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RHODES CANYON LANDFILL
CORRECTIVE MEASURES IMPLEMENTATION WORK PLAN
WSMR-14; SWMU 114 & 115

Submitted to:

US Army
White Sands Missile Range
Directorate of Environment and Safety
White Sands Missile Range, New Mexico 88002-5048

June 2003

Submitted by:

BAE SYSTEMS
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EXECUTIVE SUMMARY

The Rhodes Canyon Landfill consists of two inactive cells, Solid Waste Management Unit (SWMU)-114 and SWMU-115. The site is located within the White Sands Missile Range at the intersection of Range Road 6 and Range Road 7 in Otero County, New Mexico (Figure 1-1). A site diagram is included as Figure 1-2.

The start-up date for the oldest landfill (SWMU-115) is unknown, but was closed in 1976 prior to the implementation of the Resource Conservation and Recovery Act (RCRA). SWMU-115 is irregularly shaped based on the results from a geophysical survey conducted during the 1992 Phase I RCRA Facility Investigation (RFI); the southern section is approximately 400-feet across while the northern section is approximately 380-feet long and 120-feet wide. SWMU-114 is the most recently active area, reportedly receiving waste until approximately 1987. SWMU-114 is located east of SWMU-115 and is approximately 360-feet by 480-feet in aerial extent with an 8-foot chain link perimeter fence. The exact dates of landfill operation could not be determined.

SWMU-114 was reported by the RCRA Facility Assessment (RFA) to have received office refuse and construction debris from the Rhodes Canyon Range Center. The RFA reported that SWMU-115 received sanitary waste from Rhodes Canyon Range Center and inert missile debris from uprange impact areas.

Long term groundwater monitoring of the site has been conducted semi-annually since the installation of one up-gradient and three down-gradient wells in 1995. The constituents, which were found to exceed the NMWQCC standards, can be attributed to the physical and chemical weathering of geologic materials. These constituents include total dissolved solids, chloride, fluoride, nitrate/nitrite as N, sulfate, iron, strontium, and sodium. The results indicate that the presence or influence of contaminated leachate on those concentrations is minimal.

In an effort to protect human health and the environment, the scope of work in the CMI will limit the potential pathways to receptors and routes of exposure. The soil cover has been designed to accomplish this by preventing direct contact with the buried waste and minimizing infiltration of storm water runoff. Groundwater monitoring will be conducted annually to monitor any impacts to groundwater quality caused by waste left in place at these SWMUs.

TABLE OF CONTENTS

Section **Page**

TABLE OF CONTENTS
concluded

Section **Page**

List of Figures

List of Tables

LIST OF ACRONYMS

CAP	Corrective Action Plan
CFR	Code of Federal Regulations
CMI	Corrective Measures Implementation
CMS	Corrective Measures Study
DAF	Dilution Attenuation Factor
DQO	Data Quality Objective
DRO	Diesel Range Organics
DSERTS	Defensive Site Environmental Restoration Tracking System
EPA	Environmental Protection Agency
FID	Flame Ionization Detector
GC	Gas Chromatograph
GRO	Gasoline Range Organics
HA	Health Advisory
HDPE	High Density Polyethylene
HPLC	High Performance Liquid Chromatography
ICP-AES	Inductively Coupled Plasma – Atomic Emission Spectroscopy
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MEK	2-Butanone
mg/L	Milligrams per liter
MIBK	4-Methyl-2-pentanone
MS	Mass Spectrometry
MW	Monitoring Well
NAVD88	North America Vertical Datum 1988
NFA	No further action
NMED	New Mexico Environment Department
NMSA	New Mexico Statutes Annotated
NMWQCC	New Mexico Water Quality Control Commission
QA	Quality Assurance
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RPD	Relative Percent Differences
SM	Standard Methods
SSHSP	Site Specific Health and Safety Plan
SSL	Soil Screening Level
SVOCs	Semi-volatile Organic Compounds
SWMU	Solid Waste Management Unit

LIST OF ACRONYMS
concluded

TCE	Trichloroethylene
TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total Dissolved Solids
TI	Technical Inspector
ug/L	Micrograms per liter
UXO	Unexploded Ordnance
VOCs	Volatile Organic Compounds
WSMR	White Sands Missile Range

RHODES CANYON LANDFILL
CORRECTIVE MEASURES IMPLEMENTATION WORK PLAN
WSMR-14; SWMU 114 & 115

1.0 INTRODUCTION

1.1 Facility Description

Rhodes Canyon Landfill (IRP 10, WSMR-14) is located within the White Sands Missile Range at the intersection of Range Road 6 and Range Road 7 in Otero County, New Mexico (Figure 1-1). A site diagram is included as Figure 1-2.

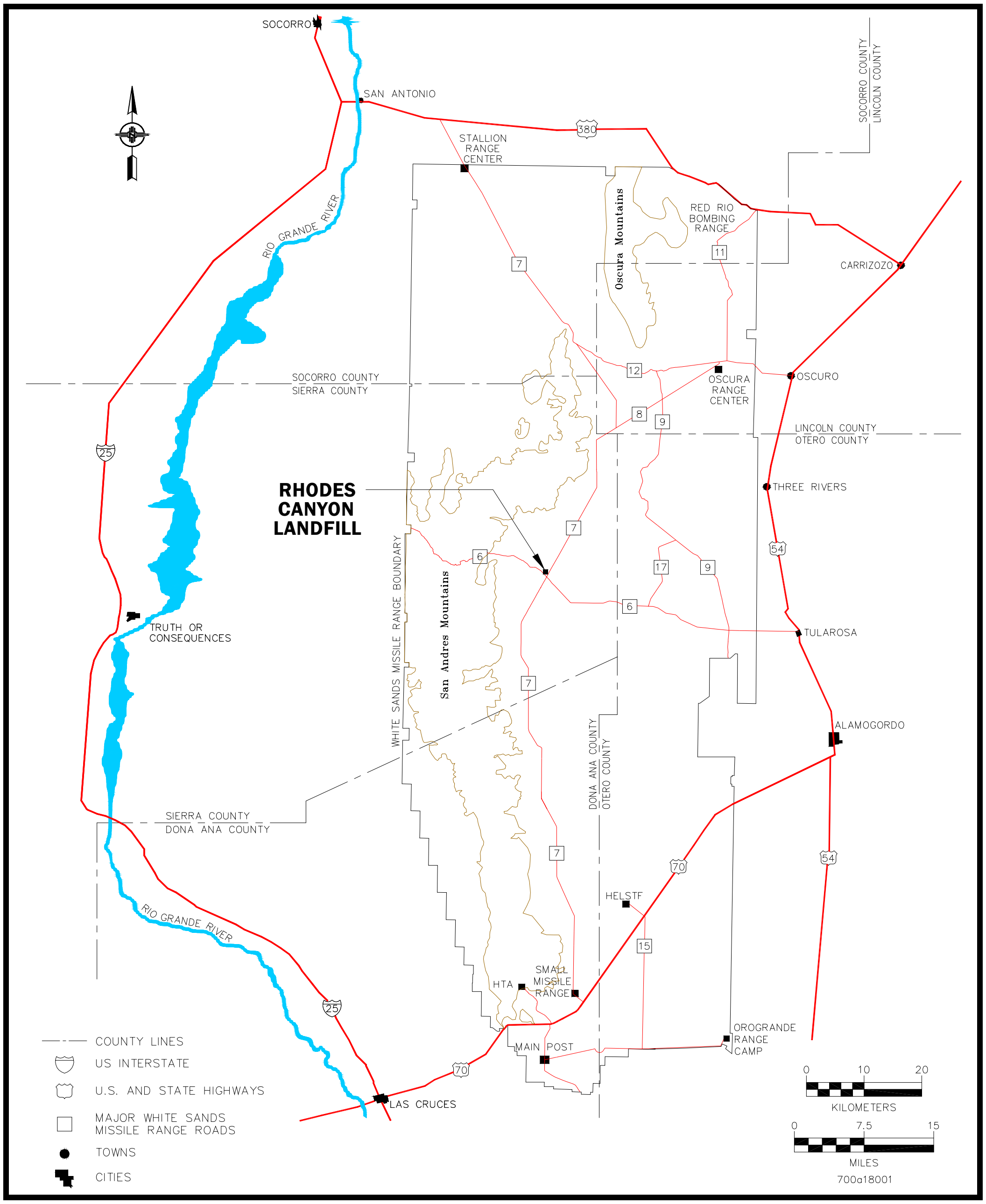

Figure 1-1. Site Location Map.

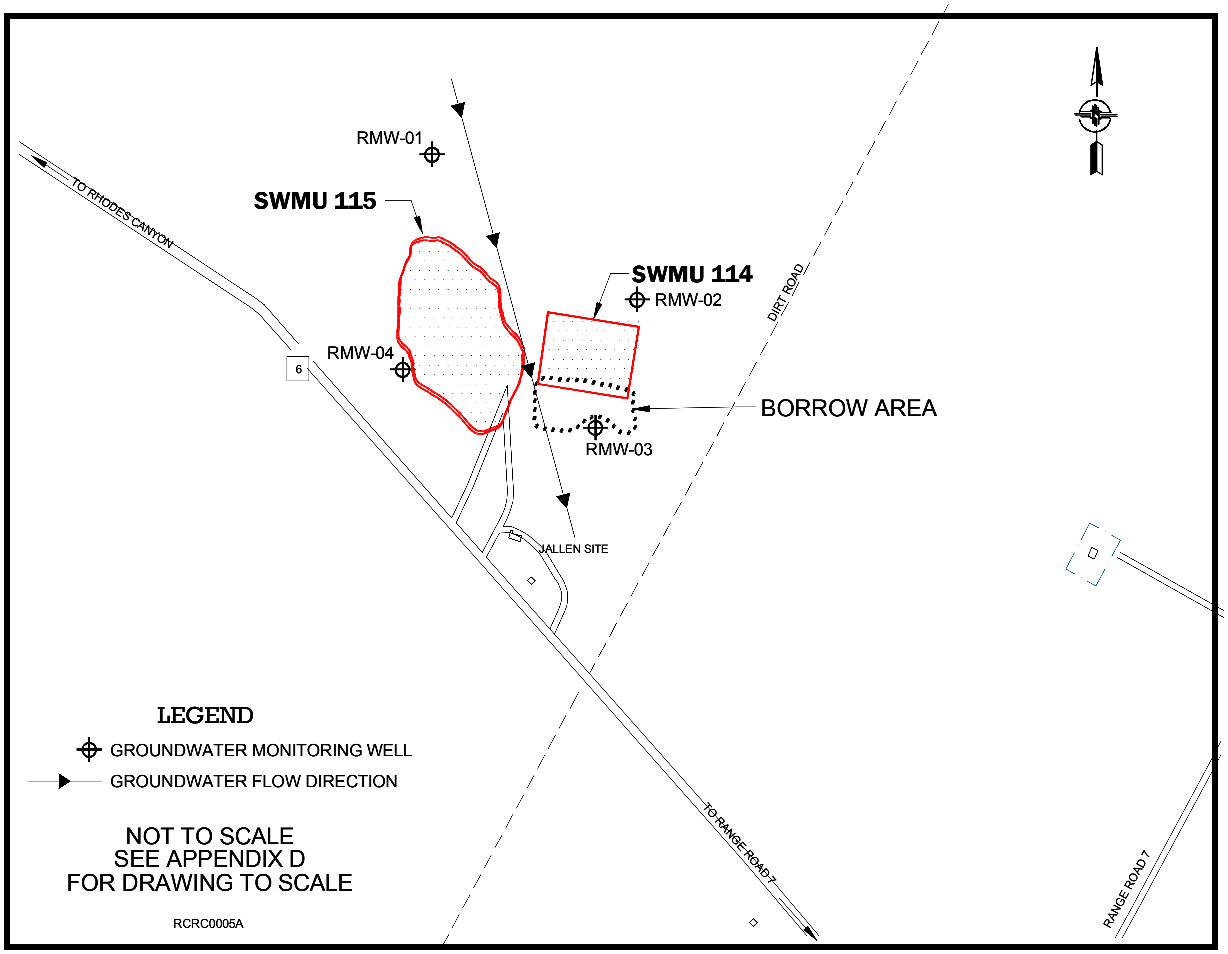

Figure 1-2. Site Diagram.

The landfill consists of two inactive cells, Solid Waste Management Unit (SWMU)-114 and SWMU-115. In aerial extent, SWMUs 114 and 115 are approximately 2.8 acres 9.6 acres, respectively.

1.2 Environmental Setting

The White Sands Missile Range is located in south-central New Mexico in the Tularosa Basin and covers approximately 3,200 square miles. The range is restricted to military, civilian and contract employees of the U.S. Army and other Department of Defense agencies.

The climate is relatively warm and dry. The average annual precipitation is 11 inches. The temperature during the winter ranges from 30 to 60 degrees Fahrenheit. During the summer temperatures can rise in excess of 100 degrees Fahrenheit.

The site has a diverse landscape with numerous mountains ranges and valleys. This provides a variety of lowland and mountain habitats for numerous plants and animals (U.S. Army 1998).

1.3 Corrective Measures Objectives and Scope

The purpose of the corrective measures outlined in this work plan is to construct a soil cover over both SWMU-114 and SWMU-115. The soil cover is intended to create positive drainage away from the cells thus reducing the possibility of leachate formation. It is also intended to prevent direct contact with the buried materials by humans and wildlife.

The scope of the work plan includes the following:

- Grading to promote positive drainage of storm water.
- Construct a swale, made of an HDPE liner, to channel rainfall off the soil cover.
- Plant native vegetation to prevent erosion.
- Post signs marking the boundaries of the soil cover.
- Monitor and repair (as needed) the cover.
- Continue groundwater monitoring to detect any contaminants that may be present in the groundwater.

1.4 Regulatory Requirements

This document was prepared in accordance with the regulations established under the Hazardous Waste Act, NMSA 1978, sections 74-4-1 through 74-4-14 and the Water Quality Act, NMSA 1978, sections 74-6-1 through 74-6-17; and the guidance published by the New Mexico Environment Department.

2.0 SITE CHARACTERIZATION

2.1 Site Description and Operational History

The SWMU 115 origination date is unknown, however, it was closed in 1976 prior to the implementation of RCRA. It is irregularly shaped based on the results of a geophysical survey conducted during the 1992 Phase I RCRA Facility Investigation (RFI). The southern section is approximately 400-feet across while the northern section is approximately 380 feet long and 120-feet wide (International Technology Corporation 1992).

SWMU-114 received waste until approximately 1987. It is located east of SWMU-115 and is approximately 360-feet by 480-feet in aerial extent with an 8-foot chain link perimeter fence. The exact dates of landfill operation are not known.

SWMU-114 was reported by the RCRA Facility Assessment (RFA) to have received office refuse and construction debris from the Rhodes Canyon Range Center. The RFA reported that SWMU-115 received sanitary waste from Rhodes Canyon Range Center and inert missile debris from uprange impact areas (Kearney 1988).

2.2 Site Geology

The site lies along the western edge of the Tularosa Basin near the alluvial fans of the San Andres Mountains. Stream deposits and other valley fill from the Quaternary age characterize the area geology. The deposits are described as being chiefly red clay, gypsum, sand and gravel (Meizner and Hare 1915).

Site-specific geology was characterized in 1995 when the four monitor wells (RMW-1, RMW-2, RMW-3 and RMW-4) were installed (ESE 1996). The soil consists of alternating layers of clay, silty clay, sandy silt and gravel. The gravel encountered ranged from angular to sub-angular with a strong reaction to hydrochloric acid, indicating a limestone provenance. The clay and silty clay encountered was moderate-brown, reddish-brown and light reddish-brown. Some soil contained organic matter. No odors were noted on the drilling log.

2.3 Site Hydrogeology

Recharge to the regional aquifer is from precipitation falling on the mountain ranges and alluvial fans, which border the bolson on the west. This precipitation infiltrates the unconsolidated, relatively coarse deposits of the Tertiary/Quaternary alluvial fan deposits and arroyos along the eastern flank of the San Andres Mountains. The resultant groundwater flows toward the center of the Tularosa Basin, generally to the east-southeast.

Dissolved constituents in the groundwater increase with distance eastward from the mountain front, reflecting the increased residence time of groundwater moving from the western bolson margin toward the center of the Tularosa Basin. However, groundwater flow direction within the western Tularosa Basin is presumed to discharge to the south as underflow in the contiguous northern Hueco Basin of western Texas. No surface expressions of groundwater have been reported within the western Tularosa Basin.

Long term monitoring of the wells has demonstrated that the groundwater flows to the southeast (MEVATEC 2001). The depth to groundwater varies between and 71 feet and 80 feet.

The nearest potable water supply well is located at the High Energy Laser System Test Facility more than 30 miles to the south.

2.4 Previous Site Investigations

A RCRA Facility Assessment (RFA) was completed in 1988 and concluded that there was a low potential of release to the groundwater, surface water, air or subsurface gas (Kearney 1988). A copy of the RFA conclusions is included as part of Appendix A.

A Phase I RCRA Facility Investigation (RFI) was completed in 1992, which consisted of an electromagnetic study to delineate the extent of the debris and a soil gas survey to determine the presence and concentrations of subsurface volatile organic compound (VOC) vapors (ITC 1992). The electromagnetic study revealed the extent of the landfill cell, SWMU-115. The soil gas survey did not detect any VOCs, elevated microbial activity or methane. During the soil gas survey, several items of unexploded ordnance (UXO) were discovered and destroyed in place. The RFI recommended a Class 3 Permit Modification to terminate the RFI/CMS process and installation of a fence around the SWMU for safety reasons associated with the UXO. A copy of the RFI conclusions is included as part of Appendix B.

Groundwater monitoring began in 1995 following the installation of four on-site wells. The wells are sampled and analyzed semi-annually for an array of compounds that include: water quality parameters, dissolved ions, nutrients, total metals, dissolved metals, dissolved salts, volatile organic compounds, semi-volatile organic compounds, pesticides, herbicides, explosive residues and petroleum hydrocarbons. These analytes were established for this site in order to better identify if a release of the contaminates from the landfill resulted and to understand the water quality in the area. Before samples are collected, the wells are purged and monitored for temperature, pH, conductivity and appearance. All data collected during sampling activities is recorded in a bound field logbook.

The Groundwater Monitoring Program has demonstrated that the compounds detected above the New Mexico Water Quality Control Commission (NMWQCC) standards can be attributed to naturally occurring processes in the Tularosa Basin. These compounds are chloride, fluoride, nitrate/nitrite as N, sulfate, iron, strontium, total dissolved solids (TDS), iron and sodium.

Archeological studies were performed on SWMU-114, SWMU-115 and surrounding areas. Previous cultural-resource surveys for Rhodes Canyon Landfill include Laumbach (1981), Eidenbach et al. (1982), Clifton (1988) and Kirpatrick (1986b). In May 1998, a Historic Property Identification report was completed. This survey concluded that the site is potentially eligible for the National Register of Historic Places and recommended a damage assessment be performed from the impact of the installation of monitoring well RMW-4 (HSR 1998).

A final archeology survey report was submitted in July 1999, which documented the collection and preservation of 457 stone artifacts found in the project area west of RMW-4 (HSR 1999). The survey recommended that an archeologist be present during any earthmoving activities and that an archeological survey be completed prior to any work adjacent to the site. The Historic Property Identification and Archeology Survey site diagrams are included as Appendix C.

2.5 Conceptual Model of Migration

A conceptual model of contaminant migration is created using existing geological, hydrogeological and chemical data from the site. The model evaluates the contaminants of concern and their potential pathways. The findings are described below.

Supporting data used in the conceptual model, such as site maps, groundwater analyses, cross-sections, and monitoring well construction diagrams are included as Appendix D.

2.5.1 Contaminants of Concern

The two Rhodes Canyon Landfill cells received refuse classified as sanitary waste, office waste and inert missile debris (Kearney 1988). The contaminants of concern include any potential compounds associated with the waste or the leachate formed therein. A comprehensive battery of tests was chosen to screen for potential contaminants. The contaminants of concern are listed in Table 2-1 (on following page) and have been updated based on historical groundwater data.

Table 2-1. Rhodes Canyon Landfill Analyte List.

Parameter	Reference Method	Method Type
Water Quality Parameters		
CO_3^{-2} & HCO_3^- Alkalinity	SM 2320B	Titrimetric
PH Specific Conductance Total Dissolved Solids (TDS) Total Organic Carbon	SM 4500-H+ SM 2510B SM 2540C EPA 415.1	Electrometric Conductivity Gravimetric Combustion
Dissolved Ions		
Nitrate-N Nitrite-N	EPA 300.0	Ion Chromatography
Ammonium Perchlorate	EPA 314.0	Ion Chromatography
Nutrients		
Ammonia-N Total Kjeldahl Nitrogen	SM 4500-NH3 B,E EPA 351.3	Colorimetric Colorimetric
Total Metals		
Arsenic Barium Beryllium Cadmium Chromium Cobalt Copper Lead Molybdenum Nickel Selenium Silver Tin Vanadium Zinc	SW846-6010B	ICP-AES
Mercury	SW846-7470A	Cold Vapor-Atomic Absorption (AA)
Hexavalent Chromium	SM 3500-Cr D	Spectrophotometer
Dissolved Metals		
Arsenic Barium Beryllium Cadmium Chromium Cobalt Copper Lead Lithium Nickel Selenium Silver Tin Vanadium Zinc	SW846-6010B	ICP-AES
Organics		
Volatile Organic Compounds (VOCs)	SW846-8260B	GC/MS
Semi-Volatile Organic Compounds (SVOCs)	SW846-8270C	GC/MS
Explosive Residues	SW846-8330 C18	HPLC

EPA – Environmental Protection Agency
ICP-AES - Inductively Coupled Plasma-Atomic Emission Spectroscopy
SM – Standard Methods
GC – Gas Chromatography; MS - Mass Spectrometry; FID - Flame Ionization Detector
mg/L – milligrams per liter equivalent to parts per million
HPLC - High Performance Liquid Chromatography
µg/L – micrograms per liter parts per billion
DRO – Diesel Range Organics; GRO – Gasoline Range Organics

All laboratory analytical results are compared to New Mexico Water Quality Control Commission (NMWQCC) standards for groundwater. When NMWQCC standards are not available the EPA's maximum contaminant level (MCL), maximum contaminant level goal (MCLG) and health advisories (HA) are compared.

Groundwater samples have been collected semi-annually from RMW-1, RMW-2, RMW-3 and RMW-4 since 1996, with the exception of one missed sample event in 1997. The contaminants of concern, which exceed the standards for groundwater, include total dissolved solids, chloride, fluoride, nitrate/nitrite as N, sulfate, iron, strontium, and sodium. A summary of the results is illustrated in graphs and is included as Appendix D.

A concentration term was developed for each of the contaminants of concern using the EPA guidance, "Calculating Exposure Concentrations at Hazardous Waste Sites, OSWER 9285.6-10". The concentration term, expressed as the 95th upper confidence limit (UCL95) was calculated using the software ProUCL v 2.0 and the methods referred to in the EPA guidance document. The statistical analysis results are provided in Table 2-2.

Table 2-2. Statistical Analysis Results.

	TDS (ppm)				**NMWQCC Std.**
	RMW-1	**RMW-2**	**RMW-3**	**RMW-4**	
Number of samples	13	13	13	13	
Distribution	Non Parametric	Non Parametric	Non Parametric	Non Parametric	
Minimum	5,100	5,300	6,000	4,500	
Maximum	6,831	7,150	7,740	7,350	
95% UCL	5,703	6,049	**6,628**	5,546	1,000
	Chloride (ppm)				**NMWQCC Std.**
	RMW-1	**RMW-2**	**RMW-3**	**RMW-4**	
Number of samples	13	13	13	13	
Distribution	Non Parametric	Non Parametric	Log Normal	Non Parametric	
Minimum	427	473	2,000	408	
Maximum	4,200	4,400	5,200	2,563	
95% UCL	**2,602**	2,100	2,270	1,720	250
	Fluoride (ppm)				**NMWQCC Std.**
	RMW-1	**RMW-2**	**RMW-3**	**RMW-4**	
Number of samples	11	11	11	11	
Distribution	Log Normal	Log Normal	Log Normal	Log Normal	
Minimum	0.2	0.1	0.4	0.3	
Maximum	7.5	8	8.5	6.5	
95% UCL	4.0	4.3	**4.7**	3.8	1.6

	Nitrate/Nitrite as N (ppm)				NMWQCC Std.
	RMW-1	RMW-2	RMW-3	RMW-4	
Number of samples	11	11	10	11	
Distribution	Non Parametric	Non Parametric	Log Normal	Log Normal	
Minimum	0.5	0.3	0.3	0.1	
Maximum	8.4	9.1	8.0	8.4	
95% UCL	3.8	3.8	3.8	**6.6**	10
	Sulfate (ppm)				**NMWQCC Std.**
	RMW-1	**RMW-2**	**RMW-3**	**RMW-4**	
Number of samples	13	13	13	13	
Distribution	Normal	Normal	Normal	Non Parametric	
Minimum	1,000	140	1,100	80	
Maximum	1,862	2,722	3,000	1,200	
95% UCL	1,453	1,702	**2,083**	1,033	600
	Iron (ppm)				**NMWQCC Std.**
	RMW-1	**RMW-2**	**RMW-3**	**RMW-4**	
Number of samples	5	5	5	5	
Distribution	Non Parametric	Non Parametric	Non Parametric	Normal	
Minimum	<0.02	<0.02	<0.01	<0.01	
Maximum	0.03	<0.0275	<0.0275	0.05	
95% UCL	0.024	0.019	0.019	**0.038**	1.0
	Strontium (ppm)				**NMWQCC Std.**
	RMW-1	**RMW-2**	**RMW-3**	**RMW-4**	
Number of samples	5	5	5	5	
Distribution	Normal	Non Parametric	Normal	Non Parametric	
Minimum	8.5	8.6	12	9	
Maximum	17.7	20.2	22.7	17.3	
95% UCL	15	15.8	**20.7**	13.5	17 (HA)
	Sodium (ppm)				**NMWQCC Std.**
	RMW-1	**RMW-2**	**RMW-3**	**RMW-4**	
Number of samples	12	12	12	12	
Distribution	Normal	Normal	Log Normal	Normal	
Minimum	540	798	963	475	
Maximum	1,200	1,400	1,600	1,000	
95% UCL	998	1,111	**1,239**	802	20 (HA)

The well having the highest concentration term was bordered with a bold line. RMW-1 is upgradient of the landfill. RMW-3 is downgradient. The other two wells are side gradient. RMW-1 has an equal or higher concentration term than RMW-3 for chloride, nitrate/nitrite as N, and iron. This would suggest that the elevated levels of those contaminants are the result of naturally occurring processes that dissolve them into the groundwater.

Total dissolved solids, fluoride, sulfate, strontium and sodium increase modestly at RMW-3. Therefore it cannot be demonstrated using this analysis that the constituents are solely the result of naturally occurring processes.

2.5.2 Potential Pathways

The pathways of contaminant migration are important when developing the conceptual model. These are the means by which contamination may impact human heath or the environment. The pathways evaluated in this model include groundwater, surface water, direct contact, air and subsurface gas.

2.5.2.1 Groundwater

The RFA concluded that there was a low potential for release to the groundwater. Subsequent monitoring has demonstrated that the landfill's impact on groundwater quality has been minimal.

The nearest potable water supply well is located at the High Energy Laser System Test Facility more than 30 miles to the south of the Rhodes Canyon Landfill.

The groundwater is considered a potential pathway, but can be minimized by preventing infiltration of surface water.

2.5.2.2 Surface Water

The RFA concluded that there was a low potential for release to surface water. Stream flow is intermittent in this area and is limited to storm events. The runoff infiltrates into the alluvial-basin aquifer and does not sustain stream flow (Waltemeyer 2001).

Surface water is not considered a potential pathway.

2.5.2.3 Direct Contact

Direct contact with the landfill material may pose a threat if sharp objects or UXOs become unburied. Institutional controls such as a fence, signs and maintenance of the cover will be used to limit exposure.

Direct contact is considered a potential pathway.

2.5.2.4 Air and Subsurface Gas

The RFA concluded that there was a low potential for release to air or subsurface gas. A soil-gas survey was completed as part of the 1992 Phase I RCRA on SWMU-115. A grid was applied to the site based on an electromagnetic survey completed for the same investigation. The grid was biased to areas, interpreted to be trench cells. Fifty-eight samples were collected from the grid and analyzed for:

- Methane
- Carbon Dioxide

- 2-Butanone (MEK)
- Chloroform
- Benzene
- Trichloroethylene (TCE)
- 4-methyl-2-pentone (MIBK)
- Toluene
- Ethylbenzene
- m, o,& p-Xylene

Carbon dioxide concentrations ranged from 0.84 g/m^3 to 35 g/m^3. There are no enclosed structures on or near the cells where carbon dioxide could accumulate and displace oxygen. Analytical results revealed no other compounds detected above the reporting limits. The subsurface gas is not considered a potential pathway and is of no further concern.

3.0 SITE DESIGN

3.1 Design Objectives

The corrective measures objective is to design and construct a 25-year life soil cover over both SWMU-114 and SWMU-115. Corrective action at this site will achieve closure by demonstrating that the contaminants pose an acceptable level of risk under current and projected future land use. The design adheres to the "containment" presumptive remedy recommended by the Environmental Protection Agency. The agency has prescribed this type of remedy when residual contamination poses a direct threat, but does not pose a groundwater threat (USEPA 1991).

3.2 Design Criteria

The major components of the corrective measures include:

- A soil cover constructed over SWMUs 114 and 115
- A swale to channel rainwater off the soil cover
- Native vegetation to prevent erosion
- Installation of a perimeter fence
- Signs to provide notice of institutional controls
- Post closure care to maintain the soil cover

The soil cover is designed to last 25-years. It is expected that natural erosion, thru wind and rain, will change the initial contours of the altered landscape. The establishment of vegetation and the depth of cover are designed to prevent exposure of the buried material and to shed water away from the cells. The swale is designed to aid in shedding water off of the cover, but is not intended to remain impermeable for the life of the cover, if required, the lining will be replaced as preventive maintenance.

The spacing and construction of the signage will be designed to capture the attention of anyone traveling in the area, without interfering with the migration of wildlife. The signs will notify personnel that they are not permitted to travel through the restricted area.

The post closure care is designed to prevent soil cover erosion and prevent exposure of the buried landfill material. Maintenance of the soil cover will be performed as necessary.

4.0 CORRECTIVE ACTION

4.1 Site Work

4.1.1 Soil Cover

The existing topography permits surface water to flow across the site and infiltrate the landfill. This water then has the potential to form contaminated leachate, which could impact the groundwater. The soil cover is intended to create positive drainage away from the cells and minimize the formation of leachate. In addition, it is intended to prevent human and wildlife from direct contact with the buried materials.

The cover will be constructed by regrading the site and from borrow in an area north of monitoring well, RMW-3. The final grading plan and construction details are provided in Appendix E.

The cover consists of a single layer with a minimum thickness of 30 inches. The cover will be made of native soil so that the natural vegetation can be established. Compaction of the soils is not necessary since the cover is intended to be permeable. It is expected that significant compaction will occur when the heavy equipment places the material. Settling of the cover is addressed in the Post Closure Care Program.

A Licensed Land Surveyor will be on-site during construction to assure the cover is constructed and contoured to design specifications. A contour map will be developed providing final contours of soil cover and location of survey points. An Archeologist will be present to assure that any disturbance of the soil will not impact culturally or historically sensitive areas.

The following table lists the dimensions of the areas to be affected and the quantities of materials to be used during construction:

Table 4-1.
Construction Components and Dimensions.

Component	Dimensions
Area of cover covering SWMU-114 and SWMU-115, including the borrow area listed below.	Approximately 1,100-feet by 1,200-feet. Approximately 30.3-acres.
Borrow Area to the north of RMW-3.	Approximately 530-feet by 270-feet. Approximately 3.3-acres.
Elevation of cover at the greatest elevation.	4,066-feet.
Elevation of cover at the lowest elevation.	4,055-feet.
Quantity of removed soil (cut).	405-cubic yards.
Quantity of filled soil (fill).	60,368-cubic yards.

Notes:
1. Elevation data is based on North America Vertical Datum, 1988 (NAVD88).
2. Dimensions and quantities generated from Magee and Associates Consulting Engineers Site Plans, 2000.

4.1.2 Swale

Some runoff will be generated within the boundaries of the cover during heavy rains. A swale will be constructed to dissect the soil cover and trend from the northwest to the southeast, perpendicular to topographic contours.

The swale will be approximately 18-feet wide and both sides will slope inward at a 1/3 slope. A 40-mil (1.6-inch) high-density polyethylene liner will be installed to protect against swale erosion. The liner will be covered with medium stone to keep it in place. The fill beneath the liner will be mechanically compacted in 9-inch lifts to a density of 95%. A 2% grade will direct surface water from the soil cover to the swale.

4.1.3 Vegetation

Wind and rain will continue to shape the landscape. Establishing vegetation will minimize erosion of the cover. The vegetation will be established by germinating the topsoil with native grasses and plants. The topsoil from the borrow area will be removed and set aside for use in establishing the vegetative layer. This soil layer already contains the proper balance of nutrients and is good seed base to start the vegetative layer. The following table represents the reseeding list generated on an area-specific basis:

Table 4-2. Reseeding Table.

Common Name	Species Name	Pounds per acre (pure live seed)
Alkali sacatone	*Sporobolus airoides*	1.0
Sand dropseed	*S. cryptandrus*	0.5
Four-wing saltbush	*Atriplex canescens*	6.0
Mesa dropseed	*S. flexuorus*	0.5

Reseeding will be performed in late June or July to coincide with the rainy season. Seed application will include hydro mulching or a manual broadcast applicator, based on recommendations from the White Sands Missile Range Environment & Safety Directorate.

4.1.4 Security

A permanent chain link fence will be erected following construction of the landfill cap to enclose both SWMU 114 and 115. Signs will be posted at the entrances to the fenced in area and every 300 feet around the perimeter. Refer to Figure 4-1 for the approximate fence boundaries.

The sign will be written in dual languages (English and Spanish) and warn that entry is prohibited. It will provide a contact phone number and will indicate the location of the SWMUs. An example of the sign is provided in Figure 4-2.

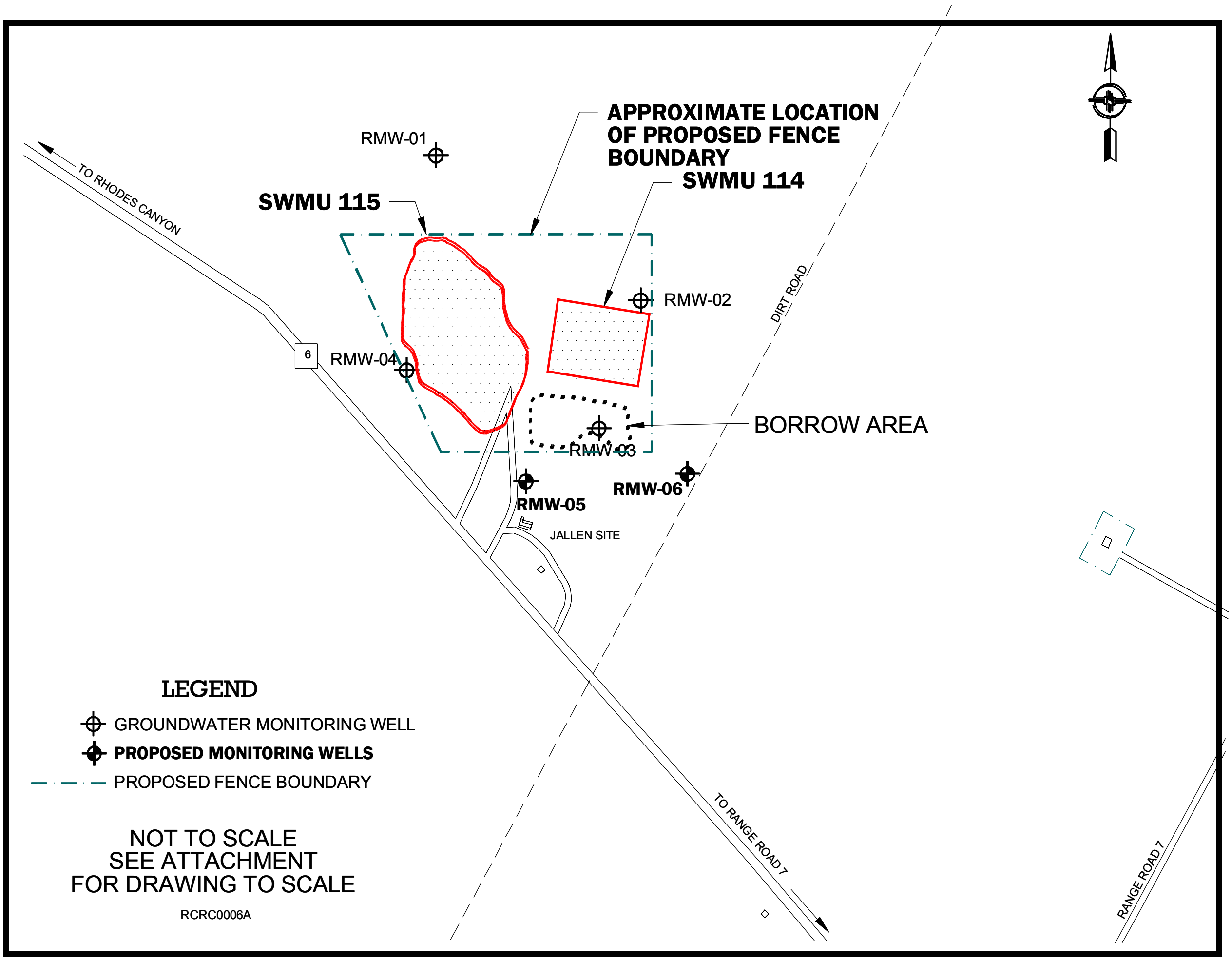

Figure 4-1. Proposed Fence Boundary.

Figure 4-2. Proposed Signs.

4.2 Sampling and Analysis

There are no sampling and analysis tasks associated with the construction of the soil cover.

4.3 Construction Safety Procedures

All personnel on-site will adhere to construction safety procedures as specified in the SSHSP included as Appendix F.

4.4 Waste Management Procedures

There is not expected to be any waste generated during construction. Surface debris discovered during construction will be containerized in 55-gallon drums and properly disposed.

4.5 Construction Contingency Procedures

Changes to the design and/or specifications might be necessary during construction due to an unforeseen problem or circumstance. If the unforeseen problems and/or circumstance prevent the corrective measure from being implemented, a secondary corrective measure will be designed and implemented. Regulatory notification would accompany any significant changes to the Construction Workplan.

4.6 Secondary Corrective Measures

The Task Manager will review the circumstances surrounding the work stoppage and develop a secondary corrective measure. The NMED will be notified of the work stoppage and the events surrounding it. A revised schedule would be submitted with a new work plan.

Secondary corrective measures may include the over-excavation of SWMU-114 and SWMU-115. The landfill cells will be over excavated and the debris will be placed in double-plastic lined roll-off containers. Composite samples from the containers will be collected and analyzed for the full range of TCLP contaminants and labeled “Analysis Pending”. The containers will be stored on site in a staging area to be disposed of as hazardous waste or non-hazardous waste as indicated by the sample results. The contents of the containers will be properly disposed of off-site and a waste disposal manifest will be retained as documentation.

The excavation will be sampled along the centerline every 50 feet and along each wall every 50-feet, with a bias to areas of visual or olfactory evidence of contamination. The samples will be collected and submitted for laboratory analysis for the contaminants of concern. Following sample collection, the pits will be secured so that no human or wildlife will be endangered.

The soil sample analytical results will be compared to NMED SSL DAF 20. If the soil sample analytical results exceed the NMED SSL DAF 20, further excavation of the pits will commence and the pits will be re-sampled until the Task Manager is satisfied that all debris and contaminants have been removed. If the soil sample analytical results do not exceed the NMED SSL DAF 20, the pits will be backfilled with native soil borrowed from near the site. The closure of SWMU-114 and SWMU-115 by over-excavation may serve as the secondary corrective measure in the event the primary corrective measure cannot be implemented as planned.

4.7 Post Closure Care

Post Closure Care will be implemented to provide long-term maintenance and monitoring of the soil cover.

The soil cover will be inspected semi-annually by trained personnel. The personnel will be examining the cover to ensure that there are no signs of human or animal disturbance, that no solid waste has been uncovered and that water is not ponding over the landfill cells. The inspection will be documented in a bound logbook noting the personnel onsite and any observations.

Analytical data gathered during annual groundwater monitoring events will be evaluated for deviations from the established background levels.

At a minimum, the following tasks will be completed during the semi-annual cap inspection:

1. Verify that the gate is closed and locked.
2. Walk the fence and check for breaches or deterioration in construction
3. Ensure that signage remains in tact and legible.
4. Confirm that the monitoring wells are locked and well covers are tight.
5. Inspect the landfill cap for traffic, vegetation, erosion, animal activity, settlement and waste protrusion.

Restoration of the soil cover will be performed if land filled material becomes exposed or water begins ponding over the cells.

4.8 Performance Monitoring

Groundwater will continue to be sampled annually following construction of the cover. Two new downgradient monitoring wells will be installed and sampled in place of the two side gradient wells. The two proposed wells are further discussed in the sampling and analysis plan located in Appendix G. The existing analyte list as shown in Table 2-1 will be sampled for one round following the installation of the new wells.

The analyte list will be reduced to include water quality parameters, dissolved ions, nutrients, total metals and dissolved metals if the results from the two new wells are consistent with the previous sampling results from the other four wells. To date no pesticides, herbicides, or explosive residues have been detected in any of the wells. Volatile organic compounds, semi-volatile organic compounds and petroleum hydrocarbons have been detected occasionally at trace amounts just above the detection limit. Although some of these analytes have been sampled for previously, an updated contaminate of concern list is provided in Table 2-1.

A field logbook will be maintained for each sampling event. The book will serve to permanently record the persons present, the date and times of any activities, the well number, air temperature, relative humidity, general weather conditions, and any monitoring data described below.

Each well will be purged according to standard operating procedures after the static water level is measured in each of the monitoring wells. A complete description of the standard operating procedures used to acquire field measurements and collect groundwater samples is included as Appendix G. The purge volume is calculated for each well by obtaining depth to water, total well depth and well casing diameter. Temperature, pH, conductivity and appearance are monitored and recorded during purging.

Every sample will be collected in a new certified clean container for laboratory chemical analyses. Equipment that has come into contact with the groundwater will be decontaminated after each well using an Alconox/water solution and a water rinsate. All purge and decontamination water will be containerized for analysis and proper off-site disposal.

Performance monitoring will be conducted for 25 years with reviews conducted every 5 years. The 5-year reviews will establish if the proposed performance monitoring requirements need to be modified based on the results of the performance monitoring during the previous 5 years. Use of Low flow monitoring techniques or increased/decreased monitoring will be evaluated at least during the 5-year review with NMED concurrence and approval.

4.9 Corrective Measure Completion Criteria

The soil cover at Rhodes Canyon Landfill is intended to have a 25-year life. The Post Closure Care of the soil cover will continue until groundwater monitoring is deemed no longer necessary through the use of five-year reviews. Upon receiving no further action (NFA) approval from NMED, groundwater monitoring and Post Closure Care will cease and the White Sands Missile Range will prepare a Corrective Measures Completion Report.

4.10 Project Schedule

Timely submission of deliverables and completion of construction will adhere to Table 4-3. The Project Schedule is tentative and will be affected by Army funding, submission of reports, internal and regulatory approval, and the commencement of the CMI scope of work for Rhodes Canyon Landfill.

Table 4-3. Project Schedule.

Task	Completion Date
CMI re-submittal to NMED	10 June 03
NMED CMI Technical Review	30 June 03
Public Meeting	30 July 03
Public Comment Period (45 days)	15 September 03
NMED approval and Notice to Proceed	26 September 03
Initiate Implementation of CMI	1 October 03
Submission of quarterly progress reports	Quarterly after initiation of CMI
Completion of CMI Scope of Work	TBD
Submission of Construction Completion Report to NMED	90-days after completion of CMI
Submission of Corrective Measures Completion Report to NMED	TBD

5.0 PROJECT MANAGEMENT

The project organization reflects the relationship between the White Sands Missile Range point-of-contact and the BAE SYSTEMS team assembled to plan, organize, control, and execute this project. Within the BAE SYSTEMS project management system, the key positions are the Program Manager, Task Manager and Task Coordinator. The basic organization chart for this project is shown on Figure 5-1.

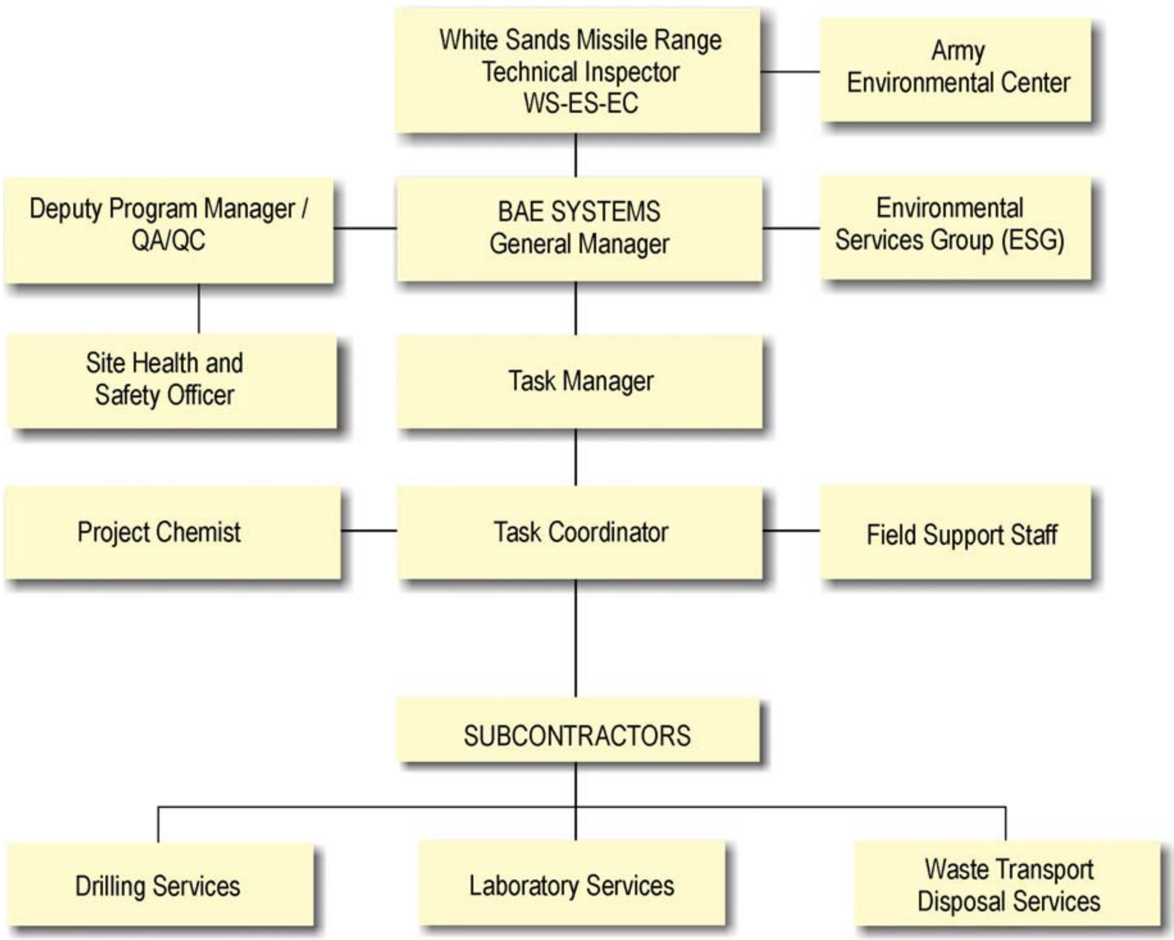

Figure 5-1. Project Personnel Organization Chart.

5.1 Duties and Responsibilities

5.1.1 Technical Inspector

The technical inspector is an employee of the U.S. Army and functions as the point of contact for the White Sands Missile Range. For this project, the Technical Inspector's responsibilities include:

- Communicates w/AEC on funding issues
- Develops scope of work
- Reviews and approves workplans

- Acquires funding
- Point of contact for the public and regulatory agency

5.1.2 Program Manager

The Program Manager is the senior BAE SYSTEMS representative on the project, and functions as the focal point for White Sands. For this project, the Program Manager's responsibilities include:

- Overall project management
- Total planning, organization and execution of the Corrective Measures Implementation Workplan.
- Maintaining contact with the Technical Inspector throughout the work
- Directing the Task Manager in conducting a successful project
- Providing resources to the Task Manager to accomplish project responsibilities
- Guiding the Task Manager on the approach to a public relations program
- Reviewing and approving all deliverables

5.1.3 QA/QC Manager

The QA/QC Manager for this project is responsible for the following:

- Acting for the Program Manager in his absence
- Reviewing project progress
- Ensuring project QC protocols and procedures are followed
- Documenting that all quality objectives have been met
- Assisting the Task Coordinator in evaluating alternatives to meeting project objectives
- Providing guidance on the allocation of resources

5.1.4 Task Manager

The Task Manager for this project will be responsible and accountable to the Program Manager for overall direction and performance of the project including:

- Developing and executing the Work Plan
- Directing the Task Coordinator
- Keeping Program Manager and Technical Inspector appropriately informed
- Approving uses of technical resources
- Coordinating all assigned resources
- Periodic review of progress and progress reporting
- Resolving Work Plan issues
- Schedule and budget tracking
- Quality and timeliness of deliverables
- Work performed by subcontractors
- Technical liaison between the Task Coordinator and the Program Manager

5.1.5 Task Coordinator

The Task Coordinator will be responsible for coordinating all site activities, including those of the on-site contractors, and all laboratory activities. These include execution of the fieldwork in accordance with appropriate sections of this Corrective Measures Implementation Work Plan. Specific responsibilities include:

- Day to day execution of the Work Plan
- Reporting project progress to the Task Manager
- Coordinating, directing and overseeing field technical support staff
- Providing overall direction and supervision of the site work and related activities
- Ensuring that all staff and subcontractors meet White Sands security requirements
- Completing all appropriate field logs for project activities
- Providing overall supervision of the collection, handling, and shipping of all samples
- Monitoring sampling operations to ensure that all project site personnel are fully implementing and executing the provisions of this Work Plan
- Understanding the quality requirements of each field task, and bringing to the attention of management, conditions which may adversely impact the quality of the data or other work product.
- Execution of all field QC procedures

5.1.6 Site Health and Safety Officer

The Site Health and Safety Officer will report to the Task Manager and be responsible for:

- Directing all health and safety activities on site
- Reporting safety-related incidents or accidents to the Task Manager
- Temporarily suspending field activities, if health and safety of personnel are endangered
- Maintaining health and safety equipment on-site
- Conducting pre-work and daily health and safety meetings
- Verifying personnel working on the site have completed medical surveillance and health and safety training.
- Maintaining documentation of health and safety measures taken at the site, including:
  - Communication of provisions of the Site Safety and Health Plan
  - Levels of protection and required upgrades
  - Incident reporting
  - Upgrading or downgrading levels of protection in response to field conditions

5.1.7 Project Chemist

As part of the project team, the project chemist will provide technical support during sample collection and analysis. The project chemist will report to the Task Coordinator and duties will include:

- Evaluating analytical data to determine usability of results
- Verifying laboratory procedures and QA protocols
- Immediate notification to the Task Manager of potential data problems
- Confirming field QC procedures to obtain representative data

5.2 Work Products

5.2.1 Progress Reports

During implementation of the Rhodes Canyon Landfill CMI, progress reports will be submitted on a quarterly basis. These quarterly progress reports shall be submitted during construction and Post Closure Care of the cover. These progress reports shall include:

1. A description of significant activities during the reporting period.
2. A summary of cover effectiveness with a comparison of the cover anticipated effectiveness.
3. Summaries of all findings including any inspection results.
4. Summaries of all contacts with representatives of the local community, public interest groups or regulatory officials during the reporting period.
5. Summaries of all problems or potential problems encountered during the reporting period.
6. Actions being taken/planned to rectify problems.
7. Changes in personnel during the reporting period.
8. Projected work for the next reporting period.
9. Any results of testing/data generated during the reporting period requested by regulatory officials shall be provided.

5.2.2 Construction Completion Report

Following the completion of the construction of corrective measures at Rhodes Canyon Landfill, a Construction Completion Report will be completed and submitted for review and approval. The Construction Completion Report will be submitted to NMED no later than 90-days following the completion of construction of the corrective measure. The purpose of the Construction Completion Report is to document that the project was completed in accordance with the Final Plans and Specifications. The construction Completion Report will include, at a minimum, the following elements:

1. Purpose.
2. Synopsis of the corrective measure, design criteria, and certification that the corrective measure was constructed in accordance with the Final Plans and Specifications.
3. Explanation and description of any modifications to the Final Plans and Specifications and why these were necessary for the project.
4. Results of any operational testing and/or monitoring, indicating how initial operation of the corrective measure compares to the design criteria.
5. Summary of significant activities that occurred during construction. Included will be a discussion of problems encountered and how they were addressed.
6. Summary of any inspection findings, included will be copies of key inspection documents in the appendices.
7. As built drawings and/or photographs.
8. Schedule indicating when any treatment systems will begin full-scale operations.

5.2.3 Corrective Measures Completion Report

Following the completion of corrective measures at Rhodes Canyon Landfill, a Corrective Measures Completion Report will be completed and submitted for review and approval.
The Corrective Measures Completion Report will be submitted to NMED no later than 90-days following completion of corrective measures. Completion of the corrective measures will be determined based on the 5-year review, which could continue for 25 years. The purpose of the Corrective Measures Completion Report is to fully document how the corrective measure completion criteria have been satisfied and why the corrective measure and/or monitoring may cease. The Corrective Measure Completion Report shall, at a minimum include the following elements:

1. Purpose.
2. Synopsis of the corrective measure.
3. Corrective Measure Completion Criteria: A description of the process and criteria for determining when corrective measures, maintenance and monitoring may cease.
4. Demonstration that the completion criteria have been met. Included will be results of testing and/or monitoring, indicating how operation of the corrective measure compares to the completion criteria.
5. A summary of work accomplishments (e.g., performance levels achieved, total hours of treatment operation, total treated and/or excavated volumes, nature and volume of wastes generated, etc.).
6. Summary of significant activities that occurred during operations. Included will be a discussion of problems encountered and how they were addressed.
7. Summary of inspection findings (included will be copies of key inspection documents in appendices).
8. Summary of total operation and maintenance costs associated with the corrective measure.

5.2.4 Performance Monitoring Report

A performance monitoring report will be submitted to the NMED annually, which summarizes the groundwater monitoring results, cap inspections and maintenance. The report will include, at a minimum the following elements:

1. Introduction
2. Scope of services
3. Regulatory Criteria
4. Post Closure Care Inspections and Maintenance
5. Groundwater Monitoring Results
6. Groundwater Chemical Analytical Data
7. Summary

5.3 Public Involvement Plan

The purpose of the Public Involvement Plan for the construction of the soil cover at Rhodes Canyon Landfill is to provide a plan for the involvement of the public for the proposed Corrective Measures at the Rhodes Canyon Landfill. White Sands will do all of the following depending on the interest of the public:

1. Conduct an open house/informal meeting in a public location where people can talk with NMED and WSMR one-to-one regarding the Rhodes Canyon Landfill CMI.
2. Maintain an easily accessible public repository of information on the site-specific corrective action program. This information shall include all permits, approved work plans and reports associated with the corrective action.
3. Publish a newsletter for distribution to the interested public describing the proposed action.

The schedule for implementation of the public involvement plan is included in Table 5-1.

Table 5-1. Public Involvement Plan Schedule

Task	Completion Date
CMI re-submittal to NMED	10 June 03
NMED CMI Technical Review	30 June 03
Public Meeting	30 July 03
Public Comment Period (45 days)	15 September 03
NMED approval and Notice to Proceed	26 September 03
Initiate Implementation of CMI	1 October 03

5.4 Cost Estimate/Financial Assurance

A cost estimate for the implementation of the proposed corrective measures as outlined in this report is detailed below in the Table 5-2. Table 5-2 provides a cost estimate for the clean closure of the Rhodes Canyon Landfill for cost comparison purposes. The final estimate and or costs may vary based on actual contractor estimates. The detailed cost estimates are provided in Appendix I. Because White Sands Missile Range is a Federal Facility, it is exempt from the Financial Assurance requirements of 40 CFR 265.

Table 5-2. Construction of a Soil Cover/O&M/Monitoring Cost Estimate.

Task	Cost Estimate (thousands)
Construction of the soil cover.	$435
Installation of Monitoring Wells, site perimeter fence and signs	$217
Groundwater Monitoring (1-25 years)*	$1,823
O&M of site (1-25 years)*	$438
Grand Total	**$2,913**

Notes:
$ = Current U.S. Dollars.
* = Assuming 3% inflation every year throughout the span of O&M and groundwater monitoring.

Table 5-3. Clean Closure Cost Estimate.

Task	Cost Estimate (thousands)
Clean Closure	**$25, 666**

Notes:
$ = Current U.S. Dollars.

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