(2) For a child from age 1 through 6 years

# TABLE 18-13

## PROPOSED CORRECTIVE ACTION LEVELS AND RFI CRITERIA FOR NONCARCINOGENS DETECTED AT CANNON AFB - SOIL AND GROUNDWATER

| | Chemicals | Chronic Oral RfD (mg/kg/day) | Soil RCRA Action Level (mg/kg) | Soil RFI Criterion (mg/kg) | Groundwater RCRA Action Level (mg/L) | Groundwater RFI Criterion (mg/L) |
|---|---|---|---|---|---|---|
| Volatiles: | 1,1,1-Trichloroethane | 9.0E-02 | 7200 | 7200 | 0.2* | 0.2* |
| | 2-Butanone (MEK) | 5.0E-02 | 4000 | 4000 | 1.75 | 1.75 |
| | Acetone | 1.0E-01 | 8000 | 8000 | 3.5 | 3.5 |
| | Bromoform | 2.0E-02 | 1600 | 1600 | 0.1*,(1) | 0.1*,(1) |
| | Carbon Disulfide | 1.0E-01 | 8000 | 8000 | 3.5 | 3.5 |
| | Chloroform | 1.0E-02 | 800 | 800 | 7 | 7 |
| | Dibromomethane | 1.0E-02 | 800 | 800 | 0.35 | 0.35 |
| | Ethylbenzene | 1.0E-01 | 8000 | 8000 | 0.7*,(2) | 0.7*,(2) |
| | Toluene | 2.0E-01 | 16000 | 16000 | 1* | 1* |
| | Xylenes (total) | 2.0E+00 | 160000 | 160000 | 10*,(2) | 10*,(2) |
| Semi-Volatiles: | 3-Methylphenol | 5.0E-02 | 4000 | 4000 | 1.75 | 1.75 |
| | 4-Methylphenol | 5.0E-02 | 4000 | 4000 | 1.75 | 1.75 |
| | 2,4,5-Trichlorophenol | 1.0E-01 | 8000 | 8000 | 3.5 | 3.5 |
| | 4-Chloroaniline | 4.0E-03 | 320 | 320 | 0.14 | 0.14 |
| | Anthracene | 3.0E-01 | 24000 | 24000 | 10.5 | 10.5 |
| | Butyl benzyl phthalate | 2.0E-01 | 16000 | 16000 | 7 | 7 |
| | Di-n-butylphthalate | 1.0E-01 | 8000 | 8000 | 3.5 | 3.5 |
| | Fluoranthene | 4.0E-02 | 3200 | 3200 | 1.4 | 1.4 |
| | Naphthalene | 4.0E-03 | 320 | 320 | 0.14 | 0.14 |
| | Phenol | 6.0E-01 | 48000 | 48000 | 21 | 21 |
| | Pyrene | 3.0E-02 | 2400 | 2400 | 1.05 | 1.05 |
| Pesticides: | Methoxychlor | 5.0E-03 | 400 | 400 | 0.04* | 0.04* |
| Metals: | Antimony | 4.0E-04 | 32 | 32 | 0.014 | 0.014 |
| | Barium | 7.0E-02 | 5600 | 5600 | 2* | 2* |

## TABLE 18-13

## PROPOSED CORRECTIVE ACTION LEVELS AND RFI CRITERIA FOR NONCARCINOGENS DETECTED AT CANNON AFB – SOIL AND GROUNDWATER

| Chemicals | Chronic Oral RfD (mg/kg/day) | Soil RCRA Action Level (mg/kg) | Soil RFI Criterion (mg/kg) | Groundwater RCRA Action Level (mg/L) | Groundwater RFI Criterion (mg/L) |
|---|---|---|---|---|---|
| Cadmium, food | 1.0E-03 | 80 | 80 | | |
| Cadmium, water | 5.0E-04 | | | 0.005*,(2) | 0.005*,(2) |
| Chromium III | 1.0E+00 | 80000 | 80000 | 35 | 35 |
| Chromium VI | 5.0E-03 | 400 | 400 | 0.175 | 0.175 |
| Chromium, total | | | | 0.1*,(2) | 0.1*,(2) |
| Copper | 3.7E-02 | 2960 | 2960 | 1.3** | 1.3** |
| Lead | | | | 0.015** | 0.015** |
| Manganese | 1.0E-01 | 8000 | 8000 | 3.5 | 3.5 |
| Mercury | 3.0E-04 | 24 | 24 | 0.002* | 0.002* |
| Nickel | 2.0E-02 | 1600 | 1600 | 0.7 | 0.7 |
| Selenium | 5.0E-03 | 400 | 400 | 0.05*,(2) | 0.05*,(2) |
| Silver | 5.0E-03 | 400 | 400 | 0.175 | 0.175 |
| Thallium | 7.0E-05 | 5.6 | 5.6 | 0.00245 | 0.00245 |
| Vanadium | 7.0E-03 | 560 | 560 | 0.245 | 0.245 |
| Zinc | 2.0E-01 | 16000 | 16000 | 7 | 7 |

* = final MCL

** = SDWA action level

(1) = MCL for total trihalomethanes

(2) = effective July 30, 1992

TABLE 18-14

PROPOSED CORRECTIVE ACTION LEVELS AND RFI
CRITERIA FOR CARCINOGENS DETECTED AT CANNON AFB - SOIL AND GROUNDWATER

| | Chemical | EPA Weight of Evidence | Assumed Risk Level | Exposure Duration (years) | Oral Slope Factor (mg/k-d)-1 | Soil RCRA Action Level (mg/kg) | Soil RFI Criterion (mg/kg) | Groundwater RCRA Action Level (mg/L) | Groundwater RFI Criterion (mg/L) |
|---|---|---|---|---|---|---|---|---|---|
| Volatiles: | Benzene | A | 1.0E-06 | 70 | 2.9E-02 | 24.14 | 24.14 | 5.0E-03* | 5.0E-03* |
| | Bromoform | B2 | 1.0E-06 | 70 | 7.9E-03 | 88.61 | 88.61 | 1.0E-01*,(1) | 1.0E-01*,(1) |
| | Chloroform | B2 | 1.0E-06 | 70 | 6.1E-03 | 114.75 | 114.75 | 1.0E-01*,(1) | 1.0E-01*,(1) |
| | Chloromethane | C | 1.0E-05 | 70 | 1.3E-02 | 538.46 | 538.46 | 2.69E-02 | 2.69E-02 |
| | Dibromochloromethane | C | 1.0E-05 | 70 | 8.4E-02 | 83.33 | 83.33 | 4.17E-03 | 4.17E-03 |
| | Methylene Chloride | B2 | 1.0E-06 | 70 | 7.5E-03 | 93.33 | 93.33 | 4.67E-03 | 4.67E-03 |
| | Tetrachloroethene | B2 | 1.0E-06 | 70 | 5.1E-02 | 13.73 | 13.73 | 5.0E-03* | 5.0E-03* |
| | Trichloroethene | B2 | 1.0E-06 | 70 | 1.1E-02 | 63.64 | 63.64 | 5.0E-03* | 5.0E-03* |
| | Vinyl Chloride | A | 1.0E-06 | 70 | 1.9E+00 | 0.37 | 0.37 | 2.0E-03* | 2.0E-03* |
| Semi-volatiles: | bis(2-Ethylhexyl)phthalate | B2 | 1.0E-06 | 70 | 1.4E-02 | 50.00 | 50.00 | 2.50E-03 | 2.50E-03 |
| | Benzo(a)anthracene | B2 | 1.0E-06 | 70 | 8.4E-01 | 0.83 | 0.83 | 4.17E-05 | 4.17E-05 |
| | Benzo(a)pyrene | B2 | 1.0E-06 | 70 | 5.8E+00 | 0.12 | 0.12 | 6.03E-06 | 6.03E-06 |
| | Benzo(b)fluoranthene | B2 | 1.0E-06 | 70 | 8.1E-01 | 0.86 | 0.86 | 4.32E-05 | 4.32E-05 |
| | Benzo(k)fluoranthene | B2 | 1.0E-06 | 70 | 3.8E-01 | 1.84 | 1.84 | 9.21E-05 | 9.21E-05 |
| | Carbazole | B2 | 1.0E-06 | 70 | 2.0E-02 | 35.00 | 35.00 | 1.75E-03 | 1.75E-03 |
| | Chloroform | B2 | 1.0E-06 | 70 | 6.1E-03 | 114.75 | 114.75 | 1.0E-01*,(1) | 1.0E-01*,(1) |
| | Chrysene | B2 | 1.0E-06 | 70 | 3.0E-02 | 23.33 | 23.33 | 1.17E-03 | 1.17E-03 |
| | Dibenzo(a,h)anthracene | B2 | 1.0E-06 | 70 | 6.4E+00 | 0.11 | 0.11 | 5.47E-06 | 5.47E-06 |
| | Indeno(1,2,3-c,d)pyrene | B2 | 1.0E-06 | 70 | 1.4E+00 | 0.50 | 0.50 | 2.50E-05 | 2.50E-05 |
| | Pentachlorophenol | B2 | 1.0E-06 | 70 | 1.2E-01 | 5.83 | 5.83 | 1.0E-03* | 1.0E-03* |
| Pesticides: | 4,4-DDD | B2 | 1.0E-06 | 70 | 2.4E-01 | 2.92 | 2.92 | 1.46E-04 | 1.46E-04 |
| | 4,4-DDE | B2 | 1.0E-06 | 70 | 3.4E-01 | 2.06 | 2.06 | 1.03E-04 | 1.03E-04 |
| | 4,4-DDT | B2 | 1.0E-06 | 70 | 3.4E-01 | 2.06 | 2.06 | 1.03E-04 | 1.03E-04 |
| | alpha-Chlordane | B2 | 1.0E-06 | 70 | 1.3E+00 | 0.54 | 0.54 | 2.0E-03* | 2.0E-03* |
| | gamma-Chlordane | B2 | 1.0E-06 | 70 | 1.3E+00 | 0.54 | 0.54 | 2.0E-03* | 2.0E-03* |
| | Heptachlor epoxide | B2 | 1.0E-06 | 70 | 9.1E+00 | 0.08 | 0.08 | 2.0E-04* | 2.0E-04* |
| Metals: | Arsenic | A | 1.0E-06 | 70 | 1.8E+00 | 0.39 | 0.39 | 1.94E-05 | 1.94E-05 |
| | Beryllium | B2 | 1.0E-06 | 70 | 4.3E+00 | 0.16 | 0.16 | 8.14E-06 | 8.14E-06 |

* = final MCL
(1) = MCL for total trihalomethanes
(2) = Effective July 30, 1992

# TABLE 18-15

## EPA WEIGHT-OF-EVIDENCE CARCINOGENIC CLASSIFICATION OF CHEMICALS

| Group | Description | Description of Evidence |
|---|---|---|
| A | Human carcinogen | Sufficient evidence from epidemiologic studies to support a causal association between exposure and cancer |
| B1 or B2 | Probable human carcinogen | B1 indicates that limited human data are available from epidemiologic studies. B2 indicates sufficient evidence in animals and inadequate or no evidence in humans of carcinogenicity. |
| C | Possible human carcinogen | Limited evidence of carcinogenicity in animals |
| D | Not classifiable as to human carcinogenicity | Inadequate evidence of carcinogenicity in animals |
| E | No evidence of carcinogenicity in humans | No evidence of carcinogenicity in at least two adequate animal tests or in both epidemiologic and animal studies. |

Substances in groups B and C are considered potential carcinogens.

## TABLE 18-16

## TOXICITY VALUES FOR POTENTIAL CHEMICALS OF CONCERN AT CANNON AFB

| Compound | Exposure Route | Toxicity: Subchronic RfD (mg/kg-day) | Toxicity: Chronic RfD (mg/kg-day) | Carcinogenicity: Slope Factor $(mg/kg/day)^{-1}$ | Carcinogenicity: EPA Weight of Evidence Category | Sources and Comments[Z] |
|---|---|---|---|---|---|---|
| VOLATILES: | | | | | | |
| 1,1,1-Trichloroethane | Inhalation | 3E+00[t] | 3E-01[d,t] | -- | D | HEAST FY-91 |
| | Oral | 9E-01[f] | 9E-02[f,n] | -- | D | |
| Benzene | Inhalation | -- | -- | 2.9E-02[a] | A | HEAST FY-91 |
| | Oral | -- | -- | 2.9E-02[a,f] | A | |
| Ethylbenzene | Inhalation | 2.9E+00 | 2.9E-01 | — | D | IRIS 1/1/92 |
| | Oral | 1E+00[p] | 1E-01 | — | D | |
| Tetrachloroethene | Inhalation | ND | ND | 1.8E-03 | B2 | HEAST FY-91 |
| | Oral | 1E-01 | 1E-02[a] | 5.1E-02[r] | B2 | |
| Toluene | Inhalation | 6E-01 | 6E-01[k] | -- | D | IRIS 8/1/91, |
| | Oral | 2E+00 | 2E-01[a] | -- | D | HEAST FY-91 |
| Trichloroethene | Inhalation | -- | -- | 6E-03[y] | B2 | IRIS 6/1/90, |
| | Oral | -- | -- | 1.1E-02[s] | B2 | HEAST FY-91 |
| Xylenes (total) | Inhalation | 9E-02 | 9E-02 | -- | D | HEAST FY-91 |
| | Oral | 4E+00 | 2E+00 | -- | D | |

**TABLE 18-16**
**(Continued)**

| Compound | Exposure Route | Toxicity: Subchronic RfD (mg/kg-day) | Toxicity: Chronic RfD (mg/kg-day) | Carcinogenicity: Slope Factor $(mg/kg/day)^{-1}$ | Carcinogenicity: EPA Weight of Evidence Category | Sources and Comments[Z] |
|---|---|---|---|---|---|---|
| SEMIVOLATILES: | | | | | | |
| Carbazole | Inhalation | -- | -- | ND | B2 | HEAST FY-91 |
| | Oral | -- | -- | 2E-02 | B2 | (no IRIS file). |
| PESTICIDES: | | | | | | |
| 4,4-DDD | Inhalation | -- | -- | NA | B2 | HEAST FY-91 |
| | Oral | -- | -- | 2.4E-01[a] | B2 | |
| 4,4-DDE | Inhalation | -- | -- | ND | B2 | HEAST FY-91 |
| | Oral | -- | -- | 3.4E-01[a] | B2 | |
| 4,4-DDT | Inhalation | ND | ND | 3.4E-01[a,f] | B2 | HEAST FY-91 |
| | Oral | 5E-04 | 5E-04[a] | 3.4E-01[a] | B2 | |
| alpha-Chlordane | Inhalation | ND | ND[d] | 1.3E+00[a,f] | B2 | HEAST FY-91 |
| | Oral | 6E-05 | 6E-05[a] | 1.3E+00[a] | B2 | (No IRIS file). |
| gamma-Chlordane | Inhalation | ND | ND[d] | 1.3E+00[a,f] | B2 | HEAST FY-91 |
| | Oral | 6E-05 | 6E-05[a] | 1.3E+00[a] | B2 | (No IRIS file). |
| Heptachlor epoxide | Inhalation | -- | -- | 9.1E+00[a,f] | B2 | IRIS 1/1/92, |
| | Oral | 1.3E-04 | 1.3E-05 | 9.1E+00[a] | B2 | HEAST FY-91 |

## TABLE 18-16
## (Continued)

| Compound | Exposure Route | Toxicity: Subchronic RfD (mg/kg-day) | Toxicity: Chronic RfD (mg/kg-day) | Carcinogenicity: Slope Factor $(mg/kg/day)^{-1}$ | Carcinogenicity: EPA Weight of Evidence Category | Sources and Comments[Z] |
|---|---|---|---|---|---|---|
| METALS: | | | | | | |
| Barium | Inhalation | 1E-03[o] | 1E-04[o] | -- | -- | HEAST FY-91 |
| | Oral | 7E-02 | 7E-02 | -- | -- | |
| Cadmium | Inhalation | ND | ND[d] | 6.1E+00[a] | B1 | IRIS 4/1/91, |
| | Oral | ND[g] | 1E-03 (food)[a,h] 5E-04 (water) | ND[i] | ND[i] | HEAST FY-91 |
| Chromium III* | Inhalation | 5.7E-06 | 5.7E-07[k] | -- | -- | HEAST FY-91 |
| | Oral | 1E+01 | 1E+00[a] | -- | -- | |
| Chromium VI | Inhalation | 5.7E-06 | 5.7E-07[k] | 4.2E+01[a] | A | IRIS 1/1/92, |
| | Oral | 2E-02 | 5E-03[a] | ND[i] | ND[i] | HEAST FY-91 |
| Copper | Inhalation | -- | -- | -- | D | IRIS 1/1/92 |
| | Oral | 3.7E-02[l] | 3.7E-02[l] | -- | D | |
| Nickel | Inhalation | ND | ND[d] | 8.4E-01[a,aa] 1.7E+00[a,bb] | A[aa,bb] | HEAST FY-91 (No IRIS file). |
| | Oral | 2E-02 | 2E-02[n] | ND[i] | ND[i] | |
| Selenium | Inhalation | -- | -- | -- | D | IRIS 1/1/92 |
| | Oral | 5E-02[j] | 5E-03 | -- | D | |

## TABLE 18-16
## (Continued)

| Compound | Exposure Route | Toxicity: Subchronic RfD (mg/kg-day) | Toxicity: Chronic RfD (mg/kg-day) | Carcinogenicity: Slope Factor $(mg/kg/day)^{-1}$ | Carcinogenicity: EPA Weight of Evidence Category | Sources and Comments[Z] |
|---|---|---|---|---|---|---|
| Vanadium | Inhalation | -- | -- | -- | D | HEAST FY-91 |
| | Oral | 7E-03 | 7E-03[d] | -- | D | (No IRIS file). |
| Zinc | Inhalation | ND | ND | -- | D | IRIS 1/1/92, |
| | Oral | 2E-01 | 2E-01[d] | -- | D | HEAST FY-91 |
| Thallium | Inhalation | -- | -- | -- | -- | Heast FY-91 |
| | Oral | 7E-04 | 7E-05 | -- | -- | |

[a] Verified, available on IRIS.
[b] CRAVE-verified as an EPA weight-of-evidence Group D substance.
[c] An absorption factor of 30% is used to calculate the unit risk from the slope factor.
[d] Under review by the RfD/RfC workgroup (non-carcinogens) or the CRAVE workgroup (carcinogens).
[e] A unit risk of 5E-05 $(ug/l)^{-1}$ has been proposed by the Risk Assessment Forum and this recommendation has been scheduled for SAB review.
[f] Based on route-to-route extrapolation.
[g] Because of background dietary exposure, a subchronic oral RfD was not estimated.
[h] Verified, 2 separate RfDs, 1E-03 for food, 5E-04 for water.
[i] There is inadequate evidence for carcinogenicity of this compound by oral intake.
[j] Subchronic RfD calculated by multiplying chronic RfD by 10.
[k] Verified; workgroup concurrence on final data file and IRIS input pending.
[l] Calculated value by HEAST methodology from the RfC ($mg/m^3$) or RfD (mg/l).
[n] The oral RfD, while still available on IRIS, is being reconsidered by the RfD workgroup.
[o] Developmental effects have been used as the basis of calculation.
[p] Calculated slope factor by HEAST methodology from unit risk [($\mu g/m^3$) or $\mu g/l$)].
[r] CRAVE-EPA group verified, pending input into IRIS. Quantitative estimates were not calculated by the CRAVE workgroup.

## TABLE 18-16
## (Concluded)

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[s] Values removed from IRIS pending further review; new verified values are pending input into IRIS.

[t] These values differ from those in the HEA (U.S. EPA, 1987) because the study chosen as the basis for the inhalation RfD values was changed to conform to the inhalation study chosen as the basis of the oral RfD derived on IRIS.

[u] EPA's RfD Work Group considered it inappropriate to establish an RfD.

[w] U.S. EPA (1990) only verified a unit risk for inhalation exposure.

[x] A minor calculation error in estimation of transformed dose in 1986 HEEP is corrected here.

[y] This value was calculated from the unit risk and is based on the administered dose: (1.7E - 06$m^3/\mu g$ x 1 $\mu g$/1.0E - 03mg x 70 kg - day/20$m^3$). The inhalation slope factor listed in HEAST (EPa 1991e) is based on the metabolized dose.

[z] For both oral and inhalation toxicity values

[aa] for refinery dust

[bb] for nickel subsulfide

DI Data inadequate for quantitative risk assessment, per HEAST FY-91.

NA Not applicable or not available.

ND Not determined.

-- No EPA-verified toxicity value.

* Only species of chromium quantitatively evaluated, as only species found naturally (ATSDR 1989).

# TABLE 18-17

## RELATIVE POTENCY ESTIMATES FOR PAHs

| Chemical | Slope Factor[1] | Relative Potency Factor[2] | Potency-adjusted Slope Factor[3] $(mg/kg/day)^{-1}$ |
|---|---|---|---|
| Benzo(a)pyrene | 5.8 | 1.0 | 5.8 |
| Benzo(a)anthracene | | 0.145 | 0.84 |
| Benzo(b)fluoranthene | | 0.140 | 0.81 |
| Benzo(j)fluoranthene | | 0.061 | 0.35 |
| Benzo(k)fluoranthene | | 0.066 | 0.38 |
| Chrysene | | 0.0044 | 0.03 |
| Dibenzo(a,h)anthracene | | 1.11 | 6.44 |
| Indeno(1,2,3-cd)pyrene | | 0.232 | 1.35 |

1 Potency factor for BaP from Glen Rice. ECAO. Cincinnati, Ohio.

2 Clement Associates, Incorporated. 1988. Comparative Potency Approach for Estimating the Cancer Risk Associated with Exposure to Mixtures of Polycyclic Aromatic Hydrocarbons. Contract No. 68-02-4403.

3 Chemical-specific potency factor multiplied by benzo(a)pyrene slope factor.

# TABLE 18-18

## WATER SUPPLY WELLS IN THE VICINITY OF CANNON AFB

| Well No.* | Location** | Well Use | Depth (feet) |
|---|---|---|---|
| W-1 | 02N.34E.12.11222 | Irrigation Well | 418 |
| W-2 | 02N.35E.07.122221 | Irrigation Well | 375 |
| W-3 | 02N.35E.07.231 | Community Water Supply | 337 |
| W-4 | 02N.35E.07.232 | Community Water Supply | 350 |
| W-5 | 02N.35E.08.12211 | Irrigation Well | 400 |
| W-6 | 02N.35E.07.44442 | Commercial Well | 350 |
| W-7 | 02N.35E.07.34442 | Commercial Well | Unknown |
| W-8 | 02N.35E.07.313 | Community Water Supply | 360 |
| W-9 | 02N.35E.07.333 | Community Water Supply | 290 |
| W-10 | O2N.35E.07.331 | Community Water Supply | 290 |
| W-11 | 02N.35E.07.334 | Community Water Supply | 290 |
| W-12 | 02N.35E.17.22442 | Irrigation Well | 334 |
| W-13 | 02N.35E.21.1111 | Irrigation Well | 335 |
| W-14 | 02N.35E.20.23434 | Irrigation Well | 340 |
| W-15 | 02N.35E.21.331313 | Irrigation Well | 323 |
| W-16 | 02N.35E.20.312432 | Irrigation Well | 365 |
| W-17 | 02N.35E.29.21133 | Irrigation Well | 365 |
| W-18 | 02N.35E.29.242443 | Irrigation Well | 355 |
| W-19 | 02N.35E.30.42344 | Irrigation Well | 364 |
| W-20 | 02N.35E.31.11221 | Irrigation Well | 320 |
| W-21 | 02N.34E.36.222221 | Irrigation Well | 315 |
| W-22 | 02N.34E.25.412222 | Irrigation Well | 318 |
| W-23 | 02N.34E.26.44421 | Domestic Well | Unknown |
| W-24 | 02N.34E.23.32222 | Irrigation Well | Unknown |
| W-25 | 02N.34E.23.11111 | Irrigation Well | 415 |
| W-26 | 02N.34E.14.41112 | Irrigation Well | 365 |
| W-27 | 02N.34E.14.31121 | Irrigation Well | Unknown |

**TABLE 18-18**
**(Concluded)**

| Well No.* | Location** | Well Use | Depth (feet) |
|---|---|---|---|
| W-28 | 02N.34E.14.11121 | Irrigation Well | 386 |
| W-29 | 02N.34E.36.32211 | Irrigation Well | Unknown |
| W-30 | 02N.35E.043.1111 | Irrigation Well | 400 |
| W-31 | 01N.35E.06.12222 | Irrigation Well | 293 |
| W-32 | 01N.35E.05.11222 | Irrigation Well | Unknown |
| W-33 | 01N.35E.05.23331 | Live Stock Well | Unknown |
| W-34 | 01.N.35E.04.11111 | Irrigation Well | Unknown |
| W-35 | 02.N.35E.32.4111.1 | Irrigation | 388 |

* Well Nos. assigned by Walk, Haydel for ease of identification on Figure 1-3.

** All wells in New Mexico are assigned a location number by the U.S.G.S. and/or the State Engineer's Office of New Mexico which is based on the system of public land surveyors.

References:

Walk, Haydel and Associates. Final, Installation Restoration Program, Remedial Investigation Report, Volume I. January 1990.

# TABLE 18-19

## CANNON AFB WATER SUPPLY WELLS

| Well Number | GPM | Pump Size | Depth (feet) |
|---|---|---|---|
| 1 | 460 | 10" | 368 |
| 2 | 540 | 8" | 385 |
| 3 | 820 | 8" | 404 |
| 4 | 510 | 8" | 357 |
| 5 | 50 | 5" | 345 |
| 6 | 250 | 6" | 365 |
| 7 | 600 | 6" | 382 |
| 8 | 770 | 6" | 415 |
| 9 | 80 | 6" | 382 |

GPM = Gallons Per Minute

Reference:

Walk, Haydel and Associates. Final Installation Restoration Program, Remedial Investigation Report, Volume I. January 1990.

## TABLE 18-20

## CANNON AFB
## EXPOSURE SCENARIOS AND EXPOSURE POINT CONCENTRATION SELECTION RATIONALE*

| Risk Assessment Area | SWMU | Receptors | Exposure Point Concentrations | Rationale |
|---|---|---|---|---|
| 1 (FTA 2, 3, 4) | 106, 107, 109 | A1, B1<br>B2, B3, B4 | C1<br>C2 | D6<br>D7, D8 |
| 1 (Landfill #5) | 113 | A1, B1 | * | D1, D5 |
| 2 | 86-90 | A1, B1 | C1 | D2, D6 |
| 3 (NE Drainage Ditch; Entomology Rinse Area) | 95-96 | A1, B1,<br>B2, B3, B4 | C1<br>C2 | D2, D3, D6<br>D7 |
| 3 (Lagoon Sediment) | 101, 102 | A1, B1 | C1 | D1, D9 |
| 4 | 78, 81 | A1, B1 | C1 | D2, D6 |
| 5 | 76 | A1, B1 | C1 | D1, D2, D6 |
| 6 | 34 | A1, B2 | C2 | D3, D4 |
| 7 | 98 | B2 | C3 | D3, D7 |

Legend: FTA (fire training area)
VOC (volatile organic compounds)
UCL (upper confidence limit of the arithmetic mean concentration)

A. Current Exposure

1. Maintenance (general duty) Worker — Soil ingestion, dermal contact with soil, inhalation of VOCs and particulates

B. Future Exposure

1. Maintenance (general duty) Worker — Soil ingestion, dermal contact with soil, inhalation of VOCs and particulates
2. Construction (intrusive) Worker — Soil ingestion, dermal contact with soil, inhalation of VOCs and particulates

## TABLE 18-20
## (Concluded)

| | |
|---|---|
| 3. Residential Child | Soil ingestion, dermal contact with soil, inhalation of VOCs and particulates |
| 4. Residential Adult | Soil ingestion, dermal contact with soil, inhalation of VOCs and particulates |

C. Exposure Point Concentrations

1. Surface soil (Average and 95% UCLs)
2. Surface and Subsurface Soil (Average and 95% UCLs; 0-10' deep)
3. Subsurface soil only (Average and 95% UCLs on depths between 5'-23')

D. Rationale

1. Area already covered with clean cap or area/medium not readily accessible
2. Area too small for plausible major intrusive action (< ½ acre) (Neptune et al., 1990)
3. Odd-shaped land area for plausible major intrusive action
4. Lack of or insufficient surface soil samples; area was tilled and former surface and subsurface soils were mixed
5. Soil instability - Landfill
6. Non-intrusive work
7. Excavation/intrusive, soil turnover
8. Predicted air concentrations only for FTAs
9. Predicted air concentrations only for Northeast Drainage Ditch and Entomology Rinse Area.

Notes

- Groundwater exposure pathway may be complete, but is judged to be insignificant due to lack of current contamination and the site geology/hydrogeology which impedes metal migration/transport; re-assessment is possible with additional groundwater data. For landfill #5, only groundwater data has been collected; no soil samples were taken as the majority of the landfill is closed and currently only receives non-hazardous waste.

# TABLE 18-21

## TIME-WEIGHTED AVERAGE BODY WEIGHT FOR CHILDHOOD EXPOSURES

| Age | Years in Age Group | Weight, kg |
|---|---|---|
| 0 < 3 | 3 | 11.6 |
| 3 < 6 | 3 | 17.4 |
| 6 < 9 | 3 | 25.0 |
| 9 < 12 | 3 | 36.0 |
| 12 < 15 | 3 | 50.6 |
| 15 < 18 | 3 | 61.2 |
| 18 < 30 | 12 | 70 |
| Time-weighted Average Body Weight | | |
| Child (0-9 years): 18 kg | | |
| Child (0-30 years): 48 kg | | |

Source: EPA (1989d), Table 5-3

## TABLE 18-22

## SUMMARY OF RISK CHARACTERIZATION FOR CANNON AFB
## RAA1

| Receptor/Pathway | Average Exposure | | | Reasonable Maximum Exposure | | |
|---|---|---|---|---|---|---|
| | Cancer Risk | Subchronic Hazard Index | Chronic Hazard Index | Cancer Risk | Subchronic Hazard Index | Chronic Hazard Index |
| Current Worker - Maintenance | | | | | | |
| -- Soil Ingestion | 5.04E-13 | 1.07E-09 | 1.06E-08 | 1.35E-10 | 5.52E-08 | 5.50E-07 |
| -- Dermal Contact - Soil | 1.95E-13 | 2.30E-11 | 2.12E-10 | 4.72E-11 | 1.46E-09 | 1.38E-08 |
| -- Inhalation - VOCs | 1.75E-07 | 3.63E-04 | 3.63E-04 | 2.83E-06 | 2.38E-03 | 2.38E-03 |
| -- Inhalation - Particulates[1] | 0.00E+00 | 1.08E-04 | 1.08E-03 | 0.00E+00 | 4.43E-04 | 4.43E-03 |
| | 1.75E-07 | 4.71E-04 | 1.44E-03 | 2.83E-06 | 2.83E-03 | 6.81E-03 |
| Future Worker - Maintenance | | | | | | |
| -- Soil Ingestion | 5.04E-13 | 1.07E-09 | 1.06E-08 | 1.35E-10 | 5.52E-08 | 5.50E-07 |
| -- Dermal Contact - Soil | 1.95E-13 | 2.30E-11 | 2.12E-10 | 4.72E-11 | 1.46E-09 | 1.38E-08 |
| -- Inhalation - VOCs | 1.75E-07 | 3.63E-04 | 3.63E-04 | 2.83E-06 | 2.38E-03 | 2.38E-03 |
| -- Inhalation - Particulates[1] | 0.00E+00 | 1.08E-04 | 1.08E-03 | 0.00E+00 | 4.43E-04 | 4.43E-03 |
| | 1.75E-07 | 4.71E-04 | 1.44E-03 | 2.83E-06 | 2.83E-03 | 6.81E-03 |
| Future Worker - Intrusive | | | | | | |
| -- Soil Ingestion | 5.01E-11 | 2.59E-07 | 1.57E-06 | 3.63E-10 | 1.92E-06 | 1.08E-05 |
| -- Dermal Contact - Soil | 3.89E-12 | 1.79E-08 | 9.98E-08 | 6.33E-11 | 3.14E-07 | 1.67E-06 |
| -- Inhalation - VOCs | 3.97E-08 | 7.59E-04 | 7.59E-04 | 2.15E-07 | 4.55E-03 | 4.55E-03 |
| -- Inhalation - Particulates | 0.00E+00 | 5.02E-04 | 5.02E-03 | 0.00E+00 | 1.72E-03 | 1.72E-02 |
| | 3.97E-08 | 1.26E-03 | 5.78E-03 | 2.16E-07 | 6.27E-03 | 2.17E-02 |

**TABLE 18-22**
**(Concluded)**

| Receptor/Pathway | Average Exposure | | | Reasonable Maximum Exposure | | |
|---|---|---|---|---|---|---|
| | Cancer Risk | Subchronic Hazard Index | Chronic Hazard Index | Cancer Risk | Subchronic Hazard Index | Chronic Hazard Index |
| Future Resident - Adult | | | | | | |
| -- Soil Ingestion | 3.09E-10 | 1.77E-07 | 1.08E-06 | 9.52E-08 | 1.68E-05 | 9.46E-05 |
| -- Dermal Contact - Soil | 1.20E-10 | 6.13E-08 | 3.42E-07 | 1.66E-08 | 2.74E-06 | 1.46E-05 |
| -- Inhalation - VOCs | 9.69E-06 | 2.02E-02 | 2.02E-02 | 7.52E-05 | 5.27E-02 | 5.27E-02 |
| -- Inhalation - Particulates[1] | 0.00E+00 | 8.41E-03 | 8.41E-02 | 0.00E+00 | 1.20E-02 | 1.20E-01 |
| | 9.69E-06 | 2.86E-02 | 1.04E-01 | 7.53E-05 | 6.48E-02 | 1.73E-01 |
| Future Resident - Child | | | | | | |
| -- Soil Ingestion | 6.01E-09 | 3.45E-06 | 2.09E-05 | 2.78E-07 | 4.91E-05 | 2.76E-04 |
| -- Dermal Contact - Soil | 1.32E-10 | 6.76E-08 | 3.77E-07 | 1.81E-08 | 2.99E-06 | 1.59E-05 |
| -- Inhalation - VOCs | 3.77E-05 | 7.84E-02 | 7.84E-02 | 1.10E-04 | 7.69E-02 | 7.69E-02 |
| -- Inhalation - Particulates[1] | 0.00E+00 | 3.27E-02 | 3.27E-01 | 0.00E+00 | 1.76E-02 | 1.76E-01 |
| | 3.77E-05 | 1.11E-01 | 4.05E-01 | 1.10E-04 | 9.45E-02 | 2.53E-01 |

[1] No carcinogenic chemicals with EPA-verified toxicity factors were identified for inhalation of chemicals of concern in particulates.

## TABLE 18-23

## SUMMARY OF RISK CHARACTERIZATION FOR CANNON AFB
## RAA2

| | Average Exposure | | | Reasonable Maximum Exposure | | |
|---|---|---|---|---|---|---|
| Receptor/Pathway | Cancer Risk | Subchronic Hazard Index | Chronic Hazard Index | Cancer Risk | Subchronic Hazard Index | Chronic Hazard Index |
| Current Worker - Maintenance | | | | | | |
| -- Soil Ingestion | 8.05E-14 | 1.41E-04 | 2.54E-04 | 8.64E-12 | 9.25E-03 | 1.45E-02 |
| -- Dermal Contact - Soil | 3.12E-14 | 6.51E-11 | 6.44E-10 | 3.02E-12 | 2.36E-09 | 2.33E-08 |
| -- Inhalation - VOCs | 9.10E-09 | 6.45E-05 | 2.03E-04 | 1.02E-07 | 2.60E-04 | 8.19E-04 |
| -- Inhalation - Particulates | 5.89E-09 | 7.27E-03 | 7.23E-02 | 8.64E-08 | 3.83E-02 | 3.80E-01 |
| | 1.50E-08 | 7.47E-03 | 7.28E-02 | 1.88E-07 | 4.78E-02 | 3.96E-01 |
| Future Worker - Maintenance | | | | | | |
| -- Soil Ingestion | 8.05E-14 | 1.41E-04 | 2.54E-04 | 8.64E-12 | 9.25E-03 | 1.45E-02 |
| -- Dermal Contact - Soil | 3.12E-14 | 6.51E-11 | 6.44E-10 | 3.02E-12 | 2.36E-09 | 2.33E-08 |
| -- Inhalation - VOCs | 9.10E-09 | 6.45E-05 | 2.03E-04 | 1.02E-07 | 2.60E-04 | 8.19E-04 |
| -- Inhalation - Particulates | 5.89E-09 | 7.27E-03 | 7.23E-02 | 8.64E-08 | 3.83E-02 | 3.80E-01 |
| | 1.50E-08 | 7.47E-03 | 7.28E-02 | 1.88E-07 | 4.78E-02 | 3.96E-01 |

## TABLE 18-24

## SUMMARY OF RISK CHARACTERIZATION FOR CANNON AFB
## RAA3

| | Average Exposure | | | Reasonable Maximum Exposure | | |
|---|---|---|---|---|---|---|
| Receptor/Pathway | Cancer Risk | Subchronic Hazard Index | Chronic Hazard Index | Cancer Risk | Subchronic Hazard Index | Chronic Hazard Index |
| Current Worker - Maintenance | | | | | | |
| -- Soil Ingestion | 1.11E-10 | 1.21E-04 | 1.30E-04 | 1.02E-08 | 7.46E-03 | 7.86E-03 |
| -- Dermal Contact - Soil | 4.32E-11 | 5.27E-06 | 2.42E-06 | 3.55E-09 | 1.56E-05 | 7.18E-05 |
| -- Inhalation - VOCs | 4.76E-11 | 2.75E-07 | 2.75E-07 | 3.48E-10 | 1.20E-06 | 1.20E-06 |
| -- Inhalation - Particulates | 9.49E-10 | 3.40E-03 | 3.40E-02 | 1.17E-08 | 1.50E-02 | 1.50E-01 |
| | 1.15E-09 | 3.52E-03 | 3.41E-02 | 2.57E-08 | 2.25E-02 | 1.58E-01 |
| Future Worker - Maintenance | | | | | | |
| -- Soil Ingestion | 1.11E-10 | 1.21E-04 | 1.30E-04 | 1.02E-08 | 7.46E-03 | 7.86E-03 |
| -- Dermal Contact - Soil | 4.32E-11 | 5.27E-06 | 2.42E-06 | 3.55E-09 | 1.56E-05 | 7.18E-05 |
| -- Inhalation - VOCs | 4.76E-11 | 2.75E-07 | 2.75E-07 | 3.48E-10 | 1.20E-06 | 1.20E-06 |
| -- Inhalation - Particulates | 9.49E-10 | 3.40E-03 | 3.40E-02 | 1.17E-08 | 1.50E-02 | 1.50E-01 |
| | 1.15E-09 | 3.52E-03 | 3.41E-02 | 2.57E-08 | 2.25E-02 | 1.58E-01 |

**TABLE 18-24**
**(Concluded)**

| Receptor/Pathway | Average Exposure | | | Reasonable Maximum Exposure | | |
|---|---|---|---|---|---|---|
| | Cancer Risk | Subchronic Hazard Index | Chronic Hazard Index | Cancer Risk | Subchronic Hazard Index | Chronic Hazard Index |
| Future Worker - Intrusive | | | | | | |
| -- Soil Ingestion | 1.30E-10 | 4.06E-04 | 8.84E-04 | 5.21E-10 | 4.21E-03 | 4.57E-03 |
| -- Dermal Contact - Soil | 1.01E-11 | 1.11E-06 | 5.11E-06 | 9.09E-11 | 1.00E-05 | 4.60E-05 |
| -- Inhalation - VOCs | 0.00E+00 | 1.90E-07 | 1.90E-07 | 0.00E+00 | 9.48E-07 | 9.48E-07 |
| -- Inhalation - Particulates | 8.51E-11 | 3.13E-04 | 3.12E-03 | 4.51E-10 | 2.14E-03 | 2.14E-02 |
| | 2.25E-10 | 7.20E-04 | 3.61E-03 | 1.06E-09 | 6.36E-03 | 2.96E-02 |
| Future Resident - Adult | | | | | | |
| -- Soil Ingestion | 8.02E-10 | 2.78E-04 | 3.31E-04 | 1.37E-07 | 3.68E-02 | 4.00E-02 |
| -- Dermal Contact - Soil | 3.11E-10 | 3.81E-06 | 1.75E-05 | 2.39E-08 | 8.76E-05 | 4.02E-04 |
| -- Inhalation - VOCs | 0.00E+00 | 4.82E-06 | 4.82E-06 | 0.00E+00 | 1.02E-05 | 1.02E-05 |
| -- Inhalation - Particulates | 7.46E-09 | 1.83E-02 | 1.83E-01 | 5.57E-08 | 5.20E-02 | 5.20E-01 |
| | 8.58E-09 | 1.86E-02 | 1.84E-01 | 2.16E-07 | 8.90E-02 | 5.61E-01 |
| Future Resident - Child | | | | | | |
| -- Soil Ingestion | 1.56E-08 | 5.41E-03 | 6.44E-03 | 3.99E-07 | 1.07E-01 | 1.17E-01 |
| -- Dermal Contact - Soil | 3.43E-10 | 4.20E-06 | 1.93E-05 | 2.60E-08 | 9.55E-05 | 4.38E-04 |
| -- Inhalation - VOCs | 0.00E+00 | 1.87E-06 | 1.87E-06 | 0.00E+00 | 1.49E-05 | 1.49E-05 |
| -- Inhalation - Particulates | 2.90E-08 | 7.13E-02 | 7.12E-01 | 8.12E-08 | 7.59E-02 | 7.58E-01 |
| | 4.50E-08 | 7.67E-02 | 7.19E-01 | 5.06E-07 | 1.83E-01 | 8.76E-01 |

## TABLE 18-25

## SUMMARY OF RISK CHARACTERIZATION FOR CANNON AFB
## RAA4

| | Average Exposure | | | Reasonable Maximum Exposure | | |
|---|---|---|---|---|---|---|
| Receptor/Pathway | Cancer Risk | Subchronic Hazard Index | Chronic Hazard Index | Cancer Risk | Subchronic Hazard Index | Chronic Hazard Index |
| Current Worker - Maintenance | | | | | | |
| -- Soil Ingestion | 1.19E-12 | 1.01E-07 | 5.68E-07 | 2.89E-10 | 7.34E-06 | 4.07E-05 |
| -- Dermal Contact - Soil | 4.64E-13 | 3.90E-08 | 2.20E-07 | 1.01E-10 | 2.56E-06 | 1.42E-05 |
| -- Inhalation - VOCs | 7.28E-12 | 5.24E-08 | 1.63E-07 | 1.82E-10 | 4.70E-07 | 1.47E-06 |
| -- Inhalation - Particulates | 7.59E-12 | 0.00E+00 | 0.00E+00 | 3.17E-10 | 0.00E+00 | 0.00E+00 |
| | 1.65E-11 | 1.92E-07 | 9.51E-07 | 8.89E-10 | 1.04E-05 | 5.64E05 |
| Future Worker - Maintenance | | | | | | |
| -- Soil Ingestion | 1.19E-12 | 1.10E-07 | 5.68E-07 | 2.89E-10 | 7.34E-06 | 4.07E-05 |
| -- Dermal Contact - Soil | 4.64E-13 | 3.90E-08 | 2.20E-07 | 1.01E-10 | 2.56E-06 | 1.42E-05 |
| -- Inhalation - VOCs | 7.28E-12 | 5.24E-08 | 1.63E-07 | 1.82E-10 | 4.70E-07 | 1.47E-06 |
| -- Inhalation - Particulates | 7.59E-12 | 0.00E+00 | 0.00E+00 | 3.17E-10 | 0.00E+00 | 0.00E+00 |
| | 1.65E-11 | 1.92E-07 | 9.51E-07 | 8.89E-10 | 1.04E-05 | 5.64E-05 |

## TABLE 18-26

## SUMMARY OF RISK CHARACTERIZATION FOR CANNON AFB
## RAA5

| | Average Exposure | | | Reasonable Maximum Exposure | | |
|---|---|---|---|---|---|---|
| Receptor/Pathway | Cancer Risk[1] | Subchronic Hazard Index | Chronic Hazard Index | Cancer Risk[1] | Subchronic Hazard Index | Chronic Hazard Index |
| Current Worker - Maintenance | | | | | | |
| -- Inhalation - VOCs | 0.00E+00 | 3.96E-02 | 3.96E-02 | 0.00E+00 | 3.36E-01 | 3.36E-01 |
| | 0.00E+00 | 3.96E-02 | 3.96E-02 | 0.00E+00 | 3.36E-01 | 3.36E-01 |
| Future Worker - Maintenance | | | | | | |
| -- Inhalation - VOCs | 0.00E+00 | 3.96E-02 | 3.96E-02 | 0.00E+00 | 3.36E-01 | 3.36E-01 |
| | 0.00E+00 | 3.96E-02 | 3.96E-02 | 0.00E+00 | 3.36E-01 | 3.36E-01 |

[1] No carcinogenic chemicals of concern were identified.

## TABLE 18-27

## SUMMARY OF RISK CHARACTERIZATION FOR CANNON AFB
## RAA6

| Receptor/Pathway | Average Exposure | | | Reasonable Maximum Exposure | | |
|---|---|---|---|---|---|---|
| | Cancer Risk[1] | Subchronic Hazard Index | Chronic Hazard Index | Cancer Risk[1] | Subchronic Hazard Index | Chronic Hazard Index |
| Current Worker - Maintenance | | | | | | |
| -- Soil Ingestion | 0.00E+00 | 1.73E-06 | 3.20E-06 | 0.00E+00 | 1.31E-04 | 1.80E-04 |
| -- Dermal Contact - Soil | 0.00E+00 | 2.94E-12 | 2.94E-11 | 0.00E+00 | 1.29E-10 | 1.29E-09 |
| -- Inhalation - VOCs | 0.00E+00 | 7.08E-07 | 7.08E-07 | 0.00E+00 | 2.76E-06 | 2.76E-06 |
| -- Inhalation - Particulates(2) | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| | 0.00E+00 | 2.43E-06 | 3.91E-06 | 0.00E+00 | 1.34E-04 | 1.83E-04 |
| Future Worker - Intrusive | 0.00E+00 | 1.82E-05 | 3.37E-05 | 0.00E+00 | 1.68E-04 | 2.30E-04 |
| -- Soil Ingestion | 0.00E+00 | 6.20E-12 | 6.20E-11 | 0.00E+00 | 8.27E-11 | 8.27E-10 |
| Dermal Contact - Soil | 0.00E+00 | 9.30E-08 | 9.30E-08 | 0.00E+00 | 4.15E-07 | 4.15E-07 |
| -- Inhalation - VOCs | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| -- Inhalation - Particulates(2) | 0.00E+00 | 1.83E-05 | 3.38E-05 | 0.00E+00 | 1.69E-04 | 2.31E-04 |

1 No carcinogenic chemicals of concern were identified.

## TABLE 18-28

## SUMMARY OF RISK CHARACTERIZATION FOR CANNON AFB
## RAA7

| Receptor/Pathway | Average Exposure | | | Reasonable Maximum Exposure | | |
|---|---|---|---|---|---|---|
| | Cancer Risk[1] | Subchronic Hazard Index | Chronic Hazard Index | Cancer Risk[1] | Subchronic Hazard Index | Chronic Hazard Index |
| Future Worker - Intrusive | | | | | | |
| -- Soil Ingestion | 0.00E+00 | 2.73E-04 | 2.73E-04 | 0.00E+00 | 1.45E-03 | 1.45E-03 |
| -- Dermal Contact - Soil | 0.00E+00 | 9.58E-10 | 9.58E-09 | 0.00E+00 | 1.75E-08 | 1.75E-07 |
| -- Inhalation - VOCs | 0.00E+00 | 1.06E-05 | 1.06E-05 | 0.00E+00 | 6.18E-05 | 6.18E-05 |
| -- Inhalation - Particulates[(2)] | 0.00E+00 | 3.83E-04 | 3.83E-03 | 0.00E+00 | 1.53E-03 | 1.53E-02 |
| | 0.00E+00 | 6.67E-04 | 4.12E-03 | 0.00E+00 | 3.04E-03 | 1.68E-02 |

1 No carcinogenic chemicals of concern were identified.

# TABLE 18-29

## HABITAT TYPES ON CANNON AFB

| SWMU | Habitat | Receptors |
|---|---|---|
| Age Drainage Ditch (SWMU 34) | Suburban, mowed, grassy areas | Earthworms<br>Robins |
| Engine Test Cell (SWMU 86-90) | Disturbed, industrial area | ____ |
| NE Stormwater Drainage (SWMU 95) | Short to mid-grassy open areas, mowed. | Small rodents<br>Hawks |
| Sewage Lagoons (SWMU 101, 102) | Water | Waterfowl |
| Landfill 5 (SWMU 113) | Grassland, some shrub, disturbed, weedy areas | Small rodents<br>Jackrabbits<br>Hawks |
| Old Entomology Rinse Area (SWMU 96) | Disturbed, weedy, some grassland | Small rodents |
| Sludge Weathering Pit (SWMU 76) | Disturbed/bare areas, mowed grass, weeds | Small rodents |
| Fire Department Training Area 1 (SWMU 78) | Open space, mowed, mixed-species grassland | Small rodents<br>Hawks |
| Solvent Disposal Area (SWMU 81) | Open space, mowed, mixed-species grassland | Small rodents<br>Hawks |
| Fire Training Area 2 (SWMU 106) | Open space, mowed mixed-species grassland | Small rodents<br>Hawks |
| Fire Training Area 3 (SWMU 107) | Disturbed, bare | ____ |
| Fire Training Area 4 (SWMU 109) | Disturbed, asphalt | ____ |
| Sanitary Sewer Line (SWMU 96) | Buried sewer line | ____ |
| Playa Lake (Not a SWMU in this RI) | Aquatic, surrounded by open grassy, weedy area | Aquatic: Algae, invertebrates, insects<br>Birds: Waterfowl (mostly ducks), shorebirds<br>Mammals: Small rodents (mostly mice) |

## TABLE 18-30

## COMPARISON OF MEAN, MAXIMUM, AND UCL CONCENTRATIONS IN SURFACE WATER SAMPLES TO FEDERAL AND STATE WATER QUALITY CRITERIA (μg/l)

| Chemicals | Concentration Detected | | | Sample Number | Federal Ambient Water Quality Criteria[1] | | New Mexico Water Quality Criteria[2] | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Max. | UCL | | Fresh Acute | Fresh Chronic | Livestock & Wildlife Watering | Irrigation | Warm Water Fishery[3] | |
| | | | | | | | | | Acute | Chronic |
| INORGANICS | | | | | | | | | | |
| Barium | 89 | 110 | 136 | CAN101-101N-3002 | -- | -- | -- | -- | -- | -- |
| Cadmium | ND | ND | ND | | 3.9+ | 1.1+ | 50 | 10 | 3.9 | 1.13 |
| Chromium | 6.1 | 8.3J | 9.3 | CAN101-101N-3003 | 16(hex)<br>1700(tri) | 11(hex)<br>210(tri) | 1,000(hex) | 100 | 1,736.5 (hex) | 207 |
| Cobalt | 4.7 | 4.8J | 5.3 | CAN101-101N-3003 | -- | -- | 1,000 | 50 | -- | -- |
| Copper | 28 | 51 | 62 | CAN101-101N-3003 | 18+ | 12+ | 500 | 200 | 18+ | 12+ |
| Cyanide | | 11 | | CAN101-101S-3001 | 22 | 5.2 | -- | -- | 22 | 5.2 |
| Lead | 4.8 | 7.1 | 8.7 | CAN101-101N-3003 | 82+ | 3.2+ | 100 | 5,000 | 82+ | 3.2+ |
| Mercury | 0.6 | 1.1 | 1.1 | CAN101-101N-3003 | 2.4 | 0.012 | 10 | -- | 2.4 | 0.012 |
| Nickel | 10 | 5.4J | 24 | CAN101-101N-3003 | 1,400+ | 160+ | -- | -- | 1,845+ | 155+ |
| Selenium | 4.9 | 4.9J | 5.0 | CAN101-101N-3003<br>CAN101-101S-3001 | 280 | 35 | 50 | 130 or<br>250++ | 20 | 5 |
| Silver | 15 | 40J | 51 | CAN101-101N-3003 | 4.1+ | 0.12+ | -- | -- | 4.1+ | 0.12+ |
| Sulfide, total | | 3,700 | | CAN101-101N-3003 | -- | 2+++ | -- | -- | -- | -- |
| Vanadium | 17 | 38 | 47 | CAN101-101N-3003 | -- | -- | 100 | 100 | -- | -- |
| Zinc | 55 | 120 | 151 | CAN101-101N-3003 | 120+ | 110+ | 25,000 | 2,000 | 117 | 106 |

# TABLE 18-30
## (Continued)

| Chemicals | Concentration Detected | | | Sample Number | Federal Ambient Water Quality Criteria[1] | | New Mexico Water Quality Criteria[2] | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Max. | UCL | | Fresh Acute | Fresh Chronic | Livestock & Wildlife Watering | Irrigation | Warm Water Fishery[3] | |
| | | | | | | | | | Acute | Chronic |
| ORGANICS | | | | | | | | | | |
| Acetone | | 35 | | CAN-101-101S-300 | -- | -- | -- | -- | -- | -- |
| 2-Acetylaminofluorene | | 34 | | CAN-101-101N-3003 | -- | -- | -- | -- | -- | -- |
| bis(2-ethylhexyl)phthalate | | 15 | | CAN101-101N-3003 | -- | -- | -- | -- | -- | -- |
| Bromoform | 5.8 | 2.6J | 16 | CAN101-101N-3003 | -- | -- | -- | -- | -- | -- |
| Carbon disulfide | 5.4 | 1.1J | 16 | CAN101-101N-3003 | -- | -- | -- | -- | -- | -- |
| Chloroform | 6.8 | 5.4 | 16 | CAN101-101N-3003 | 28,900 | 1,240 | -- | -- | -- | -- |
| Dibromomethane | 5.7 | 2.1 | 16 | CAN101-101N-3003 | -- | -- | -- | -- | -- | -- |
| Di-n-butylphthalate | | 15 | | CAN101-101N-3003 | -- | -- | -- | -- | -- | -- |
| 3/4-methylphenol | | 0.0064 | | CAN101-101N-5003 | -- | -- | -- | -- | -- | -- |
| Naphthalene | 7.3 | 12 | 14 | CAN101-101N-3003 | 2,300 | 620 | -- | -- | -- | -- |
| Pentachlorophenol | | 0.0078 | | CAN101-101N-5003 | 20 | 13 | -- | -- | -- | -- |
| Phenol | 4.6 | 3.8 | 5.8 | CAN101-101N-3003 | 10,200 | 2,560 | -- | -- | -- | -- |
| Tetrachloroethene | | 7.1 | | CAN101-101N-5003 | 5,280 | 840 | -- | -- | -- | -- |
| 2,4,5-Trichlorophenol | | 0.0066 | | CAN101-101N-3003 | -- | -- | -- | -- | -- | -- |
| Toluene | 6.7 | 5 | 15 | CAN101-101N-3003 | 17,500 | -- | -- | -- | -- | -- |
| Xylenes (total) | 5.6 | 1.7 | 16 | CAN101-101N-3003 | -- | -- | -- | -- | -- | -- |

ND = not detected
J = value estimated

\+ hardness dependent
\+ + in presence of > 500 mg/l $SO_4$
\+ + + sulfide/hydrogen sulfide

UCL = Upper 95% confidence limits

## TABLE 18-30
## (Concluded)

(1) U.S. EPA, Office of Water Regulations and Standards. 1986. Quality Criteria for Water. EPA 440/5-86-001. Washington, D.C. May.
(2) New Mexico Water Quality Control Commission. 1991. Water Quality Standards for Interstate and Intrastate Streams in New Mexico. Rule No. WQCC91-1. Santa Fe, New Mexico. Rule No. WQCC91-1. Santa Fe, New Mexico. May.
(3) For comparison purposes only; standard not applicable to water in the lagoons.

## TABLE 18-31

## COMPARISON OF MAXIMUM CONCENTRATIONS OF METALS IN SEDIMENTS TO REFERENCE CRITERIA

| Chemical | Max. Conc. Sediment | EPA Threshold Sediment Criterion(1) | Cannon AFB Soils Background Concentration |
|---|---|---|---|
| Aluminum | 17,700 J | | 10447 |
| Arsenic | 14.7 J | 33 | 1.95 |
| Barium | 635 | | 903 |
| Cadmium | 11.75 | 31 | 1.01 |
| Chromium | 51 J | | 9.31 |
| Cobalt | 14.7 | | 4.06 |
| Copper | 346 | 136 | 15.44 |
| Iron | 13,200 J | | 8683 |
| Lead | 157 | 132 | 8.64 |
| Magnesium | 6690 J | | 111903 |
| Manganese | 155 | | 167 |
| Mercury | 8.1 J | 0.8 | |
| Nickel | 27.6 J | | 8.49 |
| Selenium | 35.3 | | 1.35 |
| Silver | 96.9 | | 0.94 |
| Vanadium | 97.9J | | 26.74 |
| Zinc | 672 | 760 | 21.82 |

**NOTES:**

All concentrations in mg/kg

(1) EPA Threshold Sediment Concentrations from Fitchko (1989)
(2) RCRA Human Health Proposed Criteria (see Table 18-15)
(3) Current RCRA/RFI (1989) Criteria.

# TABLE 18–32

## CALCULATION OF PESTICIDE CONCENTRATIONS IN WATER BY SEDIMENT PARTITIONING

| Chemical | Conc. in Sediment (mg/kg) | Koc | Foc | Conc. in Water (mg/L) |
|---|---|---|---|---|
| Aldrin | 0.017 | 2.29E+04 | 0.133 | 5.58E–06 |
| Dieldrin | 0.033 | 2.29E+04 | 0.133 | 1.08E–05 |
| Chlordane (alpha) | 0.031 | 7.76E+02 | 0.133 | 3.00E–04 |
| Chlordane (gamma) | 0.045 | 7.76E+02 | 0.133 | 4.36E–04 |
| DDT | 0.033 | 1.23E+04 | 0.133 | 2.02E–05 |
| Endrin | 0.033 | 2.63E+04 | 0.133 | 9.43E–06 |
| Heptachlor | 0.017 | 2.19E+04 | 0.133 | 5.84E–06 |
| Gamma–BHC | 0.017 | 2.95E+03 | 0.133 | 4.33E–05 |
| PCBs–1016 | 0.33 | 3.55E+03 | 0.133 | 6.99E–04 |
| PCBs–1221 | 0.65 | 3.55E+03 | 0.133 | 1.38E–03 |
| PCBs–1254 | 0.49 | 3.55E+03 | 0.133 | 1.04E–03 |
| Toxaphene | 1.7 | 1.48E+03 | 0.133 | 8.64E–03 |

$$\text{Concentration [water (mg/L)]} = \frac{\text{Concentration [sediment (mg/kg)]}}{\text{Koc} * \text{Foc}}$$

Foc = Fraction of Organic Carbon in Sediment
Koc = Sediment – Water Partition Coefficient (Chapman, 1989)

# TABLE 18-33

## COMPARISON OF MAXIMUM CONCENTRATIONS OF ORGANIC CHEMICALS IN SEDIMENTS TO REFERENCE CRITERIA

| Chemical | Max. Conc. Sediment (mg/kg) | EPA Threshold Contaminant Concentration[1] (mg/kg) | Water Conc.[3] (mg/L) | AWQC Acute[2] (mg/L) | AWQC Chronic[2] (mg/L) |
|---|---|---|---|---|---|
| Aldrin | 0.017 | 0.021 | 5.58E-06 | 3.0E-03 | |
| Dieldrin | 0.033 | | 1.08E-05 | 2.5E-03 | 1.9E-06 |
| Endosulfan | 0.017 | | | | |
| Endosulfan 1 | 0.033 | | | | |
| Endosulfan Sulfate | 0.033 | | | | |
| Endrin | 0.033 | | 9.43E-06 | 1.8E-04 | 2.3E-06 |
| Endrin Aldehyde | 0.033 | | | | |
| Endrin Ketone | 0.033 | | | | |
| Heptachlor | 0.017 | | 5.84E-06 | 5.2E-04 | 3.89E-06 |
| Heptachlor Epoxide | 0.017 | | | | |
| Methoxychlor | 0.17 | | | | |
| PCB 1016 | 0.33 | | 6.99E-04 | 2.0E-03 | 1.4E-05 |
| PCB 1221 | 0.65 | | 1.38E-03 | 2.0E-03 | 1.4E-05 |
| PCB 1232 | 0.33 | | 6.99E-04 | 2.0E-03 | 1.4E-05 |
| PCB 1242 | 0.33 | | 6.99E-04 | 2.0E-03 | 1.4E-05 |
| PCB 1248 | 0.33 | | 6.99E-04 | 2.0E-03 | 1.4E-05 |
| PCB 1254 | 0.49 | | 1.04E-03 | 2.0E-03 | 1.4E-05 |
| PCB 1260 | 0.33 | | 6.99E-04 | 2.0E-03 | 1.4E-05 |
| Toxaphene | 1.7 | | 8.64E-03 | 7.3E-04 | 2.0E-07 |
| alpha-BHC | 0.017 | | | | |
| alpha-Chlordane | 0.031 | | 3.0E-04 | 2.4E-03 | 4.3E-06 |
| beta-BHC | 0.017 | | | | |
| delta-BHC | 0.017 | | | | |
| gamma-BHC (lindane) | 0.017 | 0.012 | 4.33E-05 | 2.0E-03 | 8.0E-05 |

**TABLE 18-33**
**(Concluded)**

| Chemical | Max. Conc. Sediment (mg/kg) | EPA Threshold Contaminant Concentration[1] (mg/kg) | Water Conc.[3] (mg/L) | AWQC Acute[2] (mg/L) | AWQC Chronic[2] (mg/L) |
|---|---|---|---|---|---|
| gamma-chlordane | 0.045 | | 4.36E-04 | 2.4E-03 | 4.3E-06 |
| 4,4-DDD | 0.053 | 13 | | | |
| 4,4-DDE | 0.09 | 28 | | | |
| 4,4-DDT | 0.033 | 0.006 | 2.02E-05 | 1.1E-03 | 1.1E-06 |
| 4-Chloraniline | 100 | | | | |
| bis(2-ethylhexyl phthalate) | 340 | | | | |

NOTES:

(1) EPA Threshold Contaminant Concentrations from Fitchko (1989).
(2) Federal (EPA) Clean Water Act AWQC (1986).
(3) Water concentration partitioned using max. sediment value (see Table 18-32)

# TABLE 18-34

## SOIL ANALYTICAL RESULTS FOR SWMU LOCATIONS WHERE CANNON BACKGROUND CONCENTRATIONS WERE EXCEEDED

| | Normal Range in U.S. Soils (1) | Levels in Southwest (2) | Cannon Background (3) | SWMU Number | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 34 | 76 | 78 | 86-90 | 95 | 107 | 109 |
| Al | 700 - 100,000 | 5,000 | 10,447 | < | < | 19,100 | < | < | -- | -- |
| As | 0.1 - 40 | 6.5 | 1.95 | < | < | 2.18 | < | < | -- | -- |
| Ba | 10 - 5,000 | 500 | 903 | < | < | < | 1,350 | 3,820 | -- | -- |
| Cd | 0.01 - 2.0 | -- | 1.01 | 1.3 | < | 14.2 | 6.79 | 1.8 | -- | -- |
| Cr | 5 - 1,500 | 30 | 9.31 | 12.3 | 10 | 30 | 87.1 | 115 | 10.1 | 10 |
| Co | 0.5 - 65 | 3 - 7 | 4.06 | < | 4.6 | < | 16 | 12.6 | -- | -- |
| Cu | 1 - 700 | 20 | 15.44 | 15 | < | 449 | 304 | 59 | -- | -- |
| Fe | 100 - 100,000 | 15,000 | 8,683 | < | 9,300 | 9,920 | 38,600 | 41,200 | -- | -- |
| Pb | 10 - 700 | 15 | 8.64 | 40.7 | 12.6 | 411 | 215 | 147 | 298 | 17.6 |
| Mn | 20 - 10,000 | 500 | 167 | < | 226 | 195 | 578 | 443 | -- | -- |
| Se | <0.1 - 4.3 | 0.30 | 1.35 | 2.2 | 8.4 | -- | -- | -- | -- | -- |
| Zn | <5 - 2,900 | 45 | 21.82 | 237 | 24.9 | 589 | 2,840 | 467 | -- | -- |
| Hg | <0.01 - 4.6 | 0.32 | -- | -- | -- | 0.1 | 0.15 | 0.38 | -- | -- |
| Ni | 2 - 750 | 15 | 8.49 | -- | -- | < | 76.7 | 49.1 | -- | -- |
| Be | <1 - 15 | 1 - 2 | 0.68 | -- | -- | 0.44 | 0.37 | -- | -- | -- |
| Sb | 0.2 - 10 | <1 | 5.44 | -- | -- | -- | 56.2U | -- | -- | -- |
| Ag | 0.01 - 8 | -- | 0.94 | -- | -- | -- | 1.16 | -- | -- | -- |
| Other: | | | | | | | | | | |
| Benzo(a)pyrene | -- | -- | | 0.2 | | | | | | |

All concentrations in mg/kg

< Max and UCL values lower than Cannon background value (Table 2-7).

(1) Values mainly from Bowen (1979). Values for Cu, Pb, Zn, and Se from USGS (1984)
(2) Values from Table 2-7
(3) Values from Table 2-7

## TABLE 18-35

## TOXICITY INFORMATION FOR METALS TO BIRD SPECIES

| Chemical | Organism | Dose (D) (mg/kg-BW/d)<br>Dietary Level (DL) (mg/kg) | Test Duration | Toxicity Type | Screening Intake Value (mg/kg-BW/d) | Reference |
|---|---|---|---|---|---|---|
| Copper | mallards | 29 D<br>250 DL | -- | NOEL | 29 | NAS 1977 |
| Cyanide | mouse | 3 D | -- | LD50 | 0.003 | USDHHS 1987 |
| Lead | Kestrels | 50 DL | -- | NOEL | 7.5 (mallards=4.2) | Scheuhammer 1987 |
| | ring doves | 100 DL | -- | LOEL | 7.5 (mallards=4.2) | Scheuhammer 1987 |
| | Japanese quail | 10 DL | -- | LOEL | 7.5 (mallards=4.2) | Scheuhammer 1987 |
| | chickens | 200 DL | -- | LOEL | 7.5 (mallards=4.2) | Scheuhammer 1987 |
| Mercury | ducks | 0.1 DL | -- | TDLO | 0.0057 | Scheuhammer 1987 |
| | mallards | 0.0005 DL | -- | LDLO | 2.8E-06 | Golchfield and Burger 1987 |
| | mallards | 3 DL | 21 days | LOEL | 0.017 | Scheuhammer 1987 |
| Silver | rats | 330 D | | LD10 | 3.3 | USDHHS 1987 |
| Zinc | mallards | 3,000-12,000 DL | 60 days | LDLO | 1.68 | Gasaway and Buss 1972 |

## TABLE 18-36

## HAZARD CALCULATION FOR DUCKS FROM WATER AND SEDIMENT INGESTION

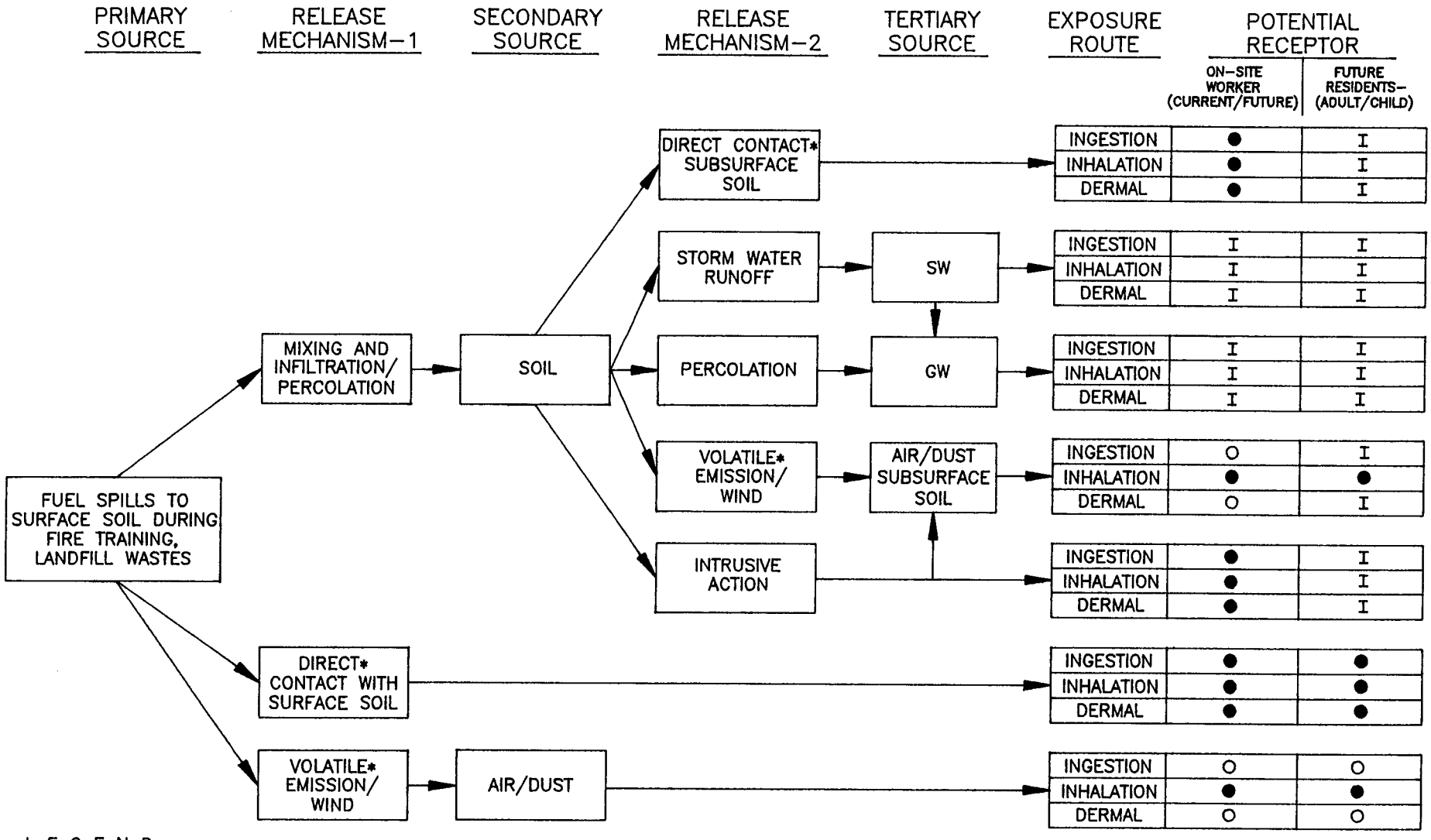
| Ref. | Water | Cu | Cn | Pb | Hg | Ag | Zn | |
|---|---|---|---|---|---|---|---|---|
| Calder 1983 | Intake (l/day) | 0.063 | 0.063 | 0.063 | 0.063 | 0.063 | 0.063 | |
| Teres 1991 | Body weight (kg) | 1.11 | 1.11 | 1.11 | 1.11 | 1.11 | 1.11 | |
| | Concentration (mg/l) | 0.051 | 0.011 | 0.0071 | 0.0011 | 0.04 | 0.12 | |
| | Dose (mg/kg/d) | 0.0028945 | 0.0006243 | 0.0004029 | 0.0000624 | 0.0022702 | 0.0068108 | |
| | Screening Value (mg/kg/d) | 29 | 0.003 | 4.2 | 0.0057 | 3.3 | 1.68 | |
| | Hazard Quotient | 0.0001 | 0.2081 | 0.0001 | 0.0110 | 0.0007 | 0.0041 | |
| | **Sediment** | **Cu** | **Cn** | **Pb** | **Hg** | **Ag** | **Zn** | |
| Nagy 1987 | Food Intake (kg/day) | 0.062 | 0.062 | 0.062 | 0.062 | 0.062 | 0.062 | |
| Teres 1991 | Body weight (kg) | 1.11 | 1.11 | 1.11 | 1.11 | 1.11 | 1.11 | |
| Goodman & Fisher 1967 | % Sediment in Diet | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | |
| | Matrix effect | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | |
| | Sediment Intake (kg/day) | 0.031 | 0.031 | 0.031 | 0.031 | 0.031 | 0.031 | |
| | Concentration (mg/kg) | 346 | NA | 157 | 8.1 | 96.9 | 672 | |
| | Dose (mg/kg/d) | 0.97 | 0.00 | 0.44 | 0.02 | 0.27 | 1.88 | |
| | Screening Value (mg/kg/d) | 29 | 0.003 | 4.2 | 0.0057 | 3.3 | 1.68 | |
| | Hazard Quotient | 0.033 | 0.000 | 0.104 | 3.969 | 0.082 | 1.117 | |
| | Water & Sediment Hazard Quotient | 0.03 | 0.21 | 0.10 | 3.98 | 0.08 | 1.12 | |
| | **Hazard Index** | | | | | | | 5.52 |

Notes:

Maximum values were used to represent water and sediment concentrations

Woodward-Clyde Consultants

# FIRE TRAINING AREAS 2, 3, & 4 AND LANDFILL 5




LEGEND

- I INCOMPLETE EXPOSURE PATHWAYS
- ● SIGNIFICANT EXPOSURE PATHWAY
- O RELATIVELY INSIGNIFICANT EXPOSURE PATHWAY
- * DOES NOT APPLY TO LANDFILL 5 WHICH IS COVERED WITH FILL AND VEGETATED

| | |
|---|---|
| Job No. : | 89MC114W |
| Prepared by : | P.T. |
| Date : | 4/13/92 |

RISK ASSESSMENT AREA 1
CONCEPTUAL SITE MODEL

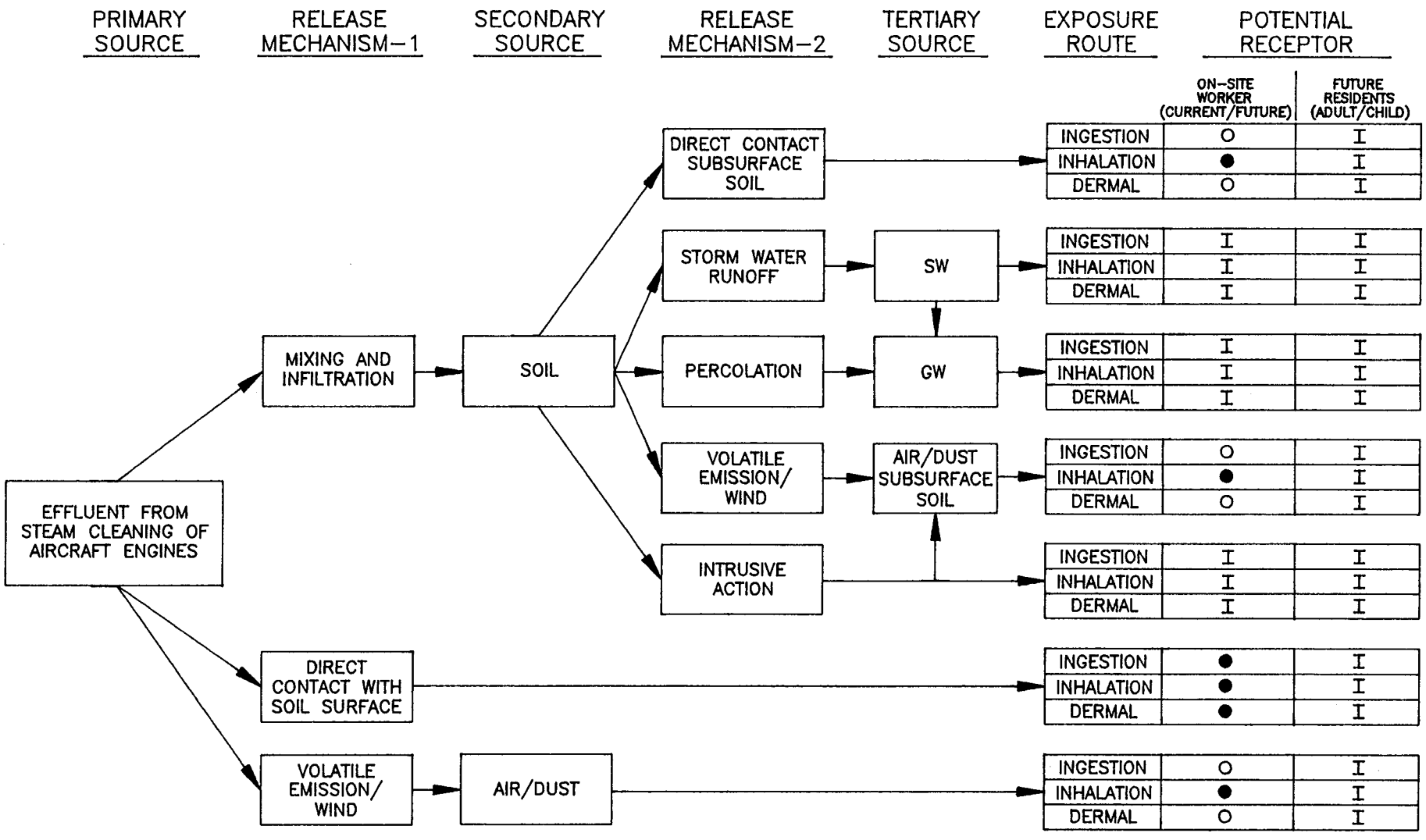
CANNON AIR FORCE BASE

C114W001

FIG. 18-1

Woodward-Clyde Consultants

# ENGINE CELL TEST AREA




LEGEND

- I INCOMPLETE EXPOSURE PATHWAYS
- ● SIGNIFICANT EXPOSURE PATHWAY
- O RELATIVELY INSIGNIFICANT EXPOSURE PATHWAY

| | |
|---|---|
| Job No. : | 89MC114W |
| Prepared by : | P.T. |
| Date : | 4/13/92 |

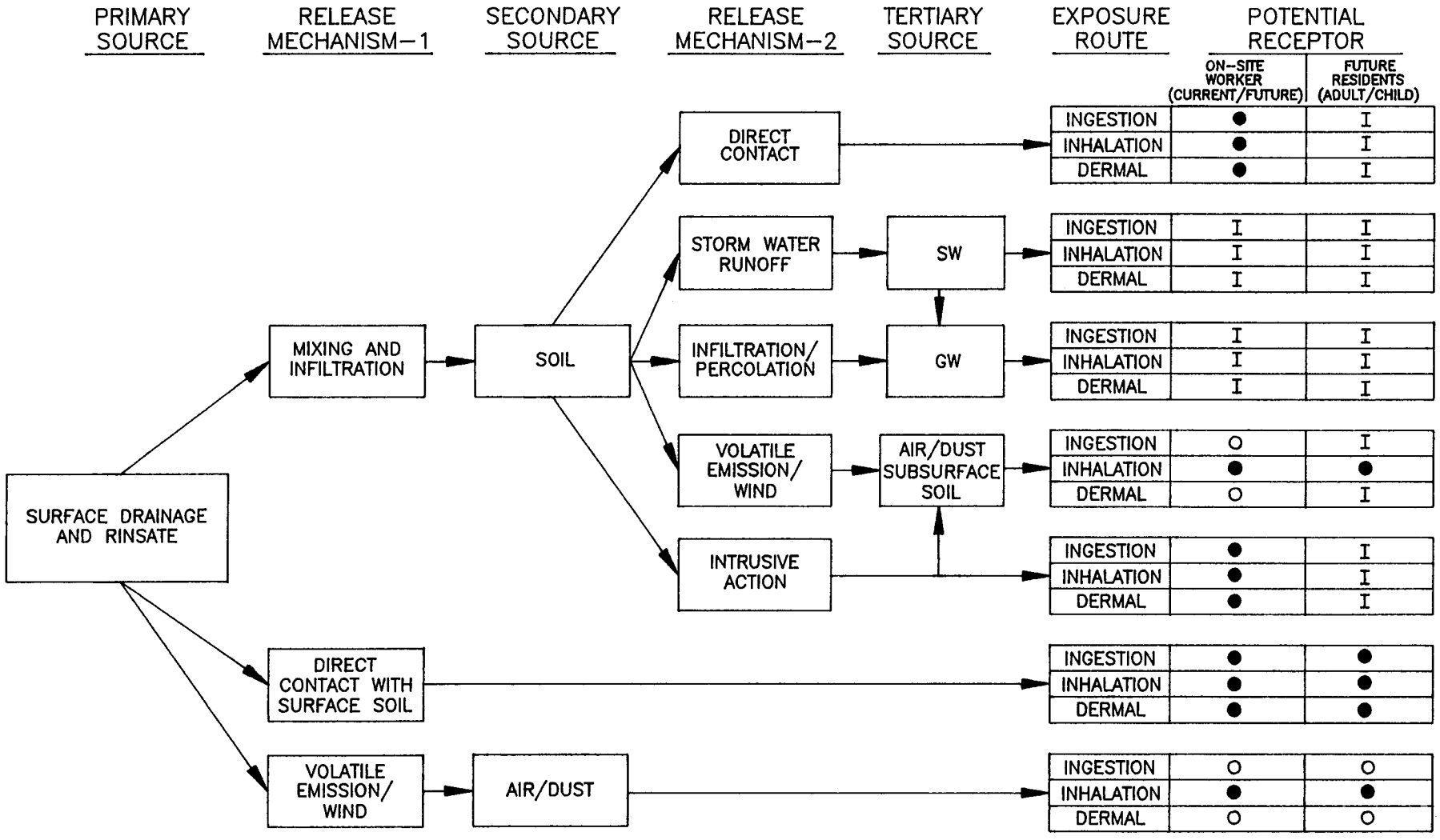
RISK ASSESSMENT AREA 2
CONCEPTUAL SITE MODEL
CANNON AIR FORCE BASE

C114W002

FIG. 18-2

Woodward-Clyde Consultants

# NE STORM DRAINAGE AREA
# OLD ENTOMOLOGY RINSE AREA




LEGEND

- I INCOMPLETE EXPOSURE PATHWAYS
- ● SIGNIFICANT EXPOSURE PATHWAY
- O RELATIVELY INSIGNIFICANT EXPOSURE PATHWAY

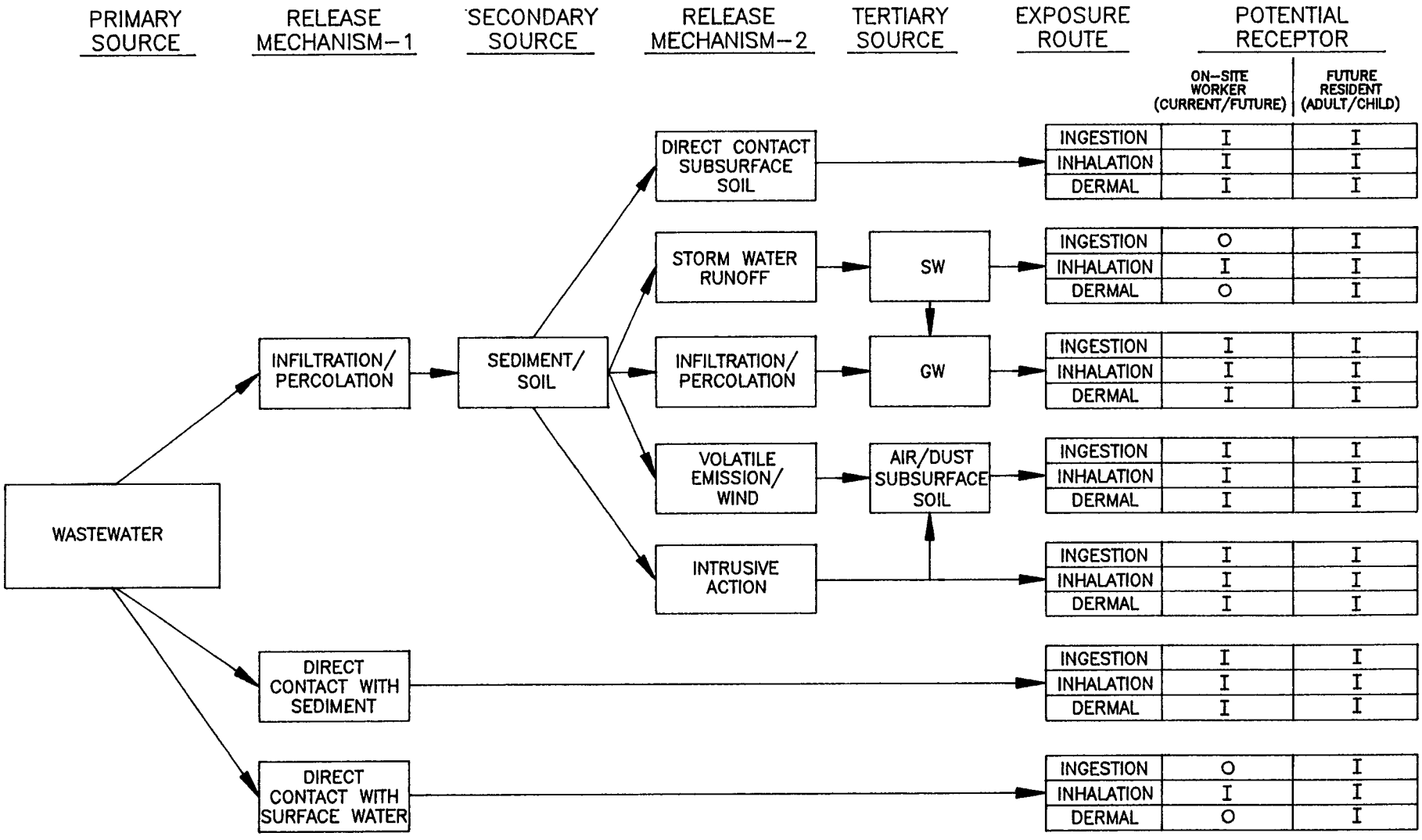
| | |
|---|---|
| Job No. : | 89MC114W |
| Prepared by : | P.T. |
| Date : | 4/13/92 |

RISK ASSESSMENT AREA 3A
CONCEPTUAL SITE MODEL
CANNON AIR FORCE BASE

C114W003

FIG. 18-3

# WASTEWATER LAGOONS AND EFFLUENT DISCHARGE




LEGEND

- I INCOMPLETE EXPOSURE PATHWAYS
- ● SIGNIFICANT EXPOSURE PATHWAY
- O RELATIVELY INSIGNIFICANT EXPOSURE PATHWAY

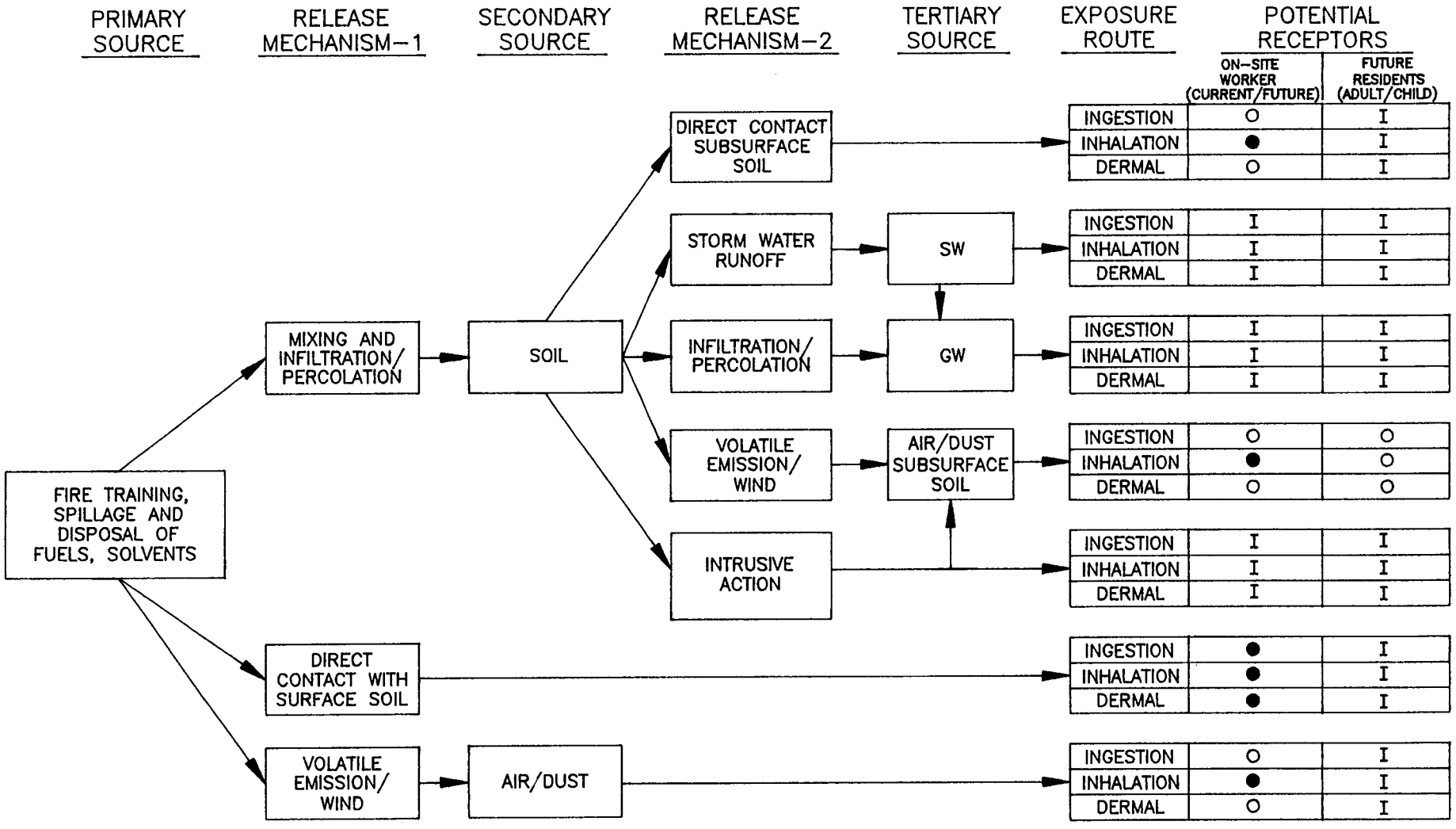
| | |
|---|---|
| Job No. : | 89MC114W |
| Prepared by : | P.T. |
| Date : | 4/13/92 |

RISK ASSESSMENT AREA 3B
CONCEPTUAL SITE MODEL
CANNON AIR FORCE BASE

C114W004

FIG. 18-4

# FIRE TRAINING AREA 1
# SOLVENT DISPOSAL AREA




LEGEND

- I INCOMPLETE EXPOSURE PATHWAYS
- ● SIGNIFICANT EXPOSURE PATHWAY
- O RELATIVELY INSIGNIFICANT EXPOSURE PATHWAY

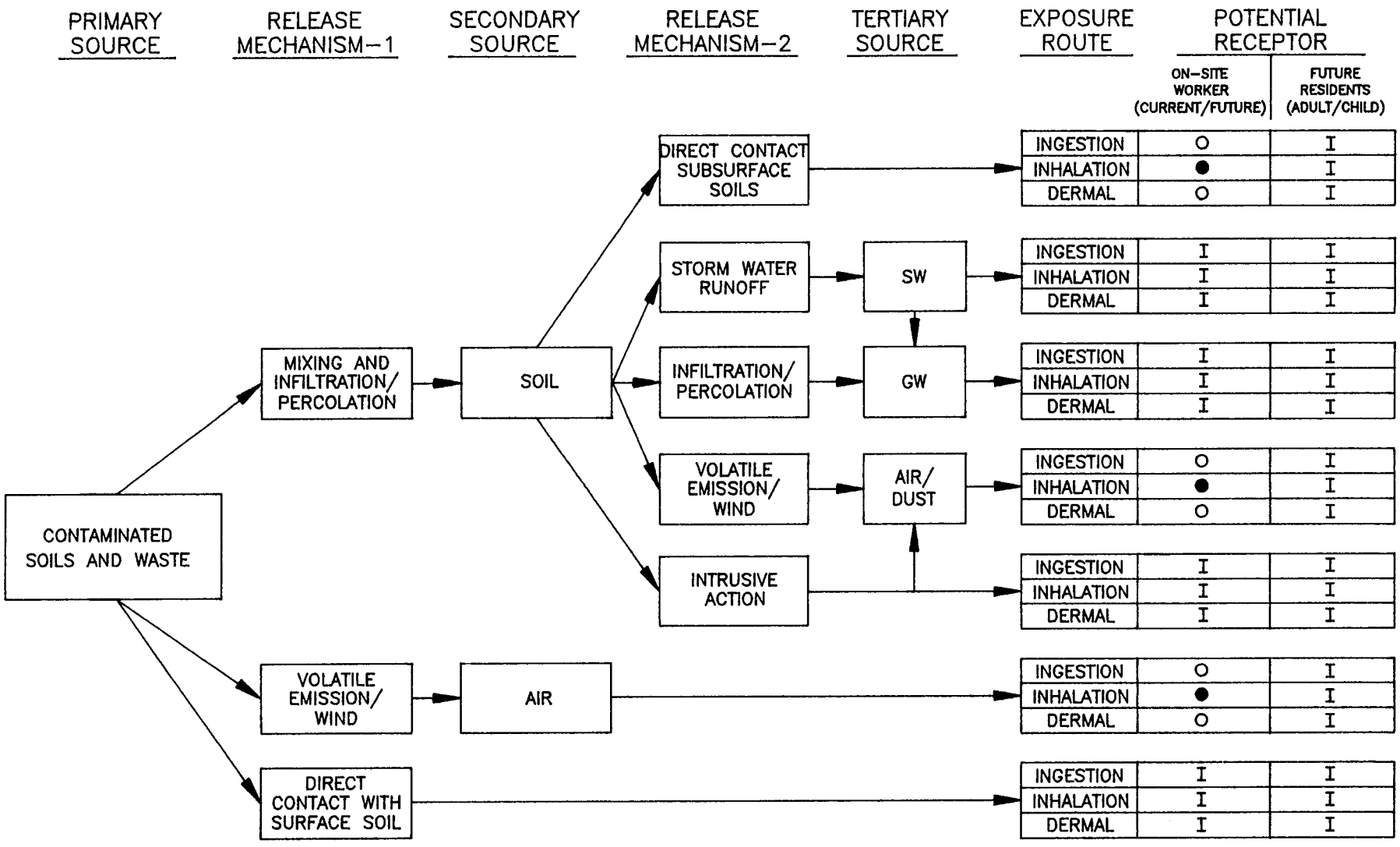
| | |
|---|---|
| Job No. : | 89MC114W |
| Prepared by : | P.T. |
| Date : | 4/13/92 |

RISK ASSESSMENT AREA 4
CONCEPTUAL SITE MODEL
CANNON AIR FORCE BASE

C114W005

FIG. 18-5

## SLUDGE WEATHERING PIT




LEGEND

- I INCOMPLETE EXPOSURE PATHWAYS
- ● SIGNIFICANT EXPOSURE PATHWAY
- O RELATIVELY INSIGNIFICANT EXPOSURE PATHWAY

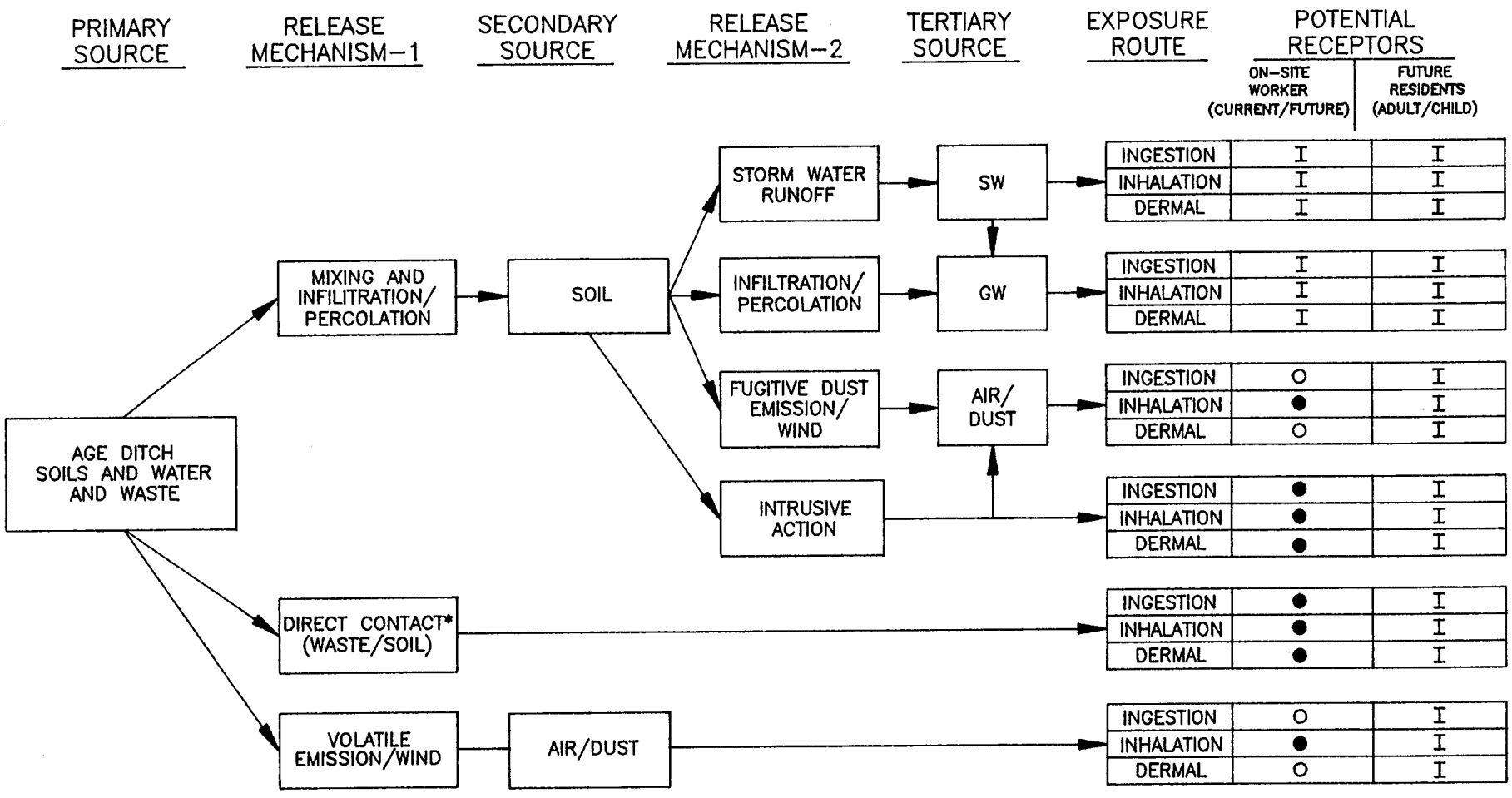
| | |
|---|---|
| Job No. : | 89MC114W |
| Prepared by : | P.T. |
| Date : | 4/13/92 |

RISK ASSESSMENT AREA 5
CONCEPTUAL SITE MODEL
CANNON AIR FORCE BASE

C114W006

FIG. 18-6

# AGE DRAINAGE DITCH




LEGEND

- I INCOMPLETE EXPOSURE PATHWAY
- ● SIGNIFICANT EXPOSURE PATHWAY
- O RELATIVELY INSIGNIFICANT EXPOSURE PATHWAY
- * TILLING PERFORMED IN OCT. 1988

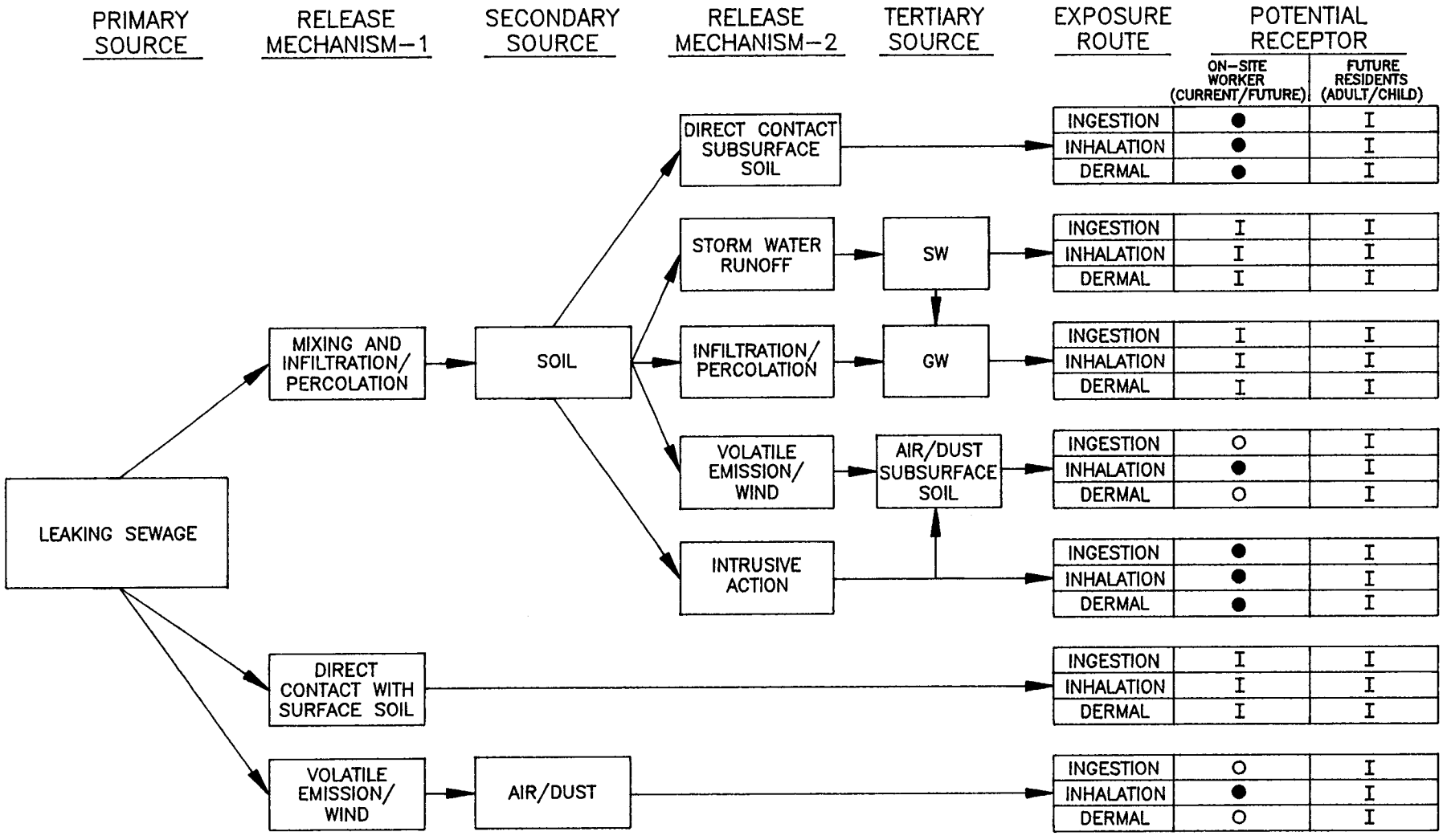
| | |
|---|---|
| Job No. : | 89MC114W |
| Prepared by : | P.T. |
| Date : | 4/13/92 |

RISK ASSESSMENT AREA 6
CONCEPTUAL SITE MODEL
CANNON AIR FORCE BASE

C114W007

FIG. 18-7

## SANITARY SEWER LINE




LEGEND

- I INCOMPLETE EXPOSURE PATHWAYS
- ● SIGNIFICANT EXPOSURE PATHWAY
- O RELATIVELY INSIGNIFICANT EXPOSURE PATHWAY

| | |
|---|---|
| Job No. : | 89MC114W |
| Prepared by : | P.T. |
| Date : | 4/13/92 |

RISK ASSESSMENT AREA 7
CONCEPTUAL SITE MODEL
CANNON AIR FORCE BASE

C114W008

FIG. 18-8

# 19.0
# APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS ANALYSIS

Both RCRA and CERCLA requirements for evaluating the nature and extent of potential hazardous waste contamination at each SWMU will be included in the investigations at Cannon AFB.

Cannon AFB must evaluate the SWMUs identified by the USEPA during the RCRA Facility Assessment (RFA) as a condition of their RCRA Part B permit. The investigations conducted by WCC, although termed a Remedial Investigation, are designed to satisfy RFI guidance for characterizing the SWMUs and developing and implementing corrective action measures, if necessary.

Cannon AFB is conducting this investigation under the Air Force's IRP. The IRP requires that the investigation follow the regulatory requirements of CERCLA and is the basis for assessment and response actions on USAF installations. The Superfund Amendments and Reauthorization Act of 1986 (SARA) augmented the scope and requirements of CERCLA and gave specific directives to federal facilities regarding investigation of waste disposal sites. Under SARA, determination of Applicable or Relevant and Appropriate Requirements (ARARs) is required, and potential remediation alternatives should be considered at the initiation of a Remedial Investigation/Feasibility Study (RI/FS).

As part of future Feasibility Studies (Corrective Measure Studies under RCRA), alternative remedial or corrective action measures will be evaluated to assess the degree to which they attain or exceed applicable and relevant federal and state public health and environmental standards. A preliminary identification and discussion of potential ARARs applicable to the planned RI at Cannon AFB is presented below. Review of these ARARs will highlight any site-specific regulatory conditions that might either limit the choice of alternatives or place limits on contaminant concentrations.

The ARARs presented herein are chemical-specific and location-specific. Identification of action-specific ARARs can only be addressed during the detailed analysis of remedial action alternatives.

## 19.1 DEFINITION OF ARARs

Cleanup standards for remedial 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, SARA requires that any hazardous substance or pollutant remaining on site meet the level or standard of control established by ARAR standards, requirements, criteria, or limitations established 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 under SARA.

"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, chemical-specific TBC values are used to establish cleanup targets.

## 19.2 CHEMICAL-SPECIFIC ARARs

The chemical-specific ARARs and other criteria or guidelines to be considered presented in Tables 19-1, 19-2, 19-3, 19-4, and 19-5 are 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 set cleanup levels for the chemicals of concern in the designated media, or to set a safe level of discharge (e.g., wastewater discharge, taking into account water quality standards) where a discharge occurs as part of the remedial activity.

Sources for potential target cleanup levels included selected standards, criteria, and guidelines that are typically considered as ARARs for remedial actions conducted under CERCLA, as well as some recently published guidance and proposed action levels developed under RCRA that should be regarded as TBCs. In addition, New Mexico has developed standards for groundwater and surface water. A summary of these federal and state regulations, standards, and criteria is presented in Table 19-1.

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 on Table 19-2. Also included are hazardous constituent concentration limits under RCRA Subpart F. Secondary maximum contamination levels (SMCLs) established under SDWA are also presented on Table 19-2 although they are not federally enforceable and should be regarded as TBCs.

State and federal standards for surface water quality for any possible contaminants are presented on Table 19-3 and are considered applicable or relevant and appropriate only if the remedial activity impacts surface waters. If, during remediation, contaminated groundwater is extracted and proposed for discharge to on-site or off-site surface waters, or if contaminated runoff from a remediation site drains into surface waters, then these standards and criteria would be applicable. Surface waters present at the site consist of playas, which are included by the state under its surface water quality standards. Federal ambient water quality criteria protective of aquatic life could be relevant and appropriate if the playas became contaminated. As no human consumption of either the surface water or aquatic organisms in these playas occurs, federal criteria protective of human health are not relevant or appropriate. If no values are shown for possible contaminants on Table 19-3, there are no standards at this time.

## 19.3 TBCs

In general, very few cleanup standards exist for soil contamination. For petroleum-related spills, cleanup levels are often based upon guidance developed from underground storage tank (UST) investigations or, if non-petroleum wastes are involved, levels are often based on site-specific risk assessment, hazardous waste definition, or background levels. New Mexico has its own UST regulations which are considered "TBCs" for all SWMUs where petroleum contamination not associated with USTs is found. This approach was adopted for all petroleum related releases with the exception of Fire Department Training Area No. 4. This SWMU did, at one time, have a UST at the site,

which would make the State UST regulations applicable for this SWMU if petroleum contamination is found.

Recently some human health-based criteria for soil and water contaminant levels have been published as guidance for RCRA Facility Investigations (hereinafter referred to as the "RFI Guidance"), and RCRA-related action levels have been proposed (Table 19-1). However, these figures 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 chemical-specific ARARs and represent potential cleanup levels only. Actual cleanup levels that may be applied to a particular area will depend on site-specific requirements based in part on the Remedial Investigation and are subject to final approval by the appropriate regulatory agency or agencies. The RCRA 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 on Tables 19-4 and 19-5 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 there is a potential need for corrective measures and if a Corrective Measures Study is warranted. As previously discussed, they do not necessarily represent a target cleanup level. The proposed RCRA action levels, also on Tables 19-4 and 19-5, if exceeded, may also trigger a Corrective Measure Study. However, because these levels are only proposed, at this time they are not enforceable under RCRA (55 FR 30798, July 27, 1990).

## 19.4 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 on Table 19-6. 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 floodplain restrictions on management of hazardous waste.

Due to the possible presence of both federal- and state-listed threatened/endangered (T/E) species at the site, the federal and state Endangered Species Acts are both considered "possibly" applicable. If T/E species are definitely found at the site, these acts would be applicable. Section 106 of the federal Historic Preservation Act is considered "possibly" 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 register, the evaluation process is still ongoing at the Base. Due to both architectural and archaeological surveys being conducted on Cannon AFB, the State Cultural Properties Act is also considered "possibly" applicable and communications 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 on this site fall under the current definition of wetland areas under federal wetland delineation guidance (personal communication, July 1991). The federal regulations governing wetlands, however, are not considered applicable or relevant and appropriate as long as the project does not impact the wetland areas. If the playa lakes on base continue to be considered wetlands and if remedial activities should impact these wetland areas, then the regulations would be considered applicable and coordination with the U.S. Fish and Wildlife Service would need to be initiated prior to any remedial activity. Table 19-6, therefore, shows a "possibly" applicable designation, as remedial activities are not fully known at this time. The State of New Mexico does not have its own wetlands regulations at this time.

## 19.5 COMPARISON OF LABORATORY RESULTS TO ARARS

The laboratory analytical values presented as "detected" and "estimated" for chemicals at each SWMU were compared to the applicable chemical-specific ARARs listed in Tables 19-2 through 19-5 to determine which (if any) soil, sediment, groundwater, and surface water samples exceeded the listed standards or guidelines.

For metals in soil, only values detected above the Cannon AFB background concentrations statistical range were compared against the RCRA proposed action levels and the RFI criteria for soils. Exceptions were beryllium, arsenic, and benzo(a)pyrene, whose background values exceeded the criteria/action levels for soils; therefore, all values for these chemicals were compared against the relevant criteria/action levels. Metals such as beryllium and arsenic, whose 95% UCL concentrations did not exceed background and regional soil concentrations, were not considered contaminants of concern (see Section 18.2.2) and not compared against RCRA action levels or RFI criteria for the Risk Assessment. As discussed previously in Section 18.2.3, some RFI criteria and RCRA action levels were recalculated using updated RfD and SF values. Chemical values were compared against both the original and the revised calculations. No RCRA action levels or RFI criteria levels are available for comparison of values of lead, cobalt, iron, or magnesium in soil.

As previously discussed in Section 18.6, Environmental Risk Assessment, the following metals detected in the Wastewater Lagoons' (SWMU Nos. 101 and 102) surface water samples exceeded the National Ambient Water Quality Criteria (AWQC) for: lead, copper, mercury, silver, and zinc. The sediment/water equilibrium partitioning approach was used to evaluate sediment toxicity and the values obtained were also compared against the AWQC; the chronic values for chlordane (alpha and gamma), DDT, endrin, PCBs, and toxaphene were exceeded even though chronic values are frequently below the detection levels used for surface water. Table 19-7 gives the contaminant name, sample concentrations, and the federal criteria exceeded. New Mexico standards for surface water quality (as outlined on Table 19-3) were not exceeded in any of the surface water samples. Section 18.6 of this report presents a discussion on the individual samples that exceeded the AWQC.

The state and federal groundwater quality standards presented in Table 19-2 were compared against the laboratory results for the groundwater samples taken at the Old Entomology Rinse (SWMU No. 96), the Wastewater Lagoons (SWMU Nos. 101 and 102), and Landfill No. 5 (SWMU No. 113). None of the standards were exceeded.

Soil sample results were compared against the "to be considered" RFI criteria and proposed RCRA action levels. These levels are not cleanup standards, but are

considered as screening levels used to assess whether a Corrective Measures Study is warranted. The screening levels for soils are presented in Tables 19-4 and 19-5. Table 19-8 outlines the SWMU, contaminant name, concentration of contaminant, and the criteria/level exceeded. Antimony (SWMU Nos. 86-90), beryllium (SWMU Nos. 34, 76, 78, 86-90, 95, and 98) and arsenic (SWMU Nos. 34, 76, 78, 86-90, 95 and 98) were the only metals found to exceed the applicable criteria/action levels. It should be noted that the background levels for beryllium (0.32-0.68 mg/km) and arsenic (0.43-1.95 mg/kg) also exceed these guidelines.

Sediment samples from the Wastewater Lagoons (SWMU Nos. 101 and 102) were also compared against RFI criteria and RCRA action levels for soils as there are currently no standards for sediments. Levels for PCBs, toxaphene, and bis(2-ethylhexyl)phthalate were exceeded in these samples. Sediment samples evaluated using the equilibrium partitioning approach were compared against EPA threshold contaminant concentrations (as discussed in Section 18.6) and the threshold for DDT was exceeded.

Soils at several of the SWMUs may exceed the New Mexico UST regulations for total petroleum hydrocarbon (TPH) levels if it is determined that the soils are "highly contaminated" or "saturated". The state requires a filter paper test to make this determination; the soil is considered "highly contaminated" if the filter paper leaks during the test. Soils that are not saturated and where the contaminated soil is greater than fifty feet above the seasonal high static ground water table need not be remediated. (New Mexico UST Regulations, amended, July 1990).

## TABLE 19-1

## SUMMARY OF POTENTIAL CHEMICAL-SPECIFIC ARARS/TBCs CANNON AFB

| 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 for drinking. |
| National Secondary Drinking Water Standards (40 CFR Part 143) | Establishes secondary maximum contaminant levels (SMCLs) which are nonenforceable guidelines for public drinking water systems to protect the aesthetic quality of the water. | SMCLs may be "to be considered" if groundwater is used as a drinking water source. |
| Maximum Contaminants Level Goals (MCLGs) [PL No. 99-339, 100 Stat. 642 (1986), (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 (AWQC) for surface water based on use classifications and the criteria stated under Section 304(a) of the Clean Water Act. | Federal AWQCs for protection of aquatic life may be "relevant and appropriate" if contaminants are released to site surface waters (playas) or if treated groundwater is discharged to surface waters. |

**TABLE 19-1**
**(Continued)**

| Standard, Requirement, or Criteria | Description | Comment |
|---|---|---|
| Resource, Conservation, and Recovery Act (RCRA) | | |
| Releases from Solid Waste Management Units (40 CFR Part 264.94) | Subpart F (264.94) gives concentration limits in groundwater for hazardous constituents from a regulated unit. | Applicable if organic and inorganic contamination of groundwater found at a RCRA regulated unit. |
| RCRA Facility Investigation Guidance (EPA, 1989a) | 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 (27 July 1990)(55 FR 30798) | 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 | | |
| Water Quality Standards for Interstate and Intrastate streams in New Mexico (Rule No. WQCC 91-1, 5/22/91) | Establishes water quality standards and criteria for the surface waters of the state. | Applicable only if contaminants found in waters and if contaminated water is discharged into state surface waters (playas). |
| New Mexico Drinking Water Regulations (4/16/91) (New Mexico Water Supply Regulations, Sections 202 to 203) | Establishes MCLs and standards 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, Section 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. |

**TABLE 19-1**
**(Concluded)**

| Standard, Requirement, or Criteria | Description | Comment |
|---|---|---|
| New Mexico Hazardous Waste Act 1978 | | |
| New Mexico Underground Storage Tank Regulations, amended July 1990, 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. |

# TABLE 19-2

## POTENTIAL SITE-WIDE CHEMICAL-SPECIFIC ARARs/TBCs
## GROUNDWATER QUALITY STANDARDS
## CANNON AFB
## (ug/l, unless otherwise noted)

| | | FEDERAL STANDARDS | | | | | STATE STANDARDS | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | NM WQCC Groundwater Quality Standards (d) | | | |
| Parameter | Type | SDWA Maximum Contaminant Level (a) | SDWA Maximum Contaminant Level TBCs (b) | SDWA Maximum Contaminant Level Goal (a) | SDWA Maximum Contaminant Level Goal TBCs (b) | RCRA Subpart F Concentration Limit (40 CFR 264.94) (c) | Community Water Supply System (g) | Human Health | Other Standards for Domestic Water Supply | Irrigation Use |
| pH | Field Parameter | 6.5-8.5* | | | | | | | 6.0-9.0 | 6.0-9.0 |
| Total Dissolved Solids | Indicator | 500,000 ug/l* | | | | | | | 1,000,000 ug/l | 1,000,000 ug/l |
| Carbonate | Anion | | | | | | | | | |
| Chloride | Anion | 250,000 ug/l* | | | | | | | 250,000 ug/l | 250,000 ug/l |
| Fluoride | Anion | 4,000 ug/l, 2,000 ug/l* | | 4,000 ug/l | | | 4,000 ug/l | 1,600 ug/l | | 1,600 ug/l |
| N as Nitrate | Anion | 10,000 ug/l | | | 10,000 ug/l | | 10,000 ug/l | 10,000 ug/l | | 10,000 ug/l |
| N as Nitrate + Nitrite | Anion | | 10,000 ug/l | | 10,000 ug/l | | | | | |
| N as Nitrite | Anion | | 1,000 ug/l | | 1,000 ug/l | | | | | |
| Potassium | Anion | | | | | | | | | |
| Sulfate | Anion | 250,000 ug/l* | | | | | | | 600,000 ug/l | 600,000 ug/l |
| Aluminum | Metal | | 0.50 to 200 ug/l* | | | | | | | 5,000 ug/l |
| Antimony | Metal | | | | | | | | | |
| Arsenic | Metal | 50 ug/l | | | | 50 ug/l | 50 ug/l | 100 ug/l | | 100 ug/l |
| Arsenic III | Metal | | | | | | | | | |
| Arsenic V | Metal | | | | | | | | | |
| Barium | Metal | 1,000 ug/l | 2,000 ug/l(e) | | 2,000 ug/l(e) | 1,000 ug/l | 1,000 ug/l | 1,000 ug/l | | 1,000 ug/l |
| Beryllium | Metal | | | | | | | | | |
| Boron | Metal | | | | | | | | | 750 ug/l |
| Cadmium | Metal | 10 ug/l | 5 ug/l | | 5 ug/l | 10 ug/l | 10 ug/l | 10 ug/l | | 10 ug/l |
| Calcium | Metal | | | | | | | | | |
| Chromium | Metal | 50 ug/l | 100 ug/l | | 100 ug/l | 50 ug/l | 50 ug/l | 50 ug/l | | 50 ug/l |
| Chromium III | Metal | | | | | | | | | |

# TABLE 19-2
## (Continued)

| Parameter | Type | FEDERAL STANDARDS | | | | | STATE STANDARDS | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | NM WQCC Groundwater Quality Standards (d) | | | |
| | | SDWA Maximum Contaminant Level (a) | SDWA Maximum Contaminant Level TBCs (b) | SDWA Maximum Contaminant Level Goal (a) | SDWA Maximum Contaminant Level Goal TBCs (b) | RCRA Subpart F Concentration Limit (40 CFR 264.94) (c) | Community Water Supply System (g) | Human Health | Other Standards for Domestic Water Supply | Irrigation Use |
| Chromium VI | Metal | | | | | | | | | |
| Cobalt | Metal | | | | | | | | | 50 ug/l |
| Copper | Metal | 1,000 ug/l* | | | 1,300 ug/l(f) | | | | 1,000 ug/l | 1,000 ug/l |
| | | 1,300 ug/l*** | | | | | | | | |
| Cyanide | Metal | | | | | | | 200 ug/l | | 200 ug/l |
| Iron | Metal | 300 ug/l* | | | | | | | 1,000 ug/l | 1,000 ug/l |
| Lead | Metal | 50 ug/l | | | 0(f) | 50 ug/l | 50 ug/l | 50 ug/l | | 50 ug/l |
| | | 15 ug/l*** | | | | | | | | |
| Magnesium | Metal | | | | | | | | | |
| Manganese | Metal | 50 ug/l* | | | | | | | 200 ug/l | 200 ug/l |
| Mercury | Metal | 2 ug/l | 2 ug/l | | 2 ug/l | 2 ug/l | 2 ug/l | 2 ug/l | | 2 ug/l |
| Molybdenum | Metal | | | | | | | | | 1,000 ug/l |
| Nickel | Metal | | | | | | | | | 200 ug/l |
| Selenium | Metal | 10 ug/l | 50 ug/l | | 50 ug/l | 10 ug/l | 10 ug/l | 50 ug/l | | 50 ug/l |
| Silver | Metal | 50 ug/l, 100 ug/l* | 100 ug/l | | | 50 ug/l | 50 ug/l | 50 ug/l | | 50 ug/l |
| Sodium | Metal | | | | | | | | | |
| Thallium | Metal | | | | | | | | | |
| Tin | Metal | | | | | | | | | |
| Titanium | Metal | | | | | | | | | |
| Tungsten | Metal | | | | | | | | | |
| Vanadium | Metal | | | | | | | | | |
| Zinc | Metal | 5,000 ug/l* | | | | | | | 10,000 ug/l | 10,000 ug/l |
| Gross Alpha | Radionuclide | 15 pCi/l | | | | | | | | |
| 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 ug/l | | 5,000 ug/l |

## TABLE 19-2
## (Continued)

| Parameter | Type | FEDERAL STANDARDS | | | | | STATE STANDARDS | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | NM WQCC Groundwater Quality Standards (d) | | | |
| | | SDWA Maximum Contaminant Level (a) | SDWA Maximum Contaminant Level TBCs (b) | SDWA Maximum Contaminant Level Goal (a) | SDWA Maximum Contaminant Level Goal TBCs (b) | RCRA Subpart F Concentration Limit (40 CFR 264.94) (c) | Community Water Supply System (g) | Human Health | Other Standards for Domestic Water Supply | Irrigation Use |
| 1,1-Dichloroethane | Volatile | | | | | | | 25 ug/l | | 25 ug/l |
| 1,1-Dichloroethene | Volatile | 7 ug/l | | 7 ug/l | | | 7 ug/l | 5 ug/l | | 5 ug/l |
| 1,1,1-Trichloroethane | Volatile | 200 ug/l | | 200 ug/l | | | 200 ug/l | 60 ug/l | | 60 ug/l |
| 1,1,2,2-Tetrachloroethane | Volatile | | | | | | | 10 ug/l | | 10 ug/l |
| 1,1,2,2-Tetrachloroethylene | Volatile | | | | | | | 20 ug/l | | 20 ug/l |
| 1,1,2-Trichloroethane | Volatile | | | | | | | 10 ug/l | | 10 ug/l |
| 1,1,2-Trichloroethylene | Volatile | | | | | | | 100 ug/l | | 100 ug/l |
| 1,2-Dichloroethane | Volatile | 5 ug/l | | 0 ug/l | | | 5 ug/l | 10 ug/l | | 10 ug/l |
| 1,2-Dichloroethene | Volatile | | | | | | | | | |
| 1,2-Dichloropropane | Volatile | | 5 ug/l | | 0 ug/l | | | | | |
| 2,5,9-Trimethyl-decane | Volatile | | | | | | | | | |
| 2,6-Dimethyl-heptadecane | Volatile | | | | | | | | | |
| 2,6,7-Trimethyl-decane | Volatile | | | | | | | | | |
| 2,7,10-Trimethyl-heptadecane | Volatile | | | | | | | | | |
| 4-Methyl-2-pentanone | Volatile | | | | | | | | | |
| 7-Methyl-tridecane | Volatile | | | | | | | | | |
| 4-Propylheptane | Volatile | | | | | | | | | |
| Acetone | Volatile | | | | | | | | | |
| Benzene | Volatile | 5 ug/l | | 0 ug/l | | | 5 ug/l | 10 ug/l | | 10 ug/l |
| Benzo(a)anthracene | Volatile | | | | | | | | | |
| Benzo(a)pyrene | Volatile | | | | | | | 0.7 ug/l | | 0.7 ug/l |
| Benzo(b)fluoranthene | Volatile | | | | | | | | | |
| Benzo(g,h,i)perylene | Volatile | | | | | | | | | |
| Benzo(k)fluoranthene | Volatile | | | | | | | | | |
| Bromodichloromethane | Volatile | | | | | | | | | |
| Bromoform | Volatile | | | | | | | | | |
| Bromomethane | Volatile | | | | | | | | | |
| Chlorobenzene (mono) | Volatile | | 100 ug/l | | 100 ug/l | | | | | |

## TABLE 19-2
## (Continued)

| Parameter | Type | FEDERAL STANDARDS | | | | | STATE STANDARDS | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | NM WQCC Groundwater Quality Standards (d) | | | |
| | | SDWA Maximum Contaminant Level (a) | SDWA Maximum Contaminant Level TBCs (b) | SDWA Maximum Contaminant Level Goal (a) | SDWA Maximum Contaminant Level Goal TBCs (b) | RCRA Subpart F Concentration Limit (40 CFR 264.94) (c) | Community Water Supply System (g) | Human Health | Other Standards for Domestic Water Supply | Irrigation Use |
| Chlorobenzilate | Volatile | | | | | | | | | |
| Chloroethane | Volatile | | | | | | | | | |
| Chloroform | Volatile | Tot THM** <100 ug/l | | | | | Tot THM** 100 ug/l | 100 ug/l | | 100 ug/l |
| Chloroprene | Volatile | | | | | | | | | |
| Chloromethane | Volatile | | | | | | | | | |
| Cis-1,2-Dichloroethylene | Volatile | | 70 ug/l | | 70 ug/l | | | | | |
| Cis-1,3-Dichloropropene | Volatile | | | | | | | | | |
| Dibromochloromethane | Volatile | | | | | | | | | |
| Ethyl Benzene | Volatile | | 700 ug/l | | 700 ug/l | | | 750 ug/l | | 750 ug/l |
| Fluoranthene | Volatile | | | | | | | | | |
| Halomethanes | Volatile | 100 ug/l | | | | | | | | |
| Indeno(1,2,3-cd)pyrene | Volatile | | | | | | | | | |
| Methylene Chloride | Volatile | | | | | | | 100 ug/l | | 100 ug/l |
| Phenanthrene | Volatile | | | | | | | | | |
| Phenol | Volatile | | | | | | 5 ug/l | | 5 ug/l | 5 ug/l |
| Polynuclear Aromatic Hydrocarbons (total PAH) | Volatile | | | | | | 30 ug/l | 30 ug/l | | 30 ug/l |
| Pyrene | Volatile | | | | | | | | | |
| Styrene | Volatile | | 100 ug/l | | 100 ug/l | | | | | |
| Tetrachloroethanes | Volatile | | | | | | | | | |
| Tetrachloroethene | Volatile | | 5 ug/l | | 0 ug/l | | 10 ug/l | | | |
| Toluene | Volatile | | 1,000 ug/l | | 1,000 ug/l | | | 750 ug/l | | 750 ug/l |
| Total Xylenes | Volatile | | 10,000 ug/l | | 10,000 ug/l | | | 620 ug/l | | 620 ug/l |
| Trans-1,2-Dichloroethene | Volatile | | 100 ug/l | | 100 ug/l | | | | | |
| Trans-1,3-Dichloropropene | Volatile | | | | | | | | | |
| Trichloroethanes | Volatile | | | | | | | | | |
| Trichloroethene | Volatile | 5 ug/l | | 0 ug/l | | | 5 ug/l | | | |

## TABLE 19-2
## (Continued)

| Parameter | Type | FEDERAL STANDARDS | | | | | STATE STANDARDS | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | NM WQCC Groundwater Quality Standards (d) | | | |
| | | SDWA Maximum Contaminant Level (a) | SDWA Maximum Contaminant Level TBCs (b) | SDWA Maximum Contaminant Level Goal (a) | SDWA Maximum Contaminant Level Goal TBCs (b) | RCRA Subpart F Concentration Limit (40 CFR 264.94) (c) | Community Water Supply System (g) | Human Health | Other Standards for Domestic Water Supply | Irrigation Use |
| Vinyl Acetate | Volatile | | | | | | | | | |
| Vinyl Chloride | Semi-Volatile | 2 ug/l | | | 0 ug/l | | 2 ug/l | 1 ug/l | | 1 ug/l |
| 1,2-Dichlorobenzene (ortho) | Semi-Volatile | | 600 ug/l | | 600 ug/l | | | | | |
| 1,3-Dichlorobenzene (meta) | Semi-Volatile | | | | | | | | | |
| 1,4-Dichlorobenzene (para) | Semi-Volatile | 75 ug/l | | 75 ug/l | | | 75 ug/l | | | |
| 1,2,4-Trichlorobenzene | Semi-Volatile | | | | | | | | | |
| 2-Chloronaphthalene | Semi-Volatile | | | | | | | | | |
| 2-Chlorophenol | Semi-Volatile | | | | | | | | | |
| 2-Methylnaphthalene | Semi-Volatile | | | | | | | | | |
| 2-Nitroaniline | Semi-Volatile | | | | | | | | | |
| 2-Nitrophenol | Semi-Volatile | | | | | | | | | |
| 2,4-Dichlorophenol | Semi-Volatile | | | | | | | | | |
| 2,4-Dichlorophenoxyacetic Acid (2,4-D) | Semi-Volatile (H) | 100 ug/l | 70 ug/l | | 70 ug/l | 100 ug/l | 100 ug/l | | | |
| 2,4-Dimethylphenol | Semi-Volatile | | | | | | | | | |
| 2,4-Dinitrophenol | Semi-Volatile | | | | | | | | | |
| 2,4-Dinitrotoluene | Semi-Volatile | | | | | | | | | |
| 2,4,5-TP Silvex | Semi-Volatile (H) | 10 ug/l | 50 ug/l | | 50 ug/l | 10 ug/l | 10 ug/l | | | |
| 2,4,6-Trichlorophenol | Semi-Volatile | | | | | | | | | |
| 3-Nitroaniline | Semi-Volatile | | | | | | | | | |
| 4-Bromophenyl Phenylether | Semi-Volatile | | | | | | | | | |
| 4-Chloroaniline | Semi-Volatile | | | | | | | | | |
| 4-Chlorophenyl Phenyl Ether | Semi-Volatile | | | | | | | | | |
| 4-Chloro-3-methylphenol | Semi-Volatile | | | | | | | | | |
| 4-Nitroaniline | Semi-Volatile | | | | | | | | | |
| 4,6-Dinitro-2-methylphenol | Semi-Volatile | | | | | | | | | |
| Acenaphthalene | Semi-Volatile | | | | | | | | | |
| Acetone | Semi-Volatile | | | | | | | | | |
| Acrylonitrile | Semi-Volatile | | | | | | | | | |

# TABLE 19-2
## (Continued)

| Parameter | Type | FEDERAL STANDARDS | | | | | STATE STANDARDS | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | NM WQCC Groundwater Quality Standards (d) | | | |
| | | SDWA Maximum Contaminant Level (a) | SDWA Maximum Contaminant Level TBCs (b) | SDWA Maximum Contaminant Level Goal (a) | SDWA Maximum Contaminant Level Goal TBCs (b) | RCRA Subpart F Concentration Limit (40 CFR 264.94) (c) | Community Water Supply System (g) | Human Health | Other Standards for Domestic Water Supply | Irrigation Use |
| Aldicarb | Semi-Volatile (P) | | 3 ug/l(e) | | 1 ug/l(e) | | | | | |
| Aldrin | Semi-Volatile (P) | | | | | | | | | |
| Aniline | Semi-Volatile | | | | | | | | | |
| Anthracene | Semi-Volatile | | | | | | | | | |
| Atrazine | Semi-Volatile | | 3 ug/l | | 3 ug/l | | | | | |
| Benzyl Alcohol | Semi-Volatile | | | | | | | | | |
| Bis(2-Chloroethoxy)methane | Semi-Volatile | | | | | | | | | |
| Bis(2-Chloroethyl)ether | Semi-Volatile | | | | | | | | | |
| Bis(2-Chloroisopropyl)ether | Semi-Volatile | | | | | | | | | |
| Bis(2-Ethylhexyl)phthalate | Semi-Volatile | | | | | | | | | |
| Butyl Benzylphthalate | Semi-Volatile | | | | | | | | | |
| Carbofuran | Semi-Volatile (P) | | 40 ug/l | | 40 ug/l | | | | | |
| Carbon Disulfide | Semi-Volatile | | | | | | | | | |
| Carbon Tetrachloride | Semi-Volatile | 5 ug/l | | 0 ug/l | | | 5 ug/l | 10 ug/l | | 10 ug/l |
| Chlorinated Benzenes | Semi-Volatile | | | | | | | | | |
| Chlorinated Naphthalenes | Semi-Volatile | | | | | | | | | |
| Chlordane | Semi-Volatile (P) | | 2 ug/l | | 0 ug/l | | | | | |
| Chlorophenol | Semi-Volatile | | | | | | | | | |
| DDT | Semi-Volatile (P) | | | | | | | | | |
| DDT metabolite (DDE) | Semi-Volatile (P) | | | | | | | | | |
| DDT metabolite (DDD) | Semi-Volatile (P) | | | | | | | | | |
| Diallite | Semi-Volatile | | | | | | | | | |
| Dibenzofuran | Semi-Volatile | | | | | | | | | |
| Dibenz(a,h)anthracene | Semi-Volatile | | | | | | | | | |
| Dichlorobenzene | Semi-Volatile | | | | | | | | | |
| Dichlorobenzidine | Semi-Volatile | | | | | | | | | |
| Dichloroethenes | Semi-Volatile | | | | | | | | | |
| Dieldrin | Semi-Volatile (P) | | | | | | | | | |

## TABLE 19-2
## (Continued)

| Parameter | Type | FEDERAL STANDARDS | | | | | STATE STANDARDS | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | NM WQCC Groundwater Quality Standards (d) | | | |
| | | SDWA Maximum Contaminant Level (a) | SDWA Maximum Contaminant Level TBCs (b) | SDWA Maximum Contaminant Level Goal (a) | SDWA Maximum Contaminant Level Goal TBCs (b) | RCRA Subpart F Concentration Limit (40 CFR 264.94) (c) | Community Water Supply System (g) | Human Health | Other Standards for Domestic Water Supply | Irrigation Use |
| Diethylphthalate | Semi-Volatile | | | | | | | | | |
| Dimethoate | Semi-Volatile | | | | | | | | | |
| Dimethylphthalate | Semi-Volatile | | | | | | | | | |
| Dinitrotoluene | Semi-Volatile | | | | | | | | | |
| Di-n-octylphthalate | Semi-Volatile | | | | | | | | | |
| Dioxin | Semi-Volatile | | | | | | | | | |
| Endosulfan I | Semi-Volatile (P) | | | | | | | | | |
| Endosulfan II | Semi-Volatile (P) | | | | | | | | | |
| Endosulfan Sulfate | Semi-Volatile (P) | | | | | | | | | |
| Endrin | Semi-Volatile (P) | 0.2 ug/l | | | | 0.2 ug/l | 0.2 ug/l | | | |
| Ethylene Dibromide | Semi-Volatile | | .05 ug/l | | 0 ug/l | | | 0.1 ug/l | | 0.1 ug/l |
| Fluorene | Semi-Volatile | | | | | | | | | |
| Heptachlor | Semi-Volatile (P) | | 0.4 ug/l | | 0 ug/l | | | | | |
| Heptachlor Epoxide | Semi-Volatile (P) | | 0.2 ug/l | | 0 ug/l | | | | | |
| Hexachlorobenzene | Semi-Volatile | | | | | | | | | |
| Hexachlorobutadiene | Semi-Volatile | | | | | | | | | |
| Hexachlorocyclopentadiene | Semi-Volatile | | | | | | | | | |
| Hexachlorocyclohexane, Alpha | Semi-Volatile (P) | | | | | | | | | |
| Hexachlorocyclohexane, Beta | Semi-Volatile (P) | | | | | | | | | |
| Hexachlorocyclohexane, (Lindane) | Semi-Volatile (P) | 4 ug/l | 0.2 ug/l | | 0.2 ug/l | 4 ug/l | 4 ug/l | | | |
| Hexachlorocyclohexane, Technical | Semi-Volatile (P) | | | | | | | | | |
| Hexachloroethane | Semi-Volatile | | | | | | | | | |
| Methoxychlor | Semi-Volatile (P) | 100 ug/l | 40 ug/l | | 40 ug/l | 100 ug/l | 100 ug/l | | | |
| Naphthalene | Semi-Volatile | | | | | | | | | |
| Nitrobenzene | Semi-Volatile | | | | | | | | | |
| Nitrophenols | Semi-Volatile | | | | | | | | | |
| Nitrosamines | Semi-Volatile | | | | | | | | | |
| Nitrosodibutylamine | Semi-Volatile | | | | | | | | | |

## TABLE 19-2
## (Concluded)

| Parameter | Type | FEDERAL STANDARDS | | | | | STATE STANDARDS NM WQCC Groundwater Quality Standards (d) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | SDWA Maximum Contaminant Level (a) | SDWA Maximum Contaminant Level TBCs (b) | SDWA Maximum Contaminant Level Goal (a) | SDWA Maximum Contaminant Level Goal TBCs (b) | RCRA Subpart F Concentration Limit (40 CFR 264.94) (c) | Community Water Supply System (g) | Human Health | Other Standards for Domestic Water Supply | Irrigation Use |
| Nitrosodiethylamine | Semi-Volatile | | | | | | | | | |
| Nitrosodimethylamine | Semi-Volatile | | | | | | | | | |
| Nitrosopyrrolidine | Semi-Volatile | | | | | | | | | |
| N-Nitrosodiphenylamine | Semi-Volatile | | | | | | | | | |
| N-Nitroso-di-n-dipropylamine | Semi-Volatile | | | | | | | | | |
| Pentachlorinated Ethanes | Semi-Volatile | | | | | | | | | |
| Pentachlorophenol | Semi-Volatile | | 1 ug/l(e) | | 0 ug/l(e) | | | | | |
| Toxaphene | Semi-Volatile (P) | | 3 ug/l | | 0 ug/l | 5 ug/l | 5 ug/l | | | |
| PCBs | PCBs | | 0.5 ug/l | | 0 ug/l | | | 1 ug/l | | 1 ug/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 12/7/93
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 5/1990)
(b) EPA National Primary and Secondary Drinking Water Regulations, 40 CFR Parts 141, 142, 143, Final Rule, Effective July 30, 1992 (56 Federal Register 3526; 1/30/91)
(c) NCP, 40 CFR 300; NCP Preamble 55 FR 8764; CERCLA Compliance with Other Laws Manual EPA/540/G-89/006, August 1988
(d) NM Water Quality Control Commission, NM Water Quality Regulations, Part 3, Section 3-103, 11/16/1967 amended through August 17, 1991
(e) EPA National Primary and Secondary Drinking Water Regulations, 40 CFR Parts 141, 142, 143, Final Rule, Effective January 1, 1993 (56 FR 30266, 7/01/91)
(f) EPA Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper, 40 CFR 141 and 142; effective November 6, 1991 (56 FR 26460, 6/7/91)
(g) 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 19-3

## POTENTIAL SITE-WIDE CHEMICAL-SPECIFIC ARARs
## SURFACE WATER QUALITY STANDARDS (ug/l, unless otherwise noted)
## CANNON AFB

| Parameter | Type | FEDERAL CRITERIA | | STATE STANDARDS* | |
|---|---|---|---|---|---|
| | | CWA AWQC for Protection of Aquatic Life (a) | | Attainable or Designated Uses | |
| | | Acute Value | Chronic Value | Irrigation | Livestock and Wildlife Watering |
| pH | Field Parameter | | 6.5-9 | | |
| Dissolved Oxygen | Field Parameter | 5,000 | | | |
| Fecal Coliform | Indicator | | | 1000/100ml (6) | |
| Total Dissolved Solids | Indicator | ss | ss | | |
| Turbidity | Indicator | | | | |
| Carbonate | Anion | | | | |
| Chloride | Anion | 860,000 (b)(5) | 230,000 (b)(5) | | |
| Chlorine | Anion | 19 | 11 | | |
| Fluoride | Anion | | | | |
| N as Nitrate | Anion | | | | |
| N as Nitrate+Nitrite | Anion | | | | |
| N as Nitrite | Anion | | | | |
| Potassium | Anion | | | | |

## TABLE 19-3
## (Continued)

| Parameter | Type | FEDERAL CRITERIA | | STATE STANDARDS* | |
|---|---|---|---|---|---|
| | | CWA AWQC for Protection of Aquatic Life (a) | | Attainable or Designated Uses | |
| | | Acute Value | Chronic Value | Irrigation | Livestock and Wildlife Watering |
| Sulfate | Anion | | | | |
| Aluminum | Metal | 750 | 87 | 5,000 | 5,000 |
| Antimony | Metal | 9,000 | 1,600 | | |
| Arsenic | Metal | | | 100 | 20 |
| Arsenic III | Metal | 360 | 190 | | |
| Arsenic V | Metal | 850 | 48 | | |
| Barium | Metal | | | | |
| Beryllium | Metal | 130 | 5.3 | | |
| Boron | Metal | | | 750 | 5,000 |
| Cadmium | Metal | 3.9(3) | 1.1(3) | 10 | 50 |
| Calcium | Metal | | | | |
| Chromium | Metal | | | 100 | 1,000 |
| Chromium III | Metal | 1,700 | 210 | | |
| Chromium VI | Metal | 16 | 11 | | |
| Cobalt | Metal | | | 50 | 1,000 |
| Copper | Metal | 18 (3) | 12(3) | 200 | 500 |

**TABLE 19-3**
**(Continued)**

| Parameter | Type | FEDERAL CRITERIA | | STATE STANDARDS* | |
|---|---|---|---|---|---|
| | | CWA AWQC for Protection of Aquatic Life (a) | | Attainable or Designated Uses | |
| | | Acute Value | Chronic Value | Irrigation | Livestock and Wildlife Watering |
| Cyanide | Metal | 22 | 5.2 | | |
| Iron | Metal | | 1,000 | | |
| Lead | Metal | 82 (3) | 3.2 (3) | 5,000 | 100 |
| Magnesium | Metal | | | | |
| Manganese | Metal | | | | |
| Mercury | Metal | 2.4 | .012 | | 10 |
| Molybdenum | Metal | | | | |
| Nickel | Metal | 1,400 (3) | 160 (3) | | |
| Selenium | Metal | 20 (c) | 5(c) | 130/250(7) | 50 |
| Silver | Metal | 4.1 (3) | .120 | | |
| Sodium | Metal | | | | |
| Thallium | Metal | 1,400 (1) | 40 (1) | | |
| Tin | Metal | | | | |
| Titanium | Metal | | | | |
| Tungsten | Metal | | | | |
| Vanadium | Metal | | | 100 | 100 |

**TABLE 19-3**
**(Continued)**

| Parameter | Type | FEDERAL CRITERIA | | STATE STANDARDS* | |
|---|---|---|---|---|---|
| | | CWA AWQC for Protection of Aquatic Life (a) | | Attainable or Designated Uses | |
| | | Acute Value | Chronic Value | Irrigation | Livestock and Wildlife Watering |
| Zinc | Metal | 120(3) | 110 (3) | 2,000 | 25,000 |
| Gross Alpha | Radionuclide | | | | |
| Gross Beta | Radionuclide | | | | |
| Radium 226+228 | Radionuclide | | | | 30 pCi/l |
| Strontium 90 | Radionuclide | | | | |
| Tritium | Radionuclide | | | | |
| Uranium (total) | Radionuclide | | | | |
| 1,1-Dichloroethane | Volatile | | | | |
| 1,1-Dichloroethene | Volatile | | | | |
| 1,1,1-Trichloroethane | Volatile | | | | |
| 1,1,2,2-Tetrachloroethane | Volatile | | 2,400 (1) | | |
| 1,1,2,2-Tetrachloroethylene | Volatile | | | | |
| 1,1,2-Trichloroethane | Volatile | | 9,400 (1) | | |
| 1,1,2-Trichloroethylene | Volatile | | | | |
| 1,2-Dichloroethane | Volatile | 118,000 (1) | 20,000 (1) | | |
| 1,2-Dichloroethene (total) | Volatile | | | | |

## TABLE 19-3
## (Continued)

| Parameter | Type | FEDERAL CRITERIA | | STATE STANDARDS* | |
|---|---|---|---|---|---|
| | | CWA AWQC for Protection of Aquatic Life (a) | | Attainable or Designated Uses | |
| | | Acute Value | Chronic Value | Irrigation | Livestock and Wildlife Watering |
| 1,2-Dichloropropane | Volatile | 23,000 (1) | 5,700 (1) | | |
| 2,5,9-Trimethyl-decane | Volatile | | | | |
| 2,6-Dimethyl-heptadecane | Volatile | | | | |
| 2,6,7-Trimethyl-decane | Volatile | | | | |
| 2,7,10-Trimethyl-heptadecane | Volatile | | | | |
| 4-Methyl-2-pentanone | Volatile | | | | |
| 7-Methyl-tridecane | Volatile | | | | |
| 4-Propylheptane | Volatile | | | | |
| Acetone | Volatile | | | | |
| Benzene | Volatile | 5,300 (1) | | | |
| Benzo(a)anthracene | Volatile | | | | |
| Benzo(a)pyrene | Volatile | | | | |
| Benzo(b)fluoranthene | Volatile | | | | |
| Benzo(g,h,i)perylene | Volatile | | | | |
| Benzo(k)fluoranthene | Volatile | | | | |
| Bromodichloromethane | Volatile | | | | |

**TABLE 19-3**
**(Continued)**

| Parameter | Type | FEDERAL CRITERIA | | STATE STANDARDS* | |
|---|---|---|---|---|---|
| | | CWA AWQC for Protection of Aquatic Life (a) | | Attainable or Designated Uses | |
| | | Acute Value | Chronic Value | Irrigation | Livestock and Wildlife Watering |
| Bromoform | Volatile | | | | |
| Bromomethane | Volatile | | | | |
| Carbon Tetrachloride | Volatile | 35,200 (1) | | | |
| Chlorinated Benzenes | Volatile | 250 (1) | 50 (1) | | |
| Chlorobenzene (mono) | Volatile | | | | |
| Chlorobenzilate | Volatile | | | | |
| Chloroethane | Volatile | | | | |
| Chloroform | Volatile | 28,900 (1) | 1,240 (4) | | |
| Chloromethane | Volatile | | | | |
| cis-1,2-Dichloroethylene | Volatile | | | | |
| cis-1,3-Dichloropropene | Volatile | 6,060 (1) | 244(1) | | |
| Dibromochloromethane | Volatile | | | | |
| Ethyl Benzene | Volatile | 32,000 (1) | | | |
| Fluoranthene | Volatile | 3,980 (1) | | | |
| Haloethers | Volatile | 380 (1) | 122 (1) | | |
| Halomethanes | Volatile | 11,000 (1) | | | |
| Indeno(1,2,3-cd)pyrene | Volatile | | | | |

## TABLE 19-3
## (Continued)

| Parameter | Type | FEDERAL CRITERIA | | STATE STANDARDS* | |
|---|---|---|---|---|---|
| | | CWA AWQC for Protection of Aquatic Life (a) | | Attainable or Designated Uses | |
| | | Acute Value | Chronic Value | Irrigation | Livestock and Wildlife Watering |
| Methylene Chloride | Volatile | | | | |
| Phenanthrene | Volatile | | | | |
| Phenol | Volatile | 10,200 (1) | 2,560 (1) | | |
| Polynuclear Aromatic Hydrocarbons (total PAH) | Volatile | | | | |
| Pyrene | Volatile | | | | |
| Styrene | Volatile | | | | |
| Tetrachloroethanes | Volatile | 9,320 (1) | | | |
| Tetrachloroethene | Volatile | 5, 280 (1) | 840(1) | | |
| Toluene | Volatile | 17,500 (1) | | | |
| Total Xylenes | Volatile | | | | |
| Trans-1,2-Dichloroethene | Volatile | | | | |
| Trans-1,3-Dichloropropene | Volatile | 6,060 (1) | 244(1) | | |
| Trichloroethanes | Volatile | 18,000 (1) | | | |
| Trichloroethene (TCE) | Volatile | 45,000 (1) | 21,900(1) | | |
| Vinyl Acetate | Volatile | | | | |
| Vinyl Chloride | Volatile | | | | |
| 1,2-Dichlorobenzene (ortho) | Semi-Volatile | | | | |
| 1,3-Dichlorobenzene (meta) | Semi-Volatile | | | | |
| 1,4-Dichlorobenzene (para) | Semi-Volatile | | | | |
| 1,2,4-Trichlorobenzene | Semi-Volatile | | | | |
| 2-Chloronaphthalene | Semi-Volatile | | | | |

**TABLE 19-3**
**(Continued)**

| Parameter | Type | FEDERAL CRITERIA | | STATE STANDARDS* | |
|---|---|---|---|---|---|
| | | CWA AWQC for Protection of Aquatic Life (a) | | Attainable or Designated Uses | |
| | | Acute Value | Chronic Value | Irrigation | Livestock and Wildlife Watering |
| 2-Chlorophenol | Semi-Volatile | 4,360 (1) | 2,000(1) | | |
| 2-Methylnaphthalene | Semi-Volatile | | | | |
| 2-Nitroaniline | Semi-Volatile | | | | |
| 2-Nitrophenol | Semi-Volatile | | | | |
| 2,4-Dichlorophenol | Semi-Volatile | 2,020 (1) | 365(1) | | |
| 2,4-Dichlorophenoxyacetic Acid (2,4-D) | Semi-Volatile (H) | | | | |
| 2,4-Dimethylphenol | Semi-Volatile | 2,120 (1) | | | |
| 2,4-Dinitrophenol | Semi-Volatile | | | | |
| 2,4-Dinitrotoluene | Semi-Volatile | | | | |
| 2,4,5-TP Silvex | Semi-Volatile (H) | | | | |
| 2,4,5-Trichlorophenol | Semi-Volatile | | | | |
| 2,4,6-Trichlorophenol | Semi-Volatile | | 970(1) | | |
| 3-Nitroaniline | Semi-Volatile | | | | |
| 4-Bromophenyl Phenylether | Semi-Volatile | | | | |
| 4-Chloroaniline | Semi-Volatile | | | | |
| 4-Chlorophenyl Phenyl Ether | Semi-Volatile | | | | |
| 4-Chloro-3-methylphenol | Semi-Volatile | 30 (1) | | | |
| 4-Nitroaniline | Semi-Volatile | | | | |
| 4-Nitrophenol | Semi-Volatile | 230 (1) | 150 (1) | | |
| 4,6-Dinitro-2-methylphenol | Semi-Volatile | | | | |
| Acenaphthalene | Semi-Volatile | 1,700 (1) | 520(1) | | |
| Acetone | Semi-Volatile | | | | |

**TABLE 19-3**
**(Continued)**

| Parameter | Type | FEDERAL CRITERIA | | STATE STANDARDS* | |
|---|---|---|---|---|---|
| | | CWA AWQC for Protection of Aquatic Life (a) | | Attainable or Designated Uses | |
| | | Acute Value | Chronic Value | Irrigation | Livestock and Wildlife Watering |
| Acrylonitrile | Semi-Volatile | 7,500 | 2,600 | | |
| Aldrin | Semi-Volatile (P) | 3.0 | | | |
| Aldicarb | Semi-Volatile (P) | | | | |
| Aniline | Semi-Volatile | | | | |
| Anthracene | Semi-Volatile | | | | |
| Atrazine | Semi-Volatile | | | | |
| Benzidine | Semi-Volatile | 2,500 | | | |
| Benzyl Alcohol | Semi-Volatile | | | | |
| bis(2-Chloroethoxy)methane | Semi-Volatile | | | | |
| bis(2-Chloroethyl)ether | Semi-Volatile | | | | |
| bis(2-Chloroisopropyl)ether | Semi-Volatile | | | | |
| bis(2-Ethylhexyl)phthalate | Semi-Volatile | | | | |
| Butyl Benzylphthalate | Semi-Volatile | | | | |
| Carbofuran | Semi-Volatile (P) | | | | |
| Carbon Disulfide | Semi-Volatile | | | | |
| Chlorinated Benzenes | Semi-Volatile | 250 | 50 | | |
| Chlorinated Ethers | Semi-Volatile | | | | |
| Chlorinated Naphthalenes | Semi-Volatile | 1,600 (1) | | | |
| Chloroalkylethers | Semi-Volatile | 238,000 (1) | | | |
| Chlordane | Semi-Volatile (P) | 2.4 | .0043 | | |
| Chlorophenol | Semi-Volatile | | | | |
| DDT | Semi-Volatile (P) | 1.1 | .0011 | | |
| DDT metabolite (DDE) | Semi-Volatile (P) | 1,050 | | | |

## TABLE 19-3
## (Continued)

| Parameter | Type | FEDERAL CRITERIA: CWA AWQC for Protection of Aquatic Life (a) | | STATE STANDARDS*: Attainable or Designated Uses | |
|---|---|---|---|---|---|
| | | Acute Value | Chronic Value | Irrigation | Livestock and Wildlife Watering |
| DDT metabolite (DDD) | Semi-Volatile (P) | 0.06 | | | |
| Diallite | Semi-Volatile | | | | |
| Dibenzofuran | Semi-Volatile | | | | |
| Dibenz(a,h)anthracene | Semi-Volatile | | | | |
| Dichlorobenzenes | Semi-Volatile | 1,120 | 763(1) | | |
| Dichlorobenzidine | Semi-Volatile | | | | |
| Dichloroethenes | Semi-Volatile | 11,600 (1) | | | |
| Dichloromethane | Semi-Volatile | | | | |
| Dieldrin | Semi-Volatile (P) | 2.5 | .0019 | | |
| Diethylphthalate | Semi-Volatile | | | | |
| Dimethylphthalate | Semi-Volatile | | | | |
| Di-n-butylphthalate | Semi-Volatile | | | | |
| Dinitrotoluene | Semi-Volatile | 330 (1) | 230(1) | | |
| Di-n-octylphthalate | Semi-Volatile | | | | |
| Dioxin | Semi-Volatile | 0.01 | .000010 | | |
| Endosulfan I | Semi-Volatile (P) | 0.22 | .056 | | |
| Endosulfan II | Semi-Volatile (P) | | | | |
| Endosulfan Sulfate | Semi-Volatile (P) | | | | |
| Endrin | Semi-Volatile (P) | 0.18 | .0023 | | |
| Ethylene Dibromide | Semi-Volatile | | | | |
| Fluorene | Semi-Volatile | | | | |
| Heptachlor | Semi-Volatile (P) | 0.52 | .0038 | | |
| Heptachlor Epoxide | Semi-Volatile (P) | | | | |

**TABLE 19-3**
**(Continued)**

| Parameter | Type | FEDERAL CRITERIA: CWA AWQC for Protection of Aquatic Life (a) | | STATE STANDARDS*: Attainable or Designated Uses | |
|---|---|---|---|---|---|
| | | Acute Value | Chronic Value | Irrigation | Livestock and Wildlife Watering |
| Hexachlorobenzene | Semi-Volatile | | | | |
| Hexachlorobutadiene | Semi-Volatile | 90 (1) | 9.3 (1) | | |
| Hexachlorocyclohexane, Alpha | Semi-Volatile (P) | | | | |
| Hexachlorocyclohexane, Beta | Semi-Volatile (P) | | | | |
| Hexachlorocyclohexane, (Lindane) Gama | Semi-Volatile (P) | 2.0 | 0.08 | | |
| Hexachlorocyclohexane, Technical | Semi-Volatile (P) | | | | |
| Hexachlorocyclopentadiene | Semi-Volatile | 7 (1) | 5.2 (1) | | |
| Hexachloroethane | Semi-Volatile | 980 (1) | 540 (1) | | |
| Isophorone | Semi-Volatile | 117,000 (1) | | | |
| Methoxychlor | Semi-Volatile (P) | | 0.03 | | |
| Mirex | Semi-Volatile (P) | | .001 | | |
| Naphthalene | Semi-Volatile | 2,300 (1) | 620 (1) | | |
| Nitrobenzene | Semi-Volatile | 27,000 (1) | | | |
| Nitrophenols | Semi-Volatile | 230 (1) | 150(1) | | |
| Nitrosamines | Semi-Volatile | 5,850 (1) | | | |
| Nitrosodibutylamine | Semi-Volatile | | | | |
| Nitrosodiethylamine | Semi-Volatile | | | | |
| Nitrosodimethylamine | Semi-Volatile | | | | |
| Nitrosopyrrolidine | Semi-Volatile | | | | |
| N-Nitrosodiphenylamine | Semi-Volatile | | | | |
| N-Nitroso-di-n-dipropylamine | Semi-Volatile | | | | |
| Parathion | Semi-Volatile | .065 | .013 | | |

## TABLE 19-3
## (Continued)

| Parameter | Type | FEDERAL CRITERIA | | STATE STANDARDS* | |
|---|---|---|---|---|---|
| | | CWA AWQC for Protection of Aquatic Life (a) | | Attainable or Designated Uses | |
| | | Acute Value | Chronic Value | Irrigation | Livestock and Wildlife Watering |
| Pentachlorinated Ethanes | Semi-Volatile | 7,240 (1) | 1,100 (1) | | |
| Pentachlorophenol | Semi-Volatile | 20 (4) | 13 (4) | | |
| Phthalate Esters | Semi-Volatile | 940 (1) | 3 (1) | | |
| Simazine | Semi-Volatile (P) | | | | |
| Toxaphene | Semi-Volatile (P) | 0.73 | .0002 | | |
| PCBs | PCB | 2.0 | 0.014 | | |

EXPLANATION OF TABLE

* = From "Water Quality Standards for Interstate and Intrastate Streams in New Mexico," amended 5/22/91, New Mexico Water Quality Control Commission; effective June 29, 1991.

AWQC = Ambient Water Quality Criteria
CWA = Clean Water Act
SS = species specific
NTU = Nephelometric turbidity units
(P) = Pesticide
(H) = Herbicide

If no values shown for a possible contaminant, there are no standards at this time.

## TABLE 19-3
## (Concluded)

(1) criteria not developed; value presented is lowest observed effects level (LOEL)
(2) Total trihalomethanes: chloroform, bromoform, bromodichloromethane, dibromochloromethane
(3) hardness dependent criteria
(4) pH dependent criteria (7.8 pH used)
(5) Standard is not adequately protective when chloride is associated with potassium, calcium, or magnesium, rather than sodium
(6) Monthly logarithmic mean; no single sample shall exceed 2000/100ml
(7) In presence of >500 mg/l $SO_4$

(a) EPA, Water Quality Criteria for Protection of Aquatic Life, 1986
(b) EPA, National Ambient Water Quality Criteria for Chloride - 1988
(c) EPA, National Ambient Water Quality Criteria for Selenium - 1987

State Standards on Hazardous Substances in Surface Water:

Toxic substances such as, but not limited to, pesticides, herbicides, heavy metals, and organics, shall not be present in receiving waters in concentrations which will change the ecological conditions of receiving waters to an extent detrimental to man or other organisms of direct or indirect commercial, recreational, or aesthetic value. Toxicities of substances in receiving waters will be determined by appropriate bioassay techniques, or other acceptable means, for the particular form of aquatic life which is to be preserved with the concentrations of toxic substances not to exceed 5% of the LC-50 provided that: toxic substances which, through uptake in the aquatic food chain and/or storage in plant and animal tissues can be magnified to levels which are toxic to man or other organisms, shall not be present in concentrations which result in this biological magnification or exceed 1% of the LC-50.

## TABLE 19-4

## POTENTIAL SCREENING CONCENTRATIONS FOR ORGANIC COMPOUNDS IN SOIL TO BE CONSIDERED CANNON AFB

| Compound | RFI Guidance[a] TBCs (mg/kg) | RFI Criteria[b] TBCs (mg/kg) | Proposed RCRA Action Level[c] TBCs (mg/kg) | Proposed RCRA Action Level[d] TBCs | Other TBCs (mg/kg) |
|---|---|---|---|---|---|
| Acetone | 8,000 | 8,000 | 8,000 | 8,000 | -- |
| Benzene | 24 | 24.14 | -- | 24.14 | < 10 ppm[e] |
| Chloroform | 110 | 114.75 | 100 | 114.75 | -- |
| Ethylbenzene | 8,000 | 8,000 | 8,000 | 8,000 | -- |
| Toluene | 20,000 | 16,000 | 20,000 | 16,000 | -- |
| Xylenes (total) | 200,000 | 160,000 | 200,000 | 160,000 | -- |
| BTEX | -- | -- | -- | -- | -- |
| Polynuclear Aromatic Hydrocarbons (PAH) | -- | -- | -- | -- | < 50 ppm[e] |
| TPH | -- | -- | -- | -- | < 100 ppm[e] |
| Methylene Chloride | 93 | 93.33 | 90 | 93.33 | -- |
| 1,1,1-Trichloroethane | 7,000 | 7,200 | 7,000 | 7,200 | -- |
| Trichloroethylene | 64 | 63.64 | 60 | 63.64 | -- |
| Tetrachloroethylene | 140 | 13.73 | 10 | 13.73 | -- |
| PCBs | 0.091 | -- | 0.09 | -- | 1.0 (residential)[f]<br>10-25 (industria)[f]<br>10 (nonrestr. access)[g]<br>25 (restr. access)[g] |

**TABLE 19-4**
**(Concluded)**

| Compound | RFI Guidance[a] TBCs (mg/kg) | RFI Criteria[b] TBCs (mg/kg) | Proposed RCRA Action Level[c] TBCs (mg/kg) | Proposed RCRA Action Level[d] TBCs | Other TBCs (mg/kg) |
|---|---|---|---|---|---|
| Chlordane (alpha- and gamma-) | 0.54 | 0.54 | 0.50 | 0.54 | -- |
| DDD | 2.9 | 2.92 | 3.0 | 2.92 | 13[h] |
| DDT | 40 | 2.06 | 22 | 2.06 | 0.006[h] |
| DDE | 2.1 | 2.06 | 2 | 2.06 | 28[h] |
| 2,4,5-TP, Silvex | 600 | -- | -- | -- | -- |
| Pentachlorophenol | 2,000 | 5.83 | 2,000 | 5.83 | -- |
| Phenol | 3,000 | 48,000 | 50,000 | 48,000 | -- |
| Diethylphthalate | 60,000 | -- | 60,000 | -- | -- |
| Bis(2-ethylhexyl)phthalate | 83 | 50 | 50 | 50 | -- |
| Benzo(a)pyrene | 0.06 | 0.12 | -- | 0.12 | 0.3-220[i] |
| Dibenz(a,h)anthracene | 0.014 | 0.11 | -- | 0.11 | 0.3-220[i] |

[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] Human health proposed criteria; see Table 18-16
[c] Source: Corrective Action for SWMU's at Hazardous Waste Management Facilities (55 FR 30798, 27 July 1990); these risk-based levels trigger the need for a corrective measure study.
[d] Human health proposed action levels; see Table 18-16.
[e] New Mexico Department of Environmental Improvement - New Mexico UST Regulations, amended, July 1990a.
[f] Source: Guidance on Remedial Actions for Superfund Sites with PCB Contamination (EPA OSWER Directive 9355.4-01).
[g] Source: Toxic Substances Control Act. PCB Spill Cleanup Policy (52 FR 10688).
[h] EPA Threshold Contaminant Concentrations from Fitchko (1989).
[i] Range of anthropogenic and naturally occurring total PAH concentrations (Blumer 1977, Mallet 1964).

## TABLE 19-5

## POTENTIAL CLEANUP CONCENTRATIONS FOR INORGANIC COMPOUNDS IN SOIL (TO BE CONSIDERED) CANNON AFB

| Compound | RFI Guidance[a] TBCs (mg/kg) | RFI Criteria[b] TBCs (mg/kg) | Proposed RCRA Action Level[c] TBCs (mg/kg) | Proposed RCRA Action Level[d] TBCs (mg/kg) | Other TBCs (mg/kg) |
|---|---|---|---|---|---|
| Antimony | 30 | 32 | 30 | 32 | -- |
| Arsenic | -- | 0.39 | 80 | 0.39 | -- |
| Barium | 4000 | 5,600 | 4,000 | 5,600 | -- |
| Beryllium | 0.143 | 0.16 | 0.2 | 0.16 | -- |
| Cadmium | -- | 80 | 40 | 80 | -- |
| Chromium | (III) 80,000<br>(VI) 400 | 80,000 | --<br>(VI) 400 | 80,000 | -- |
| Copper | -- | 2,960 | -- | 2,960 | -- |
| Cyanide | 2,000 | -- | 2,000 | -- | -- |
| Lead | -- | -- | -- | -- | 500[e] (residential)<br>1,000[e] (industrial) |
| Mercury | -- | 24 | 20 | 24 | -- |
| Nickel | 2,000 | 1,600 | 2,000 | 1,600 | -- |
| Thallium | 20-40 | 5.6 | 6-7 | 5.6 | -- |
| Selenium | -- | 400 | -- | 400 | -- |
| Silver | 200 | 400 | 200 | 400 | -- |
| Zinc | -- | 16,000 | -- | 16,000 | -- |

[a] RCRA Facility Investigation Guidance (EPA 1989a).
[b] Human health proposed criteria; see Table 19-16.
[c] Source: Corrective Action for SWMUs at Hazardous Waste Management Facilities (55 FR 30798, 27 July 1990).
[d] Human health proposed action levels; see Table 18-16.
[e] Source: EPA OSWER Directive 9355.4-02

## TABLE 19-6

## SUMMARY OF POTENTIAL LOCATION-SPECIFIC ARARS
## CANNON AFB

| Requirement | Applicable? | Relevant and Appropriate? | Comments |
|---|---|---|---|
| Location-Specific Laws/Requirements | | | |
| 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 19-6**
**(Continued)**

| Requirement | Applicable? | Relevant and Appropriate? | Comments |
|---|---|---|---|
| E.O. 11990 Protection of Wetlands | | | |
| 5. Minimizes impacts on areas designated as wetlands. [40 CRF 6, Appendix A] | Possibly | No | Although playas are considered wetlands by the US Fish and Wildlife Service, regulations are applicable only if the project impacts the wetland areas. |
| 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; 33 CFR 320-330] | 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. |
| 7. Requires Federal agencies to avoid, to the extent possible, adverse impacts associated with destruction or loss of wetlands | Possibly | No | As described above, although wetlands are considered by the USFWS to occur on the base in the form of playas, regulations are applicable only if the project impacts the wetland areas. |
| 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] | Possibly | --- | 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 19-6**
**(Continued)**

| Requirement | Applicable? | Relevant and Appropriate? | Comments |
|---|---|---|---|
| Bald and Golden Eagle Protection Act | | | |
| 9. Provides special protection for eagle species. | Possibly | --- | 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). |
| Wilderness Act | | | |
| 10. 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. |
| 11. 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 | | | |
| 12. 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] | Possibly | No | This regulation is applicable only if playas are impacted by remedial activities. |
| Wild and Scenic Rivers Act | | | |
| 13. 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. |

## TABLE 19-6
## (Continued)

| Requirement | Applicable? | Relevant and Appropriate? | Comments |
|---|---|---|---|
| National Historic Preservation Act (NHPA) | | | |
| 14. 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] | Possibly | --- | 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. |
| Coastal Zone Management Act | | | |
| 15. 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) | | | |
| 16. Requires coordination with the Department of Game and Fish if activities impact on endangered/ threatened species or their habitat. | Possibly | --- | 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 near the base. This act is applicable only if remedial activities potentially impact the T/E species. |

**TABLE 19-6**
**(Concluded)**

| Requirement | Applicable? | Relevant and Appropriate? | Comments |
|---|---|---|---|
| 1978 New Mexico State Cultural Properties Act (Sections 18-6-1 through 18-6-17 NMSA 1978) | | | |
| 17. Provides for the preservation, protection, and enhancement of structures, sites, and objects of historical significance within the State. | Possibly | -- | 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. |

# TABLE 19-7

## COMPARISON OF SURFACE WATER SAMPLE RESULTS TO ARARs CANNON AFB, NEW MEXICO

Contaminants in Surface Water Exceeding Standards
Wastewater Lagoons (SWMU Nos. 101 and 102)

| Contaminant | Sample Concentrations (mg/L) | Standards Exceeded* (mg/L) | |
|---|---|---|---|
| | | Acute AWQC | Chronic AWQC |
| Lead | 0.0071 | --- | 0.0032 |
| Copper | 0.020; 0.051 | 0.018 | 0.012 |
| Mercury | 0.0011 | --- | 0.000012 |
| Silver | 0.040 | 0.0041 | 0.00012 |
| Zinc | 0.12 | 0.12 | 0.11 |

Contaminants in Water by Sediment Partitioning
Wastewater Lagoons (SWMU Nos. 101 and 102)

| Chemical | Conc. in Sediment (mg/kg) | Conc. in Water (mg/L) | Standards Exceeded* (mg/L) | |
|---|---|---|---|---|
| | | | Acute AWQC | Chronic AWQC |
| Chlordane (alpha) | 0.023; 0.031; .0078 | 0.0002 0.0003; 0.0000755 | --- | 0.0000043 |
| Chlordane (gamma) | 0.042; 0.045 0.0082 0.0041 | 0.000407; 0.000436 0.000079 0.000040 | --- | 0.0000043 |
| DDT | 0.016 | 0.0000097 | --- | 0.0000011 |
| Endrin | 0.016 | 0.0000045 | --- | 0.0000023 |
| PCBs-1016 | 0.16 | 0.000339 | --- | 0.000014 |
| PCBs-1221 | 0.32 | 0.00068 | --- | 0.000014 |
| PCBs-1254 | 0.3; 0.27; 0.49; 0.22 | 0.000635 0.000572 0.00104 0.000466 | --- | 0.000014 |
| Toxaphene | 0.82 | 0.00417 | .00073 | 0.0000002 |

* EPA, Water Quality Criteria for Protection of Aquatic Life, 1986

## TABLE 19-8

## COMPARISON OF SOIL SAMPLE RESULTS TO ARARs
## CANNON AFB, NEW MEXICO

| Contaminants in Soil in Excess of RFI Criteria/RCRA Proposed Action Levels | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| SWMU | Contaminant | Sample Concentration (mg/kg) | | | | Levels Exceeded (mg/kg) | | | |
| | | | | | | [a]RFI Criteria | [b]RCRA Action Levels | [c]Revised RFI criteria | [c]Revised RCRA Action Levels |
| AGE Drainage Ditch (SWMU No. 34) | Arsenic (background is 1.95; exceeds guidelines) | 1.6<br>2.8<br>2.0<br>2.0 | | | | -- | 80 | 0.39 | 0.39 |
| | Beryllium (background is 0.32-0.68; exceeds guide-lines) | 0.55<br>0.49 | | | | 0.143 | 0.2 | 0.16 | 0.16 |
| | Benzo(a)Pyrene | 0.2<br>0.31 | | | | 0.0609 | -- | 0.12 | 0.12 |
| Fire Dept. Training Area #1 (SWMU No. 78 | Arsenic | 1.9<br>1.0<br>0.67<br>1.30<br>0.73<br>1.80 | 2.7<br>0.76<br>0.69<br>1.90<br>0.89<br>1.60 | 2.1<br>0.79<br>2.0<br>1.6<br>0.67<br>1.70 | 2.0<br>0.77<br>1.80<br>0.83<br>0.85<br>2.50 | -- | 80 | 0.39 | 0.39 |
| | Beryllium | 0.59 | 0.50 | 0.49 | 0.53 | 0.143 | 0.2 | 0.16 | 0.16 |

**TABLE 19-8**
**(Continued)**

| Contaminants in Soil in Excess of RFI Criteria/RCRA Proposed Action Levels | | | | | |
|---|---|---|---|---|---|
| SWMU | Contaminant | Sample Concentration (mg/kg) | Levels Exceeded (mg/kg) | | | |
| | | | [a]RFI Criteria | [b]RCRA Action Levels | [c]Revised RFI criteria | [c]Revised RCRA Action Levels |
| Engine Test Cell Area (SWMU Nos. 86-90) | Antimony | 87.4 | 30 | 30 | 32 | 32 |
| | Arsenic | 2.8 2.4 2.9 2.1<br>2.5 2.8 2.1 2.0<br>2.4 3.1 1.7 2.6<br>1.9 1.6 2.1 1.6<br>0.63 0.72 2.2 0.8<br>3.4 | -- | 80 | 0.39 | 0.39 |
| | Beryllium | 0.65 0.59<br>0.50 0.57<br>0.51 0.46<br>0.63 0.64<br>0.90 0.58<br>0.53 | 0.143 | 0.2 | 0.16 | 0.16 |
| Sludge Weathering Pit (SWMU No. 76) | Beryllium | 0.82 0.72<br>0.52<br>0.51 | 0.143 | 0.2 | 0.16 | 0.16 |
| NE Storm Drainage Area (SWMU No. 95) | Arsenic | 3.9 1.5 2.3<br>1.3 2.2 1.9<br>1.8 1.9 | -- | 80 | 0.39 | 0.39 |
| | Beryllium | 0.54<br>0.54 | 0.143 | 0.2 | 0.16 | 0.16 |

**TABLE 19-8**
**(Concluded)**

| Contaminants in Soil in Excess of RFI Criteria/RCRA Proposed Action Levels | | | | | | |
|---|---|---|---|---|---|---|
| SWMU | Contaminant | Sample Concentration (mg/kg) | Levels Exceeded (mg/kg) | | | |
| | | | [a]RFI Criteria | [b]RCRA Action Levels | [c]Revised RFI criteria | [c]Revised RCRA Action Levels |
| Sanitary Sewer Line (SWMU No. 98) | Beryllium | 0.72 0.49<br>0.49 0.50<br>0.64 0.54<br>0.47 0.56 | 0.143 | 0.2 | 0.16 | 0.16 |
| Wastewater Lagoons (sludge samples) (SWMU Nos. 101 and 102) | bis(2ethylhexyl) phthalate | 340; 150 | 83 | 50 | 50 | 50 |
| | PCBs | 0.3; 0.27; 0.49; 0.22; 0.16; 0.16; 0.22; 0.16; 0.16; 0.32 | 0.091 | 0.09 | -- | -- |
| | Toxaphene | 0.82 | 0.64 | 0.60 | -- | -- |

[a] Source: RCRA Facility Investigation Guidance (EPA 530/SW-89-031, May 1989)
[b] Corrective Action for SWMUs at Hazardous Waste Management Facilities (55 FR 30798, 27 July 1990; proposed rule)
[c] Human health proposed criteria/action levels, see Table 18-16.

# 20.0
# CONCLUSIONS AND RECOMMENDATIONS

A Remedial Investigation was conducted for 18 SWMUs at 13 sites on Cannon AFB, Clovis, New Mexico from October through December 1991. The RI was conducted to characterize the nature and extent of contamination (if any) at the 18 SWMUs, and to perform a Baseline Risk Assessment on the data collected at each of the SWMUs to evaluate if any further action is warranted. The Remedial Investigation was designed and performed to satisfy requirements of the USAF Installation Restoration Program, as well as the conditions of the Cannon AFB RCRA operating permit. This section summarizes the results presented in this RI Report and presents recommendations for further action at the SWMUs, based on the results of the data collected during the RI and the findings from the Baseline Risk Assessment.

The field investigation program for this RI at 18 SWMUs on Cannon AFB consisted of drilling and sample collection of surface and subsurface soils, surface and groundwater sample collection, and sediment (sludge) sampling of the Wastewater Lagoons. Following sample collection, the samples were analyzed for various chemical parameters selected based on the history of use for each SWMU. The following analyses were performed on each sample, dependent upon the SWMU location of the sample:

- TCL Volatile Organic Compounds
- Semivolatile Organic Compounds
- PCB/Pesticides
- Metals
- Total Petroleum Hydrocarbons
- Total Organic Lead
- Total Organic Carbon
- Lead and Chromium
- Appendix IX analytes

The laboratory methods used followed Contract Laboratory Program (CLP) guidelines or SW8-46 methodologies when no CLP methodology existed (i.e. Appendix IX). The data were fully QC-verified and a minimum 10 percent of the samples and/or all critical samples (risk based) were subject to a full data validation. The QC reviewed and

validated data were then used to describe the nature and extent of contamination at each SWMU, and to perform a health and environmental baseline risk analysis.

The following section describes in summary the nature and extent of contamination found for each SWMU, and results of the baseline human health and ecological risk assessment based on the data collected during the RI. Section 20.2 presents any recommendations for further work if warranted at each of the SWMUs.

## 20.1 CONCLUSIONS

The field investigation results indicate that, in general, the location and physical conditions at each of the SWMUs investigation are similar in nature. The SWMUs investigated during this RI were generally located in the western one-half of Cannon AFB in areas on the base which are not frequented by either base personnel or others. One exception is the AGE Drainage Ditch (SWMU No. 34, IRP No. SD-15) which is located east of the main runway, between two building areas, and is crossed several times a day by base personnel going between the buildings. The surface topography is generally flat and is sparsely vegetated due to the somewhat arid climate conditions. The surface material consists of sandy loam and loamy sand soils underlain by fine-grained subsurface soils with numerous discontinuous caliche layers. The sites have a thick unsaturated zone with the depth to the upper most groundwater-bearing zone being approximately 270 feet below ground surface (BGS). The uppermost groundwater zone is considered the upper Ogallala Aquifer and is the primary water supply for Cannon AFB and surrounding areas.

The following paragraphs present a summary of the nature and extent of contamination, if present, for each of the SWMUs investigated during the RI.

### AGE Drainage Ditch - SWMU No. 34/IRP No.SD-15

The analytical results for samples collected at the AGE Drainage Ditch indicate that this SWMU appears to have soil contaminated with petroleum hydrocarbons above 100 mg/kg and low levels of PAH compounds from the surface to 3 feet BGS at soil boring location 0341. The petroleum hydrocarbon concentrations decrease from the surface to

the total depth at this location. Soil samples collected at this location also indicate that the soil contains elevated concentrations of lead and zinc that appear to be above background levels. The vertical extent of elevated lead and zinc is presently unknown, since boring 0341 could not be advanced beyond 3 feet BGS due to utility restrictions. The analytical results also indicated that soil contamination does not appear to extend northeast of the culvert.

**Sludge Weathering Pit - SWMU No. 76 (IRP No. WP-14)**

The data collected for this SWMU suggest the possible presence of residual petroleum tank bottom sludge in the pit from a depth of 4 to 6 feet BGS, and underlying native soils containing petroleum compounds from a depth of 6 to possibly 18 feet BGS, particularly in the vicinity of borings 0762 and 0763. Ethyl benzene and xylenes were detected at estimated concentrations of 4000 ug/kg and 7900 ug/kg, respectively, in boring 0763 at a depth of 8 to 10 feet. Ethyl benzene and xylenes may be present at a depth of 4 to 6 feet BGS in boring 0761 and at 8 to 10 feet BGS in boring 0762, but may be masked by high detection due to laboratory dilution of samples because of non-target compounds being present. Mercury was the only metal of concern detected at this site, at concentrations of 0.13 mg/kg and 0.85 mg/kg at depths of 4 and 8 feet BGS in soil boring 0761.

**Fire Department Training Area No. 1 - SWMU No. 78 (IRP No. FT-6)**

The analytical results for samples collected at this site indicate that organic chemicals consisting of the pesticides 4,4-DDD and 4,4-DDE, and TPH are present in the surficial soils throughout the site. The results suggest that the soils below 4 to 6 feet BGS have not been significantly impacted, although a minor concentration (14 ug/kg of 4,4-DDD) was reported at 10 to 12 feet BGS in boring 0781. However, the high soil/water partition coefficient for pesticides (EPA 1979) indicated that the compounds are retained on soil particles, thus retarding migration into deeper soils. Inorganic chemicals detected at this site were the metals lead and zinc. These two metals are present in the surficial soils throughout this site, and lead was also detected at depths of 4 and 20 feet BGS in borings 0781 and 0782, respectively.

Solvent Disposal Site - SWMU No. 81 (IRP No. DP-16)

The analytical results for samples collected at this SWMU indicate that only acetone and toluene were detected at concentrations above the laboratory CRQL. The low concentrations reported for toluene, less than 17 ug/kg, suggest that toluene is not a chemical of concern at this site. However, even though acetone is a common laboratory contaminant at low concentrations, the elevated levels reported at borings 8101, 8102, 8104, 8107, and 8108 in the western portion of the SWMU (400 ug/kg, 160 ug/kg, 910 ug/kg, 210 ug/kg, and 1300 ug/kg, respectively) may indicate possible contamination from solvent disposal practices. However, based on the results from the two deeper redrill borings completed in that area, it appears that acetone is restricted to the 4 to 6 foot interval . Acetone concentrations in borings 8111 (redrill of 8102) and 8112 (redrill of boring 8107) at the 9 to 9.5 foot interval were non-detect at 2U $\mu$g/kg and 15U $\mu$g/kg, respectively. Therefore, the vertical extent of acetone in the soil in the western portion of the SWMU appears to lie between 4 to 6 feet and does not extend below 9 feet bgs.

Engine Test Cell Area - SWMU Nos. 86-90 (IRP No. SD-11)

The volatile organic chemicals acetone and toluene were detected above the laboratory CRQL at this SWMU. Toluene was detected at a concentration of 100 ug/kg in the background boring 0865, located to the west of the SWMU, and concentrations detected in samples from the other soil borings were significantly less than this concentration. In addition to acetone and toluene, petroleum hydrocarbons appear to be present from 10 to 20 feet BGS in boring 0861, located near the oil/water separator. The lateral extent of petroleum hydrocarbon contamination is not known to a great degree of certainty, but is most likely limited to the area around the northern side of the oil/water separator since no petroleum hydrocarbon staining was observed at boring location 0863, southeast of the oil/water separator.

Metals were detected at concentrations that appear to be above background levels in the upper 4 feet in all soil borings at this SWMU. In general, higher metal concentrations were detected in surface soil samples. The two borings located near the oil/water separator had results indicating lower concentrations of metals in the surface soil

compared to the borings located near the concrete pad of the former engine test cell. The background soil boring (boring 0865) had metal concentrations which were lower than samples collected at the above locations.

**NE Stormwater Drainage Area - SWMU No. 95 (IRP No. SD-20)**

No volatile or semivolatile organic compounds of concern were detected at this SWMU. Only acetone, a common lab contaminant, was detected in three samples (at 2 and 8 feet BGS in boring 0951 and at 2 feet BGS in boring 0952, at concentrations of 22 ug/kg, 17 ug/kg, and 21 ug/kg, respectively). However, hydrocarbon contamination was detected at the upstream end of the ditch, at boring location 0951. The concentration of hydrocarbon contamination diminished to the southwest in the direction of flow in the drainage ditch. The data suggest that hydrocarbon contamination may extend laterally throughout the drainage ditch, with the higher concentrations being found near the mouth. A variety of metals were detected in surface soil samples above background levels. The metals detected above background concentrations at the upstream surface soil sample location (boring 0951) were arsenic (3.9 mg/kg), cadmium (1.8 mg/kg), chromium (115J mg/kg), cobalt (12.6 mg/kg), copper (59 mg/kg), iron 41,200 mg/kg), lead (147 mg/kg), nickel (49.1 mg/kg), and zinc (467J mg/kg). At the downstream surface soil sample location (boring 0952) lead (31.6 mg/kg) and zinc (63.6 mg/kg) were detected in the surface soil sample. At both the upstream and downstream sample locations, metals concentrations in the subsurface soil samples were below or near background levels.

**Old Entomology Rinse Area - SWMU No. 96 (IRP no. SD-17)**

During the RI, both soil and groundwater samples were collected at this SWMU. Results of the surface soil sample collected and analyzed for PCBs/pesticides indicated that the pesticides 4,4-DDE and 4,4-DDT were detected at estimated concentrations of 66J ug/kg and 110J ug/kg, respectively. The $\alpha$- and $\gamma$- chlordane compounds were also detected and reported at estimated concentrations of 16J ug/kg and 47J u/kg, respectively. Also, the pesticide heptachlor epoxide was detected at an estimated concentration of 19J ug/kg. No PCBs were detected above the laboratory CRQL.

Analysis of the groundwater sample collected from the existing monitoring well, 96K, located downgradient from the Old Entomology Rinse Area indicated the presence of six metals above the detection limits for TAL metals. The metals detected were barium, chromium, copper, lead, vanadium, and zinc. The concentrations at which these metals were detected were below established maximum contaminant levels (MCLs) for groundwater quality standards. No PCBs or pesticides were present in the groundwater sample collected at this monitoring location.

**Sanitary Sewer Line - SWMU No. 98**

The volatile organic compound acetone was detected above the laboratory CRQL at one soil boring location along the sanitary sewer line at a concentration which may indicate the presence of past leakage of the sewer at boring location 9821. In the other borings in which acetone was detected above the CRQL, the concentrations suggest laboratory contamination may be present. TPH was detected in one boring (9835) above a concentration of 100 mg/kg. The metals lead and cadmium were detected at concentrations slightly above background levels at soil boring location 9826. However, these metals are not of concern at this SWMU.

**Wastewater Lagoons - SWMU Nos. 101, 102**

During the RI, sediment (sludge), surface water and groundwater samples were collected at this SWMU.

The field investigation at the Wastewater Lagoons indicated that the sludge is approximately 2 feet thick. The analytical results from the sludge samples collected within the Wastewater Lagoons indicated that acetone and 2-butanone were the only volatile organic compounds present above the laboratory CRQL, and phthalates were the only semivolatile organic compounds detected. However, the actual presence of these compounds in the lagoon sludges is questionable since they are common laboratory contaminants. Low levels of pesticides were reported throughout the sludge in both the north and south lagoon. PCBs were detected, but their presence in the sludge is questionable since they were estimated values. Metals were detected in the sludge at

concentrations consistently above background ranges for soils; however, none of the metals were detected above TC limits for the TCLP analyses.

Analyses for Appendix IX constituents in the four groundwater samples collected from existing monitoring wells E (upgradient), F, G, and H (downgradient) indicated that metals were the only analytes detected above the reporting limits. Barium and vanadium were detected in all four groundwater samples. The concentration of barium ranged from 0.023 mg/L to 0.075 mg/L. The concentration of vanadium ranged from 0.012 mg/L to 0.02 mg/L. Both of these metals had concentrations below their MCLs (for barium 1.0 mg/L; for vanadium, no MCL has been established). Evaluation of the chemical data indicates the quality of groundwater in this area does not appear to be impacted by SWMUs 101 and 102.

Three surface water samples were collected and analyzed for Appendix IX constituents; two from within the lagoons (one each from the north and south lagoon), and one sample from the wastewater splitting pool located adjacent to the lagoons. Results from the analysis of the surface water samples indicated that the content of detected metals varied according to the location of the specific sample. However, none of the detected metals had concentrations above the EPA Ambient Water Quality Criteria. The largest number of detected metals (6) was from the sample collected from the wastewater splitting pool (sample location 3003). Sulfide was detected in samples from all three locations ranging from 0.19 mg/L to 3.7 mg/L. Three volatile organic compounds were detected at sampling location 3003. Acetone was present at a concentration of 34 ug/L, chloroform at 5.4 ug/L, and toluene at 5.0 ug/L.

**Fire Department Training Area No. 2 - SWMU No. 106 (IRP No FT-7)**

Analytical results for samples collected at this SWMU indicate that TPH contamination is present in the shallow soils at depths less than 4 feet BGS and probably does not extend beyond the boundary of the SWMU. The metals lead and chromium were detected at concentrations above background levels in surface soil samples. Concentrations of lead and chromium in the subsurface soil samples were generally below site background concentrations with the exception of chromium at 11.4 mg/kg at 10 feet BGS in boring 1061 and 108 mg/kg at 10 feet BGS in boring 1063.

Fire Department Training Area No. 3 - SWMU No. 107/IRP No. FT-8

The results of the sampling and analysis of soils at this SWMU indicate the presence of the volatile organic compounds ethyl benzene and xylenes in the subsurface soils. Acetone was also detected in subsurface soil samples collected at two boring locations; however, acetone was not detected at different depths in the same borings, suggesting that acetone is probably related to laboratory contamination. Xylenes were detected at boring 1074 between 4 and 32 feet BGS at concentration of 94 and 4.9 mg/kg, respectively; however, xylenes were not detected above the quantification limit at the next sample interval. These results are supported by VOC analysis of TICs which indicate the possible presence of a variety of xylene derivatives. Ethyl benzene was detected in samples from boring 1074 at 4, 10, and 20 feet BGS at an estimated concentration of 13J and 15J, and a concentration of 5.8 mg/kg, respectively. Ethyl benzene may also be present at the 30 to 32 foot interval since the detection limit was raised to 14 mg/kg. Toluene was detected in samples from boring 1073 at the surface and in boring 1074 at 4, 20, and 62 feet bgs at estimated concentrations of 0.073J mg/kg, 6.9J mg/kg, 2.7J mg/kg, and 0.004J mg/kg, respectively. Toluene was not detected above the quatitation limits in any of the borings. The detection of xylenes, ethyl benzene, and toluene at boring 1074 is consistent with residual fuel constituents from previous fire training exercises. Benzene was not detected above the CRQL (adjusted for sample size and dilutions) in any of the soil samples.

Total petroleum hydrocarbons were detected in surface samples collected at the four boring locations at concentrations ranging from 963 mg/kg to 6080 mg/kg, with the highest concentration at boring location 1073. Elevated petroleum hydrocarbon concentrations were also detected in subsurface soils at 4 feet BGS in boring 1071, and down to 32 feet BGS in boring 1074. The VOC analysis of soil samples for boring 1074 also reported a variety of medium molecular weight saturated and unsaturated hydrocarbon TICs to a depth of 30 feet BGS.

Lead was detected in surface soil samples at boring locations 1071 and 1074 at concentrations of 151 mg/kg and 322 mg/kg, respectively. The analytical results indicate that lead contamination does not extend into deeper soils. Chromium was detected infrequently and in concentrations comparable to site background levels.

Fire Department Training Area No. 4 -SWMU No. 109

The results of the sampling and analysis of soils at this SWMU indicate the presence of the volatile organic compounds ethyl benzene and xylenes in the subsurface soils. Acetone was also detected in the soil samples collected at this SWMU, but is considered a common laboratory contaminant, and is not thought to be a contaminant of concern for this site. Xylenes were found predominantly at 4 feet BGS in boring 1093 and at 4 and 10 feet BGS in boring 1094 at concentrations of 4.1 mg/kg, 290 mg/kg, and estimated concentration of 6.7J mg/kg, respectively. Xylenes were not detected above the laboratory CRQL below 22 feet BGS in boring 1094, or below 12 feet BGS in boring 1093. Ethyl benzene was detected in boring 1094 at 4 feet BGS at an estimated value of 19 mg/kg, and may be present at the 10 to 12 foot depth because of raised detection limits. The reporting limits for TCL volatile organic analyses were raised in these two samples because of the sample dilution necessary due to target and non-target compounds. The TICs from VOC analysis indicate the possible presence of xylene derivatives in boring 1094 and 1093 at the depths described above for xylenes and ethyl benzene detections. This identification of xylenes and ethyl benzene compares well with the existence of residual fuel constituents from fire training exercises at the site.

Total petroleum hydrocarbons were detected in surface and subsurface soil samples collected from boring locations 1091, 1093, and 1094 at concentrations of 273 mg/kg, 38,500 mg/kg, and 13,600 mg/kg, respectively. The vertical extent of TPH contamination extends from ground surface to approximately 5 feet BGS at boring location 1091, and to approximately 6 feet BGS at boring location 1093. TPH concentrations of 215 mg/kg and 203 mg/kg were detected at the 50 to 52 foot and 60 to 62 foot depth intervals, respectively. at boring location 1093. These TPH concentrations may be anomalous since TPH was not detected in samples collected immediately above and below these depths. In addition, elevated concentrations of TPH were detected at boring location 1094 to a depth of approximately 20 feet BGS. VOC analysis reported TICs which were a variety of medium to high molecular weight saturated hydrocarbons at boring location 1094 for 1 to 10 feet BGS, and at boring location 1093 at 4 feet BGS. This identification is consistent with the probable existence of residual fuel constituents from on-site fire training exercises.

Chromium was detected in the surface sample collected at boring location 1093 at an estimated concentration of 19.6J mg/kg. However, since this result is an estimated value, it is not considered a chemical of concern at this site.

The xylenes and ethyl benzene concentrations found at this SWMU correlate well with the fuel staining observed during the field sampling effort near the wings of the mock airplane. These two volatile organic compounds were not detected above the laboratory CRQL at other boring locations. No metals were detected at concentrations above background levels at this SWMU. The lateral extent of xylene and ethyl benzene contamination is not well defined, but is likely confined to the area immediately outside the concrete berm and liner underlying the mock airplane. The volatile organic contamination does not appear to extend deeper than 10 feet BGS, based on the results from samples collected at boring locations 1093 and 1094. The TPH contamination present in the surface soil samples at the three boring locations associated with observed surficial staining may also be present in other areas of the SWMU where stained soil was observed during the field sampling event. Vertical TPH contamination correlated well with the ethyl benzene and xylene concentrations found at the site.

**Landfill No. 5 - SWMU No. 113**

Analyses for Appendix IX constituents for the five groundwater samples collected from existing monitoring well A (upgradient) and monitoring wells B, C, D, and I (downgradient) indicated that metals were the only analytes detected above the laboratory reporting limits. Metals analysis revealed the presence of barium and vanadium in groundwater samples from all five monitoring wells. The concentrations for these two metals were below their MCLs (for barium 1.0 mg/L, for vanadium, no MCL has been established). Barium was detected at a concentration of approximately 0.029 mg/L. The concentration for vanadium ranged from 0.023 mg/L to 0.036 mg/L. Lead was also detected in the groundwater sample collected from monitoring well 113B, at a concentration of 0.016 mg/L, well below its MCL of 0.05 mg/L. This MCL is effective only until December 7, 1992, at which time the MCL for lead will be abolished and replaced by an action level of 0.015 mg/L. However, it should be noted that this action level is for samples taken at the tap for public drinking water systems (56 FR 26460, 6/7/91).

Evaluation of the chemical data indicates the quality of groundwater has not been affected by SWMU 113.

**Baseline Risk Assessment**

The baseline risk assessment performed by WCC as part of this RI effort was conducted under the regulatory framework of RCRA and CERCLA. The 18 SWMUs investigated during this RI were grouped into Risk Assessment Areas (RAAs) comprised of an individual SWMU or a group of SWMUs which were geographically close, had common or similar chemical release sources, and had potentially overlapping exposure pathways. Based on the findings of the baseline risk assessment and comparison of soil data with risk-based RFI criteria/proposed RCRA action levels, it was concluded that health impacts to humans from the 18 SWMUs investigated during the RI are not significant. A brief summary of the baseline risk assessment results follows.

The average and reasonable maximum exposure (RME) risks and hazards were estimated for complete exposure pathways at each RAA. Generally, average chemical concentrations in soil and the 95% upper confidence limit (UCL) of the arithmetic mean concentration were used in assessing average and RME intakes, respectively, along with other average or RME intake factors. The total noncarcinogenic hazard indexes were below the EPA's level of concern (1.0) in each RAA evaluated. This was true for individual exposure pathways and combined exposure pathways in each RAA. The total carcinogenic risks were also below or within the EPA's target risk range of $1 \times 10^{-4}$ to $1 \times 10^{-6}$. In RAA 1, (Fire Department Training Area Nos. 2, 3, and 4, and Landfill 5) the RME cancer risk for the hypothetical future child resident was $1.1 \times 10^{-4}$. Although this level exceeds the EPA target risk range, the Chemicals of Concern (COC) were detected infrequently and had high detection limit values. The results may, therefore. represent an overestimation of the calculated risks.

With the exception of antimony in RAA 2 (Engine Test Cell Area), none of the concentrations of chemicals of concern in soil (using the 95 % UCL or the maximum measured concentration) exceeded RFI criteria or proposed RCRA action levels. Soil lead levels did not exceed the EPA target cleanup range of 500 to 1000 mg/kg for lead in soil. In addition, a screening calculation was performed for lead using the EPA's

Uptake Biokinetic Model. The highest 95% UCL soil lead level among the samples collected from this RI, in combination with the 95% UCL groundwater level measured in this RI data set, did not result in an exceedance of the EPA's target blood lead concentration (10 ug lead/dL of blood) using this model. An examination of the vertical extent of contamination for soils revealed a decrease in concentration at depths below approximately 30 feet.

Lead was reported in one groundwater sample from SWMU 113 at a concentration of 0.016 mg/L which exceeds the EPA action level of 0.015 mg/L, but not the EPA drinking water MCLs of 0.050 mg/L for lead. Overall, the groundwater data collected as part of the RI do not exceed EPA's MCLs for drinking water. The depth to the water table (Ogallala Aquifer) is approximately 270 feet below ground surface. After considering the groundwater monitoring well data (one round) collected during this RI, the fate and transport properties of site chemicals, and the local geology/hydrogeology, it was judged that the site impact to groundwater is not likely to be significant.

Ecological Risk Assessment

Included in the baseline risk assessment was the performance of an Ecological Risk Assessment (ERA). The focus of this ecological risk assessment was on the exposure of dabbler ducks to chemicals in water and sediments in the lagoons (SWMU 101, 102) and the exposure of small mammals to chemicals in soils at the Base. Dabbler ducks are present in the area for several months every winter; some individuals may stay the entire year. The ducks principally feed at nearby grain fields and rest (and feed) at the Playa Lake, which receives water regularly from the lagoons. The Playa Lake is a SWMU which has been identified for investigation in the future as part of the overall RI for Cannon AFB.

Both water and sediments from the lagoons were found to contain chemical concentrations which could pose some risk to waterfowl and aquatic organisms. Metals were found in the lagoon water at concentrations which exceeded acute (copper, silver, and zinc) and chronic (cyanide, lead, and mercury) AWQC. Hazard Quotients (HQs) were calculated for ducks based on toxicological literature and indicated that metal levels in the water are unlikely to pose any adverse risk. HQs for ducks from incidental

ingestion of sediments, however, indicated that mercury and zinc in sediments may pose some risk to waterfowl. No pesticides were detected in the lagoon water. Pesticide concentrations were detected in the lagoon sediments at concentrations which if converted to water concentrations by using partitioning coefficients, exceeded chronic AWQC. Compounds such as dieldrin, endrin, heptachlor, and DDT are especially persistent and stable in anaerobic sewage sludge (EPA 1979). Several of these pesticides have the potential to be acutely toxic to aquatic organisms as well as the potential to bioaccumulate to significant levels through food chains.

The lagoons are not intended for use as wildlife habitat and therefore risks to aquatic organisms such as algae and benthic invertebrates are not of concern. Dabbler ducks, however, are protected migratory waterfowl and are therefore of concern. Based on this ecological risk analysis, there is small potential for some toxic effects to occur to dabbler ducks which chronically ingest water and sediments from the lagoons. It is also possible that metal and pesticide levels in the lagoons are no higher than those found in other water bodies in the region due to the accumulation of chemicals from surface runoff. Reference concentrations were not available for sediments and water from other sewage lagoons or water bodies in the region.

Concentrations of chemicals in soils at Cannon were also evaluated in terms of potential risk to terrestrial biota. The receptor species of concern are the kites and raptors and small ground-dwelling mammals. Six metals (copper, chromium, cadmium, zinc, cobalt, and lead) and one semi-volatile organic compound (benzo(a)pyrene) were detected in soils at levels which were considered to be above background. Benzo(a)pyrene, because of its relatively low concentration at near background levels, was not considered to be a chemical of concern. None of the six metals are thought to bioaccumlate through the food chains to levels where they would pose a risk to kites or raptors. Potential risk from these metals in soil to biota was considered to be greatest through direct exposure of small mammals and other ground-dwelling organisms. Based on the calculation of toxicity values for a mouse from incidental soil ingestion, none of the six metals were considered to pose a risk to small mammal populations.

## 20.2 RECOMMENDATIONS

Based on the results of the RI, including the baseline risk assessment, a **"No Action"** remedial alternative is appropriate for the following SWMUs at Cannon AFB:

- SWMU No. 34 — AGE Drainage Ditch (IRP No. SD-15)
- SWMU No. 76 — Sludge Weathering Pit (IRP No. WP-14)
- SWMU No. 78 — Fire Department Training Area No. 1 (IRP No. FT-6)
- SWMU No. 81 — Solvent Disposal Site (IRP No. SD-20)
- SWMU No. 95 — NE Stormwater Drainage Area (IRP No. SD-20)
- SWMU No. 98 — Sanitary Sewer Line
- SWMU No. 106 — Fire Department Training Area No. 2 (IRP No. FT-7)
- SWMU No. 107 — Fire Department Training Area No. 3 (IRP No. FT-8)

**NE Stormwater Drainage Area - SWMU No. 95 (IRP No. SD-20)**

A Stormwater permit application is currently in progress for Cannon AFB to comply with the new regulations contained in 40 CFR parts 122, 123, and 124. In that permit Cannon AFB proposes to monitor effluent in the NE Stormwater Drainage annually during a storm event. The effluent sample will be analyzed for the following parameters:

- Volatile Organic Compounds
- Semi-volatile Organic Compounds
- Pesticides/PCBs
- Metals (antimony, barium, beryllium, cadmium, chromium, copper, lead, silver, thallium, zinc)

It is therefore recommended that this SWMU be listed for no further action under RCRA but continued to be monitored and results be reported under the new stormwater regulations.

Further investigation, monitoring or remedial action is recommended for the following SWMUs at Cannon AFB:

- SWMU Nos. 86-90 Engine Test Cell Area (IRP No. SD-11)
- SWMU No. 96 Old Entomology Rinse Area (IRP No. SD-17)
- SWMU Nos. 101, 102 Wastewater Lagoons
- SWMU No. 109 Fire Department Training Area No. 4
- SWMU No. 113 Landfill 5

Based on the RI results, the following presents and discusses recommendations for additional investigations at the above SWMUs.

**Engine Test Cell Area - SWMU Nos. 86-90 (IRP No. SD-11)**

The lateral extent of petroleum hydrocarbons found in the soil near the oil/water (o/w) separator (i.e., boring 0863) was not determined during this investigation. However, instead of additional characterization using borings or trenching, Cannon AFB has elected to remove the oil/water separator and surrounding soils contaminated with petroleum hydrocarbons. The following actions are proposed for FY 93 under Project No. 93-8004 for Engine Test Cell Area:

- Removal and disposal of the oil/water separator and associated piping
- Excavation of any soil contaminated with petroleum hydrocarbons and placement in the on-base land farming unit for treatment.
- Collection and laboratory analysis of confirmation samples along the walls and in the bottom of the excavation to verify removal of petroleum hydrocarbon contaminated soil to specified cleanup goals.
- Provide EPA with documentation verifying the removal of the oil/water separator and petroleum hydrocarbon contaminated soil.

**Old Entomology Rinse Area - SWMU No. 96 (IRP No. SD-17)**

Results of the surface soil sample collected at the approximate location of the former sink rinse pit and analyzed for PCBs/pesticides suggest that the pesticides 4,4-DDE, 4,4-

DDT, heptachlor epoxide, and the α- and γ- chlordane compounds may be present at low estimated concentrations at the surface (66J ug/kg, 110J ug/kg, 19 ug/kg, 16J ug/kg, and 47J u/kg, respectively). Because pesticides have been detected in shallow soil samples (i.e., 2 to 10 feet BGS, and 62 to 63 feet BGS) from previous investigations by Radian (1986) and Walk, Haydel, and Associates (1990), and continued concern of the regulatory agencies, one soil boring will be drilled to a depth of approximately 100 feet BGS at the location of sample 0961. Chemical samples will be collected at 10-foot intervals from surface to total depth in this boring and analyzed for pesticides and PCBs. Following completion of the above work, an addendum to the RI Report will be provided to the EPA discussing the sampling and analytical results from this boring and recommendations for further action. The above work will be scoped, contracted, and performed in FY 93 under the USAF IRP as weather permits.

**Wastewater Lagoons - SWMU Nos. 101, 102**

This SWMU currently is not regulated under Cannon AFB's RCRA Part B Permit but there continues to be discussion between Cannon AFB, EPA, and NMED to determine under which environmental regulation this unit will be monitored. The analytical results from the sludge samples collected within the Wastewater Lagoons indicated that volatile organic compounds (acetone and 2-butanone), semi-volatile organic compounds (phthalates), pesticides, PCBs, and metals were present. Based on these data, the one upgradient (E) and three downgradient (F, G, H) monitoring wells at this SWMU will be sampled and analyzed, using SW-846 methodologies, annually for volatile organic compounds, metals, pesticides, nitrates, sulfates, and total dissolved solids. This interim monitoring program will continue until the regulatory framework of this unit is resolved. Analytical results will be provided to EPA and NMED on an annual basis.

**Fire Department Training Area No. 4 - SWMU No. 109**

A review of Applicable or Relevant and Appropriate Requirements (ARARs) indicated that the New Mexico Underground Storage Tank (UST) remediation guidelines may be appropriate for SWMU No. 109, Fire Training No. 4. A new fire training facility, Project No. CZQZ-943002, is currently being designed and is scheduled for construction at a new location during FY 94. Until this new facility is built and operational, the

current Fire Department Training Area No. 4 will continue to be used. It would not be prudent to proceed with additional site characterization borings until the new facility is active. Therefore, the following actions are recommended for Fire Training Area No. 4 after completion of the new fire training facility in FY 94:

- Drill additional borings around and beneath the mock airplane to evaluate lateral and vertical extent of TPH in soil.
- Drill additional borings at the "tree" and "vehicle burn" area to evaluate lateral and vertical extent of TPH in these areas.
- Analyze soil samples for TPH and BTEX
- Evaluate remedial options for soils exceeding TPH cleanup goals. Analytical results from borings described above will be used to estimate the volume of soil requiring remediation.
- Select a remedial alternative and initiate remedial action.

**Landfill No. 5 - SWMU No. 113**

Evaluation of the monitoring well chemical data indicates the quality of groundwater beneath this SWMU has not been affected by Cell No. 3 (the cell that reportedly received hazardous wastes until mid-1981) at Landfill No. 5. However, since the vadose zone beneath this cell has not been investigated, the nature and extent (lateral and vertical) of any hazardous contamination that may impact the groundwater sometime in the future, has yet to be evaluated. Since the New Mexico Environmental Division regulates the activities at this SWMU, the groundwater monitoring requirements for this unit will be resolved by Cannon AFB and NMED and will not be addressed further in this report.

## Playa Lake

Even though the Playa Lake was not included in this RI, the Environmental Risk Assessment indicated potential risk to biota, especially ducks, from potential contaminants in the sediment and surface water of the Playa Lake to the east into which Wastewater Lagoon effluent drains. Because of the potential risk, it is recommended that any ecological study conducted at the Playa Lake consider the following:

- Applicability of Ambient Water Quality Criteria to the site
- Evaluation of relevant toxicity information
- Field investigations
    - to identify species present and food habits
    - collect additional sediment, surface water and biota samples

It is also recommended that if dredging of the sludge in the Wastewater Lagoons is performed in the future, analytical testing be performed to evaluate disposal options.

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# FINAL
# VOLUME II
# APPENDIXES A AND B

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# REMEDIAL INVESTIGATION REPORT FOR 18 SOLID WASTE MANAGEMENT UNITS CANNON AIR FORCE BASE CLOVIS, NEW MEXICO

App. I
SWMUs 34, 76, 78, 81, 86-90, 95
96, 98, 101, 102, 106, 107, 109, 113

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| APPENDIX D-4 | TOXICOLOGICAL PROFILES |
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# APPENDIX A
# USACE SCOPE OF SERVICES

June 26, 1991

A-E INDEFINITE DELIVERY WORK ORDER
SCOPE OF SERVICES
Remedial Investigation
Cannon Air Force Base, Clovis, New Mexico

1. Objective. The purpose of this Scope of Services (SOS) is for an Remedial Investigation (RI) of designated sites at Cannon AFB. To assure completeness the investigation shall encompass both CERCLA and RCRA requirements. Necessary data shall be gathered that will allow a complete investigation report, risk assessment, Defense Priority Model Data Package, and Decision Document for each site.

2. Scope of Services. The A-E shall do field investigation to acquire data and utilize the data obtained to prepare the documents named above.

a. Area to be Investigated. Under this scope of services, the areas listed below are to be investigated and documents prepared for each area.

| Site | IRP Designation | SWMU # |
|---|---|---|
| AGE Drainage Ditch | SD-15 | 34 |
| Engine Test Cell et al | SD-11 | 86,87,88,89,90 |
| NE Storm Drainage Area | SD-20 | 95 |
| Wastewater Lagoons | none | 101,102 |
| Landfill # 5 | LF- 5 | 113 |
| Old Entomology Rinse | SD-17 | 96 |
| Sludge Weathering Pit | WP-14 | 76 |
| Fire Training # 1 | FT- 6 | 78 |
| Solvent Disposal | DP-16 | 81 |
| Fire Training # 2 | FT- 7 | 106 |
| Fire Training # 3 | FT- 8 | 107 |
| Fire Training # 4 | none | 109 |
| Sanitary Sewer Line | none | 98 |

b. Specific Services Required.

(1) Controlling ARARs and criteria. A-E shall examine all ARARs especially CERCLA, RCRA, and supplied Work Plan closely. The Work Plan interpretation of RCRA shall govern over alternate interpretations. All Work Plan and RCRA requirements shall be fulfilled. CERCLA or New Mexico requirements may be added to this project if necessary for completeness of the Remedial Investigation. CERCLA requirements shall not apply the 3 sites above where "none" is listed as the IRP designation.

(2) Report. The report shall be an Remedial Investigation Report following standard CERCLA Remedial Investigation Report format. All parts of the Work Plan and RCRA requirements shall be included, with the cover letter enumerating where the RCRA parts can be found in the RI Report.

(3) Laboratory Qualification and Validation. The Laboratory that will be used in this project must already be participating and operating under the full compliance of the EPA Contract Laboratory Plan. As early as possible in the project Validation by the Corps of Engineers, Missouri River Division (MRD) Laboratory will be pursued and obtained.

(4) Submittals.

The following is a list of the submittals. The schedule of submittals and meetings are listed in latter pages of this SOS. Required numbers and distribution appear at the end of the SOS.

If necessary and as early as possible.

Documents (A-E LQMP) necessary for MRD Laboratory validation.

Before Field Work these need approval prior to field work.

Draft Applicable or Relevant and Appropriate Requirements (ARARs)
Work Plan Supplements
Chemical Data plan
Site Safety & Health Plan

Field Work

Daily Quality Reports

After Field Work

Quality Control Summary Report

During Sample Analysis Validation

Analytical Data

After Data Interpretation

Defense Priority Model (DPM) Data Package
Pre-Draft Remedial Investigation Report
Draft Remedial Investigation Report
Final Remedial Investigation Report
Risk Assessment included in the RI report
Decision Documents

c. Schedule. The submittals, field work, meeting schedule is as shown below.

| | |
|---|---|
| Distribute ARARs | 1 August |
| Clarification MEETING @ Cannon AFB | 15 August |
| Submit pre-work plans | 30 August |
| Pre-work safety MEETING @ Cannon AFB | 3 October |
| Mobilization | 7 October |
| Demobilization MEETING | 16 December |
| Demobilize | 20 December |
| Submit Quality Control Summary Report | 31 January |
| Lab Analytical MEETING | 24 February |
| Send Out Pre-Draft RI Report & Draft DPM Ranking | 16 March |
| Pre-Draft Report & Draft DPM Ranking MEETING | 20 April |
| Send Out Draft RI, Final DPM, & Draft Decision Documents | 18 May |
| Draft RI, Final DPM, & Draft Decision Document MEETING | 15 June |
| Send out Pre-Final RI Report, Final Decision Documents | 20 July |
| Pre-Final RI Report, Final Decision Documents MEETING | 17 August |
| Final RI Report & Decision Documents Published | 1 September |

(2) Background Data. The A-E shall review and evaluate existing records, studies, and data concerning the site as provided the Government, or otherwise available.

(3) Determination of Applicable or Relevant and Appropriate Requirements (ARARs). The A-E shall analyze requirements promulgated under federal environmental or state environmental or facility sitting laws to determine which requirements are applicable or relevant and appropriate to the distinctive sets of circumstances and actions contemplated at the specific sites included in this project. This work effort shall be performed in accordance with "CERCLA Compliance with Other Laws Manual" (EPA/540/G-89/006 and EPA/540/G-89/009) and "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final"(EPA/540/G-89/004). The A-E shall perform the following steps:

(a) Identification. The A-E shall identify potential chemical-specific, location-specific, and action-specific ARARs. This will involve contacting Federal and State agencies as well as utilizing information provided in the above referenced guidance documents. Identification of potential ARARs will occur during the RI.

(b) Analysis. The A-E shall analyze the potential ARARs to determine whether they are actually applicable to the particular conditions at the sites. If the requirements are not applicable, the A-E shall analyze them to determine whether they are relevant and appropriate to the particular conditions at the sites. The A-E shall determine whether circumstances are present that might justify a waiver of any otherwise applicable or relevant and appropriate requirements.

(c) Utilization. In the risk assessment process (both during the baseline risk assessment and the analysis of alternatives), the A-E shall utilize actual ARARs as well as other criteria or guidelines "to be considered" (TBCs) to ensure protectiveness and to set protective cleanup level targets (i.e. establish preliminary remediation goals).

(d) Documentation. The A-E shall maintain a list of potential ARARs as they are identified. Before preparation of the Draft RI report, the A-E shall submit this list to the USACE-PM for approval. The A-E shall provide detailed ARAR and TBC documentation in the RI Report (The RI Report shall present initial chemical-, location-, and action-specific ARARs documentation.

(4) Plan Submittals. This section only covers plan submittals which are required prior to commencement of any on-site activity. The laboratory validation section discusses the A-E Laboratory Quality Management Plan (A-E LQMP). This plan must be submitted as soon as possible to initiate the laboratory validation process.

(a) General. The A-E, shall prepare a field schedule, Work Plan Supplements, and the Plans discussed below. These plans shall include a detailed discussion of the technical approach the A-E plans to use to implement the requirements specified herein. All Plans must be reviewed and approved by the Contracting Officer (CO) prior to commencement of that work effort.

(b) Field Schedule. A field schedule shall be submitted outlining the order of fieldwork that will be conducted at the sites. As a minimum, the schedule should identify the tasks being conducted and the time required for each task.

(e) A-E SSHP. An A-E SSHP shall be prepared and submitted as outlined in paragraph 9 of this Scope of Services.

d. Field Investigations. All field investigations shall be conducted in accordance with the Work Plan and as further defined in Appendix A, and then the following Chemistry and Geology sections specific instructions.

4. Site-Specific Investigations.

4.1 Investigations. The investigation shall follow the Work Plan and as further defined in Appendix A as to the number of borings and samples. The Chemical Analysis program shall follow the Work Plan and in general strict EPA CLP procedures. The Chemical Data Acquisition Plan (CDAP) shall;

(1) reiterate the Work Plan procedures,
(2) the necessary additions in tests or procedures not covered in the Work Plan, and
(3) account for any other additions.

3. NOT USED.

4. Special Considerations. All materials and data gathered and developed in the performance of this work listed in this Scope shall be the property of the Corps of Engineers, Omaha District. The materials and data shall not be used or distributed by the A-E without the specific written permission from the Corps of Engineers, Omaha District.

5. Project Management.

a. Project Engineer. The A-E shall assign a Project Engineer or Project Manager. This individual shall oversee the performance of the entire project, administer all instructions from the COE, and answer or obtain answers to all questions from the COE during and after work.

b. Coordination. During the prosecution of the work under the contract, the A-E shall coordinate all field work with the Chief of Environmental Planning and shall keep in close liaison with the Corps of Engineers Project Manager (USACE PM). All requests made by others shall be referred to the USACE PM.

6. Base Support. The A-E shall coordinate all requests for Base support services through the Chief of Environmental Planning's representative. To avoid conflicts and schedule delays, (on the part of both parties) the A-E shall request all Base support services well in advance of their anticipated time of need. Likewise, it is anticipated that the Base will provide the following information and support to the A-E in a timely fashion upon request:

a. Existing Plans. The Base will provide the A-E with existing engineering plans, drawings, diagrams, aerial photographs, and other information deemed necessary to evaluate the site being investigated.

b. Utilities. The A-E and Base shall locate and mark all underground utilities in the vicinity of each site prior to any drilling or digging. The Base representative will provide assistance to the A-E by directing the A-E to the appropriate Base office/personnel or company with the pertinent information (i.e. utilities and sewer & hydrant line location maps). The A-E shall contact and coordinate any necessary site work with the appropriate personnel.

c. Permits. The Base will issue to the A-E any required or appropriate drilling or digging permits necessary for the completion of the field work. The Base will provide assistance to the A-E by providing the necessary permit forms and directing the A-E to the appropriate authority with the pertinent information. The A-E shall contact and coordinate any necessary site work with the appropriate personnel. Drilling/digging permits shall be strictly adhered to. Failure to comply with permit restrictions and required coordination with Base offices shall result in immediate revocation.

d. Security. Physical security procedures will be necessary for this project. No restricted sites or secure areas need to be entered to carry out this project.

e. Staging Area. The Base will provide a staging area for the A-E and any subcontractors to store equipment, supplies, in addition to any "drummed" materials.

f. Water Supply. The Base can provide water and potable water.

g. Equipment Cleanup. Decontamination area shall be designated by the Base. Sampling wastes shall be handled according to EPA and New Mexico ARARs. A contract modification may be necessary to dispose of wastes.

June 26, 1991

Paragraph 6. Chemistry

Analytical Plan.

1. General. Sampling activities are mostly in the Work Plan and further defined in this SOS, the chemical analysis for the RI investigation at Cannon AFB must follow the Work Plan which is EPA Contract Lab Plan (CLP) chemical procedures. All procedures and activities performed in the acquisition of data as described below must be included in the Chemical Data Acquisition Plan (CDAP) for approval.

2. Chemical Data Acquisition

2.1 Definition and Responsibility. Chemical data acquisition (CDA) consists of all field activities, laboratory activities, and contract deliverables related to the acquisition and reporting of chemical data for HTW investigation or remedial activities, which would include applicable activities at Cannon AFB. Chemical Data Acquisition as described in the CDAP must be approved by the CO prior to initiation of field work. In the event corrections and comments on the draft are provided by the CO, the changes,documented by written annotated comments shall be incorporated by the authors in a revised plan before final approval is given. It should be noted that the purpose and content of the CDAP are the same as the QAPP required for Superfund investigations by the EPA. Additional requirements by the State of New Mexico shall also be addressed.

2.2 USACE Chemical Quality Data Management. USACE requires that Quality Control (QC) and Quality Assurance (QA) samples be collected and analyzed by the contract laboratory and the USACE QA laboratory, respectively. These QC and QA samples include splits or replicates of field samples. QC samples, help the contractor and contract laboratory to identify and diagnose problems related to sampling and analysis. QA samples, are sent to a USACE QA laboratory by overnight delivery for government monitoring of sampling and contract laboratory performance. The number of QA/QC samples to be taken shall be detailed in the CDAP under Chemical Data Quality Objectives. When the following procedures, performed by the USACE QA laboratory, demonstrate that chemical quality control contract requirements were not met, samples may be reanalyzed and/or re-collected at the expense of the prime contractor:

2.2.1 Inspection of QA samples to insure that sampling procedures correspond to Chemical Data Acquisition with regard to sample containers, preservation, labeling, chain of custody, etc.

2.2.2 Analyses of QA samples.

2.2.3 Evaluation of contractor deliverables specified for the acquisition of data.

2.2.4 Comparison of analytical results obtained by contract laboratory and USACE QA laboratory from split or replicate samples. The procedures for obtaining QA laboratory services are in Appendix E to ER 1110-1-263.

2.3 Contract Laboratory Validation. Any laboratory performing chemical analyses shall be already participating in the EPA's Contract Laboratory Plan and it must be operating in strict compliance with that program, in addition it must be validated by USACE Missouri River Division (MRD). Laboratories are validated for each environmental matrix and each specific analytical method to be employed. If the prime contractor selects a laboratory which has a current (within 1 year) validation for all analytes and matrices specific to its project,additional evaluation will not be necessary. If the prime contractor selects a laboratory which does not have a current validation, the laboratory shall be validated prior to approval of the CDAP. Commercial laboratory validation procedures are in Appendix C to ER 1110-1-263. Samples may not be subcontracted to another laboratory without the approval of CEMRD and unless the second laboratory is validated for the parameters concerned.

2.3.1 The prime contractor or the contract laboratory will hold or make available all project raw data for a period of five years after samples have been analyzed.

2.4 CHEMICAL DATA ACQUISITION elements of the CDAP include the following as a minimum.

2.4.1 Project Description. This section shall include a description of the work site and any unusual conditions. Anticipated project start and completion dates shall be estimated. This section shall also provide a summary of past and future work at the site including past multimedia chemical data of significance as well as a presentation of the multimedia sampling to be carried out in the present work effort.

2.4.2 Chemical Data Quality Objectives. This section shall include a description of the general scope of work and relevant background information as it relates to the acquisition of chemical analytical data. State the objectives of the project: what questions must be answered and what decisions must be made. Describe the level and extent of chemical data required to answer questions and support decisions during the project: the approach for sample collection,sample analysis, and QA/QC which will result in the required chemical data.

2.4.3 Contractor Project Organization and Functional Area Responsibilities. The project organization for the prime contractor and any subcontractors shall be clearly defined with a discussion of quality control responsibilities. The prime contractor's Quality Assurance (QA) Officer shall report to a responsible senior officer of the company (i.e., QA management shall be separate from project management). A list of all individuals shall be provided and will include QC officers for the various components (those responsible for initiating and carrying out corrective actions and those involved in the data reporting sequence) and all analytical laboratory personnel(supervisors, chemists, and technicians). Resumes of all non-laboratory Contractor personnel listing education and experience are required, including personnel collecting samples. List the names of field personnel that will wear monitoring equipment. For laboratory personnel that are not included in the Lab Quality Management Plan, resumes listing education and experience are required.

2.4.4 Field Activities. Briefly summarize types of field activities required by the project.

2.4.5 List of Equipment, Containers, and Supplies to be taken to the Field. This section shall include all sample screening equipment to be used (brand, model, serial number) and a description of its calibration as well as sampling equipment, decontamination supplies and sample containers (specific numbers and types).

2.4.6 Sampling Locations. This section shall provide the location of each sampling point on a site map. These locations shall be identified by the Contractor after a visual inspection if they are not already specified. The rationale for the sampling location and frequency (including QA/QC) shall be addressed in the Section Data Quality Objectives.

2.4.7 Sampling and Preservation Procedures. The CDAP shall include a table, which lists sampling locations, matrix (waste, soil,water, tc.), number of field samples, number of split or replicate samples, etc. Specific sampling, preservation, etc., details shall be included. All details shall meet the requirements of one of the following: (a) EPA SW-846 method; (b) another EPA method; (c) ASTM method; (d) NIOSH method (for air sampling); or (e) another accepted published method. Container and preservation specifications shall meet all appropriate requirement. (see Appendix F to ER 1110-1-263). Each table entry shall include the reference, if any, from which the specifications were taken. Any modifications to the standard methods must be approved by the CO with the concurrence of the QA laboratory prior to their use. All methods should be referenced to the most recent edition of their source. If a standard method is not available, the Contractor or subcontractors shall propose a nonstandard method with validation data for approval by the CO.

2.4.8 Details of Sampling and Preservation Procedures. The composition and volume of sample containers shall be specified along with a description of their preparation and cleaning. Sampling equipment directly contacting the sample shall be stainless steel or Teflon. The CDAP shall describe the cleaning of equipment and precautions for prevention of sample cross contamination during collection. Any field screening methods employed to select samples for analyses shall be discussed in detail. Compositing and homogenizing procedures shall be included where appropriate. Sample containers, volumes, preservatives and holding times for the common analyses in low concentration are to be presented CDAP.

2.4.8.1 Soil Sampling Procedure. Using stainless steel or Teflon sampling equipment enough solid is removed from a specified depth to fill the required containers. The volatile organic samples should be removed first with as little mixing as possible. The remaining soil shall be placed in a clean stainless steel bowl and mixed thoroughly with stainless steel implements (spoons, spades, etc.), then divided among the sample containers to be filled and properly preserved. QC and/or QA sample containers shall be filled from the same mixture as one of the samples. If other methodologies are warranted as specified by the Data Quality Objectives they must also be clearly defined in the CDAP.

2.4.8.2 Water Sampling Procedure. An attempt shall be made to obtain the most representative water samples where appropriate, which includes field blanks,etc. Containers to be analyzed for volatiles should be filled first allowing no headspace and with as little disturbance of the water as possible. If preservative is added to the bottles prior to shipment to the field, care must be taken not to overfill the containers and pH must be measured on samples where a value is specified.

2.4.8.3 Other Matrices. Sampling methods and equipment used shall meet the requirements of EPA or NIOSH methods.

2.4.9 Field Documentation. The system for identifying and tracking the samples shall be described, and shall include the recording of field data in permanently bound notebooks along with the method of relating the field data to the proper samples. All field documentation shall be done in indelible ink. Daily Quality Control Reports shall be prepared daily, dated, signed by the site manager, and sent to the CO at a rate agreed to by the A-E and the CO. These reports shall include (with respect to chemistry) weather information at the time of sampling, samples taken with reference given to appropriate sections of the CDAP, field instrument measurements and calibrations. Any deviations from the CDAP shall be stated.

2.4.10 Sample Chain of Custody and Transportation. All sample labeling, packing, transportation and chain of custody procedures shall follow the Work Plan or CLP.

2.4.11 Laboratory Analytical Procedures. Specific laboratory procedural details shall be included in the CDAP. Each method shall be specified exactly and in detail for example by one of the following: (a) reference to an EPA SW-846 method; (b) reference to another EPA method; (c) reference to an ASTM method; (d) reference to a NIOSH method (for air analysis); (e) reference to another accepted published method; (f)reference to an accepted published method with a description of any deviations from the published procedure; or (g) complete description of the procedure, e.g., copies of laboratory instructions. Generally, nonstandard methods are not desired. In special cases that require the consideration of nonstandard methods, the contract laboratory shall be prepared to provide validation data. The use of proposed nonstandard methods requires prior approval of the CO. A list of sample preparation and analytical methods most frequently used is presented in Table D-2 (ER-1110-1-263). A table shall be included which lists for each matrix sample preparation method number, analytical method number, analytes and laboratory quantitation limits.

2.4.12 Preventive Maintenance. The instrument, including manufacturer, model, accessories, etc., shall be specified and preventive maintenance shall be described. Preventive maintenance shall be performed by qualified personnel. Records of repairs,adjustments and calibrations shall be maintained and available for inspection by the CO on request. This includes any field instrumentation.

2.4.13 Instrument Calibration and Frequency. Description of the procedure used for calibration and frequency of checks is required for each instrument or method including field instruments. These shall be consistent with the requirements of the contract and the analytical method.

2.4.14 Analytical Methods. Include the required concentration range and data on the sensitivity (detection limits), precision, and accuracy. Indicate how pre-existing data on sensitivity, precision, and accuracy were determined, and procedures to be used to validate the method. State source and purity of analytical reference materials and laboratory chemicals necessary to perform the analyses. Nominal detection limits for common analytes are given i the Work Plan. DQO's for specific projects will affect the value of required detection limits and goals for precision, accuracy, and completeness.

2.4.15 Method Specific Data Quality Objectives. Provide objectives for precision, accuracy, detection limits, and completeness. DQO's for accuracy and precision established for each measurement parameter will be based on prior knowledge of the specific measurement system used and method validation studies employing replicate analyses, spikes, standards, calibrations, recoveries, control charts and project specific requirements. Completeness refers to the amount of valid data obtainable (by the specific method in the laboratory used with the instrument to be employed) from a measurement system compared to the expected amount of data, and is usually expressed as a percentage.

2.4.16 Quality Control Checks. Quality control checks are necessary to evaluate performance reliability for each measurement parameter. Describe procedures to assess the precision, accuracy and completeness of the measurement. The numbers and types of internal laboratory QC checks and samples proposed (e.g., blanks, duplicates, splits, spikes, surrogates, and reference standards, as applicable) shall be defined clearly. At a minimum these must be run at the rates prescribed in the individual methods. The laboratory's established practice for including control samples among the samples analyzed, and any additional controls required by the present project, shall be described. Describe the feedback systems used to identify problems by means of the results obtained from control samples. Limits of data acceptability shall be included. Results from laboratory internal quality control checks shall be reported with the analytical data.

2.4.17 Corrective Action. Plans for corrective actions to be taken when results appear unusual, questionable, or limits of acceptability are exceeded shall be included. When limits of acceptability are exceeded, information justifying the poor recovery or precision shall be documented. Describe how reestablishment of control is demonstrated.

2.4.18 Data Reduction, Validation, and Documentation. Equations, including units, required to calculate the concentration or value of the measured parameter, shall be included. Describe the data management systems which collect raw data, store data, and document quality control data. If statistical procedures are used for data review before reporting, include descriptions. Data validation procedures and organization shall be specified. The contract laboratory or the prime contractor hold and make available all project raw data for a period of two years after samples have been analyzed.

2.4.19 Chemical Data Quality Control Deliverables. The contractor shall address the frequency and content of chemical data quality control reports that shall be submitted during the project.

2.4.19.1 Daily Quality Control Report (DQCR) during field activities.

2.4.19.2 Daily Quality Control Report from the contract laboratory if appropriate.

2.4.19.3 Non-routine Occurrences. Include problems identified, corrective actions, and verbal/written instructions from USACE personnel for sampling or re-analysis. These reports of significant problems should be sent to the CO within 48 hours of the occurrence.

2.4.19.4 Data Report to the QA Laboratory. The contractor's data must be submitted to the designated quality assurance laboratory (for data validation and comparison purposes) as soon as it is available. This submittal should include all sample, blank and internal quality control results such as spike and surrogate recoveries and agreement between replicate analyses. Interim data reports may be requested if the project warrants them. The following are minimum data reporting requirements:

2.4.19.4.1 Sample IDs. The contractor shall prepare a tabular presentation which matches contract laboratory sample Ids to QA laboratory sample Ids. This table shall identify all Field Duplicates and Field Blanks as such and match with their corresponding field samples where applicable.

2.4.19.4.2 Sample Receipt. The contractor shall complete and report a "Cooler Receipt Form" for all shipments for purposes of noting problems in sample packaging, chain-of-custody, and sample preservation.

2.4.19.4.3 The Quality Assurance (QA) Laboratory for this project shall be the Corps of Engineers, Missouri River Division Laboratory (CEMRD-L). The QA lab shall be notified approximately one (1) week prior to any QA sample shipments being shipped to the CEMRD laboratory. Saturday shipment arrivals shall be cleared with the lab in advance.

The QA shipping address is:

COMMANDER,
U.S.ARMY CORPS OF ENGINEERS, MISSOURI RIVER DIVISION
ATTN: CEMRD-L (Sample Custodian)
420 South 18th Street
Omaha, NE 68102-2586

Telephone: (402) 444-4314

Sample acceptance is normally 8:00 AM to 3:30 PM, Monday through Friday. All field samples and Quality Control (QC) samples shall be delivered to the A-E's contract laboratory. The receiving laboratory shall be given an appropriate advance notice, as worked out with the lab. The MRD Lab will be notified one week prior to the first delivery of samples and a 24 hour notice. Saturday delivery shall require special arrangements. The A-E may use their own "chain of custody" form when submitting samples.

2.4.19.4.4 General Organic And Inorganic Reporting. For each analytical method run, the contractor shall report all analytes for each sample as a detected concentration or as less than the specific limits of quantitation. Generally, all samples with out-of-control spike recoveries being blamed on matrix interferences shall be designated as such. All soil samples shall be reported on a dry-weight basis with percent moisture also reported unless otherwise approved. The contractor shall also report dilution factors for each sample as well as the date of extraction (if applicable) and date of analysis.

2.4.19.4.5 Internal Quality Control Reporting (at a minimum, internal quality control samples shall be analyzed at rates specified in the specific methods or higher rates if required to meet project specific Data Quality Objectives):

2.4.19.4.4.1 Laboratory Blanks (Method Blanks and Instrument Blanks). All analytes shall be reported for each laboratory blank. All non-blank sample results shall be designated as corresponding to a particular laboratory blank in term of analytical batch processing.

2.4.19.4.4.2 Surrogate Spike Samples. Surrogate Spike Recoveries shall be reported with all organic method reports where appropriate (i.e. when the method requires surrogate spikes). The report shall also specify the control limits for surrogate spike results as well as the spiking concentration. Any out-of-control recoveries (as defined in the specified method) shall result in the sample being rerun (both sets of data are to be reported) at no additional cost to the government.

2.4.19.4.4.3 Matrix Spike Samples. Matrix Spike Recoveries shall be reported for all organic and inorganic analyses. All general sample results shall be designated as corresponding to a particular matrix spike sample. The report shall indicate what field sample was spiked even if it was not a Corps of Engineers project sample. The report shall also specify the control limits for matrix spike results for each method for each matrix.

2.4.19.4.4.4 Laboratory Duplicates and/or Matrix Spike Duplicate Pairs. Relative Percent Difference shall be reported for all duplicate pairs as well as analyte/matrix specific control limits.

2.4.19.5 Quality Control Summary Report (QCSR). This document addresses quality control practices employed and summarizes the DQCR. Issues covered in this report shall include a discussion o fall data points which may have been influenced or compromised and their impact on the Data Quality Objectives or remedial decisions. An example of the elements required for this level of effort are presented below, but are not limited to the following items:

2.4.19.5.1 Project Description - Elements of this include report organization and site description.

2.4.19.5.2 Laboratory Quality Control Activities - Elements are a summary of planned laboratory quality control activities, a summary of any deviations from planned activities, and a summary of the evaluation of the data quality for each analysis and matrix.

2.4.19.5.3 Field Quality Control Activities - Elements are a summary of planned field quality control activities, a summary of any deviations from planned activities, and a summary of the evaluation of the quality of the sampling.

2.4.19.5.4 Data Presentation and Evaluation - Elements are an assessment of sampling and analysis techniques, an evaluation of the data quality of each matrix and parameter, and an evaluation of the usability of the data.

2.4.19.5.5 Lessons Learned - A summary of field or analytical procedures that could be changed or modified to better characterize chemical contamination in future work efforts.

2.4.19.5.6 DQCR Consolidation - Daily Quality Control Reports are to be consolidated and summarized.

3. Analytical Requirements. The matrix-specific analytical methods are to be presented in the CDAP, along with appropriate digestion methods must be specified in the CDAP. These methods must be EPA-approved and consistent with any applicable current State of New Mexico requirements as well as meeting specific Data Quality Objectives. The objectives and rationale and end data use for these methods must be clearly stated in the CDAP. These methods must be followed explicitly and all quality control procedures detailed in the respective methods unless otherwise authorized by the Corps of Engineers. Analytical and statistical control parameters are outlined in the Work Plan and further defined in Appendix A.

3.1 Soil. Soil samples taken from the previously documented sites shall be analyzed by approved EPA methods as described in the Work Plan, unless otherwise indicated. These methods must be detailed as described above for the CDAP.

3.1.1 Volatile organics shall be analyzed according to the Work Plan for all compounds listed in the Targeted Compound List of this method unless otherwise approved. (This analysis shall also include a ten peak library search for the tentative identification of compounds not on the above list). This method is recommended based upon its potential for positive identification.

3.2.3 Semi-volatile organics shall be prepared by methods as proscribed the Work Plan or the EPA CLP Program for all compounds in the Targeted Compound List (TCL) of this method unless other wise outlined in the CDAP. In addition, a twenty peak library search shall tentatively identify compounds not listed in the TCL. Appropriate extract cleanup methods shall also be performed where needed.

Paragraph 7.

7. Travel and Meetings. The A-E shall perform the following travel as part of the contract requirement, and the cost thereof shall be included with the contract cost. Responsible representatives from the appropriate disciplines shall attend meetings and/or make the following listed trips:

a. Field Work. All travel and/or mobilization required to obtain field data necessary to complete the Assessment as detailed herein.

b. Meetings. Attendance by the A-E will be required at seven meetings noted below.

(1) ARARs Clarification Meeting to reach agreement about the ARARs for this project. Meeting will be at Cannon AFB.

(2) Pre-Field Work Safety Meeting a few days before the field work shall start. The purpose of this meeting will be to discuss the field schedule; and allow the Base offices, Flight Line offices, Government, and the A-E to air any concerns, conflicts or problems regarding the field work which is about to start. Meeting will be at Cannon AFB.

(3) Demobilization Meeting to insure the completion of the field work is smooth, such as the sampling wastes are properly stored. Meeting will be at Cannon AFB.

(4) Lab Analytical Meeting to allow the A-E to present and discuss the project analytical results with the HQ TAC, Base, State, EPA, and Corps of Engineers analytical staff. The A-E shall be prepared to discuss any technical difficulties encountered during sample analysis, any anomalies, false positive or other laboratory problems encountered during analysis. Meeting will be at Cannon AFB.

(5) Pre-Draft RI Report and Draft DPM Ranking Meeting to review and discuss comments made about the documents. Meeting will be at Cannon AFB.

(6) Draft RI, Final DPM, and Draft Decision Documents Meeting to review and discuss comments made about the documents. Meeting will be at Cannon AFB.

(7) Pre-Final RI, Final Decision Documents Meeting to review and discuss comments made about the documents. This will be the last chance to discuss the RI Report before publishing. Meeting will be at Cannon AFB.

8. General.

a. Government Provided Work Plan Volumes I & II dated June 1990.

b. Review of Progress and Technical Adequacy.

(1) The A-E, under this contract, will interpose no objection nor restriction to the Contracting Officer's designation of another A-E for the purpose of reviewing the adequacy and correctness of the work performed under this contract.

(2) The A-E shall submit monthly progress report to the USACE PM. The monthly progress report shall indicate work performed and problems incurred during the month. The monthly progress reports shall list costs separately to aid the USACE PM in confirming payment requests.

c. Meeting Notes and Confirmation Notices.

(1) Meeting Notes. The A-E will be responsible for taking notes and preparing the reports of all meetings. Three (3) sets of meeting notes shall be prepared in typed form. The three sets shall be furnished the USACE PM. The notes will be provided within approximately seven days after the meeting. All discrepancies shall be discussed with the USACE PM, and if necessary the A-E shall resubmit the report. This report shall include the following items as a minimum:

(a) The date and place the meeting was held with a list of attenders. The roster shall include name, organization, and phone number.

(b) Written comments presented by attenders shall be attached to each report with the meeting action noted. Action shall be "A" for Approved comment, "D" for Disapproved comment, "W" for a comment that has been Withdrawn, and "E" for a comment that has an Exception noted.

(c) Comments made during the meeting, decisions affecting criteria changes, must be recorded in the basic meeting notes. Any augmentation of written comments should be documented by the meeting notes.

(2) Confirmation Notices. The A-E will be required to provide a record of all discussions, verbal directions, telephone conversations, etc., participated in by the A-E and/or his representatives on matters relative to this project and the work, irrespective of whom the other participants may have been. These records, entitled "Confirmation Notices", will be numbered sequentially and shall fully identify participating personnel, subjects discussed, and any conclusions reached. The A-E shall forward to the USACE PM within five (5) work days, a reproducible copy of said confirmation notices. Distribution of said confirmation notices will by made by the Government.

(3) Expert Testimony. All technical consultants required for the investigation provided by the A-E shall be qualified to give expert witness testimony, if required. In the event of litigation, the contract will be modified or a new contract issued to the A-E for the additional services.

Paragraph 9. HEALTH AND SAFETY INSTRUCTIONS

a. Health and Safety General. The Architect-Engineer (A-E) responsible for the tasks defined by this Scope of Services (SOS) shall review all information provided and develop the necessary documents which contain the health and safety criteria, procedures, and practices sufficient to protect on-site personnel, the environment, and potential off-site receptors from the chemical, physical, and/or biological hazards particular to this site. The A-E shall utilize the services of a Certified Industrial Hygienist (CIH) experienced in hazardous waste site operations to oversee the development and implementation of the health and safety documents required by this section. If the information made available is insufficient to allow the A-E to develop these document, a description of all additional information required shall be prepared and submitted to the Contracting Officer (CO).

b. Regulatory Requirements. All site investigation activities and health and safety documents required by this SOS shall comply with and reflect the following regulations and appropriate guidance publications, as a minimum:

(1) Federal Acquisition Regulation, F.A.R. Clause 52.236-13: Accident Prevention.

(2) U.S. Army Corps of Engineers (USACE), Safety and Health Requirements Manual, EM 385-1-1 (latest revision).

(3) Occupational Safety and Health Administration (OSHA) Construction Industry Standards, 29 CFR 1926, and General Industry Standards, 29 CFR 1910; especially 29 CFR 1910.120 - "Hazardous Waste Site Operations and Emergency Response."

(4) NIOSH/OSHA/USCG/EPA, "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities", October 1985.

(5) Other applicable Federal, State, and local safety and health requirements.

c. Documents. The following health and safety documents are required under this SOS. Avoid providing material of a general nature, not specifically related to this project or site. Information readily available in standard texts should be repeated only to the extent necessary to meet the requirements of this scope. The Safety and Health Program (Paragraph 1.c.(1)) will contain general information required by the referenced OSHA standard which is applicable to all hazardous waste activity efforts performed by the contractor. The Site Safety and Health Plan (Paragraph 1.c.(2)) should be a brief document addressing only site-specific safety and health requirements and procedures based upon site-specific conditions. Duplication of the general information contained in the Safety and Health Program is unwanted.

(1) Safety and Health Program. All contractors (A-E and their subcontractors) performing on-site activities at hazardous waste sites are required by regulation to develop and maintain a written Safety and Health Program in compliance with OSHA standard 29 CFR 1910.120(b)(1) through (b)(4). Written certification that such a program has been prepared and implemented shall be submitted to the Contracting Officer (CO) as a preface to required Site Safety and Health Plans (SSHP). The program including updates shall be made available to the CO in its entirety upon request.

(2) Site Safety and Health Plan (SSHP). The Site Safety and Health Plan required by 29 CFR 1910.120(b)(4) shall be prepared by the A-E and submitted to the Contracting Officer for review and approval prior to the commencement of any on-site work activity to be performed by the A-E and/or subcontractors. This SSHP shall describe the health and safety procedures, practices, and equipment to be implemented and utilized in order to protect affected personnel from the potential hazards associated with the site-specific tasks to be performed. The level of detail provided in the SSHP shall be tailored to the type of work, complexity of operations to be accomplished, and hazards anticipated. All topics required by OSHA standard 1910.120(b)(4), and those described below, shall be addressed in the SSHP. Where the use of a specific topic is not applicable to the project, provide a negative declaration to establish that adequate consideration was given the topic, and give a brief justification for its omission.

(a) Site Description and Contamination Characterization. Describe the location, topography, and approximate size of the site, the on-site jobs/tasks to be performed, and the duration of planned site activities. Compile a complete list of the contaminants found or known to be present in site areas to be impacted by the work to be performed. Compilation of this list shall be based on results of previous studies; or if not available, select the likely contaminants based on site history and prior site uses/activities. Include chemical names, concentration ranges, media in which found, locations on-site, and estimated quantities/volumes to be impacted by site work, if known.

(b) Hazard/Risk Analysis. Identify the chemical, physical, biological, and safety hazards of concern for each site task and/or operation to be performed. Selection of chemicals as indicators of hazard shall be based on media concentrations, toxicity, volatility or potential for air entrainment at hazardous levels, and frequency of detection. Describe chemical and physical properties of selected contaminants, sources and pathways of employee exposures, anticipated on and off-site exposure level potentials, and regulatory (including Federal, State, and local) or recommended protective exposure standards. Specify and justify "action levels" based upon airborne exposure hazards and direct skin contact potentials for upgrades/downgrades in levels of personnel protection; for implementation of engineering and/or work practice controls; for emergency evacuation of on-site personnel; and for the prevention and/or minimization of public exposures to hazards created by site activities. Air monitoring/sampling shall be performed in accordance with Paragraph: "Exposure Monitoring/Air Sampling Program" below, resulting data compared with established "action levels", and appropriate corrective actions initiated as necessary.

(c) Accident Prevention. The SSHP will serve as the Accident Prevention Plan (APP) and activity hazard analyses (phase plans), required by F.A.R. Clause 52.236-13, and Paragraphs 01.A.03 through 01.A.06 and Appendix Y of USACE EM 385-1-1. Thus, a separate APP is not necessary. Any additional topics required by EM 385-1-1, but not specifically covered in Paragraph c.(2) of this SOS, shall be addressed in an Accident Prevention section of the SSHP. Daily safety and health inspections shall be conducted to determine if operations are being performed in accordance with the SSHP, USACE and OSHA regulations, and contract requirements. In the event of an accident/incident, the A-E shall immediately notify the CO. Within two (2) working days of any reportable accident, the A-E shall complete and submit to the CO an Accident Report on ENG Form 3394 in accordance with AR 385-40 and USACE Supplements to that regulation.

(d) Staff Organization, Qualifications, and Responsibilities. Discuss the organizational structure, including lines of authority (chain of command), and overall responsibilities of the contractor and all subcontractors for site activities, including supervisor/employee relationships. Summarize the operational and health and safety responsibilities and qualifications of each key person identified. Specifically: (1) A Certified Industrial Hygienist (CIH) with experience in the hazardous waste site operations shall be responsible for the development, implementation, and oversight of the A-E's Safety and Health Program and SSHP. The SSHP shall be signed and dated by the CIH prior to submittal. (2) A fully trained and experienced Site Safety and Health Officer (SSHO), responsible to the contractor and the CIH, may be delegated to implement and continually enforce the safety and health program and site-specific plan elements on-site. (3) At least one person certified in first aid/CPR by the Red Cross, or equivalent agency, shall be continuously present on-site during site operations.

(e) Training. All personnel performing on-site activities shall have completed applicable training in accordance and compliance with 29 CFR 1910.120(e). In addition, site-specific training covering site hazards, procedures, and all contents of the approved SSHP shall be conducted by the SSHO for on-site employees and visitors prior to commencement of work or entering the site. The type, duration, and dates of all employee training performed shall be listed by employee name and certified in the SSHP.

(f) Personal Protective Equipment (PPE). In accordance with 29 CFR 1910.120(g)(5), a written Personal Protective Equipment (PPE) program which addresses all the elements listed in that regulation, and which complies with respiratory protection program requirements of 29 CFR 1910.134 is to be included in the A-E's Safety and Health Program. Therefore, the SSHP shall detail the minimum PPE ensembles (including respirators) and specific materials from which the PPE components are constructed for each site-specific task/operation to be performed, based upon the hazard/risk analysis performed above. Components of levels of protection (A,B,C,D and modifications) must be relevant to site-specific conditions, including heat stress potential and safety hazards. Include site-specific procedures for on-site fit-testing, cleaning, maintenance, inspection, and storage.

(g) Medical Surveillance. All personnel performing on-site activities shall be participants in an ongoing medical surveillance program, meeting the requirements of 29 CFR 1910.120 and ANSI Z-88.2. A description of the general medical surveillance program is to be included in the A-E's Safety and Health Program. All medical surveillance protocols and examination results shall be reviewed by a licensed physician who is certified in Occupational Medicine by the American Board of Preventative Medicine, or who, by necessary training and experience, is Board-eligible. The SSHP shall only describe the content and frequencies of any additional medical tests/examinations/consultations determined necessary by the physician due to probable site-specific conditions, potential occupational exposures, and required protective equipment. Certification of participation in the medical surveillance program, the date of last examination, and name of reviewing occupational physician shall also be included for each affected employee. The written medical opinion from the attending physician required by 29 CFR 1910.120(f)(7) shall be made available upon request to the CO for any site employee.

(h) Exposure Monitoring/Air Sampling Program. (Personal and Environmental). Where it has been determined that there may be employee exposures to and/or off-site migration potentials of hazardous airborne concentrations of hazardous substances, appropriate direct-reading (real-time) air monitoring and integrated (time-weighted average (TWA)) air sampling shall be conducted in accordance with applicable regulations (OSHA, EPA, State). Both air monitoring and air sampling must accurately represent concentrations of air contaminants encountered on and leaving the site. Sampling and analytical methods following NIOSH (for on-site personnel and site perimeter locations) and/or EPA (for site perimeter or off-site locations) criteria shall be appropriately utilized. Personnel samples shall be analyzed only by laboratories successfully participating in and meeting the requirements of the American Industrial Hygiene Association's (AIHA) Proficiency Analytical Testing (PAT) or Laboratory Accreditation programs. Meteorological monitoring shall be performed on-site as needed and used as an adjunct in determining perimeter and any off-site monitoring/sampling locations. Where perimeter monitoring / sampling is not deemed necessary, provide a suitable justification for its exclusion. Noise monitoring and radiation monitoring (alpha, beta, gamma) shall be conducted as needed, depending on the site hazard assessment. All monitoring/sampling results shall be compared to "action levels" established pursuant to Paragraph: "Hazard/Risk Analysis", above, to determine acceptability and need for corrective action.

(i) Heat/Cold Stress Monitoring. Heat and/or cold stress monitoring protocols shall be implemented, as appropriate. Work/rest schedules shall be determined based upon ambient temperature, humidity, wind speed (wind chill), solar radiation intensity, duration and intensity of work, and protective equipment ensembles. Minimum required physiological monitoring protocols which will affect work schedules shall be developed. In cases where impervious clothing is worn (full-body), the NIOSH/OSHA/USCG/EPA "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities" protocol for prevention of heat stress shall be followed, and heat stress monitoring shall commence at temperatures of 70 degrees Fahrenheit and above. Where impervious clothing is not worn, the most current published ACGIH heat stress standard (TLV) shall be used. For cold stress monitoring to help prevent frostbite and hypothermia, the most current published ACGIH cold stress standard shall be referenced and followed, as a minimum.

(j) Standard Operating Safety Procedures, Engineering Controls and Work Practices. Address the following elements as a minimum: (1) Site rules/prohibitions (buddy system, eat/drink/smoking restrictions, etc.); (2) Material handling procedures (soils, liquids, radioactive materials); (3) Drum/ container handling procedures and precautions (opening, sampling, overpacking); (4) Confined space entry procedures; (5) Hot-work, sources of ignition, and electrical safety (ground-fault protection, overhead power line avoidance, etc.); (6) Excavation safety; (7) Machine guarding; (8) Fall protection; (9) Illumination; (10) Sanitation; (11) Engineering controls.

(k) Site Control Measures. Include a site map containing work zone delineation and access points. Describe on-site and off-site communications, security (physical and procedural), and general site access.

(l) Personal Hygiene and Decontamination. Specify necessary facilities and their locations. Detail standard operating procedures, frequencies, supplies and materials to accomplish decontamination of site personnel.

(m) Equipment Decontamination. Specify necessary facilities, equipment, and their locations. Detail procedures, frequencies, supplies and materials, and methods to determine adequacy for the decontamination of equipment used on-site.

(n) Emergency Equipment and First Aid Requirements. The following items, as appropriate, shall be immediately available for on-site use: (1) First aid equipment and supplies approved by the consulting MD; (2) Emergency eyewashes/showers (comply with ANSI Z-358.1); (3) Emergency respirators (worst-case appropriate); (4) Spill control materials and equipment; and (5) Fire extinguishers (specify type, size, locations).

(o) Emergency Response and Contingency Procedures (On-Site and Off-Site). This section of the SSHP shall contain an Emergency Response Plan in compliance with 29 CFR 1910.120(l), which addresses the following elements, as a minimum: (1) Pre-emergency planning and procedures for reporting incidents to appropriate government agencies for potential chemical exposures, personal injuries, fires/explosions, environmental spills and releases, discovery of radioactive materials; (2) Personnel roles, lines of authority, communications; (3) Posted instructions and a list of emergency contacts: (physician, nearby medical facility, fire and police departments, ambulance service, federal/state/local environmental agencies, CIH, Contracting Officer); (4) Emergency recognition and prevention; (5) Site topography, layout, and prevailing weather conditions; (6) Criteria and procedures for site evacuation (emergency alerting procedures/employee alarm system, emergency PPE and equipment, safe distances, places of refuge, evacuation routes, site security and control); (7) Specific procedures for decontamination and medical treatment of injured personnel; (8) Route maps to nearest pre-notified medical facility; (9) Criteria for initiating community alert program, contacts, and responsibilities; and (10) Critique of emergency responses and follow-up.

(3) Logs, Reports, and Recordkeeping. The following logs, reports, and records shall be developed, maintained, and submitted to the CO at the conclusion of the site work: (1) Training logs (site-specific, visitor); (2) Daily safety inspection logs (may be part of the Daily QC Reports); (3) Employee/visitor register; (4) Environmental and personal exposure monitoring/sampling results.

d. Document Revisions, Addenda, and Field Modifications. Review comments issued prior to SSHP approval shall be incorporated by revising and reissuing affected pages. If major revisions are necessary, the entire Plan shall be resubmitted for review and approval. Minor changes affecting only a few pages may be made by addenda sheets and resubmitted. Once on-site, unanticipated field conditions encountered which were not addressed in the approved SSHP shall be immediately reported to the CO. Field activities in such areas shall be halted until the SSHP has been modified to reflect changed conditions and reviewed/approved by the CO.

Paragraph 10 Geology.

1.0 Field Investigations. A Chemical Data Acquisition Plan (CDAP) shall be submitted by the A-E for approval before any field work is begun. This plan shall include, at a minimum, the A-E's methods, equipment, and procedures for carrying out all field work including drilling, soil, sediment, ground water and surface water sampling, monitoring well installation, well development, ground water sampling, and decontamination procedures.

The A-E shall provide a qualified geologist or geotechnical engineer who shall be on site and responsible for all soil sampling during all soil sampling activities. A qualified geologist shall be on site and responsible for all monitoring well drilling, installation, development and testing activities. The A-E shall notify the U.S. Army Corps of Engineers (USACE) representative at least one week prior to the initiation of any of the above field investigations so that a USACE representative can plan to be present for field oversight.

2.0 Soil Borings and Monitoring Well Installations (General). Soil borings and monitoring wells will be required to investigate the vertical and horizontal extent of site-specific contaminants. Soil samples for chemical analysis will also be required from borings drilled for monitoring well installations, as described in the Site Specific section of this Scope of Services. Guidance for all field activities may be obtained from CEMRD Policy Letter # 90-001 Installation of Ground-Water Monitoring Wells and Exploratory Borings at Hazardous Waste Sites. All borings for soil sampling and monitoring well installations will be drilled and sampled according to the following requirements.

2.1 General Specifications. The wells shall be constructed according to all applicable state and local requirements. If the specifications as set forth in this Scope of Services do not meet state or local requirements, contact the Corps' Project Manager (USACE-PM) for resolution of differences. The Contractor is responsible for determining applicable state and local requirements.

2.2 Utility Clearances and Permits. The A-E is responsible for obtaining all state and local well permits required for wells with the yields anticipated during development and sampling. The A-E shall also be responsible for obtaining and coordinating all utility clearances with the site coordinator. If it is necessary to move a boring in order to avoid utilities, the A-E shall be responsible for relocating the boring to a suitable location which accomplishes the intent of the original location. The new location shall be as close as possible to the original location. The A-E shall take all reasonable precautions to protect persons and property near the drill site, and shall restore the site to its original state when the field investigations are complete.

2.3 Drilling Methods and Decontamination. All borings shall be drilled by a method of the A-E's choosing. The method(s) shall be proposed by the A-E and approved by the USACE prior to use. The method(s) shall also be discussed in the A-E CDAP. The drilling method must allow, or provisions must be made for, accurate determination of the depth to ground water surface. All drill pipe, the working face of the drill rig, sampling equipment, and well casing shall be steam cleaned prior to use at each well. The boring shall be of sufficient diameter to permit at least two (2) inches of annular space between the boring wall and the sides of the centered riser and screen. The boring diameter shall be of sufficient size to allow for the accurate placement of the screen, riser and centralizers, filter pack, seal and grout. Soil samples taken from monitoring well borings for chemical sampling purposes shall be obtained with a stainless steel split-spoon sampler. Soil volume recovered shall be adequate for analytical requirements. Use of a 3-inch diameter split spoon is acceptable, and is recommended. If the sample volume still is not adequate, another sample shall be attempted from the same depth in a boring drilled immediately adjacent to the boring in which the sample failed. This shall be done at no additional cost to the Government. Some soil samples for chemical analysis may be obtained with a stainless steel hand auger.

All sampling equipment shall be decontaminated before use by steam cleaning or using Liquinox or equivalent, followed by a tap water rinse, an isopropanol rinse, and a double deionized water rinse. Rinse waters shall be contained in pump sprayers to prevent used rinse water from contaminating subsequent samples. The working face of the rig and drill rods shall be steam cleaned between holes. The rig shall be free of leaks which could contaminate the holes (i.e., hydraulic fluid, oil, gas, etc.). No grease shall be used on drill pipe joints; however, Teflon tape or vegetable oil is acceptable. Air quality shall be monitored in and near the hole during drilling using a photoionization detector (PID) or organic vapor detector (OVA).

2.4 Geotechnical Sampling Requirements. In addition to samples required for chemical analysis described in the Site Specific section of this Scope of Services, soil samples shall be taken for lithologic description as described below:

| Test Type | Number of Tests |
|---|---|
| Gradation analysis (ASTM D 421 & 422) | One per boring 15' or less<br>Two per boring 16' to 80'<br>Three per boring beyond 81' |
| Standard Penetration Test (ASTM D 1586-84) | Four in the first ten feet of drilling and two every ten feet of drilling thereafter to the bottom of the boring. |

2.5 Logs. All drill logs shall subscribe to the following requirements:

2.5.1 Logs shall be prepared in the field, as borings are drilled, by a qualified, experienced geologist or geotechnical engineer. Each log shall be signed by the preparer.

2.5.2 All log entries shall be printed. Photo reproductions shall be clear and legible. Illegible or incomplete logs will not be accepted. Copies shall be submitted to USACE-PM as borings are completed.

2.5.3 Borehole depth information shall be from direct measurements accurate to 0.10 feet.

2.5.4 Logs shall be prepared on the attached sheets.

2.5.5 All relevant information blanks in the log heading and log body shall be completed. If surveyed horizontal control is not available at the time of drilling, location sketches referenced by measured distances or prominent surface features, shall be shown on, or attached to the log.

2.5.6 Log scale shall be 1 inch = 1 foot.

2.5.7 Each and every material type encountered shall be described in column c of the log form. (Material types are to be logged directly from samples and indirectly interpolated using professional judgement, drill cuttings, drill action, etc., between sampling intervals.)

2.5.8 Unconsolidated materials shall be described as follows:

2.5.8.1 descriptive USCS classification;

2.5.8.2 consistency of cohesive materials or apparent density of non-cohesive materials;

2.5.8.3 moisture content assessment, e.g., moist, wet, saturated, etc.;

2.5.8.4 color;

2.5.8.5 other descriptive feature (bedding characteristics, organic materials, macrostructure of fine-grained soils e.g., root holes, fractures, etc.);

2.5.8.6 depositional type (alluvium, till, loess, etc.).

2.5.9 Rock materials shall be described in accordance with standard geologic nomenclature, including:

2.5.9.1 rock type;
2.5.9.2 relative hardness;

2.5.9.3 density;

2.5.9.4 texture;

2.5.9.5 color;

2.5.9.6 weathering;

2.5.9.7 bedding;

2.5.9.8 fractures, joints, bedding planes, and cavities, including any filling material and whether open or closed; and

2.5.9.9 other descriptive features (fossils, pits, crystals, etc.).

2.5.10 Stratigraphic/lithologic changes shall be identified in column c 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, changes identified from cuttings or methods other than direct observation and measurement shall be identified by a horizontal dashed line at the appropriate scale depth based on the best judgment of the logger.

2.5.11 Logs shall clearly show in columns e and f, the depth intervals from which all samples are retained.

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

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

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

2.5.15 Logs shall identify any drilling fluid losses including depths at which they occur, rate of loss and total volume lost.

2.5.16 Logs shall show drilling fluids used including, as appropriate:

2.5.16.1 source of make-up water;
2.5.16.2 drill fluid additives by brand and product name, and mixture proportions; and

2.5.16.3 type of filter for compressed air.

2.5.17 Logs shall show depths and types of any temporary casing used.

2.5.18 Logs shall identify any intervals of hole instability.

2.5.19 Intervals of lost bedrock core shall be shown in column e. Intervals of intact soil sampling attempts shall also be shown in column e, including depths from which attempts were made and length of sample recovered from each attempt. Bedrock coring information shall be recorded in consecutively numbered runs in column h and shall include the following:

2.5.19.1 start and stop time of each core run;

2.5.19.2 depth to top and bottom of each core run;

2.5.19.3 length of core recovered from each run.

2.5.19.4 size and type of coring bit and barrel; and

2.5.19.5 measured depth to the bottom of the hole after core is removed from each run.

2.5.20 Any special drilling or sampling problems shall be recorded on logs, including descriptions of problem resolutions.

2.5.21 Logs shall include all other information relevant to a particular investigation, including but not limited to :

2.5.21.1 odors;

2.5.22.1 HNu/OVA measurements or other field screening or test results; and

2.5.21.3 any observed evidence of contamination in samples, cuttings or drilling fluids.

2.5.22 Copies of the field logs shall be included in the Draft Project Report and Final Project Report; drafted boring logs shall be submitted in the Final Project Report.

2.6 Monitoring Well Construction Diagrams. NOT USED.

2.7 Backfilling. All borings shall be backfilled by tamping the cuttings back into the hole or all borings shall be backfilled with the grout mixture described in paragraph 4.5 and tremied into place. All borings shall be backfilled immediately after the sampling is completed unless saturated conditions have been encountered or a monitoring well is installed. In borings encountering saturated conditions, a 24-hour ground-water level shall be measured before backfilling. Borings left open overnight shall be covered to lessen the potential for injury to personnel and to minimize the potential for any surface drainage entering the boring.

2.8 Drill Cuttings. Unless otherwise noted in the Site Specific section of this Scope of Services, all drill cuttings are to segregated into uncontaminated-minimally contaminated, and contaminated cuttings. The A-E is to propose a field screening procedure and contamination level where uncontaminated- minimally cuttings can be safely distributed on the surface around the boring location and contaminated cuttings are drummed for later treatment and/or disposal by the A-E. Cuttings, when distributed around the boring are to be evenly distributed and leveled near the boring. Alternatively, uncontaminated cuttings may be disposed of at a site chosen by the site coordinator.The A-E shall determine a procedure for screening, treatment and disposal of any drill fluid used to drill a boring or development water produced during boring or monitoring well installation. The field procedures chosen by the A-E shall be presented to USACE for approval prior to starting.

2.9 Surveys (General).All sampling locations shall be staked to facilitate subsequent surveying. The A-E shall perform all surveys required for this project and shall supply this office with the original or a legible reproducible copy of the surveys and field books. The surveys shall at least conform to the requirements stated in the following paragraphs.

2.9.1 New Well Installations. NOT USED.

2.9.2 Soil Borings/Sampling. All soil sampling locations shall be located horizontally. Each location shall be determined to the nearest foot, as measured from a permanent surface feature at or near each site.

2.9.3 Physical Features. At each site, all above ground and, where possible, underground physical features shall be either verified with previous report mapping or determined as required. All above ground 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 1000 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 closet 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 the Contracting Officer's Representative (USACE). The tabulation shall consist of the designated number of the well or monument, the X and Y coordinates, and all the required elevations. These items shall be submitted to Omaha District no later than the Draft Project Report.

3.0 Sampling Techniques - Equipment and Methods.

3.1 Soil Sampling. Sampling for chemical analysis shall be performed using a stainless steel split-spoon sampler. Soil grab samples for volatile organic or semi-volatile analyses shall be obtained by subsampling the material retrieved in the split spoon. Subsampling shall 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 shall not be subsampled.

All sampling devices and decontamination procedures shall be performed in a manner consistent with the most recent EPA guidelines, but as a minimum shall consist of steam cleaning, Liquinox,or equivalent, followed by a tap water rinse, an isopropanol rinse, and a double deionized water rinse.

Compositing of soil samples for total organic carbon, total recoverable petroleum hydrocarbons, and metals, shall be performed in a stainless steel bowl using stainless steel stirring devices that have been decontaminated prior to each compositing procedure. This decontamination procedure will be the same as that specified for sampling equipment.

Sampling equipment, sampling methods and decontamination procedures shall be clearly indicated by the A-E in the A-E CDAP.

3.2 Monitoring Well Sampling. The A-E shall include in the CDAP all methods and equipment to be utilized in the sampling of monitoring wells. The A-E shall propose a method or methods to sample the wells.

3.3 Water Level Measurement. After development, all wells shall be allowed to stabilize for a minimum of two (2) days prior to sampling. For all wells the A-E shall determine depth to water and the total well depth using an electronic water level probe prior to purging.

3.4 Well Sampling Before a sample is collected from a well, the water level shall be measured and recorded. Prior to purging any shallow well (water table well), determine the presence of floating hydrocarbons at the water surface using a bailer. If floating product is present, contact the director of MRD Laboratory for information regarding sampling and shipment. The well shall then be pumped or bailed with clean equipment to remove a quantity of water equal to at least five times the submerged volume of the casing. If the well does not recharge fast enough to permit removing five (5) casing volumes, the well shall be pumped or bailed dry and sampled as soon as sufficient recharge has occurred. Sample the well using the method approved by USACE (as proposed by the A-E). Samples shall be drawn and placed in the appropriate sample bottles immediately upon receipt of water at the surface. The samples shall then be placed immediately in a cooler with a temperature of 4 degree C. Following sampling and after the well has stabilized, the water level shall again be measured and recorded. Specific details are to be in the A-E CDAP.

## 4.0 Monitor Wells.

4.1 Water Source. Water for drilling, steam cleaning and other necessary field activities shall be arranged by the A-E and approved by the USACE. Chlorine-free water shall be used if a suitable source is available. The A-E shall be responsible for collecting and transporting all water to the drilling areas for required uses. The A-E shall sample the water prior to its use and test it for the same parameters specified for ground-water samples under the site-specific paragraphs of this scope and determine its chlorine content. The A-E shall also obtain the results of any additional analyses performed on the source of water in the past year, if available. This information and documentation of the source of the water (i.e. fire hydrant location, etc.) which was used and any impact it may have on any of the analytical results performed under this scope of services shall be included in both the Draft and Final Project reports. The A-E shall be responsible for providing any deionized water required to perform this work.

4.2 Monitoring Well Log Book. One log book shall be prepared by the A-E for the purpose of maintaining a record of all personnel who access the monitoring wells. The notebook shall be permanently bound with at least one page for each well and shall contain the keys to the well caps. The book shall be handed over to the site coordinator at the conclusion of the field activities performed under this Scope of Services. The log book shall include a listing of all existing monitoring wells on the site and shall identify their location by site location and/or number and horizontal coordinates.

A warning shall be clearly visible in the log book stating the responsibility of all individuals to use any special procedures required to protect the integrity of the wells and of the data obtained from them. The log book shall also contain a detailed description of the decontamination procedures required for any equipment that enters the well. The book shall contain log pages that shall include, as a minimum, labeled columns for the date, individual's name and organization, well number, well location and purpose of activity performed (i.e. sampling, water level measurement, etc.). The book shall be organized such that new wells can be added at a later date.

5.0 Site Specific Scope of Services. A Site Specific Scope of Services will be submitted to the A-E in conjunction with this document. If there are any inconsistencies or conflicts between the "site specific" and "general" versions of the Scope of Services, the A-E shall implement the instructions in the Site Specific Scope of Services. The terms site coordinator, Draft Project Report and Final Project Report referenced in this document shall be defined in the Site Specific Scope of Services. If there are any questions that cannot be resolved the A-E shall contact the USACE geologist for clarification.

The A-E shall disregard all portions of the general scope that do not apply to the tasks as outlined in the Site Specific Scope of Services. For example, if no new monitoring wells are to be installed then the A-E has no reason to refer to the sections on monitoring well installation, construction diagrams, etc.

Paragraph 11 Defense Priority Model (DPM) Data Package Instructions.

The A-E shall compile the following information from the Investigation and submit a draft with the pre-draft RI Report. The information shall include a discussion and written justification for the qualitative items listed below. Sources of quantifiable data shall be provided. The level of confidence for each item shall be discussed, e.g., whether an estimate or a measured parameter is used.

SITE DESCRIPTION

1. Describe location of the site in relation to 100-year and 25-year floodplain.

2. Describe surface erosion potential. Include % surface slope, slope length, description of vegetative cover, surface soil grain size, and evidence of surface erosion (rills, gullies, etc.).

3. Shortest linear distance to nearest installation boundary.

4. Describe the physical state of the waste - solid or adheres to soil particles, semisolid or sludge which may release free liquid upon consolidation or decomposition, or waste as a free liquid.

5. Describe the depth of the waste in the soil and the width of the waste site.

6. Describe any measures taken to reduce migration of contaminants and the effectiveness of such measures.

7. Describe the activities which take place on the site, including excavation or materials handling and vehicular traffic.

METEOROLOGY

8. Net precipitation (average annual precipitation minus average annual lake evaporation) in inches, from local meteorological station if possible.

9. Days/year with greater than 0.25 mm precipitation.

10. Maximum one-year, 24-hour rainfall amount.

11. Average soil temperature or annual ambient temperature if unavailable.

12. Annual average wind speed.

13. Percentage of time with high unobstructed wind speed.

VADOSE ZONE

14. Surface soil permeability. Determine through field or laboratory tests, soil percolation rates reported in soil survey reports or soil particle size distribution (to aid in determining the potential for infiltration vs runoff).

15. Surface soil porosity to use in determining the potential for diffusion of volatile compounds through the soil.

16. Vadose zone permeability. If not measured, discuss geologic materials comprising vadose zone.

17. Distance between deepest evidence of contamination and high water table.

18. Discuss discrete features in subsurface w/potential to "short circuit" the pathway to the water table (e.g.closed or open fractures, faults,etc.).

19. Silt content of the soil.

SURFACE WATER

20. Distance to and description of nearest down slope surface water body subject to potential contaminant runoff. Include low areas which contain water only briefly after rainfall events if there is less than 20 in. rainfall yearly.

21. Population (present users only) drinking from surface water potentially impacted by site w/in 3 miles of site, w/in 4 miles of site and w/in 5 miles of site.

22. Describe all uses of surface water bodies w/in 1 mile which are potentially impacted (recreation, food chain or non-food chain agriculture meat or dairy livestock watering, etc.)

23. Describe/show location of both aquatic or terrestrial biota/habitats associated w/surface water bodies. Include all wetlands and their sizes within:

- 3 miles downstream or 1 mile in any direction, and
- 4 miles downstream or 1.5 miles in any direction of the site of documented surface water contamination attributable to the site or downstream of a potential point of contaminant entry.

24. Identify areas recognized or managed by federal, state or local government agencies or private organizations as rare, unique, unusually sensitive, or important natural resources (critical environments) within one mile and within 1.5 miles.

25. Describe habitat used by designated endangered species w/in 1 mile and w/in 1.5 miles of the waste site.

26. Give distance from current waste location to the nearest down gradient surface water body supplying water for human consumption, domestic use, food processing or food chain agriculture within 4 miles downstream of the site of potential discharge of contaminated ground water.

GROUND WATER

27. Describe shallowest aquifer, giving hydraulic conductivity, hydraulic gradient, effective porosity.

28. Describe all uses of apparent aquifer directly below the site.

29. Distance from site to nearest surface water body that is used for human consumption, food processing or food chain agriculture or aquaculture where contaminated ground-water could potentially discharge w/in 4 mi of the site.

30. Describe the population potentially at risk from groundwater contamination by answering the questions below. Include the size of the population at risk and the degree of vulnerability.

1) Determine the "most likely travel path of groundwater borne contaminants" (the principal path along which ground water flows away from the contaminated site. Due to imprecision of determining groundwater flow direction assume the most likely flow path encompasses all areas within a 90- to 120- degree arc w/the center being the best estimate of flow direction)

2) Determine the number of people obtaining drinking water from:

a) Ground-water sources along the most likely flow path of contaminants within 3 miles and within 5 miles of the site.

b ) Ground-water sources within 3 miles and 5 miles down gradient of the site but not along most likely flow paths for contaminants. (This might include people who get water from a confined aquifer with an upward gradient where the shallow aquifer discharges to a stream)

c) Surface water downstream from potential groundwater discharge points laying directly on most likely paths of contaminant travels. Include surface water intakes w/in 3 mi of potential discharge point that is within 3 mi of site.

d) Ground water sources located within 3 miles of the site but not down gradient of the source.

31. Distance from waste location to habitat or natural area that is a ground water discharge point.

32. Define the sensitivity/importance of biota/habitats that are groundwater discharge points down gradient of the site w/in 1) 3 miles and 2) 4 miles or within 1) 1 mile or 1.5 miles in any direction from the site. Describe the sizes of wetlands and any vegetation irrigated w/groundwater, nursery, nesting or feeding grounds that are regionally important, etc.)

33. Distance from site to nearest down gradient groundwater well for human or agricultural use (using flow time)

ECOLOGY

34. Describe critical environments w/in 1 mile and 1.5 miles of the site. "Critical" includes 1) lands or waters specifically recognized or managed by federal, state, or local government agencies or private organizations as rare, unique, unusually sensitive, or important natural resources, 2) habitat used by any federally designated endangered species on a permanent or seasonal basis.

35. Distance to nearest habitat for an endangered species.

36. Distance to nearest national/state parks, forests, wildlife reserve and residential areas.

37. Distance to nearest 1) coastal or 2) fresh water wetland of 5 acres or larger in size.

DEMOGRAPHICS

38. The number of daytime employees and residents w/in a 1/4 mile radius of the site, 1/2 mile radius of the site, and 1 mile radius of the site each by 45 degree sectors.

39. Determine or estimate the population w/in a radius of 1000 feet of the site and w/in a radius of 1250 feet of the site. Include residential and day time population.

40. Distance to nearest industrial/commercial site.

41. Describe land use and zoning w/in a 1 mile radius of the site - completely remote, residential, commercial/industrial, or agricultural. Mixes of land use/zoning should be described.

42. Tabulate all contaminants and the average and highest concentrations measured in surface soil, surface water, groundwater, ambient air, and fugitive dust.

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AIR QUALITY MODELING

43. Width of area source perpendicular to wind (or effective diameter)

44. Waste loading in grams of organic waste per cubic centimeter of soil

45. Soil density

46. Contaminant information.

47. Molecular weight

48. Henry's Law constant

49. Diffusion coefficient in air, cm2 /s at reference temp

50. Density

51. Vapor pressure in atmospheres

52. Mass fraction

SITE INFORMATION

Landfills

53. Surface area

54. Thickness of cap

55. Waste bed thickness

56. Porosity of cap

Surface Impoundment

57. Surface area

58. Depth of waste

59. Diffusivity of constituent in water

60. Diffusivity of constituent in air

Paragraph 12 Baseline Risk Assessment Instructions.

a. Baseline Risk Assessment. As part of the Remedial Investigation the A-E shall perform a Baseline Risk Assessment. The details and results of the Baseline Risk Assessment shall be included in the RI Report in a section entitled "Baseline Risk Assessment." This section shall contain one subsection for each site to be addressed by the RI report. Each subsection shall be further subdivided into "Human Health Evaluation" and "Environmental Evaluation" sections. In the event that two or more of the sites are defined as hydraulically linked, and if modeling indicates receptor points are or will in the future be affected by migration from multiple sites, one discussion shall address and describe the combined effect(s) both in terms of the Human Health Evaluation and the Environmental Evaluation.

(1) Guidance. The A-E shall follow procedural and reporting recommendations given in the following guidance documents: "Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual, (Part A), EPA/540/1-89/002" and "Volume II, Environmental Evaluation Manual, EPA/540/1-89-001." The EPA document, "Ecological Assessments of Hazardous Waste Sites: A Field and Laboratory Reference Document, EPA/600/3-89/013" may also be consulted.

(2) Human Health Evaluation. The intent of the Human Health Evaluation shall be to assess the reasonable and foreseeable current and potential future exposures to as well as associated risks from site contaminants in the event no action is taken to remove contaminants and/or prevent their migration. The Human Health Evaluation shall include the following components:

(a) Data Collection and Evaluation (Identification of Chemicals of Potential Concern).

(b) Exposure Assessment. During the exposure assessment process the A-E shall utilize available monitoring data and appropriate environmental fate and transport models. In general, modeling will be used to estimate exposure point concentrations where actual monitoring results don't exist for current exposure points and to predict future concentrations at potential exposure points. A one-dimensional, simple analytical model that addresses both unsaturated zone and saturated zone transport shall be used. The A-E's cost proposal for this SOS shall include a short description of the model suggested for use.

(c) Toxicity Assessment.

(d) Risk Characterization.

(3) Environmental Evaluation. The intent of the Environmental Evaluation shall be to discuss the current and potential environmental impacts of site contaminants. The Environmental Evaluation shall include the following components:

(a) Description of Objective.

(b) Description of Data.

(c) Description of Site and Study Area.

(d) Description of Contaminants of Concern.

(e) Exposure Characterization.

(f) Risk or Threat Characterization.

(g) Description of Remediation Criteria.

(h) Description of Conclusions and Limitations.

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Paragraph 13 Submittals Distribution.

| | |
|---|---|
| US Army Engineer District, Omaha<br>Attn: Marvin Taylor, CEMRO-ED-EC<br>215 North 17 th Street<br>Omaha, Nebraska<br>68102-4978 | 12 bound copies of all reports<br>1 unbound file copy |
| Commander, 27 TFW/CC<br>Attn: Jim Richards, 27 CSG/DEV<br>Environmental Planning<br>Cannon AFB, New Mexico<br>88103-5128 | 15 bound copies<br>1 set IBM compatible 3.5" disk<br>Word Perfect 5.0 Files |
| Commander, AFRCE-Central Region<br>Attn: Ron Jans<br>Environmental Planning Division<br>1114 Commerce Street<br>Dallas, Texas<br>75242 | 4 bound copies |
| Command, HQ TAC/DEVR<br>Attn: Cedric Adams<br>Building 681<br>Langley AFB, Virginia<br>23665-5542 | 3 bound copies |

Analytical Data goes to Cannon AFB and MRD Lab

Attn: "Names" may change during the work order.

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| | | |
|---|---|---|
| AGE Ditch | 35 | Total Samples |
| IRP SD-15; SWMU # 34 | | Surface Sampling Locations |
| SURFACE SAMPLES, total | 0 | |
| TCL VOCs | | |
| SV organics | | |
| PCBs/Pesticides | | |
| Metals | | |
| BTEX | | |
| TPH | | |
| Lead | | |
| Chromium | | |

| SUBSURFACE WORK | Number | * Depth= | Tot Ftge |
|---|---|---|---|
| Borings | 2 | 10 | 20 |
| Subsurface Sampling Points | -> | 6 | |
| Subsurface Samples, total | 24 | | |
| TCL VOCs | 6 | | |
| SV organics | 6 | | |
| PCBs/Pesticides | | | |
| Metals | 6 | | |
| BTEX | | | |
| TPH | 6 | | |
| Lead | | | |
| Chromium | | | |
| Appendix 9 | | | |
| QUALITY CONTROL Totals | 11 | | |
| Trip Blanks 1/cooler | | | |
| TCL VOCs | 2 | | |
| BTEX | | | |
| Rinsate Blanks | | | |
| TCL VOCs | 1 | | |
| SV organics | 1 | | |
| PCBs/Pesticides | | | |
| Metals | 1 | | |
| BTEX | | | |
| Ambient Blanks | | | |
| TCL VOCs | 1 | | |
| BTEX | | | |
| Field Duplicates | | | |
| TCL VOCs | 1 | | |
| SV organics | 1 | | |
| PCBs/Pesticides | | | |
| Metals | 1 | | |
| BTEX | | | |
| TPH | 1 | | |
| Lead | | | |
| Chromium | | | |
| Decontamination Water | | | |
| TCL VOCs | 1 | | |
| BTEX | | | |
| MATRIX SPIKES / DUPS TOTALS | 0 | | |
| TCL VOCs | | | |
| SV organics | | | |
| PCBs/Pesticides | | | |
| Metals | | | |
| BTEX | | | |
| TPH | | | |
| Lead | | | |
| Chromium | | | |
| Appendix 9 | | | |

| | | | |
|---|---|---|---|
| ENGINE TEST CELL, et al | 81 | Total Samples | |
| IRP SD-11; SWMU # 86 | 5 | Surface Sampling Locations | |
| SURFACE SAMPLES, total | 10 | | |
| TCL VOCs | 5 | | |
| SV organics | | | |
| PCBs/Pesticides | | Four from near borings | |
| Metals | 5 | | |
| BTEX | | One from near background | |
| TPH | | boring | |
| Lead | | | |
| Chromium | | | |
| SUBSURFACE WORK | Number | * Depth- | Tot Ftge |
| Borings | 5 | 10 | 50 |
| Subsurface Sampling Points | -> | 15 | |
| Subsurface Samples, total | 45 | | |
| TCL VOCs | 15 | | |
| SV organics | | | |
| PCBs/Pesticides | | Four borings & | |
| Metals | 15 | | |
| BTEX | 15 | | |
| TPH | | One Background boring | |
| Lead | | | |
| Chromium | | | |
| Appendix 9 | | | |
| QUALITY CONTROL Totals | 20 | | |
| Trip Blanks 1/cooler | | | |
| TCL VOCs | 3 | | |
| BTEX | | | |
| Rinsate Blanks | | | |
| TCL VOCs | 1 | | |
| SV organics | | | |
| PCBs/Pesticides | | | |
| Metals | 1 | | |
| BTEX | 1 | | |
| Ambient Blanks | | | |
| TCL VOCs | 1 | | |
| BTEX | | | |
| Field Duplicates - 2 dups from surface & 2 dups from subsurface | | | |
| TCL VOCs | 4 | | |
| SV organics | | | |
| PCBs/Pesticides | | | |
| Metals | 4 | | |
| BTEX | 4 | | |
| TPH | | | |
| Lead | | | |
| Chromium | | | |
| Decontamination Water | | | |
| TCL VOCs | 1 | | |
| BTEX | | | |
| MATRIX SPIKES / DUPS TOTALS | 6 | | |
| TCL VOCs | 2 | | |
| SV organics | | | |
| PCBs/Pesticides | | | |
| Metals | 2 | | |
| BTEX | 2 | | |
| TPH | | | |
| Lead | | | |
| Chromium | | | |
| Appendix 9 | | | |

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| | | | |
|---|---|---|---|
| NE STORMWATER DRAINAGE AREA | 33 Total Samples | | |
| IRP SD-20; SWMU # 95 | Surface Sampling Locations | | |
| SURFACE SAMPLES, total | 0 | | |
| TCL VOCs | | | |
| SV organics | | | |
| PCBs/Pesticides | | | |
| Metals | | | |
| BTEX | | | |
| TPH | | | |
| Lead | | | |
| Chromium | | | |
| SUBSURFACE WORK | Number | * Depth= | Tot Ftge |
| Borings | 2 | 10 | 20 |
| Subsurface Sampling Points | -> | 6 | |
| Subsurface Samples, total | 24 | | |
| TCL VOCs | 6 | | |
| SV organics | 6 | | |
| PCBs/Pesticides | | | |
| Metals | 6 | | |
| BTEX | | | |
| TPH | 6 | | |
| Lead | | | |
| Chromium | | | |
| Appendix 9 | | | |
| QUALITY CONTROL Totals | 9 | | |
| Trip Blanks 1/cooler | | | |
| TCL VOCs | 2 | | |
| BTEX | | | |
| Rinsate Blanks | | | |
| TCL VOCs | 1 | | |
| SV organics | | | |
| PCBs/Pesticides | | | |
| Metals | | | |
| BTEX | | | |
| Ambient Blanks | | | |
| TCL VOCs | 1 | | |
| BTEX | | | |
| Field Duplicates | | | |
| TCL VOCs | 1 | | |
| SV organics | 1 | | |
| PCBs/Pesticides | | | |
| Metals | 1 | | |
| BTEX | | | |
| TPH | 1 | | |
| Lead | | | |
| Chromium | | | |
| Decontamination Water | | | |
| TCL VOCs | 1 | | |
| BTEX | | | |
| MATRIX SPIKES / DUPS TOTALS | 0 | | |
| TCL VOCs | | | |
| SV organics | | | |
| PCBs/Pesticides | | | |
| Metals | | | |
| BTEX | | | |
| TPH | | | |
| Lead | | | |
| Chromium | | | |
| Appendix 9 | | | |

| | | |
|---|---|---|
| WASTEWATER TREATMENT LAGOONS | 60 | Total Samples |
| IRP ; SWMU # 101 | 8 | Surface Sampling Locations |
| SURFACE SAMPLES, total | 32 | |
| TCL VOCs | 8 | |
| SV organics | 8 | |
| PCBs/Pesticides | 8 | |
| Metals | 8 | |
| BTEX | | |
| TPH | | |
| Lead | | |
| Chromium | | |
| SUBSURFACE WORK | | |
| Subsurface Sampling Points -> | 4 | |
| Subsurface Samples, total | 4 | |
| TCL VOCs | | ONE Appendix nine to MRD |
| SV organics | | |
| PCBs/Pesticides | | FOUR from wells, |
| Metals | | |
| BTEX | | ONE dup from down |
| TPH | | gradient well |
| Lead | | |
| Chromium | | ONE blank |
| Appendix 9 | 4 | |
| QUALITY CONTROL Totals | 15 | |
| Trip Blanks 1/cooler | | |
| TCL VOCs | 3 | |
| BTEX | | |
| Rinsate Blanks for sludge samples | | |
| TCL VOCs | 1 | |
| SV organics | 1 | |
| PCBs/Pesticides | 1 | |
| Metals | 1 | |
| BTEX | | |
| Ambient Blanks | | |
| TCL VOCs | 1 | |
| Appendix 9 | 1 | well sampling |
| Field Duplicates for sludge samples | | |
| TCL VOCs | 1 | |
| SV organics | 1 | |
| PCBs/Pesticides | 1 | |
| Metals | 1 | |
| BTEX | | |
| TPH | | |
| Lead | | |
| Appendix 9 | 1 | down gradient well |
| Decontamination Water | | |
| TCL VOCs | 1 | |
| BTEX | | |
| MATRIX SPIKES / DUPS TOTALS | 9 | |
| TCL VOCs | 2 | |
| SV organics | 1 | |
| PCBs/Pesticides | 2 | |
| Metals | 2 | |
| BTEX | | |
| TPH | | |
| Lead | | |
| Chromium | | |
| Appendix 9 | 2 | |

| | | |
|---|---|---|
| LANDFILL # 5 | 10 | Total Samples |
| IRP LF- 5; SWMU # 113 | | Surface Sampling Locations |
| SURFACE SAMPLES, total | 0 | |
| TCL VOCs | | |
| SV organics | | |
| PCBs/Pesticides | | |
| Metals | | |
| BTEX | | |
| TPH | | |
| Lead | | |
| Chromium | | |
| SUBSURFACE WORK | | |
| Subsurface Sampling Points -> | | 6 |
| Subsurface Samples, total | 6 | |
| TCL VOCs | | |
| SV organics | | |
| PCBs/Pesticides | | |
| Metals | | |
| BTEX | | |
| TPH | | |
| Lead | | |
| Chromium | | |
| Appendix 9 | 6 | |
| QUALITY CONTROL Totals | 2 | |
| Trip Blanks 1/cooler | | |
| TCL VOCs | | |
| BTEX | | |
| Rinsate Blanks | | |
| TCL VOCs | | |
| SV organics | | |
| PCBs/Pesticides | | |
| Metals | | |
| BTEX | | |
| Ambient Blanks | | |
| Appendix 9 | 1 | |
| BTEX | | |
| Field Duplicates | | |
| TCL VOCs | | |
| SV organics | | |
| PCBs/Pesticides | | |
| Metals | | |
| BTEX | | |
| TPH | | |
| Lead | | |
| Appendix 9 | 1 | |
| Decontamination Water | | |
| TCL VOCs | | |
| BTEX | | |
| MATRIX SPIKES / DUPS TOTALS | 2 | |
| TCL VOCs | | |
| SV organics | | |
| PCBs/Pesticides | | |
| Metals | | |
| BTEX | | |
| TPH | | |
| Lead | | |
| Chromium | | |
| Appendix 9 | 2 | |

| | | |
|---|---|---|
| OLD ENTOMOLOGY RINSE AREA | 3 | Total Samples |
| IRP SD-17; SWMU # 96 | | Surface Sampling Locations |
| SURFACE SAMPLES, total | 0 | |
| TCL VOCs | | |
| SV organics | | |
| PCBs/Pesticides | | |
| Metals | | |
| BTEX | | |
| TPH | | |
| Lead | | |
| Chromium | | |
| SUBSURFACE WORK | | |
| Subsurface Sampling Points -> | | 1 |
| Subsurface Samples, total | 1 | |
| TCL VOCs | | |
| SV organics | | |
| PCBs/Pesticides | 1 | |
| Metals | | |
| BTEX | | |
| TPH | | |
| Lead | | |
| Chromium | | |
| Appendix 9 | | |
| QUALITY CONTROL Totals | 2 | |
| Trip Blanks 1/cooler | | |
| TCL VOCs | | |
| BTEX | | |
| Rinsate Blanks | | |
| TCL VOCs | | |
| SV organics | | |
| PCBs/Pesticides | 1 | |
| Metals | | |
| BTEX | | |
| Ambient Blanks | | |
| TCL VOCs | | |
| BTEX | | |
| Field Duplicates | | |
| TCL VOCs | | |
| SV organics | | |
| PCBs/Pesticides | 1 | |
| Metals | | |
| BTEX | | |
| TPH | | |
| Lead | | |
| Chromium | | |
| Decontamination Water | | |
| TCL VOCs | | |
| BTEX | | |
| MATRIX SPIKES / DUPS TOTALS | 0 | |
| TCL VOCs | | |
| SV organics | | |
| PCBs/Pesticides | | |
| Metals | | |
| BTEX | | |
| TPH | | |
| Lead | | |
| Chromium | | |
| Appendix 9 | | |

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| | | | |
|---|---|---|---|
| SLUDGE WEATHERING PIT | 46 | Total Samples | |
| IRP WP-14; SWMU # 76 | 2 | Surface Sampling Locations | |
| SURFACE SAMPLES, total | 6 | | |
| TCL VOCs | 2 | | |
| SV organics | 2 | | |
| PCBs/Pesticides | | | |
| Metals | 2 | | |
| BTEX | | | |
| TPH | | | |
| Lead | | | |
| Chromium | | | |
| SUBSURFACE WORK | Number | * Depth- | Tot Ftge |
| Borings | 4 | 10 | 40 |
| Subsurface Sampling Points | -> | 9 | |
| Subsurface Samples, total | 27 | | |
| TCL VOCs | 9 | | |
| SV organics | 9 | | |
| PCBs/Pesticides | | ONE boring to define | |
| Metals | 9 | bottom of Pit | |
| BTEX | | | |
| TPH | | | |
| Lead | | THREE borings | |
| Chromium | | for samples | |
| Appendix 9 | | | |
| QUALITY CONTROL Totals | 13 | | |
| Trip Blanks 1/cooler | | | |
| TCL VOCs | 2 | | |
| BTEX | | | |
| Rinsate Blanks | | | |
| TCL VOCs | 1 | | |
| SV organics | 1 | | |
| PCBs/Pesticides | | | |
| Metals | 1 | | |
| BTEX | | | |
| Ambient Blanks | | | |
| TCL VOCs | 1 | | |
| BTEX | | | |
| Field Duplicates ONE dup from surface, One from subsurface | | | |
| TCL VOCs | 2 | | |
| SV organics | 2 | | |
| PCBs/Pesticides | | | |
| Metals | 2 | | |
| BTEX | | | |
| TPH | | | |
| Lead | | | |
| Chromium | | | |
| Decontamination Water | | | |
| TCL VOCs | 1 | | |
| BTEX | | | |
| MATRIX SPIKES / DUPS TOTALS | 0 | | |
| TCL VOCs | | | |
| SV organics | | | |
| PCBs/Pesticides | | | |
| Metals | | | |
| BTEX | | | |
| TPH | | | |
| Lead | | | |
| Chromium | | | |
| Appendix 9 | | | |

| | | |
|---|---|---|
| FIRE TRAINING AREA # 1 | 148 | Total Samples |
| IRP FT- 6; SWMU # 78 | 6 | Surface Sampling Locations |
| SURFACE SAMPLES, total | 30 | |
| TCL VOCs | 6 | |
| SV organics | 6 | |
| PCBs/Pesticides | 6 | |
| Metals | 6 | |
| BTEX | | |
| TPH | 6 | |
| Lead | | |
| Chromium | | |

| SUBSURFACE WORK | Number | * Depth- | Tot Ftge |
|---|---|---|---|
| Borings | 2 | 100 | 200 |
| Subsurface Sampling Points | -> | 18 | |
| Subsurface Samples, total | 90 | | |
| TCL VOCs | 18 | | |
| SV organics | 18 | | |
| PCBs/Pesticides | 18 | | |
| Metals | 18 | | |
| BTEX | | | |
| TPH | 18 | | |
| Lead | | | |
| Chromium | | | |
| Appendix 9 | | | |
| QUALITY CONTROL Totals | 20 | | |
| Trip Blanks 1/cooler | | | |
| TCL VOCs | 4 | | |
| BTEX | | | |
| Rinsate Blanks | | | |
| TCL VOCs | 1 | | |
| SV organics | 1 | | |
| PCBs/Pesticides | 1 | | |
| Metals | 1 | | |
| BTEX | | | |
| Ambient Blanks | | | |
| TCL VOCs | 1 | | |
| BTEX | | | |
| Field Duplicates ONE from surface, ONE from subsurface | | | |
| TCL VOCs | 2 | | |
| SV organics | 2 | | |
| PCBs/Pesticides | 2 | | |
| Metals | 2 | | |
| BTEX | | | |
| TPH | 2 | | |
| Lead | | | |
| Chromium | | | |
| Decontamination Water | | | |
| TCL VOCs | 1 | | |
| BTEX | | | |
| MATRIX SPIKES / DUPS TOTALS | 8 | | |
| TCL VOCs | | | |
| SV organics | 2 | | |
| PCBs/Pesticides | 2 | | |
| Metals | 2 | | |
| BTEX | | | |
| TPH | 2 | | |
| Lead | | | |
| Chromium | | | |
| Appendix 9 | | | |

June 26, 1991

| | | | |
|---|---|---|---|
| SOLVENT DISPOSAL SITE | 29 Total Samples | | |
| IRP DP-16; SWMU # 81 | 10 Surface Sampling Locations | | |
| SURFACE SAMPLES, total | 10 | | |
| TCL VOCs | 10 | | |
| SV organics | | | |
| PCBs/Pesticides | | | |
| Metals | | | |
| BTEX | | | |
| TPH | | | |
| Lead | | | |
| Chromium | | | |
| SUBSURFACE WORK | Number | * Depth= | Tot Ftge |
| Borings | 10 | 5 | 50 |
| Subsurface Sampling Points | -> | 10 | |
| Subsurface Samples, total | 10 | | |
| TCL VOCs | 10 | | |
| SV organics | | | |
| PCBs/Pesticides | | | Grid sampling |
| Metals | | | 10 nodes |
| BTEX | | | |
| TPH | | | |
| Lead | | | |
| Chromium | | | |
| Appendix 9 | | | |
| QUALITY CONTROL Totals | 7 | | |
| Trip Blanks 1/cooler | | | |
| TCL VOCs | 2 | | |
| BTEX | | | |
| Rinsate Blanks | | | |
| TCL VOCs | 1 | | |
| SV organics | | | |
| PCBs/Pesticides | | | |
| Metals | | | |
| BTEX | | | |
| Ambient Blanks | | | |
| TCL VOCs | 1 | | |
| BTEX | | | |
| Field Duplicates ONE from surface, ONE from subsurface | | | |
| TCL VOCs | 2 | | |
| SV organics | | | |
| PCBs/Pesticides | | | |
| Metals | | | |
| BTEX | | | |
| TPH | | | |
| Lead | | | |
| Chromium | | | |
| Decontamination Water | | | |
| TCL VOCs | 1 | | |
| BTEX | | | |
| MATRIX SPIKES / DUPS TOTALS | 2 | | |
| TCL VOCs | 2 | | |
| SV organics | | | |
| PCBs/Pesticides | | | |
| Metals | | | |
| BTEX | | | |
| TPH | | | |
| Lead | | | |
| Chromium | | | |
| Appendix 9 | | | |

| | | | |
|---|---|---|---|
| FIRE TRAINING AREA # 2 | 127 | Total Samples | |
| IRP FT- 7; SWMU # 106 | 4 | Surface Sampling Locations | |
| SURFACE SAMPLES, total | 16 | | |
| TCL VOCs | | | |
| SV organics | | | |
| PCBs/Pesticides | | | |
| Metals | | | |
| BTEX | 4 | | |
| TPH | 4 | | |
| Lead | 4 | | |
| Chromium | 4 | | |
| SUBSURFACE WORK | Number | * Depth= | Tot Ftge |
| Borings | 4 | 30 | 120 |
| Subsurface Sampling Points | -> | 16 | |
| Subsurface Samples, total | 80 | | |
| TCL VOCs | 16 | | |
| SV organics | | | |
| PCBs/Pesticides | | | |
| Metals | | | |
| BTEX | 16 | | |
| TPH | 16 | | |
| Lead | 16 | | |
| Chromium | 16 | | |
| Appendix 9 | | | |
| QUALITY CONTROL Totals | 21 | | |
| Trip Blanks 1/cooler | | | |
| TCL VOCs | 2 | | |
| BTEX | 2 | | |
| Rinsate Blanks | | | |
| TCL VOCs | | | |
| SV organics | | | |
| PCBs/Pesticides | | | |
| Metals | | | |
| BTEX | 1 | | |
| Ambient Blanks | | | |
| TCL VOCs | | | |
| BTEX | 1 | | |
| Field Duplicates ONE from surface, TWO from subsurface | | | |
| TCL VOCs | 3 | | |
| SV organics | | | |
| PCBs/Pesticides | | | |
| Metals | | | |
| BTEX | 3 | | |
| TPH | 3 | | |
| Lead | 3 | | |
| Chromium | 3 | | |
| Decontamination Water | | | |
| TCL VOCs | | | |
| BTEX | 1 | | |
| MATRIX SPIKES / DUPS TOTALS | 10 | | |
| TCL VOCs | 2 | | |
| SV organics | | | |
| PCBs/Pesticides | | | |
| Metals | | | |
| BTEX | 2 | | |
| TPH | 2 | | |
| Lead | 2 | | |
| Chromium | 2 | | |
| Appendix 9 | | | |

June 26, 1991

| | | | |
|---|---|---|---|
| FIRE TRAINING AREA # 3 | 127 | Total Samples | |
| IRP FT- 8; SWMU # 107 | 4 | Surface Sampling Locations | |
| SURFACE SAMPLES, total | 16 | | |
| TCL VOCs | | | |
| SV organics | | | |
| PCBs/Pesticides | | | |
| Metals | | | |
| BTEX | 4 | | |
| TPH | 4 | | |
| Lead | 4 | | |
| Chromium | 4 | | |
| SUBSURFACE WORK | Number | * Depth= | Tot Ftge |
| Borings | 4 | 30 | 120 |
| Subsurface Sampling Points | -> | 16 | |
| Subsurface Samples; total | 80 | | |
| TCL VOCs | 16 | | |
| SV organics | | | |
| PCBs/Pesticides | | | |
| Metals | | | |
| BTEX | 16 | | |
| TPH | 16 | | |
| Lead | 16 | | |
| Chromium | 16 | | |
| Appendix 9 | | | |
| QUALITY CONTROL Totals | 21 | | |
| Trip Blanks 1/cooler | | | |
| TCL VOCs | 2 | | |
| BTEX | 2 | | |
| Rinsate Blanks | | | |
| TCL VOCs | | | |
| SV organics | | | |
| PCBs/Pesticides | | | |
| Metals | | | |
| BTEX | 1 | | |
| Ambient Blanks | | | |
| TCL VOCs | | | |
| BTEX | 1 | | |
| Field Duplicates ONE from surface, TWO from subsurface | | | |
| TCL VOCs | 3 | | |
| SV organics | | | |
| PCBs/Pesticides | | | |
| Metals | | | |
| BTEX | 3 | | |
| TPH | 3 | | |
| Lead | 3 | | |
| Chromium | 3 | | |
| Decontamination Water | | | |
| TCL VOCs | | | |
| BTEX | 1 | | |
| MATRIX SPIKES / DUPS TOTALS | 10 | | |
| TCL VOCs | 2 | | |
| SV organics | | | |
| PCBs/Pesticides | | | |
| Metals | | | |
| BTEX | 2 | | |
| TPH | 2 | | |
| Lead | 2 | | |
| Chromium | 2 | | |
| Appendix 9 | | | |

| | | |
|---|---|---|
| FIRE TRAINING AREA # 4 | 160 | Total Samples |
| IRP ; SWMU # 109 | 4 | Surface Sampling Locations |
| SURFACE SAMPLES, total | 16 | |
| TCL VOCs | 4 | |
| SV organics | | |
| PCBs/Pesticides | | |
| Metals | | |
| BTEX | | |
| TPH | 4 | |
| Lead | 4 | |
| Chromium | 4 | |

| SUBSURFACE WORK | Number | * Depth= | Tot Ftge |
|---|---|---|---|
| Borings | 4 | 60 | 240 |
| Subsurface Sampling Points | -> | 28 | |
| Subsurface Samples, total | 112 | | |
| TCL VOCs | 28 | | |
| SV organics | | | |
| PCBs/Pesticides | | | |
| Metals | | | |
| BTEX | | | |
| TPH | 28 | | |
| Lead | 28 | | |
| Chromium | 28 | | |
| Appendix 9 | | | |
| QUALITY CONTROL Totals | 24 | | |
| Trip Blanks 1/cooler | | | |
| TCL VOCs | 5 | | |
| BTEX | | | |
| Rinsate Blanks | | | |
| TCL VOCs | 1 | | |
| SV organics | | | |
| PCBs/Pesticides | | | |
| Metals | | | |
| BTEX | | | |
| Ambient Blanks | | | |
| TCL VOCs | 1 | | |
| BTEX | | | |
| Field Duplicates ONE from surface, THREE from subsurface | | | |
| TCL VOCs | 4 | | |
| SV organics | | | |
| PCBs/Pesticides | | | |
| Metals | | | |
| BTEX | | | |
| TPH | 4 | | |
| Lead | 4 | | |
| Chromium | 4 | | |
| Decontamination Water | | | |
| TCL VOCs | 1 | | |
| BTEX | | | |
| MATRIX SPIKES / DUPS TOTALS | 8 | | |
| TCL VOCs | 2 | | |
| SV organics | | | |
| PCBs/Pesticides | | | |
| Metals | | | |
| BTEX | | | |
| TPH | 2 | | |
| Lead | 2 | | |
| Chromium | 2 | | |
| Appendix 9 | | | |

June 26, 1991

| | | | |
|---|---|---|---|
| SANITARY SEWER LINES | 201 Total Samples | | |
| IRP ; SWMU # 98 | Surface Sampling Locations | | |
| SURFACE SAMPLES, total | 0 | | |
| TCL VOCs | | | |
| SV organics | | | |
| PCBs/Pesticides | | | |
| Metals | | | |
| BTEX | | | |
| TPH | | | |
| Lead | | | |
| Chromium | | | |
| SUBSURFACE WORK | Number | * Depth= | Tot Ftge |
| Borings | 50 | 10 | 500 |
| Subsurface Sampling Points | -> | 50 | |
| Subsurface Samples, total | 150 | | |
| TCL VOCs | 50 | | |
| SV organics | | | |
| PCBs/Pesticides | | | |
| Metals | 50 | | |
| BTEX | | | |
| TPH | 50 | | |
| Lead | | | |
| Chromium | | | |
| Appendix 9 | | | |
| QUALITY CONTROL Totals | 33 | | |
| Trip Blanks 1/cooler | | | |
| TCL VOCs | 7 | | |
| BTEX | | | |
| Rinsate Blanks | | | |
| TCL VOCs | 5 | | |
| SV organics | | | |
| PCBs/Pesticides | | | |
| Metals | | | |
| BTEX | | | |
| Ambient Blanks | | | |
| TCL VOCs | 5 | | |
| BTEX | | | |
| Field Duplicates | | | |
| TCL VOCs | 5 | | |
| SV organics | | | |
| PCBs/Pesticides | | | |
| Metals | 5 | | |
| BTEX | | | |
| TPH | 5 | | |
| Lead | | | |
| Chromium | | | |
| Decontamination Water | | | |
| TCL VOCs | 1 | | |
| BTEX | | | |
| MATRIX SPIKES / DUPS TOTALS | 18 | | |
| TCL VOCs | 6 | | |
| SV organics | | | |
| PCBs/Pesticides | | | |
| Metals | 6 | | |
| BTEX | | | |
| TPH | 6 | | |
| Lead | | | |
| Chromium | | | |
| Appendix 9 | | | |

End of Scope of Services

June 26, 1991

Total for each kind of sampling 1,062 Total Samples

185 Subsurface Sampling Points; 43 Surface Sampling Locations

| | |
|---|---|
| SURFACE SAMPLES, total | 136 |
| TCL VOCs | 35 |
| SV organics | 16 |
| PCBs/Pesticides | 14 |
| Metals | 21 |
| BTEX | 8 |
| TPH | 18 |
| Lead | 12 |
| Chromium | 12 |
| SUBSURFACE WORK | |
| Subsurface Samples, total | 653 |
| TCL VOCs | 174 |
| SV organics | 39 |
| PCBs/Pesticides | 19 |
| Metals | 104 |
| BTEX | 47 |
| TPH | 140 |
| Lead | 60 |
| Chromium | 60 |
| Appendix 9 | 10 |
| QUALITY CONTROL Totals | 200 |
| Trip Blanks 1/cooler | |
| TCL VOCs | 34 |
| BTEX | 4 |
| Rinsate Blanks | |
| TCL VOCs | 13 |
| SV organics | 4 |
| PCBs/Pesticides | 3 |
| Metals | 5 |
| BTEX | 3 |
| Ambient Blanks | |
| TCL VOCs | 13 |
| BTEX | 2 |
| Appendix 9 | 2 |
| Field Duplicates | |
| TCL VOCs | 28 |
| SV organics | 7 |
| PCBs/Pesticides | 4 |
| Metals | 16 |
| BTEX | 10 |
| TPH | 19 |
| Lead | 10 |
| Chromium | 10 |
| Appendix 9 | 2 |
| Decontamination Water | |
| TCL VOCs | 9 |
| BTEX | 2 |
| MATRIX SPIKES / DUPS TOTALS | 73 |
| TCL VOCs | 18 |
| SV organics | 3 |
| PCBs/Pesticides | 4 |
| Metals | 12 |
| BTEX | 6 |
| TPH | 14 |
| Lead | 6 |
| Chromium | 6 |
| Appendix 9 | 4 |

GRAND TOTAL FOR SAMPLES 1,062 Total Samples

228 Sampling Locations

| | | |
|---|---|---|
| SAMPLES, | total | 1,062 |
| | TCL VOCs | 324 |
| | SV organics | 69 |
| | PCBs/Pesticides | 44 |
| | Metals | 158 |
| | BTEX | 82 |
| | TPH | 191 |
| | Lead | 88 |
| | Chromium | 88 |
| | Appendix 9 | 18 |

| BORINGS | Number | Total Footage |
|---|---|---|
| | 87 | 1,360 |

# APPENDIX B
# 1991 WCC FIELD INVESTIGATION INFORMATION

# APPENDIX B-1
# 1991 WCC FIELD BORING LOGS

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 0341

| | | | |
|---|---|---|---|
| BORING LOCATION AGE Drainage Ditch Boring 0341 | | ELEVATION AND DATUM 4300.28' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER M. Powless | DATE STARTED 12-8-91<br>DATE FINISHED 12-8-91 | |
| DRILLING EQUIPMENT Mobile B-61 Drill Rig | | COMPLETION DEPTH 3 | SAMPLER |
| DRILLING METHOD HSA - 7½" OD, 4¼" ID | DRILL BIT 7½" | NO. OF SAMPLES DIST. | UNDIST. Analytical - 1 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST | COMPL. 24 HRS. |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY JMButh |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite grout | FROM 0 TO 3 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | Piezometer Installation | Water Content | Piezometer Date | SAMPLES: Type No. | Recov. ft. | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | start Drilling at 14:25 |
| | | | | | | | | | collect one tyvek stainless steel S.S. sample from 1-3' CAN034-0341-0001 |
| 1 | SAND, medium reddish brown Very fine grained, subangular, Silty Non-calcareous. | | | | | | | 5 | |
| | | | | | | | | | cT - 14:30 CAN034-0341-0101 (MFD) |
| | | | | | | AH | | 7 | OVA - augers & B. Zone } 0 ppm |
| 2 | | | | | | | | 8 | collect |
| | | | | | | | | 6 | Decon water at 15:10 CAN034-0341-0181 |
| 3 | encountered concrete at 3' Bottom of Boring | | | | | | | | |
| | | | | | | | | | collect Ambient blank at 15:00 CAN034-0341-0151 |
| | | | | | | | | | Collect Rinsate blank at 16:40 CAN034-0341-0172 |

PROJECT NO. 89MC114W

SHEET 1 OF 1

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 0342

| | | | |
|---|---|---|---|
| BORING LOCATION AGE Drainage Ditch | | ELEVATION AND DATUM 4300.07' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER B. Kingsley | DATE STARTED 10-22-91 / DATE FINISHED 10-22-91 | 3" stainless st |
| DRILLING EQUIPMENT Mobile B-53 | | COMPLETION DEPTH 11' | SAMPLER 2" SS, 2" Gardner |
| DRILLING METHOD HSA - 6" OD, 3 3/4 ID | DRILL BIT 6 1/2" Bullet | NO. OF SAMPLES DIST. — | UNDIST. Anal tubes-3 Geotech-2 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL. — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY Sm Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite Grout | FROM 0 TO 11 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov. ft. | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Started Drilling at: 10:40 No surf. sample collected stainless st Anal S.S. from ~~0-2'~~ 1.5-3 at 10:50 |
| 1 | | | | | | | | | CAN0342-0001 CAN0342-0101 OVA. Background in sampler FD collected |
| | SAND - reddish Brown, vFn. gr, very silty, well sorted. | | | | | | 1.5 | 6 | |
| 2 | | SM | | | | A1 | | | SPT from ~~2-4'~~ 3-5' at 10:55 |
| | | | | | | | | 6 | OVA: B.G. 0 ppm in sampler |
| | | | | | | | | 6 | |
| 3 | | | | | | | | 3 | |
| | | | | | | G1 | 1.9 | 2 | |
| 4 | | | | | | | | | stainless st Anal S.S. from ~~4-6'~~ 5-7' at: 11:30 |
| | | | | | | | | 5 | |
| | | | | | | | | 3 | OVA - B.G. in sampler CAN0342-0005 MS/MSD collected OVA - 0ppm in auger |
| 5 | Sand, Reddish brown V. Fn to fn gr., sub angular well sorted. silty (20%) | | | | | | | 5 | |
| | | SM | | | | A2 | | 6 | |
| 6 | ~~Bottom~~ Top of sample stained 4" | | | | | | 1.5 | 7 | SPT from ~~7-9'~~ 7-9' at: 11:35 |
| | | | | | | | | 8 | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114-W

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 0342

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, et |
|---|---|---|---|---|---|---|---|---|---|
| 7 | Sand, Med, reddish Brown V-Fn gr. silty (20%) well sorted | | | | | | | 3 | |
| | | | | | | G2 | | 2 | |
| 8 | | | | | | | 1.2 | 3 | ~~Stainless ST Ancl. S.S. from~~ |
| | | SM | | | | | | 4 | |
| 9 | SAND, reddish brown V. Fn To Fn grained well sorted. silty (20%) | | | | | | | 6 | Stainless ST Ancl. S.S from 9-11' at: 12:20 |
| | | | | | | | 1.7 | 10 | OVA - Back grd in sample CAN 0342-0009 |
| 10 | | | | | | A3 | | 16 | OVA - 0 ppm in augers |
| | | | | | | | | 19 | |
| 11 | Bottom of Boring | | | | | | | | Grouted Boring from 0-11' with Cement-Bentonite grout. at: 13:35 |

PROJECT NO. 89MC114W

SHEET 2 OF 2

redrill of Boring 0342

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 0343

| | | | |
|---|---|---|---|
| BORING LOCATION ACE Drainage Ditch, B. | | ELEVATION AND DATUM 4300.00' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER M. Peuless | DATE STARTED 12-8-91 / DATE FINISHED 12-8-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 10 | SAMPLER Jt. stainless 5.5 |
| DRILLING METHOD HSA-7 1/2" OD, 4 1/4" ID | DRILL BIT 7 1/2" | NO. OF SAMPLES DIST. NA | UNDIST. Auto Tied-1 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA / 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY Sm Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite Grout | FROM 0 TO 10 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | Recov. ft. | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | Start Drilling at 13:15 |
| 1 | | | | | | | | | See original boring log of 0342 for Lithologic description. |
| 2 | | | | | | | | 5 | |
| | | | | | | | | 7 | Stainless steel S.S from 1.5-3.5 |
| | | | | | | G1 | 1.5 | 6 | OVA. augers S.S B.Zone } 0 ppm |
| 3 | | | | | | | | 4 | at 3:20 |
| 4 | | | | | | | | | |
| 5 | | | | | | | | 5 | Stainless steel S.S sample from 5-7'. at 13:35 |
| 6 | | | | | | G2 | 1.4 | 4 | OVA- auger S.S B.Zone } 0 ppm |
| | | | | | | | | 6 | |
| 7 | | | | | | | | 7 | |

PROJECT NO. 89MC114 W

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 0343

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer installation | Water Content | Piezometer Date | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | | |
| 8 | | | | | | | | | collect Analytical stainless steel S.S from 8-10' |
| | | | | | | | | 4 | at 13:45 |
| | | | | | | A1 | 1.7 | 4 | CAN034-0343-0008 |
| 9 | | | | | | | | | |
| | | | | | | | | 3 | collect ambient blank at 14:05 |
| | | | | | | | | 7 | CAN034-0343-0152 |
| 10 | | | | | | | | | |
| | Bottom of Boring | | | | | | | | collect Rinsate blank at 14:15 CAN034-0343-0171 |
| | | | | | | | | | collect Decon Water at 14:45 CAN034-0343-0181 |

PROJECT NO. 8914C114W

SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 0760

| | | | |
|---|---|---|---|
| BORING LOCATION Sludge Weathering Pit | | ELEVATION AND DATUM 4316.05' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER B. Kingsley | DATE STARTED 10-21-91 / DATE FINISHED 10-21-91 | |
| DRILLING EQUIPMENT Mobile B-53 | | COMPLETION DEPTH 19' | SAMPLER 3" stainless steel S.S., 2" steel S.S. |
| DRILLING METHOD HSA-6" OD, 3¾" ID | DRILL BIT 6½" Bullet | NO. OF SAMPLES DIST. NA | UNDIST. Geotech-9 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL NA 24 HRS NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY SMButh |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement/Bentonite Grout | FROM 0 TO 19 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | Recov./ft. | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | SAND, medium brown, very fine grained to fine grained; silty angular, well sorted, Dry | SM | | | | | | 3 | 10:05- Start air rotary pump started drilling at 10:30 |
| | | | | | | G1 | .2 | 3 | SPT from 0 to 2' at 10:35 |
| 1 | | | | | | | | 5 | Collect gradation analysis sample CAN0760760-4000 |
| | | | | | | | | 3 | from 0 to 2' at 10:35 |
| 2 | SAND medium brown, very fine to fine grained, angular, well sorted, silty (10%), Dry | SM | | | | | | 2 | SPT from 2 to 4' at 10:40 |
| | | | | | | G2 | 1.0 | 4 | |
| 3 | | | | | | | | 4 | |
| | | | | | | | | 5 | |
| 4 | SAND Light grey to dark grey mottled, very fine grained, silty (15%) | SM | | | | | | 5 | SPT from 4 to 6' at 10:55 |
| | Stained Light to dark grey, Dry | | | | | G3 | 1.8 | 4 | OVA - S.S. - 0 ppm augers - 72 ppm B Zone - 0 ppm |
| 5 | | | | | | | | 5 | |
| | | | | | | | | 13 | |
| 6 | Drill one foot through concrete | | | | | | | | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W SHEET 1 OF 3

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 0760

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | SAND, Light grey, very fine grained, well sorted, silty (10%) Calcareous, Dry | SM | | | | | | | SPT from 7 To 9' |
| | | | | | | | | 8 | at 11:07 |
| | | | | | | | | | change air monitoring tube |
| | | | | | | G4 | 1.5 | 4 | OVA-S.S.- 0 ppm |
| 8 | | | | | | | | | augers- 6 ppm |
| | | | | | | | | 5 | B. Zone - 0 ppm |
| | | | | | | | | 7 | |
| 9 | SAND, Light grey, very fine grained, mottled w/ white patches, silty (15%) Dry | SM | | | | | | | SPT from 9 To 11' |
| | | | | | | | | 4 | at 11:30 |
| | | | | | | | | | OVA-S.S.- 22ppm |
| | | | | | | G5 | 1.2 | 5 | -augers- 34 ppm |
| 10 | | | | | | | | | -B. Zone - 0 ppm |
| | | | | | | | | 6 | |
| | | | | | | | | 15 | |
| 11 | | | | | | | | | tried SPT |
| | | | | | | | | | Spoon would not Penetrate- |
| | | | | | | | | | Drilled 1 foot |
| 12 | Sand, as above | | | | | | | | SPT from 12 To 12.5' |
| | | | | | | G6 | .5 | 66 | at 11:50 |
| | | | | | | | | | 12:00- change Air monitoring tube |
| | | | | | | | | | CAN076-0760-6002 |
| 13 | SAND Light brownish grey, very fine grained, angular, silty well sorted, Dry | SM | | | | | | | (time - 53 min) |
| | | | | | | | | 9 | SPT from 13 To 14.5' |
| | | | | | | | | | at 12:15 |
| | | | | | | G7 | 1.4 | 42 | OVA -S.S- 0 ppm |
| 14 | | | | | | | | | -augers- 74 ppm |
| | | | | | | | | 67 | B. Zone - 0 ppm |
| 15 | SAND Light greyish brown, very fine grained, angular, well sorted, ~~trace~~ silty calcareous, musty smell, Dry. | SM | | | | | | | SPT from 15 To 17' |
| | | | | | | | | | at 12:45 |
| | | | | | | G8 | 1.3 | 45 | |
| | | | | | | | | 30 | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 0760

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | | | | | | G8 | 1.5 | 35 | |
| | | | | | | | | 38 | |
| 17 | SAND, very light brown, silty very fine grained, angular, well sorted, mottled white throughout musty smell, calcite cement, Dry | Caliche (SM) | | | | | | 51 | SPT from 17 to 19' at 14:00 |
| 18 | | | | | | G9 | 1.7 | 43 | OVA-S.S. -Augers -B Zone } 0 ppm |
| | | | | | | | | 52 | shut air sampler off at 14:25 |
| | | | | | | | | 57 | CANOX-0760-6003 |
| 19 | Bottom of Hole | | | | | | | | Grouted boring from 0-15' w/ Cement-Bentonite grout. at 15:13 (3 to 5% Bentonite Mix) |
| | | | | | | | | | 6" blow counts taken w/ a 140lb hammer dropped 30" |

PROJECT NO. 89MC114W

SHEET 3 OF 3

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 0761

| | | | |
|---|---|---|---|
| BORING LOCATION Sludge Weathering Pit | | ELEVATION AND DATUM 4316.08' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER B. Kingsley | DATE STARTED Oct 28-91 / DATE FINISHED Oct 28-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 27' | SAMPLER 3" stainless steel S.S., 2" steel S.S. |
| DRILLING METHOD HSA 6" OD, 3 3/4" ID | DRILL BIT 6 1/2" Bullet | NO. OF SAMPLES DIST. NA | UNDIST. Analytical - 3, Geotech - 8 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY SMBruth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement - Bentonite Grout | FROM 0 TO 27 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | Recov./ft. | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | SAND, medium brown, very fine grained plant roots slightly calcareous, silty (20%), Dry | SM | | | | | | 8 | SPT from 0-2' at 8:20 |
| 1 | | | | | | G1 | .8 | 10 | start Drilling at 8:15 |
| | | | | | | | | 10 | |
| | | | | | | | | 12 | |
| 2 | SAND, very fine grained medium brown, subangular calcareous, Dry silty | SM | | | | | | 7 | SPT from 2-4' at 8:25 Gradation Anal CAN 076-0761-0002 |
| | | | | | | G2 | 1.0 | 9 | |
| 3 | | | | | | | | 7 | |
| | | | | | | | | 11 | |
| 4 | SAND, very fine grained, silty brown, calcite cement, Dry | caliche (SM) | | | | | | 6 | stainless steel Analytical S.S. from 4-6' at 8:35 |
| | | | | | | A1 | .6 | 7 | CAN076-0761-0009 CAN076-0761-0701 MRD |
| 5 | | | | | | | | 7 | |
| | | | | | | | | 8 | OVA in auger and S.S. - 0 ppm Petroleum odor |
| 6 | Sand, med to dark brown very fine grained, subangular, silty calcareous speckled w/ white patches of calcite, Dry | SM | | | | G3 | .8 | 2 | SPT from 6-8' at 8:50 |
| | | | | | | | | 2 | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. G761

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetr. Resist. Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | G3 | .4 | 2 | odor |
| | | | | | | | | 3 | SPT from 8-10' at 9:30 |
| 8 | | | | | | | | 7 | |
| | | | | | | | | 2 | Petroleum odor |
| | SAND, pale, brown, very fine grained, silty calcite cemented, Dry | Caliche (SM) | | | | | | 7 | OVA in S.S. - 0 ppm |
| 9 | | | | | | G4 | .5 | 2 | |
| | | | | | | | | 11 | |
| | | | | | | | | 2 | |
| | | | | | | | | 12 | |
| | | | | | | | | 7 | Stainless steel Analytical S.S. from auger, at: 9:45 CAN076-0701-0010 OVA in auger |
| 10 | Sand, pale brown, very fine + fine grained, with scattered silty calcite cemented. Dry | Caliche (SM) | | | | | | 12 | |
| | | | | | | A2 | 1.3 | 14 | 84 ppm |
| 11 | | | | | | | | | OVA in S.S. |
| | | | | | | | | 7 | 0 ppm musty odor |
| | | | | | | | | 8 | |
| 12 | | | | | | | | | SPT from 12-14 at 9:55 |
| | Sand, Light brown, very fine grained, silty, (20%) calcareous., Dry | SM | | | | | 1.3 | 16 | No odor. |
| | | | | | | G5 | | 10 | |
| | | | | | | | | 9 | |
| | | | | | | | | 11 | |
| 14 | | | | | | | | | SPT from 14-16 at 10:15 |
| | Sand, medium brown grades downward to pale brown very fine grained, calcite cement silty (15%) | SM/ caliche | | | | | | 6 | |
| | | | | | | G6 | 1.3 | 17 | OVA in auger 68 ppm |
| 15 | | | | | | | | 16 | OVA in S.S. - 0 ppm |
| | | | | | | | | 9 | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC119W

SHEET 2 OF 4

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 0761

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetr. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | Sand medium brown, very fine grained, angular, wellsorted, silty Calcareous, locally mottled white Dry. | SM | | | | | | 7 | SPT from 16-18' at 10:30 |
| | | | | | | SS 7 | 1.0 | 12 | OVA in auger - 10 ppm OVA in S.S - 5 ppm smusty odor |
| 17 | | | | | | | | 14 | |
| | | | | | | | | 36 | |
| 18 | Sand, med. to pale brown very fine to fine grained, silty trace med grained, subangular to rounded, Locally mottled white calcareous to calcite cemented. | SM/caliche | | | | | | 15 | SPT from 18-20 at 10:40 |
| | | | | | | SS 8 | | 19 | OVA in Auger 8 ppm |
| 19 | | | | | | | | 29 | OVA in S.S. 0 ppm |
| | | | | | | | | 16 | |
| 20 | Drill to 25' | | | | | | | | collect |
| 21 | | | | | | | | | |
| 22 | | | | | | | | | |
| 23 | | | | | | | | | |
| 24 | | | | | | | | | |
| 25 | | | | | | | | | |

PROJECT NO. 89MC114W

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 0761

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, et |
|---|---|---|---|---|---|---|---|---|---|
| 25 | SAND, pale brown to locally mottled white, very fine to fine grained, angular to subangular, silty. Calcite cement. | SM | | | | AB | | 35 / 140 | Stainless steel Analytical S.S from 25-26' at 1115 CAN076-0761-0025 |
| 26 | Bottom of Boring. | | | | | | | | OVA in augers and S.S. - 0 ppm slight odor grouted boring from 0 to 26' with cement-Bentonite grout (3-5% Bentonite) 6" Blow counts taken with a 140# hammer dropped 30". collect decon water at 1125 CAN076-0761-0781 |

PROJECT NO. 89MC114W

SHEET 4 OF 4

**Woodward-Clyde Consultants** PROJECT NAME Sanford AFB HOLE NO. 0762

| | |
|---|---|
| BORING LOCATION Sludge weathering pit | ELEVATION AND DATUM 4316.02' MSL |
| DRILLING AGENCY Environmental drilling / DRILLER R. Kingsley | DATE STARTED 10-28-91 / DATE FINISHED 10-29-91 |
| DRILLING EQUIPMENT Mobile B-61 | COMPLETION DEPTH 33' / SAMPLER 3" stainless 2" |
| DRILLING METHOD HSA 6" OD 3 3/4" ID / DRILL BIT 12 bit | NO. OF SAMPLES DIST. NA / UNDIST. Analytical & Geotech |
| SIZE AND TYPE OF CASING NA | WATER ELEV. FIRST NA / COMPL. NA / 24 HRS. NA |
| TYPE OF PERFORATION NA / FROM TO FT. | LOGGED BY Larry Gardiner / CHECKED BY Tom Beck |
| SIZE AND TYPE OF PACK NA / FROM TO FT. | |
| TYPE OF SEAL Cement Bentonite grout / FROM 0 TO 33 FT | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | Recov. ft. | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | SAND, medium to dark brown very fine grained silty, non-calcareous, Dry | SM | | | | A1 | | 9 | started drilling at 13:55 |
| | | | | | | | | 9 | Surface sample collected at 17:10 10-23-91 CAN0762-0762-0000 |
| 1 | | | | | | S1 | 1.5 | 10 | SPT from 0-2' at 14:00 |
| | | | | | | | | 11 | |
| 2 | Sand as above | | | | | | | 6 | SPT from 2-4' at 14:05 |
| | | | | | | | 1.2 | 6 | |
| 3 | | | | | | G2 | | 5 | |
| | | | | | | | | 5 | |
| 4 | | | | | | | | 3 | |
| | base of Pit | | | | | | | 5 | SPT from 4-6' at 14:15 |
| 5 | Sand, Light brn grey, very fine grained calcareous, Dry Soil looks altered by contamination, Dry, silty | SM | | | | S3 | 1.0 | 5 | strong petroleum odor |
| | | | | | | | | 4 | OVA in base SS 29 ppm in auger 0 ppm in B Zone - 0 ppm |
| 6 | Sand Light brownish grey very fine grained, stained dark bluish grey at base, Dry silty. | SM | | | | G4 | | 6" stalled | Stainless ST Analytical from 6-8' at 14:30 (use as SPT) Drilled to 8' cut new Anal from 6-8' strong odor |
| 7 | | | | | | | | | |

PROJECT NO. 95MC114N

SHEET 1 OF 4

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 0762

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | | OVA in S.S - 39 ppm in augers - 35 ppm |
| 8 | SAND, pale grayish Brown very fine grained, angular, silty well sorted, calcite cement, Dry | Caliche | | | | | | 10 | ← retake stainless steel Anal. S. from S/0' at 14:50 |
| | | | | | | | 1.7 | 12 | OVA Top 158-180 ppm OVA in augers 19 ppm |
| 9 | | | | | | A2 | | 15 | CAN076-0762-0008 MS/MSD (6 Jars) |
| | | | | | | | | 17 | Gradation Anal. CAN076-0762-0008 |
| 10 | Sand, Light Medium brown with white mottles, very fine grained, Subangular to angular well sorted, slightly silty (<5%) calcareous, Dry | SM-SP | | | | | 1.1 | 7 | SPT from 10-12' at 15:05 |
| | | | | | | | | 9 | OVA in augers 9 ppm in S.S. - 0 ppm |
| 11 | | | | | | G5 | | 17 | B. Zone - 0 ppm |
| | | | | | | | | 20 | |
| 12 | SAND, medium brown very fine to fine grained angular, well sorted. silty, calcareous, Dry | SM | | | | | 1.2 | 10 | SPT from 12-14' at 15:20 |
| | | | | | | | | 11 | OVA in augers - 10 ppm OVA in S.S - 0 ppm |
| 13 | | | | | | G6 | | 15 | OVA in B. Zone - 0 ppm |
| | | | | | | | | 22 | |
| 14 | Sand, Light brown, very fine to fine grained, angular, well sorted, calcite cemented, Dry silty | Caliche (SM) | | | | A3 | 1.5 | 10 | ← Stainless St Analytical S.S. from 14-16 |
| | | | | | | | | 35 | at 15:35 CAN076-0762-0084 OVA in augers 102 ppm |
| | | | | | | | | 40 | MS/MSD 17 ppm |
| 16 | | | | | | | | 25 | OVA - B. Zone - 0 ppm faint odor |

PROJECT NO. 89MC114U SHEET 2 OF 4

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 0762

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | Sand, pale brown, very fine to medium grained, fair sorting subangular to rounded, silty well cemented w/calcite | (SM) caliche | | | | | | 10 | SPT from 16-18' at 15:45 OVA in 3.5-0 ppm |
| | | | | | | G7 | | 86 | OVA-auger 15-0 ppm -B. 20m-0ppm |
| 17 | | | | | | | | 40 | |
| | | | | | | | | 25 | |
| 18 | Sand, pale brown as above | | | | | G8 | | 35 18 to 18.3 | SPT from 18-18.3 stalled. at 16:00 |
| 19 | Drilled from 18.3' to 25' | | | | | | | | |
| 20 | | | | | | | | | |
| 21 | | | | | | | | | |
| 22 | | | | | | | | | |
| 23 | | | | | | | | | |
| 24 | | | | | | | | | |
| 25 | | | | | | | | | |

PROJECT NO. 89M4140 SHEET 3 OF 4

**Woodward-Clyde Consultants** PROJECT NAME CAIUNOW AFB HOLE NO. 0762

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 25 | SAND, LT. brown, very fine to fine grained, angular, to subrounded, silty (25%) calcareous | SM | | | | G9 | | 96 6" | SPT from 25-26 at 12:30 |
| | | | | | | | | | stop drilling for the day |
| 26 | | | | | | | | | Start Drilling at 13:30 10-29-91 |
| 27 | | | | | | | | | |
| 28 | | | | | | | | | |
| | | | | | | | | | Collect rinsate blank at 15:05 CAN07K0762-0771 |
| 29 | | | | | | | | | |
| 30 | | | | | | | | | Stainless steel analytical S.S from ~~30-32~~ 31-33 |
| | | | | | | | | | at: 13:45 10-29-91 |
| 31 | | | | | | | | | OVA in ~~35~~ |
| | | | | | | 6" | | 63 | S.S - 0 ppm OVA-auger-0 ppm |
| | | | | | | | | | No odor |
| | SAND, Light reddish brown very fine to medium grained fair sorting, subangular to subrounded unconsolidated (Loose) non calcareous, Dry | | | | | A4 | | 69 | Clean |
| 32 | | | | | | | | | CAN07G-0762-0831 |
| | | SP | | | | | | 90 | |
| | | | | | | | | | Grouted Boring from 0-33' w/ Cement-Bentonite grout (3-5% Bentonite) |
| | | | | | | | | 80 | |
| 33 | Bottom of boring | | | | | | | | |
| | | | | | | | | | 6" blow counts taken w/ 140 lb hammer dropped 30" |

PROJECT NO. 89MC114W

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 0763

| | | | |
|---|---|---|---|
| BORING LOCATION Sludge Weathering Pit | | ELEVATION AND DATUM 4315.87' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER B. Kingsley | DATE STARTED 10-29-91 / DATE FINISHED 10-29-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 24 | SAMPLER 3" Shelby / 3" Steel |
| DRILLING METHOD HSA 6" OD, 3 3/4" ID | DRILL BIT 6 1/2" Bullet | NO. OF SAMPLES DIST. NA | UNDIST. Analytical Geotech - 8 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY LARRY GARDINER | CHECKED BY SM Beth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite Grout | FROM 0 TO 24 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov./ft. | SAMPLES: Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | Sand, medium brown, very fine grained, silty (15%) non-calcareous, Dry | SM | | | | G1 | | 5 | Surface sample collected at 16:40 on 10-23-91 started drilling at: 15:15 |
| | | | | | | | | 10 | |
| 1 | | | | | | G1 | .8 | 11 | SPT from 0-2' at - 15:20 |
| | | | | | | | | 9 | |
| 2 | SAND, as above | | | | | | | | SPT from 2-4' at 15:35 |
| | | | | | | | | 5 | |
| | | | | | | G2 | 1.2 | 6 | |
| 3 | | | | | | | | 6 | |
| | | | | | | | | 9 | |
| 4 | base of pit. | | | | | | | | SPT from 4-6' at 15:45 |
| | SAND, pale grayish brown locally stained medium bluish gray & very fine grained, Dry, silty | SM | | | | | | 3 | strong Pit odor. |
| | | | | | | G3 | 1.5 | 4 | 34 ppm-OVA In S.S. |
| 5 | | | | | | | | 4 | OVA-augers-0 ppm OVA Rzone-0 ppm |
| | | | | | | | | 4 | |
| 6 | Sand, as above Changes to light brown at base Very fine grained silty calcareous, Dry | SM | | | | | | | SPT from 6-8' at 15:55 |
| | | | | | | G4 | | 12 for 6" | encountered concrete will drill it out strong odor |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 1 OF 3

10/68

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 0763

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist Blows/6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | | |
| 8 | SAND, grayish brown very fine grained silty (25%) Dry | SM | | | | A2 | 13 | 9<br>10 | stainless steel analytical S.S from 8-10' at 16:05 |
| 9 | | | | | | | | 14 | OVA-70 ppm in augers<br>OVA - 34 ppm in S.S.<br>CAN076-0763-0761 AD |
| 10 | SAND medium brown very fine to fine grained, well sorted calcareous, Dry, silty | SM | | | | | | 16<br>10 to 10.8 | SPT from 10-12' Odor at 16:10 |
| 11 | | | | | | G5 | | | |
| 12 | SAND pale brown very fine grained angular, silty abundant calcite | Caliche (SM) | | | | | | 31 | SPT from 12-14' at 16:30<br>drill 3" on halted |
| 13 | | | | | | G6 | | | |
| 14 | SAND, Pale brown, very fine to fine grained, subangular well sorted, cemented w/ calcite, silty | Caliche (SM) | | | | G7 | 1.9 | 23<br>48<br>31<br>29 | SPT from 14-16' at 16:50<br>Gradation Anal Sample CAN076-0763-0764 |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 2 OF 3

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. B63

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist. Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | Sand, Light, medium brown, very fine to fine grained, wellsorted, slightly silty (10%) calcite cement. | Calitha (SM) | | | | | | 45 | SPT from 16-18' at 17:00 |
| 17 | | | | | | B8 | 1.5 | 44 | |
| | | | | | | | | 47 | |
| | | | | | | | | 42 | Stainless |
| 18 | Sand, light reddish brown, very fine to fine grained, subangular to subrounded, silty well sorted, calcite cement. | SM | | | | | | 35 | from 18-20' at 17:20 |
| | | | | | | A3 | 1.6 | 58 | CAN076-0763-0018 |
| 19 | | | | | | | | 50 | OVA in top of SS-8ppm slight odor. |
| | | | | | | | | 63 | |
| 20 | | | | | | | | | |
| 21 | | | | | | | | | |
| 22 | SAND, medium reddish brown, very fine to fine grained, subangular to subrounded, well sorted, silty some calcite cement. | SM | | | | | | | Stainless |
| | | | | | | | | 35 | from 22-24' |
| | | | | | | A4 | 1.4 | 39 | at 17:50 CAN076-0763-0022 |
| 23 | | | | | | | | 45 | OVA in Overgloves S.S-0 ppm |
| | | | | | | | | 44 | |
| 24 | Bottom of Boring | | | | | | | | No odor grouted boring from 0-24' w/ cement-Bentonite grout (3-5% Bentonite mix) |
| | | | | | | | | | " blue County taken from 14.5 to hammer dropped - 30" |

PROJECT NO. 89CH14W SHEET 2 OF 3

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0781

| | | | |
|---|---|---|---|
| BORING LOCATION Fire Training Area No. 1 | | ELEVATION AND DATUM 4316.83 | |
| DRILLING AGENCY Environmental Drilling | DRILLER L. Weeks | DATE STARTED 10-12-91 DATE FINISHED 10-13-91 | |
| DRILLING EQUIPMENT Failing F-10 | | COMPLETION DEPTH 101.5' | SAMPLER 3" Stainless Steel SS 2" Steel SS |
| DRILLING METHOD HSA 4¼"ID 8¼"OD | DRILL BIT 8¼ Bullet | NO. OF SAMPLES DIST. — | UNDIST. Analytical - 13 Geotech - 15 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL. — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kubeczko | CHECKED BY Tom ACRE |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement Bentonite Grout | FROM 0 TO 101.5 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov. ft. | Penetr. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | Sand, orange to brown-orange, fine grained, subangular to subrounded, well sorted, silt(10-20%), trace clay(3-5%), slightly moist, loose | | | | | A1 | | 4 | Collect Surface Soil Spl from 0.0 to 0.5' @ 945 on 10-13-91 CAN078-0781-0000 CAN078-0781-0801 MRD OVA on sample = 0 ppm |
| | | | | | | | | 9 | Started drilling @ 1330 on 10-12-91 |
| 1 | | | | | | G1 | .5 | 6 | SPT Spl from 0' to 2' @ 1330 CAN078-0781-4000 |
| | | | | | | | | 3 | Collected gradation analysis sample from 0' to 0.5' @ 1330 |
| 2 | | SM | | | | | | 3 | SPT Spl from 2' to 4' @ 1335 CAN078-0781-4002 |
| | | | | | | | | 5 | EPA Consultant arrived on site @ 1335 |
| 3 | | | | | | G2 | 1 | 11 | Collect decon water sample @ 1335 CAN078-0781-0881 |
| | | | | | | | | 15 | |
| 4 | Sand, orange to brown-orange, fine grained, subangular, well sorted, silt(15-20%), clay (5-10%), calcareous (15-20%), slightly moist loose | | | | | | | 3 | Stainless Steel SS Spl from 4' to 6' @ 1345 OVA on sample = 0ppm CAN078-0781-0004 EPA Split |
| | | | | | | | | 7 | |
| 5 | | | | | | A2 | 1.2 | 9 | OVA @ 5' in augers = 0ppm in breathing zone = 0ppm |
| | Scattered pale orange tan tan-orange caliche mottling | SM | | | | | | 7 | |
| 6 | | | | | | | | 4 | SPT Spl from 6 to 8' @ 1400 CAN078-0781-4006 |
| | | | | | | G3 | 1 | 7 | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W T2H

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0781

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | Sand, orange to pale orange, fine grained, sub-angular to subrounded, well sorted, silt (10-15%) clay (3-5%), calcareous (15-20%), occassional tan mottling (caliche), loose | SM | | | | G3 | 1 | 6 | |
| | | | | | | | | 6 | |
| 8 | Sand, orange, fine grained, subangular to sub-rounded, well sorted, little silt (15-20%), trace clay (5%), little calcareous (10-20%), dry to slightly moist, loose | | | | | | | 2 | SPT Spl from 8' to 10' @ 1408 CAN078-0781-4008 |
| | | | | | | G4 | 1.2 | 7 | |
| 9 | | | | | | | | 7 | |
| | | | | | | | | 5 | OVA @ 10' in augers = 0ppm in breathing zone = 0ppm |
| 10 | | | | | | | | 4 | Stainless Steel SS Spl from 10' to 12' @ 1417 OVA on sample = 0 ppm CAN078-0781-0010MS/MSD |
| | | | | | | A3 | 1.4 | 9 | |
| 11 | | | | | | | | 7 | |
| | | SM | | | | | | 6 | |
| 12 | | | | | | | | 4 | SPT Spl from 12' to 14' @ 1436 CAN078-0781-4012 |
| | | | | | | G5 | 1.8 | 4 | |
| 13 | | | | | | | | 4 | |
| | | | | | | | | 5 | |
| 14 | Sand, orange, fine grained, subangular, well sorted, little silt (15-25%), little clay (10%), little to some calcareous (15-25%), occassional tan tan-orange caliche streaks / pockets, dry to slightly moist, loose to medium dense | | | | | | | 3 | SPT Spl from 14' to 16' @ 1441 CAN078-0781-4014 |
| | | | | | | G6 | 1.5 | 9 | OVA @ 15' in augers = 0ppm in breathing zone = 0 ppm |
| 15 | | | | | | | | 11 | |
| | | | | | | | | 27 | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W T2H

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0781

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | Sand, pale orange to tan-orange, fine grained, subangular, well sorted, trace silt (5-10%), rare clay (1-3%), some calcareous (20-25%), occassional streaks / pockets of caliche, dry, medium dense to dense | | | | | | | 11 | SPT Spl from 16' to 18' @ 1458 CAN078-0781-4016 |
| | | | | | | G7 | 15 | 35 | |
| 17 | | | | | | | | 36 | |
| | | | | | | | | 39 | |
| 18 | | | | | | | | 10 | SPT Spl from 18' to 20' @ 1510 CAN078-0781-4018 |
| | | | | | | | | 16 | |
| 19 | | | | | | G8 | 14 | 16 | |
| | | | | | | | | 10 | OVA @ 20' in augers = 0 ppm in breathing zone = 0 ppm |
| 20 | | SM | | | | | | 11 | Stainless steel SS Spl from 20' to 22' @ 1525 |
| | | | | | | | | 29 | OVA on sample = 0 ppm except between 21.6' & 21.9' Took TCL VOC sample from this interval 0.6 ppm CAN078-0781-0020 EPA Split |
| 21 | | | | | | A4 | 18 | 34 | |
| | | | | | | | | 51 | |
| 22 | | | | | | | | | |
| 23 | | | | | | | | | |
| 24 | | | | | | | | | |
| 25 | | | | | | | | | OVA @ 25' in augers = 0 ppm in breathing zone = 0 ppm |

PROJECT NO. 89MC114W T2H

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0781

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 25 | Sand, pale orange tan-orange, fine grained, subangular, well sorted, silty (10-20%), trace clay (5%), some calcareous w/ calcium carbonate cement (25-35%), dense to very dense, | | | | | | | 25 | SPT Spl from 25' to 26.5' @ 1542 CAN078-0781-4025 |
| | | | | | | | | 35 | |
| 26 | | | | | | G9 | 1.1 | | |
| | | | | | | | | 62 | |
| 27 | | SM | | | | | | | |
| 28 | | | | | | | | | |
| 29 | | | | | | | | | OVA @ 30' in augers = 0 ppm in breathing zone = 0 ppm |
| 30 | | | | | | A5 | .5 | 190 | Stainless Steel SS Spl from 30' to 30.5' @ 1605 OVA on sample = 0 ppm CAN078-0781-0030 |
| 31 | Caliche, tan-orange, little sand (15-20%), trace silt (5-10%) trace clay (5-10%), very dense dry | | | | | | | | |
| 32 | | CALICHE | | | | | | | |
| 33 | | | | | | | | | |
| 34 | | | | | | | | | |

PROJECT NO. 89MC114W T2H

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0781

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 34 | Caliche, tan orange, little sand (10-15%), trace silt (5-10%) trace clay (5-10%), very dense, dry | CALICHE | | | | | | | OVA @ 35' in augers = 0 ppm in breathing zone = 0 ppm |
| 35 | | | | | | | | 50 | SPT Spl from 35' to 36' @ 1640 |
| | | | | | | | | 75 | Collected gradation analysis sample CAN078-0781-4035 |
| 36 | Sand, orange, fine grained, sub angular to sub-rounded, well sorted, silty (10-15%), trace clay (5%), little calcareous (15-20%), slightly moist medium dense. | | | | | G10 | .5 | | |
| 37 | | | | | | | | | |
| 38 | | | | | | | | | |
| 39 | | SM | | | | | | | |
| 40 | Occassional frosted rounded sand grains | | | | | | | | OVA @ 40' in augers = 0 ppm in breathing zone = 0 ppm |
| | | | | | | | | 16 | Stainless Steel SS Spl from 40' to 41.5' @ 1700 |
| | | | | | | | | 32 | OVA on sample = 0 ppm CAN078-0781-0040 |
| 41 | | | | | | A6 | .5 | 60 | EPA Split |
| 42 | | | | | | | | | |
| 43 | | | | | | | | | |

PROJECT NO. 89MC 114W T2H

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0781

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist Blows 6 in. | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 43 | Sand, orange, fine grained, subangular to subrounded, well sorted, silty (10-20%), trace clay (5%), little calcareous (15-20%), slightly moist, medium dense to dense | | | | | | | | |
| 44 | | | | | | | | | EPA Consultant left site @ 1730<br>OVA @ 45' in augers = 0ppm in breathing zone = 0ppm |
| 45 | | | | | | | | 29 | SPT Spl from 45' to 47' @ 1733<br>CAN078-0781-4045 |
| | | | | | | | | 33 | |
| 46 | | | | | | G11 | 11 | | |
| | | SM | | | | | | 32 | |
| | | | | | | | | 45 | |
| 47 | | | | | | | | | |
| 48 | | | | | | | | | |
| 49 | | | | | | | | | OVA @ 50' in augers = 0ppm in breathing zone = 0 ppm |
| 50 | Sand, pale orange tan-orange to orange, fine grained, subangular to subrounded, well sorted, silty (10-15%), trace clay (5%), little to some calcareous (15-25%), very dense, dry to slightly moist | | | | | | | 96 | Stainless Steel SS Spl from 50' to 51' @ 1815<br>OVA on Sample = 0ppm<br>CAN078-0781-0050 |
| | | | | | | | | 114 | |
| 51 | | SM | | | | A7 | 1 | | |
| 52 | | | | | | | | | |

PROJECT NO. 89MC114W T2H

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0781

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist. Blows (6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 52 | Sand, pale orange, fine grained, subangular, well sorted, silty (10-20%), trace clay (5-10%), calcareous (10-15%), slightly moist, medium dense to dense | | | | | | | | |
| 53 | | | | | | | | | |
| | | SM | | | | | | | |
| 54 | | | | | | | | | |
| | | | | | | | | | OVA @ 55' in augers = 0 ppm in breathing zone = 0ppm |
| 55 | | | | | | | | 23 | SPT Spl from 55' to 57' @ 1920 CAN078 0781-4055 |
| | | | | | | | | 29 | |
| 56 | | | | | | G12 | 1.5 | | |
| | Sand, pale orange, fine grained, subangular well sorted, silty (10-15%), little clay (5-15%), slightly moist, medium dense to dense | | | | | | | 37 | |
| | | | | | | | | 42 | |
| 57 | | | | | | | | | |
| 58 | | | | | | | | | |
| | | SM | | | | | | | |
| 59 | | | | | | | | | |
| | | | | | | | | | OVA @ 60' in augers = 0ppm in breathing zone = 0ppm |
| 60 | | | | | | | | 20 | Stainless Steel SS Spl from 60' to 62' @ 2000 |
| | | | | | | A8 | 1.5 | 54 | OVA on sample = 0ppm except between 61.0' & 61.5 = 8 ppm; Took TCL VOC sample here CAN078-0781-0060 |
| 61 | | | | | | | | | |

PROJECT NO. 89MC114W T2H

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0781

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc |
|---|---|---|---|---|---|---|---|---|---|
| 61 | Sand, pale orange, fine grained, subangular, well sorted, silty (5-15%), clayey (5%), medium dense, slightly moist | | | | | A8 | 1.5 | 60 | |
| | | | | | | | | 78 | |
| 62 | | | | | | | | | |
| 63 | | | | | | | | | |
| 64 | | SM | | | | | | | OVA @ 65' in augers = 0ppm in breathing zone = 0ppm |
| 65 | | | | | | | | 21 | SPT spl from 65' to 67' @ 2015 CAN078-0781-4065 |
| | | | | | | | | 27 | |
| 66 | | | | | | G13 | 1.3 | 38 | |
| | | | | | | | | 49 | |
| 67 | | | | | | | | | |
| 68 | | | | | | | | | |
| 69 | | | | | | | | | |
| 70 | | | | | | | | | OVA @ 70' in augers = 0ppm in breathing zone = 0ppm |

PROJECT NO. 89MC114W T2H

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0781

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist. Blows/6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 70 | Sand, light orange, fine grained, subrounded well sorted, trace silt (3-5%) trace calcareous (3-5%), trace black specs/grains & varicolored grains (5-10%), slightly moist, dense to very dense | | | | | | | 32 | Stainless Steel SS Spl from 70' to 72' @ 2035 OVA on sample = 0 ppm CAN078-0781-0070 |
| | | | | | | A9 | 12 | 61 | |
| 71 | | | | | | | | 72 | |
| | | | | | | | | 101 | |
| 72 | | | | | | | | | |
| 73 | | | | | | | | | |
| 74 | | SP | | | | | | | |
| | | | | | | | | | OVA @ 75' in augers = 0 ppm in breathing zone = 0 ppm Stopped drilling @ 75' @ 2130 on 10-12-91 |
| 75 | | | | | | | | 29 | Stainless steel SS Spl from 75' to 77' @ 730 on 10-13-91 CAN078-0781-0075 |
| | | | | | | A10 | 7 | 63 | OVA on sample = 0 ppm |
| 76 | | | | | | | | 57 | |
| | | | | | | | | 59 | Collected gradation analysis spl from 75' to 76' @ 730 CAN078-0781-4075 |
| 77 | | | | | | | | | |
| 78 | | | | | | | | | |
| 79 | | | | | | | | | |

PROJECT NO. 89MC114W T2H

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0781

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 79 | Sand, light to medium orange, fine to medium grained, subrounded, well sorted, predominantly quartz w/3-10% black specs & orange / black grains, rare silt (1-3%), slightly moist to moist, dense to very dense | | | | | | | | OVA @ 80' in augers = 0ppm in breathing zone = 0ppm |
| 80 | | | | | | | | 25 | Stainless Steel SS Spl from 80' to 81' @ 830 OVA on sample = 0 ppm CAN078-0781-0080 |
| | | | | | | A11 | 1 | 80 | |
| 81 | | | | | | | | | |
| 82 | | | | | | | | | |
| 83 | | SP | | | | | | | |
| 84 | | | | | | | | | OVA @ 85' in augers = 0ppm in breathing zone = 0 ppm |
| 85 | | | | | | | | 27 | SPT Spl from 85' to 87' @ 850 CAN078-0781-4085 |
| | | | | | | G14 | 1.5 | 35 | |
| 86 | | | | | | | | 49 | |
| | | | | | | | | 50 | |
| 87 | | | | | | | | | |
| 88 | | | | | | | | | |

PROJECT NO. 89MC114W T2H

SHEET 10 OF 12

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0781

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 88 | Sand, light to medium orange, medium grained, subrounded, well sorted, predominantly quartz w/ 3-5% orange & 3-5% dark colored & black grains, occassional well rounded grains, slightly moist to moist, dense | | | | | | | | |
| 89 | | | | | | | | | OVA @ 90' in augers = 0 ppm in breathing zone = 0 ppm |
| 90 | | | | | | | | 16 | Stainless Steel SS Spl from 90' to 92' @ 920 CAN078-0781-0090 OVA on sample = 0 ppm |
| | | | | | | | | 47 | |
| 91 | | | | | | A12 | 1.5 | 73 | |
| | | | | | | | | 95 | |
| 92 | | SP | | | | | | | |
| 93 | | | | | | | | | |
| 94 | | | | | | | | | |
| | | | | | | | | | OVA @ 95' in augers = 0 ppm in breathing zone = 0 ppm |
| 95 | | | | | | | | 14 | SPT Spl from 95' to 97' @ 945 CAN078-0781-4095 |
| | | | | | | G15 | 2 | 29 | |
| 96 | | | | | | | | 38 | |
| | | | | | | | | 53 | |
| 97 | | | | | | | | | |

PROJECT NO. 89MC114W T2H

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0781

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 97 | Sand, light to medium orange, medium grained, subrounded, well sorted, predominantly quartz w/ rare dark colored grains, rare silt (<1%), occassional scattered pockets of calcium carbonate remented sand, slightly moist, medium dense to dense | | | | | | | | Collected ambient blank water sample @ 955 CAN078-0781-0851 |
| 98 | | | | | | | | | |
| 99 | | SP | | | | | | | |
| 100 | | | | | | | | 16 | Stainless Steel SS Spl from 100' to 101.5' @ 1050 OVA on sample = 0 ppm CAN078-0781-0100 |
| | | | | | | A | 13 | 34 | |
| 101 | | | | | | | 15 | 200 | |
| | Bottom of hole - 101.5' | | | | | | | | |
| 102 | | | | | | | | | Stopped drilling @ 101.5' @ 1050 on 10-13-91 |
| | | | | | | | | | Borehole diameter = 8¼" |
| | | | | | | | | | 1100 Ran tremie pipe to TD. |
| 103 | | | | | | | | | 1145 Pump grout in 75 gallon batches and pulled 25' of augers at a time all the way up to surface |
| 104 | | | | | | | | | 1300 Will need to top off grout later and place metal spike in borehole |
| 105 | | | | | | | | | Grout Mix 28 bags cement 80 lbs bentonite 200 gallons of water |
| 106 | | | | | | | | | |

PROJECT NO. 89MC114W T2H

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0782

| | | | |
|---|---|---|---|
| BORING LOCATION Fire Training Area No. 1 | | ELEVATION AND DATUM 4316.75' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER L. Weeks | DATE STARTED 10-13-91 DATE FINISHED 10-14-91 | |
| DRILLING EQUIPMENT Failing F-10 | | COMPLETION DEPTH 102' | SAMPLER 3" Stainless Steel SS 2" Steel SS |
| DRILLING METHOD HSA 4¼" ID 8¼" OD | DRILL BIT 8¼" Bullet | NO. OF SAMPLES DIST. — | UNDIST. Analytical - 10 Geotech - 18 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL. — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kubeczko | CHECKED BY JM Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement - Bentonite Grout | FROM 0 TO 102 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov. ft. | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | Sand, brown-orange, fine grained, subangular, well sorted, silty (10-25%), trace clay (3-5%), slightly moist, medium dense | | | | | A1 | | 3 | Collected Surface Soil Spl from 0 to 0.5' @830 on 10-13-91 CAN078-0782-0000 OVA on sample = 0 ppm |
| | | | | | | | | 7 | |
| 1 | | | | | | G1 | .5 | 11 | Started drilling @ 1415 on 10-13-91 SPT Spl from 0' to 2' @ 1418 CAN078-0782-4000 |
| | | SM | | | | | | 13 | |
| 2 | | | | | | | | 6 | SPT Spl from 2' to 4' @ 1422 CAN078-0782-4002 |
| | | | | | | | | 7 | |
| 3 | | | | | | G2 | 1.2 | 16 | |
| | | | | | | | | 37 | OVA @ 4' in augers = 0 ppm in breathing zone = 0 ppm |
| 4 | Sand, orange to brown-orange, fine grained, subangular to subrounded, well sorted, silty (5-15%), trace clay (5%), calcareous (15-20%) w/ pockets of tan-orange caliche, medium dense, dry to slightly moist | | | | | | | 12 | Stainless Steel SS Spl from 4' to 6' @ 1430 OVA on sample = 0 ppm CAN078-0782-0004 |
| | | | | | | A2 | 2 | 16 | |
| 5 | | SM | | | | | | 21 | |
| | | | | | | | | 34 | EPA Split |
| 6 | | | | | | | | 11 | SPT Spl from 6' to 8' @ 1500 CAN078-0782-4006 |
| | | | | | | G3 | 1.6 | 12 | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W T2H

SHEET 1 OF 12

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0782

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc |
|---|---|---|---|---|---|---|---|---|---|
| 7 | Caliche, tan-orange, silty (5-10%), sandy (5-10%) clayey (10%), medium dense, dry | CALICHE | | | | G3 | 1.6 | 25 | |
| | | | | | | | | 36 | |
| 8 | Sand, pale orange to tan-orange, fine grained subangular to subrounded, well sorted, silty (10-15%), trace clay (3-5%), calcareous (15-25%) w/ calcium carbonate cement & occassional caliche pockets & layers, medium dense, dry | | | | | | | 6 | SPT Spl from 8' to 10' @ 1505 CAN078-0782-4008 |
| | | | | | | G4 | 1.1 | 11 | |
| 9 | | | | | | | | 30 | |
| | | | | | | | | 34 | OVA @ 10' in augers: 0 ppm in breathing zone: 0 ppm |
| 10 | | | | | | | | 9 | Stainless Steel SS Spl from 10' to 12' @ 1515 OVA on sample = 0 ppm CAN078-0782-0010 |
| | | | | | | A3 | 2 | 14 | Field Duplicate @ 1500 CAN078-0782-0861 |
| 11 | | | | | | | | 20 | MRD Duplicate CAN078-0782-0802 |
| | | SM | | | | | | 37 | |
| 12 | | | | | | | | 12 | SPT Spl from 12' to 14' @ 1530 CAN078-0782-4012 |
| | | | | | | G5 | 1.3 | 14 | |
| 13 | | | | | | | | 53 | |
| | | | | | | | | 72 | |
| 14 | | | | | | | | 17 | SPT Spl from 14' to 16' @ 1545 CAN078-0782-4014 |
| | | | | | | G6 | 1.4 | 24 | Collected gradation analysis sample |
| 15 | | | | | | | | 50 | OVA @ 15' in augers = 0 ppm in breathing zone = 0 ppm |
| | | | | | | | | 50 | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W T2H

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0782

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist. Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | Sand, pale orange to tan-orange, fine grained, subangular to subrounded, well sorted, silty (10-15%), calcareous (15-25%) w/ calcium carbonate cement & occassional caliche pockets & layers, trace clay (3-5%), medium dense, dry | SM | | | | | | 19 | SPT Spl from 16' to 18' @ 1600 CAN078-0782-4016 |
| | | | | | | | | 24 | |
| | | | | | | G7 | 1.7 | | |
| 17 | | | | | | | | 21 | |
| | Caliche, tan-orange, sandy (5-10%), silty (5-10%), clayey (5%), very dense, dry | CALICHE | | | | | | 73 | |
| 18 | | | | | | | | 50 | SPT Spl from 18' to 20' @ 1620 CAN078-0782-4018 |
| | | | | | | | | 60 | |
| | | | | | | G8 | 1.5 | | |
| 19 | Sand, orange to pale orange, fine grained, subangular, well sorted, silty (5-15%), calcareous (15-25%), trace clay (3-5%), medium dense to dense, slightly moist | SM | | | | | | 39 | |
| | | | | | | | | 48 | OVA @ 20' in augers: 0ppm in breathing zone = 0ppm |
| 20 | | | | | | | | 35 | Stainless Steel SS Spl from 20' to 21.5' @ 1635 OVA on sample = 0 ppm CAN078-0782-0020 |
| | | | | | | | | 134 | |
| | Occassional pockets/layers of caliche | | | | | A4 | 1.4 | | |
| 21 | | | | | | | | 200 | |
| 22 | | | | | | | | | |
| 23 | | | | | | | | | |
| 24 | | | | | | | | | |
| 25 | | | | | | | | | OVA @ 25' in augers: 0 ppm in breathing zone: 0 ppm |

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0782

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, et |
|---|---|---|---|---|---|---|---|---|---|
| 25 | Sand, orange to pale orange, fine grained, subangular, well sorted, silty (10-15%), calcareous (15-25%), trace clay (5%), medium dense, slightly moist | | | | | | | 19 | SPT Spl from 25' to 27' @ 1640 CAN078-0782-4025 |
| | | | | | | | | 29 | |
| 26 | | | | | | 69 | 1.7 | | |
| | | | | | | | | 30 | |
| | | | | | | | | 25 | |
| 27 | | | | | | | | | |
| | | SM | | | | | | | |
| 28 | | | | | | | | | |
| 29 | | | | | | | | | |
| | | | | | | | | | OVA @ 30' in auger: 0 ppm in breathing zone = 0 ppm |
| 30 | | | | | | | | 65 | Stainless Steel SS Spl from 30' to 31' @ 1700 OVA on sample = 0 ppm CAN078-0782-0030 |
| | Caliche, tan-orange, sandy (10-15%), silty (5-15%), trace clay (5-10%), very dense, dry, occassional interbedded sand stringers | | | | | | | 105 | |
| 31 | | | | | | A5 | .7 | | |
| 32 | | CALICHE | | | | | | | |
| 33 | | | | | | | | | |
| 34 | | | | | | | | | |

PROJECT NO. 89MC114W TJH

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0782

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 34 | Caliche, tan-orange, sandy (10-20%), silty (5-10%), trace clay (5-10%), very dense dry | CALICHE | | | | | | | OVA @ 35' in augers = 0ppm in breathing zone = 0ppm |
| 35 | | | | | | | | 50 | SPT Spl from 35' to 35.5' @ 1730 CAN078-0782-4035 |
| 36 | Sand, orange, fine grained, subangular, well sorted, silty (10-15%) calcareous (15-25%), trace clay (3%), medium dense to dense, occassional caliche pockets, slightly moist | SM | | | | G10 | 5 | 50 | |
| 37 | | | | | | | | | |
| 38 | | | | | | | | | |
| 39 | | | | | | | | | OVA @ 40' in augers = 0ppm in breathing zone = 0 ppm |
| 40 | | | | | | | | 15 | Stainless Steel SS Spl from 40' to 42' @ 1800 OVA on sample = 0 ppm CAN078-0782-0040 |
| 41 | | | | | | A6 | 1.8 | 22 | Collected rinsate blank sample from split spoon @ 40' to 42' @ 1810 |
| | | | | | | | | 30 | CAN078-0782-0871 |
| 42 | | | | | | | | 45 | |
| 43 | | | | | | | | | |

PROJECT NO. 89MC114W T2H

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0782

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 43 | Sand, orange, fine grained, subangular to subrounded, well sorted, silty (10-15%) calcareous (15-20%), trace clay (5%), medium dense to dense, slightly moist, occasional calcium carbonate cemented & caliche pockets. | | | | | | | | |
| 44 | | | | | | | | | OVA @ 45' in augers = 0 ppm in breathing zone = 0 ppm |
| 45 | | | | | | | | 29 | SPT Spl from 45' to 47' @ 1815 CAN078-0782-4045 |
| | | | | | | | | 41 | |
| 46 | | | | | | G11 | 1.7 | | |
| | | | | | | | | 27 | |
| | | | | | | | | 43 | |
| 47 | | SM | | | | | | | |
| 48 | | | | | | | | | |
| 49 | | | | | | | | | |
| | | | | | | | | | OVA @ 50' in augers = 0 ppm in breathing zone = 0 ppm |
| 50 | | | | | | | | 98 | Stainless Steel SS Spl from 50' to 51' @ 1830 OVA on sample = 0 ppm CAN078-0782-0050 |
| | | | | | | | | 35 | |
| 51 | | | | | | A7 | 1.0 | | |
| 52 | | | | | | | | | |

PROJECT NO. 89MC114W T2H

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0782

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 52 | Sand, orange, fine to medium grained, subrounded, well sorted, predominantly quartz w/1-3% dark colored grains, silty (3-5%), medium dense to dense, slightly moist | | | | | | | | |
| 53 | | | | | | | | | |
| 54 | | | | | | | | | OVA @ 55' in augers = 0 ppm in breathing zone = 0 ppm |
| 55 | | | | | | | | 20 | SPT Spl from 55' to 57' @ 1845 CAN078-0782-4055 |
| | | | | | | G12 | 2.6 | 32 | Collected gradation analysis sample from 55 to 57' @ 1845 CAN078-0782-4055 |
| 56 | | SP | | | | | | 39 | |
| | | | | | | | | 49 | |
| 57 | | | | | | | | | |
| 58 | | | | | | | | | |
| 59 | | | | | | | | | OVA @ 60' in augers = 0 ppm in breathing zone = 0 ppm |
| 60 | | | | | | | | 29 | Stainless Steel SS Spl from 60' to 62' @ 1920 OVA on sample = 0 ppm CAN078-0782-0060 |
| | | | | | | A8 | 1.8 | 34 | |
| 61 | | | | | | | | | |

PROJECT NO. 89MC114W T2H

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0782

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist. Blows 6 in. | REMARKS (Drill Rate, Fluid loss, Odor, et |
|---|---|---|---|---|---|---|---|---|---|
| 61 | Sand, orange, fine to medium grained, subrounded, well sorted, predominantly quartz w/3-5% dark colored & orange grains, silty (3-5%), medium dense, slightly moist | | | | | A8 | LT | 57 | |
| | | | | | | | | 78 | |
| 62 | | | | | | | | | |
| 63 | | | | | | | | | |
| 64 | | | | | | | | | |
| | | | | | | | | | OVA @ 65' in augers: 0 ppm in breathing zone: 0 ppm Stopped drilling @ 65' @ 1935 on 10-15-91 |
| 65 | | SP | | | | | | 24 | SPT Spl from 65' to 67' @ 545 CAN078-0782-4065 |
| | | | | | | | | 27 | |
| 66 | | | | | | G13 | 18 | 38 | Started drilling @ 545 @ 65' on 10-14-91 |
| | | | | | | | | 45 | |
| 67 | | | | | | | | | |
| 68 | | | | | | | | | |
| 69 | | | | | | | | | |
| | | | | | | | | | OVA @ 70' in auger: 0 ppm in breathing zone: 0 ppm |
| 70 | | | | | | | | | |

PROJECT NO. 89MC114W T2H

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0782

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 70 | Sand, orange, fine grained, subangular to subrounded, well sorted, predominantly quartz w/5% dark colored grains, trace silt (1-2%), calcareous (5-15%), medium dense to dense, slightly moist | | | | | | | 36 | SPT Spl from 70' to 72' @ 600 CAN078-0782-4070 |
| | | | | | | G14 | 1.8 | 31 | |
| 71 | | | | | | | | 45 | |
| | | | | | | | | 50 | |
| 72 | | SP | | | | | | | |
| 73 | | | | | | | | | |
| 74 | | | | | | | | | OVA @ 75' in augers - 0ppm in breathing zone - 0 ppm |
| 75 | | | | | | | | 95 | Stainless Steel SS Spl from 75' to 765' @ 700 OVA on sample - 0ppm CAN078-0782-0075 |
| | Sand, light to medium orange, subrounded, well sorted, predominantly quartz w/ 3-5% dark colored & 1-3% orange grains, rare rounded sand grains, rare silt (1-3%), dense, slightly moist to moist, fine grained | | | | | | | 75 | |
| 76 | | | | | | A9 | 1.3 | 56 | |
| 77 | | SP | | | | | | | |
| 78 | | | | | | | | | |
| 79 | | | | | | | | | |

PROJECT NO. 89MC114W T2H

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0782

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 79 | Sand, light to medium orange, subrounded to subangular, well sorted, fine grained, predominantly quartz w/3-5% dark colored & 3-5% orange grains, rare silt (1-3%), occassional pockets of calcareous sand, dense, slightly moist to moist | | | | | | | | OVA @ 80' in augers: 0 ppm in breathing zone = 0 ppm |
| 80 | | | | | | | | 11 | SPT Spl from 80' to 82' @ 715 CAN078-0782-4080 |
| | | | | | | | | 44 | |
| 81 | | | | | | G15 | 1.4 | | |
| | | | | | | | | 40 | |
| | | | | | | | | 47 | |
| 82 | | | | | | | | | |
| 83 | | SP | | | | | | | |
| 84 | | | | | | | | | |
| | | | | | | | | | OVA @ 85' in augers: 0 ppm in breathing zone = 0 ppm |
| 85 | | | | | | | | 15 | SPT Spl from 85' to 86' @ 735 CAN078-0782-4085 |
| | | | | | | | | 50 | |
| 86 | | | | | | G16 | .9 | | |
| 87 | | | | | | | | | |
| 88 | | | | | | | | | |

PROJECT NO. 89MC114W T2H

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0782

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 88 | Sand, light to medium orange, fine to medium grained, subrounded w/occassional rounded grains, well sorted, predominantly quartz w/ 5% dark colored grains & 3-5% orange grains, occassional layers/pockets of calcareous sand, dense, slightly moist | | | | | | | | |
| 89 | | | | | | | | | OVA @90' in augers = 0 ppm in breathing zone = 0 ppm |
| 90 | | | | | | | | 10 | SPT Spl from 90' to 91.5' @ 800 CAN078-0782-4090 |
| | | | | | | | | 35 | |
| 91 | | | | | | G17 | 1.1 | 50 | Collected gradation analysis sample from 90' to 91.5' @ 800 |
| 92 | | SP | | | | | | | |
| 93 | | | | | | | | | |
| 94 | | | | | | | | | OVA @ 95' in augers = 0 ppm in breathing zone = 0 ppm |
| 95 | | | | | | | | 11 | SPT Spl from 95' to 97' @ 830 CAN 078-0782-4095 |
| | | | | | | | | 34 | |
| 96 | | | | | | G18 | 1.7 | 50 | |
| | | | | | | | | 50 | |
| 97 | | | | | | | | | |

PROJECT NO. 89MC114W T2H

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0782

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc |
|---|---|---|---|---|---|---|---|---|---|
| 97 | Sand, light to medium orange, medium to fine grained, subrounded, well sorted, predominantly quartz w/3-5% dark colored & 3-5% orange grains, rare silt (1-2%), dense, slightly moist | | | | | | | | |
| 98 | | | | | | | | | |
| 99 | | SP | | | | | | | OVA @ 100' in augers = 0 ppm in breathing zone = 0 ppm |
| 100 | | | | | | | | 17 | Stainless Steel SSSpl from 100 to 102' @ 925 OVA on sample = 0 ppm CAN078-0782-0100 |
| | | | | | | | | 51 | |
| 101 | | | | | | A10 | 2 | | |
| | | | | | | | | 72 | |
| | | | | | | | | 91 | |
| 102 | | | | | | | | | Stopped drilling @ 102' @ 925 on 10-14-91 |
| | Bottom of hole - 102' | | | | | | | | Borehole diameter = 8 1/4" |
| 103 | | | | | | | | | 1000 Ran tremie pipe to bottom of hole 1030 Pumped grout in 90 gallon batches and pulled 30' of augers |
| 104 | | | | | | | | | 1050 Augers got stuck after 2nd batch of grout Broke top head bearing trying to unstick augers |
| 105 | | | | | | | | | 1110 Finally loosened augers Pulled 70' of augers Pumped 3rd batch of grout |
| 106 | | | | | | | | | Grout Mix 30 bags of cement 90 lbs of bentonite 210 gallons of water will top off grout & place stake later |

PROJECT NO. 89MC114W T2H

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0788

| | | | |
|---|---|---|---|
| BORING LOCATION Fire Training Area No. 1 (Redrill of Boring 0782) | | ELEVATION AND DATUM ~3' west of Boring 0782 | 4316.71' MSL |
| DRILLING AGENCY Environmental Drilling | DRILLER D. Sampson | DATE STARTED 12-7-91 / DATE FINISHED 12-9-91 | |
| DRILLING EQUIPMENT CME-75 | | COMPLETION DEPTH 102' | SAMPLER 3" Stainless Steel SS |
| DRILLING METHOD HSA 4¼" ID 7¾" OD | DRILL BIT 8" Bullet Bit | NO. OF SAMPLES DIST. — | UNDIST. Analytical = 10 Geotechnical = 0 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kubeczko | CHECKED BY SM Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite Grout | FROM 0 TO 102 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov. ft. | Penetr. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | See boring log 0782 for lithology descriptions | | | | | A1 | | | Collected surface soil sample from 0' to 0.5' @ 1350 CAN078-0788-0000 (VOCs, TPH) Collected MRD Duplicate Sample from 0' to 0.5' @ 1350 CAN078-0788-0807 (VOCs, TPH) OVA on sample = 0 ppm Started drilling @ 1550 |
| 1 | | | | | | | | | |
| 2 | | SM | | | | | | | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | 4 | Stainless Steel SS Sample from 4' to 6' @ 1605 CAN078-0788-0004 (VOCs) OVA on sample = 0 ppm |
| | | | | | | | | 7 | |
| 5 | | | | | | A2 | 00 | 11 | |
| | | SM | | | | | | 12 | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC 114W T12

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0788

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | | |
| | | CALICHE | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | 7 | Stainless Steel SS Sample from 10' to 12' @ 1630 CAND78-0788-0010 (VOCs, TPH) |
| | | | | | | | | 11 | Collected MRD Duplicate Sample from 10' to 12' @ 1630 |
| 11 | | | | | | A3 | 20 | | |
| | | | | | | | | 12 | CAND78-0788-0808 (VOCs, TPH) |
| | | SM | | | | | | | Collected field Duplicate Sample from 10' to 12' @ 1645 |
| | | | | | | | | 24 | CAND78-0788-0863 (VOCs, TPH) |
| 12 | | | | | | | | | OVA on sample = 0 ppm |
| | | | | | | | | | Collected rinsate blank sample from split spoon at 10' to 12' @ 1655 CAND78-0788-0878 |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W T12

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0788

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | | | | | | | | | |
| | | SM | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | CALICHE | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | 13 | Stainless Steel SS Sample from 20' to 21.5'@ 1700 CAN078-0788-0020 (TPH) |
| | | | | | | | | 22 | OVA on sample = 0 ppm |
| 21 | | | | | | A4 | 1.4 | 25 | |
| | | SM | | | | | | | |
| 22 | | | | | | | | | |
| 23 | | | | | | | | | |
| 24 | | | | | | | | | |
| 25 | | | | | | | | | Stopped drilling @ 25'@ 1720 on 7-7-91 |

PROJECT NO. 89MC114W T12

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0788

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetr. Resist (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 25 | | | | | | | | | Started drilling @25'@ 630 on 12-8-91 |
| 26 | | | | | | | | | |
| 27 | | | | | | | | | |
| | | SM | | | | | | | |
| 28 | | | | | | | | | |
| 29 | | | | | | | | | |
| 30 | | | | | | | | 37 | Stainless Steel SS Sample from 30' to 31' @ 650 CAN078-0788-0030 (TPH) |
| | | | | | | A5 | 1.0 | | |
| | | | | | | | | 63 | OVA on sample = 0.8 ppm |
| 31 | | | | | | | | | |
| 32 | | CALICHE | | | | | | | |
| 33 | | | | | | | | | |
| 34 | | | | | | | | | |

PROJECT NO. 89MC114W T12

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0788

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist. Blows (6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 34 | | | | | | | | | |
| | | CALICHE | | | | | | | |
| 35 | | | | | | | | | |
| 36 | | | | | | | | | |
| 37 | | | | | | | | | |
| 38 | | | | | | | | | |
| 39 | | SM | | | | | | | |
| 40 | | | | | | | | 11 | Stainless Steel SS Sample from 40' to 42' @ 735 CAN078-0788-0040MS/MSD (TPH) OVA on sample = 0 ppm |
| | | | | | | | | 18 | |
| 41 | | | | | | A6 | 20 | | |
| | | | | | | | | 29 | |
| | | | | | | | | 29 | |
| 42 | | | | | | | | | |
| 43 | | | | | | | | | |

PROJECT NO. 89MC114W T12

SHEET 5 OF 12

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0788

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist. Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, et |
|---|---|---|---|---|---|---|---|---|---|
| 43 | | | | | | | | | |
| 44 | | | | | | | | | |
| 45 | | | | | | | | | |
| 46 | | | | | | | | | |
| 47 | | SM | | | | | | | |
| 48 | | | | | | | | | |
| 49 | | | | | | | | | |
| 50 | | | | | | A7 | 10 | 87 | Stainless Steel SS Sample from 50' to 51' @ 840 CAN078-0788-0050 (VOCs, TPH) |
| 51 | | | | | | | | 193 | OVA on sample = 0 ppm |
| 52 | | | | | | | | | |

PROJECT NO. 89MC114W T12

**Woodward-Clyde Consultants** PROJECT NAME: Cannon AFB HOLE NO. 0788

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 52 | | | | | | | | | |
| 53 | | | | | | | | | |
| 54 | | | | | | | | | |
| 55 | | | | | | | | | |
| 56 | | SP | | | | | | | |
| 57 | | | | | | | | | |
| 58 | | | | | | | | | |
| 59 | | | | | | | | | |
| 60 | | | | | | | | 12 | Stainless Steel SS Sample from 60' to 62' @ 940 |
| | | | | | | A8 | 20 | | CAN078-0788-0060 (VOCs, TPH) |
| | | | | | | | | 20 | OVA on sample: 0 ppm |
| 61 | | | | | | | | | |

PROJECT NO. 89MC114W T12

SHEET 7 OF 12

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0788

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, e |
|---|---|---|---|---|---|---|---|---|---|
| 61 | | | | | | | | | |
| | | | | | | A8 | 20 | 25 | |
| | | | | | | | | 41 | |
| 62 | | | | | | | | | |
| 63 | | | | | | | | | |
| 64 | | | | | | | | | |
| 65 | | SP | | | | | | | |
| 66 | | | | | | | | | |
| 67 | | | | | | | | | |
| 68 | | | | | | | | | |
| 69 | | | | | | | | | |
| 70 | | | | | | | | | |

PROJECT NO. 89MC114W T12

SHEET 8 OF 12

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0788

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 70 | | | | | | | | | |
| 71 | | | | | | | | | |
| 72 | | | | | | | | | |
| | | SP | | | | | | | |
| 73 | | | | | | | | | |
| 74 | | | | | | | | | |
| 75 | | | | | | | | 10 | Stainless Steel SS Sample from 75' to 76.5' @ 1030 CAN078-0788-0075 (VOCs) OVA on sample = 0 ppm |
| | | | | | | A9 | 1.5 | 19 | |
| 76 | | | | | | | | 30 | |
| 77 | | SP | | | | | | | |
| 78 | | | | | | | | | |
| 79 | | | | | | | | | |

PROJECT NO. 89 MC114W T12

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0788

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, et |
|---|---|---|---|---|---|---|---|---|---|
| 79 | | | | | | | | | |
| 80 | | | | | | | | | |
| 81 | | | | | | | | | |
| 82 | | | | | | | | | |
| 83 | | SP | | | | | | | |
| 84 | | | | | | | | | |
| 85 | | | | | | | | | |
| 86 | | | | | | | | | |
| 87 | | | | | | | | | |
| 88 | | | | | | | | | |

PROJECT NO. 89MC114W T12

SHEET 10 OF 12

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0788

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist. (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 88 | | | | | | | | | |
| 89 | | | | | | | | | |
| 90 | | | | | | | | | |
| 91 | | | | | | | | | |
| 92 | | SP | | | | | | | |
| 93 | | | | | | | | | |
| 94 | | | | | | | | | |
| 95 | | | | | | | | | |
| 96 | | | | | | | | | |
| 97 | | | | | | | | | |

PROJECT NO. 89MC114W T12

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0788

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetr. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc |
|---|---|---|---|---|---|---|---|---|---|
| 97 | | | | | | | | | |
| 98 | | | | | | | | | |
| 99 | | SP | | | | | | | |
| 100 | | | | | | | | 29 | Stainless Steel SS Sample from 100' to 102' @ 1200 CAN078-0788-0100 (VOCs) OVA on Sample = 0 ppm |
| | | | | | | | | 38 | |
| 101 | | | | | | A10 | 20 | | |
| | | | | | | | | 39 | |
| | | | | | | | | 53 | Stopped drilling @ 102' @ 1210 on 12-8-91 |
| 102 | | | | | | | | | 12-9-91 - 1200 |
| | Bottom of hole - 102' | | | | | | | | Grouted borehole w/cement-bentonite grout from 0' to 102'. Placed metal spike into grouted borehole |
| 103 | | | | | | | | | Grout Mix 33 sacks cements 100 lbs of bentonite 230 gallons of water |
| 104 | | | | | | | | | |
| 105 | | | | | | | | | |
| 106 | | | | | | | | | |

PROJECT NO. 89MC114W T12

SHEET 12 OF 12

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 8101

| | | | |
|---|---|---|---|
| BORING LOCATION Solvent Disposal Site | | ELEVATION AND DATUM 4314.40' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER B. Kingsley | DATE STARTED 10-12-91 DATE FINISHED 10-12-91 | |
| DRILLING EQUIPMENT Mobile B-53 | | COMPLETION DEPTH 6' | SAMPLER 3" Stainless Steel SS 2" Steel SS |
| DRILLING METHOD HSA 3¾" ID 6" OD | DRILL BIT 6½" Bullet | NO. OF SAMPLES DIST. — | UNDIST. Analytical - 2 Geotech - 2 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL. — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kubeczko | CHECKED BY SMButh |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite Grout | FROM 0 TO 6 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov./L | Penetr. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | Sand, orange-red brown-red, fine grained, sub angular to subrounded, well sorted, silty (10-20%), trace clay (1-5%), slightly moist, medium dense | | | | | A1 | | 10 | Collected Surface Soil Spl from 0 to 0.5' @ 1843 on 10-11-91 CAN081-8101-0000 |
| | | | | | | | | 15 | Collected MRD Spl from 0' to 0.5 CAN081-8101-0901 |
| 1 | | | | | | G1 | 1.2 | | Started drilling @ 825 on 10-12-91 |
| | | | | | | | | 11 | SPT Spl from 0' to 2' @ 825 CAN081-8101-4000 |
| | | SM | | | | | | 8 | Collected Gradation analysis spl from 0' to 0.5' @ 1845 on 10-11-91 OVA on sample = 0 ppm |
| 2 | Increasing silt (25-35%) & clay (5-10%) from 2' to 2.5' | | | | | | | 5 | SPT Spl from 2' to 4' @ 835 CAN081-8101-4002 |
| | | | | | | | | 6 | |
| 3 | | | | | | G2 | 1.5 | | |
| | | | | | | | | 9 | |
| | | | | | | | | 13 | OVA @ 4' in augers @ 845 = 0 ppm; in breathing zone = 0 ppm |
| 4 | Sand, pale-orange to orange, fine grained, subangular to subrounded, well sorted, trace silt (5-10%) trace clay (1-5%), little to some calcareous (15-25%), slightly moist, medium dense | | | | | | | 10 | Stainless Steel SS Spl from 4' to 6' @ 845 CAN081-8101-0004 |
| | | | | | | | | 12 | OVA on sample = 0 ppm |
| 5 | | SM | | | | A2 | 2 | | |
| | | | | | | | | 16 | |
| | | | | | | | | 25 | |
| 6 | | | | | | | | | |
| | Bottom of Hole - 6' | | | | | | | | 1535 Grout borehole from 0 to 6' w/ Cement-Bentonite grout. Placed metal spike in grouted boring |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W T2I SHEET 1 OF 1

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 8102

| | | | |
|---|---|---|---|
| BORING LOCATION Solvent Disposal Site | | ELEVATION AND DATUM 4314.49' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER B. Kingsley | DATE STARTED 10-12-91 / DATE FINISHED 10-12-91 | |
| DRILLING EQUIPMENT Mobile B-53 | | COMPLETION DEPTH 6' | SAMPLER 3" Stainless Steel SS / 2" Steel SS |
| DRILLING METHOD HSA 3 3/4" ID 6" OD | DRILL BIT 6 1/2" Bullet | NO. OF SAMPLES DIST. — | UNDIST. Analytical - 2, Geotech - 2 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL. — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kubeczko | CHECKED BY Sm Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonit Grout | FROM 0 TO 6 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov./L | SAMPLES: Penetr. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | Sand, orange-red brown-red, fine grained, subangular to subrounded, well sorted, silty (10-20%), trace clay (3-5%), slightly moist, medium dense | | | | | A1 | | 8 | Collected Surface Soil Spl from 0 to 0.5' @ 1851 on 10-11-91 CAN081-8102-0000 |
| | | | | | | | | 9 | Collected decon water sample @ 1853 CAN081-8102-0981 |
| 1 | | | | | | G1 | 1.1 | 9 | Started drilling @ 900 on 10-12-91 |
| | | SM | | | | | | 10 | SPT Spl from 0' to 2' @ 900 CAN081-8102-4000 OVA on sample = 0ppm |
| 2 | | | | | | | | 8 | SPT Spl from 2' to 4' @ 910 |
| | | | | | | | | 10 | Collected Gradation Analysis Spl from 2' to 4' @ 910 CAN081-8102-4002 |
| 3 | | | | | | G2 | 1.5 | | |
| | | | | | | | | 18 | |
| | | | | | | | | 20 | OVA @ 4' in augers = 0ppm in breathing zone = 0 ppm |
| 4 | Sand, pale orange w/occassional tan tan-orange caliche mottling, fine graine, subangular, well sorted, trace silt (5-10%) trace clay (1-3%), some calcareous (20-30%), slightly moist to dry, medium dense to dense | | | | | | | 20 | Stainless Steel SS Spl from 4' to 6' @ 925 CAN081-8102-0004 |
| | | SM | | | | A2 | 2 | 29 | OVA reading for sample = 0ppm except between 5 & 5.5' = 11.3ppm |
| 5 | | | | | | | | 35 | TCL VOCs spl was collected from this interval |
| | | | | | | | | 31 | |
| 6 | | | | | | | | | |
| | Bottom of hole - 6' | | | | | | | | 1535 Grout borehole from 0 to 6' w/Cement-Bentonite grout. Placed metal spike in grouted borehole |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W T2I SHEET 1 OF 1

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 8103

| | | | |
|---|---|---|---|
| BORING LOCATION Solvent Disposal Site | | ELEVATION AND DATUM 4314.32' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER B. Kingsley | DATE STARTED 10-12-91 / DATE FINISHED 10-12-91 | |
| DRILLING EQUIPMENT Mobile B-53 | | COMPLETION DEPTH 6' | SAMPLER 3" Stainless Steel SS / 2" Steel SS |
| DRILLING METHOD HSA 3¾" ID 6" OD | DRILL BIT 6½" Bullet | NO. OF SAMPLES DIST. — | UNDIST. Analytical - 2 / Geotech 2 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL. — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kubeczko | CHECKED BY SM Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement - Bentonite Grout | FROM 0 TO 6 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | Recov./L | Penetr. Resist. (Blows/6 In) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | Sand, orangered brown-red, fine grained, subangular, well sorted, silty (10-20%), trace clay (5%), slightly moist, loose | | | | | A1 | | 6 | Collect Surface Soil Spl from 0' to 0.5 @ 1855 on 10-11-91 CAN081-8103-0000 |
| | | | | | | | | 7 | Started drilling @ 940 on 10-12-91 |
| 1 | | SM | | | | G1 | 1.5 | 7 | SPT Spl from 0' to 2' @ 940 CAN081-8103-4000 OVA on sample = 0 ppm |
| | | | | | | | | 7 | |
| 2 | Becoming increasingly silty (20-35%) & clayey (10%) from 1.75' to 2.0' | | | | | | | | |
| | Sand, orange, fine grained, subangular to subrounded, well sorted, little silt (15%), trace clay (3-5%), little calcareous (15-20%), loose to medium dense, slightly moist | | | | | | | 6 | SPT Spl from 2' to 4' @ 945 CAN081-8103-4002 |
| | | | | | | G2 | 1.3 | 7 | |
| 3 | | | | | | | | 10 | |
| | | | | | | | | 9 | OVA @ 4' in augers = 0 ppm in breathing zone = 0 ppm |
| 4 | | SM | | | | | | | |
| | Occassional tan tan-orange caliche mottling | | | | | | | 11 | Stainless Steel SS Spl from 4' to 6' @ 1000 OVA on Sample = 0ppm CAN081-8103-0004 |
| | | | | | | A2 | 1.5 | 20 | Collected MRD Duplicate from 4' to 6' @ 1000 CAN081-8103-0902 |
| 5 | | | | | | | | 23 | |
| | | | | | | | | 21 | Collect gradation analysis sample from 4' to 5' @ 1000 CAN081-8103-4004 |
| 6 | | | | | | | | | |
| | Bottom of hole - 6' | | | | | | | | 1530 Grouted borehole from 0 to 6' w/ Cement-Bentonite grout. Placed metal spike in to grouted borehole |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W T2I

SHEET 1 OF 1

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 8104

| | | | |
|---|---|---|---|
| BORING LOCATION Solvent Disposal Site | | ELEVATION AND DATUM 4314.57' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER B. Kingsley | DATE STARTED 10-12-91 DATE FINISHED 10-12-91 | |
| DRILLING EQUIPMENT Mobile B-53 | | COMPLETION DEPTH 6' | SAMPLER 3" Stainless Steel SS 2" Steel SS |
| DRILLING METHOD HSA 3¾" ID 6" OD | DRILL BIT 6½" Bullet | NO. OF SAMPLES DIST. — | UNDIST. Analytical - 2 Geotek - 2 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL. — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kubeczko | CHECKED BY SM Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite Grout | FROM 0 TO 6 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov. ft. | Penetr. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | Sand, orange-red brown-red, fine grained, subrounded, well sorted, little silt (10-15%), trace clay (5-15%), loose, slightly moist | | | | | A1 | | 4 | Collected Surface Soil Spl from 0 to 0.5' @ 1858 on 10-11-91 CAN081-8104-0000 |
| | | | | | | | | 5 | Started drilling @ 1015 on 10-12-91 |
| 1 | | | | | | G1 | 1.3 | 6 | SPT from 0' to 2' @ 1015 CAN081-8104-4000 OVA on sample = 0 ppm |
| | | SM | | | | | | 7 | |
| 2 | | | | | | | | 6 | SPT Spl from 2' to 4' @ 1025 CAN081-8104-4002 |
| | | | | | | | | 7 | Collected gradion analysis sample from 2' to 4' @ 1025 |
| 3 | | | | | | G2 | 1.3 | 7 | |
| | | | | | | | | 11 | OVA @ 4' in augers = 1 ppm in breathing zone = 0 ppm |
| 4 | Sand, light to medium orange, fine grained, subrounded to subangular, well sorted, little silt (10-15%), trace clay (5-10%), some calcareous (20-25%), occassional tan tan-orange mottling (caliche), dry to slightly moist, medium dense | SM | | | | | | 12 | Stainless Steel SS Spl from 4' to 6' @ 1035 OVA for sample = 2.1 ppm CAN081-8104-0004 MS/MSD |
| | | | | | | A2 | 1.7 | 17 | |
| 5 | | | | | | | | 23 | |
| | | | | | | | | 25 | |
| 6 | | | | | | | | | 1525 Grouted borehole from 0 to 6' w/ Cement-Bentonite Grout. Placed metal spike in grouted borehole |
| | Bottom of hole - 6' | | | | | | | | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W T2I

SHEET 1 OF 1

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 8105

| | | | |
|---|---|---|---|
| BORING LOCATION Solvent Disposal Site | | ELEVATION AND DATUM 4314.43' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER B. Kingsley | DATE STARTED 10-12-91 / DATE FINISHED 10-12-91 | |
| DRILLING EQUIPMENT Mobile B-53 | | COMPLETION DEPTH 6' | SAMPLER 3" Stainless Steel SS / 2" Steel SS |
| DRILLING METHOD HSA 3¾" ID 6" OD | DRILL BIT 6½" Bullet | NO. OF SAMPLES DIST. — | UNDIST. Analytical - 2 / Geotech - 2 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL. — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kubeczko | CHECKED BY SM Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement - Bentonite Grout | FROM 0 TO 6 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov./ft. | SAMPLES: Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | Sand, orange-red brown-red, fine grained, subangular to subrounded, well sorted, little silt (15-25%), trace clay (5-10%), loose, slightly moist | | | | | A1 | | 6 | Collected Surface Soil Spl from 0' to 0.5' @ 1902 on 10-11-91 CAN081-8105-0000 CAN081-8105-0962 FD |
| | | | | | | | | 9 | Started drilling @ 1050 on 10-12-91 |
| 1 | | | | | | G1 | 1 | 7 | SPT Spl from 0' to 2' @ 1050 CAN081-8105-4000 OVA on sample = 0 ppm |
| | Increasing clay (10-15%) | SM | | | | | | 7 | |
| 2 | | | | | | | | 4 | SPT Spl from 2' to 4' @ 1105 CAN081-8105-4002 |
| | | | | | | | | 4 | |
| 3 | | | | | | G2 | 1.7 | 5 | |
| | Becoming very slightly calcareous | | | | | | | 4 | OVA @ 4' in augers = 0 ppm in breathing zone = 0 ppm |
| 4 | Sand, pale orange, fine grained, subangular to subrounded, well sorted, silty (10-15%), trace clay (5%), some calcareous (20-25%), occassional tan tan-orange caliche mottling, medium dense, dry to slightly moist | SM | | | | | | 10 | Stainless Steel SS Spl from 4' to 6' @ 1110 OVA on sample = 0.1 ppm CAN081-8105-0004 |
| 5 | | | | | | A2 | | 14 | Collected gradation analysis sample from 4' to 5' @ 1110 CAN081-8105-4004 |
| | | | | | | | | 17 | |
| | | | | | | | | 25 | |
| 6 | | | | | | | | | 1520 |
| | Bottom of hole - 6' | | | | | | | | Grouted borehole from 0 to 6' w/cement-bentonite grout. Placed metal spike in grouted borehole. |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W T2I

SHEET 1 OF 1

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 8106

| | | | |
|---|---|---|---|
| BORING LOCATION Solvent Disposal Site | | ELEVATION AND DATUM 4314.38' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER B. Kingsley | DATE STARTED 10-12-91 DATE FINISHED 10-12-91 | |
| DRILLING EQUIPMENT Mobile B-53 | | COMPLETION DEPTH 6' | SAMPLER 3" Stainless Steel SS 2" Steel SS |
| DRILLING METHOD HSA 3 3/4" ID 6" OD | DRILL BIT 6 1/2" Bullet | NO. OF SAMPLES DIST. — | UNDIST. Analytical - 2 Geotech - 2 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL. — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kubeczko L. Gardiner | CHECKED BY SM Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite Grout | FROM 0 TO 6 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov./ft. | Penetr. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | Sand. med. brown, sub angular, well sorted, some silt. | SM | | | | A1 | | 4 | Collected Surface Soil Spl from 0' to 0.5' @ 1907 on 10-11-91 CAN081-8106-0000 |
| | | | | | | | 1.0 | 6 | Collected ambient water blank @ 1910 CAN081-8106-0951 |
| 1 | | | | | | G1 | | 10 | Started drilling @ 11:30 on 10-12-91 OVA on sample = 0 ppm SPT Spl from 0' to 2' @ 1130 |
| | | | | | | | | 8 | Collected gradation analysis sample from 0 to 0.5' @ 1918 on 10-11-91 CAN081-8106-4000 |
| 2 | SAND as above | | | | | | | 6 | SPT Spl from 2' to 4' @ 1140 |
| | | | | | | | 1.5 | | |
| | | | | | | G2 | | 6 | |
| 3 | | | | | | | | 8 | |
| | | | | | | | | 9 | |
| 4 | SAND, LT. brown, tan, v. fine gr, some silt, well sorted, | | | | | | 1.0 | 13 | Stainless Steel SS Spl from 4' to 6' @ 1155 CAN 081-8106-0009 collected sample on 10-12-91 - 11:55 |
| | | | | | | A2 | | 30 | OVA - S.S. - 0 ppm |
| 5 | | | | | | | | 34 | |
| | | SM | | | | | | 29 | |
| 6 | Bottom of hole. | | | | | | | | 1515 Grout bore hole with cement-Bentonite grout from 0 to 6' |

PROJECT NO. 89MC114W T2I

SHEET 1 OF 1

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 8107

| | | | |
|---|---|---|---|
| BORING LOCATION Solvent Disposal Site | | ELEVATION AND DATUM 4314.62' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER B. Kingsley | DATE STARTED 10-12-91 / DATE FINISHED 10-12-91 | |
| DRILLING EQUIPMENT Mobile B-53 | | COMPLETION DEPTH 6' | SAMPLER 3" Stainless Steel SS / 2" Steel SS |
| DRILLING METHOD HSA 3¾" ID 6" OD | DRILL BIT 6½" Bullet | NO. OF SAMPLES DIST. — | UNDIST. Analytical - 2 / Geotech - 2 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL. — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kubeczko / L. Gardiner | CHECKED BY SMButh |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite Grout | FROM 0 TO 6 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov./L. | SAMPLES: Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | A1 | | 4 | Collected Surface Soil Spl from 0 to 0.5' @ 1910 on 10-11-91 CAN081-8107-0000 |
| | | | | | | | | 5 | Collected rinsate blank water sample from trowel @ 1925 on 10-11-91 CAN081-8107-0971 |
| 1 | SAND, Med. brown, very fine gr., well sorted, some silt | SM | | | | G1 | 1.0 | 6 | Started drilling @ 1030 on 10-12-91 |
| | | | | | | | | 6 | SPT Spl from 0 to 2' @ 1120 OVA - 0 ppm in S.S. |
| 2 | SAND, as above | | | | | | | 6 | SPT Spl from 2 to 4' @ 11:25 Gradation Analyses collected at 12:30 * CAN 081-8107-4002 |
| 3 | | | | | | G2 | 1.0 | 6 | OVA - 0 ppm in S.S. |
| | | | | | | | | 7 | |
| | | | | | | | | 8 | |
| 4 | Sand, Light brown, v. fine gr. subangular, some silt, calc. | | | | | | | 12 | Stainless Steel SS Spl from 4' to 6' @ 12:46 CAN081-8107-0004 Analytical Sample OVA - 10 ppm at top of sampler |
| 5 | | SM | | | | A2 | 1.0 | 28 | |
| | | | | | | | | 32 | |
| | | | | | | | | 29 | |
| 6 | Bottom of ~~Boring~~ Hole | | | | | | | | 1510 Grouted borehole from 0 to 6' w/ cement-bentonite grout. Placed metal spike into grouted borehole. |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W T2I

SHEET 1 OF 1

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 8108

| | | | |
|---|---|---|---|
| BORING LOCATION Solvent Disposal Site | | ELEVATION AND DATUM 4314.51' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER B. Kingsley | DATE STARTED 10-12-91 DATE FINISHED 10-12-91 | |
| DRILLING EQUIPMENT Mobile B-53 | | COMPLETION DEPTH 6' | SAMPLER 3" Stainless Steel SS 2" Steel SS |
| DRILLING METHOD HSA 3¾" ID 6" OD | DRILL BIT 6½" Bullet | NO. OF SAMPLES DIST. — | UNDIST. Analytical - 2 Geotech - 2 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kubeczko L. Gardiner | CHECKED BY SM Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement - Bentonite Grout | FROM 0 TO 6 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov./L | Penetra. Resist. (Blows/6 In) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | A1 | | 2 | Collected surface Soil Spl from 0 to 0.5' @ 1915 on 10-11-91 CAN081-8108-0000 |
| 1 | Sand, Med. brown, very fine to fine gr, fair sorting, sub Angular to angular, silty | SM | | | | | 1.2 | 4 | Started drilling @ 13:00 on 10-12-91 |
| | | | | | | G1 | | 4 | SPT Spl from 0' to 2' @ 13:05 OVA in S.S. - 0 ppm |
| | | | | | | | | 6 | |
| 2 | SAND as above | | | | | | | 5 | SPT Spl from 2' to 4' @ 13:15 OVA in S.S. - 0 ppm |
| | | | | | | | | 8 | |
| 3 | | | | | | G2 | 1.5 | 9 | |
| | | | | | | | | 13 | |
| 4 | Sand, Lt. Brown, U Fn gr. well sorted, Sub = angular. calcareous, silty | SM | | | | | | 17 | Stainless Steel SS Spl from 4' to 6' @ 13:25 CAN-081-8108-0004 CAN-081-8108-0761 CAN081-8108-0004 Grad Anal. FD |
| | | | | | | | | 31 | |
| 5 | | | | | | A2 | 1.5 | 37 | OVA in Sampler 0 ppm |
| | | | | | | | | 44 | |
| 6 | Bottom of ~~Boring~~ Hole | | | | | | | | 1510 Grouted borehole from 0 to 6' w/ cement-bentonite grout. Placed metal spike in grouted borehole |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W T2I SHEET 1 OF 1

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 8109

| | | | |
|---|---|---|---|
| BORING LOCATION Solvent Disposal Site | | ELEVATION AND DATUM 4314.37' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER B. Kingsley | DATE STARTED 10-12-91 DATE FINISHED 10-12-91 | |
| DRILLING EQUIPMENT Mobile B-53 | | COMPLETION DEPTH 6' | SAMPLER 3" Stainless Steel SS 2" Steel SS |
| DRILLING METHOD HSA 3¾" ID 6" OD | DRILL BIT 6½" Bullet | NO. OF SAMPLES DIST. — | UNDIST. Analytical - 2 Geotech - 2 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kubecka L. Gardiner | CHECKED BY SM Barth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite Grout | FROM 0 TO 6 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov. ft. | Penetr. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SAND, Med. brown, U Fine to fine gr. Sub Angular Tr silt | SM | | | | A1 | 1.4 | 4 | Collected Surface Soil Spl from 0' to 0.5 @ 1920 on 10-11-91 CAN081-8109-0000 |
| | | | | | | | | 4 | Started drilling @ on 10-12-91 13:30 |
| | | | | | | G1 | | 6 | SPT Spl from 0' to 2' @ 13:35 OVA in S.S. - 0 ppm |
| 2 | | | | | | | | 7 | |
| | SAND, Med, brown U. Fn to Fn gr. Sub Angular, well sorted. Tr silt. | SM | | | | G2 | 1.6 | 8 | SPT Spl from 2' to 4' @ 13:45 Gradation Analysis Sample at 13:55 - CAN-081-8109-0002 OVA in SS. - 0 ppm |
| 3 | | | | | | | | 9 | |
| | | | | | | | | 8 | |
| | | | | | | | | 11 | |
| 4 | Sand, Lt. brown, UFn to Fine gr. subangular, well sorted. some silt. calc. | SM | | | | A3 | 1.8 | 9 | Analytical Stainless Steel SS Spl from 4' to 6' @ 14:05 collected Sample @ 14:10 CAN-081-8109-0004 OVA in S.S. - 0 ppm |
| | | | | | | | | 23 | |
| 5 | | | | | | | | 31 | |
| | | | | | | | | 28 | |
| 6 | | | | | | | | | 1505 Grouted borehole from 0 to surface w/ cement-bentonite grout. Placed metal spike in grouted borehole |
| | Bottom of ~~Boring~~ Hole | | | | | | | | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC 114W T2I SHEET 1 OF 1

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 8110

| | | | |
|---|---|---|---|
| BORING LOCATION Solvent Disposal Site | | ELEVATION AND DATUM 4314.45' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER B. Kingsley | DATE STARTED 10-12-91 DATE FINISHED 10-12-91 | |
| DRILLING EQUIPMENT Mobile B-53 | | COMPLETION DEPTH 6' | SAMPLER 3" Stainless Steel SS 2" Steel SS |
| DRILLING METHOD HSA 3¾" ID 6" OD | DRILL BIT 6½" Bullet | NO. OF SAMPLES DIST. — | UNDIST. Analytical - 2 Geotech - 2 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kubeczko L. Gardiner | CHECKED BY Tom Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite Grout | FROM 0 TO 6 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov./ft. | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | A1 | | 4 | Collected Surface Soil Spl from 0 to 0.5' @ 1930 on 10-11-91 CAN081-8110-0000 MS/MSD |
| | | | | | | | | 5 | Started drilling at 14:25 |
| 1 | SAND Med. brown, V. Fu. gr. sub Ang to Angular, Well sorted. silty | SM | | | | G1 | .8 | 7 | SPT-0-2' at 14:30 |
| | | | | | | | | 7 | OVA in SS. 0 ppm |
| 2 | SAND, as above ~~tse~~ silty. | SM | | | | | | 5 | SPT spl from 2-4 at 14:35 OVA in S.S. - 0 ppm |
| | | | | | | G2 | .4 | 6 | |
| 3 | | | | | | | | 6 | |
| | | | | | | | | 8 | Analytical SPT Spl (3") from 4-6 at 14:45 |
| 4 | SAND Lt. brown, U. Fu to fine gr, ~~but~~ silty, subangular to angular, Well sorted, calc. | SM | | | | | | 9 | CAN-ODC-8110-0004 Analytical CAN-ODC-8110-4004 Gradation Anal. |
| | | | | | | A2 | .2 | 16 | OVA in SS - 0 ppm |
| 5 | | | | | | | | 20 | Finished Drilling at 14:50 |
| | | | | | | | | 22 | 1500 |
| 6 | Bottom of ~~Boring~~ Hole | | | | | | | | Grouted boring from 0-6' w/ cement-bentonite grout |
| 7 | | | | | | | | | |

PROJECT NO. 89MC 114W T2I SHEET 1 OF 1

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 8111

| | | | |
|---|---|---|---|
| BORING LOCATION Solvent Disposal Area 1 | | ELEVATION AND DATUM 4314.42' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER D. Kingsley | DATE STARTED 11-6-91 / DATE FINISHED 11-6-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 9.5 | SAMPLER 3" stainless steel S.S, 2" steel S.S |
| DRILLING METHOD HSA 6" OD, 3¼" ID | DRILL BIT | NO. OF SAMPLES DIST. -2 | UNDIST. Analytical - 2 Geotech - 0 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY LARRY GARDINER | CHECKED BY SMBrith |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite grout | FROM 0 TO 9.5 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | Recov. ft. | Penetr. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | SAND, medium reddish brown, very fine grained subangular, silty non-calcareous. | SM | | | | | | | Started drilling at 15:45 Continuous split barrel from 0-5 feet at 15:55 OVA in augers-0ppm in barrel-0ppm Breathing zone-0ppm |
| 1 | | | | | | | | | |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | continuous split barrel sample from 5-9' at 16:30 CAN081-8111-0005 OVA in augers-0ppm in barrel-0ppm Breathing zone 0ppm |
| 5 | SAND, pale brown very fine grained calcite cement | | | | | A1 | | | |
| 6 | SAND, medium reddish brown very fine grained, calcareous, silty | SM | | | | | | | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114 W

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 8111

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | SAND pale brown w/ white patches, very fine grained, silty tightly cemented w/ calcite hard (Caliche) | SM | | | | A2 | | | collected. Analyzed from continuous split barrel from 9-9.5 at 16:55 CAN081-8111-0009 |
| | 9.5 Bottom of boring | | | | | | | | |
| 10 | | | | | | | | | |
| 11 | | | | | | | | | OVA in augers barrel Breathing Zone 0 |
| | | | | | | | | | grouted boring from 0-9.5' w/ cement-Bentonite grout |

PROJECT NO. 89MC114W

SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME ~~Solvent~~ CANNON AFB HOLE NO. 8112

| | | | |
|---|---|---|---|
| BORING LOCATION Solvent Disposal Area ~~Bor~~ | | ELEVATION AND DATUM 4314.62' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER B. Kingsley | DATE STARTED 11-7-91 / DATE FINISHED 11-7-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 9.4 | SAMPLER continuous split barrel |
| DRILLING METHOD HSA -6" OD, 3¼" ID | DRILL BIT 6¼" Bullet | NO. OF SAMPLES DIST. Anal-2 | UNDIST. Analytical -2 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY SMButh |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite grout | FROM 0 TO 9.4 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov./ft. | SAMPLES: Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | Started Drilling at 7:40 |
| | SAND, medium brown very fine grained angular to subangular. well sorted non-calcareous, silty | SM | | | | | | | collected surf sample: 0-.5 CAN081-8112-0000 713d |
| 1 | | | | | | | | | continuous split barrel from 0-5' at 8:00 |
| 2 | | | | | | | 3.5/5 | | OVA in augers - 0 ppm |
| 3 | | | | | | | | | OVA in S. boild. 0 ppm Breathing zone-0 ppm |
| 4 | | | | | | | | | |
| 5 | Sand. Pale brown, very fine grained, silty calcite cemented. (caliche) | SM | | | | | 3/5 | | Analytical continuous split barrel from 5-9.4 at 8:45 |
| 6 | | | | | | A1 | | | collected sample from base CAN081-8112-0005 |
| 7 | | | | | | | | | OVA in augers - 0 ppm in barrel - 0 ppm Breathing zone - 0 ppm |

PROJECT NO. 85MC114W

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 8112

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | SAND, medium reddish brown to pale brown mottled throughout, very fine grained, angular, silty cemented with calcite. discontinuous caliche | SM | | | | | | | collected gradation analysis from 5-9' CAN081-8112-4005 |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| | Bottom of Boring | | | | | | | | grouted boring from 0-9.4' w/ cement - Bentonite grout |

PROJECT NO. 89MCN4W

SHEET 2 OF 2

Redrill of 8107

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 8113

| | | | |
|---|---|---|---|
| BORING LOCATION Solvent Disposal 1 | | ELEVATION AND DATUM 4314.47' MSL | |
| DRILLING AGENCY Environmental | DRILLER E Lancaster | DATE STARTED 11-04-91 DATE FINISHED 11-04-91 | |
| DRILLING EQUIPMENT Mobil B-61 | | COMPLETION DEPTH 6' | SAMPLER 3" stainless |
| DRILLING METHOD HSA-6" OD, 3¼" ID | DRILL BIT | NO. OF SAMPLES DIST. None | UNDIST. analytical - 7 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY Sam Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL cement-Bentonite grout | FROM 0 TO 6 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recovery | SAMPLES: Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | start Drilling at 10:45 |
| 1 | | | | | | | | | Drill to 4' |
| 2 | | | | | | | | | See original Boring Log of 8107 for Lithologic description |
| 3 | | | | | | | | | |
| 4 | | | | | | | | 8 | collect analytical stainless steel s.s from 4-6' at 11:00 |
| | | | | | | | | 15 | CAN 081-8113-0009 MS/MSD |
| 5 | | | | | | | | 20 | OVA- augers S.S. B. Zone } 0 ppm |
| | | | | | | | | 27 | |
| 6 | Bottom of Boring | | | | | | | | collect Rinsate blank at 11:25 VOCs only CANON-8113-0972 |
| | | | | | | | | | grouted boring from 0-6' w/ cement-Bentonite grout |

PROJECT NO. 89 McCaw

SHEET 1 OF 1

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 0861

| | | | |
|---|---|---|---|
| BORING LOCATION Engine Test Cell Area | | ELEVATION AND DATUM 4268.92' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER B. Kingsley | DATE STARTED 10-10-91 / DATE FINISHED 10-10-91 | |
| DRILLING EQUIPMENT Mobile B-53 | | COMPLETION DEPTH 10' | SAMPLER 3" stainless steel S.S. 2" steel S.S. |
| DRILLING METHOD HSA 6" OD, 3 3/4" ID | DRILL BIT 6 1/2" Bullet | NO. OF SAMPLES DIST. NA | UNDIST. Analytical - 4 Geotech - 2 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY SM Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite grout | FROM 0 TO 10 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recovery | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | SAND, medium brown, very fine to fine grained, angular, silty calcareous hard | SM | | | | A1 | | 9 | Start Drilling at 9:10 |
| | | | | | | | | 11 | collected surface sample from 0 to 0.5' at 11:00 |
| 1 | | | | | | G1 | 1.2 | 9 | CANON6-0861-0000 CANON6-0861-0003 |
| | | | | | | | | 7 | collect gradation analysis sample at 9:15 CAN.6A-0861-4000 subsurface |
| 2 | SAND, dark brown, fine grained, angular to subangular, silty, calcareous (entire sample stained dark brown) | | | | | | | 8 | collected analytical stainless steel S.S. sample from 2-4' at 9:45 |
| | | | | | | | 1.3 | 8 | CANON6-0861-0002 |
| 3 | | | | | | A2 | | 6 | OVA-S.S-11 ppm -augers-0 ppm B.Zone-0 ppm |
| | | | | | | | | 5 | |
| 4 | SAND, darky brown, fine grained, angular, silty, calcareous (stained dark brown) | SM | | | | | | 4 | collect analytical stainless steel S.S. sample from 4-6' at 10:05 |
| | | | | | | | 1.0 | | |
| | | | | | | A3 | | 7 | CANON6-0861-0004 |
| 5 | | | | | | | | 10 | OVA in S.S. - 19 ppm augers - 0 ppm B Zone - 0 ppm |
| | | | | | | | | 9 | |
| 6 | SAND, as above stained dark brown | | | | | | | 2 | spt from 6 to 8' at 10:15 |
| | SAND, Light brown, fine grained, angular, well sorted, silty, soft Damp | | | | | G2 | 1.7 | 3 | Damp |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114 W

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. G861

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist. Blows 6 in. | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | G2 | | 4 | |
| | | | | | | | | 4 | |
| 8 | SAND, very light to medium brown, very fine to fine grained, angular, silty, calcite cemented locally | SM | | | | A4 | | 5 | collected analytical stainless steel S.S. Sample from 8 to 10' at 10:25 CANO86-0861-0008 |
| 9 | | | | | | | | 8 | OVM-S.S. - 21 ppm -Augers - 0 ppm B. Zone - 0 ppm |
| | | | | | | | | 10 | |
| | | | | | | | | 12 | collect decon water CANO86-0861-0281 |
| 10 | Bottom of Boring | | | | | | | | grouted boring from 0-10' w/ cement-Bentonite grout |

PROJECT NO. 89MC114W

SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 0862

| | | | |
|---|---|---|---|
| BORING LOCATION Engine Test Cell Area | | ELEVATION AND DATUM 4268.96' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER B. Kingsley | DATE STARTED 10-10-91 / DATE FINISHED 10-10-91 | |
| DRILLING EQUIPMENT Mobile B-53 | | COMPLETION DEPTH 10' | SAMPLER 3" stainless steel S.S. 2" steel S.S. |
| DRILLING METHOD HSA 6" OD, 3 3/4" ID | DRILL BIT 6 1/2" Bullet | NO. OF SAMPLES DIST. NA | UNDIST. Analytical - 4 Geotech - 2 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY SMButh |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite grout | FROM 0 TO 10 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov. ft. | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | SAND, medium brown, very fine grained, well sorted, calcareous, hard, silty (25%) | SM | | | | A1 | | 1 | Started Drilling at 11:00 |
| | | | | | | | | 14 | collected surface analytical sample from 0 to .5 at 11:00 |
| 1 | SAND, Light brown, calcite cement | Caliche | | | | G1 | 1.4 | 16 | CAN086-0862-0000 |
| | | | | | | | | 16 | |
| 2 | SAND, very fine grained, medium brown, calcareous | | | | | | | 12 | collected analytical stainless steel S.S. sample from 2-4' at 11:30. |
| | | | | | | A2 | 1.5 | 12 | CAN086-0862-0002 MS/MSD |
| 3 | | SM | | | | | | 8 | OVA-S.S. - 22 ppm augers - 0 ppm B. Zone - 0 ppm |
| | | | | | | | | 8 | |
| 4 | SAND, medium brown, very fine grained, very silty (30%) non-calcareous | | | | | | | 10 | collected stainless steel analytical S.S. sample from 4-6' at 12:00 |
| | | | | | | A3 | | 10 | CAN086-0862-0004 ~~CAN086-0862-0026~~ (FD) ~~0111550~~ OVA-S.S. augers Breathing Zone } 0 ppm |
| 5 | | | | | | | 1.5 | 19 | |
| | | | | | | | | 14 | |
| 6 | | | | | | | | 4 | SPT from 6-8' at 12:08 |
| | | | | | | G2 | 1.5 | 2 | OVA-S.S. auger B. Zone } 0 ppm |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 0862

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | SAND, Light brown, very fine grained, very silty, calcareous | | | | | G2 | 1.5 | 1 | |
| | | SM | | | | | | 1 | |
| 8 | SAND, Light brown, very fine grained, | | | | | | | 5 | collect analytical S. stainless steel SS sample from 8'to10' at 12:15 CANO86-0862-000A |
| 9 | | | | | | A4 | 1.7 | 7 | OVA-SS, auger B Zone } 0 ppm |
| | | | | | | | | 9 | |
| 10 | | | | | | | | 15 | Collect gradation analysis sample at 12:20 CANO86-0862-4008 |
| | Bottom of Boring | | | | | | | | grouted boring from 0-10' w/ cement-Bentonite grout. collect ambient blank at 17:00 CANO86-0862-0251 |

PROJECT NO. 89MC114W

SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. OP63

| | | | |
|---|---|---|---|
| BORING LOCATION Engine Test Cell Area | | ELEVATION AND DATUM 4268.70' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER B. Kingsley | DATE STARTED 10-10-91 / DATE FINISHED 10-10-91 | |
| DRILLING EQUIPMENT Mobile B-53 | | COMPLETION DEPTH 10' | SAMPLER 3" stainless steel S.S. 2" steel S.S. |
| DRILLING METHOD HSA-6" OD, 3 3/4" ID | DRILL BIT 6 1/2" Bullet | NO. OF SAMPLES DIST. | UNDIST. 0 analytical-4 Geotech-2 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST | COMPL 24 HRS. |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY SMButh |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite grout | FROM 0 TO 10 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recovery | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | SAND, medium brown, very fine grained, subangular to subrounded, well sorted, silty | SM | | | | A1 | | 14 | start drilling at 12:30 |
| | | | | | | | | 21 | collected surface sample at 14:30 CAN OP6-OP63-0000 MS/MSD |
| 1 | | | | | | G1 | 1.5 | 18 | SPT from 0-2' at 14:45 |
| | | | | | | | | 18 | OVA-S.S. Auger B.Zone } 0 ppm |
| 2 | SAND, medium brown, very fine to fine grained, subangular, fair sorting, loose, silty (5%) | SM | | | | | | 8 | collect analytical stainless steel S.S sample from 2-4' at 15:00 |
| | | | | | | A2 | 1.8 | 7 | CAN OP6-OP63-0002 |
| 3 | | | | | | | | 6 | OVA-S.S. Augers B.Zone } 0 ppm |
| | | | | | | | | 5 | |
| 4 | SAND, medium brown, very fine grained, subangular, well sorted. silty. | SM | | | | | | 6 | collect analytical stainless steel S.S sample from 4 to 6' at 15:25 |
| | | | | | | | | 6 | CAN OP6-OP63-0004 |
| 5 | | | | | | A3 | 1.5 | 5 | OVA-S.S. Augers B.Zone } 0 ppm |
| | | | | | | | | 5 | |
| 6 | SAND, Medium brown, very fine grained, subangular, well sorted silty 20% | SM | | | | | | 2 | SPT from 6 to 8' at 15:40 |
| | | | | | | G2 | 1.7 | 3 | OVA-S.S. Augers B.Zone } 0 ppm |
| 7 | | | | | | | | | collect gradation analysis CAN OP6-OP63-4003 |

PROJECT NO. 89MC114W

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 0863

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist. Blows 6 in. | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | SAND, Light brown, very fine grained, subangular, clayey, silty Calcareous | SM | | | | B2 | 1.7 | 3 | |
| | | | | | | | | 9 | |
| 8 | SAND, medium brown, very fine grained, angular, calcareous silty (15-20%) | SM | | | | | | 2 | Collect analytical stainless steel S.S sample from 8 to 10' at 15:50 |
| | | | | | | A4 | 1.5 | 5 | CANOR-0863-0008 CANOR-0863-0262 at 15:46 (FD) |
| 9 | | | | | | | | 5 | OVA-S.S. auger B.zone } 0 ppm |
| | | | | | | | | 9 | |
| 10 | Bottom of Boring | | | | | | | | grouted boring from 0 to 10' w/cement-Bentonite grout. |

PROJECT NO. 89MC114W

SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANADAI AFB HOLE NO. 0864

| | | | |
|---|---|---|---|
| BORING LOCATION: Engine Test Cell Area | | ELEVATION AND DATUM: 4268.95' MSL | |
| DRILLING AGENCY: Environmental Drilling | DRILLER: B Kingsley | DATE STARTED: 10-10-91<br>DATE FINISHED: 10-10-91 | |
| DRILLING EQUIPMENT: Mobile B-53 | | COMPLETION DEPTH: 10' | SAMPLER: 3" stainless steel S.S., 2" steel S.S. |
| DRILLING METHOD: HSA-16"OD, 3¾"ID | DRILL BIT: 6½" Bullet | NO. OF SAMPLES: DIST. NA | UNDIST. Analytical 3, Geotech - 2 |
| SIZE AND TYPE OF CASING: NA | | WATER ELEV.: FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION: NA | FROM TO FT. | LOGGED BY: Larry Gardiner | CHECKED BY: SM Butler |
| SIZE AND TYPE OF PACK: NA | FROM TO FT. | | |
| TYPE OF SEAL: Cement-Bentonite grout | FROM 0 TO 10 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | Recov. ft. | Penetr. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | SAND, medium brown, very fine grained, angular, clayey, calcareous | SM SC | | | | A1 | | 3 | started drilling at 16:10 |
| | | | | | | | | 6 | collected surface analytical sample at 16:20 from 0-.5' CANOPG-0864-0000 |
| 1 | | | | | | G1 | 1.5 | | CANOPG-0864-0264 (FD) at 16:32 |
| | | | | | | | | 6 | SPT from 0 to 2' at 16:40 |
| | | | | | | | | 5 | OVA-S.S. augers B. Zone } 0 ppm |
| 2 | SAND, medium brown, very fine grained, subangular, silty, calcareous silty (2097) | SM | | | | | | 5 | collected analytical S.S. sample from 2 to 4' at 16:30 CANOPG-0864-0002 |
| | | | | | | A2 | 1.5 | 7 | |
| 3 | | | | | | | | 8 | |
| | | | | | | | | 9 | |
| 4 | SAND, light to medium brown angular, very fine grained, locally silty | SM | | | | | | 4 | Collect analytical stainless steel S.S sample from 4 to 6' at 17:00 CANOPG-0864-0004 |
| | | | | | | A3 | 1.5 | 6 | OVA-S.S augers B. Zone } 0 ppm |
| 5 | | | | | | | | 8 | |
| | | | | | | | | 10 | |
| 6 | SAND, light to medium brown very fine grained, angular, clayey-silty. | SM | | | | G2 | 1.5 | 5 | SPT from 6 to 8' at 17:05 |
| | | | | | | | | 5 | OVA-S.S. augers B. Zone } 0 ppm |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 0864

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetr. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | | |
| | | | | | | C2 | 1.5 | 7 | |
| | | | | | | | | 9 | |
| 8 | SAND Light to medium brown very fine grained, calcareous, silty w/ localized patches of calcite cement | SM / caliche | | | | | | 9 | collect analytical stainless steel S.S. sample from 8 to 10' at 17:15 CAN086-0864-0008 |
| | | | | | | A4 | 1.5 | 11 | |
| 9 | | | | | | | | 13 | collect ~~gradation~~ gradation analysis sample from 8 to 16' at 17:15 CAN086-0864-4008 |
| | | | | | | | | 15 | |
| 10 | | | | | | | | | |
| | Bottom of Boring | | | | | | | | OVA - S.S. augers B. Zone } 0 ppm |
| | | | | | | | | | grouted boring from 0-10' w/ cement-Bentonite grout. |

PROJECT NO. 89MC114W

SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 0865

| | | | |
|---|---|---|---|
| BORING LOCATION Engine Test Cell Area | | ELEVATION AND DATUM 4269.19' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER B. Kingsley | DATE STARTED 10-11-91 DATE FINISHED 10-11-91 | |
| DRILLING EQUIPMENT Mobile B-53 | | COMPLETION DEPTH 10' | SAMPLER 3" stainless steel S.S., 2" steel S.S. |
| DRILLING METHOD HSA - 6" OD, 3¾" ID | DRILL BIT 6½" Bullet | NO. OF SAMPLES DIST. NA | UNDIST. Analytical - 4 Geotech - 2 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY SMButh |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite grout | FROM 0 TO 10 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov. ft. | Penetr. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | SAND, medium brown, very fine to fine grained, subangular, silty calcareous, hard Dry | SM | | | | A1 | | 8 | started drilling at 9:20 |
| | | | | | | | | 17 | collected surface analytical Soil sample from 0 to .5' at 9:25 CANOR-0865-0000 |
| 1 | | | | | | G1 | 1.4 | 10 | collected Gradation analysis sample from 0 to 2' at 9:45 CANOR-0865-0000 |
| | | | | | | | | 8 | OVA-S.S. augers B. Zone } 0 ppm |
| 2 | SAND, Light to dark brown, very fine grained, angular, silty some calcite cement, Dry | SM | | | | | | 10 | collected analytical stainless steel S.S. sample from 2 to 4' at 10:05 CANOR-0865-0002 |
| | | | | | | A2 | 1.5 | 7 | |
| 3 | | | | | | | | 6 | OVA-S.S. augers B. Zone } 0 ppm |
| | | | | | | | | 5 | stopped drilling at 10:05 started drilling at 14:25 |
| 4 | SAND, medium brown, very fine grained, subangular to angular, silty well sorted., Dry | SM | | | | | | 4 | collected analytical stainless steel S.S. sample from 4 to 6' at 14:35 CANOR-0865-0004 |
| | | | | | | A3 | 1.7 | 4 | OVA-S.S. augers B. Zone } 0 ppm |
| 5 | | | | | | | | 6 | |
| | | | | | | | | 9 | |
| 6 | SAND, Light brown, very fine grained, angular, calcareous, Dry silty | SM | | | | | | 4 | SPT from 6 to 8' at 14:45 |
| | | | | | | G2 | 1.7 | 10 | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. OP65

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | G2 | 1.7 | 11 | |
| | | | | | | | | 12 | |
| 8 | SAND, Light to medium brown, subangular to angular, very fine grained, some silt, calcareous, Dry | SM | | | | | | 7 | collect analytical stainless steel S.S. sample from 8 to 10' at 15:05 CANOPL-OP65-0008 |
| | | | | | | A4 | 1.8 | 10 | |
| 9 | | | | | | | | 9 | OVA-S.S. augers B. Zone } 0 ppm |
| | | | | | | | | 7 | |
| 10 | Bottom of Boring | | | | | | | | Grouted boring from 0-10' w/cement-Bentonite grout- |
| | | | | | | | | | Collect Rinsate blank at 9:00 CANOPL-OP65-0277 |

PROJECT NO. 89MC114W

SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 0866

| | | | |
|---|---|---|---|
| BORING LOCATION Engine Test cell | | ELEVATION AND DATUM 4268.80' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER B. Kingsley | DATE STARTED 11-6-91 / DATE FINISHED 11-6-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 25' | SAMPLER 3" stainless |
| DRILLING METHOD HSA 6" OD, 3 3/4" ID | DRILL BIT 6 1/2" bullet | NO. OF SAMPLES DIST. NA | UNDIST. Analytical - 4 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY Tom Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite Grout | FROM 0 TO 23 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov./L | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | Started drilling at 9:40 |
| | SAND, Med. brown, Very fine to fine grained, subangular to subrounded, well sorted silty, ~~cal~~ local calcite inclusions, moderately hard. | SM | | | | A1 | | | continous split barrel from 0-5' at 9:50 |
| 1 | | | | | | | 3'/4' | | Surface sample collected from 0-1.5 at: 9:30 CAN086-0866-0000 CAN086-0866-0203 MRD |
| 2 | | | | | | | | | OVA in augers 360 ppm in Breathing Space 0 ppm in split barrel-0 ppm |
| 3 | | | | | | | | | |
| 4 | SAND, dark brown, Very fine to fine grained silty Subangular well sorted. calcareous | SM | | | | A2 | | | |
| 5 | | | | | | | 3'/3.5' | | continuous split barrel from ~~3-8'~~ 4-9' at 10:10 dark staining. OVA in augers 360 ppm in S.S.-0 ppm breathing Space 0 ppm strong Petroleum odor collected sample CAN086-0866-0004 |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 1 OF 3

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 0866

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, et |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | | |
| 8 | Caliche, Sand, pale brown to white, very fine to fine grained, silty well sorted, subangular well cemented with calcite | Caliche ~~SM~~ (SM) | | | | | | | |
| 9 | | | | | | | | | |
| 10 | SAND, pale brown, very fine to fine grained well sorted sand in a calcite matrix (Caliche) | caliche (SM) | | | | | 1.4 | 20 | |
| | | | | | | | | 64 | Analytical stainless steel 10½' |
| 11 | | | | | | | | 19 | S.S. from ~~11-13'~~ |
| | | | | | | A2 | | 9 | at 10:40 CANOPC-0866-0010 |
| 12 | | | | | | | | | OVA in augers 4 ppm OVA in S.S.-0 ppm air space-0 ppm slight ~~no~~ odor |
| 13 | | | | | | | | | No stain |
| | SAND pale brown very fine to fine grained subangular to subrounded well sorted, silty, cemented w/ calcite | caliche ~~SM~~ (SM) | | | | | | 5 | Analytical stainless steel S.S. from 13-15' |
| | | | | | | A3 | | 8 | at 11:20 CANOPC-0866-0017 |
| 14 | | | | | | | 1.5 | 9 | OVA in augers 100 ppm in S.S.-0 ppm |
| | | | | | | | | 11 | breathing zone-0 ppm |
| 15 | | | | | | | | | odor |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. G86b

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | SAND, pale reddish brown, very fine to fine grained subangular to subrounded, silty well sorted, cemented w/ calcite. | SM | | | | | | 20 | Analytical stainless steel S.S. from 18-20' aT: 12:55 CANO 86-0SU-0018 |
| 19 | | | | | | A4 | 1.8 | 34 | OVA in augers 80 ppm |
| | | | | | | | | 45 | in S.S.— 12 ppm (bottom) |
| 19.8 | | | | | | | | 50 | Breathing zone—0 ppm |
| 20 | | | | | | | | | fair odor No stain |
| 21 | | | | | | | | | |
| 22 | | | | | | | | | |
| 23 | SAND, pale brown, very fine to fine grained, silty well sorted, subangular to angular cemented w/ calcite | SM | | | | | | 26 | Analytical stainless steel SS from 23-25' aT 13:35 CANO 86-0SU-0023 |
| | | | | | | A5 | 1.4 | 19 | OVA in augers 0 ppm |
| 24 | | | | | | | | | in S.S. 0 ppm breathing zone 0 ppm |
| | | | | | | | | 14 | No odor |
| | SAND, pale reddish brown, very fine grained, subangular calcareous. | | | | | | | 50 | No stain |
| 25 | BOTTOM of Boring | | | | | | | 24.7 | Grouted Boring from 0-25' w/ cement-Bentonite grout |

PROJECT NO. 89 M6114 W.

SHEET 3 OF 3

redrill of 0861

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 0867

| | | | |
|---|---|---|---|
| BORING LOCATION Engine test cell | | ELEVATION AND DATUM 4268.85' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER E Lancaster | DATE STARTED 11-24-91 / DATE FINISHED 11-24-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 10' | SAMPLER 3" stainless S.S. |
| DRILLING METHOD HSA - 6" OD, 3¼" ID | DRILL BIT 6½" Bullet | NO. OF SAMPLES DIST. NA | UNDIST. 8 natural - 1 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY Sm Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL cement - Bentonite Grout | FROM 0 TO 10 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft. | SAMPLES: Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | A1 | | | start drilling at 12:20 |
| 1 | | | | | | | | | see original |
| 2 | | | | | | | | 6 | Boring Log on Boring 0861 |
| | | | | | | | | 8 | for Lithologic description |
| 3 | | | | | | | 1.8 | 9 | |
| | | | | | | | | 7 | collected surface sample from 0-.5' at 12:25 |
| 4 | | | | | | | | 5 | |
| | | | | | | | | | CANO-0867-0000 CANO-0867-0268 (FD) at 12:35 |
| 5 | | | | | | | 1.7 | 6 | |
| | | | | | | | | 9 | ~~cell~~ stainless steel S.S. at 12:25 from 2-4' |
| | | | | | | | | 8 | OVA readings S.S. B.2 } 0 ppm |
| 6 | | | | | | | | | stainless steel S.S. from 4-6' at 12:35 |
| | | | | | | | | | OVA readings S.S. B.2 } 0 ppm |
| 7 | | | | | | | | | |

PROJECT NO. 89MC14W

SHEET 1 OF 2

Redrill of 0866

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB. HOLE NO. 0867

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | | |
| 8 | | | | | | | | | Collect one hydra stainless steel |
| | | | | | | | | 6 | S.S. sample from |
| | | | | | | A2 | 1.6 | 7 | 8-10' at 12:45 CANOR-0867-0008 |
| 9 | | | | | | | | | OVA- |
| | | | | | | | | 8 | augers S.S, B Zone } 0ppm |
| | | | | | | | | 8 | |
| 10 | | | | | | | | | |
| | Bottom of Boring | | | | | | | | grout boring from 0 to 10' with cement-Bentonite grout - (3-5% Bentonite) |

PROJECT NO. 89MC164U

SHEET 2 OF 2

Rodrill 0862

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 0868

| | | | |
|---|---|---|---|
| BORING LOCATION Engine Test Cell | | ELEVATION AND DATUM 4268.71' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER E. Lancaster | DATE STARTED 11-24-91 / DATE FINISHED 12-24-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 6' | SAMPLER 3½ stainless |
| DRILLING METHOD HSA-6"OD-3¼ID | DRILL BIT 6½" Bullet | NO. OF SAMPLES DIST. NA | UNDIST. Analyt. -3 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY Sam Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite Grout | FROM 0 TO 6 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | Recov. ft. | Penetr. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | A' | | | Start Drilling at 0810 |
| | | | | | | | | | Collect surface sample 0-.5 at 12:45 CANOR-0868-0000 CANOR-0868-0203 (MRD) |
| 1 | | | | | | | | | |
| 2 | | | | | | | 2 | 4 | collected stainless steel Analytical S.S. from 2-4 13:25 CANOR-0868-0002 MS/MSD |
| | | | | | | AB | | 6 | OVAugers- 0ppm -S.S.- 10 ppm B.Zone- 0 ppm |
| 3 | | | | | | | 1.0 | 4 | |
| | | | | | | | | 5 | collected Analytical stainless steel S.S. sample from 4-6' at 13:45 CANOR-0868-0004 CANOR-0868-0204 (FD) at 13:30 |
| 4 | | | | | | | | 7 | |
| | | | | | | AB | 2.0 | 7 | Collected Ambient blank for Surface Sample- CANOR-0868-0250 at 12:50 |
| 5 | | | | | | | | 8 | |
| | | | | | | | | 8 | |
| 6 | Bottom of Boring | | | | | | | | See original log of 0862 for Lithologic description. |
| 7 | | | | | | | | | grouted boring from 0-6' w/ cement-bentonite grout |

PROJECT NO. 89MC114W

SHEET 1 OF 1

(redrill of o

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 0869

| | | | |
|---|---|---|---|
| BORING LOCATION: Engine test Cell | | ELEVATION AND DATUM: 4268.64' MSL | |
| DRILLING AGENCY: Environmental Drilling | DRILLER: E. Lancaster | DATE STARTED: 11-24-91 / DATE FINISHED: 11-24-91 | |
| DRILLING EQUIPMENT: Mobile B-61 | | COMPLETION DEPTH: 10 | SAMPLER: 3" Stainless |
| DRILLING METHOD: HSA - 6" OD, 3¼" ID | DRILL BIT | NO. OF SAMPLES: DIST. NA | UNDIST. Anal - 3 |
| SIZE AND TYPE OF CASING: NA | | WATER ELEV.: FIRST NA | COMPL. NA / 24 HRS. NA |
| TYPE OF PERFORATION: NA | FROM TO FT. | LOGGED BY: Larry Gardiner | CHECKED BY: Sam Buth |
| SIZE AND TYPE OF PACK: NA | FROM TO FT. | | |
| TYPE OF SEAL: Cement-Bentonite Grout | FROM 0 TO 10 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | Recov./L | Penetr. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | A1 | | | start Drilling at 13:15 |
| 1 | | | | | | | | | collect surface sample from 0-.5' at 13:15 CANOPC-0869-0000 |
| 2 | | | | | | | | | collect stainless steel Analytical S.S from 2-4' at 14:25 |
| | | | | | | | 1.4 | 4 | |
| | | | | | | A2 | | 5 | CANOPC-0869-0002 |
| 3 | | | | | | | | 5 | a piece of asphalt was in the S. Spoon |
| | | | | | | | | 5 | OVA in Auger - 0 ppm in S.S - 36 ppm in B.Z - 0 ppm |
| 4 | | | | | | | | | collect stainless steel at 14:35 from 4-6' |
| | | | | | | | | 6 | |
| | | | | | | A3 | | 7 | CANOPC-0869-0004 CANOPC-0869-0204 MRD |
| 5 | | | | | | | .4 | | |
| | | | | | | | | 8 | OVA - auger, S.S, B.Zone } 0 ppm |
| | | | | | | | | 9 | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | see original Boring 0863 for lithologic Log. |

PROJECT NO. 89MC114W

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 0869

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist. Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | | |
| 8 | | | | | | | | 4 | Collected analytical standard S.S. from 8-10 at 15:00 |
| | | | | | | AS | 1.3 | 3 | CANO86-0869-0008 |
| 9 | | | | | | | | 4 | CANO86-0869-0265 at 15:10 FD |
| | | | | | | | | 21 | OVA augers-24 ppm S.S.-60 ppm (top) B.Z. -0 ppm |
| 10 | Bottom of Boring | | | | | | | | Sample stained black at top of S.S. Took sample from the top |
| | | | | | | | | | Collect Decon water at 15:30 CANO86-0869-0282 |
| | | | | | | | | | Collect Rinsate blank at 15:25 CANO86-0869-0222 |
| | | | | | | | | | Grout boring from 0-10' w/ cement-Bentonite grout. |

PROJECT NO. 89MC114W

SHEET 2 OF 2

redrill boring 8610

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 8610

| | | | |
|---|---|---|---|
| BORING LOCATION Engine Test Cell | | ELEVATION AND DATUM 4269.05' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER E. Lancaster | DATE STARTED 11-24-91 / DATE FINISHED 11-24-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 6 | SAMPLER 3½" Stainless |
| DRILLING METHOD HSA, 6" OD, 3¼" ID | DRILL BIT | NO. OF SAMPLES DIST. NA | UNDIST. Analytical - 3 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL NA / 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY Tom Beith |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement - Bentonite grout | FROM 0 TO 6 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov./L | SAMPLES: Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | A1 | | | Start Drilling at 15:30 |
| | | | | | | | | | Collect surface sample from 0-.5' at 13:00 (MS/MSD) CANOR-8610-0000 CANOR-8610-0266 (FD) |
| 1 | | | | | | | | | |
| 2 | | | | | | | | | collect ~~Continuous~~ Analytical stainless steel S.S from 2-4' at 15:35 |
| | | | | | | | | 3 | |
| | | | | | | A2 | | 5 | CANOR-8610-0002 |
| 3 | | | | | | | 1.0 | 5 | OVA- augers S.S. B. Zone } 0 ppm |
| | | | | | | | | 5 | |
| 4 | | | | | | | | 4 | Collect analytical stainless steel S.S. from 4-6' at 15:45 CANOR-8610-0004 |
| | | | | | | A3 | | 5 | OVA augers - 19 ppm S.S. - 6 ppm B. Zone - 0 ppm |
| 5 | | | | | | | 2.0 | 5 | |
| | | | | | | | | 10 | See original log of Boring 0864 for lithologic description |
| 6 | Bottom of Boring | | | | | | | | grout boring from 0-6' w/ cement-Bentonite grout (3% Bentonite) |
| 7 | | | | | | | | | |

PROJECT NO. 89M C114W

SHEET 1 OF 1

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 0951

| | | | |
|---|---|---|---|
| BORING LOCATION NE stormwater Drainage | | ELEVATION AND DATUM 4279.86' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER B. Kingsley | DATE STARTED 10-15-91 / DATE FINISHED 10-15-91 | |
| DRILLING EQUIPMENT Mobile B-53 | | COMPLETION DEPTH 10' | SAMPLER 3" stainless steel S.S., 2" steel S.S. |
| DRILLING METHOD HSA 6" OD 3 3/4" ID | DRILL BIT 6 1/2" Bullet | NO. OF SAMPLES DIST. NA | UNDIST. Analytical - 3 Geotech - 2 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY SM Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement / Bentonite grout | FROM 0 TO 10 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov./ft. | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | SAND, black, very fine to fine grained, well sorted, moist, silty petroleum odor, black staining | SM | | | | A1 | | 1-18" | Surface soil sample collected at 16:15, 10-14-91 CAN095-0951-0000 |
| 1 | | | | | | G1 | | | Started drilling at 11:30, 10-15-91 Grab sample from 0-5 at 11:45 |
| | | | | | | | | 1-6" | SPT from 0 to 2' at 11:45 OVA-S.S. - 0 ppm auger - 9.8 ppm B Zone - 0 ppm |
| 2 | SAND, Light brown, very fine to fine grained, silty, moist | SM | | | | | | 12 | collect analytical stainless steel S.S. sample from 2 to 4' at 11:55 CAN095-0951-0002 |
| | | | | | | A2 | 2.0 | 17 | |
| 3 | | | | | | | | 18 | |
| | | | | | | | | 14 | OVA-S.S. - 41 ppm auger - 0 ppm B Zone - 0 ppm |
| 4 | SAND, Light brown, very fine to fine grained, well sorted, silty moist | SM | | | | | | 6 | collect analytical stainless steel S.S. sample from 4 to 6' at 12:15 |
| | | | | | | A3 | 1.9 | 11 | CAN095-0951-0004 CAN095-0951-0301 MRD |
| 5 | | | | | | | | 15 | OVA-S.S. auger B Zone } 0 ppm |
| | | | | | | | | 16 | |
| 6 | SAND, Light to pale brown, silty fine grained, angular, localized patch of white calcareous material | SM | | | | G2 | | 8 | SPT from 6 to 8' at 12:30 |
| | | | | | | | 1.8 | 11 | ~~collect~~ |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 0951

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | G2 | 1.8 | 11 | |
| | | | | | | | | 18 | |
| 8 | SAND, Light brown, mottled pale brown to white, very fine grained to fine grained, well sorted, calcareous, silty | SM | | | | | | 11 | collect analytical stainless steel S.S. sample from 8 to 10' at 12:55 CAN095-0951-0008 OVA in SS - 0 ppm auger - 31 ppm B. Zone - 0 ppm |
| | | | | | | A4 | 1.8 | 29 | |
| 9 | | | | | | | | 55 | |
| | | | | | | | | 50 | |
| 10 | Bottom of Boring | | | | | | | | grouted boring from 0 to 10' w/ cement - Bentonite grout |
| | | | | | | | | | collect Ambient blank CAN095-0951-0371 at 14:20 collect Rinsate blank CAN095-0951-0371 at 14:15 |

PROJECT NO. 89MC114W

SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 0952

| | | | |
|---|---|---|---|
| BORING LOCATION NE. Stormwater Drainage Ditch | | ELEVATION AND DATUM 4278.35' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER B. Kingsley | DATE STARTED 10-15-91 / DATE FINISHED 10-15-91 | |
| DRILLING EQUIPMENT Mobile B-53 | | COMPLETION DEPTH 10' | SAMPLER 3" stainless steel S.S., 2" steel S.S. |
| DRILLING METHOD HSA-6" OD, 3¾" ID | DRILL BIT 6½" Bullet | NO. OF SAMPLES DIST. NA | UNDIST. Analytical - Geotech - |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY SM Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite Grout | FROM 0 TO 10 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | Recov./L | Penetr. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | SAND, Light brown, fine grained well sorted, wet, silty stained dark grey in top 2" | SM | | | | A1 | | 1 | Collect surface soil sample at 16:00 on 10-14-91 CAN095-0952-0000 MS/MSD |
| | | | | | | | | 1 | Start drilling at 8:20 |
| 1 | | | | | | | 1.6 | | SPT from 0 to 2' at 8:30 |
| | | | | | | G1 | | 1 | |
| | | | | | | | | 1 | |
| 2 | SAND, Light brown, very fine to fine grained, well sorted, wet silty | SM | | | | | | 1 | collect analytical stainless steel S.S sample from 2 to 4' at 8:40 |
| | | | | | | A2 | 1.7 | 1 | CAN095-0952-0002 MS/MSD |
| 3 | | | | | | | | 2 | OVA-S.S. augers B. Zone } 0 ppm |
| | | | | | | | | 2 | |
| 4 | SAND, Light brown, very fine to fine grained, well sorted, silty wet | SM | | | | | | 1 | collect analytical stainless steel S.S. sample from 4 to 6' at 8:55 |
| | | | | | | A3 | 1.8 | 1 | CAN095-0952-0004 |
| 5 | | | | | | | | 1 | OVA-S.S. augers B. Zone } 0 ppm |
| | | | | | | | | 1 | |
| 6 | SAND, Light brown, very fine to fine grained, well sorted, silty wet | SM | | | | | | 1 | SPT from 6 to 8' at 9:10 |
| | | | | | | A2 | 1.5 | 4 | collected gradation analysis sample from 6 to 8' at 9:10 CAN095-0952-0006 |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114CN

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 0952

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist. Blows (6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | 5 | |
| | | | | | | G2 | 1.5 | | |
| | | | | | | | | 7 | |
| 8 | SAND Light brown, fine grained, well sorted, wet, silty | SM | | | | | | | collect analytical stainless steel S.S from 8 to 10' at 9:20 CAN095-0952-0008 |
| | | | | | | | | 5 | |
| | | | | | | A4 | 1.5 | 12 | |
| 9 | | | | | | | | | OVA-S.S augers B. zone } 0 ppm |
| | | | | | | | | 16 | |
| | | | | | | | | 17 | |
| 10 | | | | | | | | | |
| | Bottom of Boring | | | | | | | | Grouted boring from 0 to 10' w/ cement-Bentonite Grout |
| | | | | | | | | | collect decon water at 9:30 CAN095-0952-0381 |

PROJECT NO. 89MC114W

SHEET 2 OF 2

(redrill of 0951)

**Woodward-Clyde Consultants** PROJECT NAME CANYON AFB HOLE NO. 0953

| | |
|---|---|
| BORING LOCATION NE. stormwater drainage ditch | ELEVATION AND DATUM 4280.08' MSL |
| DRILLING AGENCY Environmental Drilling / DRILLER M Paulsen | DATE STARTED 12-7-91 / DATE FINISHED 12-7-91 |
| DRILLING EQUIPMENT Mobile B-61 | COMPLETION DEPTH 9.5 / SAMPLER 2" stainless steel |
| DRILLING METHOD HSA 7½" OD, 4¼" ID / DRILL BIT 7½" Bullet | NO. OF SAMPLES DIST. NA / UNDIST. Analytical only 64 |
| SIZE AND TYPE OF CASING NA | WATER ELEV. FIRST NA / COMPL. NA / 24 HRS. NA |
| TYPE OF PERFORATION NA / FROM TO FT. | LOGGED BY Larry Gardiner / CHECKED BY SMButh |
| SIZE AND TYPE OF PACK NA / FROM TO FT. | |
| TYPE OF SEAL Cement-Bentonite Grout / FROM 0 TO 9.5 FT | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recovery | SAMPLES: Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | A1 | | | Start drilling at 13:30 |
| | | | | | | | | | collect analytical surface sample from 0-.5 at 10:00 CAN095-0953-0000 MS/MSD |
| 1 | See original boring Log of boring 0951 for Lithologic description | | | | | | | | collect ambient blank at 10:25 CAN095-0953-0353 |
| 2 | | | | | | | | 9 | Collect analytical stainless steel S.S. sample from 2-4' at 13:40 |
| | | | | | | | | 11 | CAN095-0953-0002 |
| 3 | | | | | | A2 | 16 | 11 | CAN095-0953-0302 MRD wet |
| | | | | | | | | 14 | OVA- augers S.S. B. Zone } 0 ppm |
| 4 | | | | | | | | 9 | Collect analytical stainless steel S.S. sample from 4-6' at 13:55 |
| 5 | | | | | | A3 | 17 | 10 | CAN095-0953-0004 wet |
| | | | | | | | | 14 | OVA- augers S.S. B. Zone } 0 ppm |
| 6 | | | | | | | | 13 | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNONAFR HOLE NO. 0953

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | | |
| 8 | | | | | | | | 21 | collect analytical stainless s.s sample from 8-10' |
| | | | | | | A4 | 1.5 | 36 | aT 14:05 AN095-0953-0008 |
| 9 | | | | | | | | 36 | wet OVA- augers s.s B.Zone } 0ppm |
| | Bottom of Boring | | | | | | | | |
| 10 | | | | | | | | | grout boring from 0 to 9.5' w/cement-Bentonite grout. |

PROJECT NO. 89MC114W

SHEET 2 OF 2

(redrilling 0952)

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 0954

| | | | |
|---|---|---|---|
| BORING LOCATION NE. stormwater drainage Ditch | | ELEVATION AND DATUM 4278.51' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER M. Powless | DATE STARTED / DATE FINISHED 12-3-91 / 12-3-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 10 | SAMPLER 3"- stainless S.S. |
| DRILLING METHOD HSA. 7½" OD, 4¼" ID | DRILL BIT 7½" bullit | NO. OF SAMPLES DIST. NA | UNDIST. Analytical-3 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY LARRY Gardiner | CHECKED BY SMButh |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite grout | FROM 0 TO 10 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | Recov./L | Penetr. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | Start drilling at 8:55 |
| 1 | | | | | | | | | See original Log of boring 0952 for Lithologic description |
| 2 | | | | | | | | | Collect analytical stainless steel S.S. |
| | | | | | | | | 4 | Sample from 2-4' at T 9:05 |
| 3 | | | | | | A1 | | 4 | CAN095-0954-0002 MS/MSD |
| | | | | | | | 1.7 | 4 | CAN095-0954-0003 FD |
| | | | | | | | | 6 | at 9:15 |
| 4 | | | | | | | | | Collect analytical stainless steel S.S. |
| | | | | | | | | 1 | sample from 4-6' at T 9:30 |
| 5 | | | | | | A2 | 1.4 | 1 | CAN095-0954-0004 |
| | | | | | | | | 1 | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 0954

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | | |
| 8 | | | | | | | | | collect analytical stainless steel S.S. Sample 8-10' at 10:30 CAN095-0954-0008 |
| | | | | | | | 1.3 | 3 | |
| | | | | | | A3 | | 4 | |
| 9 | | | | | | | | 6 | |
| | | | | | | | | 18 | |
| 10 | | | | | | | | | |
| | Bottom of Boring. | | | | | | | | collect Rinsate blank at 10:25 CAN-095-0954-0373 |
| | | | | | | | | | collect Decon water Sample at 10:50 CAN095-0954-0384 |
| | | | | | | | | | grout boring from 0-10' with cement-Bentonite grout. |

PROJECT NO. 89MC114 CU

SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 8801

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer - N. end of Torch | | ELEVATION AND DATUM 4308.12' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER E. Lancaster | DATE STARTED 11-18-91 / DATE FINISHED 11-18-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 22.5' | SAMPLER 3" Stainless S.S |
| DRILLING METHOD HSA 6" OD, 3¼" ID | DRILL BIT 6½" Bullet | NO. OF SAMPLES DIST. NA | UNDIST. Andytrol - 1 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY Sam Beth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite Grout | FROM 0 TO 22.5 | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov./L | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | SAND, dark reddish brown, very fine to fine grained sub-angular to angular, well sorted slightly silty - Non-calcareous | SM | | | | | 2/4 | | Started drilling at 10:50 |
| 1 | | | | | | | | | Continuous split barrel from 0-4' at 10:55 |
| | | | | | | | | | ~~collected~~. |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | SAND, as above | SM | | | | | | | Continuous split barrel from 4-9' at 11:10 |
| 5 | | | | | | | 2/5 | | OVA in auger - 12 ppm |
| | | | | | | | 6/5 | | OVA in S.S - 0 ppm |
| | | | | | | | | | OVA in B.Z - 0 ppm |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 1 OF 3

**Woodward-Clyde Consultants** PROJECT NAME SAVANNAH AFB HOLE NO. 9P01

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist. Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | | |
| 8 | SAND, Light reddish brown to pale brown, very fine grained, silty, lightly cemented w/ calcite, Calcite stringers through out | | | | | | | | |
| 9 | sand, medium to Pale brown, very fine grained, angular, well sorted, calcareous calcite patches scattered throughout. | SM | | | | | | | Continuous split bard from 9-14' at 11:30 |
| 10 | | | | | | | 1/5 | | OVA in Augers bard B.Z. } 0 ppm |
| 11 | | | | | | | | | |
| 12 | | | | | | | | | |
| 13 | SAND Light reddish brown. very fine grained, angular, silty well sorted, calcareous. | SM | | | | | 2/2.5 | | Continuous split bard from 14.-16.5 at 11:45 |
| 14 | | | | | | | | | OVA in auger bard B.Z. } 0 ppm |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 2 OF 3

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9801

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | | | | | | | | | |
| | SAND medium, reddish brown, very fine to fine grained, subangular, silty cemented w/ calcite. | SM | | | | | | 17 | stainless steel S.S. from 16.5-18.5' at 12:10 |
| 17 | | | | | | | 2.0 | 49 | OVA in augers S.S. B.Z. } 0 ppm |
| | | | | | | | | 99 | |
| 18 | | | | | | | | 96 | |
| | Sand, " as above | | | | | | | | stainless steel S.S. from 18.5-20.5 at 12:40 |
| 19 | | | | | | | | 11 | |
| | | | | | | | 1.6 | 54 | OVA in augers S.S. B.Z. } 0 ppm |
| | | | | | | | | 53 | |
| 20 | | | | | | | | 74 | |
| | Sand, Light, reddish brown very fine to fine grained, silty, subrounded to subangular, well sorted, cemented w/calcite | SM | | | | | 1.8 | 12 | Analytical stainless steel S.S. from 20.5-22.5' at 13:05 CAN09A-9801-0020 MS/MSD |
| 21 | | | | | | A1 | | 47 | OVA in augers S.S. B.Z. } 0 ppm |
| | | | | | | | | 62 | |
| 22 | | | | | | | | 72 | |
| | Bottom of Boring. | | | | | | | | grouted boring from 0-22.5' w/ Cement-Bentonite grout |
| 23 | | | | | | | | | collected gradation analysis sample 0-.5' at 16:05 CAN09A-9801-4000 surface |

PROJECT NO. 8919C114W

SHEET 3 OF 3

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9802

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer Line - N. End of Torch | | ELEVATION AND DATUM 4307.26' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER E. Lancaster | DATE STARTED 11-19-91 / DATE FINISHED 11-19-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 22' | SAMPLER 2" stainless steel S.S. |
| DRILLING METHOD HSA 6" OD, 3¼" ID | DRILL BIT 6½" Bullet | NO. OF SAMPLES DIST. NA | UNDIST. Analytical-1 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gordiner | CHECKED BY Sm Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite grout | FROM 0 TO 22 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov./L | SAMPLES: Penetr. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | Started Drilling at 7:25 |
| 1 | SAND dark reddish brown very fine grained, silty (20%) Non calcareous | | | | | | | | continuous split at 7:40 from 0-4' |
| | | SM | | | | | 2/4 | | OVA in augers barrel B.Z. } 0 ppm |
| 2 | | | | | | | | | very moist |
| 3 | | | | | | | | | |
| 4 | Sand Medium reddish brown, very fine grained silty (15%) non calcareous | SM | | | | | | | continuous split barrel from 4-9 at 7:50 |
| 5 | | | | | | | 3/5 | | OVA in augers barrel B.Z. } 0 ppm |
| 6 | | | | | | | | | slightly moist |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114LD

SHEET 1 OF 3

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9802

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, e |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | | |
| 8 | Sand, pale brown very fine grained, well sorted calcite cement, calcite lenticular lenses silty | (SM) Caliche | | | | | | | |
| 9 | Sand medium red brown very fine, calcareous, silty | SM | | | | | 1/1 | | continuous split barrel from 9-10' at 8:15 |
| 10 | | | | | | | | | OVA in augers barrel B.2. } 0 ppm Hard. Drill to 12' |
| 11 | | | | | | | | | |
| 12 | | | | | | | | | continuous split barrel from 12-13' at 8:50 |
| 13 | SAND, medium to pale brown silty. Very fine, subangular well sorted, calcite cement, some lenses of calcite | SM Caliche | | | | | 2/5 | | OVA in augers S. barrel B2 } 0 ppm |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 2 OF 3

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9802

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist. Blows 6 in. | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | | | | | | | | | |
| 17 | | | | | | | | | Analytical continuous split Barrel with poly Butt liner from 17-22' at 9:35 CANOGF-9802-0007 |
| 18 | SAND, medium reddish brown, very fine to fine grained. subangular, calcareous silty. | SM | | | | | | | |
| 19 | | | | | | A1 | 8/5 | | OVA in augers barrel B.Z. } 0 ppm |
| 20 | | | | | | | | | grouted Boring from 0-22' w/ cement-Bentonite grout |
| 21 | | | | | | | | | Blow counts taken with c 140 lb hammer, dropped 30". |
| 22 | Bottom of BORING. | | | | | | | | collect gradation analysis sample at 11:15 CANOGF-9802-0008 surface |

PROJECT NO. 89MC14W

SHEET 3 OF 3

Woodward-Clyde Consultants PROJECT NAME CANNON AFB HOLE NO. 9802

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer Line | | ELEVATION AND DATUM | |
| DRILLING AGENCY Environmental Drilling | DRILLER B. Kingsley | DATE STARTED 11-9-91 DATE FINISHED 11-9-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH NA | SAMPLER NA |
| DRILLING METHOD HSA - 6" OD, 3 1/4" ID | DRILL BIT 6 1/2" | NO. OF SAMPLES / DIST. | UNDIST. |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. / FIRST | COMPL. / 24 HRS. |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY LARRY Gordinier | CHECKED BY SMButh |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL NA | FROM NA TO FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft. | SAMPLES: Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | Start Drilling at 7:25 |
| 1 | | | | | | | | | Drilled into water line stopped Drilling. |
| 2 | Drilled into water line at this location | | | | | | | | at 3 ft. |
| 3 | Will move boring location and try again. | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 1 OF 1

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9803

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer outfall | | ELEVATION AND DATUM NA | |
| DRILLING AGENCY Environmental Drilling | DRILLER B. Kingsbury | DATE STARTED 11-8-91 / DATE FINISHED 11-8-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 15 | SAMPLER Split barrel |
| DRILLING METHOD HSA 6" OD, 3¼" ID | DRILL BIT 6¼ | NO. OF SAMPLES DIST. NA | UNDIST. Analytical-1 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY SMButh |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite Grout | FROM 0 TO 15 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft. | SAMPLES: Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | Start Drilling at 13:05 Drilled 1 foot continuous split barrel from 1-5' at 13:15 |
| 1 | SAND medium reddish brown very fine to fine grained angular to subangular, silty well sorted. | SM | | | | | | | |
| 2 | | | | | | | | | |
| 3 | | | | | | | 2/4 | | |
| 4 | | | | | | | | | |
| 5 | SAND pale brown, very fine grained 50% calcite (Caliche) silty | caliche (SM) | | | | | | | Continuous split barrel from 5-10' at 13:30 |
| 6 | | | | | | | 2.5/5 | | OVA in Auger 0 ppm in Barrel 0 ppm in Breathing Zone 0 ppm |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9803

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, ...) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | SAND, Light reddish brown very fine grained angular, well sorted, silty calcareous Discontinuous horizontal lenses of caliche | SM | | | | | 2/5 | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | Note: Must collect another sample, as barrel was not lined, (see 9803 redrill) |
| 10 | Sand Pale brown very fine grained, well sorted w/ calcite (Caliche), silty | Caliche (SM) | | | | | | | Collected analytical continuous split barrel from 10-15' at 13:55 |
| 11 | | | | | | | | | CAN098-9803-00110 |
| | | | | | | | 2/5 | | OVA-augers -Barrel Brushy Zone } 0ppm |
| 12 | SAND, Light brown very fine to fine grained well sorted angular, silty calcareous, | SM | | Sl. moist | | A1 | | | sample is slightly moist |
| 13 | | | | | | | | | grouted boring from 0 to 15' w/ cement-Bentonite grout. |
| 14 | | | | | | | | | |
| 15 | Bottom of Boring | | | | | | | | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 2 OF 2

(Redrill)

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9803

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer on Torch | | ELEVATION AND DATUM 4303.44' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER E. Lancaster | DATE STARTED 11-23-91 / DATE FINISHED 11-23-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 15 | SAMPLER 3" stainless steel S.S. |
| DRILLING METHOD HSA-6"OD, 3¼"ID | DRILL BIT 6½" | NO. OF SAMPLES DIST. NA | UNDIST. Stainless Analytical - 1 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY SMButh |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite grout | FROM 0 TO 15 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov./ft. | SAMPLES: Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | Start drilling at 9:05 |
| 1 | | | | | | | | | Drill to 10' and take stainless S.S. sample |
| 2 | | | | | | | | | See original boring Log for lithologic description |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 1 OF 2

Redrill

**Woodward-Clyde Consultants** PROJECT NAME CANYON AFB HOLE NO. 9803

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist. Blows 6 in. | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | 4 | stainless steel analytical S.S from 10-12' at 9:35 collected |
| | | | | | | G1 | 1.2 | 4 | |
| 11 | | | | | | | | 4 | Gradation Analysis from 10-12' CANO98-9803-4010 |
| | | | | | | | | 8 | |
| 12 | | | | | | | | 10 | Collected Analytical Stainless Steel S.S. from 12-14 at 9:40 CANO98-9803-0012 |
| | | | | | | A1 | 1.6 | 15 | |
| 13 | | | | | | | | 20 | CANO98-9803-0302 (MRD) |
| | | | | | | | | 27 | |
| 14 | Bottom of Boring | | | | | | | | collected Rinsate blank at 12:05 CANO98-9803-0373 |
| 15 | | | | | | | | | grouted boring from 0-14' at 16:00 w/ Cement-Bentonite grout |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CAIVNON AFB HOLE NO. 9804

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer on torch | | ELEVATION AND DATUM 4301.93' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER E. Lancaster | DATE STARTED 11-23-91 / DATE FINISHED 11-23-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 16 | SAMPLER SM Stainless S.S. |
| DRILLING METHOD HSA-6"OD, 3¼"ID | DRILL BIT 6¼" Bullet | NO. OF SAMPLES DIST. NA | UNDIST. Analytical - 1 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY Sm Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement Bentonite grout | FROM 0 TO 16 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Date | SAMPLES Type No. | Recov./L | Penetr. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | Start Drilling at 9:55. Drill to 5' |
| 1 | | | | | | | | | continuous split barrel sample from 5 to 6' |
| 2 | SAND, medium reddish brown, very fine grained, angular to subangular, well sorted, silty | SM | | | | | | | at 10:05 encountered chert at 6' |
| 3 | | | | | | | | | Move boring 2 feet down stream. |
| 4 | | | | | | | | | start drilling at 11:35 |
| 5 | | | | | | | | | encountered chert at 6' again. moved boring ~~[illegible]~~ 3' to the right of original boring |
| 6 | chert, Light brown w/ dark brown banding, dense | | | | | | 2/4 | | started drilling at 12:20 encountered chert again moved 10' down stream ~~[illegible]~~ started drilling at 13:05 |
| 7 | SAND Light reddish brown very fine to fine grained well sorted, subangular, silty, calcite cement | SM | | | | | | | continuous split barrel from 8-10' at 13:30 ~~[illegible]~~ Auger 0 ppm Barrel 0 ppm B.Z. - 0 ppm |

PROJECT NO. 89MC114W

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9804

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetr. Resist. Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, et |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | | collected gradation Anal. Sample from 6-10' at 13:30 CAN0929804-0006 |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | Chert, Light. brown banded. | | | | | | | | Drill out chert from 10 to 12' |
| 11 | | | | | | | | | |
| 12 | SAND, Pale brown, very fine grained to medium grained silty, subangular to Rounded, calcite cement. Locally the sand is starting to Lithify into Rock. Locally hard crystalline calcite. | SM | | | | | | 31 | Analyzed stainless steel S.S. from 12-14' at 13:55 |
| 13 | | | | | | G1 | 1.8 | 67 | OVA- auger S.S. B. Zone } 0 ppm |
| | | | | | | | | 69 | |
| | | | | | | | | 33 | |
| 14 | SAND, Pale brown to patches of reddish brown, very fine to fine grained subangular to subrounded, calcite cement, silty and siliceous cement. siliceous cement is lithifying sediment | SM | | | | A1 | 1.7 | 23 | collected analyzed stainless steel S.S. from 14-16 at 14:05 |
| 15 | | | | | | | | 32 | CAN0929804-0014 |
| | | | | | | | | 31 | OVA augers S.S. B. Zone } 0 ppm |
| | | | | | | | | 52 | Grouted all borings at 16:20 w/ cement-Bentonite grout |
| 16 | Bottom of Boring | | | | | | | | |

PROJECT NO. 83MC114W SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9205

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer on Torch Blvd | | ELEVATION AND DATUM 4298.52' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER B. Kingsley | DATE STARTED 11-13-91 / DATE FINISHED 11-13-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 13' | SAMPLER 3" stainless |
| DRILLING METHOD HSA - 6" OD, 3¼" ID | DRILL BIT 6¼" Bullet | NO. OF SAMPLES DIST. NA | UNDIST. Analytical - 1, Geotech - 2 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY SM Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite grout | FROM 0 TO 13 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov./L | SAMPLES: Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | Asphalt | | | | | | | | start drilling 10:45 |
| 1 | | | | | | | | | |
| 2 | SAND, dark brown, very fine grained, silty | SM | | | | | | | continuous split barrel from 2-7' at 10:55 |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9805

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | SAND, medium reddish brown very fine grained angular, silty patches of calcite throughout, calcareous | SM | | | | G1 | 1.7 | 12<br>17 | stainless steel S.S. from 7-9' at 11:10 gradation Anal. CANO98-9805-4007 |
| 8 | | | | | | | | 11<br>7 | OVA in augers S.S B.Z. } 0 ppm |
| 9 | SAND, as above | SM | | | | G2 | 1.8 | 6<br>9<br>8<br>6 | stainless steel S.S. from 9-11' at 11:20<br>OVA in augers S.S. and B.Z. } 0 ppm |
| 10 | | | | | | | | | |
| 11 | SAND, as above | SM | | | | A1 | 1.9 | 6<br>6<br>7 | Analyzed stainless steel S.S. from 11-13' at 11:35<br>CANO98-9805-0011<br>CANO98-9805-1362 (FD) |
| 12 | | | | | | | | | |
| 13 | SAND, pale brown, very dia- to fine grained angular calcite cement (caliche) silty | caliche (SM) ~~SM~~ | | | | | | 6 | OVA in augers in S.S in B.Z. } 0 ppm |
| | Bottom of Boring | | | | | | | | grout Boring from 0-13' w/ cement Bentonite Grout. |
| | | | | | | | | | collected Ambient Blank CANO98-9805-1352 at 12:10 |

PROJECT NO. 89MC114A SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 8806

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer on Dock | | ELEVATION AND DATUM 4299.04' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER B. Kingsley | DATE STARTED 11-12-91 / DATE FINISHED 11-12-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 18 | SAMPLER 3" stainless S.S. |
| DRILLING METHOD HSA 6" OD, 3¼" ID | DRILL BIT 6½" | NO. OF SAMPLES DIST. NA | UNDIST. Analytical Geotech-2 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Zacky Gardiner | CHECKED BY SM Beth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite grout | FROM 0 TO 18 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft. | SAMPLES: Penetr. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | Started Drilling at 13:30 |
| 1 | SAND, dark, brown, very fine grained, silty (20%) | SM | | | | | | | Augered down to 8' to be sure we missed water lines |
| 2 | | | | | | | | | Surface sample not taken because surface layer was compacted soil brought in from another location to ~~Sur~~ same as parking lot base. |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |

PROJECT NO. 89/K/114 W

SHEET 1 OF 3

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 98 06

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | | |
| 8 | SAND medium reddish brown calcite patches scattered throughout very fine. grained, angular silty, Calcareous | SM | | | | | | | continuous split barrel from 8-12 at 16:15 |
| 9 | | | | | | | 2/14 | | to hard to core deeper |
| | | | | | | | | | Drilled to 13' |
| 10 | | | | | | | | | OVA in auger - 0 ppm in barrel 0 ppm in B2 - 0 ppm |
| 11 | | | | | | | | | |
| 12 | | | | | | | | | |
| 13 | Pale reddish Brown Sand very fine grained, subangular + angular, silty, calcareous dry | SM | | | | G1 | 15 | 11 | Analytical stainless steel S.S. from 13-15' at 16:25 |
| | | | | | | | | 18 | |
| 14 | | | | | | | | 20 | OVA in auger S.S. B.2, 0 ppm |
| | | | | | | | | 23 | |
| 15 | SAND, ~~very~~ Lt. brown, silty very fine grained, angular patches of calcite throughout lightly Cemented w/Calcite | SM | | | | G2 | | 14 | Analytical S.S. from 15-17' at 16:45 |
| | | | | | | | | 15 | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 2 OF 3

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9806 1

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | | | | | | | 1.9 | 16 | |
| | | | | | | G2 | | | |
| | | | | | | | | 16 | |
| 17 | Sand, Light reddish brw very fine grained, subangular well sorted, silty (15%) calcareous | SM | | | | | 1.7 | 20 | Collected Analytical stainless S.S. from 17-18' at 16:55 CANOSA-9806-0017 |
| | | | | | | A1 | | 35 | OVM in augers S.S. B.Z. } 0 ppm |
| 18 | Bottom of Boring | | | | | | | | |
| 19 | | | | | | | | | Grout boring from 0-18' with cement bentonite grout. blow counts taken by dropping a 140 lb hammer 30" |

PROJECT NO. 89MC114W

SHEET 3 OF 3

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9807

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer on Torch Blvd | | ELEVATION AND DATUM 4299.29' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER B. Kingsley | DATE STARTED 11-12-91 / DATE FINISHED 11-13-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 13' | SAMPLER 3" stainless steel S.S. |
| DRILLING METHOD HSA 6'OD, 3½"ID | DRILL BIT 7½" bullet | NO. OF SAMPLES DIST. N/A | UNDIST. 2 analytical-1 |
| SIZE AND TYPE OF CASING N/A | | WATER ELEV. FIRST N/A | COMPL N/A 24 HRS. N/A |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY Sam Beth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-bentonite grout | FROM 0 TO 13 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft. | SAMPLES: Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | ~~Sand, Do~~ asphalt. | | | | | | | | Start Drilling at 8:05 |
| | | | | | | | | | continuous split Barrel from 0-4' at 8:15 |
| 1 | Sand, dark brown mottled Light brown very fine grained, angular, silty (15%) | SM | | | | | | | |
| 2 | Light brown mottles are calcareous | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | Sand, dark brown w/ lenses ~~of~~ and patches of Calcite cemented Sand Light brown, Very fine grained, angular, silty | SM | | | | | | | |
| 5 | | | | | | | | | continuous split Barrel from 4-8' at 8:25 |
| 6 | | | | | | | | | OVA in augers bored Breathe z. } 0 ppm |
| 7 | | | | | | | | | |

PROJECT NO. 89MC117W

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9807

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | sand Light brown very fine grained, calcite cement (caliche) silty mottled medium brown to lenticular | caliche (SM) | | | | | | | |
| 8 | Sand, As above | | | | | | | 8 | Stainless st S.S from 8-9.5 at 8:35 |
| | | | | | | G1 | 1/2 | 35 | OVA-in augers |
| 9 | | | | | | | | 50 | S.S. B.Z. } 0ppm |
| 10 | | | | | | | | | Drill to 11' soil Hard S.S. would not penetrate past 9.5' |
| 11 | Sand, Light reddish Brown, very fine grained subangular, calcareous, silty | SM | | | | | | 11 | Stainless and BG. from 11-13 at 8:50 |
| 12 | | | | | | A1 | 1.0 | 5 | CAN098-9807-0011B |
| | | | | | | | | 7 | gradation and sample |
| | | | | | | | | 8 | CAN098-9807-0012B |
| 13 | | | | | | | | | |
| | Base of Boring | | | | | | | | grouted Boring from 0-13 ft w/ cement Bentonite grout. |
| | | | | | | | | | Blow counts taken by dropping a 140 lb hammer 30" |

PROJECT NO. 89MC114W SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9808

| | | | |
|---|---|---|---|
| BORING LOCATION: Sanitary Sewer line - Torch - boring 9808 | | ELEVATION AND DATUM: 4300.06' MSL | |
| DRILLING AGENCY: Environmental Drilling | DRILLER: B. Kingsley | DATE STARTED: 11-8-91 / DATE FINISHED: 11-8-91 | |
| DRILLING EQUIPMENT: Mobile B-61 | | COMPLETION DEPTH: 10' | SAMPLER: 3" Stainless Steel S.S. |
| DRILLING METHOD: NSA 6" OD — 3 1/4" ID | DRILL BIT: 6 1/2" Bulkt | NO. OF SAMPLES: DIST. NA | UNDIST. Analytical - 0, Geotech - 1 |
| SIZE AND TYPE OF CASING: NA | | WATER ELEV.: FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION: NA | FROM TO FT. | LOGGED BY: Larry Gardiner | CHECKED BY: SM Beth |
| SIZE AND TYPE OF PACK: NA | FROM TO FT. | | |
| TYPE OF SEAL: Cement - Bentonite Grout | FROM 0 TO 10 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | Recov. ft. | Penetra. Resist. (Blows/6 in.) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | SAND, medium brown, very fine to fine grained. well sorted, subangular, silty (20%) calcareous | SM | | | | | 3/4 | | Started Drilling at 9:45 continuous split barrel from 0-4' at 10:05 |
| 1 | Roots to 1.5 feet | | | | | | | | |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | SAND, med. brown, mottled pale brown, very fine to fine grained, subangular patches of calcite cement scattered throughout, silty | SM | | | | | 3/4 | | Continuous split barrel from 4-8' at 10:10 |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9208

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | | |
| 8 | | | | | | | | | Analytical stainless steel |
| | | | | | | | | 11 | S.S. from 8-10' at 10:20 |
| | | | | | | G1 | | 1 | Went through |
| 9 | | | | | | | 1.3 | | sewer line |
| | | | | | | | | 1 | Spoon dropped 1 foot. |
| | | | | | | | | 11 | stopped boring at 10' |
| 10 | | | | | | | | | |
| 11 | | | | | | | | | |
| 12 | | | | | | | | | |
| 13 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 2 OF 2

Redrill

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9808 (redri

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer line - Torch Blvd | | ELEVATION AND DATUM | |
| DRILLING AGENCY Environmental Drilling | DRILLER B. Kingsley | DATE STARTED 11-12-91 / DATE FINISHED 11-12-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 9.7 | SAMPLER 3" stainless steel S.S. |
| DRILLING METHOD HSA-6" OD, 3" ID | DRILL BIT 6½" Bullet | NO. OF SAMPLES DIST. NA | UNDIST. Analytical - 1 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY LARRY Gardiner | CHECKED BY Sm Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-bentonite grout | FROM 0 TO 9.7 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov./ft. | SAMPLES: Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | See original Boring log for Lithologr description down to 8' | | | | | | | | Redrill along side boring that penetrated sewer line. |
| 1 | | | | | | | | | Start Drilling 11-12-91 at 8:30 |
| 2 | | | | | | | | | Augered down to 8' to take Analytical Sample |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 1 OF 2

Redrill

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 980B (redrill)

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetr. Resist. Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, et |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | | Date 11-12-91 |
| 8 | SAND, light reddish brown very fine grained, subangular to angular, well sorted, silty, calcareous patches of white calcite. | S/M | | | | | | 5 | Analytical Stainless steel S.S. from 8-9.7 |
| 9 | | | | | | | | 6 | at 8:50 (11-12-91) CAN98-9808-0008 OVA in augers-0 |
| | | | | | | A1 | | 8 | in S.S.-60ppm |
| | | | | | | | | | in B.Z.-0ppm |
| | | | | | | | | 3 | slightly ~~dark~~ damp |
| 10 | Bottom of Boring | | | | | | | | at 9.7' the S.S. ~~bottomed~~ bounced on something hard. stopped right there. pulled augers wait on base civil Engineers To Approve Borings. |
| | | | | | | | | | grout boring from 0 - 10' w/ cement-Bentonite grout |

PROJECT NO. 89MC1110

SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9809

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer on Torch Blvd | | ELEVATION AND DATUM 4300.40' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER Eddie Lancaster | DATE STARTED 11-13-91 / DATE FINISHED 11-13-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 16' | SAMPLER 3" stainless steel S.S. |
| DRILLING METHOD HSA 6" OD, 3¼" ID | DRILL BIT 6½" Bullet | NO. OF SAMPLES DIST. NA | UNDIST. geological Geotech - 2 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gordiner | CHECKED BY SMButh |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL cement-Bentonite grout | FROM 0 TO 16 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov. ft. | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | asphalt | | | | | | | | Started drilling at 13:20 |
| 1 | SAND, Dark reddish brown very fine to fine grained, well sorted, angular, noncalcareous silty | SM | | | | | 2/5 | | continuous split barrel from 1-5' at 13:55 |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | SAND, reddish brown very fine grained, angular well sorted, calcareous, silty | SM | | | | | | | continuous split barrel from 5-10' at 14:00 |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME C ANNON AFB HOLE NO. 9809

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | SAND, dark reddish brown as above | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | SAND pale, brown, very fine grained, Lenticular lenses of calcite, silty | caliche (SM) | | | | | | | |
| 10 | Sand, medium ~~pale~~ Reddish brown very fine grained, angular well sorted, silty (SM) ~~Lenticular~~ ~~lenses of~~ calcite cemented patches of calcite scattered throughout | SM | | | | | | 5 | stainless steel S.S. from 10-12' at 14:10 |
| 11 | | | | | | G1 | .9 | 7 | collected gradation analysis |
| | | | | | | | | 21 | CAN0988-9809-4010 |
| | | | | | | | | 15 | OVA in augers S.S. B2 } 0 ppm |
| 12 | No Recovery | | | | | | | 11 | stainless steel S.S from 12-14 |
| | | | | | | | | 11 | No Recovery |
| 13 | | | | | | G2 | | 10 | OVA in augers - 0 ppm S.S. - 0 ppm B2 on - 0 ppm |
| | | | | | | | | 10 | |
| 14 | SAND, medium reddish brown very fine to fine grained, subangular to angular, calcareous, silty | SM | | | | | | 9 | collected stainless steel Analytical S.S. from 14-16' |
| 15 | | | | | | A1 | | 8 | at 14:25 CAN0988-9809-0014 |
| | | | | | | | | 11 | OVA in augers S.S. B.2. } 0 ppm grouted Boring |
| | | | | | | | | 11 | from 0-16' w/ cement-Bentonite grout. |
| 16 | Bottom of Boring | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9810

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer on Flight Apron | | ELEVATION AND DATUM 4297.55' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER E. Lancaster | DATE STARTED 11-25-91 / DATE FINISHED 11-25-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 17' | SAMPLER 3" stainless steel E.S. |
| DRILLING METHOD HSA 6" OD, 3¼" ID | DRILL BIT 6½" Bullet | NO. OF SAMPLES DIST. NA | UNDIST. NA |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY Sm Brith |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite grout | FROM 0 TO 17 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov./L | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | start drilling at 15:05 |
| | | | | | | | | | Drill to 3' |
| 1 | | | | | | | | | |
| 2 | | | | | | | | | |
| 3 | SAND, medium reddish brown, very fine grained, angular to subangular, well sorted, silty slightly calcareous | SM | | | | | 3/15 | | continuous split barrel from 3-8' at 15:25 |
| 4 | | | | | | | | | OVA augers, S.S., B. Zone 0 ppm |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |

PROJECT NO. 89140/14 W SHEET 1 OF 3

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9 MO

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist Blows (6 in) | REMARKS (Drill Rate, Fluid loss, Odor, et |
|---|---|---|---|---|---|---|---|---|---|
| 7 | SAND, Light reddish brown very fine grained subangular to angular, cemented w/calcite discontinuous lenses of calcite throughout, silty | calcrete (SM) | | | | | | | |
| 8 | SAND, Light reddish brown very fine grained subangular silty (15%) calcite cement | SM | | | | | | | continuous split barrel sample from 8-13' at 15:30 |
| 9 | | | | | | | 2/13 | | |
| 10 | | | | | | | | | |
| 11 | | | | | | | | | |
| 12 | | | | | | | | | |
| 13 | SAND, ~~for~~ Medium reddish brown very fine grained, silty subangular trace Medium grained rounded, calcareous silty (10%) | SM | | | | | | 5 | stainless steel Analytical S.S from 13-25' at 15:35 |
| 14 | | | | | | G1 | 1.74 | | OVA augers S.S B. Zone } 0 ppm |
| | | | | | | | | 3 | |
| | | | | | | | | 4 | |
| 15 | SAND as above | | | | | A1 | 1.3 | 3 | collected stainless steel Analytical S.S from 15-17' at 15:45 CANNON-98A-00 of 15 |
| | | | | | | | 1.96 | 6 | OVA augers S.S. B Zone } 0 ppm |
| 16 | | | | | | | | | |

PROJECT NO. 89M5114A

SHEET 2 OF 3

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9M6

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | | | | | | A1 | | 9 | collect gradation analysis sample from 15-17' at 15:45 |
| | | | | | | | | 4 | |
| 17 | Bottom of Boring | | | | | | | | grout boring from 0-17' w/ cement-Bentonite grout |
| | | | | | | | | | Blow counts taken with a 140 lb hammer dropped 30" |

PROJECT NO. 89MC114W

SHEET 3 OF 3

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9812

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer on Flight line | | ELEVATION AND DATUM 4292.03' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER B. Kingsley | DATE STARTED 11-9-91 / DATE FINISHED 11-9-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 15 | SAMPLER 3" stainless |
| DRILLING METHOD HSA- 6" OD, 3¼" ID | DRILL BIT 6½" Bullet | NO. OF SAMPLES DIST. NA | UNDIST. Analytical-1 Geotech-2 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY Bill Butler |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-bentonite grout | FROM 0 TO 15 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov./L. | SAMPLES: Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | SAND medium brown, very fine grained, silty (pos) Calcareous, Dry | SM | | | | | 2/5 | | Started Drilling at 13:10 continuous split barrel at 13:20 from 0-5' |
| 1 | | | | | | | | | |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | SAND, pale, brown very fine to fine grained, angular to subangular, cemented w/ calcite (caliche) silty | caliche (SM) ~~SM~~ | | | | | | | |
| 5 | | | | | | | 2.5/ | | continuous split barrel from 5-9.5 at 13:40 |
| 6 | | | | | | | 4.5 | | Encountered something hard, augers Bounced. move over 3 ft to original spot - try again |
| 7 | | | | | | | | | |

PROJECT NO. 89MC184W

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9812

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | | augered to 14:45 ~~collect~~ stainless steel. S. S. from 10-12' at 15:10 |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | SAND medium, reddish brown very fine to fine grained silty (~~15%~~) calcareous | SM | | | | | | 5 | sample is moist |
| | | | | | | G1 | 1.9 | 5 | OVA in augers 0 ppm OVA in S.S. - 0 ppm in Breathing zone - 0 ppm |
| 11 | | | | | | | | 5 | |
| | | | | | | | | 16 | |
| 12 | SAND, pale brown, fine grained subangular to subrounded, silty, calcite, cement; caliche | | | | | G2 | .9 | 18 | stainless steel, S.S. from 12-13' at 15:35 |
| | | | | | | | | 60 | collected analytical stainless sample from 13-13' at 15:50 |
| 13 | SAND pale brown, very fine to fine grained silty. subangular to subrounded cemented w/ calcite., caliche | SM | | | | | | 53 | |
| | | | | | | A1 | 1.7 | 73 | moist OVA in augers S. S. Breath Zone } 0 ppm |
| 14 | | | | | | | | 88 | CANOAP-9812-0013 Gradation analysis CANOCP-SPR-4013 |
| | | | | | | | | 70 | |
| 15 | Bottom of Boring | | | | | | | | collected Rinsate blank at 16:30 CANO91-9812-1371 |
| 16 | | | | | | | | | grout Boring from 0-15' w/ Cement Bentonite grout |

PROJECT NO. 89MC114U

SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9813

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer, - Flight line | | ELEVATION AND DATUM 4290.41' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER B. Kingsley | DATE STARTED 11-10-91 / DATE FINISHED 11-10-91 | |
| DRILLING EQUIPMENT CME Mobile B-61 | | COMPLETION DEPTH 15' | SAMPLER 3" Stainless Steel - S.S. |
| DRILLING METHOD HSA 6" OD, 3¼" ID | DRILL BIT 6½" | NO. OF SAMPLES DIST. NA | UNDIST. Analr - 1 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY Sm Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite grout | FROM 0 TO 15 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft. | SAMPLES: Penetr. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | Start Drilling 7:55 |
| 1 | | | | | | | | | Continuous Split barrel from 0 - 2 at 8:20 |
| 2 | Caliche. very hard Sand very fine grained pale brown silty | ~~SM~~ caliche (SM) | | | | | | | would not go below 2' drilled to 5' |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | SAND, Light reddish to Pale Brown, very fine grained, subangular. well cemented w/ calcite. very hard, silty | SM | | | | | | | continuous Split barrel from 5 - 6 ft at 8:45 |
| 6 | | | | | | | | | drilled to 10' core barrel would not cut soil |
| 7 | | | | | | | | | |

PROJECT NO. 89/4C114W

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9813

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | | |
| 8 | | | | | | | | | collect Ambient Blank at 11:55 CAN098-9813-1351 |
| 9 | | | | | | | | | |
| 10 | SAND Lt. reddish brown very fine to fine grained, sub-angular to sub rounded, well sorted, calcareous, lightly cemented, silty. | SM | | | | | | 11 | Analytical stainless steel S.S from 10-11.7 at 8:50 |
| | | | | | | | 1.8 | 45 | |
| 11 | | | | | | | | 50 | OVA in augers - 0p in S.S - 0p Breathing - 0ppm |
| | | | | | | | | 75 | |
| | | | | | | | | 47 | |
| 12 | SAND Lt. reddish to pale brown very fine to fine grained, silty well cemented w/ calcite (caliche) hard | caliche | | | | | 1.5 | 100 | Analytical stainless steel S.S from 12-12.5 at 9:25 |
| 13 | SAND, pale brown, very fine to fine grained, subangular well cemented w/ calcite, very hard silty | caliche (SM) | | | | A1 | | 70 | stainless steel S.S. from 12.5 to 13 at 9:40 OVA in S.S - 24 ppm |
| | | | | | | | | 125 | Stainless steel Anal. S.S from 13 - at 10:05 CAN098-9813-0013 |
| 14 | | | | | | | 1.7 | 75 | OVA in augers - 0 ppm OVA in S.S - 0ppm - in Breathzone - 0ppm |
| | | | | | | | | 80 | |
| 15 | Bottom of Boring. | | | | | | | | Collected gradation sample CAN098-9813-4013 grouted Boring from 0-15' w/ Cement-Bentonite grout |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 9814

| | | | |
|---|---|---|---|
| BORING LOCATION ~~Sanitary~~ Sanitary Sewer on Flight line | | ELEVATION AND DATUM 4289.77' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER | DATE STARTED 11-10-91 / DATE FINISHED 11-10-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 15.5' | SAMPLER 3" Stainless |
| DRILLING METHOD HSA 6" OD, 3¼" ID | DRILL BIT 6 7/8 | NO. OF SAMPLES DIST. NA | UNDIST. Anch-7 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardner | CHECKED BY SMButh |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-bentonite grout | FROM 0 TO 15.5 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov./ft. | SAMPLES: Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | SAND, light, reddish brown very fine grained subangular silty | | | | | | | | Started drilling at 11:30 |
| 1 | | SM | | | | | 3/4 | | Continuous split barrel from 0-4' at 11:45 |
| | | | | | | | | | Very hard, drilling Rocks |
| 2 | | | | | | | | | Drill to 10.5' to take S.S. |
| 3 | | | | | | | | | |
| 4 | SAND, Light brown blebs of calcite throughout scattered hard pebbles, silty | SM SW | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9814

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist. Blows (6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |
| 11 | Sand, Pale brown, very fine to fine grained well sorted, calcareous to cemented w/ calcite. (Caliche), silty | Caliche (SM) | | | | | 1.0/1.0 | 101 | Stainless steel S.S. from 10.5-11 at 12:15 |
| | | | | | | | .2 | 200 | Stainless S.S. from 11-11.5 at 12:35 OVA-0 ppm |
| | | SM | | | | | | | Drill too 13.5' to Hard to take S. sample |
| 12 | | | | | | | | | |
| 13 | | | | | | | | | |
| 14 | Sand, Light reddish brown, silty very fine to fine grained, well sorted lightly cemented w/ Calcite Softer than above | SM | | | | | .41 | 39 | Collect stainless steel. Anal. S.S. from 13.5 to 15.5 at 12:55 |
| | | | | | | | 1.2 | 37 | CAN098-9814-0013 Grad. Anal. CAN098-9814-0013 OVA in Auger - 0 ppm |
| | | | | | | | | 31 | in S.S. - 0 ppm |
| 15 | | | | | | | | | in Breathing Z. 0 ppm |
| | | | | | | | | 50 | |
| | Bottom of Boring | | | | | | | | Grouted ~~Completed~~ Boring from 0-15.5 w/ cement - Bentonite grout. |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME Sanwin AFB HOLE NO. 9815

| | | | |
|---|---|---|---|
| BORING LOCATION: Sanitary Sewer Line - Flight Line | | ELEVATION AND DATUM: 4288.35' MSL | |
| DRILLING AGENCY: Environmental Drilling | DRILLER: B. Kingsley | DATE STARTED: 11-10-91 / DATE FINISHED: 11-10-91 | |
| DRILLING EQUIPMENT: Mobile B-61 | | COMPLETION DEPTH: 10' | SAMPLER: 3" stainless |
| DRILLING METHOD: HSA - 6" OD 3¼ ID | DRILL BIT: 6½" | NO. OF SAMPLES: DIST. NA | UNDIST. Analytical - 1 |
| SIZE AND TYPE OF CASING: NA | | WATER ELEV.: FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION: NA | FROM TO FT. | LOGGED BY: LARRY Gardiner | CHECKED BY: SM Butler |
| SIZE AND TYPE OF PACK: NA | FROM TO FT. | | |
| TYPE OF SEAL: Cement - Bentonite grout | FROM 0 TO 10 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recovery | SAMPLES: Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | Started drilling at 14:15 |
| | SAND, medium reddish brown, very fine grained, angular, calcareous, silty | SM | | | | | | | Continuous split Barrel from 0-5' at 14:25 |
| 1 | | | | | | | 2.5/5 | | Boring is near grates that show the sewer line only 5' down. Changed target depth to 10' |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | SAND, medium Reddish brown very fine grained, calcareous, silty (15%) | SM | | | | | | 5 | Stainless steel c.s. drive 5-7' at 14:40 |
| | | | | | | A1 | 1.8 | 7 | CAN0[illegible]-9815-0005 CAN0[illegible]-9815-1361 FD |
| 6 | | | | | | | | 8 | OVA in auger-0 ppm in S.S.-110 ppm Breath zone-0 ppm |
| | | | | | | | | 9 | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114G1

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9815

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, et |
|---|---|---|---|---|---|---|---|---|---|
| 7 | SAND, Pale brown very fine grained, well cemented w/ caliche (caliche) | | | | | | 1.5 | 10 | Stainless steel ~~split barrel~~ S.S. from 7-9' at 14:55 |
| | | | | | | | | 18 | |
| 8 | | Caliche SM | | | | | | 36 | OVA in auger S.S. B.Z. } 0 ppm |
| | | | | | | | | 60 | |
| 9 | Sand, as above (caliche) | | | | | | .5/1 | 90 | Stainless steel S.S. from 9-10' at 15:15 |
| ~~10~~ | | | | | | | | 120 | OVA in auger S.S. B.Z. } 0 ppm |
| 10 | Bottom of Boring | | | | | | | | grout boring from 0-10' w/ cement-Bentonite grout |

PROJECT NO. 89MC114W

SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB. HOLE NO. 9816

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer on Flight line | | ELEVATION AND DATUM 4288.20' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER B. Kingsley | DATE STARTED 11-18-91 / DATE FINISHED 11-18-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 11' | SAMPLER 3" stainless |
| DRILLING METHOD HSA 6" OD, 3¼" ID | DRILL BIT 6½" | NO. OF SAMPLES DIST. NA | UNDIST. Analytical - 1 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardner | CHECKED BY SM Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL cement-bentonite grout | FROM 0 TO 11 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recovery | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | Top soil SAND, dark brown fine grained, silty (25%) | SM | | | | | | | Started Drilling at 15:30 |
| 1 | | | | | | | | | Continuous split barrel from 0-5' at 15:30 |
| | SAND Pale Reddish Brown, very fine grained silty some clay low plasticity, | SM | | | | | 1/5 | | collect gradation analysis sample from 0-.5' at 12:30 on 11-26-91 |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | SAND medium reddish brown very fine to fine grained calcareous well sorted, angular, silty | SM | | | | | | | collected stainless steel SS. from 5-7' at 16:00 CANGS-9816-0005 OVA in Cuttings - 0 in SS - 64 ppm BZ. 0 ppm |
| | | | | | | | | 5 | |
| 6 | | | | | | All | 1.5 | 8 | |
| | | | | | | | | 8 | |
| 7 | | | | | | | | 8 | |

PROJECT NO. 85MC114W

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9816

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist. Blows/6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc |
|---|---|---|---|---|---|---|---|---|---|
| 7 | SAND, medium reddish brown, very fine to fine grained angular, well sorted, Calcareous silty. | SM | | | | | | 5 | Stainless steel S.S. from 7-9' at 16:15 |
| | | | | | | | | 5 | OVA in augers S.S. B.Z. } 0 ppm |
| 8 | | | | | | | 1.6 | 6 | |
| | | | | | | | | 5 | |
| 9 | SAND, medium reddish brown very fine, grained, angular, silty well sorted, Calcareous | SM | | | | | | 5 | Stainless steel S.S. from 9-11' at 16:30 |
| | | | | | | | | 4 | OVA in augers S.S. B.Z. } 0 ppm |
| 10 | | | | | | | 1.7 | 5 | |
| | | | | | | | | 9 | |
| 11 | Bottom of Boring | | | | | | | | grouted boring from 0-11' with cement-Bentonite grout. |
| | | | | | | | | | Blow counts taken with a 140 lb hammer dropped 30" |

PROJECT NO. 79MC1146

SHEET 2 OF 2

(Redrill)

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9817

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer - Flight line | | ELEVATION AND DATUM 4288.56' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER E Lancaster | DATE STARTED 11-21-91 / DATE FINISHED 11-21-91 | |
| DRILLING EQUIPMENT ~~HSA-6"~~ Mobile B-61 | | COMPLETION DEPTH 14 | SAMPLER out split barrel w/ liner |
| DRILLING METHOD HSA-6" OD, 3¼" ID | DRILL BIT 6¼" | NO. OF SAMPLES DIST. NA | UNDIST. cylinder - 1 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardner | CHECKED BY SMButh |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-bentonite grout | FROM 0 TO 14 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft. | SAMPLES: Penetr. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | See 9817 original boring Log for Lithologic description. | | | | | | | | start Drilling at 13:55 |
| 1 | | | | | | | | | Drill ~~auger~~ w/ bit down to 9' |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |

PROJECT NO. _____ SHEET 1 OF 2

(redrill)

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9817

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | see 9817 original boring log for Lithologic description. | | | | | | | | continuous split barrel w/ Poly But. Liner from 9-14' at 14:35 CAN098-9817-0009 sample Taken from base of Liner |
| 10 | | | | | | | 2/5 | | |
| 11 | | | | | | A1 | | | OVA augers barrel B. Zone } 0 ppm |
| 12 | | | | | | | | | Gradation Anal. sample taken CAN098-9817-0009 at 14:35 |
| 13 | | | | | | | | | collected Ambient blank at 15:06 CAN098-9817-1353 |
| 14 | Bottom of Boring | | | | | | | | grout boring from 0-14' w/ cement-Bentonite grout. |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |

PROJECT NO. 89/MC/14W

SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON HOLE NO. 9817

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer - Flight line | | ELEVATION AND DATUM NA | |
| DRILLING AGENCY Environmental Drilling | DRILLER B. Kingsley | DATE STARTED 11-11-91 / DATE FINISHED 11-11-91 | |
| DRILLING EQUIPMENT Mobile B61 | | COMPLETION DEPTH 14 | SAMPLER continuous split barrel |
| DRILLING METHOD HSA 6" OD, 3¾" ID | DRILL BIT | NO. OF SAMPLES DIST. NA | UNDIST. Analytical - 1 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY Scott Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite Grout | FROM 0 TO 14 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov./L | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | SAND, light red. brown very fine grained, silty | SM | | | | | 3/4 | | Start drilling at 9:10 continuous split barrel at 9:20 from 0-4' OVA in auger - 0 ppm in S.S - 0 ppm in B.Z. - 0 ppm |
| 1 | | | | | | | | | |
| 2 | | | | | | | | | |
| 3 | Caliche, Sand, Very fine grained calcite cement, silty | Caliche (SM) | | | | | | | moist |
| 4 | | | | | | | | | continuous split barrel from 4-9' at 9:30 CANOOP-SB170009 OVA-auger S.S. B.Z. } 0 ppm |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | Note: Must retake this sample |
| 7 | | | | | | | | | |

PROJECT NO. 87MC114W

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9817

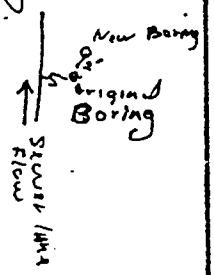
| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist Blows (6 in) | REMARKS (Drill Rate, Fluid loss, Odor, et |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | | |
| | Slow transition from Caliche to normal Sand | | | | | | 3/5 | | |
| 8 | SAND, medium reddish brown, very fine to fine grain silty, angular calcareous. discontinuous lens of calcareous material | | | | | | | | |
| 9 | | SM | | | | | | | Continuous split barrel from 9-14 at 10:25 OVA: in augers - 0 ppm in barrel - 0 ppm B.Z. - 0 ppm |
| 10 | | | | | | | | | |
| 11 | SAND, Light reddish brown To pale brown, very fine to fine grained, silty calcite cemented. hard | SM | | | | | | | must retake this sample (No Liner)! |
| 12 | | | | | | | | | sample retaken in a redrill on 11-21-92 at 14:35 |
| 13 | | | | | | | | | |
| 14 | Bottom of Boring | | | | | | | | grouted boring from 0-14' w/ cement Bentonite grout |

PROJECT NO. 89MC11442

SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 98B

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer line on Flight line | | ELEVATION AND DATUM 4289.54' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER E. Lancaster | DATE STARTED 11-21-91 / DATE FINISHED 11-21-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 14.5 | SAMPLERS continuous split barrel w/ liner |
| DRILLING METHOD HSA - 6" OD, 3½" ID | DRILL BIT 6½" | NO. OF SAMPLES DIST. NA | UNDIST. equal thick-1 / Geotech-1 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardner | CHECKED BY SM Brith |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite grout | FROM 0 TO 14.5 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | Recov. ft. | Penetr. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | start Drilling at 15:10 |
| 1 | No sample until 5' | | | | | | | | continuous split barrel from 0-3½' at 15:30 encountering concrete |
| | | | | | | | | | Move boring 2' away |
| 2 | | | | | | | | |   |
| 3 | | | | | | | | | start Boring at 15:45 |
| 4 | | | | | | | | | Auger down to 5' |
| 5 | Sand, Pale brown, very fine to fine grained, subangular to angular, silty well cemented with calcite (weathered) caliche | caliche (SM) | | | | | | | continuous split barrel from 5-9' at 16:15 |
| 6 | | | | | | | | | OVA in augers barrel B. zone } 0 ppm |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9818

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetr. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | | |
| 8 | | | | | | | 2/4 | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | hard could not penetrate Drilled to 11.5 |
| 11 | | | | | | | | | |
| | | | | | | | | | collected continuous split barrel w/liner |
| 12 | SAND, Pale reddish brown very fine grained, subangular well sorted. well cemented with calcite, weathered, silty | caliche (SM) | | | | | 2/ 3/ | | Analytical sample from 11.5-14.5 at 16:50 CAN098-9818-0011 CAN098-9818-1301 (MRD) To Hard To take total 5 feet sample taken at top of barrel |
| 13 | | | | | | A1 | | | OVA augers barrel B. Zone 0 ppm |
| 14 | | | | | | | | | |
| | Bottom of Boring | | | | | | | | collected gradation Analysis Sample CAN098-9818-4011 |
| 15 | | | | | | | | | grouted Boring from 0-14.5 ft w/ cement - Bentonite grout |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANYON AFB HOLE NO. 9819

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer on Flight line | | ELEVATION AND DATUM 4289.73' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER | DATE STARTED 11-22-91 / DATE FINISHED 11-22-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 17.5' | SAMPLER Count split Barrel |
| DRILLING METHOD HSA 6" OD, 3¼" ID | DRILL BIT 6½" | NO. OF SAMPLES DIST. NA | UNDIST. Analytical-1 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardner | CHECKED BY Sim Beth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite Grout | FROM 0 TO 17.5 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft. | SAMPLES: Penetr. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | Top Soil dark brown Sand, silty, Dry | | | | | | | | Started Drilling 9:40 |
| 1 | SAND, medium brown, very fine grained, angular, well sorted silty (10%) Dry | SM | | | | | 3/4 | | Continuous split barrel from 0-4' at 9:55 |
| 2 | | | | | | | | | OVA. augers barrel B.zone } 0 ppm |
| 3 | | | | | | | | | |
| 4 | SAND, pale reddish brown very fine grained, angular silty (15%) cemented w/ calcite. | Caliche (SM) ~~SM~~ | | | | | | | Continuous split barrel from 4-9' at 10:15 |
| 5 | | | | | | | 3/5 | | OVA- augers- 4 ppm Barrel - 0 ppm B.Z. - 0 ppm |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 1 OF 3

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 8819

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist. Blows 6 in. | REMARKS (Drill Rate, Fluid loss, Odor, et |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | | |
| | | | | | | | 3/5 | | |
| 8 | | | | | | | | | |
| 9 | Sand, medium reddish brown, very fine to fine grained angular to subangular, silty ~~calc~~ calcareous clayey. | | | | | | | | continuous split barrel from 9-12' at 10:30 |
| 10 | | SM | | | | | | | OVA- auger - 4 ppm barrel - 0 ppm B. Zone - 0 ppm |
| 11 | SAND, pale brown to white very fine to fine grained, silty subangular, well cemented w/ calcite - hard (caliche) | caliche (SM) | | | | | | | |
| 12 | SAND, pale brown very fine to fine grained sub angular, well cemented w/ calcite - hard | | | | | | | | collected Analytical Continuous ~~split~~ split barrel w/ liner from 12-14' at 10:55 CANO88-8819-0012 |
| 13 | | | | | | A1 | 1.5/2 | | OVA- auger - 0 ppm barrel - 6 ppm B.Z. - 0 ppm |
| 14 | | | | | | | | | |
| 15 | | | | | | | 3/3.5 | | coring tube was wet and stained bluish green on the outside The sample itself was not wet or stained (sample from Top |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 2 OF 3

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9819

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | SAND Pale brown, silty very fine grained subangular cemented w/ calcite hard (caliche) | caliche (SM) | | | | | | | continuous split Barrel from 14-17.5 at 10:25 |
| 17 | | | | | | | | | OVA - augers barrel B. zone } 0 ppm |
| | Bottom of Boring | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | gradation Analysis sample from 12-14 at 10:55 CANO88-9819-002 |
| 20 | | | | | | | | | grout boring from 0-17.5' w/ cement Bentonite grout |
| 21 | | | | | | | | | |
| 22 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 3 OF 3

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9820

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer - on Flight line | | ELEVATION AND DATUM 4289.67' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER E. Lancaster | DATE STARTED 11-22-91 / DATE FINISHED 11-22-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 11' | SAMPLER Continuous split barrel |
| DRILLING METHOD HSA - 6" OD 3¼" ID | DRILL BIT 6½" | NO. OF SAMPLES DIST. NA | UNDIST. Analytical - 1 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY Sm Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite grout | FROM 0 TO 11 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | Recov. ft. | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | Started drilling at 12:05 |
| 1 | SAND, medium brown, very fine grained, angular well sorted, silty, Dry | SM | | | | | | | Drilled to 3.5' encountered chert ~~concrete~~ concrete. Move 2' down stream start drilling at 12:20. drilled to 3.5 ft, encountered chert, moved boring, again encountered chert at 3.5' ~~1310 start drilling~~ |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | sewer line o 1 o 2 o 3 ● 4 |
| 4 | SAND, Pale Brown, Very fine grained angular, cemented w/calcite (caliche) dry | ~~SM~~ caliche | | | | | 15/12 | | Start Drilling on 4th boring at ~~1310~~ 13:10 Continuous split barrel from 4-6' at 13:30 |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | changed target depth because sewer manhole is close. The depth to the base of the sewer is 6' |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9820

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | SAND pink reddish brown very fine grained well sorted, calcite cement. silty. | caliche (SM) | | | | | | | collected Continuous Analytical split barrel sample from - 6-11' at 13:45 |
| 8 | | | | | | | 3/3 | | CAN098-9820-0001 CAN098-9820-136J (FD) |
| 9 | | | | | | A1 | | | OVA- augers & barrel B.Z. 0ppm |
| 10 | | | | | | | | | inner tube was wet and stained green-gray on the outside of it inside sample was not stained but damp. |
| 11 | Bottom of Boring | | | | | | | | grout Boring from 0-11' w/ cement-Bentonite grout |
| 12 | | | | | | | | | |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 90021

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer on Torch | | ELEVATION AND DATUM 4300.53' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER E Lancaster | DATE STARTED 11-20-91 / DATE FINISHED 11-20-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 29' | SAMPLER 3" stainless |
| DRILLING METHOD HSA 6" OD, 3¼" ID | DRILL BIT 6½" | NO. OF SAMPLES DIST. NA | UNDIST. Auger-3, Geoprobe-4 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gordinier | CHECKED BY SMBeth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement Bentonite Grout | FROM 0 TO 29 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov./L | SAMPLES: Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | Start Drilling at 15:25 |
| 1 | | | | | | | | | Auger down to 5' to ensure water line is not hit. |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | SAND, dark reddish brown very fine grained, angular, silty (15%) non calcareous trace streaks of calcite | SM | | | | G1 | 1/4 | | continuous split barrel from 5-9' at 15:55 |
| 6 | | | | | | | | | OVA - auger bowl 0 ppm, B.2 ppm |
| 7 | | | | | | | | | collected gradation sample CAN09RAB21-4005 |

PROJECT NO. 89MC114W

SHEET 1 OF 4

**Woodward-Clyde Consultants** PROJECT NAME _____ HOLE NO. 9821

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | SAND, medium Reddish brown, very fine grained. angular, well sorted, calcite nodules, hard, calcite cement silty (20%) | SM | | | | | | | collected analytical stainless steel sample from 9-11' at 16:05 |
| | | | | | | A1 | 1.9 | 9 / ~~19~~ / 17 / ~~20~~ | CAN098-9821-0009(A)/MS1 OVA in S.S. - 68 ppm |
| 10 | Top of split spoon had dark brown staining | | | | | | | 20 / ~~20~~ | augers - 0 B2 - 0 |
| | | | | | | | | 20 | Damp |
| 11 | SAND medium reddish brown very fine, angular, calcareous Loose | | | | | | | 14 | Analytical stainless steel SS from 11-13' at 16:15 |
| | | | | | | B2 | 1.0 | 15 / 11 | Damp OVA augers - 0 ppm SS - 54 ppm B.2 - 0 ppm |
| 12 | | | | | | | | 11 | |
| 13 | SAND, med red-brown as above calcareous soft | SM | | | | | | 6 | Analytical stainless steel S.S. from 13-15 at 16:45 |
| | | | | | | | 1.9 | 6 | OVA in augers - 0 ppm |
| 14 | | | | | | B3 | | 5 | in SS - 20 ppm in B.2 - 0 ppm |
| | | | | | | | | 6 | damp |
| 15 | SAND reddish brown as above. slightly calcareous soft | SM | | | | B4 | | 6 | Stainless steel analytical S.S. from 15-17' at 17:00 |
| | | | | | | | 1.9 | 6 | damp. OVA - augers - 0 S.S. - 20 ppm |
| 16 | | | | | | | | | Stopped drilling - 17:15 |

PROJECT NO. 89MC114W

SHEET 2 OF 4

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9821

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | | | | | | | | 6 | Start Drilling 11-21-91 at 7:30 AM |
| | | | | | | | | 11 | |
| 17 | SAND, Light reddish brown to pale brown, very fine to fine grained, angular trace of medium grained subrounded, well sorted, calcite cement, slightly silty. | | | | | | | 10 | collected Analytical stainless steel S.S. from 7-19 at 8:15 11-21-91 |
| | | | | | | | 1.9 | 17 | CAN098-9821-0017 (Top of S.S.) |
| 18 | | | | | | A2 | | 27 | OVA-augers-0 ppm - S.S- 12 ppm (Top) - B.2. 0 ppm |
| | | SM | | | | | | 49 | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |
| 21 | | | | | | | | | |
| 22 | No Recovery | | | | | | | 141 (6") | Stainless steel analytical S.S. sample collected from 22-22.5 at 8:50 |
| | | | | | | | 2.0 | | |
| 23 | SAND, Pale brown, very fine grained, subangular to angular, well cemented w/ calcite (Caliche), hard, silty | caliche (SM) | | | | A3 | | 35 | No Recover |
| | | | | | | | | 100 | stainless steel Analytical S.S. sample from 23-24 at 9:20 |
| 24 | | | | | | | | | CAN098-9821-0023 |
| | | | | | | | | | OVA in augers-0 ppm in S.S.-0 ppm in B.2.-0 ppm |
| 25 | | | | | | | | | |

PROJECT NO. 89MC114W

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9821

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc |
|---|---|---|---|---|---|---|---|---|---|
| 25 | | | | | | | | | |
| 26 | | | | | | | | | |
| 27 | | | | | | | | | |
| 28 | SAND pale to Light reddish Brown, very fine to fine grained, angular to sub angular, well sorted, silty tightly cemented. only partly by calcite hard. (this is a sandstone) | SM | | | | | .9 / 1 | 29 / 115 | Analytical stainless steel S.S. from 28-29 at 10:00 OVA-auger-0 ppm - S.S.-0 ppm - B.Z.-0 ppm |
| 29 | | | | | | | | | |
| | Bottom of Boring | | | | | | | | grout boring from 0-29' w/ cement Bentonite grout. |
| 30 | | | | | | | | | Blow counts taken with a 140 lb hammer dropped 30" |
| | | | | | | | | | collect rinsate blank at 7:15 11-21-91 CAN098-9821-1372 |

PROJECT NO. 85MC114W

SHEET 4 OF 4

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 9822

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer Line; 142' Damstream of Manhole # 139 | | ELEVATION AND DATUM 4300.80' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER M. Powless | DATE STARTED 11-22-91 / DATE FINISHED 11-22-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 16' | SAMPLER Coring Split Barrel 3" Stainless Steel SS |
| DRILLING METHOD HSA 4¼" ID 7¼" OD | DRILL BIT 7½" Finger Bit | NO. OF SAMPLES DIST. 2 | UNDIST. Analytical: 1 Geotechnical: 2 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kubeczko | CHECKED BY SMBeith |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite Grout | FROM 0 TO 16 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft. | SAMPLES: Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | Sand, dark gray-black, fine grained, subrounded, well sorted, silty (10-20%), clayey (10-20%), slightly moist | SM | | | | | | | Started Drilling @ 1120<br>Coring Split Barrel Sample from 0' to 5' @ 1125<br>CAN098-9822-4000<br>OVA on sample: 0 ppm |
| 1 | Sand, brown-orange to orange, fine grained, sub-angular, well sorted, silty (15-20%), slightly moist | | | | | | | | |
| 2 | | SM | | | | L1 | 3.9 | | |
| 3 | | | | | | | | | Collected gradation analysis sample from 3' to 4' @ 1125<br>CAN098-9822-4003<br>Hit concrete @ 5'; moved hole ~2' east. @ 1130<br>Hit concrete @ 5'; moved hole ~4' downstream @ 1150 |
| 4 | Caliche, tan-orange pale orange, silty (10-15%), clayey (5-15%), sandy (5-10%), slightly moist | CALICHE | | | | | | | OVA @ 5' in augers: 0.6 ppm<br>in breathing zone: 0 ppm |
| 5 | | | | | | | | | Coring Split Barrel Sample from 5' to 10' @ 1200<br>CAN098-9822-4005<br>OVA on sample: 0 ppm |
| 6 | Sand, orange, fine grained, sub angular, well sorted, silty (10-15%), clayey (5-10%), calcareous (10-20%) w/ scattered pockets & thin layers of tan-orange to pale orange caliche, slightly moist | SM | | | | L2 | 4.1 | | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W T2M

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 9822

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist Blows (6 in) | REMARKS (Drill Rate, Fluid loss, Odor, et |
|---|---|---|---|---|---|---|---|---|---|
| 7 | Sand, orange, fine grained, subangular, well sorted, silty (10-15%), clayey (5-10%), calcareous (10-20%) w/scattered pockets & thin layers of tan-orange to pale orange caliche, slightly moist. | | | | | | | | |
| 8 | | | | | | L2 | 4.1 | | |
| 9 | | SM | | | | | | | OVA @ 10' in augers = 1.4 ppm in breathing zone = 0 ppm |
| 10 | | | | | | | | 10 | Stainless Steel SS Sample from 10' to 12' @ 1210 CAN098-9822-4010 OVA on sample = 0 ppm |
| | | | | | | | | 12 | |
| 11 | | | | | | G1 | 1.6 | | |
| | | | | | | | | 18 | |
| | | | | | | | | 29 | |
| 12 | | | | | | | | 15 | Stainless Steel SS Sample from 12' to 14' @ 1220 CAN098-9822-4012 OVA on sample = 0 ppm |
| | | | | | | | | 30 | |
| 13 | Caliche, tan-orange pale orange, silty (10-15%), clayey (5-10%), sandy (10-20%) w/ pockets of pale orange sandy, slightly moist to dry, dense | CALICHE | | | | G2 | 1.7 | | |
| | | | | | | | | 45 | |
| | | | | | | | | 79 | OVA @ 14' in augers = 0 ppm in breathing zone = 0 ppm |
| 14 | Sand, orange, fine grained, subangular, well sorted, silty (10-15%), clayey (5-10%), calcareous (10-25%) w/ abundant pockets of tan-orange caliche, dense, slightly moist | SM | | | | | | 24 | Stainless Steel SS Sample from 14' to 16' @ 1240 CAN098-9822-0014 OVA on sample = 0 ppm |
| 15 | | | | | | A1 | 1.9 | 46 | Stopped drilling @ 16' @ 1250 |
| | | | | | | | | 64 | Grouted borehole w/ cement bentonite grout from 0' to 16'. Placed metal spike into grouted borehole |
| 16 | Caliche, tan-orange, silty (10-15%), clayey (5-10%), sandy (10-20%) w/ pockets of pale orange sand, dry to slightly moist, dense | CALICHE | | | | | | 151 | |
| | Bottom of hole - 16' | | | | | | | | |

PROJECT NO. 89MC114W T2M

SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 9823

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer Line; 275' Downstream of Manhole # 139 | | ELEVATION AND DATUM 4301.43' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER M. Powless | DATE STARTED 11-21-91 DATE FINISHED 11-21-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 16' | SAMPLER Coring Split Barrel 3" Stainless steel SS |
| DRILLING METHOD HSA 4¼" ID 7¼" OD | DRILL BIT 7½" Finger Bit | NO. OF SAMPLES DIST. 2 | UNDIST. Andy Kral = 1 Geotechnical = 2 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kuberczko | CHECKED BY SMButh |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement - Bentonite Grout | FROM 0 TO 16 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov./L | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | Asphalt | ASPHALT | | | | | | | Started Drilling @ 1500 |
| | Sand, orange brown-orange, fine grained, sub-angular, well sorted, silty (10-20%), clayey (5-15%) slightly moist | SM | | | | | | | Coring split barrel Sample from 0' to 5' @ 1505 CAN098-9823-4000 |
| 1 | | | | | | | | | |
| 2 | | | | | | L1 | 3.3 | | |
| 3 | Caliche, pale orange tan-orange light orange, silty (5-10%), clayey (5-15%), sandy (5%), slightly moist | CALICHE | | | | | | | |
| 4 | Sand, orange, fine grained, subangular, well sorted, silty (5-15%), clayey (5-10%), calcareous (10-15%) w/ scattered pockets of tan-orange caliche, slightly moist | SM | | | | | | | OVA @ 5' in augers = 0 ppm in breathing zone = 0 ppm |
| 5 | | | | | | | | | Coring Split Barrel Sample from 5' to 10' @ 1510 CAN098-9823-4005 OVA on sample = 0 ppm |
| | | | | | | L2 | 4.7 | | |
| 6 | Caliche, tan-orange pale orange, silty (5-15%), clayey (5-10%), siliceous (5-25%), scattered layers & pockets of silicified (cherty) caliche, dry, sandy (5%) | CALICHE | | | | | | | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W T2M

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 9823

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | Caliche, tan-orange pale orange, silty (5-15%), clayey (5-10%), siliceous (5-25%), scattered layers & pockets of silicified (cherty) caliche, dry, sandy (5-10%) | CALICHE | | | | | | | |
| 8 | | | | | | L2 | 4.7 | | |
| 9 | Sand, orange, fine grained, subangular, well sorted, silty (5-15%), clayey (5-10%), calcareous (5-15%) w/ scattered pockets of tan-orange to very pale orange caliche, slightly moist, loose to medium dense | | | | | | | | OVA @ 10' in augers: 0 ppm in breathing zone: 0 ppm |
| 10 | | | | | | | | 7 | Stainless Steel Split Spoon Spl from 10' to 12' @ 1515 CAN098-9823-4010 OVA on sample: 0 ppm |
| | | | | | | | | 11 | |
| 11 | | | | | | G1 | 1.8 | | |
| | | | | | | | | 14 | |
| | | | | | | | | 17 | |
| 12 | | SM | | | | | | 9 | Stainless Steel SS Sample from 12' to 14' @ 1520 CAN098-9823-4012 OVA on sample: 0 ppm |
| | | | | | | | | 12 | Collected gradation analysis sample from 12' to 14' @ 1520 |
| 13 | | | | | | G2 | 1.7 | 13 | CAN098-9823-4012 |
| | | | | | | | | 20 | OVA @ 14' in augers: 0.8 ppm in breathing zone: 0 ppm |
| 14 | | | | | | | | 8 | Stainless Steel SS Sample from 14' to 16' @ 1530 CAN098-9823-0014 MS/MSD OVA on sample = 0.2 ppm |
| 15 | | | | | | A1 | 1.9 | 10 | Stopped drilling @ 16' @ 1540 |
| | | | | | | | | 12 | Grouted borehole w/cement bentonite grout from 0' to 16'. Placed metal spike into grouted borehole |
| | | | | | | | | 19 | |
| 16 | Bottom of hole - 16' | | | | | | | | |

PROJECT NO. 89MC114W T2M

SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 9824

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer Line; 75' Downstream of Manhole # 148 | | ELEVATION AND DATUM 4302.60' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER M. Powless | DATE STARTED 11-22-91 DATE FINISHED 11-22-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 16' | SAMPLER Coring Split Barrel 3" Stainless Steel SS |
| DRILLING METHOD HSA 4 1/4" ID 7 1/4" OD | DRILL BIT 7 1/8" Finger Bit | NO. OF SAMPLES DIST. 2 | UNDIST. Analytical = 1 Geotechnical = 2 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kuberzko | CHECKED BY Sm Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement - Bentonite Grout | FROM 0 TO 16 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | Recov./L. | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | Asphalt, road bed, black | ASPHALT | | | | | | | Started drilling @ 750 |
| 1 | Sand, brown-orange orange, fine grained, sub-angular, well sorted, silty (10-20%), clayey (5-15%) slightly moist | SM | | | | | | | Coring split barrel sample from 0' to 5' @ 755 CAN098-9824-4000 OVA on sample: 0 ppm |
| 2 | | | | | | L1 | 4.0 | | |
| 3 | | | | | | | | | |
| 4 | Caliche, tan-orange pale orange, silty (10-15%), clayey (5-10%), sandy (5-10%), dry to slightly moist | CALICHE | | | | | | | OVA @ 5' in augers: 0.2 ppm In breathing zone: 0 ppm |
| 5 | | | | | | | | | Coring Split Barrel Sample from 5' to 10' @ 805 CAN098-9824-4005 OVA on sample: 0 ppm |
| 6 | Sand, orange, fine grained, subangular, well sorted, silty (5-15%), clayey (5-10%), calcaeus (10-15%) w/ scattered pockets of tan-orange pale orange caliche, slightly moist | SM | | | | L2 | 4.2 | | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W T2M

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 9824

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist. Blows/6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | Sand, orange, fine grained, subangular, well sorted, silty (5-15%), clayey (5-10%), calcareous (10-20%) w/ scattered tan-orange pale orange pockets of caliche, slightly moist, medium dense | | | | | | | | Collected gradation analysis sample from 7' to 8' @ 805 CAN098-9824-4008 |
| 8 | | | | | | L2 | 1.2 | | |
| 9 | | | | | | | | | OVA @ 10' in augers = 0.8 ppm in breathing zone = 0 ppm |
| | | SM | | | | | | | |
| 10 | | | | | | | | 8 | Stainless Steel SS Sample from 10' to 12' @ 810 CAN098-9824-4010 OVA on sample = 0 ppm |
| | | | | | | | | 9 | |
| 11 | | | | | | G1 | 1.7 | | |
| | | | | | | | | 12 | |
| | | | | | | | | 16 | |
| 12 | | | | | | | | 6 | Stainless Steel SS Sample from 12' to 14' @ 820 CAN098-9824-4012 OVA on sample = 0 ppm |
| | | | | | | | | 11 | |
| 13 | Caliche, tan-orange pale-orange, silty (5-15%), clayey (5-10%), sandy (5-15%), w/ pockets of sand, slightly moist, dense | CALICHE | | | | G2 | 1.8 | 24 | |
| | | | | | | | | 38 | OVA @ 14' in augers = 0.4 ppm in breathing zone = 0 ppm |
| 14 | Sand, orange, fine grained, subangular, well sorted, silty (10-15%), clayey (5%), calcareous (10-20%) w/ scattered pockets of tan-orange caliche, medium dense to dense, slightly moist | | | | | | | 21 | Stainless Steel SS Sample from 14' to 16' @ 835 CAN098-9824-0014 OVA on sample = 0 ppm |
| | | SM | | | | A1 | 1.9 | 30 | Collected ambient blank water sample @ 850 CAN098-9824-1354 |
| 15 | | | | | | | | 34 | Stopped drilling @ 16' @ 845 |
| | | | | | | | | 40 | Grouted borehole w/ cement-bentonite grout from 0' to 16'. Placed metal spike into grouted borehole |
| 16 | Bottom of hole: 16' | | | | | | | | |

PROJECT NO. 89MC114W T2M

SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 9825

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer Line; 105' Downstream of Manhole #148 | | ELEVATION AND DATUM 4302.61' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER M. Powless | DATE STARTED 11-22-91 DATE FINISHED 11-22-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 16' | SAMPLER Coring Split Barrel 3" Stainless Steel SS |
| DRILLING METHOD HSA 4¼" ID 7¼" OD | DRILL BIT 7½" Finger Bit | NO. OF SAMPLES DIST. 2 | UNDIST. Analytical = 1 Geotechnical = 2 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kubeczko | CHECKED BY Sm Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite Grout | FROM 0 TO 16 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft. | SAMPLES: Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | Asphalt, roadbed, black | ASPHALT | | | | | | | Started drilling @ 930 |
| 1 | Sand, brown-orange orange, fine grained, subangular, well sorted, silty (10-20%), clayey (5-15%), slightly moist | SM | | | | | | | Coring Split Barrel Sample from 0' to 5' @ 935 CAN098-9825-4000 OVA on sample = 0 ppm |
| 2 | | | | | | L1 | 4.3 | | |
| 3 | | | | | | | | | |
| 4 | Caliche, tan-orange pale orange, silty (10-15%), clayey (5-10%), sandy (5-10%), dry to slightly moist | CALICHE | | | | | | | OVA @ 5' in augers = 0 ppm In breathing zone = 0 ppm |
| 5 | | | | | | | | | Coring Split Barrel Sample from 5' to 10' @ 940 CAN098-9825-4005 OVA on sample = 0 ppm |
| 6 | | | | | | L2 | 4.5 | | |
| 7 | Sand, orange, fine grained, subangular, well sorted, silty (5-15%), clayey (5-15%), calcareous (10-15%) w/ scattered pockets of tan orange caliche, slightly moist | SM | | | | | | | |

PROJECT NO. 89MC114W T2M

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 9825

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows (6 in) | REMARKS (Drill Rate, Fluid loss, Odor, ...) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | Sand, orange, fine grained, sub angular, well sorted, silty (5-10%), clayey (5-15%), calcareous (10-20%) w/ scattered pockets of pale orange caliche, medium dense, slightly moist | | | | | | | | |
| 8 | | | | | | L2 | 4.5 | | |
| 9 | | SM | | | | | | | OVA @ 10' in augers: 0 ppm in breathing zone: 0 ppm |
| 10 | | | | | | | | 6 | Stainless Steel SS Sample from 10' to 12' @ 945 CAN098-9825-4010 OVA on sample: 0 ppm |
| 11 | | | | | | G1 | 1.9 | 7 | Collected gradation analysis sample from 10' to 12' CAN098-9825-4010 |
| | | | | | | | | 9 | |
| | | | | | | | | 11 | |
| 12 | | | | | | | | 6 | Stainless Steel SS Sample from 12' to 14' @ 950 CAN098-9825-4012 OVA on sample: 0 ppm |
| 13 | Caliche, tan-orange pale orange, silty (5-15%), clayey (5-10%), sandy (5-10%), w/ pockets of sand, medium dense, slightly moist | CALICHE | | | | G2 | 1.9 | 11 | |
| | | | | | | | | 21 | |
| | | | | | | | | 29 | OVA @ 14' in augers: 0.3 ppm in breathing zone: 0 ppm |
| 14 | Sand, orange light orange, fine grained, subangular, well sorted, silty (5-10%), clayey (5-10%), calcareous (15-25%) w/ scattered pockets & layers of tan-orange caliche, dense to very dense, slightly moist | SM | | | | | | 36 | Stainless Steel SS Sample from 14' to 16' @ 1000 CAN098-9825-0014 OVA on sample: 0.2 ppm |
| 15 | | | | | | A1 | 1.9 | 55 | Collected MRD Duplicate from 14' to 16' @ 1000 CAN098-9825-1304 |
| | | | | | | | | 65 | Stopped drilling @ 16' @ 1010 |
| | Caliche, tan-orange pale orange, silty (10-15%), clayey (5-10%), sandy (10-20%) w/ pockets of orange sand, very dense, slightly moist | CALICHE | | | | | | 93 | Grouted borehole w/ cement bentonite grout from 0' to 16'. Placed metal spike into grouted borehole |
| 16 | Bottom of hole - 16' | | | | | | | | |

PROJECT NO. 89MC114W T2M

SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9826

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer on Torch | | ELEVATION AND DATUM 4302.59' MSL | |
| DRILLING AGENCY Enviroumental Drilling | DRILLER E. Lancaster | DATE STARTED 11-26-91 / DATE FINISHED 11-26-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 17' | SAMPLER 3" stainless s.s. |
| DRILLING METHOD HSA - 6" OD, 3¼" ID | DRILL BIT 6" bullet | NO. OF SAMPLES DIST. NA | UNDIST. Ancorel - 1 Corestick - 1 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY SMButh |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite Grout | FROM 0 TO 17 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov./ft | SAMPLES: Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | Start drilling at 7:50 |
| 1 | | | | | | | | | Drill to 3' |
| 2 | | | | | | | | | |
| 3 | SAND, medium reddish brown, very fine to fine grained, silty subangular to - angular, well sorted, non calcareous | SM | | | | | | | continuous split barrel from 3' at 8:15 |
| 4 | | | | | | | 1.9 / 5 | | OVA - augers - 9 ppm barrel - 0 ppm B. Zone 0 - ppm |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 1 OF 3

**Woodward-Clyde Consultants** PROJECT NAME CAANG AFB HOLE NO. 9826

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | 1.5/5 | | |
| 8 | SAND, medium reddish brown, as bar, becoming calcareous calcite ~~[illegible]~~ patches locally, silty | SM | | | | | | | continuous split barrel from 8-13' at 8:35 |
| 9 | | | | | | | | | OVA auger - 88 ppm barrel - 0 ppm B. Zone - 0 ppm |
| 10 | | | | | | | 3/5 | | |
| 11 | SAND, Light reddish brown to Pale brown, very fine to fine grained, well sorted, subangular silty well cemented w/ calcite patches as calcite hard | calche (SM) | | | | | | | |
| 12 | | | | | | | | | |
| 13 | SAND, Light reddish brown very fine to fine grained subangular, to angular, calcareous discontinuous calcite lenses silty | SM | | | | | | 7 | Analytical stainless steel S.S. from 13-15' at 8:45 |
| 14 | | | | | | | 1.7 | 6 | OVA auger - 8 ppm S.S - 0 ppm B. Zone - 0 ppm |
| | | | | | | | | 7 | |
| | | | | | | | | 7 | |
| 15 | SAND as above | | | | | A1 | 1.0 | 7 | collected analytical stainless steel S.S. from 15-17' at 8:55 CANG9P-9826-0015 |
| | | | | | | | | 10 | OVA auger S.S. B. Zone } 0 ppm |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 2 OF 3

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9826

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | | | | | | A2 | | 15 | collected gradation Analysis sample at 8:55 |
| | | | | | | | | 22 | CANO98-9826-4015 |
| 17 | Bottom of Boring - | | | | | | | | Collect Rinsate blank at 10:45 CANO98-9826-1374 |
| | | | | | | | | | Grout Boring from 0-17 w/ cement-Bentonite grout |
| | | | | | | | | | blowcounts taken with 140 lb hammer dropped 30" |

PROJECT NO. 89MC114G SHEET 3 OF 3

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9827

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer Line on Track | | ELEVATION AND DATUM 4302.87' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER E Lancaster | DATE STARTED 11-19-91 / DATE FINISHED 11-19-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 19 | SAMPLER 3" stainless |
| DRILLING METHOD HSA-6" OD, 3¼" ID | DRILL BIT 4½" Bit | NO. OF SAMPLES DIST. NA | UNDIST. Shelby tube / Geoprobe |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY Sm Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite Grout | FROM 0 TO 19 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | Recov./L | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | Asphalt | | | | | | | | Started drilling at 13:20 |
| 1 | | | | | | | | | continuous split barrel from 1.5-6.5' at 13:35 |
| 2 | SAND, dark reddish brown very fine grained, subangular well sorted. non-carcareous, silty | | | | | | | | |
| 3 | | SM | | | | | 2/5 | | |
| 4 | | | | | | | | | |
| 5 | SAND Pale Brown, silty very fine, calcite cemented Lenticular Lenses of calcite | caliche (SM) | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | continuous split barrel from 6.5-11.5 at 14:05 |

PROJECT NO. 89MC114W

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9827

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | SAND, pale brown, very fine to fine grained, subangular, silty well sorted, calcite cement | calcite (SM) | | | | | | | OVA in augers barrel B.Z. } 0 ppm |
| 8 | | | | | | | 3/5 | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |
| 11 | | | | | | | | | |
| | SAND, medium reddish brown very fine grained, well sorted silty (5%) calcareous | SM | | | | | 1.5/2 | | continuous split barrel from 11.5-13.0 at 14:15 OVA 0 ppm augers barrel B.Z. |
| 13 | No recovery | | | | | | | 34 | stainless steel S.S. from 13-15 at 14:25 |
| | | | | | | | 1.4 | 41 | No Recovery |
| 14 | | | | | | | | 19 | OVA augers S.S. BZ } 0 ppm |
| | | | | | | | | 18 | |
| 15 | SAND, medium reddish brown very fine grained, subangular to subrounded, some calcite cement, silty | SM | | | | | 1.7 | 13 | stainless Analytical S.S from 15-17 at 14:45 |
| | | | | | | | | 16 | OVA in augers S.S. 13.2. } 0 ppm |
| 16 | | | | | | | | | gradation Analysis CANOA-9827-4015 |

PROJECT NO. 89MC114a SHEET 2 OF 3

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9827

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | | | | | | | | 26 | |
| | | | | | | | | 34 | |
| 17 | Sand, Light reddish brown very fine to fine grained, silty Subangular to angular, well sorted, calcareous | SM | | | | | 18 | 22 | Analytical stainless S.S. from 17-19' at 15:00 |
| | | | | | | | | 32 | CAN098-9827-0017 |
| 18 | | | | | | A1 | | 34 | CAN098-9827-1363 (FB) at 15:10 |
| | | | | | | | | 37 | |
| 19 | | | | | | | | | OVA in augers S.S. B.2. } 0 ppm |
| | Bottom of Boring | | | | | | | | grouted Boring from 0-19' w/cement-Bentonite grout |
| | | | | | | | | | Blow counts taken by dropping a 140 lb hammer 30" |

PROJECT NO. 89MC140

SHEET 3 OF 3

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9828

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer - on torch | | ELEVATION AND DATUM 4302.79' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER E Lonceastin | DATE STARTED 11-20-91 / DATE FINISHED 11-20-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 18 | SAMPLER 3" stainless steel, S.S. |
| DRILLING METHOD HSA 6" OD, 3 1/4" ID | DRILL BIT 1 1/2" Bullet | NO. OF SAMPLES DIST. NA | UNDIST. Amphitrite / Geotech |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Lary Gardiner | CHECKED BY Sm Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite grout | FROM 0 TO 18 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft. | SAMPLES: Penetr. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | Asphalt | | | | | | | | start Drilling at 8:40 |
| 1 | SAND, dark reddish brown very fine grained, Subangular silty, non calcareous | SM | | | | | 1.5/4 | | continuous split barrel from 0.8-7.2 at 8:55 |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | SAND, pale brown, very fine grained, subangular, silty well sorted, cemented w/ Calcite, Discontinuous Lenses of Calcite. | ~~SP~~ caliche (SM) | | | | | 2.5/5 | | continuous split barrel from 4.2-9.2' at 9:10 ~~CANNON AFB~~ 14 OVA-augers - 0 ppm S.S. - 0 ppm BZ - 0 ppm |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |

PROJECT NO. 89MS114W

SHEET 1 OF 3

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 98-28

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | SAND, as above | | | | | | | | continuous split barrel from 9-14' at 9:15 OVA. augers, barrel, B-2 } 0 ppm |
| 10 | | | | | | | | | |
| 11 | | | | | | | 8/13 | | |
| 12 | | | | | | | | | |
| 13 | | | | | | | | | |
| 14 | Sand, medium reddish brown very firm to fine grained, subangular to angular, silty calcareous. | SM | | | | | | 4 | stainless ST from 14-16' at 9:20 |
| | | | | | | A1 | 1.5 | 4 | OVA in augers B2 - 0 ppm |
| 15 | | | | | | | | 5 | S.S. - 2 ppm CAN098-9828-0016 |
| | | | | | | | | 9 | |
| 16 | | | | | | | | | |

PROJECT NO. 85MC114W

SHEET 2 OF 3

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9828

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist Blows (6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | Calcite, very fine crystalline tr. Sand, (Caliche) white, hard weathered. | | | | | | | 20 | Stainless ST S.S. sample from 16-18' at 9:45 |
| | Sand, pale brown, very fine to fine grained, well sorted, silty subangular to angular calcite cement | caliche (SM) | | | | | 1.9 | 40 | |
| 17 | | | | | | | | 73 | collected gradation analysis |
| | | | | | | | | 112 | Sample from 16-18' |
| 18 | Bottom of BORING. | | | | | | | | CAN068-9828-4016 |
| | | | | | | | | | grouted Boring from 0-18' w/cement-Bentonite grout. |
| | | | | | | | | | blow counts taken by dropping a 140 lb hammer 30" |

PROJECT NO. 89MC114N SHEET 3 OF 3

**Woodward-Clyde Consultants** PROJECT NAME CANNON. AFB HOLE NO. 9829

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer Line on Torch | | ELEVATION AND DATUM 4303.26' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER Eddie Lancaster. | DATE STARTED 11-19-91 / DATE FINISHED 11-19-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 18' | SAMPLER 3" stainless. ST |
| DRILLING METHOD HSA-6" OD, 3¼" ID | DRILL BIT 6½" Bullet | NO. OF SAMPLES DIST. NA | UNDIST. Shelby tube-1 Butch-1 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY Sam Butch |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL cement-Bentonite grout | FROM 0 TO 18 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov./ft. | SAMPLES: Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | asphalt | | | | | | | | start drilling at 16:25 |
| 1 | Sand, dark reddish brown very fine grained, subangular silty non-calcareous | SM | | | | | 2/5 | | continuous split barrel from .8 to 4.2' at 16:35 OVA in augers barrel 0 ppm B.Z. |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| | Sand, light reddish brown very fine grained, subangular, silty well sorted, calcareous with patches of calcite | SM | | | | | 3/3 | | continuous split barrel from 4.2-9.2 at 16:45 OVA - as above |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC/14W

SHEET 1 OF 3

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9829

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows (6 in) | REMARKS (Drill Rate, Fluid loss, Odor, et |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| | SAND, pale brown, very fine grained, subangular, well sorted cemented w/ calcite, silty | SM/calcite | | | | | | | continuous split barrel from 9.2-14 at 16:55 |
| 10 | | | | | | | 3/5 | | OVA. augers - 0 ppm Sbarrel - 0 ppm B.Z. - 0 ppm |
| 11 | | | | | | | | | |
| 12 | | | | | | | | | |
| 13 | | | | | | | | | |
| | SAND, pale brown, very fine calcite cemented, well sorted subangular, calcareous tightly cemented w/ calcite silty | SM calcite (gm) | | | | | | | stainless steel from 14-16' at 17:10 |
| 14 | | | | | | | | 6 | |
| | SAND, light reddish brown very fine grained, angular to subangular, well sorted calcareous | SM | | | | | 1.8 | 12 | Gradation Analysis from 14-16' at 17:10 |
| 15 | | | | | | | | 15 | CAN098-9829-9 |
| | | | | | | | | 21 | OVA-auger 55 B.Zone } 0 ppm |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 2 OF 3

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9829

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist. Blows (6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 14 | SAND, as above | SM | | | | | | 13 | Stainless st. Analytical SS from 16-18' at 07:20 |
| | | | | | | A1 | 18 | 22 | CANOS9829-0016 |
| 17 | | | | | | | | 32 | OVA- augers S.S. B.2. } 0 ppm |
| | | | | | | | | 34 | |
| 18 | Bottom of Boring | | | | | | | | grouted Boring from 0-18' w/ cement-Bentonite grout. |
| | | | | | | | | | blow counts taken by dropping a 140 lb hammer 30" |

PROJECT NO. 89MC114W

SHEET 3 OF 3

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9830

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer on Flight line | | ELEVATION AND DATUM 4290.71' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER E. Lancaster | DATE STARTED 11-22-91 / DATE FINISHED 11-22-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 11' | SAMPLER Continuous split barrel |
| DRILLING METHOD HSA-6" OD; 3" ID | DRILL BIT 6¼" | NO. OF SAMPLES DIST. NA | UNDIST. Undisturbed - 1 Grab - 1 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY SM Beth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite grout | FROM 0 TO 11 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov./ft. | SAMPLES: Penetr. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | Start Drilling at 14:50 |
| 1 | SAND medium brown, Very fine grained, Subangular Silty, calcareous | | | | | | 2/4 | | continuous split barrel from 0-3.5 at 14:55 |
| | Chert, light brown, in base of barrel | | | | | | 3.5 | | |
| 2 | | | | | | | | | |
| | | SM | | | | | | | |
| 3 | | | | | | | | | |
| | | | | | | | | | continuous split barrel from 3.5-6 at 15:10 |
| 4 | SAND medium brown very fine grained, subangular silty (20%), slightly calcareous moist | SM | | | | | | | moist |
| | | | | | | | 2/1.25 | | OVA in augers bored B2 zone } 0 ppm |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | Collected Analytical Sample continuous split barrel w/ liner from 6-11' at 15:45 CAN 98-9830-0001 (Top of barrel) |
| | | | | | | | 3/1.5 | | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9830

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, et |
|---|---|---|---|---|---|---|---|---|---|
| 7 | SAND, pale brown, very fine grained, subangular, well sorted, silty calcitic cement clayey, very moist to moist (caliche) | Caliche (SM) | | | | | | | collected gradation analysis sample from 6-11' at 15:45 CANON 830-4001 |
| 8 | | ~~SM~~ | | | | | 3/5 | | OVA- augers-28 ppm barrel-0 ppm B, zone 0 ppm |
| | | | | | | A1 | | | |
| 9 | | | | | | | | | grouted boring from 0-11' w/cement Bentonite grout |
| 10 | | | | | | | | | |
| 11 | | | | | | | | | |
| | Bottom of Boring | | | | | | | | Blow counts taken by dropping a 140 lb hammer - 30" |
| 12 | | | | | | | | | |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC141W

SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9831

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer - Flight line | | ELEVATION AND DATUM 4289.79' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER E Lancaster | DATE STARTED 11-22-91 / DATE FINISHED 11-22-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 12' | SAMPLER continuous split w/ sampler |
| DRILLING METHOD HSA-6" OD - 3¼" ID | DRILL BIT 3" | NO. OF SAMPLES DIST. NA | UNDIST. Analytical Restriction |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY Sm Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite grout | FROM 0 TO 12 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov./ft. | Penetr. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | started drilling at 16:05 |
| 1 | SAND, dark reddish brown very fine grained, silty to clayey. well sorted. slightly calcareous damp | SM | | | | | | | continuous split barrel from 0-4 at 16:15 Gradation Analysis CAN-98-9831-4000 |
| 2 | | | | | | | 2/4 | | encountered hard chert at 4.5 ft. moved boring ~~other~~ down stream 2' |
| 3 | | | | | | | | | started drilling at 16:40 |
| 4 | SAND, Pale brown, very fine grained, calcite cement weathered, silty (15%) | ~~SM~~ caliche (SM) | | | | | | | encountered chert at 4.5' move boring 2' down stream again start drilling at 17:00 |
| 5 | Sand, pale brown, very fine grained, subangular to angular, calcite cement, weathered (caliche) | | | | | | 1.3/2 | | continuous split barrel from 5-7' at 17:15 |
| 6 | | | | | | | | | OVA augers - 15 ppm barrel - 0 ppm B. zone - 0 ppm |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 9831

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist Blows (6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | SAND page, reddish brown, very fine grained subangular, cemented w/ calcite, unweathered. | caliche ~~SM~~ (SM) | | | | | | | Analyzed continuous split barrel sample collected from 7-12' at 17:30 / CAN098-9831-0007 |
| 8 | | | | | | | 3/5 | | OVA- Augers - 0 ppm barrel - 0 ppm B. Zone - 0 ppm sample taken from top of barrel |
| 9 | | | | | | | | | |
| 10 | | | | | | A1 | | | grouted boring from 0-12' w/ cement-Bentonite grout |
| 11 | | | | | | | | | blow count taken by dropping a 140 lb hammer 30" |
| 12 | Bottom of Boring | | | | | | | | |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 9832

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer Line; 175' Upstream of Manhole # 203 | | ELEVATION AND DATUM 4287.34' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER M. Powless | DATE STARTED 11-21-91 DATE FINISHED 11-21-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 14' | SAMPLER Coring Split Barrel 3" Stainless Steel SS |
| DRILLING METHOD HSA 4¼"ID 7¼"OD | DRILL BIT 7⅞" Finger Bit | NO. OF SAMPLES DIST. 2 | UNDIST. Analytical = 1 Geotechnical = 2 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL. — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kubeczko | CHECKED BY SM Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement - Bentonite Grout | FROM 0 TO 14 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov./L | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Sand, orange, fine grained, subangular, well sorted, silty (10-15%), clayey (5-10%), calcareous (10-15%) w/ scattered pockets of tan-orange caliche, dry to slightly moist | SM | | | | | | | Started drilling @ 725<br>Coring Split Barrel Sample from 0' to 4' @ 730<br>CAN098-9832-4000<br>OVA on sample: 0 ppm |
| 2 | Sand, brown-orange to orange, fine grained, sub-angular, well sorted, silty (10-20%), clayey (5-15%), rare calcareous (1-2%), slightly moist | | | | | L1 | 3.8 | | |
| 3 | | SM | | | | | | | OVA @ 4' in augers: 0 ppm<br>in breathing zone: 0 ppm |
| 4 | | | | | | | | | Coring Split Barrel Sample from 4' to 8' @ 740<br>CAN098-9832-4004<br>OVA on sample: 0 ppm |
| 5 | | | | | | L2 | 3.5 | | |
| 6 | Caliche, tan-orange very pale orange, silty (10-15%), clayey (5-10%), slightly sandy (5%), dry | CALICHE | | | | | | | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W T2M

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 9832

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetr. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | Caliche, tan-orange to very pale orange, silty (10-15%), clayey (5-10%), sandy (5%) occassional sand pockets & thin layers, dry to slightly moist | CALICHE | | | | L2 | 3.5 | | |
| 8 | Sand, orange, fine grained, subangular, well sorted, silty (5-15%), clayey (5%), calcareous (15-20%) w/ scattered pockets of tan-orange caliche, slightly moist, medium dense | SM | | | | | | 16 | Stainless Steel SS Sample from 8' to 10' @ 745 CAN098-9832-4008 OVA on sample: 0 ppm |
| | | | | | | G1 | 1.7 | 21 | |
| 9 | | | | | | | | 24 | |
| | | | | | | | | 24 | OVA @ 10' in augers: 0 ppm in breathing zone: 0 ppm |
| 10 | | | | | | | | 17 | Stainless Steel SS Sample from 10' to 12' @ 750 CAN098-9832-4010 OVA on sample: 0 ppm |
| | | | | | | | | 24 | |
| 11 | Caliche, pale orange to tan-orange, silty (10-15%), clayey (5-15%), sandy (5-20%), abundant scattered pockets & layers of sand, slightly moist to moist | | | | | G2 | 1.4 | | |
| | | | | | | | | 7 | |
| | | | | | | | | 8 | |
| 12 | | CALICHE | | | | | | 11 | Stainless Steel SS Sample from 12' to 14' @ 800 CAN098-9832-0012 OVA on sample: 0.2 ppm |
| | | | | | | | | 16 | |
| 13 | | | | | | A1 | 1.9 | 15 | Collected gradation analysis sample from 12' to 14' @ 800 CAN098-9832-4012 |
| | | | | | | | | 16 | Stopped drilling @ 14' @ 805 |
| 14 | Bottom of hole - 14' | | | | | | | | Grouted borehole w/cement bentonite grout from 0' to 14'. Placed metal spike into grouted borehole. |
| 15 | | | | | | | | | Collected ambient blank water sample @ 900 CAN098-9832-1355 Collected deron water sample @ 1000 CAN098-9832-1381 |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W T2M

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 9833

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer Line; 125' Downstream of Manhole # 203 | | ELEVATION AND DATUM 4284.92' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER M. Powlers | DATE STARTED 11-20-91 DATE FINISHED 11-20-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 12' | SAMPLER Coring Split Barrel 3" Stainless Steel SS |
| DRILLING METHOD HSA 4¼" ID 7¼" OD | DRILL BIT 7½" Finger Bit | NO. OF SAMPLES DIST. 2 | UNDIST. Analytical = 1 Geotechnical = 1 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kuberczko | CHECKED BY SM Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement - Bentonite Grout | FROM 0 TO 12 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft. | SAMPLES: Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | Sand, orange-brown brown-orange, fine grained, subangular, well sorted, silty (10-20%), clayey (10-15%), slightly moist | | | | | | | | Started drilling @ 1550 |
| | | | | | | | | | Coring Split Barrel Sample from 0' to 4' @ 1555 CAN098-9833-4000 OVA on sample = 0 ppm |
| 1 | | | | | | | | | |
| | | SM | | | | | | | |
| 2 | | | | | | L1 | 3.5 | | |
| 3 | | | | | | | | | |
| | | | | | | | | | OVA @ 4' in augers = 0 ppm in breathing zone = 0 ppm |
| | Sand, orange to brown-orange, fine grained, subangular, well sorted, silty (10-20%), clayey (5-10%), calcareous (10-15%), slightly moist | | | | | | | | |
| 4 | | | | | | | | | Coring Split Barrel Sample from 4' to 8' @ 1610 CAN098-9833-4004 OVA on sample = 0 ppm |
| 5 | | | | | | | | | |
| | | SM | | | | L2 | 3.8 | | |
| | Occassional pockets & thin layers of tan-orange caliche | | | | | | | | |
| 6 | | | | | | | | | Collected gradation analysis sample from 6' to 7' @ 1610 CAN098-9833-4006 |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W T2M

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 9833

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | Sand, orange, fine grained, subangular, well sorted, silty (5-10%), clayey (5-10%) calcareous (10-20%) w/scattered pockets & thin layers of tan-orange to very pale orange caliche, slightly moist, loose | | | | | L2 | 3.3 | | |
| 8 | | SM | | | | | | 6 | Stainless Steel SS Sample from 8' to 10' @ 1615 CAN098-9833-4008 OVA on sample: 0 ppm |
| | | | | | | | | 4 | |
| 9 | | | | | | G1 | 4.9 | | |
| | Becoming slightly moist to moist, increasing caliche | | | | | | | 9 | |
| | | | | | | | | 11 | OVA @ 10' in augers: 0.1 ppm In breathing zone: 0 ppm |
| 10 | | | | | | | | 5 | Stainless Steel SS Sample from 10' to 12' @ 1620 CAN098-9833-0010 OVA on sample: 0 ppm |
| | | | | | | | | 8 | |
| 11 | Caliche, tan-orange to very pale orange, silty (5-10%), clayey (5-15%), sandy (5%), slightly moist to moist | | | | | A1 | 1.9 | | Collected Rinsate Blank from decanned stain. steel split spoon @ 1730 CAN098-9833-1375 |
| | | CALICHE | | | | | | 7 | |
| | | | | | | | | 9 | Stopped drilling @ 12' @ 1625 |
| 12 | Bottom of hole - 12' | | | | | | | | Grouted borehole w/cement-bentonite grout from 0' to 12'. Placed metal spike into grouted borehole |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W T2M

SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 9834

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer Line; 298' Downstream of Manhole # 203 | | ELEVATION AND DATUM 4283.97' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER M. Powlers | DATE STARTED 11-20-91 DATE FINISHED 11-20-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 12' | SAMPLER Coring Split Barrel 2" Stainless Steel SS |
| DRILLING METHOD HSA 4¼" ID 7¼" OD | DRILL BIT 7⅝" Finger Bit | NO. OF SAMPLES DIST. 2 | UNDIST. Analytical = 1 Geotechnical = 1 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL. — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kuberzko | CHECKED BY SMBurth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement - Bentonite Grout | FROM 0 TO 12 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov. ft. | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 1, 2, 3, 4 | Sand, brown-orange, fine grained, subangular, well sorted, silty (5-15%), clayey (10-15%), slightly moist | SM | | | | L1 | 3.1 | | Started drilling @ 1425<br>Coring split barrel Sample from 0' to 4' @ 1430<br>CAN098-9834-4000<br>OVA on sample = 0 ppm<br>Possible utility fill sand between 1' and 1.25'<br>Brought up a blue wire during augering<br>OVA @ 4' in augers = 0 ppm<br>in breathing zone = 0 ppm |
| 5 | Caliche, tan-orange to pale orange, silty (10-15%), clayey (5-10%), sandy (5%), slightly moist, occassional pockets & layers of sand | CALICHE | | | | | | | Coring Split Barrel Sample from 4' to 8' @ 1435<br>CAN098-9834-4004<br>OVA on sample = 0 ppm |
| 6 | Sand, orange, fine grained, subangular, well sorted, silty (5-15%), clayey (5-10%), calcareous | SM | | | | L2 | 3.8 | | |
| 7 | Caliche, tan-orange pale orange, silty (5-10%), clayey (5-15%), sandy (5%), slightly moist, occassional pockets & layers of sand | CALICHE | | | | | | | |

PROJECT NO. 89MC114W T2M

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 9834

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | Caliche, tan-orange pale orange, silty (5-10%), clayey, (5-15%), sandy (5-10%), slightly moist, occassional pockets of sand | CALICHE | | | | L2 | | | |
| 8 | Sand, orange, fine grained, subangular, well sorted, silty (5-15%), clayey (5-10%), calcareous (15-20%) w/ scattered pockets of tan-orange caliche, slightly moist | | | | | | | 15 | Stainless Steel SS Sample from 8' to 10' @ 1445 CAN098-9834-4008 OVA on sample = 0 ppm |
| | | | | | | | | 27 | |
| 9 | | | | | | G1 | 1.7 | | |
| | | | | | | | | 51 | |
| | | | | | | | | 75 | OVA @ 10' hangers = 0.2 ppm in breathing zone: 0 ppm |
| 10 | Becoming cemented w/ calcium carbonate & increased pockets of caliche | SM | | | | | | 24 | Stainless Steel SS Sample from 10' to 12' @ 1500 CAN098-9834-0010 OVA on sample = 0 ppm |
| | | | | | | | | 40 | |
| 11 | | | | | | A1 | | | Collected gradation analysis sample from 10' to 11 @ 1500 |
| | | | | | | | | 54 | CAN098-9834-4010 |
| | | | | | | | | 103 | Stopped drilling @ 12' @ 1505 |
| 12 | Bottom of hole - 12' | | | | | | | | Grouted borehole w/cement-bentonite grout from 0' to 12'. Placed metal spike into grouted borehole |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W T2M

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 9835

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer Line; 314' Upstream of Manhole #203-A | | ELEVATION AND DATUM 4283.95 | |
| DRILLING AGENCY Environmental Drilling | DRILLER M. Powless | DATE STARTED 11-20-91 DATE FINISHED 11-20-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 12' | SAMPLER Coring Split Barrel 3" Stainless Steel SS |
| DRILLING METHOD HSA 4¼" ID 7¼" OD | DRILL BIT 7½" Finger Bit | NO. OF SAMPLES DIST. 2 | UNDIST. Analytical = 1 Geotechnical = 1 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL. — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kubecko | CHECKED BY SMButh |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-bentonite Grout | FROM 0 TO 12 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov./ft. | Penetr. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Sand, brown-orange, fine grained, subangular, well sorted, silty (10-20%), clayey (10-15%), slightly moist | SM | | | | | | | Started drilling @ 1220<br>Coring Split Barrel Sample from 0' to 4' @ 1225<br>CAN098-9835-4000<br>OVA on sample = 0 ppm |
| 2 | | | | | | L1 | 3.9 | | |
| 3 | Sand, orange, fine grained, subangular, well sorted, silty (10-15%), clayey (5-10%), calcareous (10-20%) w/ scattered pockets of tan-orange caliche, slightly moist | SM | | | | | | | |
| 4 | | | | | | | | | OVA @ 4' in augers = 0 ppm<br>in breathing zone = 0 ppm |
| 5 | Caliche, tan-orange pale orange, silty (5-10%), sandy (5%), clayey (5-15%), slightly moist | CALICHE | | | | | | | Coring Split Barrel Sample from 4' to 8' @ 1235<br>CAN098-9835-4004<br>OVA on sample = 0 ppm<br>Collected gradation analysis sample from 4' to 5' @ 1235<br>CAN098-9835-4004 |
| 6 | Sand, orange, fine grained, subangular, well sorted, silty (10-15%), clayey (5-10%), calcareous (15-20%) w/ scattered pockets of tan-orange caliche, slightly moist | SM | | | | L2 | 3.9 | | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W T2M

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 9835

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, et |
|---|---|---|---|---|---|---|---|---|---|
| 7 | Sand, orange, fine grained, subangular, well sorted, silty (5-10%), clayey (5-10%), calcareous (15-20%) w/ scattered pockets & thin layers of tan-orange pale orange & orange caliche, medium dense, slightly moist | | | | | L2 | 1.9 | | |
| 8 | | | | | | | | 17 | Stainless Steel SS Sample from 8' to 10' @ 1240 CAN098-9835-4008 OVA on sample: 0 ppm |
| | | | | | | | | 15 | |
| 9 | | SM | | | | G1 | 1.7 | 24 | |
| | | | | | | | | 29 | OVA @ 10' in augers 0.2 ppm in breathing zone: 0 ppm |
| 10 | | | | | | | | 16 | Stainless Steel SS Sample from 10' to 12' @ 1245 CAN098-9835-0010 OVA on sample: 0 ppm |
| | | | | | | | | 21 | |
| 11 | | | | | | A1 | 1.8 | 23 | |
| | Caliche, pale orange to orange, silty (10-15%), clayey (5-10%), sandy (5%), medium dense, slightly moist occassional sandy pockets & layers | CALICHE | | | | | | 30 | Stopped drilling @ 12' @ 1250 |
| 12 | Bottom of hole - 12' | | | | | | | | Grouted borehole w/ cement bentonite grout from 0 to 12'. Placed metal spike into grouted borehole |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W T2M

SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 9836

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer Line; 240' Upstream of Manhole # 203-A | | ELEVATION AND DATUM 4283.37' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER M. Powless | DATE STARTED 11-20-91 / DATE FINISHED 11-20-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 12' | SAMPLER Coring Split Barrel 3" Stainless Steel SS |
| DRILLING METHOD HSA 4¼" ID 7¼" OD | DRILL BIT 7⅞" Finger Bit | NO. OF SAMPLES DIST. 2 | UNDIST. Analytical: / Geotechnical: / |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL. — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kubeczko | CHECKED BY SMButh |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-bentonite Grout | FROM 0 TO 12 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | Recov./L | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | Sand, orange brown-orange, fine grained, subangular, well sorted, silty (10-15%), clayey (10-15%), slightly moist | | | | | | | | Started drilling @ 1105 |
| | | | | | | | | | Coring Split Barrel Sample from 0' to 4' @ 1110 |
| | | | | | | | | | CAN098-9836-4000 |
| | | | | | | | | | OVA on sample: 0 ppm |
| 1 | | | | | | | | | Collected gradation analysis sample from 0' to 0.5' @ 1110 |
| | | | | | | | | | CAN098-9836-4000 |
| 2 | | SM | | | | L1 | 3.7 | | |
| 3 | | | | | | | | | |
| | | | | | | | | | OVA @ 4' in augers: 0 ppm in breathing zone: 0 ppm |
| 4 | | | | | | | | | |
| | Sand, orange, fine grained, subangular, well sorted, silty (10-15%), calcareous (15-20%) w/ scattered pockets of tan-orange very pale orange caliche, clayey (5%), slightly moist to dry | | | | | | | | Coring Split Barrel Sample from 4' to 8' @ 1120 |
| | | | | | | | | | CAN098-9836-4004 |
| | | | | | | | | | OVA on sample: 0 ppm |
| 5 | | SM | | | | L2 | 4 | | |
| | Caliche, very pale orange tan-orange white, silty (5-10%), sandy (5-10%), clayey (5-10%), slightly moist to dry | | | | | | | | |
| 6 | | CALICHE | | | | | | | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W T2M

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 9836

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetr. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | Sand, orange, fine grained, subangular, well sorted, silty (10-15%), calcareous (15-20%) w/scattered pockets of tan-orange caliche, clayey (5%), slightly moist, medium dense | | | | | L2 | 4 | | |
| 8 | | | | | | | | 14 | Stainless Steel SS Sample from 8' to 10' @ 1125 CAN098-9836-4008 OVA on sample = 0 ppm |
| | | | | | | | | 19 | |
| 9 | | | | | | G1 | 1.8 | | |
| | | SM | | | | | | 23 | |
| | | | | | | | | 27 | OVA @ 10' in augers = 0.8 ppm in breathing zone = 0 ppm |
| 10 | | | | | | | | 18 | Stainless Steel SS Sample from 10' to 12' @ 1135 CAN098-9836-0010 OVA on sample = 0 ppm |
| | | | | | | | | 24 | |
| 11 | | | | | | A1 | 1.9 | | |
| | | | | | | | | 28 | |
| | | | | | | | | 28 | Stopped drilling @ 12' @ 1145 |
| 12 | Bottom of hole - 12' | | | | | | | | Grouted borehole w/cement-bentonite grout from 0 to 12'. Placed metal spike into grouted borehole |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W T2M

SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 9837

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer Line; 150' Upstream of Manhole # 203A | | ELEVATION AND DATUM 4282.47' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER M. Powless | DATE STARTED 11-20-91 DATE FINISHED 11-20-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 13' | SAMPLER Coring Split Barrel 3" Stainless Steel SS |
| DRILLING METHOD HSA 4¼" ID 7¼" OD | DRILL BIT 7½" Finger Bit | NO. OF SAMPLES DIST. 2 | UNDIST. Analytical : 1 Geotechnical : 1 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL. — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kubeczko | CHECKED BY SM Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement - Bentonite Grout | FROM 0 TO 13 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov./L | SAMPLES: Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | Sand, brown red-brown orange brown, fine grained, subangular, well sorted, silty (10-15%), clayey (5-15%), calcareous (5-10%), slightly moist | | | | | | | | Started drilling @ 750 |
| | | | | | | | | | Coring Split Barrel Sample from 0' to 4' @ 755 |
| | | | | | | | | | CAN098-9837-4000 |
| | | | | | | | | | OVA on sample = 0.2 ppm from 3' to 4'; 0 ppm rest of sample |
| 1 | | | | | | | | | |
| 2 | | | | | | L1 | 27 | | |
| | | SM | | | | | | | |
| 3 | | | | | | | | | |
| | | | | | | | | | OVA @ 4' in auger = 1 ppm in breathing zone = 0 ppm |
| 4 | | | | | | | | | Coring Split Barrel Sample from 4' to 9' @ 810 |
| | | | | | | | | | CAN098-9837-4004 |
| | | | | | | | | | OVA on sample = 0.1 ppm |
| 5 | | | | | | | | | |
| | | | | | | L2 | 4.2 | | |
| 6 | Caliche, tan-orange very pale orange, silty (5-10%), sandy (5-10%), clayey (5%), slightly moist | | | | | | | | |
| | | CALICHE | | | | | | | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W T2M

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 9837

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetr. Resist. Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | Caliche, tan-orange very pale orange, silty (5-15%), sandy (5-10%), clayey (5%), slightly moist | CALICHE | | | | | | | |
| 8 | | | | | | L2 | 4.2 | | |
| | Sand, orange, fine grained, subangular, well sorted, calcareous (10-15%), silty (5-15%), clayey (5%), loose, slightly moist, occassional tan-orange caliche pockets | | | | | | | | OVA @ 9' in augers: 0.2 ppm in breathing zone: 0 ppm |
| 9 | | | | | | | | 3 | Stainless Steel SS Spl from 9' to 11' @ 825 CAN098-9837-4009 |
| | | | | | | | | 5 | OVA on sample: 0 ppm |
| 10 | | | | | | G1 | 4.8 | | Collected gradation analysis sample from 9' to 11' @ 825 |
| | | | | | | | | 6 | CAN098-9837-4009 |
| | | SM | | | | | | 8 | |
| 11 | | | | | | | | 6 | Stainless Steel SS Spl from 11' to 13' @ 845 CAN098-9837-0011 MS/MSD |
| | | | | | | | | 7 | OVA on sample = 5 ppm between 12.5' & 13' Took TCL VOCs sample from this interval. Rest of sample ranged between 2 & 3 ppm |
| 12 | | | | | | A1 | 4.9 | | |
| | | | | | | | | 9 | |
| | | | | | | | | 16 | Stopped drilling @ 13' @ 850 |
| 13 | Bottom of hole - 13' | | | | | | | | Grouted borehole w/ cement-bentonite grout from 0 to 13'. Placed metal spike in grouted borehole |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W T2M

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 9838

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer Line; 20' Downstream of Manhole # 203A | | ELEVATION AND DATUM 4284.53' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER M. Powless | DATE STARTED 11-25-91 DATE FINISHED 11-25-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 11' | SAMPLER Coring Split Barrel 3" Stainless Steel SS |
| DRILLING METHOD HSA 4¼" ID ¼" OD | DRILL BIT 7¼" Finger Bit | NO. OF SAMPLES DIST. 2 | UNDIST. Analytical: 1 Geotechnical: 1 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kubeczko | CHECKED BY Sm Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite Grout | FROM 0 TO 11 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov./ft. | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | Concrete | CONCRETE | | | | | | | Started Drilling @ 1645<br>Cored concrete from 0' to 0.5' @ 1550 |
| 1 | Sand, pale orange, fine grained, subangular, well sorted, silty (10-15%), clayey (10-15%), calcareous (5-15%), slightly moist | SM | | | | | | | Coring Split Barrel Sample from 0.5' to 4' @ 1650<br>CAN098-9838-4000<br>OVA on sample = 0 ppm |
| 2 | Sand, orange-brown to brown-orange, fine grained, subangular, well sorted, silty (10-20%), clayey (5-15%), slightly moist | | | | | L1 | 3.3 | | |
| 3 | | SM | | | | | | | Collected gradation analysis sample from 3' to 4' @ 1650<br>CAN098-9838-4003<br>OVA at 4' in augers = 1.8 ppm in breathing zone = 0 ppm |
| 4 | | | | | | | | | Coring Split Barrel Sample from 4' to 7' @ 1655<br>CAN098-9838-4004<br>OVA on sample = 0 ppm |
| 5 | | | | | | | | | |
| 6 | Caliche, pale orange, silty (10-15%), clayey (10-20%), sandy (5-15%), slightly moist | CALICHE | | | | L2 | | | |
| 7 | Sand, pale orange, fine grained, subangular, well sorted, silty (10-15%), clayey (5-10%), calcareous (10-20%) w/ scattered pockets of pale caliche, slightly moist | SM | | | | | | | |

PROJECT NO. 89MC114W T2M

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 9838

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (") | SAMPLES: Penetra. Resist. Blows (6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | Sand, pale orange, fine grained, subangular, well sorted, silty (5-15%), clayey (5-10%), calcareous (10-20%) w/scattered pockets of pale orange caliche, medium dense, slightly moist | | | | | | | 22 | Stainless Steel SS Sample from 7' to 9' @ 1700 CAN098-9838-4007 OVA on sample = 0 ppm |
| | | | | | | | | 24 | |
| 8 | | | | | | G1 | 19 | | |
| | | | | | | | | 29 | |
| | | SM | | | | | | 31 | OVA at 9' in augers = 0.2 ppm in breathing zone = 0 ppm |
| 9 | | | | | | | | 26 | Stainless Steel SS Sample from 9' to 11' @ 1715 CAN098-9838-0009 OVA on sample = 0 ppm |
| | | | | | | | | 31 | |
| 10 | | | | | | A1 | 20 | | Collected MRD Duplicate from 9' to 11' @ 1715 CAN098-9838-1303 |
| | | | | | | | | 21 | |
| | | | | | | | | 29 | Stopped drilling at 11' @ 1720 |
| 11 | Bottom of hole - 11' | | | | | | | | Grouted borehole w/cement-bentonite grout from 0' to 11'. Placed metal spike into grouted borehole |
| 12 | | | | | | | | | |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W T2M

SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 9839

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer Line; 170' Downstream of Manhole # 203-A | | ELEVATION AND DATUM 4284.08' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER M. Powless | DATE STARTED 11-25-91 / DATE FINISHED 11-25-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 11' | SAMPLER Coring Split Barrel 2" Stainless Steel SS |
| DRILLING METHOD HSA 4¼" ID 7¼" OD | DRILL BIT 7½" Finger Bit | NO. OF SAMPLES DIST. 2 | UNDIST. Analytical = 1 Geotechnical = 1 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL. — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kubeczko | CHECKED BY SmButh |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite Grout | FROM 0 TO 11 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | Recov. ft. | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | Concrete | CONCRETE | | | | | | | Started drilling @1545 Cored concrete from 0' to 0.5' @ 1515 |
| 1 | Sand, pale orange, fine grained, subangular, well sorted, silty (5-15%), clayey (10-15%), calcareous (5-15%), slightly moist | SM | | | | | | | Coring Split Barrel Sample from 0.5' to 4' @ 1550 CAN098-9839-4000 OVA on sample = 0 ppm |
| 2 | Sand, brown-orange orange-brown, fine grained, subangular, well sorted, silty (5-15%), clayey (10-20%) slightly moist | | | | | L1 | 3.4 | | |
| 3 | | SM | | | | | | | OVA at 4' in augers = 0 ppm in breathing zone = 0 ppm |
| 4 | | | | | | | | | Coring Split Barrel Sample from 4' to 7 @ 1600 CAN098-9839-4004 OVA on sample = 0 ppm Collected gradation analysis sample from 5' to 6' @ 1600 CAN098-9839-4005 |
| 5 | Caliche, pale orange, silty (10-15%), clayey (10-20%), sandy (5-15%), slightly moist | | | | | L2 | 2.9 | | |
| 6 | | CALICHE | | | | | | | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W T2M

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 9839

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetr. Resist. Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | Sand, pale orange to orange, fine grained, subangular, well sorted, silty (10-15%), clayey (5%), calcareous (10-20%) w/ occassional pockets of tan-orange pale orange caliche, medium dense, slightly moist | SM | | | | | | 13 | Stainless Steel SS Sample from 7' to 9' @ 1605 CAN098-9839-4007 OVA on sample = 0 ppm |
| | | | | | | | | 15 | |
| 8 | | | | | | G1 | 1.7 | | |
| | | | | | | | | 19 | |
| | | | | | | | | 21 | OVA at 9' in augers = 0.7 ppm in breathing zone = 0 ppm |
| 9 | | | | | | | | 14 | Stainless Steel SS Sample from 9' to 11' @ 1615 CAN098-9839-0009 OVA on sample = 0 ppm |
| | | | | | | | | 18 | |
| 10 | | | | | | A1 | 1.8 | | |
| | | | | | | | | 17 | |
| | | | | | | | | 19 | Stopped drilling at 11' @ 1620 |
| 11 | Bottom of hole - 11' | | | | | | | | Grouted borehole w/cement-bentonite grout from 0' to 11'. Placed metal spike into grouted borehole |
| 12 | | | | | | | | | |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W T2M

SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 9840

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer Line; 490' Downstream of Manhole # 203-A | | ELEVATION AND DATUM 4281.03' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER M. Powless | DATE STARTED 11-19-91 DATE FINISHED 11-19-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 11' | SAMPLER Coring Split Barrel 3" Stainless Steel SS |
| DRILLING METHOD HSA 4¼" ID 7¼" OD | DRILL BIT 7⅞" Finger Bit | NO. OF SAMPLES DIST. 2 | UNDIST. Analytical : 1 Geotechnical : 1 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL. — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kubeczko | CHECKED BY SM Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite Grout | FROM 0 TO 11' FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft. | SAMPLES: Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | Sand, brown-orange, fine grained, subangular, well sorted, silty (10-20%), clayey (5-15%), slightly moist | | | | | | | | Started Drilling @ 1510 |
| | | | | | | | | | Coring Split Barrel Sample from 0' to 4' @ 1515 |
| | | | | | | | | | CAN098-9840-4000 |
| | | | | | | | | | OVA on sample = 0 ppm |
| 1 | | | | | | | | | |
| | | SM | | | | | | | |
| 2 | | | | | | L1 | 3.2 | | |
| 3 | | | | | | | | | |
| | Sand, orange, fine grained, subangular, well sorted, silty (5-15%), clayey (5%), calcareous (10-15%) w/ scattered pockets of tan-orange pale-orange caliche, dense, slightly moist | | | | | | | | OVA @ 4' in augers = 0 ppm in breathing zone = 0 ppm |
| 4 | | | | | | | | | Coring Split Barrel Sample from 4' to 7' @ 1525 |
| | | | | | | | | | CAN098-9840-4004 |
| | | | | | | | | | OVA on sample = 0 ppm |
| 5 | | | | | | | | | Collected gradation analysis sample from 5' to 6' @ 1525 |
| | | SM | | | | L2 | 2.8 | | CAN098-9840-4005 |
| | Scattered nodules & very thin layers of silica/chert replaced caliche | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W T2M

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 9840

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | Caliche, tan-orange very pale-orange, sandy (10-15%), silty (10%), clayey (5-10%), slightly moist, medium dense | CALICHE | | | | | | 10 | Stainless Steel SS Sample from 7' to 9' @ 1545 CAN098-9840-4007 OVA on sample = 0 ppm |
| | | | | | | | | 9 | |
| 8 | Sand, orange to pale orange, fine grained, subangular, well sorted, silty (10-15%), clayey (5%), calcareous (10-15%) w/ scattered tan-orange to very pale orange, caliche pockets and very thin layers, medium dense, slightly moist | | | | | G1 | 17 | 16 | |
| | | | | | | | | 23 | OVA @ 9' in auger = 0 ppm in breathing zone = 0 ppm |
| 9 | | SM | | | | | | 6 | Stainless Steel SS Sample from 9' to 11' @ 1600 CAN098-9840-0009 OVA on sample = 0.8 ppm |
| | | | | | | | | 8 | Collected Field Duplicate Sample from 9' to 11' @ 1630 CAN098-9840-1365 |
| 10 | | | | | | A1 | 18 | 15 | |
| | | | | | | | | 21 | Stopped drilling @ 11' @ 1605 |
| 11 | Bottom of hole - 11' | | | | | | | | Grouted borehole w/cement-bentonite grout from 0' to 11'. Placed Metal Spike into grouted borehole |
| 12 | | | | | | | | | |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W T2M

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 9841

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer Line ; 24' Downstream of Manhole # 204 | | ELEVATION AND DATUM 4281.28' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER M. Powless | DATE STARTED 11-19-91 DATE FINISHED 11-19-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 8' | SAMPLER (Coring Split Barrel 3" Stainless Steel SS |
| DRILLING METHOD HSA 4¼" ID 7¼" OD | DRILL BIT 7½" Finger Bit | NO. OF SAMPLES DIST. 1 | UNDIST. Analytical = 1 Geotechnical = 1 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL. — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kubeczko | CHECKED BY SMButh |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite Grout | FROM 0 TO 8 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft. | SAMPLES: Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | Sand, orange to brown-orange, fine grained, sub-angular, well sorted, silty (10-20%), clayey (10-15%), slightly moist | | | | | | | | Started drilling @ 1350 Coring Split Barrel Sample from 0' to 4' @ 1355 CAN098-9841-4000 OVA on sample = 0 ppm Collected gradation analysis sample from 1' to 2' @ 1355 CAN098-9841-4001 |
| 1 | | | | | | | | | |
| | | SM | | | | | | | |
| | | | | | | L1 | 4 | | |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| | Sand, orange, fine grained, subangular, well sorted, silty (10-15%), clayey (5-10%), calcareous (10-15%) w/ scattered pockets of tan-orange to very pale orange caliche, slightly moist | | | | | | | | OVA @ 4' in augers = 0 ppm in breathing zone = 0 ppm |
| 4 | | | | | | | | 7 | Stainless Steel SS Sample from ' to ' @ 1410 CAN098-9841-4004 OVA on sample = 0 ppm |
| | | | | | | | | 21 | |
| 5 | | | | | | G1 | 1.9 | | |
| | | SM | | | | | | 11 | |
| | | | | | | | | 19 | |
| 6 | | | | | | | | 9 | Stainless Steel SS sample from 6' to 8' @ 1420 CAN098-9841-0006 OVA on sample = 0 ppm |
| | Increased caliche pockets w/ thin layers | | | | | A1 | 1.8 | 7 | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W T2M

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 9841

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | Caliche, tan-orange to orange, sandy (10-15%), silty (5-10%), clayey (5%), slightly moist | CALICHE | | | | | | 11 | |
| | Sand, orange to pale orange, fine grained, sub-angular, well sorted, silty (10-15%), clayey (5%), calcareous (15-20%) w/ abundant tan-orange caliche pockets, slightly moist, medium dense | SM | | | | A1 | 1.8 | 14 | OVA @ 8' in augers = 0.6ppm in breathing zone = 0 ppm |
| 8 | Bottom of hole - 8' | | | | | | | | Stopped drilling @ 8' @ 1425 |
| | | | | | | | | | Grouted borehole from 0 to 8' w/cement-bentonite grout. Placed metal spike into grouted borehole |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |
| 11 | | | | | | | | | |
| 12 | | | | | | | | | |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W T2M

SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 9842

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer Line; 60' Downstream of Manhole # 204 | | ELEVATION AND DATUM 4281.35' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER M. Powless | DATE STARTED 11-19-91 DATE FINISHED 11-19-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 8 | SAMPLER Coring Split Barrel |
| DRILLING METHOD HSA 4¼" ID 7¼" OD | DRILL BIT 7½" Finger Bit | NO. OF SAMPLES DIST. 2 | UNDIST. — |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL. — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kuberczko | CHECKED BY SMButh |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite Grout | FROM 0 TO 8 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft. | SAMPLES: Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 1, 2, 3 | Sand, orange-brown brown-orange, fine grained, subangular, well sorted, silty (10-20%), clayey (10-15%), slightly moist | SM | | | | L1 | 3.5 | | Started drilling @ 1305<br>Coring Split Barrel Sample from 0' to 4' @ 1310<br>CAN098-9842-4000<br>OVA on sample = 0 ppm |
| 4 | Sand, orange, fine grained, subangular, well sorted, silty (10-20%), clayey (5-10%), scattered tan orange caliche & calcareous (5-15%), slightly moist | | | | | | | | OVA @ 4' in augers = 0 ppm<br>in breathing zone = 0 ppm<br>Coring Split Barrel Sample from 4' to 8' @ 1320<br>CAN098-9842-4004 |
| 5, 6 | | SM | | | | A1 | 3.8 | | |
| 7 | Caliche tan-orange to pale orange to orange, sandy (5-15%), silty (5-10%), clayey (5-10%), slightly moist | CALICHE | | | | | | | |

PROJECT NO. 89MC114W T2M

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 9842

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc |
|---|---|---|---|---|---|---|---|---|---|
| 7 | Caliche, tan-orange to pale-orange, to orange, sandy (5-15%), silty (5-10%), clayey (5-10%), slightly moist, occassional sand streaks | CALICHE | | | | A1 | XX | | Collected analytical sample from 7' to 8' @ 1320 CAN098-9842-0007 OVA on sample = 0 ppm Collected gradation analysis sample from 7' to 8' @ 1320 CAN098-9843-4007 |
| 8 | Bottom of hole - 8' | | | | | | | | OVA @ 8' in augers = 0 ppm in breathing zone = 0 ppm Stopped drilling @ 8' @ 1325 Grouted borehole w/cement-bentonite grout from 0 to 8'. Placed Metal spike into grouted borehole |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |
| 11 | | | | | | | | | |
| 12 | | | | | | | | | |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W T2M

SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 9843

| | | | |
|---|---|---|---|
| BORING LOCATION Sanitary Sewer Line; 245' Downstream of Manhole # 204 | | ELEVATION AND DATUM 4281.25' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER M. Powless | DATE STARTED 11-19-91 DATE FINISHED 11-19-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 9' | SAMPLER Core Split Barrel |
| DRILLING METHOD HSA 4¼" ID 7¼" OD | DRILL BIT 7½" Finger Bit | NO. OF SAMPLES DIST. 2 | UNDIST. — |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL. — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kubeczko | CHECKED BY SM Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite Grout | FROM 0 TO 9' FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov. ft. | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | Sand, red-brown, fine grained, subangular, well sorted, silty (10-20%), clayey (5-10%), rare tan-orange caliche pockets, slightly moist | | | | | | | | Started drilling @ 1105 Coring Split barrel Sample from 0' to 4' @ 1110 CAN098-9843-4000 OVA on Sample = 0ppm |
| 1 | | | | | | | | | |
| | | SM | | | | | | | |
| | | | | | | L1 | 32 | | |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | Collected gradation analysis sample from 3' to 4' @ 1110 CAN098-9843-4003 OVA @ 4' in augers = 0ppm in breathing zone = 0ppm |
| 4 | Sand, orange, fine grained, subangular, well sorted, silty (10-15%), clayey (5%), calcareous (10-15%) w/ scattered tan-orange caliche pockets, slightly moist | | | | | | | | Coring Split Barrel Sample from 4' to 9' @ 1125 CAN098-9843-4004 |
| 5 | | | | | | | | | |
| | | SM | | | | A1 | 5 | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W T2M

SHEET 1 OF 2

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 9843

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc |
|---|---|---|---|---|---|---|---|---|---|
| 7 | Caliche, tan-orange very pale orange, sandy (10-15%), silty (5-10%), clayey (5%), dense, dry to slightly moist, occassional streaks of orange sand | | | | | | | | |
| 8 | | CALICHE | | | | A1 | 5 | | Collected analytical sample from 8' to 9' @ 1125 CAN098-9843-0008 Collected MRD Duplicate Sample from 8' to 9' @ 1125 CAN098-9843-1305 OVA on sample = 0 ppm |
| 9 | Bottom of hole - 9' | | | | | | | | OVA @ 9' in augers = 0 ppm in breathing zone = 0 ppm Stopped drilling @ 9' @ 1130 |
| 10 | | | | | | | | | Grouted borehole w/cement bentonite grout from 0 to 9'. Placed metal spike into grouted borehole |
| 11 | | | | | | | | | |
| 12 | | | | | | | | | |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W T2M

SHEET 2 OF 2

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 1061

| | | | |
|---|---|---|---|
| BORING LOCATION Fire training Area #2 | | ELEVATION AND DATUM 4261.27' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER B. Kingsley | DATE STARTED 10-23-91 / DATE FINISHED 10-23-91 | |
| DRILLING EQUIPMENT Mobile B-53 | | COMPLETION DEPTH 31.5' | SAMPLER 3" stainless std S.S, 2" steel S.S |
| DRILLING METHOD HSA - 6" OD, 3 3/4" ID | DRILL BIT 6 1/2" Bullet | NO. OF SAMPLES DIST. NA | UNDIST. Analytical S.S Gravesh-H |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY LARRY Gardner | CHECKED BY Sam Beath |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement - Bentonite grout | FROM 0 TO 31.5 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov./L | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | SAND, reddish brown, very fine grained, subangular, silty (10%) | SM | | | | A1 | | 5 | collected surface soil sample from 0 to .5 feet at 7:55 CAN106-1061-0001 |
| 1 | | | | | | | | 8 | Start drilling at 8:05 |
| | | | | | | G1 | 1.8 | 8 | SPT from 0 to 2' at 8:07 |
| | | | | | | | | 8 | OVA - S.S, augers, B.Zone } 0 ppm |
| 2 | SAND, pale brown, very fine grained, silty (20%) mottled with patches of calcite cement. | Caliche (SM) | | | | | | 10 | Collected Gradation analysis sample CAN106-1061-4000 at 8:07 |
| | | | | | | G2 | 1.5 | 12 | SPT from 2 to 4' at 8:20 |
| 3 | | | | | | | | 9 | |
| | | | | | | | | 8 | |
| 4 | SAND, pale reddish brown, mottled white, very fine grained, silty (5%) cemented with Calcite, grades downward to reddish sand | Caliche (SM) | | | | | | 11 | collect analytical stainless steel S.S sample from 4 to 6' at 8:30 |
| | | | | | | A2 | 1.5 | 20 | CAN106-1061-0004 MS/MSD |
| 5 | | | | | | | | 18 | OVA - augers, S.S, B.Zone } 0 ppm |
| | | | | | | | | 19 | |
| 6 | SAND, medium brown, very fine grained, silty (20%) well sorted, grades to light brown, calcareous sand at base | SM | | | | | | 6 | SPT from 6-8' at 8:45 |
| | | | | | | G3 | 1.8 | 10 | OVA in S.S augers, B.Zone } 0 ppm |
| 7 | | | | | | | | | |

FD - CAN100-1061-1063

PROJECT NO. 89MC114W

SHEET 1 OF 4

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 1061

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, et |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | 10 | |
| | | | | | | | | 9 | |
| 8 | SAND. medium brown with pale brow mottles Very fine grained, subangular, well-sorted, slightly calcareous, silty | SM | | | | | | 3 | collected SPT from 8-10' at: 8:55 |
| | | | | | | | 1.5 | 4 | OVA in S.S. — 0 ppm |
| 9 | | | | | | G4 | | 5 | |
| | | | | | | | | 5 | collected standard ST. Analytical from - 10-12' at: 9:05 |
| 10 | SAND, reddish brown, U.Fn grained, subangular to angular wellsorted, silty, calcareous. | SM | | | | | 1.7 | 13 | CAN/06-1061-0010 CAN/06 1061-1061 Field Dy |
| | | | | | | A3 | | 19 | |
| 11 | | | | | | | | 29 | OVA in S.S.-0 ppm |
| | | | | | | | | 35 | |
| 12 | Top 1FT SAND, LT palebrown, very fine to fine grained, subangular, very calcareous, silty | SM | | | | | 1.0 | 15 | collected SPT from 12-14' at: 9:20 |
| | | | | | | G5 | | 21 | OVA in SS - 0 ppm |
| 13 | Sand, - reddish brown - very fine grained. silty. | SM | | | | | | 42 | |
| | | | | | | | | 64 | |
| 14 | Sand, reddishbrown, very fine grained, subangular, well sorted, calc., silty Pale brown mottles. | SM | | | | | | 16 | collected SPT from 14-16' at: 9:40 Gradation Analysis CAN06-1061-4044 |
| | | | | | | | 1.8 | 35 | OVA - S.S - 0 ppm |
| 15 | | | | | | G6 | | 48 | OVA in Auger - 0 ppm |
| | | | | | | | | 60 | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W SHEET 2 OF 4

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 1061

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetr. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | Sand, reddish brown, very fine grained, angular to subangular, well sorted, silty non-calcareous. | SM | | | | | | 14 | Collected SPT from 16-18' at: 10:00 |
| | | | | | | 27 | | 25 | OVA in S.S.- 0 ppm |
| 17 | | | | | | | 14 | 36 | |
| | | | | | | | | 53 | |
| 18 | SAND, Reddish brown, very fine to fine grained, subangular silty well sorted, slightly calcareous | SM | | | | | | 17 | Collected SPT from 18-20' at: 10:35 |
| | | | | | | | | 31 | OVA in S.S.- 0 ppm |
| 19 | SAND, Light reddish brown, Very fine grained, well sorted increase in calcite., silty | SM | | | | | | 44 | |
| | | | | | | | | 43 | |
| 20 | SAND, pale reddish brown Very fine to fine grained. ~~silty~~ well sorted Subrounded to subangular Silty., calcareous cement. | SM | | | | | | 17 | Collected stainless ST. Analytical S.S from 20-22' at: 11:10 CANCOG-1061-0020 |
| | | | | | | A41 | | 42 | OVA in S.S.- 0 ppm |
| 21 | | | | | | | | 46 | OVA in augers, 0 ppm |
| | | | | | | | | 52 | |
| 22 | | | | | | | | | ~~collected SPT from 22-24' at:~~ |
| 23 | | | | | | | | | |
| 24 | | | | | | | | | ~~collected SPT from 24-26' at:~~ |
| 25 | | | | | | | | | |

PROJECT NO. 89MC 114 W

SHEET 3 OF 4

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 1061

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 25 | SAND, Light brown, very fine grained, well sorted, silty pale Brown mottles, calcite cement. dark Brown staining at the top of S.S. | SM (Caliche) | | | | | | 19 | Collected SPT from 25-27' at: 11:35 |
| | | | | | | G10 | | 21 | OVA in S.S.-0 ppm |
| 26 | | | | | | | 40 | 44 | ~~collected SPT from 26-28'~~ at: |
| | | | | | | | | 38 | Added two gal of DI water around augers. |
| 27 | | | | | | | | | |
| 28 | | | | | | | | | ~~collected SPT from 28-30' at:~~ |
| 29 | | | | | | G11 | | | Blowcounts taken w/ a 140lb hammer dropped 30" |
| 30 | SAND, Light reddish brown very fine grained, subangular to angular, well sorted, calcite cemented loosily. silty | SM | | | | | | 25 | Collected stainless st. analytical S.S sample from 30-32' at: 12:30 |
| 31 | | | | | | A5 | | 45 | CAN06-1061-0030 |
| | | | | | | | | 51 | OVA in SS-0 ppm OVA in augers-0 ppm |
| 31.5 | Bottom of Boring | | | | | | | | |
| | | | | | | | | | Collected Rinsate blank at: 13:50 CAN06-1061-1071 |
| | | | | | | | | | Grouted Boring with cement Bentonite grout from 0-31.5 at 14:45 |

PROJECT NO. 89MC114W

SHEET 4 OF 4

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 1062

| | | | |
|---|---|---|---|
| BORING LOCATION Fire Training Area #2 | | ELEVATION AND DATUM 4261.20' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER B. Kingsley | DATE STARTED 10-23-91 / DATE FINISHED 10-25-91 | |
| DRILLING EQUIPMENT Mobile B-53 | | COMPLETION DEPTH 31 | SAMPLER 3" Stainless 2" S.S. |
| DRILLING METHOD HSA 6" OD, 3 3/4" ID | DRILL BIT 6 1/4" Bulkt | NO. OF SAMPLES DIST. NA | UNDIST. Analytical - 5 Geotech 8 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY SM Beth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite Grout | FROM 0 TO 31 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov./ft. | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | SAND medium reddish brown Very fine to fine grain. sub-angular, wellsorted. Non-calcareous, silty | SM | | | | A1 | | 4 | Start drilling at 16:10 surface soil collected from 0-.3 at 13:45 CAN106-1062-0000 CAN106-1062-(0-2') |
| | | | | | | | .9 | 7 | SPT from 0-2' at: 16:10 |
| 1 | | | | | | G1 | | 9 | |
| | Base of S.S. pale brown calc. Sand | | | | | | | 24 | |
| 2 | SAND, pale brown., very fine grained, mottled, Lt white calcite cemented loosely, silty | caliche (SM) | | | | | | 17 | SPT from 2-4' at 16:20 |
| | | | | | | G2 | .9 | 18 | OVA in S.S. on augers - 0 ppm B. Zone - 0 ppm Geotech Anal. CAN106-1062-0002 |
| 3 | | | | | | | | 8 | |
| | | | | | | | | 10 | SPT |
| 4 | SAND, Light reddish brown to pale Brown mottled. Very fine grained, angular, silty (15%) well sorted, calcite cement. | caliche (SM) | | | | G3 | | 8 | S.S. from 4-6' at 14:30 |
| | | | | | | | | 10 | Drillers took Geotech Rather than Stainless |
| 5 | | | | | | | .8 | 13 | will take Anal. on next Drive |
| | | | | | | | | 18 | OVA in SS samples 0 ppm Stainless - Analytical |
| 6 | SAND, Light brown, Very fine grained subangular, silty (10%) calcite cement | caliche (SM) | | | | A2 | | 9 | SPT from 6-8' at: 16:45 CAN106-1062-0006 |
| | | | | | | A3 | 1.3 | 18 | OVA in SS - 0 ppm augers - 0 ppm B. Zone - 0 ppm |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 1 OF 4

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 1062

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetrat. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | 14 | |
| | | | | | | | | 13 | |
| 8 | SAND, Light reddish brown very fine to fine grained sub-angular, silty calcite cement. | | | | | | | | SPT from 8-10' at 17:00 |
| | | | | | | | 1.1 | 6 | OVA in SS - 0 ppm |
| 9 | | | | | | G4 | | 7 | OVA augers 0 ppm B. Zone 0 ppm |
| | | SM | | | | | | 9 | |
| | | | | | | | | 10 | |
| 10 | SAND reddish brown, very fine to fine grained, silty sub angular, well sorted calcareous. | SM | | | | | | 8 | stainless S.S. Analytical from 10-12' at 17:45 CAN 1001-1011-0010 |
| 11 | | | | | | A3 | 1.0 | 16 | OVA in SS - 0 ppm augers - 0 ppm B. Zone - 0 ppm |
| | | | | | | | | 25 | |
| | | | | | | | | 37 | |
| 12 | SAND reddish brown grades downward to pale brown, very to fine grained, silty, calcite increases downward. | SM | | | | | 1.1 | 16 | SPT from 12-14' at 17:25 |
| | | | | | | | 1.5 | 40 | 17:45 shut down for night at 13.5 feet. |
| 13 | | | | | | | | 67 | |
| | | | | | | | | | Started Drilling 10-24-91 at 8:15 |
| 14 | SAND pale brown to medium reddish brn, very fine grained, silty (20%) well sorted calcareous | SM | | | | | | | SPT from 14-16' at 8:20 |
| | | | | | | | 1.0 | 20 | OVA - SS - 0 ppm |
| 15 | | | | | | S5 | | 45 | - auger - 0 ppm B. Zone - 0 ppm |
| | | | | | | | | 30 | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 1062

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | SAND Medium reddish brown very fine to fine grained, silty well sorted, angular, calcareous at base of s.s grades interpole red brown sand calcite cemented | SM | | | | G6 | 1.2 | 16 | SPT from 16-17.5 at: 8:50 |
| | | | | | | | | 22 | OVA in S.S - 0 ppm |
| 17 | | | | | | | | | - auger - 0 ppm |
| | | | | | | | | | - B. Zone 0 ppm |
| | | | | | | | | 67 | |
| 18 | SAND, Pale, brown, very fine to fine grained, Angular, silty well sorted. cemented w/ calcite, mottled with white patches | | | | | | .8 | 30 | SPT from 18-19 at 9:10 |
| | | | | | | G7 | | 120 | Gradation Analysis sample at: 9:10 |
| 19 | | | | | | | | | CANAG-1062-4018 |
| | | | | | | | | | Add 2 gal of DI water to augers |
| 20 | SAND pale brown, Fine grained sub angular, well sorted, silty well cemented w/ calcite. | calcite (SM) | | | | | | 57 | Stainless steel Analytical from: 20-22 at: 10:05 |
| | | | | | | A4 | 1.7 | 167 | CANIOG-1061-0020 |
| 21 | | | | | | | | | CANIOG-1061-1062 (Field Dup) |
| | | | | | | | | 293 | OVA in S.S. - 0 ppm |
| | | | | | | | | | auger - 0 ppm |
| | | | | | | | | 300 | B. Zone - 0 ppm |
| 22 | | | | | | | | | |
| 23 | | | | | | | | | |
| 24 | | | | | | | | | |
| 25 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 3 OF 4

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB. HOLE NO. 1062

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, e |
|---|---|---|---|---|---|---|---|---|---|
| 25 | SAND, reddish brown to pale brown, Fine grained sub angular to Angular, well sorted, silty, loosely to tightly cemented with calcite. | caliche (SM) | | | | | 5 | 46 | SPT from 25-26 at: 10:55 |
| | | | | | | GP | | 75 | OVA in S.S- 0 ppm |
| 26 | | | | | | | | | OVA-augers } 0 ppm - B.zone } |
| 27 | | | | | | | | | |
| 28 | | | | | | | | | Drilled to 28' and U-joint went out. on rig 12:00 |
| 29 | | | | | | | | | |
| | | | | | | | | | 10-25-91 started Drilling 8:15 |
| 30 | SAND Light reddish Brown very fine to fine grained, silty angular to subangular, well sorted calcite cemented. | caliche (SM) | | | | | f | 70 | stainless steel Analytical from at 8:25 |
| | | | | | | A5 | | 250 | CAN100-1062-0030 OVA in SS } augers - 0 ppm B.zone - 0 ppm |
| 31 | Bottom of Boring | | | | | | | | |
| 32 | | | | | | | | | grouted boring from 0 to 31' with Cement Bentonite grout (3-5% bentonite) |
| | | | | | | | | | blow counts taken with a 140 lb hammer, dropped 30" |

PROJECT NO. 89MC 114W

SHEET 4 OF 4

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 1063

| | | | |
|---|---|---|---|
| BORING LOCATION Fire training Area No 2 | | ELEVATION AND DATUM 4261.69' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER B Kingsley | DATE STARTED 10-25-91 DATE FINISHED 10-26-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 32' | SAMPLER 3" stainless steel S.S., 2" steel S.S. |
| DRILLING METHOD HSA-6" OD, 3 3/4" OD | DRILL BIT 6 1/2" Bullit | NO. OF SAMPLES DIST. NA | UNDIST. Analytical-5 Geotech-4 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY SMButh |
| SIZE AND TYPE OF PACK N/A | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite Grout | FROM 0 TO 32 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov./ft. | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | A1 | | 2 | Started Drilling at: 10:50 |
| | SAND, reddish brown, very fine grained, subangular well sorted, slightly silty and slightly calcareous. | SM | | | | G1 | 1.5 | 5 | collected surface sample at ~~11:00~~ 14:15 on 10-23-91 CAN 1061/1063-0000 MS/MSD |
| 1 | | | | | | | | 20 | SPT from 0-2' at: 11:10 |
| | | | | | | | | 22 | |
| 2 | SAND, pale, brown, very fine grained, sub angular, well sorted, silty calcite cemented. | ~~SP~~ SM (Caliche) | | | | G2 | .9 | 54 | SPT from 2-4' at 11:20 |
| 3 | | | | | | | | 47 | |
| | | | | | | | | 37 | |
| | | | | | | | | 22 | |
| 4 | SAND, pale Brown, very fine grained, subangular, silty well sorted, tightly cemented w/ calcite. | SM (Caliche) | | | | | | 16 | Stainless steel Analytical from 4-6' at: 11:30 |
| | | | | | | A2 | | 22 | OVA in SS. 0 ppm CAN 1061/1063-0004 |
| 5 | | | | | | | 1.6 | 27 | CAN 1061/1063-4004 Grad Anal. |
| | | | | | | | | 32 | |
| 6 | | | | | | B3 | | 50 | SPT from 6-8' at 11:43 |
| | | | | | | | | 21 | OVA 1455 0 ppm |
| 7 | | | | | | | | | OVA-augers-0 ppm |

PROJECT NO. 89MC114W

SHEET 1 OF 4

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 1063

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist. Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | SAND, pale brown, Very fine to medium grained, silty Subangular to rounded fair sorting, cemented w/ calcite. (pale brown & white mottled) | SM (calcite) | | | | | .45 | ~~SPT from~~ | |
| | | | | | | G3 | | 31 | |
| | | | | | | | | 52 | SPT from 8-9' at 13:15 |
| 8 | | | | | | | | 30 | OVA batteries Dead |
| | | | | | | G4 | 1.0 | 28 | |
| 9 | | | | | | | | 32 | |
| | SAND Pale brown, Very fine to medium grained subangular to subrounded calcite cement silty | SM (calcite) | | | | | | 24 | |
| 10 | | | | | | | | 12 | stainless ST Analytical from 10-12' at 13:25 CANNON-1063-0010 |
| | | | | | | | .4 | 28 | |
| 11 | | | | | | A3 | | 34 | |
| | SAND, Reddish Brown, Very fine grained, calcareous | | | | | | | 62 | |
| 12 | SAND reddish brown, very fine grained, subangular, well sorted, silty (10%) calcareous. | SM | | | | | | 15 | SPT from 12-14 at 13:40 |
| | | | | | | G5 | | 29 | |
| 13 | | | | | | | .15 | 35 | |
| | | | | | | | | 42 | |
| 14 | | | | | | | | 18 | SPT from 14-16' at: 14:00 |
| | SAND; Very fine to medium grained, Light reddish brown fair sorting, subangular to rounded, silty | SM | | | | G6 | 1.0 | 25 | |
| 15 | | | | | | | | 30 | |
| | | | | | | | | 40 | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 2 OF 4

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 1063

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist. Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | SAND, pale reddish brown, mottled, very fine to fine grained, subrounded, well sorted, calcite cement silty | SM (caliche) | | | | | | 16 | SPT from 14-18 at 14:20 |
| | | | | | | G7 | 1.5 | 25 | 14:25 Shut Rig down to repair blow hammer |
| 17 | | | | | | | | 28 | |
| | | | | | | | | 41 | SPT from 17-20' at 17:40 |
| 18 | SAND, reddish brown Fine grained, Subangular well sorted, calcareous silty | SM | | | | | | 13 | Drillers back at 17:00 with repaired Blow hammer |
| | | | | | | | 1.5 | 19 | |
| | | | | | | G8 | | | |
| 19 | | | | | | | | 23 | OVA not working |
| | | | | | | | | 85 | |
| 20 | SAND, reddish Brown Very fine to fine grained subangular to subrounded well sorted, calcite cemented, silty | SM (caliche) | | | | | | 27 | Stainless steel S.S Analytical from 20-22' |
| | | | | | | | 1.7 | 33 | at 18:20 CAN06-1063-0020 |
| 21 | | | | | | A4 | | | |
| | | | | | | | | 30 | collect ambient blank at 16:25 CAN06-1063-1051 |
| | | | | | | | | 24 | |
| 22 | | | | | | | | | |
| 23 | | | | | | | | | |
| 24 | | | | | | | | | |
| 25 | | | | | | | | | |

PROJECT NO. 89MC114W

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB. HOLE NO. 1063

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetr. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, ...) |
|---|---|---|---|---|---|---|---|---|---|
| 25 | SAND, reddish brown locally light brown mottled, very to fine grained angular to sub rounded, wellsorted, silty slight calcite cemented. ~~bright~~ brown mottles are well cemented w/ calcite | SM ~~(calcite)~~ | | | | | | 15 | SPT from 25-27' at 8:15 on 10-26-91 |
| 20 | | | | | | 69 | 1.5 | 19 | Collect gradation analysis sample CAN10-1063-4025 |
| | | | | | | | | 16 | |
| | | | | | | | | 16 | |
| 27 | | | | | | | | | |
| 28 | | | | | | | | | |
| 29 | | | | | | | | | |
| 30 | SAND, pale reddish brown, fine to medium grained, subangular to sub rounded. well sorted., silty calcite cement | SP ~~SM~~ | | | | | | 46 | Stainless steel Analytical S.S. from 30-32' at 9:25 CAN10-1063-0030 |
| | | | | | | | 1.7 | 54 | |
| 31 | | | | | | AS | | 58 | OVA in S.S. and augers - 0 ppm Breathing Zone 0 ppm |
| | | | | | | | | 44 | |
| 32 | Bottom of Boring. | | | | | | | | grout Boring from 0 to 32' with cement bentonite grout (3-5% Bentonite) Blow counts taken with a 140 lb hammer dropped 30" |

PROJECT NO. 89MC 114 W

SHEET 4 OF 4

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 1064

| | | | |
|---|---|---|---|
| BORING LOCATION: Fire training Area # 2 | | ELEVATION AND DATUM: 4261.61' MSL | |
| DRILLING AGENCY: Environmental Drilling | DRILLER: B. Kingsley | DATE STARTED: 10-26-91 / DATE FINISHED: 10-26-91 | |
| DRILLING EQUIPMENT: ~~HSA 6" OD, 3 3/4" ID~~ Mobile B-61 | | COMPLETION DEPTH: 32' | SAMPLER: 3" stainless / 2" steel |
| DRILLING METHOD: HSA 6" OD, 3 3/4" ID | DRILL BIT: 6 1/2" Bullet | NO. OF SAMPLES: DIST. NA | UNDIST. Analytical 2 / Geotech 5 / 9 |
| SIZE AND TYPE OF CASING: NA | | WATER ELEV.: FIRST NA | COMPL. NA / 24 HRS. NA |
| TYPE OF PERFORATION: NA | FROM TO FT. | LOGGED BY: Larry Gardiner | CHECKED BY: Smith |
| SIZE AND TYPE OF PACK: NA | FROM TO FT. | | |
| TYPE OF SEAL: Cement Bentonite Grout | FROM 0 TO 32 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recovery | SAMPLES: Penetr. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | SAND Reddish brown, fine grained subangular, wellsorted, silty (15%) Non-calcareous | SM | | | | A1 | | 6 | Surface sample from 0-.5 at 14:30 10-23-91 |
| 1 | | | | | | | | 8 | Started Drilling at 12:00 |
| | | | | | | B1 | 15 | 8 | SPT from 0-2' at 12:05 |
| 2 | | | | | | | | 19 | SPT from 2-4' at 12:15 |
| | SAND, pale brown Very fine grained silty subangular to subrounded, mottled white, calcite cemented | SM (caliche) | | | | B2 | 13 | 13 | |
| 3 | | | | | | | | 12 | |
| | | | | | | | | 12 | |
| | | | | | | | | 10 | |
| 4 | SAND, Reddish brown, fine grained, subangular wellsorted, calcite cement silty, | SM | | | | A2 | | 6 | stainless steel Analytical S.S. from 4-6' at 12:35 CAN06-1064-0004 |
| 5 | | | | | | | 1.4 | 10 | OVA in S.S. 0 ppm |
| | | | | | | | | 12 | |
| | | | | | | | | 12 | |
| 6 | SAND, ~~as above~~ pale brown, very fine to fine grained subangular to subrounded, well cemented w/ calcite, silty | SM (caliche) | | | | B3 | 14 | 6 | SPT from 6-8' at 12:40 |
| 7 | | | | | | | | 9 | |

PROJECT NO. 89/4C/140

SHEET 1 OF 4

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 1064

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetr. Resist. Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | 11 | |
| | | | | | | G3 | | | |
| | | | | | | | | 12 | |
| 8 | SAND, very to fine gr. pale brown, well cemented w/ calcite, as above, silty | | | | | | | | SPT from 8-10 at 12:45 collect. Gradation Analysis CAN106-1064-0008 |
| 9 | | SM | | | | G4 | | | |
| | | | | | | | | 6 | |
| | | | | | | | | 9 | |
| 10 | SAND Pale Red Brown, very fine to grained, subangular to sub rounded, cemented w/ calcite silty | | | | | | | 9 | Stainless st Analytical S.S from 10-12' |
| | | | | | | A3 | | 21 | at 13:05 |
| 11 | | | | | | | | | CAN106-1064-0010 |
| | | | | | | | | 49 | OVA in auger & S.S - 0 ppm |
| | SAND Pale Brown calcite increasing | | | | | | | 95 | |
| 12 | SAND, Pale brown, very fine grained, angular to sub-angular, well sorted, well cemented w/ calcite, silty | SM (calche) | | | | | | 20 | SPT from 12-14' at 13:15 |
| | | | | | | | | 40 | OVA in S.S - 0 ppm |
| 13 | | | | | | G5 | | | |
| | | | | | | | | 45 | |
| | | | | | | | | 57 | |
| 14 | SAND, as above | SM (calche) | | | | | | | SPT from 14-16' at 13:30 |
| | | | | | | | | 30 | OVA in S.S - 0 ppm |
| | | | | | | G6 | | 57 | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 2 OF 4

**Woodward-Clyde Consultants** PROJECT NAME _____ HOLE NO. 1064

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | SAND, reddish brown, very fine to fine grained subangular to subrounded, well sorted, Calcareous., silty | | | | | | | 24 | SPT from 16-18' at 13:50 |
| | | | | | | G7 | | 31 | |
| 17 | | | | | | | 1.9 | 39 | |
| | | SM | | | | | | 42 | SPT from 18-20 at 14:10 |
| 18 | SAND Red brown as above | | | | | | | 16 | |
| | SAND, pale brown to white mottled, very fine grained subangular, well cemented w/ calcite | | | | | G8 | 1.8 / 1.0 | 58 | |
| 19 | | SM (caliche) | | | | | | | |
| 20 | SAND, pale brown, very fine grained, angular to subangular silty, (20%) cemented w/ calcite | | | | | | | | stainless steel Analytical S.S. from 20-22 at 14:20 |
| | | | | | | | | 28 | |
| | | | | | | | 1.8 | 48 | CAN106-1064-0020 CAN106-1064-1002 (MRD) |
| 21 | | | | | | A4 | | 67 | |
| | | | | | | | | 60 | OVA in S.S. and Augers - 0 ppm |
| 22 | | | | | | | | | |
| 23 | | | | | | | | | |
| 24 | | | | | | | | | |
| 25 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 3 OF 4

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 1064

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc |
|---|---|---|---|---|---|---|---|---|---|
| 25 | SAND, pale brown, fine grained, subangular to subrounded, silty well sorted, cemented w/ calcite, | SM (Caliche) | | | | G9 | | 32 52 | SPT from 25-26 at 14:45 |
| 26 | | | | | | | | | |
| 27 | | | | | | | | | |
| 28 | | | | | | | | | |
| 29 | | | | | | | | | |
| 30 | SAND, reddish brown, very fine to fine grained, silty subangular, well sorted, calcareous to lightly cemented with calcite | SM | | | | | | 10 | Stainless steel Analytical S.S, from 30 - 32, at 15:20 |
| 31 | | | | | | | 1.0 | 12 | CAN106-1064-0030 |
| | | | | | | A5 | | 24 | CAN106-1064-4030 Gradatio Analysis |
| | | | | | | | | 72 | OVA in S.S and augers - 0 ppm. |
| 32 | Bottom of Boring | | | | | | | | Collected Decon water at 16:00 CAN106-1064-1081 Grouted boring from 0 to 32' with Cement Bentonite grout (3-5% bentonite) |

PROJECT NO. 89MC114W SHEET 4 OF 4

(redrilled 1061)

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 1065

| | | | |
|---|---|---|---|
| BORING LOCATION Fire training Area #2 | | ELEVATION AND DATUM 4261.44' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER M Powless | DATE STARTED 12-5-91 / DATE FINISHED 12-5-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 6' | SAMPLER 3" stainless S.S. |
| DRILLING METHOD HSA - 7½" OD, 4¼" ID | DRILL BIT 8¼" Bullet | NO. OF SAMPLES DIST. NA | UNDIST. Analytical - 1 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST NA | COMPL. NA 24 HRS NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY Scott Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite grout | FROM 0 TO 6 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft. | SAMPLES: Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | start Drilling at 13:30 |
| 1 | | | | | | | | | Drill with bit to 4' |
| 2 | | | | | | | | | See original boring Log 1061 for lithologic description |
| 3 | | | | | | | | | |
| 4 | | | | | | | | 11 | collect analytical stainless steel S.S sample from 4-6' |
| | | | | | | A1 | 1.9 | 15 | at 13:40 CAN06-1065-0004 MS/MSD |
| 5 | | | | | | | | 12 | OVA auger S.S B.Zone } 0 ppm |
| | | | | | | | | 20 | |
| 6 | | | | | | | | | Collect ~~Rinsate~~ Rinsate blank at 14:05 CAN06-1065-1072 |
| | Bottom of boring | | | | | | | | grouted boring from 0-6' w/ cement-Bentonite grout |

PROJECT NO. 89MC14W

SHEET 1 OF 1

(redrill of 106

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 1066

| | | | |
|---|---|---|---|
| BORING LOCATION Fire training Area #2 | | ELEVATION AND DATUM 4261.84' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER M. Pawless | DATE STARTED 12-5-91 DATE FINISHED 12-5-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 32 | SAMPLER 3" stainless S.S. |
| DRILLING METHOD HSA 7½OD-4¼ ID | DRILL BIT 8¼" bullet | NO. OF SAMPLES / DIST. | UNDIST. Analytical - 3 Geotech - 7 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. / FIRST | COMPL. / 24 HRS. |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardinor | CHECKED BY Sm Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement + Bentonite grout | FROM 0 TO 32 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recovery | SAMPLES: Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | start drilling at 8:45 |
| | | | | | | | | | Drill to 4' with bit. |
| 1 | | | | | | | | | |
| | | | | | | | | | See original boring Log 1063 for lithologic description. |
| 2 | | | | | | | | | |
| | | | | | | | | | at 9:15 drillers took sub into town to machine threads. FT would not screw on S.S. |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | collect analytical stainless steel S.S sample from 4-6' at 10:03 |
| | | | | | | | | 7 | |
| | | | | | | A1 | 1.5 | 11 | CAN106-1206-0004 |
| 5 | | | | | | | | | |
| | | | | | | | | 12 | OVA - augers S.S. B. Zone } 0 ppm |
| | | | | | | | | 39 | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W SHEET 1 OF 4

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 1066

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist. Blows 6 in. | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | | |
| 8 | | | | | | | | | Drill To 10' |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | stainless steel |
| | | | | | | | | 11 | s.s. from 10-12' |
| | | | | | | | | | at 10:30 |
| | | | | | | | 1.7 | 14 | |
| 11 | | | | | | GI | | | GVA- |
| | | | | | | | | 13 | auger S.S R.Zone } 0 ppm |
| | | | | | | | | 16 | |
| 12 | | | | | | | | | |
| | | | | | | | | | Drill To 20' |
| 13 | | | | | | | | | 0 |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W

**Woodward-Clyde Consultants** PROJECT NAME C ANNON AFB HOLE NO. 1066

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | collect analytical stainless steel |
| | | | | | | | | 14 | ~~ab~~ S.S from 20-22' |
| | | | | | | | 1.8 | | at 10:50 |
| | | | | | | A2 | | 20 | OVA- |
| 21 | | | | | | | | | Auger S.S. B. Zone } 0 ppm |
| | | | | | | | | 16 | |
| | | | | | | | | 20 | CAN106-1066-0020 |
| 22 | | | | | | | | | |
| 23 | | | | | | | | | |
| 24 | | | | | | | | | |
| 25 | | | | | | | | | |

PROJECT NO. 89MC114W

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 1066

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist. Blows 6 in. | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 25 | | | | | | | | | |
| 26 | | | | | | | | | Collect Ambient blank at 11:15 CAN106-1066-1052 |
| 27 | | | | | | | | | |
| 28 | | | | | | | | | |
| 29 | | | | | | | | | |
| 30 | | | | | | | | 15 | collect analytical stainless steel S.S sample from 30-32' at 11:30 CAN106-1066-0030 |
| | | | | | | A3 | | 18 | |
| 31 | | | | | | | | 11 | OVA - augers S.S. B.Zone } 0 ppm |
| | | | | | | | | 20 | |
| 32 | Bottom of Boring | | | | | | | | collect decon water sample at 11:55 CAN106-1066-1052 |
| | | | | | | | | | grout boring from 0-32' w/ Cement-Bentonite grout. |

PROJECT NO. 8914C114W

SHEET 4 OF 4

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 1071

| | | | |
|---|---|---|---|
| BORING LOCATION Fire training Area #3 | | ELEVATION AND DATUM | |
| DRILLING AGENCY Environmental Drilling | DRILLER B. Kingsley | DATE STARTED 10-8-91 / DATE FINISHED 10-9-91 | |
| DRILLING EQUIPMENT Mobile B-53 | | COMPLETION DEPTH 31' | SAMPLER 3" stainless steel S.S., 2" steel S.S |
| DRILLING METHOD HSA 10" OD, 3 3/4" ID | DRILL BIT 6 1/2" Bullit | NO. OF SAMPLES / DIST. NA | UNDIST. Analytical-S Geotech-S |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. / FIRST NA | COMPL. NA / 24 HRS. NA |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY LARRY Gardiner | CHECKED BY Scott Beth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite grout | FROM 0 TO 31 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov. ft. | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | SAND, Lt. brown, very fine grained, subangular, silty | SM | | | | A1 | | 5 | Collected surface soil sample at 13:55 from 0 to 0.5' CAN07-1071-0000 |
| | | | | | | | 1.5 | 4 | ~~collected gradation analysis sample from 0 to 1.5' at CAN07-1071-1073 (FD)~~ |
| 1 | | | | | | G1 | | 3 | ~~CAN07-1071-4000~~ |
| | | | | | | | | 8 | Start drilling at 14:00 OVA in S.S auger B. Zone } 0 ppm |
| 2 | | | | | | | | 7 | |
| | | | | | | G2 | 1.3 | 6 | spt from 2 to 3.5' at 14:05 |
| 3 | | | | | | | | 8 | |
| | SAND, reddish brown, very fine grained, subangular to angular, silty, damp | SM | | | | | | 7 | spt from 3.5 to 5' at 14:10 |
| 4 | | | | | | G3 | 1.0 | 7 | |
| | | | | | | | | 8 | |
| 5 | SAND, reddish brown to tan, | | | | | | | 5 | Collected stainless steel S.S sample from 5-6.5' at 14:15 |
| | | | | | | A2 | 1.2 | 6 | CAN07-1071-0005 MS/MSD |
| 6 | | | | | | | | 4 | OVA-S.S.-0 ppm auger-0 ppm B. Zone-0 ppm |
| | | | | | | | | 7 | Collected Rinsate blank CAN07-1071-1071 |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 1071

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | 7 | |
| | | | | | | | 1.6 | 5 | |
| 8 | SAND, very fine grained, light reddish brown, angular, well sorted, silty | SM | | | | | | 6 | SPT from 8.5 to 10' at 15:10 |
| | | | | | | | | 8 | |
| 9 | | | | | | G4 | 1.9 | 10 | |
| | | | | | | | | 6 | |
| 10 | SAND, reddish brown, very fine grained, angular, well sorted, silty Calcareous | | | | | | | 7 | collected stainless steel, analytical S.S. sample from 10-11.5' at 15:25 |
| | | | | | | A3 | 1.5 | 14 | |
| 11 | | | | | | | | 16 | CAN/07-1071-0010 ~~CAN/07-1071-1071~~ ~~(FD)~~ |
| | SAND, reddish brown, very fine to fine grained, subangular, well sorted, silty, Calcareous | SM | | | | | | 5 | OVA-S.S.-augers-B. zone } 0 ppm |
| 12 | | | | | | | 1.8 | 1 | |
| | | | | | | | | 2 | |
| 13 | SAND, as above, calcareous | | | | | | | 2 | |
| | | | | | | | | 2 | SPT from 13.5 to 15' at 16:00 |
| 14 | | | | | | G5 | 1.8 | 1 | collect gradation analysis sample at 16:30 from 13.5-15' CAN/07-1071-4013 |
| | | | | | | | | 1 | |
| 15 | SAND, reddish brown, very fine to fine grained, subangular, well sorted, silty | SM | | | | | | | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 2 OF 4

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 1071

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | | | | | | | | | |
| 17 | SAND, Light brown, very fine grained, well sorted, silty cemented w/ calcite, hard | (SM) caliche | | | | | | 50 | |
| | | | | | | | | 50 (4") | |
| 18 | | | | | | | | | Augers halted at 18'. added 1 gal. of DI water around augers drilled to 20' |
| | | | | | | | | 50 (6") | |
| 19 | | | | | | | | | |
| 20 | SAND, Light brown, very fine grained, angular, calcite cemented, silty | caliche (SM) | | | | | | 113 | Collected stainless steel analytical sample from 20 to 21 at 18:50 |
| | | | | | | A4 | .9 | | CAN107-1071-0020 |
| | | | | | | | | 140 | |
| 21 | | | | | | | | | GVA-S.S augers B. Zone } 0 ppm |
| 22 | | | | | | | | | |
| 23 | SAND, Light reddish brown very fine grained, angular, well sorted, silty, Calcareous | SM | | | | | | | SPT from 23.5 to 25' at 8:25 |
| | | | | | | | | 36 | |
| 24 | | | | | | G6 | 1.5 | | |
| | | | | | | | | 24 | |
| | | | | | | | | 15 | |
| 25 | | | | | | | | | |

PROJECT NO. 25MC114W

SHEET 3 OF 4

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 1071

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 25 | | | | | | | | | |
| 26 | | | | | | | | | |
| 27 | | | | | | | | | |
| 28 | SAND, light brown, very fine grained, calcite cemented, hard, silty | caliche (SM) | | | | | | | |
| | | | | | | | | 21 | SPT from 28.5 To 29.5 11:30 |
| 29 | | | | | | G7 | .9 | 29 | |
| | | | | | | | | 39 | collected stainless steel analytical S.S. Sample from 29.5 - 31.0 at 11:45 (10-9-91) CAN07-1071-0029 |
| 30 | | | | | | AS | .3 | 49 | |
| | | | | | | | | 108 | OVA-S.S. augers B.Zone } 0 ppm |
| 31 | Bottom of Boring | | | | | | | | |
| | | | | | | | | | grouted Boring from 0 to 31' w/cement-Bentonite grout placed metal spike into grouted Borehole |

PROJECT NO. 89MC114W

SHEET 4 OF 4

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1072

| | | | |
|---|---|---|---|
| BORING LOCATION Fire Training Area No. 3 | | ELEVATION AND DATUM 4265.80' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER L. Weeks | DATE STARTED 10-24-91 DATE FINISHED 10-25-91 | |
| DRILLING EQUIPMENT Failing F-10 | | COMPLETION DEPTH 31' | SAMPLER 3" Stainless Steel SS 2" Steel SS |
| DRILLING METHOD HSA 3¾" ID 6¾" OD | DRILL BIT 7¼" Bullet | NO. OF SAMPLES DIST. — | UNDIST. Analytical - 5 Geotechnical - 9 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL. — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kubeczko | CHECKED BY Jim Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite Grout | FROM 0 TO 31 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov. ft. | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | Sand, light gray-brown to gray-tan, fine grained, subrounded to subangular, well sorted, calcareous w/ caliche pockets & layers (15-25%), silty (5-10%), trace clayey (5%), dry to slightly moist, medium dense | SM | | | | A1 | | 15 | Collected surface soil Spl from 0' to 0.5' @ 1450 on 10-23-91 CAN107-1072-0000 |
| | | | | | | | | 16 | Collected MRD Duplicate CAN107-1072-1101 OVA on sample = 0 ppm |
| 1 | Sand, red-brown brown-orange, fine grained, subangular, well sorted, silty (10-20%), clayey (5-15%), slightly moist, medium dense to dense | | | | | G1 | 1.7 | 10 | Started drilling @ 1620 on 10-24-91 |
| | | | | | | | | 13 | SPT Spl from 0' to 2' @ 1620 CAN107-1072-4000 |
| 2 | | SM | | | | | | 8 | SPT Spl from 2' to 4' @ 1625 CAN107-1072-4002 |
| | | | | | | | | 10 | Collected gradation analysis sample from 2' to 4' @ 1625 |
| 3 | | | | | | G2 | 1.1 | 22 | |
| | | | | | | | | 37 | OVA @ 4' in augers = 0.2 ppm in breathing zone = 0 ppm |
| 4 | Caliche, pale orange to tan-orange, silty (5%), sandy (5-15%), clayey (5-10%), slightly moist, medium dense | | | | | | | 15 | Stainless Steel SS Spl from 4' to 6' @ 1650 OVA on sample = 0 ppm CAN107-1072-0004 |
| | | | | | | | | 17 | |
| 5 | | CALICHE | | | | A2 | 1.7 | 10 | |
| | | | | | | | | 15 | |
| 6 | | | | | | | | 6 | SPT Spl from 6' to 8' @ 1705 CAN107-1072-4006 |
| | Sand, light to medium orange, fine grained, subangular, well sorted, calcareous (15-20%), silty (10-15%), clayey (5-10%), slightly moist, loose | SM | | | | G3 | 1.3 | 7 | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W T2K

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1072

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist. Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc |
|---|---|---|---|---|---|---|---|---|---|
| 7 | Sand, medium to light orange, fine grained, subangular, well sorted, calcareous (15-20%) w/ scattered pockets of tan-orange caliche, silty (5-15%), clayey (5-10%), slightly moist, loose | | | | | | | 8 | |
| | | | | | | G3 | 1.3 | 5 | |
| 8 | | | | | | | | 5 | SPT Spl from 8' to 10' @ 1715 CAN107-1072-4008 |
| | | | | | | | | 5 | |
| | | | | | | G4 | 1.6 | | |
| 9 | | | | | | | | 6 | |
| | | | | | | | | 6 | OVA @ 10' in augers = 0.2 ppm In breathing zone = 0 ppm |
| 10 | | SM | | | | | | 5 | Stainless Steel SS Spl from 10' to 12' @ 1725 OVA on sample = 6 ppm CAN107-1072-0010 |
| | | | | | | | | 5 | |
| | | | | | | A3 | 1.7 | | |
| 11 | | | | | | | | 5 | |
| | | | | | | | | 10 | |
| 12 | | | | | | | | 6 | SPT Spl from 12' to 14' @ 1730 CAN107-1072-4012 |
| | | | | | | | | 10 | |
| 13 | | | | | | G5 | 1.7 | | |
| | | | | | | | | 12 | |
| | Caliche, pale orange, sandy (10-15%), silty (5-15%) clay (10%), slightly moist, medium dense | CALICHE | | | | | | 24 | OVA @ 14' in augers = 0.4 ppm in breathing zone = 0 ppm |
| 14 | Sand, orange, fine grained, subangular, well sorted, calcareous (15-25%) w/ occassional pockets & thin layers of caliche, silty (10-15%), clayey (5-10%), slightly moist, medium dense | | | | | | | 9 | SPT Spl from 14' to 16' @ 1745 CAN107-1072-4014 |
| | | | | | | | | 11 | |
| 15 | | SM | | | | G6 | 1.5 | | |
| | | | | | | | | 17 | |
| | | | | | | | | 15 | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W T2K

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1072

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | Sand, orange, fine grained, subangular, well sorted, silty (10-15%), calcareous (10-20%), clayey (5-10%), occassional pockets of tan-orange caliche, medium dense, slightly moist | | | | | | | 7 | SPT Spl from 16' to 18' @ 1805 CAN107-1072-4016 |
| | | | | | | | | 15 | |
| 17 | | | | | | G7 | 1.8 | | |
| | | | | | | | | 20 | |
| | | | | | | | | 21 | |
| 18 | | | | | | | | 11 | SPT Spl from 18' to 20' @ 1815 CAN107-1072-4018 |
| | | | | | | | | 13 | Collected gradation analysis sample from 18' to 20' @ 1815 |
| 19 | | | | | | G8 | 1.8 | | |
| | | | | | | | | 19 | |
| | | | | | | | | 19 | OVA @ 20' in augers = 0 ppm in breathing zone = 0 ppm |
| 20 | | | | | | | | | |
| | | SM | | | | | | 21 | Stainless Steel SS Spl from 20' to 22' @ 1830 CAN107-1072-0020 OVA on sample = 0 ppm |
| | | | | | | | | 59 | |
| 21 | | | | | | A4 | 1.9 | | |
| | | | | | | | | 59 | Collected Field Duplicate Sample from 20' to 22' @ 1900 |
| | | | | | | | | 58 | CAN107-1072-1162 |
| 22 | | | | | | | | | Stopped drilling @ 22' @ 1900 on 10-24-91 Started drilling @ 22' @ 730 on 10-25-91 |
| 23 | | | | | | | | | |
| 24 | | | | | | | | | |
| 25 | | | | | | | | | OVA @ 25' in augers = 0 ppm in breathing zone = 0 ppm |

PROJECT NO. 89MC114W T2K

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1072

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 25 | Sand, orange, fine grained, sub angular, well sorted, calcareous (15-20%), silty (10-15%), clayey (5-10%), medium dense, slightly moist | | | | | | | 8 | SPT Spl from 25' to 27' @ 815 CAN107-1072-4025 |
| | | | | | | | | 8 | |
| 26 | | | | | | G9 | 1.9 | | |
| | | | | | | | | 5 | |
| | | | | | | | | 12 | |
| 27 | | SM | | | | | | | |
| 28 | | | | | | | | | |
| 29 | | | | | | | | | OVA @ 30' in augers: 0 ppm in breathing zone: 0 ppm |
| 30 | Sand, pale orange, fine grained, subangular to sub-rounded, well sorted, calcareous (10-20%), silty (5-15%), trace clayey (5%), dense to very dense, occassional pockets of caliche, dry to slightly moist | SM | | | | | | 42 | Stainless Steel SS Spl from 30' to 31' @ 845 OVA on sample: 0 ppm CAN107-1072-0030 |
| | | | | | | | 1.0 | 142 | Stopped drilling @ 850 @ 31' on 10-25-91 |
| 31 | | | | | | A5 | | | |
| | Bottom of hole - 31' | | | | | | | | Pulled augers & placed tremie pipe to bottom of hole |
| 32 | | | | | | | | | Borehole diameter = 7¼" 10-27-91 1030 Grouted borehole from 0' to 31' w/ cement-bentonite grout |
| | | | | | | | | | Grout Mix 7 bags cement 30 lbs bentonite 50 gallons of water |
| 33 | | | | | | | | | Placed metal spike into grouted borehole, will top off later if necessary |
| 34 | | | | | | | | | |

PROJECT NO. 89MC114W T2K

SHEET 4 OF 4

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1073

| | | | |
|---|---|---|---|
| BORING LOCATION Fire Training Area No. 3 | | ELEVATION AND DATUM 4265.66' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER L. Weeks | DATE STARTED 10-25-91 DATE FINISHED 10-25-91 | |
| DRILLING EQUIPMENT Failing F-10 | | COMPLETION DEPTH 31' | SAMPLER 3" Stainless Steel SS 2" Steel SS |
| DRILLING METHOD HSA 3¾" ID 6¾" OD | DRILL BIT 7¾" Bullet | NO. OF SAMPLES DIST. — | UNDIST. Analytical - 5 Geotechnical - 9 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL. — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kubeczko | CHECKED BY SMButh |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement - Bentonite Grout | FROM 0 TO 31 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov. ft. | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | Sand, light gray-brown to light orange-brown, fine grained, subrounded to subangular, well sorted, calcareous w/ pockets & layers of caliche (15-25%), silty (5-10%), clayey (5%), dry to slightly moist, medium dense | SM | | | | A1 | | 21 | Collected Surface Soil Spl from 0' to 0.5' @ 1510 on 10-23-91 CAN107-1073-0000 MS/MSD OVA on sample = 0 ppm |
| | | | | | | | | 30 | Started drilling @ 1000 on 10-25-91 |
| 1 | Sand, red-brown brown-orange rust, fine grained, subangular, well sorted, silty (10-20%), clayey (10-15%), medium dense, slightly moist | | | | | G1 | 1.9 | 20 | SPT Spl from 0' to 2' @ 1010 CAN107-1073-4000 |
| | | | | | | | | 18 | |
| 2 | | SM | | | | | | 5 | SPT Spl from 2' to 4' @ 1015 CAN107-1073-4002 |
| | | | | | | G2 | 1.7 | 10 | |
| 3 | | | | | | | | 10 | |
| | | | | | | | | 11 | OVA @ 4' in augers = 0.9 ppm in breathing zone = 0 ppm |
| 4 | Caliche, pale orange to tan-orange, silty (10%) sandy (5-15%), clayey (5-10%), medium dense, slightly moist | | | | | | | 20 | Stainless Steel SS Spl from 4' to 6' @ 1020 OVA on sample = 1.1 ppm CAN107-1073-0004 |
| | | CALICHE | | | | A2 | 1.7 | 20 | |
| 5 | | | | | | | | 23 | |
| | | | | | | | | 16 | |
| 6 | Sand, orange, fine grained, subangular, well sorted, calcareous (15-25%) w/ scattered pale orange caliche pockets / layers, silty (10-15%), clayey (5-10%), loose, slightly moist | SM | | | | | | 6 | SPT Spl from 6' to 8' @ 1035 CAN107-1073-4006 |
| | | | | | | G3 | 1.6 | 7 | Collected gradation analysis from 6' to 8' @ 1035 |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W T2K

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1073

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc |
|---|---|---|---|---|---|---|---|---|---|
| 7 | Caliche, pale orange, sandy (10-20%), silty (5-15%) clayey (5-10%), slightly moist | CALICHE | | | | G3 | 1.6 | 8 | |
| | | | | | | | | 8 | |
| 8 | Sand, light to medium orange, fine grained, subangular, well sorted, calcareous w/ scattered pockets & thin layers of pale orange caliche (10-25%), silty (10-15%), clayey (5%), loose to medium dense, slightly moist | | | | | | | 6 | SPT Spl from 8' to 10' @ 1040 CAN107-1073-4008 |
| | | | | | | G4 | 1.2 | 7 | |
| 9 | | | | | | | | 13 | |
| | | | | | | | | 11 | OVA @ 10' in augers = 0 ppm In breathing zone = 0 ppm |
| 10 | | | | | | | | 7 | Stainless Steel SS Spl from 10' to 12' @ 1050 OVA on sample = 0 ppm CAN107-1073-0010 |
| | | | | | | A3 | 1.6 | 7 | |
| 11 | | SM | | | | | | 7 | |
| | | | | | | | | 7 | |
| 12 | | | | | | | | 2 | SPT Spl from 12' to 14' @ 1100 CAN107-1073-4012 |
| | | | | | | G5 | 1.4 | 7 | |
| 13 | | | | | | | | 9 | |
| | | | | | | | | 13 | OVA @ 14' in augers = 0 ppm in breathing zone = 0 ppm |
| 14 | | | | | | | | 9 | SPT Spl from 14' to 16' @ 1110 CAN107-1073-4014 |
| | | | | | | G6 | 1.3 | 15 | |
| 15 | | | | | | | | 20 | |
| | | | | | | | | 21 | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W T2K

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1073

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | Sand, light to medium orange, fine grained, subangular, well sorted, calcareous w/abundant pockets & thin layers of pale orange to tan-orange caliche (15-25%), silty (10-15%), clayey (5-10%), medium dense, slightly moist | | | | | | | 15 | SPT Spl from 16' to 18' @ 1120 CAN107-1073-4016 |
| | | | | | | | | 16 | Collected ambient blank water sample @ 1120 CAN107-1073-1151 |
| 17 | | | | | | G7 | 1.7 | 20 | |
| | | | | | | | | 21 | |
| 18 | | | | | | | | 12 | SPT Spl from 18' to 20' @ 1130 CAN107-1073-4018 |
| | | SM | | | | | | 11 | |
| 19 | | | | | | G8 | 1.7 | 9 | |
| | | | | | | | | 6 | OVA @ 20' in augers = 0.2 ppm in breathing zone = 0 ppm |
| 20 | | | | | | | | 9 | Stainless Steel SS Spl from 20' to 22' @ 1145 OVA on sample = 0 ppm CAN107-1073-0020 |
| | | | | | | | | 13 | |
| 21 | | | | | | A4 | 1.6 | 36 | |
| | Sand, pale orange to orange, fine grained, subangular, well sorted, calcareous w/ abundant pale orange tan-orange caliche pockets & thin layers (20-35%), silty (10-15%) clayey (5-10%), dry to slightly moist, dense | | | | | | | 61 | |
| 22 | | | | | | | | | |
| 23 | | SM | | | | | | | |
| 24 | | | | | | | | | |
| 25 | | | | | | | | | OVA @ 25' in augers: 0 ppm in breathing zone = 0 ppm |

PROJECT NO. 89MC114W T2K

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1073

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 25 | Sand, pale orange to light orange, fine grained, subangular, well sorted, calcareous w/abundant tan orange pale orange caliche pockets & thin layers (20-70%), silty (10-15%), clayey (5-10%), dry to slightly moist, dense to very dense | SM | | | | | | 8 | SPT Spl from 25' to 26.5' @ 1200 CAN107-1073-4025 |
| | | | | | | G9 | 1.1 | 50 | Collected gradation analysis sample from 25' to 26.5 @ 1200 |
| 26 | | | | | | | | 100 | |
| 27 | | | | | | | | | |
| 28 | | | | | | | | | |
| 29 | | | | | | | | | OVA @ 30' in augers = 0 ppm in breathing zone = 0 ppm |
| 30 | | | | | | | | 100 | Stainless Steel SS Spl from 30' to 31' @ 1220 OVA on sample = 0 ppm CAN107-1073-0030 |
| | | | | | | A5 | 1.0 | 200 | |
| 31 | | | | | | | | | Stopped drilling @ 31' @ 1230 on 10-25-91 |
| | Bottom of hole - 31' | | | | | | | | Pulled augers & placed tremie pipe to bottom of hole |
| 32 | | | | | | | | | Borehole diameter = 7¼" 10-27-91 1000 Grouted borehole from 0' to 31' w/cement-bentonite grout |
| 33 | | | | | | | | | Grout Mix 7 bags cement 30 lbs bentonite 55 gallons of water Place metal spike into grout borehole, will top off later if necessary |
| 34 | | | | | | | | | |

PROJECT NO. 89MC114W T2K

SHEET 4 OF 4

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1074

| | | | |
|---|---|---|---|
| BORING LOCATION Fire Training Area No. 3 | | ELEVATION AND DATUM 4264.85' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER L. Weeks | DATE STARTED 10-25-91 DATE FINISHED 10-26-91 | |
| DRILLING EQUIPMENT Failing F-10 | | COMPLETION DEPTH 67.1' | SAMPLER 3" Stainless Steel SS 2" Steel SS |
| DRILLING METHOD HSA 3¾" ID 6¾" OD | DRILL BIT 7¼" Bullet | NO. OF SAMPLES DIST. — | UNDIST. Analytical - 9 Geotechnical - 10 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL. — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kubeczko | CHECKED BY Scott Beith |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite Grout | FROM 0 TO 67.1 FT. | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov. ft. | Penetr. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | Sand, brown gray-brown, fine grained, subangular to subrounded, well sorted, silty (10-20%), clayey (5-15%), moderate to strong fuel odor, dark gray staining, loose, slightly moist | | | | | A1 | | 6 | Collected Surface Soil Spl from 0' to 0.5 @1530 on 10-23-91 OVA on sample = 13 ppm CAN107-1074-0000 |
| | | | | | | | | 6 | |
| 1 | | | | | | G1 | 1.1 | 5 | Started drilling @1450 10-25-91 SPT Spl from 0' to 2' @1455 CAN107-1074-4000 OVA on sample = 3.2 ppm |
| | | | | | | | | 5 | |
| 2 | | SM | | | | | | 2 | SPT Spl from 2' to 4' @1500 CAN107-1074-4002 OVA on sample = 35 ppm |
| | | | | | | | | 4 | |
| 3 | | | | | | G2 | 1.7 | 7 | |
| | | | | | | | | 9 | OVA @4' in augers = 10 ppm in breathing zone = 0 ppm |
| 4 | | | | | | | | | |
| | Caliche, light brown to light orange-brown, sandy (10-15%), silty (5-10%), clayey (5-10%), brown-gray staining, very strong fuel odor, medium dense | | | | | | | 10 | Stainless Steel SS Spl from 4' to 6' @1505 OVA on sample = 240 ppm between 4.5' & 5' took VOCs sample from this interval. Rest of sample ranged from 110 to 210 ppm CAN107-1074-0004 |
| 5 | | | | | | A2 | 1.8 | 15 | |
| | | CALICHE | | | | | | 9 | |
| | | | | | | | | 7 | |
| 6 | | | | | | G3 | 1.2 | 1 | SPT Spl from 6' to 8' @1510 CAN107-1074-4006 OVA on sample = 45 ppm |
| | | | | | | | | 1 | |
| 7 | | | | | | | | | |

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1074

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | Caliche, light orange brown to tan-orange, sandy (10-25%), silty (5-10%), clayey (5-10%), scattered brown staining, loose, occassional streaks w/increased sand, slightly moist, very strong fuel & possibly pesticide odor | | | | | G3 | 1.2 | 2 | |
| | | | | | | | | 1 | |
| 8 | | | | | | | | 5 | SPT Spl from 8' to 10' @ 1525 CAN107-1074-4008 |
| | | | | | | | | 7 | Collected gradation analysis sample from 8' to 10' @ 1525 OVA on sample = 63 ppm |
| 9 | | | | | | G4 | 1.7 | 6 | |
| | | | | | | | | 4 | OVA @ 10' in augers = 24 ppm in breathing zone = 0 ppm |
| 10 | | | | | | | | 3 | Stainless Steel SS Spl from 10' to 12' @ 1550 OVA on sample = 38 ppm CAN107-1074-0010 |
| | | CALICHE | | | | | | 3 | |
| 11 | | | | | | A3 | .6 | 3 | |
| | | | | | | | | 6 | |
| 12 | | | | | | | | 1 | SPT Spl from 12' to 14' @ 1555 CAN107-1074-4012 OVA on sample = 47 ppm |
| | Decreased staining | | | | | | | 1 | |
| 13 | | | | | | G5 | 1.4 | 1 | |
| | | | | | | | | 2 | OVA @ 14' in augers = 5 ppm in breathing zone = 0 ppm |
| 14 | | | | | | | | 3 | SPT Spl from 14' to 16' @ 1605 CAN107-1074-4014 OVA on sample = 13 ppm |
| | | | | | | | | 5 | |
| 15 | | | | | | G6 | 1.5 | 8 | |
| | | | | | | | | 10 | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W T2K

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1074

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | Sand, pale orange to tan-orange, fine grained, subangular, well sorted, calcareous w/occassional tan-orange caliche pockets (20-25%), silty (5-10%), clayey (3-5%), moderate to strong fuel odor, medium dense to dense, slightly moist, possibly gasoline | | | | | | | 12 | SPT Spl from 16' to 18' @ 1615 CAN107-1074-4016 OVA on sample = 8 ppm |
| | | | | | | G7 | 1.3 | 12 | |
| 17 | | | | | | | | 16 | |
| | | | | | | | | 21 | |
| 18 | | | | | | | | 14 | SPT Spl from 18' to 20' @ 1625 CAN107-1074-4018 OVA on sample = 21 ppm |
| | | | | | | G8 | 1.6 | 16 | |
| 19 | | | | | | | | 16 | |
| | Becoming pale orange to orange in color | | | | | | | 17 | OVA @ 20' in augers = 28 ppm in breathing zone = 0 ppm |
| 20 | Odor becoming more like a solvent or paint thinner type | SM | | | | | | 24 | Stainless Steel SS Spl from 20' to 22' @ 1640 OVA on sample = 17 ppm CAN107-1074-0020 |
| | | | | | | | | 38 | |
| 21 | | | | | | A4 | 1.7 | 55 | Collected MRD Duplicate Sample from 20' to 22' @ 1640 CAN107-1074-1101 |
| | | | | | | | | 106 | |
| 22 | | | | | | | | | |
| 23 | | | | | | | | | |
| 24 | | | | | | | | | |
| 25 | | | | | | | | | OVA @ 25' in augers = 21 ppm in breathing zone = 0 ppm |

PROJECT NO. 89MC114W T2K

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1074

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist. Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 25 | Sand, orange, fine grained, subangular, well sorted, calcareous (10-20%) w/ scattered pale orange caliche pockets (5-10%), silty (5-15%), clayey (3-5%), medium dense to dense, moderate to strong fuel odor possibly gasoline, slightly moist | | | | | | | 13 | SPT Spl from 25' to 27' @ 1700 CAN107-1074-4025 OVA on sample = 18 ppm |
| | | | | | | G9 | 1.7 | 24 | |
| 26 | | | | | | | | 50 | |
| | | | | | | | | 50 | |
| 27 | | | | | | | | | |
| 28 | | | | | | | | | |
| 29 | | SM | | | | | | | OVA @ 30' in augers = 32 ppm in breathing zone = 0 ppm |
| 30 | | | | | | | | 23 | Stainless Steel SS Spl from 30' to 32' @ 1725 OVA on sample = 11 ppm CAN107-1074-0030 |
| | | | | | | A5 | 1.9 | 34 | Collected gradation analysis from 30' to 32' @ 1725 CAN107-1074-4030 |
| 31 | | | | | | | | 39 | |
| | | | | | | | | 43 | |
| 32 | | | | | | | | | |
| 33 | | | | | | | | | |
| 34 | | | | | | | | | |

PROJECT NO. 89MC114W T2K

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1074

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 34 | Sand, orange to pale orange, fine grained, subangular, well sorted, calcareous (15-20%), w/ occassional pale orange caliche pockets, silty (5-15%), clayey (5-10%), medium dense, moderate fuel odor | | | | | | | | OVA @ 35' in augers = 22 ppm In breathing zone = 0 ppm |
| 35 | | | | | | | | 25 | SPT Spl from 35' to 37' @ 1810 CAN107-1074-4035 OVA on sample = 16 ppm |
| | | | | | | | | 25 | |
| 36 | | | | | | G10 | 1.8 | | |
| | | | | | | | | 22 | |
| | | | | | | | | 29 | Stopped drilling @ 37' @ 1810 on 10-25-91 |
| 37 | | | | | | | | | Collected decon water sample from drillers decon water tank @ 900 on 10-26-91 CAN107-1074-1181 |
| | | | | | | | | | 1000 |
| 38 | | SM | | | | | | | Switched over to 3¼" ID augers; Pulled 35' of 3¼" augers and ran back into the borehole w/ 35' of 3¼" augers |
| | | | | | | | | | Started drilling @ 37' @ 1200 on 10-26-91 |
| 39 | | | | | | | | | New augers are 3¼" ID, 6¼" OD w/ a 7¼" Bullet Bit |
| | | | | | | | | | OVA @ 40' in augers = 15 ppm in breathing zone = 0 ppm @ 1230 |
| 40 | | | | | | | | | |
| 41 | | | | | | | | | |
| 42 | | | | | | | | | |
| 43 | | | | | | | | | |

PROJECT NO. 89MC114W T2K

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1074

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist. Blows (6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 43 | Sand, light to medium orange, fine grained, subangular to subrounded, well sorted, predominantly quartz w/ rare (1-3%) dark colored grains, silty (15-20%), calcareous (10-20%), trace clay (3-5%), scattered pockets of tan-orange caliche & calcium carbonate cemented sand, dense to very dense, slightly moist, very slight to slight fuel odor | | | | | | | | |
| 44 | | | | | | | | | OVA @ 45' in auger: 8.1 ppm in breathing zone = 0 ppm |
| 45 | | | | | | | | 53 | Stainless Steel SS Spl from 45' to 47' @ 1525 OVA on sample = 3 ppm CAN107-1074-0045 |
| | | | | | | | | 78 | |
| 46 | | | | | | A6 | 1.5 | | |
| | | | | | | | | 159 | |
| | | | | | | | | 200 | |
| | | SM | | | | | | | |
| 47 | | | | | | | | | |
| 48 | | | | | | | | | |
| 49 | | | | | | | | | |
| | | | | | | | | | OVA @ 50' in augers: 3.6 ppm in breathing zone: 0 ppm |
| 50 | | | | | | | | 41 | Stainless Steel SS Spl from 50' to 52' @ 1610 OVA on sample: 3.2 ppm CAN107-1074-0050 |
| | | | | | | | | 82 | |
| 51 | | | | | | A7 | 1.8 | | |
| | | | | | | | | 124 | |
| | | | | | | | | 200 | |
| 52 | | | | | | | | | |

PROJECT NO. 89MC114W T2K

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1074

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 52 | Sand, light to medium orange, fine grained, subangular, well sorted, predominantly quartz w/rare (1-3%) black grains, silty (15-20%) calcareous (10-20%), trace clay (3-5%), scattered pockets of tan-orange caliche & calcium carbonate, cemented sand, dense to very dense, slightly moist, very slight fuel odor | SM | | | | | | | |
| 53 | | | | | | | | | |
| 54 | | | | | | | | | |
| 55 | | | | | | | | | OVA @ 55' in augers = 0.4 ppm in breathing zone = 0 ppm @ 1630 |
| 56 | Sand, orange, fine to medium grained, subrounded, well sorted, predominantly quartz w/rare (1-2%) black grains, rare silt (1-3%), slightly moist medium dense to dense, scattered rare dark gray patches (possible staining) | SP | | | | | | | |
| 57 | | | | | | | | | |
| 58 | | | | | | | | | |
| 59 | | | | | | | | | OVA @ 60' in augers = 7.7 ppm in breathing zone = 0 ppm |
| 60 | | | | | | | | 23 | Stainless Steel SS Spl from 60' to 62' @ 1655 OVA on sample = 0.1 ppm CAN107-1074-0060 |
| | | | | | | A8 | 49 | 39 | |
| 61 | | | | | | | | | |

PROJECT NO. 89MC114W T2K

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1074

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist Blows (6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 61 | Sand, orange, fine to medium grained, subrounded, well sorted, predominantly quartz w/ rare (1-2%) black grains, rare silt (1-3%), medium dense to dense, scattered rare dark gray patches (possible staining?), slightly moist | | | | | | | 42 | |
| | | | | | | A8 | 1.9 | | |
| | | | | | | | | 61 | |
| 62 | | | | | | | | | |
| 63 | | SP | | | | | | | |
| 64 | | | | | | | | | OVA @ 65' in augers = 20 ppm in breathing zone = 0 ppm @ 1730 |
| 65 | | | | | | | | | |
| 66 | | | | | | | | | |
| | | | | | | | | | Auger refusal @ 67' @ 1755 |
| | Caliche, tan, very siliceous (70%), very dense | CALICHE | | | | | | | |
| 67 | | | | | | A9 | .1 | 200 | Stainlers Steel SS Spl from 67' to 67.1' @ 1800 OVA on sample = 0 ppm stopped drilling @ 67.1' @ 1800 |
| | Bottom of hole - 67.1' | | | | | | | | 1815 Mixed Grout 15 bags of cements 45 lbs of powdered bentonite 120 gallons of water |
| 68 | | | | | | | | | 1900 Ran tremie pipe to bottom of hole, pumped 60 gallons of grout and pulled 30' of augers |
| 69 | | | | | | | | | 1930 pumped another 60 gallons of grout and pulled remaing augers Will place a metal spike when hole is topped off |
| 70 | | | | | | | | | |

PROJECT NO. 89MC114W T2K

(redrill of Boring 1074)

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 1075

| | | | |
|---|---|---|---|
| BORING LOCATION Fire training Area #3 | | ELEVATION AND DATUM 4264.85' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER D. Sampson | DATE STARTED 12-10-91 DATE FINISHED 12-10-91 | |
| DRILLING EQUIPMENT CME 75 | | COMPLETION DEPTH 52 | SAMPLER 3" stainless S.S. |
| DRILLING METHOD HSA 7 3/4" OD, 4 1/4" ID | DRILL BIT 8" bullet | NO. OF SAMPLES DIST. | UNDIST. Analytical 2 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST | COMPL. 24 HRS. |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY JM Butler |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement Bentonite grout | FROM 0 TO 52 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft. | SAMPLES: Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | start Drilling at 8:30 |
| 1 | | | | | | | | | See original Boring Log of boring 1074 for Lithologic description |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | 1 | stainless S.S from 4-6' at 8:40 |
| | | | | | | A1 | 2.0 | 1 | |
| 5 | | | | | | | | 1 | OVA auger - 0 ppm S.S. - 16 ppm base B.Z. - 8 ppm Petroleum odor |
| 6 | | | | | | | | 1 | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 1 OF 6

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 1075

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | 2 | collect analyzed stainless steel S.S. sample from 10-12' at 9:05 |
| | | | | | | A2 | 20 | 2 | CAN107-1075-0010 MS/MSD |
| 11 | | | | | | | | 5 | OVA - augers - 0 ppm |
| | | | | | | | | 4 | S.S. - 29 ppm B.Zone - 0 ppm |
| 12 | | | | | | | | | strong petroleum odor |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 1075

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetr. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | 13 | stainless steel S.S from 20-22 at 9:50 |
| | | | | | | A3 | | 20 | |
| 21 | | | | | | | | 33 | OVA- Augers - 72 ppm S.S - 29 ppm B.Zone - 0 ppm strong Petroleum odor |
| | | | | | | | | 39 | |
| 22 | | | | | | | | | |
| 23 | | | | | | | | | |
| 24 | | | | | | | | | |
| 25 | | | | | | | | | |

PROJECT NO. 89MC114W

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 1875

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 25 | | | | | | | | | |
| 26 | | | | | | | | | |
| 27 | | | | | | | | | |
| 28 | | | | | | | | | |
| 29 | | | | | | | | | |
| 30 | | | | | | | | | stainless steel S.S. |
| | | | | | | | | 14 | from 30-32' |
| | | | | | | A41.9 | | 16 | at 10:20 |
| 31 | | | | | | | | | OVA - |
| | | | | | | | | 22 | auger-172 ppm |
| | | | | | | | | | S.S. - 160 Bad ppm |
| | | | | | | | | 23 | B.Z. - 0 ppm |
| | | | | | | | | | petroleum odor |
| 32 | | | | | | | | | |
| 33 | | | | | | | | | |
| 34 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 4 OF 6

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 1075

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 34 | | | | | | | | | |
| 35 | | | | | | | | | |
| 36 | | | | | | | | | |
| 37 | | | | | | | | | |
| 38 | | | | | | | | | |
| 39 | | | | | | | | | |
| 40 | | | | | | | | | Stainless steel |
| | | | | | | | | 53 | S.S from 40-42' |
| | | | | | | | | | aT 11:00 |
| | | | | | | | 2.0 | 24 | OVA - Auger 10 ppm |
| 41 | | | | | | | | | S.S. - 0 ppm |
| | | | | | | | | 36 | B.Zone - 0 ppm |
| | | | | | | | | | slight odor |
| | | | | | | | | 29 | |
| 42 | | | | | | | | | |
| 43 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 5 OF 6

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 1075

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 43 | | | | | | | | | |
| 44 | | | | | | | | | collect Ambient blank at 11:20 CAN07-1075-1152 |
| 45 | | | | | | | | | Collect Decon water at 12:00 CAN07-1075-1182 |
| 46 | | | | | | | | | Collect Rinsate blank at 12:15 CAN07-1075-1172 |
| 47 | | | | | | | | | Grout boring from 0-52' w/ cement Bentonite grout. |
| 48 | | | | | | | | | |
| 49 | | | | | | | | | |
| 50 | | | | | | | | | collect analytical stainless steel |
| | | | | | | | | 50 | S.S. sample from 50-52' at 11:40 |
| | | | | | | 1A5 | | 61 | CAN07-1075-0050 |
| 51 | | | | | | | | 89 | slight odor |
| | | | | | | | | 180 | OVA- auger - 42 ppm S.S. - 0 ppm B. zone - 0 ppm |
| 52 | | | | | | | | | |

PROJECT NO. 89MC19W

SHEET 6 OF 6

(redrill of Boring 107

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 1076

| | | | |
|---|---|---|---|
| BORING LOCATION Fire training Area #3 | | ELEVATION AND DATUM 4265.66' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER M. Pawless | DATE STARTED 12-6-91 / DATE FINISHED 12-6-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 31.1 | SAMPLER 3" stainless S.S. |
| DRILLING METHOD HSA 7½" OD, 4¼" ID | DRILL BIT 7½" bullet | NO. OF SAMPLES: DIST. | UNDIST. Analytical - 2 Geotech - 2 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV.: FIRST | COMPL. / 24 HRS. |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY Larry Gardiner | CHECKED BY TMButh |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite grout | FROM 0 TO 31.1 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov./ft. | SAMPLES: Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | start drilling at 7:50 |
| 1 | | | | | | | | | drill w/ bit To 4' |
| 2 | | | | | | | | | See original boring log of 1073 for Lithologic description |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | collect Analytical stainless steel S.S sample from 4-6' at 8:00 |
| | | | | | | | | 13 | |
| | | | | | | A1 | 1.5 | 18 | CAN07-1076-0004 |
| 5 | | | | | | | | | OVA- |
| | | | | | | | | 14 | Auger S.S. B.Zone } 0 ppm |
| | | | | | | | | 19 | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 1076

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist. Blows (6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | stainless steel S.S from 10-12' at 8:25 |
| | | | | | | | | 4 | |
| | | | | | | | 1.5 | 6 | OVA |
| 11 | | | | | | | | | auger S.S. B.Zone } 0 ppm |
| | | | | | | | | 5 | |
| | | | | | | | | 11 | |
| 12 | | | | | | | | | |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W

SHEET 2 OF 4

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 1076

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | Stainless steel S.S. from 20-21.5' T.D.: 45 |
| | | | | | | | | 11 | |
| | | | | | | | 1.8 | | |
| | | | | | | | | 21 | OVA- auger S.S. B-zone } 0 ppm |
| 21 | | | | | | | | (5.11) | |
| | | | | | | | | 50 | |
| 22 | | | | | | | | | |
| 23 | | | | | | | | | |
| 24 | | | | | | | | | |
| 25 | | | | | | | | | |

PROJECT NO. 85MC114W

SHEET 3 OF 4

**Woodward-Clyde Consultants** PROJECT NAME CANNON AFB HOLE NO. 1076

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 25 | | | | | | | | | |
| 26 | | | | | | | | | |
| 27 | | | | | | | | | |
| 28 | | | | | | | | | |
| 29 | | | | | | | | | |
| 30 | | | | | | | 0 | 50 (6") | collect stainless steel Analytical S.S. Sample from 30 - 30.4' CAN/07-1076-0030 at 9:10 |
| | | | | | | A2 | 1.1 / 1.1 | 85 (10") | (No recovery) |
| 31 | | | | | | | | 100 (3") | OVA |
| | Bottom of boring | | | | | | | | auger S.S. } 0 ppm ~~B.Zone~~ CAN 107-1076-1165 FD |
| 32 | | | | | | | | | grout Boring from 0-32' w/ cement-Bentonite grout |
| | | | | | | | | | Collect analytical stainless steel S.S Sample from 30'4" TO 31.1" at 9:35 CAN 107-1076-0030 CAN 107-1076-1165 at 9:45 |

PROJECT NO. 89MC114W

SHEET 4 OF 4

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1091

| | | | |
|---|---|---|---|
| BORING LOCATION Fire Training Area No. 4 | | ELEVATION AND DATUM 4265.46' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER L. Weeks | DATE STARTED 10-8-91 DATE FINISHED 10-9-91 | |
| DRILLING EQUIPMENT Failing F-10 | | COMPLETION DEPTH 61' | SAMPLER 3" Stainless SS 2" SS |
| DRILLING METHOD HSA 8¼" OD 4¼" ID | DRILL BIT 8¼ Bullet Bit | NO. OF SAMPLES DIST.: — | UNDIST. Analytical - 8 (3") Geotech - 16 (2") |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL. — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kubeczko | CHECKED BY Tom Acree |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement/Bentonite Grout | FROM 0 TO 61' FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov. ft. | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | Asphalt | ASPHALT | | | | | | | Started drilling @ 1430 |
| | Sand, red-brown brown-red, fine grained, subrounded, well sorted, silty (10-20%), trace clay (3-5%), dry to slightly moist, loose, very slightly calcareous | | | | | A1 | | 6 | Surface soil collected @ 0 to 0.5' @ 1500 CAN109-1091-0000 SPT from 0.25 to 1.75' @ 1545 |
| 1 | | | | | | G1 | .5 | 3 | Collected Gradation analysis spl from 0.25' to 0.75' @ 1545 CAN109-1091-4000 OVA on sample = 0 ppm |
| | | | | | | | | 5 | Collected MRD Duplicate from 0.25 to 0.5 @ 1500 CAN109-1091-1201 |
| 2 | | | | | | | | 5 | SPT from 1.75' to 3.25' @ 1600 CAN109-1091-4001 |
| | | | | | | G2 | 1 | 5 | |
| 3 | | SM | | | | | | 3 | |
| | | | | | | | | 5 | SPT from 3.25' to 4.75' @ 160 CAN109-1091-4003 |
| 4 | | | | | | G3 | 1.2 | 5 | |
| | | | | | | | | 6 | |
| | | | | | | | | | OVA @ 5' in augers @ 1615 = 0 ppm; in breathing zone = 0 ppm |
| 5 | | | | | | | | 5 | Stainless Steel SS spl from 5' to 7' @ 1615 CAN109-1091-0005 OVA on sample = 0 ppm |
| | | | | | | A2 | 1.5 | 5 | |
| 6 | Sand, pale orange, fine grained, subrounded, well sorted, silty (15-30%), calcareous (10-20%), dry, loose, calcium carbonate cement in places, trace clay | SM | | | | | | 6 | Collected Rinsate Blank Spl from 5' to 7' SS @ 1635 |
| | | | | | | | | 5 | CAN109-1091-1271 |
| 7 | | | | | | | | | |

PROJECT NO. 89 MC 114 W T 2L

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1091

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | Sand, pale orange tan-orange, fine grained, subrounded, well sorted, little to some silt (15-30%), Some calcareous (20-25%), dry, loose moderate calcium carbonate cementing, rare clay | | | | | | | 5 | SPT Spl from 7' to 8.5' @ 1620 CAN109-1091-4007 |
| | | | | | | G4 | 1.2 | 5 | |
| 8 | | | | | | | | 7 | |
| | Increasing calcium carbonate cement | | | | | | | 35 | SPT from 8.5' to 10' @ 1625 CAN109-1091-4008 |
| 9 | | | | | | G5 | 1.4 | 15 | |
| | | | | | | | | 15 | OVA @ 10' in augers @ 1700 = 0 ppm; in breathing zone = 0 ppm |
| 10 | | | | | | | | 15 | Stainless Steel SS Spl from 10' to 12' @ 1700 CAN109-1091-0010 OVA on sample = 0 ppm |
| | | SM | | | | A3 | 1.7 | 17 | |
| 11 | | | | | | | | 18 | |
| | | | | | | | | 22 | |
| 12 | | | | | | | | 10 | SPT Spl from 12' to 13.5' @ 1705 CAN109 1091-4012 |
| | | | | | | G6 | | 12 | |
| 13 | | | | | | | | 21 | |
| | Sand, pale orange tan-orange, very fine to fine grained, subangular to subrounded, well sorted, some silt (15-35%), very calcareous (20-30%), dry, loose, rare clay | | | | | | | 5 | SPT from 13.5' to 15' @ 1710 CAN109-1091-4013 |
| 14 | | | | | | G7 | .5 | 3 | |
| | | | | | | | | 3 | OVA @ 15' in augers @ 1710 = 0 ppm; in breathing zone = 0 ppm |
| 15 | | | | | | | | 5 | SPT Spl from 15' to 17' @ 1715 CAN109-1091-4015 |
| | | | | | | G8 | 1.7 | 3 | |
| 16 | | | | | | | | | |

PROJECT NO. 89 MC 114W T2L

SHEET 2 OF 8

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1091

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | Sand, orange to pale orange, very fine to fine grained, subangular to subrounded, well sorted, silty (10-20%), calcareous w/calcium carbonate cement (10-20%), dry to slightly moist, medium dense to dense, trace clay | | | | | | | 8 | |
| | | | | | | G8 | 1.7 | 10 | |
| 17 | | | | | | | | 12 | SPT Spl from 17' to 18.5' @ 1720 CAN 109-1091-4017 |
| | | | | | | G9 | 1.4 | 9 | |
| 18 | | | | | | | | 17 | |
| | | | | | | | | 21 | SPT from 18.5' to 20' @ 1730 CAN109-1091-4018 |
| 19 | | | | | | G10 | 1.5 | 27 | |
| | | SM | | | | | | 32 | OVA @ 20' in augers @ 1755 = 2 ppm; in breathing zone = 0 ppm |
| 20 | | | | | | | | 25 | Stainless Steel SS from 20' to 22' @ 1755 CAN109-1091-0020 MS/MSD |
| | Increased calcium carbonate cement | | | | | | | 70 | TCL VOC Spl taken from 20 to 20.5; OVA = 6 ppm |
| 21 | | | | | | A4 | 2 | 77 | |
| | | | | | | | | 95 | |
| 22 | | | | | | | | | |
| 23 | | | | | | | | | |
| 24 | Sand, pale orange tan-orange, fine to very fine grained, subrounded, well sorted, little to some silt (15-25%), little calcareous w/ occassional calcium carbonate cement, dry, medium dense, trace clay | SM | | | | | | 12 | SPT from 23.5' to 25' @ 1815 CAN109-1091-4023 |
| | | | | | | G11 | 1.5 | 13 | |
| 25 | | | | | | | | 16 | OVA @ 25' in augers @ 1820 = 0 ppm; in breathing zone = 0 ppm |

PROJECT NO. 89MC114W T2L

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1091

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 25 | Sand, orange tan-orange, very fine to fine grained, subrounded, well sorted, little to some silt (15-30%), calcareous w/ calcium carbonate cement (20-30%), medium dense, dry to very slightly moist, trace clay | | | | | | | | |
| 26 | | | | | | | | | |
| 27 | | | | | | | | | |
| 28 | | | | | | | | | Stopped drilling @ 28.5' @ 1830 on 10-8-91 |
| | | | | | | | | 16 | Started drilling @ 28.5' @ 800 on 10-9-91 |
| 29 | | SM | | | | G12 | 1.5 | 25 | SPT from 28.5' to 30' @ 800 CAN109-1091-4028 Collected Gradation Analysis Spl CAN109-1091-4028 |
| | | | | | | | | 27 | OVA @ 30' in augers @ 820 = 0 ppm; in breathing zone = 0 ppm |
| 30 | Sand, orange red-orange, fine grained, subangular to subrounded, well sorted, silty (20-25%), calcareous (5-15%), trace clay (5-10%), slightly moist, medium dense | | | | | | | 14 | Stainless Steel SS Spl from 30' to 32' @ 820 |
| | | | | | | A5 | 1.8 | 20 | CAN109-1091-0030 CAN109-1091-1261 @ 840 OVA on sample = 0 ppm |
| 31 | | | | | | | | 22 | |
| | Becoming slightly mottled w/ pale orange tan-orange | | | | | | | 35 | |
| 32 | | | | | | | | | |
| 33 | | | | | | | | | |
| | | | | | | G13 | 1.3 | 16 | SPT from 33.5' to 35' @ 845 CAN109-1091-4033 |
| 34 | | | | | | | | | |

PROJECT NO. 89MC114W T2L

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1091

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 34 | Sand, pale orange tan-orange, fine grained, subrounded, well sorted, little to some silt (20-30%), calcareous w/ calcium carbonate cement (30 %), medium dense to dense, dry, trace clay (5%), rare black specs/grains | | | | | G13 | 2.3 | 29 | |
| | | | | | | | | 45 | OVA @ 35' in augers @ 850 = 0 ppm; in breathing zone = 0 ppm |
| 35 | | | | | | | | | |
| 36 | | | | | | | | | |
| 37 | | | | | | | | | |
| 38 | | SM | | | | | | | |
| | | | | | | | | 5 | SPT from 38.5' to 40' @ 1050 CAN109-1091-4038 |
| 39 | | | | | | G14 | .4 | 6 | |
| | Sand, pale orange tan-orange, fine grained, subrounded, well sorted, interbedded caliche, silty (10-20%), calcareous (30-40%), clayey (10-15%), dense, dry, scattered black specs/grains (5%) | | | | | | | 47 | OVA @ 40' in augers @ 1115 = 8 ppm; in breathing zone = 0 ppm |
| 40 | | | | | | | | 34 | Stainless Steel SS from 40' to 41' @ 1115 CAN109-1091-0040 |
| | | | | | | | | 156 | OVA 40.5' to 40.9' = 22 ppm |
| | | | | | | A6 | .9 | | Took TCL VOCs SPL from 40.5' to 40.9' |
| 41 | | | | | | | | | |
| 42 | | | | | | | | | |
| 43 | | | | | | | | | |

PROJECT NO. 89MC114W T7L

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1091

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, et |
|---|---|---|---|---|---|---|---|---|---|
| 43 | Sand, orange to light orange, fine grained, subangular, well sorted, silty (10-20%), clayey (5-10%), calcareous w/ calcium carbonate cement (20-30%), dry to slightly moist medium dense, trace black specs/grains | | | | | | | | |
| 44 | | | | | | | | | |
| | | | | | | | | | OVA @ 45' in augers @ 1200 = 8 ppm; in breathing zone = 0 ppm |
| 45 | | | | | | | | 19 | SPT from 45' to 46.5' @ 1215 |
| | | | | | | | | | CAN109-1091-4045 |
| | | | | | | G15 | 1.5 | 17 | |
| 46 | | | | | | | | 29 | |
| 47 | | SM | | | | | | | |
| 48 | | | | | | | | | |
| 49 | | | | | | | | | |
| | | | | | | | | | OVA @ 50' in augers @ 1230 = 5.1 ppm; in breathing zone = 0 ppm |
| 50 | Sand, orange, fine grained, sub angular to subrounded, well sorted, trace silt (5-10%), trace clay (5%), calcareous (10-20%), slightly moist, very dense | | | | | | | 47 | Stainless steel SS Spl from 50' to 51.5' @ 1230 |
| | | | | | | | | | CAN109-1091-0050 |
| | | | | | | A7 | 1.5 | 48 | OVA Reading @ 51 to 51.5' 74 ppm |
| 51 | | SM | | | | | | 51 | Took TCL VOCs spl from this interval |
| 52 | | | | | | | | | |

PROJECT NO. 89MC114W T2L

SHEET 6 OF 8

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1091

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist. Blows (6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 52 | Sand, orange, fine grained, subangular to subrounded, well sorted, trace silt (5-10%), trace clay (5%), calcareous (10-20%), slightly moist, very dense | | | | | | | | |
| 53 | | SM | | | | | | | |
| 54 | | | | | | | | | |
| | | | | | | | | | OVA @ 55' in augers @ 1305 = 6.2 ppm; in breathing zone = 0 ppm |
| 55 | Sand, pale orange, fine grained, subrounded, well sorted, interbedded caliche, silty (10-15%), clayey (5-10%), calcareous w/ calcium carbonate cement (20-25%), very dense, dry | | | | | | | 27 | SPT Spl from 55' to 56.5' @ 1305 CAN109-1091-4055 |
| | | | | | | G16 | 1.4 | 74 | |
| 56 | | SM | | | | | | 84 | |
| 57 | | | | | | | | | |
| 58 | | | | | | | | | |
| 59 | | | | | | | | | OVA in breathing zone = 0 ppm @ 1345 |
| | | | | | | | | | OVA @ 60' in augers @ 1350 = 7.4 ppm |
| 60 | Sand, orange, fine grained, subrounded, well sorted, silty (10-15%), clayey (5-10%), calcareous (20%), slightly moist, very dense | | | | | A8 | 1 | 46 | Stainless Steel SS Spl from 60' to 61' @ 1400 OVA on sample = 0 ppm CAN109-1091-0060 |
| | | | | | | | | 75 | Stopped drilling @ 61' @ 1400 on 10-9-91 |
| 61 | | | | | | | | | |

PROJECT NO. 89MC 114W T2L

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1091

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc |
|---|---|---|---|---|---|---|---|---|---|
| 61 | Bottom of hole - 61' | | | | | | | | 10-9-91<br>1500<br>Pulled 5' of auger & ran tremie pipe to bottom of borehole<br>Mixed 17 sacks of Portland type II Cement, 50 pounds of powdered bentonite and 120 gallons of water<br>Tremied grout into borehole and systematically pulled augers<br>Will place metal spike when boring is topped off with grout<br>Notes:<br>All Split Spoon Samples were driven w/ a 140 pound hammer dropping 30 inches<br>Borehole diameter is 8¼" |
| 62 | | | | | | | | | |
| 63 | | | | | | | | | |
| 64 | | | | | | | | | |
| 65 | | | | | | | | | |
| 66 | | | | | | | | | |
| 67 | | | | | | | | | |
| 68 | | | | | | | | | |
| 69 | | | | | | | | | |
| 70 | | | | | | | | | |

PROJECT NO. 89MC114W T2L

SHEET 8 OF 8

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1092

| | | | |
|---|---|---|---|
| BORING LOCATION Fire Training Area No. 4 | | ELEVATION AND DATUM 4264.49' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER L. Weeks | DATE STARTED 10-10-91 DATE FINISHED 10-11-91 | |
| DRILLING EQUIPMENT Failing F-10 | | COMPLETION DEPTH 62' | SAMPLER 3" Stainless SS 2" SS |
| DRILLING METHOD HSA 4¼" ID 8¼" OD | DRILL BIT 8¼" Bullet Bit | NO. OF SAMPLES DIST. — | UNDIST. Analytical = 8 Geotech = 12 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL. — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kuberzko | CHECKED BY Tom ACRE |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement/Bentonite Grout | FROM 0 TO 62 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov. ft. | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | Gravel, black & gray | GP | | | | | | | Started drilling @ 930 |
| | Sand, brown-red to red-brown, fine grained, subangular, little silt (10-15%), trace clay (5-10%) slightly moist, loose, well sorted | | | | | A1 | | 6 | SPT from 0' to 2' @ 930 CAN109-1092-4000 |
| | | | | | | | | 4 | Collected surface soil spl from 0.0' to 0.5' @ 1345 |
| 1 | | SM | | | | G1 | 1 | 4 | CAN109-1092-0000 Field Duplicate @ 1400 CAN109-1092-1264 |
| | | | | | | | | 4 | OVA on sample: 0 ppm |
| 2 | Sand, brown-red to orange-red, fine grained, subangular, well sorted, little silt (5-15%), trace clay (5%), little calcareous (10-15%) slightly moist to moist, loose to medium dense | | | | | | | 6 | SPT from 2' to 4' @ 932 CAN109-1092-4002 |
| | | | | | | | | 12 | Gradation analysis Collect @ 2' to 4' |
| 3 | | | | | | G2 | 1.2 | | |
| | | SM | | | | | | 14 | |
| | | | | | | | | 16 | |
| 4 | | | | | | | | 5 | Stainless Steel SS spl from 4' to 6' @ 1000 CAN109-1092-0004 OVA on sample = 0 ppm |
| | | | | | | | | 4 | OVA @ 5' in augers @ 1000 = 0 ppm; in breathing zone = 0 ppm |
| 5 | Sand, tan-orange pale orange, fine grained, subangular, well sorted, little calcareous w/calcium carbonate cement (20%), silty (10-15%) trace clay (5-10%), slightly moist, loose | SM | | | | A2 | 1.5 | 4 | |
| | | | | | | | | 4 | |
| 6 | Sand, orange w/ tan-orange pale orange mottling, fine grained, subangular, well sorted, little silt (15-20%), calcareous w/ scattered caliche/calcium carbonate cement, slightly moist, trace clay (1-5%), loose | SM | | | | | | 3 | SPT from 6' to 8' @ 1005 CAN109-1092-4006 |
| | | | | | | G3 | 1.4 | 3 | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W T2L

SHEET 1 OF 8

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1092

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | Sand, orange w/ tan-orange pale orange mottling, fine grained, subangular, well sorted, little silt (10-20%), calcareous w/ scattered caliche & calcium carbonate cement, slightly moist trace clay (1-5%), loose to medium dense | | | | | | | 4 | |
| | | | | | | G3 | 2.4 | 5 | |
| 8 | | SM | | | | | | 5 | SPT from 8' to 10' @ 1010 CAN109-1092-4008 |
| | | | | | | | | 8 | |
| 9 | | | | | | G4 | 1.5 | 8 | |
| | | | | | | | | 13 | OVA @ 10' in augers @ 1015 = 0 ppm; in breathing zone = 0 ppm |
| 10 | Sand, orange, fine grained, subangular to subrounded, well sorted, trace silt (5-10%), calcareous (15-25%), trace clay (1-3%), slightly moist, loose to medium dense | | | | | | | 5 | Stainless steel SS spl from 10' to 12' @ 1015 CAN109-1092-0010 OVA on sample = 0 ppm |
| | | | | | | A3 | 1.7 | 8 | |
| 11 | | | | | | | | 9 | |
| | | | | | | | | 11 | |
| 12 | | SM | | | | | | 5 | SPT from 12' to 14' @ 1020 CAN109-1092-4012 |
| | | | | | | | | 7 | |
| 13 | | | | | | G5 | 1.7 | 3 | |
| | | | | | | | | 9 | |
| 14 | | | | | | | | 4 | SPT from 14' to 16' @ 1025 CAN109-1092-4014 |
| | | | | | | | | 12 | OVA @ 15' in augers @ 1025 = 0 ppm; in breathing zone = 0 ppm |
| 15 | Sand, pale orange tan-orange, fine grained, subangular to subrounded, well sorted, some calcareous & calcium carbonate cement/caliche (30-35%), trace silt (5-10%), rare clay, slightly moist, medium dense | SM | | | | G6 | 2 | 21 | |
| | | | | | | | | 30 | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W T2L

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1092

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | Caliche, tan-orange pale orange, sandy (10-15%), clayey (5-10%), predominantly calcium carbonate (75-80%), occassional thin sand stringers, very stiff, slightly moist | CALICHE | | | | | | 19 | SPT from 16' to 18' @ 1040 CAN109-1092-4016 |
| | | | | | | | | 25 | |
| 17 | | | | | | G7 | 1.5 | | |
| | | | | | | | | 33 | |
| | | | | | | | | 39 | |
| 18 | | | | | | | | 19 | SPT from 18' to 20' @ 1050 CAN109-1092-4018 |
| | | | | | | | | 21 | |
| 19 | | | | | | G8 | 1.8 | | |
| | | | | | | | | 29 | |
| | | | | | | | | 34 | OVA @ 20' in augers @ 1115 = 4.1 ppm; in breathing zone = 0 ppm |
| 20 | Sand, pale orange tan-orange, fine grained, subangular to subrounded, well sorted, little silt (15-20%), trace clay (5%), some calcareous & calcium carbonate cement w/ occassional caliche, slightly moist, medium dense to dense | SM | | | | | | 24 | Stainless Steel SS Spl from 20' to 22' @ 1115 |
| | | | | | | | | 17 | OVA between 21.5' & 22 = 58 ppm took TCL VOC Spl from this interval CAN109-1092-0020 |
| 21 | | | | | | A4 | 1.8 | | |
| | | | | | | | | 25 | |
| | | | | | | | | 42 | |
| 22 | | | | | | | | | |
| 23 | | | | | | | | | |
| 24 | | | | | | | | | |
| 25 | | | | | | | | | OVA @ 25' in augers @ 1130 = 5.2 ppm; in breathing zone = 0 ppm |

PROJECT NO. 89MC114W TQL

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1092

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetr. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 25 | Sand, orange, fine grained, subangular, well sorted, silty (5-15%), calcareous (5-10%). | SM | | | | | | 13 | SPT from 25' to 26.5' @ 1130 CAN109-1092-4025 |
| | | | | | | G9 | 1.2 | 16 | |
| 26 | Caliche, pale orange tan-orange, sandy (15-20%), clayey (1-5%), predominantly calcium carbonate (80-85%), very stiff, occassional thin sand stringers, slightly moist, rare black specs/grains | | | | | | | 65 | |
| 27 | | | | | | | | | |
| 28 | | CALICHE | | | | | | | |
| 29 | | | | | | | | | OVA @ 30' in augers @ 1200 = 0ppm; in breathing zone = 0 ppm |
| 30 | Sand, orange w/ pale orange tan-orange mottling of caliche (10%), fine grained, subangular to subrounded, well sorted, silty (15-20%), trace clay (5%), little calcareous w/ occassional calcium carbonate cement, slightly moist, dense to very dense, rare black specs/grains | | | | | | | 20 | Stainless Steel SS Spl from 30' to 32' @ 1200 |
| | | | | | | A5 | | 50 | CAN109-1092-0030 OVA on sample = 0ppm |
| 31 | | | | | | | 2 | 59 | |
| | | | | | | | | 74 | |
| 32 | | SM | | | | | | | |
| 33 | | | | | | | | | |
| 34 | | | | | | | | | |

PROJECT NO. 89MC114W T2L

SHEET 4 OF 8

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1092

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist. Blows/6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 34 | Sand, pale orange tan-orange, subangular to subrounded, well sorted, little silt (10-15%), trace clay (5%), calcareous & calcium carbonate cement (20-30%), trace black specs/grains, dry to slightly moist, medium dense, occassional very light tan mottling | | | | | | | | OVA @ 35' in augers @ 1230 = 0 ppm; in breathing zone = 0 ppm |
| 35 | | | | | | | | 11 | SPT from 35' to 37 @ 1230 |
| | | | | | | G10 | | 25 | Collected gradation analysis Spl from 35' to 37' CAN109-1092-4035 |
| 36 | | | | | | | 2 | 20 | |
| | | | | | | | | 16 | |
| 37 | | | | | | | | | |
| 38 | | SM | | | | | | | |
| 39 | | | | | | | | | |
| 40 | | | | | | | | | OVA @ 40' in augers @ 1315 = 0 ppm; in breathing zone = 0 ppm |
| | | | | | | | | 37 | Stainless Steel SS Spl from 40' to 41.5' @ 1315 |
| | | | | | | A6 | 1.3 | 60 | CAN109-1092-0040 OVA on sample from 41 to 41.5 = 58 ppm took TCL VOCs Spl from this interval; OVA on rest of sample = 0 ppm |
| 41 | | | | | | | | 91 | |
| 42 | | | | | | | | | |
| 43 | | | | | | | | | |

PROJECT NO. 89MC114W T2L

SHEET 5 OF 8

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1092

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist. Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc |
|---|---|---|---|---|---|---|---|---|---|
| 43 | Sand, orange to pale orange, fine grained, subangular to subrounded, well sorted, little silt (5-15%), trace clay (5%), little calcareous (10-15%), rare black specs/grains, medium dense, dry to slightly moist | | | | | | | | Collected surface soil spl from approximately 5' west of boring 1092 @ 1345 CAN109-1092-0000 Collected Field Duplicate surface soil sample at same place @ 1400 CAN109-1092-1264 |
| 44 | | | | | | | | | OVA @ 45' in augers @ 1415 = 0 ppm; in breathing zone = 0 ppm |
| 45 | | | | | | | | 17 | SPT from 45' to 47' @ 1415 CAN109-1092-4045 |
| | | | | | | G11 | | 28 | Added 2 gallons of distilled water to inside of augers to facilitate drilling |
| 46 | | SM | | | | | 1.7 | 26 | |
| | | | | | | | | 20 | |
| 47 | | | | | | | | | |
| 48 | | | | | | | | | |
| 49 | | | | | | | | | |
| | | | | | | | | | OVA @ 50' in augers @ 1515 = 8.5; in breathing zone = 0 ppm |
| 50 | Sand, orange, fine grained, subrounded to subangular, well sorted, trace silt (5%), some calcareous (15-25%), rare clay, rare black specs/grains, slightly moist to dry, medium dense | | | | | | | 17 | Stainless Steel SS Spl from 50' to 52' @ 1515 |
| | | | | | | A7 | | 25 | OVA between 50'-52' ranged between 32 to 68 highest readings from 51.5' to 52' Took TCL VOCs from this interva |
| 51 | | SM/SP | | | | | 2 | 23 | CAN09-1092-0050 |
| | | | | | | | | 40 | OVA on rest of sample = 0 ppm |
| 52 | | | | | | | | | |

PROJECT NO. 89MC 114W T2L

SHEET 6 OF 8

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1092

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist Blows/6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 52 | Sand, orange, fine grained, subangular to subrounded, well sorted, trace silt (5-10%), trace clay (1-3%), little to some calcareous (15-25%), slightly moist to dry, medium dense, rare black spec/grains | | | | | | | | Collected Ambient Blank water sample @ 1525 CAN109-1092-1251 |
| 53 | | | | | | | | | |
| 54 | | | | | | | | | |
| | | | | | | | | | OVA @ 55' in augers @ 1535 = 2.8 ppm |
| 55 | | | | | | | | 13 | SPT from 55' to 57' @ 1535 |
| | | | | | | G12 | | 25 | |
| 56 | | | | | | | 18 | | |
| | | SM/SP | | | | | | 30 | |
| | | | | | | | | 31 | |
| 57 | | | | | | | | | |
| 58 | | | | | | | | | |
| 59 | | | | | | | | | |
| | | | | | | | | | OVA @ 60' in augers @ 1630 = 0 ppm; in breathing zone = 0 ppm |
| 60 | | | | | | | | | Stainless Steel SS Spl from 60' to 62' @ 1630 |
| | | | | | | | | 29 | |
| | | | | | | A8 | 2 | | OVA for sample = 0 ppm except between 61' and 61.5'; took TCL VOCs spl from 61.0 to 61.5' OVA = 2.1 ppm |
| | | | | | | | | 54 | |
| 61 | | | | | | | | | |

PROJECT NO. 89MC 114W T2L

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1092

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist. Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, et |
|---|---|---|---|---|---|---|---|---|---|
| 61 | Sand, orange, fine grained, subangular to sub-rounded, well sorted, trace silt (5-10%), trace clay (1-5%), little to some calcareous (15-25%) slightly moist, dense to very dense, rare black specs /grains | SM/SP | | | | A8 | 2 | 63<br>74 | CAN109-1092-0060<br>Stopped drilling @ 62' @ 1630 on 10-10-91 |
| 62 | Bottom of hole ~ 62' | | | | | | | | 10-11-91 - 900<br>Pulled 5' of augers and placed tremie pipe to bottom of borehole<br>905<br>Clutch went out on Failing F-10; pulled off of borehole<br>1000<br>Brought Mobile B-53 rig over to boring 1092 and pulled augers; hole slough ~ 0.5'. Placed tremie pipe before pulling augers<br>1200<br>Mixed 13 bags of Portland Type I-II Cement w/40 lbs of bentonite & 90 gallons of water<br>1220<br>Pumped grout into borehole.<br>1230<br>Pulled tremie pipe Approximately 25' of 1" Schedule 40 PVC tremie broke off at the threads Can not retrieve. will leave in borehole<br>1240<br>Will Place metal spike when boring is topped off with grout<br>Notes:<br>All Split Spoons Samples were driven w/ a 140 pound hammer falling 30 inches<br>Borehole diameter is 8¼" |
| 63 | | | | | | | | | |
| 64 | | | | | | | | | |
| 65 | | | | | | | | | |
| 66 | | | | | | | | | |
| 67 | | | | | | | | | |
| 68 | | | | | | | | | |
| 69 | | | | | | | | | |
| 70 | | | | | | | | | |

PROJECT NO. 89MC114W T2L

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1093

| | | | |
|---|---|---|---|
| BORING LOCATION Fire Training Area No. 4 | | ELEVATION AND DATUM 4265.24' MSL | |
| DRILLING AGENCY Environmenta Drilling | DRILLER L. Weeks | DATE STARTED 10-15-91 DATE FINISHED 10-22-91 | |
| DRILLING EQUIPMENT Failing F-10 | | COMPLETION DEPTH 100' | SAMPLER 3" Stainless Steel SS 2" Steel SS |
| DRILLING METHOD HSA 4¼" ID 8¼" OD | DRILL BIT 8¼" Bullet | NO. OF SAMPLES DIST. — | UNDIST. Analytical - 12 Geotech - 14 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kubeczko | CHECKED BY Scott Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite Grout | FROM 0 TO 100 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov. ft. | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Sand, dark gray, fine grained, subangular, well to moderately sorted, predominantly quartz w/ trace dark colored grains, silty (10-15%) clayey (5-10%), abundant black & gray fuel staining & odor, slightly moist to moist, loose | SM | | | | A1 | | 5 | Collected Surface Soil Spl from 0' to 0.5' @ 1150 on 10-15-91 CAN109-1093-0000 MS/MSD CAN109-1093-1200 MS/MSD |
| | | | | | | | | 6 | Started drilling @ 1700 on 10-15-91 |
| | | | | | | G1 | 1.4 | 11 | SPT Spl from 0' to 2' @ 1700 CAN109-1093-4000 |
| | | | | | | | | 7 | OVA on sample = 35 ppm |
| 2 | Sand, brown-orange, fine grained, subangular well sorted, silty (10-20%), trace clay (5-10%), slight fuel odor, slightly moist | | | | | | | 4 | SPT Spl from 2' to 4' @ 1710 CAN109-1093-4002 |
| | | | | | | | | 2 | OVA on sample = 14 ppm |
| 3 | | | | | | G2 | 2 | 5 | |
| | | | | | | | | 4 | OVA @ 4' in augers = 1 ppm in breathing zone = 0 ppm |
| 4 | Sand, pale orange to orange, fine grained, sub-angular, well sorted, silty (5-15%), calcareous (15-25%), trace clay (1-3%), scattered tan-orange caliche pockets, loose to medium dense, slightly moist, moderate fuel odor | SM | | | | | | 8 | Stainless Steel SS Spl from 4' to 6' @ 1745 OVA on sample = 10.5 ppm CAN109-1093-0004 |
| | | | | | | | | 7 | |
| 5 | | | | | | A2 | 1.4 | 10 | Collect Field Duplicate from 4' to 6' @ 1800 CAN109-1093-1262 |
| | Increasing pockets & thin layers of caliche w/ increasing fuel odor | | | | | | | 9 | |
| 6 | | | | | | | | 4 | SPT Spl from 6' to 8' @ 1800 CAN109-1093-4006 |
| | Caliche, tan-orange, silty (5-15%) sandy (5-10%), trace clay (5%), slightly moist, loose, moderate fuel odor | CALICHE | | | | G3 | 1.8 | 7 | OVA on sample = 12 ppm |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W T2L

SHEET 1 OF 12

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1093

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows/6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | Sand, orange to light orange, fine grained, subangular, well sorted, silty (10-25%), calcareous (20-25%) w/ scattered layers & pockets of tan tan-orange caliche, trace clay (1-5%), moderate to strong fuel odor, slightly moist, loose | | | | | | | 7 | |
| | | | | | | G3 | 1.8 | 5 | |
| 8 | | | | | | | | 5 | SPT Spl from 8' to 10' @ 1805 CAN109-1093-4008 OVA on sample? 17 ppm |
| | | | | | | | | 5 | |
| 9 | | | | | | G4 | 1.4 | 5 | |
| | | | | | | | | 5 | OVA @ 10' in augers = 30 ppm in breathing zone = 0.4 ppm |
| 10 | | | | | | | | 4 | Stainless Steel SS Spl from 10' to 12' @ 1820 OVA on sample = 22 ppm CAN109-1093-0010 |
| | | | | | | | | 5 | |
| 11 | | SM | | | | A3 | 1.5 | 5 | |
| | | | | | | | | 7 | |
| 12 | | | | | | | | 3 | SPT Spl from 12' to 14' @ 1830 CAN109-1093-4012 OVA on sample = 8 ppm Collected gradation analysis sample from 12' to 14' @ 1830 |
| | | | | | | | | 3 | |
| 13 | | | | | | G5 | 1.4 | 3 | |
| | | | | | | | | 3 | OVA @ 15' in augers = 34 ppm in breathing zone = 1.1 ppm |
| 14 | | | | | | | | 4 | SPT Spl from 14' to 16' @ 1835 CAN109-1093-4014 OVA on sample = 31 ppm |
| | | | | | | | | 4 | |
| 15 | Caliche, tan-orange pale orange, sandy (10%), silty (5-10%), clayey (5-15%), medium dense, slightly moist, slight to moderate fuel odor | CALICHE | | | | G6 | 1.7 | 11 | |
| | | | | | | | | 14 | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W T2L

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1093

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | Sand, pale orange tan-orange, fine grained, subangular, well sorted, calcareous (20-30%) w/ pockets & layers of caliche, silty (5-10%), clayey (5-10%), medium dense, slightly moist | SM | | | | | | 4 | SPT Spl from 16' to 18' @ 1855 CAN109-1093-4016 OVA on sample = 0.8 ppm |
| | | | | | | G7 | 1.8 | 11 | |
| 17 | Caliche, tan-orange pale orange, sandy (5-10%), silty (10-15%), clayey (5-15%), medium dense, slightly moist | CALICHE | | | | | | 13 | |
| | | | | | | | | 14 | |
| 18 | Sand, pale orange tan-orange, fine grained, subangular, well sorted, calcareous (15-25%), silty (5-10%), clayey (5%), medium dense, slightly moist | SM | | | | | | 7 | SPT Spl from 18' to 20' @ 1900 CAN109-1093-4018 OVA on sample = 0.2 ppm |
| | | | | | | | | 9 | |
| 19 | | | | | | G8 | 1.2 | 13 | |
| | | | | | | | | 12 | OVA @ 20' in augers: 6 ppm in breathing zone: 0 ppm |
| 20 | Caliche, tan-orange pale orange, sandy (5-15%), silty (5-10%), clayey (5%), medium dense, slightly moist | CALICHE | | | | | | 20 | Stainless Steel SS Spl from 20' to 22' @ 1920 OVA on sample = 0 ppm CAN109-1093-0020 |
| | | | | | | | | 66 | |
| 21 | | | | | | A4 | 1.5 | 100 | |
| | | | | | | | | 135 | |
| 22 | | | | | | | | | |
| 23 | Sand, orange to pale orange, fine grained, subangular, well sorted, silty (10-15%), calcareous (15-20%), clayey (5%), occassional pockets of caliche & calcium carbonate cement, medium dense, slightly moist | SM | | | | | | | |
| 24 | | | | | | | | | |
| 25 | | | | | | | | | OVA @ 25' in augers: 2 ppm in breathing zone: 0 ppm Stopped drilling @ 1945 on 10-15-91 |

PROJECT NO. 89MC114W T2L

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1093

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetr. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, et |
|---|---|---|---|---|---|---|---|---|---|
| 25 | Sand, orange to pale orange, fine grained, subangular, well sorted, silty (10-15%), calcareous (15-20%), clayey (5%), occassional pocket of coliche/calcium carbonate cement medium dense, slightly moist, rare black specs/grains | | | | | | | 9 | SPT Spl from 25' to 27' @ 725 on 10-16-91 CAN109-1093-4025 |
| | | | | | | | | 17 | Started drilling @ 25' @ 730 on 10-16-91 |
| 26 | | | | | | G9 | 1.8 | | OVA on sample = 0 ppm |
| | | | | | | | | 21 | |
| | | | | | | | | 23 | |
| 27 | | | | | | | | | |
| 28 | | | | | | | | | |
| 29 | | | | | | | | | |
| | | SM | | | | | | | OVA @ 30' in augers = 1.5 ppm in breathing zone = 0 ppm |
| 30 | | | | | | | | 12 | Stainless Steel SS Spl from 30' to 32' @ 755 OVA on sample = 0 ppm CAN109-1093-0030 |
| | | | | | | | | 17 | |
| 31 | | | | | | A5 | 1.7 | | |
| | | | | | | | | 46 | |
| | | | | | | | | 51 | |
| 32 | | | | | | | | | |
| 33 | | | | | | | | | |
| 34 | | | | | | | | | |

PROJECT NO. 89MC114W T2L

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1093

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 34 | Sand, medium to light orange, fine grained, subangular to subrounded, well sorted, calcareous (25-30%) w/ scattered pale orange caliche layers / pockets, silty (10-15%), clayey, (5-10%), dense, dry to slightly moist | | | | | | | | OVA @ 35' in augers: 1.9 ppm in breathing zone: 0 ppm |
| 35 | | | | | | | | 46 | SPT Spl from 35' to 37' @ 825 CAN109-1093-4035 OVA on sample: 0 ppm |
| | | | | | | | | 50 | |
| 36 | | | | | | G10 | 1.4 | | |
| | | | | | | | | 75 | |
| | | | | | | | | 91 | |
| 37 | | | | | | | | | |
| 38 | | SM | | | | | | | |
| 39 | | | | | | | | | |
| | | | | | | | | | OVA @ 40' in augers: 0.1 ppm in breathing zone: 0 ppm |
| 40 | | | | | | | | 24 | Stainless Steel SS Spl from 40' to 42' @ 850 OVA on sample = 4.8 between 40.5 & 41 Collected TCL VOCs from this interval CAN109-1093-0040 |
| | | | | | | | | 57 | |
| 41 | | | | | | A6 | 1.3 | | |
| | | | | | | | | 50 | |
| | | | | | | | | 73 | |
| 42 | | | | | | | | | |
| 43 | | | | | | | | | |

PROJECT NO. 89MC114W T2L

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1093

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist. Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 43 | Sand, orange, fine grained, subangular to sub-rounded, well sorted, silty (10-20%), calcareous, (15-20%), clayey (5-10%), medium dense to dense, slightly moist, rare dark colored grains, occassional very slight fuel odor | | | | | | | | |
| 44 | | | | | | | | | OVA @ 45' in augers = 0 ppm in breathing zone = 0 ppm |
| 45 | | | | | | | | 20 | SPT Spl from 45' to 47' @ 915 |
| | | | | | | | | 21 | CAN109-1093-4045 OVA on sample = 0 ppm Collected gradation analysis sample from 45' to 47' @ 915 |
| 46 | | | | | | G11 | L7 | 24 | |
| | | SM | | | | | | 22 | |
| 47 | | | | | | | | | |
| 48 | | | | | | | | | |
| 49 | | | | | | | | | |
| | | | | | | | | | OVA @ 50' in augers = 0 ppm in breathing zone = 0 ppm |
| 50 | | | | | | | | 16 | Stainless Steel SS Spl from 50' to 52' @ 1000 OVA on sample = L1 CAN109-1093-0050 |
| | | | | | | | | 34 | |
| 51 | | | | | | A7 | L6 | 54 | |
| | | | | | | | | 67 | |
| 52 | | | | | | | | | |

PROJECT NO. 89MC114W T2L

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1093

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 52 | Sand, orange, fine grained, subrounded to subangular, well sorted, silty (5-10%), clayey (5%), calcareous (15-20%), slightly moist to dry, occassional caliche pockets / thin layers, medium dense to dense, very slight fuel odor | | | | | | | | |
| 53 | | | | | | | | | |
| 54 | | | | | | | | | OVA @55' in augers = 0.4 ppm in breathing zone = 0 ppm |
| 55 | | | | | | | | 17 | SPT Spl from 55' to 56.5' @ 1030 |
| | | | | | | | | 24 | CAN109-1093-4055 OVA on sample = 0 ppm |
| 56 | | SM | | | | G12 | 1.1 | 61 | |
| 57 | | | | | | | | | |
| 58 | | | | | | | | | |
| 59 | | | | | | | | | OVA @ 60' in auger = 0.6 ppm in breathing zone = 0 ppm @ 1050 |
| 60 | Sand, orange, fine grained, subangular to subrounded, well sorted, silty (10-15%) calcareous (20-25%), trace clay (1-5%), slightly moist, very slight fuel odor | | | | | A8 | 1.7 | 24 | Stainless Steel SS Spl from 60' to 62' @ 1100 OVA on sample = 0.6 ppm CAN109-1093-0060 |
| 61 | | | | | | | | 50 | |

PROJECT NO. 89MC114W T2L

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1093

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 61 | Sand, pale orange, fine grained, subangular to subrounded, well sorted, silty (5-15%), calcareous (15-25%), trace clay (5%), very dense, slightly moist, very slight fuel odor rare scattered dark gray stained patches | | | | | A8 | 1.7 | 100 | |
| | | | | | | | | 187 | Stopped drilling @ 62' @ 1100 on 10-16-91 Reamed out hole @ 1140 |
| 62 | | | | | | | | | Started drilling @ 62' @ 1530 on 10-21-91 |
| 63 | | | | | | | | | |
| 64 | | | | | | | | | OVA @ 65' in augers = 480ppm in breathing zone = 0 ppm |
| 65 | | SM | | | | | | 114 | Stainless Steel SS Spl Ato 65' to 66' @ 1625 OVA on sample = 7.1ppm CAN109-1093-4065 |
| | | | | | | G13 | .7 | 115 | |
| 66 | | | | | | | | | |
| 67 | | | | | | | | | |
| 68 | | | | | | | | | |
| 69 | | | | | | | | | |
| 70 | | | | | | | | | OVA @ 70' in augers = 380ppm in breathing zone = 0 ppm |

PROJECT NO. 89MC114W T2L

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1093

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 70 | Sand, orange, fine to medium grained, subangular to subrounded, well sorted, trace silty (5-10%), calcareous (15-20%), rare clay (1-3%), occassional pockets of caliche/calcium carbonate cemented sand, dense to very dense, slightly moist, very slight fuel odor | | | | | | | 40 | Stainless Steel SS Spl from 70 to 72' @ 1710<br>OVA on sample = 11 ppm<br>CAN109-1093-0070 |
| 71 | | | | | | A9 | 1.8 | 42 | |
| | | | | | | | | 89 | |
| 72 | | | | | | | | 120 | Stopped drilling @ 72' @ 1730 on 10-21-91<br>Started drilling @ 72' @ 800 on 10-22-91 |
| | | SM | | | | | | | |
| 73 | | | | | | | | | |
| 74 | | | | | | | | | |
| | | | | | | | | | OVA @ 75' in augers = 18 ppm<br>in breathing zone = 0 ppm |
| 75 | Sand, orange, fine to medium grained, sub-rounded, well sorted, trace silty (1-5%) predominantly quartz w/rare (1-2%) black grains, slightly moist, dense, very slight fuel odor, rare dark gray stained patches/splotches | | | | | G14 | .3 | 65 | SPT Spl from 75' to 75.5' @ 835<br>OVA on sample = 0.2 ppm<br>CAN109-1093-4075 |
| 76 | | | | | | | | | |
| 77 | | SP/SM | | | | | | | |
| 78 | | | | | | | | | |
| 79 | | | | | | | | | |

PROJECT NO. 89MC114W T2L

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1093

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 79 | Sand, orange, fine to medium grained, sub-rounded, well sorted, trace silt (1-5%), predominantly quartz w/ rare (1-2%) black grains, slightly moist, dense, very slight fuel odor, rare dark gray stained patches/splotches | | | | | | | | OVA @ 80' in augers: 2.3 ppm in breathing zone = 0 ppm |
| 80 | | | | | | | | 17 | Stainless Steel SS Spl from 80' to 82' @ 945 OVA on sample: 5.1 ppm CAN109-1093-0080 |
| | | | | | | | | 48 | |
| 81 | | | | | | A10 | 4.8 | | |
| | | | | | | | | 45 | |
| | | | | | | | | 50 | |
| 82 | | | | | | | | | |
| 83 | | SP/SM | | | | | | | |
| 84 | | | | | | | | | |
| 85 | | | | | | | | | |
| 86 | | | | | | | | | |
| 87 | | | | | | | | | |
| 88 | | | | | | | | | |

PROJECT NO. 89MC114W T2L

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1093

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 88 | Sand, orange, medium grained, subrounded well sorted, predominantly quartz w/rare dark colored & orange grains (1-2%), rare silt, calcareous (5-10%), slightly moist, dense | | | | | | | | |
| 89 | | | | | | | | | |
| 90 | | | | | | | | 20 | Stainless Steel SS spl from 90' to 92' @ 1220 |
| | | | | | | | | 60 | CAN109-1093-0090 OVA on sample = 1.1 ppm |
| 91 | | | | | | A11 | 1.9 | | Collected gradation analysis sample from 90' to 92' @ 1220 |
| | | | | | | | | 61 | CAN109-1093-4090 |
| | | | | | | | | 47 | |
| 92 | | SP | | | | | | | |
| 93 | | | | | | | | | |
| 94 | | | | | | | | | |
| 95 | | | | | | | | | |
| 96 | | | | | | | | | |
| 97 | | | | | | | | | |

PROJECT NO. 89MC 114W T2L

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1093

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 97 | Sand, orange, medium grained, subrounded to subangular, well sorted, predominantly quartz w/ 1-3% dark colored & orange grains, occassional rounded grains, dense to very dense, slightly moist to moist | | | | | | | | |
| 98 | | SP | | | | | | 17 | Stainless Steel SS Spl from 98' to 100' @ 1320 |
| | | | | | | | | 45 | CAN109-1093-0098 OVA on sample = 0 ppm |
| | | | | | | A12 | 1.7 | | |
| 99 | | | | | | | | 120 | |
| | | | | | | | | 141 | Stopped drilling @ 100' @ 1330 on 10-22-91 |
| 100 | | | | | | | | | |
| | Bottom of hole - 100' | | | | | | | | 1520 Prepared Grout Mix 27 bags of cement 80 pounds of powdered bentonite 190 gallons of water |
| 101 | | | | | | | | | 1630 Pumped 100 gallons of grout; tried to pull 30' of augers, auger got stuck, during pulling process augers broke off 10' below ground surface |
| 102 | | | | | | | | | 1730 Pumped 1000 gallons of water into augers to dilute grout |
| | | | | | | | | | 10-27-91 |
| 103 | | | | | | | | | 1300 Mixed grout to pressure grout augers in place |
| | | | | | | | | | 1400 Set packer between 1st & 2nd augers ~ 13' below ground surface |
| 104 | | | | | | | | | 1430 Pumped 80 gallons of grout into augers, then 15 gallons of water, let pressures equilibriate |
| | | | | | | | | | 1530 Pumped 60 gallons of grout into augers and along outside near the top of augers |
| 105 | | | | | | | | | Will place metal spike into grouted borehole when topped off w/ grout |
| 106 | | | | | | | | | |

PROJECT NO. 89MC 114W T2L

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1094

| | | | |
|---|---|---|---|
| BORING LOCATION Fire Training Area No. 4 | | ELEVATION AND DATUM 4265.25' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER L. Weeks | DATE STARTED 10-27-91 DATE FINISHED 10-29-91 | |
| DRILLING EQUIPMENT Failing F-10 | | COMPLETION DEPTH 92' | SAMPLER 3" Stainless Steel SS 2" Steel SS |
| DRILLING METHOD HSA 3¼" ID 6¼" OD | DRILL BIT 7¼" Bullet | NO. OF SAMPLES DIST. — | UNDIST. Analytical - 11 Geotechnical - 12 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kubeczko | CHECKED BY SM Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite Grout | FROM 0 TO 92' FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov. ft. | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | Sand, gray-brown, fine grained, subangular, well sorted, silty (10-20%), clayey (5-10%), dark gray fuel staining, loose to medium dense, slightly moist, very strong fuel odor | SM | | | | A1 | | 8 | Collected Surface Soil Spl from 0' to 0.5' @ 1220 on 10-15-91 OVA on sample = 35 ppm CAN109-1094-0000 |
| | | | | | | | | 6 | Started drilling @ 1545 on 10-27-91 |
| 1 | | | | | | G1 | 1.4 | 5 | |
| | | | | | | | | 8 | SPT Spl from 0' to 2' @ 1545 CAN109-1094-4000 OVA on sample = 20 ppm |
| 2 | Sand, brown-orange rust-orange, fine grained, subangular, well sorted, silty (10-20%), clayey (5-10%), slight brown-gray fuel staining, loose to medium dense, slightly moist, very strong fuel odor | SM | | | | | | 6 | SPT Spl from 2' to 4' @ 1555 CAN109-1094-4002 OVA on sample = 70 ppm |
| | | | | | | | | 4 | |
| 3 | | | | | | G2 | 1.7 | | |
| | | | | | | | | 6 | |
| | | | | | | | | 12 | OVA @ 4' in augers = 22 ppm in breathing zone = 0 ppm |
| 4 | | | | | | | | 5 | Stainless Steel SS Spl from 4' to 6' @ 1605 OVA on sample = 36 ppm CAN109-1094-0004 |
| | | | | | | | | 12 | |
| 5 | Caliche, pale orange to tan-orange, sandy (10-20%), silty (5-15%), clayey (5-10%), yellow to light brown staining, very strong fuel odor, dense, slightly moist | CALICHE | | | | A2 | 1.9 | 37 | |
| | | | | | | | | 29 | |
| 6 | Becoming very sandy w/ thin sand stringers | | | | | | | 5 | SPT Spl from 6' to 8' @ 1610 CAN109-1094-4006 OVA on sample = 73 ppm |
| | | | | | | G3 | 1.8 | 5 | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W T2L

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1094

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetr. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, et |
|---|---|---|---|---|---|---|---|---|---|
| 7 | Caliche, pale orange to tan-orange, sandy (15-35%) w/ thin sand stringers, silty (10-15%), clayey (5-10%), light brown staining, very strong fuel odor, loose to medium dense, slightly moist | | | | | | | 6 | |
| | | | | | | G3 | 18 | 8 | |
| 8 | | CALICHE | | | | | | 5 | SPT Spl from 8' to 10' @ 1625 CAN109-1094-4008 OVA on sample = 92 ppm |
| | | | | | | | | 5 | |
| | | | | | | G4 | 18 | | |
| 9 | | | | | | | | 6 | |
| | | | | | | | | 5 | OVA @ 10' in augers = 1000+ ppm in breathing zone = 1.5 ppm |
| 10 | Sand, orange, fine grained, subangular, well sorted, calcareous (10-20%) w/ scattered thin layers of pale orange caliche, silty (10-15%), clayey (5-10%), loose, slightly moist, strong fuel odor | | | | | | | 2 | Stainless Steel SS Spl from 10' to 12' @ 1640 OVA on sample = 110 ppm CAN109-1094-0010 |
| | | | | | | | | 3 | |
| | | | | | | A3 | 18 | | |
| 11 | | | | | | | | 4 | |
| | | | | | | | | 5 | |
| 12 | | | | | | | | 4 | SPT Spl from 12' to 14' @ 1650 CAN109-1094-4012 OVA on sample = 32 ppm |
| | | SM | | | | | | 3 | |
| | | | | | | G5 | 19 | | |
| 13 | | | | | | | | 3 | |
| | | | | | | | | 3 | OVA @ 14' in augers = 188 ppm in breathing zone = 0 ppm |
| 14 | | | | | | | | 3 | SPT Spl from 14' to 16' @ 1655 CAN109-1094-4014 OVA on sample = 24 ppm |
| | Caliche, tan-orange, sandy (15-30%), silty (10-15%), clayey (5-10%), loose, strong fuel odor, slightly moist | | | | | | | 5 | |
| 15 | | CALICHE | | | | G6 | 20 | | |
| | | | | | | | | 5 | |
| | Sand, orange, fine grained, subangular, well sorted, calcareous (15-20%), silty (5-15%), clayey (5%), loose, slightly moist, moderate fuel odor | SM | | | | | | 10 | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W T2L

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1094

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist. Blows 6 in. | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | Sand, orange, fine grained, subangular, well sorted, calcareous (10-20%) w/ scattered pockets of caliche, silty (10-20%), trace clayey (2-5%), medium dense, slightly moist, moderate to slight fuel odor | | | | | | | 5 | SPT Spl from 16' to 18' @ 1710 CAN109-1094-4016 OVA on sample = 3.6 ppm |
| | | | | | | G7 | 1.7 | 8 | |
| 17 | | | | | | | | 12 | |
| | | | | | | | | 13 | |
| 18 | | | | | | | | 5 | SPT Spl from 18' to 20' @ 1720 CAN109-1094-4018 OVA on sample = 24 ppm |
| | | | | | | | | 11 | Collected gradation analysis sample from 18' to 20' @ 1720 |
| 19 | | | | | | G8 | 1.8 | 11 | Stopped drilling @ 20' @ 1720 on 10-27-91 |
| | | | | | | | | 10 | OVA @ 20' in augers = 9 ppm In breathing zone = 0 ppm |
| 20 | | SM | | | | | | 3 | Stainless Steel SS Spl from 20' to 22' @ 845 OVA on sample = 3.3 ppm CAN109-1094-0020 |
| | | | | | | | | 10 | Collected field duplicate sample from 20' to 22' @ 915 CAN109-1094-1263 |
| 21 | | | | | | A4 | 2.0 | 12 | Collected MRD duplicate sample from 20 to 22' @ 845 CAN109-1094-1203 |
| | | | | | | | | 19 | |
| 22 | | | | | | | | | Started drilling @ 840 @ 20' on 10-28-91 |
| 23 | | | | | | | | | |
| 24 | | | | | | | | | |
| 25 | | | | | | | | | OVA @ 25' in augers = 4 ppm in breathing zone = 0 ppm |

PROJECT NO. 89MC114W T2L

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1094

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetr. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, e |
|---|---|---|---|---|---|---|---|---|---|
| 25 | Sand, orange, fine grained, subangular to subrounded, well sorted, calcareous (10-15%), silty (5-15%), clayey (5-10%), medium dense to dense, slightly moist, very slight musty odor | SM | | | | | | 14 | SPT Spl from 25' to 27' @ 915 CAN109-1094-4025 OVA on sample = 0.2 ppm |
| | | | | | | | | 21 | |
| 26 | Sand, pale orange to orange, fine grained, subangular to subrounded, well sorted, calcareous (10-20%) w/ scattered pockets & thin layers of tan-orange caliche, silty (10-15%), trace clayey (2-5%), medium dense to very dense, dry to slightly moist, very slight musty fuel odor | | | | | G9 | 17 | 39 | |
| | | | | | | | | 33 | |
| 27 | | | | | | | | | |
| 28 | | | | | | | | | |
| 29 | | | | | | | | | |
| | | SM | | | | | | | OVA @ 30' in augers = 0.6 ppm In breathing zone = 0 ppm |
| 30 | | | | | | | | 43 | Stainless Steel SS Spl from 30' to 31' @ 930 OVA on sample = 0.2 ppm CAN109-1094-0030 |
| | | | | | | | | 109 | |
| 31 | | | | | | A5 | 10 | | |
| 32 | | | | | | | | | |
| 33 | | | | | | | | | |
| 34 | | | | | | | | | |

PROJECT NO. 89MC114W T2L

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1094

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist Blows (6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 34 | Sand, pale orange, fine grained, sub angular to sub-rounded, well sorted, calcareous (20-30%) w/ scattered pockets & thin layers of caliche, silty (10-15%), trace clayey (3-5%), dry to very slightly moist, medium dense to dense | | | | | | | | OVA @ 35' in augers = 0 ppm In breathing zone = 0 ppm |
| 35 | | | | | | | | 32 | SPT Spl from 35' to 37' @ 1005 CAN109-1094-4035 OVA on sample = 0 ppm |
| | | | | | | | | 36 | |
| 36 | | | | | | G10 | 1.7 | | |
| | | | | | | | | 40 | |
| | | | | | | | | 50 | |
| 37 | | | | | | | | | |
| 38 | | SM | | | | | | | |
| 39 | | | | | | | | | OVA @ 40' in augers = 0 ppm In breathing zone = 0 ppm |
| 40 | | | | | | | | 21 | Stainless Steel SS Spl from 40' to 41.5' @ 1040 OVA on sample = 0 ppm CAN109-1094-0040 |
| | | | | | | | | 89 | |
| 41 | | | | | | A6 | 1.3 | | |
| | | | | | | | | 110 | |
| 42 | | | | | | | | | |
| 43 | | | | | | | | | |

PROJECT NO. 89MC114W T2L

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1094

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 43 | Sand, light orange, fine grained, subangular to subrounded, well sorted, calcareous (10-15%), w/ occassional very small pockets of tan to tan-orange caliche, slightly moist, medium dense to dense, very slight fuel odor, rare dark colored grains, silty (10-15%), trace clay (3-5%) | | | | | | | | |
| 44 | | | | | | | | | OVA @ 45' in augers = 0 ppm in breathing zone = 0 ppm |
| 45 | | | | | | | | 29 | SPT Spl from 45' to 47' @ 1130 CAN109-1094-4045 OVA on sample = 8 ppm |
| | | | | | | | | 30 | |
| 46 | | | | | | G11 | 18 | | |
| | | SM | | | | | | 24 | |
| | | | | | | | | 20 | |
| 47 | | | | | | | | | |
| 48 | | | | | | | | | |
| 49 | | | | | | | | | |
| | | | | | | | | | OVA @ 50' in augers = 0.4 ppm in breathing zone = 0 ppm |
| 50 | Sand, light to medium orange, fine grained, subrounded, well sorted, predominantly quartz w/ trace (3-5%) dark colored grains, silty (5-10%), calcareous (15-20%), trace clayey (3-5%), slightly moist, medium dense, very slight fuel odor | | | | | | | 12 | Stainless Steel SS Spl from 50' to 52' @ 1210 OVA on sample = 2.8 ppm CAN109-1094-0050 |
| | | | | | | | | 26 | |
| 51 | | SM | | | | A7 | 18 | | |
| | | | | | | | | 37 | |
| | | | | | | | | 50 | |
| 52 | | | | | | | | | |

PROJECT NO. 89MC114W T2L

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1094

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 52 | Sand, light to medium orange, fine grained, subangular to subrounded, well sorted, calcareous (15-20%) w/ occassional pockets of tan-orange caliche, silty (5-15%), rare clay (1-3%), slightly moist, dense, very slight fuel odor. | | | | | | | | |
| 53 | | | | | | | | | |
| 54 | | | | | | | | | OVA @ 55' in augers: 1.7 ppm In breathing zone: 0 ppm |
| 55 | | | | | | | | 17 | SPT Spl from 55' to 57' @ 1350 CAN109-1094-4055 OVA on sample = 1.1 ppm |
| 56 | | SM | | | | G12 | 2 | 44 | Collected gradation analysis sample from 55' to 57' @ 1350 |
| | | | | | | | | 38 | |
| 57 | | | | | | | | 47 | |
| 58 | | | | | | | | | |
| 59 | | | | | | | | | OVA @ 60' in augers: 0.6 ppm In breathing zone: 0 ppm |
| 60 | | | | | | A8 | 19 | 30 | Stainless Steel SS Spl from 60' to 62' @ 1445 OVA on sample = 5.1 ppm CAN109-1094-0060 |
| 61 | | | | | | | | 60 | |

PROJECT NO. 89MC114W T2L

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1094

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 61 | Sand, light to medium orange, fine grained, subangular to subrounded, well sorted, predominantly quartz w/3-5% dark colored grains, calcareous (10-20%) w/occassional pockets of tan to tan-orange caliche, silty (5-10%), trace clayey (3-5%), dense, slightly moist, very slight fuel odor | | | | | | | 70 | |
| | | | | | | A8 | 19 | | |
| | | | | | | | | 108 | |
| 62 | | | | | | | | | |
| 63 | | | | | | | | | |
| 64 | | | | | | | | | |
| | | | | | | | | | OVA @ 65' in auger = 0.5 ppm in breathing zone = 0 ppm @ 1505 |
| 65 | | SM | | | | | | | |
| 66 | | | | | | | | | |
| 67 | | | | | | | | | |
| 68 | | | | | | | | | |
| 69 | | | | | | | | | |
| | | | | | | | | | OVA @ 70' in augers = 5.1 ppm in breathing zone = 0 ppm |
| 70 | | | | | | | | | |

PROJECT NO. 89MC114W T2L

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1094

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 70 | Sand, light to medium orange, fine grained, subangular, well sorted, pedominantly quartz w/1-3% dark colored grains, calcareous (10-20%) w/ occassional pockets of tan-orange caliche. silty (5-10%), trace clay (1-3%), dense to very dense, slightly moist, very slight fuel odor rare scattered dark gray patches/splotches (possible staining?) | | | | | | | 39 | Stainless Steel SS Spl from 70' to 72' @ 1525 OVA on sample = 6.2 ppm CAN109-1094-0070 |
| | | | | | | | | 115 | |
| 71 | | | | | | A9 | 1.6 | | |
| | | | | | | | | 147 | |
| | | | | | | | | 200 | |
| 72 | | | | | | | | | |
| 73 | | | | | | | | | |
| 74 | | SM | | | | | | | |
| | | | | | | | | | OVA @ 75' in augers = 0.8 ppm in breathing zone = 0 ppm @ 1610 |
| 75 | | | | | | | | | |
| 76 | | | | | | | | | |
| 77 | | | | | | | | | |
| 78 | | | | | | | | | |
| 79 | | | | | | | | | |

PROJECT NO. 89MC114W T21

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1094

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| 79 | Sand, orange to light orange, fine to medium grained, subrounded, well sorted, predominantly quartz w/ rare (1-2%) dark colored grains, calcareous (10-15%), rare silt (1-3%), rare clay (1-3%), slightly moist, very dense very slight fuel odor | | | | | | | | OVA @ 80' in augers: 0 ppm In breathing zone: 0 ppm |
| 80 | | | | | | | | 21 | Stainless Steel SS Spl from 80' to 82' @ 1700 OVA on sample = 7.8 ppm CAN109-1094-0080 |
| | | | | | | | | 90 | Collected MRD Duplicate sample from 80' to 82' @ 1700 CAN109-1094-1204 |
| 81 | | | | | | A10 | 85 | 135 | Collected gradation analysis sample from 80' to 82' @ 1700 CAN109-1094-4080 |
| | | | | | | | | 200 | |
| 82 | | | | | | | | | |
| 83 | | SP | | | | | | | |
| 84 | | | | | | | | | |
| | | | | | | | | | OVA @ 85' in augers: 0 ppm In breathing zone: 0 ppm @ 1720 |
| 85 | | | | | | | | | |
| 86 | | | | | | | | | |
| 87 | | | | | | | | | |
| 88 | | | | | | | | | |

PROJECT NO. 89MC114W T2L

SHEET 10 OF 11

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1094

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (') | SAMPLES: Penetra. Resist. Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 88 | Sand, orange to light orange, medium grained, subrounded, well sorted, predominantly quartz w/rare (1-2%) dark colored grains, trace calcareous (3-5%), rare silt (1-3%), very dense, slightly moist | | | | | | | | |
| 89 | | | | | | | | | Stopped drilling @ 90' @ 1740 on 10-28-91 Started drilling @ 90' @ 730 on 10-29-91 |
| | | | | | | | | | OVA @ 90' in augers = 0 ppm In breathing zone = 0 ppm |
| | | SP | | | | | | | |
| 90 | | | | | | | | | Stainless Steel SS Spl from 90' to 92' @ 845 |
| | | | | | | | | 47 | OVA on Sample = 0 ppm CAN109-1094-0090 |
| | | | | | | | | 100 | |
| 91 | | | | | | All | 1.7 | | |
| | | | | | | | | 132 | |
| | | | | | | | | 195 | Stopped drilling @ 92' @ 845 on 10-29-91 |
| 92 | | | | | | | | | |
| | Bottom of hole = 92' | | | | | | | | Borehole Diameter = 7¼" |
| | | | | | | | | | Grouted borehole from 0 to 92' w/ cement-bentonite grout |
| | | | | | | | | | 930 |
| 93 | | | | | | | | | Placed tremie pipe to bottom of hole inside augers |
| | | | | | | | | | Mixed Grout |
| | | | | | | | | | Grout Mixture: 23 bags of cements 75 pounds of bentonite 200 gallons of water |
| 94 | | | | | | | | | |
| | | | | | | | | | 1000 Pulled 30' of augers due to possible formation collapse |
| 95 | | | | | | | | | 1230 Pumped 100 gallons of grout into borehole; pulled 30' of augers |
| | | | | | | | | | 1300 Pumped 100 gallons of grout into borehole; pulled 30' of augers |
| 96 | | | | | | | | | Will place metal spike into grouted borehole when topped off |
| 97 | | | | | | | | | |

PROJECT NO. 89MC114W T21

SHEET 11 OF 11

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1095

| | | | |
|---|---|---|---|
| BORING LOCATION Fire Training Area No.4 (Redrill of Boring 1091) | | ELEVATION AND DATUM ~3' West of Boring 1091 4265.44' MSL | |
| DRILLING AGENCY Environmental Drilling | DRILLER D. Sampson | DATE STARTED 12-9-91 DATE FINISHED 12-9-91 | |
| DRILLING EQUIPMENT CME-75 | | COMPLETION DEPTH 61' | SAMPLER 3" Stainless Steel SS |
| DRILLING METHOD HSA 4¼" ID 7¾" OD | DRILL BIT 8" Bullet Bit | NO. OF SAMPLES DIST. — | UNDIST. Analytical = 6 Geotechnical = 1 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL. — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kubeczko | CHECKED BY JM Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite Grout | FROM 0 TO 61 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov. ft. | Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | See boring log 1091 for lithology descriptions | ASPHALT | | | | | | | Started drilling @ 840 on 12-9-91 |
| 1 | | | | | | | | | |
| 2 | | | | | | | | | |
| 3 | | SM | | | | | | | |
| 4 | | | | | | | | | |
| 5 | | | | | | | | 5 | Stainless Steel SS Sample from 5' to 7' @ 855 CAN109-1095-4005 OVA on sample = 0 ppm |
| | | | | | | | | 6 | |
| 6 | | | | | | G1 | 20 | 7 | |
| 7 | | SM | | | | | | 5 | |

PROJECT NO. 89MC114W T12 SHEET 1 OF 8

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1095

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist. Blows 6 in. | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | 3 | Stainless Steel SS Sample from 10' to 12' @ 915 CAN109-1095-0010 (TOC) |
| | | | | | | | | 4 | OVA on sample = 0 ppm |
| 11 | | SM | | | | A1 | 1.8 | 5 | |
| | | | | | | | | 6 | |
| 12 | | | | | | | | | |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W T12

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1095

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist. Blows (6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| | | SM | | | | | | | |
| 20 | | | | | | | | | |
| | | | | | | | | 14 | Stainless Steel SS Sample from 20' to 22' @ 935 CAN109-1095-0020 MS/MSD (TOC) |
| | | | | | | | | 25 | OVA on sample = 0.5 ppm |
| 21 | | | | | | A2 | 2.0 | | |
| | | | | | | | | 31 | |
| | | | | | | | | 35 | |
| 22 | | | | | | | | | |
| 23 | | | | | | | | | |
| 24 | | | | | | | | | |
| | | SM | | | | | | | |
| 25 | | | | | | | | | |

6

PROJECT NO. 89MC114W T12

SHEET 3 OF 8

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1095

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist. Blows 6 in. | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 25 | | | | | | | | | |
| 26 | | | | | | | | | |
| 27 | | | | | | | | | |
| 28 | | | | | | | | | |
| 29 | | SM | | | | | | | |
| 30 | | | | | | | | 24 | Stainless Steel SS Sample from 30' to 32' @ 1010 CAN109-1095-0030 (VOCs, TOC) |
| | | | | | | | | 34 | OVA on sample = 4.2 ppm Collected field duplicate sample from 30' to 32' @ 1025 |
| 31 | | | | | | A3 | 2.0 | | |
| | | | | | | | | 39 | CAN109-1095-1265 |
| | | | | | | | | 45 | Collected rinsate blank sample from 30' to 32' @ 1040 CAN109-1095-1272 |
| 32 | | | | | | | | | |
| 33 | | | | | | | | | |
| 34 | | | | | | | | | |

PROJECT NO. 89MC114W T12

SHEET 4 OF 8

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1095

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist. Blows 6 in. | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 34 | | | | | | | | | |
| 35 | | | | | | | | | |
| 36 | | | | | | | | | |
| 37 | | | | | | | | | |
| 38 | | SM | | | | | | | |
| 39 | | | | | | | | | |
| 40 | | | | | | | | | |
| | | | | | | A4 | 1.0 | 23 | Stainless Steel SS Sample from 40' to 41' @ 1115 CAN109-1095-0040 (VOC, TOC) |
| | | | | | | | | 28 | OVA on sample = 2.6ppm |
| 41 | | | | | | | | | |
| 42 | | | | | | | | | |
| 43 | | | | | | | | | |

22

PROJECT NO. 89MC114W T12

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1095

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 43 | | | | | | | | | |
| 44 | | | | | | | | | |
| 45 | | | | | | | | | |
| 46 | | SM | | | | | | | |
| 47 | | | | | | | | | |
| 48 | | | | | | | | | |
| 49 | | | | | | | | | |
| 50 | | | | | | | | 46 | Stainless Steel SS Sample from 50' to 51.5' @ 1155 CAN109-1095-0050 (VOCs, TOC) |
| | | | | | | A5 | 1.5 | 41 | OVA on sample = 1.8ppm 74 |
| 51 | | SM | | | | | | 75 | |
| 52 | | | | | | | | | |

PROJECT NO. 89MC114W T12

SHEET 6 OF 8

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1095

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetr. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 52 | | | | | | | | | |
| 53 | | SM | | | | | | | |
| 54 | | | | | | | | | |
| 55 | | | | | | | | | |
| 56 | | | | | | | | | |
| 57 | | | | | | | | | |
| 58 | | SM | | | | | | | |
| 59 | | | | | | | | | |
| 60 | | | | | | | | | Collected decon water sample @ 1230 CAN109-1095-1282 (VOCs) |
| | | | | | | A6 | 1.0 | 21 | Stainless Steel SS Sample from 60' to 61' @ 1240 CAN 109-1095-0060 (VOCs, TOC) |
| | | | | | | | | 30 | OVA on sample = 0 ppm |
| 61 | | | | | | | | | Stopped drilling @ 61' @ 1245 on 12-9-91 |

PROJECT NO. 89MC114W T12

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1095

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 61 | Bottom of hole - 61' | | | | | | | | 12-10-91<br>Grouted borehole w/ cement-bentonite grout from 0' to 61'. Placed metal Spike into grouted borehole<br><br>Grout Mix<br>16 sacks of cements<br>50 lbs of bentonite<br>110 gallons of water |
| 62 | | | | | | | | | |
| 63 | | | | | | | | | |
| 64 | | | | | | | | | |
| 65 | | | | | | | | | |
| 66 | | | | | | | | | |
| 67 | | | | | | | | | |
| 68 | | | | | | | | | |
| 69 | | | | | | | | | |
| 70 | | | | | | | | | |

PROJECT NO. 89MC114W T12

SHEET 8 OF 8

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1096

| | | | |
|---|---|---|---|
| BORING LOCATION Fire Training Area No. 4 (Redrill of Boring 1092) | | ELEVATION AND DATUM ~5' north of Boring 1092 | 4264.50' MSL |
| DRILLING AGENCY Environmental Drilling | DRILLER M. Powless | DATE STARTED 11-23-91 DATE FINISHED 11-24-91 | |
| DRILLING EQUIPMENT Mobile B-61 | | COMPLETION DEPTH 62' | SAMPLER 3" Stainless Steel SS |
| DRILLING METHOD HSA 4¼" ID 7¼" OD | DRILL BIT 7½" Finger Bit | NO. OF SAMPLES DIST. — | UNDIST. Analytical: 8 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL. — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kubeczko | CHECKED BY SM Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement-Bentonite Grout | FROM 0 TO 62 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG Lithology | Piezometer Installation | Water Content | Piezometer Data | SAMPLES Type No. | Recov./L | Penetr. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | See boring log 1092 for lithology descriptions | | | | | A1 | .5 | 4 | Started drilling @ 1400 Collected surface soil sample from 0' to 0.5' @ 1400 CAN109-1096-0000 Collected field duplicate sample from 0' to 0.5' @ 1415 CAN109-1096-1267 (VOCs) OVA on sample = 0 ppm |
| 1 | | SM | | | | | | | |
| 2 | | | | | | | | | |
| 3 | | SM | | | | | | | |
| 4 | | | | | | | | 8 | Stainless Steel SS Sample from 4' to 6' @ 1450 CAN109-1096-0004 (VOCs) OVA on sample = 0 ppm |
| | | | | | | A2 | 1.7 | 5 | |
| 5 | | | | | | | | 5 | |
| | | SM | | | | | | 4 | |
| 6 | | | | | | | | | |
| | | SM | | | | | | | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC114W T12

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1096

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | | |
| 8 | | SM | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | 7 | Stainless Steel SS Sample from 10' to 12' @ 1505 CAN109-1096-0010 (VOCs) |
| | | | | | | | | 10 | OVA on sample = 0 ppm |
| 11 | | | | | | A3 | 2.8 | | |
| | | | | | | | | 8 | |
| | | | | | | | | 11 | |
| 12 | | SM | | | | | | | |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| | | SM | | | | | | | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W T12

SHEET 2 OF 8

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1096

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist. Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | CALICHE | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |
| | | | | | | | | 21 | Stainless Steel SS Sample from 20' to 22' @ 1530 CAN109-1096-0020 (VOCs) |
| | | | | | | | | 48 | OVA on sample = 20 ppm |
| 21 | | | | | | A4 | 1.9 | | |
| | | | | | | | | 61 | |
| | | | | | | | | 75 | |
| 22 | | | | | | | | | |
| | | SM | | | | | | | |
| 23 | | | | | | | | | |
| 24 | | | | | | | | | |
| 25 | | | | | | | | | |

PROJECT NO. 89MC114W T12

SHEET 3 OF 8

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1096

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 25 | | SM | | | | | | | |
| 26 | | | | | | | | | |
| 27 | | | | | | | | | |
| 28 | | CALICHE | | | | | | | |
| 29 | | | | | | | | | |
| 30 | | | | | | | | 28 | Stainless Steel SS Sample from 30' to 32' @ 1625 CAN109-1096-0030 (VOCs) |
| | | | | | | | | 55 | OVA on sample = 0 ppm |
| 31 | | | | | | A5 | LT | 123 | |
| | | | | | | | | 150 | |
| 32 | | SM | | | | | | | |
| 33 | | | | | | | | | |
| 34 | | | | | | | | | |

PROJECT NO. 89 MC 114W T12

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1096

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 34 | | | | | | | | | |
| 35 | | | | | | | | | |
| 36 | | | | | | | | | |
| 37 | | | | | | | | | |
| 38 | | SM | | | | | | | |
| 39 | | | | | | | | | |
| 40 | | | | | | | | 65 | Stainless Steel SS Sample from 40' to 41.5' @ 1715 CAN109-1096-0040 (VOCs) |
| | | | | | | | | 100 | OVA on sample = 10 ppm |
| 41 | | | | | | A6 | 1.5 | | |
| | | | | | | | | 141 | Stopped drilling @ 41.5' @ 1740 on 11-23-91 |
| 42 | | | | | | | | | Started drilling @ 41.5' @ 720 on 11-24-91 |
| 43 | | | | | | | | | |

PROJECT NO. 89MC114W T12

SHEET 5 OF 8

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1096

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist. Blows (6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 43 | | | | | | | | | |
| 44 | | | | | | | | | |
| 45 | | | | | | | | | |
| 46 | | SM | | | | | | | |
| 47 | | | | | | | | | |
| 48 | | | | | | | | | |
| 49 | | | | | | | | | |
| 50 | | | | | | | | 22 | Stainless Steel SS Sample from 50' to 52' @ 930 CAN109-1096-0050 (VOCs) OVA on sample = 10 ppm |
| | | | | | | | | 37 | |
| 51 | | SM/SP | | | | A7 | 1.8 | 40 | |
| | | | | | | | | 49 | |
| 52 | | | | | | | | | |

PROJECT NO. 89MC114W T12

SHEET 6 OF 8

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1096

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 52 | | | | | | | | | |
| 53 | | | | | | | | | |
| 54 | | | | | | | | | |
| 55 | | | | | | | | | |
| 56 | | | | | | | | | |
| | | Sm/SP | | | | | | | |
| 57 | | | | | | | | | |
| 58 | | | | | | | | | |
| 59 | | | | | | | | | |
| 60 | | | | | | | | 27 | Stainless Steel SS Sample from 60' to 62' @ 1110 CAN109-1096-0060 (VOCs) |
| | | | | | | A8 | 1.6 | 60 | OVA on sample = 0 ppm |
| 61 | | | | | | | | | |

PROJECT NO. 89MC114W T12

SHEET 7 OF 8

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1096

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows/6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 61 | | SM/SP | | | | A8 | 1.6 | 81 | |
| | | | | | | | | 92 | Stopped drilling @ 62' @ 1115 |
| 62 | Bottom of hole 62' | | | | | | | | 1700 Grouted borehole w/cement bentonite grout from 0' to 62'. Placed metal spike into grouted borehole |
| 63 | | | | | | | | | Grout Mix 16 sacks cement 50 lbs of bentonite 115 gallons of water |
| 64 | | | | | | | | | |
| 65 | | | | | | | | | |
| 66 | | | | | | | | | |
| 67 | | | | | | | | | |
| 68 | | | | | | | | | |
| 69 | | | | | | | | | |
| 70 | | | | | | | | | |

PROJECT NO. 89MC114W T12

SHEET 8 OF 8

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1097

| | | | |
|---|---|---|---|
| BORING LOCATION Fire Training Area No. 4 (Redrill of Boring 1093) | | ELEVATION AND DATUM ~3' north of Boring 1093 | 4265.33' MSL |
| DRILLING AGENCY Environmental Drilling | DRILLER D. Sampson | DATE STARTED 12-5-91 DATE FINISHED 12-7-91 | |
| DRILLING EQUIPMENT CME-75 | | COMPLETION DEPTH 82' | SAMPLER 3" Stainless Steel SS |
| DRILLING METHOD HSA 4¼" ID 7¾" OD | DRILL BIT 8" Bullet Bit | NO. OF SAMPLES DIST. — | UNDIST. Analytical = 6 Geotechnical = 3 |
| SIZE AND TYPE OF CASING NA | | WATER ELEV. FIRST — | COMPL. — 24 HRS. — |
| TYPE OF PERFORATION NA | FROM TO FT. | LOGGED BY David A. Kuberczko | CHECKED BY SM Buth |
| SIZE AND TYPE OF PACK NA | FROM TO FT. | | |
| TYPE OF SEAL Cement - Bentonite Grout | FROM 0 TO 82 FT | | |

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft. | SAMPLES: Penetra. Resist. (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | A1 | | | Collected surface soil sample from 0' to 0.5 @ 1130 CAN109-1097-0000 (TPH) OVA on sample = 30 ppm |
| 1 | | | | | | | | | Started drilling @ 1150 |
| 2 | | SM | | | | | | | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | 4 | Stainless Steel SS Sample from 4' to 6' @ 1200 CAN109-1097-0004 (VOCs) |
| | | | | | | | | 12 | OVA on sample = 16 ppm |
| 5 | | SM | | | | A2 | 2 | 13 | Collected ambient blank water sample @ 1210 CAN109-1097-1252 (VOCs) |
| 6 | | | | | | | | 9 | |
| | | CALICHE | | | | | | | |
| 7 | | | | | | | | | |

PROJECT NO. 89MC 114 W T12

SHEET 1 OF 10

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1097

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist (Blows/6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | Sm | | | | | | 4 | Stainless Steel SS Sample from 10' to 12' @ 1245 CAN109-1097-0010 (TPH) |
| | | | | | | | | 5 | OVA on sample = 14 ppm |
| 11 | | | | | | A3 | 1.7 | | Collected field duplicate sample from 10' to 12' @ 1225 |
| | | | | | | | | 5 | CAN109-1097-1266 (TPH) |
| | | | | | | | | 6 | |
| 12 | | | | | | | | | |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | CALICHE | | | | | | | |
| 16 | | | | | | | | | |

PROJECT NO. 89MC114W T12

SHEET 2 OF 10

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1097

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist. Blows (6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | | SM | | | | | | | |
| 17 | | CALICHE | | | | | | | |
| 18 | | SM | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | CALICHE | | | | | | 17 | Stainless Steel SS Sample from 20' to 22' @ 1345 CAN109-1097-0020 (TPH) OVA on sample = 0 ppm |
| | | | | | | | | 48 | |
| 21 | | | | | | A4 | 1.8 | | |
| | | | | | | | | 59 | |
| | | | | | | | | 54 | |
| 22 | | | | | | | | | |
| 23 | | SM | | | | | | | |
| 24 | | | | | | | | | |
| 25 | | | | | | | | | Stopped drilling @ 25' @ 1430 on 12-5-91 |

PROJECT NO. 89MC114W T12

SHEET 3 OF 10

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1097

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist. (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 25 | | | | | | | | | Started drilling @ 25' @ 1300 on 12-6-91 |
| 26 | | | | | | | | | |
| 27 | | | | | | | | | |
| 28 | | | | | | | | | |
| 29 | | SM | | | | | | | |
| 30 | | | | | | | | 15 | Stainless Steel SS Sample from 30' to 32' @ 1320 CAN109-1097-4030 OVA on sample = 1.1 ppm |
| | | | | | | | | 29 | |
| 31 | | | | | | G1 | 1.9 | | |
| | | | | | | | | 35 | |
| | | | | | | | | 43 | |
| 32 | | | | | | | | | |
| 33 | | | | | | | | | |
| 34 | | | | | | | | | |

PROJECT NO. 89MC114W T12

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1097

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 34 | | | | | | | | | |
| 35 | | | | | | | | | |
| 36 | | | | | | | | | |
| 37 | | | | | | | | | |
| 38 | | SM | | | | | | | |
| 39 | | | | | | | | | |
| 40 | | | | | | | | 20 | Stainless Steel SS Sample from 40' to 42' @ 1350 CAN109-1097-0040 (VOEs) OVA on sample = 2.4 ppm |
| | | | | | | | | 57 | |
| 41 | | | | | | A5 | 20 | | |
| | | | | | | | | 96 | |
| | | | | | | | | 75 | |
| 42 | | | | | | | | | |
| 43 | | | | | | | | | |

PROJECT NO. 89MC 114W T12

SHEET 5 OF 10

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1097

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist. Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 43 | | | | | | | | | |
| 44 | | | | | | | | | |
| 45 | | | | | | | | | |
| 46 | | | | | | | | | |
| 47 | | SM | | | | | | | |
| 48 | | | | | | | | | |
| 49 | | | | | | | | | |
| 50 | | | | | | | | 13 | Stainless Steel SS Sample from 50' to 52' @ 1455 CAN109-1097-4050 OVA on sample = 8.2 ppm |
| | | | | | | | | 18 | |
| 51 | | | | | | G2 | L9 | | |
| | | | | | | | | 20 | |
| | | | | | | | | 23 | |
| 52 | | | | | | | | | |

PROJECT NO. 89MC114W T12

SHEET 6 OF 10

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1097

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 52 | | | | | | | | | |
| 53 | | | | | | | | | |
| 54 | | | | | | | | | |
| 55 | | | | | | | | | |
| 56 | | SM | | | | | | | |
| 57 | | | | | | | | | |
| 58 | | | | | | | | | |
| 59 | | | | | | | | | |
| 60 | | | | | | | | 20 | Stainless Steel SS Sample from 60' to 62' @ 1540 CAN109-1097-4060 OVA on sample=2.4 ppm |
| | | | | | | G3 | 1.8 | 27 | |
| 61 | | | | | | | | | |

PROJECT NO. 89MC114W T12

SHEET 7 OF 10

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1097

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetra. Resist Blows 6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 61 | | | | | | | | 49 | |
| | | | | | | G3 | 1.8 | | |
| | | | | | | | | 50 | |
| 62 | | | | | | | | | |
| 63 | | | | | | | | | |
| 64 | | | | | | | | | |
| 65 | | SM | | | | | | | |
| 66 | | | | | | | | | |
| 67 | | | | | | | | | |
| 68 | | | | | | | | | |
| 69 | | | | | | | | | |
| 70 | | | | | | | | | |

PROJECT NO. 89MC114W T12

SHEET 8 OF 10

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1097

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. (ft) | SAMPLES: Penetr. Resist. Blows/6 in | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 70 | | | | | | | | 19 | Stainless Steel SS Sample from 70' to 72' @ 1625 CAN109-1097-4070 OVA on sample = 17 ppm |
| | | | | | | | | 24 | |
| 71 | | | | | | G4 | 00 | | |
| | | | | | | | | 43 | |
| | | | | | | | | 61 | |
| 72 | | SM | | | | | | | |
| 73 | | | | | | | | | |
| 74 | | | | | | | | | |
| 75 | | | | | | | | | |
| 76 | | | | | | | | | |
| | | SP/SM | | | | | | | |
| 77 | | | | | | | | | |
| 78 | | | | | | | | | |
| 79 | | | | | | | | | |

PROJECT NO. 89MC114W 712

SHEET 9 OF 10

**Woodward-Clyde Consultants** PROJECT NAME Cannon AFB HOLE NO. 1097

| DEPTH (FEET) | DESCRIPTION | GRAPHIC LOG: Lithology | GRAPHIC LOG: Piezometer Installation | Water Content | Piezometer Data | SAMPLES: Type No. | SAMPLES: Recov. ft | SAMPLES: Penetra. Resist (Blows 6 in) | REMARKS (Drill Rate, Fluid loss, Odor, etc) |
|---|---|---|---|---|---|---|---|---|---|
| 79 | | | | | | | | | |
| 80 | | SP/SM | | | | | | 17 | Stainless Steel SS Sample from 80' to 82' @ 1710 CAN109-1097-0080 (VOCs) |
| | | | | | | A6 | | 21 | OVA on sample = 11.2 ppm |
| 81 | | | | | | | | 28 | |
| | | | | | | | | 45 | Stopped drilling @ 82' @ 1715 on 12-6-91 |
| 82 | Bottom of hole - 82' | | | | | | | | 12-7-91 Grouted borehole from 0' to 82' w/ cement-bentonite grout. Placed metal spike into grouted borehole |
| 83 | | | | | | | | | Grout Mix 35 sacks cement 100 pounds of bentonite 210 gallons of water |
| 84 | | | | | | | | | |
| 85 | | | | | | | | | |
| 86 | | | | | | | | | |
| 87 | | | | | | | | | |
| 88 | | | | | | | | | |

PROJECT NO. 89MC114W T12

# APPENDIX B-2
# 1991 WCC FIELD SAMPLING DATA SHEETS FOR SURFACE SOIL, SLUDGE, SURFACE WATER, AND GROUNDWATER SAMPLES

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

Location Identification: AGE Drainage Ditch  Date: 10-24-91

Samplers' Signature: J. Davidson  Time: 15:55

Type of Sample: Surface: ✓  Subsurface: _____

Type of Soil Cover: Sand

Depth Interval: 0 - .5'

Sample Identification: CAN034-0341-0000 MS/MSD

Soil type (i.e. sand silt clay): SAND

USCS Abbreviation: SM

Color: medium brown

Staining: None

Odor: None

| Containers | Number | Preservatives |
|---|---|---|
| 16 oz | 2 | none |
| 8 oz | 2 | none |
| 4 oz | 2 | none |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: _____

Comments: _____

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

Location Identification: SWMU # 34 Boring 0344 Date: 12-10-91

Samplers' Signature: David A. Kubejko Time: 1120

Type of Sample: Surface: X Subsurface: _____

Type of Soil Cover: Sandy loam

Depth Interval: 0' to 0.5'

Sample Identification: CAN034- 0344-0000 MS/MSD

| | |
|---|---|
| Soil type (i.e. sand silt clay) | Sand |
| USCS Abbreviation | SM |
| Color | Medium to dark gray brown-gray |
| Staining | Dark gray |
| Odor | None |

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz Glass | 2 | None |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: MS/MSD

Comments: OVA on sample = 0 ppm

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

Location Identification: SWMU# 76 Boring 0762 Date: 10·23·91

Samplers' Signature: David A. Kulesza Time: 1710

Type of Sample: Surface: X Subsurface: _____

Type of Soil Cover: Sandy loam

Depth Interval: 0' to 0.5'

Sample Identification: CAN076-0762-0000

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

USCS Abbreviation SM

Color Orange-brown

Staining None

Odor None

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz Glass | 2 | None |
| 8 oz Glass | 1 | None |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: _____

Comments: _____

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

Location Identification: SWMU # 76 Boring 0763 Date: 10-23-91
Samplers' Signature: David A. Rubeglo Time: 1640

Type of Sample: Surface: X Subsurface: _____
Type of Soil Cover: Sandy loam
Depth Interval: 0' to 0.5'
Sample Identification: CAN076-0763-0000 MS/MSD

Soil type (i.e. sand silt clay) Sand
USCS Abbreviation SM
Color Orange-brown
Staining None
Odor None

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz Glass | 6 | None |
| 8 oz Glass | 3 | None |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: Field Duplicate CAN076-0763-0762 @1750

Comments: _____

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

Location Identification: SWMU # 78 Boring 0781 Date: 10-13-91
Samplers' Signature: David A. Kulyko Time: 945

Type of Sample: Surface: X Subsurface: _____
Type of Soil Cover: Sandy loam
Depth Interval: 0' to 0.5'
Sample Identification: CAN078-0781-0000

Soil type (i.e. sand silt clay) Sand
USCS Abbreviation SM
Color Orange to brown-orange
Staining None
Odor None

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz Glass | 2 | None |
| 16 oz Glass | 1 | None |
| 8 oz Glass | 2 | None |
| * 16 oz Glass | 1 | None |
| | | |
| | | |
| | | |

QA/QC Samples Collected: MRD CAN078-0781-0801 @ 945

Comments: * Collected gradation analysis sample from 0' to 0.5 @ 1330 on 10-12-91 CAN078-0781-4000

OVA on sample = 0 ppm

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

Location Identification: SWMU 078 Boring 0782 Date: 10-23-91

Samplers' Signature: J Gardner Time: 8:30

Type of Sample: Surface: ✓ Subsurface: _____

Type of Soil Cover: Sand

Depth Interval: 0' to 0.5'

Sample Identification: CAW078-0782-0000

| | |
|---|---|
| Soil type (i.e. sand silt clay) | Sand |
| USCS Abbreviation | SM |
| Color | Brown-orange |
| Staining | None |
| Odor | None |

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz Glass | 1 | None |
| 16 oz Glass | 1 | None |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: _____

Comments: OVA on sample = 0 ppm

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

Location Identification: SWMU 078 Boring 0783 Date: 10-12-91
Samplers' Signature: L Gardner Time: 18:20

Type of Sample: Surface: ✓ Subsurface: _____
Type of Soil Cover: SAND
Depth Interval: 0 - .5'
Sample Identification: CAN 078-0783-0000

Soil type (i.e. sand silt clay) Sand
USCS Abbreviation SM
Color grayish brown
Staining —
Odor —

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz | 1 | None |
| 16 oz | 1 | None |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: Field Duplicate collected.
CAN 078-0783-0862 @ 1820 on 10-12-91

Comments: _____

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

Location Identification: SWMU 078- 0784 Date: 10-13-91

Samplers' Signature: L. Gardner Time: 10:35

Type of Sample: Surface: ✓ Subsurface: _____

Type of Soil Cover: Sand

Depth Interval: 0 - .5'

Sample Identification: CAN078-0784 - 0000

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

USCS Abbreviation SM

Color Med. Brown

Staining —

Odor —

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz | 1 | None |
| 16 oz | 1 | None |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: _____

Comments: _____

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

Location Identification: SWMU 078- 0785 Date: 10-23-91

Samplers' Signature: L Darden Time: 10:55

Type of Sample: Surface: ✓ Subsurface: _____

Type of Soil Cover: Sand

Depth Interval: 0-.5

Sample Identification: CAN 078-0785-0000

Soil type (i.e. sand silt clay): Sand

USCS Abbreviation: SM

Color: Med. Brown

Staining: —

Odor: —

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz | 1 | None |
| 16 oz | 1 | None |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: _____

Comments: _____

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

Location Identification: SWMU 078 Sample 078C Date: 10-13-91
Samplers' Signature: L Gardner Time: 10:15

Type of Sample: Surface: ✓ Subsurface: _____
Type of Soil Cover: Sand
Depth Interval: 0 - .5'
Sample Identification: CAN078-078C-0000

Soil type (i.e. sand silt clay): Sand
USCS Abbreviation: SM
Color: Med. Brown
Staining: —
Odor: —

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz. | 1 | None |
| 16 oz | 1 | None |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: _____

Comments: _____

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

Location Identification: SWMU # 78 Boring 0787 Date: 12-16-91

Samplers' Signature: David A. Kulesko Time: 915

Type of Sample: Surface: X Subsurface: _____

Type of Soil Cover: Sandy loam

Depth Interval: 0' to 0.5'

Sample Identification: CAN078-0787-0000 MS/MSD

Soil type (i.e. sand silt clay): Sand

USCS Abbreviation: SM

Color: Brown-orange

Staining: None

Odor: None

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz Glass | 2 | None |
| 40 ml Glass | 4 | HCl |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: Ambient Blank CAN078-0787-0857 @ 920

Decon Water CAN078-0787-0887 @ 925

Comments: OVA on sample = 0 ppm

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

Location Identification: SWMU # 78 Boring 0788 Date: 12-7-91

Samplers' Signature: David A. Kulzko Time: 1350

Type of Sample: Surface: X Subsurface: _____

Type of Soil Cover: Sandy loam

Depth Interval: 0' to 0.5'

Sample Identification: CAN078-0788-0000

| | |
|---|---|
| Soil type (i.e. sand silt clay) | Sand |
| USCS Abbreviation | SM |
| Color | Brown-orange |
| Staining | None |
| Odor | None |

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz Glass | 2 | None |
| 8 oz Glass | 2 | None |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: MRD Duplicate CAN078-0788-0807 @ 1350

Comments: OVA on sample = 0 ppm

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

Location Identification: SWMU # 78 Boring 0789 Date: 12-16-91

Samplers' Signature: David A. Kulgho Time: 930

Type of Sample: Surface: X Subsurface: _____

Type of Soil Cover: Sandy loam

Depth Interval: 0' to 0.5'

Sample Identification: CAN078-0789-0000

| | |
|---|---|
| Soil type (i.e. sand silt clay) | Sand |
| USCS Abbreviation | SM |
| Color | Gray-brown |
| Staining | None |
| Odor | None |

| Containers | Number | Preservatives |
|---|---|---|
| 8 oz Glass | 1 | None |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: _____

Comments: OVA on sample = 0 ppm

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

Location Identification: SWMU # 78 Boring 7810 Date: 12-16-91

Samplers' Signature: David A. Kulgho Time: 940

Type of Sample: Surface: X Subsurface: _____

Type of Soil Cover: Sandy loam

Depth Interval: 0' to 0.5'

Sample Identification: CAN078-7810-0000

| | |
|---|---|
| Soil type (i.e. sand silt clay) | Sand |
| USCS Abbreviation | SM |
| Color | Brown to orange-brown |
| Staining | None |
| Odor | None |

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz Glass | 2 | None |
| 8 oz Glass | 2 | None |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: Field Duplicate CAN078-7810-0864 @ 950

Comments: OVA on sample = 0 ppm

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

Location Identification: SWMU # 78 Boring 7811 Date: 12-16-91

Samplers' Signature: David A. Zulejko Time: 1005

Type of Sample: Surface: X Subsurface: _____

Type of Soil Cover: Sandy loam

Depth Interval: 0' to 0.5'

Sample Identification: CAN078-7811-0000

| | |
|---|---|
| Soil type (i.e. sand silt clay) | Sand |
| USCS Abbreviation | SM |
| Color | Brown |
| Staining | None |
| Odor | None |

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz Glass | 1 | None |
| 8 oz Glass | 1 | None |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: _____

Comments: OVA on sample = 0 ppm

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

Location Identification: SWMU # 78 Boring 7812 Date: 12-16-91

Samplers' Signature: David A. Kulyko Time: 1015

Type of Sample: Surface: X Subsurface: _____

Type of Soil Cover: Sandy loam

Depth Interval: 0' to 0.5'

Sample Identification: CAN078-7812-0000

| | |
|---|---|
| Soil type (i.e. sand silt clay) | Sand |
| USCS Abbreviation | SM |
| Color | Brown to orange-brown |
| Staining | None |
| Odor | None |

| Containers | Number | Preservatives |
|---|---|---|
| 8 oz Glass | 1 | None |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: _____

Comments: OVA on sample = 0 ppm

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

Location Identification: SWMU #81 Boring 8101 Date: 10-11-91

Samplers' Signature: David A. Kulyko Time: 1843

Type of Sample: Surface: X Subsurface: _____

Type of Soil Cover: Sandy loam

Depth Interval: 0' to 0.5'

Sample Identification: CAN081-8101-0000

| | |
|---|---|
| Soil type (i.e. sand silt clay) | Sand |
| USCS Abbreviation | SM |
| Color | Orange-red brown-red |
| Staining | None |
| Odor | None |

| | Containers | Number | Preservatives |
|---|---|---|---|
| | 4 oz Glass | 1 | None |
| * | 16 oz Glass | 1 | None |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

QA/QC Samples Collected: MRD CAN081-8101-0901 @ 1940

Comments: * Collected gradation analysis sample from 0' to 0.5' @ 1845 CAN081-8101-4000
OVA on sample = 0 ppm

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

Location Identification: SWMU # 81 Boring 8102 Date: 10-11-91
Samplers' Signature: David A. Kulesko Time: 1851

Type of Sample: Surface: X Subsurface: _____
Type of Soil Cover: Sandy loam
Depth Interval: 0' to 0.5'
Sample Identification: CAN081-8102-0000

| | |
|---|---|
| Soil type (i.e. sand silt clay) | Sand |
| USCS Abbreviation | SM |
| Color | Orangered brown-red |
| Staining | None |
| Odor | None |

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz Glass | 1 | None |
| 40 ml Glass | 2 | HCl |
| * 16 oz Glass | 1 | None |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: Decon Water CAN081-8102-0981 @1853

Comments: Collected gradation analysis sample from 2' to 4' @ 910 on 10-12-91 CAN081-8102-4002

OVA on sample = 0 ppm

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

Location Identification: SWMU #81 Boring 8103 Date: 10-11-91

Samplers' Signature: David A. Kulesko Time: 1855

Type of Sample: Surface: X Subsurface: _____

Type of Soil Cover: Sandy loam

Depth Interval: 0' to 0.5'

Sample Identification: CAN081-8103-0000

| | |
|---|---|
| Soil type (i.e. sand silt clay) | Sand |
| USCS Abbreviation | SM |
| Color | Orange-red brown-red |
| Staining | None |
| Odor | None |

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz Glass | 1 | None |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: _____

Comments: OVA on sample = 0 ppm

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

Location Identification: SWMU # 81 Boring 8104 Date: 10-11-91
Samplers' Signature: David A. Kubzko Time: 1858

Type of Sample: Surface: X Subsurface: _____
Type of Soil Cover: Sandy loam
Depth Interval: 0' to 0.5'
Sample Identification: CAN081- 8104- 0000

Soil type (i.e. sand silt clay) Sand
USCS Abbreviation SM
Color Orange-red brown-red
Staining None
Odor None

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz Glass | 1 | None |
| * 16 oz Glass | 1 | None |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: _____

Comments: * Collected gradation analysis sample from 2' to 4' @ 1025 on 10-11-91 CAN081-8104-4002

OVA on sample: 0 ppm

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

Location Identification: SWMU #81 Boring 8105 Date: 10-11-91

Samplers' Signature: David A. Kubejko Time: 1902

Type of Sample: Surface: X Subsurface: _____

Type of Soil Cover: Sandy loam

Depth Interval: 0' to 0.5'

Sample Identification: CAN081-8105-0000

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

USCS Abbreviation SM

Color Orange-red brown-red

Staining None

Odor None

| Containers | Number | Preservatives |
|---|---|---|
| 4oz Glass | 2 | None |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: Field Duplicate CAN081-8105-0962 @ 1930

Comments: _____

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

Location Identification: SWMU #81 Boring 8106 Date: 10-11-91

Samplers' Signature: David A. Kulesko Time: 1907

Type of Sample: Surface: X Subsurface: _____

Type of Soil Cover: Sandy loam

Depth Interval: 0' to 0.5'

Sample Identification: CAN081-8106-0000

| | |
|---|---|
| Soil type (i.e. sand silt clay) | Sand |
| USCS Abbreviation | SM |
| Color | Orange-red brown-red |
| Staining | None |
| Odor | None |

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz Glass | 1 | None |
| * 16 oz Glass | 1 | None |
| 40 ml Glass | 2 | HCl |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: Ambient Blank CAN081-8106-0951

Comments: * Collected gradation analysis sample from 0' to 0.5' @ 1918 CAN081-8106-4000

OVA on sample = 0 ppm

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

Location Identification: SWMU #81 Boring 8107 Date: 10-11-91

Samplers' Signature: David A. Rubegko Time: 1910

Type of Sample: Surface: X Subsurface: _____

Type of Soil Cover: Sandy loam

Depth Interval: 0' to 0.5'

Sample Identification: CAN081-8107-0000

| | |
|---|---|
| Soil type (i.e. sand silt clay) | Sand |
| USCS Abbreviation | SM |
| Color | Orange-red brown-red |
| Staining | None |
| Odor | None |

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz Glass | 1 | None |
| 40 ml Glass | 2 | HCl |
| * 16 oz Glass | 1 | None |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: Rinsate Blank CAN081-8107-0971 @ 1925

Comments: * Collected gradation analysis sample from 2' to 4' @ 1230 on 10-12-91 CAN081-8107-4002

OVA on sample = 0 ppm

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

Location Identification: SWMU# 81 Boring 8108 Date: 10-11-91

Samplers' Signature: David A. Kulesho Time: 1915

Type of Sample: Surface: X Subsurface: _____

Type of Soil Cover: Sandy loam

Depth Interval: 0' to 0.5'

Sample Identification: CAN081-8108-0000

| | |
|---|---|
| Soil type (i.e. sand silt clay) | Sand |
| USCS Abbreviation | SM |
| Color | Orange-red brown-red |
| Staining | None |
| Odor | None |

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz Glass | 1 | None |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: _____

Comments: OVA on sample = 0 ppm

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

Location Identification: SWMU # 81 Boring 8109 Date: 10-11-91

Samplers' Signature: David A. Kubezko Time: 1920

Type of Sample: Surface: X Subsurface: _____

Type of Soil Cover: Sandy loam

Depth Interval: 0' to 0.5'

Sample Identification: CAN081- 8109- 0000

| | |
|---|---|
| Soil type (i.e. sand silt clay) | Sand |
| USCS Abbreviation | SM |
| Color | Orange-red brown-red |
| Staining | None |
| Odor | None |

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz Glass | 1 | None |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: _____

Comments: OVA on sample = 0 ppm

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

Location Identification: SWMU # 81 Boring 8110 Date: 10-11-91

Samplers' Signature: David A. Kulesza Time: 1930

Type of Sample: Surface: X Subsurface: _____

Type of Soil Cover: Sandy loam

Depth Interval: 0' to 0.5'

Sample Identification: CAN081-8110-0000 MS/MSD

| | |
|---|---|
| Soil type (i.e. sand silt clay) | Sand |
| USCS Abbreviation | SM |
| Color | Orange-red brown-red |
| Staining | None |
| Odor | None |

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz Glass | 2 | None |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: MS/MSD

Comments: OVA on sample = 0ppm

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

Location Identification: SWMU #81 Boring 8114 Date: 12-16-91

Samplers' Signature: David A. Kulczyk Time: 1030

Type of Sample: Surface: X Subsurface: _____

Type of Soil Cover: Sandy loam

Depth Interval: 0' to 0.5'

Sample Identification: CAN081-8114-0000 MS/MSD

| | |
|---|---|
| Soil type (i.e. sand silt clay) | Sand |
| USCS Abbreviation | SM |
| Color | Orange-red brown-red |
| Staining | None |
| Odor | None |

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz Glass | 2 | None |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: Ambient Blank CAN081-8114-0952 @ 1035
Decon Water CAN081-8114-0982 @ 1040

Comments: OVA on sample = 0 ppm

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

Location Identification: 08U1 Date: 10-10-91

Samplers' Signature: Larry Gardner Time: ~~9:45~~ 11:00

Type of Sample: Surface: ✓ Subsurface: _____

Type of Soil Cover: Sand

Depth Interval: surface 0 - .5'

Sample Identification: CAN08-08U1-0000

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

USCS Abbreviation SM

Color brn

Staining —

Odor —

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz | 1 | none |
| 16 oz | 1 | none |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: Field Duplicate CAN08-08U1-0263

Comments: _____

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

Location Identification: Engine Test Cell 0862 Date: 10-10-91

Samplers' Signature: Larry Gaudin Time: 11:00

Type of Sample: Surface: ✓ Subsurface: _____

Type of Soil Cover: Sand

Depth Interval: 0 - .5

Sample Identification: CAIV-086-0862-0000

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

USCS Abbreviation SM

Color ~~Grayish~~ medium Brown

Staining No

Odor No

| Containers | Number | Preservatives |
|---|---|---|
| 4oz | 1 | hcl + |
| 16oz | 1 | none |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: _____

Comments: _____

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

Location Identification: SWMU-086 Boring 0863 Date: 10-10-91
Samplers' Signature: J Gardner Time: 14:30

Type of Sample: Surface: ✓ Subsurface: _____
Type of Soil Cover: Sand
Depth Interval: 0 - .5
Sample Identification: CAN086-0863-0000

Soil type (i.e. sand silt clay) Sand
USCS Abbreviation SM
Color medium dk. brown
Staining —
Odor —

| Containers | Number | Preservatives |
|---|---|---|
| 4oz | 1 | none |
| 16 oz | 1 | none |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: MS/MSD

Comments:

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

Location Identification: Engine Test Cell-0864 Date: 10-10-91

Samplers' Signature: L. Gardiner Time: 16:20

Type of Sample: Surface: ✓ Subsurface: _____

Type of Soil Cover: SAND

Depth Interval: 0 - .5

Sample Identification: CAN086-0864-0000

| | |
|---|---|
| Soil type (i.e. sand silt clay) | SAND |
| USCS Abbreviation | ~~SM~~ SC |
| Color | medium brown |
| Staining | None |
| Odor | None |

| Containers | Number | Preservatives |
|---|---|---|
| 16 oz | 2 | none |
| 4 oz | 2 | none |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: Field Dup CAN086-0864-0264 at 16:32

Comments: _____

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

Location Identification: CAN08-0865 Date: 10-11-91
Samplers' Signature: T. Gardner Time: 9:25

Type of Sample: Surface: ✓ Subsurface: _____
Type of Soil Cover: Sand
Depth Interval: 0-.5
Sample Identification: CAN 08-0865-0000

Soil type (i.e. sand silt clay) Sand
USCS Abbreviation SP
Color Med. Brn
Staining —
Odor —

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz | 1 | None |
| 16 oz | 1 | None |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: — collect Rinsate blank at 9:00
CAN08-0865-0271

Comments:

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

Location Identification: Engine Test Cell Boring 0867 Date: 11-24-91

Samplers' Signature: J. Gardner Time: 12:25

Type of Sample: Surface: ✓ Subsurface: _____

Type of Soil Cover: SAND

Depth Interval: 0 - .5'

Sample Identification: CAN08C-0867-0000

CAN08C-0867-0268 FD at 12:35

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

USCS Abbreviation SM

Color medium ~~dark~~ Brown

Staining No

Odor No

| Containers | Number | Preservatives |
|---|---|---|
| 4oz | 2 | None |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: Field Dup.

Comments: _____

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

Location Identification: Engine test Cell -0868 Date: 11-24-91

Samplers' Signature: J. Jardin Time: 12:45

Type of Sample: Surface: ✓ Subsurface: _____

Type of Soil Cover: SAND

Depth Interval: 0 - .5

Sample Identification: CAN086-0868-0000
CAN086-0868-0203 (MRD)

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

USCS Abbreviation SM

Color medium ~~dark~~ brown

Staining No

Odor No

| Containers | Number | Preservatives |
|---|---|---|
| 4oz | 2 | None |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: Ambient Blank CAN086-0868-0252 at 12:30

Comments: MRD ~~at~~ also

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

Location Identification: Engine test cell, 0869 Date: 11-24-91
Samplers' Signature: L. Gardiner Time: 13:15

Type of Sample: Surface: ✓ Subsurface: _____
Type of Soil Cover: SAND
Depth Interval: 0 - .5
Sample Identification: CANOPC-0869-0000

Soil type (i.e. sand silt clay) SAND
USCS Abbreviation SM
Color medium ~~dark~~ brown
Staining No
Odor No

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz | 1 | None |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: _____

Comments: _____

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

Location Identification: Engine test cell 8610 Date: 11-24-91

Samplers' Signature: L Gardiner Time: 13:00

Type of Sample: Surface: ✓ Subsurface: _____

Type of Soil Cover: SAND

Depth Interval: 0-.5

Sample Identification: CAN086-8610-0000 MS/MSD

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

USCS Abbreviation SM

Color medium brown

Staining No

Odor No

| Containers | Number | Preservatives |
|---|---|---|
| 4oz | 3 | None |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: collect Field Dup CAN086-8610-0266 at 13:00

Comments: _____

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

Location Identification: NE Storm Drainage Area 0951 Date: 10-14-91
Samplers' Signature: J. Davidson Time: 16:15

Type of Sample: Surface: ✓ Subsurface: _____
Type of Soil Cover: Sand, gravel & cobbles
Depth Interval: 0 - .5
Sample Identification: CAN095-0951-0000

Soil type (i.e. sand silt clay) Sand & gravel
USCS Abbreviation SM
Color black
Staining yes
Odor slight

| Containers | Number | Preservatives |
|---|---|---|
| 4oz | 1 | None |
| 16oz | 1 | None |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: collect gradation Analysis at 11:45 10-15-91
CAN095-0951-4000 (surface)

Comments: _____

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

Location Identification: NE. Storm drainage Area 0952 Date: 10-14-91
Samplers' Signature: L. Gardner Time: 16:00

Type of Sample: Surface: ✓ Subsurface: _____
Type of Soil Cover: Sand & gravel
Depth Interval: 0 - .5'
Sample Identification: CAN095-0952-0000 MS/MSD

Soil type (i.e. sand silt clay) Sand & gravel
USCS Abbreviation SM
Color med to dark brown
Staining None
Odor None

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz | 1 | None |
| 16 oz | 1 | None |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: MS/MSD

Comments: _____

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

Location Identification: NE stormwater Boring 0953 Date: 12-7-91
Samplers' Signature: J Gardiner Time: 10:00

Type of Sample: Surface: ✓ Subsurface: _____
Type of Soil Cover: SAND & gravel
Depth Interval: 0 - .5'
Sample Identification: CAN095-0953-0000 MS/MSD

Soil type (i.e. sand silt clay) SAND, gravel
USCS Abbreviation SM
Color black
Staining yes
Odor yes

| Containers | Number | Preservatives |
|---|---|---|
| 4oz | 2 | None |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: collected Ambient blank - CAN095-0953-0853 at 10:25

Comments: _____

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

Location Identification: OLD entemology Rinse Date: 10-24-91
Samplers' Signature: J. Gardiner Time: 16:45

Type of Sample: Surface: ✓ Subsurface: _____
Type of Soil Cover: Sand
Depth Interval: 0-.5
Sample Identification: CAN096-0961-0000 MS/MSD

Soil type (i.e. sand silt clay) SAND
USCS Abbreviation SM
Color Medium Brown
Staining None
Odor None

| Containers | Number | Preservatives |
|---|---|---|
| 16 oz | 2 | None |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: MS/MSD

Comments: _____

## Field Sampling Data Sheet For Groundwater Samples

Well No.: 096 K  Date: 11-13-91
Sampler's Signature: David A. Kulesko  Time: 1700

Sample Identification: CAN096-096K-2001 ms/msd

Water Level: 273.60' BTOC
Depth to Bottom of Well: 300.00' BTOC
Volume to be Excavated: 86 gallons

Field Parameters

| | Before 0 | 1st Vol 17 | 2nd Vol 31 | 3rd Vol | 4th Vol | 5th Vol | Sample |
|---|---|---|---|---|---|---|---|
| pH | 12.01 | 11.88 | 11.91 | | | | 11.92 |
| Conductivity | 1270 | 1250 | 1240 | | | | 1230 |
| Temperature | 16.0 | 16.5 | 17.0 | | | | 16.8 |
| Chlorine (5th vol) | | | | | | 0 | |

| Containers | Number | Preservatives |
|---|---|---|
| 1 ltr Glass Amber | 12 | None |
| 500 ml Poly | 6 | $HNO_3$ |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: MRD Duplicate CAN096-096K-0601 @ 1700
Field Duplicate CAN096-096K-0661 @ 1600
Rinsate Blank CAN096-096K-0671 @ 1800

Comments:
Collected Rinsate Blank from decanned sampling (teflon) bailer
Bailed well Dry after evacuating approximately 31 gallons; allowed well to recover to 80% of original volume before sampling

## FIELD SAMPLING DATA SHEET FOR SLUDGE SAMPLES

Location Identification: CAM101-101M 5001 Date: 10/15/91
Samplers' Signature: [illegible] Time: 1630
Weather: Clear, 75°, Beautiful.

Sample Identification: CAM101-101M-5001

Description of Sludge: Black Soupy Mix -- Not Much Fun

| Containers | Number | Preservatives |
|---|---|---|
| CAM101-101M-0461 | 4 | – |
| CAM101-101M5001 | 4 | – |
| CAM101-101M5001/MS | 4 | – |
| CAM101-101M5001/MSD | 4 | – |
| | | – |
| | | – |
| | | – |
| | | – |

QA/QC Samples Collected: Field Dup / MS/MSD

Comments: Filled VOAs First Followed by SVOA, Metals

Sludge Sample Collection

22792A/89MC114W/SOP.5 10-01-91/RPT/3

## FIELD SAMPLING DATA SHEET FOR SLUDGE SAMPLES

Location Identification: 5002 Date: 10/15/91
Samplers' Signature: [illegible] Time: 1726
Weather: Sunny Clear

Sample Identification: CAX101-101X-5002

Description of Sludge: Black Soupy mixture not much consistency.

| Containers | Number | Preservatives |
|---|---|---|
| CAX 101-101X-5002 | 5 | — |

QA/QC Samples Collected:

Comments:

## FIELD SAMPLING DATA SHEET FOR SLUDGE SAMPLES

Location Identification: 5003 Date: 10/25
Samplers' Signature: [illegible] Time: 1315
Weather: Cooling off Bright Sunshine

Sample Identification: CAH101-101H-5003

Description of Sludge: Black Soup / Poor Soup Consistency

| Containers | Number | Preservatives |
|---|---|---|
| CAH101-101H-5003 | 6 | – |
| | | – |
| | | – |
| | | – |
| | | – |
| | | – |
| | | – |

QA/QC Samples Collected: None

Comments: Two Power Pops VOC's Collected First / Sample Homogenized

Sludge Sample Collection

22792A/89MC114W/SOP.5 10-01-91/RPT/3

## FIELD SAMPLING DATA SHEET FOR SLUDGE SAMPLES

Location Identification: 5004 Date: 10/15/91
Samplers' Signature: [illegible] Time: 1830
Weather: Sun setting, cooler (70°) beautiful sunset

Sample Identification: CAM101-101M-5004

Description of Sludge:

| Containers | Number | Preservatives |
|---|---|---|
| CAM101-101M-5004 | 4 | — |

QA/QC Samples Collected: NON

Comments: Finished for early

Sludge Sample Collection

22792A/89MC114W/SOP.5 10-01-91/RPT/3

## FIELD SAMPLING DATA SHEET FOR SLUDGE SAMPLES

Location Identification: SWMU # 101 South Lagoon  Date: 10-16-91
Samplers' Signature: _____  Time: 1726
Weather: Clear 75°F

Sample Identification: CAN101. 1015. 5005

Description of Sludge: Black Soupy Mix

| Containers | Number | Preservatives |
|---|---|---|
| | 4 | None |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: _____

Comments: _____

## FIELD SAMPLING DATA SHEET FOR SLUDGE SAMPLES

Location Identification: SWMU #101 South Lagoon  Date: 10-16-91
Samplers' Signature: _____  Time: 1748
Weather: Clear 75°F

Sample Identification: CAN101 - 1015 - 5006

Description of Sludge: Black Soupy Mix - Greenish

| Containers | Number | Preservatives |
|---|---|---|
| | 4 | None |

QA/QC Samples Collected: _____

Comments: _____

## FIELD SAMPLING DATA SHEET FOR SLUDGE SAMPLES

Location Identification: SWMU #101 South Lagoon  Date: 10-16-91
Samplers' Signature: _____  Time: 1810
Weather: Clear 75°F

Sample Identification: CAN 101- 1015- 5007

Description of Sludge: Black- green Soupy mix

| Containers | Number | Preservatives |
|---|---|---|
| | 1 | None |
| | 3 | None |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: _____

Comments: Collected VOC Sample and then lost dredge
Resampled for other parameters on 11-10-91 @ 1415

## FIELD SAMPLING DATA SHEET FOR SLUDGE SAMPLES

Location Identification: SWMU # 101 South Lagoon  Date: 11-10-91
Samplers' Signature: _____  Time: 1415
Weather: Cloudy 40° F

Sample Identification: CAN101-1015-5007

Description of Sludge: Black Soupy Mix

| Containers | Number | Preservatives |
|---|---|---|
| | 3 | None |

QA/QC Samples Collected: _____

Comments: _____

## FIELD SAMPLING DATA SHEET FOR SLUDGE SAMPLES

Location Identification: SWMU #101 South Logan Date: 11-10-91
Samplers' Signature: _____ Time: 1500
Weather: Cloudy 40°F

Sample Identification: CAN101-1015-5008

Description of Sludge: Black Soupy Mix

| Containers | Number | Preservatives |
|---|---|---|
| | 4 | None |
| 40 ml | 3 | HCl |
| 1 liter | 4 | None |
| 500 ml poly | 1 | $HNO_3$ |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: Rinsate Blank CAN101-1015-0471 @ 1325

Comments: _____

Sludge Sample Collection

## FIELD SAMPLING DATA SHEET FOR SLUDGE SAMPLES

Location Identification: Wastewater Lagoon  Date: 12-17-91
Samplers' Signature: L Gadim  Time: 11:30
Weather: Sunny - Windy

Sample Identification: CAN101-10VN-5009

Description of Sludge: Black Soupy Mix

| Containers | Number | Preservatives |
|---|---|---|
| 4oz | 1 | None |

QA/QC Samples Collected:

Comments:

## FIELD SAMPLING DATA SHEET FOR SLUDGE SAMPLES

Location Identification: Waste Water Lagoons Date: 12-17-91
Samplers' Signature: J Gardner Time: 12:50
Weather: Sunny - Windy

Sample Identification: CAN101-101N-5010 MS/MSD

Description of Sludge: Black; Soupy Mix.

| Containers | Number | Preservatives |
|---|---|---|
| 4oz | 2 | None |

QA/QC Samples Collected: CAN101-101N-0452 Ambient blank at 12:05
CAN101-101N-0473 Rinsate Blank at 13:
CAN101-101N-0482 Decon water at 13:
CAN101-101N-0463 Field Duplicat at 12:45

Comments:

Sludge Sample Collection

22792A/89MC114W/SOP.5 10-01-91/RPT/3

## FIELD SAMPLING DATA SHEET FOR SLUDGE SAMPLES

Location Identification: Waste Water Lagoons  Date: 12-17-91
Samplers' Signature: J Daudin  Time: 12:15
Weather: Sunny Windy

Sample Identification: CAN 101-101N-5011

Description of Sludge: Black Soupy Mix

| Containers | Number | Preservatives |
|---|---|---|
| 4oz | 1 | None |

QA/QC Samples Collected:

Comments:

## FIELD SAMPLING DATA SHEET FOR SLUDGE SAMPLES

Location Identification: Waste Water Lagoons Date: 12-17-91
Samplers' Signature: L Pardue Time: 15:20
Weather: Sunny - Windy

Sample Identification: CAN101-7015 - 5012

Description of Sludge: Black Soupy Mix

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz | 1 | None |

QA/QC Samples Collected:

Comments:

## FIELD SAMPLING DATA SHEET FOR SLUDGE SAMPLES

Location Identification: Waste Water Lagoons Date: 12-17-91
Samplers' Signature: J Dashn Time: 15:30
Weather: Sunny - Windy

Sample Identification: CAN101-WS-5013

Description of Sludge: Black Soupy Mix

| Containers | Number | Preservatives |
|---|---|---|
| 4oz | 1 | None |

QA/QC Samples Collected:

Comments:

Sludge Sample Collection

## FIELD SAMPLING DATA SHEET FOR SLUDGE SAMPLES

Location Identification: Waste Water Lagoon Date: 12-17-91
Samplers' Signature: L Gardin Time: 10:00
Weather: Sunny - Windy

Sample Identification: CANIV 70S- 5614

Description of Sludge: Black Sludge Mix

| Containers | Number | Preservatives |
|---|---|---|
| 4oz | 1 | None |

QA/QC Samples Collected:

Comments:

Sludge Sample Collection

## FIELD SAMPLING DATA SHEET FOR SLUDGE SAMPLES

Location Identification: Waste Water Lagoon Date: 12-17-91
Samplers' Signature: [illegible] Time: 15:45
Weather: Sunny - Windy

Sample Identification: CAN101-1015-5015

Description of Sludge: Black Soupy Mix

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz | 1 | None |

QA/QC Samples Collected:

Comments:

## Field Sampling Data Sheet for Surface Water Samples

Location Identification: 3001 Date: 10/16
Samplers' Signature: [illegible] Time: 1615
Weather: Clear, 80°, windy

Type of Sample: Composite _____ Grab X

Sample Identification: CA1/01-1015-3001

| | |
|---|---|
| pH | 8.60 |
| Conductivity | 1100 |
| Temperature | 24° |
| Flow rate (flumes) or volume (surge pond) | – |

Description of Water: Green, somewhat chunky in places.

Color: Green
Odor: Some
Turbidity: Yes X No _____

| Containers | Number | Preservatives |
|---|---|---|
| VOA | 6 | – |
| Semi VOA | 4 | |
| PCB/Pest. | 4 | |
| Herbicides | 4 | |
| Metals | 2 | Y |
| Sulfides | 2 | Y |
| Cyanide | 2 | Y |
| | | |

QA/QC Samples Collected: Yes Field Dup

Comments:

## Field Sampling Data Sheet for Surface Water Samples

Location Identification: 3002 Date: 10/14/91
Samplers' Signature: [illegible] Time: 9:35
Weather: Clear slight breeze & wsb

Type of Sample: Composite _____ Grab X

Sample Identification: CAH101-101M-3002

| | | |
|---|---|---|
| pH | 7.02 | - SYDS 3.98 → 7.01 |
| Conductivity | 1550 | - Recalibrated |
| Temperature | 15.5 | - OK w/ Thermo |
| Flow rate (flumes) or volume (surge pond) | — | |

Description of Water: Green High Susp. Solids

Color: Green
Odor: Youbet
Turbidity: Yes Youbet. No _____

| Containers | Number | Preservatives |
|---|---|---|
| CAH101-101M-3002 | | |
| VOAS | 3 | - |
| Semi VOA | 2 | - |
| Pest/PCB | 2 | - |
| Herbicide | 2 | - |
| Metals | 1 | HNO3 |
| Sulfide | 1 | |
| Cyanide | 1 | NaOH |

QA/QC Samples Collected: Ambient Blanks, Trip Blanks

Comments: _____

## Field Sampling Data Sheet for Surface Water Samples

Location Identification: 3003 Date: 10/16/91
Samplers' Signature: C. deCuman Time: 11:45
Weather: Clear, Sunny, Windy

Type of Sample: Composite _____ Grab X

Sample Identification: CAN101-101N-3003

| | | |
|---|---|---|
| pH | | * Battery dead |
| Conductivity | 1100 | |
| Temperature | 24° | |
| Flow rate (flumes) or volume (surge pond) | — | |

Description of Water: Murky, Sometimes Black,

Color: Black
Odor: Yes
Turbidity: Yes slightly turbid No —

| Containers | Number | Preservatives |
|---|---|---|
| CAN101-101N-3003 | | - |
| VOA | 6 | HCl |
| Semi VOA | 4 | — |
| PCB/Pest | 4 | — |
| Herbicide | 4 | — |
| Metals | 2 | $HNO_3$ |
| Cyanide | 2 | NaOH |
| Sulfide | 2 | Zinc Acetate/NaOH |

QA/QC Samples Collected: MS/MSD / Trip Blank

Comments:

## Field Sampling Data Sheet for Surface Water Samples

Location Identification: Waste water Lagoon Date: 12-17-91
Samplers' Signature: J Cardin Time: 14:55
Weather: Sunny - windy

Type of Sample: Composite _____ Grab ✓

Sample Identification: CAN101-1015-3004

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

Description of Water: murky green

Color: green
Odor: _____
Turbidity: Yes ✓ No _____

| Containers | Number | Preservatives |
|---|---|---|
| 40 ml | 6 | HCl |

QA/QC Samples Collected: Field Duplicate CAN101-1015-0464 @1500
Trip Blank CAN101-1015-0493 @1600

Comments: _____

## Field Sampling Data Sheet For Groundwater Samples

Well No.: 101 E
Date: 11-11-91
Sampler's Signature: David A. Kulesho
Time: 1200

Sample Identification: CAN101- 101E- 2001

Water Level: 278.62' BTOC
Depth to Bottom of Well: 342.20' BTOC
Volume to be Excavated: 207.5 gallons

Field Parameters

| | Before 0 | 1st Vol 42 | 2nd Vol 84 | 3rd Vol 126 | 4th Vol 168 | 5th Vol 210 | Sample |
|---|---|---|---|---|---|---|---|
| pH | 7.65 | 7.77 | 7.78 | 7.80 | 7.95 | 7.71 | 7.73 |
| Conductivity | 700 | 730 | 720 | 710 | 750 | 730 | 740 |
| Temperature | 15.8 | 16.8 | 17.5 | 17.8 | 18.3 | 17.9 | 17.9 |
| Chlorine (5th vol) | | | | | | 0 | |

| Containers | Number | Preservatives |
|---|---|---|
| 40 ml Glass | 3 | HCl |
| 1 ltr Glass Amber | 5 | None |
| 250 ml Poly | 1 | NaOH |
| 250 ml Poly | 1 | Zinc Acetate / NaOH |
| 500 ml Poly | 2 | $HNO_3$ |
| * 40 ml Glass | 3 | HCl |
| | | |
| | | |

QA/QC Samples Collected: * Decon Water CAN101- 101E- 0481 @ 1100 on 11-21-91

Comments:

## Field Sampling Data Sheet For Groundwater Samples

Well No.: 101 F
Sampler's Signature: David A. Pilsko

Date: 12-17-91
Time: 1420

Sample Identification: CAN101-101F-2001

Water Level: 275.24' BTOC
Depth to Bottom of Well: 344.00' BTOC
Volume to be Excavated: 224.5 gallons

Field Parameters

| | Before 0 | 1st Vol 45 | 2nd Vol 90 | 3rd Vol 135 | 4th Vol 180 | 5th Vol 225 | Sample |
|---|---|---|---|---|---|---|---|
| pH | 6.94 | 6.98 | 7.02 | 7.02 | 7.05 | 6.99 | 7.01 |
| Conductivity | 1460 | 1480 | 1590 | 1590 | 1610 | 1600 | 1590 |
| Temperature | 16.1 | 17.5 | 16.7 | 16.8 | 17.1 | 16.9 | 16.8 |
| Chlorine (5th vol) | | | | | | 0 | |

| Containers | Number | Preservatives |
|---|---|---|
| 40 ml Glass | 3 | HCl |
| 1 Ltr Glass Amber | 5 | None |
| 250 ml Poly | 1 | NaOH |
| 250 ml Poly | 1 | Zinc Acetate / NaOH |
| 500 ml Poly | 1 | $HNO_3$ |
| | | |
| | | |
| | | |

QA/QC Samples Collected: Trip Blank CAN101-101F-0493 @ 1430

Comments:

## Field Sampling Data Sheet For Groundwater Samples

Well No.: 101G
Date: 11-9-91
Sampler's Signature: David A. Kulesho
Time: 915

Sample Identification: CAN 101- 101G-2001 ms/msd

Water Level: 276.72' BTOC
Depth to Bottom of Well: 345.36' BTOC
Volume to be Excavated: 224 gallons

Field Parameters

| | Before 0 | 1st Vol 45 | 2nd Vol 90 | 3rd Vol 135 | 4th Vol 180 | 5th Vol 225 | Sample |
|---|---|---|---|---|---|---|---|
| pH | 7.91 | 7.84 | 7.69 | 7.46 | 7.40 | 7.39 | 7.41 |
| Conductivity | 1200 | 1195 | 1230 | 1230 | 1310 | 1310 | 1300 |
| Temperature | 16.0 | 16.8 | 18.0 | 18.5 | 16.5 | 18.1 | 17.5 |
| Chlorine (5th vol) | | | | | | 0 | |

| Containers | Number | Preservatives |
|---|---|---|
| 40 ml Glass | 15 | HCl |
| 1 Ltr Glass Amber | 25 | None |
| 250 ml Poly | 5 | NaOH |
| 250 ml Poly | 5 | Zinc acetate / NaOH |
| 500 ml Poly | 10 | $HNO_3$ |
| * 40 ml Glass | 1 | HCl |
| | | |
| | | |

QA/QC Samples Collected:
ms/msd MRD Duplicate CAN101-101G-0402 @ 915
Field Duplicate CAN101-101G-0463 @ 800
* Trip Blank CAN 101-101G-0491

Comments:

Monitoring Well Sampling Using A Dedicated Submersible Pump

## Field Sampling Data Sheet For Groundwater Samples

Well No.: 101 H  Date: 11-9-91
Sampler's Signature: David A. Kubesko  Time: 1630

Sample Identification: CAN101-101H-2001

Water Level: 276.30' BTOC
Depth to Bottom of Well: 342.48' BTOC
Volume to be Excavated: 216 gallons

Field Parameters

| | Before 0 | 1st Vol 43 | 2nd Vol 86 | 3rd Vol 129 | 4th Vol 172 | 5th Vol 216 | Sample |
|---|---|---|---|---|---|---|---|
| pH | 7.48 | 7.41 | 7.38 | 7.38 | 7.41 | 7.37 | 7.36 |
| Conductivity | 1150 | 1100 | 1130 | 1130 | 1110 | 1130 | 1120 |
| Temperature | 19.0 | 19.5 | 20.1 | 20.2 | 20.3 | 19.9 | 18.0 |
| Chlorine (5th vol) | | | | | | 0 | |

| Containers | Number | Preservatives |
|---|---|---|
| 40 ml Glass | 6 | HCl |
| 1 Ltr Glass Amber | 10 | None |
| 250 ml Poly | 2 | NaOH |
| 250 ml Poly | 2 | Zinc acetate / NaOH |
| 500 ml Poly | 2 | $HNO_3$ |
| | | |
| | | |
| | | |

QA/QC Samples Collected: Ambient Blank CAN101-101H-0452 @ 1400

Comments:

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

Location Identification: SWMU #106 Boring 1061 Date: 10-23-91

Samplers' Signature: L. Gardner Time: 7:55

Type of Sample: Surface: ✓ Subsurface: _____

Type of Soil Cover: SAND

Depth Interval: 0-.5

Sample Identification: CAN106-1061-0000

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

USCS Abbreviation SM

Color reddish brown

Staining None

Odor None

| Containers | Number | Preservatives |
|---|---|---|
| 8 oz | 2 | None |
| 4 oz | 2 | None |
| 4 oz | 2 | None |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: Collected Field Dupilicate CAN106-1061-1063

Comments: _____

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

Location Identification: SWMU # 106 Boring 1062 Date: 10·23·91

Samplers' Signature: David A. Kulczyk Time: 1345

Type of Sample: Surface: X Subsurface: _____

Type of Soil Cover: Sandy loam

Depth Interval: 0' to 0.5'

Sample Identification: CAN106-1062-0000

| | |
|---|---|
| Soil type (i.e. sand silt clay) | Sand |
| USCS Abbreviation | SM |
| Color | Brown-orange Rust-orange |
| Staining | None |
| Odor | None |

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz Glass | 3 | None |
| 8 oz Glass | 3 | None |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: MRD CAN106-1062-1001

Comments: _____

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

Location Identification: SWMU # 106 Boring 1063 Date: 10-23-91

Samplers' Signature: David A. Kubejko Time: 1415

Type of Sample: Surface: X Subsurface: _____

Type of Soil Cover: Sandy loam

Depth Interval: 0' to 0.5'

Sample Identification: CAN106-1063-0000 ms/msd

| | |
|---|---|
| Soil type (i.e. sand silt clay) | Sand |
| USCS Abbreviation | SM |
| Color | Brown-orange Rust-orange |
| Staining | None |
| Odor | None |

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz Glass | 4 | None |
| 8 oz Glass | 2 | None |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: ms/msd

Comments: _____

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

Location Identification: SWMU # 106 Boring 1064 Date: 10-23-91
Samplers' Signature: David A. Kulejko Time: 1430

Type of Sample: Surface: X Subsurface: _____
Type of Soil Cover: Sandy loam
Depth Interval: 0' to 0.5'
Sample Identification: CAN106-1064-0000

Soil type (i.e. sand silt clay): Sand
USCS Abbreviation: SM
Color: Brown-orange Rust-orange
Staining: None
Odor: None

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz Glass | 2 | None |
| 8 oz Glass | 1 | None |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: _____

Comments: _____

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

Location Identification: SWMU # 107 Boring 1071 Date: Oct 1 91

Samplers' Signature: Larry Gardner Time: 1355

Type of Sample: Surface: ✓ Subsurface: _____

Type of Soil Cover: Sand

Depth Interval: 0-.5 ft

Sample Identification: CAN 107-1071-0000

Soil type (i.e. sand silt clay): Sand

USCS Abbreviation: SM

Color: LT. Brown

Staining: —

Odor: —

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz Glass | 2 | None |
| 16 oz Glass | 2 | None |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: ✓

Comments: _____

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

Location Identification: SWMU # 107 Boring 1072 Date: 10-23-91

Samplers' Signature: David A. Kubeto Time: 1450

Type of Sample: Surface: X Subsurface: _____

Type of Soil Cover: Sandy loam

Depth Interval: 0' to 0.5'

Sample Identification: CAN107-1072-0000

| | |
|---|---|
| Soil type (i.e. sand silt clay) | Sand |
| USCS Abbreviation | SM |
| Color | Tan-gray to light gray brown |
| Staining | None |
| Odor | None |

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz Glass | 3 | None |
| 8 oz Glass | 3 | None |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: MRD CAN107-1072-1101 @ 1450

Comments: OVA on sample = 0 ppm

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

Location Identification: SWMU # 107 Boring 1073 Date: 10-23-91

Samplers' Signature: David A. Kulesza Time: 1510

Type of Sample: Surface: X Subsurface: _____

Type of Soil Cover: Sandy loam

Depth Interval: 0' to 0.5'

Sample Identification: CAN107-1073-0000 MS/MSD

Soil type (i.e. sand silt clay): Sand

USCS Abbreviation: SM

Color: Tan-gray to light gray-brown

Staining: None

Odor: None

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz Glass | 4 | None |
| 8 oz Glass | 2 | None |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: MS/MSD

Comments: OVA on sample: 0 ppm

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

Location Identification: SWMU # 107 Boring 1074 Date: 10·23·91

Samplers' Signature: David A. Kulyba Time: 1530

Type of Sample: Surface: X Subsurface: _____

Type of Soil Cover: Sandy loam

Depth Interval: 0' to 0.5'

Sample Identification: CAN107-1074·0000

| | |
|---|---|
| Soil type (i.e. sand silt clay) | Sand |
| USCS Abbreviation | SM |
| Color | Brown to gray-brown |
| Staining | Dark gray to black staining |
| Odor | Moderate fuel odor |

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz Glass | 2 | None |
| 8 oz Glass | 1 | None |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: _____

Comments: OVA on sample = 13 ppm

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

Location Identification: SWMU # 109 Boring 1091 Date: 10-8-91

Samplers' Signature: David A. Kubesko Time: 1500

Type of Sample: Surface: X Subsurface: _____

Type of Soil Cover: Sandy loam

Depth Interval: 0.25' to 0.50'

Sample Identification: CAN109· 1091-0000

| | |
|---|---|
| Soil type (i.e. sand silt clay) | Sand |
| USCS Abbreviation | SM |
| Color | Red. brown / Brown-red |
| Staining | None |
| Odor | None |

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz Glass | 2 | None |
| 8 oz Glass | 2 | None |
| 16 oz Glass | 1 | None |
| * 16 oz Glass | 1 | None Gradation Analysis |
| | | |
| | | |
| | | |

QA/QC Samples Collected: MRD Duplicate CAN109·1091-1201 @ 1500

Comments: * Gradation Analysis Sample CAN109· 1091-4000 @ 1545
OVA on sample = 0 ppm

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

Location Identification: SWMU #109 Boring 1092 Date: 10-10-91

Samplers' Signature: David A. Kubsch Time: 1345

Type of Sample: Surface: X Subsurface: _____

Type of Soil Cover: Sandy loam

Depth Interval: 0 to 0.5'

Sample Identification: CAN109-1092-0000

| | |
|---|---|
| Soil type (i.e. sand silt clay) | Sand |
| USCS Abbreviation | SM |
| Color | Brown-red to red-brown |
| Staining | None |
| Odor | None |

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz Glass | 2 | None |
| 16 oz Glass | 2 | None |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: Field Duplicate CAN109-1092-1264 @ 1400

Comments: OVA on sample = 0 ppm

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

Location Identification: SWMU # 109 Boring 1093 Date: 10-15-91

Samplers' Signature: David A. Kulyko Time: 1150

Type of Sample: Surface: X Subsurface: _____

Type of Soil Cover: Sandy loam

Depth Interval: 0' to 0.5'

Sample Identification: CAN 109· 1093·0000 MS/MSD

| | |
|---|---|
| Soil type (i.e. sand silt clay) | Sand |
| USCS Abbreviation | SM |
| Color | Dark gray |
| Staining | Black ? very dark gray |
| Odor | Strong fuel odor |

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz Glass | 5 | None |
| 8 oz Glass | 4 | None |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: MS/MSD MRD Duplicate CAN 109· 1093· 1202 @ 1150

Comments: OVA on sample = 35 ppm

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

Location Identification: SWMU# 109 Boring 1094 Date: 10-15-91

Samplers' Signature: David A. Kulesko Time: 1220

Type of Sample: Surface: X Subsurface: _____

Type of Soil Cover: Sandy loam

Depth Interval: 0' to 0.5'

Sample Identification: CAN109-1094-0000

| | |
|---|---|
| Soil type (i.e. sand silt clay) | Sand |
| USCS Abbreviation | SM |
| Color | Gray-brown |
| Staining | Dark gray to black |
| Odor | Strong fuel odor |

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz Glass | 2 | None |
| 8 oz Glass | 1 | None |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: _____

Comments: OVA on sample = .35 ppm

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

Location Identification: SWMU # 109 Boring 1096 Date: 11-23-91

Samplers' Signature: David A. Kulesko Time: 1400

Type of Sample: Surface: X Subsurface: _____

Type of Soil Cover: Sandy loam

Depth Interval: 0' to 0.5'

Sample Identification: CAN109-1096-0000

Soil type (i.e. sand silt clay): Sand

USCS Abbreviation: SM

Color: Brown-orange and Brown-red to red-brown

Staining: None

Odor: None

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz Glass | 2 | None |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: Field Duplicate CAN109-1096-1267 @ 1415

Comments: OVA on sample = 0 ppm

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

Location Identification: SWMU # 109 Boring 1097 Date: 12-5-91

Samplers' Signature: David A. Kulesbo Time: 1130

Type of Sample: Surface: X Subsurface: _____

Type of Soil Cover: Sandy loam

Depth Interval: 0' to 0.5'

Sample Identification: CAN 109-1097-0000

| | |
|---|---|
| Soil type (i.e. sand silt clay) | Sand |
| USCS Abbreviation | SM |
| Color | Dark gray |
| Staining | Black & very dark gray |
| Odor | Strong fuel odor |

| Containers | Number | Preservatives |
|---|---|---|
| 8 oz Glass | 1 | None |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: _____

Comments: OVA on sample = .30 ppm

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

Location Identification: SWMU # 109 Boring 1098 Date: 12-16-91
Samplers' Signature: David A. Kulebo Time: 1100

Type of Sample: Surface: X Subsurface: _____
Type of Soil Cover: Sandy loam
Depth Interval: 0' to 0.5'
Sample Identification: CAN109-1098-0000 MS/MSD

| | |
|---|---|
| Soil type (i.e. sand silt clay) | Sand |
| USCS Abbreviation | SM |
| Color | Gray-brown Black-brown |
| Staining | Dark gray to black |
| Odor | Strong fuel odor |

| Containers | Number | Preservatives |
|---|---|---|
| 4 oz Glass | 3 | None |
| 8 oz Glass | 3 | None |
| * 40 ml Glass | 2 | HCl |
| * 1 ltr Glass | 1 | $H_2SO_4$ |
| | | |
| | | |
| | | |

QA/QC Samples Collected: * Rinsate Blank CAN109-1098-1273 @ 1115
MRD Duplicate CAN109-1098-1201 @ 1100

Comments: OVA on sample = 21 ppm

## Field Sampling Data Sheet For Groundwater Samples

Well No.: 113 A
Date: 11-11-91
Sampler's Signature: David A. Kulesko
Time: 1645

Sample Identification: CAN 113 - 113A - 2001

Water Level: 266.45' BTOC
Depth to Bottom of Well: 280.94' BTOC
Volume to be Excavated: 47.5 gallons

Field Parameters

| | Before 0 | 1st Vol 10 | 2nd Vol 20 | 3rd Vol 30 | 4th Vol 40 | 5th Vol 50 | Sample |
|---|---|---|---|---|---|---|---|
| pH | 7.90 | 7.87 | 7.81 | 7.79 | 7.78 | 7.88 | 7.88 |
| Conductivity | 630 | 620 | 600 | 640 | 660 | 650 | 620 |
| Temperature | 15.5 | 15.9 | 16.7 | 17.0 | 16.8 | 16.6 | 15.5 |
| Chlorine (5th vol) | | | | | | 0 | |

| Containers | Number | Preservatives |
|---|---|---|
| 40 ml Glass | 6 | HCl |
| 1 ltr Glass Amber | 10 | None |
| 250 ml Poly | 2 | NaOH |
| 250 ml Poly | 2 | Zinc Acetate / NaOH |
| 500 ml Poly | 4 | $HNO_3$ |
| * 40 ml Glass | 1 | HCl |
| | | |
| | | |

QA/QC Samples Collected: Rinsate Blank CAN 113 · 113A · 0571 @ 1100 on 11-13-91
* Trip Blank CAN 113 · 113A · 0591 @ 1300 on 11-21-91

Comments: Collected Rinsate Blank on sample hose after sampling well 113A and decanning hose

## Field Sampling Data Sheet For Groundwater Samples

Well No.: 113 B
Date: 11-10-91
Sampler's Signature: David A. Kubeshko
Time: 1030

Sample Identification: CAN113· 113B· 2001

Water Level: 269.80' BTOC
Depth to Bottom of Well: 282.74' BTOC
Volume to be Excavated: 43 gallons

Field Parameters

| | Before 0 | 1st Vol 9 | 2nd Vol 18 | 3rd Vol 27 | 4th Vol 36 | 5th Vol 45 | Sample |
|---|---|---|---|---|---|---|---|
| pH | 7.60 | 7.66 | 7.68 | 7.70 | 7.76 | 7.70 | 7.61 |
| Conductivity | 730 | 750 | 740 | 730 | 750 | 740 | 760 |
| Temperature | 15.8 | 16.2 | 17.2 | 16.8 | 17.5 | 17.4 | 18.0 |
| Chlorine (5th vol) | | | | | | 0 | |

| Containers | Number | Preservatives |
|---|---|---|
| 40 ml Glass | 6 | HCl |
| 1 ltr Glass Amber | 10 | None |
| 250 ml Poly | 2 | NaOH |
| 250 ml Poly | 2 | Zinc Acetate / NaOH |
| 500 ml Poly | 4 | $HNO_3$ |
| | | |
| | | |
| | | |

QA/QC Samples Collected: Field Duplicate CAN113·113B·0561 @ 1000

Comments:

## Field Sampling Data Sheet For Groundwater Samples

Well No.: 113C
Date: 11-10-91
Sampler's Signature: David A. Kulesko
Time: 730

Sample Identification: CAN113 · 113C-2001

Water Level: 271.40' BTOC
Depth to Bottom of Well: 280.42' BTOC
Volume to be Excavated: 29.5 gallons

Field Parameters

| | Before 0 | 1st Vol 6 | 2nd Vol 12 | 3rd Vol 18 | 4th Vol 24 | 5th Vol 30 | Sample |
|---|---|---|---|---|---|---|---|
| pH | 7.60 | 7.62 | 7.67 | 7.70 | 7.71 | 7.72 | 7.71 |
| Conductivity | 690 | 700 | 700 | 680 | 700 | 695 | 680 |
| Temperature | 15.0 | 15.7 | 16.5 | 16.9 | 16.7 | 16.0 | 16.1 |
| Chlorine (5th vol) | | | | | | 0 | |

| Containers | Number | Preservatives |
|---|---|---|
| 40 ml Glass | 6 | HCl |
| 1 Ltr Glass Amber | 10 | None |
| 250 ml Poly | 2 | NaOH |
| 250 ml Poly | 2 | Zinc Acetate / NaOH |
| 500 ml Poly | 2 | $HNO_3$ |
| | | |
| | | |
| | | |

QA/QC Samples Collected: MRD Duplicate CAN113-113C-0501 @ 730

Comments:

## Field Sampling Data Sheet For Groundwater Samples

Well No.: 113 D  Date: 11-10-91
Sampler's Signature: David A. Kulejko  Time: 1640

Sample Identification: CAN 113 - 113D - 2001 MS/MSD

Water Level: 268.02' BTOC
Depth to Bottom of Well: 279.42' BTOC
Volume to be Excavated: 37.5 gallons

Field Parameters

| | Before 0 | 1st Vol 8 | 2nd Vol 16 | 3rd Vol 24 | 4th Vol 32 | 5th Vol 40 | Sample |
|---|---|---|---|---|---|---|---|
| pH | 8.07 | 8.02 | 7.82 | 7.86 | 7.82 | 7.74 | 7.72 |
| Conductivity | 580 | 590 | 620 | 650 | 650 | 630 | 640 |
| Temperature | 16.0 | 16.0 | 16.5 | 17.3 | 17.1 | 17.0 | 17.0 |
| Chlorine (5th vol) | | | | | | 0 | |

| Containers | Number | Preservatives |
|---|---|---|
| 40 ml Glass | 9 | HCl |
| 1 ltr Glass Amber | 15 | None |
| 250 ml Poly | 3 | NaOH |
| 250 ml Poly | 3 | Zinc Acetate/NaOH |
| 500 ml Poly | 3 | $HNO_3$ |
| | | |
| | | |
| | | |

QA/QC Samples Collected: MS/MSD

Comments:

## Field Sampling Data Sheet For Groundwater Samples

Well No.: 113 I
Date: 11-10-91
Sampler's Signature: David A. Kulesza
Time: 1330

Sample Identification: CAN113 - 113I - 2001

Water Level: 270.01' BTOC
Depth to Bottom of Well: 288.40' BTOC
Volume to be Excavated: 92.5 gallons

Field Parameters

| | Before 0 | 1st Vol 20 | 2nd Vol 40 | 3rd Vol 60 | 4th Vol 80 | 5th Vol 100 | Sample |
|---|---|---|---|---|---|---|---|
| pH | 7.70 | 7.79 | 7.63 | 7.74 | 7.77 | 7.77 | 7.80 |
| Conductivity | 670 | 690 | 720 | 700 | 700 | 700 | 690 |
| Temperature | 16.0 | 16.8 | 17.3 | 17.2 | 17.1 | 16.7 | 17.2 |
| Chlorine (5th vol) | | | | | | 0 | |

| Containers | Number | Preservatives |
|---|---|---|
| 40 ml Glass | 6 | HCl |
| 1 ltr Glass Amber | 10 | None |
| 250 ml Poly | 2 | NaOH |
| 250 ml Poly | 2 | Zinc Acetate / NaOH |
| 500 ml Poly | 2 | $HNO_3$ |
| | | |
| | | |
| | | |

QA/QC Samples Collected: Ambient Blank CAN113-113I-0551 @ 1430

Comments:

## Field Sampling Data Sheet For Groundwater Samples

Well No.: 113I
Date: 12-17-91
Sampler's Signature: David A. Kulczyk
Time: 1120

Sample Identification: CAN113 · 113I · 2002 MS/MSD

Water Level: 270.00' BTOC
Depth to Bottom of Well: 288.40' BTOC
Volume to be Excavated: 92.0 gallons

Field Parameters

| | Before 0 | 1st Vol 20 | 2nd Vol 40 | 3rd Vol 60 | 4th Vol 80 | 5th Vol 100 | Sample |
|---|---|---|---|---|---|---|---|
| pH | 7.19 | 7.26 | 7.36 | 7.37 | 7.37 | 7.38 | 7.39 |
| Conductivity | 720 | 710 | 720 | 740 | 730 | 730 | 720 |
| Temperature | 16.9 | 17.6 | 17.8 | 17.5 | 17.5 | 17.9 | 18.1 |
| Chlorine (5th vol) | | | | | | 0 | |

| Containers | Number | Preservatives |
|---|---|---|
| 40 ml Glass | 9 | HCl |
| * 40 ml Glass | 3 | HCl |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: * Field Duplicate CAN113 · 113I · 0562 @ 1130

Comments:

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

Location Identification: Offsite Background OFS1 Date: 12-10-91

Samplers' Signature: David A. Kulgbo Time: 950

Type of Sample: Surface: X Subsurface: _____

Type of Soil Cover: Sandy loam

Depth Interval: 0' to 0.5'

Sample Identification: CANOFS· OFS1-0000

| | |
|---|---|
| Soil type (i.e. sand silt clay) | Sand |
| USCS Abbreviation | SM |
| Color | Brown - orange to red - brown |
| Staining | None |
| Odor | None |

| Containers | Number | Preservatives |
|---|---|---|
| 8 oz Glass | 2 | None |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: _____

Comments: Sample was collected just north of the ball park at Chavez Housing Area northwest of the main gate at Cannon AFB. The sample is west of the corner of a brick retaining wall of some housing units

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

Location Identification: Offsite Background OFS2 Date: 12-10-91

Samplers' Signature: David A. Kulczyk Time: 1010

Type of Sample: Surface: X Subsurface: _____

Type of Soil Cover: Sandy loam

Depth Interval: 0' to 0.5'

Sample Identification: CANOFS-OFS2-0000

| | |
|---|---|
| Soil type (i.e. sand silt clay) | Sand |
| USCS Abbreviation | SM |
| Color | Orange-brown brown-orange |
| Staining | None |
| Odor | None |

| Containers | Number | Preservatives |
|---|---|---|
| 8 oz Glass | 2 | None |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: _____

Comments: Sample was collected near a lone tree in an open field south of the ball park at Chavez Housing Area, northwest of the main gate at Cannon AFB. The sample is a few feet west of the tree

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

Location Identification: Offsite Background OFS3 Date: 12-10-91

Samplers' Signature: David A. Kulejko Time: 1050

Type of Sample: Surface: X Subsurface: _____

Type of Soil Cover: Sandy loam

Depth Interval: 0' to 0.5'

Sample Identification: CANOFS-OFS3-0000

| | |
|---|---|
| Soil type (i.e. sand silt clay) | Sand |
| USCS Abbreviation | SM |
| Color | Red-orange brown-orange |
| Staining | None |
| Odor | None |

| Containers | Number | Preservatives |
|---|---|---|
| 8 oz Glass | 2 | None |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

QA/QC Samples Collected: _____

Comments: Sample was collected behind the back parking lot of the Officers Club on Octagon Street. The sample is approximately 60 feet west of the curbs of the back lot

# APPENDIX B-3
# SURVEYING DATA FOR ALL SAMPLE LOCATIONS

AGE DRAINAGE DITCH
SWMU NO. 34

C:\CAFB\TESTHOLE\TESTHOLE Tue Dec 31 11:31:24 1991



| NUMBER | DESCRIPTION | NORTHING | EASTING | ELEVATION |
|---|---|---|---|---|
| 0341 | BORING | 1236002.1880 | 805702.5583 | 4300.2800 |
| 0342 | BORING | 1236043.0885 | 805744.0410 | 4300.0700 |
| 0343 | BORING | 1236042.1781 | 805743.1547 | 4300.0000 |
| 0344 | BORING | 1236001.5139 | 805704.5999 | 4300.1500 |

EDS

SLUDGE WEATHERING PIT
SWMU NO. 76

C:\CAFB\TESTHOLE\TESTHOLE Thu Dec 26 15:20:39 1991 

| NUMBER | DESCRIPTION | NORTHING | EASTING | ELEVATION |
|---|---|---|---|---|
| 760 | BORING | 1239490.0054 | 807532.4573 | 4316.0500 |
| 761 | BORING | 1239495.3501 | 807524.5751 | 4316.0800 |
| 762 | BORING | 1239495.7382 | 807540.9410 | 4316.0200 |
| 763 | BORING | 1239482.3983 | 807532.7958 | 4315.8700 |
| A | BERM | 1239475.1950 | 807550.2407 | 0.0000 |
| B | BERM | 1239506.1002 | 807551.4290 | 0.0000 |
| C | BERM | 1239506.8596 | 807510.5200 | 0.0000 |
| D | BERM | 1239475.8776 | 807511.2844 | 0.0000 |

EDS

FIRE DEPARTMENT TRAINING AREA NO. 1
SWMU NO. 78



| NUMBER | DESCRIPTION | NORTHING | EASTING | ELEVATION |
|---|---|---|---|---|
| 781 | BORING | 1239311.9401 | 810959.3579 | 4316.8300 |
| 782 | BORING | 1239292.1592 | 810944.0232 | 4316.7500 |
| 783 | BORING | 1239283.0410 | 810951.0416 | 4316.7100 |
| 784 | BORING | 1239280.4164 | 810934.4356 | 4316.6000 |
| 785 | BORING | 1239319.7774 | 810969.9217 | 4316.5500 |
| 786 | BORING | 1239308.3529 | 810886.4645 | 4316.8700 |
| 787 | BORING | 1239309.9880 | 810958.5422 | 4316.9100 |
| 788 | BORING | 1239291.7848 | 810941.7260 | 4316.7100 |
| 789 | BORING | 1239282.5316 | 810950.8270 | 4316.6000 |
| 7810 | BORING | 1239280.2332 | 810933.6685 | 4316.5500 |
| 7811 | BORING | 1239319.2284 | 810969.1850 | 4316.5900 |
| 7812 | BORING | 1239308.9835 | 810887.2982 | 4316.9800 |
| A | BERM | 1239305.5452 | 810911.2235 | 0.0000 |
| B | BERM | 1239271.8157 | 810927.0691 | 0.0000 |
| C | BERM | 1239271.7167 | 810966.4069 | 0.0000 |
| D | BERM | 1239300.6653 | 810991.0610 | 0.0000 |
| E | BERM | 1239335.6816 | 810974.9076 | 0.0000 |
| F | BERM | 1239335.5890 | 810933.7039 | 0.0000 |

EDS

SOLVENT DISPOSAL SITE
SWMU NO. 81

C:\CAFB\TESTHOLE\TESTHOLE Thu Dec 26 14:43:44 1991



| NUMBER | DESCRIPTION | NORTHING | EASTING | ELEVATIO |
|---|---|---|---|---|
| 8101 | BORING | 1239506.2178 | 811290.8618 | 4314.4000 |
| 8102 | BORING | 1239504.7731 | 811300.9278 | 4314.490 |
| 8103 | BORING | 1239503.5786 | 811310.6927 | 4314.320 |
| 8104 | BORING | 1239496.2396 | 811288.1899 | 4314.5700 |
| 8105 | BORING | 1239494.0889 | 811298.8802 | 4314.4300 |
| 8106 | BORING | 1239494.1922 | 811308.8343 | 4314.380 |
| 8107 | BORING | 1239485.7900 | 811287.2070 | 4314.6200 |
| 8108 | BORING | 1239483.7524 | 811297.0931 | 4314.5100 |
| 8109 | BORING | 1239482.9258 | 811306.9737 | 4314.370 |
| 8110 | BORING | 1239514.7542 | 811313.3936 | 4314.450 |
| 8111 | BORING | 1239503.1285 | 811301.5420 | 4314.4200 |
| 8112 | BORING | 1239487.2496 | 811288.2640 | 4314.6200 |
| 8113 | BORING | 1239489.3693 | 811289.6589 | 4314.470 |
| 8114 | BORING | 1239492.9144 | 811308.6083 | 4314.330 |

EDS

ENGINE TEST CELL
SWMU NOS. 86-90

C:\CAFB\TESTHOLE\TESTHOLE Thu Dec 26 14:14:19 1991



| NUMBER | DESCRIPTION | NORTHING | EASTING | ELEVATION |
|---|---|---|---|---|
| 0861 | BORING | 1229461.4662 | 808379.7927 | 4268.9200 |
| 862 | BORING | 1229454.0202 | 808370.5370 | 4268.9600 |
| 863 | BORING | 1229451.4620 | 808390.7645 | 4268.7000 |
| 864 | BORING | 1229439.2439 | 808335.4696 | 4268.9500 |
| 865 | BORING | 1229459.8446 | 808171.7184 | 4269.1900 |
| 866 | BORING | 1229461.6646 | 808380.9380 | 4268.8000 |
| 867 | BORING | 1229462.5927 | 808378.7814 | 4268.8500 |
| 868 | BORING | 1229457.7507 | 808370.6086 | 4268.7100 |
| 869 | BORING | 1229452.1008 | 808387.8977 | 4268.6400 |
| 8610 | BORING | 1229439.3897 | 808338.8646 | 4269.0500 |

EDS

NE STORMWATER DRAINAGE
SWMU NO. 95



| NUMBER | DESCRIPTION | NORTHING | EASTING | ELEVATION |
|---|---|---|---|---|
| 951 | BORING | 1235330.1794 | 808710.7412 | 4279.8600 |
| ~~952~~ 953 | BORING | 1235249.0128 | 808942.3118 | 4278.5100 |
| ~~953~~ 952 | BORING | 1235327.7120 | 808714.5440 | 4280.0800 |
| 954 | BORING | 1235246.0644 | 808946.4206 | 4278.3500 |

EDS

OLD ENTOMOLOGY RINSE AREA
SWMU NO. 96



| NUMBER | DESCRIPTION | NORTHING | EASTING | ELEVATION |
|---|---|---|---|---|
| 0961 | BORING | 1235138.0067 | 810514.3974 | 4279.3246 |

EDS

SANITARY SEWER LINE
TORCH BLUD
SWMU NO. 98



| NUMBER | DESCRIPTION | NORTHING | EASTING | ELEVATION |
|---|---|---|---|---|
| 9801 | | 1238272.7408 | 806108.9983 | 4308.1200 |
| 9802 | | 1238218.6291 | 806120.5489 | 4307.2600 |
| 9803 | | 1237831.9775 | 806119.4738 | 4303.4400 |
| 9804 | | 1237231.0200 | 806122.8312 | 4301.9300 |
| 9805 | | 1234735.5138 | 804186.7349 | 4298.5207 |
| 9806 | | 1234783.0482 | 804231.3483 | 4299.0400 |
| 9807 | | 1235134.8996 | 804583.7093 | 4299.2934 |
| 9808 | | 1235236.2790 | 804673.7129 | 4300.0600 |
| 9809 | | 1235293.9180 | 804733.6810 | 4300.4000 |
| 9821 | | 1235352.8966 | 804783.9654 | 4300.5300 |
| 9822 | | 1235752.0163 | 805174.2759 | 4300.8000 |
| 9823 | | 1235834.5286 | 805266.9802 | 4301.4300 |
| 9824 | | 1235963.5399 | 805393.2757 | 4302.6000 |
| 9825 | | 1235990.7408 | 805408.4205 | 4302.6100 |
| 9826 | | 1236067.0193 | 805495.6791 | 4302.5900 |
| 9827 | | 1236278.4874 | 805701.1231 | 4302.8700 |
| 9828 | | 1236346.0357 | 805768.0764 | 4302.7900 |
| 9829 | | 1236514.5991 | 805935.4810 | 4303.2600 |

EDS

SANITARY SEWER LINE
TAXIWAY B & EAST OF RUNWAY
SWMU NO. 98



| NUMBER | DESCRIPTION | NORTHING | EASTING | ELEVATION |
|---|---|---|---|---|
| 9810 | BORING | 1236563.2800 | 806802.5300 | 4297.5500 |
| 9812 | BORING | 1236412.0900 | 807400.5300 | 4292.0300 |
| 9813 | BORING | 1236394.4700 | 807441.5700 | 4290.4100 |
| 9814 | BORING | 1236398.4100 | 807468.3700 | 4289.7700 |
| 9815 | BORING | 1236381.3500 | 807496.2200 | 4288.3500 |
| 9816 | BORING | 1236374.1300 | 807523.5000 | 4288.2000 |
| 9817 | BORING | 1236379.2000 | 807544.0400 | 4288.5600 |
| 9818 | BORING | 1236356.9256 | 807584.0014 | 4289.5400 |
| 9819 | BORING | 1236364.7555 | 807601.0382 | 4289.7300 |
| 9820 | BORING | 1236349.1600 | 807666.6700 | 4289.6700 |
| 9830 | BORING | 1236317.4700 | 807753.0700 | 4290.7100 |
| 9831 | BORING | 1236233.7300 | 808091.6400 | 4289.7900 |
| 9832 | BORING | 1236040.5509 | 808868.8002 | 4287.3400 |
| 9833 | BORING | 1235965.5928 | 809164.3779 | 4284.9200 |
| 9834 | BORING | 1235923.8996 | 809344.6365 | 4283.9700 |
| 9835 | BORING | 1235916.9998 | 809404.3867 | 4283.9500 |
| 9836 | BORING | 1235899.1848 | 809474.4516 | 4283.3700 |
| 9837 | BORING | 1235867.5106 | 809559.9264 | 4282.4700 |
| 9838 | BORING | 1235826.5931 | 809729.1327 | 4284.5300 |
| 9839 | BORING | 1235722.7454 | 809839.1784 | 4284.0800 |
| 9840 | BORING | 1235521.2903 | 810086.7230 | 4281.0300 |
| 9841 | BORING | 1235501.8143 | 810126.8978 | 4281.2800 |
| 9842 | BORING | 1235468.9254 | 810151.5473 | 4281.3500 |
| 9843 | BORING | 1235352.5066 | 810293.5558 | 4281.2500 |

EDS

WASTEWATER LAGOONS
SWMU NOS. 101, 102

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| NUMBER | DESCRIPTION | NORTHING | EASTING | ELEVATION |
|---|---|---|---|---|
| 3003 | BORING | 1235009.1800 | 810321.6400 | 4279.9500 |
| 3002 * | SAMPLE | 1234488.1492 | 810324.0259 | 4281.0000 |
| 3004/3001 | SAMPLE | 1233543.8335 | 810483.8363 | 4281.0000 |
| 5003 | SAMPLE | 1234563.3215 | 810357.5194 | 4281.0000 |
| 5009/5001 | SAMPLE | 1234864.3357 | 810257.1941 | 4281.0000 |
| 5010/5002 | SAMPLE | 1234764.1818 | 810416.5112 | 4281.0000 |
| 5011/5004 | SAMPLE | 1234420.9901 | 810514.4941 | 4281.0000 |
| 5012/5005 | SAMPLE | 1233593.9532 | 810280.9938 | 4281.0000 |
| 5013 */5006 | SAMPLE | 1233332.7266 | 810337.1001 | 4281.0000 |
| 5014 */5007 | SAMPLE | 1233434.7507 | 810505.1140 | 4281.0000 |
| 5015 /5008 | SAMPLE | 1233382.7037 | 810855.9536 | 4281.0000 |

EDS

* POINT LOCATED BY APPROXIMATION FROM DRAWING IN "FIELD SAMPLING PLAN".

FIRE DEPARTMENT TRAINING AREA NO. 2

SWMU NO. 106



| NUMBER | DESCRIPTION | NORTHING | EASTING | ELEVATION |
|---|---|---|---|---|
| 1 | BERM | 1227662.2790 | 809421.4559 | 0.0000 |
| 2 | BERM | 1227621.4514 | 809412.7186 | 0.0000 |
| 3 | BERM | 1227595.7249 | 809378.3816 | 0.0000 |
| 4 | BERM | 1227616.6014 | 809343.4847 | 0.0000 |
| 5 | BERM | 1227652.0393 | 809330.2534 | 0.0000 |
| 1061 | BORING | 1227638.2526 | 809353.2450 | 4261.2700 |
| 1062 | BORING | 1227627.9177 | 809395.3695 | 4261.2000 |
| 1063 | BORING | 1227624.6716 | 809563.7653 | 4261.6900 |
| 1064 | BORING | 1227650.7292 | 809546.9721 | 4261.6100 |
| 1065 | BORING | 1227638.4405 | 809355.4962 | 4261.4400 |
| 1066 | BORING | 1227626.5301 | 809562.7295 | 4261.8400 |
| A | BERM | 1227679.0610 | 809572.9796 | 0.0000 |
| B | BERM | 1227657.7402 | 809615.4858 | 0.0000 |
| C | BERM | 1227620.8530 | 809595.0973 | 0.0000 |
| D | BERM | 1227600.5021 | 809561.7578 | 0.0000 |
| E | BERM | 1227620.0816 | 809526.3857 | 0.0000 |
| F | BERM | 1227632.8907 | 809515.4782 | 0.0000 |

EDS

FIRE DEPARTMENT TRAINING AREA NO. 3

SWMU NO. 107

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| NUMBER | DESCRIPTION | NORTHING | EASTING | ELEVATIO |
|---|---|---|---|---|
| 1071 | BORING | 1228318.1183 | 810001.4245 | 4265.480 |
| 1072 | BORING | 1228324.4692 | 809972.5739 | 4265.800 |
| 1073 | BORING | 1228271.8004 | 809978.8897 | 4265.6600 |
| 1074 | BORING | 1228286.4186 | 810030.1422 | 4264.8500 |
| 1075 | BORING | 1228285.0067 | 810032.3501 | 4264.850 |
| 1076 | BORING | 1228274.8422 | 809981.2307 | 4265.660 |
| A | BERM | 1228356.0960 | 809954.0927 | 0.0000 |
| B | BERM | 1228363.5848 | 809993.4629 | 0.0000 |
| C | BERM | 1228343.5755 | 810029.7006 | 0.000 |
| D | BERM | 1228304.0486 | 810050.5673 | 0.000 |
| E | BERM | 1228265.6960 | 810043.0426 | 0.0000 |
| F | BERM | 1228244.8396 | 809996.9082 | 0.000 |

EDS

FIRE DEPARTMENT TRAINING AREA NO.4

SWMU NO. 109



| NUMBER | DESCRIPTION | NORTHING | EASTING | ELEVATION |
|---|---|---|---|---|
| 1091 | BORING | 1227791.0783 | 810528.8861 | 4265.4600 |
| 1092 | BORING | 1227575.4634 | 810526.7057 | 4264.4900 |
| 1093 | BORING | 1227683.0261 | 810414.3771 | 4265.2400 |
| 1094 | BORING | 1227634.3762 | 810453.6856 | 4265.2500 |
| 1095 | BORING | 1227793.3677 | 810531.8252 | 4265.4400 |
| 1096 | BORING | 1227579.9733 | 810524.3087 | 4264.5000 |
| 1097 | BORING | 1227685.5328 | 810413.3710 | 4265.3300 |
| 1098 | BORING | 1227638.1672 | 810450.9199 | 4265.0700 |

EDS

MONITORING WELLS AT
WASTEWATER LAGOONS (SWMU NO. 101)
OLD ENTOMOLOGY RINSE AREA (SWMU NO. 96)
LANDFILL NO. 5 (SWMU NO. 113)

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| NUMBER | DESCRIPTION | NORTHING | EASTING | CONS BASE ELEVATION |
|---|---|---|---|---|
| 1001 | TESTWELL E | 1235063.5443 | 809705.0864 | 4281.1100 |
| 1002 | TESTWELL F | 1234545.0413 | 810709.1161 | 4276.3000 |
| 1003 | TESTWELL G | 1233696.3498 | 810906.6399 | 4277.8100 |
| 1004 | TESTWELL H | 1233170.4388 | 810462.2392 | 4272.3300 |
| 1005 | TESTWELL K | 1234698.8024 | 811028.0421 | 4274.3000 |
| 1006 | TESTWELL A | 1228225.1655 | 809337.3899 | 4265.0200 |
| 1007 | TESTWELL B | 1226600.2258 | 811121.1823 | 4263.3100 |
| 1008 | TESTWELL I | 1226224.3618 | 811123.5121 | 4262.8400 |
| 1009 | TESTWELL J | 1225949.8998 | 810987.7561 | 4262.4200 |
| 1010 | TESTWELL D | 1226029.4899 | 809948.3243 | 4263.3000 |
| 1011 | TESTWELL C | 1225989.8281 | 810614.4206 | 4265.0300 |

EDS

| WELL | RISER ELEVATION |
|---|---|
| E | 4283.06 |
| F | 4279.29 |
| G | 4280.02 |
| H | 4274.50 |
| K | 4277.48 |
| A | 4267.05 |
| B | 4265.41 |
| I | 4265.18 |
| J | |
| D | 4265.28 |
| C | 4267.25 |

OFFSITE BACKGROUND SITES



| NUMBER | DESCRIPTION | NORTHING | EASTING | ELEVATION |
|---|---|---|---|---|
| OFS1 | BORING | 1242520.1438 | 803383.0608 | 4326.4021 |
| OFS2 | BORING | 1241124.4047 | 803976.9886 | 4315.3267 |
| OFS3 | BORING | 1236558.8614 | 801027.4295 | 4316.8835 |

EDS

CONTROL POINTS

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| NUMBER | DESCRIPTION | NORTHING | EASTING | ELEVATI |
|---|---|---|---|---|
| 30 | PORTAIR CAP | 1239978.7900 | 808821.4700 | 4323.806 |
| 31 | PORTAIR AZ MK | 1239942.2440 | 806413.8730 | 4348.000 |
| BRASS CAP | CONTROL POINT | 1236566.6100 | 807351.8900 | 4294.020 |
| KP-89 | CONTROL POINT | 1236140.4370 | 810682.8470 | 4291.750 |
| KP-85 | CONTROL POINT | 1236932.0800 | 806416.5900 | 4300.390 |
| KP-78 | CONTROL POINT | 1236713.3900 | 805990.3000 | 4302.690 |
| KP-67 | CONTROL POINT | 1238234.7300 | 806078.9400 | 4307.520 |
| KP-33 | CONTROL POINT | 1238473.4790 | 808778.4660 | 4309.235 |
| LY-113 | CONTROL POINT | 1241933.1786 | 803606.5152 | 4322.120 |
| LY-112 | CONTROL POINT | 1240027.5828 | 806267.6669 | 4316.310 |
| LY-111 | CONTROL POINT | 1235816.2101 | 801842.8486 | 4308.386 |
| LY-110 | CONTROL POINT | 1236594.9760 | 806251.3824 | 4299.810 |
| LY-109 | CONTROL POINT | 1235342.9400 | 804684.1800 | 4300.690 |
| LY-108 | CONTROL POINT | 1236260.6900 | 805556.0270 | 4303.020 |
| LY-107 | CONTROL POINT | 1239539.7630 | 808061.4750 | 4318.690 |
| LY-106 | CONTROL POINT | 1239053.5230 | 810828.6350 | 4317.350 |
| LY-105 | CONTROL POINT | 1233081.3340 | 809988.3180 | 4281.380 |
| LY-104 | CONTROL POINT | 1231261.9660 | 811230.5040 | 4271.4300 |
| LY-103 | CONTROL POINT | 1227532.3810 | 810943.5710 | 4265.600 |
| LY-102 | CONTROL POINT | 1227676.2530 | 809846.3430 | 4265.510 |
| LY-101 | CONTROL POINT | 1230268.2130 | 809960.6140 | 4273.7300 |
| LY-100 | CONTROL POINT | 1234088.5850 | 809918.6640 | 4278.7900 |
| PI-15 | CONTROL POINT | 1236408.5900 | 802472.1000 | 4316.[illegible]70 |
| PI-9 | CONTROL POINT | 1237273.3300 | 803320.5900 | 4316.[illegible]50 |

EDS

# APPENDIX B-4
# SANITARY SEWER LINE VIDEO CAMERA SURVEY REPORT

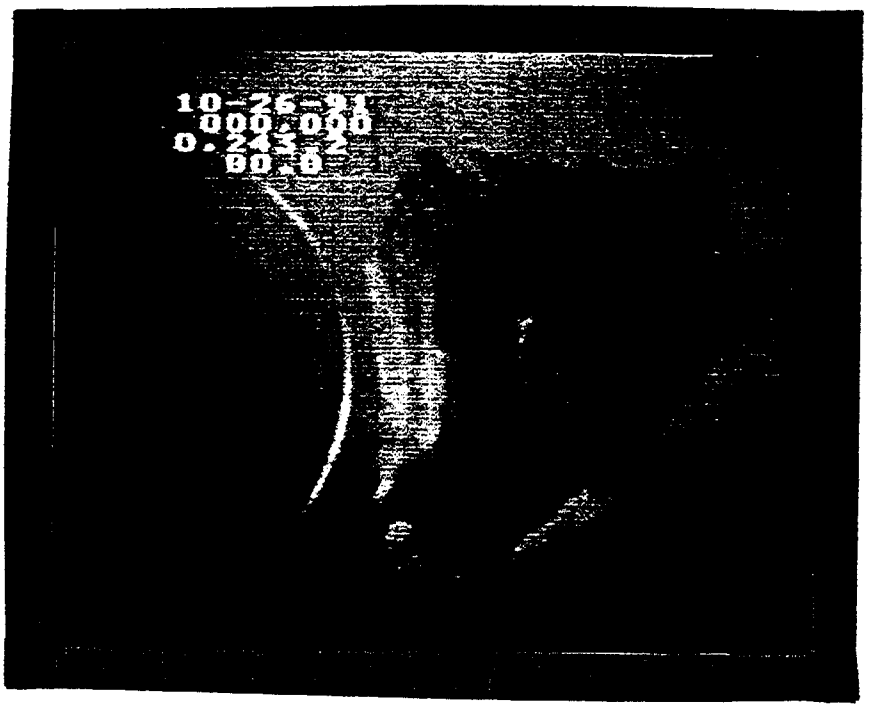
CCC

CCTV Inspection of Sanitary Sewer Trunk Lines

# CANNON AIR FORCE BASE

For:

WOODWARD-CLYDE CONSULTANTS
Engineering and sciences applied to the earth and its environment




Cook Construction Company, Inc.
Albuquerque, New Mexico
October 1991

CONTENTS

I. Introduction/Purpose of Report

II. Findings/Specific Line Evaluation/Field Television Inspection Reports.

III. Observation - Summary

IV. Recommendations

V. Economic Factors

## I. INTRODUCTION AND PURPOSE OF REPORT

In September, 1991, Woodward-Clyde Consultants, Environmental Engineers contacted Cook Construction Company, Inc. for cleaning and closed circuit television inspection of a portion of the sanitary sewer system at Cannon AFB, Clovis New Mexico. The purpose of the inspection was to determine the condition of the conduits and to locate possible points of exfiltration from the system, that could cause soil or ground water contamination.

The cleaning and inspection of the designated lines, was performed between October 15th and November 2, 1991.

CCC

## INTENSITY CODES

II. Findings/Field Television Inspection Reports/Specific Line Evaluations.

The following data defines the degree and extent of the pipe conditions observed.

**Alignment codes:**

A) Begin 1/4 pipe water.
B) Begin 1/2 pipe water.
C) Camera under water.
D) End camera under water.
E) End 1/2 pipe water.
F) End 1/4 pipe water.

**Crack codes:**

A) <1/2"W, <1'L
B) <1/2"W, 1'-2'L
C) <1/2"W, >2'L
D) >1/2"W, <1'L
E) >1/2"W, 1'-2'L
F) >1/2"W, >2'L
G) Hole in pipe-small
H) Pipe missing-<60 degrees
I) Pipe missing->60 degrees

**Debris codes:**

A) Debris-Light
B) Debris-Medium
C) Debris-Heavy
D) Grease-Light
E) Grease-Medium
F) Grease-Heavy

**Joint codes:**

A) DRP JT >90% clear
B) DRP JT 80-90% clear
C) DRP JT <80% clear
D) SHF JT >90% clear
E) SHF JT 80-90% clear
F) SHF JT <80% clear
G) WD JT 2"-3"
H) WD JT 3"-4"
I) WD JT >4"
J) BRK JT-light
K) BRK JT-medium
L) BRK JT-heavy
M) Typical joint
N) Visible gasket
O) Leaking at joint

**Lateral codes:**

A) PTR SER 0"-1"
B) PTR SER 1"-2"
C) PTR SER 2"-3"
D) PTR SER 3"-+
E) Defect SER Conn
F) Dead/unused SER
G) Factory service
H) Plumber service

**Roots codes:**

A) Roots-light
B) Roots-medium
C) Roots-heavy

**Structural codes:**

A) Line DET-light
B) Line DET-medium
C) Line DET-heavy
H) Pipe DET-heavy
L) Pipe DET-light
M) Pipe DET-medium
N) Pipe DET-none
D) Oval <5%
E) Oval >5% &<10%
F) Oval >10%
G) Collapsed

CCC

# TELEVISION INSPECTION REPORT

**PROJECT:** Sanitary sewer inspection - Cannon Air Force Base; Clovis, New Mexico

**FOR:** Woodward-Clyde Consultant
4582 So. Ulster Parkway - Denver, CO

**PRINCIPAL:** Jeff Ehrenzeller, P.E.

**INSPECTION DATES:** October 16, 1991

**WEATHER:** Fair - moderate temperatures

**LOCATION:** Start manhole #192 North end of Torch Blvd; TV - South to manhole #195 also on Torch Blvd.

**PIPE SIZE; TYPE:** 12" VCP - 3ft joints

**TAPE NO.:** #1 - Segment; "A"

**TECHNICIAN:** Juan Carlos Santiago

| DISTANCE READING | CLOCK REF POSITION | REMARKS / NOTES |
|---|---|---|
| 18.0-19.0 | - | Dip in line |
| 39.1 | - | Typical misaligned joint; probably caused by out of round pipe; but within tolerance at the time of installation. |
| 150.0-156.0 | - | Slight dip in line. |
| 239.1 | - | Typical misaligned joint; probably caused by out of round pipe; but within tolerance at the time of installation. |
| 281.4 | 10:00 | Small amount of roots in joint. Root Condition "A" |
| 287.0 | 2:00 | Typical misaligned joint; probably caused by out of round pipe; but within tolerance at the time of installation. |
| 302.6 | 1:00 | Appears to be a broken pipe blister. A hole probably would have root intrusions. |
| 345.0-351.0 | - | Slight dip in line. |
| 349.8 | 3:00 | Small pie shaped crack. Crack Condition "A" |

(Continued)

| DISTANCE READING | CLOCK REF POSITION | REMARKS / NOTES |
|---|---|---|
| 369.3 | 11:00 | Live service connection - 1/4" protrusion - Lateral code "H" |
| 389.3 | 12:00 | Small longitudinal crack. Crack condition "B" |
| 391.5 | 12:00 | Live service connection, some cracks at service. Lateral code "H" |
| 398.6 | 9:00 | Small diagonal crack. Crack condition "A" |
| 401.8 | 8:00 | Typical misaligned joint; probably caused by out of round pipe, but within tolerance at the time of installation. |
| 438.3 | 9:00 | Small root intrusion |
| 501-508 | - | Slight dip in line. |
| 516-524 | - | Slight dip in line. |
| 532.7 | - | End T.V. |
| 539.0 | - | E.O.L. |

| M.H.# | FLOW | M.H.# |
|---|---|---|
| 192 | South | 195 |
| Depth=13'-6" | | Depth=8'-5" |

**TOTAL FEET TELEVISED (539 ft)**

**COMMENTS:**

CCC

Specific Line Evaluation

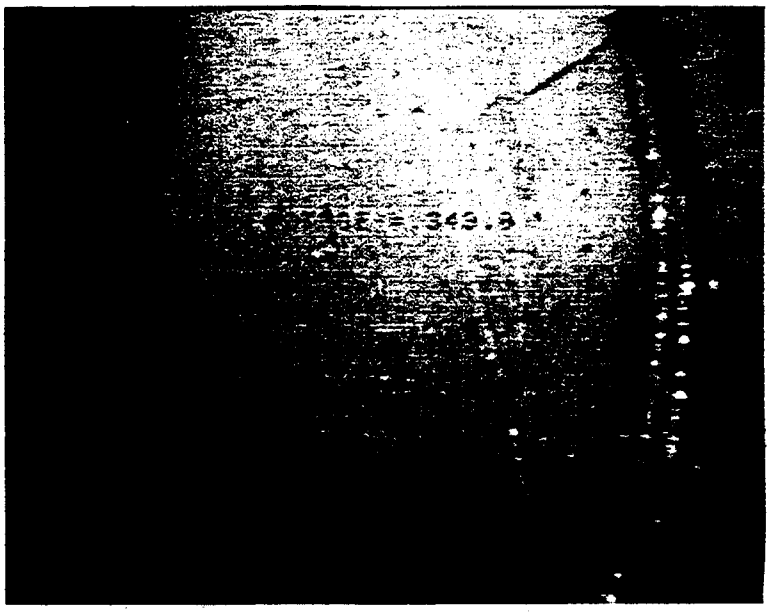
Tape #1; Segment "A"

Manhole #192 South to Manhole #195

Direction of TV-South. with flow.

The photo-print shows a specific sewer pipe defect for this section of line. The most severe condition observed was usually selected for the photograph.

Photo shows a V-shaped crack in the pipe at the spigot end. Approx. Sta. 349.9



This segment of line was constructed using 12" VC pipe. Roots have grown through the joints in several sections of pipe. Also, some house service lines have minor protrusions into the main line. Small cracks were observed at several joints.

CCC

# TELEVISION INSPECTION REPORT

**PROJECT:** Sanitary sewer inspection - Cannon Air Force Base; Clovis, New Mexico

**FOR:** Woodward-Clyde Consultant
4582 So. Ulster Parkway - Denver, CO

**PRINCIPAL:** Jeff Ehrenzeller, P.E.

**INSPECTION DATES:** October 17, 1991

**WEATHER:** Fair - moderate temperatures

**LOCATION:** Start manhole #195 on Torch Blvd; TV - South to manhole #196 also on Torch Blvd.

**PIPE SIZE; TYPE:** 12" VCP - 3ft joints

**TAPE NO.:** #1 - Segment; "B"

**TECHNICIAN:** Juan Carlos Santiago

| DISTANCE READING | CLOCK REF POSITION | REMARKS / NOTES |
|---|---|---|
| 4.4 | - | Typical offset joint; probably caused by out of round pipe, which was within tolerance at the time of installation. |
| 126.9 | 12:00 | Live service connection - Lateral code "H" |
| 227.9 | - | Typical offset joint; probably caused by out of round pipe, which was within tolerance at the time of installation. |
| 248.5 | 10:00to2:00 | Pitting in crown of pipe. |
| 255.1 | - | Misaligned joint - Joint code "D" |
| 258.8 | - | End T.V. |
| 263.0 | - | E.O.L. |

**M.H.#** 195
Depth=8'-5"

**FLOW** South

**M.H.#** 196
Depth=10'-2"

**TOTAL FEET TELEVISED (263 ft)**

**COMMENTS:**

CCC

Specific Line Evaluation

Tape #1; Segment "B"

Manhole #195 South to Manhole #196

Direction of TV-South, with flow.

The photo-print shows a specific sewer pipe defect for this section of line. The most severe condition observed was usually selected for the photograph.

Photo shows a typical misaligned joint; probably caused by out of round pipe, but within tolerance at the time of installation. Approx. Sta. 255.1

This segment of line was constructed using 12" VC pipe. Some deterioration in the crown of the pipe was noted.

CCC

# TELEVISION INSPECTION REPORT

**PROJECT:** Sanitary sewer inspection - Cannon Air Force Base; Clovis, New Mexico

**FOR:** Woodward-Clyde Consultant
4582 So. Ulster Parkway - Denver, CO

**PRINCIPAL:** Jeff Ehrenzeller, P.E.

**INSPECTION DATES:** October 17, 1991

**WEATHER:** Fair - moderate temperatures

**LOCATION:** Start manhole #196 on Torch Blvd; TV - South to manhole #197 also on Torch Blvd.

**PIPE SIZE; TYPE:** 12" VCP - 3ft joints

**TAPE NO.:** #1 - Segment; "C"

**TECHNICIAN:** Juan Carlos Santiago

| DISTANCE READING | CLOCK REF POSITION | REMARKS / NOTES |
|---|---|---|
| 5.0 | - | Typical misaligned joint; probably caused by out of round pipe, which was within tolerance at the time of installation. |
| 44.0-46.0 | 10:00to2:00 | Some pitting in crown of pipe. |
| 107.8 | 12:00 | Live service connection - Lateral code "H" |
| 126.7 | - | Typical misaligned joint; probably caused by out of round pipe, which was within tolerance at the time of installation. |
| 133.5 | 11:00 | Root intrusion through joint. Root code "A" |
| 173.5 | 12:00 | Live service connection - Lateral code "H" |
| 189.4 | 11:00 | Live service connection - Lateral code "H" |
| 241.8 | 12:00 | Live service connection - Lateral code "H" |

(Continued)

| DISTANCE READING | CLOCK REF POSITION | REMARKS / NOTES |
|---|---|---|
| 246.1 | - | Typical misaligned joint; probably caused by out of round pipe, which was within tolerance at the time of installation. |
| 295.0 | 5:00 | Possible root intrusion. |
| 374.3 | 7:00 | Possible root intrusion. |
| 401.0 | - | End T.V. |
| 401.1 | - | E.O.L. |

**M.H.#** 196
Depth=10'-2"

**FLOW** South

**M.H.#** 197
Depth=10'-10"

**TOTAL FEET TELEVISED (401 ft)**

**COMMENTS:** Note service line connection in manhole.

CCC

Specific Line Evaluation

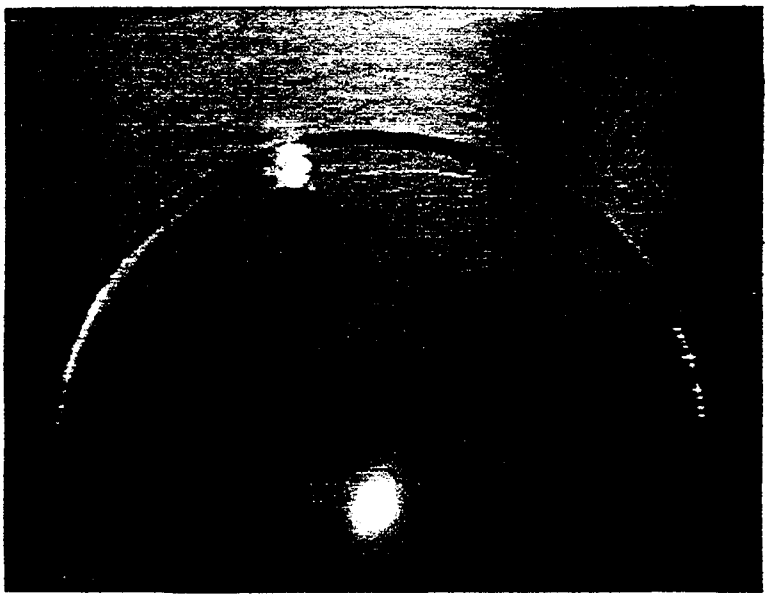
Tape #1; Segment "C"

Manhole #196 South to Manhole #197

Direction of TV-South, with flow.

The photo-print shows a specific sewer pipe defect for this section of line. The most severe condition observed was usually selected for the photograph.

Photo shows a small root intrusion through the joint, and a small radial crack in the crown of the pipe.
Approx. Sta. 133.5



This segment of line was constructed using 12" VC pipe. Roots have grown through the joints in several sections of pipe. The house service lines appear to be adequate. Additionally, it was observed that the vitreous coating has deteriorated in several pieces of pipe.

CCC

# TELEVISION INSPECTION REPORT

**PROJECT:** Sanitary sewer inspection - Cannon Air Force Base; Clovis, New Mexico

**FOR:** Woodward-Clyde Consultant
4582 So. Ulster Parkway - Denver, CO

**PRINCIPAL:** Jeff Ehrenzeller, P.E.

**INSPECTION DATES:** October 17, 1991

**WEATHER:** Fair - moderate temperatures

**LOCATION:** Start manhole #197 on Torch Blvd; TV - South to manhole #198 also on Torch Blvd.

**PIPE SIZE; TYPE:** 12" VCP - 3ft joints

**TAPE NO.:** #1 - Segment; "D"

**TECHNICIAN:** Juan Carlos Santiago

| DISTANCE READING | CLOCK REF POSITION | REMARKS / NOTES |
|---|---|---|
| 11.5 | - | Typical misaligned joint; probably caused by out of round pipe, which was within tolerance at the time of installation. |
| 117.2 | 8:00 | Possible root intrusion. |
| 178.1 | 12:00 | Live service connection - Lateral code "H" |
| 179.0 | - | Shifted joint - Joint code "D" |
| 234.8 | 12:00 | Live service connection - Lateral code "H" |
| 238.8 | 10:00 | Live service connection - Lateral code "H" |
| 327.1 | 12:00 | Live service connection - Lateral code "H" |
| 369.8 | - | Note the series of offset joints. |
| 377.0 | 12:00 | Live service connection - Lateral code "H" |

(Continued)

| DISTANCE READING | CLOCK REF POSITION | REMARKS / NOTES |
|---|---|---|
| 396.0 | - | End of T.V. |
| 397.0 | - | E.O.L. |

| M.H.# | FLOW | M.H.# |
|---|---|---|
| 197 | South | 198 |
| Depth=11.9' | | Depth=12.0' |

**TOTAL FEET TELEVISED (397 ft)**

**COMMENTS:** Note most of the connections showed between 45 degrees & 90 degrees of non-congruent joint.

CCC

Specific Line Evaluation

Tape #1; Segment "D"

Manhole #197 South to Manhole #198

Direction of TV-South, with flow.

The photo-print shows a specific sewer pipe defect for this section of line. The most severe condition observed was usually selected for the photograph.

Photo shows an offset joint in the pipe that appears to have been caused by settlement.
Approx. Sta. 179.0

This segment of line was constructed using 12" VC pipe. Roots have grown through the joints at one location . The house service line appears to be satisfactory.

CCC

# TELEVISION INSPECTION REPORT

**PROJECT:** Sanitary sewer inspection - Cannon Air Force Base; Clovis, New Mexico

**FOR:** Woodward-Clyde Consultant
4582 So. Ulster Parkway - Denver, CO

**PRINCIPAL:** Jeff Ehrenzeller, P.E.

**INSPECTION DATES:** October 18, 1991

**WEATHER:** Fair - moderate temperatures

**LOCATION:** Start manhole #198 on Torch Blvd; TV - South to manhole #198A also on Torch Blvd.

**PIPE SIZE; TYPE:** 12" VCP - 3ft joints

**TAPE NO.:** #1 - Segment; "E"

**TECHNICIAN:** Juan Carlos Santiago

| DISTANCE READING | CLOCK REF POSITION | REMARKS / NOTES |
|---|---|---|
| 21.9 | - | Typical misaligned joint; probably caused by out of round pipe, but within tolerance at the time of installation. |
| 131.4 | - | Note line of displaced joints. |
| 144.9 | - | End T.V. |
| 147.0 | - | E.O.L. |

| M.H.# | FLOW | M.H.# |
|---|---|---|
| 198 | South | 198A |
| Depth=12.0' | | Depth=10.4' |

**TOTAL FEET TELEVISED (147 ft)**

**COMMENTS:** No significant defects observed. Most of the connections showed between 45 degrees and 90 degrees of non-congruent joint.

CCC

Specific Line Evaluation

Tape #1; Segment "E"

Manhole #198 South to Manhole #198A

Direction of TV-South, with flow.

The photo-print shows a specific sewer pipe defect for this section of line. The most severe condition observed was usually selected for the photograph.

Photo shows a series of noncongruent joints. This condition is probably caused by out-of-round pipe, that was within tolerance at time of installation. Approx. Sta. 131.2

This segment of line was constructed using 12" VC pipe. This section of pipe was in good condition.

CCC

# TELEVISION INSPECTION REPORT

**PROJECT:** Sanitary sewer inspection - Cannon Air Force Base; Clovis, New Mexico

**FOR:** Woodward-Clyde Consultant
4582 So. Ulster Parkway - Denver, CO

**PRINCIPAL:** Jeff Ehrenzeller, P.E.

**INSPECTION DATES:** October 18, 1991

**WEATHER:** Fair - moderate temperatures

**LOCATION:** Start manhole #198A on Torch Blvd; TV - South to manhole #199 also on Torch Blvd.

**PIPE SIZE; TYPE:** 12" VCP - 3ft joints

**TAPE NO.:** #1 - Segment; "F"

**TECHNICIAN:** Juan Carlos Santiago

| DISTANCE READING | CLOCK REF POSITION | REMARKS / NOTES |
|---|---|---|
| 7.0 | - | Typical misaligned joint; probably caused by out of round pipe, but within tolerance at the time of installation. |
| 141.5 | - | End T.V. |
| 142.0 | - | E.O.L. |

| M.H.# | FLOW | M.H.# |
|---|---|---|
| 198A | South | 199 |
| Depth=10.4' | | Depth=13.4' |

**TOTAL FEET TELEVISED (142 ft)**

**COMMENTS:** No significant defects observed. Most of the connections showed between 45 degrees and 90 degrees of non-congruent joint.

CCC

# TELEVISION INSPECTION REPORT

**PROJECT:** Sanitary sewer inspection - Cannon Air Force Base; Clovis, New Mexico

**FOR:** Woodward-Clyde Consultant
4582 So. Ulster Parkway - Denver, CO

**PRINCIPAL:** Jeff Ehrenzeller, P.E.

**INSPECTION DATES:** October 18, 1991

**WEATHER:** Fair - moderate temperatures

**LOCATION:** Start manhole #199 on Torch Blvd and Argentia , TV - Southeast to manhole #200 near 195 Argentia.

**PIPE SIZE; TYPE:** 15" VCP - 3ft joints

**TAPE NO.:** #2 - Segment; "A"

**TECHNICIAN:** Juan Carlos Santiago

| DISTANCE READING | CLOCK REF POSITION | REMARKS / NOTES |
|---|---|---|
| 8.2 | - | Typical misaligned joint; probably caused by out of round pipe, but within tolerance at the time of installation. |
| 80.7 | - | Debris in bottom of pipe. |
| 213.5 | - | End T.V. |
| 215.0 | - | E.O.L. |

| M.H.# | FLOW | M.H.# |
|---|---|---|
| 199 | Southeast | 200 |
| Depth=14.0' | | Depth=13.0' |

**TOTAL FEET TELEVISED (215 ft)**

**COMMENTS:** Small amounts of debris in bottom of line.

CCC

Specific Line Evaluation

Tape #2; Segment "A"

Manhole #199, to Manhole #200

Direction of TV-Southeast, with flow.

The photo-print shows a specific sewer pipe defect for this section of line. The most severe condition observed was usually selected for the photograph.

Photo shows some debris in the bottom of the pipe that could not be removed by conventional cleaning methods. Approx. Sta. 81.7

This segment of line was constructed using 15" VC pipe. The condition of the pipe appeared to be satisfactory.

CCC

# TELEVISION INSPECTION REPORT

**PROJECT:** Sanitary sewer inspection - Cannon Air Force Base; Clovis, New Mexico

**FOR:** Woodward-Clyde Consultant
4582 So. Ulster Parkway - Denver, CO

**PRINCIPAL:** Jeff Ehrenzeller, P.E.

**INSPECTION DATES:** October 18, 1991

**WEATHER:** Fair - moderate temperatures

**LOCATION:** Start manhole #200 located near 195 Argentia St., TV - Southeast to manhole #200A near the operational apron.

**PIPE SIZE; TYPE:** 15" VCP - 3ft joints

**TAPE NO.:** #2 - Segment; "B"

**TECHNICIAN:** Juan Carlos Santiago

| DISTANCE READING | CLOCK REF POSITION | REMARKS / NOTES |
|---|---|---|
| 15.3 | - | Blister in pipe coating. |
| 32.8 | - | Typical misaligned joint; probably caused by out of round pipe, but within tolerance at the time of installation. |
| 83.2 | - | End T.V. |
| 86.0 | - | E.O.L. |

.H.#
'00
pth=13.0'

FLOW
Southeast

M.H.#
200A
Depth=10.6'

**TOTAL FEET TELEVISED (86 ft)**

**MENTS:** Small amounts of debris in bottom of line. Most of the connections showed between 45 degrees and 90 degrees of non-congruent joint.

CCC

Specific Line Evaluation

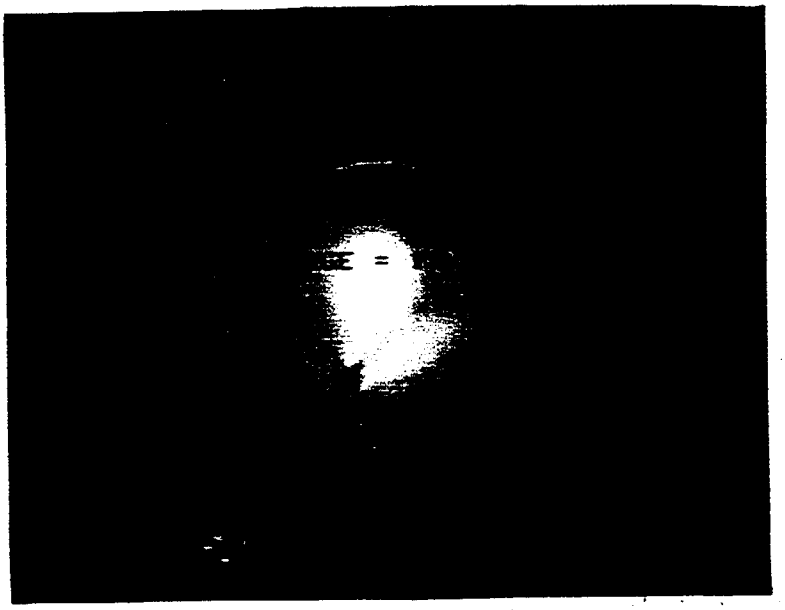
Tape #2; Segment "B"

Manhole #200, to Manhole #200A

Direction of TV-Southeast, with flow.

The photo-print shows a specific sewer pipe defect for this section of line. The most severe condition observed was usually selected for the photograph.

Photo shows a blister in the vitreous coating of the pipe. Approx. Sta. 13.0



This segment of line was constructed using 15" VC pipe. The condition of the pipe appeared to be satisfactory.

CCC

# TELEVISION INSPECTION REPORT

**PROJECT:** Sanitary sewer inspection - Cannon Air Force Base; Clovis, New Mexico

**FOR:** Woodward-Clyde Consultant
4582 So. Ulster Parkway - Denver, CO

**PRINCIPAL:** Jeff Ehrenzeller, P.E.

**INSPECTION DATES:** October 19, 1991

**WEATHER:** Fair - moderate temperatures

**LOCATION:** Start manhole #113A located on Torch Blvd, Southwest of the intersection with Trident Ave. TV Northeast to manhole #113, also located on Torch Blvd, Northeast of the intersection with Trident Ave.

**PIPE SIZE; TYPE:** 10" VCP - 3ft joints

**TAPE NO.:** #2 - Segment; "C"

**TECHNICIAN:** Juan Carlos Santiago

| DISTANCE READING | CLOCK REF POSITION | REMARKS / NOTES |
|---|---|---|
| 6.8 | - | Typical misaligned joint; probably caused by out of round pipe, but within tolerance at the time of installation. |
| 61.7 | - | End T.V. |
| 62.0 | - | E.O.L. |

| M.H.# | FLOW | M.H.# |
|---|---|---|
| 113A | Northeast | 113 |
| Depth=6'6" | | Depth=5'10" |

**TOTAL FEET TELEVISED (62 ft)**

**COMMENTS:** Televised from manhole #113A, through manhole #113 to manhole #118. No pipe deficiency observed.

CCC

# TELEVISION INSPECTION REPORT

**PROJECT:** Sanitary sewer inspection - Cannon Air Force Base; Clovis, New Mexico

**FOR:** Woodward-Clyde Consultant
4582 So. Ulster Parkway - Denver, CO

**PRINCIPAL:** Jeff Ehrenzeller, P.E.

**INSPECTION DATES:** October 19, 1991

**WEATHER:** Fair - moderate temperatures

**LOCATION:** Start manhole #113 located on Torch Blvd, Northeast of the intersection with Trident Ave. TV Northeast to manhole #118, also located on Torch Blvd, Southwest of the Sextant Ave. intersection.

**PIPE SIZE; TYPE:** 10" VCP - 3ft joints

**TAPE NO.:** #2 - Segment; "D"

**TECHNICIAN:** Juan Carlos Santiago

| DISTANCE READING | CLOCK REF POSITION | REMARKS / NOTES |
|---|---|---|
| 2.9 | 9:00to2:00 | Shifted joint, Joint code "F" |
| 16.0 | - | Typical misaligned joint; probably caused by out of round pipe, but within tolerance at the time of installation. |
| 28.2 | 2:30 | Root intrusion, Root code "A" |
| 51.6 | 2:00 | Root intrusion, Root code "A" |
| 54.6 | 3:00 | Root intrusion, Root code "A" |
| 61.5 | 9:00 | Root intrusion, Root code "A" |
| 64.2 | 6:00to9:00 | Misaligned joint, some root intrusion, Root code "A" |
| 81.6 | 10:00 | Root intrusion, Root code "A" |
| 84.2 | 10:00 | Root intrusion, Root code "A" |
| 87.3 | 2:00 | Longitudial crack, Crack code "A" |
| 87.9 | 2:00 | Radial crack, Crack code "A" |
| 89.3 | 1:00 | Root intrusion, Root code "A" |
| 93.7 | Several | Root intrusion, Root code "A" |
| 122.7 | 11:00 | Longitudial crack between end of pipe & service line, Crack code "A" |

(Continued)

| DISTANCE READING | CLOCK REF POSITION | REMARKS / NOTES |
|---|---|---|
| 123.2 | 11:00 | Live service connection, Lateral code "H" |
| 128.8 | 12:00 | Live service connection, Lateral code "H" |
| 155.4 | 11:00 | False service line connection |
| 192.0to200.0 | - | Dip in line |
| 199.5to283.3 | - | No recording, camera under water. |
| 283.0to302.0 | - | Dip in line. |
| 320.5 | - | End T.V. |
| 320.5to331.0 | - | E.O.L. |

| M.H.# | FLOW | M.H.# |
|---|---|---|
| 113 | Northeast | 118 |
| Depth=5'10" | | Depth=5'7" |

TOTAL FEET TELEVISED (331.0 ft)

COMMENTS:

CCC

Specific Line Evaluation

Tape #2; Segment "D"

Manhole #113, to Manhole #118

Direction of TV-Northeast, with flow.

The photo-print shows a specific sewer pipe defect for this section of line. The most severe condition observed was usually selected for the photograph.

Photo shows a small longitudinal crack between the spigot and a service line connection in the pipe. Approx. Sta. 122.7

This segment of line was constructed using 10" VC pipe. Roots have grown through the joints in several sections of pipe.

# TELEVISION INSPECTION REPORT

**PROJECT:** Sanitary sewer inspection - Cannon Air Force Base; Clovis, New Mexico

**FOR:** Woodward-Clyde Consultant
4582 So. Ulster Parkway - Denver, CO

**PRINCIPAL:** Jeff Ehrenzeller, P.E.

**INSPECTION DATES:** October 19, 1991

**WEATHER:** Fair - moderate temperatures

**LOCATION:** Start at manhole #118 located South of the intersection of Sextant Ave. and Torch Blvd; TV-Northeast to manhole #122, also located on Torch Blvd.

**PIPE SIZE; TYPE:** 12" VCP - 3ft joints

**TAPE NO.:** #2 - Segment; "E"

**TECHNICIAN:** Juan Carlos Santiago

| DISTANCE READING | CLOCK REF POSITION | REMARKS / NOTES |
|---|---|---|
| 13.0 | - | Typical misaligned joint, probably caused by out of round pipe, but within tolerance at the time of installation. |
| 24.5 | 8:00 | Possible root intrusion, Root code "A" |
| 96.0to119.0 | - | Dip in line. |
| 135.0 | - | Shifted joint, Joint code "F" |
| 164.0to180.0 | - | Dip in line. |
| 195.9 | 2:00 | Longitudial crack between service and end of pipe, Crack code "A" |
| 196.0 | 2:00 | Live service connection, Lateral code "H" |
| 205.9 | 2:00 | Live service connection, Lateral code "H" |
| 220.0to224.3 | - | Build-up of debris in line ahead of camera. Removed |
| 222.0 | - | Clean pipe. |

(Continued)

| DISTANCE READING | CLOCK REF POSITION | REMARKS / NOTES |
|---|---|---|
| 234.3 | – | Typical misaligned joint; probably caused by out of round pipe, but within tolerance at the time of installation. |
| 238.3 | – | Back flow near end of line. |
| 242.0to246.0 | – | Buried manhole #121 |
| 243.0 | – | Reset TV |
| 243.0 | – | E.O.L. |

| M.H.# | FLOW | Through M.H.# | FLOW | M.H.# |
|---|---|---|---|---|
| 118 | Northeast | 121 | Northeast | 122 |
| | | | | See next sheet |
| Depth=5'7" | | Depth=5'11" | | Depth=7'2" |

**TOTAL FEET TELEVISED (243.0 ft)**

**COMMENTS:** Televised through manhole #121 which is buried.

# TELEVISION INSPECTION REPORT

**PROJECT:** Sanitary sewer inspection - Cannon Air Force Base; Clovis, New Mexico

**FOR:** Woodward-Clyde Consultant
4582 So. Ulster Parkway - Denver, CO

**PRINCIPAL:** Jeff Ehrenzeller, P.E.

**INSPECTION DATES:** October 19, 1991

**WEATHER:** Fair - moderate temperatures

**LOCATION:** Start at buried manhole #121, located in Torch Blvd, Northeast of Sextant Ave., TV Northeast to manhole #122 located in Torch Blvd; midway between Sextant Ave. and Arcadia Ave.

**PIPE SIZE; TYPE:** 12" VCP - 3ft joints

**TAPE NO.:** #2 - Segment; "F"

**TECHNICIAN:** Juan Carlos Santiago

| DISTANCE READING | CLOCK REF POSITION | REMARKS / NOTES |
|---|---|---|
| 17.5 | - | Typical misaligned joint; probably caused by out of round pipe, which was within tolerance at the time of installation. |
| 85.8 | 9:00 | Diagonal crack at joint. Crack code "A" |
| 130.1 | 3:00 | Longitudinal crack near service. Crack code "A" |
| 130.9 | 3:00 | Live service line, Lateral code "H" |
| 161.8 | 10:00 | Root intrusion, Root code "A" |
| 175.0 | - | Root intrusion at manhole |
| 178.0 | - | End T.V. |
| 178.0 | - | E.O.L. |

| M.H.# | FLOW | M.H.# |
|---|---|---|
| 121 Buried | Northeast | 122 |
| Depth=5'11" | with flow | Depth=7'2" |

**TOTAL FEET TELEVISED (178.0 ft)**

**COMMENTS:**

CCC

Specific Line Evaluation

Tape #2; Segment "F"

Manhole #121, to Manhole #122

Direction of TV-Northeast, with flow.

The photo-print shows a specific sewer pipe defect for this section of line. The most severe condition observed was usually selected for the photograph.

Photo shows a large amount of roots growing between the pipe and the face of the manhole. Approx. Sta. 175.0

This segment of line was constructed using 15" VC pipe. Roots have grown through the joints in several sections of pipe. Small cracks were observed at several joints.

CCC

# TELEVISION INSPECTION REPORT

**PROJECT:** Sanitary sewer inspection - Cannon Air Force Base; Clovis, New Mexico

**FOR:** Woodward-Clyde Consultant
4582 So. Ulster Parkway - Denver, CO

**PRINCIPAL:** Jeff Ehrenzeller, P.E.

**INSPECTION DATES:** October 20, 1991

**WEATHER:** Fair - moderate temperatures

**LOCATION:** Start at manhole #200A located near the operational apron, TV Southeast to manhole #201 located in operational apron.

**PIPE SIZE; TYPE:** 15" VCP - 3ft joints

**TAPE NO.:** #2 - Segment; "G"

**TECHNICIAN:** Juan Carlos Santiago

| DISTANCE READING | CLOCK REF POSITION | REMARKS / NOTES |
|---|---|---|
| 31.4 | 7:00 | Build-up in line. |
| 34.1 | - | Typical misaligned joint; probably caused by out of round pipe, but within tolerance at the time of installation. |
| 175.0to180.0 | - | Slight dip in line. |
| 250.0to260.0 | - | Slight dip in line. |
| 270.0to280.0 | - | Slight dip in line. |
| 291.9 | - | End T.V. |
| 292.0 | - | E.O.L. |

| M.H.# | FLOW | M.H.# |
|---|---|---|
| 200A | Southwest | 201 |
| Depth=13'4" | | Depth=12'0" |

**TOTAL FEET TELEVISED (292.0 ft)**

**COMMENTS:**

CCC

# TELEVISION INSPECTION REPORT

**PROJECT:** Sanitary sewer inspection - Cannon Air Force Base; Clovis, New Mexico

**FOR:** Woodward-Clyde Consultant
4582 So. Ulster Parkway - Denver, CO

**PRINCIPAL:** Jeff Ehrenzeller, P.E.

**INSPECTION DATES:** October 19, 1991

**WEATHER:** Fair - moderate temperatures

**LOCATION:** Start at manhole #201 located in the operational apron, TV Southeast to manhole #202 located in taxiway "A" near the operational apron.

**PIPE SIZE; TYPE:** 15" VCP - 3ft joints

**TAPE NO.:** #3 - Segment; "A"

**TECHNICIAN:** Juan Carlos Santiago

| DISTANCE READING | CLOCK REF POSITION | REMARKS / NOTES |
|---|---|---|
| 49.3 | - | Typical misaligned joint; probably caused by out of round pipe, but within tolerance at the time of installation. |
| 62.5 | 12:00 | False service connection. Lateral code "F" |
| 86.6 | 5:00 | Longitudinal crack, Crack code "B" |
| 86.6 | 9:00 | Longitudinal crack, Crack code "B" |
| 88.2 | 11:00to12:00 | Root intrusions, Root code "A" |
| 91.5 | 2:00 | Root intrusion, Root code "A" |
| 95.2 | 11:00to12:00 | Radial crack, Crack code "A" |
| 90.0to99.0 | - | Slight dip in line |
| 105.2 | - | Debris in bottom of pipe. |
| 124.3 | - | Debris in bottom of pipe. |
| 345.0to360.0 | - | Slight dip in line |
| 374.8 | 12:00 | Radial crack, Crack code "A" |
| 401.0 | 6:00to12:00 | Appears to be roots growing in line |
| 423.7 | 10:00 | Root intrusion, Root code "A" |
| 535.1 | 11:00to1:00 | Radial crack, Crack code "A" |
| 540.0to552.4 | - | Slight dip in line. |

(Continued)

| DISTANCE READING | CLOCK REF POSITION | REMARKS/NOTES |
|---|---|---|
| 594.7 | - | End T.V. |
| 596.0 | - | E.O.L. |

| M.H.# | FLOW | M.H.# |
|---|---|---|
| 201 | Southwest | 202 |
| Depth=12'0" | with flow | Depth=8'8" |

TOTAL FEET TELEVISED (596.0 ft)

COMMENTS:

CCC

Specific Line Evaluation

Tape #3; Segment "A"

Manhole #201, to Manhole #202

Direction of TV-Southeast, with flow.

The photo-print shows a specific sewer pipe defect for this section of line. The most severe condition observed was usually selected for the photograph.

Photo shows a small root intrusion through joint. Approx. Sta. 88.2

This segment of line was constructed using 15" VC pipe. Roots have grown through the joints in several sections of pipe. Also, small cracks were observed at several joints.

# TELEVISION INSPECTION REPORT

**PROJECT:** Sanitary sewer inspection - Cannon Air Force Base; Clovis, New Mexico

**FOR:** Woodward-Clyde Consultant
4582 So. Ulster Parkway - Denver, CO

**PRINCIPAL:** Jeff Ehrenzeller, P.E.

**INSPECTION DATES:** October 20, 1991

**WEATHER:** Fair - moderate temperatures

**LOCATION:** Start at manhole #202, located in taxiway "A" near the operational apron, TV Southeast to manhole #202A, located between taxiway "A" and Runway 4/22.

**PIPE SIZE; TYPE:** 15" VCP - 3ft joints

**TAPE NO.:** #3 - Segment; "B"

**TECHNICIAN:** Juan Carlos Santiago

| DISTANCE READING | CLOCK REF POSITION | REMARKS / NOTES |
|---|---|---|
| 19.0 | 11:00 | Possible blister of vitrified material. |
| 25.4 | - | Typical misaligned joint; probably caused by out of round pipe, but within tolerance at the time of installation. |
| 74.5 | 11:00 | Radial crack, crack code "A" |
| 90.1 | 11:00 | Radial crack, crack code "A" |
| 92.6 | 10:00 | Possible root intrusion. |
| 98.9 | 11:00to12:00 | Radial crack, crack code "A" |
| 102.7 | 10:00 | Longitudinal crack, crack code "B" |
| 102.7 | 1:00 | Longitudinal crack, crack code "A" |
| 105.5 | 10:00to11:00 | Both radial and longitudinal cracks, both code "A" |
| 111.1 | - | Typical misaligned joint; probably caused by out of round pipe, but within tolerance at the time of installation. |
| 132.6 | 1:00 | Longitudinal crack and radial crack, both code "A" |

(Continued)

| DISTANCE READING | CLOCK REF POSITION | REMARKS/NOTES |
|---|---|---|
| 138.8 | 8:00 | Radial crack, crack code "A" |
| 141.9 | 7:00 | Semi-circular crack, crack code "B" |
| 145.9 | 10:00to3:00 | Radial cracks, crack code "A" |
| 150.6 | - | Root intrusions through joint. |
| 151.0 | 11:00to1:00 | Radial crack, crack code "B" |
| 162.9 | - | Root intrusion, root code "A |
| 163.0 | 11:00to1:00 | Radial crack, crack code "A" |
| 169.6 | 2:00 | Root intrusion, root code "A" |
| 172.0 | 7:00 | Semi-circular crack, radial, crack code "A" |
| 203.2 | 8:00 | Longitudinal crack, crack code "A" and radial crack, crack code "B" |
| 206.4 | 1:00 | Radial crack, crack code "A" |
| 211.5 | - | Displaced joint where pipe changes from VCP to URC. |
| 218.0 | - | Note corrosion in crown of pipe. |
| 230.9 | - | Displaced joint where pipe changes from URC to VCP, also cracked joint crack code "D" |
| 232.9 | 10:00 | Radial crack, crack code "A" |
| 236.5 | - | Root intrusion, root code "A" |
| 244.7 | 10:00 | Root intrusion, root code "A" |
| 248.4 | 9:00 | Pie shaped crack, crack code "A" |
| 278.5 | 9:00to11:00 | Root intrusion through joint, root code "A". |
| 281.2 | 9:00to11:00 | Root intrusion through joint, root code "A" |
| 281.8 | 10:00to2:00 | Radial crack, crack code "A" |
| 284.3 | 9:00to1:00 | Root intrusion through joint, root code "A" |
| 287.6 | - | Root intrusion through joint, root code "A" |
| 290.6 | 3:00to5:00 | Radial crack, crack code "A" |
| 297.3 | 9:00to3:00 | A series of radial cracks and longitudinal cracks, code "A" |
| 299.4 | 12:00to2:00 | Radial crack, crack code "A" |
| 303.3 | 10:00to1:00 | Radial crack, crack code "A" |
| 306.6 | 7:00and2:00 | Radial cracks, crack code "A" |
| 310.1 | 2:00 | Longitudinal crack, crack code "A" |
| 310.1 | 11:00 | Radial crack, crack code "A" |
| 315.9 | 11:00to1.00 | Radial and longitudinal cracks, code "A" |
| 340.5 | 11:00 | Radial crack, crack code "A" |
| 355.2 | 11:00 | Longitudinal crack, crack code "A" |
| 358.3 | 9:00to11:00 | Radial crack, crack code "A" |
| 363.5 | 9:00to2:00 | Radial crack, crack code "A" |

(Continued)

| DISTANCE READING | CLOCK REF POSITION | REMARKS/NOTES |
|---|---|---|
| 370.0 | 9:00to12:00 | Radial crack, crack code "A" |
| 371.7 | 9:00 | Longitudinal crack, crack code "A" |
| 373.4 | 11:00 | Small radial crack, crack code "A" |
| 382.7 | 1:00 | Longitudinal crack, crack code "A" |
| 385.7 | 10:00to2:00 | Radial and longitudinal cracks, crack code "A" |
| 391.7 | - | End T.V. |
| 396.0 | - | E.O.L. |

| M.H.# | FLOW | M.H.# |
|---|---|---|
| 202 | Southeast | 202A |
| Depth=8'8" | | Depth=10'2" |

**TOTAL FEET TELEVISED (396.0 ft)**

**COMMENTS:** Additional root growth observed at stations 293.4; 297.2; 306.6; 310.1; 358.3; 364.1 and 382.7. Also a large number of joints showed between 45 degrees and 90 degrees of non-congruent connection.

CCC

Specific Line Evaluation

Tape #3; Segment "B"

Manhole #202, to Manhole #202A

Direction of TV-Southeast, with flow.

The photo-print shows a specific sewer pipe defect for this section of line. The most severe condition observed was usually selected for the photograph.

Photo shows a small amount of root growth and a radial crack in the crown of the pipe. Approx. Sta. 98.9

This segment of line was constructed using 15" VC pipe. Roots have grown through the joints in several sections of pipe. Also, small cracks were observed at several joints.

CCC

Specific Line Evaluation

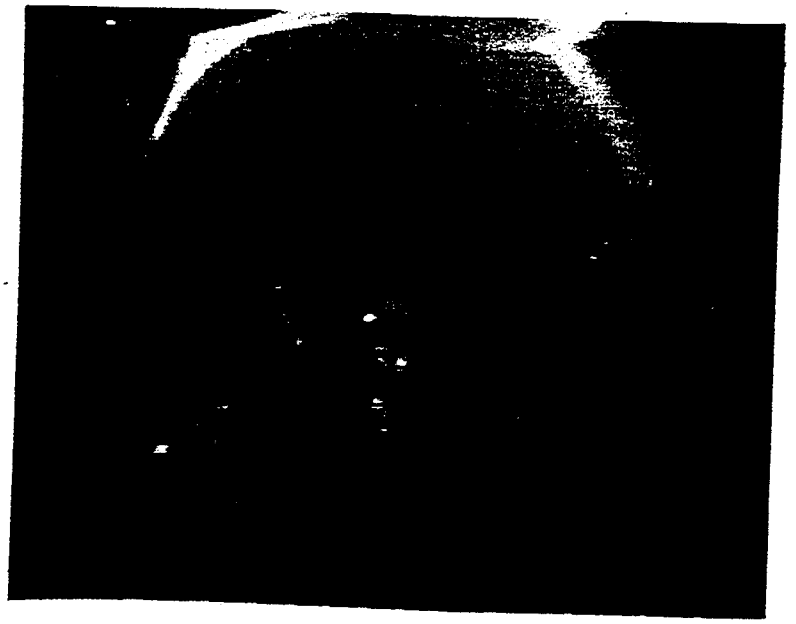
Tape #3; Segment "B"

Manhole #202, to Manhole #202A

Direction of TV-Southeast, with flow.

The photo-print shows a specific sewer pipe defect for this section of line. The most severe condition observed was usually selected for the photograph.

Photo shows condition of joint where the pipe changes from VCP to un-reinforced concrete pipe. Approx. Sta. 229.4



This segment of line was constructed using 15" URC and VC pipe. Roots have grown through a significant number of joints in this section of pipe. Also, small cracks were observed at nearly every joint.

# TELEVISION INSPECTION REPORT

**PROJECT:** Sanitary sewer inspection - Cannon Air Force Base; Clovis, New Mexico

**FOR:** Woodward-Clyde Consultant
4582 So. Ulster Parkway - Denver, CO

**PRINCIPAL:** Jeff Ehrenzeller, P.E.

**INSPECTION DATES:** October 21, 1991

**WEATHER:** Fair - moderate temperatures

**LOCATION:** Start at manhole #122, located on Torch Blvd approximately 421 ft. Northeast of the Sextant Ave. intersections, TV Northeast through manhole #138, to manhole #139, also located on Torch Blvd at the Arcadia Ave. intersection.

**PIPE SIZE; TYPE:** 15" VCP - 3ft joints

**TAPE NO.:** #4 - Segment; "A"

**TECHNICIAN:** Juan Carlos Santiago

| DISTANCE READING | CLOCK REF POSITION | REMARKS / NOTES |
|---|---|---|
| 4.7 | 11:00&5:00 | Root intrusion, root code "A" |
| 6.5 | 5:00 | Root intrusion, root code "A" |
| 12.1 | 7:00 | Root intrusion, root code "A" |
| 13.8 | - | Typical misaligned joint; probably caused by out of round pipe, but within tolerance at the time of installation. |
| 14.0 | 5:00 | Root intrusion through joint, root code "A" |
| 17.0 | - | Typical misaligned joint; probably caused by out of round pipe, but within tolerance at the time of installation. |
| 29.4to35.0 | 7:00 | It appears a section of the pipe glazing is missing. |
| 44.6 | 3:00 | Root intrusion through joint, root code "A" |

(Continued)

| DISTANCE READING | CLOCK REF POSITION | REMARKS/NOTES |
|---|---|---|
| 47.4 | 5:00to7:00 | Root intrusion through joint, root code "A" |
| 54.9 | 1:00 | Root intrusion through joint, root code "A" |
| 55.9 | 12:00 | Live service line, lateral code "H" |
| 60.2 | - | Radial crack, crack code "A" |
| 67.6to70.6 | 12:00 | Missing section in crown of pipe; crack code "H" cavity has been created. |
| 73.0 | 10:00 | Cracks at joint, crack code "A" |
| 85.4 | 2:00 | Root intrusion through joint, root code "A" |
| 87.8 | 10:00to2:00 | Root intrusion through joint, root code "A" |
| 132.9 | 1:00 | Live service line, lateral code "H" |
| 134.7 | 12:00 | Root intrusion through joint, root code "A" |
| 137.2 | 10:00 | Flaking of glazing material. |
| 138.3 | 3:00to5:00 | Typical misaligned joint; probably caused by out of round pipe, but within tolerance at the time of installation. |
| 159.9 | 5:00 | Root intrusion through joint, root code "A" |
| 185.9 | 9:00 | Root intrusion through joint, root code "A" |
| 189.6 | - | Pipe side wall deterioration. |
| 198.9 | 10:00 | Pipe deterioration |
| 201.6 | - | Joint separation |
| 203.8 | - | End T.V. |
| 204.0 | - | E.O.L. |

| M.H.# | | FLOW | M.H.# |
|---|---|---|---|
| 122 | Flow | Through 138 | To 139 |
| Depth=8'8" | Northeast | Depth=12'9" | Depth= |

**TOTAL FEET TELEVISED (204.0 ft) to manhole #138**

**COMMENTS:**

CCC

Specific Line Evaluation

Tape #4; Segment "A"

Manhole #122, to Manhole #138

Direction of TV-Northeast, with flow.

The photo-print shows a specific sewer pipe defect for this section of line. The most severe condition observed was usually selected for the photograph.

Photo shows a significant hole in the top of the pipe. Also, a cavity is being created around the opening. Note, the camera is upside down in this photograph. Approx. Sta. 67.6

This segment of line was constructed using 15" VC pipe. Roots have grown through several joints in this section of pipe.

CCC

# TELEVISION INSPECTION REPORT

**PROJECT:** Sanitary sewer inspection - Cannon Air Force Base; Clovis, New Mexico

**FOR:** Woodward-Clyde Consultant
4582 So. Ulster Parkway - Denver, CO

**PRINCIPAL:** Jeff Ehrenzeller, P.E.

**INSPECTION DATES:** October 21, 1991

**WEATHER:** Fair - moderate temperatures

**LOCATION:** Start at manhole #138, located on Torch Blvd 266 ft. Southwest of the Arcadia Ave. intersection, TV Northeast to manhole #139, also located on Torch Blvd at the Arcadia Ave. intersection.

**PIPE SIZE; TYPE:** 15" VCP - 3ft joints

**TAPE NO.:** #4 - Segment; "B"

**TECHNICIAN:** Juan Carlos Santiago

| DISTANCE READING | CLOCK REF POSITION | REMARKS / NOTES |
|---|---|---|
| 3.4 | - | Debris build-up on pipe walls. |
| 8.7 | 1:00 | Root intrusion through joint, root code "A" |
| 14.6 | 11:00 | Root intrusion through joint, root code "A" |
| 19.8 | 1:00&11:00 | Debris build-up in joint, debris code "D" |
| 23.1 | 1:00&11:00 | Debris build-up in joint, debris code "D" |
| 26.8 | 1:00&11:00 | Debris build-up in joint, debris code "D" |
| 110.0 | 8:00 | Root intrusion through joint, root code "A" |
| 147.9 | 12:00 | Live service line, lateral code "H" |
| 200.4 | 12:00 | Live service line, lateral code "H" |
| 265.9 | - | End T.V. |
| 266.0 | - | E.O.L. |

| M.H.# | FLOW | M.H.# |
| --- | --- | --- |
| 138 | Northeast | 139 |
| Depth=12'9" | | Depth=10'9" |

TOTAL FEET TELEVISED (266.0 ft)

COMMENTS: A grease and debris build-up was evident at every joint between 26ft and 99ft.

CCC

Specific Line Evaluation

Tape #4; Segment "E"

Manhole #138, to Manhole #139

Direction of TV-Northeast, with flow.

The photo-print shows a specific sewer pipe defect for this section of line. The most severe condition observed was usually selected for the photograph.

Photo shows a typical deposit of debris attached to the crown of the pipe and joint. Approx. Sta. 22.9

This segment of line was constructed using 15" VC pipe. Roots have grown through several joints in this section of pipe. Also, debris build-up was evident between stations 19.0 and 27.0.

# TELEVISION INSPECTION REPORT

**PROJECT:** Sanitary sewer inspection - Cannon Air Force Base; Clovis, New Mexico

**FOR:** Woodward-Clyde Consultant
4582 So. Ulster Parkway - Denver, CO

**PRINCIPAL:** Jeff Ehrenzeller, P.E.

**INSPECTION DATES:** October 22, 1991

**WEATHER:** Fair - moderate temperatures

**LOCATION:** Start at manhole #139, located on Torch Blvd. at the intersection with Arcadia Ave., TV Northeast to manhole #148, also located on Torch Blvd. at the intersection with Eureka St.

**PIPE SIZE; TYPE:** 15" VCP - 3ft joints

**TAPE NO.:** #4 - Segment; "C"

**TECHNICIAN:** Juan Carlos Santiago

| DISTANCE READING | CLOCK REF POSITION | REMARKS / NOTES |
|---|---|---|
| 0.0 | Top of pipe | Debris build-up |
| 39.2 | Top of pipe | Debris build-up |
| 62.2 | - | Live service line, lateral code "H" |
| 71.7 | 1:00to5:00 | Typical misaligned joint; probably caused by out of round pipe, but within tolerance at the time of installation. |
| 90.0-92.0 | 1:00 | Slight build-up of debris in crown of pipe. |
| 108.0-111.0 | 1:00 | Slight build-up of debris in crown of pipe. |
| 118.0-155.0 | - | Slight dip in line. |
| 139.8 | 9:00 | Radial and longitudinal crack in pipe at joint, crack code "A". |
| 167.0-175.0 | - | Slight dip in line. |
| 197.4 | 8:00 | Diagonal crack at joint, crack code "A". |
| 236.2to245.2 | - | Slight dip in line, also some build-up of debris. |

(Continued)

| DISTANCE READING | CLOCK REF POSITION | REMARKS/NOTES |
|---|---|---|
| 247.0to273.0 | - | Build-up in crown of pipe, debris codes "D" & "F". |
| 273.3 | 10:00to12:00 | Radial crack near joint, crack code "A". |
| 277.0to288.0 | - | Slight dip in line. |
| 292.3 | 1:00 | Live service line, lateral code "H" |
| 312.5 | - | Typical misaligned joint; probably caused by out of round pipe, but within tolerance at the time of installation. |
| 333.0 | 12:00 | Live service line, lateral code "H" |
| 362.3 | 1:00 | Root intrusion, root code "A". |
| 366.1 | 12:00 | False service connection. |
| 370.4 | - | End T.V. |
| 372.0 | - | E.O.L. |

**M.H.#** 139 Depth=10'9"

**FLOW**

**M.H.#** 148 Depth=12'9"

**TOTAL FEET TELEVISED (372.5 ft)**

**COMMENTS:** As the line increases in length, the build-up decreases.

CCC

Specific Line Evaluation

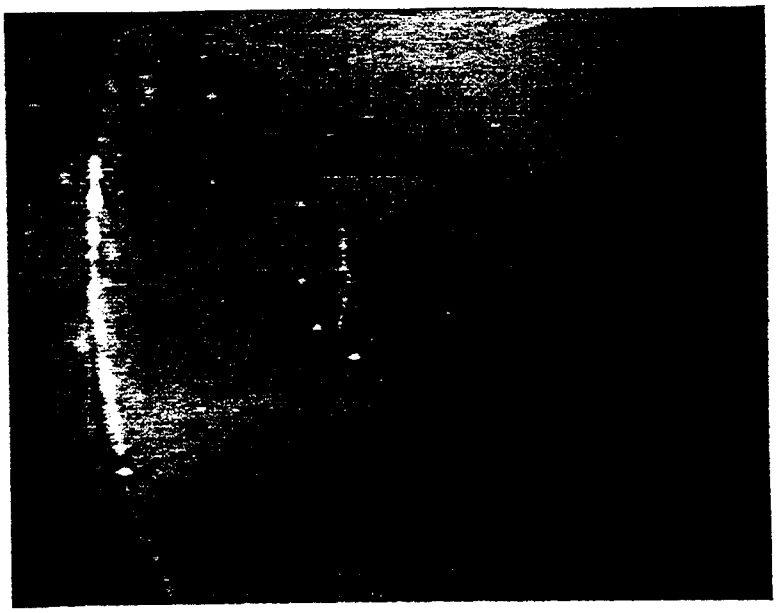
Tape #4; Segment "C"

Manhole #139, to Manhole #148

Direction of TV-Northeast, with flow.

The photo-print shows a specific sewer pipe defect for this section of line. The most severe condition observed was usually selected for the photograph.

Photo shows both radial and longitudinal cracks in the bell of the pipe. Approx. Sta. 139.8



This segment of line was constructed using 15" VC pipe. Also, small cracks were observed at several joints.

CCC

# TELEVISION INSPECTION REPORT

**PROJECT:** Sanitary sewer inspection - Cannon Air Force Base; Clovis, New Mexico

**FOR:** Woodward-Clyde Consultant
4582 So. Ulster Parkway - Denver, CO

**PRINCIPAL:** Jeff Ehrenzeller, P.E.

**INSPECTION DATES:** October 22, 1991

**WEATHER:** Fair - moderate temperatures

**LOCATION:** Start at manhole #148, located on Torch Blvd. at the intersection with Eureka St., TV Northwest to manhole #156, also located on Torch Blvd. at the intersection with Casablanca Ave.

**PIPE SIZE; TYPE:** 15" VCP - 3ft joints

**TAPE NO.:** #4 - Segment; "D"

**TECHNICIAN:** Juan Carlos Santiago

| DISTANCE READING | CLOCK REF POSITION | REMARKS / NOTES |
|---|---|---|
| 0.0 | 12:00 | Radial crack, crack code "A"; Roots, root code "A" |
| 2.4 | 9:00 | Radial crack, crack code "A" |
| 9.1 | 3:00 | Root intrusion, root code "A" |
| 20.1 | 3:00 | Protruding live service line, code "A"; lateral code "H". |
| 48.4 | 11:00 | Longitudinal crack, crack code "A". |
| 53.0 | 12:00 | Blemish in pipe at joint. |
| 62.0to67.0 | 11:00to1:00 | Grease build-up in crown of pipe, debris code "F". |
| 72.4 | 3:00 | Root intrusion, root code "A". |
| 72.4 | 2:00to5:00 | Typical misaligned joint; probably caused by out of round pipe, but within tolerance at the time of installation. |
| 72.9 | 2:00to4:00 | Longitudinal and radial cracks, crack code "A" & "B". |
| 75.8 | 2:00 | Longitudinal and radial cracks, crack code "A". |

(Continued)

CCC

| DISTANCE READING | CLOCK REF POSITION | REMARKS/NOTES |
|---|---|---|
| 78.9 | 10:00to2:00 | Longitudinal and radial cracks, crack code "A" |
| 81.8 | 10:00to2:00 | Longitudinal and radial cracks, crack code "A" |
| 100.2 | 11:00to3:00 | Radial crack, crack code "A" |
| 100.2 | 11:00 | Longitudinal crack, crack code "A". |
| 103.3 | 9:00to3:00 | Radial crack, crack code "A". |
| 128.3 | 12:00 | Possible hole in pipe; grease build-up |
| 130.0to160.0 | 11:00to1:00 | Degrees of grease build-p. |
| 180.6 | 12:00 | Live service line, lateral code "H", grease build-up. |
| 216.9 | 3:00 | Longitudinal crack, crack code "B". |
| 218.3 | 3:00 | Live service line, lateral code "H". |
| 218.5 | 3:00 | Longitudinal crack, from service line, crack code "A". |
| 260.0to270.0 | Crown | Grease build-up, debris code "D". |
| 290.0to310.0 | Crown | Grease build-up, debris code "D". |
| 320.0 | 3:00 | Live service line, lateral code "H". |
| 321.8 | - | See next tape #5 |
| 347.9to355.0 | Crown | Grease build-up, debris code "F". |
| 406.5 | - | End T.V. |
| 410.0 | - | E.O.L. |

**M.H.#** 148
Depth=12'9"

**FLOW**

**M.H.#** 156
Depth=12'9"

**TOTAL FEET TELEVISED (410.0 ft)**

**COMMENTS:**

CCC

Specific Line Evaluation

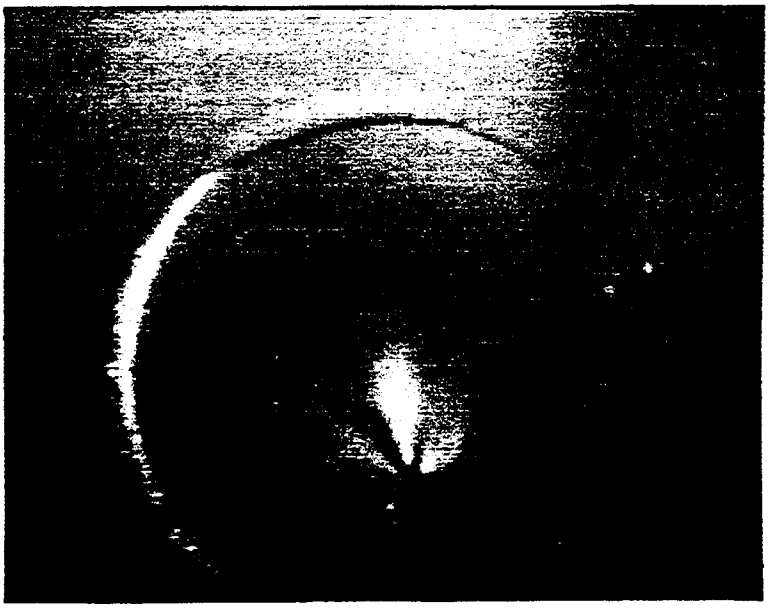
Tape #4; Segment "D"

Manhole #148, to Manhole #156

Direction of TV-Northwest, with flow.

The photo-print shows a specific sewer pipe defect for this section of line. The most severe condition observed was usually selected for the photograph.

Photo shows a blemish in the crown of the pipe.
Approx. Sta. 53.3



This segment of line was constructed using 15" VC pipe. Roots have grown through a few joints in this section of pipe. Also, small cracks were observed at several joints.

CCC

# TELEVISION INSPECTION REPORT

**PROJECT:** Sanitary sewer inspection - Cannon Air Force Base; Clovis, New Mexico

**FOR:** Woodward-Clyde Consultant
4582 So. Ulster Parkway - Denver, CO

**PRINCIPAL:** Jeff Ehrenzeller, P.E.

**INSPECTION DATES:** October 24, 1991

**WEATHER:** Fair - moderate temperatures

**LOCATION:** Start at manhole #156, located on Torch Blvd. at the intersection with Casablanca, TV Northeast to manhole #159, also located on Torch Blvd., between Argentina and Casablanca intersections.

**PIPE SIZE; TYPE:** 15" VCP - 3ft joints

**TAPE NO.:** #5 - Segment; "A"

**TECHNICIAN:** Juan Carlos Santiago

| DISTANCE READING | CLOCK REF POSITION | REMARKS / NOTES |
|---|---|---|
| 00.0to7.6 | Crown | Some grease build-up in crown of pipe. |
| 7.9 | 9:00 | Root intrusion, root code "A". |
| 14.1 | 9:00 | Root intrusion, root code "A". |
| 23.2 | 3:00 | Root intrusion, root code "A". |
| 31.1 | 9:00 | Typical misaligned joint; probably caused by out of round pipe, but within tolerance at the time of installation. |
| 50.9 | 3:00&9:00 | Root intrusion, root code "A". |
| 72.1 | 10:00 | Root intrusion, root code "A". |
| 73.9 | 12:00 | Live service line, lateral code "H". |
| 78.8 | 12:00 | Grease build-up, debris code "D". |
| 111.8 | 12:00 | Appears to be a false service connection, lateral code "F". |
| 124.0 | 4:00 | Root intrusion, root code "A". |
| 157.0 | 12:00 | Grease build-up around service line. |
| 158.3 | 12:00 | Live service line, lateral code "H". Broken pipe-slight protrusion. |
| 161.5 | 3:00 | Radial crack, crack code "A". |

(Continued)

| DISTANCE READING | CLOCK REF POSITION | REMARKS/NOTES |
|---|---|---|
| 175.5 | 12:00 | U-shaped crack, crack code "B". Piece of pipe missing. |
| 234.3 | 12:00 | Grease build-up, debris code "F". |
| 246.0 | 12:00 | Grease build-up, debris code "F". |
| 325.0 | 12:00 | Grease build-up, debris code "D". |
| 383.8 | - | End T.V. |
| 384.0 | - | E.O.L. |

**M.H.#** 156
Depth=12'9"

**FLOW**

**M.H.#** 159
Depth=14'0"

**TOTAL FEET TELEVISED (384.0 ft)**

**COMMENTS:**

CCC

Specific Line Evaluation

Tape #5; Segment "A"

Manhole #156, to Manhole #159

Direction of TV-Northeast, with flow.

The photo-print shows a specific sewer pipe defect for this section of line. The most severe condition observed was usually selected for the photograph.

Photo shows a live house service lateral with broken pipe at connection. Approx. Sta. 158.3

This segment of line was constructed using 15" VC pipe. Roots have grown through the joints at several sections of pipe. Also, there was debris build-up in this line segment.

CCC

# TELEVISION INSPECTION REPORT

**PROJECT:** Sanitary sewer inspection - Cannon Air Force Base; Clovis, New Mexico

**FOR:** Woodward-Clyde Consultant
4582 So. Ulster Parkway - Denver, CO

**PRINCIPAL:** Jeff Ehrenzeller, P.E.

**INSPECTION DATES:** October 24, 1991

**WEATHER:** Fair - moderate temperatures

**LOCATION:** Start at manhole #159, located on Torch Blvd. between Argentia and Casablanca, intersections, TV Northeast to manhole #199, also located on Torch Blvd., at the intersection with Argentia.

**PIPE SIZE; TYPE:** 15" VCP - 3ft joints

**TAPE NO.:** #5 - Segment; "B"

**TECHNICIAN:** Juan Carlos Santiago

| DISTANCE READING | CLOCK REF POSITION | REMARKS / NOTES |
|---|---|---|
| 4.6 | - | Typical misaligned joint; probably caused by out of round pipe, but within tolerance at the time of installation. |
| 7.0to11.0 | 11:00to1:00 | Appears to be some pitting in the crown of pipe. |
| 34.0to90.0 | - | Grease build-up, debris codes "A" and "B". |
| 42.8 | 1:00 | Longitudinal crack, crack code "A". |
| 49.0 | 9:00 | Radial crack, crack code "A". |
| 67.6 | 12:00 | Live service line, lateral code "H". |
| 87.1 | 12:00 | Live service line, protruding, lateral code "B". |
| 92.1 | 12:00 | Live service line, lateral code "B". |
| 99.0to108.0 | 12:00 | Grease build-up, debris code "B". |
| 152.7 | 12:00 | Live service line, lateral code "A". |
| 187.6 | 12:00 | Live service line, protruding, lateral code "B". |
| 194.0to204.0 | 12:00 | Grease build-up debris code "A". |
| 235.0to247.0 | - | Dip in line. |

(Continued)

| DISTANCE READING | CLOCK REF POSITION | REMARKS/NOTES |
|---|---|---|
| 300.2 | 12:00 | Live service line, lateral code "H". |
| 304.0to324.0 | - | Dip in line. |
| 332.1 | - | End T.V. |
| 332.5 | - | E.O.L. |

| M.H.# | FLOW | M.H.# |
|---|---|---|
| 159 | Northeast | 199 |
| Depth=14'0" | | Depth=13'9" |

TOTAL FEET TELEVISED (332.0 ft)

COMMENTS: Grease build-up of varying degrees throughout the entire line.

Specific Line Evaluation

Tape #5; Segment "B"

Manhole #159. to Manhole #199

Direction of TV-Northeast. with flow.

The photo-print shows a specific sewer pipe defect for this section of line. The most severe condition observed was usually selected for the photograph.

Photo shows
some deterioration
of the pipe
in the crown.
Approx. Sta. 10.6

This segment of line was constructed using 15" VC pipe.
Two joints of pipe showed deteriorating in the crown.

CCC

# TELEVISION INSPECTION REPORT

**PROJECT:** Sanitary sewer inspection - Cannon Air Force Base; Clovis, New Mexico

**FOR:** Woodward-Clyde Consultant
4582 So. Ulster Parkway - Denver, CO

**PRINCIPAL:** Jeff Ehrenzeller, P.E.

**INSPECTION DATES:** October 25, 1991

**WEATHER:** Fair - moderate temperatures

**LOCATION:** Start at manhole #203A, located East of runway 22 near the aircraft parking areas, TV Southeast to manhole #204, located between parking apron and lagoon.

**PIPE SIZE; TYPE:** 15" VCP - 3ft joints

**TAPE NO.:** #6 - Segment; "A"

**TECHNICIAN:** James Varnell

| DISTANCE READING | CLOCK REF POSITION | REMARKS / NOTES |
|---|---|---|
| 00.0 | 5:00 | Diagonal crack, crack code "A". |
| 3.0 | 10:00 | Crack at first joint, crack code "A" |
| 6.2 | - | Joint separation, radial and longitudinal crack, crack code "A". |
| 15.2 | 7:00 | Radial crack, crack code "A", joint separation. |
| 18.6 | 7:00 | Diagonal crack, crack code "A". |
| 27.0 | 3:00 | Longitudinal crack, crack code "A". |
| 34.9 | - | Typical misaligned joint; probably caused by out of round pipe, but within tolerance at the time of installation. |
| 36.3 | 4:00 | Radial crack, crack code "A". |
| 48.3 | - | Offset joint |
| 63.8 | - | Root intrusion through joint, root code "A"; also blemish at joint. |
| 69.7 | - | Offset joint - See comments |
| 112.7 | 8:00 | Longitudinal crack, crack code "A". |
| 118.2 | 9:00 | Root intrusion, root code "A". |
| 140.0 | 7:00 | Diagonal crack, crack code "A". |

(Continued)

| DISTANCE READING | CLOCK REF POSITION | REMARKS/NOTES |
|---|---|---|
| 158.6 | 7:00 | Radial crack, crack code "A". |
| 159.0 | 5:00 | Radial crack, crack code "A". |
| 168.6 | 7:00&5:00 | Radial cracks, crack code "A". |
| 194.9 | 5:00 | Radial crack, crack code "A". |
| 200.9 | 5:00 | Radial crack, crack code "A". |
| 225.3 | 9:00 | Diagonal crack, crack code "A". |
| 265.3 | 9:00 | Radial crack, crack code "A", blemish on side of pipe. |
| 306.9 | 9:00 | V-shaped crack, crack code "A". |
| 312.6 | 12:00 | Longitudinal crack, crack code "A". |
| 315.5to318.8 | 12:00 | Longitudinal crack, crack code "C", joint to joint. |
| 318.8 | 12:00 | Longitudinal crack, crack code "C". |
| 319.3to321.7 | 9:00 | Longitudinal crack, crack code "C", joint to joint. |
| 339.6 | 3:00 | V-shaped crack at joint, crack code "A". |
| 351.5 | 12:00 | Longitudinal crack from joint, crack code "A", some roots. |
| 352.0 | 7:00 | Longitudinal crack from joint, crack code "A", some roots. |
| 355.1 | 3:00 | Radial crack, crack code "A". |
| 370.3 | 11:00to1:00 | Longitudinal cracks from joint, crack code "A". |
| 382.4 | 2:00 | Longitudinal cracks from joint, crack code "A". |
| 388.8 | 1:00 | Longitudinal crack from joint, crack code "C". |
| 406.1 | 11:00to2:00 | Longitudinal crack from joint, crack code "A". |
| 442.6 | 12:00 | Longitudinal crack from joint, crack code "A". |
| 445.8 | 10:00to1:00 | Longitudinal crack from joint, crack code "A". |
| 448.3 | 1:00 | Longitudinal crack from joint, crack code "A". |
| 452.2 | 11:00to12:00 | Longitudinal crack from joint, crack code "A". |
| 454.9 | 12:00 | Longitudinal crack from joint, crack code "A", joint to joint. |
| 458.1 | 12:00 | Longitudinal crack from joint, crack code "A". |
| 463.0 | 12:00 | Root intrusion, root code "A". |
| 466.9 | 11:00 | Longitudinal crack from joint, crack code "A". |
| 469.9 | 12:00 | Root intrusion, root code "A". |

(Continued)

| DISTANCE READING | CLOCK REF POSITION | REMARKS/NOTES |
|---|---|---|
| 470.0 | 11:00 | Longitudinal crack from joint, crack code "A". |
| 475.9 | 10:00to12:00 | Longitudinal crack from joint, crack code "A", joint to joint. |
| 479.2 | 11:00to1:00 | Longitudinal crack from joint, crack code "A". |
| 484.9 | 1:00 | Longitudinal crack from joint, crack code "A", joint to joint. |
| 487.9 | 12:00 | Longitudinal crack from joint, crack code "A". |
| 487.9 | 12:00to2:00 | Radial crack, crack code "A". |
| 488.8 | 12:00 | Longitudinal crack from joint, crack code "A". |
| 490.7 | 12:00 | Longitudinal crack from joint, crack code "A", joint to joint. |
| 500.5 | - | End T.V. |
| 503.5 | - | E.O.L. |

| M.H.# | FLOW | M.H.# |
|---|---|---|
| 203A | Southeast | 204 |
| Depth=5'6" | | Depth=2'6" |

**TOTAL FEET TELEVISED (503.5 ft)**

**COMMENTS:** Several off-set and misaligned joints were evident throughout the line segment.

CCC

Specific Line Evaluation

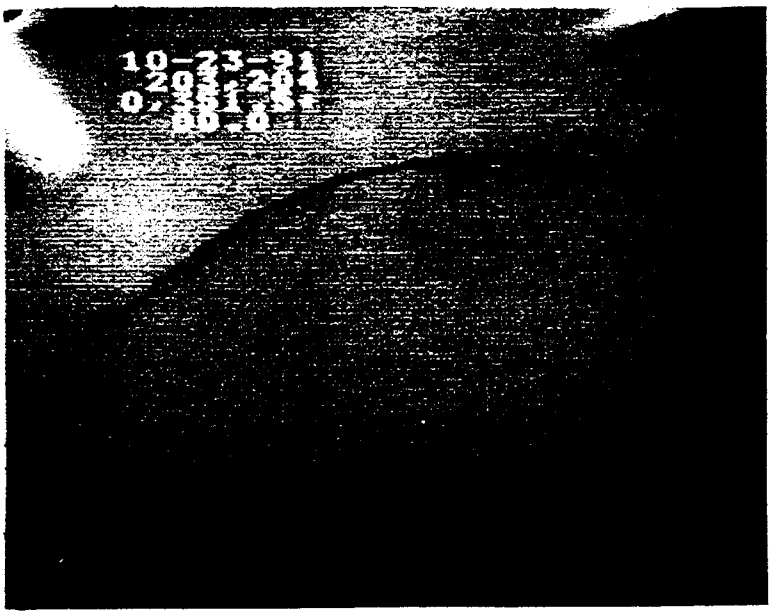
Tape #6; Segment "A"

Manhole #203A, to Manhole #204

Direction of TV-Southeast, with flow.

The photo-print shows a specific sewer pipe defect for this section of line. The most severe condition observed was usually selected for the photograph.

Photo shows a small amount of root intrusion and a longitudinal crack at 12:00. Approx. Sta. 351.5




This segment of line was constructed using 15" VC pipe. Roots have grown through the joints in several sections of pipe. Also, small cracks were evident at almost every joint.

# TELEVISION INSPECTION REPORT

**PROJECT:** Sanitary sewer inspection - Cannon Air Force Base; Clovis, New Mexico

**FOR:** Woodward-Clyde Consultant
4582 So. Ulster Parkway - Denver, CO

**PRINCIPAL:** Jeff Ehrenzeller, P.E.

**INSPECTION DATES:** October 26, 1991

**WEATHER:** Fair - moderate temperatures

**LOCATION:** Start at manhole #204, located between aircraft parking apron and the lagoon, TV Southeast to manhole #205, located at the lagoon site.

**PIPE SIZE; TYPE:** 15" VCP - 3ft joints

**TAPE NO.:** #6 - Segment; "B"

**TECHNICIAN:** James Varnell

| DISTANCE READING | CLOCK REF POSITION | REMARKS / NOTES |
|---|---|---|
| 7.1 | 5:00 | V-shaped crack at joint, crack code"A". |
| 9.8 | 9:00 | Possible root growth, root code "A". |
| 12.9 | 12:00 | Possible root growth, root code "A". |
| 16.0 | 1:00 | Small crack, crack code "A". |
| 22.6 | 7:00 | Longitudinal crack at joint, crack code "A". |
| 37.0 | 7:00to11:00 | V-shaped crack at joint, crack code "A". |
| 37.0 | 12:00to3:00 | Small longitudinal cracks, crack code "A". |
| 58.7 | 3:00to5:00 | V-shaped crack, crack code "B". |
| 58.7 | 9:00 | Radial crack, crack code "A". |
| 65.2 | 7:00 | Longitudinal crack at joint, crack code "A". |
| 73.8 | 12:00 | Longitudinal crack at joint, crack code "A". |
| 83.0 | 9:00to3:00 | Longitudinal crack at joint, crack code "A". |

(Continued)

| DISTANCE READING | CLOCK REF POSITION | REMARKS/NOTES |
|---|---|---|
| 104.6 | 10:00to1:00 | Longitudinal crack at joint, crack code "A". |
| 107.3 | 12:00 | Longitudinal crack at joint, crack code "A". |
| 110.3 | 11:00 | Longitudinal crack at joint, crack code "A". |
| 113.5 | 1:00 | Longitudinal crack at joint, crack code "A". |
| 140.9 | 9:00 | Longitudinal crack at joint, crack code "A". |
| 161.9 | 12:00 | Possible root intrusion, root code "A". |
| 170.2 | 12:00 | Typical misaligned joint; probably caused by out of round pipe, but within tolerance at the time of installation. |
| 189.8 | 11:00 | Longitudinal crack at joint, crack code "A". |
| 195.9 | 4:00 | Radial crack, crack code "A". |
| 199.0 | 11:00 | Longitudinal crack at joint, crack code "A". |
| 204.9 | 1:00&3:00 | Longitudinal crack at joint, crack code "A". |
| 205.3 | 7:00 | Piece of pipe missing at joint. |
| 208.1 | 9:00 | Radial crack, crack code "A". |
| 226.8 | 7:00 | Longitudinal crack at joint, crack code "A". |
| 229.4 | 12:00 | Longitudinal crack at joint, crack code "A". |
| 232.4 | 4:00 | Radial crack, crack code "A". |
| 235.8 | 7:00 | Longitudinal crack at joint, crack code "A". |
| 238.6 | 7:00 | Longitudinal and radial cracks at joint, crack code "A". |
| 241.7 | 12:00 | Longitudinal crack at joint, crack code "A". |
| 243.5 | 4:00 | Piece of pipe missing, cavity being created. |
| 244.8 | 9:00 | Small radial crack, crack code "A". |
| 244.9 | 4:00 | Longitudinal crack at joint, crack code "A". |
| 248.0 | 7:00 | Longitudinal crack at joint, crack code "A". |
| 248.0 | 12:00&3:00 | Longitudinal crack at joint, crack code "A". |

(Continued)

| DISTANCE READING | CLOCK REF POSITION | REMARKS/NOTES |
|---|---|---|
| 250.8 | 12:00 | Longitudinal crack at joint, crack code "A". |
| 253.9 | 11:00&1:00 | Longitudinal crack at joint, crack code "A". |
| 253.9 | 3:00 | Longitudinal crack at joint, crack code "A". |
| 257.1 | 9:00 | Radial crack, crack code "A". |
| 257.1 | 1:00 | Longitudinal crack at joint, crack code "A". |
| 260.2 | 5:00to7:00 | V-shaped crack at bottom of pipe, crack code "B". |
| 263.1 | 1:00 | Plugged service line and missing pipe. |
| 263.1 | 5:00 | Radial crack, crack code "A". |
| 265.4 | 5:00 | Root intrusion, possible growth from old service area. |
| 269.4 | 9:00 | V-shaped crack, crack code "A". |
| 269.4 | 12:00&7:00 | Radial and longitudinal crack at joint, crack code "A". |
| 272.5 | 12:00to1:00 | V-shaped crack, crack code "A". |
| 275.4 | 7:00to5:00 | V-shaped crack, crack code "B". |
| 275.4 | 11:00 | Longitudinal crack, crack code "A". |
| 280.3 | - | Typical misaligned joint; probably caused by out of round pipe, but within tolerance at the time of installation. |
| 284.6 | 1:00 | Longitudinal crack at joint, crack code "A". |
| 290.9 | 9:00 | Radial crack near joint, crack code "A". |
| 306.1 | 5:00 | Radial crack near joint, crack code "A". |
| 312.3 | 9:00to6:00 | V-shaped crack, crack code "A". |
| 315.5 | 3:00 | Small radial crack, crack code "A". |
| 324.6 | 8:00,5:00,1:00 | Longitudinal cracks at joint, crack code "A". |
| 327.7 | 9:00 | Longitudinal crack at joint, crack code "A". |
| 339.9 | 7:00 | Longitudinal crack at joint, crack code "A". |
| 342.9 | 9:00to6:00 | Radial crack at bottom of pipe, crack code "A". |
| 342.9 | 12:00&3:00 | Longitudinal crack at joint, crack code "A". |
| 346.0 | 5:00to8:00 | V-shaped crack at bottom of pipe, crack code "A". |

(Continued)

| DISTANCE READING | CLOCK REF POSITION | REMARKS/NOTES |
|---|---|---|
| 349.0 | 4:00,10:00,1:00 | Longitudinal crack at joint, crack code "A". |
| 385.6 | 10:00 | Radial crack, crack code "A". |
| 388.9 | 8:00 | Radial crack, crack code "A". |
| 388.9 | 5:00 | Longitudinal crack at joint, crack code "A". |
| 395.2 | 5:00 | Longitudinal crack at joint, crack code "A". |
| 398.0 | 10:00 | Radial crack, crack code "A". |
| 398.0 | 5:00 | Missing piece of pipe at joint. |
| 401.1 | 7:00 | Longitudinal crack from joint, crack code "A". |
| 407.1 | 9:00 | Longitudinal crack from joint, crack code "A". |
| 409.9 | 5:00 | Longitudinal crack from joint, crack code "A". |
| 440.8 | 6:00to10:00 | V-shaped crack, crack code "B". |
| 455.0 | - | End T.V. |
| 457.1 | - | E.O.L. |

**M.H.#** 204
Depth=2'5"

**FLOW**
Southeast

**M.H.#** 205
Depth=2'5"

**TOTAL FEET TELEVISED (457.1 ft)**

**COMMENTS:**

CCC

Specific Line Evaluation

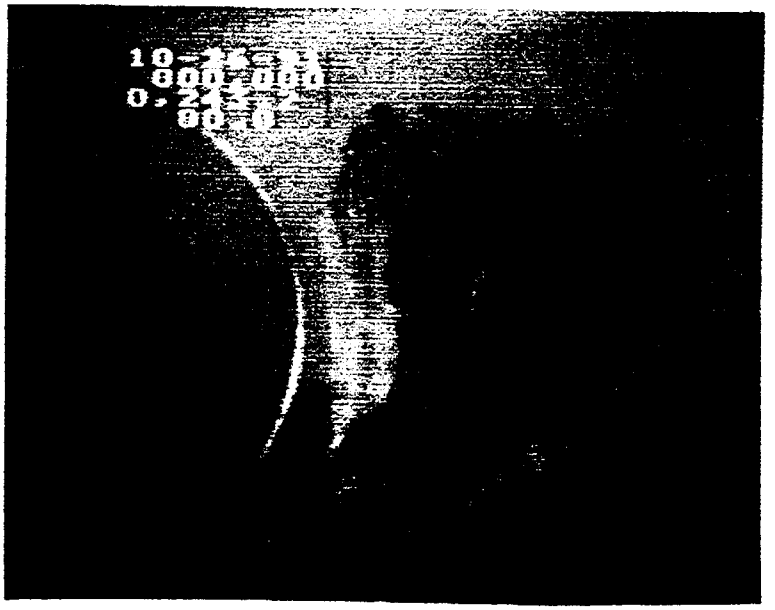
Tape #6; Segment "B"

Manhole #204, to Manhole #205

Direction of TV-Southeast, with flow.

The photo-print shows a specific sewer pipe defect for this section of line. The most severe condition observed was usually selected for the photograph.

Photo shows a missing piece of pipe. Also, note the cavity being created by subsidence. Approx. Sta. 243.2



This segment of line was constructed using 15" VC pipe. There were several "V" shaped cracks at the joints. This shape of crack can result in loss of pipe as shown.

CCC

Specific Line Evaluation

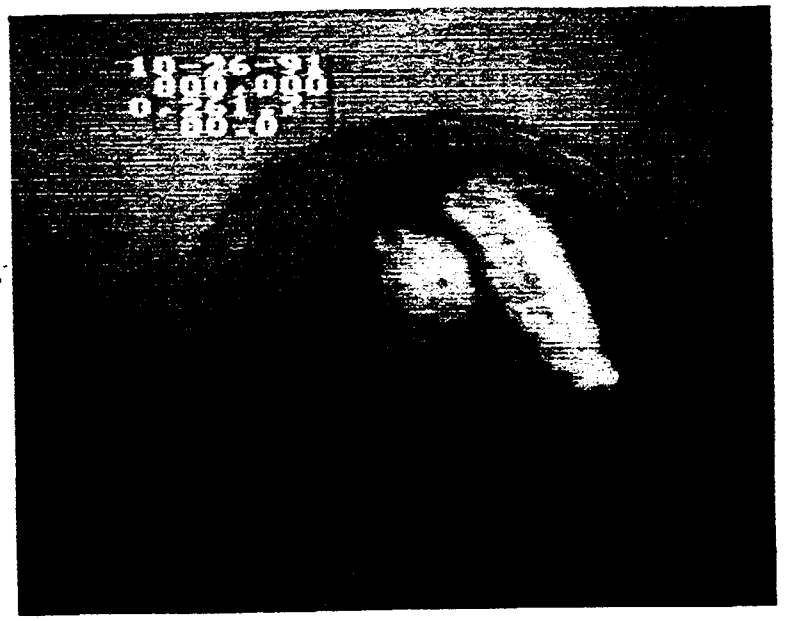
Tape #6; Segment "B"

Manhole #204, to Manhole #205

Direction of TV-Southeast, with flow.

The photo-print shows a specific sewer pipe defect for this section of line. The most severe condition observed was usually selected for the photograph.

Photo shows an existing service line connection that appears to be plugged with concrete. Note the protrusion in the line. Approx. Sta. 261.7




This segment of line was constructed using 15" VC pipe. There were several "V" shaped cracks at the joints. This shape of crack can result in loss of pipe as shown.

CCC

# TELEVISION INSPECTION REPORT

**PROJECT:** Sanitary sewer inspection - Cannon Air Force Base; Clovis, New Mexico

**FOR:** Woodward-Clyde Consultant
4582 So. Ulster Parkway - Denver, CO

**PRINCIPAL:** Jeff Ehrenzeller, P.E.

**INSPECTION DATES:** October 27, 1991

**WEATHER:** Fair - moderate temperatures

**LOCATION:** Start at manhole #202A, located between Taxiway "A" and Runway 22/4, TV Southeast to manhole #203, located approximately 550ft. Southeast of the center line of runway 22/4.

**PIPE SIZE; TYPE:** 15" VCP - 3ft joints

**TAPE NO.:** #6A - Segment; "A"

**TECHNICIAN:** Juan Carlos Santiago

| DISTANCE READING | CLOCK REF POSITION | REMARKS / NOTES |
|---|---|---|
| 3.0 | 3:00 | Radial crack, crack code "A". |
| 5.0&5.7 | 5:00 | Radial crack, crack code "A". |
| 10.8 | 9:00 | Radial crack, crack code "A". |
| 13.7 | 5:00 | Longitudinal crack from joint, crack code "A". |
| 23.3 | 8:00 | Longitudinal crack from joint, crack code "A". |
| 32.5 | - | Typical misaligned joint; probably caused by out of round pipe, but within tolerance at the time of installation. |
| 32.5 | 3:00&9:00 | Longitudinal crack from joint, crack code "A". |
| 41.6 | 3:00 | V-shaped crack, crack code "A". |
| 57.0 | 4:00 | Longitudinal crack from joint, crack code "A". |
| 60.4 | 12:00 | Small radial crack, crack code "A". |
| 69.4 | 6:00 | V-shaped crack, crack code "A". |

(Continued)

| DISTANCE READING | CLOCK REF POSITION | REMARKS/NOTES |
|---|---|---|
| 94.2 | 5:00 | Longitudinal crack from joint, crack code "A". |
| 97.4 | 7:00 | Longitudinal crack from joint, crack code "A". |
| 131.0 | 7:00 | V-shaped crack, crack code "A". |
| 230.2 | 12:00 | Radial crack, crack code "A". |
| 252.6 | 12:00 | Chip at pipe joint. |
| 295.4 | 12:00 | Radial crack, crack code "A". |
| 304.1 | 12:00 | Chip at pipe joint, joint code "J". |
| 340.0&348.0 | 12:00 | Some deterioration in crown of pipe. |
| 354.3 | 9:00 | Radial crack, crack code "A". |
| 412.9 | - | Offset joint. |
| 500.5 | - | End T.V. |

**M.H.#** 202A
Depth=5'6"

**FLOW**
Southeast

**M.H.#** 203
Depth=5'9"

TOTAL FEET TELEVISED (500.5 ft)
DISTANCE BETWEEN MANHOLES (1430.0 ft)

**COMMENTS:**

Specific Line Evaluation

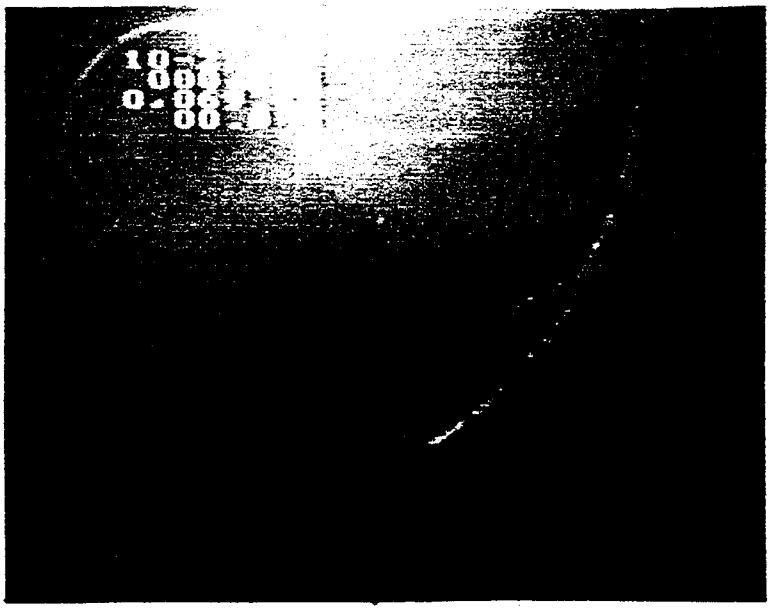
Tape #6A; Segment "A"

Manhole #202A, to Manhole #203

Direction of TV-Southeast, with flow.

The photo-print shows a specific sewer pipe defect for this section of line. The most severe condition observed was usually selected for the photograph.

Photo shows a semi-circular crack at the joint.
Approx. Sta. 69.4



This segment of line was constructed using 15" VC pipe. This section of pipe has three V-shaped cracks, along with several radial and longitudinal cracks.

CCC

# TELEVISION INSPECTION REPORT

**PROJECT:** Sanitary sewer inspection - Cannon Air Force Base; Clovis, New Mexico

**FOR:** Woodward-Clyde Consultant
4582 So. Ulster Parkway - Denver, CO

**PRINCIPAL:** Jeff Ehrenzeller, P.E.

**INSPECTION DATES:** October 27, 1991

**WEATHER:** Fair - moderate temperatures

**LOCATION:** Start at manhole #203, located approximately 550ft Southeast of the centerline of Runway 22/4, TV Northwest, against flow, towards manhole 202A, located between Taxiway A and Runway 22/4.

**PIPE SIZE; TYPE:** 15" VCP - 3ft joints

**TAPE NO.:** #6A - Segment; "B"

**TECHNICIAN:** Juan Carlos Santiago

| DISTANCE READING | CLOCK REF POSITION | REMARKS / NOTES |
|---|---|---|
| 7.0 | - | Typical misaligned joint; probably caused by out of round pipe, but within tolerance at the time of installation. |
| 17.0 | 1:00 | Small root growth at joint, root code "A". |
| 20.2 | 12:00 | Small root growth at joint, root code "A". |
| 174.8 | 1:00 | Small piece of pipe missing at joint. |
| 309.1 | 1:00 | Small piece of pipe missing at joint. |
| 312.1 | 1:00 | Small piece of pipe missing at joint. |
| 483.5 | 1:00 | Crack in spigot and on pipe. |
| 498.6 | - | End T.V. |

(Continued)

| M.H.# | FLOW | M.H.# |
|---|---|---|
| 203 | Northwest | 222A |
| Depth=5'9" | | Depth=5'6" |

TOTAL FEET TELEVISED (498.6 ft)
DISTANCE BETWEEN MANHOLES (1430.0 ft)

COMMENTS: A small amount of root growth was observed at several joints. Also, since the television is in reverse of flow, the spigot ends of the pipe are evident at each joint.

CCC

Specific Line Evaluation

Tape #6A; Segment "B"

Manhole #203, to Manhole #202A

Direction of TV-Northwest, against the flow.

The photo-print shows a specific sewer pipe defect for this section of line. The most severe condition observed was usually selected for the photograph.

Photo shows a longitudinal crack and some joint deterioration. Approx. Sta. 174.8

This segment of line was constructed using 15" VC pipe. There were several small crack at the joint in this section of pipe.

# TELEVISION INSPECTION REPORT

**PROJECT:** Sanitary sewer inspection - Cannon Air Force Base; Clovis, New Mexico

**FOR:** Woodward-Clyde Consultant
4582 So. Ulster Parkway - Denver, CO

**PRINCIPAL:** Jeff Ehrenzeller, P.E.

**INSPECTION DATES:** October 27, 1991

**WEATHER:** Fair - moderate temperatures

**LOCATION:** Start at manhole #203, located approximately 550ft Southeast of the centerline of Runway 22/4, TV Southeast, to manhole #203A, located at the aircraft parking area.

**PIPE SIZE; TYPE:** 15" VCP - 3ft joints

**TAPE NO.:** #7 - Segment; "A"

**TECHNICIAN:** Juan Carlos Santiago

| DISTANCE READING | CLOCK REF POSITION | REMARKS / NOTES |
|---|---|---|
| 3.0 | 10:00to11:00 | V-shaped crack at joint, crack code "B". |
| 3.0 | 8:00 | Longitudinal crack, crack code "A". |
| 7.9 | 10:00 | Longitudinal crack, crack code "A". |
| 11.2 | 7:00to10:00 | V-shaped crack, crack code "B". |
| 17.1 | 9:00 | Deterioration in joint. |
| 23.3 | 12:00 | Longitudinal crack, crack code "B". |
| 23.3 | 9:00to3:00 | Radial crack, crack code "A". |
| 29.1 | 3:00 | V-shaped crack, crack code "B". |
| 35.3 | 3:00 | V-shaped crack, crack code "B". |
| 38.0 | 12:00 | Longitudinal crack, crack code "A". |
| 50.2 | 10:00to2:00 | 2 V-shaped cracks, crack code "B". |
| 53.5 | 4:00to6:00 | 2 V-shaped cracks, crack code "B". |
| 59.5 | 5:00 | V-shaped crack, crack code "A". |
| 62.6 | 11:00 | Longitudinal crack, crack code "A". |
| 71.6 | 3:00 | Longitudinal crack, crack code "B". |
| 80.9 | - | Chipped pipe at joint. |
| 80.9 | 1:00 | V-shaped crack, crack code "A". |
| 85.2 | 11:00 | Longitudinal crack, crack code "A". |
| 87.6 | 3:00 | 2 V-shaped cracks, crack code "A". |

(Continued)

| DISTANCE READING | CLOCK REF POSITION | REMARKS/NOTES |
|---|---|---|
| 90.1 | 1:00 | Longitudinal crack, crack code "A". |
| 90.1 | 7:00 | Chipped joint. |
| 93.6 | 4:00 | Longitudinal crack, crack code "A". |
| 96.6 | 12:00 | V-shaped crack, crack code "A". |
| 103.1 | 5:00 | Longitudinal crack, crack code "A". |
| 108.8 | 3:00to5:00 | Radial crack, crack code "A". |
| 111.6 | 3:00 | V-shaped crack, crack code "A". |
| 123.8 | 1:00to5:00 | 2 V-shaped cracks, crack code "A". |
| 126.7 | 10:00 | Longitudinal crack, crack code "A". |
| 129.7 | 9:00 | V-shaped crack, crack code "A". |
| 132.8 | 12:00to1:00 | V-shaped crack, crack code "A". |
| 139.3 | 12:00to3:00 | 2 V-shaped cracks, crack code "A". |
| 145.2 | 10:00to3:00 | 2 V-shaped cracks, crack code "A". |
| 148.3 | 9:00to12:00 | 2 V-shaped cracks, crack code "A". |
| 151.3 | 7:00 | Radial crack from joint, crack code "A". |
| 154.3 | 1:00&3:00 | Longitudinal cracks, crack code "A". |
| 160.1 | 7:00to11:00 | 2 V-shaped cracks, crack code "A". |
| 163.2 | 3:00 | V-shaped crack, crack code "A". |
| 169.2 | 12:00 | Longitudinal crack, crack code "A". |
| 172.6 | 9:00 | Longitudinal crack, crack code "A". |
| 172.6 | 3:00 | Longitudinal crack, crack code "A". |
| 175.1 | 11:00&1:00 | Longitudinal crack, crack code "A". |
| 179.7 | 10:00&12:00 | Longitudinal crack, crack code "A". |
| 184.5 | 2:00 | V-shaped crack, crack code "A". |
| 187.5 | 5:00 | V-shaped crack, crack code "A". |
| 187.5 | 12:00 | Longitudinal crack, crack code "A". |
| 190.7 | 9:00 | V-shaped crack, crack code "A". |
| 195.8 | 5:00 | Pipe deterioration at joint. |
| 198.7 | 3:00 | Longitudinal crack, crack code "A". |
| 201.6 | 1:00 | Longitudinal crack, crack code "A". |
| 204.3 | 11:00to12:00 | Radial crack, crack code "A". |
| 213.9 | 1:00 | Longitudinal crack, crack code "A". |
| 231.9 | 3:00 | Longitudinal crack, crack code "A". |
| 235.0 | 9:00 | Longitudinal crack, crack code "A". |
| 237.9 | 10:00&12:00 | Longitudinal crack, crack code "A". |
| 247.1 | 3:00 | Longitudinal crack, crack code "A". |
| 256.6 | 10:00 | Longitudinal crack, crack code "A". |
| 259.2 | 11:00 | Longitudinal crack, crack code "A". |
| 262.6 | 9:00 | Longitudinal crack, crack code "A". |
| 274.6 | 2:00 | Longitudinal crack, crack code "A". |
| 277.5 | 9:00 | Longitudinal crack, crack code "A". |
| 283.8 | 1:00 | Longitudinal crack, crack code "A". |
| 290.0 | 12:00 | Longitudinal crack, crack code "A". |
| 296.1 | 9:00 | Longitudinal crack, crack code "A". |
| 296.1 | 7:00 | V-shaped crack, crack code "A". |

(Continued)

| DISTANCE READING | CLOCK REF POSITION | REMARKS/NOTES |
|---|---|---|
| 299.1 | 9:00-3:00&4:00 | Longitudinal cracks, crack code "A". |
| 302.3 | 1:00 | Chipped pipe. |
| 302.3 | 9:00 | Longitudinal crack, crack code "A". |
| 305.3 | 7:00to9:00 | V-shaped crack, crack code "A". |
| 307.9 | 3:00 | Longitudinal crack, crack code "A". |
| 323.2 | 10:00 | Longitudinal crack, crack code "A". |
| 326.3 | 6:00to10:00&9:00 | Radial and longitudinal cracks, crack code "A". |
| 329.1 | 10:00to7:00&5:00 | Radial and longitudinal cracks, crack code "A". |
| 332.5 | 5:00 | V-shaped crack, crack code "A". |
| 338.5 | 12:00&8:00 | Longitudinal cracks, crack code "A". |
| 344.3 | 12:00 | Longitudinal crack, crack code "A". |
| 347.5 | 11:00 | Longitudinal crack, crack code "A". |
| 351.1 | 7:00to11:00 | 2 V-shaped cracks, crack code "A". |
| 353.6 | 3:00 | Longitudinal crack, crack code "A". |
| 358.6 | 8:00 | Longitudinal crack, crack code "A". |
| 362.7 | 12:00to1:00 | V-shaped crack, crack code "A". |
| 365.5 | 3:00to4:00 | V-shaped crack, crack code "A". |
| 368.7 | 11:00 | Longitudinal crack, crack code "A". |
| 368.7 | 7:00 | V-shaped crack, crack code "A". |
| 371.8 | 11:00&12:00 | Longitudinal cracks, crack code "A". |
| 380.8 | 12:00 | Longitudinal cracks, crack code "A". |
| 384.1 | 9:00 | Longitudinal cracks, crack code "A". |
| 386.9 | 1:00&7:00 | Longitudinal cracks, crack code "A". |
| 389.9 | 12:00 | Longitudinal cracks, crack code "A". |
| 393.0 | 9:00 | V-shaped crack, crack code "A". |
| 395.9 | 9:00&12:00 | Longitudinal cracks, crack code "A". |
| 400.4 | - | End T.V. |

**M.H.#**
203
Depth=5'9"

**FLOW**
Southeast

**M.H.#**
203A
Depth=5'5"

**TOTAL FEET TELEVISED (400.4 ft)**

**COMMENTS:**

CCC

Specific Line Evaluation

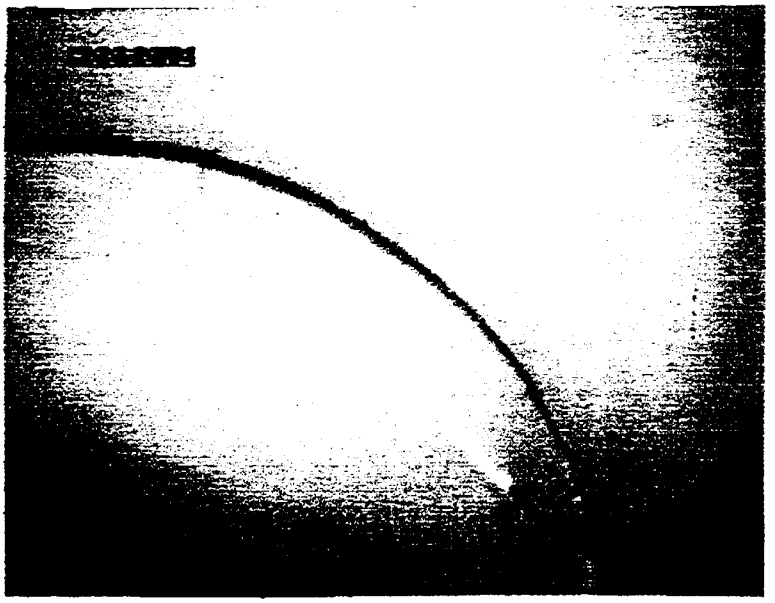
Tape #7; Segment "A"

Manhole #203, to Manhole #203A

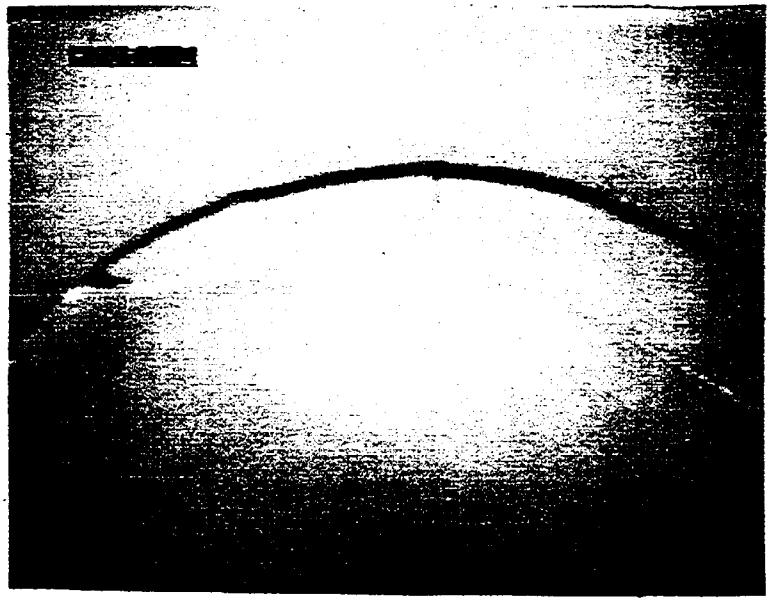
Direction of TV-Southeast, with flow.

The photo-print shows a specific sewer pipe defect for this section of line. The most severe condition observed was usually selected for the photograph.

Photos show a series of wedge shaped cracks in crown of pipe. Approx. Sta. 50.2



This segment of line was constructed using 15" UC pipe. There were seven (7) sections of V-shaped cracks and a series of small longitudinal and radial cracks in this segment of line.



CCC

# TELEVISION INSPECTION REPORT

**PROJECT:** Sanitary sewer inspection - Cannon Air Force Base; Clovis, New Mexico

**FOR:** Woodward-Clyde Consultant
4582 So. Ulster Parkway - Denver, CO

**PRINCIPAL:** Jeff Ehrenzeller, P.E.

**INSPECTION DATES:** October 27, 1991

**WEATHER:** Fair - moderate temperatures

**LOCATION:** Start at manhole #203A, located near the aircraft parking area, Southeast of Runway 22/4, TV Northwest against the flow to manhole #203, also located Southeast of Runway 22/4.

**PIPE SIZE; TYPE:** 15" VCP - 3ft joints

**TAPE NO.:** #7 - Segment; "B"

**TECHNICIAN:** Juan Carlos Santiago

| DISTANCE READING | CLOCK REF POSITION | REMARKS / NOTES |
|---|---|---|
| 18.3 | - | Typical joint overlaps due to pipe condition at time of installation. |
| 44.3 | 12:00 | Debris in line, debris code "A", possible defect in pipe. |
| 74.5 | 3:00 | Longitudinal crack, crack code "A". |
| 99.5 | 10:00 | Longitudinal crack, crack code "A". |
| 102.2 | 11:00 | Longitudinal crack and radial crack crack code "A". |
| 126.0 | 10:00 | Longitudinal crack, crack code "A". |
| 138.7 | 5:00 | Longitudinal crack, crack code "A". |
| 147.4 | 4:00 | Longitudinal crack and radial crack crack code "A". |
| 150.8 | - | Hole in crown of pipe, crack code "H". Cavity being created. |
| 152.9 | 12:00 | Longitudinal crack, crack code "A". |
| 165.9 | 1:00 | Grease in crown of pipe. |
| 171.5 | 8:00 | Radial crack, crack code "A". |
| 198.7 | 12:00 | Chipped pipe. |
| 201.5 | 9:00 | Longitudinal crack, crack code "A". |

(Continued)

| DISTANCE READING | CLOCK REF POSITION | REMARKS/NOTES |
|---|---|---|
| 220.1 | 9:00 | Longitudinal crack, crack code "A". |
| 220.5 | 3:00 | Longitudinal crack and radial crack crack code "A". |
| 223.3 | 5:00 | Longitudinal crack and radial crack crack code "A". |
| 226.2 | 9:00&3:00 | Radial and longitudinal cracks, crack code "A". |
| 229.6 | 6:00to3:00 | Radial cracks, crack code "A". |
| 232.5 | 10:00 | Longitudinal crack, crack code "A". |
| 232.5 | 10:00to5:00 | Radial crack and longitudinal crack, crack code "A". |
| 233.5 | 3:00 | Longitudinal crack, crack code "B"; entire length of pipe. |
| 235.2 | 9:00 | Longitudinal crack, crack code "A". |
| 235.2 | 3:00 | 2 radial cracks, crack code "A". |
| 238.2 | 5:00 | Longitudinal crack, crack code "A". |
| 238.5 | 8:00 | Radial crack, crack code "A". |
| 241.3 | 10:00 | Longitudinal crack, crack code "A". |
| 241.3 | 3:00 | Longitudinal cracks and radial cracks, crack code "A". |
| 244.4 | 3:00 | Radial crack, crack code "A". |
| 244.4 | 9:00 | Radial crack, crack code "A". |
| 250.4 | 9:00 | V-shaped crack, crack code "A". |
| 253.7 | 3:00&9:00 | Longitudinal crack, crack code "A". |
| 256.7 | 5:00 | Radial crack, crack code "A". |
| 259.9 | 3:00&9:00 | Longitudinal cracks, crack code "A". |
| 262.7 | 8:00&4:00 | Longitudinal cracks, crack code "A". |
| 265.7 | 9:00 | Longitudinal crack, crack code "A". |
| 275.0 | 5:00&9:00 | Longitudinal cracks, crack code "A". |
| 278.0 | 4:00 | Longitudinal crack, crack code "A". |
| 284.0 | 10:00 | Longitudinal crack, crack code "A". |
| 286.9 | 4:00 | Radial crack, crack code "A". |
| 290.2 | 3:00 | Longitudinal crack, crack code "A". |
| 293.2 | 12:00&3:00 | Longitudinal crack, crack code "A". |
| 296.0 | 3:00 | Longitudinal crack, crack code "A". |
| 302.2 | 3:00 | Longitudinal crack, crack code "A". |
| 311.4 | 9:00&11:00 | Longitudinal cracks, crack code "A". |
| 314.7 | 3:00&5:00 | Longitudinal crack, crack code "A". |
| 315.2 | - | End T.V. |

**M.H.#**
203A
Depth=5'9"

**FLOW**
Northwest

**M.H.#**
203
Depth=5'5"

**TOTAL FEET TELEVISED (315.2 ft)**

**COMMENTS:** Grease build-up in crown of pipe between Sta. 40.0 and 75.0.

Specific Line Evaluation

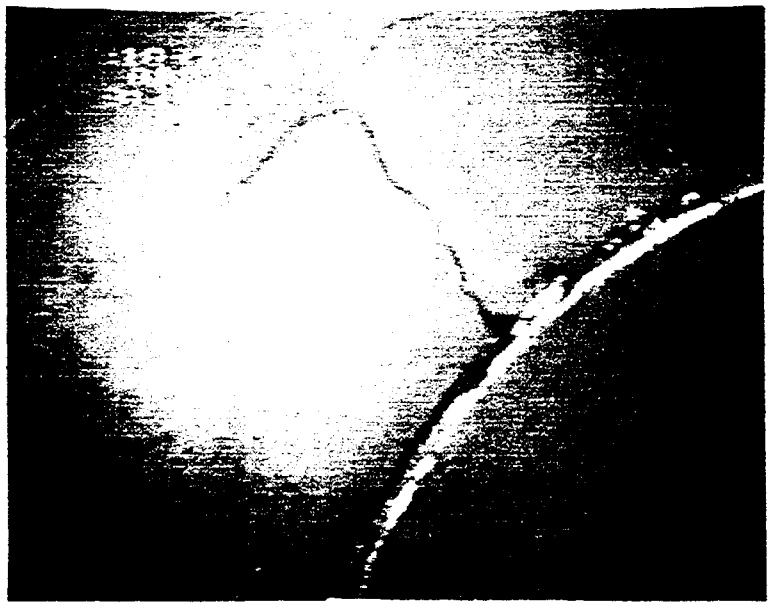
Tape #7; Segment "B"

Manhole #203A, to Manhole #203

Direction of TV-Northwest, against the flow.

The photo-print shows a specific sewer pipe defect for this section of line. The most severe condition observed was usually selected for the photograph.

Photo shows a "T" shape crack at the joint. Approx. Sta. 102.2



This segment of line was constructed using 15" UC pipe. There were several longitudinal and radial cracks at the joints. One piece of pipe was missing (See photo Sta. 149.2).

CCC

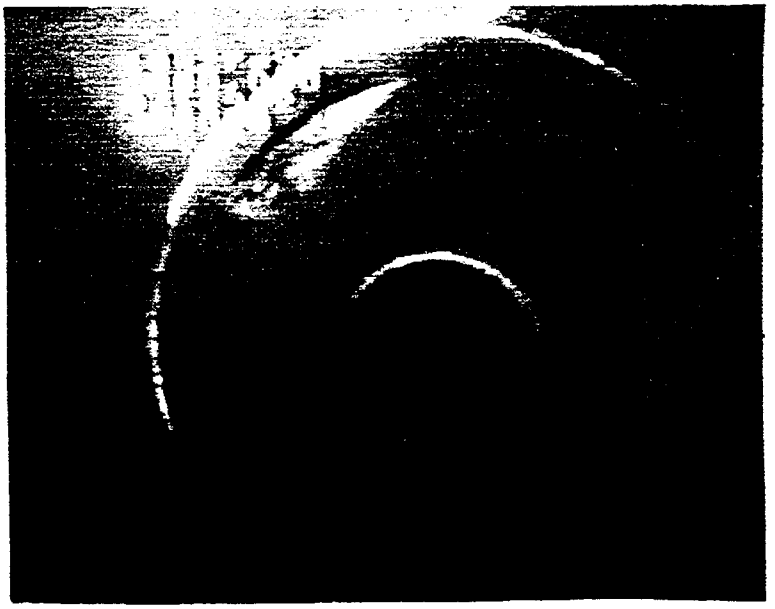
Specific Line Evaluation

Tape #7; Segment "B"

Manhole #203A, to Manhole #203

Direction of TV-Northwest, against the flow.

The photo-print shows a specific sewer pipe defect for this section of line. The most severe condition observed was usually selected for the photograph.



Photos show a missing piece of pipe and the resulting cavity.
Approx. Sta. 149.2

This segment of line was constructed using 15" UC pipe. There were several longitudinal and radial cracks at the joints.

## III. OBSERVATIONS - SUMMARY

The vitrified clay pipe in general appears to be in fair condition. However, there are several joints that have separated, displaced or are misaligned, probably due to line settlement, which allowed roots to grow into the sewer lines. Also, at two locations, pieces of pipe were missing. These locations are; Tape #4, segment A, station 67.6; and Tape #7, segment B, station 150.8. Additionally, minor longitudinal and radial cracks at the joints could cause disintegration of the pipe in the future.

As for the section of concrete pipe, the sewer gases have not significantly depleted the cement binder which allows the aggregate to be eroded away therefore destroying the pipe. All of the concrete pipe appears to be in satisfactory conditions at this time. However, some joint deterioration has permitted roots to grow into the sewer line.

In summary, both the vitrified clay pipe (VCP) and unreinforced concrete pipe (UCP) are in fair condition. Nevertheless, many of the joints have failed, and the life of the line has been reduced to a degree that rehabilitation should be considered.

## IV. RECOMMENDATIONS

It is recommended that corrective action be taken to reduce the I & I and prevent soil contamination from exfiltration and possible damage that might result from sewer back ups. Whatever course of corrective action is pursued, it is very important that broken pipe be addressed, between manholes #122 and #138; and manholes # 203 and #203A.

Corrective action to prevent continued exfiltration of raw sewage into the existing ground (also possibly ground water contamination), and I & I reduction could be achieved by the following methods:

Alternate A. Cleaning, testing, and sealing of all pipe joints by grouting using packer assemblies. Removal and replacement of all cracked pipe joints that do not pass pressure testing.

Alternate B. Removal of all existing lines and replacement with new sewer lines.

Alternate C. Sliplining with butt fused High Density Polyethylene Liner (HDPE) SDR 26, in all diameter lines. Excavate for point repairs and renew house service connections on the lines.

Alternate D. Lining the VCP and UVC pipe with a (HDPE) Liner, called **U-Liner**. This is new trenchless technology that can rehabilitate the lines and restore them to a 50 year life expectancy, leaving no annular space, therefore eliminating possible root growth problems. No point repairs are required and the service line can be reinstated internally.

After corrective action is taken and the problems remedied, a scheduled sewer cleaning program with periodic television inspection should be implemented. A preventive maintenance program can go a long way in eliminating future problems.

V. ECONOMIC FACTORS

Any and all corrective actions should consider economic factors and possible service disruption during time required for the rehabilitation. In the below four recommended choices for corrective action, "C" (sliplining would probably prove to be the least expensive and least time consuming of the four alternatives. However, alternate "D" should probably be employed in order to insure that no future root growth can enter the wastewater system.

Alternate "A" would not prove feasible because of the excessive number of joints that need sealing. Also there is a strong possibility that whatever caused the joint displacement would continue and crack open a newly sealed joint in time.

Alternate "B" is estimated to be more expensive than alternate "C" or "D", considering the existing site improvements and the temporary by-pass pumping of sewage that would be required. Alternative "B" would be by far the most disruptive and time consuming of the four alternates.

Alternate "C" is estimated to be the least expensive and least time consuming of the possible two viable alternatives, "C" and "D".

Alternative "D" would give the greatest long term economical benefit because it eliminates the annular space between the host pipe and liner that occurs with regular sliplining. Also, this procedure could be the best system for rehabilitating due to the negligible flow reduction.

As a matter of information, HDPE liner pipe is a smooth chemically resistant homogeneous economical extruded pipe. No disruption of service or by-pass pumping is normally required during the installation of the HDPE. HDPE is also capable of being maintained with standard equipment and methods. The smooth interior wall of HDPE is smoother than clay and concrete, which means it conveys more volumetric flow in a smaller diameter pipe. (Manning's "n" = .009 verses clay at .013 and concrete at .015.)

(No analysis of any environmental considerations are addressed, however they could become significant if rehabilitation of the sewers is not taken.)

## Cleaning Specification

All cleaning shall be performed per the standards set by The National Association of Sewer Service Companies, "Recommended Specifications For Sewer Collection System Rehabilitation," Fifth Edition, Section 3, Sewer line cleaning using High-Velocity Jet (Hydro-cleaning) Equipment, Peabody Myers, Series 2100 Hydro-vactor.

**Pertinent Sections are as follows:**

### Section 3 - Sewer Line Cleaning

3.1 Intent: The intent of sewer line cleaning is to remove foreign materials from the lines and restore the sewer to a minimum of 95% of the original carrying capacity. Since the success of the other phases of work depends a great deal on the cleanliness of the lines, the importance of this phase of the operation is emphasized. It is recognized that there are some conditions such as broken pipe and major blockages that prevent cleaning from being accomplished or where additional damage would result if cleaning were attempted or continued. Should such conditions be encountered, the Contractor will not be required to clean those specific manhole sections. If in the course of normal cleaning operations, damage does result from preexisting and unforeseen conditions such as broken pipe, the Contractor will not be held responsible.

3.2 Cleaning Equipment:

(a) High-Velocity Jet (Hydrocleaning) Equipment: All high-velocity sewer cleaning equipment shall be constructed for ease and safety of operation. The equipment shall have a selection of two or more high-velocity nozzles. The nozzles shall be capable of producing a scouring action from 15 to 45 degrees in all size lines designated to be cleaned. Equipment shall also include a high-velocity gun for washing and scouring manhole walls and floor. The gun shall be capable of producing flows from a fine spray to a solid stream. The equipment shall carry its own water tank, auxiliary engines, pumps, and hydraulically driven hose reel.

no less often than at the end of each workday. Under NO circumstances will the Contractor be allowed to accumulate debris, etc., on the site of work beyond the stated time.

3.7 Final Acceptance: Acceptance of sewer line cleaning shall be made upon the successful completion of the television inspection and shall be to the satisfaction of the Owner's Representative. If TV inspection shows the cleaning to be unsatisfactory, the Contractor shall be required to re-clean and re-inspect the sewer line until the cleaning is shown to be satisfactory. In areas where television inspection is not performed, the Owner's Representative may require the Contractor to pull a double squeegee (with each squeegee the same diameter as the sewer) through each manhole section as evidence of adequate cleaning.

CCC

## CCTV-Inspection-Specification

All closed circuit television inspection (CCTV) shall be performed per the standards set by The National Association of Sewer Service Companies, "Recommended Specifications for Sewer Collection System Rehabilitation," Fifth edition, Section #5, Television Inspection, using Cues, Inc. Radial View Camera. (RVC-360 degree tm) with audio comments concerning pipe conditions on video tapes, (VHS) format.

**Pertinent Sections are as follows:**

### Section 5 - Television Inspection

5.1 After cleaning, the manhole sections shall be visually inspected by means of closed-circuit television. Inspection will be done one manhole section at a time and the flow in the section being inspected will be suitably controlled as specified (see SEWER FLOW CONTROL).

5.2 The television camera used for the inspection shall be one specifically designed and constructed for such inspection. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe. The camera shall be operative in 100% humidity conditions. The camera, television monitor, and other components of the video system shall be capable of producing picture quality to the satisfaction of the Owner's Representative; and if unsatisfactory, equipment shall be removed and no payment will be made for an unsatisfactory inspection.

5.3 The camera shall be moved through the line in either direction at a moderate rate, stopping when necessary to permit proper documentation of the sewer's condition. In no case will the television camera be pulled at a speed greater than 30 feet per minute. Manual winches power winches, TV cable, and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions shall be used to move the camera through the sewer line. If, during the inspection operation, the television camera will not pass through the entire manhole section, the Contractor shall set up his equipment so that the inspection can be performed from the opposite manhole. If, again the camera fails to pass through the entire manhole section, the inspection shall be considered complete and no additional inspection work will be required.

5.4 When manually operated winches are used to pull the television camera through the line, telephones or other suitable means of communication shall be set up between the two manholes of the section being inspected to insure good communications between members of the crew.

5.5 The importance of accurate distance measurements is emphasized. Marking on the cable, or the like, which would require interpolation for depth of manhole, will not be allowed. Accuracy of the distance meter shall be checked by use of a walking meter, roll-a-tape, or other suitable device, and the accuracy shall be satisfactory to the Owner's Representative.

5.6 Documentation of the television results shall be as follows:

(a) Television Inspection Logs: Printed location records shall be kept by the Contractor and will clearly show the location in relation to an adjacent manhole of each infiltration point observed during inspection. In addition, other points of significance such as locations of building sewers, unusual conditions, roots, storm sewer connections, broken pipe, presence of scale and corrosion, and other discernible features will be recorded and a copy of such records will be supplied to the Owner.

(b) Photographs: 35 mm, or other standard-size photographs of the television picture of problems, shall be taken by the Contractor upon request of the Owner's Representative, this being at an extra charge to the Owner.

(c) Videotape Recordings: The purpose of tape recording shall be to supply a visual and audio record of problem areas of the lines that may be replayed. Videotape recording playback shall be at the same speed that it was recorded. Slow motion or stop-motion playback features may be supplied at the option of the Contractor. Title to the tape shall remain with the Contractor until project is complete. At project completion, tapes will be given to Owner for Owner's use and further evaluation.