DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 377TH AIR BASE WING (AFMC)

19 Apr 00

APR 2000
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MEMORANDUM FOR MS. JENNIFER PARKER
GROUNDWATER QUALITY BUREAU
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FROM: 377 ABW/EM
2050 Wyoming Blvd SE,
Building 20685, Suite 125
Kirtland AFB NM 87117-5270

SUBJECT: Stage I Abatement Plan for ST-106, Kirtland AFB Bulk Fuels Facility,

1. We are forwarding a copy of the final Stage I Abatement workplan for the subject site. There are no volumes of appendices associated with this report. Included is an electronic copy of the document in Word 97 on a 3.5" disk.

2. Please contact Mr. Mark Holmes at 505-846-9005 or me at 505-846-9002 if you have any questions on this matter.

HARRY M. DAVIDSON
Acting Chief, Restoration Branch
Environmental Management Division

Atch:
1. Abatement Plan

cc:
NMED-HRMB (Mr. Kieling) w/o atch
NMED-HRMB KAFB (Mr. R.Rocha) w/o atch
EPA Region 6 (Ms. Tellez) 2 copies w/o atch
HQ AFMC/CEVC (Mr. Fort) w/o atch
AFCEE (Mr. Arnold) w/o atch
CH2MHILL (Ms. Minchak) w/o atch
377 ABW/EMC (Mr. Montano) w/o atch

Kirtland Air Force Base
Albuquerque, New Mexico

Stage 1 Abatement Plan
ST-106, Kirtland AFB
Bulk Fuels Facility

April 19, 2000

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

CONTENTS

CONTENTS (continued)

FIGURES

TABLES

ACRONYMS

AFB	Air Force Base
AFCEE	Air Force Center for Environmental Excellence
bgs	belowground surface
CLP	Contract Laboratory Program
CMS	Corrective Measures Study
CRP	Community Relations Plan
cu yd	cubic yard
DCQAP	Data Collection Quality Assurance Plan
DMP	Data Management Plan
DRO	diesel range organic
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
FSP	Field Sampling Plan
HHRB	human health risk-based (EPA Region 6 Human Health Media-Specific Screening Levels)
HSP	Health and Safety Plan
IDW	Investigation-Derived Waste
IDWMP	Investigation-Derived Waste Management Plan
IRP	Installation Restoration Program
mg/kg	milligram per kilogram
mi	mile
MS/MSD	matrix spike/matrix spike duplicate
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
OSI	Onsite Investigation
PARCC	precision, accuracy, representativeness, completeness, comparability
PID	photoionization detector
PPE	personal protective equipment
ppm	parts per million
QAPP	Quality Assurance Project Plan
QA/QC	quality assurance/quality control
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation

SOP	Standard Operating Procedure
SSHP	Site Safety and Health Plan
SWMU	solid waste management unit
SVOC	semi-volatile organic compound
TPH	total petroleum hydrocarbon
USAF	U.S. Air Force
UST	underground storage tank
VOC	volatile organic compound

EXECUTIVE SUMMARY

This draft Stage 1 Abatement Plan has been prepared to describe field activities that will be conducted at site ST-106, Kirtland Air Force Base (AFB) Bulk Fuels Facility. The investigation will assess the site geology and hydrogeology and the nature, extent, and magnitude of possible petroleum hydrocarbon releases associated with operations at the site. The investigation activities described in this Abatement Plan along with other data collection and review activities will be performed as specified in 20 NMAC 6.2 Section 4106.C. This Abatement Plan will serve as a guide while the investigation is being conducted.

This Kirtland AFB Bulk Fuels Facility contains bulk storage for jet fuel (JP8), diesel fuel, and unleaded gasoline. Jet fuel is stored in two aboveground storage tanks (2.1 and 4.2 million gallons), diesel fuel is stored in two aboveground storage tanks (5,000 and 10,000 gallons), and unleaded gasoline is stored in one 10,000-gallon aboveground storage tank. The fuel delivered to the JP8 off-loading rack (Building 2405) is conveyed to a pump house (Building 1033) via two 14-inch-diameter belowground transfer lines. The fuel is then pumped to the aboveground JP8 storage tanks by piping of varying sizes that is partially above and belowground.

In November 1999 three known discharges occurred from the lines that transfer fuel from the JP8 off-loading rack (Building 2405) to the pump house at the facility. The discharges included a failure of one of the 14-inch-diameter belowground transfer pipelines (pipeline #22) during a hydrostatic pressure test, failure of a cam-lock coupling during pressure test of the second belowground transfer pipeline (pipeline #23), and failure of the second belowground transfer pipeline (pipeline #23) during a hydrostatic pressure test after the cam-lock coupling problem had been corrected. The nature and extent of contamination associated with these November 1999 discharges will be investigated by installing five soil borings around the area of the surface discharges and seven borings along the length of the failed belowground pipeline. All soil samples will be analyzed for total petroleum hydrocarbons and benzene, toluene, ethylbenzene, and xylenes (U.S. Environmental Protection Agency [EPA] Methods 8015 Modified and 8020). Select soil samples will be analyzed for semi-volatile organic compounds as well. The sample results will be validated and then compared to appropriate New Mexico Environment Department action levels and EPA human health risk-based screening levels to determine if soils are contaminated and/or represent a threat to human health or the environment.

In addition to the documented November 1999 releases, there is reason to suspect that other, undocumented historic releases may have occurred at the site. Previous Appendix III Resource Conservation and Recovery Act Facility Investigations have been conducted for the condensate holding tank, which is adjacent to the ST-106 pump house (the condensate holding tank is designated at Solid Waste Management Unit 341). Results from these investigations are applicable to the investigation of ST-106 and have shown the presence of elevated concentrations of petroleum hydrocarbons and associated compounds in soils in the vicinity of the condensate holding tank.

To investigate the presence and nature and extent of possible undocumented historic releases additional investigative activities at the site will be conducted. Suspected areas of possible releases will be broadly screened using a soil gas survey and then additional confirmation sampling will also be conducted by installing and collecting soil samples at 11 additional soil boring locations. Soil gas samples will be screened for petroleum hydrocarbons and volatile organic compounds. All soil samples will be analyzed for total petroleum hydrocarbons and benzene, toluene, ethylbenzene, and xylenes (U.S. Environmental Protecton Agency [EPA] Methods 8015 Modified and 8020). Select soil samples will also be analyzed for semi-volatile organic compounds and samples collected in the pump house area, where unleaded gasoline may have been released, will also be analyzed for Methyl Tertiary Butyl Ether (MTBE). The sample results will be validated and then compared to appropriate New Mexico Environment Department action levels and EPA human health risk-based screening levels to determine if soils are contaminated and/or represent a threat to human health or the environment.

1. INTRODUCTION

CH2M HILL prepared this Investigation Stage 1 Abatement Plan to describe field activities that will be conducted at site ST-106, Kirtland Air Force Base (AFB) Bulk Fuels Facility. The investigation will assess the site geology and hydrogeology and the nature, extent, and magnitude of possible petroleum hydrocarbon releases associated with operations at the site. The investigation activities described in this Abatement Plan along with other data collection and review activities will be performed as specified in 20 New Mexico Administrative Code (NMAC) 6.2 Section 4106.C. This Abatement Plan will serve as a guide while the investigation is being conducted. The Abatement Plan describes site background and environmental settings, results of previous investigations, data gaps, and the site-specific investigation work plan and rationale. The investigation will be conducted in accordance with the Kirtland AFB Base-Wide Plans for the Installation Restoration Program (IRP) (USAF, 1995) and the New Mexico Environment Department (NMED) Ground and Surface Water Protection Regulations.

1.1 Objectives and Scope

The objectives of the Stage 1 Abatement Plan investigation are to:

- Define the site geology and hydrogeology
- Delineate the horizontal and vertical extent and magnitude of potential petroleum hydrocarbon contamination in the vadose-zone soils
- Collect and review available regional hydrogeologic and surface water hydrology data
- Inventory existing water wells within a 1-mile (mi) radius of the site.

The scope of the Stage 1 Abatement Plan investigation will include known and potential petroleum hydrocarbon release areas within the ST-106 Kirtland AFB Bulk Fuels Facility. Due to the depth of the regional groundwater table in the ST-106 area (depths greater than 450 ft) the scope of the Phase 1 Abatement Plan investigation will only include the vadose-zone soils at the facility. If the Phase 1 investigation indicates the likelihood of an impact to groundwater from petroleum hydrocarbon releases at the facility further investigation of the groundwater may be conducted as part of a second investigation phase.

1.2 Approach and Implementation

To delineate the petroleum hydrocarbon contamination in vadose-zone soils associated with the documented November 1999 releases surface and subsurface soil samples will be collected using a direct-push and/or hollow stem auger drilling rig at the site. Furthermore, to investigate possible undocumented historic releases at the site a soil gas screening survey will be conducted and additional surface and subsurface soil samples will be collected from other possible release areas using a direct-push and/or hollow stem auger drilling rig. The soil gas survey will include collection of soil gas samples from pre-determined grid locations across the site. The soil gas samples will be analyzed by an onsite laboratory and will provide screening data on possible undocumented subsurface source areas of petroleum hydrocarbon contamination. Available site-specific and regional geologic, hydrogeologic, and hydrologic data and information on water wells within a 1-mi radius of the site will be reviewed as part of the investigation and provided in the final investigation report.

The results of the investigation will be used to determine whether additional investigation or abatement actions are required at the site.

1.3 Background Issues

1.3.1 Regulatory Requirements

Soil samples will be collected and analyzed in compliance with applicable regulations of the NMED. Any changes from guidelines will be stated in this Abatement Plan. This Abatement Plan has been prepared in accordance with the Resource Conservation Recovery Act (RCRA) Sampling and Analysis Plans/Work Plans outline provided to the Base by the NMED (NMED, 1998) with modifications made to reflect specific requirements of the NMED Ground Water Quality Bureau Stage 1 Abatement Plan site investigation requirements.

1.3.2 Other Issues

This Abatement Plan serves as the scoping document for the investigation. The following documents will serve as additional project scoping documents during this investigation:

- IRP Base-Wide Final Project Management Plan
- IRP Base-Wide Final Data Collection Quality Assurance Plan (DCQAP) consisting of Part I: Field Sampling Plan (FSP), and Part II: Quality Assurance Project Plan (QAPP)
- IRP Base-Wide Final Data Management Plan (DMP)
- IRP Base-Wide Final Site Safety and Health Plan (SSHP)
- IRP Base-Wide Final Investigation-Derived Waste Management Plan (IDWMP)
- IRP Base-Wide Final Community Relations Plan (CRP)

The procedures detailed in the Base-Wide Plans will be adhered to for all aspects of the investigation activities unless they are specifically modified by this Abatement Plan or the subsequent site-specific Health and Safety Plan (HSP) addendum. A copy of the Kirtland AFB Base-Wide Plan is provided with this Stage 1 Abatement Plan as a reference for the documents referred to in the bullets above.

1.4 Data Quality Objectives Process

The data quality objectives (DQOs) development process and data quality indicators detailed in the Base-Wide Plan will be adhered to for all aspects of the investigation activities unless they are specifically modified by this Abatement Plan or the subsequent site-specific HSP.

2. ST-106, Kirtland AFB Bulk Fuels Facility

2.1 Characterization and Setting

2.1.1 Site Description

This Kirtland AFB Bulk Fuels Facility is located in the western part of Kirtland AFB. The site contains bulk storage for jet fuel (JP8), diesel fuel, and unleaded gasoline. Jet fuel is stored in two aboveground storage tanks (2.1 and 4.2 million gallons), diesel fuel is stored in two aboveground storage tanks (5,000 and 10,000 gallons), and unleaded gasoline is stored in one 10,000 gallon aboveground storage tank. The site has one JP8 off-loading rack (Building 2405) that has an annual throughput of approximately 20 to 25 million gallons of product. A second smaller off-loading rack location is used for the delivery of diesel and unleaded gasoline fuels. This rack is smaller and has a considerably smaller product throughput.

The fuel delivered to the JP8 off-loading rack (Building 2405) is conveyed to a pump house (Building 1033) via two 14-inch-diameter belowground transfer lines. The fuel is then pumped to the aboveground JP8 storage tanks by piping of varying sizes that is partially above and belowground. (see Figure 2-1 for a site location map).

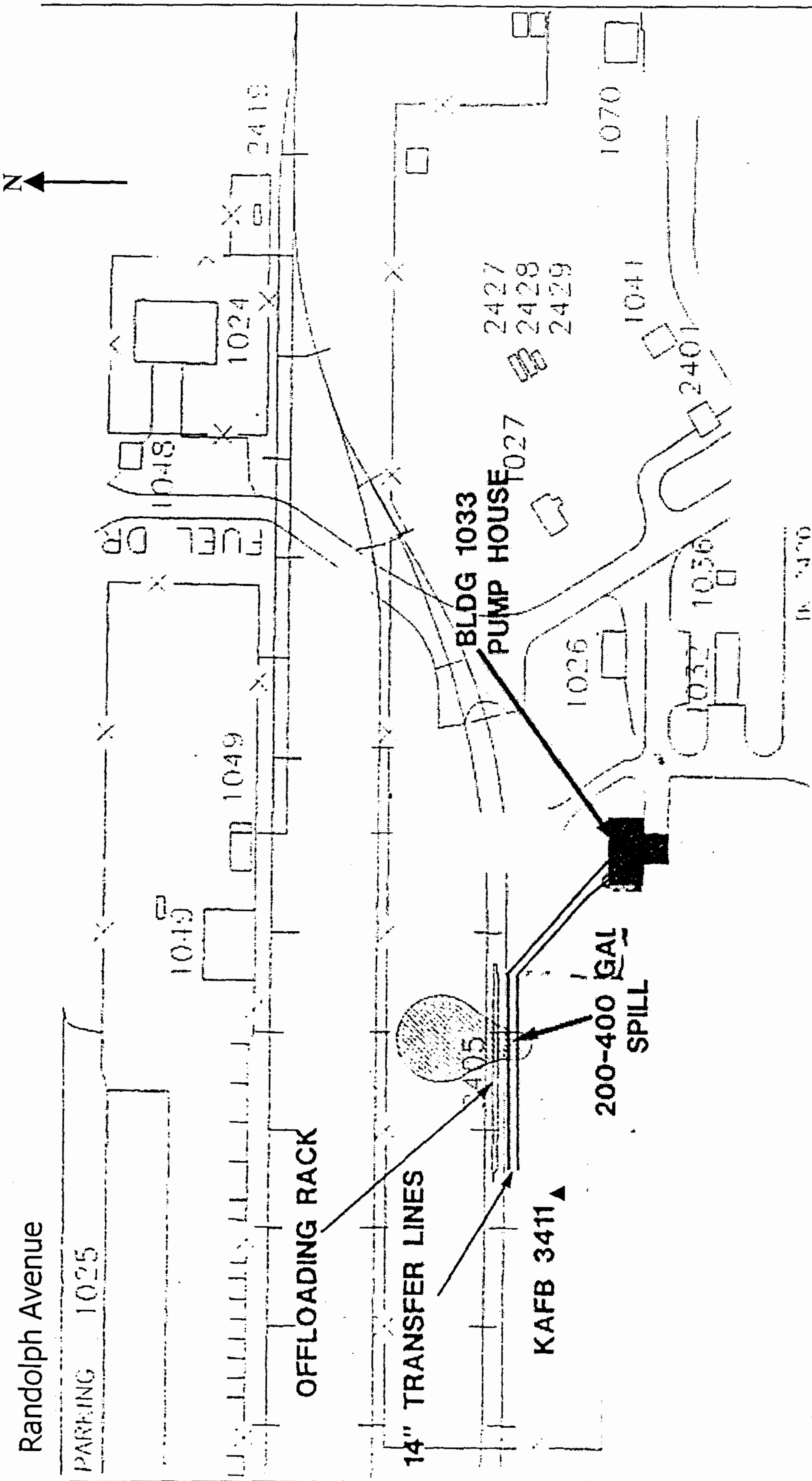
2.1.2 Operational History

The ST-106 facility provides bulk storage of jet fuel, diesel fuel, and unleaded gasoline. Fuels are delivered to the various off-loading racks and transferred to aboveground storage tanks. Refueling trucks routinely fill up at the facility and transport fuel as needed to the Base flightline.

In November 1999 three known discharges occurred from the lines that transfer fuel from the JP8 off-loading rack (Building 2405) to the pump house at the facility. The discharges included a failure of one of the 14-inch-diameter belowground transfer pipelines (pipeline #22) during a hydrostatic pressure test, failure of a cam-lock coupling during pressure test of the second belowground transfer pipeline (pipeline #23), and failure of the second belowground transfer pipeline (pipeline #23) during a hydrostatic pressure test after the cam-lock coupling problem had been corrected. The primary belowground transfer pipeline (pipeline #22) had been in a state of failure for an unknown duration and therefore the total amount of fuel released is unknown. The volumes of the second two discharges were estimated to be approximately 200 to 400 gallons, and 30 gallons, respectively. For all discharges the product released was JP8. Due to the failure of the belowground fuel pipelines from the main JP8 rack the main rack is currently not operating and an alternate off-loading rack location has been set up to allow delivery of fuel.

2.1.3 Waste Characteristics

The materials known or suspected to have been released at ST-106 are all petroleum hydrocarbon compounds, primarily JP8. Any releases that may have occurred before the Base switched to JP8 (approximately 1991) would have been JP4.



1 inch approximately equal to 138 ft.

Figure 2-1. ST-106 Kirtland AFB Bulk Fuels Facility Site Map

2.2 Investigatory Approach

2.2.1 Existing Data

2.2.1.1 Nonsampling Data

No nonsampling soil or groundwater data exist for ST-106.

2.2.1.2 Sampling Data

Previous investigations have been conducted under the Kirtland AFB IRP and as part of the Base's underground storage tank (UST) compliance upgrades at areas that are related to or located within the Kirtland AFB Bulk Fuels Facility. Data collected during these investigations is pertinent to the Stage I Abatement Plan investigation being conducted to address petroleum hydrocarbon releases from the facility. These previous investigations are summarized below.

Solid Waste Management Unit (SWMU) ST-341, Building 1033, Condensate Holding Tank RCRA Facility Investigations (RFIs)

A condensate holding tank, designated as SWMU ST-341, is located at Building 1033, which is the pump house building associated with ST-106. Several RCRA investigation phases have been conducted at the ST-341 site and data from these investigations is pertinent to the overall investigation of ST-106.

Previous investigations conducted at SWMU ST-341 include the Appendix III Phase 1 and Appendix III Phase 2 RFIs (USAF, 1995 and 1997). During the Appendix III Phase 1 RFI in July 1994, 29 soil samples were collected from six boreholes surrounding the condensate holding tank at Building 1033, one borehole located near the overflow pipe outflow line in a nearby evaporation pond, and one background borehole in an area away from any known or suspected sources of contamination. The six borings surrounding the condensate holding tank area adjacent to Building 1033 (ST-342C-02 through -06, and –08) are pertinent to the investigation of ST-106.

During the Phase 2 RFI in October and November 1996, 72 soil samples and five field replicates were collected from 16 boreholes at SWMU ST-341. Four boreholes were drilled using hollow stem augers or advanced by direct-push methods near the condensate holding tank, three direct-push boreholes were advanced along the overflow pipe, and nine boreholes were advanced or drilled in and around the evaporation pond. The four borings advanced near the condensate holding tank adjacent to Building 1033 (ST-341C-09, ST-341-14, -17, and -26) are pertinent to the investigation of ST-106, Bulk Fuels Facility.

Soil sampling results for the Appendix III Phase 1 and Phase 2 RFI soil boring locations applicable to the ST-106 Abatement Plan investigation are summarized below and provided in tables in Appendix A. Figure A-1 also is provided in Appendix A showing the soil boring locations from the Appendix III Phase 1 and Phase RFIs. Full analytical results are available in the Appendix III Phase 1 and Appendix III Phase 2 RFI reports (USAF, 1995 and 1997).

The 1994 Appendix III Phase 1 RFI revealed:

- Five volatile organic compounds (VOCs) (chlorobenzene, ethylbenzene, toluene, m-,p-xylene, and o-xylene) were detected in 15 samples at concentrations below current adjusted U.S. Environmental Protection Agency (EPA) Region 6 residential human health risk-based (HHRB) screening levels (for noncarcinogenic compounds the screening level is adjusted to 10 percent of the published value to account for possible additive effects from multiple compounds). The maximum detected concentration in any of the samples was a 150 milligram per kilogram (mg/kg) concentration of m,p-xylene.

- One or more of four semi-volatile organic compounds (SVOCs) were detected in three samples at concentrations exceeding the current EPA Region 6 HHRB residential screening levels. Benzo(a)anthracene (4.9 mg/kg, screening level 0.62 mg/kg), benzo(a)pyrene (1.8 mg/kg, screening level 0.062 mg/kg), benzo(b)fluoranthene (2.4 mg/kg, screening level 0.62 mg/kg), and indeno(1,2,3-c,d)pyrene (0.88 mg/kg, screening level 0.62 mg/kg) were found in the 9- to 10-ft interval of borehole ST-341C-03. Benzo(a)pyrene (0.30 mg/kg, screening level 0.062 mg/kg) was found in the 8- to 9-ft interval of borehole ST-341C-05. Benzo(a)anthracene (2.6 mg/kg, screening level 0.62 mg/kg), benzo(a)pyrene (0.85 mg/kg, screening level 0.062 mg/kg), and benzo(b)fluoranthene (1.5 mg/kg, screening level 0.62 mg/kg) were found in the 5- to 6-ft interval of borehole ST-341C-08.

- Diesel range organics (DROs) (5.2 to 2,000 mg/kg) were detected in 12 samples and gasoline range organics (GROs) (0.22 to 360,000 mg/kg) were detected in 16 samples. The NMED action level (100 mg/kg) was exceeded in nine samples by DROs and six samples by GROs.

The Appendix III Phase 1 RFI concluded that a contaminant release has occurred at ST-341. Petroleum hydrocarbon contamination was found to extend to at least 12 ft belowground surface (bgs) near the holding tank. Additional work was recommended to fully characterize the degree and extent of contamination at the site.

The 1996 Appendix III Phase 2 RFI revealed:

- Petroleum hydrocarbon concentrations (3,000 to 15,000 mg/kg of jet fuel A [an analytical "fingerprint" used to identify JP8], 920 to 1,700 mg/kg DROs, 1,100 to 7,600 mg/kg GROs) in excess of the NMED action level (100 mg/kg) were detected to 37 ft bgs near the holding tank.

- Potentially contaminated soils beneath Building 1033 were not investigated.

The Appendix III Phase 2 RFI recommended that a Corrective Measures Study (CMS) address contamination associated with the condensate holding tank.

1996 UST Investigation

A 250-gallon steel UST (designated UST 133) adjacent to the pump house (Building 1033) was used as the condensate holding tank until its removal in 1996. Upon removal the old UST was observed to be cracked and leaking. The UST was replaced with a 300-gallon UST situated in a concrete vault with an electronic leak monitoring system that is currently in use.

Following removal of the 250-gallon UST, soil samples were collected in accordance with the NMED UST Soil/Water Sampling and Disposal Guidelines. The analytical result for a soil sample collected from the center bottom of the excavation was reported as 18,000 parts per million (ppm) total petroleum hydrocarbons (TPH). An Onsite Investigation (OSI) was then performed to document the extent of the contamination. A drill was used to collect soil samples from the base of the excavation. Twenty soil samples were collected from the boring at continuous 5-ft depth intervals starting at 5 ft bgs and continuing to 100 ft bgs. All samples were analyzed for Jet Fuel A and GRO compounds using Method 8015 Modified. The analytical results for samples from 5, 10, 15, 20, and 25 ft bgs were, respectively, 480, 3,100, 1,600, <5.0, and 5.7 ppm for Jet Fuel A, and 410, 2,000, 1,100, <5.0, and 13 ppm for GRO compounds. All samples from the 30- to 100-ft depth had analytical results of less than the method detection level for both Jet Fuel A and GRO compounds.

November 1999 Release Activities

As stated earlier, a release occurred in November 1999 during hydrostatic pressure testing of the 14-inch-diameter belowground transfer lines from the JP8 off-loading rack. Approximately 76 cubic yards (cu yd) of stained surface soil from an approximately 25 ft x 75 ft area were excavated and disposed of offsite. The full details of the release response activities were provided in the 15-day notification of discharge report submitted to the NMED by Kirtland AFB on December 16, 1999.

2.2.2 Conceptual Model

2.2.2.1 Nature and Extent of Contamination

Data collected during the Appendix III RFIs of SWMU ST-341, the UST investigation of UST 133, and the investigation of the November 1999 release have concluded that soil contamination is present at ST-106. Sampling data indicate that the primary contaminant of concern is petroleum hydrocarbons.

2.2.2.2 Fate and Transport

Petroleum hydrocarbon contamination in the surface and near surface soils at ST-106 could pose a threat to human health and the environment through exposure to contaminated surface or subsurface soils if the area is disturbed or excavated. Contaminated surface and near-surface soils also could potentially migrate offsite due to wind or water erosion. Furthermore, since the vertical extent and magnitude of the soil contamination has not been fully delineated, it cannot be determined if the soil contamination poses a threat of impacting groundwater.

2.2.2.3 Data Gaps

The number of possible release locations and discrete areas within the Bulk Fuels Facility that may have negatively impacted soil has not been fully determined. Furthermore, the horizontal and vertical extents of petroleum hydrocarbon contamination has not been delineated in the area surrounding the site pump house (Building 1033) or any other undiscovered release areas.

2.2.3 Sampling Activities

2.2.3.1 Contaminant Source

The presumed source of the petroleum hydrocarbon contamination observed or potentially occurring in the soils at the site is releases from various operational components at the facility (i.e., releases from the condensate holding tank, leaks from belowground transfer lines, spills at the JP8 off-loading rack area).

2.2.3.2 Media Characterization

Surface and subsurface soil contamination will be characterized by conducting a soil gas survey to identify potential areas of soil contamination and then collecting surface and subsurface soil samples from 21 investigative direct-push and hollow stem auger drill boreholes. Samples will be collected in accordance with the Standard Operating Procedure (SOP) in the Base-Wide Plan (SOP A1.6), except as modified by this Abatement Plan. The soil sampling SOP is included in Appendix B to this Abatement Plan.

3. DATA COLLECTION DESIGN AND PROCEDURES

3.1 Data Quality Objectives (DQOs)

The DQOs development process outlined in the Kirtland AFB Base-Wide Plan DCQAP Part II QAPP Section 4.1.1 has been employed to develop the DQOs for this investigation. The process is described below:

1. *Statement of Problem*
   Known petroleum hydrocarbon releases occurred at the Kirtland AFB ST-106 Bulk Fuels Facility and were reported in November 1999. Furthermore, other undocumented historic releases may have occurred at the site as well. The horizontal and vertical extent, nature, and magnitude of possible petroleum hydrocarbon contamination in vadose-zone soils at ST-106 Kirtland AFB Bulk Fuels Facility needs to be determined and a conceptual site model of the site geology, hydrogeology, and surface water hydrology needs to be developed to allow evaluation of whether contamination presents a risk to human health or the environment.

2. *Identification of a Decision that Addresses the Problem*
   The horizontal and vertical extent of petroleum hydrocarbon contamination in the soils at ST-106 can be determined by collecting and analyzing surface and subsurface soil samples and evaluating whether or not the sample results are indicative of the presence of contamination. In addition, a soil gas survey at the site can be used as a screening tool at the site to identify other possible areas of undocumented subsurface soil contamination. Areas of concern at the site will be investigated by collecting and analyzing soil samples. The extent of the petroleum hydrocarbon contamination in a given area will be established, when uncontaminated soil samples are collected laterally, on four sides of the area, and vertically, and analyzed for the contaminants of concern.

   A decision on an applicable site conceptual model will be based on site-specific data gathered during the field investigation activities as well as review of available regional and site-specific geologic, hydrogeologic, and surface water hydrologic data from previous investigations.

3. *Identification of Inputs that Affect the Decision*
   Inputs that will affect the decision of whether or not soil samples from areas within the ST-106 facility are uncontaminated include the analytical results for collected soil samples, established regional background concentrations in soil (non-detect for petroleum hydrocarbons), established EPA Region 6 HHRB soil screening levels, NMED-approved Kirtland AFB background values, and NMED action levels.

   Inputs that will affect the decision of what constitutes an appropriate site conceptual model will include the applicability of available regional geologic, hydrogeologic, and surface water hydrologic data.

4. *Specification of the Domain of the Decision*
   The domain of the decision of whether or not soils at the Fuels Management Facility have been negatively impacted is restricted to evaluation of only those soil parameters for which samples are analyzed; for which regional background data are available; and for which a regulatory standard (i.e., EPA Region 6 HHRB screening level) exists.

The domain of the decision of an applicable site conceptual model for the ST-106 facility is limited to those areas for which data are collected or available.

5. *Development of a Logic Statement*
If the analytical data for soil samples collected during this Stage I Abatement Plan investigation exceed existing screening levels or action levels and such exceedances cannot be attributed to regionally occurring, background concentrations for a given compound, the area or depth from which the soil sample was collected will be considered contaminated and additional horizontal and/or vertical delineation will be required until uncontaminated samples are collected.

If the data collected during this investigation and available data from previous investigation at and near the site provide geologic, hydrogeologic, and surface water data applicable to the site conditions at the facility, then those data will be deemed pertinent and representative in the development of a site conceptual model.

6. *Establishment of Constraints on Uncertainty*
Uncertainty in the data used to evaluate the logic statements will be constrained by following the applicable SOPs and quality assurance/quality control (QA/QC) guidelines specified in the Base-Wide Plan; selecting the appropriate analytical support level for the soil sample data; and by adhering to both the field and laboratory data quality indicator (precision, accuracy, representativeness, completeness, comparability [PARCC]) objectives discussed in the Base-Wide Plan DCQAP Part II QAPP Section 4.2, and evaluation of the applicability of available regional data.

7. *Optimization of Design for Obtaining Data*
To optimize the quality of data collected for evaluation, this Abatement Plan has been developed to be used as guidance during the investigation. Furthermore, field activities will be conducted as specified by the applicable sections of the Base-Wide Plan FSP and SOPs unless specifically modified in this Abatement Plan, or in the site-specific HSP.

3.2 Quality Assurance/Quality Control (QA/QC)

The QA/QC practices specified in the Kirtland Base-Wide Plan FSP and QAPP will be followed during all sampling activities unless specifically modified in this Abatement Plan, or in the site-specific HSP.

3.3 Investigation Activities

The main field investigation associated with this project will include advancing several boreholes across the site and collecting soil samples in areas that are known or possible sources of historic petroleum product discharges. As a further screening tool, a soil gas survey will be employed to further assist in identifying possible areas of undocumented historic releases. In addition to information generated during the field investigation, available regional and site-specific geologic, hydrogeologic, and surface water hydrologic data will be collected and evaluated. Surrounding water wells within a 1-mi radius of the site will also be inventoried and evaluated for potential impacts from the releases at the ST-106 facility.

The investigation activities that will be conducted are as follows:

- Collection and analysis of surface and subsurface soil samples

- Collection and analysis of soil gas samples
- Collection and evaluation of regional and site-specific geologic, hydrogeologic, and surface water data
- Inventory and evaluation of available information for wells within a 1-mi radius of the site

Detailed discussions of the investigation activities are presented in two separate sections below. One section addresses the program proposed to investigate the areas of the known releases reported during November 1999 and a second section addresses activities proposed to further evaluate the site as a whole for other areas of undocumented historic releases.

3.3.1 Soil Sampling Program to Address November 1999 Reported Releases

Soil sampling will be conducted to delineate the nature, extent, and magnitude of petroleum hydrocarbon contamination associated with the documented November 1999 releases at the ST-106 facility. The two specific areas associated with the documented November 1999 petroleum hydrocarbon releases within the facility will be investigated by advancing soil borings using a direct-push or hollow stem auger drill technique. These areas will include the area of the documented November 1999 JP8 surface and shallow subsurface releases, and the lengths of the 14-inch-diameter belowground transfer lines that convey fuel from the off-loading rack to the pump house (specifically Pipeline #22) that had been in a state of failure for an undetermined period of time. Attempts will be made to advance all of the proposed soil borings using the direct-push drill rig. If at certain locations the direct-push drill rig is unable to achieve the necessary boring depths a hollow stem auger drill rig will be used. A sample of JP8 fuel will be supplied to the analytical laboratory as a standard against which to "fingerprint" the petroleum hydrocarbon materials identified in soil sample to allow differentiation between the recent, documented JP8 releases and possible historic releases of older and/or different petroleum hydrocarbon products.

Proposed soil boring locations are shown on Figure 3-1. Soil sample collection will follow those procedures specified in the Base-Wide Plan SOP A1.6. Sample locations, depths, and analytical parameters are summarized below:

- Five boreholes will be advanced in the area of the November 1999 surface and shallow subsurface release – one central boring and four lateral borings oriented approximately 50 ft to the north, south, east, and west of the central boring. The central boring will be placed in the center of the spill area and is anticipated to be approximately 40 ft bgs. The lateral borings will be advanced to the depth of the deepest positive headspace reading observed in the central boring and are anticipated to be approximately 30 ft bgs. If headspace and/or analytical laboratory results from lateral boring samples indicate that the horizontal extent of contamination in a given direction has not been constrained and additional lateral boring will be installed in that direction.
- Seven soil borings will be installed along the length of 14-inch-diameter belowground pipelines that transfer fuel from the JP8 off-loading rack to the pump house to address releases associated with the known failure of these transfer lines. The borings will be spaced every 50 ft along the 300-ft length of the lines. There are two transfer lines but it is assumed that the lines are immediately adjacent to each other and can be investigated at the same time. Each boring is anticipated to be approximately 30 ft bgs. If the soil gas survey findings indicate that a release may have occurred at a specific location along the transfer lines length, additional borings at a

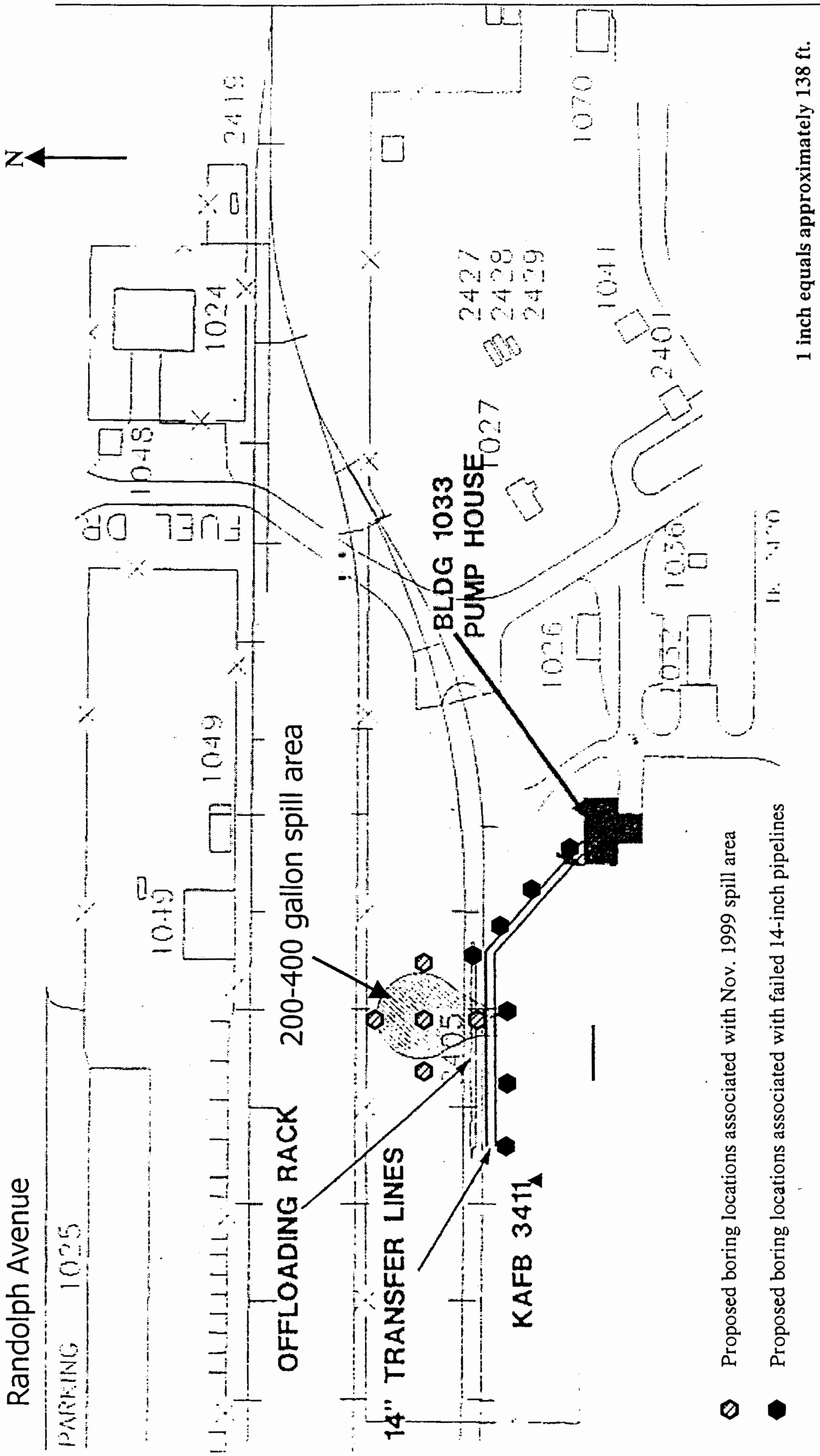


Figure 3-1. ST-106 Kirtland AFB Bulk Fuels Facility Proposed Soil Boring Locations Related to November 1999 Documented Releases

tighter spacing may be installed in that area. Careful review of facility drawings, discussions with operations personnel, and use of a metal detector to determine the locations of the belowground lines will assist in avoiding puncturing or damaging a belowground pipeline.

- At each soil boring location soil samples will be collected at 5-ft intervals and a field headspace analysis will be done using a photoionization detector (PID). Borings will be advanced until two consecutive soil samples display no headspace reading (~0 ppm). At each boring location two soil samples will be selected and submitted for laboratory analysis. The soil samples that will be selected for laboratory analysis will include the sample collected from the maximum depth interval of a given boring and a sample from the interval that displayed the highest headspace reading.

- All soil samples will be analyzed for TPH by EPA Method 8015 Modified and benzene, toluene, ethylbenzene and xylenes (BTEX) by EPA Method 8020. In addition, the sample from the central vertical delineation boring in the November 1999 release area with the highest TPH concentration and the sample from the seven borings installed along the belowground transfer lines with the highest TPH concentration will be analyzed for SVOCs by EPA Method 8270. The appropriate QA/QC samples as specified in the Base-Wide Plan will be collected and analyzed by the analytical laboratory selected for the project. The substitution of SW846 Update III equivalent analysis methods will be acceptable if requested by the laboratory.

- Following completion of drilling, boreholes will be properly abandoned by backfilling with any remaining soil cuttings and then filling the remaining borehole space with bentonite powder and the horizontal location of all soil borings will be surveyed.

- Drill cuttings will be managed as outlined in the IDWMP section of this Abatement Plan.

Tables 3-1 and 3-2 summarize the proposed sampling related to the documented November 1999 releases at ST-106, Bulk Fuels Facility.

Table 3-1. Proposed Sampling To Address November 1999 Documented Releases

Data Needs	Investigative Technique	Location	Number of Samples	Analyses	Selected Analytical Options[a]
Determine horizontal and vertical extent of possible petroleum hydrocarbon contamination from November 1999 JP8 release area Determine horizontal and vertical extent of possible petroleum hydrocarbon contamination along length of 14-inch belowground lines	Drill five boreholes with a direct-push drill rig and collect soil samples at 5-ft intervals to a depth of 40 ft bgs for the central boring and 30 ft bgs for the lateral borings Advance seven boreholes with a direct-push drill rig at 50-ft intervals along length of belowground transfer lines and collect soil samples at 5-ft intervals to a depth of 30 ft bgs	ST-106	~24 environmental soil samples ~2 duplicate soil samples ~ 1 matrix spike/matrix spike duplicate soil samples ~ 1 equipment blanks during soil sample program	TPH BTEX SVOCs	Level II

Table 3-2. Summary of Analytical Parameters to Address November 1999 Documented Releases

Sample Number[a]	TPH EPA 8015 Modified	BTEX EPA 8020	SVOCs EPA 8270
ST106-SB-01-xxxx and –yyyy [b]	2	2	1
ST106-SB-02-xxxx and –yyyy	2	2	
ST106-SB-03-xxxx and –yyyy	2	2	
ST106-SB-04-xxxx and –yyyy	2	2	
ST106-SB-05-xxxx and –yyyy	2	2	
ST106-SB-06-xxxx and –yyyy	2	2	1
ST106-SB-07-xxxx and –yyyy	2	2	1
ST106-SB-08-xxxx and –yyyy	2	2	1
ST106-SB-09-xxxx and –yyyy	2	2	1
ST106-SB-10-xxxx and –yyyy	2	2	1
ST106-SB-11-xxxx and –yyyy	2	2	1
ST106-SB-12-xxxx and –yyyy	2	2	1
QC Samples [c]			
Equip Rinsate [d]	1	1	1
Field Duplicate [e]	2	2	1
MS/MSD Samples [f]	1	1	1
Trip Blank		1	
Total Samples	28	29	12

[a] *Sample Number* denotes site designation–matrix–sample location-sampling event number; (i.e., sample number ST106- SB-01-0002 would be a subsurface soil sample collected at ST-106 from boring location 01 from the 0- to 2-ft interval bgs).

[b] The depth intervals of the two samples collected for laboratory analysis from each boring location will be based on the total depth of the boring and the field headspace readings.

[c] Estimated field QC samples.

[d] *Equipment Rinsate Blanks*—Collected for each type of nondedicated sampling equipment used and analyzed for the same parameters as the samples they are used to collect. Equipment blanks will be collected and sent to the laboratory on a daily basis. Only equipment blanks collected every other day will be analyzed.

[e] *Field Duplicates*—A field duplicate sample is a second sample collected at the same location as the original sample and is collected simultaneously or in immediate succession. Collected at a frequency of 10% of the total number of samples for chemical analyses, or daily, whichever results in more samples, and analyze for the same parameters as equivalent samples.

[f] *Matrix Spike/Matrix Spike Duplicate* (MS/MSD) for laboratory quality control, collected 1 in 20 samples (5 percent frequency).

3.3.2 Soil Sampling Program to Address Possible Undocumented Historic Releases

Additional soil boring locations as well as a soil gas screening survey are proposed to investigate the possibility of other areas of undocumented historic releases at the ST-106 facility. It is unknown if any such areas exist, but age of the facility and the amount of petroleum hydrocarbon product that is moved through the facility suggests that there may have been other undocumented or unknown releases that occurred in the past. Therefore, to provide a comprehensive evaluation of the nature and extent of contamination at this site, it is necessary to supplement the investigation of the known releases that were documented in November 1999 with some additional investigation of the facility as a whole.

3.3.2.1 Soil Gas Screening Survey

The initial phase of the field investigation to investigate undocumented historic releases at the facility will be a soil gas screening survey. This screening survey will assist in identifying undocumented areas of possible historic hydrocarbon releases. The petroleum hydrocarbon fuels (i.e., JP8) currently used at the site are primary a kerosene-based product, which is not readily identifiable in a soil gas matrix because the components are not highly volatile. However, some components of JP8 fuel may be detectable in soil gas. Furthermore, JP4, which was used at the site prior to approximately 1991, would be identifiable in a soil gas survey as would standard gasoline, which is currently and has been historically dispensed at the facility as well. Therefore, unlike the November 1999 releases that have the location and type of product releases well documented, since there is no guidance on areas of possible historic releases use of a screening tool such as a soil gas survey may be useful. The soil gas survey results will not be used in lieu of or to reduce or to eliminate any of the soil boring sampling activities proposed.

A direct-push drill technique will be used to advance a soil gas sampling probe to approximately 5 to 10 ft bgs and a soil gas sample will be collected and analyzed immediately by an onsite laboratory. Soil gas samples will be analyzed for a standard suite of VOCs including benzene, toluene, ethylbenzene, xylenes, total volatile petroleum hydrocarbons, and chlorinated solvents. Chlorinated solvents are not expected as contaminants of concern but these data can easily be gathered during the investigation so they will be included in the analytical suite. The soil gas survey will be a screening tool to assess the possible presence of not only JP8 but also other products that are or have been historically present at the site (including gasoline, diesel fuel, and JP4 jet fuel). It is anticipated that low-level petroleum hydrocarbon soil gas hits may occur across the site due to the nature of site operations and the presence of known contaminated areas. The soil gas survey will be conducted on a gridded pattern and the results will then be reviewed to determine if a plume of elevated soil gas concentration occurs in a specific area(s) indicating the possible presence of an undocumented release. The details of the soil gas survey are presented below. Figure 3-2 shows the anticipated soil gas sampling grid pattern.

- The soil gas survey activities will be focused in three specific areas of the facility where undocumented releases could have potentially occurred. These areas include the approximately 250-ft x 100-ft area surrounding the JP8 off-loading rack (the possible historic release(s) in this area includes general spillage or overfill), the approximately 150-ft x 150-ft area surrounding the pump house (Building 1033) (the possible historic release(s) in this area would be releases from the pumphouse equipment and the associated condensate holding tank), and the approximately 250-ft x 250-ft area between the pump house and the aboveground storage tank area at the site (the possible historic release in this area would be releases from the belowground piping although that piping was not found to have failed a pressure test).

- Within each area of interest, the soil gas sample locations will initially be laid out on a grid spacing of approximately 50-ft x 50-ft. Based on soil gas results reported during the survey, the grid spacing may be expanded or tightened in areas of interest.

- Approximately 60 to 75 soil gas samples are anticipated to be collected and analyzed by the onsite laboratory. If during the early implementation of the screening survey it is apparent that the petroleum hydrocarbon fuels at the site are not being well identified in the soil gas matrix due to the limited volatility of these products, the remainder of the screening survey may be eliminated.

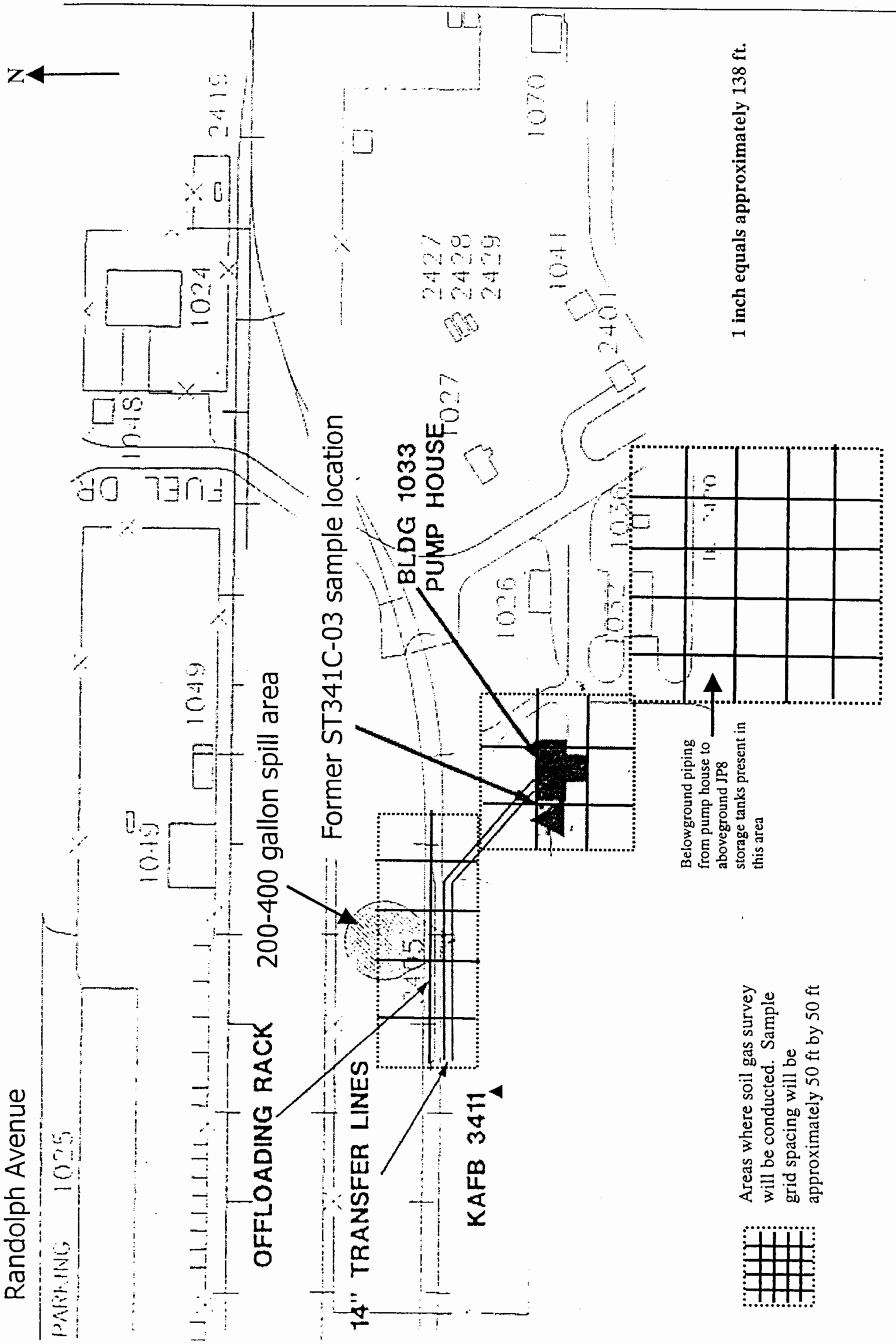


Figure 3-2. ST-106 Kirtland AFB Bulk Fuels Facility Proposed Soil Gas Sample Locations

3.3.2.2 Soil Sampling

In addition to unknown areas of historic releases that will potentially be identified during the soil gas screening survey, there are also two additional areas that are likely candidates of possible historic releases that will be investigated with a soil boring program. These areas include the area immediately surrounding the JP8 off-loading rack where it is suspected that historic spills or overfills may have occurred and the pump house (Building 1033) area where soil contamination was identified in previous RCRA Appendix III investigations. It is felt that these areas have a high likelihood of historic releases and therefore while a drill rig is mobilized to the site, soil borings will be advanced in these areas to more fully define possible contamination.

Attempts will be made to differentiate any contamination that may be associated with the documented November 1999 releases and possible historic undocumented releases. It is felt that spatial separation of the November 1999 release areas and the possible historic release areas will allow discrete subinvestigations to be conducted in those areas. Also, analytical analyses will be used to attempt to "fingerprint" the nature of the petroleum hydrocarbon contamination encountered in different areas. The degree of weathering and possible different chemical nature of the material released (i.e., JP8, weathered JP4, diesel, gasoline) should allow some resolution between separate subplumes of impacted soils.

If during the implementation of the soil gas survey discussed above additional areas that may have subsurface petroleum hydrocarbon contamination are identified, additional soil borings may be advanced to investigate those areas as well. Although the soil gas screening is proposed in the area between the pump house and the aboveground storage tanks at the site, no actual soil boring locations are proposed in that area at this time. Since the integrity line testing of the belowground lines that run from the pump house to the aboveground tanks did not indicate a failure of those lines, installation of soil borings in that area is not warranted at this time. Evaluation of the area, which has the potential for a release, with the soil gas survey will help provide a comprehensive survey of the entire facility while concentrating the actual investigation activities in the areas of the known release. If contamination in the area between the pump house and the aboveground storage tanks is indicated by the soil gas survey, further investigation would be conducted during a second phase of the project.

Proposed soil boring locations are shown on Figure 3-3. Soil sample collection will follow those procedures specified in the Base-Wide Plan SOP A1.6. Sample locations, depths, and analytical parameters are summarized below:

- Five boreholes will be advanced in the JP8 off-loading rack area – one central boring, three lateral borings oriented approximately 50 ft to the northwest, southwest, and southeast of the central boring, and one boring at the eastern end of the off-loading rack in the location of the observed pipeline release. Only three lateral borings are proposed for this area because it is assumed that the borings installed around the November 1999 spill area will contribute to constraining the lateral extent of contamination associated with the off-loading rack. The central boring will be placed as close as possible to the middle of the off-loading rack area and the depth is anticipated to be approximately 40 ft bgs. The lateral borings will be advanced to the depth of the deepest positive headspace reading observed in the central boring and are anticipated to be approximately 30 ft bgs. If headspace and/or analytical laboratory results from lateral boring samples indicate that the horizontal extent of contamination in a given direction has not been constrained and additional lateral boring will be installed in that direction.

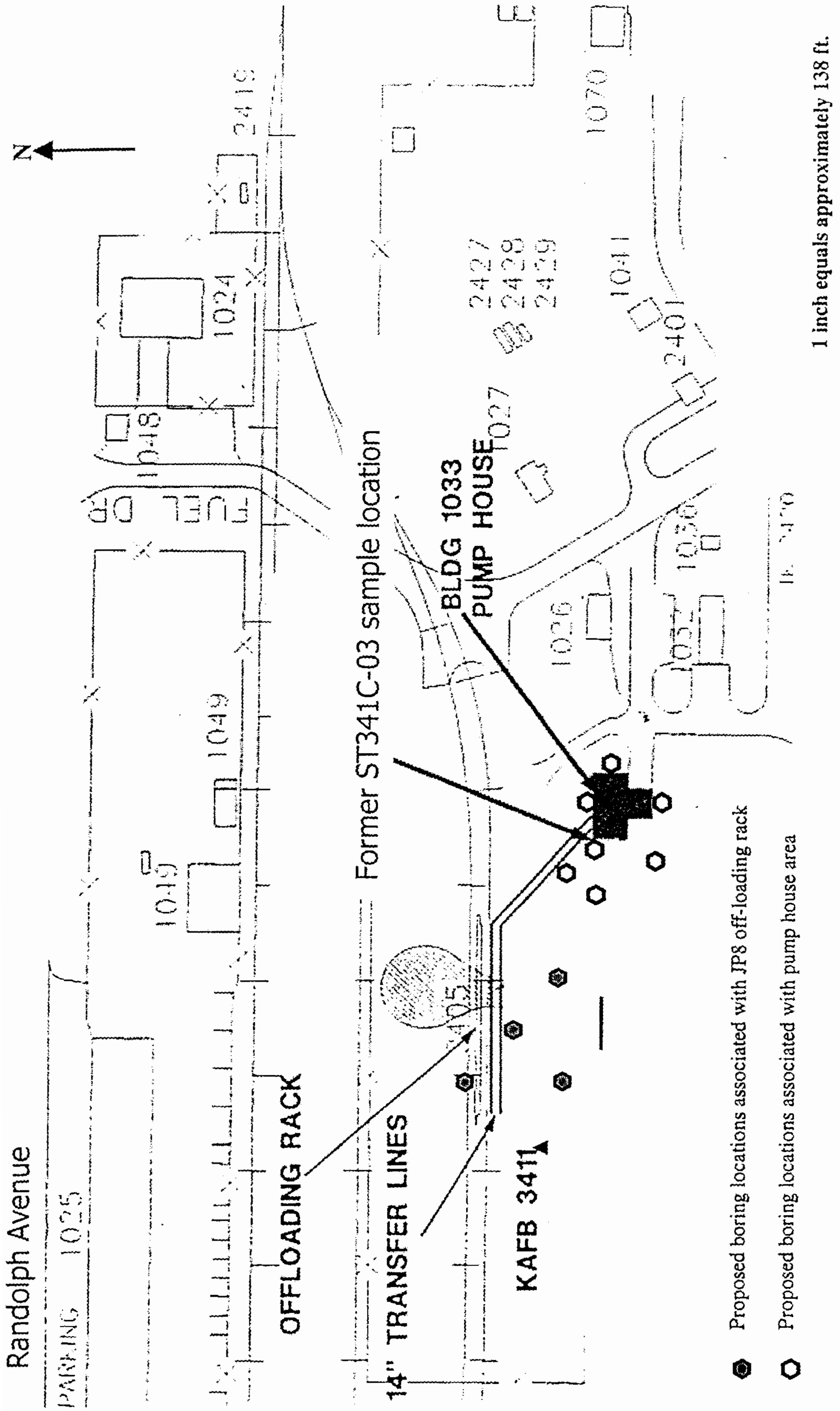


Figure 3-3. ST-106 Kirtland AFB Bulk Fuels Facility Proposed Soil Boring Locations Related to Possible, Undocumented Historic Releases

- Seven boreholes will be advanced in the pump house area (Building 1033). Analytical results from ST-341C-03 for the interval from 9 to 10 ft bgs indicated a GRO concentration of 360,000 mg/kg; however, no samples were collected from greater depths at that location to constrain the vertical extent of petroleum hydrocarbon contamination. Two additional boreholes (ST-341-14 and -17) were installed in the condensate holding tank area during the Appendix III Phase 2 RFI using a hollow stem auger drill rig and were advanced to 87 and 97 ft bgs with samples collected at 10-ft intervals. Petroleum hydrocarbon contamination was found in boring ST-341-14 to -37 ft bgs. However, neither ST-341-14 nor -17 were installed in the central portion of the area with the highest petroleum hydrocarbon concentrations identified during the Appendix III Phase 1 investigation. A single borehole installed as part of the UST 133 investigation in 1996 was advanced to 100 ft bgs. Samples were collected at 5-ft intervals from 0 to 100 ft bgs. TPH concentrations in excess of the NMED 100 mg/kg action level were present in samples from 5 to 15 ft bgs.

  To verify the vertical extent of contamination in this area an additional vertical delineation boring centered at the former ST-341C-03 location is proposed. The depth of the vertical delineation boring is anticipated to be approximately 50 ft bgs. Depending on geologic conditions at the site this borehole may need to be installed using a hollow stem auger drill rig.

  The horizontal extent of petroleum hydrocarbon contamination detected in multiple borings in the area of the condensate holding tank was not fully constrained in any direction during the Appendix III RFIs or the UST investigation. Therefore, six lateral borings around the condensate holding tank location and the pump house will be installed. A boring will be installed approximately 30 ft north-northwest of former boring ST-341C-03, approximately 40 ft west of ST-341C-03, and approximately 30 ft south of former boring ST-341C-08. Also three borings, will be installed around the pump house itself, one approximately 10 ft east of the eastern side of Building 1033, one approximately 10 ft north of the northern side of the building, and one approximately 10 ft south of the southern side of the building. The lateral borings will be advanced to at least the depth of the deepest positive headspace reading observed in the central boring and are anticipated to be approximately 40 ft bgs. If headspace and/or analytical laboratory results from lateral boring samples indicate that the horizontal extent of contamination in a given direction has not been constrained, an additional lateral boring will be installed in that direction.

- At each soil boring location soil samples will be collected at 5-ft intervals and a field headspace analysis will be done using a PID. Borings will be advanced until two consecutive soil samples display no headspace reading (~0 ppm). At each boring location two soil samples will be selected and submitted for laboratory analysis. The soil samples that will be selected for laboratory analysis will include the sample collected from the maximum depth interval of a given boring and a sample from the interval that displayed the highest headspace reading.

- All soil samples will be analyzed for TPH by EPA Method 8015 Modified and benzene, toluene, ethylbenzene and xylenes (BTEX) by EPA Method 8020. The samples collected from the area around the pump house will also be analyzed for Methyl Tertiary Butyl Ether (MTBE) to address possible gasoline contamination that may have been historically released in that area. In addition, the sample from each central vertical delineation boring with the highest TPH concentration will be analyzed for SVOCs by EPA Method 8270. The appropriate QA/QC samples as specified in the Base-Wide Plan will be collected and analyzed by the analytical laboratory selected for the project. The substitution of SW846 Update III equivalent analysis methods will be acceptable if requested by the laboratory.

- Following completion of drilling, boreholes will be properly abandoned by backfilling with any remaining soil cuttings and then filling the remaining borehole space with bentonite powder and the horizontal location of all soil borings will be surveyed.

- Drill cuttings will be managed as outlined in the IDWMP section of this Abatement Plan.

Tables 3-3 and 3-4 summarize the proposed sampling at ST-106, Bulk Fuels Facility.

Table 3-3. Proposed Sampling to Address Possible Undocumented Historic Releases

Data Needs	Investigative Technique	Location	Number of Samples	Analyses	Selected Analytical Options[a]
Survey potential or known facility release areas for indication of subsurface petroleum hydrocarbon contamination	Conduct soil gas survey in 250-ft x 100-ft area surrounding the JP8 off-loading rack, 150-ft x 150-ft area surrounding pump house, and 250-ft x 125-ft area between pump house and aboveground JP8 storage tanks. Soil gas sample locations will be spaced on a 50-ft x 50-ft grid.	ST-106	60-75 soil gas samples	TPH VOCs	Level II
Determine horizontal and vertical extent of possible petroleum hydrocarbon contamination at JP8 off-loading rack area Determine horizontal and vertical extent of petroleum hydrocarbon contamination identified during Appendix III RFIs in pump house (Building 1033) area	Drill five boreholes with a direct-push drill rig and collect soil samples at 5-ft intervals to a depth of 40 ft bgs for the central boring and 30 ft bgs for the lateral borings Drill five boreholes with a direct-push or hollow stem auger drill rig and collect soil samples at 5-ft intervals to a depth of 50 ft bgs for the central boring and 40 ft bgs for the lateral borings		~20 environmental soil samples ~2 duplicate soil samples ~ 1 MS/MSD soil samples ~ 1 equipment blanks during soil sample program	TPH BTEX SVOCs	

[a] Refers to the type of data package from the analytical laboratory. Level I/Level II data packages are defined by the Air Force Center for Environmental Excellence (AFCEE) contract; the Level II report is equivalent to an EPA Contract Laboratory Program (CLP) report.

Table 3-4. Summary of Analytical Parameters to Address Possible Undocumented Historic Releases

Sample Number[a]	TPH EPA 8015 Modified	BTEX EPA 8020	SVOCs EPA 8270	Halocarbons and Hydrocarbons (soil gas)
ST106-SG01 through SG75				●
ST106-SB-13-xxxx and –yyyy[b]	2	2	1	
ST106-SB-14-xxxx and –yyyy	2	2		
ST106-SB-15-xxxx and –yyyy	2	2		
ST106-SB-16-xxxx and –yyyy	2	2		
ST106-SB-17-xxxx and –yyyy	2	2	1	
ST106-SB-18-xxxx and –yyyy	2	2		
ST106-SB-19-xxxx and –yyyy	2	2		
ST106-SB-20-xxxx and –yyyy	2	2		
ST106-SB-21-xxxx and –yyyy	2	2		
ST106-SB-22-xxxx and –yyyy	2	2		
ST106-SB-23-xxxx and –yyyy	2	2		
QC Samples [c]				
Equip Rinsate [d]	1	1	1	
Field Duplicate [e]	2	2		
MS/MSD Samples [f]	1	1		
Trip Blank		1		
Total Samples	26	27	3	60-75

[a] ***Sample Number*** denotes site designation–matrix–sample location-sampling event number; (i.e., sample number ST106-SB-01-0002 would be a subsurface soil sample collected at ST-106 from boring location 01 from the 0- to 2-ft interval bgs).

[b] The depth intervals of the two samples collected for laboratory analysis from each boring location will be based on the total depth of the boring and the field headspace readings.

[c] Estimated field QC samples.

[d] ***Equipment Rinsate Blanks***—Collected for each type of nondedicated sampling equipment used and analyzed for the same parameters as the samples they are used to collect. Equipment blanks will be collected and sent to the laboratory on a daily basis. Only equipment blanks collected every other day will be analyzed.

[e] ***Field Duplicates***—A field duplicate sample is a second sample collected at the same location as the original sample and is collected simultaneously or in immediate succession. Collected at a frequency of 10% of the total number of samples for chemical analyses, or daily, whichever results in more samples, and analyzed for the same parameters as equivalent samples.

[f] ***MS/MSD*** for laboratory quality control, collected 1 in 20 samples (5 percent frequency).

3.3.3 Regional and Site Data Review

Available data on regional and site-specific geologic, hydrogeologic, and surface water hydrology conditions will be collected, reviewed, and evaluated. Also, an inventory of existing wells within a 1-mile radius of the site will be compiled. Review of these data will provide information on potential fate and transport and migration rate of contamination if it were to reach the regional groundwater table. Surface water hydrology and general site conditions and descriptions will allow evaluation of potential for contaminated soil to impact surface water bodies or human health or the environment due to site runoff.

4. PROJECT MANAGEMENT

4.1 Project Scheduling and Reporting Requirements

A summary of the expected schedule for conducting the Abatement Plan investigation activities is presented below. A more detailed graphic schedule also is attached (Figure 4-1).

Prepare and submit Stage 1 Abatement Plan	17 April 00
Investigation field work	8 May 00 - 26 May 00
Prepare and submit draft Investigation Report	10 July 00
Kirtland AFB review of draft Report	10 July 00 - 14 July 00
Revise and submit final Investigation Report	21 July 00

4.2 Health and Safety Plan

A site-specific HSP addendum to the Kirtland AFB Base-Wide HSP will be prepared. Health and safety practices specified in the Kirtland AFB Base-Wide HSP will be adhered to unless modified by the site-specific HSP addendum.

4.3 Investigation-Derived Waste Management Plan (IDWMP)

The following categories of investigation-derived waste (IDW) will be generated during the investigation: soil cuttings from soil borings and used personal protective equipment (PPE). Characterization and disposal of IDW will adhere to those guidelines set forth in the IDWMP portion of the Kirtland AFB Base-Wide Plan, unless modified by this Abatement Plan, or the site-specific HSP. Specific IDW characterization and disposal procedures and modifications are summarized below:

4.3.1 Soil Cuttings

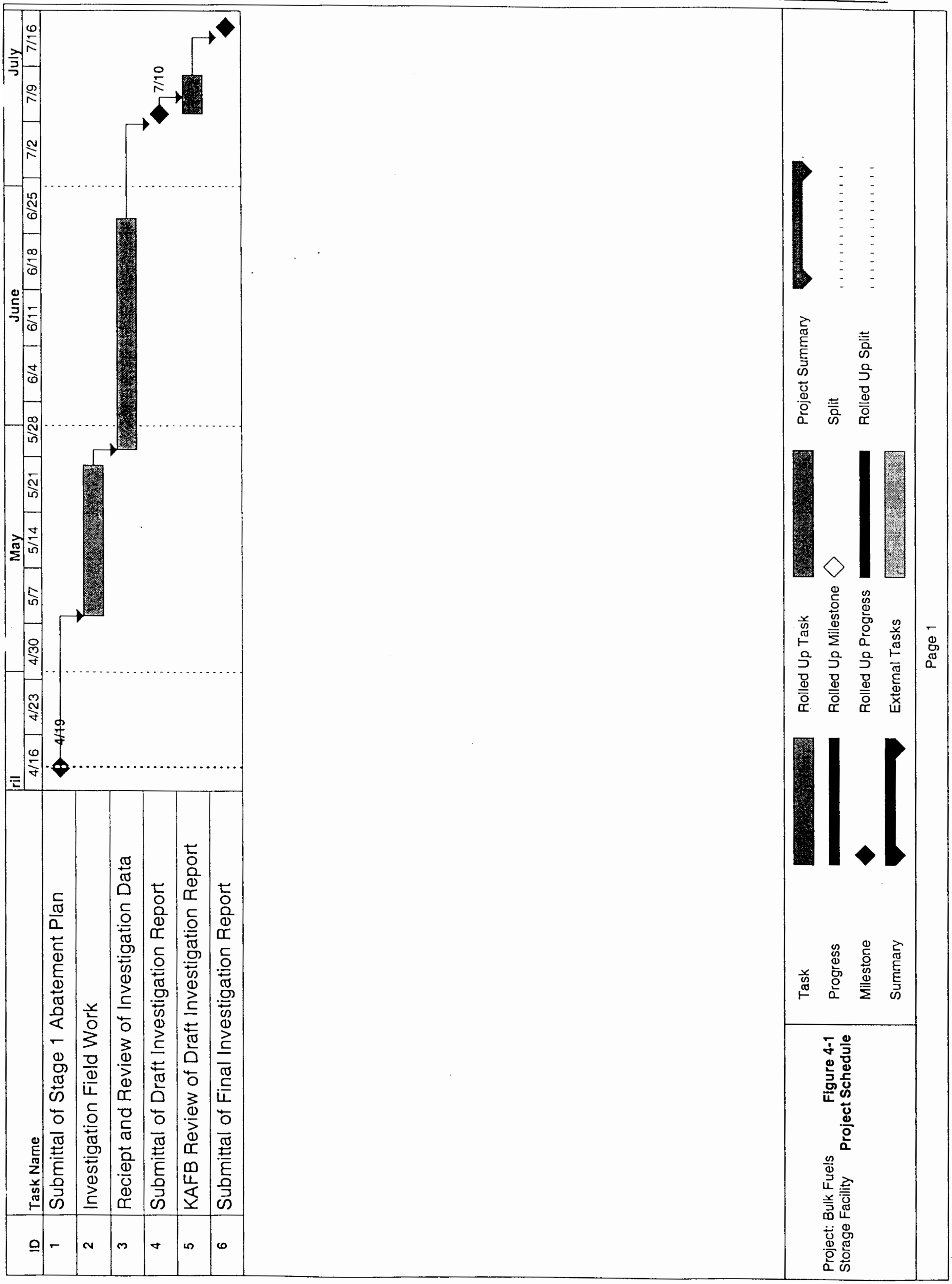
Any generated soil cuttings material from direct-push borehole advancement that is not collected as soil samples for analysis will be returned to the borehole after drilling is complete. Any generated soil cuttings from hollow stem auger borehole advancement will be drummed and held onsite pending receipt of analytical data. If upon receipt of analytical data the drummed cuttings are determined to be uncontaminated, the cuttings will be spread onsite, if it is acceptable to the facility manager. If the cuttings have less than 1,000 mg/kg petroleum hydrocarbon concentrations, they will be disposed of at the Kirtland AFB landfill. If analytical results indicate the soil cuttings contain petroleum hydrocarbon concentrations greater than 1,000 mg/kg they will be disposed of at appropriate off-Base facility.

4.3.2 PPE

Generated PPE from site activities will be treated and disposed of as domestic waste unless there is indication that it is severely contaminated (i.e., gross staining, soil cuttings displayed PID hits). If observations indicate that soil that contacted the PPE is severely contaminated, PPE will be contained and labeled and an appropriate facility for PPE disposal will be selected.

4.4 Community Relations Plan (CRP)

The CRP portion of the Kirtland AFB Base-Wide Plan will be adhered to during implementation of the Abatement Plan investigation.


ID
Task Name
1
Submittal of Stage 1 Abatement Plan
2
Investigation Field Work
3
Reciept and Review of Investigation Data
4
Submittal of Draft Investigation Report
5
KAFB Review of Draft Investigation Report
6
Submittal of Final Investigation Report
ril
May
June
July
4/16
4/23
4/30
5/7
5/14
5/21
5/28
6/4
6/11
6/18
6/25
7/2
7/9
7/16
4/19
7/10
Project: Bulk Fuels Storage Facility
Figure 4-1
Project Schedule
Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress
External Tasks
Project Summary
Split
Rolled Up Split
Page 1

REFERENCES

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Appendix A

Previous SWMU ST-341 RFI Data

SWMU ST-341 Appendix III, Phase 1 RFI (October 1995)

Summary of reportable concentrations for soil analyses at SWMU ST-341, Building 1033, Condensate Holding Tank. (Concentrations in mg/kg)

Chemical Class	Analyte	HHRB Screening Level [a, b]	Borehole Number and Sample Depth Interval (ft)																					
			ST-341C-02				ST-341C-03					ST-341C-04				ST-341C-05				ST-341C-06		ST-341C-08		
			0-2	2-4	5-7	10-12	0-2 FR	0-2	2-3	5-6	9-10	0-2	2-4	5-7	10-12	0-1	2-3	5-6	8-9	0-1	1-2	0-1	2-3	5-6
VOC's	Chlorobenzene	5.4	---	---	---	---	---	---	---	---	---	---	0.124	---	---	---	---	---	0.375	---	0.46	---	---	---
	Ethylbenzene [c]	2.3	---	---	---	---	---	---	---	---	45.0	---	0.07	0.07	---	---	---	---	0.375	---	---	---	---	30.0
	Toluene [c]	5.2	---	---	---	---	---	---	---	---	---	---	0.11	0.17	0.17	---	---	---	0.17	---	---	---	---	6.6
	M,P-xylene [c]	2.1	0.02	---	0.56	0.43	---	0.01	---	---	150	0.12	0.36	0.156	12.0	---	---	0.008	0.75	---	0.64	0.006	---	64.0
	O-xylene [c]	2.8	---	---	0.29	0.25	---	---	---	---	60.0	0.12	0.124	0.058	5.0	---	0.004	---	0.375	---	0.50	---	---	27.0
SVOC's	Acenapthene	280	---	---	---	---	---	---	---	---	1.8	---	---	---	---	---	---	---	0.22	---	---	---	---	0.75
	Anthracene	1600	---	---	---	---	---	---	---	---	2.1	---	---	---	---	---	---	---	0.24	---	---	---	---	0.91
	Benzo(a)anthracene [d]	0.62	---	---	---	---	---	---	---	---	4.9	---	---	---	---	---	---	---	0.51	---	---	---	0.39	2.6
	Benzo(a)pyrene [d]	0.062	---	---	---	---	---	---	---	---	1.8	---	---	---	---	---	---	---	0.30	---	---	---	---	0.85
	Benzo(b)fluoranthene [d]	0.62	---	---	---	0.11	---	---	---	---	2.4	---	---	---	---	---	---	---	0.35	---	---	---	---	1.5
	Benzo(g,h,i)perylene	N/A	---	---	---		---	---	---	---	0.71	---	---	---	---	---	---	---	---	---	---	---	---	---
	Benzo(k)fluoranthene [d]	6.2	---	---	---	0.09	---	---	---	---	2.6	---	---	---	---	---	---	---	0.31	---	---	---	---	1.3
	Bis(2-ethylhexyl)phthalate [d]	35	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.26	---	---	---	---	---
	Crysene[c]	62	---	---	---	---	---	---	---	---	3.5	---	---	---	---	---	---	---	---	---	---	---	0.44	1.8
	Di-n-butylphthalate	610	---	---	0.37	---	---	---	---	---	---	0.23	---	---	---	---	---	---	---	0.26	---	---	---	---
	Dibenzofuran	23	---	---	---	---	---	---	---	---	1.1	---	---	---	0.30	---		---	---	---	---	---	---	0.66
	1,2-Dichlorobenzene	370	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.003	---	0.19	---	0.33	---	---	---
	1,3-Dichlorobenzene	4.1	---	---	---	---	---	---	---	---	---	---	---	---	---	0.006	0.006	---	0.375	0.016	0.26	---	---	---
	1,4-Dichlorobenzene [d]	3.1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.31	---	0.48	---	---	---
	Fluoranthene	230	---	---	---	0.45	---	---	---	---	10.0	---	---	---	0.38	---	---	---	1.2	---	---	---	1.0	6.0
	Fluorene	200	---	---	---	---	---	---	---	---	1.2	---	---	---	---	---	---	---		---	---	---	---	0.76
	Indeno(1,2,3-c,d)pyrene [d]	0.62	---	---	---	---	---	---	---	---	0.88	---	---	---	---	---	---	---		---	---	---	---	0.45
	2-Methylnaphthalene	N/A	---	---	---	8.3	---	---	---	---	8.7	1.0	---	5.8	6.0	---	---	---	0.37	---	2.0	---	---	6.5
	Naphthalene	5.5	---	---	---	3.2	---	---	---	---	6.0	0.36	---	3.0	2.5	---	---	---		---	0.98	---	---	3.0
	Phenanthrene	N/A	---	---	---	0.43	---	---	---	---	9.0	---	---	---	---	---	---	---	0.70	---	---	---	1.0	5.5
	Phenol	3600	0.61	0.96	1.0	2.3	---	---	---	---	---	1.1	1.4	2.5	1.4	---	---	---		---	---	---	---	---
	Pyrene	170	---	---	---	0.30	---	---	---	---	9.9	---	---	---	0.31	---	---	---	1.1	---	---	---	0.95	5.6
TPH	DRO [e]	100	---	---	---	2000	---	---	---	---	2000	630	57.0	1000	1200	---	7.4	---	130	200	500	---	5.2	340
	GRO [e]		0.25	0.50	2700	37.0	---	8.0	---	0.22	360000	25.0	6300	1.1	6900	---	---	0.43	1.2	---	16.0	---	---	25000
Other	Moisture %		6.3	10.3	9.1	10.8	9.4	9.6	9.3	10.1	7.2	8.5	10.7	10.5	12.1	2.5	9.9	10.7	5.9	9.0	8.1	7.0	8.4	9.2

Footnotes: - - - = Not detected

* = Not analyzed

N/A = No applicable HHRB screening level

[a] Current EPA Region 6 HHRB Residential Screening Levels

[b] The HHRB screening levels for non-carcinogenic compounds are reduced to 10% of the level to account for possible additive effects from multiple compounds.

[c] The combined benzene, toluene, ethylbenzene, xylenes action level used by the NMED UST Bureau is 50 mg/kg.

[d] Indicates a carcinogenic compunds, HHRB screening levels not adjusted to 10% of level.

[e] NMED combined action level for GRO and DRO compounds

SWMU ST-341 Appendix III, Phase 2 (HNUS) RFI (July 1996)
Summary of AFCEE-approved reportable concentration at SWMU ST-341, Building 1033, Condensate Holding Tank.
(Concentrations in mg/kg)

Chemical Class	Analyte	HHRB Screening Level [a]	Borehole Number and Sample Depth Interval (ft)												
			ST-341C-09		ST-341-14										
			0-2	10-12	5-7	15-17	25-27	25-27FR	35-37	45-47	55-57	65-67	75-77	85-87	95-97
TPH	DRO [c]	100	- - -	2000	1600	1700	1200	1100	920	- - -	- - -	- - -	- - -	- - -	- - -
	GRO [c]		0.25	37.0	7600	3400	4700	4400	1100	- - -	- - -	- - -	- - -	- - -	- - -
	Jet fuel A	N/A	- - -	- - -	15000	8900	13000	7500	3000	*	*	*	*	*	*
VOC's	Chlorobenzene	5.4	- - -	- - -	*	*	*	*	*	*	*	*	*	*	*
	Ethylbenzene [d]	2.3	- - -	- - -	*	*	*	*	*	*	*	*	*	*	*
	Toluene [d]	5.2	- - -	- - -	*	*	*	*	*	*	*	*	*	*	*
	M,P-xylene [d]	2.1	0.016	0.43	*	*	*	*	*	*	*	*	*	*	*
	O-xylene [d]	2.8	- - -	0.25	*	*	*	*	*	*	*	*	*	*	*
SVOC's	Benzo(b)fluoranthene [c]	0.62	- - -	0.11	*	*	*	*	*	*	*	*	*	*	*
	Benzo(k)fluoranthene [c]	6.2	- - -	0.094	*	*	*	*	*	*	*	*	*	*	*
	Fluoranthene	230	- - -	0.45	*	*	*	*	*	*	*	*	*	*	*
	2-Methylnaphthalene	N/A	- - -	8.3	*	*	*	*	*	*	*	*	*	*	*
	Naphthalene	5.5	- - -	3.2	*	*	*	*	*	*	*	*	*	*	*
	Phenanthrene	N/A	- - -	0.43	*	*	*	*	*	*	*	*	*	*	*
	Phenol	3600	0.61	2.3	*	*	*	*	*	*	*	*	*	*	*
	Pyrene	170	- - -	0.30	*	*	*	*	*	*	*	*	*	*	*
Other	Moisture %		6.3	10.8	*	*	*	*	*	*	*	*	*	*	*

Footnotes: - - - = Not detected

* = Not analyzed

N/A = No applicable HHRB screening level

[a] Current EPA Region 6 HHRB Residential Screening Levels

[b] The HHRB screening levels for non-carcinogenic compounds are reduced to 10% of the level to account for possible additive effects from multiple compounds.

[c] NMED combined action level for GRO and DRO compounds

[d] The combined benzene, toluene, ethylbenzene, xylenes action level used by the NMED UST Bureau is 50 mg/kg.

[e] Indicates a carcinogenic compunds, HHRB screening levels not adjusted to 10% of level.

SWMU ST-341 Appendix III, Phase 2 (HNUS) RFI (July 1996) (continued)
Summary of AFCEE-approved reportable concentration at SWMU ST-341, Building 1033, Condensate Holding Tank.
(Concentrations in mg/kg)

Chemical Class	Analyte	HHRB Screening Level [a]	Borehole Number and Sample Depth Interval (ft)													
			ST-341-17								ST-341-26					
			5-7	15-17	25-27	35-37	45-47	55-57	65-67	85-87	10-12	20-22	30-32	40-42	50-52	50-52FR
TPH	DRO [c]	100	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	GRO [c]		- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	Jet fuel A	N/A	*	*	*	*	*	*	*	*	*	*	*	*	*	*
VOC's	Chlorobenzene	5.4	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Ethylbenzene [d]	2.3	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Toluene [d]	5.2	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	M,P-xylene [d]	2.1	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	O-xylene [d]	2.8	*	*	*	*	*	*	*	*	*	*	*	*	*	*
SVOC's	Benzo(b)fluoranthene [c]	0.62	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Benzo(k)fluoranthene [c]	6.2	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Fluoranthene	230	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	2-Methylnaphthalene	N/A	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Naphthalene	5.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Phenanthrene	N/A	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Phenol	3600	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Pyrene	170	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Other	Moisture %		*	*	*	*	*	*	*	*	*	*	*	*	*	*

Footnotes: - - - = Not detected

* = Not analyzed

N/A = No applicable HHRB screening level

[a] Current EPA Region 6 HHRB Residential Screening Levels

[b] The HHRB screening levels for non-carcinogenic compounds are reduced to 10% of the level to account for possible additive effects from multiple compounds.

[c] NMED combined action level for GRO and DRO compounds

[d] The combined benzene, toluene, ethylbenzene, xylenes action level used by the NMED UST Bureau is 50 mg/kg.

[e] Indicates a carcinogenic compunds, HHRB screening levels not adjusted to 10% of level.

Appendix B

Soil Sampling SOP

- Decontamination equipment
- Health and safety equipment

If a situation arises in which the groundwater recharge is too slow to allow for efficient sampling, a temporary PVC well can be installed for sampling at a later time. This well, however, must be installed according to the following specifications:

- The well will be narrower in diameter than the DPT borehole, leaving annular space around the casing
- The well will be installed between 2 and 5 ft into the water table
- New PVC casing and screen will be used, decontaminated with a stream cleaner and rinsed with copious quantities of deionized water
- Installation of well will occur with decontaminated gloves
- The well will be sampled and removed within 48 hours of installation
- If left unattended or overnight, locking well caps should be used, or a seal should be used that can indicate tampering
- One volume of the sampling device will be purged prior to sampling

General Methodology:

- Verify that the subcontractor has the necessary drilling and sampling equipment, as well as proper decontamination supplies.
  Confirm that sampling locations are staked and that the clearances from all on-Base and off-Base utilities have been obtained. Do not begin the sampling until proper digging permits have been obtained and all of the utilities have been marked.
- Locate the sample location and position the DPT rig. If the sample point is on thick asphalt or concrete, the DPT subcontractor will use a hammer-drill or equivalent to drill a hole through the pavement.
- Verify that the sampling tip has been properly decontaminated, as specified in SOP A2.1 before beginning penetration.

Soil Sampling Methodology

- For soil sampling, hydraulically advance the sampler to above the target sample interval, unlock the piston point, and advance the sampling device through the sampling interval.
  1. Pull the rods using the hydraulic apparatus and remove the sample insert or split spoon.
  2. Log the soil and collect the required samples as specified in the project specific addendum.
- Continue sampling at additional depth intervals or abandon the borehole, as appropriate for the location

Groundwater Sampling Methodology:

- If groundwater sampling is necessary, advance the sampler into the water table and collect a sample with the sampling device as specified in SOP A1.2.
- Collect and manage all wastes as specified in the site-specific IDWMP.
- Abandon all boreholes and repair pavement before moving to a new site as specified in SOP A1.9.

Comments:

- If a buried object impedes the DPT sampler or if an insufficient sample volume is recovered, reposition the rig in a location to satisfy the intent of the original sample point and try again. Note this on the borehole logging form.
- If the total recovered sample volume is insufficient for both screening and laboratory analysis, a second hole will be pushed as close as possible to the original hole and an additional sample will be taken from the same depth interval. The two samples will be composited prior to sampling for chemical analysis.

For easy retrieval when core boxes are stacked, the sides and ends of the box should also be labeled and include project number, boring number, top and bottom depths of core, and box number.

A photograph of the recovered core and the labeling on the inside cover will be taken. If moisture content is not critical, the core should be wetted with potable tap water and wiped clean for the photograph (This will help to show true colors and bedding features in the cores).

Due to the weight of the core, a filled core box should always be handled by two people. Core boxes temporarily stored on-site should be protected from the weather. The core boxes should be removed from the site in a careful manner as soon as possible.

Thin Wall (Shelby Tube) Sampling

When it is desired to take undisturbed samples of soil, thin-walled seamless tube samplers (Shelby tubes) will be used. These samples are not recommended by EPA for environmental samples. Tube samplers, whether of carbon steel or stainless steel, should not be used for taking VOC samples. The following method applies:

1. Clean out the hole to the sampling elevation being careful to minimize the chance for disturbance or contamination of the material to be sampled. In saturated materials, withdraw the drill bit slowly to prevent loosening of the soil around the hole and maintain the water level, if present, in the hole at or above groundwater level.
2. The use of bottom discharge bits or jetting through an open-tube sampler to clean out the hole will not be allowed. Any side discharge bits are permitted.
3. The sampler must be of a stationary piston-type to limit sample disturbance and aid in retaining the sample. Either the hydraulically operated or control rod-activated type of stationary piston sampler may be used. Prior to inserting the tube sampler in the hole, check to insure that the sampler head contains a check valve. The check valve is necessary to keep water in the rods from pushing the sample out of the tube sampler during sample withdrawal and to maintain a suction within the tube to help retain the sample.
4. With the sampling tube resting on the bottom of the hole and any water level in the boring at the natural groundwater level or above, push the tube into the soil by a continuous and rapid motion, without impacting or twisting. In no case will the tube be pushed further than the length provided for the soil sample. Allow a free space in the tube for cuttings and sludge. Data to be recorded on the sampling tube when sampling with Shelby Tubes include the maximum pressure exerted for the push, and duration in seconds of the push.
5. After pushing the tube, the sampler should sit five to 15 minutes in the borehole prior to removal. Immediately before removal, the sample must be sheared by rotating the rods with a pipe wrench a minimum of two revolutions.
6. Upon removal of the sampler tube from the hole, measure the length of sample in the tube and also the length penetrated. Remove disturbed material at both ends of the tube and measure the length of sample again. After removing at least 1 in. of soil from the lower end and after inserting an impervious disk, seal both ends of the tube with at least 1/2-in. of wax applied in a way that will prevent the wax from entering the sample. Newspaper or other

types of filler must be placed in voids at either end of the sampler prior to sealing with wax. Place plastic caps on the ends of the sampler, tape them into place, and dip the ends in wax to seal them.

7. Affix labels to the tubes, as required, and record sample number, depth, penetration, and recovery length on the label. Mark the same information and "'up" direction on the tube with indelible ink, and mark the end of the sample. Complete Chain-of-Custody and other required forms. Do not allow tubes to freeze, and store the samples vertically (with the same orientation they had in the ground, i.e., top of sample is up) in a cool place out of the sun at all times. Ship samples protected with suitable resilient packing material to reduce shock, vibration, and disturbance.
8. Using soil removed from the ends of the tube, carefully describe the sample using the methods presented in SOP A1.7.
9. When thin-wall tube samplers are used to collect soil for certain chemical analyses, it may be necessary to avoid using wax, newspaper, or other fillers. Project-specific addendum will address specific materials allowed dependent on analytes being tested.

Thin-walled undisturbed sampling costs; therefore, thin-walled tube samplers are restricted in their usage by the consistency of the soil to be sampled. Often very loose and/or wet samples cannot be retrieved by the samplers, and soils with a consistency in excess of very stiff cannot be penetrated by the sampler. Devices such as Dension or Pitcher cores can be used in conjunction with the tube samplers to obtain undisturbed samples of stiff soils. Using these devices normally increases sampling costs and therefore their use should be weighed against the increased cost and the need for an undisturbed sample. In any case, if a sample cannot be obtained with a tube sampler, an attempt should be made with a split-spoon sampler at the same depth so that at least a sample can be obtained for classification purposes.

Direct Push Sampling for Soil and Groundwater

Direct push technology (DPT) will be used to rapidly collect soil and water samples whenever possible. This technique provides for collection of undisturbed samples and does not generate soil cuttings. This section discusses the DPT method only.

The contractor will need a copy of the DPT subcontractor work plan, waste containers, and appropriate health and safety gear. All additional equipment and materials will be provided by the DPT subcontractor. The DPT subcontractor should be equipped with a rig capable of pushing 30 ft and collecting soil and groundwater samples from any interval within that depth. Equipment should include at minimum the following items:

- Hydraulic ram with hammer assembly
- 1-to 1.5-in. diameter drill rods
- Stainless steel piston-type, split-spoon, or equivalent soil sampling device that allows for lithologic characterization and retrieval of at least 400 mL of sample volume
- Geoprobe®, Hydrocone®, bailer, Teflon® tubing and peristaltic pump, or equivalent water sampling device
- Small diameter PVC riser and screen to make temporary wells if recovery is too slow

7. Decontaminate according to the procedures outlined in SOP A2.1.
8. Place analytical samples into the shipping cooler and chill on ice to 4°C, if required. Prepare sample(s) for delivery to the laboratory for analysis within 24 hours of collection.
9. Fill out field logbook, sample log sheet, custody seals, labels, and Chain-of-Custody forms. Example copies of these forms are included in the QAPP, Part II of Volume II.

Split-Spoon Sampling Procedure

The following procedure will be used for split-spoon sampling:

1. Wear appropriate PPE as outlined in the SSHP. In addition, samplers will don new sampling gloves at each location.
2. Drill borehole to the desired sampling depth. Drive split-spoon into the undisturbed soil which is to be sampled.
3. A stainless steel 2 in. (or 3 in.) O.D. split-spoon sampler will be driven with blows from a 140-lb (or 300-lb) hammer falling 30 in. until either approximately 2 ft. has been penetrated or 100 blows within a 6-in. interval have been applied. This process is referred to as the Standard Penetration Test (ASTM D 1586-74). A decontaminated split-spoon will be used for each sample collected for chemical analyses.
4. Soil borings designated for engineering parameters such as Atterberg limits, permeability, sieve analysis, etc., will be obtained using a Shelby tube according to ASTM 1557. Shelby tubes can be used when cohesive materials are encountered, and when an undisturbed sample is required for testing.
5. Record the number of blows required for each 6 in. of penetration or fraction thereof. The first 6 in. is considered to be a seating drive. The sum of the number of blows required for the second and third 6 in. of penetration is termed the penetration resistance. If the sampler is driven less than 2 ft., the penetration resistance is still the blows encountered for the 2nd and 3rd 6-inch intervals. If more than 50 blows have been counted for a particular 6-inch interval, then refusal shall be entered on the log.
6. Bring the sampler to the surface and remove both ends and one-half of the split-spoon so that the recovered soil rests in the remaining half of the barrel. Place split-spoon on clean polyethylene sheeting. Describe thoroughly the approximate recovery (length), Unified Soil Classification System (USCS) classification, composition, color, moisture, etc., of the recovered soil. A copy of a typical bore log form is depicted in Figure A1.6-1.
7. Fill jars with soil using stainless steel spatulas or spoons
8. Empty remaining contents of the split-spoon into a decontaminated stainless steel pan. Homogenization of soil samples will be conducted by first removing rocks, twigs, leaves and other debris not considered part of the sample. The soil should be removed from the sampling device and placed in a stainless steel pan, then thoroughly mixed using a stainless steel spoon. The soil in the pan should be scraped from the sides, corners and bottom of the pan, rolled to the middle of the pan, and initially mixed. The sample should then be quartered and moved to the four corners of the pan. Each quarter of the sample should be mixed individually, and then rolled to the center of the container and the entire sample mixed again.
9. Decontaminate split-spoon sampler according to the procedures outlined in SOP A2.1.

10. Place analytical samples in sample cooler and chill to 4°C. Samples will be shipped to the laboratory within 24 hours.
11. Fill out field notebook, sample log sheet, labels, custody seals, and Chain-of-Custody forms for analytical samples. Example copies of these forms are included in the QAPP, Part II of Volume II.

Rock Core Sampling

After rock coring has been completed and the core recovered, the rock core will be carefully removed from the barrel, placed in a core tray (previously labeled "top" and "bottom" to avoid confusion), classified, and measured for percentage of recovery as well as the rock quality designation (RQD). See the Classification of Rocks section in SOP A1.7 for a description of how to measure the RQD of a core. Each core will be described and classified in the field notebook or on appropriate forms described in SOP A1.7.

After sampling, rock cores must be placed in the sequence of recovery in well-constructed wooden boxes or manufactured plastic core boxes provided by the drilling contractor. Rock cores from two different borings will not be placed in the same core box unless accepted by the Field Geologist. The core boxes should be constructed to accommodate at least 20 linear feet of core in rows of approximately 5 ft. each and should be constructed with hinged tops secured with screws and a latch (usually a hook & eye) to keep the top securely fastened down. Wood partitions will be placed at the end of each core run and between rows. The depth from the surface of the boring to the top and bottom of the drill run and run number will be marked on the wooden partitions with indelible ink. Any core loss areas will be spaced with wooden blocks, PVC pipe, or other sturdy material so that the entire core run is represented. The order of placing cores will be the same in all core boxes. The top of each core obtained should be clearly and permanently marked on each box. The width of each row must be compatible with the core diameter to prevent lateral movement of the core in the box. Similarly any empty space in a row will be filled with an appropriate filler material or spacers to prevent longitudinal movement of the core in the box.

The inside and outside of the core-box lid will be marked by indelible ink to show all pertinent data on the box's contents. At a minimum, the following information must be included:

- Project name
- Project number
- Boring number
- Footage (depths)
- Run number(s)
- Recovery
- Box number(x of x)

It is also useful to draw a large diagram of the core in the box, on the inside of the box top. This provides more room for elevations, run numbers, recoveries, comments, etc., than could be entered on the upper edges of partitions or spaces in the core box.

SOP A1.6 Subsurface Soil Sampling

The following elements regarding soil borings should be considered when developing project-specific plans:

- All drilling will conform to state and local regulations. Permits, applications, and other documents required by state and local authorities will be obtained.
- The location of all borings will be approved in writing by the base before drilling commences.
- The drill rig and all equipment that enters a borehole will be decontaminated in accordance with SOP A2.1.
- The drill rig will not leak any fluids that may enter the hole or contaminate equipment that is placed in the hole. The use of rags or diapers to absorb leaking fluids is unacceptable. All leaking fluids will be caught in a proper container until the leak is repaired. If sample integrity could be comprised by leaking drill rig fluids, then sample operation may be shut down until the leak is repaired.
- No fluids will be used to advance soil borings.
- A standard penetration test will be performed each time a split spoon sample is taken. The test will be performed in accordance with ASTM D-1586. Sampling for lithologic logging should be continuous especially near ground surface in the area of potential contamination sources. The depth to which continuous lithologic sampling is completed will be determined on a site-by-site basis after review of site specific stratigraphic data collected during previous investigations. In most cases, the collection of continuous lithologic samples should begin at the ground surface and continue until the water table is encountered. The method of continuous sample collection is dependent on the drilling method used. Common sampling methods include split-spoon samplers, thin-walled samplers, and core barrels. All of these sampling devices can be used with minimal disturbance of the sample.
- Soils to be analyzed for VOC and TOC will be taken with a California (brass) ring or equivalent sampler. These samples will not be composited or homogenized. The ends of the rings will be covered with Teflon® or metal foil. The rings will then be sealed with end caps.
- Surface water and extraneous materials will not enter the boring.
- Boreholes will be abandoned as specified in project-specific addenda.
- All trash and drill cuttings will be disposed as dictated in project-specific addendum to the IDWMP.

Subsurface soil samples may be collected using a stainless steel hand auger or split-spoon sampler. Project-specific addenda will specify the method to be used on the basis of field requirements.

Lithologic logging is necessary to determine the physical characteristics of the subsurface. This information will be used in conjunction with contaminant chemical and physical data to determine how the contaminant will move from it's source to potential receptors. This data will also be used for evaluating the feasibility of various remediation technologies for cleanup of subsurface contamination. The stratigraphy at KAFB is complex with lateral variation of highly heterogeneous alluvial fan and axial ancestral Rio Grande lithofacies. Small lenses of clay or sand present in these lithofacies can determine how a contaminant is transported from the source site. These lenses may be missed if lithologic sampling is not continuous.

Before digging begins a digging permit, "Base Civil Engineering Work Clearance Request" form, needs to be completed and approved by the Chief of Operations or Chief of Engineering and Environmental Planning at the base. The work clearance request is processed just prior to the start of work. If delays are encountered and the conditions at the job site change (or may have to be changed) this work clearance request must be reprocessed. The type of information that must accompany this permit includes;

- location
- work order/job number
- contract number
- if the area has been staked/clearly marked or not
- a sketch of the excavation
- type of facility work involved, i.e. pavements, drainage systems, railroad tracks, overhead or underground utility or communications, aircraft or vehicular traffic flow, security, etc.
- date clearance requested and terminated
- requesting official, phone number, and organization

Hand Auger Sampling
The following procedure will be used for hand auger sampling:

1. Wear appropriate PPE as specified in the SSHP. In addition, samplers will don new sampling gloves at each location.
2. Use a decontaminated hand driven 6" stainless steel bucket auger. The diameter of the auger may be modified to suit site specific conditions and shall be specified in the project-specific addendum.
3. Begin turning the auger in a clockwise direction and continue until the desired sampling depth is obtained.
4. Remove the auger and fill jars with soil using stainless steel spatulas or spoons.
5. Empty remaining contents of the auger into a decontaminated stainless steel pan. Homogenization of soil samples will be conducted by first removing rocks, twigs, leaves and other debris if they are not considered part of the sample. The soil should be removed from the sampling device and placed in a stainless steel pan, then thoroughly mixed using a stainless steel spoon. The soil in the pan should be scraped from the sides, corners and bottom of the pan, rolled to the middle of the pan, and initially mixed. The sample should then be quartered and moved to the four corners of the pan. Each quarter of the sample should be mixed individually, and then rolled to the center of the container and the entire sample mixed again.
6. If it is determined that the sample volume is insufficient to satisfy the analytical requirements, another sample must be obtained from a location immediately adjacent to the first sample.

SOP A.1.5 Surface Soil Sampling

Surface soil sampling will be performed by the following procedure:

1. Wear appropriate PPE as specified in the SSHP. In addition, samplers will don new sampling gloves at each location.
2. Use a decontaminated stainless steel scoop/trowel to scrape away surficial organic material (grass, leaves, etc.).
3. Obtain soil sample using a scoop/trowel, after organic materials have been scraped away, by scooping soil from the surface to 3 in. below surface or the depth specified in the project-specific addendum.
4. Record appropriate air monitoring results.
5. Samples for VOC and TOC analysis will be obtained as discrete grab samples. Empty remaining contents of the scoop into a decontaminated stainless steel pan.
6. Homogenization of soil samples will be conducted by first removing rocks, twigs, leaves and other debris if they are not considered part of the sample. The soil should be removed from the sampling device and placed in a stainless steel pan, then thoroughly mixed using a stainless steel spoon. The soil in the pan should be scraped from the sides, corners and bottom of the pan, rolled to the middle of the pan, and initially mixed. The sample should then be quartered and moved to the four corners of the pan. Each quarter of the sample should be mixed individually, then rolled to the center of the container and the entire sample mixed again. Fill jars with soil using stainless steel spatulas or spoons.
7. Place analytical samples in cooler and chill to 4°C. Samples will be shipped within 24 hours to an appropriate laboratory.
8. Decontaminate scoop/trowel as specified in SOP A2.1.
9. Fill out field logbook, sample log sheet, custody seals, labels, and Chain-of-Custody forms. Example copies of these forms are included in the QAPP, Part II of Volume II.

Field Bore Log

Page 1 of ______

FOSTER WHEELER ENVIRONMENTAL
Kirtland Air Force Base

Sketch Map

Site Type ____________________
Date/Time Started ____________________ Site ID _______ Dia. of Hole ______
Surface Elevation ____________________ Date/Time Completed ____________
Completion Depth (ft.) ____________________ Water Level Initial (ft.) ____________
Equipment and Drilling Method ________ Drilling Company ____________ No. Samples ______
____________________ Driller ____________________
Size and Bit Type ____________________ Drilling Fluid ____________________
Sampler Type ____________________ Diameter (in.) ______ Driving Wt.(lbs.) ______ Drop (in.) ____
Geologist/Date ____________________ Checked by/Date ____________________
(Signature)

Depth (ft)	Sample Numbers	Sample Type	Sample Interval	Recovery (ft./ft.)	Blow Count	USCS Abbreviation	P.I.D.	Description - Soil Classification
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								

Figure A1.6-1

Typical Bore Log Form Used to Describe Split Spoon Samples