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ENGINEERING, SCIENCE AND CONSTRUCTION

RESPONSIVENESS – INTEGRITY - TEAMWORK

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JUL 2008
NMED Hazardous Waste Bureau

July 1, 2008

New Mexico Environment Department
Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6303

Attention: Mr. James P. Bearzi
Chief, Hazardous Waste Bureau

Subject: Response to 8 May 2008 Notice of Disapproval: Voluntary Corrective Measures Work Plan, Site OT-14 Soil Remediation, November 2007, Holloman AFB, 6572124422 HWB-HAFB-07-012

Dear Mr. Bearzi.

Enclosed please find one (1) hard copy and one (1) electronic copy (MS Word) of the revised work plan that incorporate all the responses to the Notice of Disapproval (NOD). Holloman Air Force Base provided transmittal of the matrix (comment response table) in a letter dated June 23, 2008, which is attached for reference. One (1) hard and one (1) electronic copy of the revised work plan are also being provided to Ms. Dezbah Tso by this transmittal.

If you have any questions, please feel free to call me at 303-597-2450.

Sincerely,
Bhate Environmental Associates, Inc.

Frank Gardner

Frank Gardner, P.G.
Program Manager

cc:

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VOLUNTARY CORRECTIVE MEASURES WORK PLAN
SITE OT-14 SOIL REMEDIATION
HOLLOMAN AFB, NEW MEXICO

Holloman Air Force Base
New Mexico

July 2008

Contract No.: DACA45-03-D-0023
Delivery/Task Order: 0021
Bhate Project No.: 9050361.01.03

Headquarters, Air Combat Command
Langley Air Force Base, Virginia

49 CES/CEV
Holloman Air Force Base, New Mexico

July 2008

VOLUNTARY CORRECTIVE MEASURES
WORK PLAN
SITE OT-14 SOIL REMEDIATION
HOLLOMAN AIR FORCE BASE, NEW MEXICO

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VOLUNTARY CORRECTIVE MEASURES
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VOLUNTARY CORRECTIVE MEASURES WORK PLAN

SITE OT-14 SOIL REMEDIATION

HOLLOMAN AIR FORCE BASE, NEW MEXICO

July 2008

VOLUNTARY CORRECTIVE MEASURES WORK PLAN

SITE OT-14 SOIL REMEDIATION

HOLLOMAN AIR FORCE BASE, NEW MEXICO

VOLUNTARY CORRECTIVE MEASURES WORK PLAN SITE OT-14 SOIL REMEDIATION HOLLOMAN AFB, NEW MEXICO

Prepared for:

49 CES/CEV
Holloman Air Force Base
New Mexico

Under Contract To:

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

Contract No. DACA45-03-D-0023
Task Order No. 021

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VOLUNTARY CORRECTIVE MEASURES WORK PLAN SITE OT-14 SOIL REMEDIATION HOLLOMAN AFB, NEW MEXICO

REVIEW SHEET

This Work Plan has been reviewed and approved by:

John Hymer Site Manager		July 2, 2008~~November 26, 2007~~
	Signature	Date
Jim Moore, P.G. Project Manager		July 2, 2008~~November 26, 2007~~
	Signature	Date
Frank Gardner, P.G. Program Manager		July 2, 2008~~November 26, 2007~~
	Signature	Date

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VOLUNTARY CORRECTIVE MEASURES WORK PLAN SITE OT-14 SOIL REMEDIATION HOLLOMAN AFB, NEW MEXICO

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ACRONYMS AND ABBREVIATIONS

AAF	Army Air Field
AFB	Air Force Base
AFCEE	Air Force Center for Environmental Excellence
AFCESA	Air Force Civil Engineer Support Agency
AF Fm	Air Force Form
amsl	Above mean sea level
ANSI	American National Standards Institute
AOC	Area of Concern
ASTM	American Society for Testing and Materials
bgs	Below ground surface
Bhate	Bhate Environmental Associates, Inc.
CE	Civil Engineering
CES/CEV	Civil Engineering Squadron/Environmental Flight
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
CMS	Corrective Measures Study
COC	Chain-of-custody
COPCs	Chemicals of potential concern
CSM	Conceptual site model
CRZ	Contamination reduction zone
cu yds	Cubic yards
DPT	Direct push technology
DQO	Data quality objective
DRO	Diesel range organics
ERP	Environmental Restoration Program
ERPIMS	Environmental Restoration Program Information Management System
EZ	Exclusion zone
°F	Degrees Fahrenheit
FID	Flame ionization detector
FS	Feasibility Study
ft	Feet
FWENC	Foster Wheeler Environmental Corporation
GPS	Global positioning system
GRO	Gasoline range organics
HAFB	Holloman Air Force Base
HASP	Health and Safety Plan
ID	Inside diameter
IDW	Investigation-Derived Waste
IRP	Installation Restoration Program
ISEA	International Safety Equipment Association
ln ft	Linear feet
µg/kg	Micrograms per kilogram

~~µg/L Micrograms per liter~~
~~mg/kg Milligrams per kilogram~~

ACRONYMS AND ABBREVIATIONS (CONTINUED)

µg/L	Micrograms per liter
mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter
MCL	Maximum contaminate level
MS	Matrix spike
MSD	Matrix spike duplicate
MSL	Mean seal level
NAD	North American Datum
NAVFAC	Naval Facilities Engineering Command
NFA	No Further Action
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NMWQCC	New Mexico Water Quality Control Commission
ORO	Oil range organics
OSHA	Occupational Safety and Health Administration
OVA	Organic vapor analyzer
P.G.	Professional Geologist
PID	Photo ionization detector
PPE	Personal protective equipment
ppm	Parts per million
PVC	Polyvinyl chloride
QA	Quality assurance
QC	Quality control
QAPP	Quality Assurance Project Plan
RAO	Remedial Action Operation
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RI	Remedial Investigation
SSHO	Site Safety and Health Officer
SSL	Soil screening level
SOP	Standard Operating Procedure
SVOC	Semi-volatile organic compound
SWMU	Solid Waste Management Unit
SWPPP	Storm Water Pollution Prevention Plan
SZ	Support zone

TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total dissolved solids
TPH	Total petroleum hydrocarbons
UFGS	Unified Facilities Guide Specifications
USACE	United States Army Corps of Engineers
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
VCMs	Voluntary Corrective Measures
VOC	Volatile organic compound
WRCC	Western Regional Climate Center
WSMR	White Sands Missile Range
WWTP	Wastewater Treatment Plant

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1 INTRODUCTION

Bhate Environmental Associates, Inc. (Bhate), has been retained by the U.S. Army Corps of Engineers (USACE), under contract DACA45-03-D-0023, Task Order No. 021, to conduct Voluntary Corrective Measures (VCMs) at several of the Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs) at Holloman Air Force Base (HAFB), New Mexico. This document is to provide a work plan that will serve as the primary working document for the additional investigation, risk evaluation, and excavation activities of the pesticide contaminated soil located at SWMU 197, the former Entomology Shop (Environmental Restoration Program [ERP] Site OT-14). This VCM Work Plan also provides the site specific information and requirements outlined in the Notice of Disapproval (HWB-HAFB-07-012) issued by the New Mexico Environment Department (NMED) in May 2008. The Notice of Disapproval letter and the responses to NMED comments are included in Attachment A of this Work Plan.

OT-14, the former Entomology Shop (Building 66), and affected area is approximately 0.2 acres. According to interviews with former Base personnel familiar with the shop, from 1968 to 1977, pesticide spraying and washing equipment was rinsed out in an open area adjacent to the building (Radian, 1992). Currently, the area is sometimes used to stage emergency spill response equipment. Presently, the area is flat and covered with an ~~non~~ engineered asphalt cap.

Phase I and Phase II Resource Conservation and Recovery Act (RCRA) Facility Investigations (RFIs) have been conducted at the site. Soil samples collected at the site identified pesticides in several samples. However, analytical results from only fiv~~thre~~e samples exceeded the ~~New Mexico Environment Department (~~NMED ~~)~~ Residential Soil Screening Levels (SSLs). These samples were collected and analyzed between approximately 13 and 16 years ago. Groundwater surrounding the perimeter of the site contained one herbicide (2,4-DB at a maximum concentration of 4.0 micrograms per liter [µg/L]), benzene (at a maximum concentration of 0.82 µg/L), methylene chloride (at a maximum concentration of 32 µg/L), and toluene (at a maximum concentration of 1.3 µg/L). No semi-volatile organic compounds (SVOCs) were identified in the groundwater samples. Total dissolved solids (TDS) in groundwater samples collected at the site ranged from 11,000 milligrams per liter (mg/L) to 16,000 mg/L. A detailed summary of the previous results is summarized in Section 2.0 of this Work Plan.

The objectives of this Work Plan are to provide additional characterization to fill in the data gaps needed to completely identify the extent of pesticide contaminated soil and compare the results to risk based levels. Contaminated soil exceeding these risked based levels will be removed, through excavation (above the NMED soil screening levels) with verification of complete removal via confirmation sampling from the excavation. The excavated soil will be transported offsite for disposal at an appropriate facility.

The Work Plan describes:

1. The methods and locations for additional soil and groundwater investigation to fully characterize the current conditions at the site.

2. The methodology for comparison of all soil and groundwater analytical result to the NMED SSLs and New Mexico Water Quality Control Commission (NMWQCC) and/or Federal Groundwater Standards.

3. The methodology for a site specific risk evaluation, if necessary, to demonstrate risk based levels for constituents remaining at the site.

4. The excavation (and confirmatory sampling) of soil exceeding either the site NMED SSLs or the site specific risk evaluation levels (as calculated by the risk evaluation).

This document has been written to provide relevant information on the geologic, hydrologic, and other environmental conditions for HAFB and at the site and the procedures by which this VCM will be completed. Information is provided for the entire Base and its surrounding environ as well as OT-14, specifically. This VCM calls for a three pronged approach. First, collect additional soil and groundwater samples to fully characterize the site. Second, compare those results to the NMED SSLs and NMWQCC groundwater standards, or other risked based standards. And third, if necessary, remove soil impacted above the applicable standards.

1.1 Base and Site Description

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

1.1.1 Holloman Air Force Base

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

Tactical Fighter Wing arrived at HAFB and has remained since. Today, HAFB also serves as the training center for the German Air Force's Tactical Training Center.

1.1.2 Site OT-14

SWMU 197 (OT-14) occupies approximately two-tenths of an acre in the northwestern corner of the Civil Engineering yard on the Main Base. OT-14 is adjacent to Building 66 and is surrounded by paved areas. The topography of the site is relatively flat. The former Entomology Shop, OT-14 was located in Building 66. At the site, pesticides and equipment (spraying units) for application across the Base were mixed, stored, and maintained. Mixing and maintaining was performed in an area outside of Building 66. Figure 1-2 indicates the location of OT-14 on the Base while Figure 1-3 is a layout map of OT-14 indicating the locations of the previous sampling efforts.

1.2 Physiography and Topography

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

OT-14 and the surrounding area are relatively flat. The investigation area is paved with asphalt and a concrete apron for Building 66.

1.3 Surface Water and Hydrology

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

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

1.4 Geology

1.4.1 Regional Geology

The sedimentary rocks which make up the adjacent mountain ranges are between 500 and 250 million years old (White Sands Missile Range (WSMR), 2003). During the period when the area was submerged under the shallow intra-continental sea, the layers of limestone, shale, gypsum, and sandstone were deposited. In time, these layers were pushed upward through various tectonic forces forming a large bulge on the surface. Approximately 10 million years ago the center began to subside resulting in a vertical drop of thousands of feet leaving the edges still standing (the present day Sacramento and San Andres mountain ranges). In the millions of years following, rainfall, snowmelt, and wind eroded the mountain sediments depositing them in the valley (i.e. Tularosa Basin). Water carrying eroded gypsum, limestone, dolomite, gravel, and other alluvial matter continues to flow into the basin with no route of exit.

The Tularosa Sub-basin is geologically described as a bolson, which is an extensive flat alluvium-floored depression, into which drainage from the surrounding mountains flows toward a central playa. The overlying alluvium generally consists of unconsolidated gravels (limestone, dolomite, and gypsum), sands, and clays. A fining sequence from the San Andreas and Sacramento Ranges towards the basin's center characterizes the area with the near surface soils as alluvial, eolian, and lacustrine deposits. The alluvial fan deposits are laterally discontinuous units of interbedded sand, silt, and clay while the eolian deposits consist primarily of gypsum sands. The eolian and alluvial deposits are usually indistinguishable due to the reworking of the alluvial sediment by eolian processes. The playa, or lacustrine deposits, consist of silty clay containing gypsum and are contiguous with the alluvial fan and eolian deposits.

Mesozoic rocks in the northwest mark the Colorado Plateau, topped by younger Tertiary strata. Quaternary age sediments have washed off the Southern Rockies into the open basins and the Rio Grande Rift, a failed spreading center or aulacogen. This would-be ocean basin runs up the center of the state with the Rio Grande flowing down its middle, exposing the Paleozoic and Precambrian rocks on its uplifted flanks. Later Cenozoic volcanic intrusions of Quaternary and Tertiary age are also associated with the rifting.

The great Permian Basin of Texas continues into the state from the southeast with younger Quaternary-Tertiary sediments of the Great Plains cover the whole eastern edge. Basin-and-

range terrain of Tertiary sediments and volcanics appear in the extreme southwest coupled with wide dry basins choked with Quaternary coarse sediments eroded from the blocks of uplifted older rocks.

1.4.2 Site OT-14 Geology

Soil borings installed during the first phase of investigation (Radian, 1992) and Phase II RI (Radian, 1995) were used to construct the site stratigraphy cross-section presented in Figures 1-3 and 1-4. Drilling logs from the RI are included in Attachment B of this Work Plan. Site stratigraphy consists of mostly of silty-sands (Radian, 1995). A 2 to 8 thick foot sand lens was observed in two wells (MW-14-03 and MW-14-04) but no basal confining layer was observed although the deepest boring was only 14.5 feet below ground surface (bgs).

1.5 Hydrogeology

1.5.1 Regional Hydrogeology

The predominance of the groundwater occurs as an unconfined aquifer in the unconsolidated deposits of the central basin, with the primary source of recharge as rainfall percolation and minor amounts of stream run-off along the western edge of the Sacramento Mountains. Surface water/rainfall migrates downward into the alluvial sediments at the edge of the shallow aquifer near the ranges, and flows downgradient through progressively finer-grained sediments towards the central basin. Because the Tularosa Basin is a closed system, water that enters the area only leaves either through evaporation or percolation. This elevated amount of percolation results in a fairly high water table. Beneath HAFB, groundwater ranges from 5 to 50 feet. Flow for the Base is generally towards the southwest with localized influences from the variations in the topography of the Base. Near the arroyos, groundwater flows directly toward the surface drainage feature.

Groundwater quality in the Tularosa Basin is of potable quality at the recharge areas in close proximity to the Sacramento Mountains and becomes increasingly mineralized toward the central portion of the basin and discharge areas (Radian, 1993). The majority (over 70 %) of the ERP Sites / SWMUs / AOCs located across HAFB, have groundwater monitoring wells containing water with an average TDS concentration greater than 10,000 mg/L. This TDS data supports the hypothesis that TDS concentrations below 10,000 mg/L at HAFB are caused by dilution of natural groundwater from leaking water lines and surface irrigation from the domestic water supply. TDS concentrations greater than 10,000 mg/L exceed the NMWQCC limit as potable water and thus, the groundwater beneath HAFB has been designated as unfit for human consumption. Likewise, U.S. Environmental Protection Agency (USEPA) guidelines have identified the groundwater as a Class IIIB water source, characterized by TDS concentrations exceeding 10,000 mg/L.

In addition, there are no potable water wells on HAFB. Potable water for the base and the city of Alamogordo is derived from the nearby Sacramento Mountains. The only production water well, used for livestock irrigation, is located approximately 12 miles southwest of SWMU 197 (OT-14).

1.5.2 Site OT-14 Hydrogeology

During the Phase I RFI, groundwater elevations were measured at 4 locations across the site on November 4, 1991. Depth to water was approximately 5 feet below ground surface (bgs) with groundwater elevations ranging between 4072.64 to 4073.84 feet mean sea level (MSL). Figure 1-5 is a site map indicating the November 4, 1991, water elevations.

The local groundwater flow direction is southerly with a gradient of approximately 0.004. Hydraulic conductivity tests performed on the wells using the slug test method resulted in an average conductivity of 3.47×10^{-3} feet per minute (ft/min) (Radian, 1992).

1.6 Climate

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

1.7 Water Use

HAFB is located in the Tularosa Sub-basin. Potable water is available from municipal wells along the margins of the basin with more saline water towards the center. The principle sources of potable water are located in a long narrow north-south trending area east of Alamogordo and Tularosa and in the far southern part of the basin. HAFB is also supplied potable water from Lake Bonito, which is in the Pecos River Basin.

Within the boundaries of OT-14, storm water run-off is controlled by the minimal topographic relief as per the existing grade and landscaping. Appurtenances can be found along the perimeter of the Civil Engineering (CE) yard for collection into the Base storm water drainage system.

2 HISTORICAL DATA REVIEW AND CONCEPTUAL SITE MODEL

This section presents an overview of the previous investigations and the preliminary conceptual site model for Site OT-14. Since 1991, Site OT-14 has been the subject of two environmental investigations related to evaluating the soil and groundwater conditions to determine the nature and extent of pesticides (and other potential contaminants). A petition for No Further Action (NFA) in 1999 was rejected by the NMED on the basis of insufficient characterization. For this reason, additional investigation and potential remediation is being proposed in this Work Plan. Most of the information presented in this section was obtained from the following historical reports:

- *Installation Restoration Program Records Search for Holloman Air Force Base, New Mexico*, August 1983, CH_2M Hill.
- *Draft Final Remedial Investigation (RI) Report, Investigation, Study and Recommendation for 29 Waste Sites, Holloman Air Force Base, NM*, June 1992, Radian Corporation.
- Foster Wheeler Environmental Corporation & Radian Corporation. June 1995. *Draft Final Phase II RCRA Facility Investigation Report, Table 1 Solid Waste Management Units, Holloman Air Force Base, New Mexico.*
- Foster Wheeler Environmental Corporation. July 1997. *Project Closeout Report Installation Restoration Sites SD-08, and OT-14 Remedial Action, Holloman Air Force Base, New Mexico.*

The analytical results and sample locations for the subsurface soil and groundwater samples collected during the two previous investigations and the OT-14 asphalt cap design specifications are included in Attachment B of this Work Plan.

The site was first identified as a potential source for release to the environment during the 1983 Installation Restoration Program (IRP) records search (CH2M-Hill, 1983) and originally believed to be present at Building 67. The 1988 RCRA Facility Assessment (RFA) field inspection could not locate the site (A.T. Kearney, 1988). However, a literature search and interviews with Base personnel conducted in February 1991 provided the location of the site as adjacent to Building 66 located in the Civil Engineering yard.

From 1968 to 1977, pesticide spraying and washing equipment was rinsed out in an open area adjacent to the building (Radian, 1992). In July 1977, soil samples were collected from the rinse area and the results revealed the presence of persistent pesticides (Radian, 1992). The upper 6 to 8 inches of the affected area was tilled and treated with lime and charcoal. Interviews with Base

personnel familiar with the Entomology Shop operations stated that the pesticide commonly used was DDT and this and other pesticides were routinely mixed with diesel fuel as a solvent. Interviews with past employees indicated that mixing and rinsing of spraying equipment was performed outside adjacent to Building 66. Currently, the area is sometimes used to stage emergency spill response equipment. The area is flat and covered with an engineered asphalt cap. A telephone pole has been installed through the northeastern portion~~center~~ of the asphalt cap.

Phase I Remedial Investigation and Phase II RFI investigations have been conducted at the site. Soil samples collected at the site identified pesticides in several samples. Analytical results from only five~~three~~ samples and ~~and~~ three~~two~~ analytes exceeded the NMED Residential SSLs for pesticides. However, these samples were collected and analyzed between approximately 13 and 16 years ago. Groundwater surrounding the perimeter of the site did not exhibit impact by OT-14. However, no water samples were collected immediately beneath the contamination. A detailed summary of the previous investigation results are summarized in Section 2.1 below.

2.1 Phase I RI and Phase II RFI

2.1.1 Phase I R~~F~~I at OT-14

Phase I investigation activities at the site were conducted as part of the 29 Sites Remedial Investigation (RI) (Radian, 1992). During the Phase I RI, five soil borings (SB-14-01 through SB-14-05) were drilled and four monitoring wells (MW-14-01 through MW-14-04) were installed (Figure 1-3). Two soil samples from each boring were analyzed for organochlorine pesticides, chlorinated herbicides, and volatile organic compounds (VOCs).

Elevated concentrations of 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, aldrin, and chlordane were detected in soil samples collected from the five borings drilled in areas of former drum storage and mixing activities (Radian, 1992). The concentrations of these organochlorine pesticides were significantly higher in the surface intervals (0 to 2 feet [ft]) than in the 2 to 4 ft sample intervals. Only three soil samples contained pesticides (4,4'-DDT and chlordane) in excess of the current NMED SSLs (NMED, 2006a). Soil samples from 0 to 2 feet bgs at borings SB-14-02, SB-14-03, and SB-14-04 exceeded the SSLs. They are located north and west of the Building 66 (Figure 2-1). The maximum concentrations of each pesticide exceeding the SSLs are 4,4'-DDT at 36,000 micrograms per kilogram (µg/kg) and chlordane at 34,000 µg/kg. These values are within the same order of magnitude as the SSLs. Table 2-1 is a summary of soil analytical results from samples collected at OT-14. The table also includes the NMED SSLs for the identified constituents.

Four monitoring wells were installed and sampled. One ~~organo~~chlorinated herb~~pest~~icide, 2,4'-DB was identified in two wells (maximum concentration of 4.0 µg/L at MW-14-03) but significantly less than the NMWQCC standard of 70 µg/L. No VOCs, except benzene (maximum concentration of 0.82 µg/L), methylene chloride (maximum concentration of 32

µg/L), and toluene (maximum concentration of 1.3 µg/L) were detected in the groundwater samples (Radian, 1995). TDS in the groundwater samples collected at the site ranged between 11,000 mg/L and 16,000 mg/L which exceeds the NMWQCC standards for regulated groundwater (10,000 mg/L). Major dissolved anions (chloride, sulfate, fluoride, and nitrate) exceeded the NMWQCC human health standards for groundwater with a TDS concentration below 10,000 mg/L (New Mexico Administrative Code [NMAC] 20.6.2)~~but were comparable to background levels~~. However, TDS concentrations in groundwater at site OT-14 range~~s~~ from 11,000 to 16,000 mg/L which exceeds the NMWQCC standard for potable groundwater (10,000 mg/L). Table 2-2 is a summary of the groundwater analytical results from samples collected and analyzed at OT-14 during the Phase I R~~F~~I.

In 1993 a risk assessment was performed as part of the Phase I RFI (29 Sites RI). Based upon the risk assessment procedures used at the time, the assessment indicated that pesticide contamination in shallow soil (0.5 to 2.0 feet bgs) at the site posed a risk to human health. The investigation concluded that further investigation to characterize the extent of organochlorine pesticides in soil was necessary (Radian, 1995).

At the direction of USEPA, a Feasibility Study (FS) was performed at the site as part of the Phase II investigation (Radian, 1995). The FS was performed to determine the appropriate Remedial Action Operation (RAO) for the site. The conservative estimate of soil impacted by pesticides, in 1995, at the site was 740 cubic yards (cu yds). The 1993 FS concluded that containment with an impermeable cap was a more appropriate action. The cap was installed in 1996.

2.1.2 Phase II RFI at OT-14

To verify the lateral extent of pesticides exceeding the cleanup criteria estimated during the FS, a Phase II RFI was conducted in 1994. During the investigation, soil samples were collected from the 12 soil borings (DP-14-01 through DP-14-12) drilled with a direct push technology (DPT) rig. The soil borings were located along the perimeter of the former drum storage and mixing area as shown on Figure 1-3. Soil samples were collected from 0 to 2 feet bgs. All soil samples were analyzed for pesticides using USEPA method 8080 (which was the appropriate methodology at the time of the investigation). A summary of the analytical results from these samples are presented in Table 2-1.

A total of 12 soil samples were~~have been~~ collected both within and along the perimeter of the drum storage area ~~site~~ during the ~~both~~ P~~p~~hase II investigation~~s of sampling~~. ~~Only three samples contained pesticides (4,4' DDT , chlordane and heptachlor) in excess of the NMED SSLs.~~ Soil samples from 0.5 to 2~~1.5~~ feet bgs at borings DP~~SB~~-14-10~~02~~, ~~SB-14-03,~~ and DP~~SB~~-14-12~~04~~ exceeded the NMED SSLs for heptachlor (1,080 µg/kg) and chlordane (16,200 µg/kg) respectively. These soil borings~~y~~ are located northeast~~ and west~~ of~~of the~~ Building 66 (Figure 2-1). The maximum concentrations of each pesticide exceeding the SSLs are ~~4,4' DDT at 36,000~~

~~micrograms per kilogram (µg/kg)~~ chlordane at 26~~34~~,000 µg/kg (DP-14-12) and heptachlor at 2,200 µg/kg (DP-14-10). These values are within the same order of magnitude as the SSLs.

The analytical results from the Phase I and II investigations indicate that pesticide contamination is concentrated in a narrow band that runs approximately east to west in the central part of the site.

2.1.3 Asphalt Cap

Historically, the site entered the Feasibility Study/Corrective Measures Study (FS/CMS) process to establish a health-based RAO for soil contamination at the site. The RAO for the site was to prevent unacceptable health risk to workers by dermal contact with contaminated soils. The FS/CMS established risk based cleanup criteria and estimated that approximately 740 cu yds of soil would require corrective action. At that time, excavation of that volume of material was considered inappropriate and an impermeable cap over the affected zone was recommended (Radian, 1995). A cap consisting of geotextile fabric layer, a geomembrane layer, a geonet drainage layer, and an aggregate base layer topped with ~~liner material and~~ asphalt was constructed and installed by Foster Wheeler Environmental Corporation (FWENC) at the site in 1996 (FWENC, 1997~~6~~). Specifications on the impermeable cap that was constructed are included in Attachment B, of this work plan.

2.2 Conceptual Site Model

The conceptual site model (CSM) for the VCM at OT-14 is that the site contains a narrow and shallow (0 to 2 feet bgs) area of pesticide contaminated soil overlying groundwater (approximately 5 feet bgs). Groundwater at the site has a TDS concentration ranging between 11,000 mg/L and 16,000 mg/L which exceeds the NMWQCC standards for regulated groundwater (10,000 mg/L). Groundwater samples collected from the perimeter of the contaminated soil do not contain pesticides. Other constituents in groundwater such as fluoride and nitrates have exceeded NMWQCC standards but are not inconsistent with background groundwater quality at the Base.

From the analytical results of soil and groundwater samples collected 13 and 16 years ago (1991 and 1994), it appears that approximately 400~~360~~ cu yds of soil may have exceeded the NMED SSLs (Figure 2-1). The concentrations of pesticides identified in the soil samples analyzed were within the same order of magnitude as the NMED SSLs.

The area has been capped with liner material and asphalt to prevent migration of the pesticides. The cap, warm temperatures, and the shallow groundwater should have created an environment favorable to degradation of pesticides (i.e. anaerobic environment). Most likely the original concentrations of pesticides have decreased in the past 13 to 16 years resulting in both less volume of soil exceeding the SSLs and/or a reduction in pesticide concentrations. This natural

degradation might eliminate the necessity for any further action at the site. However, additional characterization to demonstrate the validity of the conceptual site model will be necessary. The data proposed for collection in Section 3 of this work plan includes additional soil samples co-located with the original observations along with additional samples across the site to document the present conditions. Also, groundwater samples will be collected from the existing monitoring wells and one additional well placed in the center of the area of contamination (in order to characterize impacts to groundwater directly beneath the pesticide contaminated soil). These soil and groundwater samples will be analyzed for VOCs, SVOCs, pesticides, RCRA metals, and Total Petroleum Hydrocarbons (TPH).

Collection of these additional data will result in one of the following pathway(s) to site close out:

1. Observable concentrations of remaining pesticides are less than the published NMED SSLs. Impacts to groundwater are defined and groundwater has a TDS greater than 10,000 mg/L. Or, detected groundwater constituents do not pose a threat to human health or the environment (risk based evaluation). The site is eligible for No Further Action (NFA) according to Criterion 5: The SWMU/AOC has been characterized or remediated in accordance with current applicable State or federal regulations, and the available data indicate that contaminants pose an acceptable level of risk under current and projected future land use. This approach does not require any excavation or intrusive VCM to achieve NFA.

2. Observable concentrations of pesticides have degraded during the past 15 years but not to the levels below the SSLs. Impacts to groundwater are defined and groundwater has a TDS greater than 10,000 mg/L. Or, groundwater has TDS less than 10,000 mg/L and remaining constituents do not pose a threat to human health or the environment (risk based evaluation). Module 4 Appendix 4-F page 3 of 5, Section V.1 of the Hazardous Waste Facility Permit states that the Base may propose alternate risked based levels for Corrective Action. Site specific risk assessment indicates the remaining pesticides are not a threat. These alternate standards would not require excavation of the pesticide impacted soil. The Base would then petition for NFA according to Criterion 5: The SWMU/AOC has been characterized or remediated in accordance with current applicable State or federal regulations, and the available data indicate that contaminants pose an acceptable level of risk under current and projected future land use. This approach does not require any excavation or intrusive VCM to achieve NFA. However, it will be necessary to generate some site specific risked based action levels to support this approach.

3. Observable concentrations of pesticides have not degraded during the past 15 years to levels either less than the NMED SSLs or proposed alternative site specific risked based standards. Soil with pesticide concentrations exceeding the NMED SSLs will be excavated and transported for offsite disposal at the appropriate TSD facility. Confirmation soil samples will be collected from the side walls (and bottom) of the

excavation consistent with NMED guidelines. Impacts to groundwater are defined and groundwater has a TDS greater than 10,000 mg/L. Or, groundwater has TDS less than 10,000 mg/L and remaining constituents do not pose a threat to human health or the environment (risk based evaluation). The Base would petition for NFA according to Criterion 5: The SWMU/AOC has been characterized or remediated in accordance with current applicable State or federal regulations, and the available data indicate that contaminants pose an acceptable level of risk under current and projected future land use. This approach will require excavation, transportation, and disposal of pesticide contaminated soil along with the collection and analysis of confirmation samples from the sidewalls.

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3 ADDITIONAL INVESTIGATION ACTIVITIES

The primary objective of the additional investigation component of this VCM Work Plan is to collect sufficient subsurface soil and groundwater data to characterize and confirm the delineation of pesticide contaminated soil and groundwater, if any. Data from the investigation phase will be used to implement the VCM strategy(s) identified in the conceptual site model (Section 2.2 of this Work Plan). If necessary, a site specific risk evaluation to evaluate exposure pathways relative to current and future industrial/commercial workers and residents will be conducted after the investigation and/or excavation activities have been completed. A complete description of the risk evaluation process is presented in Section 6.2 of this Work Plan. The second component of this VCM (Section 4 of this Work Plan) is to remove, through excavation, and properly dispose the contaminated soil.

3.1 Pre-investigation Requirements

Before site activities can begin, there are several pre-investigation documents and approval requirements to be met, including Air Force Form (AF Fm) 332 approval, Base dig permit with utility clearances, site security measures, and facility manager notification of the intended operations. Bhate will coordinate project requests for Base installation support services through the 49th Civil Engineering Squadron/Environmental Flight (CES/CEV). Pertinent to the start of activities, a pre-construction meeting and site walk-through will be conducted with the USACE Resident Engineer, HAFB personnel, and Bhate Site Manager, to inspect site conditions for site/equipment access, equipment staging, and decontamination area(s), potential site hazards, and emergency evacuation routes. Also reviewed at this time will be project procedures in accordance with the schedule and planned activities.

3.1.1 AF Form 332

Prior to initiating excavation activities a completed and approved AF Fm 332, will be obtained. This form authorizes construction work at HAFB and is required for the initiation of any construction work. This work order describes what activities will take place at the location.

3.1.2 Dig Permit/Utility Clearances

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

3.1.3 Site Security

Site security is concerned with safety at the site during all drilling activities, and areas surrounding the drilling activity, and will be addressed as outlined in the *Basewide Health and Safety Plan* (HASP) (Bhate, 2003b). At a minimum the exclusion zone will be secured with caution tape, and traffic cones surrounding the perimeter of the site. The size of the exclusion zone will be determined by the size of the drilling and support equipment, and the prevailing site conditions. Open boreholes will not be left unattended without first securing the immediate area surrounding the borehole, and covering the opening so that it does not become a hazard.

3.2 Investigation Requirements

Field activities will be performed in accordance with the Site-Specific Addendum to the Basewide Health and Safety Plan, the Quality Assurance Project Plan (QAPP) Addendum (Appendices A and B, respectively), as well as other USACE mandated procedures for laboratories and activities such as groundwater sampling. The field work for this additional investigation will be conducted in accordance with HAFB Standard Operating Procedures (SOPs) provided in the *Basewide Quality Assurance Project Plan* (Bhate, 2003a) and the *Bhate Standard Operating Procedures (BSOPs)* (Bhate, 2002). These SOPs outline methodologies for soil boring advancement, soil sampling, soil sample description, field screening, sample management, equipment decontamination, and chain-of-custody procedures. Sample nomenclature will follow the Environmental Restoration Program Information Management System (ERPIMS) format presented in the *ERPIMS '98 Data Loading Handbook, Version 4.0.* (Air Force Center for Environmental Excellence [AFCEE], 1997). The specific HAFB SOPs for this sampling event are listed below:

HAFB SOP-1 Documentation, Sample Handling, Chain-of Custody, and Shipping

HAFB SOP-2 Sampling Equipment Documentation

HAFB SOP-3 Staking, Utility Clearance, and Permitting

HAFB SOP-4 Direct Push Sampling for Soil and Groundwater

HAFB SOP-5 Soil Sampling for Chemical Analysis

HAFB SOP-6 Procedure for Field Screening of Volatile Organics

HAFB SOP-7 Lithologic Description and Geotechnical Sampling

HAFB SOP-8 Groundwater Sampling for Chemical Analysis

HAFB SOP-9 Field Management of Investigation-Derived Waste

HAFB SOP-10 Borehole Abandonment and Site Restoration

The following sections describe the locations and procedures for DPT soil and groundwater sampling and the groundwater monitoring well installation, sampling, and analysis to be performed.

3.2.1 Laboratory Analytical Methods

The chemical analysis of soil and groundwater samples collected during this additional investigation at OT-14 will follow the USEPA SW-846 protocol. The soil and groundwater samples will be analyzed as follows:

- Pesticides by USEPA Method 8081
- VOCs by USEPA Method 8260B
- SVOCs by USEPA Method 8270C
- TPH (Gasoline Range Organics [GRO], Diesel Range Organics [DRO], Oil Range Organics [ORO]) by modified USEPA Method 8015B~~M~~
- RCRA 8 Metals (arsenic, barium, chromium, cadmium, lead, mercury, selenium, and silver) by USEPA Methods 6010B/7470A (groundwater) and 6010B/7471A (soil)

The groundwater samples collected from monitoring wells will also be analyzed for:

- TDS by USEPA Method 160.1

A total of 14 soil samples (based on 6 DPT boreholes/2 samples per borehole), including two field duplicate samples will be collected. Additionally, two trip blanks (one estimated for every shipment of VOC samples), and one matrix spike/matrix spike duplicate (MS/MSD) sample will be submitted for laboratory analysis. Six g~~and 6 g~~roundwater samples will be collected from five monitoring wells including~~including~~ one~~1~~ field duplicate. In addition, one MS/MSD, and one trip blank for each shipment of VOC samples will ~~sample will~~ be submitted to the laboratory for analysis. ~~All samples for VOC analysis will require a trip blank.~~ The samples will be placed on ice and shipped under strict chain-of-custody to Accutest Laboratories in Orlando, Florida. Residual soil from the soil sampling will be discarded in accordance with the waste management procedures established in Section 3.4, Investigation-Derived Waste (IDW) Management.

3.2.2 DPT Soil Sampling

Soil samples will be collected continuously from soil borings using DPT methodology in accordance with HAFB SOP No. 4. Each boring will be visually classified and lithology described in the field according to HAFB SOP No. 7 and the Unified Soil Classification System (USCS) (American Society for Testing and Materials [ASTM] D 2487-92 and ASTM D 2488-90). The specific locations of the borings may be modified based on site-specific (access, any observed or underground utilities, etc.) field conditions. Based upon the depth to groundwater at the site (5 feet bgs), the estimated depth of each soil boring will be to a maximum of 15 feet.

Six DPT soil borings (14-DP-13 to 14-DP-18) will be completed at the locations shown on Figure 3-1. Soil~~amples~~ will be collected continuously, using a Geoprobe® Dual Tube sampling system, at five~~our~~ foot intervals. Soils will be continuously field screened in accordance with HAFB SOP No. 6 using an Organic Vapor Analyzer (OVA) with soil-headspace screening techniques, to assist in the selection of sample intervals ~~at two foot intervals~~. Notation will also be made of any visual (discoloration) and/or aromatic observations (such as a mothball odor) that are indicative of potential contamination.

A qualified surveyor will locate the DPT boreholes using a global positioning system (GPS), in accordance with methods described in the Basewide QAPP (Bhate, November 2003a). All horizontal coordinates will be referenced to the State Plane Coordinate System, New Mexico Central, North American Horizontal Datum 1983, and ~~and~~ surveyed to an accuracy of +/- 1.0 ft. For the purpose of soil boring locations no vertical elevations will be recorded.

A maximum of two soil samples per boring will be collected and sent for off-site laboratory testing as per the following methodology:

- Each boring will be drilled to 15~~2~~ ft bgs (depth to groundwater estimated at 5 feet bgs).
- Continuous OVA readings will be collected during each soil boring.
- Soil samples from 0 to 2 foot interval will be collected from each boring for laboratory analysis.
- The second sample from each boring will be collected based upon the interval with the highest OVA readings or if odors indicate potential contamination. ~~from across the water table (anticipated to be between 4 and 6 feet bgs).~~ However, if odors and / or OVA readings do not indicate noticeable contamination in the borehole~~at another interval~~, the second sample will be collected from just above the water table (anticipated to be between 4 and 6 feet bgs). ~~that interval.~~

A total of 14 soil samples (based on 6 DPT boreholes/2 samples per borehole), including two duplicate samples. In addition, two trip blanks, and one MS/MSD sample will be collected for

quality control (QC) analysis. Each soil sample will be analyzed by an offsite laboratory for VOCs, SVOCs, TPH (DRO/GRO/ORO), pesticides, and RCRA 8 metals. Samples selected for laboratory analysis will be labeled, handled, and prepared for shipment in accordance with HAFB SOP-1. The soil samples which will be submitted for chemical analysis are summarized in Table 3-1.

3.2.2.1 Geotechnical Soil Sampling

A total of two undisturbed geotechnical samples are to be collected from 1 of the 6 DPT boreholes (Figure 3-1). The geotechnical data will be utilized for the risk based evaluation that will be included in the closure report. The geotechnical data are required to perform the risk evaluation as specified by the NMED (NMED 2006a). The soil samples will be collected from borings that have not been impacted by pesticides, therefore these boring/geotechnical sampling locations will be determined during the additional investigation. The undisturbed soil samples (two per borehole) will be collected from 0 to 2 ft bgs and at a depth above the water table where the lithology is representative of the site. The geotechnical soil samples collected during this investigation will be analyzed as follows:

- Moisture Content by USEPA Method 160.3M
- Dry Bulk Density by ASTM Method D2937
- Specific Gravity by ASTM Method D1429-86
- Fractional Organic Carbon Content by ASTM Method D2974

The soil samples for geotechnical analysis will be collected in a thin-walled tube sampler, the tube ends will be capped and the top and bottom ends of the tube labeled. The soil core samples will be shipped to Accutest Laboratories in Orlando, Florida for analysis. The soil samples which will be submitted for geotechnical analysis are also summarized in Table 3-1.

3.2.3 DPT Groundwater Monitoring Well Installation and Sampling

A temporary monitoring well will be installed at OT14-DP-15 for the purpose of collecting a groundwater sample from beneath the maximum area of contamination (Figure 3-1).

The temporary groundwater monitoring well will be constructed of 1-inch inside diameter (ID) polyvinyl chloride (PVC). The well will be screened with 5 feet of 0.020 inch factory slotted PVC. The annular space surrounding the screen was backfilled with 10/20 Colorado silica sand and capped with a 2-foot layer of bentonite pellets. The monitoring well will be completed with a flush mount steel manhole cover to protect the well, from surface water infiltration and damage due to vehicles and heavy equipment, for future use if necessary. The well will be developed to promote hydraulic communication with the aquifer and to remove fines prior to sampling.

Procedures for DPT groundwater sampling are outlined in HAFB SOP-4. Following sampling, the temporary monitoring well will remain~~be~~ onsite until all analytical data relative to the well has been reviewed. Once permission has been obtained form NMED the well will be completely removed from the ground and the borehole will be sealed in accordance with HAFB SOP-10.

Four existing monitoring wells (MW-14-01, MW-14-02, MW-14-03, and MW-14-04) and the newly installed temporary monitoring well (OT14-TMW-15) will ~~also~~ be sampled under this Work Plan (Figure 3-1). Prior to sampling each of the wells will be purged with a peristalitic pump, utilizing low flow techniques. During purging of the 5 wells, a multi-parameter sonde with a flow through cell, will be used to collect water quality parameters (pH, conductivity, dissolved oxygen, and temperature). Water quality parameters will be recorded in a Monitoring Well Sample Collection Log. ~~These wells are:~~

~~MW-14-01, MW-14-02, MW-14-03, and MW-14-04 and are shown in Figure 3-1.~~ A total of 6 groundwater samples including one duplicate sample, ~~–~~will be collected from the 4 existing monitoring wells and 1 temporary monitoring well. In addition, one MS/MSD, and one trip blank for each shipment of VOC samples will be submitted to the laboratory for analysis. The 8 aqueous samples will be analyzed by an offsite laboratory for pesticides, VOCs, SVOCs, TPH (DRO/GRO/ORO), RCRA 8 metals, and TDS. Monitoring well groundwater samples will be labeled, handled, and prepared for shipment in accordance with HAFB SOP-1. The groundwater samples which will be submitted for chemical analysis are summarized in Table 3-2.

3.2.3.1 Surveying

A registered New Mexico Surveyor will survey the new temporary and existing permanent monitoring well locations in accordance with methods described in the Basewide QAPP (Bhate, November 2003a). Horizontal locations will be relative to the State Plane Coordinate System, New Mexico Central, North American Horizontal Datum 1983, and surveyed to an accuracy of +/- 1.0 ft. Vertical elevations will be referenced to the North American Datum (NAD) 1983. The top of casing (vertical control) will be used to determine the depth and elevation of the groundwater and surveyed to an accuracy of +/-0.01 ft. During this investigation the source area(s) will be mapped to scale showing ancillary structures, sampling locations, buildings, roads, sidewalks, paved and unpaved areas. Additionally, all maps will include a projection, coordinate system and datum (e.g., State Plane Coordinate System, New Mexico Central, North American Horizontal Datum 1983~~latitude/longitude~~), north arrow, scale, and the site boundaries.

3.2.3.2 Groundwater Elevations

During the sampling of monitoring wells under this Work Plan, groundwater elevations will be measured. Elevations will be measured for the 4 existing wells and the temporary well at 14-DP--15. A current groundwater table contour map of OT-14 will be developed from the groundwater elevation data collected during this investigation.

3.3 Sample Identification System

Each environmental sample collected will be identified on the sample label and chain-of-custody (COC) records, regardless of type. Sample documentation, handling, and shipping will be in accordance with HAFB SOP-1. Table 3-3 provides the sample collection information inclusive of the container type and quantity for the soil and groundwater samples collected during the additional investigation at OT-14. The field duplicate samples will appear in sequence with the regular samples. The sample identification nomenclature for soil samples collected from DPT boreholes will be as follows:

OT-14-DP-13-2a

Site alpha-numeric identifier: OT14 = Site OT-14

Sample type identifier: DP = direct push boring

Sequential direct push boring number: 13, 14, etc.

Ending depth of sample interval: 2

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

The sample identification nomenclature for groundwater samples collected from temporary monitoring wells installed into direct push boreholes will be as follows:

OT14-TMW-~~DP~~153~~-~~a

Site alpha-numeric identifier: OT14 = Site OT-14

Sample type identifier: TMW~~DP~~ = temporary monitoring well~~direct push boring~~

Sequential direct push boring number: 15~~13, 14, etc.~~

Reserved for QA sample identifiers: a = field duplicate, TB = trip blank, MS = matrix spike, MSD = matrix spike duplicate

The sample identification nomenclature for groundwater samples collected from existing permanent monitoring wells will be as follows:

~~OT14-~~MW-14-014~~-~~a

Site ~~alpha-~~numeric identifier: ~~OT~~14 = Site 14

Sample type identifier: MW = monitoring well

Monitoring well number: 01, 02, etc.

Reserved for QA sample identifiers: a = field duplicate, TB = trip blank, MS = matrix spike, MSD = matrix spike duplicate

3.4 Investigation-Derived Waste Management

IDW will be managed and characterized according to HAFB SOP-9. Whenever possible, waste minimization techniques will be used to reduce the amount of IDW. IDW generated by installing the temporary monitoring well and subsequent groundwater sampling activities will be managed and characterized according to the following guidelines. The borehole cuttings will be screened with a photo ionization detector (PID) or OVA for the presence of organic vapors. If the soil is free of organic vapors, it will be spread on the ground surrounding the well. If PID screening of the soil indicates the presence of organic vapors, the soil will be placed in a 55-gallon drum and characterized for determining proper disposal~~ the FT-31 landfarm at HAFB~~. Purged groundwater from development and sampling activities will be containerized, characterized, and maintained by Bhate until disposal through the HAFB Wastewater Treatment Plant (WWTP), pending laboratory analysis. Other liquid wastes, such as decontamination rinses, will be handled as if contaminated and containerized pending laboratory analysis~~are anticipated to be non-hazardous and as such.~~, If the laboratory results indicate analyte concentrations exist below target concentrations, the liquid wastes will be disposed of via the HAFB WWTP. ~~can be disposed of through the HAFB WWTP.~~ Personal protective equipment (PPE) and other site non-hazardous debris/waste shall be cleaned and disposed per Sections 3.4.1 and 3.4.2 of this Work Plan~~in standard trash receptacles~~.

The IDW soil and groundwater characterization samples will be analyzed as follows:

- Pesticides by USEPA Method 8081
- VOCs by USEPA Method 8260B
- SVOCs by USEPA Method 8270C
- TPH (GRO, DRO, ORO) by modified USEPA Method 8015B
- RCRA 8 Metals (arsenic, barium, chromium, cadmium, lead, mercury, selenium, and silver) by USEPA Methods 6010B/7470A (groundwater) and 6010B/7471A (soil)

3.4.1 General Decontamination Procedures

Small equipment, such as sampling tools, will be decontaminated in accordance with HAFB SOP-2. Heavy equipment such as the DPT rig, etc., will be decontaminated by steam cleaning at a temporary decontamination pad set up at the site. Decontamination water will be collected in 5 gallon bucket containers. The containers and decontamination pad will be managed in a secure area and the decontamination water will be~~ either allowed to evaporate or~~ combined with the purged groundwater and discharged to the HAFB WWTP, pending laboratory analysis. Sediment remaining in the decontamination pad area after the water has ~~either evaporated or~~ been containerized for characterization~~discharged to the WWTP~~, will be combined with the soil

boring cuttings to be characterized. Disposal of soil will depend on laboratory analysis and will either be~~remediated in the onsite landfarm~~, transported offsite to an appropriate disposal facility, or spread on the ground if the analytical results indicate that the soil is suitable for use as backfill.

3.4.2 Personal Protective Equipment

Prior to disposal, used PPE, disposable items, and the decontamination pad liner will be rinsed clean with tap water and diluted detergent solution. Rinse water will be collected in 5 gallon buckets and combined with other decontamination water that will be characterized and disposed of properly, pending laboratory analysis. Cleaned PPE and presumed clean, based upon non-contact with contaminated soils, water, or equipment, and other disposable clean items will be contained in trash bags and disposed of at the applicable onsite sanitary waste receptacle.

3.5 Site Restoration

Upon completion of the site inspection activities, the site will be restored to the original condition. Sampling locations will have been backfilled or grouted to the surface. The site will be canvassed for trash, debris, etc.

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4 EXCAVATION PROCEDURES

If the soil analytical results described in Section 3 exceed the NMED SSLs and exceed site specific risked based levels as described in Section 6, then pesticide contaminated soil will be excavated and transported offsite for disposal. The objective of the soil remediation at OT-14 is to excavate, transport, and dispose of the pesticide contaminated soil. Subsurface soil contaminated with pesticides in excess of the NMED SSLs will be excavated and transported offsite for disposal. Based upon the historical analytical results, it is anticipated that the top 2 feet of soil beneath the cap may be excavated in the areas where soil is contaminated with pesticides in excess of the NMED SSLs. Completion of excavation will be documented through the collection of side wall and bottom samples in accordance with NMED guidance.

The construction general permit requires a project Storm Water Pollution Prevention Plan (SWPPP) to be submitted for excavation sites which will disturb greater than one acre of surface soils. For the planned activities, inclusive of the temporary clean soil stock piles, the total area of disturbance and/or excavation is less than one acre. Therefore, a project SWPPP will not be prepared and submitted.

Except where noted below, the excavation activities will be conducted in accordance with the procedures outlined in Unified Facilities Guide Specifications (UFGS) Section 02111 *Excavation and Handling of Contaminated Material* (included as Appendix C of this Work Plan) and the *USACE Safety and Health Requirements Manual, EM 385-1-1* (USACE, 2003). The UFGS are a joint effort of the USACE, the Naval Facilities Engineering Command (NAVFAC), and the Air Force Civil Engineer Support Agency (AFCESA). The UFGS are for use in providing construction specifications and guidelines for the military services.

4.1 Pre-Excavation Activities

Before excavation and other site activities can begin, there are several pre-construction documents and approval requirements to be met, including: Form 332 approval, dig permit with utility clearances, site security measures, and facility manager notification of the intended operations. Bhate will coordinate project requests for Base installation support services through the 49th CES/CEV. Pertinent to the start of activities, a pre-construction meeting and site walk-through will be conducted with HAFB personnel, and the Bhate Site Manager to inspect site conditions for site/equipment access, equipment staging area(s), soil stockpile areas, potential site hazards, and emergency evacuation routes. Also reviewed at this time will be project procedures in accordance with the schedule and planned activities.

4.1.1 AF Form 332

Prior to initiating excavation activities a completed and approved AF Fm 332, will be obtained. This form authorizes construction work at HAFB and is required for the initiation of any construction work. This work order describes what activities will take place at the location.

4.1.2 Dig Permit/Utility Clearances

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

4.1.3 Excavation Area Site Safety

As an Occupational Safety and Health Administration (OSHA) Class II excavation, site safety is concerned with the excavation and the areas around the excavation. Concerns include: the proper designation and demarcation of excavation boundaries (i.e. exclusion zone [EZ], contamination reduction zone [CRZ], and support zone [SZ]), compliance with excavation requirements, posting of potential hazards, and control of un-authorized site personnel. This is discussed in the *Basewide Health and Safety Plan* (Bhate, 2003b). Although the excavation will occur in a relatively low pedestrian traffic area, site control will still be paramount for the safety at the site. Notification of the excavation activities, duration, and alternate routes for pedestrian traffic will have been provided to the appropriate personnel in Building 66 prior to the initiation of any field activities.

At a minimum, the site will be secured with caution tape surrounding the perimeter of the site delineating the outer boundary of the SZ. This is essential in the utility clearance process and it serves as the demarcation of the site for both project and non-project persons. A CRZ and/or EZ will be established as guided by the HASP and prevailing site conditions. The depth to the bottom of the excavation, if necessary, is expected to reach 2 feet below the asphalt cap~~gs~~. At the immediate edge of the excavation, a temporary construction fence will be erected completely around the excavation site. Postings will indicate the excavation hazard as well. In addition, when workers will be in or around an excavation, a certified competent person (as per 29 Code of Federal Regulations [CFR] Part 1926 Subpart P) shall inspect the excavation, the adjacent areas, and protective systems daily, as needed throughout the work shifts, and after every rainstorm or other hazard-increasing occurrence (USACE, 2003).

At a minimum Level D PPE will be used during excavation activities. Depending on site conditions and exposure monitoring upgrades in PPE and dust suppression may be necessary. Dust suppression measures include spraying potable water (contained in a water truck) to

dampen soil. Further details regarding PPE usage and direct reading exposure monitoring can be found in Appendix A of this Work Plan.

4.2 Decontamination Procedures

Small equipment, such as sampling tools, will be decontaminated in accordance with the *Basewide Quality Assurance Project Plan* (Bhate, 2003a). Decontamination rinses, will be handled as if contaminated and containerized pending laboratory analysis. If the laboratory results indicate analyte concentrations exist below target concentrations, the liquid wastes will be disposed of via the HAFB WWTP. Heavy equipment, such as the backhoe, trackhoe, etc., will be decontaminated at a temporary decontamination pad set up at the site. Decontamination of heavy equipment will consist of dry brush decontamination. Soil that is removed from the heavy equipment will be containerized and characterized for offsite disposal or used as backfill, pending laboratory analysis.

4.3 Excavation Activities

4.3.1 Excavation Boundary

The exact area of excavation (if necessary) is not certain without the collection of the additional soil samples described in Section 3 of this Work Plan. However, based upon previous investigations, it would most likely be limited to the area north, northeast and northwest of Building 66 as shown on Figure 4-1.

4.3.2 Excavation Shoring

During the excavation activities, personnel will not enter the excavation at any time. Shoring or benching may need to be erected ensuring that the excavation sidewalls do not collapse. The determination will be made as the excavation progresses. If any slumping or sidewall failure is evident, then shoring and/or benching will be implemented.

Excavation activities associated with other soil remediation projects at HAFB (e.g., SS-02/05, FT-31, and SS-17) indicate that the native soils demonstrate significant stability achieving near vertical walls during these excavations. The soils, in the vicinity of the presumed contamination area are native as determined from the previous investigations. At this time, shoring of the excavation is not intended. However, sidewall benching may be required.

4.3.3 Soil Excavation

Excavation activities will utilize the appropriate excavation equipment and a wheel loader to assist with soil management. Workers exposed to vehicular or equipment traffic including signalpersons, spotters or inspectors, shall wear high visibility apparel meeting American National Standards Institute/International Safety Equipment Association (ANSI/ISEA) 107 Class

3 requirements (USACE, 2003). All overburden soils determined to be clean will be removed prior to the removal of the contaminated soils (.—Sections 5.1.1 and 5.1.2, of this work plan, provide further details regarding overburden screening and sampling). However, overburden at this site will most likely consist of asphalt and liner material. The clean overburden soils, if any, will be temporarily stockpiled for subsequent backfilling. Soil stockpiles will be managed as to not allow for any material to be removed or transported off-site via wind or precipitation (see Section 7 of this Work Plan, Waste Management). Contaminated soil will be placed directly into (live loaded) roll off boxes or transport trucks suitable for delivery to the disposal facility.

4.3.3.1 Confirmation Soil Sampling

After the excavation is complete, and all suspected pesticide contaminated soils have been removed, sidewall confirmation samples will be collected. Samples will be collected using the bucket of the back-hoe. A soil sample will be obtained from the interior of the bucket to minimize the potential for outside source contamination. Confirmatory soil sSamples shallwill be biased to areas with the greatest potential for contamination and collected at a minimum frequency of 2 per 18 linear feet (ln ft) per side wall at mid-depth of the contamination zone. At a minimum, 1 sample per side wall will be collected for side walls less than 18 ln ft. A summary of sampling criteria and rationale is presented in Table 4-1.

4.3.4 Excavation Backfilling and Compaction

Backfilling of the excavation will not begin until confirmatory sampling confirms the absence of contaminated soils exceeding NMED Residential SSLs. Additional excavation may be required until these conditions are met. Clean soils will be obtained for backfill as needed from the HAFB borrow area or FT-31 Landfarm. Backfill adjacent to any and all types of structures shall be placed and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials to prevent wedging action or eccentric loading upon or against the structure. The material shall be placed in successive horizontal layers of loose material not more than 8 inches in depth. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. The compaction of the final two base lifts will be confirmed by determination of the soil density via an in-place nuclear or similar method per ASTM Method D 2922 (located in Appendix D of this Work Plan). If applicable, the final 12-inches of backfill will adhere to the specifications of Subgrade Preparation found in UFGS Section 02770A *Concrete Sidewalks and Curbs and Gutters* (located in Appendix E of this Work Plan).

4.3.5 Soil Disposal

Contaminated soil will be transported to the appropriate offsite facility based upon the soil sample analytical results and the toxicity characteristic leaching procedure (TCLP) analysis. Section 5.1 of this work plan, provides further details regarding the TCLP sampling of soil to be

disposed of at offsite facilities. The soil will be handled, transported, and managed in accordance with the NMED guidelines and respective facility's requirements. Waste manifests will be signed by Holloman AFB's Remedial Project Manager.

4.3.6 Site Restoration

Upon completion of site excavation and backfill activities, the site will be restored to its original appearance. Construction equipment and debris will be removed. The site will be canvassed for trash, debris, etc. Final grade for areas of the site which will not have a surface improvement upon them will allow for positive drainage in accordance with the surrounding area.

If any section(s) of walk way are removed or damaged during the excavation they will be replaced in similar construction and match in appearance to that which was removed. The design and construction, inclusive of materials, will be completed in accordance with the UFGS specifications for concrete sidewalks and gutters, Section 02770A *Concrete Sidewalks and Curbs and Gutters*, March 2004 (located in Appendix E of this Work Plan). Matching of the new sidewalk to the existing sidewalk has primacy over the UFGS guideline. The guideline should be adhered to utilizing best management practices and holding to the intent of the guideline. The guideline shall be implemented in its entirety except for the following Parts and/or subparts:

Sections 1.1 through 1.3	Sections 2.2.2 and 2.2.3
Section 1.6.2	Sections 3.7.1.1 and 3.7.1.3

Sections 2.1.3-Reinforcement Steel; 3.5.3-Reinforcement Steel Placement; and 3.7.4-Protective Coating are only applicable if the existing sidewalk is constructed in a similar manner.

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5 EXCAVATION SOIL SAMPLING AND ANALYSIS

If soil excavation as described in Section 4 of this Work Plan is necessary, then screening, soil sampling, and laboratory analysis of soil generated from the excavation as well as the completed sidewalls and bottom will be necessary. The following describe the procedures and methods for soil sample collection and analysis.

Table-5-1 provides the analytical methods and container requirements for samples collected for offsite laboratory analysis. The rationale, methods, and frequency for screening samples was previously detailed in Table 4-1.

5.1 Excavation Sampling

The excavation soil sampling requirements are detailed in Table 4-1 which includes the laboratory analysis of stockpiled soils and excavation sidewall confirmation samples to denote the extent of excavation. Additionally, the excavated soil will be field screened with an OVA and observed for noticeable odors (such as the smell of mothballs). Excavated soil that is suspect or visibly contaminated will be directly loaded into trucks or roll off boxes for transport to the appropriate disposal facility. A representative sample of the stockpiled excavated soil will be collected for waste characterization analysis using the ~~the toxicity characteristic leaching procedure (~~TCLP analysis~~)~~. Table 5-1 details the specific analysis to be performed on the TCLP leachate.

5.1.1 Overburden Field Screening

During excavation activities, field screening (headspace analysis with an OVA) will be performed on overburden soil at a frequency of one per every 25 cubic yards of excavated soil. Further, olfactory sensing will be used to detect odors similar to mothballs. If the headspace analysis reveals the presence of significant contamination (>300 parts per million [ppm] on the OVA), the soil will be placed into transports for offsite disposal. Otherwise the overburden soil will be stockpiled on site for backfill purposes. Table 4-1 includes details concerning field screening of overburden soils.

5.1.2 ~~Overburben~~Overburden Stockpile Sampling

Excavation at OT-14 should not generate overburden. However, this section has been included in the unlikely event that overburden is generated. For backfill characterization purposes, laboratory validation sampling will be performed at a frequency of one sample per every 200 cubic yards of stockpiled overburden soil. The samples will be analyzed for TPH (DRO, GRO, ORO), VOCs, SVOCs, RCRA metals, and pesticides. Table 5-1 details the specific analyses to be performed on the stockpile soil samples.

5.1.3 Excavation Confirmation Sampling

Excavation confirmation samples will be collected at a frequency of two per 18 linear feet (ln ft) per side wall at mid-depth of the contamination zone. At a minimum, one sample per side wall will be collected for side walls less than 18 ln ft. Analytical confirmation sampling from the bottom of the excavation will be collected at a rate of one per 400 square feet.

Samples will be analyzed by a fixed-base laboratory for TPH, -ORO, -DRO, and –GRO, using USEPA Method 8015B~~M~~, VOCs (USEPA Method 8260B), SVOCs (USEPA Method 8270C), RCRA 8 metals (Method 6010B/7471A), and pesticides (Method 8081). If any single sample demonstrates an exceedance of NMED residential SSLs, excavation will continue along that face or to greater depth until field screening deems termination with re-evaluation via laboratory confirmation analysis.

Soil data collected will adhere to project data quality objective (DQO) requirements, method reporting limits, duplicate field samples, and QA samples as established within the Basewide QAPP (Bhate, 2003a). Sample quantities, containers, methods of preservation, and holding times will be consistent with the requirements of associated method protocols and is detailed in Table 5-1 of this work plan. Laboratory analyses will be completed at a standard turn-around time of 7 days.

5.2 Analytical Methods

Each laboratory soil sample (including the field duplicates) will be analyzed for their respective analytes in accordance with Table 5-2. Samples will be analyzed for VOCs, by Method 8260B; SVOCs, by Method 8270C; RCRA 8 Metals, by Method 6010B/7471A; and TPHs –ORO, -DRO, and –GRO, by Method 8015B~~M~~.

Laboratory analyzed samples will be completed by Accutest Laboratories in Orlando, Florida.

6 RISK BASED CLEAN-UP APPROACH

The objective of the excavation activities presented is to remove the remaining pesticide contaminated soil from OT-14 to support closure of the site. Data collected as a result of field screening will be evaluated based upon the DQO's for the project. The results from the offsite laboratory confirmation samples from the additional characterization sampling will be used to determine if excavation is necessary. If excavation is necessary, sample analytical results from the sidewalls of the excavation will be evaluated to determine whether excavation activities at the site have removed the contaminated soil to the point where there is an acceptable risk due to exposure at the site. If the completed evaluation indicates an acceptable risk, then no further excavation will be required and the site can be considered for closure with no further action.

6.1 Evaluation of VOCs, SVOCs, TPH, Metals, and Pesticides

For any ~~TPH,~~ metals, VOCs, SVOCs, or pesticides that are detected in excavated soil, the concentration will be evaluated against the screening levels provided in the revised NMED guidance document *Technical Background Document for Development of Soil Screening Levels, Revision 4.0*, June 2006 (NMED, 2006a). In addition, naturally occurring inorganic constituents (e.g., metals) will be compared to background levels established specifically for HAFB. It is anticipated that the *Basewide Background Study Work Plan, Holloman AFB NM* (Bhate, 2008) will be implemented in late 2008. Laboratory data for each collected soil sample will be compared to the~~se~~ SSLs and the soon-to-be established background levels. Although the presence of TPH is not anticipated at this site, the TPH soil analytical results will be compared to the *NMED TPH Screening Guidelines*, October 2006 (NMED, 2006b)~~NMED SSLs~~ for petroleum hydrocarbons.

Analytes dectected in groundwater will be evaluated against groundwater standards set forth in the *New Mexico Administrative Code (NMAC) 20.6.2, New Mexico Water Quality Control Commission (NMWQCC) Regulations, September 15, 2002* (NMAC 20.6.2), the USEPA maximum contaminant levels (MCLs) and the soon-to-be established background levels.

6.2 Risk Based Evaluation

Subsequent to the investigative and excavation activities detailed in this work plan, a risk based evaluation will be performed to ensure that the risks to future receptors are acceptable at OT-14. The risk based evaluation will be included in the submittal of the Site OT-14 Accelerated Corrective Measures C~~l~~ompletion~~scout~~ Report. The following sections present the various steps that will be included in the risk evaluation.

6.2.1 Review of Available Analytical Data

As a first step in the risk evaluation process, soil and groundwater data produced by this source area investigation will be combined with the historical data. The data will then be reviewed to determine (i) the most probable source(s) of contamination, (ii) that soil and groundwater impacts have been adequately delineated, and (iii) if any additional chemicals were detected that were not previously of concern at the site. Additionally, the data will be evaluated to ensure it meets standards for data quality established in the NMED *Technical Background Document for Development of Soil Screening Levels, Revision 4.0* (NMED, ~~June~~ 2006a).

6.2.2 Revision of the Conceptual Site Model

Following a review of available data, the CSM will be revised. This includes (i) re-assessing the distribution of chemicals of potential concern (COPCs) in soil and groundwater, (ii) verifying current and future land use, and (iii) verifying site stratigraphy and hydrogeology. To date, the COPCs identified in soil and groundwater at OT-14 are 4,4'-DDT, heptachlor, and chlordane. However, additional COPCs may be identified during the review of data collected during the source investigation.

6.2.3 Development of the Exposure Model

Once the conceptual site model has been refined, an exposure model will be developed. The exposure model is based on the CSM, and identifies the following:

- Media of concern,
- Current and future receptors, and
- Complete and incomplete exposure pathways

The media of concern includes surficial soil, subsurface soil, soil to depth of construction, and groundwater. Based on current information available for OT-14, receptors include (i) a current and future commercial/industrial worker and (ii) a future construction worker. Complete routes of exposure for each media of concern/COPC/receptor combination will be identified based on the above information.

6.2.4 Preliminary Screening Evaluation

As a first step, maximum concentrations for each COPC in soil~~each media of concern~~ will be compared with the NMED Residential SSLs~~creening Levels~~ presented in Table A-1 of the *Technical Background Document for Development of Soil Screening Levels, Revision 4.0* (NMED, ~~June~~ 2006a), Table 2b of the *NMED TPH Screening Guidelines* (NMED, 2006b), and the soon-to-be established background levels for HAFB. Likewise, the maximum concentrations for each COPC in groundwater will be compared with the NMWQCC groundwater standards, USEPA MCLs, and the soon-to-be established groundwater background levels for HAFB. If the maximum concentration of each COPC in soil and groundwater is below its respective SSL,

NMWQCC groundwater standard, and USEPA MCL, no additional analysis will be performed, and the findings will be reported to NMED. Depending on the results of the screening evaluation, site-specific screening levels may be developed for all complete routes of exposure identified in the exposure model. Development of site-specific screening levels is described below.

6.2.5 Calculation of Site-Specific SSLs

Parameters required for the calculation of site-specific SSLs include:

- Carcinogenic toxicity values (Slope Factors),
- Non-carcinogenic toxicity values (Reference Doses),
- Exposure Factors, and
- Fate and Transport Parameters.

Default toxicity values and exposure factors will be obtained from Tables C-1 and B-1 (respectively) of the *Technical Background Document for Development of Soil Screening Levels, Revision 4.0* (NMED, ~~June~~ 2006a). Site-specific fate and transport parameters will be obtained from available reports for the site. Using the above information, site-specific screening levels will be calculated using equations presented in the *Technical Background Document for Development of Soil Screening Levels, Revision 4.0* (NMED, ~~June~~ 2006a).

6.2.6 Site-Specific Screening Level Evaluation

The site-specific screening levels will be compared with the representative concentration of each COPC in each media of concern. If any COPC exceeds its respective site-specific screening level, target levels for the COPC will be developed during the risk-based evaluation.

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7 WASTE MANAGEMENT

IDW generated by the activities of this excavation will include excavated soil, decontamination residuals, and PPE (Table 7-1). Each waste stream will be managed and characterized according to the following guidelines. Waste containers and the decontamination pad will be managed in a secure area.

7.1 Excavated Soil

7.1.1 Clean Soils – Stockpiles

Although, clean overburden soil is not anticipated for the VCM at OT-14, this section addresses the stockpiling of soil in the unlikely event it becomes necessary. The clean soil stockpiles will be constructed in accordance with best management practices to mitigate soil loss due to erosion, wind, and run-off. They will employ the use of a plastic liner, straw bales for berming or silt fencing and a cover. Soils will be placed on thick plastic sheeting within a constructed berm for protection from off-site transportation by wind and rain until characterization is complete. If laboratory analysis indicates concentrations are below the SSL for TPH of 940 milligrams per kilogram (mg/kg), and the SSL for each individual VOC, SVOC, metals, and pesticide constituent, the stockpiled soil will be used as backfill once the excavation activities are complete.

7.1.2 Contaminated Soils

Excavated contaminated soils will be handled in accordance with Sections 4 and 5 of this Work Plan. Contaminated soils will be live loaded and transported to the selected location for treatment/disposal. To facilitate disposal, a representative soil sample will be collected from the contaminated soil for TCLP analysis. TCLP analysis will be performed to profile the contaminated soil for disposal purposes. The TCLP analysis is summarized in Table 5-1.

7.2 Decontamination Water

Decontamination water ~~is anticipated to be non hazardous and as such, can be disposed of through the HAFB WWTP. When feasible, decontamination water will be allowed to evaporate from the decontamination pad area.~~will be handled as if contaminated and containerized in 55 gallons drums or a frac tank, pending laboratory analysis. If the laboratory results indicate analyte concentrations exist below target concentrations, the liquid wastes will be disposed of via the HAFB WWTP.

7.3 Personal Protective and Disposable Sampling Equipment

Prior to disposal, used PPE, disposable items, and the decontamination pad liner will be rinsed clean with tap water and diluted detergent solution. Rinse water will be collected in 5 gallon

buckets and combined with other decontamination water that will be characterized and disposed of properly, pending laboratory analysis. Cleaned PPE and presumed clean, based upon non-contact with contaminated soils, water, or equipment, and other disposable clean items will be contained in trash bags and disposed of at the applicable onsite sanitary waste receptacle.~~PPE and other site non-hazardous debris/waste shall be placed in plastic trash bags and disposed in a standard trash dumpster or receptacle as directed by HAFB personnel.~~

7.4 Construction Rubble

Unless visibly stained, all construction debris (sidewalk and/or asphalt if encountered) is assumed to be non-hazardous, non-contaminated, and will be disposed of accordingly at the Base re-use facility.

8 PROJECT QUALITY ASSURANCE

The laboratory performing the chemical sample analysis will follow the *Basewide Quality Assurance Project Plan* (Bhate, 2003a) and the Quality Assurance Project Plan Addendum (Appendix B of this Work Plan).

8.1 Standard Operating Procedures

Applicable SOPs for completing this excavation are located in Appendix A of the *Basewide QAPP* (Bhate, 2003a).

8.2 Sample Identification

Each environmental sample will be identified on the sample label and COC records for each sample collected, regardless of type. Field duplicates will be paired with another field sample and will be classified as blind samples. The duplicate samples will appear in sequence with the regular samples. The identifier nomenclature will adhere to the procedures and guidelines established in the *Basewide QAPP*. Sample labeling will adhere to the format provided in the *Basewide QAPP*.

8.3 Project Documentation

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

8.3.1 Sample Documentation

Sample documentation, identification, and tracking will adhere to the prescribed methods found in the *Basewide QAPP*. All sampling activities will include documentation of significant activities, potential environmental influences during sampling, field variances, and sample identification information. At a minimum, field logbooks will be utilized to record dates and times, sampling protocols, project numbers, and sampler's name. Daily Quality Assurance Reports will be completed and submitted weekly to the HAFB Project Manager. Other pertinent information will include COC numbers and air-bill tracking number. Chain-of-custody forms will be completed and included with each sample shipment; one COC per cooler.

At a minimum, the following sample collection information will be logged in the field book:

- Date and time
- Sample identification number
- Project number
- Sampler name
- Preservative (if any)
- Analysis
- Map or schematic of sampling location

If no map of sampling locations is available prior to sampling, a drawing of the site will be sketched on the left page of the field logbook to provide an illustration of all sampling points. Measured distances from sampling points to a fixed reference point will be recorded.

8.3.2 Field Logbook

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

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

The following general requirements apply to field logbooks:

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

8.3.3 Field Analytical Data

The field analytical data collected at the site will include the field screening readings for selection of PPE, as well as field screening for headspace analysis. The breathing zone of the site will be screened for VOCs in the field at the time of sample collection utilizing an OVA. If a high humidity condition exists at the time of sample collecting, a Flame Ionization Detector (FID) is recommended since a PID is not a completely reliable screening instrument under these conditions. The field screening data will be recorded in the field logbook.

8.3.4 Data Reporting

Data obtained during the excavation, confirmation or field screening samples, will be reported according to the *Basewide QAPP* (Bhate, 2003a). In accordance with the USACE *Environmental Quality - Chemical Quality Assurance for Hazardous Toxic and Radioactive Waste (HTRW) Projects, Engineer Manual, EM 200-1-6* (USACE~~E~~, 1997)~~M200-1-6~~,~~,~~ the investigative data is classified as definitive data. The data will be generated using rigorous, analyte-specific analytical methods where analyte identifiers and quantitations are confirmed and QA/Quality Control (QC) requirements have been satisfied. For this project, regular, field duplicate, and matrix spike/matrix spike duplicate (MS/MSD) samples are to be collected concurrently. The data will meet the objectives of the project for level of accuracy and precision required, intended use of the data, analytical methods, time constraints, and allowable decision errors. Risk evaluation and sampling results will be tabulated and summarized in the Accelerated Corrective Measures Completion~~VCM~~ R~~r~~eport for the site. An ERPIMS submittal is not required for the excavation phase of this project.

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9 HEALTH AND SAFETY REQUIREMENTS

Project Health and Safety practices will adhere to the *Basewide Health and Safety Plan* [HASP] (Bhate, 2003b) and the Site Specific Addendum to the *Basewide HASP*, as included in Appendix A of this Work Plan, for the excavation activities. All work will be conducted in accordance with the USACE *Safety and Health Requirements Manual, EM 385-1-1*, 3 November 2003. It is anticipated that no greater than modified level D PPE will be required to complete the site inspection and sampling activities. This includes: OSHA approved safety shoes, ANSI approved safety glasses (Z87.1) and hard hat (Z89.1-1997: Type I), sleeved shirt and long pants, and as required, hearing protection, and leather work gloves and/or nitrile gloves during sampling.

Site security is part of safety at the site for the excavation. Items of concern include the proper designation and demarcation of the investigation boundaries (i.e., SZ, CRZ, and EZ), as appropriate. Likewise, compliance with any intrusive work requirements, posting of potential hazards, and control of un-authorized site personnel will be completed. This is discussed in the *Basewide HASP*.

At a minimum, the site will be secured with caution tape surrounding the perimeter of the site delineating the outer boundary of the SZ. This is essential in the utility clearance process and it serves as the demarcation of the site for both project and non-project persons. A CRZ and/or EZ will be established as guided by the HASP and site prevailing conditions.

Excavation depths are not expected to exceed 2~~4~~ ft, however soil will be removed until clean confirmatory samples are collected which could potentially extend the excavation below 4 ft bgs~~and be less than 9 ft~~; therefore sidewall benching may be required.

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10 ORGANIZATION AND SCHEDULE

Mr. Jim Moore, Professional Geologist (P.G.), will serve as the Bhate Field Manager during the additional investigation phase of this VCM project. During the corrective measures (excavation) phase of the project at OT-14, Mr. John Hymer will serve as the Bhate Site Manager and as the Site Safety and Health Officer (SSHO) overseeing and directing all excavation and soil screening and confirmation sampling activities. Mr. Hymer will also provide on-site management of any sub-contractors for the project. Mr. Moore is also the Bhate Project Manager and will ensure required project documents, permits, contractual agreements, and other program tasks are completed. Key project personnel are listed in Table 10-1. The additional investigation and excavation activities are anticipated to begin in the Spring of 2008 and will last approximately 6 weeks.

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11 REFERENCES

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USACE. November 2003. *Safety: Safety and Health Requirements Manual EM 385-1-1*.

WRCC. 2003. Desert Research Institute State Narrative Web Page, http://www.wrcc.dri.edu/narratives/NEWMEXICO.htm.

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TABLES

FIGURES

ATTACHMENT A

NMED CORRESPONDANCE

ATTACHMENT B

HISTORICAL DATA FROM PREVIOUS REPORTS

APPENDIX A

SITE-SPECIFIC ADDENDUM TO THE BASEWIDE HEALTH AND SAFETY PLAN

APPENDIX B

QUALITY ASSURANCE PROJECT PLAN ADDENDUM

APPENDIX C

UFGS SECTION 02111
EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL

SEPTEMBER 2003

APPENDIX D

ASTM STANDARD D2922 *TEST METHODS FOR DENSITY OF SOIL AND SOIL-AGGREGATE IN PLACE BY NUCLEAR METHODS (SHALLOW DEPTH)*

APPENDIX E

UFGS SECTION 02770A
CONCRETE SIDEWALKS AND CURBS AND GUTTERS

MARCH 2004

NEW MEXICO ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
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BILL RICHARDSON
Governor

DIANE DENISH
Lieutenant Governor

RON CURRY
Secretary

JON GOLDSTEIN
Deputy Secretary

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

May 8, 2008

REC'D MAY 14 2008

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

SUBJECT: NOTICE OF DISAPPROVAL: VOLUNTARY CORRECTIVE MEASURES WORK PLAN, SITE OT-14 SOIL REMEDIATION, NOVEMBER 2007 HOLLOMAN AIR FORCE BASE, NEW MEXICO EPA ID#: NM6572124422 HWB-HAFB-07-012

Dear Mr. Scruggs:

The New Mexico Environment Department (NMED) has reviewed the subject Work Plan, which was submitted for the performance of additional site characterization activities and voluntary corrective measures at Site OT-14 (SWMU 197), Holloman Air Force Base (the Permittee). Upon completion of the Work Plan review, the NMED has determined that the Work Plan cannot be approved at this time, as revisions are necessary. The Permittee is required to address the following deficiencies before the NMED can make a final determination regarding approval.

GENERAL COMMENTS

1. Figures/maps provided in work plans and reports must be shown to scale, depict the boundaries of the site, include a north arrow, and show a coordinate system (e.g., UTM, latitude/longitude). Further, the figures/maps must also list the coordinate system, projection, and each datum (e.g., Transverse Mercator Projection, New Mexico State Plane Coordinate System, Central Zone, 1983 North American Horizontal Datum, 1983 North American

Vertical Datum). The Permittee must revise all figures to satisfy these requirements.

2. Sample result tables provided in work plans and reports must explain all abbreviations, quality flags, and special formatting (e.g., **bold** type used to communicate specific information, J = ?, B = ?) in the footnotes. The test methods must be listed and legible, spelling errors must be corrected, and sample dates provided on the tables. The Permittee must revise all tables to satisfy these requirements.

SPECIFIC COMMENTS

3. **Section 1, page 1-1, 2nd paragraph, last sentence**

The sentence states the area is "covered with a non-engineered asphalt cap." This sentence contradicts the description in Section 2 (page 2-1, 3rd paragraph, 7th sentence), which states that the area is "covered with an engineered asphalt cap." The Permittee must resolve this discrepancy.

4. **Section 1, page 1-1, 3rd paragraph, 5th sentence**

The sentence excludes methylene chloride (maximum concentration 32 micrograms per liter (µg/L), which is one of the detected volatile organic compounds (VOCs) in groundwater, according to Table 2-2 and the first paragraph of Section 2.1.1. The Permittee shall revise the sentence to include methylene chloride and its maximum detected concentration.

5. **Section 2, page 2-1, 3rd paragraph, last sentence**

The sentence states that a telephone pole is "installed through the center of the asphalt cap." No figure depicts this telephone pole. The Permittee must revise Figures 3-1 and 4-1 to show the telephone pole to clarify its relationship with the proposed temporary monitoring well and position within the proposed excavation.

6. **Section 2.1.1, page 2-2, 1st paragraph, 2nd to last sentence**

The sentence states "[m]ajor dissolved anions (chloride, sulfate, fluoride, and nitrate) exceeded the New Mexico Water Quality Control Commission (NMWQCC) standards but were comparable to background levels." The Permittee must confirm that the background levels used for comparison will be the soon-to-be established background levels and not a prior form of background levels.

7. **Section 2.1.2, page 2-2, 2nd paragraph**

According to the heading, Section 2.1.2 discusses the Phase II Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) conducted in 1994. However, the second paragraph primarily details the results of the 1991 Phase I RFI soil sampling, especially concentrations that exceeded NMED Residential Soil Screening Levels (SSLs). The second paragraph merely alludes to the 1994 results, with no detailed discussion. Section 2.1.1 is the

proper place for the detailed discussion of 1991 Phase I RFI soil sample results. In fact, the discussion of 1991 soil sample concentrations that exceed NMED SSLs is notably absent from Section 2.1.1. Finally, the second paragraph's summary does not correspond to the data as presented in Table 2-1. The Permittee must:

a) Discuss the Phase I samples and their results in Section 2.1.1. The Phase I samples have sample numbers beginning SB-14-##.

b) Discuss the Phase II samples and their results in Section 2.1.2. The Phase II samples have sample numbers beginning DP-14-##.

c) Update Section 2, page 2-1, fourth paragraph, second sentence to reflect the corrections discussed in Sections 2.1.1 and 2.1.2. The sentence currently states, "Analytical results from only three samples and two analytes exceeded NMED Residential SSLs for pesticides." This sentence (Section 2, 4th paragraph, 2nd sentence) and any other occurrence of this sentence in the document must be corrected to read "five samples" and "three analytes."

8. **Section 3.2, page 3-2, 4th sentence**

The sentence states "[s]ample nomenclature will follow the Environmental Restoration Program Information Management System (ERPIMS) format," but provides no reference; the Permittee shall provide a reference.

9. **Section 3.2, page 3-2**

The Work Plan references Holloman Air Force Base (HAFB) Standard Operating Procedures (e.g., HAFB SOP-3) that provide guidance on sampling activities, decontamination, documentation, etc. The NMED has neither recently reviewed nor approved the guidance documents; the Permittee shall therefore submit the following documents for NMED review and approval: HAFB SOP-1, -2, -3, -4, -5, -6, -7, -8, -9, and -10.

10. **Section 3.2.1, page 3-3**

The Work Plan states that soil and groundwater samples will be submitted for analysis of total petroleum hydrocarbons (TPH)-gasoline range organics (GRO), TPH-diesel range organics (DRO), and TPH-oil range organics (ORO) by modified U.S. Environmental Protection Agency (USEPA) Method 8015M to Accutest Laboratories in Orlando, Florida. According to information posted on the Accutest Laboratories website (www.accutest.com), Accutest Laboratories performs analysis of TPH-GRO and TPH-DRO using USEPA Method 8015B; however, it mentions neither TPH-ORO nor Method 8015M. According to the USEPA, the current revision of SW-846 is Revision 6, Final Update IV, dated February 2007, and the most recent method for TPH-GRO and TPH-DRO is 8015C. Furthermore, USEPA Method 8015C only specifies analysis of TPH-GRO and TPH-DRO and not TPH-ORO. The Permittee must clarify the meaning of "modified USEPA Method 8015M" and specify whether this modified method is based upon USEPA Method 8015B or 8015C.

11. **Section 3.2.1, page 3-3, last paragraph; Section 3.2.2, page 3-4, last paragraph; Table 3-1; and Table 4-1 of Appendix B**

Both paragraphs state that collected samples will consist of 14 soil samples (based on six direct push technology [DPT] boreholes with two samples per borehole, including two field duplicate samples); Section 3.2.1 (page 3-3, last paragraph) further declares that all samples for VOC analysis will require a trip blank. The numbers and types of samples do not match those provided in either Table 3-1 or Table 4-1 of the Quality Assurance Project Plan Addendum (Appendix B). Table 3-1 lists two trip blanks, two field duplicates, and one matrix spike/matrix spike duplicate sample, in addition to 12 borehole samples (based on six DPT boreholes with two samples per borehole). Table 4-1 of Appendix B indicates four trip blanks, one field duplicate, and one matrix spike/matrix spike duplicate sample, in addition to 12 borehole samples (based on six DPT boreholes with two samples per borehole). The Permittee must perform the following:

a) Update both paragraphs to include two trip blank samples, one matrix spike/matrix spike duplicate sample, and the total number of samples.

b) Update Table 4-1 (Appendix B) to include two trip blank samples, two field duplicate samples, and update the total number of samples.

c) Include equipment blanks as described in Comment 52.

12. **Section 3.2.2, pages 3-3 and 3-4: 1st, 2nd, and 4th paragraphs**

These paragraphs inconsistently and contradictorily describe the DPT borehole soil sampling. The first paragraph states "[b]ased upon the depth to groundwater at the site, the estimated depth of each boring will be 5 feet." The second paragraph adds, "Samples will be collected continuously at four foot intervals" with field-screening by Organic Vapor Analyzer (OVA) conducted "at two foot intervals." The fourth paragraph declares, "Each boring will be drilled to "12 ft bgs" with continuous collection of OVA readings. Moreover, the fourth paragraph indicates that soil sample collection will occur at the "0 to 2 foot interval" and "from across the water table (anticipated to be between 4 to 6 feet bgs)." The Permittee must rectify these inconsistencies and contradictions in all paragraphs to describe accurately the proposed sampling event.

13. **Section 3.2.2, page 3-4, 2nd paragraph**

The second sentence specifies, "All horizontal coordinates will be referenced to the State Plane Coordinate System, New Mexico Central…," but does not indicate which datum or whether vertical coordinates will be established. The Permittee will declare a datum and specify whether vertical coordinates are included or excluded. If vertical coordinates are included, the Permittee must specify the coordinate system, datum, and measurement accuracy.

14. **Section 3.2.2.1, page 3-5; Table 3-1; and Table 4-1 of Appendix B**

Section 3.2.2.1, Table 3-1, and Table 4-1 of Appendix B states that American Society for Testing and Materials (ASTM) Method D1429 will determine soil sample specific gravity. According to a review of the ASTM methods at www.astm.org, the chosen method appears inconsistent with its intent at OT-14. ASTM D1429 is entitled "Standard Test Method for Specific Gravity of Water and Brine," and its purpose is to "cover the determination of the specific gravity of water and brine free of separable oil." Additionally, ASTM D1429, which contains several methods, applies to "clear waters or those containing only a moderate amount of particulate matter, sea water or brines," and "samples of water containing water or sludge." The Permittee must:

a) Discuss selection of the method, particularly whether it is appropriate for soil samples. If the Permittee determines ASTM D1429 to be inappropriate, the Permittee must propose another method.
b) If ASTM D1429 remains the chosen method, explain which revision of the method will be used, whether ASTM D1429-86 (listed on the Accutest website, dated 1986) or the most recent version (ASTM D1429-03, dated 2003).

15. **Section 3.2.3, page 3-5, 2nd paragraph**

The last sentence states, "Following sampling, the temporary monitoring well will be completely removed from the ground and the borehole will be sealed in accordance with HAFB SOP-10." The newly constructed well must remain in-place until after receipt and review of all analytical results related to the well; and after the Permittee obtains permission for removal from the NMED. Furthermore, the Permittee shall protect the temporary well from surface water infiltration (runon/runoff) and install devices to protect from vehicles (e.g., bollards). The Permittee will alter the sentence or add sentences to include this information.

16. **Section 3.2.3, page 3-5, 3rd paragraph**

The paragraph incompletely describes the sampling of the groundwater monitoring wells. The paragraph describes laboratory analyses and the number of samples; however, the discussion excludes field parameters (e.g., pH, temperature, electrical conductivity, etc.). The Permittee will:

a) Revise the paragraph to include field parameters.
b) Add a table to include the field parameters and use information consistent with Table 3-1 of Appendix B.
c) Include the revisions of Comment 17.

17. **Section 3.2.3, page 3-5, 3rd paragraph; Table 3-2; and Table 4-1 of Appendix B**

This paragraph and both tables inconsistently list and describe the number of proposed groundwater samples (Comment 11). Moreover, this paragraph and tables failed to address equipment blanks (Comment 52). The Permittee will alter each table and the paragraph, making each element mutually consistent and ensuring the paragraph describes all sample types (e.g., matrix spike/matrix spike duplicate and equipment blanks).

18. **Section 3.2.3.1, page 3-5, 3rd sentence**

The sentence states, "Vertical elevations will be referenced to the North American Datum (NAD) [of] 1983." The Permittee will provide a reference datum for the horizontal locations.

19. **Section 3.2.3.1, page 3-6, last sentence**

The sentence states, "... all maps will include a coordinate system (e.g., latitude/longitude) and the site boundaries." All maps must also include a north arrow and scale and list the coordinate system, projection, and each datum (e.g., Transverse Mercator Projection, New Mexico State Plane Coordinate System, Central Zone, 1983 North American Horizontal Datum, 1983 North American Vertical Datum). The Permittee must revise the sentence to include these requirements.

20. **Section 3.3, page 3-6, 2nd paragraph**

The paragraph describes nomenclature "for groundwater samples collected from direct push boreholes." The Work Plan describes soil sample collection from direct push boreholes in Sections 3.2.2 and 3.2.2.1 and groundwater samples from the temporary and existing monitoring wells in Section 3.2.3. However, the Work Plan does not describe collection of groundwater samples from direct push boreholes. The Permittee shall correct this discrepancy.

21. **Section 3.4, page 3-7**

The section does not provide the laboratory analytical methods for characterizing investigation-derived waste water. The Permittee shall describe the laboratory analytical methods and procedures for characterization of investigation-derived waste water.

22. **Section 3.4, page 3-7, 2nd to last sentence**

The sentence states, "Other liquid wastes, such as decontamination rinses, are anticipated to be non-hazardous and as such, can be disposed of through the HAFB Wastewater Treatment Plant or (WWTP)." The Permittee shall treat all liquid wastes, particularly decontamination rinses, in the same manner as purged groundwater from development and sampling activities. They shall "be containerized and maintained by Bhate until disposal through the HAFB Wastewater Treatment Plant (WWTP), pending laboratory analysis," as required above. If

the laboratory results indicate analyte concentrations exist below target concentrations, the Permittee may dispose of liquid wastes via the HAFB WWTP. The Permittee shall alter the sentence to comply with these conditions.

23. **Section 3.4.1, page 3-7, 3rd sentence**

The sentence states, "The containers and decontamination pad will be managed in a secure area and the decontamination water will either be allowed to evaporate or combined with the purged groundwater and discharged to the HAFB WWTP." The Permittee will:

a) Clarify to which containers the sentence refers because no discussion of containers appears in the paragraph.
b) Alter the sentence and/or paragraph to include a description of the containers.
c) Remove the phrase, "either allowed to evaporate or," from this sentence.
d) Add the phrase, "pending laboratory analysis" to the end of the sentence.

24. **Section 3.4.1, page 3-7, last sentence**

The sentence states, "Sediment remaining in the decontamination pad area after the water has either evaporated or been discharged to the WWTP, will be combined with the soil to be remediated in the onsite landfarm or spread on the ground." The Permittee will modify the sentence or paragraph to incorporate the following:

a) Evaporation of any liquid waste (i.e., purge groundwater, decontamination water, etc.) is not an approved method of disposition or treatment; therefore, the Permittee shall remove references to evaporation.
b) Liquid waste collection, maintenance, and characterization by laboratory analysis prior to disposition will occur.
c) Prior to disposition, the sediment from the decontamination pad requires characterization and data evaluation. To spread the sediment on the ground, the analytical results must indicate the sediment is suitable for use as clean backfill; otherwise, disposal in an appropriate facility or combination of the sediment with the soil to be remediated must occur. The Permittee shall revise the section to include these statements.

25. **Section 3.4.2, page 3-7, 1st sentence**

The sentence states, "Prior to disposal, used personal protective equipment (PPE), disposable items, and the decontamination pad liner will be rinsed clean with tap water and diluted detergent solution." The Permittee must describe collection, management, and characterization of the water and detergent solution.

26. **Section 4**

Section 4 discusses the mechanics of the excavation, including equipment, required forms and approvals, site safety, decontamination, shoring, and backfilling; however, no mention of

dust suppression appears. The first mention of dust suppression occurs in Table 5-1 of Appendix A. The Permittee must revise the section to include dust suppression activities.

27. **Section 4, page 4-1, 1st paragraph, 2nd to last sentence; Section 4.1.3, page 4-2, 2nd paragraph, 4th sentence; and Section 9, last paragraph**

Section 4 (first paragraph, second to last sentence) states, "Based upon the historical analytical results, it is anticipated that the top 2 feet of soil beneath the cap may be excavated…." Likewise, the second paragraph of Section 4.1.3 states "the depth to the bottom of the excavation, if necessary, is expected to reach 2 feet bgs." According to Section 9, last paragraph, "excavation depths are expected to exceed 4 ft, and be less than 9 ft…." The Permittee must revise each sentence to state clearly and consistently the expected depth of excavation.

28. **Section 4.2, page 4-2, last sentence**

The sentence states, "Heavy equipment, such as the backhoe, trackhoe, etc. will be decontaminated at a temporary decontamination pad set up at the site." The Permittee shall provide specifics on the decontamination process and describe collection, management, and characterization of decontamination solutions.

29. **Section 4.3.1, page 4-3, last sentence**

According to the sentence, Figure 4-1 shows the proposed excavation area. However, the proposed excavation area does not include previous DPT soil boring locations 14-DP-10 and 14-DP-12. According to Table 2-1, 14-DP-10 (2,200 micrograms per kilogram (µg/kg) exceeded the NMED SSL for heptachlor (1,080 µg/kg) and 14-DP-12 (26,000 µg/kg) exceeded the NMED SSL for chlordane (16,200 µg/kg). The Permittee must:

a) Explain the exclusion of the two sample locations from the excavation plan.
b) Alter the excavation description to include both sampling locations.
c) Modify Figure 4-1 to include both sampling locations and the changes listed in Comment 5 and the General Comment 1.
d) Sample nomenclature for the DPT soil borings is inconsistent between the figures and Table 2-1. Using the two DPT soil borings missing from Figure 4-1, Table 2-1 lists them as DP-14-10 and DP-14-12 while the figures list them as 14-DP-10 and 14-DP-12. The Permittee must establish consistent sample nomenclature among all figures, tables, and within the text of the Work Plan.
e) Update the calculation of the proposed excavated soil listed in Section 2.2, 2nd paragraph, 1st sentence, which states, "… it appears that approximately 360 cubic yards of soil may have exceeded the NMED SSLs (Figure 2-1)." The updated calculation will include area surrounding the two soil boring locations and the proposed excavation depth in Comment 27.

30. **Section 4.3.3, page 4-3, 3rd sentence**

The sentence states, "All overburden soils determined to be clean will be removed prior to the removal of contaminated soils." At the end of the sentence, the Permittee must insert references to Sections 5.1.1 and 5.1.2, which describe field screening and characterization of the overburden soils. Without the reference, the information in the section appears incomplete.

31. **Section 4.3.3.1, page 4-3, 4th sentence**

The sentence states "Samples will be collected at a minimum frequency of 2 per 18 linear feet (ln ft) per side wall at mid-depth of the contamination zone." The Permittee must revise the sentence to state that confirmatory sample collection shall be biased to areas with the greatest potential for contamination.

32. **Section 4.3.4, page 4-4**

The first sentence of the section states, "Clean soils will be obtained for backfill as needed from the HAFB borrow area or FT-31 Landfarm." Subsequent sentences describe the particulars of the backfill and pertinent methods. The Permittee must revise the section to include the statement that the excavation will not be backfilled until confirmation sampling confirms the absence of contaminated soil. This may require additional excavation and confirmation sampling based upon the results of the first round and subsequent rounds of confirmatory sampling.

33. **Section 4.3.5, page 4-4, 1st sentence**

The sentence states, "Contaminated soil will be transported to the appropriate offsite facility based upon the soil sample analytical results and (toxicity characteristic leaching procedure) (TCLP) analysis." The Permittee must include a reference to Section 5.1, which describes the waste characterization analysis using the toxicity characteristic leaching procedure, and Section 5.1.3 Excavation Confirmation Sampling. The Permittee must also define TCLP in this section, as this appears to be the first time the acronym is used in the document; the occurrence in Section 5.1 is not the first call-out of TCLP.

34. **Section 5.1.1, page 5-1**

The Permittee must include reference to Table 4-1 in this section.

35. **Sections 5.1.2 and 5.1.3, page 5-1**

The Permittee must include reference to Table 5-1 in these sections.

36. **Table 5-1**

The table does not specify the holding times for mercury, which is included in the analyses of

the RCRA metals and the TCLP metals. The Permittee must add holding times for mercury analyses to the table.

37. **Section 6.1, page 6-1 and Section 6.2.4, page 6-2**

Both sections state that the Permittee will compare analyte concentrations against the NMED Residential SSLs. The Permittee must revise these sections to include comparison with the soon-to-be established background levels, in addition to the NMED Residential SSLs.

38. **Section 6.1, page 6-1**

The last sentence states, "Although the presence of TPH is not anticipated at this site, the analytical results will be compared to NMED SSLs for petroleum hydrocarbons." The Permittee will:

a) At the end of this sentence, the Permittee will insert reference to the *New Mexico Environment Department TPH Screening Guidelines*, October 2006 (NMED, 2006b), to differentiate TPH screening levels from soil screening levels in the *Technical Background Document for Development of Soil Screening Levels, Revision 4.0*, June 2006 (NMED, 2006a).

b) Update the References section to include the most current version of the *TPH Screening Guidelines*. Update all call-outs of "(NMED, 2006)."

c) Include statements that describe the use of the groundwater data and specify the standards that will be used for comparison (e.g., New Mexico NMWQCC standards and soon-to-be established background concentrations).

39. **Section 6.2, page 6-1, 2nd sentence**

The sentence states that the Permittee will submit a "Closeout Report." The Permittee must modify the sentence, declaring submission of an Accelerated Corrective Measures Completion Report.

40. **Section 6.2.4, page 6-2, 2nd sentence**

The sentence states, "If the maximum concentration of each chemical of potential concern (COPC) in soil and groundwater is below its respective SSL, no additional analysis will be performed, and the findings will be reported to NMED." The first sentence in the paragraph refers to the *Technical Background Document for Development of Soil Screening Levels, Revision 4.0*, June 2006. The Permittee will:

a) Describe the comparison of all data, both soil and groundwater, to soon-to-be established background concentrations.

b) Groundwater data are not evaluated using soil screening levels. Revise the section to detail the evaluation of groundwater data, including comparison to soon-to-be established background concentrations and the NMWQCC standards.

41. **Section 7.1.1, page 7-1, last sentence**

The sentence states, "If laboratory analysis indicates concentrations are below the SSL for TPH of 940 milligrams per kilogram (mg/kg), and the SSL for each individual VOC, semi-volatile organic compound (SVOC), and pesticide constituent, the stockpiled soil will be used as backfill once the excavation activities are complete." The Permittee will include metals in the list of constituents to maintain consistency with the proposed sampling program.

42. **Section 7.2, page 7-1**

The Permittee will refer to Comments 23 and 24, regarding decontamination water, and modify this section in accordingly.

43. **Section 7.3, page 7-1; Section 3.4, page 3-7, last sentence; and Section 3.4.2, page 3-7, 1st sentence**

Section 7.3 and Section 3.4 (last sentence) indicate that PPE will be placed directly into standard trash receptacles. In contrast, Section 3.4.2, page 3-7, 1st sentence states, "Prior to disposal, used PPE…will be rinsed clean with tap water and diluted detergent solution." Comment 25 addresses the sentence in Section 3.4.2. The Permittee shall revise Sections 7.3 and 3.4 to establish consistency with Section 3.4.2 (including all revisions required by comments) regarding handling of PPE.

44. **Section 8.3.4, page 8-2, 2nd sentence**

The sentence states, "In accordance with U.S. Army Corps of Engineers (USACE) EM200-1-6, the investigative data is classified as definitive data." The Permittee must provide a title for USACE EM200-1-6 in the sentence and include the document in the list of References.

45. **Section 8.3.4, page 8-3, 2nd to last sentence**

The sentence states, "Risk evaluation and sampling results will be tabulated and summarized in the Voluntary Corrective Measures (VCM) report for the site." The Permittee must change "VCM report" to "Accelerated Corrective Measures Completion Report."

46. **All tables**

No table describes the proposed field screening of the soil borings or the collected sample headspace (headspace analysis); consequently, the tables present an incomplete summary of sampling activities, as described in the Work Plan text. The Permittee must either generate a new table to capture the field screening of soil boring and sample headspace or add this element to an existing table.

47. **Appendix A, HASP Addendum: Section 2, page 2-1, 3rd paragraph, 2nd sentence**

The sentence states, "Analytical results from only three samples and two analytes exceeded the New Mexico Environment Department (NMED) Residential Soil Screening Levels (SSLs) for pesticides." This summary is inconsistent with the data results, as detailed in Comment 7. The Permittee shall refer to Comment 7 for guidance on correcting and revising the sentence.

48. **Appendix A HASP Addendum: Section 3.1, page 3-1, Table 3-1 and Attachment B**

The tables list the chemicals expected at OT-14. Both tables list only four VOCs (benzene, toluene, ethylbenzene, and xylenes). Table 3-1 lists "pesticides" and Attachment B lists four pesticides (chlordane, heptachlor, aldrin, and DDT). The Permittee must explain the absence of the following chemicals, which previous sampling and analysis detected, revealed elevated concentrations, or indicated the exceedence of NMED SSLs:

- Methylene chloride
- 2-4-D
- 4,4-DDD
- 4,4-DDE

49. **Appendix A HASP Addendum: Section 6.2, page 6-1, Table 6.3**

According to the 1st sentence in Section 6.2, Table 6-3 describes required decontamination procedures. However, the table lacks all procedures described in the Work Plan Sections 3.4 and 4.2 (refer to Comments 21, 22, 23, 24, 25, 28, and 42). The Permittee must revise Table 6.2 of Appendix A to contain all decontamination procedures described in the Work Plan.

50. **Appendix A HASP Addendum: Section 7, page 7-1**

The second sentence states, "Site communication amongst works shall be a combination of verbal and line of sight hand communications." The last sentence states, "Cellular telephone use is not permitted while operating equipment." The section does not indicate how the support zone will communicate with heavy equipment operators or communication between heavy equipment operators, should either be necessary. The Permittee shall revise the section to include communications with and among heavy equipment operators.

51. **Appendix B Quality Assurance Project Plan Addendum: Section 3, Table 3-2**

Table 3-2 of Appendix B summarizes the definitive data for soil and groundwater samples. The table does not list any data related to investigation derived waste characterization; TCLP is not included among the parameters. The Permittee will revise the table to include all definitive data described in the Work Plan.

52. **Appendix B Quality Assurance Project Plan Addendum: Section 4, Tables 4-1 and 4-2**

Neither Table 4-1 nor Table 4-2 of Appendix B list any equipment blanks. The equipment blank helps to assess contamination introduced by the sampling equipment either directly or through improper cleaning. The Permittee will revise Section 4, Tables 4-1 and 4-2 of Appendix B, and Work Plan Sections 3.2.1, 3.2.2, 3.2.3, 4.3.3.1, and Table 3-1 of the Work Plan to include the equipment blank. Comments 11 and 17 also address some of these sections and tables.

53. **Appendix B Quality Assurance Project Plan Addendum: Section 4, Table 4-3**

Table 4-3 of Appendix B provides the laboratory (Accutest) quality control limits for each analyte. A comparison of these quality control limits with the evaluation criteria (e.g., NMED Residential SSLs and NMWQCC standards) reveal that some laboratory reporting limits for soil samples exceed NMED Residential SSLs. If the TDS of the groundwater are less than 10,000 milligrams per liter (mg/L), some water reporting limits will exceed the NMWQCC standards. The Permittee must:

a) Obtain new, lower reporting limits from Accutest or contract with a laboratory that can provide lower reporting limits.
b) Revise Table 4-3 of Appendix B, listing the new reporting limits, including comparison to evaluation criteria, chemical abstracts services (CAS) numbers for all analytes, and properly spelled, legible words (e.g., truncated words appear in the table).

Please submit the required information in the form of a revised Corrective Measures Work Plan that incorporates all the responses to the above NOD in two hard copies indicating added information in highlights, and deleted information in strikeouts, and on two CDs compatible with Microsoft Word. Further, in order to expedite review of the responses, provide a matrix of the comments and HAFB responses.

If you have any questions on the NOD or if you would like to discuss the comments prior to your response, please contact Dezbah Tso of my staff at (505) 222-9528, or at the above letterhead address.

Sincerely,

for James P. Bearzi
Chief
Hazardous Waste Bureau

JPB:dat

cc: J. Kieling, NMED HWB
W. Moats, NMED HWB
C. Amindyas, NMED HWB
D. Tso, NMED HWB
L. King, EPA, Region 6 (6PD-F)
File: HAFB 2008 and Reading
HWB-HAFB-07-012

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REMEDIAL INVESTIGATION (RI) REPORT

INVESTIGATION, STUDY AND RECOMMENDATION FOR 29 WASTE SITES HOLLOMAN AIR FORCE BASE, NM

Volume I

DRAFT FINAL

Prepared for:

49 SG/CEV
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U.S. Army Corps of Engineers
Omaha District
Omaha, Nebraska

June 1992

4.8 Site 14--Former Entomology Shop Area

4.8.1 Site Description

The Former Entomology Shop Area was reported to be located in Building 67. From 1968 to 1977, pesticide spraying and washing equipment was rinsed out in an open area adjacent to the building. In July 1977, soil samples were collected from the rinse area, and the results revealed the presence of several persistent pesticides. As a result of these analyses, the soils in the disposal area were treated with lime and powdered charcoal. The top 6 to 8 in. of soil was then tilled. No investigation has been done since the treatment.

A literature search conducted in February 1991 revealed that the Former Entomology Area was not located in Building 67 as indicated in previous records. Interviews with the former Head of Entomology (Bill Wright) and the former Chief of Operations, and historical photos from Bioenvironmental Engineering, all revealed that the former entomology storage and mixing areas were located adjacent to existing Building 66. Figure 4-19 illustrates the location of the storage and mixing areas. The approximate location was determined in the field with one of the interviewees and with the use of historical photos. Although the Former Entomology Office was located in Building 67, mixing and drum storage was conducted at the area located adjacent to Building 66. The interviews also indicated that the pesticides commonly used at this site included DDT and chlordane. Diesel fuel was routinely used to solubilize the pesticides.

IRP Site 14 is a SWMU listed on Table 1 of Holloman's HSWA Permit. Corresponding RCRA name and reference are Former Entomology Shop, SWMU No. 229. Figure 4-19 is a map of the Former Entomology Shop Area. The site is located inside the Civil Engineering yard. It is bounded on the northwest by the Civil Engineering yard fence, on the southeast by Building 66, and by a smaller building on the

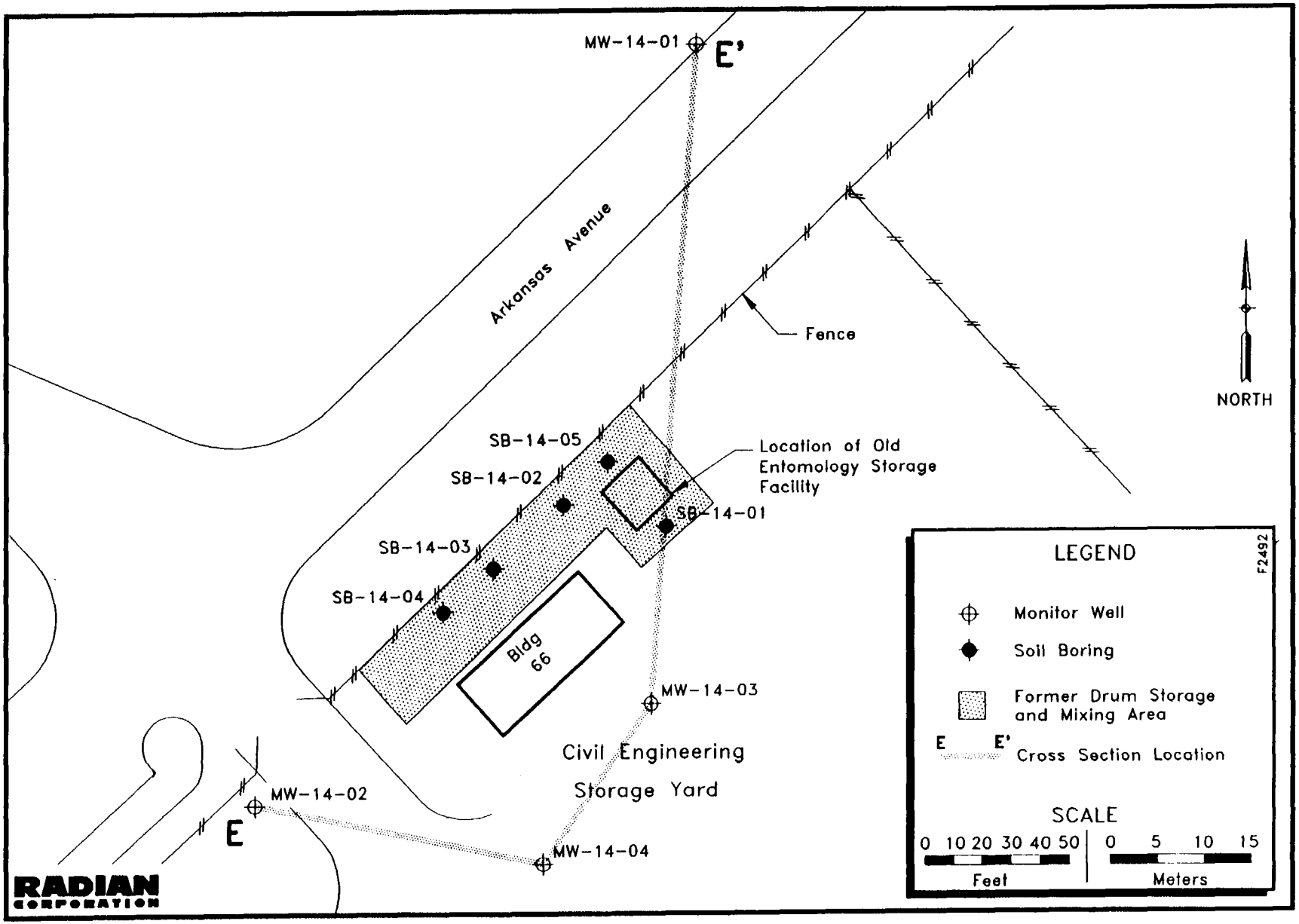


Figure 4-19. Soil Boring, Monitor Well, and Cross Section Locations for Site 14

northeast. Part of the area is currently used to store emergency spill response and other miscellaneous equipment. Site topography is generally flat and there is no natural vegetation.

4.8.2 Site Investigation

Five soil borings were drilled to groundwater in potential source locations (Figure 4-19) at Site 14. A total of two samples were retained from each of the five soil borings. Split-spoon samples were collected from 0 to 2 ft and 2 to 4 ft BGL because groundwater was encountered at 5 ft BGL. Samples were analyzed for volatile organics, petroleum hydrocarbons, organochlorine pesticides, organophosphorus pesticides, and chlorinated herbicides.

Four monitor wells were installed outside the spill sites at Site 14 (Figure 4-19). Three of the wells were located downgradient of the site and the other one was located upgradient. These wells were developed, sampled, and slug tested. One round of groundwater samples was analyzed for volatile organics, organochlorine pesticides, organophosphorus pesticides, chlorinated herbicides, anions, and total dissolved solids. In addition, two soil samples collected from monitor well borings were analyzed for geotechnical properties.

4.8.3 Geology and Hydrogeology

The subsurface conditions at Site 14 were defined by direct sampling and observation of the drilling operations of five soil borings and four monitor well borings. Drilling logs located in Appendix D and geotechnical results located in Appendix E provide a detailed description of the stratigraphy and geologic properties present at the site.

To correlate and interpret the site stratigraphy, cross-section E-E', shown in Figure 4-20, was constructed from drilling logs and water-level data for Site 14. Figure 4-19 shows the location of the cross-section. Site stratigraphy mostly consists of silty sands. Borings MW-14-01 and MW-14-02 consist entirely of medium to fine grained silty sand. A 2 to 8 ft thick lens of sand was seen in borings MW-14-03 and MW-14-04. Lenses of silty, clayey sand and silt underlie the sand in those borings. This stratigraphy is typical of the alluvial, eolian, and playa deposits in the Tularosa Basin. The deepest borings were drilled to 14.5 ft and revealed no basal confining layer.

Groundwater occurs in a shallow unconfined aquifer beneath the site approximately 5 ft BGL in the sand and silty sand deposits. Using 4 November 1991 water-level data, three-point plots were calculated to determine local groundwater flow direction and hydraulic gradient. As shown in Figure 4-21, groundwater flows south/southwest at a rate of 24 ft/year. The hydraulic gradient is approximately 4.09×10^{-3}. These calculations were confirmed using data from a second water-level survey conducted on 25 March 1992. All water-level measurements are provided in Appendix D, and all calculations for groundwater flow direction, hydraulic gradient, and groundwater velocity are included in Appendix C.

In situ permeability (slug) tests were performed on all four monitor wells at the site. Based on data from these tests, hydraulic conductivities were calculated using the Bouwer and Rice (1976) method described in Section 3.7.1. Plots illustrating the results are provided in Appendix C, and the hydraulic conductivities are provided below.

Well Number	Hydraulic Conductivity
MW-14-01	8.0931×10^{-4} ft/min
MW-14-02	3.5600×10^{-3} ft/min
MW-14-03	3.1850×10^{-3} ft/min
MW-14-04	3.6990×10^{-3} ft/min

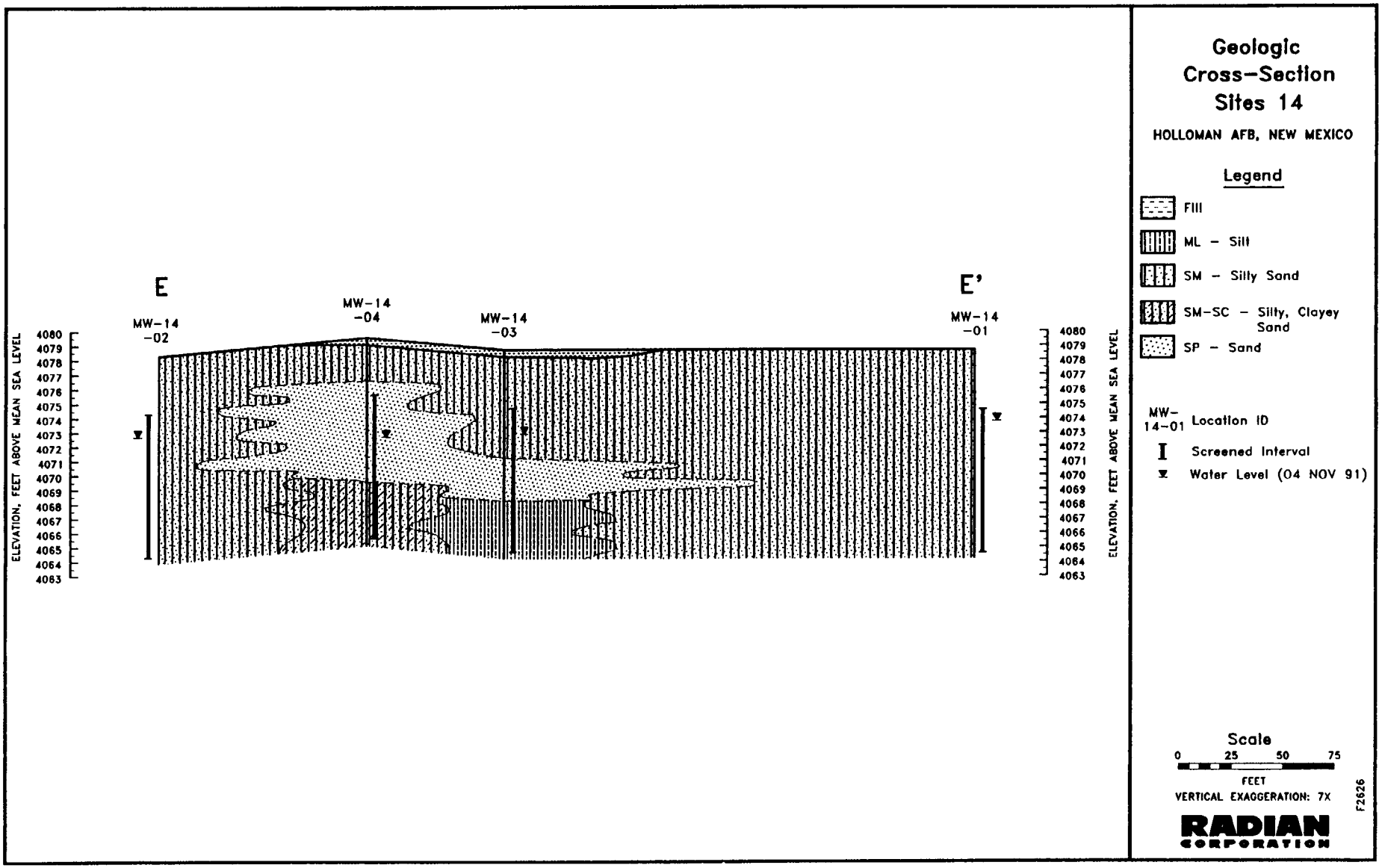


Figure 4-20. Geologic Cross Section for Site 14

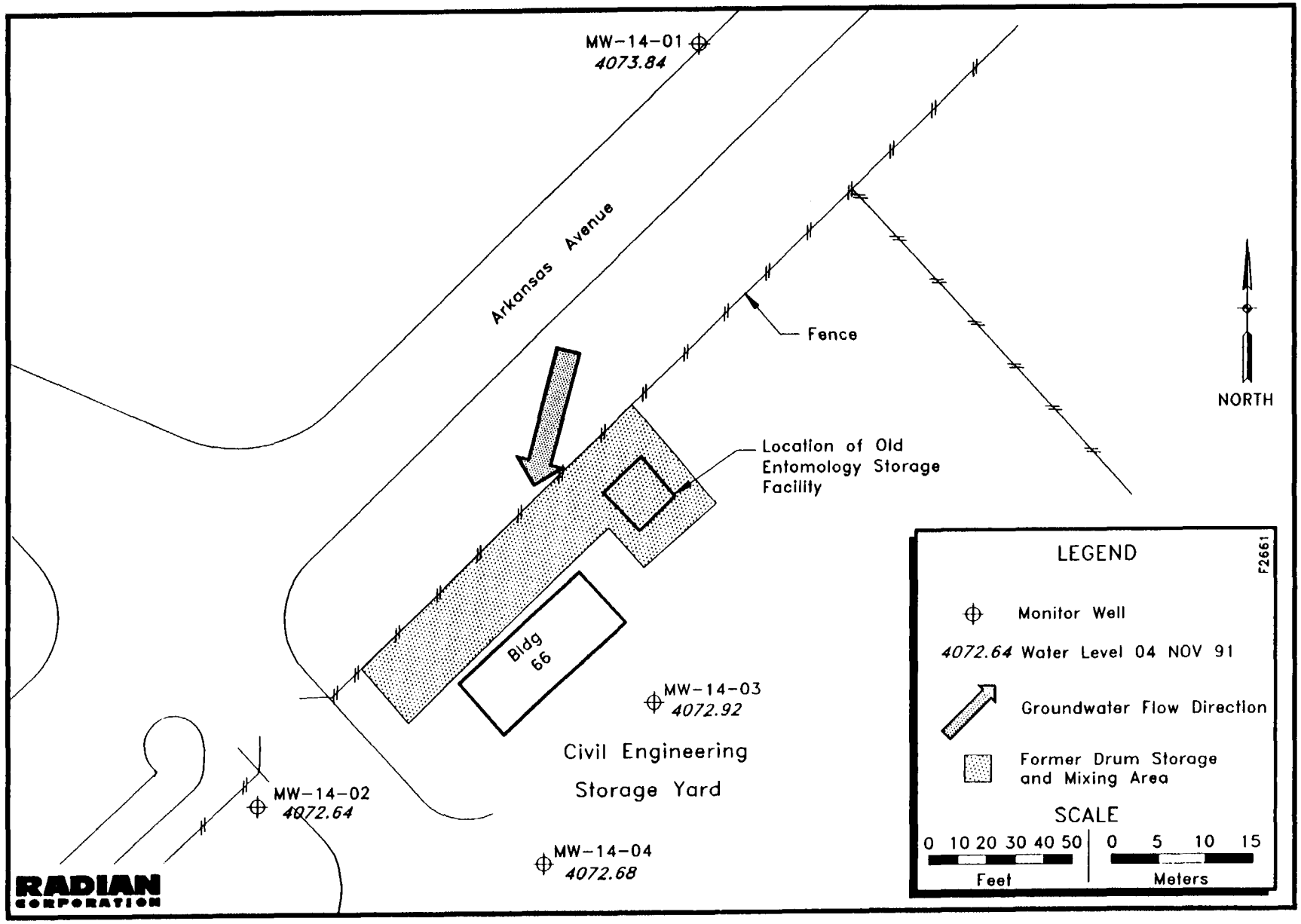


Figure 4-21. Monitor Well Locations and Groundwater Flow Direction for Site 14

These values are within typical ranges for the sand and silty sand deposits logged at Site 14.

4.8.4 Analytical Results

Soils

Four soil borings were drilled to determine whether a release had occurred at Site 14. These borings were located in the former drum storage and mixing areas which are the potential source areas for the site.

Table 4-34 summarizes the results of organic soil analyses for detected constituents. As anticipated, the predominant organic compounds detected were the organochlorine pesticides 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, aldrin, and chlordane, which were detected in all soil borings. Concentrations are highest at the surface (0 to 2 ft BGL) in SB-14-02, SB-14-03, and SB-14-04, and attenuate with depth. Several other organochlorine pesticides, including heptachlor and gamma-BHC, were also detected in one or more soil borings. Samples were also analyzed for organophosphorus pesticides, although none were detected. The chlorinated herbicide MCPP was detected in the sample from 0 to 2 ft in SB-14-04. Methylene chloride was detected in all site samples but one. However, methylene chloride was also blank detected for all of these samples, so its presence in natural samples is uncertain. Petroleum hydrocarbons were detected in surface samples from SB-14-02, SB-14-03, and SB-14-04 at concentrations ranging from 23.1 to 208 mg/kg.

Groundwater

Four monitor wells were installed to determine whether a release had occurred at Site 14. The monitor well network installed at Site 14 was based on an assumed south-southwesterly flow direction. As planned, MW-14-01 is upgradient of the site, and MW-14-02, MW-14-03, and MW-14-04 are downgradient.

Table 4-34

Concentrations of Organic Analytes in Site 14 Soil Samples

Location:	SB-14-01				SB-14-02			
Sample ID: Depth:	91JULJ014-001 0 - 2 ft		91JULJ014-002 2.5 - 4.5 ft		91JULJ014-003 0 - 2 ft		91JULJ014-004 2 - 4 ft	
Analyte	Result	(DL)	Result	(DL)	Result	(DL)	Result	(DL)
EPA 418.1 - TRPH (mg/kg)	ND	(11.5)	ND	(13.2)	40.4 @	(11.2)	ND	(13.8)
SW8080 - Organochlorine Pesticides (μg/kg)								
4,4'-DDD	180 C	(5.6)	ND	(0.64)	3100 C	(55)	230 C	(6.5)
4,4'-DDE	160 C	(5.6)	ND	(0.64)	3900 C	(55)	250 C	(6.5)
4,4'-DDT	320 C	(11)	ND	(1.3)	6500 C	(110)	460 C	(13)
Aldrin	26 X@	(5.6)	ND	(0.64)	640 X	(55)	52 X	(6.5)
Chlordane	1100 C	(28)	ND	(3.2)	17000 C	(270)	1300 C	(33)
Endosulfan II	8.3 J	(17)	ND	(1.9)	ND	(160)	ND	(20)
Endosulfan Sulfate	ND	(28)	1.6 JB	(3.2)	ND	(270)	ND	(33)
Heptachlor	ND	(5.6)	ND	(0.64)	150 C@	(55)	12 C@	(6.5)
Heptachlor epoxide	ND	(5.6)	ND	(0.64)	ND	(55)	ND	(6.5)
delta-BHC	ND	(5.6)	1.9 C@	(0.64)	ND	(55)	ND	(6.5)
gamma-BHC	5.7 X@	(5.6)	ND	(0.64)	2800 C	(55)	190 C	(6.5)
SW8150 - Chlorinated Herbicides (μg/kg)								
MCPP	ND	(11000)	ND	(13000)	ND	(11000)	ND	(13000)
SW8240 - Volatile Organics (μg/kg)								
Methylene chloride	680 B	(110)	640 B@	(130)	230 B@	(110)	190 B@	(130)

Table 4-34

(Continued)

Location:	SB-14-03				SB-14-04			
Sample ID: Depth:	91JULJH014-005 0 - 2 ft		91JULJH014-006 2 - 4 ft		91JULJH014-007 0 - 2 ft		91JULJH014-008 5 - 7 ft	
Analyses	Result	(DL)	Result	(DL)	Result	(DL)	Result	(DL)
EPA 418.1 - TRPH (mg/kg)	208	(10.8)	ND	(11.8)	23.1 @	(11.5)	ND	(14.0)
SW8080 - Organochlorine Pesticides (μg/kg)								
4,4'-DDD	10000 CD	(54)	16 C	(0.60)	3200 CD	(57)	6.0 C	(0.67)
4,4'-DDE	6100 CD	(540)	13 C	(0.60)	2200 CD	(57)	3.9 C	(0.67)
4,4'-DDT	36000 CD	(1100)	41 C	(1.2)	4400 CD	(110)	9.1 C	(1.3)
Aldrin	160 X	(5.4)	2.7 X@	(0.60)	1700 DX	(57)	3.8 X	(0.67)
Chlordane	4500 CD	(270)	56 C	(3.0)	34000 CD	(290)	78 C	(3.3)
Endosulfan II	ND	(16)	ND	(1.8)	ND	(17)	ND	(2.0)
Endosulfan Sulfate	ND	(27)	ND	(3.0)	ND	(29)	0.57 J	(3.3)
Heptachlor	20 C@	(5.4)	0.030 J	(0.60)	770 CD	(57)	1.0 C@	(0.67)
Heptachlor epoxide	ND	(5.4)	0.15 J	(0.60)	ND	(5.7)	ND	(0.67)
delta-BHC	ND	(5.4)	1.6 C@	(0.60)	64 X	(5.7)	ND	(0.67)
gamma-BHC	5.0 J	(5.4)	0.68 C@	(0.60)	10 C@	(5.7)	0.65 J	(0.67)
SW8150 - Chlorinated Herbicides (μg/kg)								
MCPP	ND	(10000)	ND	(12000)	43000 @	(11000)	ND	(13000)
SW8240 - Volatile Organics (μg/kg)								
Methylene chloride	130 B@	(110)	ND	(120)	570 B@	(120)	180 B@	(130)

Table 4-34

(Continued)

Location:	SB-14-05			
Sample ID: Depth:	91JULH014-009 0 - 2 ft		91JULH014-010 2 - 4 ft	
Analyses	Result	(DL)	Result	(DL)
EPA 418.1 - TRPH (mg/kg)	ND	(11.7)	ND	(14.8)
SW8080 - Organochlorine Pesticides (μg/kg)				
4,4'-DDD	35 C	(5.6)	6.6 C	(0.69)
4,4'-DDE	30 C	(5.6)	12 C	(0.69)
4,4'-DDT	130 C	(11)	19 C	(1.4)
Aldrin	ND	(5.6)	ND	(0.69)
Chlordane	ND	(28)	17 C@	(3.5)
Endosulfan II	ND	(17)	ND	(2.1)
Endosulfan Sulfate	ND	(28)	ND	(3.5)
Heptachlor	ND	(5.6)	ND	(0.69)
Heptachlor epoxide	ND	(5.6)	ND	(0.69)
delta-BHC	ND	(5.6)	1.9 C@	(0.69)
gamma-BHC	ND	(5.6)	0.81 C@	(0.69)
SW8150 - Chlorinated Herbicides (μg/kg)				
MCPP	ND	(11000)	ND	(14000)
SW8240 - Volatile Organics (μg/kg)				
Methylene chloride	130 B@	(120)	670 B@	(140)

NOTE: Table presents only constituents detected in soil at this site.
ND = Not Detected, at the reported detection limit; C = Presence and quantitation of analyte confirmed by second column analysis; X = SW8080--Presence of analyte confirmed by second column analysis, but quantitation was not confirmed; @ = Measured result is less than five times the detection limit; B = Analyte detected in laboratory blank analysis, no blank subtraction performed; D = Secondary dilution required for this analyte; J = Detected below the detection limit.

Table 4-35 summarizes results of groundwater analyses for inorganic and organic constituents. Detected concentrations for groundwater quality parameters were compared to the UTLs for background outlined in Section 4.1.2. All groundwater quality parameters were detected at concentrations below background UTLs. The prevalent organic compounds detected in site wells were the chlorinated herbicide 2,4-DB, benzene, and toluene. The herbicide 2,4-DB was detected in MW-14-03 and MW-14-04. Benzene and toluene were detected at concentrations below detection limits in MW-14-02. Methylene chloride was detected in samples from all site wells. Although methylene chloride was not blank detected for these samples, it was blank detected for many other samples analyzed for this RI, so its presence in natural samples is uncertain.

4.8.5 Conclusions

Conclusions are addressed with respect to the nature and extent of contamination, a comparison of the results to action levels, and the results of the risk assessment. The nature and extent discussion summarizes the presence and/or distribution of contaminant sources in soil and groundwater. For this discussion, analytical results and statistical comparisons are used to assess the degree to which media are affected. The proposed RCRA corrective action "action levels" are compared to the analytical results to provide a consistent comparison between the sites at Holloman AFB. However, these levels were not used to determine if a site requires further action. The site-specific risk assessment is the primary basis for the recommendations. A summary of the results for Site 14 was taken from the Risk Assessment Report (Radian, 1992), and is presented below.

Nature and Extent of Contamination

The predominant constituents in Site 14 soils were 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, aldrin, and chlordane. The highest concentrations were at or near the surface in SB-

Table 4-35

Concentrations of Inorganic and Organic Analytes in Site 14 Groundwater Samples

Location: Sample ID:	MW-14-01 14-01-01		MW-14-02 14-02-01		MW-14-03 14-03-01		MW-14-04 14-04-01	
Analyte	Result	(DL)	Result	(DL)	Result	(DL)	Result	(DL)
Inorganic results								
EPA 160.1 - Total Dissolved Solids (mg/L)	11000	(10)	12000	(10)	12000	(10)	16000	(10)
EPA 300.0 - Chloride (mg/L)	3700	(26)	4000	(26)	3400	(26)	4900	(26)
EPA 300.0 - Sulfate (mg/L)	3800	(2.5)	3500	(2.5)	4400	(5.0)	5000	(10)
EPA 340.2 - Fluoride (mg/L)	4.6	(0.10)	2.7	(0.10)	3.8	(0.10)	2.9	(0.10)
EPA 353.1 - Nitrate-Nitrite (mg/L)	0.63	(0.022)	4.9	(0.11)	15	(0.22)	19	(0.22)
EPA 365.2 - Total Phosphorus (mg/L)	0.12	(0.020)	0.31	(0.020)	0.21	(0.020)	0.28	(0.020)
Organic results								
SW8150 - Chlorinated Herbicides (ug/L)								
2,4-DB	ND	(0.86)	ND	(0.90)	4.0 @	(0.87)	2.5 @	(0.88)
SW8240 - Volatile Organics (ug/L)								
Benzene	ND	(5.0)	0.82 J	(5.0)	ND	(5.0)	ND	(5.0)
Methylene chloride	32	(5.0)	10 @	(5.0)	3.0 J	(5.0)	11 @	(5.0)
Toluene	ND	(5.0)	1.3 J	(5.0)	ND	(5.0)	ND	(5.0)

NOTE: Table presents only constituents detected in groundwater at this site.
ND = Not Detected, at the reported detection limit.
@ = Measured result is less than five times the detection limit.
J = Detected below the detection limit.

14-02, SB-14-03, and SB-14-04. These borings were located along the fence where the drums were stored and where most mixing activities occurred. Concentrations dropped off considerably with depth, implying that these constituents are limited to the near surface. Groundwater results confirm that the pesticides have not migrated downward, because no organochlorine and organophosphorus pesticides were detected in any samples. One chlorinated herbicide, 2,4-DB, was detected in groundwater but not in soil samples.

Comparison of Results to Action Levels

Table 4-36 lists the analytes that were detected above risk-based action levels at Site 14. Only pesticides were detected above action levels in site borings. The pesticides 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, aldrin, and chlordane were detected at concentrations above action levels in surface samples from SB-14-02, SB-14-03, and SB-14-04. Aldrin and chlordane were also detected at concentrations above the action level from 2 to 4 ft in SB-14-02, and chlordane was detected at a concentration above action levels in SB-14-01. Heptachlor and gamma-BHC were each detected at concentrations above the action level in one boring. Fluoride was detected above action levels in groundwater samples from all site wells. However, detected fluoride concentrations were below UTLs for background, indicating that they are characteristic of regional groundwater quality rather than the result of a release at the site.

Risk Assessment Results

The health risk assessment found that potential exposures to on- and off-Base residents were acceptable. However, the occupational exposure scenario resulted in unacceptable risks. The concentrations of pesticides (primarily chlordane) in soil at this site resulted in both carcinogenic and noncarcinogenic risks that were excessive. The carcinogenic risk for the average exposure scenario was 1E-04; in general, risks due to average exposure scenarios should not exceed 1E-06. The Hazard Index value for this site

Table 4-36

Soil and Groundwater Analytes Detected Above Risk-Based Action Levels at Site 14

Analyte	Location ID	Result		Action Level
Soil Results (mg/kg)				
4,4'-DDD	SB-14-02	3.1	C	3
4,4'-DDD	SB-14-03	10.0	CD	3
4,4'-DDD	SB-14-04	3.2	CD	3
4,4'-DDE	SB-14-02	3.9	C	2
4,4'-DDE	SB-14-03	6.1	CD	2
4,4'-DDE	SB-14-04	2.2	CD	2
4,4'-DDT	SB-14-02	6.5	C	2
4,4'-DDT	SB-14-03	36	CD	2
4,4'-DDT	SB-14-04	4.4	CD	2
Aldrin (0-2 ft BGL)	SB-14-02	0.64	X	0.04
Aldrin (2-4 ft BGL)	SB-14-02	0.052	X	0.04
Aldrin	SB-14-03	0.16	X	0.04
Aldrin	SB-14-04	1.7	DX	0.04
Chlordane	SB-14-01	1.1	C	0.5
Chlordane (0-2 ft BGL)	SB-14-02	17	C	0.5
Chlordane (2-4 ft BGL)	SB-14-02	1.3	C	0.5
Chlordane	SB-14-03	4.5	CD	0.5
Chlordane	SB-14-04	34	CD	0.5
Heptachlor	SB-14-04	0.77	CD	0.2
gamma-BHC	SB-14-02	2.8	C	0.5

Table 4-36

(Continued)

Analyte	Location ID	Result	Action Level
Groundwater Results (mg/L)			
Fluoride	MW-14-01	4.6	2
Fluoride	MW-14-02	2.7	2
Fluoride	MW-14-03	3.8	2
Fluoride	MW-14-04	2.9	2
Methylene chloride[a]	MW-14-01	0.032	0.005
Methylene chloride[a]	MW-14-02	0.01 @	0.005
Methylene chloride[a]	MW-14-04	0.011 @	0.005

Note: Result units were changed to match action level units for this table.

C = Presence and quantitation of analyte confirmed by second column analysis.
D = Secondary dilution required for this analyte.
X = SW8080--Presence of analyte confirmed by second column analysis, but quantitation was not confirmed.
[a] Methylene chloride was determined to be a laboratory contaminant in a QA/QC review and is, therefore, not considered to be above the action level in samples from the site.
@ = Measured result is less than five times the detection limit.

was 3; a value greater than 1 is indicative of potential adverse health effects. The unacceptable risks were due primarily to dermal contact with soil at the site.

It was difficult to identify the appropriate assumptions for occupational exposure scenarios. For this assessment, the frequency and duration of contact with soil had to be estimated. Based on the actual uses of this site, exposure is expected to vary from day to day depending on whether, for example, storage pallets are being moved to or from the unpaved area. The exposure assessment for this site was intended to be conservative, but not unrealistic. For this reason, the unacceptable risks should be considered possible, although not necessarily probable.

The environmental evaluation identified a borderline risk to black-tailed jackrabbits. The EQ for this site was 1.3 due to chlordane and 4,4'-DDT. The evaluation was based on uptake of pesticides by plants, followed by ingestion of plants by the rabbits. The site is not currently vegetated. Moreover, given that the site experiences heavy traffic during the day and is fenced in at night, rabbits have limited access to the site. Therefore, the borderline EQ value is unlikely to represent a realistic concern.

The human health risk assessment identified unacceptable carcinogenic and noncarcinogenic risk to on-site workers. The assessment was based on average soil concentrations, whereas "hot spots" with very high pesticide concentrations were identified at the surface (e.g., chlordane at 34,000 μg/kg). Based on the unacceptable health risks associated with occupational exposure to the soils at this site, remedial alternatives should be considered.

4.8.6 Recommendations

The risk assessment provided the primary basis for the RI recommendations. The health risk assessment for Site 14 indicates unacceptable risk. Therefore, it is

recommended that the site should proceed beyond the RI/RFI stages into the FS/CMS stages and, if necessary, to implementation of an IRP remedial action/RCRA corrective action remedy. Pre-design investigation may be warranted to determine the extent of remediation required.

D.1

Drilling Logs

DRILLING LOG

HOLE NO. MW-14-01

F2442

1. COMPANY NAME	RADIAN CORPORATION
2. DRILLING SUBCONTRACTOR	SOUTHWEST ENG INC
SHEET 1 OF 2 SHEETS	
3. PROJECT	HOLLOMAN AFB RI/FS FOR 29 SITES
4. LOCATION	14
5. NAME OF DRILLER	ALEX SANCHEZ
6. MANUFACTURER'S DESIGNATION OF DRILL	HOLLOW-STEM AUGER
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	BOREHOLE DIA.: 7.5"
8. HOLE LOCATION	670836.2 (Y),553687.9 (X)
9. SURFACE ELEVATION	4079.16
10. DATE STARTED	10 AUG 91
11. DATE COMPLETED	10 AUG 91
12. OVERBURDEN THICKNESS	
15. DEPTH GROUNDWATER ENCOUNTERED	5.0 ft bgl
13. DEPTH DRILLED INTO ROCK	
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	04 NOV 91 5.7 ft bmp
14. TOTAL DEPTH OF HOLE	14.5 ft.
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

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

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

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

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS/RECOVERY h
	1, 2, 3, 4	SILTY SAND, some clay: moderate brown (5YR 4/4), low plasticity, very moist. (SM)				0,1,1,1	0.4/2.0 ft
	5, 6, 7	SILTY SAND: light brown (5YR 5/6), caliche nodules, increasing with depth. (SM)					4.4/5.0 ft ▽ water level at 5.3 ft bgl
	8	SILTY SAND, as above: moderate yellowish-brown (10YR 5/4), caliche nodules increasing with depth. (SM)					
	9	SILTY SAND, as above, some clay: moderate brown, caliche nodules, low plasticity. (SM)					

DRILLING LOG

HOLE NO. MW-14-01

PROJECT HOLLOMAN AFB RI/FS

INSPECTOR LEM

SHEET 2 OF 2 SHEETS

F2442

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS/RECOVERY h
		SILTY SAND, as above. (SM)					
	11						
	12						
	13			MW-014-001			geotechnical sample 12.5-15.0 ft
	14	SILTY SAND, as above: very pale orange. (SM)					
							TD= 14.5 ft
	15						
	16						
	17						
	18						
	19						
	20						
	21						
	22						
	23						
	24						
	25						
	26						
	27						

DRILLING LOG

HOLE NO. MW-14-02

F2443

1. COMPANY NAME	RADIAN CORPORATION
2. DRILLING SUBCONTRACTOR	SOUTHWEST ENG INC
SHEET 1 OF 2 SHEETS	
3. PROJECT	HOLLOMAN AFB RI/FS FOR 29 SITES
4. LOCATION	14
5. NAME OF DRILLER	ALEX SANCHEZ
6. MANUFACTURER'S DESIGNATION OF DRILL	HOLLOW-STEM AUGER
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	BOREHOLE DIA.: 7.5"
8. HOLE LOCATION	670573.37 (Y),553532.6 (X)
9. SURFACE ELEVATION	4078.39
10. DATE STARTED	10 AUG 91
11. DATE COMPLETED	10 AUG 91
12. OVERBURDEN THICKNESS	
15. DEPTH GROUNDWATER ENCOUNTERED	3.0 ft bgl
13. DEPTH DRILLED INTO ROCK	
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	04 NOV 91 5.70 ft bmp
14. TOTAL DEPTH OF HOLE	14.4 ft.
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

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

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

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

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS/RECOVERY h
	1						
	2	SILTY SAND: greyish-orange (10YR 7/4), moist, caliche nodules. (SM)				6,5,12,10	2.0/2.0 ft
	3	SILTY SAND, as above: light brown (5YR 5/6), saturated at 3.0 ft. (SM)					
	4	SILTY SAND, as above. (SM)	DH=0.0ppm C=0.0ppm			4,6,8,2	2.0/2.0 ft
	5						
	6	SILTY SAND, as above. (SM)	DH=0.1ppm				water level at 5.70 ft bgl
							5.0/5.0 ft
	7						
	8			MW-014-002			geotechnical sample 7.5-10.0 ft
	9						

DRILLING LOG

HOLE NO. MW-14-02

F2443

PROJECT HOLLOMAN AFB RI/FS

INSPECTOR LEM

SHEET 2 OF 2 SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS/RECOVERY h
		SILTY SAND, as above. (SM)					5.0/5.0 ft
	11						
	12						
	13						
	14						TD= 14.4 ft
	15						
	16						
	17						
	18						
	19						
	20						
	21						
	22						
	23						
	24						
	25						
	26						
	27						

DRILLING LOG

HOLE NO. MW-14-03

F2369

1. COMPANY NAME	RADIAN CORPORATION
2. DRILLING SUBCONTRACTOR	SOUTHWEST ENG INC
SHEET 1 OF 2 SHEETS	
3. PROJECT	HOLLOMAN AFB RI/FS FOR 29 SITES
4. LOCATION	14
5. NAME OF DRILLER	ART VALTIERRA
6. MANUFACTURER'S DESIGNATION OF DRILL	HOLLOW-STEM AUGER
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	BOREHOLE DIA.: 7.5"
8. HOLE LOCATION	670608.20(Y), 553671.88(X)
9. SURFACE ELEVATION	4078.74
10. DATE STARTED	10 AUG 91
11. DATE COMPLETED	10 AUG 91
12. OVERBURDEN THICKNESS	
15. DEPTH GROUNDWATER ENCOUNTERED	25 ft bgl
13. DEPTH DRILLED INTO ROCK	
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	04 NOV 91 5.81 ft bmp
14. TOTAL DEPTH OF HOLE	14.5 ft.
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

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

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

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

a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS/RECOVERY h
		FILL: asphalt	HS=0.0ppm			47,18,8,8	1.8/2.0 ft
	1	SILTY SAND: brown (5YR 4/4), homogeneous, moist, very fine, subrounded. (SM)					
	2	grades to orange-pink (5YR 8/4) at 2 ft.					
		Wet at ~2.5'	HS=0.0ppm			5,7,7,12	2.0/2.0 ft
	3	Caliche found beginning at 3.5'					
	4						Core Sampler
	5						
	6						▽ -water at 5.81 ft
	7						
	8	SAND, light brown (5YR 5/6), some/little silt: fine to very fine, wet, subrounded, no caliche, laminated. (SP)					
	9	Small amount of dark/black stains					small amount of dark/black stains at 9.5 ft

PROJECT HOLLOMAN AFB RI/FS FOR 29 SITES HOLE NO. MW-14-03

DRILLING LOG

HOLE NO. MW-14-03

PROJECT HOLLOMAN AFB RI/FS

INSPECTOR ACD

SHEET 2 OF 2 SHEETS

a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS/RECOVERY h
	11	SANDY, CLAYEY SILT: dark yellowish-brown (10R 4/6), white gypsum spotting, medium plasticity, firm, low toughness. (ML)					
	12						
	13						
	14						TD= 14.5 ft
	15						
	16						
	17						
	18						
	19						
	20						
	21						
	22						
	23						
	24						
	25						
	26						
	27						

DRILLING LOG

HOLE NO. MW-14-04

F2370

1. COMPANY NAME	RADIAN CORPORATION
2. DRILLING SUBCONTRACTOR	SOUTHWEST ENG INC
SHEET 1 OF 2 SHEETS	
3. PROJECT	HOLLOMAN AFB RI/FS FOR 29 SITES
4. LOCATION	14
5. NAME OF DRILLER	ART VALTIERRA
6. MANUFACTURER'S DESIGNATION OF DRILL	HOLLOW-STEM AUGER
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	BOREHOLE DIA.: 7.5"
8. HOLE LOCATION	670552.85(Y), 553633.56(X)
9. SURFACE ELEVATION	4079.68
10. DATE STARTED	10 AUG 91
11. DATE COMPLETED	10 AUG 91
12. OVERBURDEN THICKNESS	
15. DEPTH GROUNDWATER ENCOUNTERED	3 ft bgl
13. DEPTH DRILLED INTO ROCK	
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	04 NOV 91 6.99 ft bmp
14. TOTAL DEPTH OF HOLE	14.5 ft.
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

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

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

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

a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS/RECOVERY h
		FILL, asphalt					1.8/2.0 ft
	1	SILTY SAND: tan-orange (5YR 8/4), moist, some caliche present, crumbly, very fine. (SM)				12,10,10, 12	2.0/2.0 ft
	2						
	3	SAND, yellowish-brown (5YR 5/6), small amount of silt: wet, no caliche, homogeneous, clean, fine to very fine. (SP)				5,3,4,3	1.0/2.0 ft
	4						
	5						core sampler used
		changes to brownish-yellow (10YR 6/6)					3.5/5.0 ft
	6						
		changes to very pale brown (10YR 7/4), brown staining (iron ?)					
	7						▽
							-water at 6.99 ft
		changes to yellowish-red (5YR 5/6)					
	8						
	9	fine to medium grained					

DRILLING LOG

HOLE NO. MW-14-04

F2370

PROJECT HOLLOMAN AFB RI/FS

INSPECTOR ACD

SHEET 2 OF 2 SHEETS

a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS/RECOVERY h
		SILTY, CLAYEY SAND: brown (5YR 5/6), with tan mottles, caliche from 10.0 to 10.5 ft, low plasticity. (SM-SC)					5.0/5.0 ft
	11						
	12						
	13						
	14	large (1" plus) gypsum crystals					
							TD= 14.5 ft
	15						
	16						
	17						
	18						
	19						
	20						
	21						
	22						
	23						
	24						
	25						
	26						
	27						

DRILLING LOG

HOLE NO. SB-14-01

F2436

1. COMPANY NAME	RADIAN CORPORATION
2. DRILLING SUBCONTRACTOR	SOUTHWEST ENG INC
SHEET 1 OF 1 SHEETS	
3. PROJECT	HOLLOMAN AFB RI/FS FOR 29 SITES
4. LOCATION	14
5. NAME OF DRILLER	ALEX SANCHEZ
6. MANUFACTURER'S DESIGNATION OF DRILL	HOLLOW-STEM AUGER
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	BOREHOLE DIA.: 7.5"
8. HOLE LOCATION	670669.5 (Y),553677.2 (X)
9. SURFACE ELEVATION	4078.69
10. DATE STARTED	9 AUG 91
11. DATE COMPLETED	9 AUG 91
12. OVERBURDEN THICKNESS	
15. DEPTH GROUNDWATER ENCOUNTERED	5.0 ft bgl
13. DEPTH DRILLED INTO ROCK	
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
14. TOTAL DEPTH OF HOLE	7.0 ft.
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

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

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

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

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS/RECOVERY h
		FILL: angular gravel.			91JULH014-001	2,3,5,8	
	1	SILTY SAND: moderate brown (5YR 4/4). (SM)					
	2						
		SILTY SAND: light brown (5YR 6/4), saturated. (SM)			91JULH014-002	3,3,5,8	
	3						
	4						
	5	SILTY SAND, as above. (SM)				8,5,5,10	
	6						
	7						TD= 7.0 ft
	8						
	9						

DRILLING LOG

HOLE NO.	SB-14-02
1. COMPANY NAME	RADIAN CORPORATION
2. DRILLING SUBCONTRACTOR	SOUTHWEST ENG INC
SHEET 1 OF 1 SHEETS	
3. PROJECT	HOLLOMAN AFB RI/FS FOR 29 SITES
4. LOCATION	14
5. NAME OF DRILLER	ALEX SANCHEZ
6. MANUFACTURER'S DESIGNATION OF DRILL	HOLLOW-STEM AUGER
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	BOREHOLE DIA.: 7.5"
8. HOLE LOCATION	670677.1 (Y),553640.7 (X)
9. SURFACE ELEVATION	4078.64
10. DATE STARTED	9 AUG 91
11. DATE COMPLETED	9 AUG 91
12. OVERBURDEN THICKNESS	
15. DEPTH GROUNDWATER ENCOUNTERED	5.0 ft bgl
13. DEPTH DRILLED INTO ROCK	
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
14. TOTAL DEPTH OF HOLE	6.0 ft.
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	
18. GEOTECHNICAL SAMPLES	DISTURBED / UNDISTURBED
19. TOTAL NUMBER OF CORE BOXES	
20. SAMPLES FOR CHEMICAL ANALYSIS	VOC / METALS / OTHER (SPECIFY) / OTHER (SPECIFY) / OTHER (SPECIFY)
21. TOTAL CORE RECOVERY	%
22. DEPOSITION OF HOLE	BACKFILLED / MONITORING WELL / OTHER (SPECIFY): GROUT
23. SIGNATURE OF INSPECTOR	LEM

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS/RECOVERY h
		FILL: angular gravel.			91JULH014-003	2,2,5,2	2.0/2.0 ft
	1	SILTY SAND: moderate brown (5YR 4/4). (SM)					
	2	SILTY SAND: light brown (5YR 4/4) to light brown (5YR 6/4), moist to saturated. (SM)			91JULH014-004	1,2,5,6	2.0/2.0 ft strong chemical odor
	3						
	4	SILTY SAND, as above. (SM)				3,4,6,8	2.0/2.0 ft
	5						
	6						TD= 6.0 ft
	7						
	8						
	9						

DRILLING LOG

HOLE NO. SB-14-03

F2438

1. COMPANY NAME	RADIAN CORPORATION
2. DRILLING SUBCONTRACTOR	SOUTHWEST ENG INC
SHEET 1 OF 1 SHEETS	
3. PROJECT	HOLLOMAN AFB RI/FS FOR 29 SITES
4. LOCATION	14
5. NAME OF DRILLER	ALEX SANCHEZ
6. MANUFACTURER'S DESIGNATION OF DRILL	HOLLOW-STEM AUGER
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	BOREHOLE DIA.: 7.5"
8. HOLE LOCATION	670655.26(Y), 553616.17(X)
9. SURFACE ELEVATION	4079.22
10. DATE STARTED	9 AUG 91
11. DATE COMPLETED	9 AUG 91
12. OVERBURDEN THICKNESS	
15. DEPTH GROUNDWATER ENCOUNTERED	6.3 ft bgl
13. DEPTH DRILLED INTO ROCK	
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
14. TOTAL DEPTH OF HOLE	8.0 ft.
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	
18. GEOTECHNICAL SAMPLES	DISTURBED / UNDISTURBED
19. TOTAL NUMBER OF CORE BOXES	
20. SAMPLES FOR CHEMICAL ANALYSIS	VOC / METALS / OTHER (SPECIFY) / OTHER (SPECIFY) / OTHER (SPECIFY)
21. TOTAL CORE RECOVERY	%
22. DEPOSITION OF HOLE	BACKFILLED / MONITORING WELL / OTHER (SPECIFY): GROUT
23. SIGNATURE OF INSPECTOR	LEM

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS/RECOVERY h
		FILL	DH=0.0ppm		91JULH014-005 91JULH014-011	2,4,6,8 6,17,8,4	2.0/2.0 ft 1.5/2.0 ft duplicate sample collected for RAS
	1	SILTY SAND: moderate brown (5YR 4/4). (SM)					
	2	SILTY SAND: moderate yellowish-brown (10YR 5/4), caliche bottom, saturated at bottom. (SM)	C=0.0ppm		91JULH014-006	2,1,2,4	1.5/2.0 ft strong, sweet chemical odor * sample taken
	3						
	4	SILTY SAND, as above. (SM)					
	5						
	6	SILTY SAND, as above. (SM)					
	7						
	8						TD= 8.0 ft
	9						

DRILLING LOG

HOLE NO. SB-14-04

F2439

1. COMPANY NAME	RADIAN CORPORATION
2. DRILLING SUBCONTRACTOR	SOUTHWEST ENG INC
SHEET 1 OF 1 SHEETS	
3. PROJECT	HOLLOMAN AFB RI/FS FOR 29 SITES
4. LOCATION	14
5. NAME OF DRILLER	ALEX SANCHEZ
6. MANUFACTURER'S DESIGNATION OF DRILL	HOLLOW-STEM AUGER
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	BOREHOLE DIA.: 7.5"
8. HOLE LOCATION	670640.1 (Y),553598.5 (X)
9. SURFACE ELEVATION	4079.32
10. DATE STARTED	9 AUG 91
11. DATE COMPLETED	9 AUG 91
12. OVERBURDEN THICKNESS	
15. DEPTH GROUNDWATER ENCOUNTERED	5.0 ft bgl
13. DEPTH DRILLED INTO ROCK	
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
14. TOTAL DEPTH OF HOLE	6.0 ft.
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

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

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

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

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS/RECOVERY h
		FILL: angular gravel.			91JULH014 -007	3,4,6,10 3,2,6,9	1.5/2.0 ft duplicate sample collected for MRD
	1	SILTY SAND: moderate brown (5YR 4/4). (SM)					
		SILTY SAND: moderate orange pink (5YR 8/4), caliche. (SM)					
	2	SILTY SAND, as above: very pale orange (10YR 8/2). (SM)				2,5,6,8	0.5/2.0 ft
	3						
	4	SILTY SAND, as above: greyish-orange (10YR 7/4), saturated. (SM)			91JULH014 -008	2,3,5,6	1.5/2.0 ft sweet chemical odor
	5						
	6						TD= 6.0 ft
	7						
	8						
	9						

DRILLING LOG

HOLE NO. SB-14-05

F2440

1. COMPANY NAME	RADIAN CORPORATION
2. DRILLING SUBCONTRACTOR	SOUTHWEST ENG INC
SHEET 1 OF 1 SHEETS	
3. PROJECT	HOLLOMAN AFB RI/FS FOR 29 SITES
4. LOCATION	14
5. NAME OF DRILLER	ALEX SANCHEZ
6. MANUFACTURER'S DESIGNATION OF DRILL	HOLLOW-STEM AUGER
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	BOREHOLE DIA.: 7.5"
8. HOLE LOCATION	670692.1 (Y),553656.3 (X)
9. SURFACE ELEVATION	4078.64
10. DATE STARTED	9 AUG 91
11. DATE COMPLETED	9 AUG 91
12. OVERBURDEN THICKNESS	
15. DEPTH GROUNDWATER ENCOUNTERED	4.0 ft bgl
13. DEPTH DRILLED INTO ROCK	
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
14. TOTAL DEPTH OF HOLE	4.0 ft.
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

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

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

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

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS/RECOVERY h
		FILL			91JULHO14-009	3,5,2,2	2.0/2.0 ft
	1	SILTY SAND: moderate brown (5YR 4/4). (SM)					
	2	SILTY SAND, as above. (SM)			91JULHO14-010	8,6,9,4	2.0/2.0 ft
	3	SILTY SAND, as above: greyish-orange (10YR 7/4), moist, saturated at bottom, lots of caliche nodules. (SM)					
	4						TD= 4.0 ft
	5						
	6						
	7						
	8						
	9						

D.2

Monitor Well Completion Forms

ELEVATION GROUND WATER			PROJECT HOLLOMAN AFB RI/FS
DATE INSTALLED 10 AUG 91	STARTED 0800	COMPLETED 1030	LOCATION (Coordinates or Station) 14
ELEVATION TOP OF CASING 4079.14			SIGNATURE OF INSPECTOR/INSTALLER LEM
DRILLING METHOD HOLLOW STEM AUGER			WELL NO. (as shown on drawing: title and file number) MW-14-01

MONITORING WELL CONSTRUCTION DIAGRAM

(ALL MEASUREMENTS FROM GROUND SURFACE)

PROTECTIVE CASING

TYPE OF PROTECTIVE CASING: Steel Manhole with Locking Well Cap

TOP OF WELL

PROTECTIVE POSTS

CASING DIAMETER: 2 in.

TYPE OF PIPE JOINTS: Flush Threaded

TYPE OF BLANK CASING: PVC

BACKFILL/GROUT MIX ETC. Type I Portland Cement

TOP OF SEAL

TYPE OF SEAL: 1/4" Bentonite Pellets

TOP OF FILTERPACK

TOP OF SCREEN

FILTER PACK

BOTTOM OF WELL

BOTTOM OF BORING

BORING DIAMETER

4.5 ft. LENGTH OF SOLID PIPE

9.5 ft. WELL SCREEN LENGTH

STICK-UP: 0 ft.

GROUND SURFACE

CONCRETE PAD MIN. 4.0" THICKNESS

SCREEN INFORMATION

SCREEN DIA.: 2 in.

SLOT WIDTH: 0.010 in.

SCHEDULE: 40

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

1.5 ft. bgl

3.0 ft. bgl

4.5 ft. bgl

FILTERPACK MATERIAL

TYPE: 16-40 Colorado Silica Sand

BACKFILL METHOD: Tremie through auger

14.5 ft. bgl

14.5 ft. bgl

7.5 in.

WELL DEVELOPMENT

METHOD: See well development record

TIME SPENT DEVELOPING:

VOLUME OF WATER REMOVED:

VOLUME OF WATER ADDED:

DESCRIPTION OF PREDEVELOPMENT WATER:

DESCRIPTION OF POST DEVELOPMENT WATER:

WATER LEVEL SUMMARY

WATER LEVEL MEASUREMENTS

DATE/TIME/LEVEL 10 AUG 91/1030/5.3 ft bgl

13 OCT 91/0945/5.2 ft bmp

04 NOV 91/1411/5.30 ft bmp

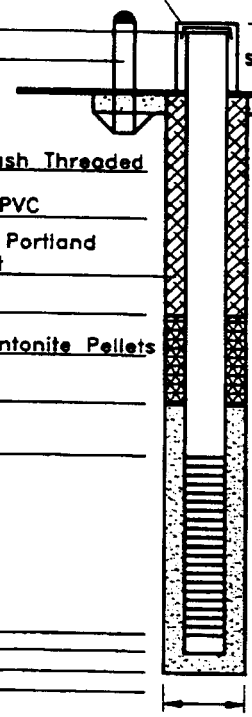
DEPTH FROM TOP CASING AFTER DEVELOPMENT:

F2334

ELEVATION GROUND WATER			PROJECT HOLLOMAN AFB RI/FS
DATE INSTALLED 10 AUG 91	STARTED 1030	COMPLETED 1230	LOCATION (Coordinates or Station) 14
ELEVATION TOP OF CASING 4078.34			SIGNATURE OF INSPECTOR/INSTALLER LEM
DRILLING METHOD HOLLOW STEM AUGER			WELL NO. (as shown on drawing: title and file number) MW-14-02

MONITORING WELL CONSTRUCTION DIAGRAM

(ALL MEASUREMENTS FROM GROUND SURFACE)



PROTECTIVE CASING

TYPE OF PROTECTIVE CASING: Steel Manhole with Locking Well Cap

TOP OF WELL

PROTECTIVE POSTS

CASING DIAMETER: 2 in.

TYPE OF PIPE JOINTS: Flush Threaded

TYPE OF BLANK CASING: PVC

BACKFILL/GROUT MIX ETC. Type I Portland Cement

TOP OF SEAL

TYPE OF SEAL: 1/4" Bentonite Pellets

TOP OF FILTERPACK

TOP OF SCREEN

FILTER PACK

BOTTOM OF WELL

BOTTOM OF BORING

BORING DIAMETER

LENGTH OF SOLID PIPE: 4.0 ft.

WELL SCREEN LENGTH: 9.5 ft.

STICK-UP: 0 ft.

GROUND SURFACE

CONCRETE PAD MIN. 4.0 THICKNESS

SCREEN INFORMATION

SCREEN DIA.: 2 in.

SLOT WIDTH: 0.010 in.

SCHEDULE: 40

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

1.5 ft. bgl

3.0 ft. bgl

4.0 ft. bgl

FILTERPACK MATERIAL

TYPE: 16-40 Colorado Silica Sand

BACKFILL METHOD: Tremie through auger

14.0 ft. bgl

14.4 ft. bgl

7.5 in.

WELL DEVELOPMENT

METHOD: See well development record

TIME SPENT DEVELOPING:

VOLUME OF WATER REMOVED:

VOLUME OF WATER ADDED:

DESCRIPTION OF PREDEVELOPMENT WATER:

DESCRIPTION OF POST DEVELOPMENT WATER:

WATER LEVEL SUMMARY

WATER LEVEL MEASUREMENTS

DATE/TIME/LEVEL 10 AUG 91/1300/5.5 ft bgl

13 OCT 91/0930/5.8 ft bmp

04 NOV 91/1419/5.70 ft bmp

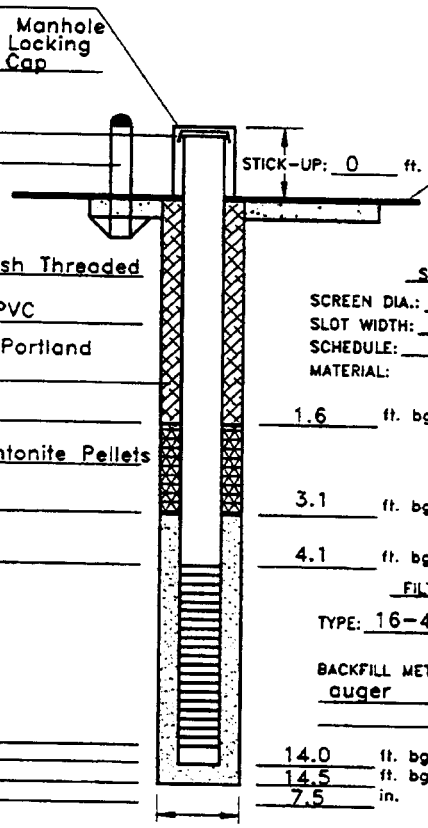
DEPTH FROM TOP CASING AFTER DEVELOPMENT:

F2335

ELEVATION GROUND WATER			PROJECT HOLLOMAN AFB RI/FS
DATE INSTALLED 10 AUG 91	STARTED	COMPLETED	LOCATION (Coordinates or Station) 14
ELEVATION TOP OF CASING 4078.74			SIGNATURE OF INSPECTOR/INSTALLER ACD
DRILLING METHOD HOLLOW STEM AUGER			WELL NO. (as shown on drawing: title and file number) MW-14-03

MONITORING WELL CONSTRUCTION DIAGRAM

(ALL MEASUREMENTS FROM GROUND SURFACE)



PROTECTIVE CASING

TYPE OF PROTECTIVE CASING: Steel Manhole with Locking Well Cap

TOP OF WELL

PROTECTIVE POSTS

CASING DIAMETER: 2 in.

TYPE OF PIPE JOINTS: Flush Threaded

TYPE OF BLANK CASING: PVC

BACKFILL/GROUT MIX ETC. Type I Portland Cement

TOP OF SEAL

TYPE OF SEAL: 1/4" Bentonite Pellets

TOP OF FILTERPACK

TOP OF SCREEN

FILTER PACK

BOTTOM OF WELL

BOTTOM OF BORING

BORING DIAMETER

LENGTH OF SOLID PIPE: 4.1 ft.

WELL SCREEN LENGTH: 9.5 ft.

STICK-UP: 0 ft.

GROUND SURFACE

CONCRETE PAD MIN. 4.0 THICKNESS

SCREEN INFORMATION

SCREEN DIA.: 2 in.

SLOT WIDTH: 0.010 in.

SCHEDULE: 40

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

1.6 ft. bgl

3.1 ft. bgl

4.1 ft. bgl

FILTERPACK MATERIAL

TYPE: 16-40 Colorado Silica Sand

BACKFILL METHOD: Tremie through auger

14.0 ft. bgl

14.5 ft. bgl

7.5 in.

WELL DEVELOPMENT

METHOD: See well development record

TIME SPENT DEVELOPING:

VOLUME OF WATER REMOVED:

VOLUME OF WATER ADDED:

DESCRIPTION OF PREDEVELOPMENT WATER:

DESCRIPTION OF POST DEVELOPMENT WATER:

WATER LEVEL SUMMARY

WATER LEVEL MEASUREMENTS

DATE/TIME/LEVEL 04 NOV 91/1416/5.81 ft bmp

DEPTH FROM TOP CASING AFTER DEVELOPMENT:

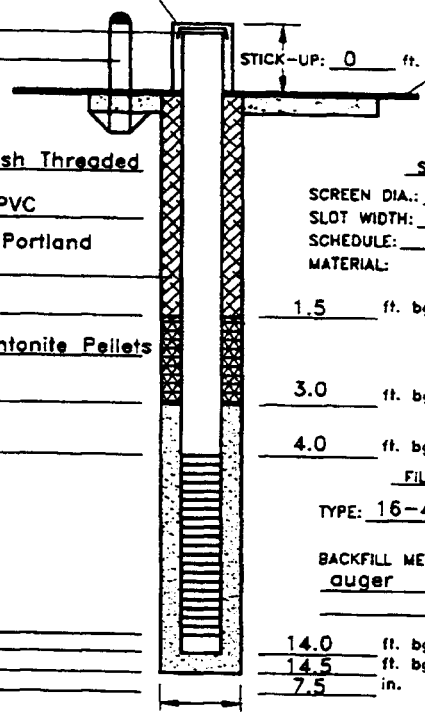
F2358

ELEVATION GROUND WATER			PROJECT HOLLOMAN AFB RI/FS
DATE INSTALLED 10 AUG 91	STARTED	COMPLETED	LOCATION (Coordinates or Station) 14
ELEVATION TOP OF CASING 4079.67			SIGNATURE OF INSPECTOR/INSTALLER ACD
DRILLING METHOD HOLLOW STEM AUGER			WELL NO. (as shown on drawing: title and file number) MW-14-04

MONITORING WELL CONSTRUCTION DIAGRAM

(ALL MEASUREMENTS FROM GROUND SURFACE)

PROTECTIVE CASING TYPE OF PROTECTIVE CASING: Steel Manhole with Locking Well Cap



TOP OF WELL

PROTECTIVE POSTS

CASING DIAMETER: 2 in.

TYPE OF PIPE JOINTS: Flush Threaded

TYPE OF BLANK CASING: PVC

BACKFILL/GROUT MIX ETC. Type I Portland Cement

TOP OF SEAL

TYPE OF SEAL: 1/4" Bentonite Pellets

TOP OF FILTERPACK

TOP OF SCREEN

FILTER PACK

BOTTOM OF WELL

BOTTOM OF BORING

BORING DIAMETER

LENGTH OF SOLID PIPE: 4.0 ft.

WELL SCREEN LENGTH: 9.5 ft.

STICK-UP: 0 ft.

GROUND SURFACE

CONCRETE PAD MIN. 4.0 THICKNESS

SCREEN INFORMATION

SCREEN DIA.: 2 in.

SLOT WIDTH: 0.010 in.

SCHEDULE: 40

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

1.5 ft. bgl

3.0 ft. bgl

4.0 ft. bgl

FILTERPACK MATERIAL

TYPE: 16-40 Colorado Silica Sand

BACKFILL METHOD: Tremie through auger

14.0 ft. bgl

14.5 ft. bgl

7.5 in.

WELL DEVELOPMENT

METHOD: See well development record

TIME SPENT DEVELOPING:

VOLUME OF WATER REMOVED:

VOLUME OF WATER ADDED:

DESCRIPTION OF PREDEVELOPMENT WATER:

DESCRIPTION OF POST DEVELOPMENT WATER:

WATER LEVEL SUMMARY

WATER LEVEL MEASUREMENTS

DATE/TIME/LEVEL 04 NOV 91/1414/6.99 ft bmp

DEPTH FROM TOP CASING AFTER DEVELOPMENT:

F2359

D.4

Groundwater Sampling Forms

Well ID: 14-01

Well Purging

Time	Volume	Clarity	Temp.	pH	Cond.
1540	0	Crystal Clear	22.4	7.13	16,100
1545	2	Slightly Cloudy	22.6	7.14	15,300
1550	4	As above	22.2	7.26	11,500
1553	6	Slightly Clearer	22.2	7.29	18,300
1555	8	As above	22.2	7.24	17,700

Going dry.

Sample Information

Date: 10/23/91

Time: 1600

Sample ID: 14-01

Sample Type					
8240	3	w/HCl			
PO4+N/N	1	w/H2SO4			
Anions	1				
Pest	1				
8140	1				
8150	1				

Well Information

Total Well Depth: 14.50

Initial Water Depth: 5.25'/6.21'

Total Head: 9.25

Five Wetted Well Casing Volumes

(= Total Head x 0.1632 gal) 7.5

Total Volume Purged 8

Purged Dry ☐ Almost

Field Measurements

Alkalinity: 210

pH: 7.29

Conductivity 19,400

Temperature 21.9

Comments:

Well ID: 14-02

Well Purging

Time	Volume	Clarity	Temp.	pH	Cond.
1500	0	brown-cloudy	23.6	7.13	46,700
1505	2	S.A.A	23.7	7.06	17,400
1510	4	S.A.A.	24.2	7.06	14,600
1515	6	S.A.A.	24.2	7.06	15,500

Sample Information

Date: 10-23-91

Time: 1500

Sample ID

Sample Type	14-02-01				
8240	3	w/	HC		
PO_4 + N/N	1	w/	H_2SO_4		
Anions	1				
Pest	1				
8140	1				
8150	1				

Well Information

Total Well Depth: 14

Initial Water Depth: 7.78/5.90

Total Head: 6.22/~~[illegible]~~

Five Wetted Well Casing Volumes

(= Total Head x 0.1632 gal) 5

Total Volume Purged 6

Purged Dry ☐

Field Measurements

Alkalinity: 560

pH: 7.10

Conductivity 14,700

Temperature 23.3

Comments:

Well ID: 14-03-01

Well Purging

Time	Volume	Clarity	Temp.	pH	Cond.
1425	0	Clear	23.0	7.27	33,600
1430	2	Cloudy, brown	23.5	7.25	15,900
1435	4	As above	23.4	7.25	15,900
1438	6	Slightly cleaner light brown	23.9	7.25	14,900
1440	7.5	As above	23.2	7.27	15,200

Sample Information

Date: 10/23/91

Time: 1430

Sample Type	Sample ID: 14-03-01				
8240	3	w/HCl			
PO4 +N/N	1	w/H2SO4			
Anions	1				
Pest.	1				
8140	1				
8150	1				

Well Information

Total Well Depth: 13.95

Initial Water Depth: 5.82 / 5.95

Total Head: 8.13

Five Wetted Well Casing Volumes

(= Total Head x 0.1632 gal) 6.6

Total Volume Purged 7.5

Purged Dry ☐

Field Measurements

Alkalinity: 325

pH: 7.28

Conductivity 17,200

Temperature 23.5

Comments:

Well ID: 14-04

Well Purging

Time	Volume	Clarity	Temp.	pH	Cond.
0845	0	Slightly Cloudy	19.7	7.36	32,000
0855	2	As above	22.1	7.30	17,600
0900	4	As above	22.5	7.32	18,600
0903	6	As above	23.9	7.28	18,200

Sample Information

Date: 10/24/91

Time: ~~0830~~ 0915
-03 -01, -02

Sample ID

Sample Type	14-04-01	14-04-02 MS	14-04-02 MSD	14-04-03 MRD		
Anions	3	1	1	1		
8080	3	1	1	1		
8140	3	1	1	1		
8150	3	1	1	1		
8240	~~3~~ 6	3	3	3		w/HCl
PO_4, N/N	3	1	1	1		w/H_2SO_4

Well Information

Total Well Depth: 13.95

Initial Water Depth: 6.94 / 7.05

Total Head: 7.01

Five Wetted Well Casing Volumes

(= Total Head x 0.1632 gal) 5.7

Total Volume Purged 6

Purged Dry ☐

Field Measurements

	Normal / Dup
Alkalinity:	250 / 225
pH:	7.33 / 7.31
Conductivity	19,300 / 19,700
Temperature	234 / 233

Comments: QA/QC

.1632
35
8160
4 8160
5.7120

DCN 95-670-008-09

Draft Final

PHASE II RCRA FACILITY INVESTIGATION REPORT

TABLE 1 SOLID WASTE MANAGEMENT UNITS
HOLLOMAN AIR FORCE BASE, NM

VOLUME I

Prepared for:

49 CES/CEV
Holloman Air Force Base, NM

and

HQ ACC/CEVR
Langley Air Force Base, VA

Prepared by:

Foster Wheeler Environmental Corporation
143 Union Blvd., Suite 1010
Lakewood, Colorado 80203
303/988-2202

Radian Corporation
8501 North Mopac Blvd.
Austin, Texas 78720
512/454-4797

Under Contract No. DACW45-94-D-0003, DO No. 02, WAD 03 with:

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

June 1995

4.6 SWMU 197 Former Entomology Shop— (IRP Site OT-14)

Organochlorine pesticide concentrations were detected in the shallow (0-2 ft) soil but not in the groundwater beneath SWMU 197 (the Former Entomology Shop) during the 29 Sites RI. The associated risk assessment concluded that the organochlorine pesticide concentrations in the soil posed an occupational health risk. To mitigate this risk, the SWMU 197 entered the FS/CMS process, which established cleanup criteria for health-based RAOs, estimated an area exceeding these cleanup criteria, and recommended (as the voluntary corrective action) the emplacement of an impermeable cap. The Phase II RFI verified the estimated extent of organochlorine pesticide concentrations in the soil. The impermeable cap will eliminate the occupational risk by eliminating the exposure pathway. NFA is recommended for SWMU 197.

4.6.1 SWMU Description

SWMU 197 occupies approximately two-tenths acre in the northwestern corner of the Civil Engineering yard on the Main Base. SWMU 197 is adjacent to Building 66 and is surrounded by paved areas. The topography of the site is relatively flat. Figure 1-2 shows the location of SWMU 197 on Holloman AFB, and Figure 4.6-1 shows the site layout.

From 1968 to 1977, pesticide spraying and washing equipment were rinsed out in an open area adjacent to existing Building 66. In addition, organochlorine pesticides (including 4,4'-DDT and chlordane) were stored and mixed at this site. Diesel fuel was routinely used to solubilize the pesticides.

In July 1977, soil samples collected from the site showed the presence of several pesticides. In an effort to stabilize this contamination, the top 6 to 8 in. of soil were treated with lime and powdered charcoal and subsequently tilled.

Geology and Hydrogeology

No drilling was conducted at SWMU 197 during the Phase II RFI. The subsurface geology at the site, as defined during the 29 Sites RI monitor well installation, consists primarily of silty sands. Lenses of sand, silt, and clayey sand were encountered in the wells installed in the southeastern portion of the site.

Groundwater at SWMU 197 occurs at approximately 5 ft bgl in the silty sand and sand deposits. The groundwater flows to the south-southwest.

4.6.2 Phase I Activities

The site was identified in the *IRP Phase I Records Search* (CH2M Hill, 1983), and, as a result, was investigated under Phase I of the IRP as OT-14 in 1991. During the 29 Sites RI, elevated concentrations of 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, aldrin, and chlordane were detected in soil samples collected from five borings drilled in areas of former drum storage and mixing activities. The concentrations of these organochlorine pesticides were significantly higher in the surface intervals (0-2 ft) than in the 2- to 4-ft sample intervals. Four monitor wells were installed and sampled. No organochlorine pesticides were detected in the samples, indicating that the groundwater had not been impacted by site activities. Soil sample locations are shown in Figure 4.6-1.

A quantitative risk assessment was conducted for SWMU 197 as part of the 29 Sites RI. It was indicated that pesticide contamination in shallow soils at the site poses an occupational health risk (Radian, 1992c).

Because surface soils at SWMU 197 pose an unacceptable human health risk, remedial action was recommended. In addition, further investigation was recommended to define the extent of organochlorine pesticide contamination in the soil (Radian, 1992b).

Table 4.6-1
Remedial Action Objective for SWMU 197

Objective	Contaminant	Cleanup Criteria (µg/kg)	Comment
Prevent dermal contact with pesticide concentrations that are in excess of the cleanup criteria in the soil.	4,4'-DDD	1500	Soils below the cleanup criteria do not present an occupational health risk.
	4,4'-DDE	1000	
	4,4'-DDT	1300	
	Aldrin	10	
	Chlordane	200	
	Heptachlor	100	
	gamma-BHC	700	

After reviewing the *29 Sites RI* (Radian, 1992b), EPA Region VI issued a letter, received by the Base on 3 November 1992, that concurred with the site recommendations.

4.6.3 Phase II Activities

The following additional investigations were conducted at SWMU 197 to address EPA Region VI concerns and implement the site recommendations:

- The corrective measures study in 1992;
- The feasibility study in 1993; and
- The Phase II RFI in 1994.

To select the appropriate remedial action, SWMU 197 was entered into the FS/CMS process. The *CMS Plan* (Radian, 1992a) established a health-based RAO for soil contamination at the site. The RAO for the site is to prevent an unacceptable health risk posed to site workers by dermal contact with contaminated soils.

The cleanup criteria are presented in Table 4.6-1. The feasibility study estimated that a total soil volume of 740 yd^3 exceeds the cleanup criteria for SWMU 197 (Radian, 1993b). The recommended remedial alternative for achieving the RAO is source containment by constructing an impermeable cap over the affected soils.

To verify the lateral extent of pesticides exceeding the cleanup criteria estimated during the FS, a Phase II RFI was conducted in 1994. During the investigation, soil samples were collected from 12 soil borings drilled with a DPT rig. The soil borings were located along the perimeter of the former drum storage and mixing area as shown in Figure 4.6-1. Soil samples were collected and composited from 0 to 2 ft bgl.

Analytical Results

All soil samples collected at SWMU 197 were analyzed for organochlorine pesticides using EPA Method SW8080. The analytical results are presented in Table 4.6-2.

Of the 12 soil samples, 8 were collected within the area estimated during the FS (Radian, 1993b) to exceed RAO cleanup criteria. Of these eight samples, four were found to contain one or more pesticides in excess of the cleanup criteria. Chlordane exceeded the cleanup criteria in all four of these samples, with concentrations ranging from

230 to 26,000 µg/kg. Aldrin (230 µg/kg) and heptachlor (2200 µg/kg) exceeded the cleanup criteria in the sample collected from soil boring 14-DP-10. 4,4'-DDE (3000 µg/kg) and 4,4'-DDT (7200 µg/kg) exceeded the cleanup criteria in one sample (14-DP-12) from the central part of the site. None of the four samples collected outside of the estimated area of contamination were found to contain any pesticides in excess of the cleanup criteria. 4,4'-DDD and gamma-BHC were not detected at concentrations in excess of the cleanup criteria.

Analytical results from the Phase I and Phase II investigations indicate that pesticide contamination is concentrated in a band that runs approximately east to west in the central part of the site. Figure 4.6.1 illustrates this trend.

4.6.4 Conclusions

The vertical and lateral extent of organochlorine pesticides concentrations in soil has been delineated. Contaminant concentrations were found to be highest across the central portion of SWMU 197. The Phase II RFI confirmed the FS estimate of soil containing organochlorine pesticides in concentrations that exceed the cleanup criteria.

The concentrations pose an occupational risk. To mitigate the risk, the selected remedial action is source containment by the emplacement of an impermeable cap over the affected soils. Once the remedial action has been implemented, the dermal exposure pathway will be eliminated, thus eliminating the occupational health risk.

4.6.5 Recommendations

VCA is recommended for SWMU 197. The recommended impermeable cap should be constructed over the soil with contaminants that exceed the health-based cleanup criteria.

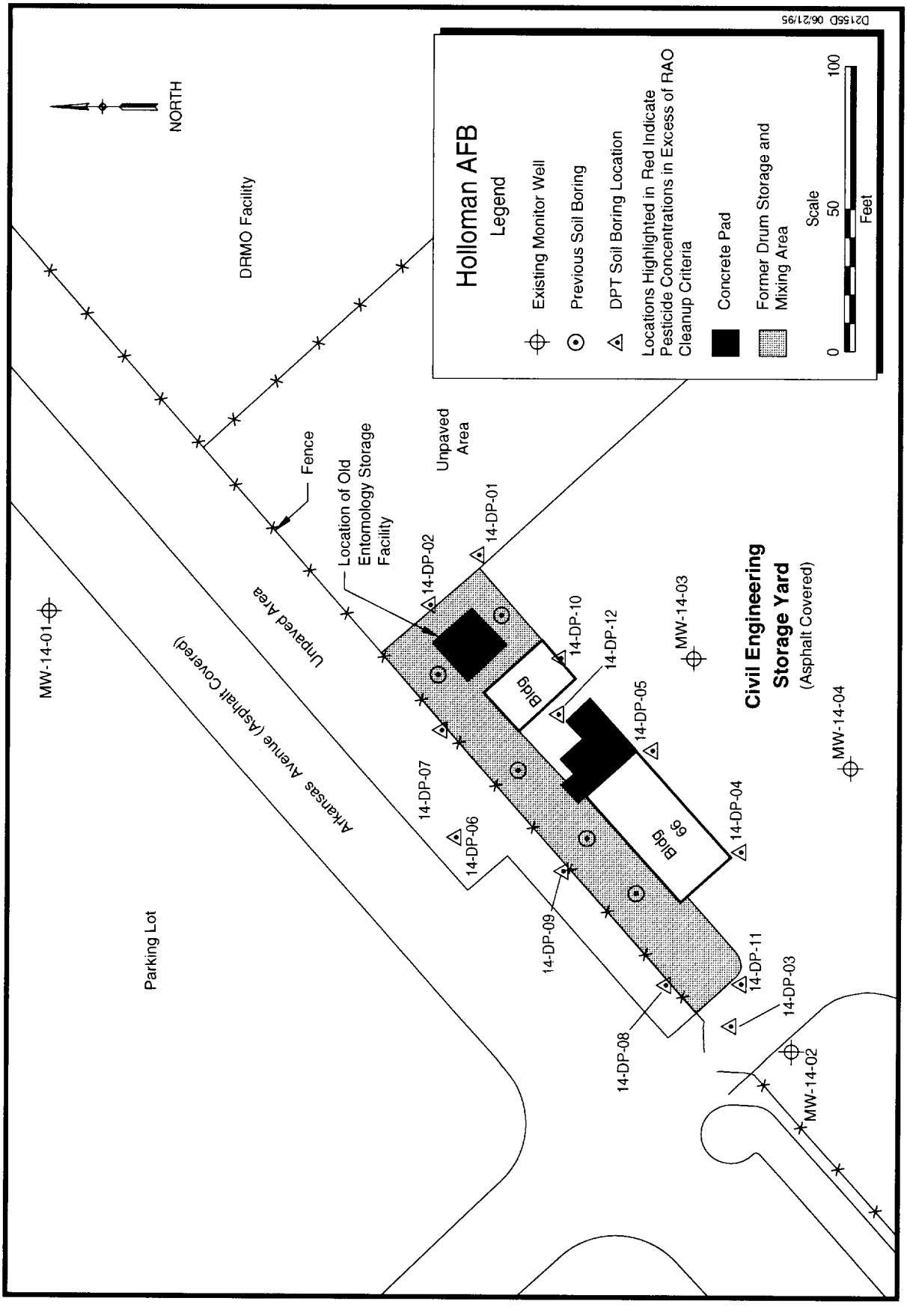


Figure 4.6-1. SWMU 197 - Soil Sample Locations

Table 4.6-2
Analytical Results for SWMU 197 Soil Samples

Location ID		DP-14-01		DP-14-02		DP-14-03		DP-14-04		DP-14-05		DP-14-06	
Beginning Depth-End Depth (ft)		0.5-2		0.5-2		0.5-2		0.5-2		0.5-2		0.5-2	
SW8080 (µg/kg)	4,4'-DDD	14 J	(15)	21	(7.4)	ND	(4.1)	ND	(8.3)	2.9 J	(3.7)	ND	(3.8)
	4,4'-DDE	42	(15)	36	(7.4)	0.50 J	(4.1)	19	(8.3)	18	(3.7)	6.5	(3.8)
	4,4'-DDT	90	(15)	43	(7.4)	ND	(4.1)	41	(8.3)	31	(3.7)	8.9	(3.8)
	Aldrin	0.44 J	(7.7)	0.81 J	(3.8)	ND	(2.1)	ND	(4.3)	ND	(1.9)	ND	(1.9)
	Chlordane	230	(77)	130	(38)	ND	(21)	88	(43)	30	(19)	ND	(19)
	Dieldrin	2.1 J	(15)	0.34 J	(7.4)	ND	(4.1)	0.073 J	(8.3)	ND	(3.7)	ND	(3.8)
	Heptachlor	ND	(7.7)	ND	(3.8)	ND	(2.1)	ND	(4.3)	ND	(1.9)	ND	(1.9)
	alpha-BHC	ND	(7.7)	0.12 J	(3.8)	ND	(2.1)	ND	(4.3)	ND	(1.9)	ND	(1.9)
	delta-BHC	ND	(7.7)	ND	(3.8)	0.24 J	(2.1)	ND	(4.3)	0.15 J	(1.9)	0.24 J	(1.9)

Location ID		DP-14-07		DP-14-08		DP-14-09		DP-14-10		DP-14-11		DP-14-12	
Beginning Depth-End Depth (ft)		0.5-2		0.5-2		0.5-2		0.5-2		0.5-2		0.5-2	
SW8080 (µg/kg)	4,4'-DDD	ND	(3.7)	ND	(4.2)	ND	(39)	ND	(370)	ND	(3.9)	ND	(,1700)
	4,4'-DDE	0.49 J	(3.7)	6.5	(4.2)	93	(39)	ND	(370)	0.92 J	(3.9)	3,000	(1,700)
	4,4'-DDT	0.34 J	(3.7)	12	(4.2)	270	(39)	68 J	(370)	3.9	(3.9)	7,400	(1,700)
	Aldrin	ND	(1.9)	ND	(2.1)	1.2 J	(20)	230	(190)	ND	(2)	ND	(890)
	Chlordane	ND	(19)	7.5 J	(21)	900	(200)	7,300	(370)	ND	(3.9)	26,000	(1,700)
	Dieldrin	ND	(3.7)	ND	(4.2)	ND	(39)	ND	(370)	ND	(3.9)	ND	(1,700)
	Heptachlor	ND	(1.9)	ND	(2.1)	ND	(20)	2,200	(190)	ND	(2)	ND	(890)
	alpha-BHC	ND	(1.9)	ND	(2.1)	ND	(20)	ND	(190)	ND	(2)	ND	(890)
	delta-BHC	ND	(1.9)	0.30 J	(2.1)	ND	(20)	150 J	(190)	ND	(2)	ND	(890)

Note: Shaded results exceed the RAO cleanup criteria presented in Table 4.6-1.

J = Estimated concentration; analyte measured below the detection limit.
ND = Not detected. No instrument response for analyte or result less than zero.
( ) = Detection limit.

Field Logs

JOB CODE: DRHM

DATE: 10/21/96

Sway 197

SAMPLE NUMBER	AREA: GENERAL: WOODS	FIELD	LANDSCAPED/PLANTER	PAVED OR GRAVEL LOT	ROAD	INSIDE BLDG.	EXCAVATION	OTHER	SPECIAL: U.S.T.	SURFACE TANKS	PUMPS/LINES	GROUND STAINS	DRUMS	JUNK/REFUSE	CONIFERS	SURFACE MATERIAL: VEGETATION	SOIL	GRAVEL	ASPHALT	CONCRETE	SUBSURFACE COMPOSITION: ORGANICS	CLAY	SILT	SAND	GRAVEL	FILL	MOISTURE: DRY	DAMP	WET	PROBE INFO.: INT.: LIQUID	RESIDUE	DECON PROBE	EXT.: SOIL	RESIDUE	PULL: TIGHT	SUCTION	TYPE: 4" S.S. PROBE	MINIPACKER PROBE	Post Run Tubing	DEPTH	ROTARY HAMMER	SLIDE HAMMER/DRIVE ROD	HYDRAULIC PROBE	TYPE: SOIL GAS SAMPLE	WATER SAMPLE	SOIL SAMPLE	OTHER	ADDITIONAL OBSERVATIONS (WRITTEN DESCRIPTION OF SAMPLE LOCATIONS)
94-DP-14-01				X													X	X	X				X	X				X												0-2			X			X		1455
94-DP-14-02				X													X	X					X	X				X												0-2			X			X		1506
94-DP-14-03				X													~~X~~	~~X~~	~~X~~				X	X				X												0-2			X			X		ASPHALT 1536
94-DP-14-04				X													X	X	X				X	X				X												0-2			X			X		ASPHALT ~~1535~~ 1541
94-DP-14-05				X													~~X~~	~~X~~	X				X	X				X												0-2			X			X		[illegible] ~~1550~~ 1555
94-DP-14-06				X													X	X	X				X	X				X												0-2			X			X		1617
94-DP-14-07				X													X	X					X	X				X												0-2			X			X		1637

ADDITIONAL NOTES:

JOB CODE: DRNM

DATE: 10/24/94

SWMU 197

SAMPLE NUMBER	AREA: GENERAL: WOODS	FIELD	LANDSCAPED/PLANTER	PAVED OR GRAVEL LOT	ROAD	INSIDE BLDG.	EXCAVATION	OTHER	AREA: SPECIAL: U.S.T.	SURFACE TANKS	PUMPS/LINES	GROUND STAINS	DRUMS	JUNK/REFUSE	CONTAINERS	SURFACE MATERIAL: VEGETATION	SOIL	GRAVEL	ASPHALT	CONCRETE	SUBSURFACE COMPOSITION: ORGANICS	CLAY	SILT	SAND	GRAVEL	FILL	MOISTURE: DRY	DAMP	WET	PROBE INFO. INT.: LIQUID	RESIDUE	DECON PROBE	EXT.: SOIL	RESIDUE	PULL: TIGHT	SUCTION	TYPE: 4" S.S. PROBE	MINPACKER PROBE	Post Run Tubing	DEPTH	TYPE: ROTARY HAMMER	SLIDE HAMMER/DRIVE ROD	HYDRAULIC PROBE	SOIL GAS SAMPLE	WATER SAMPLE	SOIL SAMPLE	OTHER	ADDITIONAL OBSERVATIONS (WRITTEN DESCRIPTION OF SAMPLE LOCATIONS)
94-HD-08				X												X	X	X					X	X				X												0-2			X			X		1640
94-HD-09				X												X	X	X					X	X				X												0-2			X			X		1655

ADDITIONAL NOTES:

JOB CODE: ORHM

DATE: 10/24/94

SAMPLE NUMBER	AREA: GENERAL: WOODS	FIELD	LANDSCAPED/PLANTER	PAVED OR GRAVEL LOT	ROAD	INSIDE BLDG.	EXCAVATION	OTHER	SPECIAL: U.S.T.	SURFACE TANKS	PUMPS/LINES	GROUND STAINS	DRUMS	JUNK/REFUSE	CONIFERS	SURFACE: MATERIAL: VEGETATION	SOIL	GRAVEL	ASPHALT	CONCRETE	SUBSURFACE: COMPOSITION: ORGANICS	CLAY	SILT	SAND	GRAVEL	FILL	MOISTURE: DRY	DAMP	WET	PROBE INFO.: INT.: LIQUID	RESIDUE	DECON PROBE	EXT.: SOIL	RESIDUE	PULL: TIGHT	SUCTION	TYPE: 4" S.S. PROBE	MINIPACKER PROBE	Post Run Tubing	DEPTH	TYPE: ROTARY HAMMER	SLIDE HAMMER/DRIVE ROD	HYDRAULIC PROBE	SOIL GAS SAMPLE	WATER SAMPLE	SOIL SAMPLE	OTHER	ADDITIONAL OBSERVATIONS (WRITTEN DESCRIPTION OF SAMPLE LOCATIONS)
F24		X															X						X	X				X												10'			X						well installed 1523
F25		X															X						X	X				X												10'			X					" " EQD 1533
94-DP-14 10				X															X				X	X				X												0'-2'			X			X		0840 BQD 10/25/94
94-DP-14 11			X	X													X	X					X	X				X												0'-2'			X			X		0905
94-24-HP F09		X															X	X					X	X				X												20'			X					1154 well installed
94-24-HP F-14		X															X	X					X	X				X												20'			X					1236 " "

ADDITIONAL NOTES:

AR 1058

Headquarters, Air Combat Command
Langley Air Force Base,
Virginia

Project Closeout Report
IRP Sites SD-08 and OT-14
Remedial Action

Holloman AFB
Alamogordo, NM

July 1997

---

49 CES/CEVR
Holloman Air Force Base
New Mexico

HOLLOMAN AIR FORCE BASE, NEW MEXICO

DELIVERY ORDER 4, WORK AUTHORIZATION DIRECTIVES 3 & 5

PROJECT CLOSEOUT REPORT FOR IRP SITE SD-08 AND SITE OT-14 REMEDIAL ACTION

TABLE OF CONTENTS

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1.0 INTRODUCTION	1
2.0 SITE DESCRIPTIONS AND HISTORY	2
2.1 IRP Site SD-08 Description	2
2.2 IRP Site OT-14 Description	2
2.3 Phase I Activities	3
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3.0 PROJECT DESCRIPTION	4
3.1 Activity Summary	5
4.0 CONSTRUCTION DOCUMENTATION	5
4.1 Daily Work Documentation	5
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4.5 Geocomposite Drainage Layer	7
4.6 Geotextile Fabric	7
4.7 High Density Polyethylene Liner	7
4.8 Site Drawings	7
5.0 REFERENCES	8

Appendix A As-Constructed/Original Site Drawings, SD-08
Appendix B As-Constructed/Original Site Drawings, OT-14
Appendix C Field Change Requests
Appendix D Completion Inspection Reports
Appendix E Geocomposite Drainage Layer
Appendix F Geotextile Fabric
Appendix G High Density Polyethylene Liner

cap. No Further Action is recommended for OT-14 and long-term groundwater monitoring was recommended for closure of Site SD-08 to ensure the remedial action is preventing further degradation of groundwater. The asphalt caps were installed in October 1996 and construction activities completed in November 1996.

3.0 PROJECT DESCRIPTION

The areas of contamination present at both sites were capped with asphalt to prevent future exposure (dermal contact with the contaminated soil and inhalation of volatiles). The planned construction was described in detail in the Draft Final Construction Workplan and two Addenda (FWENC 1996) The construction project consisted of the following major work items planned for both sites·

- Clearing and grubbing
- Removal of fencing/buildings/utility poles from site as required
- Storage of debris
- Site grading and compaction
- Proof rolling of entire site
- Geotextile fabric placement
- Geomembrane placement
- Geonet drainage layer placement
- Aggregate base course placement
- Connection between geomembrane and cap penetrations and concrete edging installed
- Asphalt top layer placement
- Fencing and gate installation
- Guardpost (stanchion) installation
- Characterization of waste material for appropriate disposal
- Site clean up

3.1 Activity Summary

Mobilization began in July 1996 with the establishment of staging and material stockpiling areas and set up of personnel and equipment decontamination zones at each site. Site preparation activities were initiated, including performance of a subsurface utility clearance and clearing and grubbing.

At SD-08 the existing prefabricated metal building was removed, as were utility poles within the limits of the proposed asphalt cap. The existing fencing was removed and replaced with commercial-grade fencing. Utility service was not required at this site; therefore, all existing underground utilities for the metal building were abandoned in place. At Site OT-14 existing sheds were moved outside the area to be capped. The old fence poles and sidewalk concrete were removed and a temporary fence was installed.

Subgrade preparation (grading and compaction) was performed at both sites in August 1996 prior to placement of the geomembrane, aggregate, and asphalt materials. Installation of the five layers of the asphalt cap (geotextile fabric, geomembrane liner, geocomposite drainage layer, aggregate base course, and asphalt surface) was begun in September 1996 and completed in November 1996. The Completion Inspection for both sites was performed in June 1997.

4.0 CONSTRUCTION DOCUMENTATION

Vendor submittals and construction activities were documented according to the procedures outlined in the Draft Final Construction Workplan. The specific submittals and construction documentation are described in detail in the following sections

4.1 Daily Work Documentation

A Daily Quality Control Report (DQCR) was prepared to document construction activities. These reports have been previously submitted to the USACE project engineer and are included herein. The DQCRs document site activities; resources used including

labor, material, and equipment; inspection and testing performed; problems encountered; and actions taken.

4.2 Field Change Requests

Field change requests (FCRs) were used to document approved changes to the Draft Final Construction Workplan. Eight FCRs were processed for each of the two sites, and all were considered to be minor changes. Copies of the FCRs are in Appendix A

4.3 Completion Inspection Reports

In accordance with the Construction Inspection Plan (Section 9 of the Construction Workplan) inspections were performed after completion of each definable feature of work to verify both the quality of work performed and compliance with specified requirements. A project preparatory inspection was performed on 22 July 1996 at both Sites SD-08 and OT-14. The preparatory grading inspection was performed on 2 August 1996, with the final grading inspection conducted on 20 August 1996. The preparatory liner installation inspection was conducted on 10 October 1996; the final liner installation inspection was performed on 15 October 1996, in conjunction with the preparatory asphalt inspection. The base coarse aggregate and prime coat were inspected on 5 November 1996. On 11 June 1997, the final asphalt cap inspection was performed. Copies of the inspection checklist associated with these field activities are in Appendix B

4.4 Project Submittals

Submittals including laboratory soil tests and field compaction tests; aggregate material gradation tests and field compaction tests; and asphalt mix design reports were all included with the DQCRs and are not attached to this closeout report.

4.5 Geocomposite Drainage Layer

Fluid Systems supplied the geocomposite drainage layer and Pioneer Lining Company (PLC), Farmington, New Mexico installed the layer. Appendix C includes a copy of the Certificate of Analysis, product description, quotation, and associated shop drawings

4.6 Geotextile Fabric

The geotextile fabric was installed by Pioneer Lining Company. Hoechst supplied the Trevira Spunbond Type 011/200 fabric. The Certificate of Compliance, product description, and shop drawings are contained in Appendix D.

4.7 High Density Polyethylene Liner

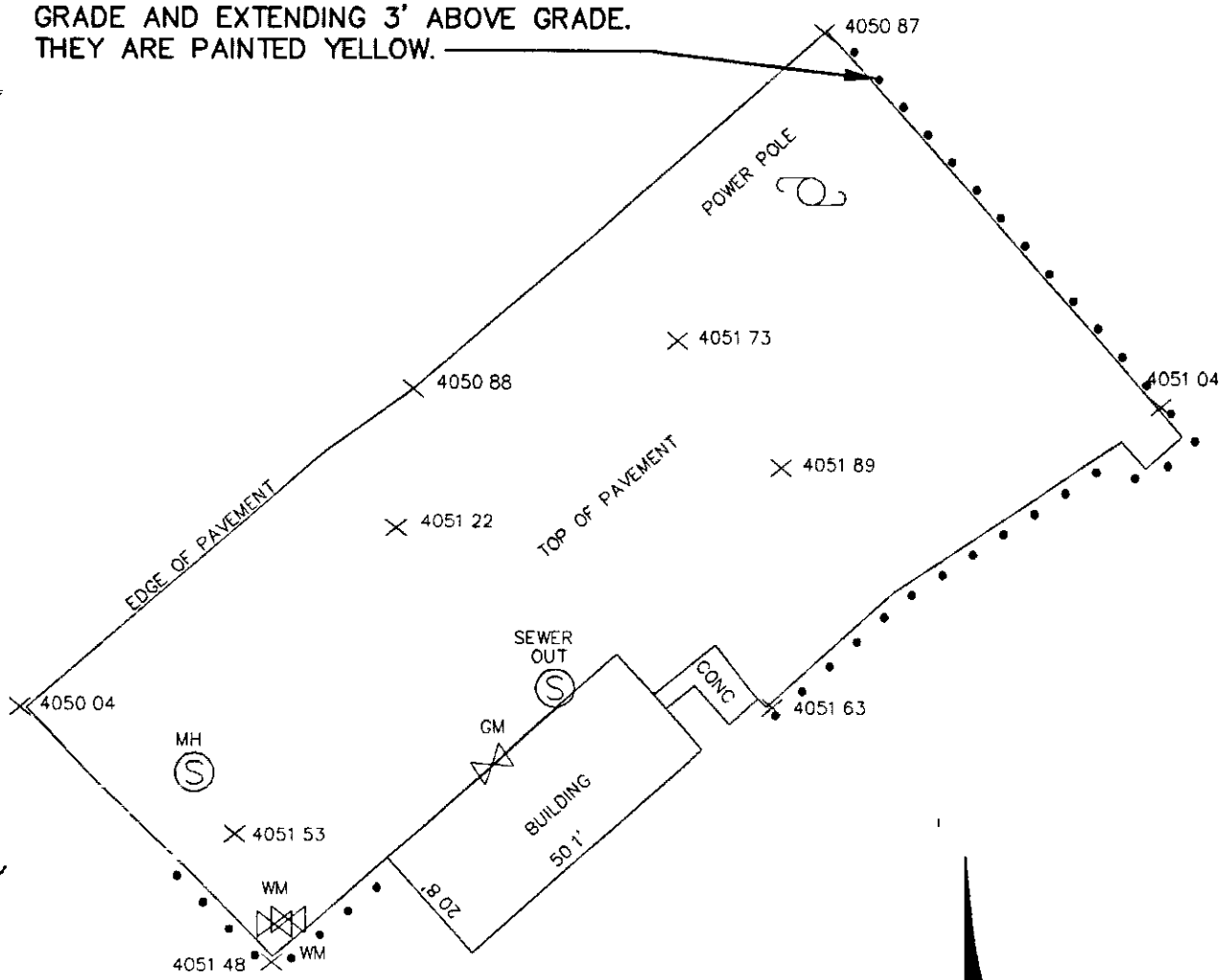
GSE Lining Technology, Inc. provided 60-mil HyperFlex product used for the geomembrane liner. A copy of their product description, confirmation notice, Certificate of Acceptance, Chain of Custody, shop drawings, and PLC's personnel resumes are included in Appendix E.

4.8 Site Drawings

All construction work was completed in accordance with the previously referenced construction workplan (FWENC 1996) except for minor changes noted in the FCRs (Appendix C). The as-constructed and original design drawings for Sites SD-08 and OT-14 are contained in Appendices A and B, respectively.

APPENDIX B
As-Constructed/Original Site Drawings, OT-14

STANCHIONS ARE 6' O.C., THEY ARE 4" GALVANIZED PIPE CONCERTED 2' BELOW GRADE AND EXTENDING 3' ABOVE GRADE. THEY ARE PAINTED YELLOW.



SCALE: 1"=30'

GRAPHIC SCALE

30 0 15 30 60

(IN FEET)
1 inch = 30 ft

I HEREBY CERTIFY THAT I AM A REGISTERED PROFESSIONAL SURVEYOR UNDER THE LAWS OF THE STATE OF NEW MEXICO, THAT THIS PLAT WAS PREPARED FROM FIELD NOTES MADE BY ME OR UNDER MY DIRECTION, THAT IT IS TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF MEETING OR EXCEEDING THE MINIMUM REQUIREMENTS OF THE STANDARDS FOR LAND SURVEYS IN THE STATE OF NEW MEXICO

WALTER C. BLACK, #6081 DATE

SOUTHWEST ENGINEERING INCORPORATED
475 ARCHULETA ROAD, LAS CRUCES, NEW MEXICO 88005

FOSTER WHEELER
OT - 14
HOLLOMAN AIR FORCE BASE,
NEW MEXICO

DATE OF SURVEY	01/24/97
DATA FILE	DATA.COL
DRAWING NUMBER	96105
PROJECT	#96105ST1
DATE	20FEB97
REVISION	0
	1 of 1

FILE: C:\DWG\96105ST1.DWG

BDR11-85S 090194

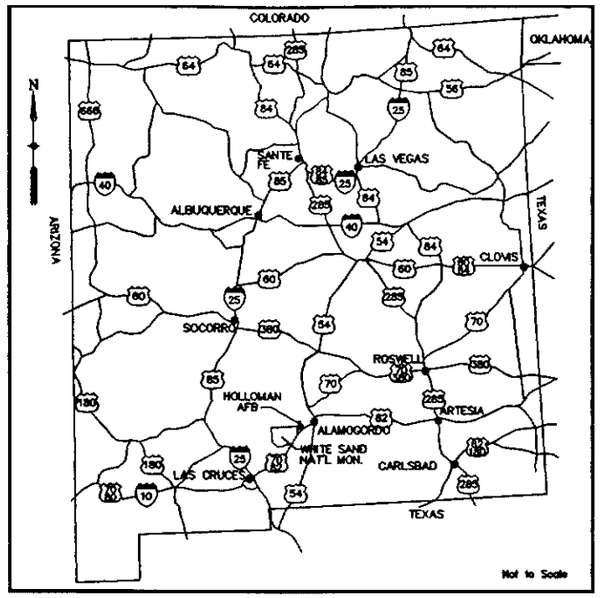
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

IRP Site OT-14 Asphalt Cap Installation 100% Design Submittal

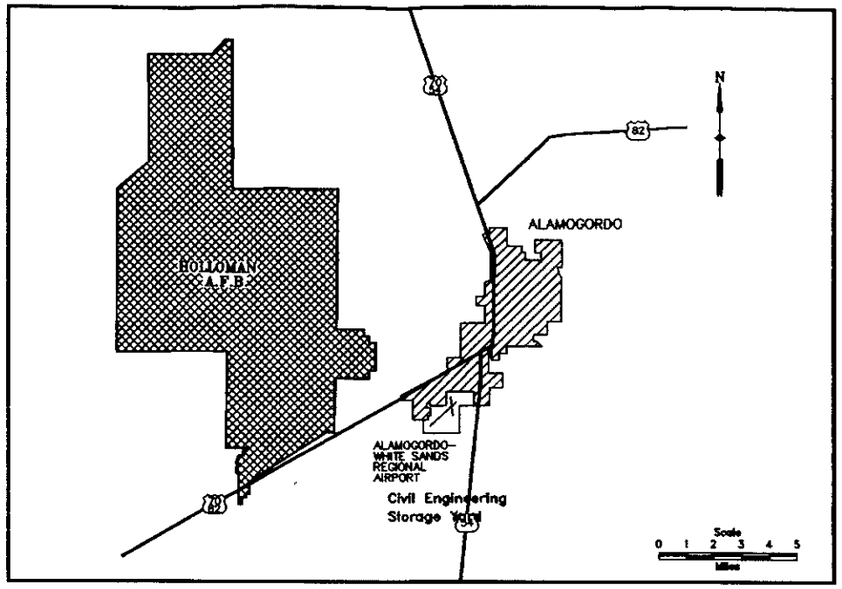
Holloman Air Force Base
Alamogordo, New Mexico

CONTRACT: DACW45-94-D-0003
DELIVERY ORDER NO. 2, WORK AUTHORIZATION DIRECTIVE NO. 1

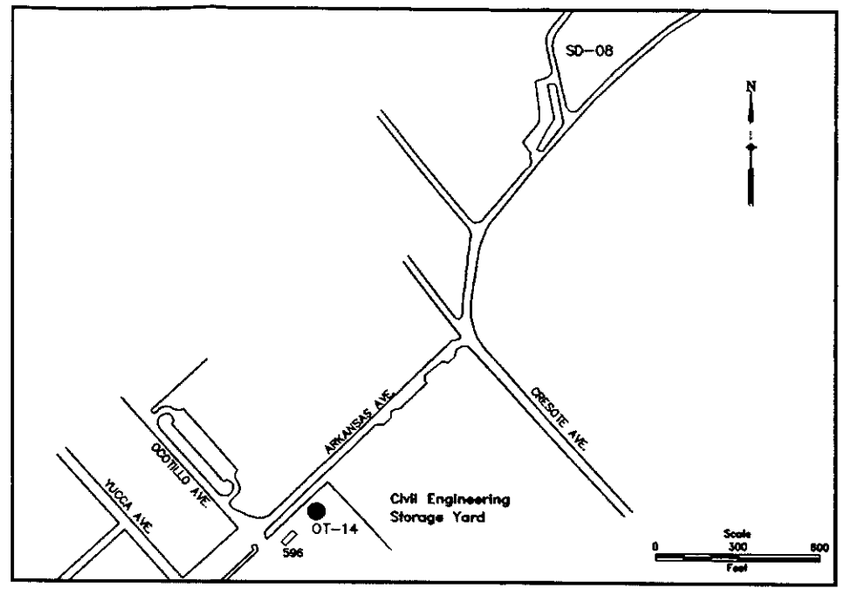
NOTE: THIS DRAWING SET HAS BEEN REDUCED TO APPROXIMATELY 1/2 SCALE.



VICINITY MAP



BASE LOCATION PLAN

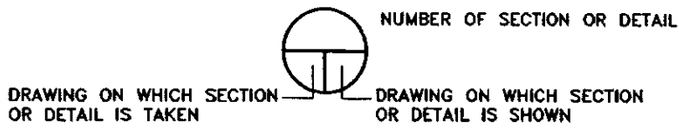


LOCATION PLAN

DRAWING INDEX

SHEET NO.	FILE REF.	REVISION	TITLE
1		C	COVER SHEET
2		C	VICINITY MAP, LOCATION PLAN, DRAWING INDEX
3		C	LIMIT OF CONTAMINATION
4		C	EXISTING CONDITIONS WITH LIMITS OF WORK
5		C	SITE GRADING PLAN
6		C	DETAILS

LEGEND



NOTE. THIS DRAWING SET HAS BEEN REDUCED TO APPROXIMATELY 1/2 SCALE.

$$ – THINK VALUE ENGINEERING – $$

REVISIONS

SYMBOL	DESCRIPTIONS	DATE	APPROVED
C	100% DESIGN SUBMITTAL FOR REVIEW	1-19-96	
B	80% DESIGN SUBMITTAL FOR REVIEW	8-25-95	
A	70% DESIGN SUBMITTAL FOR REVIEW	4-30-95	

FOSTER WHEELER ENVIRONMENTAL CORP. DENVER, COLO.

U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS OMAHA, NEBRASKA

DESIGNED BY: B. CORB

DRAWN BY: M. TEDRICK, B. BLUME, C. CONFER

CHECKED BY: R. BORREGO

REVIEWED BY: R. VERSAW

SUBMITTED BY: R. VERSAW

HOLLOMAN AFB, NEW MEXICO
IRP SITE OT-14
REMEDIAL ACTION

VICINITY MAP, LOCATION PLAN, DRAWING INDEX

DESIGN FILE: OT14C2.DGN

DATE: JAN. 19, 1996

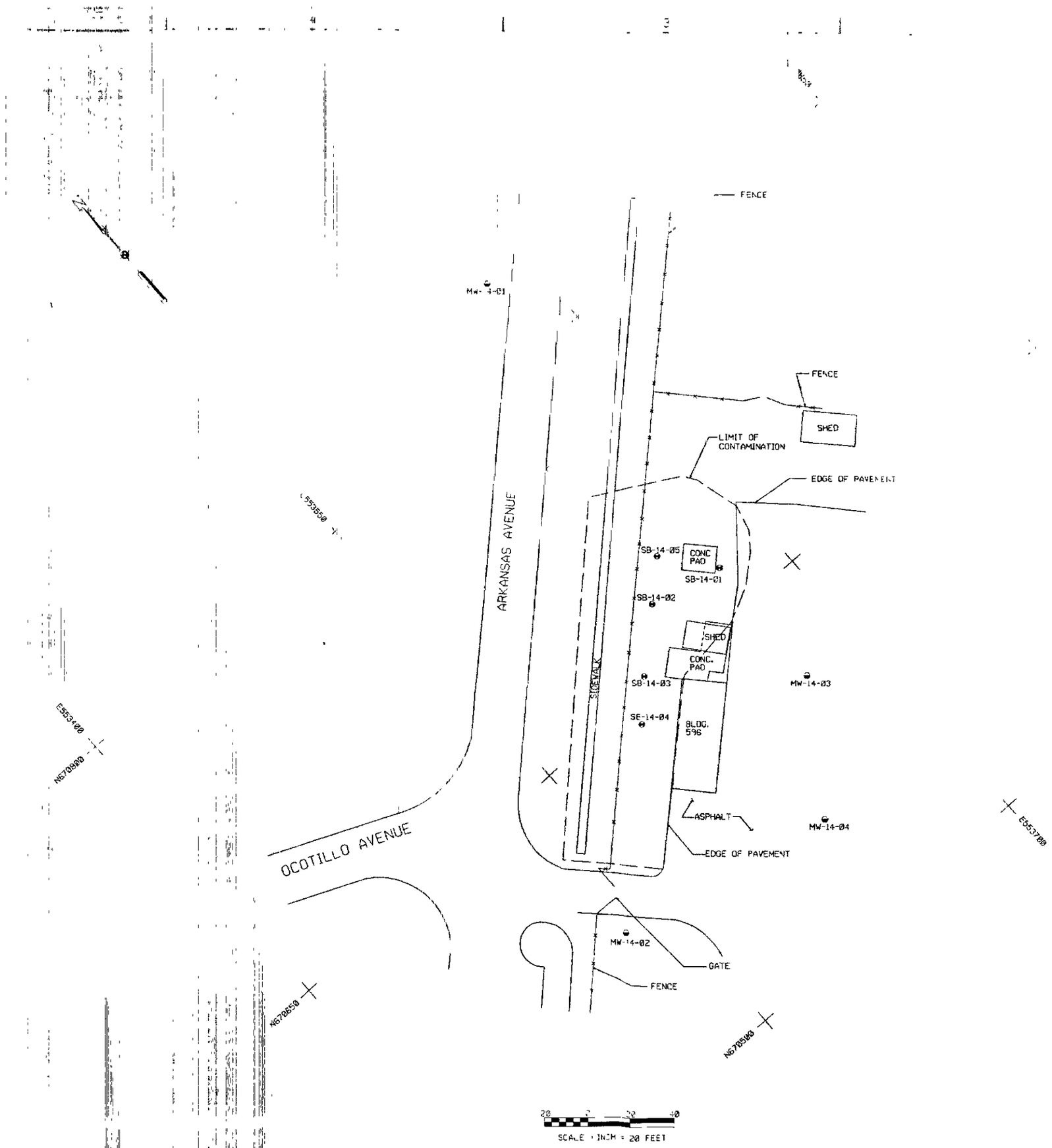
SHEET NUMBER: 2

CONTRACT NO.: DACW 45-94-D-0003

REVISION: C

NOTES:

1. AREA OF CONTAMINATION TAKEN FROM THE MANAGEMENT ACTION PLAN FOR HOLLOMAN AFB, REVISED FEBRUARY 1996
2. ALL ITEMS ARE EXISTING UNLESS OTHERWISE NOTED



LEGEND

- SOIL BORING
- MONITORING WELL
- FENCE LINE
- LIMIT OF CONTAMINATION
- ASPHALT ROAD
- BUILDING

NOTE: THIS DRAWING SET HAS BEEN REDUCED APPROXIMATELY ½ SCALE

$$ - THINK VALUE ENGINEERING - $$

REVISIONS

SYMBOL	DESCRIPTIONS	DATE	APPROVED
C	100% DESIGN SUBMITTAL FOR REVIEW	1-19-96	
B	80% DESIGN SUBMITTAL FOR REVIEW	8-25-95	
A	70% DESIGN SUBMITTAL FOR REVIEW	4-30-95	

FOSTER WHEELER ENVIRONMENTAL CORP. DENVER, COLO

U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS OMAHA, NEBRASKA

DESIGNED BY: B CORB

DRAWN BY: M TEDRICK W BLUME/C CONFER

CHECKED BY: R BORREGO

REVIEWED BY: R. VERSAW

SUBMITTED BY: R. VERSAW

HOLLOMAN AFB, NEW MEXICO
IRP SITE OT-14
REMEDIAL ACTION

LIMIT OF CONTAMINATION

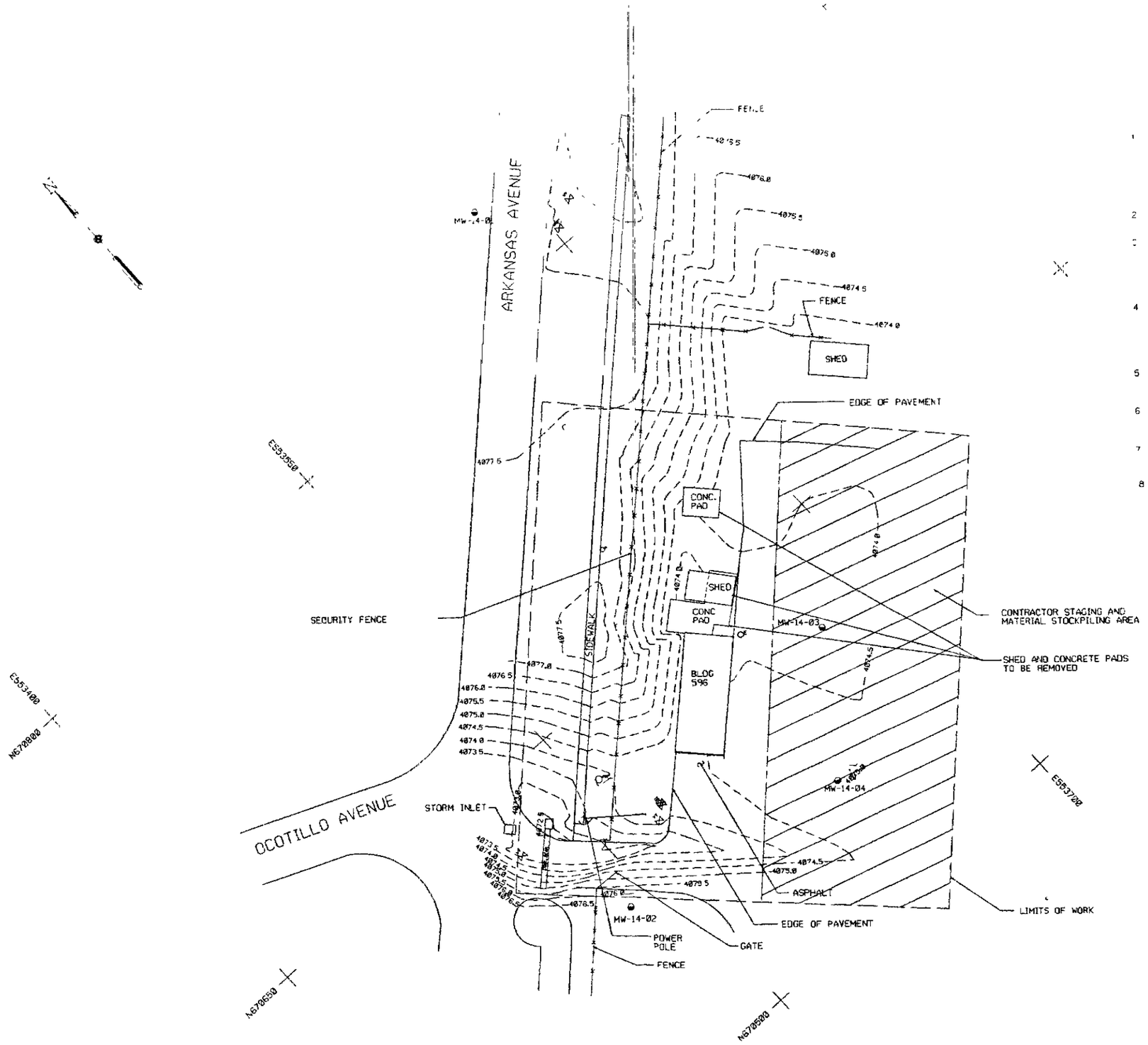
DESIGN FILE: OT14C3.DGN

DATE: JAN. 19, 1996

SHEET NUMBER: 3

CONTRACT NO.: DACW 45 94-D-0003

REVISION C



EXISTING CONDITIONS WITH LIMITS OF WORK

20 0 20' 40'

SCALE 1 INCH = 20 FEET

NOTES.

1. EXISTING UNDERGROUND UTILITIES HAVE BEEN LOCATED USING INFORMATION PROVIDED BY HOLLOMAN AFB AND ARE SHOWN FOR INFORMATION PURPOSES ONLY. THE CONTRACTOR SHOULD BE AWARE THAT THERE MAY BE ADDITIONAL UTILITIES PRESENT WHICH ARE NOT SHOWN ON THESE PLANS PRIOR TO CONSTRUCTION. THE CONTRACTOR SHALL VERIFY THE LOCATIONS OF ALL EXISTING UTILITIES WITHIN THE LIMITS OF WORK. ANY DISRUPTION OF UTILITY SERVICE SHALL BE COORDINATED WITH HOLLOMAN AFB PERSONNEL
2. THE CONTRACTOR IS RESPONSIBLE FOR TYING THE PROJECT SURVEY CONTROL INTO THE HOLLOMAN AFB COORDINATE SYSTEM
3. ALL TEMPORARY SUPPORT FACILITIES REQUIRED FOR THE PERFORMANCE OF THE WORK, INCLUDING STAGING AREAS, DECONTAMINATION FACILITIES, PARKING, UTILITIES, SECURITY FENCING, ETC. SHALL BE CONSTRUCTED BY THE CONTRACTOR. EROSION CONTROL DEVICES REQUIRED AS A RESULT OF THE SUPPORT FACILITY CONSTRUCTION SHALL BE LOCATED AND INSTALLED BY THE CONTRACTOR IN ACCORDANCE WITH ALL FEDERAL, STATE, AND LOCAL REGULATIONS
4. UTILITY POLES AND GUY WIRES SHALL BE RELOCATED OUTSIDE OF THE ASPHALT CAP BY THE CONTRACTOR PRIOR TO CONSTRUCTION. OTHER UTILITIES INCLUDING WATER, GAS AND SANITARY SEWER SHALL BE REPAIRED IF DAMAGED BY CONSTRUCTION PRIOR TO CAP CONSTRUCTION. ALL PLANS TO MODIFY EXISTING UTILITIES SHALL BE SUBMITTED TO HOLLOMAN AFB PERSONNEL FOR REVIEW AND APPROVAL PRIOR TO PERFORMING WORK
5. ALL TRAFFIC CONTROL SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR. ALL TRAFFIC CONTROL DEVICES SHALL BE IN ACCORDANCE WITH ANY APPLICABLE STATE, LOCAL OR MILITARY CODES.
6. LOCAL VEHICLE TRAFFIC SHALL BE MAINTAINED AT ALL TIMES DURING CONSTRUCTION. WRITTEN PERMISSION TO TEMPORARILY CLOSE ANY PORTION OF THE ROADWAY MUST BE OBTAINED IN WRITING FROM HOLLOMAN AFB PRIOR TO CLOSING.
7. THE CONTRACTOR SHALL CONTAIN ALL CONSTRUCTION OPERATIONS WITHIN THE LIMITS OF WORK
8. ALL ITEMS ARE EXISTING UNLESS OTHERWISE NOTED

LEGEND:

- MONITORING WELL
- MANHOLE
- UTILITY POLE
- ELECTRICAL CONDUIT
- WATER VALVE
- GAS VALVE
- FENCE LINE
- LIMITS OF WORK
- CONTOUR
- CONTRACTOR STAGING AND MATERIAL STOCKPILING AREA
- BUILDING

$$ - THINK VALUE ENGINEERING - $$

REVISIONS

SYMBOL	DESCRIPTIONS	DATE	APPR
C	100% DESIGN SUBMITTAL FOR REVIEW	1-19-96	
B	80% DESIGN SUBMITTAL FOR REVIEW	8-25-95	
A	70% DESIGN SUBMITTAL FOR REVIEW	4-30-95	

FOSTER WHEELER ENVIRONMENTAL CORP. DENVER, COLO

U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS OMAHA, NEBRASKA

DESIGNED BY: B. CORB

DRAWN BY: M. TEDRICK, W. BLUME C.CONFER

CHECKED BY: R. BORREGO

REVIEWED BY: R. VERSAW

SUBMITTED BY: R. VERSAW

HOLLOMAN AFB NEW MEXICO
IRP SITE OT-14
REMEDIAL ACTION

EXISTING CONDITIONS WITH LIMITS OF WORK

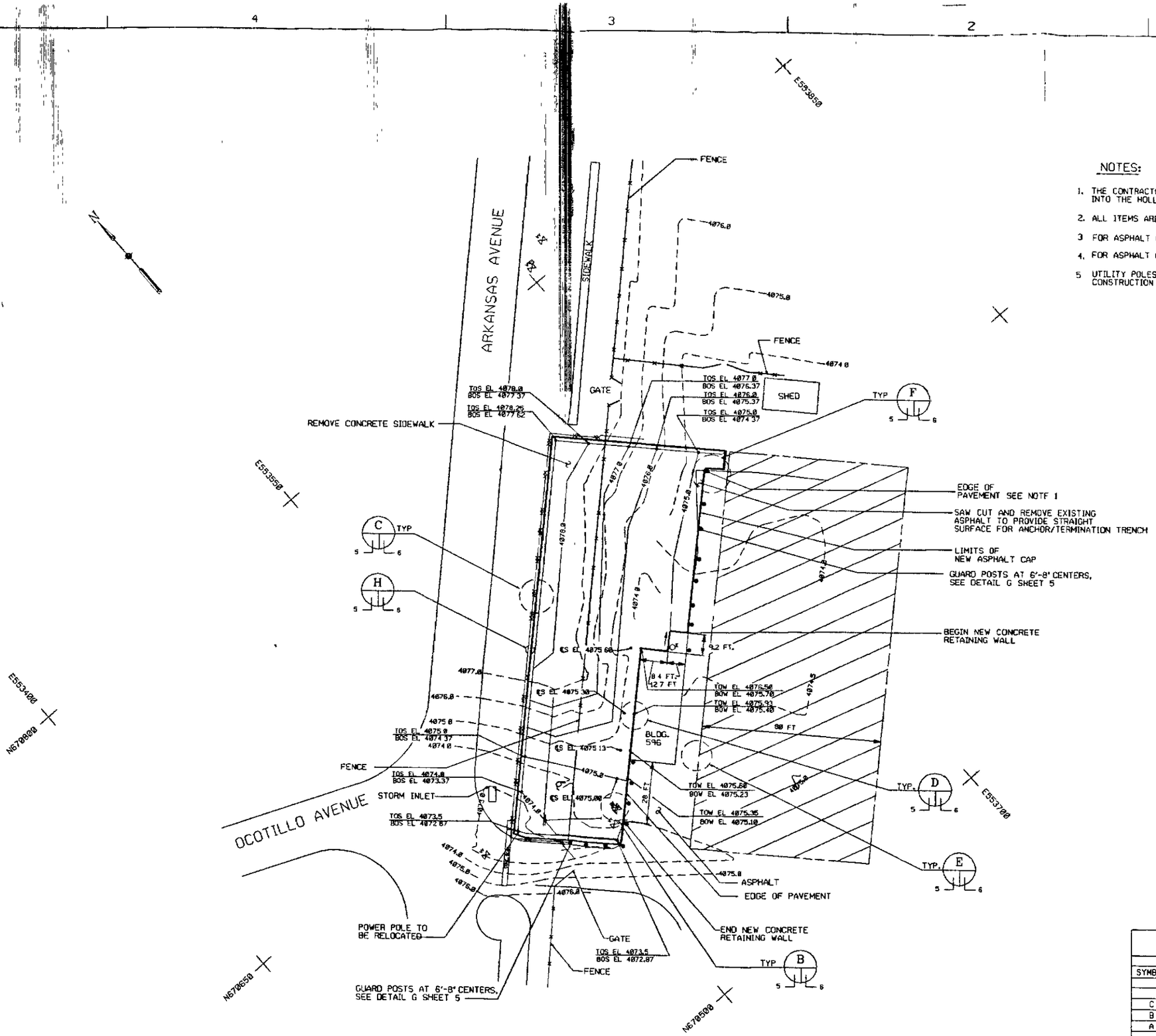
DESIGN FILE: OT14C4.DGN

DATE: JAN. 19 1996

SHEET NUMBER: 4

CONTRACT NO.: DACW 45 94-D-0003

REVISION C



SITE AND DRAINAGE PLAN

20 0 20 40'

SCALE: 1 INCH = 20 FEET

NOTES:

1. THE CONTRACTOR IS RESPONSIBLE FOR TYING THE PROJECT SURVEY CONTROL INTO THE HOLLOMAN AFB COORDINATE SYSTEM
2. ALL ITEMS ARE EXISTING UNLESS OTHERWISE NOTED.
3. FOR ASPHALT CAP SECTION, SEE DETAIL A SHEET 6.
4. FOR ASPHALT CAP PENETRATION, SEE DETAIL B SHEET 6
5. UTILITY POLES AND GUY WIRES TO BE RELOCATED BY CONTRACTOR PRIOR TO CONSTRUCTION

LEGEND:

- MONITORING WELL
- MANHOLE
- UTILITY POLE
- ELECTRICAL CONDUIT
- WATER VALVE
- GAS VALVE
- ABANDONED PIPE
- FENCE LINE
- NEW FENCE LINE
- NEW CONTOURS
- EDGE OF CAP
- GUIDE WIRE
- 4074.2 SPOT ELEVATION
- 4074.2 NEW SPOT ELEVATION
- SLOPE DIRECTION
- CONTRACTOR STAGING AND MATERIAL STOCKPILE AREA

ABBREVIATIONS:

℄S - CENTERLINE OF SWALE
TOW - TOP OF WALL
BOW - BOTTOM OF WALL
TOW - TOS OF SLOPE
BOS - BOTTOM OF SLOPE

$$ - THINK VALUE ENGINEERING - $$

REVISIONS

SYMBOL	DESCRIPTIONS	DATE	APPROVED
C	100% DESIGN SUBMITTAL FOR REVIEW	1-19-96	
B	80% DESIGN SUBMITTAL FOR REVIEW	8 25-95	
A	70% DESIGN SUBMITTAL FOR REVIEW	4 30-95	

FOSTER WHEELER ENVIRONMENTAL CORP. DENVER, COLO

U S ARMY ENGINEER DISTRICT CORPS OF ENGINEERS OMAHA, NEBRASKA

DESIGNED BY: B. CORB

DRAWN BY: M. TEDRICK W. BLUME, C. CONFER

CHECKED BY: R BORREGO

REVIEWED BY: R VERSAW

SUBMITTED BY: R VERSAW

HOLLOMAN AFB, NEW MEXICO
IRP SITE OT-14
REMEDIAL ACTION

SITE GRADING PLAN

DESIGN FILE: OT14C5.DGN

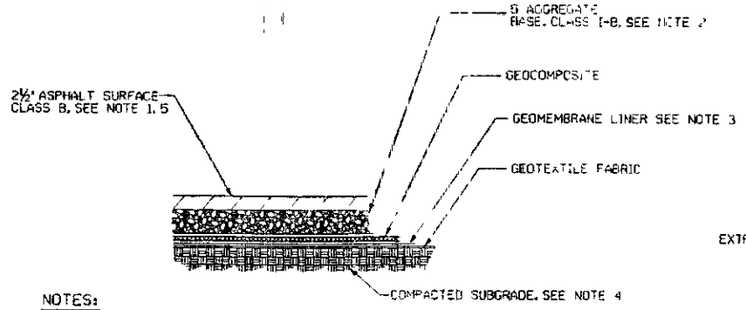
DATE: JAN. 19, 1996

SHEET NUMBER: 5

CONTRACT NO: DACW 45-94-D-0003

REVISION C

NOTE: THIS DRAWING SET HAS BEEN REDUCED APPROXIMATELY ½ SCALE.

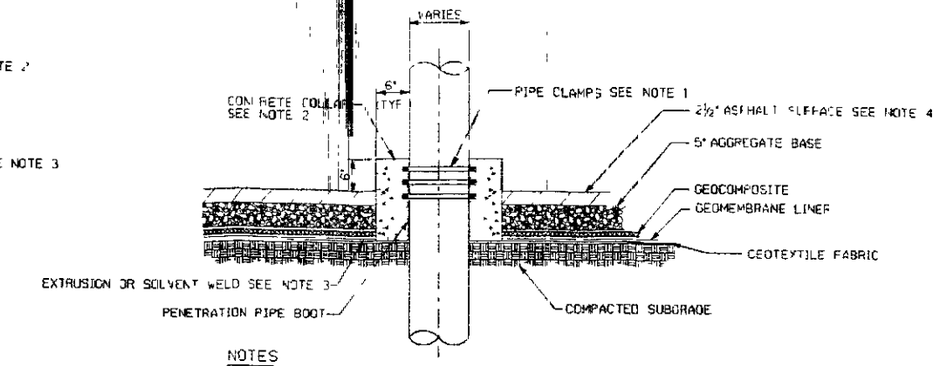


NOTES:

1. ASPHALT MATERIAL AND CONSTRUCTION SHALL BE IN ACCORDANCE WITH SPECIFICATION SECTION 02551
2. AGGREGATE BASE COURSE SHALL BE IN ACCORDANCE WITH SPECIFICATION SECTION 02231
3. GEOMEMBRANE LINER MATERIAL CAN BE BIO AS HDPE OR PVC MATERIALS AND CONSTRUCTION SHALL BE IN ACCORDANCE WITH TECHNICAL SPECIFICATION NO. 02580 OR 02590.
4. SUBGRADE SHALL BE COMPACTED BY CONTRACTOR AND APPROVED BY SITE ENGINEER IN ACCORDANCE WITH TECHNICAL SPECIFICATION SECTION 02100.
5. THE CONTRACTOR SHALL APPLY A PRIME COAT BETWEEN THE ASPHALT AN AGGREGATE LAYERS IN ACCORDANCE WITH SPECIFICATION SECTION 02551.

TYPICAL ASPHALT PAVEMENT DETAIL

DETAIL A
NOT TO SCALE
5 — 6

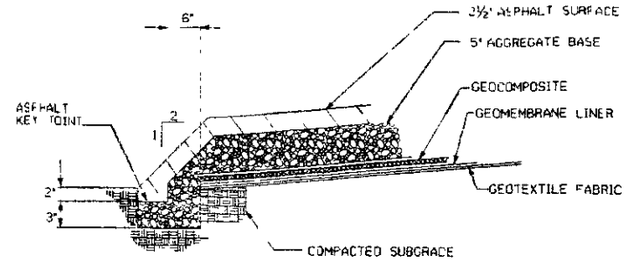


NOTES

1. CONTRACTOR SHALL INSTALL PIPE CLAMPS IN ACCORDANCE WITH THE GEOMEMBRANE MANUFACTURER'S SPECIFICATION
2. MATERIALS AND CONSTRUCTION SHALL BE IN ACCORDANCE WITH TECHNICAL SPECIFICATION NO. 03300 MINIMUM 3000 PSI CONCRETE.
3. GEOMEMBRANE LINER WELDS SHALL BE CONSTRUCTED IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS WELD TYPE IS DEPENDENT UPON LINER MATERIAL PROVIDED BY CONTRACTOR.
4. THE CONTRACTOR SHALL APPLY TACK COAT TO EXISTING BITUMINOUS OR PORTLAND CONCRETE SURFACES IN ACCORDANCE WITH SPECIFICATION SECTION 02551

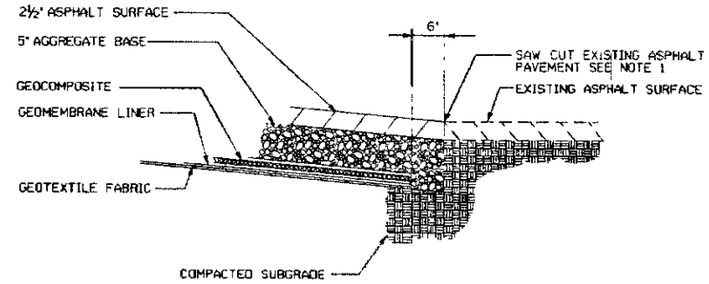
TYPICAL MONITORING WELL CASING AND UTILITY PENETRATION DETAIL

DETAIL B
NOT TO SCALE
5 — 6



ASPHALT CAP TERMINATION/ANCHOR TRENCH

DETAIL C
NOT TO SCALE
5 — 6

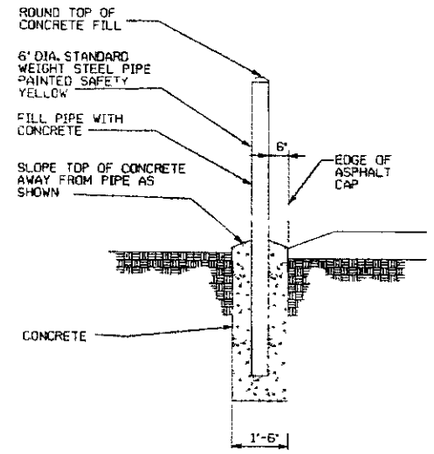


NOTE

1 THE CONTRACTOR SHALL APPLY TACK COAT TO EXISTING BITUMINOUS OR PORTLAND CONCRETE SURFACES IN ACCORDANCE WITH SPECIFICATION SECTION 02551

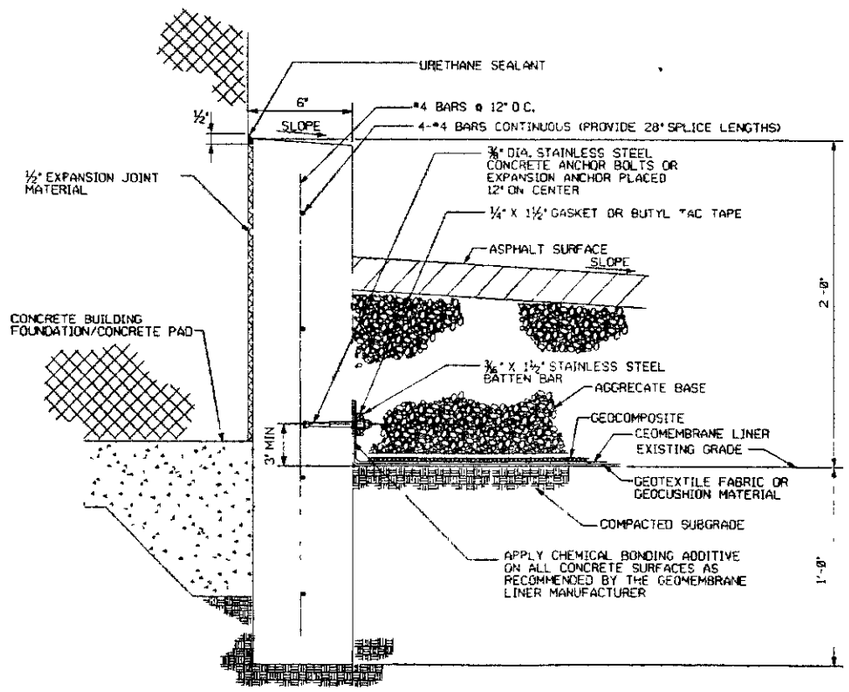
ASPHALT CAP TERMINATION/ANCHOR TRENCH AT EXISTING PAVEMENT

DETAIL F
NOT TO SCALE
5 — 6



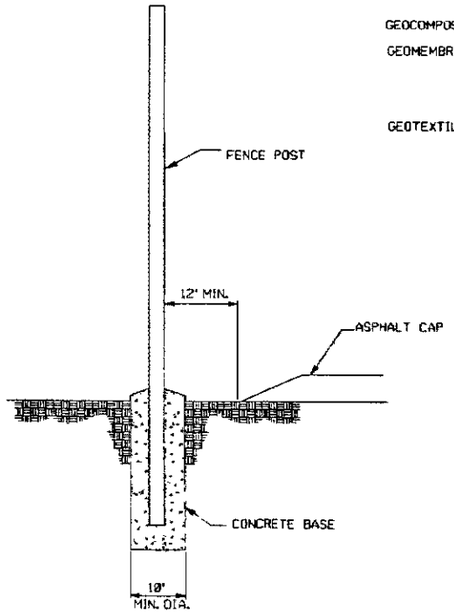
TYPICAL GUARD POST DETAIL

DETAIL G
NOT TO SCALE
5 — 6



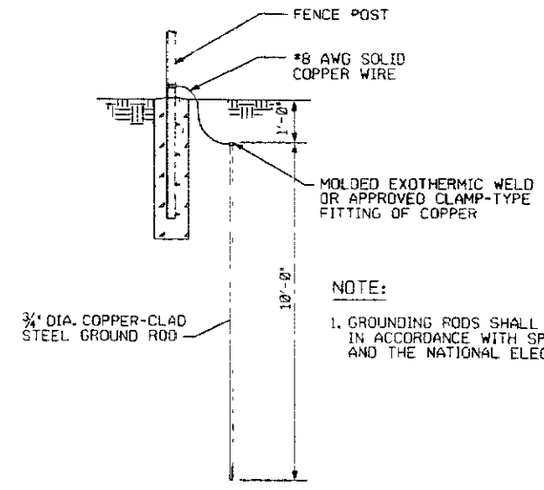
CONCRETE RETAINING WALL AND ATTACHMENT DETAIL

DETAIL D
NOT TO SCALE
5 — 6



PERIMETER FENCE OFF-SET DETAIL

DETAIL E
NOT TO SCALE
5 — 6



NOTE:

1. GROUNDING RODS SHALL BE INSTALLED IN ACCORDANCE WITH SPECIFICATION 02830 AND THE NATIONAL ELECTRIC CODE.

TYPICAL FENCE GROUNDING DETAIL

DETAIL H
NO SCALE
5 — 6

NOTE: THIS DRAWING SET HAS BEEN REDUCED APPROXIMATELY ½ SCALE.

$$ - THINK VALUE ENGINEERING - $$

REVISIONS

SYMBOL	DESCRIPTIONS	DATE	APPROVED
C	100% DESIGN SUBMITTAL FOR REVIEW	1-19-96	
B	80% DESIGN SUBMITTAL FOR REVIEW	8-25-95	
A	70% DESIGN SUBMITTAL FOR REVIEW	4-30-95	

FOSTER WHEELER ENVIRONMENTAL CORP. DENVER, COLO

U.S ARMY ENGINEER DISTRICT CORPS OF ENGINEERS OMAHA, NEBRASKA

HOLLOMAN AFB, NEW MEXICO
IRP SITE OT-14
REMEDIAL ACTION

DETAILS

DESIGNED BY: B. CORB
DRAWN BY: H TEDRICK, W BLUME, C. CONFER
CHECKED BY: R. BORREGO
REVIEWED BY: R. VERSAW
SUBMITTED BY: R. VERSAW

DESIGN FILE: OT14C6 DGN
DATE: JAN 19, 1996
SHEET NUMBER: 6
REVISION: C
CONTRACT NO.: DACW 45-94-D 0003

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DIVISION 02 - SITE CONSTRUCTION

SECTION 02111

EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL

09/03

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-- End of Section Table of Contents --

GUIDE SPECIFICATION FOR CONSTRUCTION

SECTION 02111

EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL
09/03

NOTE: This guide specification covers the requirements for excavation, handling, and temporary storage of contaminated material.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.

PART 1 GENERAL

NOTE: The following information should be shown on the project drawings:

a. Overall site plan, borrow areas, stockpile areas, storage areas, security requirements, special shoring requirements, boring logs, and access routes.

b. Individual site plans of each area of contamination with site features such as buildings, roads, utilities, topography, trees, shrubs, surface conditions, etc.

c. Limits of pavement removal, fence removal, and the location of ancillary equipment to be removed.

All specific chemical testing procedures (including air emissions analysis) should be addressed in the Sampling and Analysis Plan required by Section 01450 CHEMICAL DATA QUALITY CONTROL.

When applicable, the use of onsite field screening or field analysis (supported at a prescribed frequency by fixed laboratory analysis) should be encouraged to avoid prolonged delays or equipment downtime. Details on the appropriate application and use of field analyses can be found in Appendix H of EM 200-1-3.

****

1.1 REFERENCES

****

NOTE: Issue (date) of references included in project specifications need not be more current than provided by the latest guide specification. Use of SpecsIntact automated reference checking is recommended for projects based on older guide specifications.

****

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D 1556	(2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(2002) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 2167	(1994; R 2001) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(2000) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(2001) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 422	(1963; R 2002) Particle-Size Analysis of Soils
ASTM D 5434	(1997; R 2003) Field Logging of Subsurface Explorations of Soil and Rock
ASTM D 698	(2000a) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2003) Safety and Health Requirements Manual

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1926	Safety and Health Regulations for Construction
40 CFR 302	Designation, Reportable Quantities, and Notification

1.2 MEASUREMENT AND PAYMENT

****
NOTE: These paragraphs should be deleted if the work is in one lump-sum contract price. Coordinate requirements of these paragraphs with the bidding schedule.
****

1.2.1 Measurement

****
NOTE: Modify this paragraph if the method of payment will be on a weight basis.
****

Measurement for excavation and on-site transportation shall be based on the actual number of cubic meters yards of contaminated material in-place prior to excavation. Determination of the volume of contaminated material excavated shall be based on cross-sectional volume determination reflecting the differential between the original elevations of the top of the contaminated material and the final elevations after removal of the contaminated material. Measurement for backfilling of excavated areas shall be based on in-place cubic meters yards of compacted fill. Measurement for construction of stockpile areas shall be based on the number of square meters yards of stockpile liner constructed.

1.2.2 Payment

1.2.2.1 Excavation and Transportation

Compensation for excavation and onsite transportation of contaminated material will be paid as a unit cost. This unit cost shall include any other items incidental to excavation and handling not defined as having a specific unit cost.

1.2.2.2 Backfilling

Compensation for backfill soil, transportation of backfill, backfill soil conditioning, backfilling, compaction, and geotechnical testing will be paid as a single unit cost.

1.2.2.3 Stockpiling

Compensation for construction of stockpile areas will be paid for as a unit cost. This unit cost shall include all aspects of grading, preparation, handling, placement, maintenance, removal, treatment, and disposal of stockpile cover materials and liner materials and all other items incidental to construction of stockpiles.

1.3 SUBMITTALS

****

NOTE: Submittals must be limited to those necessary for adequate quality control. The importance of an item in the project should be one of the primary factors in determining if a submittal for the item should be required.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only **delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.**

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy projects.

Submittal items not designated with a "G" are considered as being for information only for Army projects and for Contractor Quality Control approval for Navy projects.

****

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Surveys; G, [_____]

Separate cross-sections of each area before and after excavation and after backfilling.

SD-03 Product Data

Work Plan; G, [_____]

Work Plan within [30] [_____] calender days after notice to proceed. No work at the site, with the exception of site inspections and surveys, shall be performed until the Work Plan is approved. The Contractor shall allow [30] [_____] calender days

in the schedule for the Government's review. No adjustment for time or money will be made if resubmittals of the Work Plan are required due to deficiencies in the plan. At a minimum, the Work Plan shall include:

a. Schedule of activities.

b. Method of excavation and equipment to be used.

c. Shoring or side-wall slopes proposed.

d. Dewatering plan.

e. Storage methods and locations for liquid and solid contaminated material.

f. Borrow sources and haul routes.

g. Decontamination procedures.

h. Spill contingency plan.

Closure Report; G, [_____]

[_____] copies of the Closure Report within [14] [_____] calender days of work completion at the site.

SD-06 Test Reports

Backfill; G, [_____]
Surveys; G, [_____]
Confirmation Sampling and Analysis; G, [_____]
Sampling of Stored Material; G, [_____]
Sampling Liquid; G, [_____]
Compaction; G, [_____]

Test results.

1.4 SURVEYS

Surveys shall be performed immediately prior to and after excavation of contaminated material to determine the volume of contaminated material removed. Surveys shall also be performed immediately after backfill of each excavation. The Contractor shall provide cross-sections on [7.6] [_____] meter [25] [_____] foot intervals and at break points for all excavated areas. Locations of confirmation samples shall also be surveyed and shown on the drawings. Surveys shall be performed in accordance with Section: [_____].

1.5 REGULATORY REQUIREMENTS

1.5.1 Permits and Licenses

****
NOTE: Include additional site specific requirements in this paragraph.
****

The Contractor shall obtain required federal, state, and local permits for

excavation and storage of contaminated material. Permits shall be obtained at no additional cost to the Government.

1.5.2 Air Emissions

****

NOTE: An air pathway analysis should be performed during design to determine what air monitoring and controls are required. Guidance on air pathway analyses is provided in EP 1110-1-21 Air Pathway Analysis for the Design of Hazardous, Toxic, and Radioactive Waste (HTRW) Remedial Action Projects. Specify perimeter air monitoring requirements in Section 01355 ENVIRONMENTAL PROTECTION.

****

Air emissions shall be monitored and controlled in accordance with Section 01355.

1.6 DESCRIPTION OF WORK

****

NOTE: Include any pertinent information regarding project/site conditions in this paragraph, the appendices to the specifications, or on the drawings.

If oversize material such as debris and foundations are present, the specification should describe treatment, handling, and disposal requirements for this material. Measurement and payment procedures should also be described for this material.

If clean soil overlies the contaminated material, the specification should describe how this material will be measured, removed, stored, and tested to verify they are clean.

****

The work shall consist of excavation and temporary storage of approximately [_____] cubic meters yards of contaminated material. Approximate locations of contaminated material are shown on the drawings. Characterization data on the nature and extent of the contaminated material is shown in Appendix [_____]. Subsurface conditions are shown [on the drawings] [in Appendix [_____]]. The Contractor shall submit a Work Plan as specified in the Submittals paragraph. The Contracting Officer shall be notified within [24] [_____] hours, and before excavation, if contaminated material is discovered that has not been previously identified or if other discrepancies between data provided and actual field conditions are discovered. Backfill material is [not available onsite] [available onsite and typically consists of [_____]]. Ground water is approximately [_____] meters feet below pre-excavation ground surface.

1.7 CHEMICAL TESTING

Required sampling and chemical analysis shall be conducted in accordance with Section 01450A CHEMICAL DATA QUALITY CONTROL.

1.8 SCHEDULING

The Contractor shall notify the Contracting Officer [_____] calender days prior to the start of excavation of contaminated material. The [Contracting Officer will] [Contractor shall] be responsible for contacting regulatory agencies in accordance with the applicable reporting requirements.

PART 2 PRODUCTS

2.1 BACKFILL

****

NOTE: If contaminated material removal is part of a larger project and a backfilling specification is needed for the project as a whole, refer to another specification such as Section 02315 EXCAVATION, FILLING AND BACKFILLING FOR BUILDINGS for Buildings, for backfill requirements and delete the following paragraphs.

In many cases, the degree of engineering control of the materials used as backfill may not need to be as stringent as described in this paragraph. In other cases, such as under pavements, special compaction and material requirements may apply and the specification will need to be revised to address these special requirements or another specification section should be referenced.

Backfill and topsoil brought in from offsite is usually tested to verify the material is clean. Quality assurance samples taken by the Government may also be prudent to verify the seller's claims by analyzing for target analytes. Backfill is commonly tested for the site specific contaminants being cleaned up and/or is based on suspicion of contamination at the site from which the backfill is originating.

At some sites, previously contaminated material which has been removed from the excavation is reused as backfill following treatment to remove the contaminant of concern.

****

Backfill material shall be obtained from [the location indicated on the drawings] [offsite sources approved by the Contracting Officer]. Backfill shall be classified in accordance with ASTM D 2487 as GW, GP, GM, GC, SW, SP, SM, SC, ML, MH, CL, or CH and shall be free from roots and other organic matter, trash, debris, snow, ice or frozen materials. Backfill material shall be tested for the parameters listed below at a frequency of once per [3000] [_____] cubic meters yards. A minimum of one set of classification tests shall be performed per borrow source. [One] [_____] backfill sample per borrow source shall also be collected and tested for the chemical parameters listed below.

Physical Parameter	Criteria	Test Method
Grain Size	[_____]	ASTM D 422
Compaction	[_____]	ASTM D 698
[_____]	[_____]	[_____]

Chemical Parameter	Test Frequency	Criteria
[_____]	[_____]	[_____]

Backfill shall not be used until borrow source chemical and physical test results have been submitted and approved.

2.2 SPILL RESPONSE MATERIALS

The Contractor shall provide appropriate spill response materials including, but not limited to the following: containers, adsorbents, shovels, and personal protective equipment. Spill response materials shall be available at all times when contaminated materials/wastes are being handled or transported. Spill response materials shall be compatible with the type of materials and contaminants being handled.

PART 3 EXECUTION

3.1 EXISTING STRUCTURES AND UTILITIES

No excavation shall be performed until site utilities have been field located. The Contractor shall take the necessary precautions to ensure no damage occurs to existing structures and utilities. Damage to existing structures and utilities resulting from the Contractor's operations shall be repaired at no additional cost to the Government. Utilities encountered that were not previously shown or otherwise located shall not be disturbed without approval from the Contracting Officer.

3.2 CLEARING

****

NOTE: Grubbing is typically not required at sites where contaminated soil is being excavated for treatment and/or disposal. Typically, vegetation that is cut off above a certain height is defined as clean and any stumps and brush below this height are defined as contaminated.

****

Clearing shall be performed to the limits shown on the drawings in accordance with Section 02231 CLEARING AND GRUBBING.

3.3 CONTAMINATED MATERIAL REMOVAL

****

NOTE: Excavations should be marked and secured in accordance with the requirements specified in Section 01351 SAFETY, HEALTH, AND EMERGENCY RESPONSE (HTRW/UST).

****

3.3.2 Excavation

****
NOTE: For large excavations, more than one excavation log may be required.
****

Areas of contamination shall be excavated to the depth and extent shown on the drawings and not more than [60] [_____] mm [0.2] [_____] feet beyond the depth and extent shown on the drawings unless directed by the Contracting Officer. Excavation shall be performed in a manner that will limit spills and the potential for contaminated material to be mixed with uncontaminated material. An excavation log describing visible signs of contamination encountered shall be maintained for each area of excavation. Excavation logs shall be prepared in accordance with ASTM D 5434.

3.3.3 Shoring

If workers must enter the excavation, it shall be evaluated, shored, sloped or braced as required by EM 385-1-1 and 29 CFR 1926 section 650.

3.3.4 Dewatering

****
NOTE: Dewatering can significantly increase the cost of a project involving the excavation of contaminated material and should be carefully considered during design. TM 5-818-5 Dewatering and Groundwater Control provides guidance on the design of dewatering systems.

If water from dewatering operations will be allowed to discharge on or into the ground, an NPDES permit for dewatering is required. Reference the permits paragraph of Section 01355 ENVIRONMENTAL PROTECTION for permit requirements.
****

Surface water shall be diverted to prevent entry into the excavation. [Dewatering shall be limited to that necessary to assure adequate access, a safe excavation, prevent the spread of contamination, and to ensure that compaction requirements can be met.] [No dewatering shall be performed without prior approval of the Contracting Officer.]

3.4 CONFIRMATION SAMPLING AND ANALYSIS

****
NOTE: Confirmation samples and analyses are used to verify cleanup criteria have been met. These test results should be of relatively high quality. For this reason, the designer should consider the regulatory requirements, the complexity of the monitoring needed, and quantitative Data Quality Objectives in determining the analytical methods specified.

The number of confirmation samples must be based on the size of the excavation and regulatory requirements. For small excavations, a minimum of

one sample should be taken from near the center of the excavation (or where there is the highest potential for contamination). Additional samples may be oriented symmetrically relative to the center sample and the limits of the excavation.

Many military facilities have base-wide sampling and analysis plans which have been approved by the applicable regulatory agencies. These plans may specify the number of confirmation samples which must be taken.

For larger excavations, EPA 230/02-89-042 Methods of Evaluation and Attainment of Cleanup Standards provides guidance on the design of statistically based sampling intervals.

With regulator approval, confirmation sampling and analysis may be accomplished using an averaging technique for comparison to cleanup criteria. This is based on the fact that most soil risk exposure scenarios do not model contamination as existing in discrete hot spots but as a more disperse phenomenon. Two ways to accomplish this averaging technique are to take discrete samples and average the data or by compositing sample material before analysis. A composite sample typically consists of 4 to 6 samples which are mixed together. One sample is then obtained from the composite sample for analysis. EM 200-1-3 provides guidance on compositing samples. Composite samples are not applicable to volatile organic contaminants because the compositing process will result in volatilization of contaminants. **If composite samples are required, Section 01450 CHEMICAL DATA QUALITY CONTROL should be edited by a qualified chemist to describe procedures for compositing samples.**

Confirmation sampling at a site with radioactive contamination in surface soils or on building surfaces will be performed in accordance with the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), NUREG-1575, EPA 402-R-97-016. This manual is a guide for confirmation survey design (planning) and for data evaluation. Its primary purpose is to acquire legally defensible data concerning the post excavation residual radioactivity at the site to demonstrate that the site meets release criteria.

****

The Contracting Officer shall be present to inspect the removal of contaminated material from each site. After all material suspected of being contaminated has been removed, the excavation shall be examined for evidence of contamination. If the excavation appears to be free of contamination, field analysis shall be used to determine the presence of [_____] contamination using [a real time vapor monitoring instrument] [immunoassay field kits] [_____]. Excavation of additional material shall

be as directed by the Contracting Officer. After all suspected contaminated material is removed, confirmation samples shall be collected and analyzed for the following contaminants:

Chemical Parameter	Action Level
[_____]	[_____]

Samples shall be collected at a frequency of one per [_____] square meters yards from the bottom [and each of the side walls] or as directed by the Contracting Officer. A minimum of one sample shall be collected from the bottom [and each side wall] of the excavation. Based on test results, the Contractor shall propose any additional excavation which may be required to remove material which is contaminated above action levels. Additional excavation shall be subject to approval by the Contracting Officer. Locations of samples shall be marked in the field and documented on the as-built drawings.

3.5 CONTAMINATED MATERIAL STORAGE

****

NOTE: For CERCLA sites, permits are not required to store hazardous waste in a stockpile. However, storage structures and conditions must be in compliance the Applicable, Relevant, and Appropriate Regulations (ARARs). For RCRA sites, permits are required to store hazardous waste in a stockpile. However, for RCRA sites, hazardous waste can be stored in a drum or roll-off unit for up to 90 days without a permit.

For temporary storage of more than 90 days, dual containment of hazardous liquid and some hazardous solids may be required. Containment system requirements are described in 40 CFR 264.175. For stock piles that meet the definition of a waste pile, see 40 CFR 264.250.

To provide secondary containment, tanks and roll-off units are sometimes stored on lined areas similar in design to what is described in paragraph Stockpiles.

****

Material shall be placed in temporary storage [immediately after excavation] [after treatment while awaiting test results]. The following paragraphs describe acceptable methods of material storage. Storage units shall be in good condition and constructed of materials that are compatible with the material or liquid to be stored. If multiple storage units are required, each unit shall be clearly labeled with an identification number and a written log shall be kept to track the source of contaminated material in each temporary storage unit.

3.5.1 Stockpiles

****

NOTE: Check state regulations to determine the minimum requirements for stockpiles and modify this paragraph accordingly. For contaminated material with high moisture content, the subgrade for the

stockpile must be sloped and a sump should be provided.

Scrim reinforced geomembranes are commonly specified for stockpile covers and liners. Due to their higher strength properties, scrim reinforced geomembranes can generally be thinner than non-reinforced geomembranes.

For post treatment stockpiles, chemical testing is usually required to determine if material is contaminated or clean. **Maximum stockpile size should be based on the required frequency of chemical testing. For example, if chemical tests are required at a frequency of one per 1,000 cubic meters (cubic yards), then stockpiles should be no greater than 1,000 cubic meters (cubic yards) in size.**

****

Stockpiles shall be constructed to isolate stored contaminated material from the environment. The maximum stockpile size shall be [_____] cubic meters. yards. Stockpiles shall be constructed to include:

a. [A chemically resistant geomembrane liner free of holes and other damage. Non-reinforced geomembrane liners shall have a minimum thickness of [0.5] [_____] mm. [20] [_____] mils. Scrim reinforced geomembrane liners shall have a minimum weight of 20 kg/100 square meters. 40 lbs. per 1000 square feet. The ground surface on which the geomembrane is to be placed shall be free of rocks greater than 12 mm 0.5 inches in diameter and any other object which could damage the membrane.] [Pavement shall be used as the liner system. Pavement shall be constructed in accordance with Section [_____]].

b. Geomembrane cover free of holes or other damage to prevent precipitation from entering the stockpile. Non-reinforced geomembrane covers shall have a minimum thickness of 0.25 mm. 10 mils. Scrim reinforced geomembrane covers shall have a minimum weight of 13 kg/100 square meters 26 lbs. per 1000 square feet. The cover material shall be extended over the berms and anchored or ballasted to prevent it from being removed or damaged by wind.

c. Berms surrounding the stockpile, a minimum of 300 mm 12 inches in height. Vehicle access points shall also be bermed.

d. The liner system shall be sloped to allow collection of leachate. Storage and removal of liquid which collects in the stockpile, in accordance with paragraph Liquid Storage.

3.5.2 Roll-Off Units

Roll-off units used to temporarily store contaminated material shall be water tight. A cover shall be placed over the units to prevent precipitation from contacting the stored material. **The units shall be located [as shown on the drawings] [_____]. Liquid which collects inside the units shall be removed and stored in accordance with paragraph Liquid Storage.**

3.5.3 Liquid Storage

Liquid collected from excavations and stockpiles shall be temporarily stored in [220 L barrels] [[2000] [_____] L tanks]. [55 gallon barrels] [[500] [_____] gallon tanks]. Liquid storage containers shall be water-tight and shall be located [as shown on the drawings] [_____].

3.6 SAMPLING

3.6.1 Sampling of Stored Material

****

NOTE: Additional samples are sometimes collected from excavated material to determine the contaminants present prior to treatment or disposal.

Composite samples are often collected from stockpiled material. However, composite samples cannot be taken if the samples are being analyzed for volatile organic contaminants.

At sites with radioactive contamination, ex-situ sampling of excavated material is typically performed to ensure that the material meets disposal facility acceptance criteria and, in some cases, to assist with the preparation of shipping papers. The ex-situ sampling regime is site-specific. It is usually determined in consultation with the disposal facility and its regulatory agency.

****

Samples of stored material shall be collected at a frequency of once per [_____] cubic meters. yards. Samples shall be tested for the following:

Chemical Parameter	Action Level
[_____]	[_____]

Stored material with contaminant levels that exceed the action levels shall be treated [offsite. Analyses for contaminated material to be taken to an offsite treatment facility shall conform to local, state, and federal criteria as well as to the requirements of the treatment facility. Documentation of all analyses performed shall be furnished to the Contracting Officer. Additional sampling and analyses to the extent required by the approved offsite treatment, storage or disposal (TSD) facility shall be the responsibility of the Contractor and shall be [performed at no additional cost to the Government] [subject to approval by the Contracting Officer].] [onsite. Treatment shall be in accordance with Section [_____].]

3.6.2 Sampling Liquid

****

NOTE: Liquid should generally be tested for the same contaminants as are found in the contaminated solid material being removed. The frequency of testing should be determined on a site specific basis. Offsite disposal will generally require additional testing and analysis prior to disposal.

NPDES requirements must be considered for onsite disposal of liquids.

****

Liquid collected from [excavations] [storage areas] [decontamination facilities] shall be sampled at a frequency of once for every [2,000] [_____] L [500] [_____] gallons of liquid collected. Samples shall be tested for the following:

Chemical Parameter	Action Level
[_____]	[_____]

Liquid with contaminant levels that exceed action levels shall be treated [offsite. Analyses for contaminated liquid to be taken to an offsite treatment facility shall conform to local, state, and federal criteria as well as to the requirements of the treatment facility. Documentation of all analyses performed shall be furnished to the Contracting Officer. Additional sampling and analysis to the extent required by the approved offsite treatment, storage or disposal (TSD) facility receiving the material shall be the responsibility of the Contractor and shall be [performed at no additional cost to the Government] [subject to approval by the Contracting Officer].] [onsite. Treatment shall be in accordance with Section [_____].]

3.6.3 Sampling Beneath Storage Units

****

NOTE: At some sites, samples are collected to verify the soil on which a storage unit is placed has not become contaminated.

Sampling along any connecting pipelines that transport contaminated liquid may also be appropriate. A standard practice is to sample at 6 m (20 foot) intervals under piping and at connections such as bends, elbows, or tees.

****

Samples from beneath each storage unit shall be collected prior to construction of and after removal of the storage unit. Samples shall be collected at a frequency of one per each [_____] square meters yards from a depth interval of [0 to 0.15] [_____] m [0 to 0.5] [_____] feet and shall be tested for the following:

Chemical Parameter	Action Level
[_____]	[_____]

Based on test results, soil which has become contaminated above action levels shall be removed at no additional cost to the Government. Contaminated material which is removed from beneath the storage unit shall be handled in accordance with paragraph Sampling of Stored Material. As directed by the Contracting Officer and at no additional cost to the Government, additional sampling and testing shall be performed to verify areas of contamination found beneath stockpiles have been cleaned up to below action levels.

3.7 SPILLS

****

NOTE: Regarding preestablished spill reporting procedures, the designer should consult CEMP-RT memorandum of 20 July 1995, Subject: Spill Reporting Procedures for USACE Personnel Involved in HTRW Projects.

Evaluate whether a contingency plan is needed per 40 CFR 262.34. This regulation is a potential requirement for large quantity generators of hazardous waste. At military installations, a plan is typically already in place.

****

In the event of a spill or release of a hazardous substance (as designated in 40 CFR 302), pollutant, contaminant, or oil (as governed by the Oil Pollution Act (OPA), 33 U.S.C. 2701 et seq.), the Contractor shall notify the Contracting Officer immediately. If the spill exceeds the reporting threshold, the Contractor shall follow the pre-established procedures as described in the [RCRA Contingency Plan] [Base Wide Contingency Plan] [_____] for immediate reporting and containment. Immediate containment actions shall be taken to minimize the effect of any spill or leak. Cleanup shall be in accordance with applicable federal, state, and local regulations. As directed by the Contracting Officer, additional sampling and testing shall be performed to verify spills have been cleaned up. Spill cleanup and testing shall be done at no additional cost to the Government.

3.8 BACKFILLING

****

NOTE: If allowed by the regulatory authority, field analyses should be used to reduce laboratory turn-around time and minimize the duration an excavation must be left open.

After completion of backfilling, a 0.15 meter (6 inch) layer of top soil is typically placed in areas that are not paved. The topsoil is placed in a single lift to the lines and grades shown on the drawings. Top soil and seeding requirements should be described in a different section of the specification package.

****

3.8.1 Confirmation Test Results

Excavations shall be backfilled immediately after all contaminated materials have been removed and confirmation test results have been approved. Backfill shall be placed and compacted to the lines and grades shown on the drawings.

3.8.2 Compaction

****

NOTE: The following paragraph outlines density requirements for in-place backfill. If the density

of the backfill is not critical, modify this paragraph by replacing the density testing requirements with procedural requirements for compaction.

****

Approved backfill shall be placed in lifts with a maximum loose thickness of [200] [_____] mm. [8] [_____] inches. Soil shall be compacted to [90] [_____] percent of [ASTM D 698] [ASTM D 1557] maximum dry density. Density tests shall be performed at a frequency of once per [930] [_____] square meters [10,000] [_____] square feet per lift. A minimum of [one density test] [[_____] density tests] shall be performed on each lift of backfill placed. Field in-place dry density shall be determined in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 2922. If ASTM D 2922 is used, a minimum of one in ten tests shall be checked using ASTM D 1556 or ASTM D 2167. Test results from ASTM D 1556 or ASTM D 2167 shall govern if there is a discrepancy with the ASTM D 2922 test results.

3.9 DISPOSAL REQUIREMENTS

Offsite disposal of contaminated material shall be in accordance with Section 02120A TRANSPORTATION AND DISPOSAL OF HAZARDOUS MATERIALS.

3.10 CLOSURE REPORT

****

NOTE: In addition to progress photos, video tapes have been used at some sites to record site activities.

****

[_____] copies of a Closure Report shall be prepared and submitted within [14] [_____] calender days of completing work at the site. The report shall be labeled with the contract number, project name, location, date, name of general contractor, and the Corps of Engineers District contracting for the work. The Closure Report shall include the following information as a minimum:

a. A cover letter signed by a [responsible company official] [Professional Engineer registered in the State of [_____] who is a responsible company official] certifying that all services involved have been performed in accordance with the terms and conditions of the contract documents and regulatory requirements.

b. A narrative report including, but not limited to, the following:

(1) site conditions, ground water elevation, and cleanup criteria;

(2) excavation logs;

(3) field screening readings;

(4) quantity of materials removed from each area of contamination;

(5) quantity of water/product removed during dewatering;

(6) sampling locations and sampling methods;

(7) sample collection data such as time of collection and method of preservation;

(8) sample chain-of-custody forms; and

(9) source of backfill.

c. Copies of all chemical and physical test results.

d. Copies of all manifests and land disposal restriction notifications.

e. Copies of all certifications of final disposal signed by the responsible disposal facility official.

f. Waste profile sheets.

g. Scale drawings showing limits of each excavation, limits of contamination, known underground utilities within 15 m 50 feet of excavation, sample locations, and sample identification numbers. On-site stockpile, storage, treatment, loading, and disposal areas shall also be shown on the drawings.

h. Progress Photographs. Color photographs shall be used to document progress of the work. A minimum of four views of the site showing the location of the area of contamination, entrance/exit road, and any other notable site conditions shall be taken before work begins. After work has been started, activities at each work location shall be photographically recorded [daily] [weekly]. Photographs shall be a minimum of 76.2 x 127.0 mm 3 x 5 inches and shall include:

(1) Soil removal and sampling.

(2) Dewatering operations.

(3) Unanticipated events such as spills and the discovery of additional contaminated material.

(4) Contaminated material/water storage, handling, treatment, and transport.

(5) Site or task-specific employee respiratory and personal protection.

(6) Fill placement and grading.

(7) Post-construction photographs. After completion of work at each site, the Contractor shall take a minimum of four views of each excavation site.

A digital version of all photos shown in the report shall be included with the Closure Report. Photographs shall be a minimum of 76mm by 127 mm 3 inches by 5 inches and shall be mounted back-to-back in double face plastic sleeves punched to fit standard three ring binders. Each print shall have an information box attached. The box shall be typewritten and arranged as follows:

Project Name:
Location:
Photograph No.:

Direction of View:
Date/Time:
Description of View:

-- End of Section --

Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)[1]

This standard is issued under the fixed designation D 2922; the number immediately following the designation indicates the year of original adoption or, in the case of revision. the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

These test methods have been approved for use by agencies of the Department of Defense. Consult the DoD Index of Specifications and Standards/or the specific year of issue which has been adopted by the Department of Defense.

ε1 NOTE—Table 1 was corrected editorially in December 1997.

1. Scope

1.1 These test methods cover the determination of the total or wet density of soil and soil-rock mixtures by the attenuation of gamma radiation where the source and detector(s) remain on the surface (Backscatter Method) or the source or detector is placed at a known depth up to 300 mm (12 in.) whiie the detector(s) or source remains on the surface (Direct Transmission Method).

1.2 The density in mass per unit volume of the material under test is determined by comparing the detected rate of gamma radiation with previously established calibration data.

1.3 The values tested in SI units are to be regarded as the standard. The inch-pound equivalents may be approximate.

1.4 It is common practice in the engineering profession to concurrently use pounds to represent both a unit of mass (lbm) and a unit of force (lbf). This implicitly combines two separate systems of units: that is, the absolute system and the gravitational system. It is scientifically undesirable to combine the use of two separate sets of inch-pound units within a single standard. This standard has been written using the gravitational system of units when dealing with the inch-pound system. In this system the pound (lbf) represents a unit of force (weight). However, the use of balances or scales recording pounds of mass (lbm), or the recording of density in lbm/ft^3 should not be regarded as nonconformance with this standard.

1.5 *This standard does not purport to address all of the safety concerns. if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability oj' regulator?, limitations prior to use.* For specific Hazard statements, see Section 6.

2. Referenced Documents

2.1 *ASTM Standards:*

D 698 Test Method for Moisture-Density Relations of Soil and Soil-Aggregate Mixtures Using 5.5-lb (2.49-kg) Rammer and 12-in. (305-mm) Drop[2]

D 1557 Test Method for Moisture-Density Relations of Soil and Soil-Aggregate Mixtures Using IO-lb (4.54-kg) Rammer and 18-in. (457-mm) Drop[2]

D 32 16 Test Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures'

D 30 17 Test Method for Water Content of Soil and Rock In-Place by Nuclear Methods (Shallow Depth)[2]

D4253 Test Method for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table[2]

D4643 Test Method for Determination of Water Content by the Microwave Oven Method[2]

D 47 18 Practice for Correction of Unit Weight and Water Content for Soils Containing Oversize Particles[2]

D4944 Test Method for Field Determination of Water (Moisture) Content of Soil by the Calcium Carbide Gas Pressure Tester Method[3]

D4959 Test Method for Determination of Water (Moisture) Content by Direct Heating Method[3]

3. Significance and Use

3.1 The test methods described are useful as rapid, nondestructive techniques for the in-place determination of density of soil and rock.

3.2 The test methods are suitable for quality control and acceptance testing for construction and for research and development applications.

3.3 The nondestructive nature of the tests allow repetitive measurements to be made at a single test location.

4. Interferences

4.1 The chemical composition of the sample may affect the measurement, and adjustments may be necessary.

4.2 The test methods exhibit spatial bias in that the instrument is more sensitive to the density of the material in close proximity to the surface (Backscatter Method only).

NOTE I-The nuclear gauge density measurements are somewhat biased to the surface layers of the soil being tested. This bias has *largely*

[1] These test methods are under the jurisdiction of ASTM Committee D-18 on Soil and Rock and are the direct responsibility of Subcommittee D18.08 on Special and Construction Control Tests.

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[2] *Annual Book of ASTM Standards*, Vol 04.08.

[3] *Annual Book of ASTM Standards*, Vol 04.09.

been corrected out of the direct transmission method and any remaining bias is insignificant. The backscatter method is still more sensitive to the material within the first several inches from the surface.

4.3 Oversize rocks or large voids in the source-detector path may cause higher or lower density determination. Where lack of uniformity in the soil due to layering, rock or voids is suspected, the test volume site should be dug up and visually examined to determine if the test material is representative of the full material in general and if' rock correction (see 9.6) is required.

4.4 The sample volume is approximately 0.0028 m^3 (0.10 ft^3) for the Backscatter Method and 0.0057 m^3 (0.20 ft^3) for the Direct Transmission Method when the test depth is 15 cm (6 in.). The actual sample volume is indeterminate and varies with the apparatus and the density of the material. In general. the higher the density the smaller the volume.

5. Apparatus

5. 1 *Nuclear Gage*—An electronic counting instrument, capable of being seated on the surface of the material under test, and which contains:

5. I. 1 .A sealed source of high energy gamma radiation such as cesium or radium.

5. 1 .2 *Gamma* Detector-Any type of gamma detector such as a Geiger-Mueller tube(s).

5.2 Reference Standard-A block of material used for checking instrument operation and to establish conditions for a reproducible reference count rate.

5.3 Site Preparation Device-A plate, straightedge, or other suitable leveling tool which may be used for planning the test site to the required smoothness, and in the Direct Transmission Method, guiding the drive pin to prepare a perpendicular hole.

5.4 Drive Pin-A pin of slightly larger diameter than the rod in the Direct Transmission Instrument, used to prepare a hole in the material under test for inserting the rod.

5.5 Drive Pin Extractor-A tool that may be used to remove the drive pin in a vertical direction so that the pin will not distort the hole in the extraction process.

5.5.1 A slide hammer, with a drive pin attached, may also be used both to prepare a hole in the material to be tested and to extract the pin without distortion to the hole.

6. Hazards

6.1 This equipment utilizes radioactive materials that may be hazardous to the health of the users unless proper precautions are taken. Users of this equipment must become familiar with applicable safety procedures and government regulations.

6.2 Effective user instructions together with routine safety procedures, such as source leak tests, recording and evaluation of film badge data, etc., are a recommended part of the operation and storage of this instrument.

7. Calibration

7.1 Calibration of the instrument will be in accordance with Annex A I.

8. Standardization and Reference Check

8.1 Nuclear gages are subject to long-term aging of the radioactive source, detectors, and electronic systems, which may change the relationship between count rate and material density. To offset this aging, the gage may be calibrated as the ratio of the measured count rate to a count rate made on a reference standard or to an air-gap count (for the backscatter air-gap technique, see 9.5.1.3). The reference count rate should be of the same order of magnitude as the measured count rate over the useful density range of the instrument.

8.2 Standardization of the gage shall be performed at the start of each day's work, and a permanent record of these data shall be retained. Perform the standardization with the gage located at least 8 m (25 ft) away from other sources of radioactive material, and clear of large masses or other items which may affect the reference count rate.

8.2.1 If recommended by the instrument manufacturer to provide more stable and consistent results: (*1*) turn on the gauge prior to use to allow it to stabilize, (2) leave the power on during the use of the gage for that day.

8.2.2 Using the reference standard, take at least four repetitive readings at the normal measurement period and determine the mean. If available on the gage, one measurement period of four or more times the normal period is acceptable. This constitutes one standardization check.

8.2.3 If the value obtained above is within the limits stated below, the gage is considered to be in satisfactory condition, and the value may be used to determine the count ratios for the day of use. If the value is outside these limits, allow additional time for the gage to stabilize, make sure the area is clear of sources of interference, and then conduct another standardization check. If the second standardization check is within the limits, the gage may be used, but if it also fails the test, the gage shall be adjusted or repaired as recommended by the manufacturer. The limits are as follows:

$$|N_s - N_o| \leq 2.0 \sqrt{N_o/F} \quad (1)$$

where:

N_s = value of current standardization count,

N_o = average of the past four values of N_s taken for prior usage, and

F = value of prescale. [The prescale value (F) is a divisor which reduces the actual value for the purpose of display. The manufactor will supply this value if other than 1.0.] Some instruments may have provisions to compute and display these values.

8.2.3.1 If the instrument standardization has not been checked within the previous three months, perform at least four new standardization checks, and use the mean as the value for N_o.

8.3 Use the value of N_s to determine the count ratios for the current day's use of the instrument. If for any reason the measured density becomes suspect during the day's use, perform another standardization check.

9. Procedure for Field Use

9.1 Standardize the gage. (See Section 8.)

9.2 Select a test location. If the gage will be closer than 250 mm (10 in.) to any vertical mass that might influence the result, such as in a trench or alongside a pipe, follow the manufacturer's correction procedure.

9.3 Remove all loose and disturbed material. Remove

additional material as necessary to reach the material that represents a valid sample of the zone or stratum to be tested. Surface drying and spatial bias should be considered in determining the depth of material to be removed.

9.4 Plane or scrape a smooth horizontal surface so as to obtain maximum contact between the gage and the material being tested. The placement of the gage on the surface of the material to be tested is always important, but is especially critical to the successful determination of density when using the *backscatter* method. The optimum condition in all cases, is total contact between the bottom surface of the gauge and the surface of the material being tested. To correct for surface irregularities, use of native fines or fine sand as a filler may be necessary. The depth of the filler should not exceed approximately 3 mm (⅛ in.) and the total area filled should not exceed 10 % of the bottom area of the instrument. The maximum depth of any void beneath the gage that can be tolerated without filling shall not exceed approximately 3 mm (⅛ in.). Several trial seatings may be required to achieve these conditions.

9.5 Proceed with the test in the following manner:

9.5.1 Backscatter Procedure:

9.5.1.1 Seat the gage firmly on the prepared test site.

9.5.1.3 Keep all other radioactive sources away from the gauge to avoid affecting the measurement so as not to affect the readings.

9.5.1.3 Secure and record one or more readings for the normal measurement period in the backscatter position.

NOTE 2—When using the backscatter air-gap procedure, follow the instrument manufacturers instructions regarding apparatus set up. Take the same number of readings for the normal measurement period in the air-gap position as in the standard backscatter position. Determine the air-gap ratio by dividing counts per minute obtained in the air-gap position by counts per minute obtained in standard backscatter position.

9.5.1.4 Determine the ratio of the reading to the standard count or to rhe air gap count. From this count ratio and the appropriate calibration and adjustment data, determine the in-place wet density.

9.5.2 *Direct Transmission Procedure:*

9.5.2.1 Make a hole perpendicular to the prepared surface using the guide and the hole-forming device 5.4, or by drilling if necessary. The hole shall be of such depth and alignment rhat insertion of the probe will not cause the gage to tilt from the plane of the prepared area. The depth of the hole must be deeper than the depth to which the probe will be placed. The guide shall be the same size as the base of the gauge, with the hole in the same location on the guide as the probe on the gauge. The corners of the guide are marked by scoring the surface of the soil. The guide plate is then removed and any necessary repairs are made to the prepared surface.

9.5.2.2 Proceed with testing in the following manner:

9.5.2.3 Set the gage on the soil surface, carefully aligning it with the marks on the soil so that the probe will be directly over the pre-formed hole.

9.5.2.4 Insert the probe in the hole.

9.5.2.5 Seat the gage firmly by rotating it about the probe with a back and forth motion.

9.5.2.6 Pull gently on the gage in the direction that will bring the side of the probe against the side of the hole that is closest to the detector (or source) location in the gauge housing.

9.5.2.7 Keep all other radioactive sources away from the gage to avoid affecting the measurement.

9.5.2.8 Secure and record one or more readings for the normal measurement period.

9.5.2.9 Determine the ratio of the reading to the standard count. From this count ratio and the appropriate calibration and adjustment data, determine the in-place wet density.

NOTE 3—Some instruments have built-in provisions to compute the ratio, wet density, and to enter an adjustment bias. Additionally some instruments may have provisions to measure and compute moisture content, and dry density.

9.6 If the volume tested as defined in 4.4 has excess oversize material with respect to the limitations in the appropriate Test Methods D 698, D 1557 or D 4253, then a correction for wet density (unit weight) and water content must be applied. This correction will be done in accordance with Practice D 47 18. This test method requires sampling from the actual test volume.

9.6.1 If samples of the measure material are to be taken for purposes of correlation with other test methods or rock correction, the volume measured can be approximated by a 200 mm (8 in.) diameter cylinder located directly under the center line of the radioactive source and detector(s). The height of the cylinder to be excavated will be the depth setting of the source rod when using the Direct Transmission method or approximately 75 mm (3 in.) when using the Backscatter Method.

9.6.2 An alternative to the correction for oversize particles, that can be used with mass density methods or minimal oversize situations, involves multiple tests. Tests may be taken at adjacent locations and the results averaged to get a representative value. Comparisons need to be made to evaluate whether the presence of a single large rock or void in the soil is producing unrepresentative values of density. Whenever values obtained are questionable, the test volume site should be dug up and visually examined.

10. Calculation of Results

10.1 The in-place wet density is determined as outlined in 9.5. If dry density is required, the in-place water content shall be determined using either gravimetric samples and laboratory determination of water content (Test Methods D 2216, D 4643, D 4959, D 4944), or an instrument which determines water content by neutron thermalization (Test Method D 3017).

10.1.1 If the water content is determined by nuclear methods, Test Method D 3017, subtract the kg/m³ (lbf/ft³) of moisture from the kg/m³ (lbf/ft³) of wet density, and obtain dry density in kg/m³ (lbf/ft³).

10.1.2 If the water content is determined by other methods, and is in the form of percent, proceed as follows:

$$\rho_d = \frac{100\rho_m}{100 + w} \quad (2)$$

where:

ρ_d = dry density in kg/m³ (lbf/ft³),
ρ_m = wet density in kg/m³ (lbf/ft³), and
W = water as a percent of the dry mass.

11. Report

11.1 Report the following information:

11.1.1 Standardization and adjustment data for the date of the tests.

11.1.2 Make, model and serial number of the test instrument.

11.1.3 Name of the operator(s).

11.1.4 Test site identification.

11.1.5 Visual description of material tested.

11.1.6 Test mode (backscatter or direct transmission) and test depth (if applicable).

11.1.7 Wet and dry densities in kg/m^3 or unit weights in lb/ft^3.

11.1.8 Water content in percent of dry mass or dry unit weight.

12. Precision and Bias

12.1 *Precision:*

12.1.1 Precision-Criteria for judging the acceptability of wet density test results obtained by this test method are given in Table 1. The figure in column three represents the standard deviations that have been found to be appropriate for the materials tested in column one. The figures given in column four are the limits that should not be exceeded by the difference between the results of two properly conducted tests. The figures given are based upon an interlaboratory study in which five test sites containing soils, with wet densities as shown in column two were tested by eight different devices and operators. The wet density of each test site was determined three times by each device.[4]

12.1.2 An instrument count precision of 8 kg/m^3 (0.5 lbf/ft^3) for the Backscatter Method and 4 kg/m^3 (0.25 lbf/ft^3) Direct Transmission Method are typical on a material of approximately 2000 kg/m^3 (125 lbf/ft^3) density, with a measurement time of one minute.

[4] The data used to establish this precision statement is contained in a Research Report available from ASTM Headquarters. Request RR:D 18-1004.

TABLE 1 Results of Statistical Analysis

Precision and Soil Type	Average kg/m^3 (lb/ft^3)	Standard Deviation, kg/m^3 (lb/ft^3)	Acceptable Range of Two Results kg/m^3 (lb/ft^3)
Single Operator Precision:			
Direct Transmission:			
CL	1637 (114.7)	5.4 (0.34)	15.1 (0.94)
SP	1937 (120.9)	4.3 (0.27)	11.9 (0.74)
ML	2064 (130.1)	7.4 (0.46)	20.5 (1.28)
Backscatter:			
ML	1996 (124.6)	19.4 (1.21)	54.3 (3.39)
Multilaboratory Precision:			
Direct Transmission:			
a	1637 (114.7)	10.6 (0.66)	29.8 (1.66)
SP	1937 (120.9)	10.9 (0.66)	30.6 (1.91)
ML	2084 (130.1)	12.3 (0.77)	34.4 (2.15)
Backscatter:			
ML	1996 (124.6)	36.1 (2.36)	107 (6.67)

12.1.2.1 Instrument count precision is defined as the change in density that occurs corresponding to a one standard deviation change in the count due to the random decay of the radioactive source. The density of the material and the time period of the count must be stated. It may be determined from a series of 20 or more counts taken without moving the instrument, or alternately from the calibration data using the assumption that σ is equal to the $\sqrt{count}$ at that density. The count must be the true instrument count corrected for any pre-scaling (see 8.2.3).

$$P = \frac{\sigma}{S} \tag{3}$$

where:

P = instrument precision in density (kg/m^3 or lbf/ft^3)

σ = one standard deviation of the count

S = the slope of the calibration curve at the defined density value.

12.2 *Bias:*

12.2.1 There is no accepted reference value for this test method, therefore, bias cannot be determined.

13. Keywords

13.1 density; field density; nuclear methods

ANNEX

(Mandatory Information)

A1. CALIBRATION

A1.1 Verify or reestablish calibration curves, tables, or equation coefficients at least once every 12 to 18 months and after all major repairs which may affect the instrument geometry.

A1.2 The instrument shall be calibrated in such a way as to produce a calibration response within ± 16 kg/m^3 (± 1.0 lbf/ft^3) on blocks of materials (standards) of established densities. (This calibration may be done by the manufacturer, the user, or an independent vendor.) Nuclear instrument response is influenced by the chemical composition of measured material. This response must be taken into account in establishing the assigned standard block density. The densities of materials used to establish or verify the calibration should extend through a range representative of the density of the materials to be tested. The density of these material standards shall be determined to an accuracy of ± 0.2 %.

A1.3 Sufficient data shall be taken on each density standard to ensure an instrument count precision of at least one-half the instrument count precision required for field use. The data may be presented in the form of a graph, table, equation coefficients, or stored in the gauge, to allow covering the count rate data to material density.

A1.4 The method and test procedures used in establishing

the calibration count rate data shah be the same as those used for obtaining the field count rate data.

Al .5 The material type, actual density and assigned standard block density of each calibration standard used to establish or verify the instrument calibration shall be stated as part of the calibration data.

Al .6 The standards shah be of sufficient size to not change the count rate if enlarged in any dimension. Minimum surface dimensions of approximately 6 10 mm long by 430 mm wide (24 by 17 in.) have proven satisfactory. For the Backscatter Method a minimum depth of 230 mm (9 in.) is adequate; for the Direct Transmission Method the depth shah be at least 50 mm (2 in.) deeper than the deepest rod depth. A larger surface area may be required for the Backscatter Air-Gap technique. Minimum surface dimensions may be reduced slightly if the standards are adjacent to a dense material.

Al .7 The most successful standards that have been established for accurate calibration have been made of aluminum, magnesium, aluminum/magnesium, granite and limestone. These standards have been used in combination with each other and with historical curve information to produce accurate and reliable calibration.

Al .7.1 Standards of soil, rock, and concrete that have the characteristics of reproducible uniformity are difficult to prepare. These standards may be of use for some special calibration or field calibration where local site material chemistry or background situation require special adaptation.

The American Society for Testing and Materials takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, 100 Barr Harbor Drive, West Conshohocken, PA 19428.

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USACE / NAVFAC / AFCESA **UFGS-02770A (March 2004)**

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UNIFIED FACILITIES GUIDE SPECIFICATIONS

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SECTION 02770A

CONCRETE SIDEWALKS AND CURBS AND GUTTERS
03/04

****

NOTE: This guide specification covers the requirements for concrete sidewalks and curbs and gutters.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents**, including their organization designation and telephone number, is on the Internet.**

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR)**.**

Use of electronic communication is encouraged.

This guide specification includes tailoring options for sidewalks, and curbs and gutters. Selection or deselection of a tailoring option will include or exclude that option in the section, but editing the resulting section to fit the project is still required.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.

****

PART 1 GENERAL

****

AND=GUTTERS> s/public.html> AND=GUTTERS> s/public.html>NOTE: This specification may be adjusted to cover separate curbs and gutters or combination curbs and gutters. This guide specification will not be used for integral or

monolithic curbs of concrete pavement or for curbs and gutters for bridges.
****

1.1 REFERENCES

****
NOTE: Issue (date) of references included in project specifications need not be more current than provided by the latest guide specification.
****

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182	(1991; R 2000) Burlap Cloth Made from Jute or Kenaf

ASTM INTERNATIONAL (ASTM)

ASTM A 185	(2002) Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A 615/A 615M	(2003a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 143/C 143M	(2003) Slump of Hydraulic Cement Concrete
ASTM C 171	(2003) Sheet Materials for Curing Concrete
ASTM C 172	(1999) Sampling Freshly Mixed Concrete
ASTM C 173	(1994ael) Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 231	(2003) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 309	(2003) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 31/C 31M	(2003a) Making and Curing Concrete Test Specimens in the Field
ASTM C 920	(2002) Elastomeric Joint Sealants
ASTM D 1751	(1999) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

ASTM D 1752	(1984; R 1996e1) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 5893	(1996) Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements

1.2 MEASUREMENT FOR PAYMENT

****

NOTE: The MEASUREMENT FOR PAYMENT and BASIS FOR PAYMENT paragraphs will be deleted if the work covered by this section of the specifications is included in one lump-sum contract price for the entire work covered by the invitation for bids.

****

1.2.1 Sidewalks

The quantities of sidewalks to be paid for will be the number of square meters yards of each depth of sidewalk constructed as indicated.

AND=GUTTERS> s/public.html> AND=GUTTERS> s/public.html>1.2.2 Curbs and Gutters

The quantities of curbs and gutters to be paid for will be the number of linear meters feet of each cross section constructed as indicated, measured along the face of the curb at the gutter line.

1.3 BASIS FOR PAYMENT

1.3.1 Sidewalks

Payment of the quantities of sidewalks measured as specified will be at the contract unit price per square meter yard of the thickness specified.

AND=GUTTERS> s/public.html> AND=GUTTERS> s/public.html>1.3.2 Curbs and Gutters

Payment of the quantities of curbs and gutters measured as specified will be at the contract unit price per linear meter foot of each cross section.

1.4 SUBMITTALS

****

NOTE: Submittals must be limited to those necessary for adequate quality control. The importance of an item in the project should be one of the primary factors in determining if a submittal for the item should be required.

A “G” following a submittal item indicates that the

submittal requires Government approval. Some submittals are already marked with a “G”. Only delete an existing “G” if the submittal item is not complex and can be reviewed through the Contractor’s Quality Control system. Only add a “G” if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy projects.

Submittal items not designated with a "G" are considered as being for information only for Army projects and for Contractor Quality Control approval for Navy projects.

****

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Concrete

Copies of certified delivery tickets for all concrete used in the construction.

SD-06 Test Reports

Field Quality Control

Copies of all test reports within 24 hours of completion of the test.

1.5 WEATHER LIMITATIONS

1.5.1 Placing During Cold Weather

Concrete placement shall not take place when the air temperature reaches 5 degrees C 40 degrees F and is falling, or is already below that point.

Placement may begin when the air temperature reaches 2 degrees C 35 degrees F and is rising, or is already above 5 degrees C 40 degrees F. Provisions shall be made to protect the concrete from freezing during the specified curing period. If necessary to place concrete when the temperature of the air, aggregates, or water is below 2 degrees C 35 degrees F, placement and protection shall be approved in writing. Approval will be contingent upon full conformance with the following provisions. The underlying material shall be prepared and protected so that it is entirely free of frost when the concrete is deposited. [Mixing water and aggregates] [Mixing water] [Aggregates] shall be heated as necessary to result in the temperature of the in-place concrete being between 10 and 30 degrees C 50 and 85 degrees F. Methods and equipment for heating shall be approved. The aggregates shall be free of ice, snow, and frozen lumps before entering the mixer. Covering and other means shall be provided for maintaining the concrete at a temperature of at least 10 degrees C 50 degrees F for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period.

1.5.2 Placing During Warm Weather

The temperature of the concrete as placed shall not exceed 30 degrees C 85 degrees F except where an approved retarder is used. The mixing water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature. The placing temperature shall not exceed 35 degrees C 95 degrees F at any time.

1.6 PLANT, EQUIPMENT, MACHINES, AND TOOLS

1.6.1 General Requirements

Plant, equipment, machines, and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times. The equipment shall have the capability of producing the required product, meeting grade controls, thickness control and smoothness requirements as specified. Use of the equipment shall be discontinued if it produces unsatisfactory results. The Contracting Officer shall have access at all times to the plant and equipment to ensure proper operation and compliance with specifications.

AND=GUTTERS> s/public.html> AND=GUTTERS> s/public.html>1.6.2 Slip Form Equipment

Slip form paver or curb forming machine, will be approved based on trial use on the job and shall be self-propelled, automatically controlled, crawler mounted, and capable of spreading, consolidating, and shaping the plastic concrete to the desired cross section in 1 pass.

PART 2 PRODUCTS

2.1 CONCRETE

Concrete shall conform to the applicable requirements of [Section 03300A CAST-IN-PLACE STRUCTURAL CONCRETE] [Section 02753A CONCRETE PAVEMENT FOR AIRFIELDS AND OTHER HEAVY-DUTY PAVEMENTS] [Section 02754A CONCRETE

PAVEMENTS FOR SMALL PROJECT] except as otherwise specified. Concrete shall have a minimum compressive strength of 24 MPa 3500 psi at 28 days. Maximum size of aggregate shall be 37.5 mm 1-1/2 inches.

2.1.1 Air Content

****

NOTE: The air content specified is for concrete that will be subjected to freezing weather and the possible action of deicing chemicals. In climates where freezing is not a factor but where air entrainment is used in local commercial practice to improve the workability and placeability of concrete, concrete having air content percent of 4.5 plus or minus 1.5 percent may be specified as Contractor's option to non air-entrained concrete.

****

Mixtures shall have air content by volume of concrete of 5 to 7 percent, based on measurements made immediately after discharge from the mixer.

2.1.2 Slump

****

NOTE: The desired slump will be inserted. Suggested limits are 75 mm (3 inches) plus or minus 25 mm (1 inch) for hand placed concrete or 25 mm (1 inch) plus or minus 10 mm (1/2 inch) for slipformed concrete.

****

The concrete slump shall be 50 mm plus or minus 25 mm 2 inches plus or minus 1 inch where determined in accordance with ASTM C 143/C 143M.

2.1.3 Reinforcement Steel

****

NOTE: Reinforcement steel normally will not be required for curb and gutter construction. Where conditions exist that make it advantageous to use reinforcement steel, the reinforcing steel details will be indicated, and the following paragraphs will be included in the contract specification.

****

Reinforcement bars shall conform to ASTM A 615/A 615M. Wire mesh reinforcement shall conform to ASTM A 185.

2.2 CONCRETE CURING MATERIALS

2.2.1 Impervious Sheet Materials

Impervious sheet materials shall conform to ASTM C 171, type optional, except that polyethylene film, if used, shall be white opaque.

2.2.2 Burlap

Burlap shall conform to AASHTO M 182.

2.2.3 White Pigmented Membrane-Forming Curing Compound

White pigmented membrane-forming curing compound shall conform to ASTM C 309, Type 2.

2.3 CONCRETE PROTECTION MATERIALS

Concrete protection materials shall be a linseed oil mixture of equal parts, by volume, of linseed oil and either mineral spirits, naphtha, or turpentine. At the option of the contractor, commercially prepared linseed oil mixtures, formulated specifically for application to concrete to provide protection against the action of deicing chemicals may be used, except that emulsified mixtures are not acceptable.

2.4 JOINT FILLER STRIPS

AND=GUTTERS> s/public.html> AND=GUTTERS> s/public.html>2.4.1 Contraction Joint Filler for Curb and Gutter

Contraction joint filler for curb and gutter shall consist of hard-pressed fiberboard.

2.4.2 Expansion Joint Filler, Premolded

****

NOTE: Either type of joint sealer may be specified if determined necessary by the Contracting Officer and the inapplicable publication removed. Joint sealing material may be omitted where sealing of expansion joints is not deemed essential or advisable.

****

Expansion joint filler, premolded, shall conform to ASTM D 1751 or ASTM D 1752, 13 mm 1/2 inch thick, unless otherwise indicated.

2.5 JOINT SEALANTS

Joint sealant, cold-applied shall conform to ASTM C 920 or ASTM D 5893.

2.6 FORM WORK

Form work shall be designed and constructed to ensure that the finished concrete will conform accurately to the indicated dimensions, lines, and elevations, and within the tolerances specified. Forms shall be of wood or steel, straight, of sufficient strength to resist springing during depositing and consolidating concrete. Wood forms shall be surfaced plank, 50 mm 2 inches nominal thickness, straight and free from warp, twist, loose knots, splits or other defects. Wood forms shall have a nominal length of

3 m 10 feet. Radius bends may be formed with 19 mm 3/4 inch boards, laminated to the required thickness. Steel forms shall be channel-formed sections with a flat top surface and with welded braces at each end and at not less than two intermediate points. Ends of steel forms shall be interlocking and self-aligning. Steel forms shall include flexible forms for radius forming, corner forms, form spreaders, and fillers. Steel forms shall have a nominal length of 3 m 10 feet with a minimum of 3 welded stake pockets per form. Stake pins shall be solid steel rods with chamfered heads and pointed tips designed for use with steel forms.

2.6.1 Sidewalk Forms

Sidewalk forms shall be of a height equal to the full depth of the finished sidewalk.

AND=GUTTERS> s/public.html> AND=GUTTERS> s/public.html>2.6.2 Curb and Gutter Forms

Curb and gutter outside forms shall have a height equal to the full depth of the curb or gutter. The inside form of curb shall have batter as indicated and shall be securely fastened to and supported by the outside form. Rigid forms shall be provided for curb returns, except that benders or thin plank forms may be used for curb or curb returns with a radius of 3 m 10 feet or more, where grade changes occur in the return, or where the central angle is such that a rigid form with a central angle of 90 degrees cannot be used. Back forms for curb returns may be made of 38 mm 1-1/2 inch benders, for the full height of the curb, cleated together. In lieu of inside forms for curbs, a curb "mule" may be used for forming and finishing this surface, provided the results are approved.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

****

NOTE: On most projects, major grading operations involving excavation and construction of embankments will be performed and paid for under other sections of the specifications and, therefore, are not included in this guide specification. Where such work, including the construction of any required subbase, must be done under this section, paragraphs FORM SETTING, SIDEWALK CONCRETE PLACEMENT AND FINISHING, and CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING will be revised to cover necessary additional requirements. The subgrade will be indicated as extending at least 600 mm (2 feet) in width back of curb, gutter, entrance, and combination curb and gutters.

****

The subgrade shall be constructed to the specified grade and cross section prior to concrete placement. Subgrade shall be placed and compacted [as directed] [in conformance with Section [_____]].

3.1.1 Sidewalk Subgrade

The subgrade shall be tested for grade and cross section with a template extending the full width of the sidewalk and supported between side forms.

AND=GUTTERS> s/public.html> AND=GUTTERS> s/public.html>3.1.2 Curb and Gutter Subgrade

The subgrade shall be tested for grade and cross section by means of a template extending the full width of the curb and gutter. The subgrade shall be of materials equal in bearing quality to the subgrade under the adjacent pavement.

3.1.3 Maintenance of Subgrade

The subgrade shall be maintained in a smooth, compacted condition in conformity with the required section and established grade until the concrete is placed. The subgrade shall be in a moist condition when concrete is placed. The subgrade shall be prepared and protected to produce a subgrade free from frost when the concrete is deposited.

3.2 FORM SETTING

Forms shall be set to the indicated alignment, grade and dimensions. Forms shall be held rigidly in place by a minimum of 3 stakes per form placed at intervals not to exceed 1.2 m 4 feet. Corners, deep sections, and radius bends shall have additional stakes and braces, as required. Clamps, spreaders, and braces shall be used where required to ensure rigidity in the forms. Forms shall be removed without injuring the concrete. Bars or heavy tools shall not be used against the concrete in removing the forms. Any concrete found defective after form removal shall be promptly and satisfactorily repaired. Forms shall be cleaned and coated with form oil each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed, except that with probable freezing temperatures, oiling is mandatory.

3.2.1 Sidewalks

Forms for sidewalks shall be set with the upper edge true to line and grade with an allowable tolerance of 3 mm 1/8 inch in any 3 m 10 foot long section. After forms are set, grade and alignment shall be checked with a 3 m 10 foot straightedge. Forms shall have a transverse slope [as indicated] [of 20 mm per meter 1/4 inch per foot] with the low side adjacent to the roadway. Side forms shall not be removed for 12 hours after finishing has been completed.

AND=GUTTERS> s/public.html> AND=GUTTERS> s/public.html>3.2.2 Curbs and Gutters

The forms of the front of the curb shall be removed not less than 2 hours nor more than 6 hours after the concrete has been placed. Forms back of curb shall remain in place until the face and top of the curb have been finished, as specified for concrete finishing. Gutter forms shall not be

removed while the concrete is sufficiently plastic to slump in any direction.

3.3 SIDEWALK CONCRETE PLACEMENT AND FINISHING

3.3.1 Formed Sidewalks

Concrete shall be placed in the forms in one layer. When consolidated and finished, the sidewalks shall be of the thickness indicated. After concrete has been placed in the forms, a strike-off guided by side forms shall be used to bring the surface to proper section to be compacted. The concrete shall be consolidated with an approved vibrator, and the surface shall be finished to grade with a strike off.

3.3.2 Concrete Finishing

After straightedging, when most of the water sheen has disappeared, and just before the concrete hardens, the surface shall be finished with a wood float or darby to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. A scored surface shall be produced by brooming with a fiber-bristle brush in a direction transverse to that of the traffic, followed by edging.

3.3.3 Edge and Joint Finishing

All slab edges, including those at formed joints, shall be finished with an edger having a radius of 3 mm 1/8 inch. Transverse joint shall be edged before brooming, and the brooming shall eliminate the flat surface left by the surface face of the edger. Corners and edges which have crumbled and areas which lack sufficient mortar for proper finishing shall be cleaned and filled solidly with a properly proportioned mortar mixture and then finished.

3.3.4 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 8 mm 5/16 inch from the testing edge of a 3 m 10-foot straightedge. Permissible deficiency in section thickness will be up to 6 mm 1/4 inch.

AND=GUTTERS> s/public.html> AND=GUTTERS> s/public.html>3.4 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING

3.4.1 Formed Curb and Gutter

Concrete shall be placed to the section required in a single lift. Consolidation shall be achieved by using approved mechanical vibrators. Curve shaped gutters shall be finished with a standard curb "mule".

3.4.2 Curb and Gutter Finishing

Approved slipformed curb and gutter machines may be used in lieu of hand placement.

3.4.3 Concrete Finishing

Exposed surfaces shall be floated and finished with a smooth wood float until true to grade and section and uniform in texture. Floated surfaces shall then be brushed with a fine-hair brush with longitudinal strokes. The edges of the gutter and top of the curb shall be rounded with an edging tool to a radius of 13 mm 1/2 inch. Immediately after removing the front curb form, the face of the curb shall be rubbed with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The front curb surface, while still wet, shall be brushed in the same manner as the gutter and curb top. The top surface of gutter and entrance shall be finished to grade with a wood float.

3.4.4 Joint Finishing

Curb edges at formed joints shall be finished as indicated.

3.4.5 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 6 mm 1/4 inch from the testing edge of a 3 m 10-foot straightedge. Permissible deficiency in section thickness will be up to 6 mm 1/4 inch.

3.5 SIDEWALK JOINTS

Sidewalk joints shall be constructed to divide the surface into rectangular areas. Transverse contraction joints shall be spaced at a distance equal to the sidewalk width or 1.5 m 5 feet on centers, whichever is less, and shall be continuous across the slab. Longitudinal contraction joints shall be constructed along the centerline of all sidewalks 3 m 10 feet or more in width. Transverse expansion joints shall be installed at sidewalk returns and opposite expansion joints in adjoining curbs. Where the sidewalk is not in contact with the curb, transverse expansion joints shall be installed as indicated. Expansion joints shall be formed about structures and features which project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated. Expansion joints are not required between sidewalks and curb that abut the sidewalk longitudinally.

3.5.1 Sidewalk Contraction Joints

The contraction joints shall be formed in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-fourth of the sidewalk slab thickness, using a jointer to cut the groove, or by sawing a groove in the hardened concrete with a power-driven saw, unless otherwise approved. Sawed joints shall be constructed by sawing a groove in the concrete with a 3 mm 1/8 inch blade to the depth indicated. An ample supply of saw blades shall be available on the job before concrete placement is started, and at least one standby sawing unit in good working order shall be available at the jobsite at all times during the sawing operations.

3.5.2 Sidewalk Expansion Joints

****

NOTE: For projects which do not reference Section 02760A FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS, the last paragraph will replace the reference to Section 02760A.

****

Expansion joints shall be formed with 13 mm 1/2 inch joint filler strips. Joint filler in expansion joints surrounding structures and features within the sidewalk may consist of preformed filler material conforming to ASTM D 1752 or building paper. Joint filler shall be held in place with steel pins or other devices to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, joint edges shall be rounded with an edging tool having a radius of 3 mm 1/8 inch, and concrete over the joint filler shall be removed. At the end of the curing period, expansion joints shall be cleaned and filled with cold-applied joint sealant. Joint sealant shall be gray or stone in color. [Joints shall be sealed as specified in Section 02760A FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS.] [The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing material shall not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 10 degrees C 50 degrees F at the time of application of joint sealing material. Excess material on exposed surfaces of the concrete shall be removed immediately and concrete surfaces cleaned.]

3.5.3 Reinforcement Steel Placement

****

NOTE: Reinforcement steel normally will not be required for curb and gutter construction. Where conditions exist that make it advantageous to use reinforcement steel, the reinforcing steel details will be indicated, and the following paragraphs will be included in the contract specification.

****

Reinforcement steel shall be accurately and securely fastened in place with suitable supports and ties before the concrete is placed.

AND=GUTTERS> s/public.html> AND=GUTTERS> s/public.html>3.6 CURB AND GUTTER JOINTS

Curb and gutter joints shall be constructed at right angles to the line of curb and gutter.

3.6.1 Contraction Joints

Contraction joints shall be constructed directly opposite contraction joints in abutting portland cement concrete pavements and spaced so that

monolithic sections between curb returns will not be less than 1.5 m 5 feet nor greater than 4.5 m 15 feet in length. Contraction joints shall be constructed by means of 3 mm 1/8 inch thick separators and of a section conforming to the cross section of the curb and gutter. Separators shall be removed as soon as practicable after concrete has set sufficiently to preserve the width and shape of the joint and prior to finishing.

3.6.2 Expansion Joints

****

NOTE: For projects which do not reference Section 02760A FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS, the last paragraph will replace the reference to Section 02760A.

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Expansion joints shall be formed by means of preformed expansion joint filler material cut and shaped to the cross section of curb and gutter. Expansion joints shall be provided in curb and gutter directly opposite expansion joints of abutting portland cement concrete pavement, and shall be of the same type and thickness as joints in the pavement. Where curb and gutter do not abut portland cement concrete pavement, expansion joints at least 13 mm 1/2 inch in width shall be provided at intervals not less than 10 meters (30 feet) nor greater than 35 meters (120 feet). Expansion joints shall be provided in nonreinforced concrete gutter at locations indicated. Expansion joints shall be sealed immediately following curing of the concrete or as soon thereafter as weather conditions permit. [Joints shall be sealed as specified in Section 02760A FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS.] [Expansion joints and the top 25 mm 1 inch depth of curb and gutter contraction-joints shall be sealed with joint sealant. The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing material shall not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 10 degrees C 50 degrees F at the time of application of joint sealing material. Excess material on exposed surfaces of the concrete shall be removed immediately and concrete surfaces cleaned.]

3.7 CURING AND PROTECTION

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NOTE: Only the methods of curing appropriate to local weather conditions and construction practices will be retained, but Contractor's option of at least 2 curing methods will be retained to promote competition in bidding.

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3.7.1 General Requirements

Concrete shall be protected against loss of moisture and rapid temperature changes for at least 7 days from the beginning of the curing operation.

Unhardened concrete shall be protected from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready for use before actual concrete placement begins. Protection shall be provided as necessary to prevent cracking of the pavement due to temperature changes during the curing period.

3.7.1.1 Mat Method

The entire exposed surface shall be covered with 2 or more layers of burlap. Mats shall overlap each other at least 150 mm 6 inches. The mat shall be thoroughly wetted with water prior to placing on concrete surface and shall be kept continuously in a saturated condition and in intimate contact with concrete for not less than 7 days.

3.7.1.2 Impervious Sheeting Method

The entire exposed surface shall be wetted with a fine spray of water and then covered with impervious sheeting material. Sheets shall be laid directly on the concrete surface with the light-colored side up and overlapped 300 mm 12 inches when a continuous sheet is not used. The curing medium shall not be less than 450 mm 18-inches wider than the concrete surface to be cured, and shall be securely weighted down by heavy wood planks, or a bank of moist earth placed along edges and laps in the sheets. Sheets shall be satisfactorily repaired or replaced if torn or otherwise damaged during curing. The curing medium shall remain on the concrete surface to be cured for not less than 7 days.

3.7.1.3 Membrane Curing Method

A uniform coating of white-pigmented membrane-curing compound shall be applied to the entire exposed surface of the concrete as soon after finishing as the free water has disappeared from the finished surface. Formed surfaces shall be coated immediately after the forms are removed and in no case longer than 1 hour after the removal of forms. Concrete shall not be allowed to dry before the application of the membrane. If any drying has occurred, the surface of the concrete shall be moistened with a fine spray of water and the curing compound applied as soon as the free water disappears. Curing compound shall be applied in two coats by hand-operated pressure sprayers at a coverage of approximately 5 square meters/L 200 square feet per gallon for the total of both coats. The second coat shall be applied in a direction approximately at right angles to the direction of application of the first coat. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel and shall be free from pinholes or other imperfections. If pinholes, abrasion, or other discontinuities exist, an additional coat shall be applied to the affected areas within 30 minutes. Concrete surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied shall be resprayed by the method and at the coverage specified above. Areas where the curing compound is damaged by subsequent construction operations within the curing period shall be resprayed. Necessary precautions shall be taken to insure that the concrete is properly cured at sawed joints, and that no curing compound enters the joints. The top of the joint opening and the joint groove at exposed edges shall be tightly sealed before the concrete in the region of the joint is

resprayed with curing compound. The method used for sealing the joint groove shall prevent loss of moisture from the joint during the entire specified curing period. Approved standby facilities for curing concrete pavement shall be provided at a location accessible to the jobsite for use in the event of mechanical failure of the spraying equipment or other conditions that might prevent correct application of the membrane-curing compound at the proper time. Concrete surfaces to which membrane-curing compounds have been applied shall be adequately protected during the entire curing period from pedestrian and vehicular traffic, except as required for joint-sawing operations and surface tests, and from any other possible damage to the continuity of the membrane.

3.7.2 Backfilling

After curing, debris shall be removed and the area adjoining the concrete shall be backfilled, graded, and compacted to conform to the surrounding area in accordance with lines and grades indicated.

3.7.3 Protection

Completed concrete shall be protected from damage until accepted. The Contractor shall repair damaged concrete and clean concrete discolored during construction. Concrete that is damaged shall be removed and reconstructed for the entire length between regularly scheduled joints. Refinishing the damaged portion will not be acceptable. Removed damaged portions shall be disposed of as directed.

3.7.4 Protective Coating

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NOTE: Concrete may require protection against the action of urea, sodium chloride, and calcium chloride used for de-icing purposes. Protection against these chemicals is not required for concrete of the specified air content that will be in place for a cumulative time of 6 weeks at a continuous minimum temperature of 5 degrees C (40 degrees F), excluding the curing time. Concrete which is to receive protective coating should be moist cured to eliminate the need for removing a curing membrane prior to application of the protective coating. ACI Committee Report 515 provides a detailed discussion of protective coating for concrete. The following paragraphs will be inserted if protective coating is required.

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Protective coating, of linseed oil mixture, shall be applied to the exposed-to-view concrete surface after the curing period, if concrete will be exposed to de-icing chemicals within 6 weeks after placement. Concrete to receive a protective coating shall be moist cured.

3.7.4.1 Application

Curing and backfilling operation shall be completed prior to applying two coats of protective coating. Concrete shall be surface dry and clean before each application. Coverage shall be by spray application at not more than 11 square meters/L 50 square yards per gallon for first application and not more than 15.5 square meters/L 70 square yards per gallon for second application, except that the number of applications and coverage for each application for commercially prepared mixture shall be in accordance with the manufacturer's instructions. Coated surfaces shall be protected from vehicular and pedestrian traffic until dry.

3.7.4.2 Precautions

Protective coating shall not be heated by direct application of flame or electrical heaters and shall be protected from exposure to open flame, sparks, and fire adjacent to open containers or applicators. Material shall not be applied at ambient or material temperatures lower than 10 degrees C 50 degrees F.

3.8 FIELD QUALITY CONTROL

3.8.1 General Requirements

The Contractor shall perform the inspection and tests described and meet the specified requirements for inspection details and frequency of testing. Based upon the results of these inspections and tests, the Contractor shall take the action and submit reports as required below, and any additional tests to insure that the requirements of these specifications are met.

3.8.2 Concrete Testing

3.8.2.1 Strength Testing

The Contractor shall provide molded concrete specimens for strength tests. Samples of concrete placed each day shall be taken not less than once a day nor less than once for every 190 cubic meters 250 cubic yards of concrete. The samples for strength tests shall be taken in accordance with ASTM C 172. Cylinders for acceptance shall be molded in conformance with ASTM C 31/C 31M by an approved testing laboratory. Each strength test result shall be the average of 2 test cylinders from the same concrete sample tested at 28 days, unless otherwise specified or approved. Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength, and no individual strength test result falls below the specified strength by more than 4 MPa 500 psi.

3.8.2.2 Air Content

Air content shall be determined in accordance with ASTM C 173 or ASTM C 231. ASTM C 231 shall be used with concretes and mortars made with relatively dense natural aggregates. Two tests for air content shall be made on randomly selected batches of each class of concrete placed during each

shift. Additional tests shall be made when excessive variation in concrete workability is reported by the placing foreman or the Government inspector. If results are out of tolerance, the placing foreman shall be notified and he shall take appropriate action to have the air content corrected at the plant. Additional tests for air content will be performed on each truckload of material until such time as the air content is within the tolerance specified.

3.8.2.3 Slump Test

Two slump tests shall be made on randomly selected batches of each class of concrete for every 190 cubic meters 250 cubic yards, or fraction thereof, of concrete placed during each shift. Additional tests shall be performed when excessive variation in the workability of the concrete is noted or when excessive crumbling or slumping is noted along the edges of slip-formed concrete.

3.8.3 Thickness Evaluation

The anticipated thickness of the concrete shall be determined prior to placement by passing a template through the formed section or by measuring the depth of opening of the extrusion template of the curb forming machine. If a slip form paver is used for sidewalk placement, the subgrade shall be true to grade prior to concrete placement and the thickness will be determined by measuring each edge of the completed slab.

3.8.4 Surface Evaluation

The finished surface of each category of the completed work shall be uniform in color and free of blemishes and form or tool marks.

3.9 SURFACE DEFICIENCIES AND CORRECTIONS

3.9.1 Thickness Deficiency

When measurements indicate that the completed concrete section is deficient in thickness by more than 6 mm 1/4 inch the deficient section will be removed, between regularly scheduled joints, and replaced.

3.9.2 High Areas

In areas not meeting surface smoothness and plan grade requirements, high areas shall be reduced either by rubbing the freshly finished concrete with carborundum brick and water when the concrete is less than 36 hours old or by grinding the hardened concrete with an approved surface grinding machine after the concrete is 36 hours old or more. The area corrected by grinding the surface of the hardened concrete shall not exceed 5 percent of the area of any integral slab, and the depth of grinding shall not exceed 6 mm 1/4 inch. Pavement areas requiring grade or surface smoothness corrections in excess of the limits specified above shall be removed and replaced.

3.9.3 Appearance

Exposed surfaces of the finished work will be inspected by the Government

and any deficiencies in appearance will be identified. Areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which are otherwise inconsistent with the overall appearances of the work shall be removed and replaced.

-- End of Section --