WORK PLAN
Background Study and Geochemical Evaluation Fort Wingate Depot Activity Gallup, New Mexico

Contract No. W912BV-07-D-2004
Delivery Order DM01

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Prepared for:
U.S. Army Corps of Engineers
Albuquerque District
4101 Jefferson Plaza, NE
Albuquerque, New Mexico 87109

Prepared by:
Shaw Environmental, Inc.
2440 Louisiana Blvd. NE, Suite 300
Albuquerque, New Mexico 87110

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Acronyms and Abbreviations

AFB	Air Force Base
amsl	above mean sea level
BIA	Bureau of Indian Affairs
CQCSM	Contractor QC Systems Manager
DAF	dilution attenuation factor
DFW	definable feature of work
DOE	U.S. Department of Energy
DQCR	Daily Quality Control Report
EPA	U.S. Environmental Protection Agency
EPACMTP	EPA Composite Model for Leachate Migration and Transformation Products
°F	degree(s) Fahrenheit
FADL	Field Activity Daily Log
FSP	Field Sampling Plan
FWDA	Fort Wingate Depot Activity
FWV	Field Work Variance
GIS	Geographic Information System
GPS	global positioning system
HSM	Health and Safety Manager
NGVD	National Geodetic Vertical Datum
NMED	New Mexico Environment Department
OSHA	Occupational Safety and Health Administration
QAPP	Quality Assurance Project Plan
QC	quality control
QCP	Quality Control Plan
SAP	Sampling and Analysis Plan
SDS	Spatial Data Standards
SDSFIE	Spatial Data Standards for Facilities and Infrastructure
Shaw	Shaw Environmental, Inc.
SOP	standard operating procedure
SOW	Scope of Work
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
TGSM	tailgate safety meeting
UCL	upper confidence limit
USACE	U.S. Army Corps of Engineers
UTL	upper tolerance limit
UTM	Universal Transverse Mercator
VOC	volatile organic compound

1.0 Introduction

This Work Plan provides guidance for activities related to the determination of background concentrations of inorganic constituents and site-specific dilution attenuation factors (DAF) for organic compounds at the Fort Wingate Depot Activity (FWDA) in New Mexico. Shaw Environmental, Inc. (Shaw) has prepared this Work Plan for the U.S. Army Corps of Engineers (USACE) in accordance with the Request for Proposal dated June 30, 2008, and Scope of Work (SOW) dated June 26, 2008 (Appendix A). The project activities described in this Work Plan will be performed under Contract Number W912BV-07-D-2004, Delivery Order DM01 for the USACE, Albuquerque District.

The purpose of this project is to conduct a background study to develop a baseline inorganic geochemical assessment establishing concentrations of naturally occurring inorganic constituents in soil, groundwater, surface water, and sediment. Geologic, hydrogeologic, and geochemical processes that control the distributions of naturally occurring minerals and inorganic compounds within the boundaries Fort Wingate will be identified.

In addition, site-specific DAFs or other approved and appropriate models will be developed for "non-naturally" occurring organic compounds, such as 1,2-dichloroethane; toluene; total explosives (based on a list of 14 separate explosive compounds); perchlorate; and other non-naturally occurring organic constituents potentially released to the environment. The objective of developing DAF values for organic constituents is to determine potential impacts to groundwater through release at the surface and migration to groundwater. Hence, the overall objective of this project is to determine whether a release has occurred to the environment above natural background levels, and whether a release has the potential to impact groundwater.

1.1 Work Plan Organization

This Work Plan is organized as follows. Chapter 1.0 states the project objectives, discusses the site background, and describes the environmental setting for the FWDA. Chapter 2.0 addresses project management and personnel. Chapter 3.0 presents the technical approach for establishing background metal concentrations, developing DAFs, conducting the monitoring well survey, providing Geographic Information System (GIS) submittals, and collecting samples if additional data are required. Chapter 4.0 provides the Quality Control Plan (QCP), and Chapter 5.0 lists the references cited.

Appendix B contains the project Sampling and Analysis Plan (SAP), which includes the Field Sampling Plan (FSP) and the Quality Assurance Project Plan (QAPP). The Site Safety and Health Plan (SSHP) is provided in Appendix C. Appendix D provides the points of contact for this project, and Appendix E provides the qualifications of key personnel.

1.2 Background

The FWDA is located in west-central New Mexico, approximately 130 miles west of Albuquerque and 7 miles east of Gallup (Figure 1-1). Originally founded in 1860 as a cavalry post, the U.S. Army established Fort Wingate as a munitions storage depot in 1918. The FWDA installation has had a number of missions since then, including ordnance storage, testing, and demilitarization, as well as missile defense testing. The 15,277-acre installation was closed in 1993 under the Base Realignment and Closure program (Malcolm Pirnie, 2000). Although some missile defense testing is still operational at the site, most FWDA operations now focus on assessment and remediation of contamination resulting from past military activities. Efforts to clean up affected areas have focused primarily on the removal of exploded and unexploded ordnance. However, the extent of soil contamination by metals is also being investigated at several areas of concern, including the former Igloo Blocks and Functional Test Ranges. The background concentrations of metals, established by this study, will be used to determine the presence and extent of soil contamination caused by military activities at FWDA.

1.3 Environmental Setting

1.3.1 Geographic Setting

The FWDA occupies approximately 34 square miles (15,277 acres) of land in McKinley County in northwestern New Mexico. The FWDA is located approximately 7 miles east of Gallup, and about 130 miles west of Albuquerque on U.S. Highway 66. The main entrance to the FWDA is on U.S. Highway 66, west from Exit 33 of Interstate 40.

1.3.2 Meteorology

The climate for the Ft. Wingate area varies with elevation, but is generally mild during the summer when temperatures range between 65 and 95 degrees Fahrenheit (°F), and cold during the winter when average daily temperatures range between 30 to 35°F. The warmest month of the year is July with an average maximum temperature of 89°F (NOAA, 2008), while the coldest month of the year is December with an average minimum temperature of 11°F. Daily temperature variations tend to be considerable during the summer months with a difference near 35°F. The annual average precipitation at Gallup is 11.4 inches (NOAA, 2008). The wettest month of the year is August with an average rainfall of approximately 2 inches. Most of the precipitation occurs as rain or hail in violent summer thunderstorms, and the remainder is provided by light winter snow accumulations.

1.3.3 Demographics

The FWDA installation is almost entirely surrounded by federally owned or administered land, including both national forest and tribal lands. Located north and west of the FWDA are Navajo

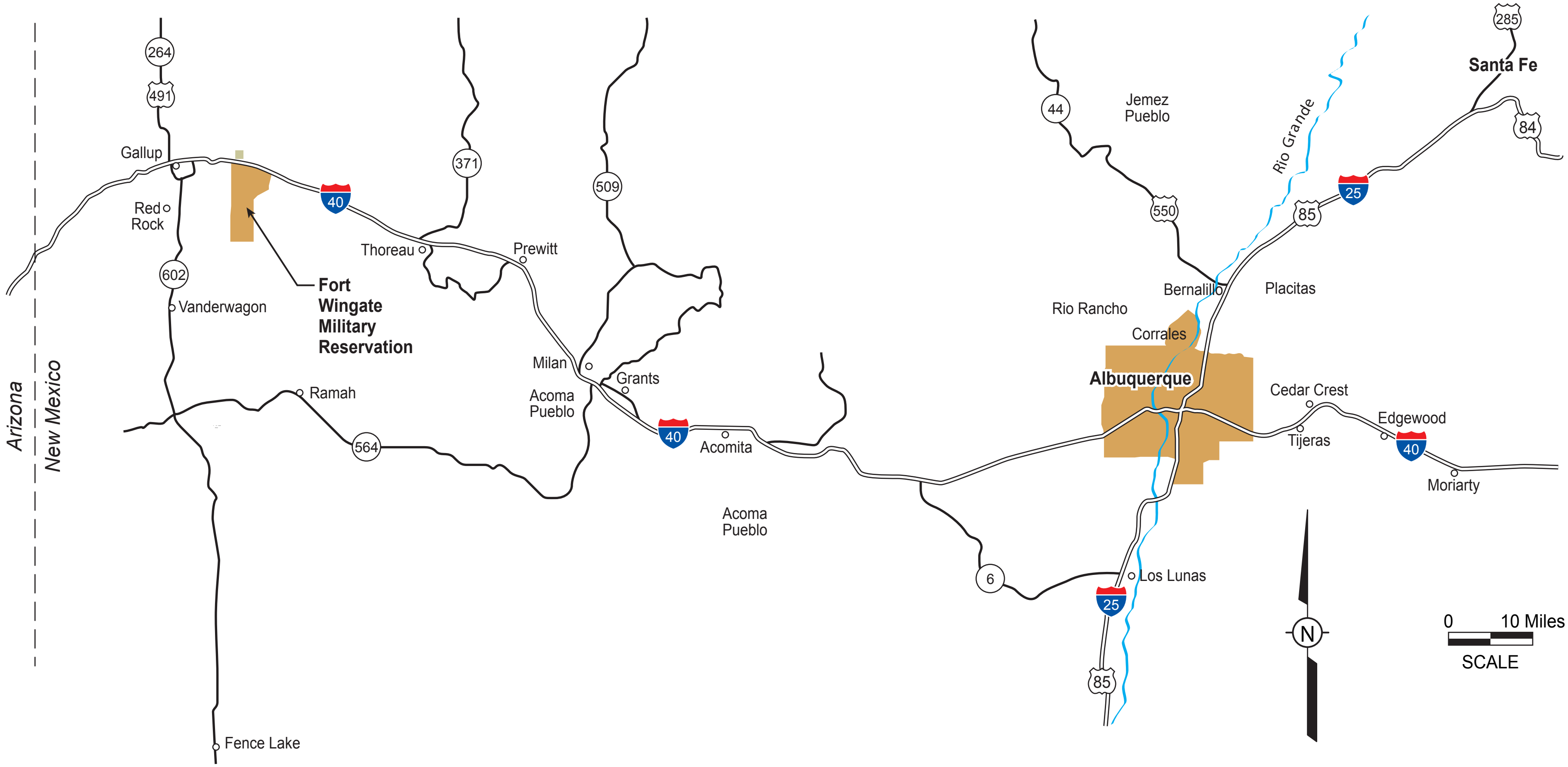

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Figure 1-1
Site Location Map
Background Study and Geochemical Evaluation
Fort Wingate Depot Activity
Gallup, New Mexico

tribal trust and allotted lands. Development north of the FWDA includes Red Rock State Park; a Zuni railroad siding; an El Paso Natural Gas fractioning plant and housing area; the small Navajo community of Church Rock; the Burlington, Northern, and Santa Fe Railroad; and transportation corridors for Interstate 40 and U.S. Highway 66. The town of Fort Wingate, located immediately to the east of the FWDA on land administered by the Bureau of Indian Affairs (BIA), was the original site of the fort headquarters. Located to the south and southeast is the largely undeveloped Cibola National Forest. Most of the land to the west is undeveloped and is tribal trust and allotment land managed by the BIA, individual Native American allottees, and the Navajo Nation.

1.3.4 Geology and Soil

1.3.4.1 Regional Geology

The FWDA can be divided into the following three topographic areas: (1) the rugged north-to-south–trending Hogback along the western and southwestern boundaries; (2) the northern hill slopes of the Zuni Mountain Range in the southern portion of the FWDA; and (3) the alluvial plains marked by bedrock remnants in the northern portion of the FWDA (Malcolm Pirnie, 2000). The elevation of the FWDA ranges from approximately 8,200 feet above mean sea level (amsl) in the south to 6,600 feet amsl in the north.

1.3.4.2 Site-Specific Geology

The FWDA is located in an erosional basin within the Navajo section of the Colorado Plateau Physiographic Province. During the uplift of the Zuni Mountain Range in the southern and southeastern portion of the installation, the area occupied by the erosional basin was under tensional stress that extensively fractured the bedrock. Differential weathering and erosion along the fractures resulted in the formation of the basin currently occupied by the FWDA (Anderson et al., 2003).

In the northern part of the installation, the surface is covered by either remnants of the Chinle Formation or alluvial deposits. The alluvial deposits consist of sediment deposited by outwash from the Zuni Mountains to the south and the Hogback in the western part of the installation. The Hogback is a monocline fold, where westerly dipping Mesozoic bedrock is exposed to form a long, sharp-crested ridge trending north to south. In areas east of the Hogback, the bedrock generally dips to the north. In the southeastern part of the FWDA, bedrock of Permian and Triassic age was uplifted by a northwest thrust fault (Anderson et al., 2003).

The majority of the FWDA is underlain by the Chinle Formation (Triassic age) that has been dissected by arroyos. The Chinle Formation consists of reddish-brown siltstone and mudstone and grayish-purple mudstone. This formation has low permeability and acts as a confining unit for the underlying San Andres-Glorieta aquifer. Sandstone of the Chinle Formation is relatively weather-resistant and forms the caprock of the remnant bedrock exposures in the northern portion of the FWDA. The softer mudstone is easily eroded to form badlands or arroyos on hill slopes and in eroded valleys (Anderson et al., 2003).

The Chinle Formation is underlain by San Andres Limestone and Glorieta Sandstone of the Permian age. The San Andres generally consists of two limestone beds separated by a sandstone layer and reaches a maximum thickness of approximately 200 feet. The Glorieta Sandstone is a fine-grained, quartz sandstone with a maximum thickness of approximately 300 feet. The San Andres-Glorieta aquifer is the principle source of water in the area (Malcolm Pirnie, 2000). This aquifer is confined, except in and near outcrop areas, by siltstone and claystone beds in the overlying Chinle Formation. Alluvial deposits are most prevalent in the northern part of the FWDA in lowland areas between bedrock remnants. Alluvial deposits are also present along intermittent streams draining the Hogback and Zuni Mountains, which flow through the northern part of the installation before joining the South Fork of the Puerco River. The alluvium ranges in grain size from clay to gravel, typical of braided stream deposits (Malcolm Pirnie, 2000).

1.3.4.3 Soil Types

Soil types found at FWDA are similar to those in cool plateau and mountain regions of New Mexico. The FWDA soil types commonly found in arroyos are permeable sand and sandy loam clays (DOE, 1990); however, most soil is composed of low permeable clay. Soils at the FWDA are primarily alluvial materials, with the exception of the Hogback along the western border and the northern hill slopes of the Zuni Mountain Range in the extreme southern portion. The alluvial materials, encompassing the area covered by this background study, do not have distinct soil horizons, because they are relatively shallow and the parent bedrock is either at or near the surface in over a quarter of the installation (DOE, 1990).

1.3.5 Hydrogeology

1.3.5.1 Regional Hydrogeology

Main drainages flow generally toward the north until the South Fork of the Puerco River is encountered, except in the southwestern corner of the installation where drainage is toward the west. Streams are intermittent and fed by rain and snowmelt from the Zuni Mountain Range and the Hogback. These streams transport sediment to low-lying areas in the northern part of the installation, creating extensive alluvial deposits among remnants of bedrock.

Due to the nature of precipitation in this semiarid region, the surface drainage is relatively shallow near headwaters. Downward erosion intensifies as the stream moves downstream resulting in a system of well-developed, steep-walled arroyos. Arroyos form because of the erodibility of localized areas of silt and clay rich bedrock (Malcolm Pirnie, 2000).

1.3.5.2 Site-Specific Hydrogeology

Fort Wingate lies between the South Fork of the Puerco River and the northern foothills of the Zuni Mountain Range. Three major drainage systems may be identified: (1) eastern drainage system; (2) western drainage system; and (3) southwestern-corner drainage system. They are divided by either bedrock ridges or bedrock remnants. Also, in the northwest part of the site, two artificial channels were constructed during the 1940s to divert water away from Magazine/Igloo groups A and B and the Administration Area (DOE, 1990).

The eastern drainage system consists of washes that run in northwestern and northeastern directions off the slopes of the Zuni Mountains. Alluvial fans form in basins at the front of the slope, as well as between bedrock remnants. In the northeast section of the installation, the drainage flows around bedrock remnants before joining the South Fork of the Puerco River.

The western drainage system (except for the southwest corner) consists primarily of two drainages covering the western portion of FWDA. Tributaries of the western drainage system pass the demolition area and cross the Hogback, then join flowing north depositing alluvium along the bedrock remnants.

The southwestern-corner drainage system flows southwest and joins the Bread Springs Wash on the western side of the Hogback. Because this system is hydrogeologically isolated from the other parts of the site and installation activities have apparently not occurred in this area, the drainage system is of less environmental concern (DOE, 1990).

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2.0 Project Management

2.1 Project Scheduling and Reporting Requirements

Shaw is responsible for planning, scheduling, and performing the project activities and fieldwork, as well as documenting and reporting project activities on a daily basis. Shaw is also responsible for compliance with applicable quality control (QC) requirements, overall project safety, the safety and health of workers under its direction, and performance of field activities according to both the Work Plan and regulatory requirements. Appendix B contains the project SAP, which includes the FSP and the QAPP. The SSHP is provided in Appendix C.

Time management will be the responsibility of the Shaw project management team. The schedules set forth in this Work Plan will be followed. Schedule changes associated with the actual project activities may require documentation by a Field Work Variance (FWV), signed by either the Shaw Project Manager or Task Order Manager and the appropriate USACE Technical Managers.

2.2 Project Organization and Resource Management

Personnel at the work site will vary in number, depending on the particular task being implemented. The chain of command is as follows: Shaw subcontractors will report to Shaw, and Shaw will report to the USACE. The organizational chart (Figure 2-1) specifies Shaw personnel responsibilities and reporting lines. Appendix D provides the points of contact for this project, and Appendix E provides the qualifications of key personnel.

All Shaw personnel and Shaw on-site subcontractors will be required to have current hazardous waste training as defined by Title 29 of the Code of Federal Regulations, Section 1910.120. Shaw will directly supervise subcontractors performing fieldwork at all times, and Shaw is responsible for the performance of work by all subcontractors under its supervision.

2.3 Record Keeping

The project also includes an optional task to collect soil, sediment, groundwater, and surface water samples. This task is not presently funded but is included here for completeness.

In addition to the planning documents, the following documents will be prepared or obtained and retained as project records, as appropriate:

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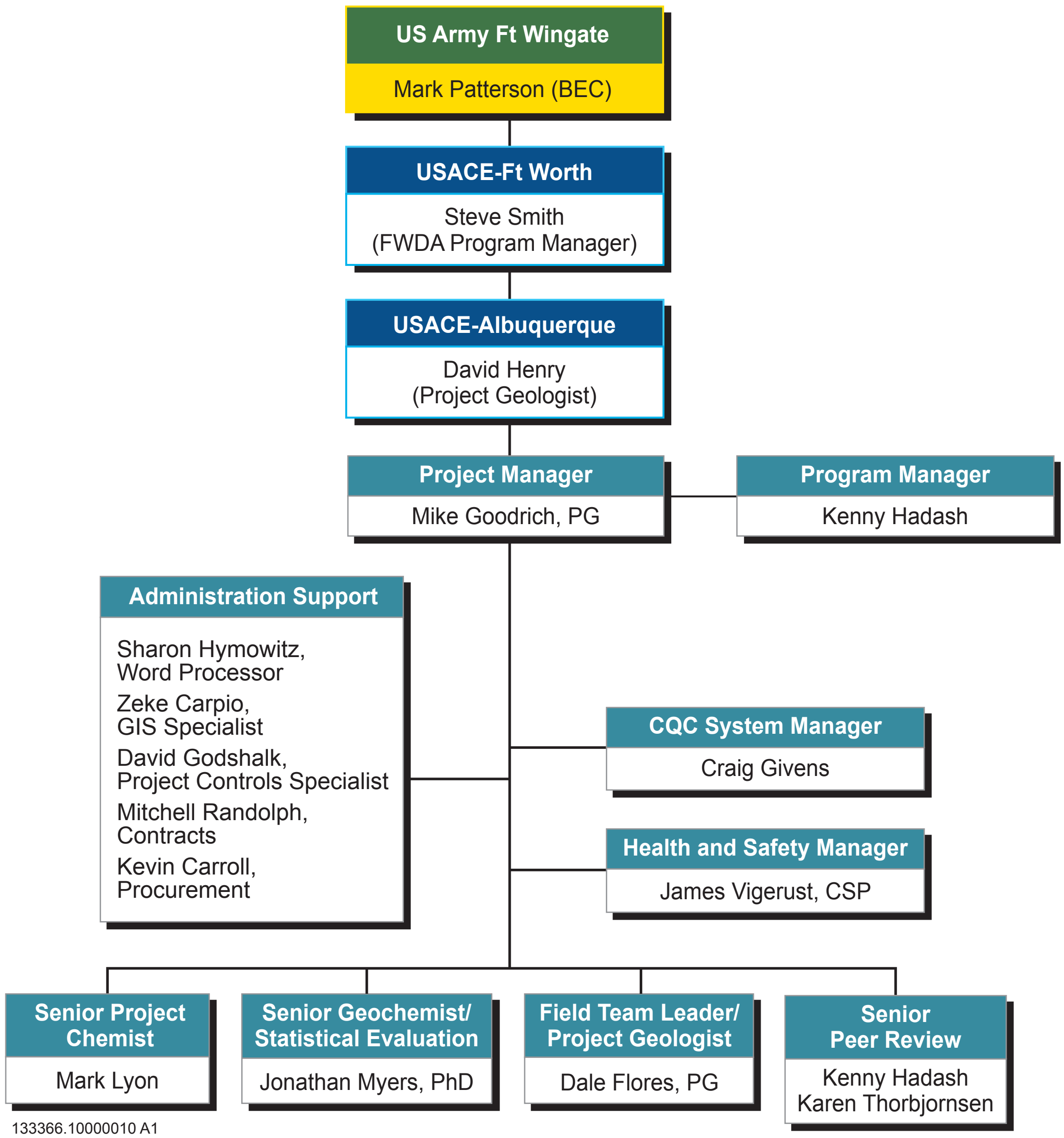

BEC - BRAC Environmental Coordinator
BRAC - Base Realignment and Closure
CQC - Contractor Quality Control
CSP - Certified Safety Professional
FWDA - Fort Wingate Depot Activity
GIS - Geographical Information System
PG - Professional Geologist

Figure 2-1

Shaw Project Management Organization Chart
Background Study and Geochemical Evaluation
Fort Wingate Depot Activity
Gallup, New Mexico

- Field documentation, including daily tailgate safety meeting (TGSM) forms, field activity daily logs (FADL), FWVs, telephone/meeting logs, sample collection forms, equipment calibration records, field audits/inspections records, well purging logs, and monitoring well survey data
- Training documentation as specified in the SSHP (Appendix C)

2.3.1 Photographic Records

Photographs of field activities will be taken routinely, kept on file, and provided to the USACE as directed.

2.3.2 Sample Documentation

Use of sample documentation, including sample numbers, labels, and chain-of-custody records, will follow the procedures and use the forms described in the SAP.

2.3.3 Sample Numbering System

Samples will be assigned a unique field identification number specific to the FWDA. Typically, the field identification number will consist of a combination of parcel, area of concern, source, and other descriptions as specified for FWDA. The specific sample numbering system for the FWDA project is outlined in the FSP (Appendix B, Part I).

2.3.4 Sample Labels

Sample labels will be affixed to each sample container. Complete collection information, sample type, matrix, time, date, field number, analysis requested, and the sampler's name will be recorded with indelible ink.

2.3.5 Chain-of-Custody Records

Chain-of-custody documentation will be completed in the field using the U.S. Environmental Protection Agency (EPA) software, "FORMS II Lite, Version 5.1," (or latest revision) in order to document sample collection, possession, and the chain of custody. A sample is considered to be in a person's custody while either under physical possession or safely secured in a controlled access location. Sample custody can be transferred by signature relinquishment and acceptance. Shipping company waybills or bills of lading are considered part of the custody record between the time of collection and receipt at the analytical laboratory. Chain-of-custody records will accompany the sample shipment until receipt at the contractor laboratory.

2.3.6 Field Records

Records of field analytical or monitoring measurements will be recorded on preprinted, prepared forms. Field documentation will consist of FADLs, sample collection logs, analytical request/chain-of-custody forms, and waste tracking logs, as applicable. Soil sampling locations will be surveyed and documented; measurements for groundwater elevation, discharge volumes and rates, and groundwater quality measurements will be taken and recorded in accordance with the SAP (Appendix B).

2.4 Documentation Procedures/Data Management and Retention

Documentation procedures will follow the QCP (Chapter 4.0). All field documentation will be provided in the final report of the field activities.

2.5 Reporting Requirements

In addition to the records generated during the implementation of Delivery Order DM01, following the completion of the activities at FWDA, a report will be prepared in draft, draft final, and final iterations and submitted to the USACE. The report will include the following elements as outlined in the SOW (Appendix A):

- Table of Contents
- List of Tables
- List of Figures
- Acronyms
- Chapter 1.0 Introduction
  - Project Objectives
  - Project Location
  - Project History
  - Regulatory Framework
  - Geologic Setting
  - Physical Setting
  - Ecological Setting
  - Soils
  - Surface Water
  - Groundwater
  - Sediment
- Chapter 2.0 Sampling Methodology
  - Previous Background Soil Sampling
  - Additional Sampling Locations
  - Sampling Procedures
  - Sample Analysis
  - Chemical Analysis for Metals

  - Physical Analysis
  - Chemical Analysis for Organic Contaminants

- Chapter 3.0 Identification of Statistical Issues
  - General Approach
  - Geochemical Evaluation of Pre-Existing Data
  - Geochemical Evaluation of New Data
  - DAF Calculations or Model
  - Methodology

- Chapter 4.0 Results of Statistical Analysis
  - Outlier Analysis
  - Uncertainties
  - Tests for Geological Group Differences
  - Tests for Lithologic Group Differences
  - Calculation of Summary Statistics

- Chapter 5.0 Conclusions

- Chapter 6.0 References

2.6 Project Personnel

The following positions will be regarded as key project personnel:

- Project Manager: Mike Goodrich, PG
- Senior Geochemist: Jonathan Myers, PhD
- Senior Project Chemist: Mark Lyon, GISP
- Field Team Leader: Dale Flores, PG
- Health and Safety Manager (HSM): James Vigerust, CSP
- Contractor QC Systems Manager (CQCSM): Craig Givens

The resumes of key personnel assigned to the project are provided in Appendix E. Figure 2-1 presents the project organizational chart.

Mike Goodrich, PG. Mr. Goodrich is a Professional Geologist and will be the Project Manager responsible for day-to-day progress on the project. He is responsible for keeping the project on schedule and within budget, preparing all required deliverables, and participating in all project meetings. In addition, Mr. Goodrich is a Senior Hydrologist with more than 22 years of technical experience in New Mexico; as such, he will take the lead in determination of site-specific DAFs.

Jonathan Myers, PhD. Dr. Myers has nearly 30 years of experience and is the Senior Geochemist on this project. He has directed the characterization of statistical distributions of background concentrations of naturally occurring metals and radionuclides in soil and groundwater at Sandia National Laboratories and Kirtland Air Force Base (AFB). Dr. Myers pioneered the use of geochemical correlations to distinguish between contamination versus naturally high background concentrations of metals in groundwater, surface water, sediment, and soil. He has applied these geochemical evaluation techniques at numerous U.S. Department of Defense, U.S. Department of Energy (DOE), and commercial facilities and has made several presentations on the topic to the New Mexico Environment Department (NMED). He also teaches short courses on geochemical evaluation techniques at environmental remediation conferences.

Mark Lyon, GISP. Mr. Lyon has 29 years of experience—23 years in applied environmental sciences and 6 years as a laboratory analyst and engineering technician involved in chemical analysis, chemical process engineering, and data acquisition instrumentation and process controls. He is also certified by ESRI as a GIS Professional and has experience in cadastral and engineering surveying, aerial photo interpretation, cartography, forest and rangeland resource inventories, and the construction trades.

Dale Flores, PG. Mr. Flores is a Professional Geologist with 20 years of experience conducting surface and subsurface soil and groundwater investigations. He has extensive experience in the selection of sample collection techniques needed to optimize the sampling design. In addition, Mr. Flores is a project manager and directs groundwater monitoring activities for the USACE, the DOE, and commercial clients as well as managing site investigations and performing monitoring well installations. He has managed field programs and written reports on groundwater and soil investigations.

James Vigerust, CSP. Mr. James Vigerust is a certified safety professional and will act as the HSM. He will serve as an advisor in evaluating health and safety concerns with respect to hazardous waste issues and general work practices. As the HSM, Mr. Vigerust will either conduct a safety audit himself or assign a Site Safety and Health Officer (SSHO) to perform the safety audit to determine whether operations are being conducted in accordance with the SSHP requirements and Occupational Safety and Health Administration (OSHA) regulations. The HSM/SSHO will have the authority to take immediate steps to correct unsafe or unhealthful conditions including the stoppage of fieldwork when deemed necessary.

Craig Givens. Mr. Givens will act as the CQCSM. As CQCSM, Mr. Givens will work with the Project Manager to ensure that all project activities comply with applicable specifications of this QCP, the approved documents, and the contract. Details of the CQCSM's responsibilities are provided in Section 4.2.

3.0 Technical Approach

The overall approach to the work at the FWDA has been developed and is described in the SOW as follows:

- Evaluate existing geochemical data and establish background concentrations for naturally occurring inorganic constituents in soil, groundwater, surface water, and sediment
- Develop site-specific DAFs for “non-naturally” occurring organic compounds to determine allowable soil concentrations that are protective of groundwater
- Provide GIS support as needed
- Attend meetings and support the USACE in regulatory discussions as requested

The SOW also includes an optional task to collect soil, sediment, groundwater, and surface water samples if additional data requirements are identified. This task is not presently funded but is included in this chapter for completeness and discussed in detail in the SAP (Appendix B).

3.1 Background Metal Concentrations

The background data screening process will include multiple procedures based on statistics and geochemistry that are designed to identify and remove potentially contaminated samples from the data sets, such that the remaining samples contain only naturally occurring concentrations of metals. These steps will be performed sequentially, although some iteration between steps may be necessary. Steps required for this task are described in this section. Following Step 7, “surviving” data will be regarded as representative of background metal concentrations at the FWDA. These data will be assessed for adequacy with regard to the number of samples and geographic coverage. At the discretion of the USACE, additional samples may be obtained if the existing screened data are deemed insufficient. Background summary statistics shall be calculated based on screened data. These statistics will include the minimum, median, arithmetic mean, 95th upper confidence limit (UCL) of the mean, 95th upper tolerance limit (UTL), and the maximum concentration. The UCLs and UTLs shall be calculated using nonparametric bootstrap methods to maintain consistency and avoid bias (EPA, 1997).

The results for a considerable number of analyses of soil, sediment, groundwater, and surface water have been made available to Shaw as several database compilations. The sample dates range from 1992 through 2008. Some of the analyzed samples are from background investigations and some are from focused site investigations. The background data includes a set of background sediment samples obtained in 1992 and sets of background soil samples obtained in 1992, 1996, and 1999. The 75 background soil samples obtained in 1999 were used in the

Soil Background Concentration Report, prepared by Malcolm Pirnie, Inc. (Malcolm Pirnie, 2000). A much larger number of samples were obtained from focused site investigations. All of the analytical data will be screened using the following steps:

1. Screen data for acceptable quality, considering analytical methods, method reporting limits, quantitation limits, matrix interferences, presence of laboratory qualifiers, comparisons of duplicate results, etc.

2. Perform a statistical outlier test for each metal. Examine outliers to determine whether they reflect site-related contamination (see Step 6), transcription errors, etc., and eliminate as appropriate.

3. Eliminate "high nondetects" (nondetected results that are present in the upper 10 percent of the distribution). Removal of these results ensures that the background screening values are not biased high due to nondetections with elevated reporting limits.

4. Eliminate samples that exhibit impacts from the presence of organic contaminants. The presence of high concentrations of organic constituents in groundwater can, under certain conditions, depress the local redox potential of the aquifer. Redox depression can cause the dissolution of naturally occurring iron and manganese oxide minerals. These minerals have very strong affinities to adsorb certain elements including antimony, arsenic, molybdenum, selenium, and vanadium; which can become mobilized when the oxide minerals dissolve. This "reductive dissolution" effect can be easily identified in volatile organic compound (VOC)-impacted groundwater samples because they will have low dissolved oxygen and redox potential; and elevated dissolved iron, manganese, and associated trace elements. VOC-impacted soil samples may also have altered trace metal concentrations due to redox effects. Additionally, some sources of VOC contamination in soil, such as used motor oil or leaded gasoline, can contain metals.

5. Prepare probability plots of metal concentrations to identify the presence of multiple distributions and statistical outliers. Examine outliers to determine whether they reflect site-related contamination (see Step 6) and eliminate as appropriate.

6. Perform geochemical evaluation to determine whether metal concentrations are naturally occurring. This step involves examining selected trace versus major element ratios to identify samples with anomalously high ratios. Samples exhibiting anomalous trace versus major element ratios should be considered suspect and be eliminated from the candidate background data set. The advantage of the geochemical evaluation is that it distinguishes anomalously high metal concentrations from naturally elevated concentrations in groundwater samples with elevated turbidity. Samples with elevated turbidity will be retained if no evidence of contamination is observed; this allows the background groundwater data set to reflect the full range of concentrations that are likely to be observed in the site data sets, thus avoiding a low bias in the background screening values. For reference, the theory and application of

geochemical evaluations in soil and groundwater can be found in Myers and Thorbjornsen (2004) and Thorbjornsen and Myers (2007), respectively.

7. Spatial relationships shall be considered during the screening process to determine whether subpopulations are present in the background data sets. Surface and deep soil samples may show different distributions, as may groundwater samples obtained from different hydrostratigraphic units. If evidence for subpopulations exists, these data shall be subdivided into groups, and separate background distributions will be defined for each group.

Following data screening, Shaw will develop background data sets and characterize background distributions for metals in soil, groundwater, surface water, and sediment at the FWDA. Due to the considerable amount of existing data, the approach shall be based on evaluating the existing data for adequacy in characterizing background distributions. These existing data shall be extensively screened using a rigorous multi-step process based on a combination of statistical and geochemical techniques to identify and eliminate any samples that (1) are not of sufficient quality, and (2) do not represent background conditions. Additional samples may be required to supplement the existing data if data that survives the screening process is inadequate with respect to the number of samples or the spatial coverage of the samples.

Extracting background data in this manner (termed "data mining") is a cost-effective approach that maximizes the value of the existing data and minimizes the number of new background samples that are necessary. The data mining approach for background characterization from existing data sets shall be conducted for this study and is recommended for environmental soil and sediment investigations by the U.S. Navy (Navy, 2002 and 2003). This approach has been successfully applied to soil and groundwater in New Mexico at Kirtland AFB and Sandia National Laboratories (IT Corporation, 1996) with approval from the NMED. Following screening of these data (and acquiring additional data if necessary), the second step required for this task is to characterize the background distributions for the 23-element Target Analyte List in each media based on EPA guidance (EPA, 1989; 1992; 1994a; 1995; and 1997).

3.2 Site-Specific Dilution Attenuation Factors

The purpose of developing DAFs is to calculate a maximum allowable soil contaminant concentration that is protective of groundwater resources at the FWDA. Shaw will develop site-specific DAF values consistent with the methodology described in the *Technical Background Document for Development of Soil Screening Levels*, Rev. 4 (NMED, 2006) and the *Soil Screening Guidance: User's Guide*, Second Edition (EPA, 1996). Shaw will use the EPA's Composite Model for Leachate Migration and Transformation Products (EPACMTP) (EPA, 1994b) to calculate DAFs based on site-specific hydraulic and hydrogeologic parameters. The EPACMTP code contains both saturated and unsaturated flow and transport modules, as well as a Monte Carlo routine that allows for a stochastic analysis of the uncertainty in model input parameters.

DAF determination will focus on flow and transport through the vadose zone at FWDA. Primary assumptions in the EPACMTP unsaturated zone module include (EPA, 1994b):

- The source area is rectangular
- Contaminants are distributed uniformly over the source area
- The soil is a homogenous and isotropic porous medium
- Flow is one-dimensional and vertically-downward
- Flow is steady state and driven by the infiltration rate
- Contaminants are present in solution or soil solid phase only
- Sorption of contaminants is described by a linear or nonlinear isotherm
- Chemical or biological degradation is described by a first order decay coefficient
- Leachate concentration entering the soil column is either constant (with either a finite or infinite duration) or decreases with time following a first order decay process

Site-specific hydrogeologic parameters, including but not limited to, the depth to groundwater, the soil type and vertical stratigraphy in the vadose zone, initial conditions/concentration in the soil, and infiltration rates from natural or man-made recharge will be applied. Geologic logs from FWDA wells and boreholes will be analyzed to determine a conceptual model of the vertical stratigraphy and geology. As much site specific input data will be used as possible; when not available, literature values will be used instead. Previous analyses indicate that EPACMTP results are most sensitive to infiltration rate (EPA, 1994b); therefore Shaw expects to treat this parameter as uncertain and use the Monte Carlo module to quantify the effect of a range of infiltration rates.

Model results will be used to determine a DAF that can be applied to specific soil contaminant concentrations and still be protective of groundwater at FWDA.

3.3 Geographic Information System Submittals

The purpose of geospatial information and electronic submittals is to manage GIS technology to effectively coordinate and integrate all pertinent data collected at the FWDA. This information can then be analyzed and used to manage project-related spatial data. Examples of data used within the GIS may include monitoring well locations, soil sampling locations, topography, and physiographic features such as roads, buildings, and streams. Where appropriate, GIS applications will be developed and used to integrate spatial data (maps) with tabulated data stored in databases.

Shaw's standard GIS platform is ArcView, currently Version 9.2. Any new geographic data collected during this project will be recorded in the UTM system (meters). All GIS and other electronic submittals will be provided to the USACE upon completion of this delivery order in accordance with the Geospatial Information and Electronic Submittals DID [Data Item Description] MR-005-07.01, dated December 20, 2007.

The data work flow and relationship between all primary components of the digital record will be documented to facilitate the use of these data by all interested parties. Close coordination will be required among database managers, staff processing field data, GIS analysts, and project task managers. Data will be differentiated between raw and final.

3.3.1 Plot Size

Plot size may vary according to scale. In general, the default size for each sheet that is plotted will be standard D-size plots (36 × 24 inches). Each sheet will have standard borders as dictated by the project and include a revision block; title block; complete index sheet layout; bar scale; legend describing SDS for Facilities and Infrastructure (SDSFIE)-compliant map symbology; grid lines or grid tic layout in feet; a True North Arrow, a Magnetic North Arrow, and a grid North arrow with their differences shown in minutes and seconds; and the computer file path location where the digital map is stored.

3.3.2 Geographical Information System Database

Shaw will maintain a database of Federal Geographic Data Committee-compliant metadata for each GIS layer, including information such as the name of the GIS Analyst, when it was made, each and all updates, dates of updates, and what was changed. This GIS data management system will also include the location of SDSFIE-compliant layers, all known metadata (using the National Geospatial Data Standards as a guide) for each layer, and will be capable of providing tabular reports of each GIS layer. This information will be tracked by utilizing the data management tools included with the latest version of ArcGIS applications.

3.4 Additional Sample Collection

Additional soil and sediment sample collection may be required to supplement the existing data. Data quality objectives for supplemental soil and sediment sample collection will be developed with stakeholder input prior to sample collection. At a minimum, the DQOs will take into account spatial distribution of samples, soil types, geologic environment, sample depth, sample collection method (multi-incremental versus discrete sampling), and delineation of associated aerial boundaries i.e. decision units if MI soil sampling is selected. An amended sampling and analysis plan will be prepared outlining the details of the methods to be employed for the supplemental sample collection. Samples will be collected in accordance with the methods discussed in the SAP (Appendix B) and described in *Protocols for Collection of Surface Soil Samples at Military Training and Testing Ranges for the Characterization of Energetic Munitions Constituents* (USACE, 2007).

4.0 Quality Control Plan

The overall SOW for this project involves analyzing existing data to determine background levels for naturally occurring inorganic constituents in soil, groundwater, surface water, and sediment at the FWDA; establishing site-specific DAFs for non-naturally occurring organic compounds/constituents; provide GIS submittals and collecting additional samples (if additional data is determined to be required).

The objectives of this QCP are to address the specific operating needs of the project and to establish the necessary levels of management and control to ensure all work performed meets the technical requirements of the applicable project plans and conforms in all respects to the requirements of the contract and applicable regulations. Specifically, this QCP addresses the following:

- Identifies the project organization
- Identifies personnel qualification and training requirements
- Identifies the processes affecting quality
- Defines corrective/preventive action procedures
- Describes data management procedures
- Defines field operations (site reconnaissance, surveying, and sampling and analysis)
- Describes procedures used to ensure contract submittals are reviewed/processed to ensure they meet contractual requirements
- Describes QC reporting requirements

4.1 Approach and Procedures

This QCP is a subpart of the overall Work Plan and identifies the approach and operational procedures to be employed to perform QC during activities associated with the project. This QCP identifies the definable features of work (DFW) for the project for which QC practices and procedures will be implemented. The quality requirements and systems established in this QCP are relevant and applicable to all project work identified in the Work Plan and performed by Shaw and its subcontractors and suppliers under this project.

Once approved, the distribution of this Work Plan shall be controlled by the CQCSM in order to ensure that the most recent, accepted version is available at all locations where investigative activities covered by this Work Plan are performed.

Revisions and FWVs to this Work Plan will require the same level of approval, control, and distribution as the original.

4.2 Project Organization

The project organization chart is depicted in Figure 2-1 of this Work Plan. Quality-related responsibilities and authorities of essential personnel in this organization are outlined in the following sections. Chemical QC organizational requirements, roles/responsibilities, and authorities are further defined in the project SAP and laboratory QAPP (Appendix B).

4.2.1 Project Manager

The Project Manager, Mike Goodrich, PG, will report to the Shaw Program Manager, Kenny Hadash, and will be responsible for the quality and timeliness of all project activities, including those performed by subcontractors. The Project Manager will be responsible for implementing this QCP and supporting the efforts of the CQCSM and other project personnel performing QC functions.

4.2.2 Senior Geochemist

The Senior Geochemist, Jonathan Myers, PhD, will report to the Project Manager and will be responsible for evaluating the existing data and determining background concentration data sets for inorganic constituents in soil, groundwater, surface water, and sediment. The Senior Geochemist will be responsible for data mining and data management (including control) of the existing data.

4.2.3 Senior Project Chemist

The Senior Project Chemist, Mark Lyon, GISP, will report administratively to the Project Manager. Mr. Lyon is responsible for managing all project chemical sampling and analysis tasks. Mr. Lyon will serve as the point of contact for USACE on all environmental chemistry and chemical QC issues. Additional project and QC-related qualification requirements, responsibilities, and authorities for the Senior Project Chemist are detailed in the project SAP and analytical QAPP.

4.2.4 Contractor QC System Manager

The CQCSM, Craig Givens, will support the Project Manager in day-to-day operations. The CQCSM will have the requisite authority, including stop-work authority, to ensure that all project site activities comply with applicable specifications of this QCP, the approved project documents, and the contract. This authority applies equally to all project activities, whether performed by Shaw or its subcontractors and suppliers.

The CQCSM will be responsible for planning and executing QC oversight of project operations, and shall ensure compliance with specified QC requirements in project plans, procedures, and contract documents. Specifically, the responsibilities of the CQCSM include the following:

- Develop, maintain, and assess the effectiveness of the project QCP-related procedures and work plans.
- Review the qualifications of proposed technical staff and subcontractors.
- Plan and ensure the performance of preparatory, initial, follow-up, and completion inspections for each DFW and issue the Daily Quality Control Report (DQCR).
- Verify that subcontracted laboratories have and operate under a QC program that complies with the Project QCP, SAP and analytical QAPP, and applicable requirements of the contract.
- Assign additional qualified personnel to conduct field and chemical QC activities when justified by project work scope and circumstances.

The CQCSM is also responsible for attending the project coordination meetings and project kick-off meetings. The CQCSM shall review, track, and assess quality issues identified during the project execution. If absent from the site during project operations, the CQCSM will designate an alternate with equivalent responsibility and authority.

4.2.5 Health and Safety Manager

The HSM, James Vigerust, CSP, will support the Project Manager and/or the Field Team Leader/Project Geologist in management of health and safety for day-to-day field operations. The HSM may delegate health and safety oversight of field operations to an SSHO.

4.2.6 Field Team Leader/Project Geologist

The Field Team Leader/Project Geologist, Dale Flores, PG, will provide field oversight, coordinate project-related activities, and will have the authority and responsibility to stop work when, in his opinion, continuation of work would pose an unacceptable safety or health risk to personnel on the site or when nonconformance to approved project plans occurs. The Field Team Leader/Project Geologist will work with the CQCSM to implement the QCP.

4.2.7 Project Subcontractors

The project may require the use of subcontracted services for analytical laboratory services. Subcontracted work will be conducted in accordance with the requirements of the contract, the Work Plan and SAP, subcontractor SOWs, and the project QCP.

4.3 Personnel Qualification and Training

Project staff shall be qualified to perform their assigned jobs by the establishment and enforcement of minimum qualification requirements for key positions, verification of initial and continued personnel proficiency, and implementation of a formal training program (where necessary) to achieve and maintain work-related proficiency as outlined herein.

4.3.1 Project QC Staff Qualification and Training

The CQCSM shall be USACE-certified in Construction Quality Management. Supplemental project QC personnel, if required to perform inspection activities during the course of the project, are to be qualified and certified by the CQCSM in accordance with established Shaw protocols for the QC function provided.

The CQCSM will be responsible for providing QC implementation and USACE QC protocol indoctrination and training to Shaw staff assigned to the project on a formal and as-needed basis.

4.3.2 Key Project Staff Qualification and Training

The Project Manager shall establish minimum qualification requirements for additional key staff positions on this project through review of contractual and other project-related requirements. The Project Manager/CQCSM shall review the qualifications of proposed key personnel against job qualifications before work may be conducted. Resumes of key project personnel are provided in Appendix E.

Senior technical staff members are to provide newly assigned technical staff on-the-job training related to specific job requirements and techniques on an as-required basis. Particular emphasis shall be paid to problem prevention. Senior staff shall monitor work performed by newly assigned staff. The frequency of monitoring shall be dependent upon the individual's demonstrated proficiency to perform assigned duties.

4.3.3 Subcontractor Qualifications

The CQCSM is responsible for verifying that subcontractors possess the requisite qualifications before procurement of services.

Subcontractors to Shaw may not subcontract their responsibilities on this project to a third party or organization without prior and written approval of the Shaw Project Manager. Where required by Work Plan assignment or procurement document requirements, Shaw QC staff shall work with major subcontractors to ensure that the subcontractor develops and implements, as necessary, supplier QC and internal training programs.

4.3.4 Safety and Health Training

Safety and health training requirements shall be established and implemented in accordance with Shaw policies and procedures specified in the SSHP (Appendix C). At a minimum, site workers and QC staff who may encounter hazardous wastes shall have completed the OSHA Hazardous Material Site Worker Training (40-hour initial training and, as applicable, 8-hour annual refresher courses). The Field Team Leader/Project Geologist shall have also completed the OSHA Hazardous Material Site Worker Training and 8-Hour Supervisor Training.

4.4 Processes Affecting Quality

To verify the performance of work activities in accordance with approved work instructions and QC program requirements, a system of planned and documented inspections will be implemented. Both internal activities and the activities of subcontractors, if applicable, will be monitored. These assessments may include the following areas:

- Conformance to data quality objectives
- Transmittal of information
- Record control and retention
- Inspection of Shaw- and subcontractor-provided materials, capabilities, and/or performance

It is the ultimate objective, through the implementation of this quality program system, to measure and judge the quality of performance of the project activities. This system will be implemented by reviewing methodologies (in the form of this Work Plan and standard operating procedures [SOP]), observing the way methods are executed, and noting the conditions of the environment in which they are performed. The qualifications of the personnel completing the work are also part of the scope of a complete quality program. If variability from these sources can be reduced through a successful quality program implementation, the consistency of the samples collected, the data gathered, the analyses performed, and the results reported can be improved.

4.4.1 Quality Control Inspections

The QC staff (including CQCSM, the Field Team Leader/Project Geologist, and the Senior Project Chemist) will be responsible for assisting the Shaw Project Manager in maintaining compliance with this QCP through the implementation of a three-phase inspection process. This section specifies the minimum requirements that must be met and to what extent QC monitoring must be conducted by the QC staff. The inspection system is based on the three-phase system of control to cover the activities. The three-phase inspection system consists of preparatory, initial, and follow-up inspections for applicable DFWs. The three-phase inspection system will be performed on all DFWs. Details of the three-phase inspection system follows.

A DFW is defined as a major work element that must be performed to execute and complete the project. It consists of an activity or task that is separate and distinct from other activities and requires separate control. The DFWs that have been identified for this project are listed in Table 4-1.

Table 4-1
Definable Features of Work
Background Study and Geochemical Evaluation
Fort Wingate Depot Activity
Fort Wingate, New Mexico

Feature No.	Definable Feature Of Work	Responsible Organization	Work Document Reference
1	Establish background data sets for soil, groundwater, surface water, and sediment	Shaw	Work Plan, Section 3.1
2	Develop site-specific dilution attenuation factors (modeling)	Shaw	Work Plan, Section 3.2
3	Use GIS to develop maps of site features	Shaw	Work Plan, Section 3.3
4	Perform background surface soil sample collection, handling, and shipment (optional task)	Shaw	Work Plan, Sections 2.3 and 3.4; SAP
5	Conduct analyses of soil samples (optional task)	Shaw/Subcontractor Laboratory	SAP/QAPP
6	Perform chemical data review and validation (optional task)	Shaw	SAP/QAPP
7	Prepare report	Shaw	Work Plan, Section 2.5

GIS = Geographic Information System.
QAPP = Quality Assurance Project Plan.
SAP = Sampling and Analysis Plan (Appendix B).
Shaw = Shaw Environmental, Inc.

4.4.1.1 Preparatory Phase Inspection

A preparatory phase inspection will be performed prior to beginning each DFW. The purposes are to review applicable work plans, processes, and specifications and verify that the necessary resources, conditions, and controls are in place and compliant before the start of work activities. The QC staff shall verify that lessons learned during similar previous work have been incorporated as appropriate into the project procedures to prevent recurrence of past problems. The QC staff shall generate and use a Preparatory Phase Inspection Checklist. Work plans and operating procedures are to be reviewed by the QC staff to ensure that prequalifying requirements or conditions, equipment and materials, appropriate work sequences, methodology, hold/witness points, and QC provisions are adequately described. The QC staff shall verify, as applicable, the following:

- The required plans and procedures have been prepared and approved and are available to the field staff.
- Field equipment and materials meet required specifications.
- Field equipment is appropriate for intended use, available, functional, and calibrated.
- Work responsibilities have been assigned and communicated.
- Field staff possesses the necessary qualifications, knowledge, expertise, and information to perform their jobs.
- Arrangements for support services (such as on-site testing and off-site test laboratories) have been made.
- Prerequisite site work has been completed.

Discrepancies between existing conditions and approved plans/procedures are to be resolved. Corrective actions for unsatisfactory and nonconforming conditions identified during a preparatory inspection are to be verified by the QC staff prior to granting approval to begin work.

4.4.1.2 Initial Phase Inspection

An initial phase inspection will be performed, as applicable, the first time each DFW is performed. The purposes will be to check preliminary work for compliance with procedures and specifications, to establish the acceptable level of workmanship, and to check for omissions and resolve differences of interpretation. The QC staff shall generate and use an initial inspection checklist. The QC staff will be responsible to ensure that discrepancies between site practices and approved specifications are identified and resolved. The QC staff will oversee, observe, and inspect all applicable DFWs at the project site and ensure that off-site activities, such as analytical testing, are properly controlled. Discrepancies between site practices and approved plans/procedures are to be resolved and corrective actions for unsatisfactory and nonconforming conditions or practices are to be verified by the CQCSM or designee before granting approval to proceed.

4.4.1.3 Follow-Up Phase Inspection

Follow-up phase inspections will be performed, as applicable, periodically while the DFW is performed in order to ensure continuous compliance and level of workmanship. The QC staff will be responsible to monitor on-site practices and operations taking place, verify continued compliance of the specifications and requirements within the contract, site work scope, and applicable approved project plans and procedures. Discrepancies between site practices and approved plans/procedures will be resolved, and corrective actions for unsatisfactory and nonconforming conditions or practices must be verified by the QC staff prior to granting approval to continue work. Follow-up inspection results will be summarized in the DQCR.

Periodic checks of procedures and/or documentation will be made for completeness, accuracy, and consistency. Follow-up inspections of field activity will typically include a review of field data and any calibration logs for all instruments in use.

4.4.1.4 Additional Inspections

Additional inspections may be performed on the same DFW at the discretion of the client or the QC staff. Completion and acceptance inspections will also be performed to verify that project requirements relevant to the DFW are satisfied.

4.4.2 Corrective/Preventive Action Procedures

Regular inspections should prevent deviations from the work plans and methods being used to perform quality work. However, this is not always the case. When unplanned deviations are detected that may affect the quality of the work performed, a nonconformance will be reported. If a change is required prior to beginning work, it will be documented as a revision to the plan document or as a planned variance (FWV).

4.4.2.1 Nonconformance Documentation

Complex field investigation, sampling, and analysis tasks are sometimes subject to nonconformances. A nonconformance is defined as an unplanned deviation that occurs during the implementation of a task that cannot usually be corrected until after it has occurred. Nonconformances may include using unapproved methods, not following procedures, or substituting unapproved materials or equipment to perform an activity. All nonconformances must go through a cycle of being identified, documented, assessed, and corrected, and will be reported. Each of these steps is critical in handling nonconformances as they are encountered.

The identification of a nonconformance is the responsibility of every person assigned to support the project. This responsibility is incorporated into each person's understanding of the tasks assigned by the supervisor or task leader and the individual's function on the project. As personnel perform their duties on the project, they must constantly be aware of the scope of the activity and recognize when a deviation from the planned activity has occurred or is occurring. After recognizing deviations, they must take action by informing their supervisors or site leaders and documenting in writing the specifics of what occurred using a nonconformance report. Shaw SOP EI-Q007, "Nonconformance Reporting," provides the details of how nonconformances will be reported and tracked. When completed, the nonconformance report may be reviewed by a peer or supervisor and will be presented to the Project Manager. The Project Manager will evaluate the nonconformance report and may assign a lead individual to work with the person who identified the nonconformance (and other team members as needed) to assess its impact on the project and develop corrective actions. Shaw SOP EI-Q008, "Corrective Action," details the corrective action process. The completed nonconformance report and documentation of any corrective action taken will be included as a permanent part of the project file.

4.4.2.2 Continual Improvement

Project staff at all levels are to be encouraged to provide recommendations for improvements in established work processes and techniques. The intent is to identify activities that are compliant but can be performed in a more efficient or cost-effective manner.

Typical quality improvement recommendations include the identification of an existing practice that should be improved (e.g., a bottleneck in production) and/or recommendations for an alternative practice that provides a benefit without compromising prescribed standards of quality. Project staff members are to bring their recommendations to the attention of project management or QC staff through verbal or written means.

Deviations from established protocols are not to be implemented without prior written approval of the Project Manager and concurrence of the CQCSM. Staff-initiated recommendations resulting in tangible benefits to the project should be formally acknowledged by project management personnel.

4.4.2.3 Variance Documentation

FWVs shall be used to address discrepancies, unforeseen conditions, inaccurate assumptions made during the work planning stages, job site interferences, and other work problems discovered during project activities that conflict with the execution of the work as detailed by the work planning documents (Work Plan, procedures, etc.). Although FWVs may be initiated for any number of reasons, the chief benefit of a FWV is to provide an expedited, documented, and technically authorized departure or change to previously approved work planning documents in order to continue with the timely execution of the project.

4.4.2.4 Project Documentation

In the performance of project tasks, Shaw and its subcontractor personnel are required to complete the necessary documentation to record such events as nonconformances, FWVs, and decisions and action items from meetings held with regulatory agencies or the USACE. This project documentation will supplement basic documentation, which can consist of field investigation data, sample collection information, analytical data records, and field reconnaissance. To assist in the collection of information, project documentation procedures have been developed and specialized forms designed. These procedures and documents are either provided as discussed in the previous sections of this document or are Shaw SOPs located on the Shaw intranet site.

4.5 Data Management

Data management for this project may include the management of existing analytical laboratory data provided by the USACE for the purpose of establishing background concentrations and newly collected earth science and analytical data from optional additional soil, groundwater, surface water, or sediment sample collection and analysis.

4.5.1 Analytical Data

Laboratory analytical data requirements for munitions constituents soil sampling are outlined in the QAPP portion of the SAP (Appendix B, Part II).

4.5.2 Earth Science Data

Shaw has a defined process for managing earth science data collected in the field, including geology, lithology, hydrogeology, and field parameters. These data are documented on field log forms designated for the specific medium and data type, and the data are recorded in bound logbooks. These data are organized in the field into packages that contain all the relevant data from a specific site, parcel, or area. Once compiled and organized, all project earth science data will be subjected to a final review by a qualified professional to ensure completeness, consistency, and conformance with site conditions.

4.6 Field Operations

4.6.1 Sampling

The SAP FSP contains a detailed discussion of sampling activities that may be performed. The SAP describes sampling methodologies, record-keeping, and quality requirements. Hand-held GPS monitors will assist in the location of specific sampling locations, which will be documented in FADLs and the DQCRs.

4.6.2 Equipment Calibration and Maintenance Requirements

Equipment calibration and instrument standardization procedures will be implemented to ensure accuracy and repeatability of all collected field data. Calibration and maintenance of any field sampling equipment or survey equipment will be documented on standard calibration logs and retained as project records. If equipment is found to be out of calibration, a nonconformance report will be prepared and any data collected with the equipment/instrument will be evaluated to determine whether it is usable. This evaluation will be documented in the nonconformance report.

4.6.3 Documentation

Shaw will maintain records of all data and related field files including analytical data, survey data, lists, photographs, maps, etc. Reports and submittals will be provided to the USACE.

4.7 Submittal Management

4.7.1 Project Submittals

Submittals will be listed and tracked using USACE Form 4288, Submittal Register. Submittals include deliverables, whether generated on- or off-site by Shaw, subcontractors, fabricators, manufacturers, suppliers, or purchasing agents.

The Submittal Register for this project will be submitted separately for approval from the USACE. Procurement documents for subcontracted services and materials shall list the required subcontractor submittals. The CQCSM is to review the list to ensure its completeness and may expand general category listings to show individual entries for each item. The approved Form 4288 becomes the scheduling document and will be used to control submittals throughout the project. Changes in submittal progress and QC activities related to submittals are to be summarized in the DQCR.

4.7.2 Project Records

A project file will be established to include a record copy of the following documents:

- Work schedule and progress reports
- Change orders and other contract modifications
- Submittal register
- Submittal records
- Personnel qualification and safety certification records

- Daily work activity summary reports, including:
  - TGSMs
  - Field sampling reports and records
  - FADLs
  - Analysis Request/Chain-of-Custody records
  - DQCRs

4.7.3 Submittal Scheduling

The Project Manager shall maintain a project submittal delivery schedule that reflects submittal dates and status on Engineering Form 4288. Submittal activities are to be incorporated into the project schedule so that submittal progress can be tracked in conjunction with overall progress. Submittal schedules shall allow for evaluation, approval, procurement, and delivery prior to the preparatory phase and before the deliverable is needed for work. Interrelated submittals shall be scheduled and submitted concurrently. Adequate time shall be allotted for required reviews and approvals.

4.7.4 Review and Approval of Submittals

Prior to client delivery or use, project submittals are to be reviewed and approved by Shaw. Knowledgeable members of the project staff, the CQCSM, and the Project Manager or designated representative will review the submittal. Multiple reviewers may be used to evaluate different components of the documents (i.e., technical, editorial, and QC reviews). Reviewers will ensure that the planning documents and report(s) meet the following requirements:

- The documents satisfy the requirements of the SOW, client requirements, and applicable regulatory requirements.
- Report assumptions are clearly stated, justified, and documented.
- The reports clearly and accurately present the investigation results.
- The basis for the recommendations and conclusions presented in the reports are clearly documented.
- The tables and figures are prepared and checked according to Shaw requirements.
- The documents have been proofread; punctuation, grammar, and spelling are correct.

The CQCSM will review submittals prepared by Shaw and its subcontractors and suppliers for completeness and compliance with the specifications of the contract, project plans, and Submittal Register requirements.

Submittals related to field equipment or materials are to be reviewed for contractual compliance. Prior to submittal to the CQCSM for certification, technical documents (e.g., reports, plans, and engineering drawings) are to be reviewed by qualified staff. Although part of the QC process, reviewers may include, but are not limited to, the QC staff. The CQCSM certification and signature are required for each submittal. Nonconforming submittals shall be returned to the originator for corrective action and resubmitted to the CQCSM for verification upon completion of approved corrective actions.

For each project document that is submitted for technical review, a Manuscript Routing Sheet or Document Review and Release Form shall be initiated by the author, submitted with the document to be reviewed, and used to document and track the review process. A copy of the completed document review form is to be submitted to the CQCSM with the corrected document and previous revision review comments for review and certification. When a submittal is the result of responding to USACE and other external review comments, a Shaw comment resolution document should accompany the submittal as well.

Submitted documents may also contain signature locations for CQCSM and Project Manager approvals. Original document review forms and external (USACE or regulator) reviewer comments are to be retained in the project file, traceable to the deliverable, for record-keeping purposes and future reference.

4.7.5 Transmittal to Client

Submittals to the USACE are to be accompanied by Engineering Form 4025, Transmittal of Shop Drawings, Equipment Data, Material Samples, or Manufacturer's Certificates of Compliance. Form 4025 shall be used for submitting both USACE "approval" and "information only" submittals, in accordance with the instructions on the reverse side of the form.

Form 4025 is to be properly completed by filling out the blank spaces and identifying each item submitted. Care is to be exercised to ensure proper listing of the submittal reference to contractual requirements, the submittal register number, and/or sheet number of the plans pertinent to the data submitted for each item. The CQCSM will sign Form 4025, upon its completion.

4.8 Daily QC Reports

The CQCSM will be responsible for the preparation and submission of the DQCRs to the USACE. One copy (hard copy or electronic copy) of the DQCR with attachments shall be submitted to the designated USACE representative on the first workday following the date covered by the report. Additional copies may be supplied to the USACE Technical Manager and USACE Program Manager, if requested.

Due to the intermittent nature of the fieldwork schedule associated with this project, DQCRs will be prepared only for those days when fieldwork is being performed.

The DQCR shall provide an overview of technical and QC activities performed each day, including those performed on subcontractor and supplier activities. The QC reports shall present an accurate and complete picture of activities accomplished and forecasted and should report both conforming and deficient conditions. These reports should be precise, factual, legible, and objective. Copies of supporting documentation, such as inspection checklists, test reports, corrective action reports, and surveillance reports shall be attached. Copies of FADLs from the Field Team Leader/Project Geologist or Senior Project Chemist will also be attached to document field activities such as depth of soil borings and samples collected.

DQCR and inspection checklist forms used on this project will be considered project records. Each DQCR is to be assigned and tracked by a three-digit sequential number identifying the current number of field workdays. DQCRs with attachments are to be maintained in the project files.

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U.S. Environmental Protection Agency (EPA), 1997, *The Lognormal Distribution in Environmental Applications*, EPA/600/R-97/006, Technical Support Center Issue, U.S. Environmental Protection Agency, Washington, D.C.

U.S. Navy (Navy), 2002, *Guidance for Environmental Background Analysis, Volume I: Soil*, NFESC User's Guide UG-2049-ENV, Naval Facilities Engineering Command, Washington, D.C., April.

U.S. Navy (Navy), 2003, *Guidance for Environmental Background Analysis, Volume II: Sediment*, NFESC User's Guide UG-2054-ENV, Naval Facilities Engineering Command, U.S. Navy, Washington, D.C.

Appendix A
Scope of Work

26 June 2008

SCOPE OF WORK
FOR
DELIVERY ORDER DM01 TO CONTRACT W912BV-07-D-2004
FORT WINGATE DEPOT ACTIVITY
BACKGROUND AND SITE SPECIFIC DILUTION ATTENUATION FACTORS

A. General. The Architect-Engineer (A-E), as an independent contractor and not as an agent of the Government, shall, in accordance with the terms and conditions more particularly set forth below, furnish all labor, management, facilities, supplies, equipment, and material as required to accomplish a , identified herein. During the prosecution of the work, the A-E shall provide adequate professional supervision and quality control to assure the accuracy, quality, completeness, and progress of the work.

B. Background. The Fort Wingate Depot Activity (FWDA) encompasses 24 square miles of land in northwestern New Mexico in McKinley County, approximately 8 miles east of Gallup, New Mexico. The FWDA is a military reservation under control of the U.S. Army. In 1988, the depot was recommended for closure under the Base Realignment and Closure (BRAC) program and closed in 1993. The FWDA facility now operates under a RCRA Hazardous Waste Facility Permit (EPA ID#: NM6213820974) issued by the New Mexico Environment Department (NMED). This permit can be downloaded off the NMED Hazardous Waste Bureau website, http://www.nmenv.state.nm.us/hwb/fwdaperm.html#Permit_(12-1-2005. As a condition of the NMED permit, the FWDA is required to undertake corrective actions to mitigate the potential risk posed by contaminants including release of explosive constituents. The objective of this Scope of Work (SOW) is to conduct a background study in order to develop a baseline inorganic geochemical assessment establishing concentrations of natural occurring inorganic constituents in soil, groundwater, surface water, and sediment. The Contractor shall identify geologic, hydrogeologic, and geochemical processes that control the distributions of naturally occurring minerals and inorganic compounds within the boundaries of the current FWDA installation. The Contractor shall develop site-specific Dilution Attenuation Factors (DAF) or other approved and appropriate models for *"non-naturally"* occurring constituents such as 1, 2-DCA, toluene, total explosive (a list of 14 separate explosive compounds), perchlorate, and other potential *"non-naturally"* occurring constituents released to the environment. The objective of DAF values apply to potential impacts to groundwater through release at the surface, and migration to groundwater. The SOW objective is to develop and execute a study to determine if a release occurred to the environment above natural background levels, and whether a release has a potential to impact groundwater. Data collected during the execution of this SOW shall be compiled in a report and submitted to the Army (Army Draft), Navajo Nation, Pueblo of Zuni, Bureau of Indian Affairs (Tribal Draft), and NMED (Final) for review and approval.

C. Work to be Performed.

1. Task 1: Develop Work Plan. The Contractor shall develop a work plan outlining techniques and methodologies to establish background concentration for inorganic compounds and constituents, establish site specific DAFs for non-naturally occurring compounds and constituents, sample collection (if additional data is required), data mining process, reconciling chemical data collected using different methods (ex: Multi-Incremental vs. Grab), and a monitoring well geospatial survey. The work plan shall also describe the methods used to determine if site samples exceed background concentrations. As part of the work

plan, a Field Sampling Plan (FSP), a Quality Assurance Project Plan (QAPP), and a Site-Safety Health Plan (SSHP) shall be included. Any samples collected as part of this Task Order (TO) shall be acquired and analyzed using the approved FSP, QAPP, and the SSHP. Laboratory testing shall be conducted using the approved QAPP. The SSHP shall also address safety concerns associated with Parcel 3, the Open Burn/Open Detonation areas. Parcel 3 has obtained an Improvised Conventional Munitions (ICM) Waiver. All work conducted in Parcel 3 shall be executed strictly IAW this ICM Waiver. All electronic laboratory data shall be submitted in Staged Electronic Data Deliverable (SEDD) format (Refer to ER 200-3-1, page 7-8).

2. Task 2: Establish Background. The Contractor will develop background data sets and characterize background distributions for metals in soil groundwater, surface water and sediment at FWDA. Due to the large amount of existing data, the approach shall be based on evaluating the existing data for adequacy in characterizing background distributions. These existing data shall be extensively screened using a rigorous multi-step process based on a combination of statistical and geochemical techniques to identify and eliminate any samples that 1) are not of sufficient quality, and 2) do not represent background conditions. Additional samples may be required to supplement the existing data if data that survives the screening process is inadequate with respect to the number of samples or the spatial coverage of the samples.

Extracting background data in this manner (termed “data mining”) is a cost-effective approach that maximizes the value of the existing data, and minimizes the number of new background samples that are needed. The data mining approach for background characterization from existing data sets shall be conducted for this study. The data mining approach is recommended for environmental soil and sediment investigations by the U.S. Navy (Navy, 2002; 2003), and has been successfully applied to soil and groundwater in New Mexico at Kirtland AFB and Sandia National Laboratories (IT Corporation, 1996) with approval from the NMED. Following screening of these data (and acquiring additional data if necessary), the second step required for this task is to characterize the background distributions for the 23-element Target Analyte List (TAL) in each media based on U.S. Environmental Protection Agency (EPA) guidance (EPA, 1989; 1992; 1994; 1995; and 1997).

3. Task 3 Data Screening Methodology. The background data screening process will include multiple procedures based on statistics and geochemistry that are designed to identify and remove potentially contaminated samples from the data sets, such that the remaining samples contain only naturally occurring concentrations of metals. These steps shall be performed sequentially, although some iteration between steps may be necessary. Steps required for this task are described below. Note: Following Step 7, “surviving” data shall be regarded as representative of background at Fort Wingate. These data shall be assessed for adequacy with regard to the number of samples and geographic coverage. At the discretion of the Fort Wingate project geologist, additional samples may be obtained if the existing screened data are deemed insufficient. Background summary statistics shall be calculated on screened data. These statistics will include the minimum, median, arithmetic mean, 95th upper confidence limit (UCL) of the mean, 95th upper tolerance limit (UTL), and the maximum concentration. The UCLs and UTLs shall be calculated using nonparametric bootstrap methods to maintain consistency and avoid bias (EPA, 1997).

1. Screen data for acceptable quality, considering analytical methods, method reporting limits, guantitation limits, matrix interferences, presence of laboratory qualifiers, comparisons of duplicate results, etc.

2. Perform a statistical outlier test for each metal. Examine outliers to determine if they reflect site-related contamination (see Step 6), transcription errors, etc., and eliminate as appropriate.

3. Eliminate "high non-detects" (non-detect results that are present in the upper ten percent of the distribution). Removal of these results ensures that the background screening values are not biased high due to non-detects with elevated reporting limits.

4. Eliminate samples that exhibit impacts from the presence of organic contaminants. The presence of high concentrations of organic contaminants in groundwater can, under some conditions, depress the local redox potential of the aquifer. Redox depression can cause the dissolution of naturally occurring iron and manganese oxide minerals. These minerals have very strong affinities to adsorb certain elements including antimony, arsenic, molybdenum, selenium, and vanadium; which can become mobilized when the oxide minerals dissolve. This "reductive dissolution" effect can be easily identified in Volatile Organic Compound (VOC)-impacted groundwater samples because they will have low dissolved oxygen and redox potential; and elevated dissolved iron, manganese, and associated trace elements. VOC-impacted soil samples may also have altered trace metal concentrations due to redox effects. Additionally, some sources of VOC contamination in soil such as used motor oil or leaded gasoline can contain metals.

5. Prepare probability plots of metal concentrations to identify the presence of multiple distributions and statistical outliers. Examine outliers to determine if they reflect site-related contamination (see Step 6), and eliminate as appropriate.

6. Perform geochemical evaluation to determine if metals concentrations are naturally occurring. This step involves examining selected trace vs. major element ratios to identify samples with anomalously high ratios. Samples exhibiting anomalous trace vs. major element ratios should be considered suspect and be eliminated from the candidate background data set. The advantage of the geochemical evaluation is that it distinguishes anomalously high metals concentrations from naturally elevated concentrations in groundwater samples with elevated turbidity. Samples with elevated turbidity shall be retained if no evidence of contamination is observed; this allows the background groundwater data set to reflect the full range of concentrations that are likely to be observed in the site data sets, thus avoiding a low bias in the background screening values. For reference, the theory and application of geochemical evaluations in soil and groundwater can be found in Myers and Thorbjornsen (2004) and Thorbjornsen and Myers (2007), respectively.

7. Spatial relationships shall be considered during the screening process to determine if subpopulations are present in the background data sets. Surface and deep soil samples may show different distributions, as may groundwater samples obtained from different hydrostratigraphic units. If evidence for subpopulations exists, these data shall be subdivided into groups, and separate background distributions defined for each group.

4. Task 4: Develop Site Specific Dilution Attenuation Factor Values. The Contractor will develop site-specific DAF values using the methodology described in the New Mexico Technical Background Document for Development of Soil Screening Levels, rev 4, June 2006. Other references for developing site-specific DAF values are Determination of Groundwater Dilution Attenuation Factors for Fixed Waste Site Areas Using EPACMTP, EPA Office of Solid Waste, May 11, 1994, and the Oakridge National Lab web-based Soil Screening Calculator at http://rais.ornl.gov/epa/ssl1.htm. The DAF values shall be developed for potential contaminants of concern. These values will be used to calculate a maximum allowable soil contaminant concentration that is protective of groundwater resources at Fort Wingate. The Contractor shall either implement the equations described in the New Mexico Technical Background Document for Development of Soil Screening Levels, and in other appropriate publications, or use an "off the shelf" numerical model such as VLEACH or SESOIL. Whichever approach is used, site-specific hydrogeologic parameters will be used, including but not limited to, the depth to groundwater, the soil type and vertical stratigraphy in the vadose zone, initial conditions/concentration in the soil, and infiltration rates from natural or man-made recharge.

5. Task 5: Monitoring Well Survey (FFP). The Contractor will use a global positioning system or equivalent surveying techniques to survey the horizontal and vertical locations of 75 existing monitoring wells. Elevations for each survey point will be reported to within 0.01 feet and referenced to the 1988 National Geodetic Vertical Datum (NGVD), as obtained from existing, permanent benchmarks. Both ground and top of casing elevations shall be surveyed. Horizontal coordinates of each survey point will be measured to within 0.1 feet and reported in the Universal Transverse Mercator coordinate system (meters). The Contractor is responsible for locating all benchmarks (control points) in advance of mobilization into the field. This survey shall be performed by a licensed surveyor. Coordinate and elevation data shall be provided to USACE in electronic and hard copy. The hard copy shall contain the surveyor's license number and signature.

6. Task 6: Meetings (FFP). The Contractor shall include in their proposal the cost associated for two meetings with the NMED in Santa Fe, NM to discuss Tasks 1, 2, and 3 described in this SOW. The objectives of these meetings are to educate the NMED on the procedures noted in Task 2, and develop a consensus for a work plan that meets the intent of the FWDA RCRA permit, and Army goals. For estimating purposes, the Contractor shall assume each meeting will take 8-hours (this includes travel to and from the meeting place). No more than three contract personnel are authorized to attend the meeting. Additionally, the Contractor shall provide a cost estimate for one site visit that will coincide with a kick-off meeting with BRAC, USACE and the Contractor. For estimating purposes, the Contractor shall assume three contract personnel for two days on-site. Cost for all other meetings shall be included in the Project Management Task, Task 6.

7. Task 7: Project Management. The Contractor is responsible for providing the USACE and BRAC with all contract-specific management reports. The Contractor will provide an experienced project manager who has the background and aptitude to track task budgets, schedule progress, and clearly convey that information to the USACE and BRAC. Project management includes monthly progress reports, project schedules, coordination with USACE and BRAC, recording minutes of all meetings (telephonic and in person), cost management, and work quality.

8. Option 1: Task 7 - Additional Data Requirements. If required due to data gaps, the Contractor shall propose a sampling approach to collect additional soil, surface water, groundwater and/or sediment. This sampling approach shall address data needs required to adequately assess background conditions. Since the data mining and evaluation process will determine additional data requirements, the Contractor shall provide a cost for this task on a Firm Fixed Unit Priced (FFUP) basis. For estimating purposed, the Contractor shall submit a cost for 20 samples per unit for each media requiring additional data (soil, surface water, groundwater, and sediment). This task shall be funded when the required number of samples is known, and will be negotiated based on the FFUP provided in Contractor's proposal. The Contractor shall use the Multi-Incremental Sampling (MIS) method for all additional soil and sediment sample collection. More information regarding MIS can be found in "Protocols for Collection of Surface Soil Samples at Military Training and Testing Ranges for the Characterization of Energetic Munitions Constituents" July 2007.

9. Task 8: GIS. The Contractor shall utilize GIS in the development of the Background Study. All available existing data that are applicable to the project shall be consolidated into a database and analyzed to relay pertinent information to the USACE, BRAC, Regulators and other stakeholders. The database shall be a living repository that is refined throughout the life of the project. The information attained through the data mining phase shall be documented in the GIS. The information attained during field activities shall be documented in GIS. The Contractor shall submit the GIS data in a format compatible to the ESRI (ArcView/ArcInfo) system, version 9.x. The Contractor shall incorporate layers that overlay on maps of the site that identify physiographic characteristics such as eco-zones and geology, and physical boundaries such as Hazardous Waste Management Units (HWMU), Solid Waste Management Units (SMWU) and (Areas of Concern), real estate parcels and installation boundaries. The Contractor shall provide all submittals in the UTM coordinate system. Archeological site location(s) will not be released to the public without written permission from USACE. The Contractor shall submit GIS files to USACE upon completion of this Task Order. All GIS files currently available will be provided to the Contractor.

10. Task 9: Sampling & Analysis and Data Quality. Existing data shall be reviewed and evaluated. Based on this review, the Contractor shall propose the additional analytical needs and the quantity of samples, including QC requirements that are sufficient to determine the natural background conditions. Data needs to be of sufficient quality to perform the background "screening" processes that are a critical component of human and ecological risk assessments. Hence, data shall meet applicable regulatory criteria needed to perform an ecological and human health risk assessment IAW the EPA Risk Assessment Guidance (RAGS) and USACE EM 200-1-4, Volumes I and II. Sampling shall be conducted to support the geochemical evaluation and statistical analysis. The Contractor shall prepare and submit for acceptance a single SAP that shall include a FSP and a QAPP in accordance with and EM 200-1-3 that describes the sampling approach, addresses contaminants of concern, and sample media. The cost of the SAP shall be firm fixed price and shall be covered under Task 2. The SAP will be subjected to regulatory and tribal review. For additional data quality requirements, refer to Section 4.1 of this SOW.

11. Task 10: Report. Data generated from activities indentified in this SOW shall be compiled and delivered to USACE, BRAC, Regulators and other

Stakeholders in a report. In general, the report shall follow the outline shown below:

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List of Figures
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Chapter 3.0 Identification of Statistical Issues
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    Geochemical Evaluation of New Data
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Chapter 4.0 Results of Statistical Analysis
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    Uncertainties
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    Tests for Lithologic Group Differences
    Calculation of Summary Statistics
Chapter 5.0
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Chapter 6.0 References

D. GENERAL REQUIREMENTS: All work under *Section C "Work to be Performed"* of this SOW shall be performed in accordance with the following general requirements.

1. Chemical Analysis and Laboratory Requirements. If required due to data gaps, the SAP shall be prepared in accordance with EM 200-1-3. The SAP shall address each requirement as identified in ER 1110-1-263 and EM 200-1-3. The laboratory shall meet all of the requirements of Appendix I in EM 200-1-3 unless approved in advance in the SAP. If there are any requirements that the laboratory cannot meet, they shall be clearly identified in the SAP.

a. Laboratory Qualifications: If required due to data gaps, the analytical laboratory utilized by the Contractor must be identified in the SAP, must have an approved self-declaration form on file with USACE, and hold applicable state and national certifications to perform the analytical methods required by this SOW.

b. Coordination with Government Quality Assurance Laboratory: If required due to data gaps, the Contractor must provide coordination of quality assurance samples (collected and transported by the Contractor) to the Government Quality Assurance (GQA) lab. There will be a 10% maximum of additional field sampling. The GQA samples will be replicates of primary field samples and will be analyzed for the same parameters as the associated primary field sample. The GQA samples shall include all sample matrices and analytical parameters except samples analyzed for disposal by Toxicity Characteristic Leaching Procedure (TCLP). The Contractor shall provide the GQA lab a minimum of two weeks notice of sample shipment, unless an alternate notification requirement is proposed and accepted by the Contracting Officer. The Government shall identify the GQA lab. Results of the field control samples and associated laboratory QC shall be provided to the GQA lab.

c. Data Reporting Requirements: If required due to data gaps, the Contractor shall provide data reporting elements for definitive data per Section I.13.4.2 of EM 200-1-3. These data shall be included in the draft and final engineering reports in tabular format. There should be, at a minimum, two types of data tables. The first shall include all analytical results for all samples collected. The second shall include all analytical results greater than Method Detection Limit (MDL) for all samples collected. Tables should be sorted by method and include appropriate data flags resulting from laboratory review and from Contractor's data validation. Data shall also be provided in the SEDD format. The Contractor's laboratory must hold and make available all project raw data for a period of five years after completion of this contract.

d. Data Validation: The Contractor shall perform data validation on all analytical data collected and produced as a result of field and lab efforts. The validation shall be performed as required in approved SAP and documented in the draft and final engineering reports. Validation documentation should address review of laboratory and field QC results. Persons performing the data validation shall have a minimum of 10 years plus directly relatable laboratory experience coupled with two years data review and two years data validation experience in accordance with current guidelines.

e. Data Quality: The Contractor shall produce and maintain data quality at a level sufficient to support project objectives as defined in the SAP. The Contractor shall also establishment a quality control process for all analytical tasks performed during the execution of this SOW, and shall be responsible for achieving the data quality objectives as defined in the SAP. Analytical data that does not meet QA requirements may be rejected by the Government and contract re-performance required at no additional cost to the Government.

2. Location Surveys and Mapping: The Contractor shall perform civil surveys and IAW EM 1110-1-4009. All data submitted shall be in the Universal Transverse Mercator (UTM) coordinate system.

3. Submittals and Correspondence:

a. Schedule: A final schedule shall be submitted a minimum of 30 days before commencing in a format compatible with Primavera or Microsoft Project. A PDF version shall also be submitted. This is an electronic submittal only.

b. Telephone Conversations/Correspondence Records. The Contractor shall keep a record of each phone conversation and written correspondence concerning this Task Order. A copy of this record shall be attached to the Project Status Report.

c. Project Status Reports. The Contractor shall prepare and submit a Monthly Progress Report describing the work performed since the previous report, work currently underway and work anticipated and any issues that will impact the project. The report shall state whether current work is on schedule and within budget. If the work is not on schedule, the Contractor shall state what corrective actions are being taken in order to get back on-schedule. The report shall be submitted not later than the 10th day of the following month. If required, data submittals shall include the monthly GIS database update, which shall be submitted on a CD.

d. Computer Files. All final text files generated by the Contractor under this contract shall be furnished to the Contracting Officer in Microsoft Word 2000 or higher software. Spreadsheets shall be in Microsoft EXCEL 2000 or higher. All electronic laboratory data shall be submitted in SEDD format (Refer to ER 200-3-1, page 7-8). All final CADD drawings shall be in Microstation 95 or higher. All GIS data shall be in ESRI (Arcview/Arcinfo) format.

e. PDF Deliverables: In addition to the paper and digital copies of submittals, the draft and final version of any and all report and/or plans shall be submitted, uncompressed, on CD/DVD in PDF format along with a linked table of contents, linked tables, linked photographs, linked graphs, and linked figures, all of which shall be suitable for viewing on the Internet. The PDF files shall be created from source documents whenever possible. PDF files shall be provided without security restrictions.

f. Identification of Responsible Personnel: Each report shall identify the specific members and title of the Contractor's staff and subcontractors that had significant and specific input into the reports' preparation or review.

g. Submittals. The Contractor shall furnish copies of the plans, maps, and reports as specified in this SOW, to each addressee listed below in the quantities indicated. The Contractor shall submit copies on CD/DVD with each hard copy of the Draft and Final versions of all submittals (Work Plans, Reports, Plans, etc) as indicated below.

4. Administrative Record: The Contractor is not required to establish or maintain an Administrative Record; however, all deliverables will be prepared and submitted in a manner which supports and complements inclusion in the project's Administrative Record.

5. Project Access: All vehicles entering FWDA are subject to post regulations. All personnel must be willing to show driver's license/government issued photo ID and proof of insurance (drivers) upon request of the caretakers' office. Speed limit on the post is 15 mph in admin area and 25 mph all other areas. FWDA is generally open (main gate unlocked) from 06:45 to 17:00 hours 5 days a week. A series of gates lies between the administrative area and different areas of the installation. The contractor will be required to coordinate with the FWDA caretakers' office during the execution of this contract for access into FWDA and the work sites. Firearms, open flames, and smoking are prohibited on FWDA, violators will be removed from the project.

6. Quality Control (QC) Plan.

a. The A-E's QC Plan shall provide and maintain an effective quality control program that will assure that all services required by this Delivery Order are performed and provided in a manner that meets professional, architectural, and engineering quality standards. The A-E's QC Plan shall be prepared in accordance with CESPDR-1110-1-8 "Quality Management Plan" Appendix D. As a minimum, all documents shall be technically reviewed by competent, independent reviewers. One copy of all independent technical review (ITR) comments shall be provided to the Government with the draft submittal. Performance of the independent technical review should not be accomplished by the same element that produced the product. Errors and deficiencies in the report documents shall be corrected prior to submitting them to the Government.

b. The A-E shall include in the QC plan a time-scaled bar chart or Critical Path Method (CPM) study schedule showing the sequence of events involved in carrying out the project tasks within the specific period of service. This should be at a detailed level of scheduling sufficient to identify all major tasks including those that control the flow of work. The bar chart or schedule shall include review and correction periods proper to submittal of each item. This should be a forward-planning, as well as a project-monitoring, tool. The bar chart or schedule reflects calendar days and not dates for each activity. When a modification to this Delivery Order occurs, the A-E shall submit a revised bar chart or schedule reflecting the change within seven calendar days of receipt of the change.

c. The QC Plan shall be implemented by an assigned person within the AE's organization who has the responsibility of being present during the times work is in progress, and shall be cognizant of and assure that all documents on the project have been coordinated. This individual shall be a person who has verifiable engineering or architectural design experience and is a registered professional engineer or architect. The A-E shall notify the District, in writing, of the name of the individual and the name of an alternate person assigned to the position.

d. The Contracting Officer will notify the A-E, in writing, of the acceptance of the QC Plan. After acceptance, any changes proposed by the A-E are subject to the acceptance of the Contracting Officer or the authorized representative.

E. Technical Criteria and Standards. The work shall be performed in accordance with the basic contract, Section C, this Scope of Work, and all furnished instructions. The project shall incorporate the Government furnished data stated in Exhibit I.

F. Submittal Schedule and Requirements. The study and other related data and/or services required in accordance with this Scope of Work shall be accomplished within the specified times. No work shall be accomplished beyond this original Scope of Work unless specifically directed by the Contracting Officer. The initial schedule for delivery of data to the Contracting Officer is in calendar days after the date of receipt of Notice to Proceed by the A-E. All narratives shall be accomplished using MicroSoft™ Word, word processing software and furnished on computer diskette or compact diskette. Delivery of completed work shall be accomplished such that the materials will be protected from handling damage. Each package shall contain a transmittal letter or shipping form, in duplicate, listing the materials being transmitted, being properly numbered, dated, and signed. Shipping Labels shall be marked as follows:

U.S. Army Engineer District Albuquerque
Attn: David Henry
4101 Jefferson Plaza, NE
Albuquerque, New Mexico 87109

DELIVERY SCHEDULE

Task #	Task	Due date
1	Army Draft WP	60 Days from NTP
1	Final WP	90 Days from NTP
1	NMED Comment Responses and Revision	185 Days from NTP
3	DAF Values Generated	180 Days from NTP
4	Well Survey	30 Days from NTP
5	Regulatory Meetings	TBD
6	Project Management	Monthly
7 Option	Execution of Additional Sampling Requirements	190 Days from NTP
10.	Army Draft Report	240 Days from NTP
	Army Comment Responses and Revision (Tribal Draft Report)	285 Days from NTP
10.	Tribal Comment Responses and Revision (Final Report)	395 Days from NTP
10.	Regulatory Comment Responses and Report Revision	470 Days from NTO

G. Information to Be Furnished By the Government:

1. General Data. The Government will furnish the A-E with data and information concerning functions and principal features of the project along with pertinent personnel information. Specific data to be furnished by the Government are set forth in the attached Exhibit I.

2. Review Comments. Review comments will be provided after each Draft Report submittal. The comments will be reviewed for possible conflicts and consolidated before being furnished. These comments will be furnished either in hard copy or on computer diskette. All comments will be provided a minimum of three working days before any scheduled review conference (as applicable).

H. Architect-Engineer Services.

1. General Design and Study Requirements. The A-E shall furnish all submittals to the address indicated in the paragraph E.

2. Review Conferences. Not applicable.

3. Review Comment Annotation and Compliance.

a. The Government's review will consist of quality assurance (QA) checks with limited technical review. Comments will be provided either in written form or on computer diskette. The A-E shall incorporate the review comments in the development of the Final Report submittal. If any review comment requires clarification and/or amplification to assure understanding, the A-E shall notify the Contracting Officer in writing. After each Draft Report submittal, the A-E will be furnished comments to be annotated and returned to the Government. Comments shall be annotated as: C-Concur; D-Do Not Concur; and E-Exception. Comments annotated with D or E shall be explained to justify noncompliance with the comment. These annotations will, in addition to explanations previously required, include a brief notation for all comments concurred with as to what action was taken and where.

b. The A-E shall furnish all annotated comments to the Government no later than seven calendar days after receipt of all comments associated with the Draft Report submittal.

c. A compliance check to insure that all accepted review comments have been incorporated will be performed upon submittal of the Final Report.

I. SPECIAL CONDITIONS.

1. Prosecution of the Work. The A-E shall furnish sufficient technical supervisory and administrative personnel at all times to ensure prosecution of the work in accordance with the delivery schedule within each delivery order. The A-E shall assure that the work is executed in a professional manner and is prosecuted vigorously. The A-E shall be responsible for checking calculations, drawings, details, notes and other work products to verify the design intent and scope of work for each delivery order have been met.

2. Project Management.

a. The A-E shall appoint an individual to serve as a single point of contact and liaison between the A-E and the Contracting Officer, and/or the Government representative, for all services required under this contract. Upon issuance of a delivery order, the A-E shall furnish, in writing, the name of the Project Manager to the Contracting Officer. The Project Manager will be responsible for the complete coordination of all work developed under the particular delivery order. All work will be accomplished with adequate internal controls and review procedures to eliminate conflicts, errors and omissions, and to assure the technical accuracy of all design information. The Government shall be notified, in writing, of any changes in the Project Manager.

b. The Government's Technical Leader for this work is Mr. David Henry, Geotechnical and HTRW Branch, Albuquerque District, telephone 505-342-3139. The Technical Leader is the Government's representative responsible for the day-to-day management of the project. Questions regarding technical issues under this delivery order should be directed to this individual. The Technical Leader does not have the authority to change the terms or conditions of this delivery order including time and cost. The A-E will be notified, in writing, of any changes in the Government's Technical Leader.

3. Verification and Return of Government Furnished Information.

a. The A-E shall advise the Contracting Officer of any discrepancies, ambiguities, and lack of clarity noted in reports, plans, specifications and other data furnished for use in connection with delivery orders under this contract, unless otherwise specifically stated in each delivery order.

b. All engineering manuals, guide specifications and other data furnished by the Government as designated by the Contracting Officer, shall be returned, if specifically requested, within 30 calendar days after the date of acceptance of the work to be accomplished under the applicable delivery order.

4. Site Visits, Inspections and Investigations. The A-E shall visit and inspect/investigate the site of the project as necessary and required during the preparation and accomplishment of the work under each delivery order. Prior to any site visit, the A-E shall notify the District's Project Manager of the visit date. All travel, costs, and expenses incurred by the Architect-Engineer or his representative(s) including consultants for such site visits, inspections, and investigations are included in the lump sum price of each delivery order.

5. Rights of Entry. The A-E shall obtain all rights-of-entry and work permits as may be necessary for access to or performance of services required by this contract, except as otherwise specifically noted in each delivery order.

6. Architect-Engineer Request for Information (A-E RFI). When the A-E needs additional, or a clarification of, information from the Government to facilitate the services required by delivery order, the A-E shall submit an A-E RFI requesting the needed information. A separate A-E RFI shall be used for each unrelated request. Although the information is requested by other documentation or methods such as, Confirmation notices, letters, memorandums, design analysis, annotated review comments, tele-copies, telephone conversations, conferences, meetings, discussions, etc., the A-E shall document the requested information on an A-E RFI. These requests, entitled "A-E Request for Information" shall be numbered sequentially and shall fully explain the requested information and all ancillary information needed. The A-E shall forward each A-E RFI to the Contracting Officer no later than five working days after the need for information is determined.

7. Conferences and Meetings.

a. The A-E shall attend and participate in all design meetings and conferences pertinent to the services as defined by the particular scope of work under each delivery order, as directed by the Contracting Officer.

b. Periodic meetings may be held whenever requested by the Contracting Officer, or the A-E, for discussion of questions and problems relating to the services required under each delivery order.

c. At the option of the Contracting Officer, the A-E may be required to attend and participate in other conferences in addition to those included in each delivery order. Labor and travel costs for such meetings/conferences will be negotiated and included by modification to the delivery order.

8. Correction of Deficiencies. After submission of the deliverables specified in each delivery order, the A-E shall make any corrections thereto, as may be necessary because of errors or omissions, including the preparation of addenda during the bidding period that may be required as a result of such deficiencies.

I. GENERAL PROVISIONS.

1. Performance Evaluation. A Performance Evaluation will be prepared at the completion of this Delivery Order and entered into the Corps of Engineers, Architect-Engineer Contract Administration Support System (ACASS). It will be made available to other Corps Districts and utilized in the selection process for future contracts.

2. Work Authorizations. Any work done without being directed to do so, in writing, by the Contracting Officer will be done at the A-E's own risk. Work beyond the original scope shall be accomplished only at the direction of the Contracting Officer. For delivery orders requiring submittals in installments, the A-E shall not proceed or initiate any successor level of work prior to receipt of approval of the preceding level.

3. Subcontractors. The A-E shall cause appropriate provisions to be inserted in all subcontracts relating to this contract to ensure fulfillment of all contractual provisions by subcontractors. If for sufficient reason, at any time during the process of this contract, the Contracting Officer determines that any subcontractor is unsatisfactory or is not performing in accordance with the contract, the A-E will be informed in writing accordingly and immediate steps shall be taken by the A-E to obtain acceptable performance or terminate the subcontract. Subletting by subcontractors shall be subject to the same requirements. Nothing contained in this contract shall be construed to create any contractual relation between any subcontractor and the Government.

4. Inspection and Acceptance.

a. Inspection During Progress. During the progress of work, all work and all the A-E's or subcontractor's plant and equipment engaged in this contract shall be subject to, and available for, inspection by the Contracting Officer during normal office hours.

b. Inspection of Delivered Work. As soon as practicable after delivery of work in any installment, the Contracting Officer will spot check for serious errors or an undue number of minor errors indicating mistakes, carelessness, or lack of adequate quality control on the part of the A-E. The Contracting Officer may forego a thorough inspection and return the entire submittal for rechecking and correction by the A-E.

c. Resubmittal. In the event that documents submitted for review are deemed to be deficient or incomplete for a particular stage of completion, the A-E will be required to correct the deficiencies and resubmit the documents in the quantities originally required and within a reasonable time as specified by the Contracting Officer. The cost of accomplishing the resubmittal data shall be borne by the A-E.

5. Certification of Computer Media. All delivery media (disks, magnetic tapes, etc,) for computer data shall be certified by the A-E to be free of known computer viruses. The name(s) and release date(s) of the virus scanning software used to analyze the delivery media shall be furnished to the Government at the time of delivery. The release or revision date of the viruses scanning software shall be current. If analysis of the delivery media by the Government finds evidence of virus infection, the media will be returned to the A-E. The A-E shall resubmit the media at no cost to the Government.

6. Progress Payments. The A-E may invoice monthly based on the progress of the project. The invoice shall give the status of the project, expressed on a percentage basis, of the total amount of work completed. All invoices shall be signed and submitted to the Albuquerque District, Attention: Jeff Nelson, A-E Contracts Section.

EXHIBIT I
GOVERNMENT FURNISHED ITEMS

REFERENCES

1. EPA, 1989, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Final Guidance*, Office of Solid Waste, Waste Management Division, U.S. Environmental Protection Agency, EPA/530/SW-89/026.

2. EPA, 1992, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Addendum to Interim Final Guidance*, Environmental Statistics and Information Division, Office of Policy, Planning, and Evaluation, U.S. Environmental Protection Agency, EPA/530/R-93/003.

3. EPA, 1994, *Statistical Methods For Evaluating The Attainment Of Cleanup Standards*, Environmental Statistics and Information Division, Office of Policy, Planning, and Evaluation, U.S. Environmental Protection Agency, EPA/230/R-94/004.

4. EPA, 1995, *Determination of Background Concentrations of Inorganics in Soils and Sediments at Hazardous Waste Sites*, Office of Research and Development, U.S. Environmental Protection Agency, EPA/540/S-96/500.

5. EPA, 1997, "The Lognormal Distribution in Environmental Applications," Technical Support Center Issue, U.S. Environmental Protection Agency, EPA/600/R-97/006.

6. EPA, 2002, "Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites," U.S. Environmental Protection Agency, OSWER 9355.4-24.

7. Myers, J. and K. Thorbjornsen, 2004, "Identifying Metals Contamination in Soil: A Geochemical Approach," *Soil & Sediment Contamination: an International Journal*. Amherst Scientific Publishers, Vol. 13, No. 1, January/February 2004, pp. 1-16.

8. IT Corporation, 1996, "Background Concentrations of Constituents of Concern to the Sandia National Laboratories/New Mexico Environmental Restoration Project and the Kirtland Air Force Base Installation Restoration Program," prepared by IT Corporation, Albuquerque, New Mexico.

9. Navy, 2002, *Guidance for Environmental Background Analysis, Volume 1: Soil*, NFESC User's Guide UG-2049-ENV, Naval Facilities Engineering Command, United States Navy, Washington, D.C.

10. Navy, 2003, *Guidance for Environmental Background Analysis, Volume II: Sediment*, NFESC User's Guide UG-2054-ENV, Naval Facilities Engineering Command, United States Navy, Washington, D.C.

11. Thorbjornsen, K. and J. Myers, 2007, "Identifying Metals Contamination in Groundwater Using Geochemical Correlation Evaluation," *Environmental Forensics*, Vol. 8, Nos. 1-2, pp. 25-35.

<u>EXHIBIT II</u>

The table below identifies personnel receiving a preliminary draft, draft and final Work Plan and Report.

Note: No tribal review required for the Work Plan

ADDRESSEE	VERSIONS	HARD COPIES	CDs
USACE - Fort Worth District Planning, Environmental and Regulatory Division ATTN: (Steven Smith) 819 Taylor Street, Room 3A12 Fort Worth, Texas 76102 T: 817-886-1879	Army Draft, Tribal Draft, Draft, and Final	1	1
Mark Patterson BRAC Environmental Coordinator Ravenna Army Ammunition Plant Building 1037 Ravenna, OH 44266 T:330-358-7312 F:330-358-7314	Army Draft, Tribal Draft, Draft, and Final	3	2
Richard Cruz Ft. Wingate Army Depot 7 Miles East of Gallup Bldg 1 Ft. Wingate, NM 87316 505-488-6109	Army Draft, Tribal Draft, Draft, and Final	3	2
Dr. Burton C. Suedel Research Biologist US Army Engineer Research and Development Center Waterways Experiment Station, EP-R 3909 Halls Ferry Road Vicksburg, MS 39180-6199 T:601-634-4578 F:601-634-3120 email:burton.suedel@usace.army.mil	Army Draft, Tribal Draft, and Final	1	1
Neal Navarro USACE – Sacramento District Engineering Division, CESPK-ED-GD Sacramento, Calif. 95814-2922 T:916-557-6948	Army Draft, Tribal Draft, and Final	1	1
David Henry USACE – Albuquerque District Environmental Engineer Branch 4101 Jefferson Plaza Albuquerque, NM 87109 T:505-342-3139	Army Draft, Tribal Draft, Draft, and Final	1	1
Bill O'Donnell US Army BRAC Office 2530 Crystal Dr. Arlington, VA 22202 T:703-601-1570	Army Draft, Tribal Draft, Draft, and Final	0	1
Tammy Diaz	Final	2	2

ADDRESSEE	VERSIONS	HARD COPIES	CDs
New Mexico Environment Dept., HWB 2905 Rodeo Park Drive, East Bldg. 1 Santa Fe, NM 87505-6303 T:505-428-2552			
Chuck Hendrickson U.S. EPA, Region 6 NM & Federal Facilities Section. 1445 Ross Ave., Suite 1200 Dallas, TX 75202-2733 T:214-665-2196	Final	1	1
Sharlene Begay-Platero (Sharlene will distribute) Navajo Nation Wingate Project Coordinator Eastern Navajo Economic Development Office 211 E. Historic Hwy. 66 Church Rock, NM 87311 T:505-863-6414	Tribal Draft, Draft, Final	1	6
Edward Edwaed Wemytewa Zuni Wingate Project Coordinator Attn: Governor's Office P.O. Box 339 1203B State Hwy 53 Zuni, NM 87327 T:505-782-7036	Tribal Draft, Draft, Final	1	8
Ben Burshia (Please FedEx) Chief of Real Estate Services Division Central Office, Bureau of Indian Affairs 1620 L Street NW. Suite 1075 Washington, DC 20036 T:202-452-7778	Tribal Draft, Draft, Final	0	1
Link Lacewell Bureau of Land Management 1474 Rodeo Rd. P.O. Box 27115 Santa Fe, NM 87502-0115 505-438-7424	Tribal Draft, Draft, Final	1	1
Rose Duwyenie BIA – NR – Environmental Protection 301 West Hill Gallup, NM 87305 T:505-863-8369	Tribal Draft, Draft, Final	1	2
Tom Bartman (Please FedEx) Office of the Solicitor Department of the Interior Mail Stop MIB 6453 1849 C Street, NW Washington, D.C. 20240 T:202-208-5000	Tribal Draft, Draft, Final	0	1
Mike Kipp U.S. Army Environmental Center	Army Draft, Tribal Draft,	1	1

ADDRESSEE	VERSIONS	HARD COPIES	CDs
SFIM-AEC-ERA 5179 Hoadley Rd. APG (EA), MD 21010-5401 T:401-436-7099	Draft, and Final		

Appendix B
Sampling and Analysis Plan
(Field Sampling Plan and Quality Assurance Project Plan)

SAMPLING AND ANALYSIS PLAN
Background Study and Geochemical Evaluation
Fort Wingate Depot Activity
Gallup, New Mexico

Contract No. W912BV-07-D-2004
Delivery Order DM01

Revision 0

Final—January 2009

Prepared for:
U.S. Army Corps of Engineers
Albuquerque District
4101 Jefferson Plaza, NE
Albuquerque, New Mexico 87109

Prepared by:
Shaw Environmental, Inc.
2440 Louisiana Blvd. NE, Suite 300
Albuquerque, New Mexico 87110

I. Field Sampling Plan

Attachments

II. Quality Assurance Project Plan

Attachments

I. Field Sampling Plan (FSP)

FIELD SAMPLING PLAN
Background Study and Geochemical Evaluation
Fort Wingate Depot Activity
Gallup, New Mexico

Contract No. W912BV-07-D-2004
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Table of Contents

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List of Attachments

Acronyms and Abbreviations

bgs	below ground surface
°C	degrees Celsius
CFR	Code of Federal Regulations
DAF	Dilution attenuation factor
DU	decision unit
EDMS	Environmental Data Management System
EPA	U.S. Environmental Protection Agency
FSP	Field Sampling Plan
FWDA	Fort Wingate Depot Activity
GPS	global positioning system
IDW	investigation-derived waste
kg	kilogram(s)
MI	multi-incremental
NMED	New Mexico Environment Department
NMWQCC	New Mexico Water Quality Control Commission
QA	quality assurance
QC	quality control
QCP	Quality Control Plan
RCRA	Resource Conservation and Recovery Act
SAP	Sampling and Analysis Plan
Shaw	Shaw Environmental, Inc.
SOP	standard operating procedure
SOW	Statement of Work
TAL	Target Analyte List
USACE	U.S. Army Corps of Engineers
UTM	Universal Trans-Mercator

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1.0 Project Background

This Field Sampling Plan (FSP) provides guidance for collecting additional soil, surface water, groundwater, and/or sediment samples in order to address additional data needs, i.e. data gaps, that may be identified during the establishment of background concentrations for naturally-occurring inorganic constituents and site-specific dilution attenuation factors (DAF) for non-naturally occurring organic compounds and constituents at the Fort Wingate Depot Activity (FWDA). A large data set of constituents and compound concentrations exist for samples previously collected at the site. Statistical and geochemical evaluations, i.e. data mining techniques, will be performed to develop background data sets and background distributions for metals in soils, groundwater, surface water, and sediment at FWDA. If the results from statistical and geochemical evaluations indicate that additional sample analyses are required to determine background distributions or DAF, then those additional samples will be collected in the field following guidance detailed in this FSP. The number of additional samples, their media, and locations are not known at this time.

1.1 Site History and Contaminants

A site history is presented in Chapter 1.0 of the Work Plan. Figure 1-1 of the Work Plan is a site location map of the FWDA area.

1.2 Summary of Existing Data

A summary of existing data from FWDA will be in the report describing the processes and procedures used to determine background distributions for metals and site-specific DAFs.

1.3 Site-Specific Definition of the Problem

The FWDA is required to undertake corrective actions to mitigate the potential risk posed by contaminants including release of explosives constituents. In order to identify any contaminant releases and determine the potential risks, the naturally occurring background concentrations for metals and DAFs for non-naturally occurring organic compounds and constituents must be known. If the data mining techniques used during the statistical and geochemical evaluations do not sufficiently characterize background for metals and DAFs for other constituents then additional sampling and analysis will be required. The environmental media, sample locations, and analyses that may be required are unknown at this time.

Sampling activities described in this FSP are designed to collect samples of surface or subsurface soils, groundwater, surface water, and/or sediment that are representative of the media and locations from which they are collected and that upon analysis can yield constituent concentrations that can be included in the background distributions or that can be used to differentiate contamination from background.

To aid in the identification of potentially hazardous constituents and determine whether or not a release has occurred, environmental media sample results will be compared to background distributions for naturally occurring inorganic constituents and site-specific DAFs for non-naturally occurring organic compounds. Samples collected under this FSP may contribute to determining the background distributions for metals and DAFs for non-naturally occurring compounds and constituents. Additional criteria can be used for comparison with site soil sample data and include the New Mexico Environment Department (NMED) soil screening levels (NMED, 2006) and the Environmental Protection Agency (EPA) Region 6 human health medium-specific screening levels for residential exposure (EPA, 2008a) (Table 3-1 of the Quality Assurance Project Plan – Part II of this Sampling and Analysis Plan [SAP]). For groundwater and surface water samples, metals analysis results can be compared to the EPA Maximum Contaminant Levels and Secondary Drinking Water Standards (EPA, 2001) (Table 3-1 of the Quality Assurance Project Plan – Part II of this SAP).

Potential risk to terrestrial ecological receptors will be assessed by screening against EPA's Eco-SSLs (EPA, 2008b). The lowest Eco-SSL available for plants, invertebrates, birds, and mammals that is also greater than the established background will be used for the screening. Two metals without EPA Eco-SSLs, mercury and thallium, do have ESLs available in the ECORISK Database, Version 2.3 (LANL, 2008). The soil ESLs in ECORISK represent feeding guilds and trophic levels relevant to potential terrestrial receptor exposure at the facility, including: plants, soil-dwelling invertebrates, deer mouse (mammalian omnivore), Montane shrew (mammalian insectivore), desert cottontail (mammalian herbivore), fox (mammalian carnivore), American robin (avian insectivore, omnivore, and herbivore), and the American kestrel (avian insectivore and carnivore). As with the EPA Eco-SSLs, the lowest available SSL in ECORISK that is also greater than the established background will be used for screening of mercury and thallium.

1.4 Sampling and Analysis Activities

Sampling activities may include the following sampling tasks:

- Multi-incremental (MI) and/or discrete sampling of surface soil and sediments
- Surface water sampling
- Groundwater sampling at existing or newly installed monitoring wells

The collected samples will be analyzed for the EPA Contract Laboratory Program's Target Analyte List (TAL) of 23 metals.

Data quality objectives (DQOs) for supplemental soil and sediment sample collection will be developed with stakeholder input prior to sample collection. At a minimum, the DQOs will take into account spatial distribution of samples, soil types, geologic environment, sample depth, sample collection method (multi-incremental versus discrete sampling), and delineation of associated aerial boundaries i.e. decision units (DU) if MI soil sampling is selected. An amended sampling and analysis plan will be prepared outlining the details of the methods to be employed for the supplemental sample collection.

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2.0 Project Organization and Responsibilities

Project organization and responsibilities are addressed in Chapter 2.0 of the Work Plan. The project organizational chart is presented in Figure 2-2 of the Work Plan. Appendix D of the Work Plan provides current contact information.

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3.0 Project Scope and Objectives

Project scope and objectives for this FSP are detailed in the "Scope of Work [SOW] for Delivery Order DM01 to Contract W912BV-07-D-2004, Fort Wingate Depot Activity, Background and Site Specific Dilution Attenuation Factors," dated June 26, 2008. The objective for the scope of work is to, "…conduct a background study in order to develop a baseline inorganic geochemical assessment establishing concentrations of natural occurring inorganic constituents in soil, groundwater, surface water, and sediment." And further, "The SOW objective is to develop and execute a study to determine if a release occurred to the environment above natural background levels, and whether a release has a potential to impact groundwater." Field sampling conducted under this FSP will, if performed, support those paired objectives.

3.1 Task Descriptions

Planned activities detailed in this section include site surveys, supplemental surface soil and/or sediment sampling, surface water sampling, and groundwater sampling.

3.1.1 Site Surveys

Site surveys include:

- Stakeout the locations for the supplemental soil and/or sediment DUs
- Locating surface water sampling locations

Stakeout of the supplemental soil or sediment sampling DUs or discrete sample locations will be accomplished using a sub-meter grade global positioning system (GPS); total data station or similar survey instruments; or sighting compass and surveyor's chain, tape measure, or distance wheel. DU intersections and study area boundaries will be designated with stakes, rebar, pin flags, or lathe driven into the ground and clearly marked with fluorescent paint and/or flagged. Adjacent DUs will be designated by naming or by row and column designations, using numerals for one and alphabetic characters for the other.

Surface water sampling locations will be identified using a hand held GPS unit. Locations will be designated with clearly marked stakes, rebar, pin flags, or lathe.

3.1.2 Supplemental Soil and/or Sediment Sampling

Data quality objectives for supplemental soil and sediment sample collection will be developed with stakeholder input prior to sample collection. At a minimum, the DQOs will take into account spatial distribution of samples, soil types, geologic environment, sample depth, sample collection method (multi-incremental versus discrete sampling), and delineation of associated aerial boundaries i.e. DUs if MI soil sampling is selected. An amended sampling and analysis plan will be prepared outlining the details of the methods to be employed for the supplemental sample collection.

3.1.3 Groundwater Sampling

Groundwater may be sampled from indicated monitoring wells at the FWDA. Monitoring wells will be purged of stagnant water prior to sampling using equipment and procedures appropriate to the type of well installation and with respect to previous sampling events. Monitoring wells may be purged and sampled using bailers, electric submersible pumps, gas-driven piston pumps, low-flow bladder pumps, BARCAD™ sampling systems, or other devices and techniques depending on the location and installation. Groundwater samples will be collected for both "total" metals analysis (unfiltered samples containing both dissolved constituents and suspended particulates) and "dissolved" metals (the sample filtered in the field through a 0.45 micron pore-size membrane). Well purging and sampling will follow established standard operating procedures (Attachment A1).

3.1.4 Surface Water Sampling

Surface water samples will be collected from indicated water courses, impoundments, or natural ponds or lakes where indicated. Surface water samples will be collected following established procedures (Attachment A1) from below the water surface.

3.2 Applicable Regulations and Standards

Federal and state regulations and standards that may be applicable to the FWDA include the following:

- Resource Conservation and Recovery Act (RCRA), 40 CFR 260–268, Management of Hazardous Waste: In the event that investigation-derived waste (IDW) sampling and analysis indicate the presence of constituents of potential concern at concentrations rendering them hazardous, storage and disposal protocols will be followed in accordance with RCRA hazardous waste regulations.

- U.S. Department of Transportation 49 CFR 172, 173, and 178: Applies to packaging IDW for removal off site and addresses hazard-class diamond labeling.

- NMED, Hazardous Waste Bureau and Ground Water Quality Bureau, Voluntary Remediation Program, *Technical Background Document for Development of Soil Screening Levels*, Revision 4.0, (NMED, 2006): Establishes human health risk-based criteria for soil remediation.

- RCRA Permit EPA ID No. NM6213820974, to U.S. Department of Army for the Fort Wingate Deport Activity (NMED, 2005).

- NMWQCC Groundwater Regulations (NMWQCC, 2002): Establishes standards for protection of groundwater.

3.3 Project Schedule

A schedule for implementation of this SAP may be developed pending identification of data gaps following data mining techniques to be used in developing background distributions and DAF

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4.0 Nonmeasurement Data Acquisition

If data gaps are identified when following the data mining process that will be used to develop background distributions for metals and DAFs for non-naturally occurring organic compounds and constituents, then that information will be used to define the environmental media to be sampled and the sampling locations. Maps or aerial photographs of the site will be used to delineate supplemental surface soil and/or sediment sampling. Monitoring wells coordinate locations, reference measurement elevations, depths, construction, and completion information for any indicated groundwater sampling will be compiled in order to plan for groundwater sampling. Surface water sampling locations will be determined. These types of information will be required and documented in an addendum to this SAP prior to implementing field sampling activities.

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5.0 Field Sampling Activities

Field sampling activities at FWDA may include stake out; supplemental surface soil and/or sediment sampling, groundwater sampling, or surface water sampling.

5.1 Site Surveys

Surveying may be performed at FWDA consisting of stakeout surveys of MI DUs and/or discrete sample locations.

5.1.1 Stakeout Surveys

Stakeout surveys will delineate the surface soil and/or sediment DU areas for MI sampling, if selected, or discrete sample locations. First the DU areas or discrete samples will be map located and then navigated to in the field. Stakeout surveys will be conducted using a sub-meter, survey-grade GPS for navigation. To delineate the DU boundaries the GPS or total data station or similar survey instruments; or sighting compass and surveyor's chain, tape measure, or distance wheel may be used to either locate the intersections or corners if the DU areas are regular in shape, or to map the boundaries if the DU areas are irregular. Stakeout positional data collected with the GPS will be in UTM coordinate system on the World Geographic Datum of 1984. Horizontal accuracy obtained during DU stakeout will be plus or minus 1 meter, which is less than the single point resolution for the anticipated map scale. Elevation data need not be collected for the stakeout survey.

5.2 Surface Soil and/or Sediment Sampling and Analysis

Supplemental soil and sediment sample collection may consist of MI or discrete sample collection based on DQOs developed for the background study. Supplemental sampling will only be performed if the data screening process determines that the quantity or quality of the existing data is inadequate. This section describes both the general approach for both MI and discrete sample collection.

MI surface soil or sediment samples may be collected from appropriately sized DU areas delineated at FWDA. MI samples will consist of combining at least 30 increments of approximate 3/4-inch or 1-inch diameter soil core from depths of 0 to 6 inches bgs. Increments will be collected by field crews with soil probes walking regular or random paths across the DU. Increments will be combined in specially designed plastic bags (NASCO Whirl-Pak®).

MI surface soil samples will be collected and then submitted to a contractor laboratory for analysis of TAL metals by EPA Methods 6010C, 6020A, 7471B (EPA, 1986). The contractor laboratory will air-dry the entire MI sample, pass the entire sample through a number 10 sieve, and further homogenize and sub-sample using either a rotary splitter or following sub-sampling procedures in Appendix A to EPA Method 8330B (EPA, 2006). Laboratory requirements for sample preparation are detailed in the Quality Assurance Project Plan (Part II of this SAP).

Discrete soil samples may be collected from the surface (0 to 6 inches bgs) or subsurface (greater than 4 inches) depending on the data needs. Soil sample collection will follow Standard Operating Procedures (SOP) EI-FS101, *Trowel/Spoon Surface Soil Sampling* (Shaw, 2006a) and EI-FS100, *Hand Auger Sampling* (Shaw, 2006b). The discrete soil samples will be passed through a No. 4 Sieve in the field prior to placing in the laboratory prepared jar.

5.2.1 Rationale/Design

MI surface soil sampling and analysis will provide average metal concentrations for appropriately sized DU areas. DU areas will be based on topography, geology, and past land use and will be of minimum reasonable size. MI surface soil sample analytical results for TAL metals will fill the identified data gaps; should those be input to the background distribution calculations or otherwise used to determine whether or not contaminant releases have occurred.

Additional discrete soil sample locations will be based on topography, geology, and post land use and results used for geochemical evaluations and to supplement the sample size to provide more meaningful statistics.

5.2.2 Quality Control Samples and Frequency

Quality assurance (QA) and quality control (QC) practices will be applied to this field activity to ensure that the data collected meet project objectives. Field QC samples will be collected and analyzed to provide indices of overall data accuracy and precision. MI field QC samples will be collected as triplicate samples from the same DU. Additional QA samples for the U.S. Army Corps of Engineers (USACE)-designated third-party QA laboratory may also be collected. Additional field QC samples will be collected at a minimum frequency of 10 percent.

5.2.3 Field Procedures

The field procedures for the MI soil and/or sediment sampling at FWDA are described in the following sections.

5.2.3.1 Field Measurements

Field measurements will be limited to checking the weight of MI soil samples to ensure that the 1 kg sample weight is collected. A top-loading kitchen-type balance may be used for checking sample weights. Accuracy of the field balance is expected to be within 10 percent. Calibration check of the field balance will not be necessary. Field measurements will be recorded on sample collection logs or field activity daily log forms.

5.2.3.2 Multi-Incremental Surface Soil Sampling for Chemical Analyses

MI surface soil sampling will follow guidance in "Protocols for Collection of Surface Soil Samples at Military Training and Testing Ranges for the Characterization of Energetic Munitions Constituents" (Hewitt et al., 2007) and Appendix A of EPA Method 8330B (EPA, 2006) and direction provided in this SAP. MI samples will consist of combining at least 30 increments of approximate 3/4-inch or 1-inch diameter soil core from depths of 0 to 6 inches bgs. Increments will be collected by field crews with soil probes walking regular or random paths across the DUs. Increments will be combined in specially designed plastic bags (NASCO Whirl-Pak®).

MI samples should be at least 1 kg (2.2 pounds) mass. MI field samples may be passed through a No. 4 (4.75-millimeter) sieve in the field to remove rocks and gravel. The sample may then be homogenized to some extent in the field by manually mixing the sample. The MI samples will be shipped to the laboratory for preparation and analysis without thermal preservation.

5.2.3.3 Decontamination Procedures

Decontamination of sampling equipment will follow Shaw Environmental, Inc. (Shaw) Standard Operating Procedure (SOP) EI-FS014, *Decontamination of Contact Sampling Equipment* (Attachment A1), with modification. Generally, dry brushing, scrubbing with detergent solutions, and rinsing with deionized water are sufficient for decontamination. Organic desorbing agents, i.e., solvents, will not be applied to sampling equipment. MI surface soil sampling equipment will be decontaminated before and between sampling each DU.

5.3 Groundwater Sampling and Analysis

Groundwater may be sampled at FWDA to fill data gaps identified during data mining and background distributions and DAF study. Groundwater samples will be analyzed for TAL metals as both total concentrations and dissolved constituents. Monitoring wells to be sampled will be identified during the background study.

5.3.1 Rationale/Design

Groundwater samples may be collected to fill data gaps identified during the background distributions and DAF study. Sampling procedures will be determined depending on the well type, completion, and historical records once the wells to be sampled are known.

5.3.2 General Sampling Methods for Groundwater

Depth-to-water measurements will be taken in all wells prior to purging and sampling. Water levels will be measured using a well sounder tape to the nearest 0.01 feet. Water level measurements, ground or top of casing elevations, and total well depths will be used to calculate water level elevations and the required purging volumes.

Groundwater samples may be collected after stagnant water has been removed from the well in order to obtain samples representative of groundwater. Groundwater samples will be analyzed for TAL metals (EPA Methods 6010C, 6020A, and 7471B). Samples should be collected directly from the pump or sampler discharge line into pre-preserved sample containers, if possible. If inline filtration is not possible for the filtered sample then groundwater will be collected in an unpreserved jar or bottle and a peristaltic pump will be used to filter the sample.

Field measurements of transient parameters, including hydrogen ion activity (pH), specific conductance, dissolved oxygen, oxidation-reduction potential, turbidity, and temperature, will be collected while purging at each monitoring well. Field meters will be either calibrated or checked each day prior to sampling in accordance with manufacturers' recommendations and applicable SOPs. Calibration results will be recorded on field calibration log forms.

5.3.3 Sampling Containers and Preservation Techniques

Groundwater samples will be collected in minimum 500-milliliter polyethylene bottles preserved with nitric acid to a pH less than 2.0. Two sample containers will be collected at each well, one unfiltered and the other filtered through 0.45 micron filter cartridges.

5.3.4 Field Quality Control Sampling Procedures

QA and QC practices will be applied to this field activity to ensure that the data collected meet project objectives. Field activities will follow documented SOPs (Attachment A1). Field QC samples will be collected and analyzed to provide indices of overall data accuracy and precision. Additionally, QA sample splits will be collected for submittal to the USACE-designated third-party QA laboratory. QC samples will be collected at a minimum frequency of 10 percent.

A groundwater duplicate field QC sample will be collected immediately after the parent sample. USACE QA sample splits will also be collected in the same manner.

5.3.5 Decontamination Procedures

Nondedicated measurement and sampling equipment, such as water level tapes, will be decontaminated prior to, and after, each use. Equipment decontamination will follow general decontamination methods and procedures for sampling equipment as detailed in Shaw SOP EI-FS014, *Decontamination of Contact Sampling Equipment* (Attachment A1).

Sampling equipment dedicated for use at specific wells will not require decontamination prior to use. Disposable sampling equipment that is used once and then disposed of will not require decontamination prior to use provided it is wrapped in the manufacturer's packaging or otherwise protected from inadvertent contamination.

5.4 Surface Water Sampling and Analysis

Surface water may be sampled at FWDA to fill data gaps identified during data mining and background distributions and DAF study. Surface water samples will be analyzed for TAL metals as total, unfiltered concentrations. Surface water sampling locations will be identified during the background study.

5.4.1 Rationale/Design

Additional surface water sampling and analysis may fill data gaps identified during the background distributions and DAF study. Sampling locations will be determined during the background study.

5.4.1.1 Sample Collection, Field Measurements, and Laboratory Analysis

Surface water samples will be collected directly from the water courses or bodies from below the surface in order to represent current field conditions. Field measurements of transient parameters, including hydrogen ion activity (pH), specific conductance, dissolved oxygen, oxidation-reduction potential, turbidity, and temperature, will be collected at each surface water sampling location. Surface water samples will be analyzed for TAL metals (EPA Methods 6010C, 6020A, and 7471B) and collected in minimum 500-milliliter polyethylene bottles preserved with nitric acid to a pH less than 2.0.

5.4.1.2 Quality Control Samples and Frequency

QA and QC practices will be applied to this field activity to ensure that the data collected meet project objectives. Field activities will follow documented SOPs (Attachment A1). Field QC samples will be collected and analyzed to provide indices of overall data accuracy and precision. Additionally, QA sample splits will be collected for submittal to the USACE-designated third-party quality assurance laboratory. QC samples will be collected at a minimum frequency of 10 percent.

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6.0 Field Operations Documentation

6.1 Daily Quality Control Reports

Daily QC Report forms will be completed and provided to the USACE as directed by the Albuquerque District representative and the Quality Control Plan (QCP) (Chapter 4.0 of the Work Plan).

6.2 Field Logbook and/or Sample Field Sheets

Daily logs of field activities, daily tailgate safety meeting forms, sample collection logs, soil boring logs, well construction diagrams, water quality measurements, and other field documentation will be recorded on preprinted, standardized forms. All field documentation will be provided to the USACE in the background study report.

6.3 Photographic Records

Photographs of field activities will be taken routinely, kept on file, and provided to the USACE representative as directed.

6.4 Sample Documentation

Use of sample documentation, including sample numbers, labels, and chain-of-custody records will follow Shaw SOPs or specific requirements in this SAP.

6.4.1 Sample Numbering System

Each sample will be assigned a unique field identification nomenclature specific for the FWDA. FWDA Sample ID's will consist of a combination of Parcel, AOC, Site identifier, source of sample, increment number for sub sample identification if necessary, type of sample, and matrix as follows:

- Parcel: 24
- AOC: 18
- Site Identifier: Y-A924 (in this case it's Revetment Y-A924 in A Block)
- Source of sample: SS (Surface Soil)
- Increment number: 000 (3 digits for subsample if necessary)
- Type of sample: M (Multi-incremental)
- Matrix: SO (Soil)

An example of an MI sample for revetment Y-A924 would be: 2418Y-A924SS-M-SO

6.4.2 Sample Labels

Sample labels will be affixed to each sample container. Complete collection information, sample type, matrix, time, date, field number, analysis requested, and the sampler's name will be recorded with indelible ink. Sample labeling guidance is found in Shaw SOP EI-FS006, *Sample Labeling* (Attachment A1).

6.4.3 Chain-of-Custody Records

Chain-of-custody documentation will be completed in the field to document sample collection, possession, and the chain of custody. Chain-of-custody documentation will follow Shaw SOP EI-FS003, *Chain of Custody Documentation–Paper* (Attachment A1). However, the EPA software, "FORMS II Lite, Version 5.1," (or latest version) may be used to generate and print sample chain-of-custody documentation in the field. Chain-of-custody information, collected in FORMS II Lite data files, will eventually be electronically transferred to a centralized database repository, the Environmental Data Management System (EDMS).

A sample is considered to be in a person's custody while either under physical custody or safely secured in a controlled access location. Sample custody can be transferred by signature relinquishment and acceptance. The shipping company waybills or bills of lading are considered part of the custody record between the time of collection and receipt at the analytical laboratory. Chain-of-custody records will accompany the sample shipment until receipt at the contractor laboratory.

6.5 Field Records

Records of field analytical or monitoring measurements will be recorded on preprinted, prepared forms. Measurements for MI samples masses, depths to groundwater, discharge volumes and rates, and groundwater and surface water quality measurements will be taken and recorded. Field measurement information collected and recorded on preprinted field forms will be electronically transferred to the EDMS.

6.6 Documentation Procedures/Data Management and Retention

Documentation procedures will follow Shaw SOPs (Attachment A1). All field documentation will be provided to the USACE in the report.

7.0 Sample Packaging and Shipping Requirements

Samples will be packaged and shipped as nonhazardous environmental samples following the procedures in Shaw SOP EI-FS012, *Shipping and Packaging of Non Hazardous Samples* and SOP EI-FS005, *Custody Seals* (Attachment A1).

Sample containers will be sealed and packed into plastic bags. Samples will be placed into a cooler for shipping. As applicable, absorbent materials will be placed in the bottom of the cooler to contain any spillage from sample breakage, meltwater, or condensation. Bubble wrap, bubble bags, or precut foam blocks will serve as cushioning material in each cooler. Groundwater samples may be packed in ice to a temperature less than 6 degrees Celsius. The ice will be placed into plastic bags to contain meltwater and packed with the samples to provide adequate cooling until receipt at the laboratory. If collected, MI soil and/or sediment samples will not be cooled, but rather collected, processed, screened, and packaged at ambient temperatures. Chain-of-custody documents will be sealed in waterproof bags and included in the shipping cooler, which will be sealed and secured prior to being relinquished to the transport company. Samples will be packed and shipped overnight to the analytical laboratory by air express carrier as soon as possible after collection so as to not exceed the sample holding times.

Field personnel are responsible for contacting and coordinating with an overnight express air carrier (e.g., Federal Express, United Parcel Service or Airborne) to arrange for sample shipment. Soil and water samples for chemical analysis will be shipped to a subcontractor laboratory for processing and analysis. The laboratory will be qualified to perform analyses for the USACE. The analytical laboratory will be selected prior to mobilization. The third-party QA laboratory will be designated by the USACE.

The shipping cooler and its contents will be inspected and inventoried upon receipt at the analytical laboratory. The temperature and condition of the samples will be documented upon receipt. The analytical laboratory will contact field personnel immediately if there are any discrepancies in the shipment documentation. The laboratory will provide sample receipt documentation with its analytical report.

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8.0 Management of Investigation-Derived Waste

Investigation derived waste (IDW) will be limited to spent decontamination wash and rinse water, and possibly groundwater purged prior to sampling. Liquid IDW decontamination wash will go in an evaporation tank constructed on site. Purge water from wells with organic compounds will also go into the evaporation tank. Purge water from wells without organics will be discharged to the ground surface.

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9.0 Nonconformance/Corrective Actions

Any nonconformances to either the requirements in this plan or the procedures referenced herein will be identified and documented, and corrective actions will be initiated as described in the QCP (Chapter 4.0 of the Work Plan) in order to prevent recurrence of the offending situation or condition.

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10.0 References

EPA, see U.S. Environmental Protection Agency.

Hewitt, Alan D., et. al, 2007, *Protocols for Collection of Surface Soil Samples at Military Training and Testing Ranges for the Characterization of Energetic Munitions Constituents*, U.S. Army Corps of Engineers (USACE), Engineer Research and Development Center, Cold Regions Research and Engineering Laboratory, ERDC/CRREL TR-07-10, Hanover, NH.

LANL, see Los Alamos National Laboratory.

Los Alamos National laboratory (LANL), 2008, *ECORISK Database, Release 2.3*, Environmental Programs Directorate, LA-UR-08-6673, Los Alamos National Laboratory, Los Alamos, New Mexico, October.

New Mexico Environment Department (NMED), 2005, *Resource Conservation and Recovery Act Permit EPA ID No. NM 6213820974 to U.S. Department of Army for the Fort Wingate Depot Activity Located in McKinley County, New Mexico*, Hazardous Waste Bureau, New Mexico Environment Department, Santa Fe, New Mexico.

New Mexico Environment Department (NMED), 2006, *Technical Background Document for Development of Soil Screening Levels*, Revision 4.0, Hazardous Waste Bureau, New Mexico Environment Department, Santa Fe, New Mexico.

New Mexico Water Quality Control Commission (NMWQCC), 2002, *New Mexico Water Quality Control Commission Regulation*, Section 20.6.2 of the New Mexico Administrative Code, New Mexico Water Quality Control Commission, Santa Fe, New Mexico.

NMED, see New Mexico Environment Department.

NMWQCC, see New Mexico Water Quality Control Commission.

U.S. Environmental Protection Agency (EPA), 1986, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846, 3rd ed., U.S. Environmental Protection Agency, Washington, D.C.

U.S. Environmental Protection Agency (EPA), 2001, *National Primary Drinking Water Regulations (40 CFR 141)*, Office of Water, U.S. Environmental Protection Agency, Washington, D.C.

U.S. Environmental Protection Agency (EPA), 2006, *Nitroaromatics, Nitramines, and Nitrate Esters by High Performance Liquid Chromatography (HPLC)*, Method 8330B, U.S. Environmental Protection Agency, Washington, D.C. <http://epa.gov/SW-846/pdfs/8330b.pdf>

U.S. Environmental Protection Agency (EPA), 2008a, *Region 6 Human Health Medium-Specific Screening Levels 2008 (Revised 03/08/08)*, U.S. Environmental Protection Agency Region 6, Dallas, Texas.

U.S. Environmental Protection Agency (EPA), 2008b, *Ecological Soil Screening Levels (updated 05/21/08)*, <http://www.epa.gov/ecotox/ecossl>

Attachment A1
Standard Operating Procedures

List of Standard Operating Procedures

Shaw Standard Operating Procedures

SOP EI-FS108	Measurement of Water Level and LNAPL in Monitoring Wells
SOP EI-FS109	Sampling of Aqueous Liquids via Bailers
SOP EI-FS110	Well Purging and Sampling Preparation
SOP EI-FS111	Low-flow Sampling/Micro-purge
SOP EI-FS112	Depth Integrated Samplers
SOP EI-FS113	Surface Water Sampling
SOP EI-FS129	Collection of Water Samples for Dissolved Parameters
SOP EI-FS014	Decontamination of Contact Sampling Equipment
SOP EI-FS006	Sample Labeling
SOP EI-FS003	Chain of Custody Documentation–Paper
SOP EI-FS012	Shipping and Packaging of Non Hazardous Samples
SOP EI-FS005	Custody Seals
SOP EI-FS100	Hand Auger Sampling
SOP EI-FS101	Travel/Spoon Surface Soil Sampling

See folder on this compact disc.

II. Quality Assurance Project Plan (QAPP)

QUALITY ASSURANCE PROJECT PLAN
Background Study and Geochemical Evaluation
Fort Wingate Depot Activity
Gallup, New Mexico

Contract No. W912BV-07-D-2004
Delivery Order DM01

Revision 0

Final—January 2009

Prepared for:
U.S. Army Corps of Engineers
Albuquerque District
4101 Jefferson Plaza, NE
Albuquerque, New Mexico 87109

Prepared by:
Shaw Environmental, Inc.
2440 Louisiana Blvd. NE, Suite 300
Albuquerque, New Mexico 87110

Table of Contents

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Acronyms and Abbreviations

%D	percent difference
ADR	Automated Data Review
DOD	U.S. Department of Defense
DQO	data quality objective
EDD	electronic data deliverable
EPA	U.S. Environmental Protection Agency
FWDA	Fort Wingate Depot Activity
GC	gas chromatography
ICP	Inductively Coupled Plasma
kg	kilogram(s)
LIMS	Laboratory Information Management System
MDL	method detection limit
MI	multi-incremental
mg	milligram(s)
MQO	measurement quality objective
PDF	portable document format
PQL	practical quantitation limit
QAPP	Quality Assurance Project Plan
QC	quality control
RL	reporting limit
RPD	relative percent difference
RSD	relative standard deviation
SEDD	staged electronic data deliverables
Shaw	Shaw Environmental, Inc.
SOP	standard operating procedure
TAL	Target Analyte List
USACE	U.S. Army Corps of Engineers

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1.0 Project Laboratory Organization and Responsibilities

The subcontractor analytical laboratories for background data gaps sampling and analysis will be determined prior to mobilization. Depending on the data gaps identified during the background study one or more environmental media may be sampled. Samples may be sent to a single, or multiple, contractor laboratories.

The subcontractor laboratories selected may be pre-qualified subcontractor laboratories holding Strategic Alliance contracts with Shaw Environmental, Inc. (Shaw). The Shaw Strategic Alliance contracts were previously awarded to 12 environmental laboratories following a competitive process that evaluated price, technical capabilities, business status, and geographic coverage. Additionally, subcontractor laboratories will substantively comply with requirements in the current version of the U.S. Department of Defense (DOD) Quality Systems Manual (DOD, 2006).

The subcontractor laboratory facilities are generally organized under a Laboratory Director into major workgroups including the following:

- Sample Control
- Client Services
- Sample Preparation
- Inorganic Analyses
- Gas Chromatography (GC) Volatiles
- GC Extractables
- GC/Mass Spectrometry
- Radiochemical Separations and Chemistry
- Radiation Counting
- Information Systems
- Quality Assurance
- Support Services

Under the Shaw Strategic Alliance contract, there is a single point of contact at the laboratory for administration of all Shaw projects.

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2.0 Data Assessment Organization and Responsibilities

The contractor analytical laboratories, in collaboration with Shaw and the U.S. Army Corps of Engineers (USACE), will assess field and analytical data generated during data gaps sampling at the Fort Wingate Depot Activity (FWDA). Each organization has responsibilities during different stages of the data collection and measurement systems.

The subcontractor laboratories will assign a project manager and project team to oversee sample analysis and reporting. The laboratories will have a Laboratory Information Management System (LIMS) to capture sampling and analysis data from sample receipt to invoice generation. Data entry errors, out-of-compliance quality control (QC) results, or nonconforming data or operations can be identified and corrected at the earliest possible indication. The laboratory will check, monitor, and correct, if necessary, its sample receipt data entry, project-specific analysis requirements, analytical detection limits, analytical results, analytical QC checks, and electronic and hard copy reporting. The laboratory will provide staged electronic data deliverables (EDD) in Automated Data Review (ADR) text file format (LDC, 2006) specified by the USACE, as well as complete Level IV analytical data reports in hard copy and electronic portable document format (PDF) files. Data reporting procedures are detailed in Section 8.2 of this Quality Assurance Project Plan (QAPP).

Shaw will follow established field operation and documentation procedures to capture and correctly transmit field sample collection data. Upon receipt of electronic analytical data from the laboratory, Shaw will perform data review, verification, and validation. Analytical results and QC measurements will be verified using the ADR program, Version 8.1 (LDC, 2006). Data verification reports will be generated using the ADR computer software. The electronic data specifications for the ADR are provided in Section 8.2 of this QAPP.

The USACE, Albuquerque or Fort Worth District, will provide Shaw with the ADR software and data acceptance criteria libraries for data verification. The USACE will coordinate with Shaw on construction of the project-specific QC acceptance criteria library that will be used for automated data verification on this project.

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3.0 Data Quality Objectives

Data quality objectives (DQO) for the background data gaps sampling and analysis activities at FWDA will necessarily be developed and specified based on the output from the background study. A discussion of general DQOs and inputs relative to FWDA background data gaps sampling is presented below.

3.1 Data Use Background

The FWDA background study may require additional sampling and analysis using either multi-incremental (MI) and/or discrete surface soils and/or sediments, groundwater, and/or surface waters for naturally occurring inorganic constituents. Chemical analysis data will be used to fill data gaps in calculating background distributions and in making geochemical evaluations. Ultimately sample analysis data collected to fill data gaps in the background study will aid in determining whether or not contaminant releases have occurred at the FWDA area.

The DQOs rely on the seven-step statistical approach specified in *Guidance for the Data Quality Objectives Process* (EPA, 2000). Groundwater is the most likely pathway for constituents of potential concern (COPC) to affect human health or the environment.

Analytical data collected in the field will be screening-level data that may include transient water chemistry and water quality parameters measured during groundwater or surface water sampling. Screening data will be recorded in field logs and other field documentation forms.

Data generated at the subcontractor analytical laboratories will be definitive data. Multi-incremental soil and/or sediment samples, groundwater, and/or surface water samples will be analyzed for U.S. Environmental Protection Agency (EPA) Target Analyte List (TAL) metals. Groundwater samples will be collected and analyzed for both total and dissolved fraction TAL metals.

Standard analytical methods, referenced in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (EPA, 1986), including draft and final updates I through IV-B, will be followed when possible. Analytical methods referenced to other EPA documents or individual laboratory operating procedures may also be acceptable.

Field QC samples will be collected and analyzed for the same parameters as the parent, co-located MI surface soil/sediment, groundwater, or surface water samples. Standard laboratory QC practices will be followed for all samples analyzed at subcontractor laboratories. Chemical analysis QC will comply with the objectives listed in the DOD Quality Systems Manual (DOD, 2006).

Metals concentrations in soil or sediment will be reported in milligrams (mg) per kilogram (kg), corrected for percent moisture, and reported on a "dry weight" basis. Groundwater and surface water sample results will be reported in mg per liter.

Target analytes, TAL metals, are listed with project-specific advisory evaluation criteria in Table 3-1. For soil and sediment samples, the evaluation criteria have been established to represent the more conservative standard of either the New Mexico Environment Department soil screening levels (NMED, 2006) or EPA Region 6 Human Health Medium-Specific Screening Levels (EPA, 2008). For groundwater and surface water samples, evaluation criteria have been established to represent the more conservative standard of either the New Mexico Water Quality Control Commission Standards for Protection of Groundwater (NMWQCC, 2002) or EPA National Drinking Water Standards Maximum Contaminant Levels or Secondary Drinking Water Standards (EPA, 2001).

3.2 Measurement Quality Objectives for Chemical Data Measurement

Measurement quality objectives (MQO) for chemical data measurements include the routine, standard QC measurements specified in the analytical methods, typically made on laboratory-prepared standard materials and samples to monitor MQOs for accuracy and precision. The MQOs are listed in Attachment A2. Laboratory QC checks may include the following:

- Calibration checks
- Quantitation limits
- Holding times
- Laboratory control samples
- Matrix spike samples
- Duplicate samples
- Method blank samples

For laboratory-generated QC measurement data, the accuracy, or bias, MQOs are those acceptance limits provided by the USACE (DOD, 2006) and project-specific precision MQO values approved by the USACE, Albuquerque District.

Shaw will enter the bias limits specified in the DOD Quality Systems Manual (DOD, 2006) into the ADR software data validation system project-specific library. Tables of acceptable values for the analytical methods, parameters, and sample matrices are included in Attachment A2. Values exceeding acceptance limits may result in qualification of the data, resampling and analysis, or other corrective actions that may be indicated.

The subcontractor analytical laboratory will report method detection limits (MDL) and practical quantitation limits (PQL), or reporting limits (RL), for each parameter analyzed. Parameters that are detected but are less than the PQL or RL will be qualified as estimated values. In all cases, the RL should be less than the advisory evaluation criteria with which analytical results will be compared. Nondetected results will be reported at the PQL or RL. Evaluation criteria for TAL metals in soil/sediment and groundwater/surface water are listed in Table 3-1.

For MI and discrete soil samples, field precision will be calculated as relative standard deviation (RSD) for detected analytes in co-located field triplicate samples. Field precision for groundwater or surface water samples will be calculated as relative percent difference (RPD) from paired parent and field duplicate samples. Field precision will be monitored but will not be used to control the analytical processes.

Bias objectives for groundwater or surface water and MI or discrete surface soil sample and sediment analytes will be expressed as percent recoveries for laboratory control samples. Values that exceed accuracy objectives may result in qualification of data, resampling and analysis, or other corrective actions that may be indicated. Matrix spiked samples will also be analyzed at the laboratory to assess analytical bias.

3.3 Measurement Quality Objectives for Field Sampling

RSD will be calculated for field co-located triplicate MI and discrete soil or sediment sample laboratory results for at least one major metal constituent on the TAL metals list. The metal, or metals, constituent selected for RSD measurement will be determined after the background study and before field mobilization. RSD for the laboratory analyzed samples should be less than 30 percent and if so will indicate an adequate number of soil increments have been collected. If RSD is greater than 30 then corrective actions will be applied to achieve the desired sampling precision.

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4.0 Sample Receipt, Handling, Custody, and Holding Time Requirements

Soil or sediment samples for TAL metals analyses may be shipped to the subcontractor analytical laboratory at ambient temperature. Preservation by cooling of the MI or discrete soil or sediment samples collected for TAL metals analyses to 6 degrees Celsius, or less, is not recommended except for mercury. If results of the background study indicate that mercury is a potential contaminant of concern then all soil and sediment MI or discrete samples will be temperature preserved prior to shipping to the laboratory.

Groundwater samples should be received at the subcontractor laboratory intact and at temperatures less than or equal to 6 degrees Celsius. The laboratory will document sample receipt conditions either on the submitted Chain-of-Custody Record or other standardized laboratory forms.

Analysis holding times for TAL metals analyses in all samples are 6 months, except mercury is 28 days.

4.1 Verification/Documentation of Cooler Receipt Condition

The project personnel will contact the subcontractor laboratory the day after sample shipment to confirm sample receipt at the laboratory. Any discrepancies or nonconforming conditions in regard to sample receipt will be discussed and resolved at that time. The laboratory will provide sample receipt documentation and records of nonconformance and corrective actions with the final analytical data report.

4.2 Corrective Action for Incoming Samples

The subcontractor laboratory will bring nonconforming incoming samples or sample custody documentation errors to the attention of the Project Chemist. Corrective actions may be applied from available alternatives, depending on the type and magnitude of the error or omission. Documentation errors will be corrected by hand, initialed and dated, and the change recorded for the file. Samples arriving at the laboratory outside of temperature acceptance criteria may still be processed, or rejected, after the laboratory notifies and obtains approval from the Project Chemist. When sample containers arrive broken, attempts will be made to recover sufficient sample quantities for analysis from inside the secondary containment. Redundant sample quantities are submitted to mitigate these situations, if they occur.

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5.0 *Multi-Incremental Sample Processing and Subsampling Procedures*

Project-specific sample preparation and subsampling requirements described in this chapter are applicable to analysis of the MI surface soil and/or sediment samples submitted for TAL metals analyses. The subcontractor analytical laboratory will adhere to the procedures for soil sample preparation and subsampling as specified in this chapter.

MI surface soil samples should be at least 1-kilogram mass. Field sampling personnel may pass MI soil or sediment samples through a No. 4 (4.75-millimeter) sieve to remove rocks and gravel. Samples will be collected in NASCO polyethylene Whirl-Paks® and packaged in shipping coolers or other suitable container for shipment to the laboratory. After the samples are received at the laboratory they will be logged in and kept in storage until processing. Sample processing and subsampling will follow the procedure described in the following steps:

1. The entire mass of the MI surface soil sample will be thin-spread onto a baker's tray and air-dried on racks overnight or for approximately 16 to 24 hours.
2. After air-drying, the sample mass will be passed through a Number 10 sieve and thoroughly mixed on the drying tray.
3. The entire, mixed sample will be repeatedly incrementally sub-sampled (30 increments minimum) or processed through a rotary splitter to yield a 10-gram sub-sample for metals digestion and analysis. A portion of the sample will also be taken for percent solids determination.
4. The entire 10-gram subsample for metals analysis will be acid-digested for analysis. Multiple digestions of increments of the 10-gram subsample, followed by recombination and dilution to volume, may be necessary for soil samples prepared by microwave-assisted acid digestion using EPA Method 3051A (EPA, 1986). Acid and diluent volumes may be proportionally adjusted if the 10-gram subsample is digested using a hot-plate (EPA Method 3050B) (EPA, 1986).

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6.0 Analytical Procedures

Chemical analytical procedures from EPA SW-846 (EPA, 1986), other recognized standard methods, or laboratory-specific standard operating procedures (SOP) will be used for all laboratory analyses. EPA sample preparation and analytical methods to be used are as follows:

- Methods 3005A, 3015, 3050B, 3051A, 6010C, 6020A, Inductively Coupled Plasma (ICP)–Atomic Emission Spectroscopy and ICP–Mass Spectroscopy, as well as Method 7470A or 7471B will be used for definitive analysis of TAL metals in soil and groundwater.

Preparation, i.e. acid digestion, of MI soil and/or sediment samples may follow a modified Method 3050B under a laboratory specific standard operating procedure whereby 10 grams of soil are digested and volumetrically diluted for analysis.

6.1 Preventive Maintenance

Preventive maintenance for analytical instrumentation and facilities will be conducted in accordance with the laboratory's Quality Assurance Plan and SOPs.

6.2 Calibration Procedures and Frequency

The calibration of analytical instruments will follow the EPA analytical method requirements, and the laboratory's Quality Assurance Plan and SOPs.

6.3 Laboratory Quality Control Procedures

Laboratory QC procedures will follow the EPA analytical method requirements and the laboratory's Quality Assurance Plan and SOPs.

6.4 Performance and System Audits

The subcontractor laboratory will be subject to internal and external performance and system audits as part of the approval process to perform work for the USACE. The selected subcontractor laboratory will be approved to perform work on this project by the USACE. The laboratory will agree to reasonable access by Shaw and the USACE for the purpose of obtaining paper or electronic files, magnetic tapes, and other information that may be requested to resolve technical questions as part of any performance audit that may be conducted. Additional performance or system audits specific to this project are not anticipated.

6.5 Nonconformance/Corrective Actions

Nonconformances and corrective action procedures at the laboratory will be in accordance with its Quality Assurance Plan and SOPs. The laboratory will provide documentation of any nonconformance/corrective actions in the Level IV analytical data reports generated for this project.

7.0 Data Reduction/Calculation of Data Quality Indicators

The laboratory will calculate and report data quality indicators for QC sample results. Calculations of data quality indicators are performed automatically using instrument or sample data uploaded or entered into the LIMS. In certain instances, when QC samples are submitted as blind to the analytical laboratory, Shaw will calculate data quality indicators for those measurements.

Data quality indicators for precision, bias, quantitation limits, and completeness will follow standard formulae and guidance in the laboratory's Quality Assurance Plan, EPA SW-846 methods (EPA, 1986), and the DOD Quality Systems Manual (DOD, 2006).

Data quality indicators that will be calculated are summarized in the following sections. Formulae are not reiterated here.

7.1 Precision

The data quality indicator to be calculated by the laboratory for precision is the RPD, which is the difference between two measurements, divided by their average, and then multiplied by 100 for percentage conversion. An RPD will be reported for each laboratory duplicate and matrix spike duplicate sample. The RPD for field duplicate sample analyses will be calculated by Shaw and included in the final field activities report.

In some instances, the percent difference (%D) or RSD will be reported as precision indicators when required in analytical method calibration procedures. The %D is the difference between a parent and duplicate measurement, divided by the parent measurement, and converted to a percentage. The RSD is the standard deviation of a group of measurements divided by the mean. RSD will be calculated and reported by Shaw for the MI field triplicate surface soil sample analyses.

The laboratory will prepare and subsample a field sample in triplicate, i.e., laboratory triplicate. The percent RSD for detected results in the laboratory triplicate should be less than 15 percent. If percent RSD is greater than 15 percent then corrective actions should be applied.

7.2 Bias

Bias, or analytical accuracy, will be calculated as percent recovery, which is the quantity result obtained from an analysis (e.g., mg/kg) divided by the known or expected quantity usually spiked into, or certified to be part of, the sample matrix. Percent recoveries will be reported for laboratory control samples.

7.3 Sample Quantitation Limits

The PQL, or RL, will be calculated and reported by the laboratory. The PQLs or RLs are nominal limits at which reported values have calculable accuracy and precision. The MDL, which is less than the PQL or RL, by which analytes can be detected but not quantified within stated accuracy and precision levels, will also be reported. PQL or RL, MDL, and analytical results will be adjusted for sample moisture content and reported on a dry weight basis by the laboratory for soil samples. Values for detected analytes less than the PQLs but greater than the MDLs will be reported and qualified as estimated values by the laboratory.

7.4 Completeness

Shaw will calculate completeness following receipt and validation of all laboratory analytical data. Completeness will be calculated as the percent usable data points, or analytical results, compared to the number of data points possible for all samples submitted and analyses requested. Completeness values for technical, analytical, and contract compliance and field sampling will be calculated for inclusion in the project report. The overall completeness goal is 90 percent.

8.0 Laboratory Operations Documentation

Laboratory operations, analytical results, and QC measures will be documented by the laboratory and provided to Shaw as part of the subcontract deliverables. Types of documentation required are described in the following sections.

8.1 Sample Management Records

Sample management records, including copies of completed Chain-of-Custody Records, sample receipt inspections, sample log-in assignments, internal chain-of-custody forms, and sample preparation logs will be compiled by the laboratory and provided in its analytical data report package.

8.2 Data Reporting Procedures

Data reports will be provided as hard copy and PDF electronic files readable with Adobe Acrobat™ software, as well as electronic data deliverables (EDD) in file formats specified by the USACE.

Data packages, or analytical reports, will be comprehensive; equivalent to the EPA Level IV data packages; and include sample management records, certificates of analysis with sample identifiers, analytical results, detection limits, QC sample results, and calculated data quality indicators, as well as raw data backup to include instrument printouts, calibration summaries, quantitation reports, and laboratory bench sheets. Raw data backup will allow for independent data validation of any result reported. Data packages will be generated that correlate to fieldwork phases or the samples submitted on individual Chain-of-Custody Records. The Level IV data packages will be provided to Shaw by the laboratory in hard copy and on compact disc in computer-readable PDF files.

The laboratory will provide EDDs for the background data gap sampling in the SEDD format and Laboratory Data Consultants, Inc. ADR format, Tables A1 and A3 (LDC, 2006) at a minimum. Electronic data in Tables A1 (Analytical Results) and A3 (Sample Analyses) are required for the EDD. Electronic data in Table A2 (Laboratory Instruments) is optional for the EDD. Shaw or the USACE will provide the laboratory with EDD specifications and the project-specific ADR library of analytical method MQOs prior to field mobilization.

8.3 Data Management Procedures

A routine sample analysis turnaround time of 28 days is anticipated for most samples submitted to the subcontractor laboratory. Typically, the analytical data report and EDDs will be received 20 to 60 days after sample submittal. Preliminary data is often available more quickly.

Analytical data packages and project files will be maintained at the subcontractor laboratory in accordance with its routine procedures. Complete Level IV data packages provided by the laboratory in electronic PDF format will be transmitted to the USACE. Hard copy data reports will be retained by Shaw. Data archival storage will comply with federal requirements.

9.0 Data Assessment Procedures

9.1 Data Quality Control Review

The subcontractor laboratory will perform initial data QC review prior to releasing the analytical data reports. Upon receipt of the reports, Shaw will review them for accuracy and completeness. The laboratory will be requested to correct obvious typographical errors, review, and correct, if necessary, unexpected or other questionable results.

9.2 Data Verification

Shaw will perform automated data verification on the laboratory-provided EDDs using the ADR software (LDC, 2006). The USACE will provide the ADR software to Shaw. Shaw will construct a project-specific analytical methods library in ADR prior to mobilization. The project-specific library will be approved by the USACE, Albuquerque District, and provided to the subcontractor laboratory. After Shaw receives the EDD from the laboratory, the data will be uploaded into the ADR. The software will compare data quality indicators for each method, matrix, and analyte against acceptance criteria in the project-specific library. Data verification reports and summaries will be printed as hard copies as well as stored in electronic PDF files using the ADR software.

9.3 Data Quality Objective Reconciliation

Shaw will review the analytical data and data validation reports, assess the usability of the data, and interpret the data in terms of the project goals. Shaw's interpretation of the data and reconciliation of the DQOs will be provided to the USACE.

9.4 Project Completeness Assessment

Shaw will assess project completeness using the criteria listed in Section 7.4 of this QAPP. The results of the completeness assessment will be provided to the USACE.

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10.0 References

DOD, see U.S. Department of Defense.

EPA, see U.S. Environmental Protection Agency.

Laboratory Data Consultants, Inc. (LDC), 2006, *Automated Data Review*, *Version 8.1*, U.S. Army Corps of Engineers, Sacramento District, Sacramento, California.

LDC, see Laboratory Data Consultants, Inc.

New Mexico Environment Department (NMED), 2006, *Technical Background Document for Development of Soil Screening Levels*, Revision 4.0, Hazardous Waste Bureau, New Mexico Environment Department, Santa Fe, New Mexico.

New Mexico Water Quality Control Commission (NMWQCC), 2002, *New Mexico Water Quality Control Commission Regulation*, Section 20.6.2 of the New Mexico Administrative Code, New Mexico Water Quality Control Commission, Santa Fe, New Mexico.

NMED, see New Mexico Environment Department.

NMWQCC, see New Mexico Water Quality Control Commission.

U.S. Department of Defense (DOD), 2006, *Quality Systems Manual for Environmental Laboratories*, Final Version 3, prepared by DOD Environmental Data Quality Workgroup, Department of the Navy, Washington, D.C.

U.S. Environmental Protection Agency (EPA), 1986, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846, 3rd ed., U.S. Environmental Protection Agency, Washington, D.C.

U.S. Environmental Protection Agency (EPA), 2000, *Guidance for the Data Quality Objectives Process*, EPA QA/G-4, Office of Environmental Information, U.S. Environmental Protection Agency, Washington, D.C., August.

U.S. Environmental Protection Agency (EPA), 2001, *National Primary Drinking Water Regulations (40 CFR 141)*, Office of Water, U.S. Environmental Protection Agency, Washington, D.C.

U.S. Environmental Protection Agency (EPA), 2008, *Region 6 Human Health Medium-Specific Screening Levels 2008 (Revised 03/08/08)*, U.S. Environmental Protection Agency Region 6, Dallas, Texas.

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Tables

Table 3-1
Advisory Evaluation Criteria
Background Study and Geochemical Evaluation
Fort Wingate Depot Activity
Fort Wingate, New Mexico

Analyte	CAS Number	Regulatory Standard					Advisory Evaluation Criteria	
		Soil			Groundwater			
		NMED SSL[a] Residential (mg/kg)	EPA Region 6[b] Residential (mg/kg)	Eco-SSL[c] (mg/kg)	NMWQCC Groundwater Standards[d] (mg/L)	EPA MCL[e] (mg/L)	Soil (mg/kg)	Water (mg/L)
Applicable to Multi-Incremental Soil and Sediment Samples and Groundwater and Surface Water Sample Analyses								
TAL Metals (EPA 6010C/6020A/7470A/7471B)[f]								
Aluminum[g]	7429-90-5	77,800	77,000	pH dependent	5.0	0.05–0.2[h]	77,000	0.05–0.2[h]
Antimony	7440-36-0	31.3	31	0.27	NE	0.006	31	0.006
Arsenic	7440-38-2	3.90	0.39	18	0.1	0.010	0.39	0.010
Barium	7440-39-3	15,600	16,000	330	1.0	2	15,600	1.0
Beryllium	7440-41-7	156	160	21	NE	0.004	156	0.004
Cadmium	7440-43-9	39	39	0.36	0.01	0.005	39	0.005
Calcium	7440-70-2	NE	NE	N/A	NE	NE	NE	NE
Chromium[i]	7440-47-3	100,000	100,000	26	0.05	0.1	100,000	0.05
Cobalt	7440-48-4	1520	900	13	0.05	NE	900	0.05
Copper	7440-50-8	3130	2900	28	1.0	1.0[j]	2900	1.0
Iron	7439-89-6	23,500	55,000	N/A	1.0	0.3[h]	23,500	0.3[h]
Lead	7439-92-1	400	400	11	0.05	0.015[j]	400	0.015[j]

Table 3-1 (Continued)
Advisory Evaluation Criteria
Background Study and Geochemical Evaluation
Fort Wingate Depot Activity
Fort Wingate, New Mexico

Analyte	CAS Number	Regulatory Standard					Advisory Evaluation Criteria	
		Soil			Groundwater			
		NMED SSL[a] Residential (mg/kg)	EPA Region 6[b] Residential (mg/kg)	Eco-SSL[c] (mg/kg)	NMWQCC Groundwater Standards[d] (mg/L)	EPA MCL[e] (mg/L)	Soil (mg/kg)	Water (mg/L)
TAL Metals (EPA 6010C/6020A/7470A/7471B)[e] (Continued)								
Magnesium	7439-95-4	NE	NE	N/A	NE	NE	NE	NE
Manganese	7439-96-5	3590	3500	220	0.2	0.05[h]	3500	0.05[h]
Mercury (elemental)	7439-97-6	100,000	NE	0.013[k]	0.002	0.002	6.7	0.002
Nickel	7440-02-0	1560	1600	38	0.2	NE	1560	0.2
Potassium	7440-09-7	NE	NE	N/A	NE	NE	NE	NE
Selenium	7782-49-2	391	390	0.52	0.05	0.05	390	0.05
Silver	7440-22-4	391	390	4.2	0.05	0.10[h]	390	0.05
Sodium	7440-23-5	NE	240	N/A	NE	NE	NE	NE
Thallium	7440-28-0	5.16	5.5	0.032[k]	NE	0.002	5.16	0.002
Vanadium	7440-62-2	78.2	390	7.8	NE	NE	78.2	NE
Zinc	7440-66-6	23,500	23,000	46	10	5[h]	23,000	5[h]

[a]New Mexico Environment Department, 2006, "Technical Background Document for Development of Soil Screening Levels," Revision 4.0, Hazardous Waste Bureau, New Mexico Environment Department, Santa Fe, New Mexico.

[b]U.S. Environmental Protection Agency, 2008a, "Region 6 Human Health Medium-Specific Screening Levels 2008 (Revised 03/08/08)," U.S. Environmental Protection Agency Region 6, Dallas, Texas.

[c]U.S. Environmental Protection Agency, 2008b, "Ecological Soil Screening Levels (updated 05/21/08)", <http://www.epa.gov/ecotox/ecossl>; lowest available Eco-SSL is presented.

Table 3-1 (Continued)
Advisory Evaluation Criteria
Background Study and Geochemical Evaluation
Fort Wingate Depot Activity
Fort Wingate, New Mexico

[d]New Mexico Water Quality Control Commission, 2002, "New Mexico Water Quality Control Commission Regulation," Section 20.6.2 of the New Mexico Administrative Code, New Mexico Water Quality Control Commission, Santa Fe, New Mexico.

[e]U.S. Environmental Protection Agency, 2001, National Primary Drinking Water Regulations (40 CFR 141), Office of Water, U.S. Environmental Protection Agency, Washington, D.C.

[f]U.S. Environmental Protection Agency, 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., U.S. Environmental Protection Agency, Washington, D.C.

[g]Aluminum is identified as an ecological COPC only for soils with a pH less than 5.5 (EPA, 2008b).

[h]National Secondary Drinking Water Standard. Nonenforceable guidelines regulating contaminants that may cause cosmetic or aesthetic effects in drinking water.

[i]Chromium III.

[j]Action Level that, if exceeded, requires water treatment.

[k]Los Alamos National Laboratory, 2008, ECORISK Database, Release 2.3, Environmental Programs Directorate, LA-UR-08-6673, Los Alamos National Laboratory, Los Alamos, New Mexico, October.

CAS = Chemical Abstracts Service.
COPC = Constituent of potential concern.
ECO-SSL = Ecological soil screening level.
EPA = U.S. Environmental Protection Agency.
MCL = Maximum contaminant level.
mg/kg = Milligram(s) per kilogram.
mg/L = Milligram(s) per liter.
N/A = Not applicable; analyte is an essential nutrient.
NE = Not established.
NMED = New Mexico Environment Department.
NMWQCC = New Mexico Water Quality Control Commission.
SSL = Soil screening level.
TAL = Target Analyte List.

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Attachment A2
Table of Measurement Quality Objectives

Table A2
Measurement Quality Objectives
Background and Site Specific Dilution Attenuation Factors; Data Gaps
Fort Wingate Depot Activity, Gallup, New Mexico

Analyte	Evaluation Criteria		Practical Quantitation/ Reporting Limits		Minimum Detection Limits		Bias[a]		Precision[a]	
	Soil (mg/kg)	Water (mg/L)	Soil	Water	Soil	Water	Soil %Recovery	Water %Recovery	Soil RPD	Water RPD
Applicable to Multi-Incremental Soil and Sediment and Groundwater and Surface Water Sample Analyses										
TAL Metals (EPA 6010C/6020A/7470A/7471B)[b]										
Aluminum	77,000[c]	0.05–0.2[d]	40 mg/kg	0.15 mg/L	10 mg/kg	0.05 mg/L	80–120	80–120	20	20
Antimony	31[c]	0.006[e]	0.2 mg/kg	0.001 mg/L	0.05 mg/kg	0.00025 mg/L	80–120	80–120	20	20
Arsenic	0.39[c]	0.010[e]	0.3 mg/kg	0.001 mg/L	0.075 mg/kg	0.00025 mg/L	80–120	80–120	20	20
Barium	15,600[c]	1.0[g]	0.5 mg/kg	0.003 mg/L	0.1 mg/kg	0.0005 mg/L	80–120	80–120	20	20
Beryllium	156[f]	0.004[e]	0.5 mg/kg	0.002 mg/L	0.025 mg/kg	0.0005 mg/L	80–120	80–120	20	20
Cadmium	39[f]	0.005[e]	0.1 mg/kg	0.0005 mg/L	0.025 mg/kg	0.000125 mg/L	80–120	80–120	20	20
Calcium	NE	NE	20 mg/kg	0.3 mg/L	5 mg/kg	0.1 mg/L	80–120	80–120	20	20
Chromium	100,000[f]	0.05[g]	1 mg/kg	0.002 mg/L	0.12 mg/kg	0.0005 mg/L	80–120	80–120	20	20
Cobalt	1520[f]	0.05[g]	1 mg/kg	0.001 mg/L	0.12 mg/kg	0.00025 mg/L	80–120	80–120	20	20
Copper	2900[c]	1.0[g]	0.6 mg/kg	0.002 mg/L	0.15 mg/kg	0.0005 mg/L	80–120	80–120	20	20
Iron	23,500[f]	0.3[d]	2 mg/kg	0.1 mg/L	0.5 mg/kg	0.025 mg/L	80–120	80–120	20	20
Lead	400[c,f]	0.015[e,h]	0.4 mg/kg	0.001 mg/L	0.1 mg/kg	0.00025 mg/L	80–120	80–120	20	20
Magnesium	NE	NE	50 mg/kg	1.0 mg/L	12.5 mg/kg	0.25 mg/L	80–120	80–120	20	20
Manganese	3500[f]	0.05[d]	0.5 mg/kg	0.002 mg/L	0.1 mg/kg	0.0005 mg/L	80–120	80–120	20	20
Mercury	6.7[c]	0.002[g,e]	0.1 mg/kg	0.0002 mg/L	0.02 mg/kg	0.0001 mg/L	80–120	80–120	20	20
Nickel	1560[f]	0.2[g]	2 mg/kg	0.004 mg/L	0.2 mg/kg	0.001 mg/L	80–120	80–120	20	20
Potassium	NE	NE	100 mg/kg	1.0 mg/L	25 mg/kg	0.25 mg/L	80–120	80–120	20	20

Table A2 (Continued)
Measurement Quality Objectives
Background and Site Specific Dilution Attenuation Factors; Data Gaps
Fort Wingate Depot Activity, Gallup, New Mexico

Analyte	Evaluation Criteria		Practical Quantitation/ Reporting Limits		Minimum Detection Limits		Bias[a]		Precision[a]	
	Soil (mg/kg)	Water (mg/L)	Soil	Water	Soil	Water	Soil %Recovery	Water %Recovery	Soil RPD	Water RPD
TAL Metals (EPA 6010C/6020A/7470A/7471B)[b] (Continued)										
Selenium	390[c]	0.05[g,e]	0.4 mg/kg	0.0015 mg/L	0.1 mg/kg	0.0005 mg/L	80–120	80–120	20	20
Silver	390[c]	0.05[g]	0.2 mg/kg	0.001 mg/L	0.05 mg/kg	0.00025 mg/L	75–120	80–120	20	20
Sodium	NE	NE	25 mg/kg	1.0 mg/L	5 mg/kg	0.25 mg/L	80–120	80–120	20	20
Thallium	5.16[c]	0.002[e]	0.04 mg/kg	0.0002 mg/L	0.01 mg/kg	0.00005 mg/L	80–120	80–120	20	20
Vanadium	78.2[f]	NE	0.5 mg/kg	0.001 mg/L	0.125 mg/kg	0.00025 mg/L	80–120	80–120	20	20
Zinc	23,000[c]	5[d]	2 mg/kg	0.025 mg/L	0.5 mg/kg	0.005 mg/L	80–120	80–120	20	20

[a]Bias and precision measurements are applicable to laboratory control samples. (Source: U.S. Department of Defense, 2006, "Quality Systems Manual for Environmental Laboratories," Final Version 3, prepared by DOD Environmental Data Quality Workgroup, U.S. Department of the Navy, for U.S. Department of Defense, Washington, D.C. or laboratory control values.)

[b]U.S. Environmental Protection Agency, 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., U.S. Environmental Protection Agency, Washington, D.C., including draft and final updates I through IV-B.

[c]U.S. Environmental Protection Agency, 2008, "Region 6 Human Health Medium-Specific Screening Levels 2008 (Revised 03/08/08)," U.S. Environmental Protection Agency Region 6, Dallas, Texas.

[d]National Secondary Drinking Water Standard. Nonenforceable guidelines regulating contaminants that may cause cosmetic or aesthetic effects in drinking water.

[e]EPA Maximum Contaminant Level. (U.S. Environmental Protection Agency, 2001, National Primary Drinking Water Regulations [40 CFR 141], Office of Water, U.S. Environmental Protection Agency, Washington, D.C.)

[f]New Mexico Environment Department, 2006, "Technical Background Document for Development of Soil Screening Levels," Revision 4.0, Hazardous Waste Bureau, New Mexico Environment Department, Santa Fe, New Mexico.

[g]New Mexico Water Quality Control Commission, 2002, "New Mexico Water Quality Control Commission Regulation," Section 20.6.2 of the New Mexico Administrative Code, New Mexico Water Quality Control Commission, Santa Fe, New Mexico.

[h]Action level that, if exceeded, requires water treatment.

EPA = U.S. Environmental Protection Agency.
mg/kg = Milligram(s) per kilogram.
mg/L = Milligram(s) per liter.
NE = Not established.
RPD = Relative percent difference.
TAL = Target Analyte List.

Appendix C
Site Safety and Health Plan

SITE SAFETY AND HEALTH PLAN

Background Study and Geochemical Evaluation
Fort Wingate Depot Activity
Gallup, New Mexico

Contract No. W912BV-07-D-2004
Delivery Order DM01

Revision 0

Final—January 2009

Prepared for:
U.S. Army Corps of Engineers
Albuquerque District
4101 Jefferson Plaza, NE
Albuquerque, New Mexico 87109

Prepared by:
Shaw Environmental, Inc.
2440 Louisiana Blvd. NE, Suite 300
Albuquerque, New Mexico 87110

Site Safety and Health Plan Disclaimer

This Site Safety and Health Plan has been designed for the methods presently planned by Shaw Environmental, Inc. for execution of the proposed work. Therefore, the Site Safety and Health Plan may not be appropriate if the certain tasks are not performed or if the scope of work is modified. Each company or contractor is responsible for the safety and health of its personnel, their actions, and the manner in which its employees perform the work. It is highly recommended that each company or contractor working at the Fort Wingate Depot Activity site perform its duties under the supervision of their internal health and safety professionals.

Site Safety and Health Plan Approvals and Acknowledgments __________

Approvals

I have read and approved this Site Safety and Health Plan (SSHP) with respect to project hazards, regulatory requirements, and Shaw Environmental, Inc. procedures.

Project Name: Background Study and Geochemical Evaluation, Fort Wingate Depot Activity, Gallup, New Mexico	Project Number: 133366.10

James Vigerust ______________________________
Project Health and Safety Manager / Date

Acknowledgments

The final, approved version of this SSHP has been provided to the Task Order Manager. I acknowledge my responsibility to provide the Task Order Manager with the equipment, materials, and qualified personnel to fully implement all safety requirements in this SSHP. I will formally review this plan with the Health & Safety Staff every six months until project completion.

Michael Goodrich ______________________________
Project Manager / Date

I acknowledge receipt of this SSHP from the Project Manager, and that it is my responsibility to explain its contents to all site personnel and facilitate the full implementation of these requirements. Any change in conditions, scope of work, or other modification that might affect worker safety requires that I to notify the Project Manager and/or the Health and Safety representative.

Dale Flores ______________________________
Field Team Leader / Date

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Acronyms and Abbreviations

ANSI	American National Standards Institute
CFR	Code of Federal Regulations
CPR	cardiopulmonary resuscitation
DAF	dilution attenuation factor
°F	degrees Fahrenheit
FWDA	Fort Wingate Depot Activity
HAZWOPER	Hazardous Waste Operations
H&S	health and safety
HSM	Health and Safety Manager
MSDS	Material Safety Data Sheet
OSHA	Occupational Safety and Health Administration
PID	photoionization detector
PM	Project Manager
PPE	personal protective equipment
Shaw	Shaw Environmental, Inc.
SHSO	Site Health and Safety Officer
SPF	skin protection factor
SSHP	Site Safety and Health Plan
SS	Site Supervisor
UV	ultraviolet

1.0 Introduction

1.1 Objective

The purpose of this project is to conduct a background study to develop a baseline inorganic geochemical assessment establishing concentrations of naturally occurring inorganic constituents in soil, groundwater, surface water, and sediment for the Fort Wingate Depot Activity (FWDA). Geologic, hydrogeologic, and geochemical processes that control the distributions of naturally occurring minerals and inorganic compounds within the boundaries Fort Wingate will be identified.

In addition, site-specific dilution attenuation factors (DAF) or other approved and appropriate models will be developed for "non-naturally" occurring compounds, such as 1,2-dichloroethane; toluene; total explosives (based on a list of 14 separate explosive compounds); perchlorate; and other potential non-naturally occurring constituents potentially released to the environment. The objective of developing DAF values is to determine potential impacts to groundwater through release at the surface and migration to groundwater. Hence, the overall objective of this project is to determine whether a release has occurred to the environment above natural background levels, and whether a release has the potential to impact groundwater.

1.2 Site and Facility Description

This project will target areas that may have been missed in previous soil background investigations. Details of this site are presented in the Work Plan.

1.3 Policy Statement

The policy of Shaw Environmental, Inc. (Shaw) is to provide a safe and healthy work environment for all employees. Shaw considers no phase of operations or administration to be of greater importance than injury and illness prevention. Safety takes precedence over expediency and shortcuts. Shaw considers all accidents and injuries preventable and will take every reasonable step to reduce the possibility of injury, illness, or accident.

This Site Safety and Health Plan (SSHP) describes the procedures that must be followed during site activities at the site. Operational changes that could affect the health and safety (H&S) of personnel, the community, or the environment will not be made without the prior approval of the Project Manager (PM) and Health and Safety Manager (HSM).

The provisions of this plan are mandatory for all personnel and subcontractors assigned to the project. All visitors to the work site must abide by the requirements of this plan.

1.4 Health and Safety Guidelines

This SSHP complies with applicable Occupational Safety and Health Administration (OSHA), U.S. Environmental Protection Agency, and Shaw H&S policies and procedures. This plan follows the guidelines established in the following documents:

- Standard Operating Safety Guides (EPA, June 1992).
- Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities (NIOSH et al., October 1985).
- Title 29 of the Code of Federal Regulations (CFR), Part 1910.120.
- 29 CFR 1910 and 1926.
- National Institute for Occupational Safety and Health Pocket Guide to Chemical Hazards (NIOSH, September 2005).
- Quick Selection Guide to Chemical Protective Clothing (Forsberg and Mansdorf, 1997)
- Shaw Environmental Health and Safety Policies and Procedures Manual (Shaw, 2008).

2.0 Responsibilities

2.1 All Personnel and Visitors

All personnel must be familiar with and adhere to these H&S procedures during the performance of work. Each person is responsible for completing tasks safely and reporting any unsafe acts or conditions to his or her immediate supervisor, the Site Health and Safety Officer (SHSO), or the Site Supervisor (SS) or Field Team Leader. No person may work in a manner that conflicts with the specified safety and environmental precautions or the intent of these procedures. After due warnings, the Field Team Leader or the PM will dismiss from the site any person who violates safety procedures. If necessary, Shaw's employees are subject to progressive discipline and may be terminated for blatant or continued violations.

All personnel and site visitors must read and acknowledge understanding of this SSHP on the form provided as Attachment B1, abide by the requirements of the plan, and cooperate with site supervision personnel in ensuring a safe and healthy work site. Site personnel will immediately report any of the following to the SS or SHSO:

- Accidents and injuries, no matter how minor
- Unexpected or uncontrolled release of chemical substances
- Symptoms of chemical exposure
- Unsafe or malfunctioning equipment
- Changes in site conditions that may affect the H&S of project personnel

2.2 Health and Safety Manager

The HSM is responsible for the technical H&S aspects of the project, including review, changes to, and approval of this SSHP. If changes to this SSHP are required, the HSM will work with the PM to formalize the change. The HSM is to address inquiries regarding Shaw procedures, project procedures, and other technical or regulatory issues. The HSM for this project is James Vigerust.

2.3 Project Manager

The PM is ultimately responsible for ensuring that all project activities are completed in accordance with the requirements and procedures in this plan. The PM will formally review this plan with the SHSO or HSM every six months until the project is completed. The PM is responsible for providing the Field Team Leader/SS with the equipment, materials, and qualified personnel necessary to fully implement all safety requirements outlined in this SSHP. The PM for this project is Mike Goodrich.

It is the PM's responsibility to make sure that tasks are completed as documented in the Work Plan. The PM will thoroughly investigate all accidents and incidents on the project.

2.4 Site Supervisor/Field Team Leader

The SS/Field Team Leader is also the on-site project geologist and is responsible for implementation of the SSHP, including communication of site requirements to all on-site project personnel (including subcontractors) and consultation with the SHSO. The SS is responsible for informing the PM and the SHSO of any changes in the work plan or procedures so that those changes may be addressed in this SSHP. The SS for this project is Dale Flores.

Other responsibilities of the SS include the following:

- Stopping work as necessary to ensure personal safety and protection of property, or in cases of life- or property-threatening safety noncompliance.
- Determining and posting routes to medical facilities and maintaining a list of emergency telephone numbers, as well as arranging emergency transportation to medical facilities.
- Establishing evacuation routes and assembly areas.
- Notifying local public emergency officers of the nature of the site operations and posting emergency telephone numbers in an appropriate location.
- Observing on-site project personnel for signs of chemical or physical trauma.
- Ensuring that all site personnel have proper medical clearance, have met applicable training requirements, and have access to training documentation.

2.5 Site Health and Safety Officer

The SHSO can make changes to this SSHP in cooperation with the HSM based upon field conditions. Any changes will be documented in the Field Activity Daily Log and Daily Safety Report by the SHSO. Field changes can be implemented appropriately in this manner without causing delays. The SHSO will advise the SS concerning H&S issues. The SHSO will ensure that all on-site Shaw and contractor personnel provide copies of certification as described in Chapter 7.0. The SHSO will conduct daily Tailgate Safety Meetings and will serve as the primary site contact on occupational H&S. The SHSO for this project is to-be-determined.

2.6 Subcontractors

Shaw may use only pre-qualified subcontractors on this project. Subcontractors will abide by all the requirements of this SSHP.

3.0 Personal Protective Equipment

Personal protective equipment (PPE) is required to safeguard site personnel from possible hazards. Varying levels of protection are required depending upon the possible level of contaminants and the degree of physical hazard. The following sections present the various levels of protection and define the conditions of use for each level.

3.1 Levels of Protection

The level of PPE will be selected by the SS or SHSO based upon the potential for contact with contaminated materials, site conditions, ambient air quality, and the judgment of supervising site personnel and H&S professionals. PPE will be effective against the compounds present at the site. A summary of the levels of protection is presented in this section. The PPE selection matrix is presented in Section 12.3.

3.1.1 Level D

The minimum level of protection required of Shaw personnel and subcontractors at the site is Level D, which will be worn as the initial protection level for site operations. The following equipment will be used:

- Work clothing as prescribed by weather, pants
- Steel-toed work boots, American National Standards Institute (ANSI) approved
- Safety glasses with side shields or goggles, ANSI approved
- Leather work gloves at the discretion of the SS or SHSO

3.1.2 Modified Level D

Modified Level D is required for personnel who come into direct contact with potential site contaminants during drilling and sampling activities. The following equipment will be used:

- Work clothing as prescribed by weather, pants
- Steel-toed work boots, ANSI approved
- Safety glasses, ANSI approved
- Disposable gloves (nitrile or latex during soil sampling)
- Hearing protection (at the discretion of the SS or SHSO)
- Leather work gloves

3.1.3 Level C

Upgrade to level C is not anticipated. If conditions warrant higher levels of protection than modified Level D, site work will be suspended until such conditions can be rectified or until this

SSHP is amended to address such hazards. All upgrades and downgrades will be approved by the SS or SHSO with the concurrence of the HSM.

3.2 Personal Protective Equipment Use

All personnel and visitors entering the exclusion zone must wear the recommended PPE in accordance with the requirements of this plan. When leaving the exclusion zone, PPE will be removed as described in Section 6.1 to minimize the spread of contamination.

4.0 Site Monitoring

4.1 Air Monitoring

Air monitoring will not be necessary during this project. However, a photoionization detector (PID) (equipped with an 11.7 electron volt lamp) will be with the soil sampling team in the event an unnatural odor is encountered.

The monitoring results will dictate work procedures and the selection of PPE, according to the Table 4-2. At a minimum, all readings will be recorded on air monitoring logs every half hour.

4.2 Noise Monitoring

Noise monitoring will not be necessary during this project. Hearing protection will be required during all drilling operations and at the discretion of the SS or SHSO during other activities.

4.3 Radiation Monitoring

Radiation monitoring will not be required during this project.

4.4 Monitoring Records

In the event that site monitoring is conducted, the PM must ensure that site monitoring records are complete and incorporated into the project file. The SS or SHSO is responsible for establishing, maintaining, and forwarding the following required monitoring information:

- Employee name, employee number
- The date, time, pertinent task information, and exposure information
- Description of the analytical methods, equipment used, and calibration data
- Type of PPE worn
- Engineering controls used to reduce exposure

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5.0 Site Control

This section describes the procedures used to control entry and exit of persons from the site. Site control is necessary to ensure that anyone on site is informed of the potential hazards and is trained in handling such.

5.1 Entry Requirements

No person will be allowed in the work area during site operations without a hazard briefing. In general, the briefing will consist of a review of the Tailgate Safety Meeting form. All people in the work area, including visitors, must sign the site-specific Tailgate Safety Meeting form. Tailgate Safety Meetings will be conducted by the SS or SHSO at the beginning of each shift, as conditions change, and for visitors as needed. In addition to the hazard briefing, no person will be allowed in the work area unless he or she is wearing the required PPE as described in Section 3.1. The SS or SHSO will maintain a list of authorized personnel who are allowed within the exclusion and contamination reduction zones.

5.2 Exit Requirements

Personnel will follow the decontamination procedures described in Chapter 6.0 prior to leaving the contamination reduction zone. All trash and equipment will be removed from the site before the completion of fieldwork.

5.3 Emergency Entry and Exit

People who must enter the site on an emergency basis will be briefed on the hazards by the SS or SHSO. All work activities will cease in the event of an emergency and any sources of emissions will be controlled, if possible.

People exiting the site because of an emergency will gather in the safe area previously designated by the SS or SHSO for a head count. The SS or SHSO is responsible for ensuring that all people who entered the work area have exited in the event of an emergency.

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6.0 Decontamination

This section describes the work zones, break area, and decontamination procedures.

6.1 Contamination Control Zones

Contamination control zones are maintained to prevent the spread of contamination and to prevent unauthorized people from entering hazardous areas. Eating, drinking, chewing gum, and tobacco use is prohibited in the exclusion and contamination reduction zones.

6.1.1 Exclusion Zone

The exclusion zone is the specific work area or the entire area of suspected contamination. The exclusion zone is the defined area where there is possible contact with a health hazard. All employees entering the exclusion zone must use the required PPE and have the appropriate training for hazardous waste work.

6.1.2 Contamination Reduction Zone

The contamination reduction zone will be established as a transition area, if necessary, to perform decontamination of personnel, equipment, and PPE. All personnel entering or leaving the exclusion zone will pass through this area to prevent cross-contamination and for accountability. PPE outer garments will be removed in the contamination reduction zone and prepared for cleaning or disposal. This is the only appropriate corridor between the exclusion zone and the support zone.

6.1.3 Support Zone

The support zone is a clean area located outside the contamination reduction zone to prevent employee exposure to hazardous substances. Eating, drinking, and tobacco use are permitted in the support zone only after washing hands.

6.2 Personnel Decontamination

All personnel working in the exclusion zone must undergo personal decontamination prior to entering the support zone. Personal decontamination will consist of the following steps:

1. Go to end of the exclusion zone
2. Remove gloves and discard in the labeled trash receptacle
3. Remove protective suit (if applicable)
4. Wash hands

6.3 Equipment Decontamination

Decontamination of nondisposable sampling equipment will consist of scrubbing the equipment with a soft bristled brush and an Alconox and water mix, then rinsing the equipment with distilled water. The decontamination water will be temporarily contained on site and allowed to evaporate. If necessary, sample containers from the contamination reduction zone will be wiped off prior to being introduced into the support zone.

6.4 Personal Protective Equipment Decontamination

Soil sampling activities will be conducted in Modified Level D PPE as described in Section 3.1.2. This protective clothing will be disposed of as solid waste.

7.0 Training

7.1 General

All on-site project personnel must have completed at least 40 hours of Hazardous Waste Operations (HAZWOPER) training, as required by OSHA Regulation 29 CFR 1910.120. All field employees must receive a minimum of three days of actual field experience under the direct supervision of a trained, experienced supervisor. Those personnel who have completed the 40-hour training more than 12 months prior to the start of the project must have completed an 8-hour refresher course within 12 months prior to the start of the project. The SS or SHSO must have completed an additional eight hours of H&S training for supervisors and must have a current first-aid/cardiopulmonary resuscitation (CPR) certificate.

7.2 40-Hour Course

The following is a list of the topics typically covered in the 40-hour HAZWOPER training course:

- Physical hazards (fall protection, noise, heat stress, cold stress)
- Job descriptions of key personnel responsible for site H&S measures
- General safety procedures
- Safety, health, and other hazards typically present at hazardous waste sites
- Use, application, and limitations of PPE
- Work practices by which employees can minimize risks from hazards
- Safe use of engineering controls and equipment on site
- Medical surveillance requirements
- Recognition of symptoms and signs that might indicate overexposure to hazards
- Worker right-to-know (Hazard Communication OSHA 29 CFR 1910.1200)
- Routes of exposure to contaminants
- Engineering controls and safe work practices
- Components of a site H&S program and SSHP
- Decontamination practices for personnel and equipment
- Confined-space entry procedures
- General emergency response procedures

7.3 Supervisor Course

Managers and supervisors must complete an additional eight hours of training that typically includes the following topics:

- General site H&S procedures
- PPE programs
- Air monitoring techniques

7.4 Site-Specific Training

Site-specific training will be accomplished through a review of this SSHP before fieldwork activities begin. All workers will review and sign the SSHP acknowledgment form at the beginning of this plan. In addition, the daily Tailgate Safety Meeting and Job Hazard Analysis will cover the work to be accomplished, hazards anticipated, protective clothing and procedures required to minimize site hazards, and emergency procedures. No work will be performed before the Tailgate Safety Meeting has been conducted and workers have signed the form.

7.5 First Aid and CPR

At least two employees with current certification in first aid/CPR will be assigned to the work crew and will be on the site whenever operations are in progress. Refresher training in first aid (triennially) and CPR (annually) are required to keep the certificate current. These individuals must also receive training as to the precautions and protective equipment necessary to protect against exposure to blood-borne pathogens.

7.6 Certification Documents

A training and medical file must be established for the project and kept on site during all operations. The 40-hour training, 8-hour refresher, other training (first-aid/CPR), and medical clearance certificates for all project field personnel will be maintained in that file. All Shaw and subcontractor personnel must provide their training and medical documentation to the SS or SHSO prior to the start of fieldwork activities.

8.0 Medical Surveillance

8.1 Medical Examination

All on-site personnel must have successfully completed a pre-placement or annual physical examination, which is provided free-of-charge to the employee. This medical surveillance program will comply with OSHA Regulation 29 CFR 1910.120.

8.2 Medical Restriction

When the examining physician identifies a need to restrict work activity, the employee's supervisor must communicate the restriction to the employee and the SS or SHSO. The terms of the restriction will be discussed with the employee and the SS or SHSO. Every attempt should be made to keep the employee working; while not violating the terms of the medical restriction.

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9.0 Project Hazards and Control Procedures

9.1 Job Hazard Assessment and Hazard Assessment Resolution Program

Job hazard assessments in conjunction with the hazard assessment resolution program are necessary to identify potential safety, health, and environmental hazards associated with each type of field activity. Each site task has been analyzed for potential hazards for which control measures are provided in Attachment B2, Job Hazard Analysis. Because of the complex and changing nature of field projects, supervisors must continually inspect the work site to identify hazards that may harm site personnel, the community, or the environment. The SS or SHSO must be aware of these changing conditions and discuss them with the HSM and the PM whenever these changes impact the health, safety, or performance of the project. The SS or SHSO will keep subcontractors informed of the changing conditions and will write addenda to modify the Job Hazard Analysis and associated hazard controls as necessary.

9.2 Field Activities, Hazards, and Control Procedures

No significant health hazards from chemical contaminants or radiation are anticipated for this project. In accordance with Chapter 3.0, decisions regarding PPE for the chemical hazards will be based upon measurements made before and during work activities. This section discusses the hazards associated with each phase of the project. General hazards that can occur when working at any field site are presented in Chapter 10.0. Control and prevention measures are presented in Attachment B2.

9.2.1 Mobilization/Demobilization

Site mobilization will include establishing work, contamination control, and support zones. A break area will be set up outside the regulated work area. Mobilization will involve staging sample coolers, setting up a sample management area, and performing decontamination of nondisposable sample equipment. During this initial phase, project personnel will conduct a site walk-through to identify safety issues that may have arisen since the submission of this plan.

Demobilization will involve the removal of all tools, sample equipment, supplies, and vehicles from the site.

The hazards of these phases of activity are associated with biological hazards, equipment failure, lifting, sharp objects, slips/trips/falls, and temperature. The site is maintained and access to the sample sites is not an issue.

9.2.2 Surveying and Soil Sampling Activities

Soil samples will be collected for subsequent analysis and evaluation of potential site contamination. The site will also be surveyed on foot. The primary hazards associated with the sampling and surveying activities include contact with contaminated substances, as well as physical hazards including lifting, slips/trips/falls, temperature, and biological hazards. Control and prevention measures are presented in Attachment B2.

9.3 Chemical Hazards

The chemical hazards associated with the collection of samples are related to inhalation, ingestion, and skin/eye exposure to potential site contaminants and chemicals.

The constituents of concern are explosive compounds and RCRA metals (see Section 1.1). Constituents of concern at the site are anticipated to be found at very low levels of environmental contamination or not detected and will not represent a significant occupational health threat to project personnel. Control will be achieved by ensuring that airborne particulates are not generated, following the procedure listed in Section 10.12. Additionally, proper sanitation (Section 10.3) and decontamination practices (Chapter 6.0) will be followed to avoid contact with potential hazardous constituents.

Other chemical hazards associated with the fieldwork exist.

- Diesel fuel, gasoline, motor oil, and hydraulic oil will be required for vehicle operation.
- Isobutylene will be used as the calibration gas for the PID.
- Decontamination will include the use of Alconox solution.

Table 9-1 lists the chemical, physical, and toxicological properties of the potential site contaminants. The table should not be considered an indicator of actual exposure potentials for any given individual or activity. This table will be reviewed at the initial Tailgate Safety Meeting to ensure personnel are familiar with the terms and hazards. The Material Safety Data Sheets (MSDS) for materials used on site are included in Attachment B3 to satisfy the requirements of the Hazard Communication Standard, OSHA 29 CFR 1910.1200. None of the preservative, decontamination, equipment related, or installation materials are expected to pose a significant health hazard.

10.0 General Control Procedures and Hazards

10.1 General Practices

- At least one copy of this plan must be at the project site in a location readily accessible to all personnel.
- All site personnel must use the buddy system (working in pairs or teams).
- Legible and understandable precautionary labels that comply with the hazard communication standard must be affixed prominently to tightly closed containers of contaminated waste, debris, and clothing.
- Removing contaminated soil from protective clothing or equipment by blowing, shaking, or any other means that disperses contaminants into the air is prohibited.
- Food, beverages, or tobacco products must not be present or consumed in the exclusion or contamination reduction zones. A support zone will be established away from the exclusion and contamination reduction zones where site workers can take breaks and where sanitation facilities are available.
- Cosmetics must not be applied within the exclusion or contamination reduction zones.
- Containers must be moved only with the proper equipment and must be secured to prevent dropping or loss of control during transport.
- Emergency equipment must be removed from storage areas and staged in readily accessible locations. This includes such items as the first-aid kit, fire extinguishers, and eyewash.
- Employees must inform their partners or fellow team members of nonvisible effects of exposure to toxic materials. The symptoms of such exposure may include the following:
  - Headaches
  - Dizziness
  - Nausea
  - Blurred vision
  - Cramps
  - Irritation of eyes, skin, or respiratory tract

- Visitors to the site must abide by the following guidelines:
  - All visitors must be instructed to stay outside the contaminated zones (exclusion and contamination reduction zones) and remain within the clean zone (support area) during the extent of their stay.
  - Visitors requesting to observe work in the exclusion zone must sign the Tailgate Safety Meeting form acknowledging that they have been briefed on the site hazards, don all appropriate PPE prior to entry, and must present the certifications described in Chapter 7.0.
  - Visitor inspection of the contaminated area is at the discretion of the SS or SHSO.

10.2 Buddy System

All on-site personnel must use the buddy system. Visual contact must be maintained between crew members at all times, and crew members must observe each other for signs of chemical exposure. Indication of adverse effects include, but are not limited to, the following:

- Changes in complexion and skin coloration
- Changes in coordination
- Changes in demeanor
- Excessive salivation and pupillary response
- Changes in speech pattern

Team members must also be aware of potential exposure to possible safety hazards, unsafe acts, or noncompliance with safety procedures.

Personnel must stay within the line of sight of another team member. If PPE or noise levels impair communications, prearranged hand signals must be used for communication (see Table 10-1).

10.3 Sanitation

Breaks will be taken in a clean "support zone" away from the active work area. An adequate supply of potable water will be provided in this zone. Portable containers used to dispense drinking water must be clearly marked, not used for any other purpose, be capable of being tightly closed, and must be equipped with a tap dispenser. Employees must not drink directly from the container or put cups in the container. Disposable cups will be supplied. Labeled trash receptacles will be set up in the contamination and support zones. Trash collected from the exclusion and decontamination zones will be separated as investigation-derived waste. Trash collected in the support area will be disposed of as nonhazardous waste. Personnel will use on-site permanent sanitation and lavatory facilities. Personnel will wash their hands before eating or drinking to prevent exposure to possible hazardous constituents.

10.4 Spill Control Plan

A spill control plan is not applicable to the Background Study and Geochemical Evaluation Work Plan. Liquids generated during the investigation will be rinsate, which are nonhazardous and will be disposed of within the site boundaries following completion of fieldwork.

10.5 Sunburn/Ultraviolet Exposure

Overexposure to ultraviolet (UV) radiation may damage the skin and cause sunburn. Chronic exposure to sunlight, especially the UVB component, accelerates skin aging and increases the risk of skin cancer. Fair-skinned individuals are more prone to this effect. Sunburn increases an individual's susceptibility to other forms of heat stress. Any worker with sunburn must pay particular attention to the prevention of heat cramps, heat exhaustion, and/or heat stroke.

The following methods can be used to avoid overexposure to UV rays from the sun:

- Avoid exposure to the sun between 10:00 a.m. and 2:00 p.m. as UV rays are most intense during this period.
- Wear protective clothing (long sleeves, hat with protective brim, pants) that provide the most coverage, consistent with the job to be performed.
- Protect eyes during sun exposure with UV-absorbing sunglasses or tinted safety glasses. Ophthalmologists recommend lenses that have a UV absorption of at least 90 percent.
- Use a commercial sunscreen product.

The American Academy of Dermatology recommends daily use of sunscreen with a Sun Protection Factor of at least 15 and one that provides protection from UVA and UVB rays. Sunscreen should be applied 15 to 30 minutes before exposure to the sun and reapplied every two hours. (American Academy of Dermatology, 2006)

10.6 Heat Stress

Wearing PPE may put site personnel at increased risk of heat stress, the effects of which range from transient heat fatigue to serious illness and death. Heat stress is caused by a number of interacting factors, including environmental conditions, clothing, workload, and individual characteristics of the worker. Because heat stress is one of the most common and potentially serious illnesses that occur during field operations, awareness of the symptoms and knowledge of preventive measures are vital.

Heat-stress monitoring should commence when personnel are wearing impermeable PPE and the ambient temperature exceeds 78 degrees Fahrenheit (ºF). If impermeable garments are not worn, heat stress monitoring should commence at 90 ºF.

One or more of the following control measures can be used to help control heat stress and are mandatory if a site worker either has a heart rate (measured as early as possible during a rest period) exceeding 75 percent of the calculated maximum heart rate, which is 200 minus the person's age, or a temperature of 99.6 ºF:

- Site personnel will be encouraged to drink plenty of water and electrolyte replacement fluids throughout the day.
- On-site drinking water will be kept cool (50 to 60 ºF).
- A work regimen that provides adequate rest periods for cooling down will be established, as required, but generally a one-third work shift reduction until sustained heart rate is below 75 percent of the calculated maximum heart rate and oral temperatures are kept at or below 99.6 ºF. A worker will not be permitted to return to work if the sustained heart rate is above the 75-percent calculated maximum or the oral temperature exceeds 100.4 ºF.
- Cooling devices, such as vortex tubes or cooling vests, should be used when personnel must wear impermeable clothing in conditions of extreme heat.
- Employees should be instructed to monitor themselves and coworkers for signs of heat stress and to take additional breaks as necessary.
- A shaded rest area must be provided, and all breaks should take place in this area.
- Site personnel must not be assigned to other tasks during breaks.
- Employees must remove impermeable garments during rest periods. This includes white Tyvek-type garments.
- All personnel will be advised of the dangers and symptoms of heat stroke, heat exhaustion, and heat cramps.
- All employees must be informed of the importance of adequate rest, acclimation, and proper diet in the prevention of heat stress disorders.

Heat Cramps. Heat cramps are caused by heavy sweating and inadequate electrolyte replacement. Signs and symptoms include muscle spasms and pain in the hands, feet, and abdomen.

Heat Exhaustion. Heat exhaustion is caused by increased stress on various body organs. Signs and symptoms include pale, cool, moist skin; heavy sweating; dizziness; nausea; and fainting.

Heat Stroke. Heat stroke is the most serious form of heat stress and should always be treated as a medical emergency. The body's temperature regulation system fails, and the body temperature rapidly rises to critical levels. Immediate action must be taken to cool the body before serious injury or death occurs. Signs and symptoms of heat stroke include red, hot, usually dry skin; lack of, or reduced, perspiration; nausea; dizziness and confusion; strong, rapid pulse; and coma.

10.7 Cold Stress

Cold and/or wet environmental conditions can place workers at risk of a cold-related illness. Most cold-related worker fatalities have resulted from failure to escape low environmental air temperatures or from immersion in low-temperature water. Site workers should be protected from exposure to cold so that the deep core temperature does not fall below 96.8 °F. Lower body temperatures will very likely result in reduced mental alertness, reduction in rational decision-making, or loss of consciousness with the threat of fatal consequences. To prevent such an occurrence, the following measures will be implemented:

- Site personnel must wear warm clothing, including mittens, hats, heavy socks, etc., when the air temperature is below 45 °F. Protective clothing, such as Tyvek or other disposable coveralls, may be used to shield employees from the wind.
- When the air temperature is below 35 °F, employees must wear clothing for warmth, in addition to chemical protective clothing, that will include the following:
  - Insulated suits, such as whole body thermal underwear
  - Wool socks or polypropylene socks to keep moisture off the feet
  - Insulated gloves
  - Insulated boots
  - Insulated head cover such as a hard hat, winter liner, or knit cap
  - Insulated jacket, with a wind- and water-resistant outer layer
- At air temperatures below 35 °F, the following work practices must be implemented:
  - If the clothing of a site worker might become wet on the job site, the outer layer of clothing must be water-impermeable.
  - If an employee's underclothing becomes wet in any way, the worker must change into dry clothing immediately. If the clothing becomes wet from sweating (and the employee is not uncomfortable), the employee may finish the task at hand prior to changing into dry clothing.
  - Site personnel must have a warm (65 °F or above) break area.
  - Hot liquids must be provided in the break area. The intake of coffee and tea should be limited, due to their circulatory and diuretic effects.
  - The buddy system must be practiced at all times on site. Any employee observed to be severely shivering must leave the work area immediately.

- Site personnel should dress in layers with thinner lighter clothing worn next to the body.
- Site personnel should avoid overdressing when going into warm areas or when performing strenuous activities.

Hypothermia. The single most important aspect of life-threatening hypothermia is a decrease in the deep core temperature of the body. Hypothermia can occur whenever temperatures are below 45 °F, and is most common during wet, windy conditions, with temperatures between 30 and 40 °F. The principal cause of hypothermia in these conditions is loss of insulating properties of clothing due to moisture, coupled with heat loss due to wind and evaporation of moisture on the skin.

Frostbite. The other illness associated with cold exposure is frostbite. Frostbite is the freezing of body tissue, which ranges from superficial freezing of surface skin layers to deep freezing of underlying tissue. Frostbite will only occur when ambient temperatures are below 32 °F. The risk of frostbite increases as the temperature drops and wind speed increases.

10.8 Biological Hazards

Spiders, ticks, bees, wasps, ants, centipedes, scorpions, rattlesnakes, and rodents can be found throughout New Mexico. Project personnel should be aware of the presence of any animals and droppings and notify the SS or SHSO if encountered. To minimize the threat of bites, all on-site personnel must avoid actions that could increase the chance of encounters, such as turning over logs or rocks and walking through brush. This section describes potentially harmful creatures that may be found on the site and details the symptoms and treatments for bites.

Should a bite or sting occur, first aid should be given immediately. First aid for these bites includes applying ice to decrease pain and swelling, elevating the area (if possible) above the level of the heart, washing the area thoroughly with cool water and mild soap, and avoiding strenuous activity. Acetaminophen can be given for pain relief.

Brown Recluse Spider (*Loxosceles* spp.)**.** The brown recluse spider is a small, nonhairy, yellowish to dark brown spider. These spiders are not aggressive and bite only when threatened, usually when pressed up against a person’s skin. Brown recluse spider bites often go unnoticed initially, because they are painless or only induce minor burning and redness. Symptoms usually develop two to eight hours after a bite and include severe pain at bite site, itching, nausea, vomiting, chills, fever, and muscle and joint pain. Most commonly, the bite site will become firm and heal with little scaring over the next few days or weeks. In very severe cases, a red zone appears around the bite, then a crust forms and falls off. The wound blisters with necrosis of skin, grows deeper, and does not heal for several months. Seek immediate medical care for brown recluse bites.

Black Widow Spider (*Latrodectus* spp.)**.** Only the female black widow spiders bite if threatened or disturbed. The female spider is usually black with a red hourglass shape on the underside of the abdomen. The first symptom of a bite is acute pain at the site of the bite. Symptoms vary in severity and start within 20 minutes to 1 hour after the bite. Local pain may be followed by severe muscle cramps, abdominal pain, weakness, and tremor. In severe cases, nausea, vomiting, fainting, dizziness, chest pain, and respiratory difficulties may follow. Abdominal pain may mimic such conditions as appendicitis or gallbladder problems. Chest pain may be mistaken for a heart attack. Blood pressure and heart rate may be elevated. Treatment for serious reactions to a black widow bite may require the use of narcotics and antivenin. If more than minor pain or whole-body symptoms occur, seek immediate medical care.

Ticks (class Arachnida)**.** Ticks are small, blood-sucking external parasites that can transmit disease. Tick-borne diseases in the United States include Lyme disease, Rocky Mountain spotted fever, and tick paralysis. The most effective way to combat tick-borne diseases is to prevent ticks from attaching to the body by wearing long-sleeved shirts, long pants cinched at the ankle, and closed-toe shoes, and using insect repellant. Keeping away from vegetation also decreases the opportunity for tick attachment. The attachment bite is usually painless and can go unnoticed. Redness, itching, and swelling are commonly seen at the site of a tick bite. Once attached, ticks are difficult to remove but should be removed promptly. To remove a tick, use rounded tweezers, grasp the tick as close as possible to the skin surface, and then pull with slow steady pressure in a direction away from the skin. Take care not to crush or squeeze the body of the tick because fluid from the tick may contain infectious agents. After the tick is removed, wash the bite site with soap and water or an antiseptic.

Bees, Wasps, Ants (order Hymenoptera)**.** In a person who is allergic, one sting can cause death from an anaphylactic reaction. Bee stings produce immediate pain and a red, swollen area about 0.5 inch across. In some people, the area swells to a diameter of 2 inches or more over the next three days. The stinger should be removed as quickly as possible. A fire ant sting usually produces immediate pain and a red, swollen area, which disappears within 45 minutes. A blister or rash may develop. An antihistamine/analgesic/corticosteroid cream can be used to decrease pain and inflammation. People who are allergic to stings should always carry a preloaded syringe of epinephrine.

Centipedes (class Chilopoda)**.** Centipedes are arthropods with long bodies, many legs, and a pair of poison claws. Centipedes normally have a drab coloration combining shades of brown and red. They can range from one to nine inches in size and are found in soil and leaf litter, under stones, and inside logs. A centipede bite will cause local inflammation and pain, generally lasting a few hours. To treat a centipede bite, clean the site well with soap and water and apply a cool compress. If pain is severe or lasts longer than 12 hours, seek medical attention.

Scorpions *(Hadrurus arizonensis, Vaejovis spinigerus, Centruroides sculpturatus)***.** Scorpions range from 1 to 6 inches and have a tail tipped with a venomous stinger. They have four pairs of legs and two pincers and can be yellow to black. The first symptom of a bite is painful, tingling, burning sensation at the sting site. The reaction may appear mild; however, severe symptoms throughout the body may develop. These symptoms include numbness, difficulty swallowing, swollen tongue, blurred vision, roving eye movements, seizures, salivation, and difficulty breathing. Seek immediate medical care. All but the mildest of symptoms require hospital admission for 24 hours of observation.

Rattlesnakes *(Crotalinae)***.** Seven species of poisonous snakes are found in New Mexico. The primary way to distinguish a rattlesnake from other snakes is the presence of a rattle at the end of the snake body. The symptoms of a poisonous bite are pain, tingling, bruising/discoloration, and swelling at the area of the bite, numbness, nausea, weakness, lightheadedness, and difficulty breathing. Apply first aid and seek immediate medical attention. If unable to reach medical care within 30 minutes, a bandage, wrapped two to four inches above the bite, may help slow venom movement. The bandage should not cut off blood flow. A suction device may be placed over the bite to help draw venom out of the wound.

10.9 Noise

Exposure to noise over the OSHA action level of 85 A-weighted decibels can cause temporary impairment of hearing; prolonged and repeated exposure can cause permanent damage to ears. The risk and severity of hearing loss increases with the intensity and duration of exposure to noise. In addition to damaging ears, noise can impair voice communication, thereby increasing the risk of on-site accidents.

All personnel must wear hearing protection with a Noise Reduction Rating of at least 20 during the operation of noise-producing machinery such as the drill rig. All personnel working in the vicinity of a drilling operation will be required to wear hearing protection. All site personnel who may be exposed to noise must also receive baseline and annual audiograms and training as to the causes and prevention of hearing loss.

10.10 Compressed Gas

Compressed gases present numerous hazards, including fire/explosions, asphyxiation in poorly ventilated areas, and missile-type projectiles from punctured or damaged cylinders releasing pressure. Resulting injuries can include burns, contusions, bone fractures, and/or death.

Compressed gas cylinders shall be properly secured in at all times, with caps in place when not in use. Compressed gas cylinders being transported shall also be properly secured (e.g., strapped to the wall of the truck bed) to prevent damage or rupture. Calibration gas cylinders will be stored/secured in accordance with the manufacturer’s instructions and/or in designated shipping containers. Compressed gas cylinders shall either be stored at a sufficient distance from welding or cutting operations to prevent sparks, hot slag, or flame from reaching the cylinders or have heat-resistant shields. Shaw Health and Safety Procedure HS304, *Compressed Gas Cylinders* (Shaw, August 2002), will be maintained on site and provides additional guidance on the safe handling and use of compressed gas cylinders.

10.11 Lifting

Back strain or injury may be prevented by using proper lifting techniques. The fundamentals of proper lifting are listed below.

- Consider the size, shape, and weight of the object to be lifted. Seek help if the object cannot be lifted safely alone or is more than 60 pounds. A worker should not carry a load that he or she cannot see around or over.
- The object should be free of dirt, grease, jagged edges, and rough or slippery surfaces.
- Gloves must be used and fingers kept away from points which could crush or pinch them, especially when putting an object down.
- Feet must be placed far enough apart for balance. The footing should be solid and the intended pathway should be clear.
- The load should be kept as low as possible, close to the body with the knees bent.
- To lift the load, grip firmly and lift with the legs, keeping the back as straight as possible.
- When putting an object down, the stance and position are identical to that for lifting, with the legs bent at the knees and the back as straight as possible while lowering the object.

10.12 Dust Control

Although dust generation is not likely to occur during this project, field personnel will remain upwind of any intrusive or dust-creating activity. If dust becomes a problem, work will stop and not continue until appropriate dust control measures are employed. Air monitoring requirements for airborne contaminants are presented in Section 4.1.

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11.0 Emergency Procedures

11.1 General

The SS or SHSO will establish evacuation routes and assembly areas for each site. All personnel entering the site will be informed of these routes and assembly areas on a daily basis. If the site is large and the evacuation routes are not obvious, a site plan marking the evacuation routes will be posted at conspicuous locations.

Each site will be evaluated for the potential for fire, explosion, chemical release, or other catastrophic events. Unusual events, activities, chemicals, and conditions will be reported to the SS or SHSO immediately. All employees must report to their immediate supervisor or the SS or SHSO any near-miss incident, accident, injury, or illness.

All emergency assistance is obtained by calling 911. It is important to provide the exact location, such as the nearest building number and address or cross street. Call 911 before reporting to any other individual listed in the approved SSHP. Other emergency numbers are listed in Table 11-1.

11.2 Safety Signals

Vehicle or portable air horns will be used for safety signals as follows:

- One long blast indicates emergency evacuation of the site.
- Two short blasts alerts personnel to clear the area around powered or moving equipment.
- Hand signals are described in Table 10-1.

11.3 Emergency Response

This section describes procedures to be taken in cases of medical emergency, first aid situations, fires, and spills. If an incident occurs, the following general procedures will be implemented:

- The SS or SHSO will evaluate the incident and assess the need for assistance.
- The SS or SHSO will call for outside assistance as needed and act as the liaison between outside agencies and on-site personnel.
- The SS or SHSO will take appropriate measures to stabilize the incident scene.
- The SS or SHSO will ensure that the PM and HSM are notified promptly of the incident.

11.3.1 Medical Emergency

All employee injuries must be promptly reported to the SS or SHSO who will ensure that the injured employee receives prompt first aid and medical attention, assist with decontamination of the injured worker, and initiate an investigation of the incident.

11.3.2 First-Aid Treatment

If needed, first aid will be provided by a trained, on-site first aid provider. First-aid kits are kept in the contamination reduction zone. First aid for specific injuries and instances are provided in Section 10.8 for biological hazards, and for inhalation, ingestion, skin contact, and eye contact in Sections 11.3.2.1–11.3.2.3 below. The general procedure for first aid is:

- <u>Survey the scene</u>. Determine if it is safe to proceed. Protect yourself from exposure before attempting to rescue the victim.
- <u>Do a primary survey of the victim</u>. Check for airway obstruction, breathlessness, and pulse. Examine the eyes, mouth, nose, and skin of the victim for symptoms.
- <u>Call 911.</u> Give the location, telephone number, situation description, number of victims, victims' condition, and care being administered.
- <u>Perform rescue breathing and CPR</u> as necessary.
- <u>Do a secondary survey of the victim</u>. Check vital signs and perform a head-to-toe exam.
- <u>Treat other conditions as necessary</u>. If the victim can be moved, take the victim to a location away from the work area where emergency medical personnel can gain access.

If treatment beyond first aid is required, the injured person should be transported to the Rehoboth McKinley Christian Hospital shown in Figure 11-1. If the injured worker shows any sign of not being in a comfortable and stable condition for transport, then an ambulance/paramedic service should be summoned. If there is any doubt as to the injured worker's condition, it is best to let the local paramedic or ambulance service attendants examine and transport the worker. After the injuries have been addressed by medical professionals, the employee will report to the Presbyterian Occupational Medicine Clinic for examination.

11.3.2.1 First Aid—Inhalation, Ingestion

Any employee experiencing symptoms of chemical overexposure as described in Table 9-1 will be removed from the work area and transported to the designated medical facility for examination and treatment. Consult Table 9-1 and call 911 and the Poison and Drug Information Center for advice. If available, refer to the MSDS for information on inducing vomiting, if recommended. If unconscious, keep the victim on his or her side and clear the airway if vomiting occurs.

11.3.2.2 First Aid—Skin Contact

Project personnel who have had skin contact with contaminants will, unless the contact is severe, proceed to the contamination reduction zone. Personnel will remove any contaminated clothing and wash the affected area with water for at least 15 minutes. The worker should be transported to the medical facility shown in Figure 11-1 if signs of skin reddening or irritation appear, or if they request a medical examination.

11.3.2.3 First Aid—Eye Contact

Project personnel who have had eye contact with chemicals or who have experienced eye irritation while in the contaminated zone must immediately proceed to the eyewash station in the contamination reduction zone. Do not decontaminate prior to using the eyewash. Remove whatever protective clothing is necessary to use the eyewash. Flush the eye with clean, running water for at least 15 minutes. Arrange prompt transport to the designated medical facility.

11.3.3 Injury and Illness Reporting

All injuries and illnesses, however minor, will be reported to the SS or SHSO immediately. The SS or SHSO must conduct an accident investigation as soon as emergency conditions no longer exist and first aid and/or medical treatment has been ensured. The accident and injury reports must be completed and submitted to the PM and HSM within 24 hours after the incident, as specified in Shaw Health and Safety Procedure HS020, *Accident Prevention Program: Reporting, Investigation, and Review* (Shaw, May 2003).

11.3.4 Fire

In the case of a fire on the site, the SS or SHSO will assess the situation and direct fire-fighting activities. The SS or SHSO will ensure that the client representative (as appropriate) is immediately notified of any fires. Site personnel, if trained, will attempt to extinguish the fire with available extinguishers, if safe to do so. In the event of a fire that site personnel are unable to safely extinguish, the local fire department will be summoned via 911. The SS or SHSO will notify FWDA staff regarding fires successfully extinguished.

11.3.5 Spill

If a spill occurs, the following procedures will be followed:

- Notify the SS or SHSO immediately.
- Evacuate immediate area of spill.

- If a small spill, don chemical resistant gloves and absorb or otherwise clean up the spill and containerize the material, absorbent, and affected soils. In case of a large spill, contact the USACE and FWDA staff.

The SS or SHSO has the authority to commit resources as needed to contain and control released material and to prevent its spread to off-site areas.

11.4 Emergency Information

Local public response agencies will be reviewed in the daily Tailgate Safety Meeting. Emergency contact information is listed in Table 11-1.

12.0 Site Safety and Health Plan Summary

This section summarizes the work, training requirements, site characterization and analysis, and required PPE. This summary does not replace the complete SSHP, which must be available on site and must be read and acknowledged by all site personnel. This summary is only intended to be used as a guide for preparing site-specific training and as a supplement to the SSHP.

12.1 Project Summary

Project Name:	Background Study and Geochemical Evaluation Fort Wingate Depot Activity
Project Number:	133366.10
Date:	November 2008
Site:	Fort Wingate, New Mexico
Prepared By:	Patrick Ostrye/Michael Goodrich
Reviewed and Approved By:	Michael Goodrich, PM and James Vigerust, Certified Safety Professional

Objective. This project will conduct a background study and geochemical evaluation and fill data gaps by supplemental sampling and analyses.

Personnel Training Requirements. Table 12-1 outlines the required training for each personnel level.

12.2 Site Characterization and Analysis

The following provides the general site characterization:

- Location of site: Fort Wingate Military Reservation, Gallup, New Mexico
- Duration of planned activity: 5 days
- Site topography: uneven, canyons and arroyos, steep and gentle grades
- Pathways for hazardous substance dispersion: soil and groundwater

The following are possible hazards during this project:

- Physical: lifting, sharp objects, slips/trips/falls, temperature
- Biological: contact dermatitis, insect/animal bites
- Chemical: explosive compounds and RCRA metals
- Mechanical: equipment failure, compressed gas cylinders, utilities, noise
- Fire: low potential

12.3 Personal Protective Equipment Selection Matrix

Table 12-2 presents the PPE selection matrix for the project.

13.0 References

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Figures

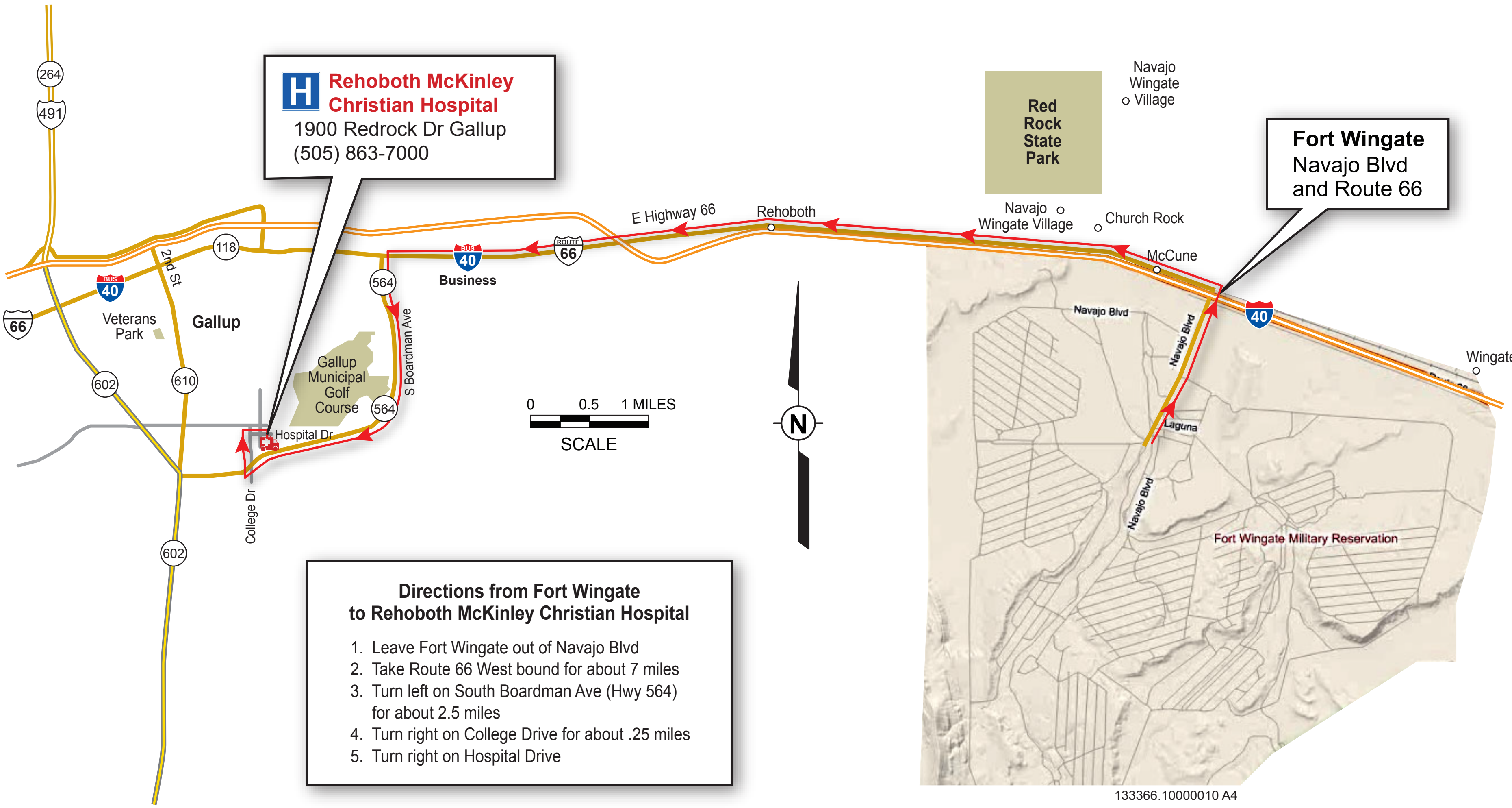

Figure 11-1

Rehoboth McKinley Christian Hospital Route Map

Background Study and Geochemical Evaluation
Fort Wingate Depot Activity
Gallup, New Mexico

Tables

Table 4-1
PID Use
Background Study and Geochemical Evaluation
Fort Wingate Depot Activity
Gallup, New Mexico

Instrument	Surveillance Frequency	Monitoring Location and Tasks	Calibration
PID (Lamp 11.7 eV) or FID	If surveillance is deemed necessary, then the frequency will be determined in the field by the SS or SHSO	At sampling locations or borehole opening, downwind, and in workers' breathing zone	Factory calibration per manufacturer's recommendation; field calibration/function test at start/end of work shift per manufacturer's directions

eV = Electron volt.
FID = Flame ionization detector.
PID = Photoionization detector.
SHSO = Site Health and Safety Officer.
SS = Site Supervisor.

Table 4-2
Real-Time Air Monitoring Action Levels
Background Study and Geochemical Evaluation
Fort Wingate Depot Activity
Gallup, New Mexico

Parameter	Reading	Action
Total Hydrocarbons	0 PID/FID units to <5 PID/FID ppm	Normal operations (Level D PPE, Modified Level D PPE)
	>5 PID ppm[a]	Stop work, leave area, and contact HSM

[a]Sustained in the breathing zone for 15 minutes.
FID = Flame ionization detector.
HSM = Health and Safety Manager.
$\mu g/m^3$ = Microgram(s) per cubic meter.
PID = Photoionization detector.
PPE = Personal protective equipment.
ppm = Parts per million.

Table 9-1
Chemical Exposure and Hazard Information
Background Study and Geochemical Evaluation
Fort Wingate Depot Activity
Gallup, New Mexico

Substance [CAS number]	Physical/ Chemical Properties	Exposure Route	Symptoms of Exposure	Treatment	Exposure Limits	IDLH Concentration
Alconox (sodium dodecylbenzenesulfonate, sodium carbonate, tetrasodium pyrophosphate, sodium phosphate) [see specific compound MSDS]	Molecular weight, boiling point: NA Solubility: 10–100% Vapor pressure: NA Specific gravity: 0.85-1.10 Flash point, upper explosive limit, lower explosive limit: NA Nonflammable, almost odorless, white granular powder	Inhalation Ingestion Skin/eye contact	Inhalation may cause irritation; ingestion may cause vomiting, diarrhea, abdominal pain, gastric distress	Eye: Irrigate immediately Skin: Soap wash promptly Inhalation: Seek fresh air Ingestion: Drink water and seek medical attention	Vary by ingredient	Varies by ingredient
Arsenic (As), Inorganic [7440-38-2] (metal) [2002-1	IP: NA MW: 74.9 BP: Sublimes FZP: 1135 °F (Sublimes) SOL: Insoluble VP: 0 mm Hg SG: 5.73 (metal) FLP: NA LEL: NA UEL: NA FLAMM: Metal: Noncombustible Solid	Inh Abs Ing Con	Ulceration of nasal septum, dermatitis, gastrointestinal disturbances, peripheral neuropathy, respiratory irritation, hyperpigmentation of skin, potential occupational carcinogen	Eye: Irrigate immediately Skin: Soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention		Ca [5 mg/m^3 (as As)]
Barium chloride (as Barium [Ba]) [10361-37-2] $BaCl_2$ [7440-39-3] Ba [2002-1]	IP: ? BP: 2840 °F FZP: 1765 °F VP: Low SG: 3.86 FLP: NA LEL: NA UEL: NA FLAMM: Noncombustible Solid	Inh Ing Con	Irritation eyes, skin, upper respiratory system; skin burns; gastroenteritis; muscle spasm; slow pulse, extra heart contractions; low potassium in the blood.	Eye: Irrigate immediately Skin: Water flush immediately Breath: Respiratory support Swallow: Immediate medical attention		50 mg/m^3 (as Ba)

Table 9-1 (Continued)
Chemical Exposure and Hazard Information
Background Study and Geochemical Evaluation
Fort Wingate Depot Activity
Gallup, New Mexico

Substance [CAS number]	Physical/ Chemical Properties	Exposure Route	Symptoms of Exposure	Treatment	Exposure Limits	IDLH Concentration
Cadmium [7440-43-9] (metal) (2002-1)	IP: NA MW: 112.4 BP: 1409 °F FZP: 610 °F SOL: Insoluble VP: 0 mm Hg SG: 8.65 FLP: NA LEL: NA UEL: NA FLAMM: Metal: Noncombustible Solid	Inh Ing	Pulmonary edema, dyspnea (breathing difficulty), cough, chest tightness, substernal (occurring beneath the sternum) pain; headache; chills, muscle aches; nausea, vomiting, diarrhea; anosmia (loss of the sense of smell), emphysema, proteinuria, mild anemia; potential occupational carcinogen	Eye: Irrigate immediately Skin: Soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention		Ca [9 mg/m^3 (as Cd)]
Chromium(III) compounds (as Cr) [16065-83-1] Cr^{+3} (2000-2)	Properties vary depending upon the specific compound.	Inh Abs Con	Irritation eyes; sensitization dermatitis	Eye: Wash immediately Skin: Wash promptly Breath: Respiratory support Swallow: Immediate medical attention		25 mg/m^3
Diesel fuel [68334-30-5]	Molecular weight: NA Boiling point: 30–806 °F Freezing point: -51 °F Solubility: <1% Vapor pressure: < 0.5 pounds per square inch Specific gravity: 0.78 - 0.955 Flash point: 129 °F Upper explosive limit: 10% Lower explosive limit: 0.3% Color varies: clear, yellow, red, blue, or blue-green liquid. Petroleum odor.	Inhalation Ingestion Skin/eye contact	Irritates eyes, skin, respiratory tract; dizziness; headache; nausea; chemical pneumonitis (from aspiration of liquid); contact dermatitis; eye redness, pain; kidney & lung damage; suspected carcinogen	Eye: Irrigate immediately Skin: Soap wash immediately Inhalation: Respiratory support Ingestion: Immediate medical attention	TWA 100 ppm [a]	NA

Table 9-1 (Continued)
Chemical Exposure and Hazard Information
Background Study and Geochemical Evaluation
Fort Wingate Depot Activity
Gallup, New Mexico

Substance [CAS number]	Physical/ Chemical Properties	Exposure Route	Symptoms of Exposure	Treatment	Exposure Limits	IDLH Concentration
Gasoline [8006-61-9]	Molecular weight: 110 Boiling point: 102 °F Freezing point: NA Solubility: Insoluble Vapor pressure: 38–300 mm Hg Specific gravity: 0.72–0.76 Flash point: -45 °F Upper explosive limit: 7.6% Lower explosive limit: 1.4% Clear liquid, characteristic odor	Inhalation Ingestion Skin/eye contact Skin absorption	Irritates eyes, skin, mucous membrane; dermatitis; headache; lassitude; blurred vision; dizziness; slurred speech; confusion; convulsions; chemical pneumonitis (aspiration liquid); possible liver & kidney damage	Eye: Irrigate immediately Skin: Soap flush immediately Inhalation: Respiratory support Ingestion: Immediate medical attention	Carcinogen [b] None [c]	Carcinogen
Hydraulic oil [NA]	Molecular weight: NA Boiling point: >600 °F Melting point: NA Solubility: Negligible Vapor pressure: <0.1 mm Hg Specific gravity: NA Flash point: 410 °F Upper explosive limit:, lower explosive limit: NA Amber-colored liquid, mild odor	Ingestion Skin/eye contact	Repeated/prolonged exposure may irritate skin, eyes, respiratory tract	Eye: Irrigate immediately Skin: Soap wash promptly Inhalation: Fresh air Ingestion: Immediate medical attention	TWA 5 mg/m^3 [a, c] ST 10 mg/m^3 [a]	NA
Isobutylene [15-11-7]	Molecular weight: NA Boiling point: 19.5 °F Freezing point: -220.6 °F Solubility: Insoluble Vapor pressure: 39 pounds per square inch Specific gravity: NA Flash point: -105 °F Upper explosive limit: 9.6 % Lower explosive limit: 1.8 % Colorless gas, unpleasant odor similar to that of burning coal	Inhalation Skin/eye contact	Irritates eyes, mucous membrane, respiratory system; inhalation of high concentrations may cause dizziness, disorientation, incoordination, narcosis, nausea	Inhalation: Immediate medical attention, respiratory support	NA	LC_{50} 620 mg/m^3

Table 9-1 (Continued)
Chemical Exposure and Hazard Information
Background Study and Geochemical Evaluation
Fort Wingate Depot Activity
Gallup, New Mexico

Substance [CAS number]	Physical/ Chemical Properties	Exposure Route	Symptoms of Exposure	Treatment		Exposure Limits	IDLH Concentration
Mercury [7439-97-6] (metal) (2002-1)	IP: ? MW: 200.6 BP: 674 °F FZP: -38 °F SOL: Insoluble VP: 0.0012 mm Hg SG: 13.6 (metal) FLP: Not applicable. LEL: NA UEL: NA. FLAMM: Metal: Noncombustible Liquid	Inh Abs Ing Con	Irritation eyes, skin; cough, chest pain, dyspnea (breathing difficulty), bronchitis pneumonitis; tremor, insomnia, irritability, indecision, headache, fatigue, weakness; stomatitis (inflammation of the mouth mucous membranes), salivation; gastrointestinal disturbance, anorexia (loss of appetite), weight loss; proteinuria (protein in the urine)	Eye: Skin: Breath: Swallow:	Irrigate immediately Wash with soap and water Respiratory support Immediate medical attention	C 0.1 mg/m^3 C 0.1 mg/m^3 Skin	10 mg/m^3
Motor Oil [NA]	Molecular weight: NA Boiling point: >600 °F Melting point: NA Solubility: Insoluble Vapor pressure: <0.01 mm Hg Flash point: 392 °F Upper explosive limit, lower explosive limit: NA Amber liquid	Inhalation Ingestion Skin/eye contact Skin absorption	Prolonged/repeated inhalation: respiratory irritation	Eye: Skin: Inhalation: Ingestion:	Irrigate Immediately Soap wash At excessive levels, seek fresh air and medical attention Seek medical advice	TWA 5 mg/m^3 [a, c] ST 10 mg/m^3 [a]	NA

Table 9-1 (Continued)
Chemical Exposure and Hazard Information
Background Study and Geochemical Evaluation
Fort Wingate Depot Activity
Gallup, New Mexico

Substance [CAS number]	Physical/ Chemical Properties	Exposure Route	Symptoms of Exposure	Treatment		Exposure Limits	IDLH Concentration
Selenium [7782-49-2] [2002-1]	IP: NA MW: 79.0 BP: 1265 °F FZP: 392 °F SOL: Insoluble VP: 0 mm Hg SG: 4.28 FLP: NA LEL: NA UEL: NA FLAMM: Combustible Solid	Inh Con Ing	Irritation eyes, skin, nose, throat; visual disturbance; headache; chills, fever; dyspnea (breathing difficulty), bronchitis; metallic taste, garlic breathing, gastrointestinal disturbance; dermatitis; eye, skin burns; in animals: anemia (low red blood cells); liver necrosis, cirrhosis (liver damage); kidney, spleen damage	Eye: Skin: Breath: Swallow:	Irrigate immediately Soap wash immediately Respiratory support Immediate medical attention		1 mg/m^3
Silver [7440-22-4] (metal) (2002-1)	IP: NA MW: 107.9 BP: 3632 °F FZP: 1761 °F SOL: Insoluble VP: 0 mm Hg SG: 10.49 (metal) FLP: Not applicable. LEL: NA UEL: NA FLAMM: Metal: Noncombustible Solid	Inh Ing Con	Blue-gray eyes, nasal septum, throat, skin; irritation, ulceration skin; gastrointestinal disturbance	Eye: Skin: Breath: Swallow:	Irrigate immediately Water flush Respiratory support Immediate medical attention		10 mg/m^3
SVOC (e.g. phenol, naphthalene) [see specific compound &/or product specific MSDSs]	Semi-volatile, vary by compound	Inhalation Ingestion Skin/eye contact Skin absorption	Irritates eyes, nose, throat; respiratory sensitization; coughing; pulmonary secretion; chest pain; dyspnea; asthma; anorexia; weight loss; lassitude; muscle ache; dark urine; cyanosis; liver & kidney damage; skin burns; dermatitis; tremor; convulsions; twitching	Eye: Skin: Inhalation: Ingestion:	Irrigate immediately Soap wash immediately Respiratory support Immediate medical attention	Vary by compound	Varies by compound

Table 9-1 (Continued)
Chemical Exposure and Hazard Information
Background Study and Geochemical Evaluation
Fort Wingate Depot Activity
Gallup, New Mexico

Substance [CAS number]	Physical/ Chemical Properties	Exposure Route	Symptoms of Exposure	Treatment		Exposure Limits	IDLH Concentration
VOC (e.g. acetone, carbon tetrachloride, benzene, freon, trichloroethane, xylene, tetrachlorethylene, toluene) [see specific compound &/or product specific MSDSs]	Volatile, vary by compound	Inhalation Ingestion Skin/eye contact Skin absorption	Irritates eyes, skin, respiratory system; nausea; vomiting; dermatitis; cardiac arrhythmias; paresthesia; dizziness; lassitude; drowsiness; headache; visual disturbance; confusion; tremor; convulsions; liver & kidney injury; pulmonary edema; asphyxia	Eye: Skin: Inhalation: Ingestion:	Irrigate immediately Soap wash immediately Respiratory support Immediate medical attention	Vary by compound	Varies by compound
Zinc (as Zinc oxide dust) [7440-66-6] Zn [1314-13-2] ZnO (2000-4)	IP: ? MW: 81.4 BP: ? FZP: 3587 °F SOL: 0.0004 % VP: 0 mm Hg SG: 5.61 FLP: NA LEL: NA UEL: NA FLAMM: Noncombustible Solid INCOMP: Chlorinated rubber (at 419 °F), water NOTE : Slowly decomposed by water.	Inh	Metal fume fever: chills, muscle ache, nausea, fever, dry throat, cough; weakness, lassitude (weakness, exhaustion); metallic taste; headache; blurred vision; low back pain; vomiting; fatigue; malaise (vague feeling of discomfort); tightness chest; dyspnea (breathing difficulty), rales, decreased pulmonary function	Breath:	Respiratory support	C15 mg/m^3 * * 15 min	500 mg/m^3

Notes:

IDLH represents the maximum concentration from which (according to National Institute for Occupational Safety and Health.), in the event of respirator failure, one could escape within 30 minutes without a respirator and without experiencing any escape-impairing or irreversible health effects.

The TWA concentration for a normal work day (usually 8 or 10 hours) and a 40-hour work week, to which nearly all workers may be repeatedly exposed, day after day without adverse effect.

[a]American Conference of Governmental Industrial Hygiene threshold limit value.

[b]National Institute for Occupational Safety and Health recommended exposure limit.

[c]Occupational Safety and Health Administration permissible exposure limit (29 CFR 1910.1028, Table Z).

Table 9-1 (Continued)
Chemical Exposure and Hazard Information
Background Study and Geochemical Evaluation
Fort Wingate Depot Activity
Gallup, New Mexico

C	*= Ceiling limit value which should not be exceeded at any time.*
CAS	*= Chemical Abstracts Service.*
CFR	*= Code of Federal Regulations.*
eV	*= Electron volt(s).*
°F	*= Degrees Fahrenheit.*
IDLH	*= Immediately dangerous to life or health.*
LC_{50}	*= Lethal Concentration, the concentration of the chemical in air that kills 50% of the test animals in a given time (usually four hours).*
mg/m^3	*= Milligram(s) per cubic meter.*
mm Hg	*= Millimeters of mercury.*
MSDS	*= Material Safety Data Sheet.*
NA	*= Not available/applicable.*
ppm	*= Part(s) per million.*
ST	*= Short-term (15-minute TWA exposure that should not be exceeded at any time during a workday, even if the TWA is not exceeded).*
SVOC	*= Semivolatile organic compound.*
TWA	*= Time-weighted average.*
VOC	*= Volatile organic compound.*

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Table 10-1
Hand Signals to be Used for Communication
Background Study and Geochemical Evaluation
Fort Wingate Depot Activity
Gallup, New Mexico

Hand Position or Action	Message Communicated
Either hand on head	“Are you OK?” or “Yes, I’m OK.” or “Do you understand?” or “Yes, I understand.”
Either hand or both hands over head waving back and forth	“I’m in trouble.” or “I need help.”
Either hand making choking motion on throat	“I’m out of air.” or “I’m having trouble breathing.”
Thumbs up	“Yes.” or “OK.” or “Successful.”
Thumbs down	“No.” or “Not successful.” or “Disagree.”

Table 11-1
Emergency Contacts
Background Study and Geochemical Evaluation
Fort Wingate Depot Activity
Gallup, New Mexico

Agency	Telephone Number
Ambulance, Hospital Emergency Care, Fire, Police, Explosives Control	911
New Mexico Poison and Drug Information Center	800-222-1222
Chemical Transportation Emergency Center (CHEMTREC)	800-424-9300
Toxic Substances Control Act Hotline	202-554-1404
Centers for Disease Control	404-498-1515
National Response Center	800-424-8802
National Pesticide Information Center	800-858-7378
Resource Conservation and Recovery Act Hotline	800-424-9346
Bureau of Explosives	903-223-8430
Other Phone Numbers: Project Manager (Michael Goodrich) Site Supervisor (Dale Flores) Site Safety and Health Officer (TBD) Health & Safety Manager (James Vigerust) U.S. Army Corps of Engineers Representative (David Henry)	 505-262-8908 505-262-8908 TBD 505-262-8800 or 505-410-4995 505-342-3139
Occupational Physician	Jerry Berke M.D. Shaw Medical Director 800-350-4511
Emergencies: Hospital: Rehoboth McKinley Christian Hospital 1900 Red Rock Drive Gallup, New Mexico (Directions provided in Figure 11-1) Follow-Up Care: Presbyterian Occupational Medicine Clinic 5901 Harper Drive NE Albuquerque, NM	 505-863-7000 505-823-8450

Table 12-1
Training Requirements
Background Study and Geochemical Evaluation
Fort Wingate Depot Activity
Gallup, New Mexico

Responsibility	40-Hour HAZWOPER	HAZWOPER Supervisor	Other (Specify)
Field Team Leader	X	X	
Health and Safety Manager	X	X	CPR/First-Aid Training
Site Supervisor/Site Health and Safety Officer	X	X	CPR/First-Aid Training
Environmental Technician	X		CPR/First-Aid Training
Driller	X		
Laborer	X		
Sampler	X		

CPR = Cardiopulmonary resuscitation.
HAZWOPER = Hazardous Waste Operations.

Table 12-2
Personal Protective Equipment Selection Matrix
Background Study and Geochemical Evaluation
Fort Wingate Depot Activity
Gallup, New Mexico

Task	Description	Level of Protection	Description
1	Mobilization/ Demobilization	Level D	Work clothing as prescribed by weather, pants; ANSI approved steel-toed work boots; ANSI approved safety glasses
2 & 3	Well Surveying	Level D	Work clothing as prescribed by weather, pants; ANSI approved steel-toed work boots; ANSI approved safety glasses
4	Soil Sample Collection	Modified Level D	Work clothing as prescribed by weather, pants; ANSI approved steel-toed work boots; ANSI approved safety glasses; disposable gloves
5	Equipment Decontamination	Modified Level D	Work clothing as prescribed by weather, pants; ANSI approved steel-toed work boots; ANSI approved safety glasses; disposable gloves (during high pressure washing: ANSI approved hard hat; hearing protection; leather work gloves; poly-coated Tyvek® coverall, full-face shield)

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Attachments

Attachment B1
SSHP Declaration

Site Safety and Health Plan Declaration/Acknowledgement Form

Background Study and Geochemical Evaluation
Fort Wingate Depot Activity, Fort Wingate, New Mexico

I have reviewed, understand, and agree to follow the Site Safety and Health Plan for the applicable U.S. Army Corps of Engineers activities. I also understand that there are additional safety and health requirements, which are presented in the attached Job Hazard Analyses. I agree to abide by the requirements of the Job Hazard Analyses for the work that I perform.

Printed Name	Signature	Company	Date

Attachment B2
Job Hazard Analysis

Job Hazard Analysis for Site Mobilization/Demobilization (Task 1)

Potential Hazards	Critical Safety Practices	PPE
Contact Dermatitis/ Poison Ivy	• Wear sleeved shirts and long pants • Identify and review poisonous plants with workers • If poisonous plants are present: – Avoid unnecessary clearing of plant/vegetation areas – Cover vegetation with plastic – Apply protective cream/lotion to exposed skin to prevent reactions	Level D
Equipment Failure	• Perform daily maintenance inspections on operating equipment and vehicles	Level D
Handling Heavy Objects	• Use proper lifting techniques and obey lifting procedures • Use mechanical lifting equipment (hand carts, trucks) to move large, awkward loads • Review lifting posture/techniques regularly at safety meetings	Level D plus work gloves
Insect/Animal Bites	• Review injury potential with workers • Avoid insect nest areas and habitats outside work areas • Use protective insect repellents • Check body for insects/insect bites during decontamination or shower	Level D
Sharp Objects	• Wear cut-resistant work gloves when a possibility of laceration exists • Maintain all hand and power tools in a safe condition	Level D plus leather gloves
Slips, Trips, Falls	• Clear walkways and work areas of equipment, tools, vegetation, excavated material, and debris • Mark, identify, or barricade other obstructions/holes • Clean mud and grease from boots before mounting drill platform • Watch for slippery ground when dismounting from the platform	Level D
Temperature	• Monitor for heat/cold stress • Provide fluids to prevent worker dehydration	Level D

Equipment	Inspection Requirements	Training Requirements
• Dolly • Automobile	• Daily equipment inspections as per manufacturer's requirements • Inspection of all emergency equipment	• See Chapters 3.0 and 7.0 • JHA review • SSHP review • Review of operations manuals

JHA = *Job Hazard Analysis.*
PPE = *Personal protective equipment.*
SSHP = *Site Safety and Health Plan.*

Job Hazard Analysis for Well Surveying/Grid Surveying for Sample Collection Multi-Incremental (MI) Surface Soil Sampling Collection (Tasks 2, 3, & 4)

Potential Hazards	Hazard Control Measures	PPE
Contact Dermatitis/ Poison Ivy	• Wear sleeved shirts and long pants • Identify and review poisonous plants with workers • If poisonous plants are present: – Avoid unnecessary clearing of plant/vegetation areas – Cover vegetation with plastic – Apply protective cream/lotion to exposed skin to prevent reactions	Level D
Contact with Hazardous Substances	• Ensure hazardous levels of vapors are not present • Only essential, trained personnel will be allowed in the exclusion and contamination reduction zones • Open wells from an upwind position • Use proper PPE and decontamination procedures • Handle samples with care • All liquids and materials used for decontamination will be contained and disposed of in accordance with federal, state, and local regulations • Review hazardous properties of site contaminants before sampling operations begin • Review first-aid procedures	Modified Level D
Compressed Gas Cylinders	• Secure with straps when transporting • Secure in upright position with bungee cords and with caps in place • Transport to well site with cylinder dolly or vehicle	Modified Level D
Equipment Failure	• Perform daily maintenance inspections on operating equipment and vehicles	Modified Level D
Handling Heavy Objects	• Use proper lifting techniques and obey lifting procedures • Use mechanical lifting equipment (hand carts, trucks) to move large, awkward loads • Review lifting posture/techniques regularly at safety meetings	Modified Level D
Slips, Trips, Falls	• Clear walkways and work areas of equipment, tools, vegetation, excavated material, and debris • Mark, identify, or barricade other obstructions/holes • Clean mud and grease from boots before mounting drill platform • Watch for slippery ground when dismounting from the platform	Modified Level D

Job Hazard Analysis for Well Surveying/Grid Surveying for Sample Collection Multi-Incremental (MI) Surface Soil Sampling Collection (Tasks 2, 3, & 4)

Potential Hazards	Hazard Control Measures	PPE
Spills	• Wear splash protection as necessary to prevent contact • Clean up spills immediately before initiating maintenance • Review maintenance procedures for safety practices	Modified Level D
Temperature	• Monitor for heat/cold stress • Provide fluids to prevent worker dehydration	Modified Level D
Underground Utilities	• Identify all underground utilities before work commences • Cease work immediately if unknown utility markers are uncovered	Modified Level D

Equipment	Inspection Requirements	Training Requirements
• Sample supplies • Global Positioning System • Dolly • Automobile	• Daily equipment inspections as per manufacturer's requirements • Inspection of all emergency equipment	• See Chapters 3.0 and 7.0 • JHA review • SSHP review • Review operations manuals • Review site-specific chemical hazards and MSDSs

JHA = Job Hazard Analysis.
kV = Kilivolt(s).
MSDS = Material Safety Data Sheet.
PPE = Personal protective equipment.
SSHP = Site Safety and Health Plan.

Job Hazard Analysis for Equipment Decontamination (Task 5)

Potential Hazards	Critical Safety Practices	PPE
Contact with Hazardous Substances	• Only essential, trained personnel will be allowed in the exclusion and contamination reduction zones • Use proper PPE and decontamination procedures • All liquids and materials used for decontamination will be contained and disposed of in accordance with federal, state, and local regulations • Review hazardous properties of site contaminants before sampling operations begin • Review first-aid procedures	Modified Level D
Equipment Failure	• Perform daily maintenance inspections on operating equipment and vehicles	Modified Level D
Handling Heavy Objects	• Use proper lifting techniques and obey lifting procedures • Use mechanical lifting equipment (hand carts, trucks) to move large, awkward loads • Review lifting posture/techniques regularly at safety meetings	Modified Level D
Slips, Trips, Falls	• Clear walkways and work areas of equipment, tools, vegetation, excavated material, and debris • Mark, identify, or barricade other obstructions/holes • Clean mud and grease from boots before mounting drill platform • Watch for slippery ground when dismounting from the platform	Modified Level D
Temperature	• Monitor for heat/cold stress • Provide fluids to prevent worker dehydration	Modified Level D

Equipment	Inspection Requirements	Training Requirements
• Dolly • Hudson sprayer	• Daily equipment inspections as per manufacturer's requirements • Inspection of all emergency equipment	• See Chapters 3.0 and 7.0 • JHA review • SSHP review • Review operations manuals • Review site-specific chemical hazards and MSDSs

JHA = *Job Hazard Analysis.*
MSDS = *Material Safety Data Sheet.*
PPE = *Personal protective equipment.*
SSHP = *Site Safety and Health Plan.*

Attachment B3
Material Safety Data Sheets
(See folder on this compact disc)

List of Material Safety Data Sheets

Alconox®

Diesel Fuel

Gasoline

Hydraulic oil

Hydrochloric acid

Isobutylene

Motor oil

Appendix D
Project Points of Contact

Project Points of Contact
Background Study and Geochemical Evaluation
Fort Wingate Depot Activity
Gallup, New Mexico

Name	Address	Affiliation	Phone
Michael Goodrich, PG (Project Manager)	Shaw Environmental 2440 Louisiana Blvd. NE. Suite 300 Albuquerque NM 87110	Shaw	T: 505-262-8908 F: 505-262-8855
Steven Smith	Fort Worth District Planning, Environmental, and Regulatory Division 819 Taylor Street, Room 3A12 Fort Worth, Texas 76102	USACE	T: 817-886-1879
Mark Patterson (Environmental Coordinator)	Ravenna Army Ammunition Plant 8451 State Route 5 Building 1037 Ravenna, OH 44266-9244	BRAC	T: 330-358-7312 F: 330-358-7314
Richard Cruz	Ft. Wingate Army Depot 7 Miles East of Gallup Bldg 1 Ft. Wingate, NM 87316	BRAC	T: 505-488-6109
Dr. Burton C. Suedel (Research Biologist)	US Army Engineer Research and Development Center Waterways Experiment Station, EP-R 3909 Halls Ferry Road Vicksburg, MS 39180-6199 email:burton.suedel@usace.army.mil	USACE	T: 601-634-4578 F: 601-634-3120
Neal Navarro	Sacramento District Engineering Division, CESPK-ED-GD Sacramento, Calif. 95814-2922	USACE	T: 916-557-6948
David Henry	Albuquerque District Environmental Engineer Branch 4101 Jefferson Plaza Albuquerque, NM 87109	USACE	T: 505-342-3139
Bill O'Donnell	US Army BRAC Office 2530 Crystal Drive Arlington, VA 22202	BRAC	T: 703-601-1570
Tammy Diaz	New Mexico Environment Dept., HWB 2905 Rodeo Park Drive, East Bldg. 1 Santa Fe, NM 87505-6303	NMED	T: 505-428-2552
Chuck Hendrickson	U.S. EPA, Region 6 NM & Federal Facilities Section 1445 Ross Ave., Suite 1200 Dallas, TX 75202-2733	U.S. EPA	T: 214-665-2196

Project Points of Contact (Continued)
Background Study and Geochemical Evaluation
Fort Wingate Depot Activity
Gallup, New Mexico

Name	Address	Affiliation	Phone
Sharlene Begay-Platero	Navajo Nation Wingate Project Coordinator Eastern Navajo Economic Development Office 211 E. Historic Hwy. 66 Church Rock, NM 87311	Navajo Nation	T: 505-863-6414
Edward Wemytewa	Attn: Governor's Office P.O. Box 339 1203B State Hwy 53 Zuni, NM 87327	Pueblo of Zuni	T: 505-782-7036
Ben Burshia	Chief of Real Estate Services Division Central Office, Bureau of Indian Affairs 1620 L Street NW. Suite 1075 Washington, DC 20036	BIA	T: 202-452-7778
Rose Duwyenie	BIA – NR – Environmental Protection 301 West Hill Gallup, NM 87305	BIA	T: 505-863-8369
Ira May	U.S. Army Environmental Center SFIM-AEC-ERA 5179 Hoadley Rd. APG (EA), MD 21010-5401	USACE	T: 401-436-7099

Appendix E
Resumes of Key Personnel

Michael T. Goodrich, RG

Professional Qualifications

Mr. Goodrich is a senior hydrologist with over 22 years of diversified experience in hydrogeologic investigations. He is a Registered Geologist whose technical specialties include numerical modeling of groundwater flow and contaminant transport, field investigations into the hydraulics of groundwater flow, performance assessment of landfills and waste disposal sites, and validation of numerical models. Mr. Goodrich is experienced in the use of geostatistics and the treatment of hydrologic data and parameter uncertainty, has excellent written and verbal communication skills, and is skilled at performing multiple tasks.

Education

M.S., Hydrology/Hydrogeology, University of Nevada, Reno, Nevada, 1986
B.S., Biology, University of New Mexico, Albuquerque, New Mexico, 1980

OSHA 8-hour Hazardous Waste Operations Update; 2008
OSHA 8-hour Supervisor Training; 1990
OSHA 40-hour Hazardous Waste Operations Training; 1989
Project Management; MWH University and other on-line classes
New Mexico Water -- Rights in Conflict; Water Law Institute
Risk Assessment for the Environmental Professional; National Groundwater Association
Decision Analysis and Groundwater Modeling; Freeze, Smith, Domenico, & Schwartz
Stochastic and Geostatistical Analysis for Groundwater Modeling; International Groundwater Modeling Center
Contaminant Transport Modeling; Princeton University

Registrations/Certifications

Registered Geologist, State of Arizona, Registration No. 40814

Professional Affiliations

National Ground Water Association
Arizona Hydrological Society

Experience and Background

Mr. Goodrich's skills focus on numerical modeling of groundwater flow, contaminant transport, and evaluation of water resources. He works extensively with commercial and industrial clients, as well as a variety of agencies within the DOD and DOE. He is familiar with a wide variety of deterministic and stochastic methods and is experienced with many current types of software. He is author or co-author on more than 20 technical reports and peer-reviewed publications. Representative projects include:

- Supported the DOE by modeling flow through a proposed Permeable Reactive Barrier at Los Alamos National Laboratory (LANL). Developed a model of saturated flow in the alluvial aquifer and evaluated the hydraulic effect of various PRB designs.

- Designed and implemented a multidimensional model for flow and contaminant transport at two different Superfund sites in Texas. Evaluated the rate and direction of flow, the affect of extraction wells on water levels, and the effects of groundwater discharge to a nearby stream. Met with Texas regulatory staff, presented results to the EPA, and authored a descriptive technical report.

- Supported LANL on preparation of the TA-16 Deep Groundwater Investigation Report. Provided conceptual model review, technical review on various report chapters, and interacted as requested with LANL senior staff/modelers.

- Supported the State of Alaska in the development of a model to simulate groundwater and surface water flow along Ship Creek, near Anchorage. Simulated the hydraulic impact from the removal of two dams along Ship Creek.

- Supported the DOE's Pantex facility by developing a variably saturated flow model using Modflow-Surfact. Simulated three-dimensional flow from a surface playa, through the vadose zone to a perched aquifer, and through a second vadose zone to the regional aquifer.

- Integral member of an SNL team that developed a high-level waste performance assessment methodology for the NRC. Also, directly supported SNL and the NRC in "HYDROCOIN" and "INTRAVAL," two international groundwater modeling studies aimed at improving performance assessment strategies. Evaluated flow and transport in porous and fractured media and under variably saturated conditions.

- Supported the DOE on a risk assessment at the Salmon Site, Tatum Dome, Mississippi. Responsible for using Modflow and MT3D to model the fate and transport of radionuclides and other contaminants resulting from two underground nuclear tests at this site. Interfaced with DOE officials at the Nevada Test Site and with the regulatory staff from the state of Mississippi.

- Supported the DOE in a variety of tasks related to a performance assessment of a proposed low-level waste disposal facility. Used VS2DT and HELP to evaluate the effectiveness of various engineered barrier designs and the long-term competency of different waste containers (e.g., glass, concrete, local soil) in the unsaturated zone. Also helped develop conceptual models of unsaturated flow and radionuclide transport that were integral to both disturbed and undisturbed performance scenarios.

- Supported the DOE by using the VS2DT and TDAST codes to develop arid environment risk assessment scenarios of hazardous waste transport through the vadose zone to the water table and through the saturated zone to a receptor well. Performed Monte Carlo runs to help address uncertainty in vadose zone hydraulic parameters. Modified VS2DT to compute zero, first, and second moments of inertia. Also performed benchmarking and verification of the VS2DT code against six other variably saturated flow and transport codes.

Jonathan Myers

Professional Qualifications

Dr. Myers holds a Ph.D. in Geochemistry and has twenty-six years of professional experience in the areas of geochemistry, environmental forensics, and environmental statistics. He has directed the characterization of statistical distributions of background concentrations of naturally occurring metals and radionuclides in soil and groundwater at Sandia National Laboratories, Kirtland AFB, and the former Walker AFB in New Mexico; radionuclides in groundwater and soil at Norton AFB; metals in soil and groundwater at Redstone Arsenal, Knolls Atomic Power Laboratory, Lee Field Naval Air Station, and San Juan Naval Air Station; metals in groundwater at Fort Chaffee and Langley AFB; and metals in groundwater and sediments at a chlorinated solvent plant in Louisiana. He then applied these background determinations to identify areas of contamination and evaluate the effectiveness of remediation efforts.

A novel approach employed by Dr. Myers has been the use of geochemical correlations to distinguish between contamination versus naturally high background concentrations of metals in groundwater, surface water, sediment, and soil. He has applied these geochemical evaluation techniques at numerous Army facilities, Navy bases, Air Force facilities, Department of Energy facilities, five commercial Superfund sites. He has also taught short courses on these geochemical evaluation and environmental forensic techniques at several international environmental remediation conferences.

Dr. Myers has taught several short courses on geochemistry of metals and environmental forensic techniques, and has published over thirty technical papers in his field of expertise. He has made several presentations to the National Academy of Sciences, the most recent being "Recommendations of the Engineered Alternatives Task Force on Improving the Long-Term Performance of the Waste Isolation Pilot Plant."

Education

Ph.D., Geochemistry, University of Wyoming, Laramie, Wyoming; 1982
M.S., Geology, University of Wyoming, Laramie, Wyoming; 1978
B.S., Geology, City University of New York, New York City, New York; 1974

Experience and Background

1995– Present — ***Senior Staff Consultant, Geosciences Group, Shaw Environmental, Inc. Albuquerque, New Mexico.*** Dr. Myers serves as a senior technical resource in the areas of geochemistry, geochemical and statistical modeling, environmental forensics, and performance assessment. He is currently supporting site characterization, remedial investigations, feasibility and treatability studies, disposal system designs, risk assessments, and fate & transport modeling at DOE, DoD, mining, and commercial Superfund Sites. Recent projects included:

- Technical director of two forensic investigations to determine the sources of polycyclic aromatic hydrocarbon (PAH) compounds detected in sediment at Redstone Arsenal (AL) and in soil at Volunteer Army Ammunition Plant (TN). Multi-component graphical, spatial, and statistical "fingerprint" evaluations were used to identify the sources of PAH compounds at both sites as general "urban runoff" that are unrelated to military activities.

- Performed geochemical forensic investigations at a brass foundry site in Alabama, a zinc smelter site in Oklahoma, and a copper mine in Arizona to identify sources of heavy metals in soil samples from residential properties. Geochemical evaluation techniques were used to compare elemental ratios in residential samples with ratios present in samples from several known source areas to infer probable sources.

- Technical director and geochemical modeler on an investigation into the origin of an arsenic groundwater plume that is coincident with a high-pH plume at the site of a former caustic plant at Redstone Arsenal, Alabama. Dr. Myers theory that the high arsenic is caused by the desorption of naturally occurring arsenic adsorbed on iron oxide sediments along the flow path was subsequently verified by additional field sampling. Verification of the theory led to the recommendation of a monitored natural attenuation remedy which was approved by regulators.

- Dr. Myers determined the source of a puzzling arsenic plume that has persisted in a transmissive aquifer beneath a commercial phosphate chemical processing facility in the mid-western US, despite the fact that the surficial source (an unlined arsenic-sulfide-phosphate sludge pond) was removed 30 years ago. Geochemical modeling techniques were used to determine that phosphate contamination stimulated anaerobic microbial activity, which precipitated arsenic-sulfides in the aquifer. Following source removal, oxic water infiltrated the anaerobic zone, which oxidized the sulfides and released the arsenic. The conceptual model was verified by the identification of arsenic sulfide precipitates within the plume.

- Technical director of a geochemical investigation at Tinker Air Force Base, Oklahoma. The investigation is designed to determine the sources of elevated concentrations of nickel and chromium in groundwater by evaluating filtration effects and serial sampling during the purging of ten monitor wells. Possible sources include contamination from electroplating operations, naturally high background, or corrosion of stainless steel well construction materials. Responsibilities include development of technical approach, sampling and analysis plan, and interpretation of resulting data. Results conclusively identified corrosion of stainless steel well construction materials as the source of the elevated metal concentrations.

- Project manager and technical director for a project to establish the statistical distributions of background concentrations of naturally occurring metals and radionuclides in groundwater, air, and soil at Sandia National Laboratories and

Kirtland Air Force Base, which are co-located on 80 square miles of land adjacent to Albuquerque, New Mexico. The work involves establishing a database of approximately 100,000 analyses, screening the data for acceptable values, determining the proper spatial scale for establishing individual distributions, and developing and implementing a statistical methodology to describe the background distributions.

- Technical director for a project to establish the statistical distributions of background concentrations of naturally occurring radionuclides in groundwater and soil at Norton Air Force Base, California. The work involved development of sampling strategies and statistical methodologies, review of soil and groundwater analytical data, statistical analyses to determine site-specific background distributions, and comparisons with regional values.

1991–1995 ***Manager, Hydrologic and Geochemical Assessment Group, IT Corporation, Albuquerque, New Mexico.*** Dr. Myers managed a group of eight scientists and engineers with specialties in geochemistry, hydrology, and contaminant flow and transport; and was responsible for technical oversight, cost and schedule, and technical staff supervision responsibilities. The group served as a technical resource for clients and the company by performing computer simulations in support of site characterization, remedial investigations, feasibility and treatability studies, disposal system designs, risk assessments, and long-term performance predictions. The group was experienced in performing groundwater flow and contaminant transport modeling, calculation of radionuclide and heavy metal source terms, and estimation of adsorption coefficients for contaminants. His specific responsibilities have included:

1985–1991 ***Section Manager, Geochemical Analysis, IT Corporation, Albuquerque, New Mexico.*** Dr. Myers managed technical staff involved in projects for the Geochemical Analysis specialty in Albuquerque. His specific responsibilities have included:

1982–1985 ***Senior Geochemist, Basalt Waste Isolation Project, Rockwell International, Richland, Washington.*** While at Rockwell International, Dr. Myers was involved in the following activities in the field of high-level nuclear waste management and disposal at the Hanford Reservation:

Professional Affiliations

American Geophysical Union
Geochemical Society
International Association of Geochemistry and Cosmochemistry
American Institute of Physics

Short Courses Taught

Geochemical Evaluations of Metals in Soil, Sediment, Groundwater, and Surface Water: How to Distinguish Naturally Elevated Concentrations from Site-Related Contamination:

- *Sixth International Conference on the Remediation of Chlorinated and Recalcitrant Compounds*, Monterey, California, May, 2008.
- *2008 Annual Groundwater Summit, National Groundwater Association,* Memphis, Tennessee, April, 2008.
- *18th Annual Association for Environmental Health and Sciences (AEHS) West Coast Conference on Soils, Sediments and Water,*San Diego, California, March 2008.
- *Society for Risk Analysis, Annual Meeting,* San Antonio, Texas, December, 2007.
- *23rd Annual International Conference on Soils, Sediments and Water,* University of Massachusetts, Amherst, Massachusetts, October, 2007.
- *Ninth International In Situ and On-Site Bioremediation Symposium,* Baltimore, Maryland, May, 2007.
- *Fourth International Conference on Remediation of Contaminated Sediments*, Savannah, Georgia, January, 2007.

Environmental Forensic Tools, *Navy Remediation Innovative Technology Seminar*, presented at four West Coast locations, Fall, 2005.

Natural Attenuation of Metals Workshop, *Third International Conference on the Remediation of Chlorinated and Recalcitrant Compounds*, Monterey, California, May 19, 2002.

Dale J. Flores, PG

Professional Qualifications

Mr. Flores is a Certified Professional Geoscientist with thirteen years of experience in conducting and managing surface and subsurface investigations. He has conducted groundwater monitoring activities for the U.S. Department of Energy (DOE), the U.S. Army Corps of Engineers (USACE), and commercial clients as well as investigations and monitoring well installations. He has managed field programs and written reports on groundwater and soil investigations. His background includes serving as a geologist for the Environmental Restoration (ER) Program at Los Alamos National Laboratory (LANL). Mr. Flores has extensive experience in conducting and managing environmental sampling programs for both government and commercial clients.

Education

B.S., Geology, University of New Mexico, Albuquerque, New Mexico; 1988
Principles of Hazardous Waste Management, Short Course, Red Rocks Community College, Lakewood, Colorado; 1989
American Society for Testing and Materials short course on vadose zone and groundwater monitoring; 1991
Occupational Safety and Health Act Hazardous Waste Operations Training, 40 hours, IT Corporation; 1993
Health and Safety Coordinator training, IT Corporation; 1994
Groundwater Engineering course, University of New Mexico, Albuquerque, New Mexico; 1995
Geographical Information Systems in Water Resource Management, University of New Mexico, Albuquerque, New Mexico; 2000

Registrations/Certifications

Active DOE "L" clearance
Certified Scientist (No. 288), New Mexico Environment Department (NMED) Underground Storage Tank (UST) Bureau.
State of Texas, Board of Professional Geoscientists, Geology-License Number 2196
U.S. Army Corps of Engineers; Construction Quality Management For Contractors, March 2005

Experience and Background

1994–Present **_Geologist, Shaw Environmental, Inc. Albuquerque, New Mexico._** Responsible for conducting geologic investigations, including geologic logging, monitoring well installations, soil sampling, and interpretation of subsurface stratigraphy.

- Served as Task Manger for Contract Task Order No. 17 under the USACE Total Environmental Restoration Contract, Sacramento District. Task Order Manager for USACE Federally Used Defense Sites at the Isleta Pueblo Ordnance Impact Area. Responsible for estimating, working with client and stakeholders to develop technical objectives, scheduling work, coordinating field efforts, supervision of field staff, and assisting with the preparation of plans and reports. The project scope was to determine the nature and extent of Material Potentially Presenting an Explosive Hazard for the portion of a range fan overlapping on the Pueblo of Isleta.

- Currently serve as Project Manager for Contract Task Order No. 15 under the USACE Total Environmental Restoration Contract, Sacramento District. Project Manager for USACE Federally Used Defense Sites at the Former Walker Air Force Base and Atlas Missile Silos. Responsible for estimating, working with client and stakeholders to develop technical objectives, scheduling work, assisting with monthly cost and schedule reports, and ensuring that client deliverables meet project objectives for four work authorization directives.

- Task manager for cleanup at six permitted sites under the Air Force Center for Environmental Excellence Installation Restoration Program (IRP) at Kirtland Air Force Base (AFB). Responsible for technical report preparation and review, fieldwork oversight, supervision of subcontractor personnel, and client interaction. Project work performed within the framework of the IRP.

- Served as rig geologist for well installation program conducted for NMED. Responsible for drilling oversight, monitoring well installation, and interpretation of subsurface conditions for leaking UST Remediation Project.

- Conducted three UST on-site investigations at ER Sites 216, 218, 221 at Sandia National Laboratories/New Mexico (SNL/NM). Responsible for sample plan preparation and for supervising on-site fieldwork. Conducted site safety evaluations.

- Generated statistical plots for background geochemistry project at SNL/NM. Responsibilities included interpreting statistical analysis of analytical data.

- Conducted and interpreted slug test data at UST remediation site for NMED. Responsible for coordinating field activities and performing falling head tests.

- Responsible for performing operation and maintenance on soil vapor extraction system at UST-contaminated site.

- Supervised soil-gas investigation at former City of Albuquerque landfill. Responsibilities included health and safety, supervision, data interpretation, and gas plume characterization.

- As Task Leader for quarterly groundwater sampling at UST-contaminated site, coordinated sampling and sample collection activities and prepared groundwater assessment report.

- As Sample Task Leader for groundwater sampling at the Mixed Waste Landfill (SNL/NM), coordinated sampling and sample collection activities and prepared reports.

- Co-authored Resource Conservation and Recovery Act Facility Investigation (RFI) report at private facility in Albuquerque (confidential client). Responsible for determining site characterization approach based on hydrogeologic conditions beneath subject facility.

- As Task Manager for Cerro Colorado and South Broadway Landfills for City of Albuquerque, ensured that monitoring requirements at landfills were performed in compliance with applicable regulations, reported monitoring results annually, and provided regulatory advisement to City of Albuquerque.

1990–1994 ***Assistant Geologist, Roy F. Weston, Albuquerque, New Mexico.*** Staff geologist (WESTON Project office), Los Alamos National Laboratory (LANL) ER Program, Los Alamos, New Mexico. Project entailed deep drilling of two boreholes in accordance with RFI work plan at Technical Area (TA) 21 for LANL.

- Performed lithologic description and interpretation of borehole geology for Los Alamos investigations in both DP Canyon and canyons downgradient of potential source area. Oversaw drill rig using dual-wall reverse air circulation drilling method and ODEX 190 casing system and geochemical/geotechnical soil sampling. Wrote TA-21 drilling investigations plan, co-wrote TA-21 quarterly technical reports.

- Served as geologist/drill rig leader for DOE Mound Facility Operable Unit 9 ER Program, Miamisburg, Ohio. Project entailed installing 70 monitoring wells and piezometers for sitewide groundwater characterization. Supervised drilling operations of Rotosonic drill rig. This included supervising support personnel, rock/soil boring and logging, geochemical/geotechnical soil sampling, rock-coring oversight using conventional air rotary methods, installing/developing and abandoning monitoring well, and tracking drilling costs.

- As geologist/sample coordinator for Water Quality Assurance Revolving Fund Project, Phoenix, Arizona, investigated groundwater in the metropolitan Phoenix area for Arizona Department of Environmental Quality. Coordinated and supervised sampling in East Washington Project Area, wrote quality water sampling reports, researched background well construction information for existing wells in project area, maintained well database, performed groundwater sampling for volatile organic compounds, installed monitoring well using dual-wall percussion hammer drilling methods, developed monitoring wells, assisted with pumping tests, and prepared well-drilling permits.

- As geologist for Uranium Mill Tailings Remedial Action Project (Albuquerque) performed groundwater sampling for DOE at 26 inactive uranium mill tailings sites in support of contamination migration studies. Performed monitoring-well and surface-water sampling, and lysimeter sampling, field water quality measurements, water level measurements, and equipment calibration; made necessary preparations for field trips; supervised field personnel; and performed samples control and handling.

1988–1990 ***Engineering Technician, Fox Consultants, Colorado and New Mexico.*** Performed shallow auger drilling/sampling of subsurface soil for foundation design, street pavement design, and permeability testing. Also performed field and laboratory tests for concrete, asphalt, and soil to ensure quality placement of these materials for construction purposes.

Professional Affiliations

Arizona Hydrologic Society
New Mexico Chapter, Water Resources Management Society

Craig Givens

Mr. Givens is a geological engineer with 21 years of professional experience in the fields of hazardous, mixed, and nuclear waste transportation and disposal engineering and Quality Assurance (QA)/Quality Control (QC). His QA/QC duties include performing project QA audits, providing project QA/QC oversight, performing QA/QC and technical reviews of project deliverables, performing project specific QA training, providing QA direction to project staff, and preparing QA plans and procedures. He is knowledgeable of QA regulations related to nuclear waste repositories, transportation, and hazardous waste sites. His engineering and project management duties have included managing transuranic (TRU) waste transportation technical support contract to the Waste Isolation Pilot Plant (WIPP) contractor; performing TRU waste transportation evaluations and modeling; providing geotechnical and hydrological expertise to hazardous, mixed, and nuclear waste disposal projects; and feasibility studies through the performance of surface and subsurface hydrological calculations, soil and rock structural calculations, and backfill and earthen sealing materials design calculations.

Education

Graduate studies, Geological Engineering, New Mexico Institute of Mining and Technology, Socorro, New Mexico

B.S., Geological Engineering, New Mexico Institute of Mining and Technology, Socorro, New Mexico; 1985

Computer Modeling Using FLAC, Itasca Consulting Group, Carlsbad, New Mexico; 1992

Engineering Operations Quality Assurance Officer Training Program, International Technology Corporation; 1991

Hazardous Waste Operations and Emergency Response (40 hour HAZWOPER), Field Sciences Institute; June 2000, and associated refreshers.

Registrations/Certifications/Clearance

Certified Lead Auditor (2003 - current)

U.S. Army Corps of Engineers (USACE) Construction Quality Management for Contractors (March 2003, Renewed April, 2007)

Experience and Background

2001–Present — ***QA Manager, Shaw Environmental, Inc. (formerly IT Corporation), Albuquerque, New Mexico.*** As QA Manager for the Shaw Environmental, Inc. (Shaw) Albuquerque Office, responsible for implementing and overseeing the QA program for all projects performed by the Shaw Albuquerque office. Knowledgeable of applicable QA requirements and regulations for the USACE and U.S. Department of Energy (DOE) including 10 CFR 830.120, DOE Order 414.1A, NQA-1, and the DOE-Carlsbad Field Office (CBFO) QA Program Document (QAPD). Specific activities include:

- Preparing Contractor Quality Control Plans and providing daily QC oversight for USACE, Total Environmental Restoration Contract (TERC) projects including site investigations at former Atlas missile silo sites and the former Walker Air Force Base in southeast New Mexico.

- Preparing QA Project Plan (QAPjP) for Shaw software development in support of Westinghouse Waste Isolation Division (WID). This QAPjP was prepared to provide QA controls for the development of the Automated TRUPACT-II Authorized Methods for Payload Control (e-TRAMPAC) software package in support of the CH-TRU waste program.

- Providing QA oversight for TRU waste packaging (TRUPACT-II, 72-B Cask, and HalfPACT) SAR submittals including QA reviews of the submittals, QA support and training for the project staff, and preparation of project required QA procedures and plans.

- Preparing a QAPD compliant QAPjP for the Idaho National Engineering and Environmental Laboratory Acceptable Knowledge project for RH-TRU waste and verifying the implementation of the QA requirements.

- Performing periodic QA program and project assessments of the Shaw WIPP CH- and RH-TRU waste program activities, which include technical report preparation, SAR submittals, and e-TRAMPAC software development.

- Managing the TRU waste transportation technical support contracts (remote handled [RH] and contact handled [CH]) for the WIPP contractor (Washington TRU Solutions LLC). Contract provides technical support and assists in preparation of CH- and RH-TRU waste transportation Safety Analysis Reports (SAR) submitted to and approved by the U.S. Nuclear Regulatory Commission (NRC) and responding to requests for additional information from the NRC.

1991–2001 ***QA Engineer/Geological Engineer, IT Corporation, Albuquerque, New Mexico.*** As a QA Engineer, assists the QA Officer in implementing IT's Engineering Operations QA program for the Albuquerque office including the performance of internal and external QA audits and assessments. As a Geological Engineer, provides geotechnical and hydrological expertise to hazardous, mixed, and nuclear waste disposal projects. Specific activities include:

- Participating as a member of a seven-person assessment team in a large-scale QA assessment of the Battelle Columbus Laboratory (Columbus, OH) TRU waste packaging and shipping program in preparation for an operational readiness review by the DOE-CBFO.

- Preparing the QAPjP for the Lawrence Livermore National Laboratory TRU Waste Characterization Project, which provides requirements and guidance for assuring that TRU waste is characterized to meet the specific objectives of the WIPP TRU Waste Characterization Program.

- Performing complete QA project audits for groundwater monitoring and sampling project at Tinker Air Force Base, Oklahoma City, OK.

- Participating in QA project audit for uranium mill tailings reclamation project at Monticello, Utah.

- Preparing a draft of the QA Program Plan for the TRUPACT-II Gas Generation Test Program.

- Preparing the annual Geotechnical Analysis Report for the WIPP underground (1997 through 2000).

- Conducting QA audits and reviews for the WIPP Brine Sampling and Evaluation Project and the Geotechnical Field Data and Analysis Report to ensure that the proper QA program elements have been included.

- Acting as interim QA Program Manager for the Mather Air Force Base Remedial Investigation/Feasibility Study project in northern California supporting the Richland, WA; Martinez, CA; and Albuquerque, NM offices.

- Conducting QA audits and reviews of CERCLA feasibility studies generated for the Hanford Site in eastern Washington to ensure that the proper QA program elements have been included.

- Assisting in the preparation of a Title II design and specification for a corrective action management unit (CAMU) for Sandia National Laboratories/New Mexico's Environmental Remediation Department. Task included coordination and technical review of design drawings and final design report.

- Performing FLAC 3.3 geomechanical modeling and geotechnical design work in support of the Panel Closure System conceptual and final designs for the operational period closure of the WIPP waste disposal panels.

- Calculating mining retrieval rates and waste disposal room consolidation properties for the WIPP Engineered Alternative Benefit/Detriment Study.

- Preparing the Backfill Engineering Analysis Report for the WIPP. Report analyzed subsidence and excavation stability to determine if there was a geomechanical advantage to backfilling part or all of the WIPP underground.

- Assisting in preparing and checking the Non-radionuclide Inventory Database. This is a database of the chemical wastes to be shipped to the WIPP site and integrates the waste types, content codes, shipping requirements, and the chemical constituents and concentrations.

- Assisting in the designing and coding of a risk assessment model for the DOE Mixed Low-Level Waste program.

- Providing technical assistance to the Yucca Mountain Project (YMP) in the areas of Exploratory Shaft (ES) sealing design, sealing material requirements and recommendations, determining ES performance goals and design requirements, and soil laboratory test analyses.
- Preparing a Limited Field Investigation report of the 100-H Area for the Hanford Site. Report included the analysis of field and laboratory data on hazardous chemicals and radionuclides found in soil samples and made conclusions concerning source of contamination and recommendations on remediation of the contaminated areas.

- Developing, evaluating, costing, and scoring hazardous and mixed waste treatment alternatives associated with CERCLA feasibility studies for the Hanford Site and George Air Force Base in California.

1990–1991 ***Quality Assurance Officer, International Technology Corporation, Albuquerque, New Mexico.*** Implemented IT's Engineering Operations QA program for the Albuquerque, Los Alamos, and Carlsbad offices. Specific activities have included:

- Conducted QA audits and reviews for the WIPP including the RCRA Part B permit application, the Engineered Alternatives Task Force (EATF), the geological study of the Air Intake Shaft, the Brine Sampling and Evaluation Project, and the Geotechnical Field Data and Analysis Report to ensure that the proper QA program elements have been included.

- Prepared the QA Program Plan for preparation of the WIPP RCRA Part B permit application.

- Assisted in performing QA grading of items and activities associated with Sandia National Laboratories, New Mexico, and the YMP high-level nuclear waste repository. Analyzed items and activities for QA concerns and determined what QA controls were required for each.

- Conducted staff training in IT QA practices to ensure proper implementation of the program requirements with project activities.

- Conducted audits of other IT offices in the region to ensure proper implementation of the IT Engineering Operations QA program.

1987–1990 ***Geological Engineer, International Technology Corporation, Albuquerque, New Mexico.*** Provided geotechnical and hydrological expertise to hazardous and nuclear waste repository projects including:

- Performed geomechanical creep modeling of the WIPP underground using FLAC and VISCOT programs.

- Provided technical assistance to the YMP in the areas of ES sealing design, sealing material requirements and recommendations, determining ES performance goals and design requirements, and soil laboratory test analyses. Specific tasks included surface hydrology analysis in the region surrounding the ES proposed location, assessing local, state and federal regulatory requirements applicable to the ES site, and estimation of filtration properties of shaft seal materials.

- Prepared and reviewed field test plans, field geomechanical monitoring of salt creep rates and waste disposal room closure rates, geophysical analyses of brine content and movement within the salt formation by resistivity and electrical induction methods for the WIPP. Assisted in the preparation of the Non-radionuclide CH-TRU Waste Inventory Data Base providing information on all CH-TRU waste to be shipped to the WIPP.

- Performed estimations of hydraulic conductivity and future performance goals of grout seals for the SKB Swedish high-level nuclear waste repository project.

1985–1987 ***Geological Engineer, Westinghouse Hanford Company / Rockwell Hanford Operations, Basalt Waste Isolation Project (BWIP), Richland, Washington.*** Rock and soil mechanics laboratory engineer for high-level nuclear waste repository siting project. Performed laboratory soil and grout properties tests on nuclear waste repository seal, backfill, and waste canister packing materials using state-of-the-art laboratory test equipment at high temperatures and pressures. Prepared and revised technical, laboratory, and operating procedures, test data reports, and test plans. Administered contracts to outside testing organizations at the Hanford site.

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