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MEMORANDUM FOR MR. JAMES BEARZI, CHIEF
HAZARDOUS AND RADIOACTIVE MATERIALS BUREAU
NEW MEXICO ENVIRONMENT DEPARTMENT
PO BOX 26110
SANTA FE NM 87502

FROM: 377 ABW/EMR
2050 Wyoming Blvd SE, Ste 124
Kirtland AFB NM 87117-5270

SUBJECT: RCRA Corrective Action Document

1. We are forwarding one copy of the ICM Report for Site WP-26, Sewage Lagoons & Golf Course Pond (WP-26); AOC SS-79 , Building 381 Spill Site (SS-79); and AOC WP-87, GRABS Site Waste Pile (WP-87). The ICM at WP-26 is a pump and treat via land application (irrigation) project for nitrate-contaminated groundwater. At the AOCs, the ICMs consisted of excavation and disposal of contaminated soil. Included with this report is a copy in Word Perfect 5.2 on 3 ½" disc. Additional copies of the report without appendices are being forwarded to Ms. Julie Jacobs with the Groundwater Protection Bureau and Mr. David Cobrain of your staff.

2. Please contact me at (505) 846-0053 if you have any questions.

CHRISTOPHER B. DEWITT, R.P.G.
Chief, Restoration Branch
Environmental Management Division

Attachment:
ICM Report

cc:
NMED-HRMB (Mr. Cobrain) w/o appendices
NMED-GWPB (Ms. Jacobs) w/o appendices
EPA Region 6 (Ms. Morlock)
AFMC/CEVR (Mr. Wray) w/o attachment
AFMC/CEVC (Mr. Fort)
IT Corp (Ms. Jercinovic) w/o attachment
AFCEE/ERDM (Mr. Arnold) w/o attachment

TV1

Kirtland Air Force Base
Albuquerque, New Mexico

Interim Corrective Measures Report for Site WP-26, Golf Course Main Pond (WP-26), and Areas of Concern SS-79, Building 381 Spill Site (SS-79), and WP-87, GRABS Site Waste Pile (WP-87)

May 1999

377 ABW/EMR
2050 Wyoming Blvd. SE
Kirtland AFB, New Mexico 87117-5270

INSTALLATION RESTORATION PROGRAM
KIRTLAND AIR FORCE BASE, NEW MEXICO

INTERIM CORRECTIVE MEASURE REPORT FOR SITE WP-26, GOLF COURSE MAIN POND (WP-26) AND AREAS OF CONCERN SS-79, BUILDING 381 SPILL SITE (SS-79) AND WP-87, GRABS SITE WASTE PILE (WP-87)

MAY 1999

Prepared For
DEPARTMENT OF THE AIR FORCE
AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE
BROOKS AIR FORCE BASE, TEXAS

WORLDWIDE FULL SERVICE REMEDIAL
ACTION CONTRACT F41624-97-D-8012
DELIVERY ORDER 0001

Prepared By
Groundwater Technology, Inc.
A Member of the IT Group
5301 Central Avenue NE, Suite 700
Albuquerque, New Mexico 87108

NOTICE

This report has been prepared for the Air Force Center for Environmental Excellence by Groundwater Technology, Inc. (GTI), a member of the IT Group, for the purpose of summarizing the implementation of Interim Corrective Measures under the U.S. Air Force Installation Restoration Program (IRP) and the Environmental Compliance Program (ECP). As the report relates to actual or possible releases of potentially hazardous substances, its release prior to a final decision on corrective measures may be in the public's interest. The limited objectives of this report and the ongoing nature of the IRP and ECP, along with the evolving knowledge of site conditions and chemical effects on the environment and health, must be considered when evaluating this report, since subsequent facts may become known which may make this report premature or inaccurate.

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Kirtland Air Force Base,
Albuquerque, New Mexico
Interim Corrective Measure Report for Site WP-26, Golf Course Main Pond (WP-26), and Areas of Concern SS-79, Building 381 Spill Site (SS-79) and WP-87, GRABS Site Waste Pile (WP-87)

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Ms. Teresa Bennett and Ms. Cymantha Liakos

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Groundwater Technology, Inc.
A member of the IT Group
5301 Central Avenue, Suite 700
Albuquerque, New Mexico 87108

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

Department of the Air Force
Air Force Center for Environmental Excellence (AFCEE)
HSC/PKVBA
3207 North Road
Brooks AFB, TX 78235-5363
Technical Manager: Mr. Rod Arnold

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The Interim Corrective Measure Report describes the scope of work procedures implemented, and results found at three sites at Kirtland Air Force Base (AFB): AOC WP-87, GRABS Site Waste Pile (WP-87); AOC SS-79, Building 381 Spill Site (SS-79); and Site WP-26, Golf Course Main Pond (WP-26). The Interim Corrective Measures implemented at these sites included removal and disposal of the GRABS Site Waste Pile, excavation and disposal of impacted soils at the Building 381 Spill Site, and recovery of nitrate-contaminated groundwater at the Golf Course Main Pond. No further action is recommended for sites WP-87 and SS-79 based on residual concentrations of constituents in soils. The groundwater recovery activities at the Golf Course Main Pond will continue, and groundwater will be monitored under the Long-Term Groundwater Monitoring Program.

14. SUBJECT TERMS

Interim Corrective Measure Report for AOC WP-87, GRABS Site Waste Pile, AOC SS-79, Building 381 Spill Site(SS-79), and Site WP-26, Golf Course Main Pond (WP-26).

15. NUMBER OF PAGES
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CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based upon my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the submitted is to the best of my knowledge and belief true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of a fine and imprisonment for knowledge of violations.

James S. Leatherwood, GS-14
Director
Environmental Management Division

This document has been approved for public release.

Robert S. Milligan
Environmental Public Affairs Officer

PREFACE

The Interim Corrective Measure (ICM) Report summarizes the scope of work, procedures implemented, and results found at three sites at Kirtland Air Force Base (AFB): areas of concern (AOCs) WP-87, GRABS Site Waste Pile (WP-87) and SS-79, Building 381 Spill Site (SS-79) and Site WP-26, Golf Course Main Pond (WP-26). The ICMs conducted at these sites include removal and disposal of the GRABS Site Waste Pile, excavation and disposal of impacted soils at the Building 381 Spill Site, and recovery of nitrate-contaminated groundwater at the Golf Course Main Pond. This report contains copies of various site documentation (permits, photographs, analytical results, waste disposal certificates, etc.) as appendices.

This work was performed under the authority of the Air Force Center for Environmental Excellence (AFCEE), Worldwide Full Service Corrective Measures Contract F41624-07-D-8012. Mr. Rod Arnold, AFCEE, is the Technical Manager for this program.

The Remedial Program Manager for this program is Mr. Chris DeWitt of Kirtland AFB, Environmental Management Division. Mr. Mark Holmes is the Project Manager for Kirtland AFB. Mr. Ron Johnston of Groundwater Technology, Inc. (GTI), a member of the IT Group, is the AFCEE Program Manager. Ms. Cymantha Liakos of GTI is the Delivery Order Project Manager. The report was prepared by Ms. Teresa J. Bennett and Ms. Cymantha Liakos, with graphics by Mr. Ezekiel Carpio and administrative assistance from Ms. Kristine Cunningham, all of GTI.

K. Cunningham for

Teresa J. Bennett
GTI
Project Geologist

Cymantha D. Liakos

Cymantha D. Liakos
GTI
Delivery Order Project Manager

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ACRONYMS

AFB	Air Force Base
AFCEE	Air Force Center for Environmental Excellence
AGE	aerospace ground equipment
AOC	area of concern
Associated	Associated Laboratories
AWWA	American Water Works Association
bgs	below ground surface
BLM	Bureau of Land Management
BTEX	benzene, toluene, ethylbenzene, and xylenes
BWP	Base-Wide Plans
CE	Civil Engineering
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DQCR	daily quality control report
DoD	Department of Defense
DOE	Department of Energy
DOT	U.S. Department of Transportation
DRO	diesel range organics
ECP	Environmental Compliance Program
EPA	U.S. Environmental Protection Agency
FCR	field change request
FSP	Field Sampling Plan
ft	feet
gpd	gallons per day
gpm	gallons per minute
GRABS	Great Reusable Air Blast Simulator
GRO	gasoline range organics
HDPE	high density polyethylene
hp	horsepower
HRMB	Hazardous and Radioactive Materials Bureau
ICM	interim corrective measure
IDW	investigation derived waste
IDWMP	Investigation Derived Waste Management Plan
in	inch
IRP	Installation Restoration Program
LTM	Long-Term Groundwater Monitoring

ACRONYMS (Continued)

mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MSL	mean sea level
N	nitrogen
NA	not applicable
ND	not detected
NE	not established
NFA	no further action
NM	not measured
NMDOT	New Mexico Department of Transportation
NMED	New Mexico Environment Department
NMSEO	New Mexico State Engineers Office
NMSWMR	New Mexico Solid Waste Management Regulations
NMWQCC	New Mexico Water Quality Control Commission
NOI	Notice of Intent
NRDA	Natural Resource Damage Assessment
NRPM	Natural Resource Program Manager
PCB	polychlorinated biphenyl
PCP	Post-Closure Plan
PID	photoionization detector
POTW	publicly-owned treatment works
ppm	parts per million
psi	pounds per square inch
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
Quanterra	Quanterra Environmental Services
RCRA	Resource Conservation and Recovery Act (of 1976)
RFI	RCRA Facility Investigation
RL	reporting limit
SAP	Sampling and Analysis Plan
SNL	Sandia National Laboratory
SOP	standard operating procedure
SVOC	semivolatile organic compounds
SWMU	solid waste management unit
TAL	target analyte list
TCLP	Toxicity Characteristic Leaching Procedure
TOC	total organic carbon
TKN	total Kjeldahl nitrogen
TOX	total organic halogen
TPH	total petroleum hydrocarbons
TRPH	total recoverable petroleum hydrocarbons

ACRONYMS (Continued)

ug/kg	micrograms per kilogram
ug/L	micrograms per liter
USAF	United States Air Force
USFS	U.S. Forest Service
USFWS	U.S. Fish & Wildlife Service
UTL	upper tolerance limit
UV	ultraviolet
VOC	volatile organic compound

EXECUTIVE SUMMARY

This Interim Corrective Measure (ICM) Report summarizes the scope of work, procedures implemented, and results found at three sites at Kirtland Air Force Base (AFB), New Mexico. The Kirtland AFB Installation Restoration Program (IRP) and Environmental Compliance Program (ECP) are conducted under the regulatory authority of the New Mexico Environmental Department (NMED). The U. S. Environmental Protection Agency (EPA) Region 6 provides additional technical review and oversight. The three sites are two ECP sites identified as areas of concern (AOCs) SS-79, Building 381 Spill Site (SS-79) and WP-87, the Great Reusable Air Blast Simulator (GRABS) Site Waste Pile (WP-87), and IRP Site WP-26, Golf Course Main Pond (WP-26), which also includes the abandoned sewage lagoons. Soil excavation and disposal was the ICM for sites WP-87 and SS-79, and remediation of nitrate-contaminated groundwater is ongoing for WP-26.

The ICMs were conducted in accordance with the procedures described in the ICM Plan (USAF, 1998), with any deviations noted in the text. The Plan was finalized in late June 1998. Field work began in July 1998 with soil excavation and stockpiling at sites WP-87 and SS-79, pending receipt of analytical results of post excavation soil samples. The aquifer test was conducted on well KAFB-0609 at WP-26 in early August 1998. The location of the recovery well at WP-26 was selected, and the well was drilled, logged, installed, and developed between mid-September and mid-December 1998. Pond reconditioning was completed by the end of January 1999. Three of the four monitoring wells at WP-26 were converted to recovery wells in late January and February 1999. All field activities were complete, and the groundwater recovery system at WP-26 was activated by the end of February 1999.

Based on the post-excavation soil sample results for WP-87 and SS-79, no further action (NFA) was recommended for these sites. Concentrations of targeted compounds in soils were below NMED Hazardous and Radioactive Materials Bureau (HRMB) background concentrations (NMED, 1997) and/or below EPA Region 6 Soil Screening Levels (EPA, 1998). Continued operation, maintenance, and monitoring are recommended for the groundwater recovery system at WP-26. The lateral and vertical extent of elevated concentrations of nitrates in groundwater have not been fully defined at WP-26. The ICM, however, will capture nitrate-contaminated groundwater in the vicinity of the Golf Course Main Pond and recycle it for beneficial use (irrigation of the golf course).

The three sites in this ICM Report are not likely to require a Natural Resources Damage Assessment (NRDA). The corrective measures implemented provide a positive impact to the environment by limiting the amount of contamination that can enter the food chain. In addition, because of the arid climate and the location of the three sites in this report, there is a very low possibility of any surface water run-off or contaminated sediments that could damage aquatic resources. The vegetation and wildlife found on and near each of the three sites are common and widely dispersed over Kirtland AFB, so there would be no impact to biodiversity. Restricted access and limited planned development at Kirtland AFB have benefited biological resources.

1. INTRODUCTION

1.1 Objective

This Interim Corrective Measure (ICM) Report summarizes the scope of work, procedures implemented, and results found at three sites at Kirtland Air Force Base (AFB), New Mexico (Figure 1-1). The Kirtland AFB Installation Restoration Program (IRP) and Environmental Compliance Program (ECP) are conducted under the regulatory authority of the New Mexico Environment Department (NMED). The U.S. Environmental Protection Agency (EPA) Region 6 provides additional technical review and oversight. The three sites are the two ECP sites identified as areas of concern (AOCs) SS-79, Building 381 Spill Site (SS-79) and Great Reusable Air Blast Simulator (GRABS) Site Waste Pile (WP-87), and IRP Site WP-26, Golf Course Main Pond (WP-26), which also includes the abandoned sewage lagoons.

This report documents the ICMs implemented at sites WP-87, SS-79, and WP-26 between August 1998 and February 1999. The scope of work and procedures for the ICMs at each of the three sites were outlined in the ICM Plan (USAF, 1998), with any deviations noted in this report and documented in Field Change Requests (FCRs) contained in Appendix D. The ICMs at sites WP-87 and SS-79 entailed: excavation; stockpiling; post-excavation soil sampling and analysis; loading, transportation, and disposal at an approved facility; and backfilling or regrading. Post-excavation soil sample results from these sites were compared to the NMED Hazardous and Radioactive Materials Bureau (HRMB) approved background concentrations (NMED, 1997) and EPA Region 6 Soil Screening Levels (EPA, 1998). Based on these comparisons, no further action (NFA) was recommended for these sites.

The ICM at site WP-26 entailed: conducting a pump test to locate the recovery well; drilling, geophysical logging, installation, and development of a recovery well; waste characterization sampling of the soil in the Golf Course Main Pond; removal of vegetation, debris, and soil in the pond; grading, shaping and compaction of the pond; installation of a 40 mil high density polyethylene (HDPE) liner; landscaping of the sides of the pond with river rock; trenching and installation of water and electrical utilities from the recovery well and three groundwater monitoring wells; installation of submersible pumps in the recovery well and three groundwater monitoring wells; and replacement of the pump equipment in the pump house used to draw water from the pond to irrigate the golf course. Nitrate-contaminated groundwater is pumped from the wells to the pond and then used, along with water pumped from Production Well No. 4 to supply water to irrigate the golf course.

1.2 Document Purpose and Organization

The purpose of this report is to document the procedures used and results found from the implementation of ICMs at three sites: WP-87, SS-79, and WP-26. Under Executive Order 12898 and the National Environmental Policy Act, Kirtland AFB is required to address environmental justice issues as they pertain to the communities adjacent to Kirtland AFB. A demographic analysis of the off-base area potentially affected by activities at WP-87, SS-79, and WP-26 indicated that 34% of the population are minorities and 12% are low-income (SNL, 1997). However, because ICM activities at these sites will result in reducing human health and environmental risk from the contaminants identified at each site, there does not appear to be the potential for disproportionately impacting minority or low-income individuals near Kirtland AFB.

Section 2 of this document summarizes the ICM activities and the results found at each of the three sites. Section 3 contains the recommendations and conclusions. The appendices contain supporting documentation referenced in the report.

2. INTERIM CORRECTIVE MEASURE (ICM) ACTIVITIES

This section presents the background information, scope of work, and results of the ICM activities conducted for the three sites at Kirtland AFB: AOC SS-79, Building 381 Spill Site (SS-79), AOC WP-87, GRABS Site Waste Pile (WP-87), and IRP Site WP-26, Golf Course Main Pond (WP-26). The ICM activities consisted of removal of contaminated soil at sites SS-79 and WP-87 and remediation of contaminated groundwater at WP-26. A photographic record of the work conducted is presented in Appendix A. Daily Quality Control Reports (DQCRs) are provided in Appendix K.

2.1 Soil Removal at AOC WP-87, GRABS Site Waste Pile (WP-87)

2.1.1 Background

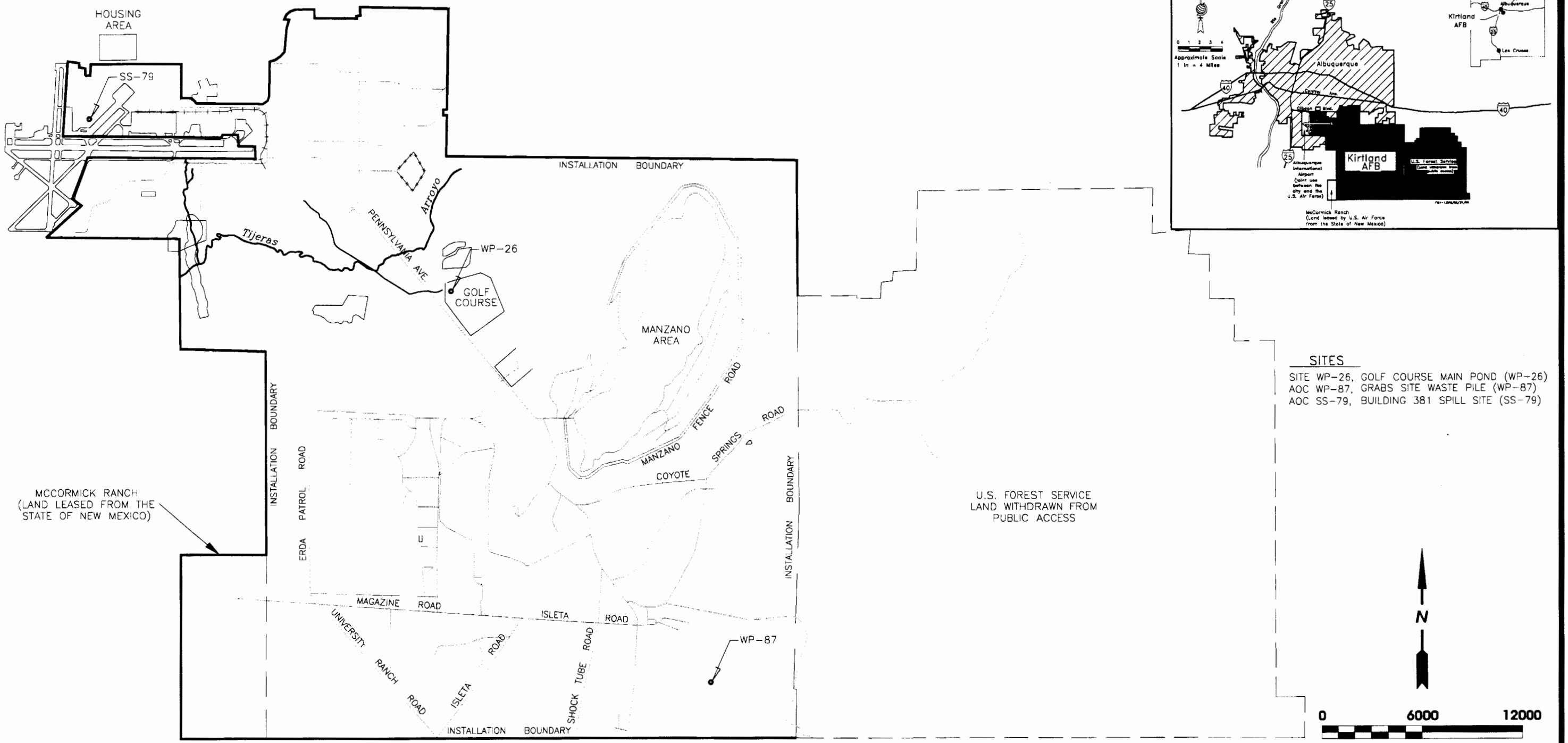
The AOC WP-87, GRABS Site Waste Pile (WP-87) is located in the southeastern region of the facility adjacent to the Shock Tube Research Facility (Figure 2-1). During its history, the site was part of a practice artillery range (1944-45) used for proximity fuse testing. More recently, the site was used as a high explosive air blast simulation testing unit during the 1980's. The area has not been used since that time due to reduced need for development of advanced nuclear and conventional missiles. The waste pile at WP-87 was located at the southeastern edge of the parking lot for the Shock Tube Facility. The pile was comprised of approximately 4 cubic yards of petroleum contaminated gravelly soil and approximately 30 cubic yards of concrete and other debris. The source of the contaminated soil was unknown but assumed to be from a spill or possibly a French drain.

An investigation to determine the nature and extent of contamination was conducted at WP-87 as part of a solid waste management unit (SWMU) assessment (USAF, 1995b). During this investigation, soil samples were collected and analyzed to determine the extent of impact. Table 2-1 summarizes the results of the waste pile sampling conducted by the base. WP-87 contained total petroleum hydrocarbons (TPH) ranging from 503 milligrams per kilogram (mg/kg) to 33,000 mg/kg. In addition, volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) were detected in the soil samples. However, only bis(2-ethylhexyl)phthalate at 52 mg/kg exceeded the EPA Region 6 risk based screening level for residential use (EPA, 1998) of 32 mg/kg. Several target analyte list (TAL) metals were detected in the waste pile soil samples, but none exceeded the NMED HRMB background concentrations, except for chromium, lead, and zinc. However, these concentrations are below the EPA Region 6 risk-based screening levels for residential soils. The base estimated that approximately 4 cubic yards of soil and 30 cubic yards of concrete debris would need to be removed to restore the area.

2.1.2 ICM Activities

2.1.2.1 Excavation

Prior to excavation, a base digging permit was obtained for the WP-87 area from the base Civil Engineering (CE) Squadron. A copy of the digging permit is provided in Appendix B. The area was also surveyed and cleared for the presence of any protected flora or fauna by the base Natural Resource Program Manager (NRPM). Soil excavation was conducted at WP-87 on August 31, 1998. Surface debris consisting of concrete, boards, wire, trash, etc., was initially cleared from the excavation site and stockpiled in a separate pile. The surface gravel and soil were then excavated using a small backhoe. A photoionization detector (PID) was used to screen the soil for relative concentrations of organic vapors and to guide the limits of excavation. Based upon the criteria set by the base, removal of soil from the bottom and sidewalls of the excavation was to proceed until the 0 parts per million (ppm) screening target level was obtained and visual



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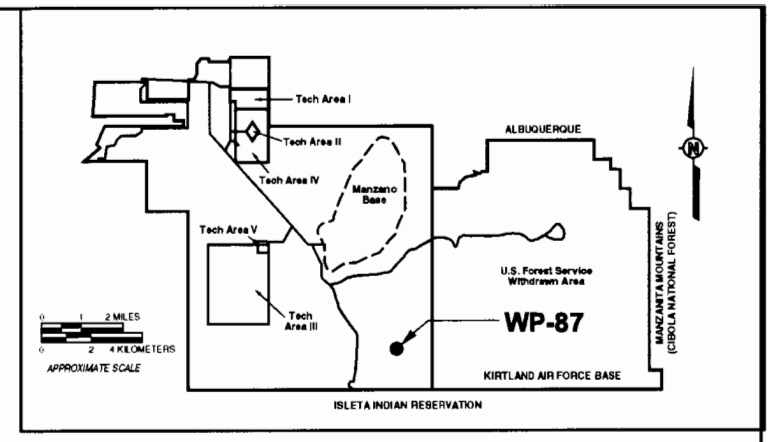
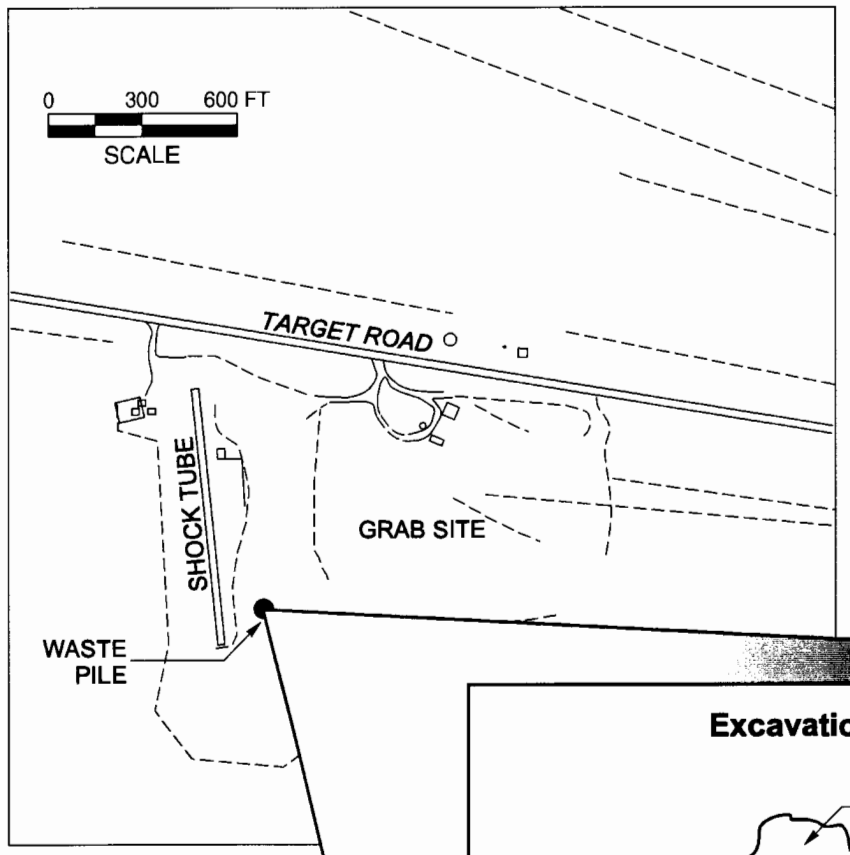
SITE LOCATION MAP

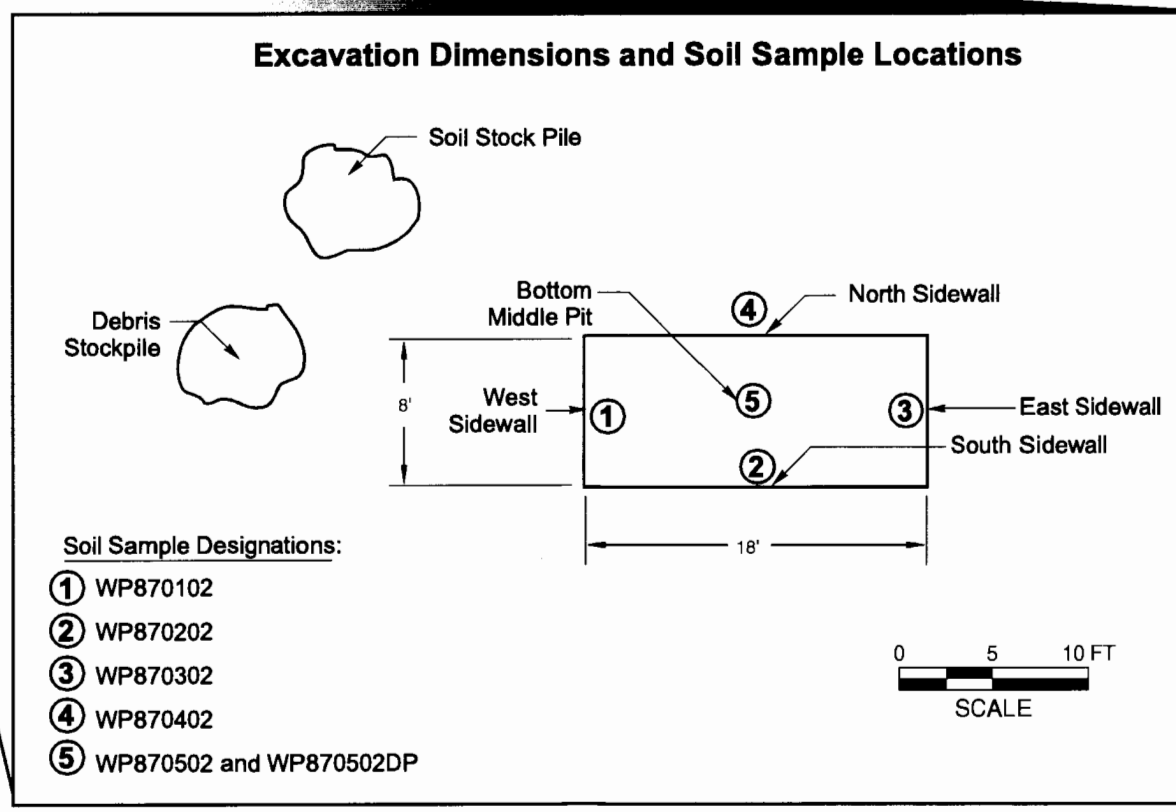
KIRTLAND AIR FORCE BASE

FIGURE 1-1



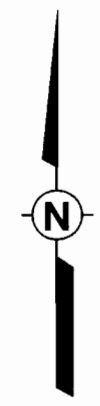


Excavation Dimensions and Soil Sample Locations



Soil Sample Designations:

1. WP870102
2. WP870202
3. WP870302
4. WP870402
5. WP870502 and WP870502DP



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SITE MAP
AOC WP-87, GRABS SITE WASTE PILE (WP-87)

KIRTLAND AIR FORCE BASE

FIGURE 2-1

Table 2-1. Previous Sample Results at AOC WP-87, GRABS Site Waste Pile (WP-87)

Parameter	Detection Limit	Result	NMED HRMB Maximum Background	EPA Region 6 Background	EPA Risk Based Screening Level
Sample ID: 9506081100 (Waste Pile Sample)					
Aluminum	25.0	6,880	NE	45,000	75,000
Boron	1.5	3.4	NE	2-100	4,900
Barium	0.5	141	214	430	5,200
Beryllium	0.02	0.40	0.65	0.5-2	150
Calcium	1.0	15,400	NE	NE	NE
Cadmium	0.15	0.87	0.9	0.01-1	37
Chromium	1.0	14.1	12.8	38	210
Cobalt	0.5	3.4	5.2	8	3,300
Copper	0.5	15.4	18.2	20	2,800
Iron	10.0	12,400	NE	NE	22,000
Lead	1.0	25.8	11.2	10-18	400
Magnesium	5.0	2,210	NE	NE	NE
Manganese	0.1	158	NE	389-850	3,100
Nickel	0.5	7.6	11.5	16	1,500
Potassium	5.0	1,150	NE	NE	NE
Sodium	10.0	174	NE	NE	NE
Vanadium	0.15	18.0	33	66	520
Zinc	5.0	253	62	22-50	22,000
Total petroleum hydrocarbons	5.0	33,300	NE	NE	NE
Acetone	0.005	0.14	NE	NE	1,400
bis(2-Ethylhexyl)phthalate	0.03	52.0	NE	NE	32
2-Butanone	0.005	0.067	NE	NE	6,900
4-Methyl-2-pentanone	0.005	0.046	NE	NE	NE

Table 2-1. Previous Sample Results at AOC WP-87, GRABS Site Waste Pile (WP-87) (Concluded)

Parameter	Detection Limit	Result	NMED HRMB Maximum Background	EPA Region 6 Background	EPA Risk Based Screening Level
Sample ID: 9506081115 (5 ft Depth Below Waste Pile)					
Aluminum	25.0	8,160	NE	45,000	75,000
Boron	1.5	6.8	NE	2-100	4,900
Barium	0.5	156	214	430	5,200
Beryllium	0.02	0.34	0.65	0.5-2	150
Calcium	1.0	52,100	NE	NE	NE
Chromium	1.0	8.9	12.8	38	210
Cobalt	0.5	3.3	5.2	8	3,300
Copper	0.5	5.5	18.2	20	2,800
Iron	10.0	9,200	NE	NE	22,000
Lead	1.0	13.7	11.2	10-18	400
Magnesium	5.0	5,920	NE	NE	NE
Manganese	0.1	142	NE	389-850	3,100
Nickel	0.5	8.0	11.5	16	1,500
Potassium	5.0	1,460	NE	NE	NE
Sodium	10.0	135	NE	NE	NE
Vanadium	0.15	29.0	33	66	520
Zinc	5.0	34.1	62	22-50	22,000
Acetone	0.050	0.030	NE	NE	1,400
bis(2-Ethylhexyl) phthalate	0.03	1.6	NE	NE	32
Total petroleum hydrocarbons	5.0	503	NE	NE	NE

1 All concentrations are in milligrams per kilogram.
2 NMED HRMB maximum background concentrations for subsurface soil for the Coyote Test Field Super Group from NMED, 1997.
3 EPA Region 6 background concentrations or range from EPA, 1998.
4 EPA screening levels are risk based screening levels for residential surface soil from EPA, 1998.

NMED HRMB New Mexico Environment Department Hazardous and Radioactive Materials Bureau
EPA U.S. Environmental Protection Agency
ft feet
NE not established

inspection indicated that excavation was complete. A final area approximately 8 feet (ft) by 18 ft by 2 ft deep was excavated (Figure 2-1). The excavated soil was placed on heavy gauge plastic (a double layer of 4 mil). The soil pile was bermed to a minimum height of 12 inches (in) using soil as indicated in the Excavation Plan of the ICM Plan. The stockpile was covered to prevent contact with precipitation and wind erosion and labeled with a nonhazardous material label pending analysis, in accordance with the Investigation-Derived Waste Management Plan (IDWMP). The completed excavation and soil stockpile were barricaded with temporary fencing and safety signs to prevent unauthorized access.

2.1.2.2 Soil Sampling and Analysis

Confirmation soil samples were collected from the excavation at the site to determine the completeness of soil removal. One grab soil sample was collected from each side wall and from the bottom of the excavation (total of five samples, WP870102 through WP870502), plus one duplicate sample from the bottom (Figure 2-1). All samples were collected from a depth of 2 ft below ground surface (bgs). In addition, a composite sample of the stockpiled soil (WP87SP01) was collected for waste characterization analysis. Soil samples were collected, handled, and field screened for headspace vapors in accordance with standard operating procedures (SOPs) presented in the Base-Wide Plans (BWP) (USAF, 1996) and the Sampling and Analysis Plan (SAP) of the ICM Plan. All soil samples were screened with a PID and the results for all samples were 0 ppm, except 0.2 ppm for the stockpile sample. The samples were submitted to Quanterra Environmental Services (Quanterra) in Arvada, Colorado, for laboratory analysis. The samples were analyzed for the parameters specified in Table 2-2.

The ICM Plan remediation goals for WP-87 were nondetectable TPH concentrations and metal concentrations below NMED HRMB background concentrations. Post-excavation results (Section 2.1.3) indicated that TPH and select metal concentrations exceeded remediation goals. However, following instruction from the base, the excavation was backfilled and no further excavation was conducted. A Field Change Request (FCR) (No. 003) for this deviation from cleanup goals is included in Appendix D. The excavation was backfilled to the surface on December 9, 1998 with clean, imported fill.

2.1.2.3 Transport and Disposal

The analytical results for the composite soil sample from the stockpile (WP87SP01) are included in Appendix C. The composite sample contained 231 mg/kg total recoverable petroleum hydrocarbons (TRPH). No benzene, toluene, ethylbenzene, and xylenes (BTEX), Toxicity Characteristic Leaching Procedure (TCLP) VOCs, SVOCs, pesticides, herbicides, or polychlorinated biphenyls (PCBs) were detected above the reporting limits (RLs) in the sample. The waste characterization sample analytical results indicated that the stockpile was characteristically nonhazardous and were used to complete a waste profile for the soil stockpile. The stockpile (approximately 12 cubic yards of soil) was transported offsite for disposal at the Waste Management Inc. facility in Rio Rancho, New Mexico, an approved Subtitle D facility. The soil was shipped under a straight bill-of-lading, in accordance with the project Transportation Plan of the ICM Plan, U.S. Department of Transportation (DOT) and the New Mexico Department of Transportation (NMDOT) requirements. A copy of the non-hazardous waste manifest is included in Appendix E. The trash and debris pile was disposed of at the Kirtland AFB Landfill and documentation is also included in Appendix E.

2.1.3 Nature and Extent of Contamination

Table 2-3 summarizes the analytical results for the ICM at WP-87. Laboratory data are contained in Appendix C. Concentrations of TPH-DRO for all samples collected from the WP-87 excavation except WP870202 were not detected above the RL. Soil sample WP870202 contained 23B mg/kg TPH-DRO. However, the associated method blank contained TPH-DRO at a reportable level (3.5J mg/kg), therefore qualifying the detection in the sample. No SVOCs were detected in the samples.

Table 2-2. Summary of Sampling Program, ICM at AOC WP-87, GRABS Site Waste Pile (WP-87), Kirtland AFB, NM

Site Location	Scope of Work	Analytical Parameters	Sampling Objective	Additional QA/QC Samples
AOC WP-87	Soil headspace VOC screening	SOP A3.12	Guide limits of excavation	NA
	5 grab soil samples from sides/ bottom of excavation	TPH-DRO by Method 8015B (M), TAL Metals by Methods 6010B/ 7000A/7471A, and SVOCs by Method 8270C	Confirmation of remedial goals.	1 - replicate 1 - equipment blank
	1 composite soil sample from stockpile	TRPH by Method 418.1, BTEX by Method 8021B, TCLP VOCs, SVOCs, Pesticides/ Herbicides by Methods 8260B, 8270C, and 8081A/ 8151A, respectively, PCBs by Method 8082, Ignitability, Corrossivity, Reactivity, and Free Liquid.	IDW characterization for disposal.	1 - trip blank per cooler (analyzed for VOCs only)

AFB	Air Force Base
AOC	area of concern
BTEX	benzene, toluene, ethylbenzene, and xylenes
DRO	diesel range organics
IDW	investigation derived waste
ICM	interim corrective measures
N	Nitrogen
NA	not applicable
PCBs	polychlorinated biphenyls
QA/QC	quality assurance/quality control
SOP	standard operating procedure
SVOCs	semivolatile organic compounds
TAL	target analyte list
TCLP	Toxicity Characteristic Leaching Procedure
TPH	total petroleum hydrocarbons
TRPH	total recoverable petroleum hydrocarbons
VOC	volatile organic compound

Table 2-3. Soil Sample Analytical Results, ICM at AOC WP-87, GRABS Site Waste Pile (WP-87), Kirtland AFB, NM

Analyte	NMED HRMB Maximum Background	WP870102	WP870202	WP870302	WP870402	WP870502/ WP870502DP
PID Field Reading (ppm)						
VOCs	NE	0	0	0	0	0/NM
TPH-DRO-EPA Method 8015 Modified (mg/kg)						
TPH-DRO	NE	ND<4.4	23B	ND<4.2	ND<4.3	2.8 J, B/4.1 J,B
SVOC-EPA Method 8270C (ug/kg)						
All analytes	NE	ND	ND	ND	ND	ND/ND
Total Metals - EPA Method 6010B/7471A (mg/kg)						
Mercury	<0.25	ND<0.036	ND<0.035	ND<0.034	ND<0.036	ND<0.035/ND<0.036
Silver	<1	ND<1.1	ND<1.1	ND<1.0	ND<1.1	ND<1.1/ND<1.1
Arsenic	5.6	**5.7**	4.1	**5.9**	5.0	3.9/3.9
Aluminum	NE	9,520	8,030	9,780	8,030	6,470/6,050
Lead	21.4	9.5	10.7	12.8	12.6	10.4/9.2
Barium	130	**187**	122	**263**	**177**	**134/177**
Selenium	<1	ND<0.55	ND<0.53	0.30J	ND<0.54	ND<0.53/ND<0.54
Beryllium	0.65	0.35	0.29	0.37	0.29	0.22/0.19J
Thallium	<1.1	0.86J	0.73J	0.58B	0.90J	0.97J/1.1
Calcium	NE	45,400	49,600	86,600	54,000	54,700/44,100
Cadmium	<1	ND<0.55	ND<0.53	ND<0.52	ND<0.54	ND<0.53/ND<0.54
Cobalt	5.2	3.7	3.5	4.5	3.3	3.3/3.0
Chromium	17.3	8.3	9.0	10.6	8.1	6.7/5.9
Copper	15.4	4.9	5.9	6.8	6.5	5.7/5.6
Iron	NE	9,330	9,330	10,200	9,050	8,820/7,660
Potassium	NE	1,860	1,530	1,790	1,410	1,230/1,100
Magnesium	NE	5,410	5,080	7,670	5,520	4,680/4,680
Manganese	NE	128	166	321	165	141/116
Sodium	NE	ND<549	ND<534	133J	ND<542	ND<528/ND<541
Nickel	11.5	9.3	10.1	10.2	8.6	7.9/7.2
Antimony	3.9	ND<6.6	**5.2J**	ND<6.3	ND<6.5	3.7J/**5.7J**
Vanadium	20.4	**44.1**	**25.1**	**25.1**	**30.3**	**21.4/22.3**
Zinc	62	25.5	31.8	29.8	26.3	26.9/21.5

FOOTNOTES

1	Shaded/bolded values indicate concentration met or exceeded the NMED HRMB maximum background concentration.
2	Sample depth = 2 ft below ground surface for all samples.
3	NMED HRMB maximum background concentrations for chemical constituents in soil for surface soils for the Coyote Test Field Super Group from NMED, 1997.
B	The associated method blank contains the target analyte at a reportable level.
J	Estimated result. Result is less than RL.
EPA	U.S. Environmental Protection Agency
mg/kg	milligrams per kilogram
ND	not detected
NE	not established
NM	not measured
NMED HRMB	New Mexico Environment Department Hazardous and Radioactive Materials Bureau
PID	photoionization detector
ppm	parts per million
SVOC	semivolatile organic compounds
TPH-DRO	total petroleum hydrocarbons-diesel range organics
ug/kg	micrograms per kilogram

Four metals were detected in the samples at concentrations exceeding the respective NMED HRMB maximum background values. Arsenic was detected in samples WP870102 and WP870302 at concentrations of 5.7 and 5.9 mg/kg, respectively, exceeding the NMED HRMB background concentration of 5.6 mg/kg. However, these detected concentrations are within the EPA Region 6 regional background range of 1.1 - 16.7 mg/kg for arsenic (EPA, 1998).

Barium was detected in all samples except WP870202 at concentrations ranging from 134 to 263 mg/kg, exceeding the NMED HRMB background concentration of 130 mg/kg. However, barium concentrations for these same samples are below the EPA regional background concentration of 430 mg/kg.

Antimony was detected in samples WP870202 and the duplicate sample from WP870502 at concentrations of 5.2J and 5.7J mg/kg, respectively, above the NMED HRMB background concentration of 3.9 mg/kg. Both results were estimated and below the RL. These results are also well below the EPA Region 6 risk based screening level for residential soil of 30 mg/kg for antimony.

All five soil samples analyzed from WP-87 contained vanadium concentrations in excess of the NMED HRMB background concentration of 20.4 mg/kg, with concentrations ranging from 21.4 to 44.1 mg/kg. However, these concentrations are below the EPA regional background concentration of 66 mg/kg for vanadium.

Based on the results of the ICM, the nature and extent of the soil contamination have been defined at the WP-87 GRABS Site Waste Pile. TPH-DRO was detected above the RL in only one sample from the excavation. However, the method blank associated with the sample detection also contained TPH-DRO, therefore qualifying the sample result. No SVOCs were detected in any of the confirmation soil samples. Arsenic, antimony, barium, and vanadium were detected in some of the samples at concentrations exceeding the corresponding NMED HRMB background concentrations. However, in all cases, the exceedances were below EPA Region 6 soil background or risk based screening values. Based on these results, NFA is recommended for the site, with respect to RCRA requirements; however, some minor additional excavation and solid waste removal followed by site restoration is warranted.

2.2 Soil Removal at AOC SS-79, Building 381 Spill Site (SS-79)

2.2.1 Background

The AOC SS-79, Building 381 Spill Site (SS-79) is located in a storage area northwest of Building 381. Building 381 contains the aerospace ground equipment (AGE) maintenance shop (Figure 2-2). Equipment used to support aircraft is repaired, maintained, and stored at this location. Currently, petroleum products such as lubricants and oils are stored in drums with secondary containment on the asphalt equipment parking surface near SS-79. The site contained visibly stained petroleum contaminated soil which is present in the parking surface median. The estimated amount of contaminated soil present at this location was 3 cubic yards.

An investigation to determine the nature and extent of contamination was conducted as part of the Appendix III Phase 2 Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) (USAF, 1995a) at SS-79. During this investigation, soil samples were collected and analyzed to determine the extent of impact. Table 2-4 summarizes the results of previous analyses conducted at SS-79. According to the Appendix III Phase 2 RFI report, the maximum TPH-DRO was 3,200 mg/kg in sample SS-79C-01 collected from 0 to 1 ft bgs. Sample SS-79C-06-2-4 (collected from 2 to 4 ft bgs) contained TPH-DRO at 6.3 mg/kg. All other samples were less than the detection limit. TPH-gasoline range organics (GRO) ranged between 0.021 mg/kg

Table 2-4. Previous Soil Sample Results at AOC SS-79, Building 381 Spill Site (SS-79)

Analyte	NMED HRMB Maximum Background [1]	EPA Region 6 Background Range [2]	EPA Region 6 Risk Based Screening Level [2]	Borehole Designation and Sample Depth Interval				
				SS-79C-01	SS-79C-02		SS-79C-03	
				0'-0'	2'-4'	7'-9'	2'-4'	7'-9'
VOCs (mg/kg)								
Acetone	NE	NE	1,400	0.03	0.017	<0.011	0.018	<0.011
Methyl ethyl ketone	NE	NE	6,900	<0.010	<0.012	<0.011	<0.012	<0.011
Methylene chloride	NE	NE	8.5	0.007	0.005	0.008	0.007	0.003
SVOCs (mg/kg)								
Benzoic acid	NE	NE	100,000	<41.0	<2.0	0.11	<1.8	<1.7
Benzyl butyl phthalate	NE	NE	NE	3.9	<0.21	<0.19	<0.19	<0.17
bis(2-Ethylhexyl)phthalate	NE	NE	32	35.0	0.14	0.053	0.046	0.072
Phenol	NE	NE	33,000	<16.0	0.34	0.71	0.058	0.66
Metals (mg/kg)								
Aluminum	NE	45,000	75,000	1,250	9,360	4,740	6,300	6,590
Antimony	3.9	NE	30	2.9	<0.15	<0.14	<0.15	<0.15
Arsenic	4.4	1.1-16.7	21	0.89	5.7	5.5	5.1	4.0
Barium	200	430	5,200	66.4	384	91.8	1,100	423
Beryllium	0.80	0.5-2	150	<0.070	0.42	0.27	0.29	0.40
Cadmium	0.9	0.01-1.0	37	0.71	<0.070	<0.070	<0.070	<0.080
Calcium	NE	NE	NE	4,740	178,000	67,200	135,000	14,000

Table 2-4. Previous Soil Sample Results at AOC SS-79, Building 381 Spill Site (SS-79) (Continued)

Analyte	NMED HRMB Maximum Background [1]	EPA Region 6 Background Range [2]	EPA Region 6 Risk Based Screening Level [2]	Borehole Designation and Sample Depth Interval				
				SS-79C-01	SS-79C-02		SS-79C-03	
				0'-0'	2'-4'	7'-9'	2'-4'	7'-9'
Metals (continued)								
Chromium, total	12.8	38	44	280	7.3	4.1	5.1	6.1
Cobalt	8.8	8	3,300	5.6	3.6	2.9	3.1	4.5
Copper	17	20	2,800	9.4	239	4.6	76.7	41.4
Iron	NE	NE	22,000	2,310	6,550	5,110	4,400	8,180
Lead	11.2	10-18	400	1,420	4.5	4.5	2.8	6.2
Magnesium	NE	NE	NE	1,550	7,450	3,390	6,450	3,970
Manganese	NE	389-850	3,100	59.8	77.2	67.2	50.2	213
Mercury	<0.1	0.10	NE	<0.020	0.02	<0.020	<0.020	<0.020
Nickel	25.4	16	1,500	5.5	6.3	3.3	4.7	5.9
Potassium	NE	NE	NE	319	1,310	684	810	1,190
Silver	<1	0.01-5	370	0.43	<0.070	<0.070	<0.070	0.40
Sodium	NE	NE	NE	111	91.7	63.0	116	211
Thallium	<1.1	NE	NE	<0.22	<0.22	<0.21	<0.22	0.44
Vanadium	33.0	66	520	3.9	24.1	23.2	19.2	25.8
Zinc	76	22-50	22,000	163	172	13.5	56.3	54.0

Table 2-4. Previous Soil Sample Results at AOC SS-79, Building 381 Spill Site (SS-79) (Continued)

Analyte	NMED HRMB Maximum Background [1]	EPA Region 6 Background Range [2]	EPA Region 6 Risk Based Screening Level [2]	Borehole Designation and Sample Depth Interval				
				SS-79C-01	SS-79C-02		SS-79C-03	
				0'-0'	2'-4'	7'-9'	2'-4'	7'-9'
TPH (mg/kg)								
Diesel fraction	NE	NE	NE	3,200	<13.0	<11.0	<12.0	<11.0
Gasoline fraction	NE	NE	NE	NA	0.241	0.021	0.124	0.156
OTHER								
Moisture %	NE	NE	NE	NA	18.6	8.8	11.9	10.1
pH	NE	NE	NE	NA	8.04	8.22	8.11	8.31

Table 2-4. Previous Soil Sample Results at AOC SS-79, Building 381 Spill Site (SS-79) (Continued)

Analyte	NMED HRMB Maximum Background [1]	EPA Region 6 Background Range [2]	EPA Region 6 Risk Based Screening Level [2]	Borehole Designation and Sample Depth Interval						
				SS-79C-04		SS-79C-05		SS-79C-06		
				2'-4'	7'-9'	2'-4'	7'-9'	2'-4'	2'-4'FR	7'-9'
VOCs (mg/kg)										
Acetone	NE	NE	1,400	<0.012	<0.010	0.013	0.005	0.013	<0.012	<0.011
Methyl ethyl ketone	NE	NE	6,900	<0.012	<0.010	0.013	<0.011	<0.012	<0.012	<0.011
Methylene chloride	NE	NE	8.5	0.014	0.007	0.013	0.008	0.003	0.004	0.003
SVOCs (mg/kg)										
Benzoic acid	NE	NE	100,000	<1.9	<1.8	0.10	<1.7	<1.7	<1.7	0.083
Benzyl butyl phthalate	NE	NE	NE	<0.19	0.046	<0.18	<0.17	<0.18	<0.18	<0.18
bis(2-Ethylhexyl)phthalate	NE	NE	32	0.14	0.12	<0.18	0.21	0.11	0.052	0.062
Phenol	NE	NE	33,000	2.4	2.2	0.11	0.14	0.89	0.31	1.5
Metals (mg/kg)										
Aluminum	NE	45,000	75,000	3,270	8,870	4,520	6,400	3,070	4,360	8,090
Antimony	3.9	NE	30	<0.15	<0.15	<0.17	<0.14	<0.14	<0.14	<0.14
Arsenic	4.4	1.1-16.7	21	2.5	5.6	2.4	4.2	2.7	2.0	5.1
Barium	200	430	5,200	198	259	63.5	215	344	63.5	34.0
Beryllium	0.80	0.5-2	150	0.21	0.54	0.28	0.32	0.20	0.27	0.47
Cadmium	0.9	0.01-1.0	37	<0.070	<0.070	<0.080	<0.070	<0.070	<0.070	<0.070
Calcium	NE	NE	NE	125,000	29,900	23,200	41,400	94,000	22,000	20,600

Table 2-4. Previous Soil Sample Results at AOC SS-79, Building 381 Spill Site (SS-79) (Continued)

Analyte	NMED HRMB Maximum Background [1]	EPA Region 6 Background Range [2]	EPA Region 6 Risk Based Screening Level [2]	Borehole Designation and Sample Depth Interval						
				SS-79C-04		SS-79C-05		SS-79C-06		
				2'-4'	7'-9'	2'-4'	7'-9'	2'-4'	2'-4'FR	7'-9'
Metals (continued)										
Chromium, total	12.8	38	44	3.0	7.6	4.8	8.2	2.7	3.7	7.9
Cobalt	8.8	8	3,300	2.0	5.3	2.5	3.3	1.8	1.9	4.7
Copper	17	20	2,800	42.1	47.9	15.3	42.9	69.2	6.8	14.7
Iron	NE	NE	22,000	2,680	10,100	5,860	8,040	2,760	4,160	10,800
Lead	11.2	10-18	400	2.2	8.1	4.5	4.2	2.6	3.4	7.6
Magnesium	NE	NE	NE	2,050	5,190	2,030	3,840	1,940	1,780	4,500
Manganese	NE	389-850	3,100	33.1	257	89.3	129	38.4	50.1	246
Mercury	<0.1	0.10	NE	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Nickel	25.4	16	1,500	3.2	8.1	4.0	6.2	2.9	3.4	7.2
Potassium	NE	NE	NE	651	1,820	924	1,200	617	872	1,640
Silver	<1	0.01-5	370	<0.070	0.27	0.21	0.15	<0.070	0.20	0.35
Sodium	NE	NE	NE	67.9	309	56.2	82.5	100	75.9	268
Thallium	<1.1	NE	NE	<0.22	0.30	<0.25	<0.21	<0.21	<0.21	0.41
Vanadium	33.0	66	520	10.2	34.9	14.5	27.1	9.9	10.0	34.6
Zinc	76	22-50	22,000	31.2	64.9	24.0	31.2	39.8	11.6	34.8

Table 2-4. Previous Soil Sample Results at AOC SS-79, Building 381 Spill Site (SS-79) (Concluded)

Analyte	NMED HRMB Maximum Background [1]	EPA Region 6 Background Range [2]	EPA Region 6 Risk Based Screening Level [2]	Borehole Designation and Sample Depth Interval						
				SS-79C-04		SS-79C-05		SS-79C-06		
				2'-4'	7'-9'	2'-4'	7'-9'	2'-4'	2'-4'FR	7'-9'
TPH (mg/kg)										
Diesel fraction	NE	NE	NE	<12.0	<11.0	<11.0	<10.0	6.3	<11.0	<11.0
Gasoline fraction	NE	NE	NE	0.097	0.071	0.034	0.127	0.26	0.186	0.206
OTHER										
Moisture %	NE	NE	NE	9.5	11.2	19.4	8.7	11.0	5.2	9.2
pH	NE	NE	NE	8.2	8.41	8.12	8.4	8.01	7.93	8.19

1 Maximum background values for subsurface soils from the North Super Group from NMED, 1997.
2 Background range and residential risk based soil screening values from EPA, 1998.

EPA U.S. Environmental Protection Agency
mg/kg milligrams per kilogram
NA not analyzed
NE not established
NMED HRMB New Mexico Environment Department Hazardous and Radioactive Materials Bureau
SVOC semivolatile organic compounds
TPH total petroleum hydrocarbons
VOC volatile organic compounds

to 0.260 mg/kg. In addition, VOCs and metals were detected in soil samples from the stained areas. Three VOCs, acetone, methyl ethyl ketone, and methylene chloride, and four SVOCs, benzoic acid, benzyl butyl phthalate, bis(2-ethylhexyl)phthalate, and phenol, were detected in the soil samples. All VOCs and SVOCs were detected in subsurface samples at concentrations significantly less than EPA risk based screening levels.

Several TAL metals were detected in the soil samples. Arsenic was detected in five samples above the NMED HRMB background concentration of 4.4 mg/kg, all of which were within the EPA Region 6 background range of 1.1-16.7 mg/kg. Barium was detected in six samples above the NMED HRMB background concentration of 200 mg/kg, only one of which also exceeded the EPA Region 6 background concentration of 430 mg/kg (1,100 mg/kg in SS-79C-03, 2-4'). Chromium in one sample, SS-79C-01 (at 280 mg/kg), exceeded both the NMED HRMB background concentration of 12.8 mg/kg and the EPA Region 6 background concentration of 38 mg/kg. Copper exceeded both the NMED HRMB background concentration of 17 mg/kg and the EPA Region 6 background concentration of 20 mg/kg in seven soil samples. Lead in SS-79C-01 (at 1,420 mg/kg) exceeded the NMED HRMB background concentration of 11.2 mg/kg and the EPA Region 6 background range of 10-18 mg/kg. Vanadium exceeded the NMED HRMB background concentration of 33 mg/kg in two samples, but both were below the EPA Region 6 background concentration of 66 mg/kg. Zinc exceeded the NMED HRMB background concentration of 76 mg/kg in two samples and exceeded the EPA Region 6 background range of 22-50 mg/kg in five samples. All metal concentrations detected in soil samples, however, were below EPA Region 6 risk based screening levels for residential soils except for the chromium and lead in sample SS-79C-01.

Based upon these results and assuming that TPH contamination was 1 ft deep, it was estimated that approximately 3 cubic yards of soil would need to be excavated to remove contaminated soil.

2.2.2 ICM Activities

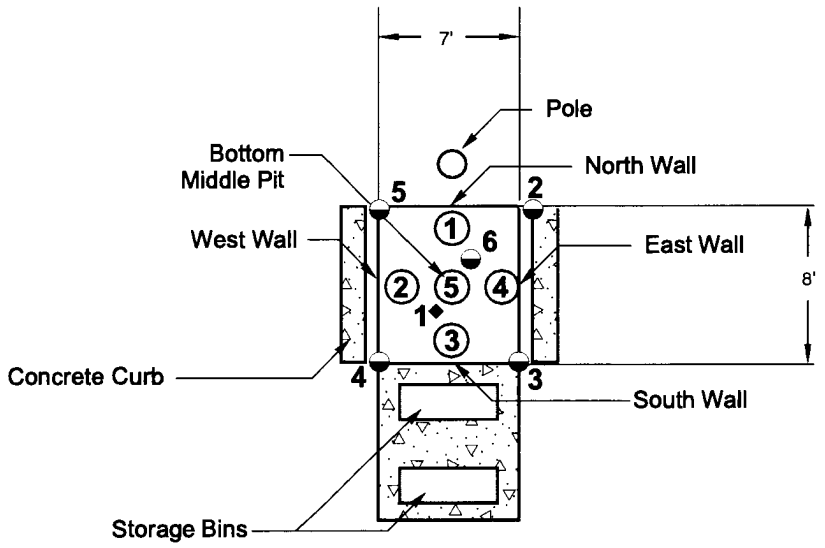
2.2.2.1 Excavation

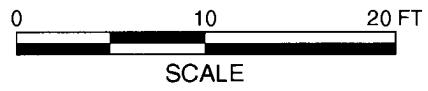
Prior to excavation, a base digging permit was obtained for the SS-79 area from the base CE Squad. A copy of the digging permit is provided in Appendix B. The area was also surveyed and cleared for the presence of any protected flora or fauna by the base NRPM. Soil excavation was conducted at SS-79 on September 1, 1998. The surface asphalt, gravel, and soil were excavated using a small backhoe. The excavated soil at the site was placed on heavy gauge plastic (a double layer of 4 mil). The soil pile was bermed to a minimum height of 12 in using soil as indicated in the Excavation Plan of the ICM Plan. The stockpile was covered to prevent contact with precipitation and wind erosion and labeled with a nonhazardous material label pending analysis, in accordance with the IDWMP. The completed excavation and soil stockpile were barricaded with temporary fencing and safety signs to prevent unauthorized access.

A PID was used to screen the soil for relative concentrations of organic vapors and to guide the limits of excavation. Based upon the criteria set by the base, removal of soil from the bottom and sidewalls of the excavation was to proceed until the 0 ppm screening target level was obtained and visual inspection indicated that excavation was complete. After approximately 3 cubic yards were removed, stained soil was still observed in the excavation, and PID readings of 362 to 482 ppm were obtained from samples collected from the west, south, and east side walls. At the direction of Kirtland AFB, no further excavation was conducted beyond the original scope. A final area approximately 8 ft by 7 ft by 3 ft deep was excavated (Figure 2-2).

The ICM Plan remediation goals for SS-79 were nondetectable TPH concentrations and metal concentrations below NMED HRMB background concentrations. Post-excavation results (Section 2.2.3) indicated that TPH and select metal concentrations exceeded remediation goals. However, following instruction from the base, the excavation was backfilled and no further excavation was conducted. A FCR (No. 003) for this deviation

Excavation Dimensions and Soil Sample Locations



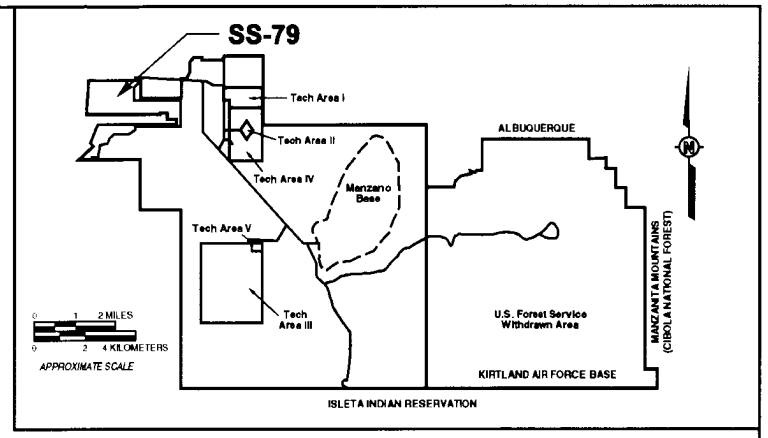


Pre-Excavation Soil Sample Locations:

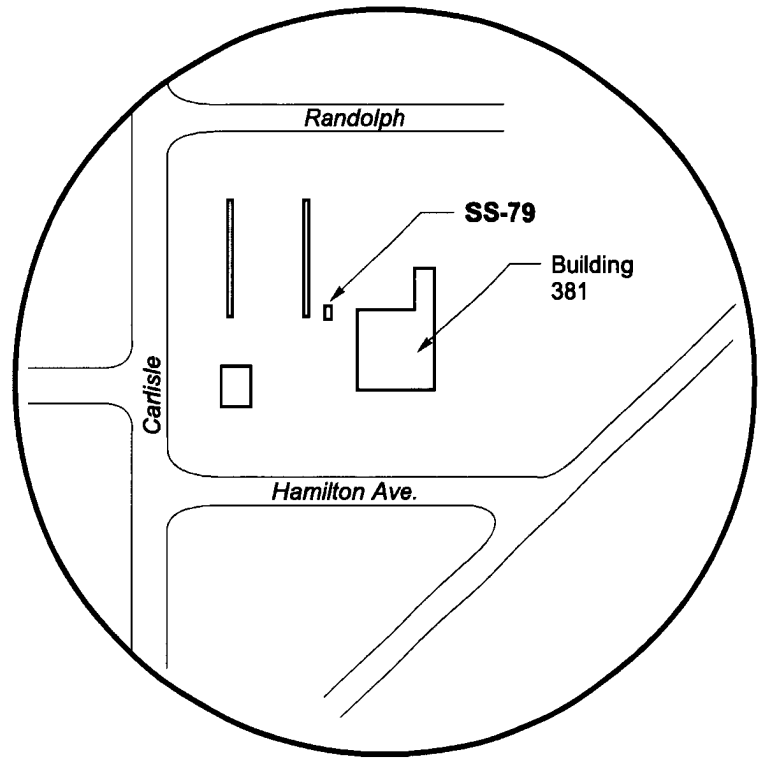
1 ◆ SS-79C-01 (surface sample location)
2 ◒ SS-79C-02 (geoprobe sample location)
3 ◒ SS-79C-03 (geoprobe sample location)
4 ◒ SS-79C-04 (geoprobe sample location)
5 ◒ SS-79C-05 (geoprobe sample location)
6 ◒ SS-79C-06 (geoprobe sample location)

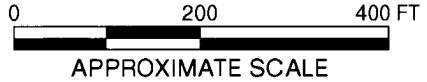
Post-Excavation Soil Sample Locations:

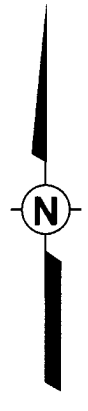
① SS790102
② SS790202 and SS790202DP
③ SS790302
④ SS790402
⑤ SS790502



Building 381







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NOTED	5-1-98	87585901.02.72.00.00 B3

SITE MAP
AOC SS-79, BUILDING 381 SPILL SITE (SS-79)

KIRTLAND AIR FORCE BASE

FIGURE 2-2

from cleanup goals is included in Appendix D. The excavation was backfilled to the surface on December 9, 1998 with clean, imported fill. The fill was compacted and Proctor tested. A final compaction of 95.7% was achieved.

2.2.2.2 Soil Sampling and Analysis

Confirmation soil samples were collected from the excavation at the site to determine the completeness of soil removal. One grab soil sample was collected from each side wall and from the bottom of the excavation (total of five samples, SS790102 through SS790402, and SS790503) plus one duplicate sample from the west side wall (Figure 2-2). All samples were collected from a depth of 2 ft bgs except the bottom sample which was collected from a depth of 3 ft. In addition, a composite sample of the stockpiled soil (SS79SP01) was collected for waste characterization analysis. Soil samples were collected, handled, and field screened for headspace vapors in accordance with SOPs presented in the BWP (USAF, 1996) and the SAP of the ICM Plan. The samples were submitted to Quanterra for laboratory analysis. The samples were analyzed for the parameters specified in Table 2-5.

2.2.2.3 Transport and Disposal

The analytical results for the composite soil sample from the stockpile (SS79SP01) are included in Appendix C. The composite sample contained 223 mg/kg TRPH. No BTEX, TCLP VOCs, SVOCs, pesticides, herbicides, or PCBs were detected above the RLs in the sample. The waste characterization sample analytical results indicated that the stockpile was characteristically nonhazardous and were used to complete a waste profile for the soil stockpile. The stockpile (approximately 10 cubic yards of soil) was transported offsite for disposal at the Waste Management Inc. facility in Rio Rancho, New Mexico, an approved Subtitle D facility. The soil was shipped under a straight bill-of-lading, in accordance with the project Transportation Plan of the ICM Plan, U.S. DOT and the NMDOT requirements. A copy of the non-hazardous waste manifest is included in Appendix E.

2.2.3 Nature and Extent of Contamination

Table 2-6 summarizes the analytical results for the ICM at SS-79. Concentrations of TPH-DRO for all samples collected from the SS-79 excavation ranged from not detected to 4,200B mg/kg. TPH-DRO concentrations exceeding 100 mg/kg included the duplicate sample collected from the west side wall (SS790202DP) (3,200B mg/kg), the south side wall sample (SS790302) (4,200B mg/kg), and the east side wall sample (SS790402) (140B mg/kg). Method blank contamination (3.5J mg/kg) was also associated with most samples. No SVOCs were detected in the samples, except 340 and 560 micrograms per kilogram (ug/kg) 2-methylnaphthalene in samples SS790202 and SS790202DP, respectively. These concentrations are well below the EPA Region 6 risk based screening level for residential soil of 55 mg/kg for naphthalene.

Two metals were detected in the samples at concentrations meeting or exceeding the respective NMED HRMB maximum background values. Antimony was detected in sample SS790402 at a concentration of 4.3J mg/kg, exceeding the NMED HRMB background concentration of 3.9 mg/kg. However, the detection in the sample is an estimated result, below the laboratory RL. This detection is also well below the EPA Region 6 risk based screening level for residential soil of 30 mg/kg for antimony. Thallium was detected in all samples except SS790202DP and SS790402 at concentrations ranging from 1.1 to 1.4 mg/kg, meeting or exceeding the NMED HRMB background concentration of <1.1 mg/kg. There is no established EPA regional background concentration or risk based screening level for thallium.

Table 2-5. Summary of Sampling Program, ICM at AOC SS-79, Building 381 Spill Site, (SS-79) Kirtland AFB, NM

Site Location	Scope of Work	Analytical Parameters	Sampling Objective	Additional QA/QC Samples
AOC SS-79	Soil headspace VOC screening	SOP A3.12	Guide limits of excavation	NA
	5 grab soil samples from sides/ bottom of excavation	TPH-DRO by Method 8015B (M), TAL Metals by Methods 6010B/ 7000A/7471A, and SVOCs by Method 8270C	Confirmation of remedial goals.	1 - replicate 1 - equipment blank
	1 composite soil sample from stockpile	TRPH by Method 418.1, BTEX by Method 8021B, TCLP VOCs, SVOCs, Pesticides/ Herbicides by Methods 8260B, 8270C, and 8081A/ 8151A, respectively, PCBs by Method 8082, Ignitability, Corrossivity, Reactivity, and Free Liquid.	IDW characterization for disposal.	1 - trip blank per cooler (analyzed for VOCs only)

AFB Air Force Base
AOC area of concern
BTEX benzene, toluene, ethylbenzene, and xylenes
DRO diesel range organics
IDW investigation derived waste
ICM interim corrective measures
PCBs polychlorinated biphenyls
QA/QC quality assurance/quality control
SOP standard operating procedure
SVOCs semivolatile organic compounds
TAL target analyte list
TCLP Toxicity Characteristic Leaching Procedure
TPH total petroleum hydrocarbons
TRPH total recoverable petroleum hydrocarbons
VOC volatile organic compound

Table 2-6. Soil Sample Analytical Results, ICM at AOC SS-79, Building 381 Spill Site (SS-79), Kirtland AFB, NM

Analyte	NMED HRMB Maximum Background	SS790102	SS790202/ SS790202DP	SS790302	SS790402	SS790503
PID Field Reading (ppm)						
VOCs	NE	0.4	482/NM	362	370	2.0
TPH-DRO-EPA Method 8015 Modified (mg/kg)						
TPH-DRO	NE	ND<4.4	76/3,200B	4,200 B	140 B	2.9 J,B
SVOC-EPA Method 8270C (ug/kg)						
2-methylnaphthalene	NE	ND	340/560	ND	ND	ND
All others	NE	ND	ND/ND	ND	ND	ND/ND
Total Metals - EPA Method 6010B/7471A (mg/kg)						
Mercury	<0.25	ND<0.036	ND<0.037/ND<0.036	ND<0.036	ND<0.036	ND<0.036
Silver	<1	ND<1.1	ND<1.1/ND<1.1	ND<1.1	ND<1.1	ND<1.1
Arsenic	5.6	2.8	3.1/2.3	2.2	2.5	3.1
Aluminum	NE	9,030	14,000/8,700	7,920	7,240	8,920
Lead	39	5.4	10.5/11.0	16.1	10.7	6.0
Barium	200	104	112/92.2	77.7	78.6	69.2
Selenium	<1	ND<0.54	ND<0.56/ND<0.55	ND<0.55	ND<0.55	ND<0.54
Beryllium	0.80	0.34	0.56/0.29	0.28	0.25	0.30
Thallium	<1.1	1.1	1.4/ 0.60B	1.3	0.85J	1.1
Calcium	NE	27,100	9,210/31,500	11,700	24,300	16,800
Cadmium	<1	ND<0.54	ND<0.56/ND<0.55	ND<0.55	ND<0.55	ND<0.54
Cobalt	7.1	3.5	4.4/3.4	5.0	3.2	3.7
Chromium	17.3	7.7	11.2/7.5	10.4	7.0	8.2
Copper	17	7.0	9.7/5.9	8.1	6.3	6.7
Iron	NE	10,900	13,600/9,640	10,500	9,180	11,000
Potassium	NE	1,360	2,660/1,650	1,580	1,290	1,400
Magnesium	NE	3,040	3,440/2,560	2,300	2,390	2,940
Manganese	NE	142	94.5/111	115	122	138
Sodium	NE	ND<545	ND<563/ND<552	ND<547	ND<550	ND<543
Nickel	25.4	7.3	9.0/6.1	6.7	6.5	7.8
Antimony	3.9	3.7J	3.0J/ND<6.6	3.3J	4.3J	ND<6.5
Vanadium	33	23.9	22.7/ 19.3	19.9	20.1	23.1
Zinc	76	22.8	32.2/24.0	36.3	25.5	23.0

FOOTNOTES

1	Shaded/bolded values indicate concentration met or exceeded the NMED HRMB maximum background concentration.
2	Sample depth = 2 ft below ground surface (bgs) for all samples, except 3 ft bgs for SS790503.
3	NMED HRMB maximum background concentrations for chemical constituents in soil for surface soils for the North Super Group from NMED, 1997.
B	The associated method blank contains the target analyte at a reportable level.
J	Estimated result. Result is less than RL.
EPA	U.S. Environmental Protection Agency
NMED HRMB	New Mexico Environment Department Hazardous and Radioactive Materials Bureau
mg/kg	milligrams per kilogram
ND	not detected
NE	not established
NM	not measured
PID	photoionization detector
ppm	parts per million
SVOC	semivolatile organic compounds
TPH-DRO	total petroleum hydrocarbons-diesel range organics
ug/kg	micrograms per kilogram

Based on the results of the ICM, the lateral extent of the soil contamination has not been defined at the AOC SS-79, Building 381 Spill Site. Concentrations of TPH-DRO ranging from 140B to 4,200 mg/kg were detected in the east, west, and south side walls of the excavation. However, no targeted compounds were detected above applicable NMED HRMB and/or EPA screening level standards, with the exception of thallium. One SVOC was detected in one sample and the corresponding duplicate at concentrations below the corresponding EPA risk based screening level. Antimony and thallium were detected in some of the samples at concentrations exceeding the corresponding NMED HRMB maximum background concentrations. However, the antimony exceedance is below EPA Region 6 risk based screening value; thallium has no published EPA background or risk based screening level. The detected thallium concentrations (1.1 to 1.4 mg/kg) only met or slightly exceeded the NMED HRMB background concentration of <1.1 mg/kg. Based on these results, additional excavation and/or characterization may be warranted for the site.

2.3 Groundwater Recovery at Site WP-26, Golf Course Main Pond (WP-26)

2.3.1 Background

The Golf Course Main Pond, which was drained and had been out of service since 1987, is located between holes three and four of the Tijeras Arroyo Golf Course at Kirtland AFB (Figure 2-3). The pond covers approximately 2.61 acres. The pond was constructed in 1962 and was used for storage of wastewater delivered from the Sewage Lagoons via a 20-in diameter pipe. The pond bottom was lined with a thin layer (approximately 4 mil) of plastic sheeting. Water from the pond was pumped to the golf course irrigation system through two 1,500 gallon per minute (gpm) four-stage Fairbanks-Morse turbine pumps equipped with 150 horsepower (hp) electric motors. The pond last received water from the Sewage Lagoons in 1987 and reportedly evaporated to dryness in January 1989. The pond liner material had weathered and disintegrated in most locations. The pond bottom had re-vegetated with a number of naturally occurring native plants including sage, grasses, non-native salt cedar and Russian olive. The pumps and pump house building were still at the site but their serviceable status was questionable. The pump house serves as the control center for the automated golf course irrigation system. Prior to the ICM, the course received all of its irrigation water from the base water system.

The purpose of the ICM at the Golf Course Main Pond is to capture and recover nitrate-contaminated groundwater in the immediate area of the golf course, store the water in the pond, and apply the water to the Tijeras Arroyo Golf Course via the irrigation system. A Notice of Intent (NOI) to discharge was submitted to NMED Groundwater Protection Bureau on May 13, 1998. Following an informal appeal process, it was determined that this was a Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) on-site remedial action, and a discharge plan was not required.

2.3.1.1 Previous Investigations

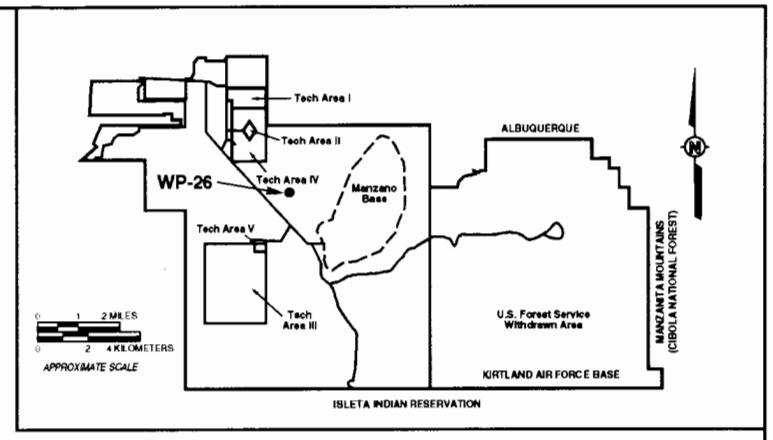
Four monitoring wells, KAFB-0602, KAFB-0608, KAFB-0609, and KAFB-0610 were installed around the Golf Course Main Pond during the Phase II Stage 2 RFI from March to April 1990 (USAF, 1993). Approximate well locations are presented in Figure 2-3 and completion specifications are summarized in Table 2-7.

Table 2-7. Well Completion Specifications for Site WP-26, Golf Course Main Pond (WP-26)

Well Designation	Elevation Top of Casing[1]	Total Depth Borehole (ft)*	Total Depth Well (ft)*	Screened Interval (ft)*	Dia. (in)	Screen Const. inch slot[2]	Date Completed	Water Elevation Level[3]	Depth of submersible pump intake setting (ft)*
KAFB-0602	5362.80	495	467	437-457	4	0.020	3/20/90	5053.84	456
KAFB-0608	5358.50	375	338	307-327	4	0.020	3/28/90	5059.21	NA
KAFB-0609	5363.20	355	345	316-336	4	0.020	3/31/90	5059.46	335
KAFB-0610	5356.80	395	363	333-353	4	0.020	4/4/90	5059.49	352
RG-1589-S-4	NS	500	455	290-350 400-440	12	0.030	10/14/98	312.58[4]	approx. 424

* below ground surface (bgs)
(1) Elevation in ft above mean sea level (MSL) (Hall Engineering, January 1997)
(2) Stainless steel (304)
(3) December 1998 in ft above MSL
(4) bgs, measured on November 6, 1998.

ft feet
in inch
NA not applicable
NS not surveyed



5

RG-1598-S-4
New Production Well

Well KAFB-0608

Well
KAFB-0609

Pond

4

Maintenance Building

Well
KAFB-0602

Pump House

Well
KAFB-0610

3

N

LEGEND

3 GOLF COURSE FAIRWAY

MONITORING WELL LOCATION

SCALE:	DRAWING DATE:	CAD FILE
NOT TO SCALE	06-26-98	87585901.02.72.00.00 B2

SITE MAP
SITE WP-26, GOLF COURSE MAIN POND (WP-26)

KIRTLAND AIR FORCE BASE

FIGURE 2-3

Groundwater samples were collected from these wells in May, August/September, and November/December 1990. Samples from the May 1990 event were analyzed for a full suite of parameters. Chromium (total and dissolved) was above the action level in well KAFB-0602. All four wells contained nitrates above the action level (10 milligrams per liter [mg/L]). Wells KAFB-0608 and KAFB-0609 also contained gross alpha radioactivity above the action level. An abbreviated parameter list was analyzed during the August/ September and November/December 1990 events. Dissolved chromium and nitrate were detected at or above action levels in well KAFB-0602, while only nitrates were above action levels in wells KAFB-0608, KAFB-0609, and KAFB-0610.

The four wells were sampled four times (February 1991, May 1991, November 1991, and May 1992) during the Stage 2A RFI. Samples were analyzed for nitrate plus nitrite during each event. The samples from the first three events were analyzed for total and dissolved chromium, uranium, and gross alpha and gross beta radioactivity. Samples collected during the second and third events were analyzed for chloride and samples from the fourth event were analyzed for metals. Organic parameters (VOCs, SVOCs, and total organic carbon [TOC]) were analyzed for from select wells during one or more sampling events. No constituents exceeded action levels during the Stage 2A RFI sampling events, except nitrates which exceeded the action level in all wells during all four events, tetrachlorethene in one well during one event, heptachlorepoxide in one well during one event, and gross beta radioactivity in one well during one event. Other volatile and semivolatile constituents detected were attributed to laboratory contamination.

A Post-Closure Plan (PCP) (USAF, 1994) for the Sewage Lagoons and Golf Course Main Pond was approved by the NMED in correspondence dated July 6, 1994. Quarterly groundwater monitoring under the PCP was initiated in June 1994 for total and hexavalent chromium and turbidity. Although not required by the PCP, Kirtland AFB also monitored nitrate/nitrite, ammonia, and VOCs during select events. Statistical analysis of chromium detections was performed after the March 1996 sampling event that indicated that the one event during which chromium exceeded the action levels (February 1995) was not significant. A request for clean closure was submitted to NMED in April 1996.

Groundwater monitoring subsequent to the March 1996 event at the Golf Course Main Pond included analyses for VOCs and nitrates based on historical detections. During the March 1996 sampling event, chloroform (1.1 micrograms per liter [µg/L]) and trichloroethylene (0.4 µg/L) were detected in well KAFB-0609. Toluene was detected in two wells during the June 1996 event: KAFB-0608 (1.2 µg/L) and KAFB-0610 (2.9 µg/L). No VOCs were detected in any of the wells in September 1996. The September 1996 event was the last monitoring event prior to incorporating the Golf Course Main Pond into the Long-Term Groundwater Monitoring (LTM) Program.

Under the LTM Program, water level measurements are recorded for all four groundwater monitoring wells at the Golf Course Main Pond during each monitoring event. Groundwater flows to the north-northwest at this site. Three wells are sampled, one upgradient (KAFB-0610) and two downgradient (KAFB-0608 and KAFB-0609), and analyzed for VOCs by EPA Methods 8260B and 504.1 and for nitrates as nitrogen (N) by EPA Method 300.0.

To date, only nitrates have exceeded the water quality standards (New Mexico Water Quality Control Commission [NMWQCC] Human Health Groundwater Standards and New Mexico Solid Waste Management Regulations [NMSWMR] health based groundwater standards). Quarterly samples were collected at WP-26 from wells KAFB-0608 through KAFB-0610 during 1996 to 1998. No VOCs have been detected in any of the groundwater monitoring wells sampled, with the exception of methylene chloride and trichloroethylene. Methylene chloride was detected in all three wells during one quarterly sampling between 5.1 ug/L and 7.6 ug/L, although this compound is attributed to laboratory contamination as it was also found in associated method blank samples. Trichlorethylene was detected during three quarterly events at well

KAFB-0609 at 0.7 ug/L to 0.9 ug/L and during one event at KAFB-0608 at 0.7 ug/L. Nitrate as N concentrations ranged from 17-23 mg/L (KAFB-0608), 17-21 mg/L (KAFB-0609), and 15-17 mg/L (KAFB-0610). All nitrate results exceed the NMSWMR health-based groundwater standard of 10 mg/L.

2.3.2 ICM Activities

The objective of the ICM at the Golf Course Main Pond is to capture nitrate-contaminated groundwater and to reapply it for beneficial use as irrigation water for the golf course. The ICM activities conducted at site WP-26 consisted of: aquifer testing to locate a groundwater extraction well; installation and geophysical logging of the extraction well; reconstruction of the Golf Course Main Pond; replacement and connection of pump equipment in the pump house used for irrigation; and deployment of submersible pumps in the recovery well and three additional groundwater monitoring wells and plumbing of the wells into the pond irrigation system. The following section summarizes each of these tasks.

2.3.2.1 Aquifer Testing

The proposed scope of work for the ICM specified the installation of a 12-in diameter extraction well with 100 ft of screen and a pump capable of delivering approximately 200 gpm. On August 6-7, 1998, an aquifer pump test was conducted on the uppermost aquifer beneath the Golf Course Main Pond using the existing monitoring wells. The purpose of the test was to obtain data to estimate aquifer characteristics for use in design and placement of the ICM extraction well. Specifically, the transmisivity of the monitored portion of the "perched" aquifer and by extrapolation, the anticipated discharge and potential capture area of an extraction well, were estimated. The complete methods and results for the aquifer test are provided in Appendix F and summarized below.

Methods

Four wells were used for the aquifer test: well KAFB-0609 was used as the pumping well, and wells KAFB-0602, KAFB-0608, and KAFB-0610 were used as observation wells. Locations of the test wells are illustrated in Figure 1 in Appendix F. Well KAFB-0609 was selected by the base to be used as the pumping well because it did not contain a dedicated pump and is located proximal to the observation wells in order to measure any variation in drawdown with respect to direction.

The aquifer test was conducted in accordance with SOP A3.7 of the Base-Wide Field Sampling Plan (FSP) (USAF, 1996). A submersible pump was installed in the pumping well (KAFB-0609) at a depth of 336.5 ft below top of casing at the bottom of the screen. The rate of groundwater extraction and the total volume pumped were monitored and recorded in the field notes at regular intervals using a totalizer flow meter. The pumping and observation wells were equipped with electronic data loggers to record groundwater fluctuations during the test. Pumped groundwater was temporarily stored on site in a 10,000-gallon capacity steel skid tank prior to waste characterization and final disposal.

A continuous rate pump test was conducted on well KAFB-0609 for a duration of 10 hours. During this time, a sustained pumping rate of 4.3 gpm was achieved and approximately 2,385 gallons of groundwater were pumped. The rate of groundwater recovery after pumping was also monitored in KAFB-0609 for approximately 9.5 hours. Plots of the depth to water versus time in the pumping well (KAFB-0609) and observation wells (KAFB-0602, KAFB-0608, and KAFB-0610) are provided in Figures 2 through 5 of Appendix F.

Water derived from the pump test was containerized onsite in above ground tanks pending results of chemical analysis and disposal. A sample of water was obtained in accordance with the procedures outlined in the SAP of the ICM Plan and submitted to Quanterra for analysis of VOCs by EPA Method 8260B and nitrates as N

by EPA Method 300.0 (Table 2-8). The analytical results for the sample (WP26060901) are included in Appendix C. The following VOCs were detected in WP26060901: chloroform (0.30J ug/L), toluene (4.0 ug/L), and trichloroethene (0.50J ug/L). The sample also contained 17.7 mg/L nitrate as N. A request to dispose of the pump test water to the publicly-owned treatment works (POTW) was submitted to the base on September 21, 1998 (Appendix I). Following receipt of Kirtland AFB's approval letter of September 23, 1998, 2,850 gallons of water were disposed of to the POTW (manhole #253 on the base) on September 24, 1998.

Data Interpretation

Groundwater fluctuations observed in the observation wells during the aquifer test were consistent and comparable to the measured barometric pressure changes and, therefore, not a result of groundwater pumping. The cone of depression created by pumping on KAFB-0609 did not extend to the observation wells. However, the data collected during recovery of well KAFB-0609 were sufficient to estimate aquifer parameters in the vicinity of the well and within the screened portion of the aquifer. As recommended in Driscoll (1986), the recovery of the water level in the pumping well was used for interpretation because it represented a steady rate of recharge to the well. The recovery of well KAFB-0609 is plotted in Figure 6 of Appendix F. Of the 29 total ft of recovery, approximately 27 ft took place in the first 20 minutes after pumping ceased. The remaining 2 ft of recovery occurred over nearly 3 hours. The rapid recovery (27 ft) in the first 20 minutes was most likely the result of well losses/recovery and not aquifer response. Therefore, only the remaining 2 ft of recovery were used to evaluate aquifer properties.

The transmissivity of the aquifer was calculated using Jacob's straight-line method and the Theis recovery method. The formulas used for these calculations as well as the results are included in Appendix F. Both the Jacob's and Theis Methods resulted in the same estimate of transmissivity of approximately 1,100 gallons per day/foot (gpd/ft) or 150 square ft/day (sq ft/day). The resulting hydraulic conductivity was calculated to be approximately 5 ft per day. The storativity of the aquifer could not accurately be calculated from the data derived from the pumping well alone.

In accordance with the work plan and in addition to the Jacob's straight line analysis, the data were also evaluated using the computer modeling program AQTESOLV™ (Geraghty & Miller, Inc.). The data derived from the pumping test were applicable to only one method in the model; the Theis Recovery Method for the later part of the recovery data was performed. The model output and results are presented in Appendix F. This evaluation resulted in a calculated transmissivity of approximately 0.09 sq ft/min. (920 gpd/ft or 120 sq ft/day). The modeled result was within the same order of magnitude as the graphical analyses of 150 sq ft/day. The transmissivity of the shallow aquifer in the vicinity of well KAFB-0609 was therefore estimated to be approximately 1,000 gpd/ft.

Data Extrapolation

The data derived from the aquifer pump test were used to provide an estimate of the yield and capture of the proposed 12-in diameter extraction well with 100 ft of screen. It was assumed that the lithology of the 20-ft tested interval in KAFB-0609 was representative of the aquifer. The lower part of the available electric log for well KAFB-0609 indicated that high transmissivity sands were not present at depth, and therefore the transmissivity calculated for the shallower interval (well KAFB-0609) was assumed to also represent deeper aquifer conditions, providing a correction for saturated thickness.

Table 2-8. Summary of Sampling Program, ICM Site WP-26, Golf Course Main Pond (WP-26), Kirtland AFB, NM

Site Location	Scope of Work	Analytical Parameters	Sampling Objective	Additional QA/QC Samples
WP-26	3 composite soil samples from pond sediment	TRPH by Method 418.1, BTEX by Method 8021B, TCLP VOCs, SVOCs, and Pesticides/Herbicides by Methods 8260B, 8270C, and 8081A/ 8151A, respectively, PCBs by Method 8082, Ignitability, Corrossivity, Reactivity, and Free Liquid.	IDW characterization for disposal.	1-trip blank per cooler (analyzed for VOCs only)
	1 purge water sample from aquifer pump test	VOCs by Method 8260B, Nitrates as N by Method 300.0.		
	1 development water sample from new production well	VOCs by Method 8260B, Nitrates as N by Method 300.0.		
	1 spent drilling mud sample from new production well installation	TCLP VOCs, SVOCs, and Metals by Methods 8260B, 8270C, and 6010B/7000A/7471A, respectively, TOC by Method 9060, and TOX by Method 9020B.		
	1 virgin drilling mud sample and 1 potable water sample used for installation of new production well	VOCs by Method 8260B, Nitrates as N by Method 300.0	Drilling materials blanks	

AFB Air Force Base
BTEX benzene, toluene, ethylbenzene and xylenes
IDW investigation derived waste
ICM interim corrective measures
N nitrogen
PCBs polychlorinated biphenyls
QA/QC quality assurance/quality control
SVOCs semivolatile organic compounds
TOC total organic carbon
TOX total organic halogen
TCLP Toxicity Characteristic Leachate procedure
TRPH total recoverable petroleum hydrocarbons
VOC volatile organic compound

Due to the limited available data regarding lithology and aquifer properties of the uppermost 100 ft of the saturated zone, it was not possible to accurately estimate the yield of a large diameter groundwater recovery well. However, the planned design and depth of the groundwater extraction well indicated that a higher rate of sustainable pumping could possibly be achieved in the new well. The larger diameter (12 in) and deeper penetration of screen, approximately 100 ft through the saturated zone, both indicated that well yield may be tripled or quadrupled, up to a minimum of approximately 50 gpm (Driscoll, 1986). Based upon the predicted discharge rate of 50 gpm, zone of groundwater capture, estimated time to capture, and anticipated drawdown were estimated. These results are presented in Appendix F.

Recommended Location

The results of the pump test and consideration of other logistical factors were used to recommend a location for the proposed extraction well (Figure 2-3). The well was located downgradient of the nitrate plume for optimum capture, and downgradient of the pond and many of the golf course fairways which could be continuing sources for the nitrate. The chosen location was also level and accessible for the drilling rig and support equipment, and slightly higher than the pond for optimum drainage of the distribution pipe (i.e., to prevent frost and ice accumulation).

2.3.2.2 Extraction Well Installation

A 12-in diameter groundwater extraction well (RG-1589-S-4) was installed to extract nitrate-contaminated groundwater from the aquifer. The well location was determined during the aquifer testing period. Prior to construction, a groundwater extraction well permit was obtained from the New Mexico State Engineer's Office (NMSEO) for the well. A copy of the permit is included in Appendix G.

Well installation commenced September 25, 1998 using standard mud rotary drilling techniques. A 12.25-in diameter pilot borehole was advanced to a total depth of 500 ft bgs. Cuttings were logged at the surface by a qualified field geologist. No noticeable groundwater was encountered during drilling. Following completion of the pilot hole, the open borehole was logged by Southwest Geophysical Services, Inc. Gamma ray, neutron, SP, and resistivity logs were run and copies are included in Appendix H. Interpretation of the logs showed that the formation consisted mainly of clay below 275 ft bgs with the exception of a 12-ft thick sand or gravel stringer at approximately 290 ft and two thin silt stringers at approximately 334 and 408 ft bgs. Based on this information and the projected depth to groundwater of approximately 309 to 314 ft, as measured in surrounding monitoring wells KAFB-0608 through -0610 and KAFB-0602, the final screened interval for the extraction well was determined. The screened interval was split between 290 to 350 ft and 400 to 440 ft bgs with blank casing separating the two intervals. This deviated from the ICM Plan which specified a screened interval of 375 to 475 ft bgs. A FCR (No. 001R) documents this change in scope (Appendix D). The pilot hole was reamed and 20-in diameter steel conductor casing was set to 40 ft bgs. The casing was grouted in place and allowed to cure for a minimum of 24 hours. After the conductor casing was cured, the hole was reamed to 18.75 inches in diameter to 465 ft bgs. Steel casing was installed from 440 to 455 ft bgs. The well screen was installed from 290 ft to 350 ft and from 400 to 440 ft and comprised of 0.030-inch wire wrapped stainless steel. Silica sand (10-20) was placed in the annulus surrounding the well screen to a depth of approximately 237 ft bgs, followed by a cement-bentonite grout to the bottom of the surface casing. A well construction log is provided in Appendix H.

After the well had been grouted and left to cure for at least 24 hours, it was developed to remove fine-grained materials from the filter pack and promote hydraulic communication with the aquifer. Development consisted of jetting of the well screens and pumping in accordance with SOP A1.8, except that air and water jetting was applied to promote maximum production. The well was also developed with a sand bailer, surging across the screened intervals.

During well development, it became apparent that the actual flow rate was significantly less than that projected for the aquifer test. Initially the low yield was attributed to inadequate well development, but after the well was throughly developed over two days, it was determined to be characteristic of the formation, which is predominantly fine-grained sediments (silts and clays). This finding is consistent with the geophysical logs recorded during well installation. The actual well yield was approximately 5 gpm. As a result of the lower flow rate, the pump for this well was re-selected based on a maximum flow rate of 10 gpm.

Using the lower flow rate of 5 gpm, the predicted capture zone can be re-calculated. The distance (r) to the downgradient stagnation point of the extraction well can be estimated as follows:

$$r = Q(\text{extraction flow rate})/2\pi * T(\text{transmissivity}) * I(\text{gradient})$$

The lateral reach (χ) is a direction perpendicular to the static groundwater can be calculated as follows:

$$\chi = \pi r$$

Based on the discharge rate of 5 gpm, a saturated thickness of 100 ft and a transmissivity of 150 square ft/day for the recovery well, and a gradient of 0.0015 (as previously measured at the site), the upgradient capture width (χ) is anticipated to be 640 ft, while the downgradient width (r) is estimated at 204 ft. Since the monitoring wells KAFB-0602, -0609, and -0610 are expected to yield between 2 and 5 gpm, their capture zones should be similar to those of the recovery well.

All fluids from drilling and well development were containerized above ground in tanks and mud circulation containers. A sample of the development water was collected in accordance with the procedures outlined in the SAP of the ICM Plan and submitted to Associated Laboratories (Associated) in Orange, CA, for analysis of VOCs per EPA Method 8260B and nitrate as N by EPA Method 300.0 (Table 2-8). The ICM Plan specified Quanterra for all project analytical laboratory services. However, due to untimely receipt of results, the laboratory was changed to Associated for development water and drilling mud waste characterization. A FCR (No. 002) was executed for this change in subcontractors. The analytical results for the sample (WP26589DEVL) are included in Appendix I. No VOCs were detected and 1.3 mg/L nitrate was detected in the sample. A request to dispose of the development water to the POTW was submitted to the base on October 27, 1998 (Appendix I). Following approval, the well development water was disposed of to the POTW on November 19, 1998.

The drilling mud was composed of water from the base water supply, groundwater, and bentonite clay. A sample of the mud was analyzed at Associated for TCLP VOCs, SVOCs, metals, TOX, TOC, and nitrate as N (Table 2-8). A copy of the analytical reports for sample WP26589DMUD are included in Appendix I. No TCLP or TOX constituents were detected in the drilling mud sample, except for the following metals (mg/L): arsenic (0.029), barium (0.396), lead (0.062), mercury (0.016), and selenium (0.012). TOC was detected at 3.5 mg/L and nitrate as N was detected at 11 mg/L. All concentrations were below regulatory levels for hazardous constituents (40 CFR 261.24). A request to transport the drilling mud offsite to the City of Albuquerque Soil Amendment Facility at the Cerro Colorado Landfill for proper disposal was submitted to the base on October 27, 1998. Following approval, the mud was transported to the Cerro Colorado Landfill on October 30, 1998. A copy of the waste manifest is included in Appendix E.

Pump Installation

After completion of well development, a Myers 2HP, 230V, single phase submersible pump and motor capable of delivering 10 gpm at 520 ft of head were installed by the drilling contractor on December 10, 1998. The pump intake was set at approximately 424 ft bgs (Table 2-7). The well was completed with a pitless adaptor for subgrade connection to the water line. The starter and control box were mounted on a panel box above ground next to the well. Pump specifications are provided in Appendix M.

2.3.2.3 Pond Construction

Prior to initiating pond construction, soil sampling for waste characterization was completed on August 7, 1998. Surface soil samples from 0-6 inches in depth were collected from 30 random locations across the pond. The samples were screened for relative concentrations of VOCs using a PID. Portions of the three grab samples yielding the highest PID readings were retained for laboratory VOC analysis and the remaining samples were divided into three groups of 10 samples each for the east, middle, and west sections of the pond. Each group of 10 samples were then composited (total of three composite samples) for analysis of waste characterization parameters in accordance with the SAP of the ICM Plan. The samples were submitted to Quanterra for laboratory analysis and analyzed for the parameters specified in Table 2-8.

The analytical results for the composite soil samples from the pond WP260E00 (east third of pond), WP260M00 (middle of pond), and WP260W00 (west third of pond) are included in Appendix C. The results for the three grab samples (WP261801, WP261501, and WP261301) collected for VOC analysis are also included in Appendix C. Composite sample WP260W00 contained 7.2B mg/kg TRPH. No TRPH was detected in the other two composite samples. No TCLP SVOCs, pesticides, herbicides, or PCBs were detected above the RLs in the composite samples. No BTEX or TCLP VOCs were detected in the three grab samples. The analytical results indicated that the surface soil from the pond was not characteristically hazardous. A request to place the soil in the Kirtland AFB Landfill was submitted to the base on September 16, 1998 (Appendix E).

Grade Staking

The new relined pond was to follow the existing contour as much as possible. However, the final shape was to be more symmetrical than the present shape. This symmetrical oval shape allowed a simpler liner installation, which significantly reduced construction costs. Prior to initiating work, a grid was laid over the pond to indicate the depth of excavation for both grubbing and final grade. This was done to monitor the progress of excavation and delineate the volume of materials removed and graded. The base of the pump house was used as the reference point.

Clearing and Grubbing

Pond construction was initiated on October 19, 1998 with clearing and grubbing activities. The bottom and head wall of the pond were scraped to remove vegetation. Approximately 6 in of material was removed from the base and side walls of the pond including the existing liner material. At completion, the entire pond area of approximately 80,000 square feet was scraped. The material was disposed of at the Kirtland AFB Landfill (Appendix E).

Grading and Shaping

Upon completion of grubbing, the pond was shaped and contoured to accept the liner. Approximately 500 cubic yards of soil was present in the eastern portion of the existing pond. This material was cut and used to fill the north-south trending finger portion of the pond and to build up a haul road for removing material from the pond.

Up to 14 in of native material were removed from the pond and stockpiled just west of the pond head wall. This soil will be used by the base for future landscaping activities at the golf course. When the native

material had been cut from the pond, the north, south and eastern sides of the oval-shaped pond were created by pushing material outward from the center of the pond to build up these sides. This lowered the sides of the pond and increased the height of the side walls. The final pond had an average minimum depth of 5 ft with approximately 1 ft of freeboard. The edges were graded to 2:1 slope and compacted to at least 95 percent density (Proctor test). An anchor trench was excavated at the top of the slope to accommodate the liner. The anchor trench was approximately 1-ft wide and 2-ft deep.

The final base of the pond was examined for liner suitability. The criteria for liner placement required the base material to be sand and/or gravel free of debris and without sharp edges. Stones were to be less than 2 inches in diameter. The bottom of the pond was raked as needed to remove sharp debris or rocks. After the liner was placed in the pond, the concrete pipeline from the pond to the sump and the sump were cleaned out and prepared for operation. The pipeline and sump were pressure washed clean and inspected and found to be in good condition.

Liner Installation

A 40 mil HDPE liner was installed by a certified liner installer (Snow Co.) on December 14-16, 1998. The liner seams were welded and 100 percent of the welds were pressure tested for integrity. The liner was also visually inspected for punctures with a 100% walkover. Other QA/QC procedures were performed as described in the Quality System Plan of the ICM Plan.

The liner was draped into the anchor trench installed along the edge of the pond. Native fill material was placed in the anchor trench and compacted to retain the liner. The ICM Plan originally specified that the entire liner surface in the bottom of the pond be covered with approximately 12 in of native material. It was decided, however, that because the native fill had sharp stones and other deleterious material that could damage the liner and sorting of the fill would add significant out of scope cost, that the fill not be placed on the pond bottom. A FCR (No. 004) for this change in scope is provided in Appendix D. Discussions with the liner installer indicated that water retention ponds typically do not have cover material over the liner unless the liner is subject to traffic or potential wind damage, neither of these conditions apply to the golf course pond. In addition, the liner manufacturer warranties the liner from ultraviolet (UV) radiation damage for 10 years regardless of fill protection. A copy of the warranty is provided in Appendix O. To protect the liner from wind damage, sand bags were temporarily placed on the liner to hold it in place until the pond was filled with water. Once filled with water, the liner will be impervious to both wind and UV damage. The portion of the liner above the water line was covered with large river rock (approximately 2 in or greater in diameter and 4 to 6 in long). The rock was carefully selected and placed to match the surrounding landscaping at the golf course. The purpose of the river rock dressing on the side slopes is to promote the aesthetics of the pond, allow for emergency egress for persons or animals accidentally entering the pond, and provide protection of the liner that is above the water line.

Pipeline Installation and Electrical Connections

A 4-in diameter pipeline was installed to connect the groundwater extraction well to the pond. A trench approximately 3 ft deep was excavated between the pond and the well head. The base of the trench was raked where necessary to remove sharp rock and stones greater than 2 inches in diameter. The pipeline was constructed of bell flanged polyvinyl chloride (PVC) C900 Class 200 water pipe rated at 985 pounds per square inch (psi) burst strength. The last 40 ft of the pipeline was sloped so that it will drain into the pond under gravity flow to prevent freezing when not in use. The portion of the pipeline installed through the north berm of the pond was constructed of ductile cast iron to prevent breakage and weathering due to exposure to the elements.

The pipeline was hydrostatically leak tested in accordance with American Water Works Association (AWWA) Method M23 for PVC supply lines. After hydrostatic testing, the pipeline was covered with clean

native fill. The pipeline trench was compacted by wheel rolling using a backhoe. Markers were placed along the pipeline run to note that a buried pipeline exists in the area.

Three-phase, 480V power was available at the pump house adjacent to the Golf Course Main Pond. The turbine pumps at the pump house were connected to the existing power feeds. Electrical wiring was placed underground from the pump house to the extraction well to supply the submersible pump. A 7.5KVA transformer was installed north of the pond near monitoring well KAFB-0608 to convert the voltage to one-phase, 240V supply required for the submersible pump in the extraction well.

Appendix N contains complete as-built information for all mechanical and electrical utilities construction.

2.3.2.4 Pump Replacement

The previous pond configuration used two multi-stage turbine pumps capable of delivering 1,500 gpm with an operating pressure of less than 200 psi. These pumps were originally installed by TP Pump, Inc. in Albuquerque, New Mexico. Upon inspection of the pumps, it was found that one pump was inoperable and beyond reasonable repair. A new three stage Gould pump capable of 1,100 gpm with a U.S. Electric Motors 75 hp, 460 V motor and associated float switches was procured and installed in the pump house and sump pit. Pump specifications are provided in Appendix M. The other turbine pump was found to be operable, but its long-term performance capabilities are unknown. During installation of the new turbine pump, the sump was inspected and the debris and water in the bottom of the sump were cleaned out using a pressure washer. Two float switches were also installed in the sump to shut off the pumps in the event of a high water level (the second switch is a backup, failsafe switch). All piping and pump connections at the pump house and sump were inspected and two pressure relief valves were found to be leaking and were replaced.

2.3.2.5 Additional Monitoring Well Connections

To supplement the water supply from the new extraction well due to lower well yield than originally estimated and to further enhance recovery of nitrate-contaminated groundwater at the site, three additional monitoring wells were connected to the recovery system. A FCR (No. 005) for this change in scope is included in Appendix D. Applications for permits to extract groundwater from the wells were submitted to the NMSEO on February 5, 1999. Copies of the permit applications are included in Appendix G. Existing monitoring wells KAFB-0602, -0609, and -0610 were plumbed into the system and equipped with submersible pumps. Two-inch diameter PVC pipe and electrical conduit were laid to the three wells and plumbed into the incoming 4-in pipeline from the extraction well at a point north of the north berm of the pond. Flow meters were installed on each monitoring well line just prior to the junction with the 4-in pipeline. Submersible 3/4 hp Grundfos pumps capable of 5 gpm were installed in each monitoring well. The pump intakes were set at approximately 1 ft above the bottom of the well screen. Pump specifications are included in Appendix M.

To further supplement the water supply in the pond for adequate irrigation of the golf course and to ensure that the pond bottom will always be covered with water to protect the liner, Production Well No. 4 was also plumbed into the pond (this work was performed by a base contractor outside of the scope of this contract). A 14-in diameter PVC water line was installed by CE from the inflow from the sewage lagoons to a discharge point through the north berm of the pond (Figure 2-3).

2.3.2.6 System Startup

Following completion of all construction ICM activities, demobilization was conducted at the site. All construction fences, trash, and debris were removed and the area was raked. A final site inspection was conducted with AFCEE and all contractor personnel on February 18, 1999. The system was activated on this date and the extraction well was brought on line. The pumps and plumbing in the monitoring wells were also tested but shut off again, pending receipt of NMSEO permits for continuous operation of the wells. Production Well No. 4 was scheduled to come on line at the end of February, but an obstruction was found in the water line and was repaired and put into operation in April. Operation and maintenance manuals for all pumps and controls are provided in Appendix M. Complete as built diagrams for the system are provided in Appendix N.

Other work completed following startup and outside the original scope of work includes:

- Replacement of two valves in the pumphouse which were noted to be broken.
- Replacement of a phase monitor in the pumphouse which was noted to have been burned out.
- Survey of the pipe inverts and sump to assess how to increase the amount of usable water for irrigation. Several discussions with the golf course superintendent were held and a letter of recommendations was submitted.

2.3.3 Nature and Extent of Contamination

Nitrate has been detected in monitoring wells KAFB-0608 through -0610 during the past two years at concentrations (15-23 mg/L) exceeding NMWQCC and NMSWMR health-based groundwater standards (10 mg/L). The lateral and vertical extent of elevated concentrations of nitrates in groundwater have not been fully defined at WP-26. The ICM, however, will capture nitrate-contaminated groundwater in the vicinity of the Golf Course Main Pond and recycle it for beneficial use (irrigation of the golf course). Continued operation, maintenance, and monitoring are recommended for the groundwater recovery system at WP-26.

According to the golf course superintendent, the amount of fertilizer used on the golf course varies depending on the season and observation of the condition of the grass plants. The current schedule for spring based on industry standard practice is 0.25 pounds of nitrate per 1,000 square foot area. In the summer, less (0.10 pounds) nitrate is needed, while more (3.0 pounds) is needed in the late fall and none is needed in late winter. The nitrate made available from the use of recovered groundwater (approximately 15-20 mg/L) in the irrigation system is not expected to require any significant modification to the current schedule, since the application of fertilizer is continuously adjusted based of agronomic considerations. For instance, if plants appear wilted, less fertilizer is applied.

During the March 1998 LTM event, the monitoring wells at the golf course were analyzed for nitrate species (nitrate as N, ammonia as N, nitrate plus nitrite as N, and total Kjeldahl nitrogen [TKN]). Both ammonia and TKN were not detected in any of the wells. Thus, nitrogen does not appear to be present in its reduced form (ammonia) or organic form (TKN) at the site. The nitrates present at 15-20 mg/L in groundwater should be fully utilizable by grass plants at the golf course. Moderated water should be applied frequently rather than a flood irrigation method to maximize the utilization of nitrates by plants and prevent their seeping back to the perched groundwater zone.

3. RECOMMENDATIONS/CONCLUSIONS

The ICMs at three sites, WP-87, SS-79, and WP-26, were implemented and serve to mitigate impacts identified at those sites. Soil and debris were removed from sites WP-87 and SS-79. Residual constituent concentrations are below EPA Region 6 risk based screening levels for residential soils. Additional characterization and/or excavation may be required at these sites.

At WP-26, groundwater recovery from four wells is ongoing. According to the conditions of the NMSEO permits, the total volume of water diverted must be reported on the 10th day of each month for the preceding calendar month. Recovered groundwater is discharged to the reconditioned pond along with water from Production Well No. 4. Water from the pond is then used to irrigate the golf course. Ongoing operation and maintenance of the recovery system will be performed by the golf course maintenance personnel. Kirtland AFB plans to connect Production Well No. 7 to the pond during fiscal year 2000, since nitrate levels have been elevated in it and pumping from it will enhance the corrective measures.

The source and extent of nitrate contamination in groundwater has not been defined. Additional assessment activities and possibly expansion of the recovery system will be necessary.

Natural Resource Damage Assessment

The Natural Resource Damage Assessment (NRDA) program is a mechanism designed to restore natural resources injured by hazardous substance releases. The NRDA program requires parties responsible for contamination and injuries to pay for losses. The NRDA measures natural resource injuries and determines liability. An NRDA demonstrates the nature of injury and any environmental pathways. It also measures the extent of injury and the necessary restoration measures and costs. In certain cases, restoration may include replacement or acquisition of equivalents for habitats, populations of wildlife, and human services, including hunting, fishing, and recreational activities.

The NRDA program is carried out by various Federal, State, and Tribal trustees for fish, wildlife, other living resources, water, lands, and protected areas. Trusteeship is derived from treaties (Federal and Tribal), statutes (Federal and State), and other regulations. Federal agencies responsible for land management include the National Park Service; U.S. Fish & Wildlife Service (USFWS); Bureau of Land Management (BLM); U.S. Department of Agriculture, including the U.S. Forest Service (USFS); Department of Defense (DoD), and the Department of Energy (DOE).

The NRDA has established a restoration fund to be used to restore resources lost or injured by the release of hazardous materials and oil spills. The NRDA program has been traditionally associated with the CERCLA. CERCLA directed the Department of the Interior to prepare rules for NRDAs at hazardous waste sites and for emergency incidents involving CERCLA substances. The integration of the NRDA with the RCRA is currently being considered by the DoD, under the proposed Range Rule.

CERCLA and RCRA provide tools to clean up contaminants from the environment. However, these clean-up programs focus on human health and environmental concerns related to human health. The programs are primarily carried out by the U.S. Environmental Protection Agency, working with the States. These programs do not concentrate on restoring natural resources, although cleanup may prevent further injuries to natural resources. The CERCLA and RCRA programs often do not deal with downstream and offsite contaminated sediments outside National Priority List and Solid Waste Management Unit boundaries. With regard to injuries to natural resources, the CERCLA states the following: 1) responsible parties are liable for compensatory damages for injuries to natural resources owned, managed, or controlled by government agencies or Indian tribes; 2) government agencies and Indian tribes may assess and collect the damages,

acting on behalf of the public as trustees for the injured natural resources, and 3) recovered damages and recovered damages must be used to restore, rehabilitate, replace, or acquire the equivalent of the injured natural resources. Therefore, the NRDA program was established to ensure restoration and compensation where needed and appropriate.

Conclusions and Recommendations:

Based on the above discussion and the site-specific conditions of each of the three sites in this ICM Report, it is unlikely that a NRDA will be required. The corrective measures have provided a positive impact to the environment by limiting the amount of contamination that can enter the food chain. In addition, because of the arid climate, the nature and extent of residual impacts, and the location of the three sites in this ICM Report, there is a very low possibility of any surface water run-off or contaminated sediments that could damage aquatic resources. The vegetation associations and wildlife found on and near the sites WP-87, SS-79, and WP-26 are common and widely dispersed over Kirtland AFB, so there would be no impact to biodiversity. Restricted access and limited planned development at Kirtland AFB have benefited biological resources.

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