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Corrective Action Decision Document
for the Roller Coaster Lagoons
and North Disposal Trench
(Corrective Action Unit No. 404)

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Revision No.: 0

March 1997

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**CORRECTIVE ACTION DECISION DOCUMENT
FOR THE ROLLER COASTER LAGOONS
AND NORTH DISPOSAL TRENCH
(CORRECTIVE ACTION UNIT NO. 404)**

DOE Nevada Operations Office
Las Vegas, Nevada

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**CORRECTIVE ACTION DECISION DOCUMENT
FOR THE ROLLER COASTER SEWAGE LAGOONS
AND NORTH DISPOSAL TRENCH
(CORRECTIVE ACTION UNIT NO. 404)**

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List of Acronyms and Abbreviations

CADD	Corrective Action Decision Document
CAIP	Corrective Action Investigation Plan
CAS	Corrective Action Site
CAU	Corrective Action Unit
CFR	<i>Code of Federal Regulations</i>
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
FFACO	<i>Federal Facility Agreement and Consent Order</i>
ft	Foot (feet)
m	Meter(s)
m ³	Cubic meter(s)
NAC	<i>Nevada Administrative Code</i>
NDEP	Nevada Division of Environmental Protection
ppb	Part(s) per billion
PRG	Preliminary Remediation Goal
RCRA	Resource Conservation and Recovery Act
TPH	Total petroleum hydrocarbon
TTR	Tonopah Test Range
VCA	Voluntary Corrective Action
yd ³	Cubic yard(s)

1.0 Introduction

The *Corrective Action Decision Document for the Roller Coaster Lagoons and North Disposal Trench* (Corrective Action Unit [CAU] No. 404) has been prepared for the U.S. Department of Energy's (DOE) Nevada Environmental Restoration Project. This Corrective Action Decision Document (CADD) has been developed to meet the requirements of the *Federal Facility Agreement and Consent Order* as stated in Appendix VI, "Corrective Action Strategy" (FFACO, 1996). The Roller Coaster Lagoons (Corrective Action Site [CAS] No. TA-03-001-TA-RC) and the North Disposal Trench (CAS No. TA-21-001-TA-RC) are included in CAU No. 404. The Roller Coaster Lagoons CAS is comprised of two large, unlined lagoons that received liquid sanitary waste during operation of the Operation Roller Coaster man camp; however, debris from construction and range cleanup was received in the lagoons following subsequent man camp operations. The man camp supported up to 600 people for approximately two months in 1963 (DOE/NV, 1996a).

The North Disposal Trench, located north of the eastern most lagoon, was installed in 1963 to receive solid waste and construction debris from the Operation Roller Coaster man camp. Subsequent to Operation Roller Coaster, the trench continued to receive construction debris and range cleanup debris (including ordnance) from Sandia National Laboratories and other operators. A small hydrocarbon spill occurred during Voluntary Corrective Action (VCA) activities (VCA Spill Area) at an area associated with the North Disposal Trench CAS. Remediation activities at this site were conducted in 1995 (DOE/NV, 1996a). A corrective action investigation was conducted in September of 1996 following the Corrective Action Investigation Plan (CAIP); the detailed results of that investigation are presented in Appendix A. The Roller Coaster Lagoons and North Disposal Trench are located at the Tonopah Test Range (TTR), a part of the Nellis Air Force Range, which is approximately 225 kilometers (140 miles) northwest of Las Vegas, Nevada, by air (Figures 1-1 and 1-2).

1.1 Purpose

The purpose of this CADD is to identify and provide a rationale for the selection of a recommended corrective action alternative based on process knowledge and the results of the corrective action investigation at the Roller Coaster Lagoons and North Disposal Trench.

Source: DOE/NV, 1992

LEGEND

- Nevada Test Site
- Tonopah Test Range boundary
- Nellis Air Force Range boundary
- - - State Line
- Road or Highway
- City

**Figure 1-1
 Tonopah Test Range Location Map**

LEGEND

- Tonopah Test Range boundary
- Primary roadway
- ▨ Operation Roller Coaster sites
- Area/gate
- ♀ Spring
- BLM Bureau of Land Management
- NAFL Nellis Air Force Range
- TTR Tonopah Test Range

SCALE

Source: Adapted from DOE/AL, 1992

Figure 1-2
Location of the Roller Coaster Lagoons and
North Disposal Trench CAU at the Tonopah Test Range

1.2 Scope

The scope of this CADD consists of the identification, evaluation, and recommendation of a preferred corrective action alternative to be implemented at the Roller Coaster Lagoons and North Disposal Trench CASSs. To achieve this scope, the following actions have been taken:

- Review and discuss the current site conditions, including the nature and extent of contamination.
- Develop corrective action objectives.
- Identify screening.
- Develop corrective action alternatives.
- Evaluate (detailed and comparative evaluation) the corrective action alternatives in relation to the corrective action standards and decision factors.
- Recommend and justify a preferred corrective action alternative.

1.3 CADD Contents

This CADD has been divided into the following sections:

- Section 1.0 - Introduction
 - Summarizes the purpose and scope of this CADD
- Section 2.0 - Corrective Action Investigation Summary
 - Provides a brief site background and the historical use of the site. It also summarizes the results of the investigation activities and the need for corrective action.
- Section 3.0 - Evaluation of Alternatives
 - Documents the steps taken in determining a preferred corrective action alternative
This included the following:
 - Identification of corrective action objectives
 - Identification of U.S. Environmental Protection Agency (EPA) screening criteria
 - Development of corrective action alternatives
 - Evaluation and comparison of corrective action alternatives
 - Recommendation of a preferred corrective action alternative
- Section 4.0 - Recommended Alternative
 - Presents the preferred corrective action alternative and the rationale for its selection based on the corrective action objectives and screening criteria

- Section 5.0 - References
 - Presents a list of all referenced documents. All work was performed in accordance with the *Corrective Action Investigation Plan: Roller Coaster Lagoons and North Disposal Trench, Tonopah Test Range* (DOE/NV, 1996a), the *Industrial Sites Quality Assurance Project Plan* (DOE/NV, 1994), and the *Corrective Action Unit Work Plan, Tonopah Test Range* (DOE/NV, 1996b).
- Appendix A - *Roller Coaster Lagoons and North Disposal Trench Corrective Investigation Report, Corrective Action Unit No. 404, Tonopah Test Range*
- Appendix B - Cost Estimates
- Appendix C - Comment/Response Form
 - Presents NDEP's comments and DOE's responses on the draft CADD

2.0 Corrective Action Investigation Summary

The following sections describe and summarize the results of the investigation activities conducted at the Roller Coaster Lagoons and North Disposal Trench CASs. Based on this information, corrective action objectives were developed to aid in the formation of corrective action alternatives.

2.1 Investigation Activities

In September 1996, IT Corporation performed a corrective action investigation that consisted of the following activities as set forth in the CAIP (DOE/NV, 1996a):

- Collected environmental surface soil samples for field screening and laboratory analysis
- Field-screened soil samples using headspace analysis for volatiles, colorimetric testing for total petroleum hydrocarbons (TPHs), and screening methods for beta and gamma radiation
- Submitted environmental samples for laboratory analysis of volatile organic compounds, semivolatile organic compounds, TPH, pesticides, Resource Conservation and Recovery Act (RCRA) metals, and beta/gamma radiation (if detected in field screening samples)

In addition, historical documents and process knowledge were used to assist in the identification of potential contaminants (Appendix A and DOE/NV, 1996a).

2.2 Results

A summary of the corrective action investigation results (Appendix A) indicated the following:

- Elevated levels of pesticides (above EPA *Region IX Preliminary Remediation Goals* [PRGs] [EPA, 1996]) were identified in the West and East Lagoon surface soils.
- No other constituents were detected above regulatory levels (i.e., EPA Region IX PRGs).

Details of the methods used and the results found during the investigation activities are presented in Appendix A.

- Screening of sample locations was below background radiological levels (less than 100 disintegrations per minute [dpm]); therefore, samples were not collected and analyzed by gamma spectroscopy.

2.3 *Need for Corrective Action*

In both the East and West Lagoons, pesticide concentrations were identified in the surface soil samples above EPA residential PRGs (EPA, 1996). In addition, pesticide concentrations were also above EPA industrial PRGs (EPA, 1996) in the West Lagoon. The PRGs are human health risk-based screening values which when exceeded indicate a potential unacceptable risk depending on a land-use scenario (i.e., industrial or residential). Because the concentrations exceed PRGs, corrective action will be required. Each lagoon is approximately 60 meters (m) (200 feet [ft]) long by 30 m (100 ft) wide with an approximate 0.3 m (1 ft) depth of impacted soils. Although contaminant levels are below regulatory levels at the North Disposal Trench CAS, the open surface depression creates an "attractive nuisance" for unpermitted waste dumping. To eliminate unauthorized dumping, the pit should be backfilled and brought to grade. The approximate length of the North Disposal Trench is 30 m (100 ft) long by 3 m (15 ft) wide.

3.0 Evaluation of Alternatives

The purpose of this section is to present the corrective action objectives for the Roller Coaster Lagoons and North Disposal Trench CASs; to present and describe the general standards and decision factors that will be used for screening alternatives; to identify and screen a baseline of proven, viable technologies; and to develop and evaluate a set of corrective action alternatives which will be used to meet the corrective action objectives.

3.1 Corrective Action Objectives

Corrective action objectives are media-specific goals for protecting human health and the environment, and they constitute the basis for the development of corrective action alternatives. The corrective action objectives are expressed in terms of contaminants, media of interest, potential exposure pathways, and cleanup goals so that an appropriate range of waste management options can be developed for analysis. In addition, the proposed corrective action must be technically sound, provide a permanent solution for the site, and be cost-effective. It must also be acceptable to DOE, the Nevada Division of Environmental Protection (NDEP), and the public.

Based on the potential exposure pathways discussed in Section 3.1.2, the following corrective action objective has been identified for the Roller Coaster Lagoon CAS: prevent or mitigate potential human exposure to surface soils containing identified pesticides (i.e., dichlorodiphenyldichloroethylene [DDE], dichlorodiphenyldichloroethane [DDD], and dichlorodiphenyltrichloroethane [DDT]).

No corrective action objectives resulting from regulatory or risk-based requirements have been identified for the North Disposal Trench because no chemicals of concern were identified above regulatory levels (EPA, 1996). However, the open pit at the trench is an inviting target for unpermitted disposal of debris. Therefore, the North Disposal Trench should be considered for some corrective action to remove the "attractive nuisance" (e.g., covering the trench with clean fill to original grade or erecting fences).

3.1.1 Chemicals of Concern

Analytes detected as a result of the investigation activities were evaluated to determine potential chemicals of concern. Based on the results of this evaluation, pesticides (DDE and DDT) were

identified in the West Lagoon above EPA Region IX industrial PRGs (EPA, 1996) (i.e., potentially unacceptable [1×10^{-6}] human health risk). While DDD, DDT, and DDE were identified above EPA Region IX residential PRGs (EPA, 1996). In the East Lagoon, DDE and DDT were identified above EPA Region IX residential PRGs (EPA, 1996). All other analyzed constituents were below levels which are protective of human health and the environment. No elevated levels of analyzed constituents were found at the North Disposal Trench CAS.

Process knowledge indicates that the lagoons received liquid sanitary waste for a limited time (approximately two months) and, thereafter, debris from construction and range cleanup activities. During investigative activities conducted in 1995 (DOE/NV, 1996a), most visible debris was removed from the lagoons and trench, thereby mitigating further releases to the environment.

3.1.2 Potential Exposure Pathways

Two potential exposure routes exist at the sites: inhalation of dust and ingestion of soil. Since surface soils are impacted by pesticides above residential and/or industrial EPA Region IX PRG (EPA, 1996) levels, inhalation of dust could be a potentially harmful exposure route. High winds and dust devils could cause suspension of the impacted surface soils. Additionally, if intrusive activities occur at the sites, ingestion of the impacted soils could be a potentially harmful exposure route.

Therefore, the potential exposure pathways for the lagoons would include the following:

- Incidental ingestion/inhalation of surface soils containing pesticides by current or future workers or potential future residents
- Dermal contact with surface soils containing pesticides by current or future workers or potential future residents

3.1.3 Preliminary Cleanup Goals

Preliminary cleanup goals were identified for the East and West Roller Coaster Lagoons CAS for the identified chemicals of concern. The cleanup goals were selected to be compatible with a

residential or industrial land-use scenario. The preliminary soil cleanup goals identified for the lagoons are the EPA Region IX PRGs (EPA, 1996) as follows:

- Residential Scenario:
 - DDD - 1,850 parts per billion (ppb)
 - DDE - 1,310 ppb
 - DDT - 1,310 ppb
- Industrial Scenario:
 - DDD - 7,950 ppb
 - DDE - 5,610 ppb
 - DDT - 5,610 ppb

Prior to setting final cleanup goals, a risk management decision needs to be made as to a final end use.

3.2 Screening Criteria

The screening criteria used to evaluate and select the preferred corrective action alternatives consisted of a variety of general standards and decision factors described in the Title 40 *Code of Federal Regulations* (CFR) Sections 260-271 and the following EPA guidance documents: *Guidance on Resource Conservation and Recovery Act Corrective Action Decision Documents* (EPA, 1991) and *Final Resource Conservation and Recovery Act Corrective Action Plan* (EPA, 1994).

The corrective action alternatives developed in Section 3.3 will be evaluated based on four general corrective action standards and five remedy selection decision factors, as described in the following text. All corrective action alternatives must meet the general standards to be selected for evaluation using the remedy selection decision factors used in the evaluation process.

The general corrective action standards are as follows:

- Attain overall protection of human health and the environment.
- Attain media cleanup standards.
- Control the source of the release(s).

- Comply with standards for management of hazardous waste as specified in Title 40 CFR 260-271 and with corrective action standards as adopted to amend *Nevada Administrative Code* (NAC) 445A, September 1996 (NAC, 1996).

The remedy selection decision factors are as follows:

- Short-term reliability and effectiveness
- Reduction of toxicity, mobility, and/or volume
- Long-term reliability and effectiveness
- Implementability
- Cost

The corrective action general standards and decision factors are described in further detail in the following text.

3.2.1 Protect Human Health and the Environment

Protection of human health and the environment is a general mandate of the RCRA statute (EPA, 1994). This standard requires that the corrective actions include any measures that are needed to be protective. These measures may or may not be directly related to media cleanup, source control, or management of wastes.

3.2.2 Attain Media Cleanup Standards

Each corrective action alternative must have the ability to meet the proposed media cleanup standards (EPA, 1996) (i.e., meet acceptable levels for removal of contaminants).

3.2.3 Control the Sources of the Release

A critical objective of any remedy must be to stop further environmental degradation by controlling or eliminating further releases that may pose a threat to human health and the environment. Unless source control measures are taken, efforts to clean up releases may be ineffective or, at best, will essentially involve a perpetual cleanup. Therefore, each corrective action alternative must use an effective source control program to ensure the long-term effectiveness and protectiveness of the corrective action effort.

3.2.4 Comply with Applicable Standards for Management of Wastes

During implementation of any corrective action alternative, all waste management activities must be conducted in accordance with all applicable state and federal regulations (e.g., RCRA Title 40

CFR land disposal restrictions). The requirements for management of the wastes, if any, derived from the corrective action characterization will be determined based on federal regulatory requirements (Title 40 CFR 262), field observations, process knowledge, and the results of laboratory analyses. Administrative controls (e.g., contractor decontamination procedures and characterization strategies) will minimize waste generated during site corrective action activities. Decontamination activities shall be performed in accordance with procedures as specified in an NDEP-approved work plan and will be designated according to the contaminants of concern present at the site. Waste management practices are detailed below.

3.2.4.1 Waste Minimization

The corrective action activities will be designed to minimize the amount of corrective action-derived waste produced. Waste produced will include excavated soil, used personal protective equipment, and decontamination waste.

3.2.4.2 Potential Waste Streams

Based on the corrective action characterization activities and process knowledge, no radioactive, hazardous, or mixed wastes are anticipated. Solid waste would consist of general construction debris, trash, soil, disposable personal protective equipment, and sampling equipment.

3.2.4.3 Waste Determination

Solid materials other than soils are waste only by virtue of contact with contaminated media. Therefore, sampling and analysis of any investigation-derived waste, separate from verification analyses, should not be required during corrective action activities.

3.2.4.4 Waste Management

Suspected hazardous wastes shall be managed in accordance with RCRA and State of Nevada hazardous waste management regulations (Title 40 CFR 262 and 265). Suspected hazardous wastes must be managed in accordance with RCRA and State of Nevada hazardous waste management regulations, interpreted as follows. Suspected hazardous wastes will be placed in U.S. Department of Transportation (DOT)-compliant drums or other DOT-compliant containers, which will be locked or fitted with tamper-indicating devices. The containers shall be compatible with the waste in accordance with the requirements of Title 40 CFR 265.172. Containers shall be handled and inspected in accordance with the requirements of Title 40 CFR 265.173 and 174, respectively. Incompatible wastes shall be managed in accordance with

Title 40 CFR 265.177 based on process knowledge (i.e., shall not be placed in the same container and shall be separated so that, in the event of a spill, leak, or release, suspected incompatible wastes shall not contact one another).

Wastes shall be characterized in accordance with the requirements of Title 40 CFR 262.11. Characterization will be based on laboratory results, process knowledge, or a combination of both. Waste pending characterization will be marked with "Hazardous Waste Awaiting Analysis" labels until its regulatory status can be determined through the receipt and evaluation of laboratory results. Once a waste determination has been made, the waste containers shall be relabeled to reflect the correct regulatory status. Waste shall be traceable to its source and/or samples considered analogous to the waste (such as waste drill core associated with a sample). Traceability shall be maintained by numbering containers and keeping appropriate records which trace waste to samples, areas, or products. After receipt of analytical results, RCRA-regulated hazardous wastes will be labeled and marked in accordance with the requirements of Title 40 CFR 262.32 and State of Nevada requirements such as writing the EPA Waste Code on the hazardous waste label (NAC 445A). If the waste is not RCRA-regulated hazardous waste, the label will be removed, and the waste will be managed as a sanitary waste (Title 40 CFR 258).

The RCRA-regulated hazardous wastes will be accumulated at the site of generation in accordance with Title 40 CFR 262.34. If a waste determination cannot be made within 90 days, a request for an extension will be made to NDEP. This request will be made prior to 90 days after the accumulation start date as specified in Title 40 CFR 252.34. The waste will be transported to the permitted hazardous waste storage pad in Area 5 of the Nevada Test Site or will be shipped to an off-site permitted treatment, storage, and disposal facility by an appropriately licensed and permitted hazardous waste hauler. A Uniform Hazardous Waste Manifest shall be completed prior to shipping hazardous waste off site in accordance with the requirements of Title 40 CFR 262.20, 262.21, 262.22, and 262.23. A copy of the manifest shall be provided to the State of Nevada.

3.2.5 Short-Term Reliability and Effectiveness

Each corrective action alternative must be evaluated with respect to its effects on human health and the environment during the construction and implementation phases of the corrective action. The following factors will be addressed for each alternative:

- Protection of the community to address any risk that results from implementation such as fugitive dusts, transportation of hazardous materials, or air quality impacts from off-gas emissions
- Protection of workers during construction and implementation
- Environmental impacts which may result from construction and implementation
- The amount of time until corrective actions are achieved

3.2.6 Reduction of Toxicity, Mobility, and/or Volume

Each corrective action alternative must be evaluated for its ability to reduce the toxicity, mobility, and/or volume of the contaminated media. Reduction in toxicity, mobility, and/or volume refers to changes in one or more characteristics of the contaminated media by the use of corrective measures that decrease the inherent threats associated with the media.

3.2.7 Long-Term Reliability and Effectiveness

Each corrective action alternative must be evaluated in terms of risk remaining at the site after corrective action objectives have been met. The primary focus of this evaluation is on the extent and effectiveness of the controls that may be required to manage risk posed by treatment residuals and/or untreated wastes.

3.2.8 Implementability

The implementability criterion addresses the technical and administrative feasibility of implementing a corrective action alternative and the availability of various services and materials needed during implementation. Each corrective action alternative must be evaluated for the following criteria: Construction and Operation, Administrative Feasibility, and Availability of Services and Materials.

- "Construction and Operation" refers to the feasibility of implementing a corrective action alternative given the existing set of waste and site-specific conditions.
- "Administrative Feasibility" refers to the administrative activities needed to implement the corrective action alternative (e.g., permits, public acceptance, rights of way, off-site approval, etc.).
- "Availability of Services and Materials" refers to the availability of adequate off-site and on-site treatment, storage capacity, disposal services, needed technical services and materials, and availability of prospective technologies for each corrective action alternative.

3.2.9 Cost

The cost estimate for each corrective action alternative shall include both capital and operation and maintenance costs, if applicable. The following is a brief description of the components of both of these costs:

- **Capital Costs:** These costs would include both direct and indirect costs. Direct costs may consist of materials, labor, mobilization, demobilization, site preparation, construction materials, equipment purchase and rental, sampling and analysis, waste disposal, and health and safety measures. Indirect costs would include such items as engineering design, permits and/or fees, start-up costs, and any contingency allowances.
- **Operation and Maintenance:** These costs would include labor, training, sampling and analysis, maintenance materials, utilities, quality assurance, and health and safety measures.

A net present worth will be calculated for each corrective action alternative if long-term operation and maintenance are required.

3.3 Development of Corrective Action Alternatives

This section will identify and briefly describe potential corrective actions and viable corrective action technologies that will be considered for the affected media.

3.3.1 Identification of Corrective Action Technologies

Viable technologies considered to be implementable at the Roller Coaster Lagoons are as follows:

- Access Restrictions
- Covering
- Excavation
- Off-Site Disposal

Other frequent technologies (i.e., stabilization) and innovative technologies were considered in the CADD. The selected technologies use standard construction methods.

3.3.1.1 Access Restrictions

Institutional controls are physical and administrative controls, such as fencing and deed restrictions, which can preclude the access or use of specified lands. Access restrictions have been commonly used at other DOE facilities nationwide. The TTR, including the Roller Coaster

Lagoons and North Disposal Trench CASs, is a restricted-access facility. Additional physical access restrictions (i.e., fences and placards) could be easily implemented; however, they may not completely prevent access to the area. Fences and locks can be breached, and placards may not stop unauthorized use of the area.

Deed restrictions, which are administrative access restrictions, specify acceptable land use and may take several forms, such as providing covenants against activities that bring humans in contact with contaminants. Deed restrictions may include requirements for approval of excavations beyond a specified depth or limitations on land use by prohibiting activities such as grazing and farming.

In general, access restrictions as stand-alone responses are considered to have limited effectiveness, but they may be used in conjunction with other technologies to increase the effectiveness of both options.

3.3.1.2 Covering

Covering generally involves the installation of a barrier over the surface of an impacted area to control erosion, limit precipitation infiltration, and mitigate potential exposure pathways.

For estimation purposes, this CADD assumes that groundwater at the site has not been impacted and that an engineered, vegetative cover that meets specified permeability and infiltration criteria will be used. The impacted area would be backfilled with clean, compacted soil and recontoured to minimize surface depressions, to provide final grade, and to provide adequate foundation for the vegetative cover. Approximately one foot of clean top soil would be placed over the backfilled soils. This top soil would be compacted and seeded with shallow-rooted native grasses (to prevent plant uptake of contaminants) that would prevent erosion, would mitigate human contact with the impacted soils, and would minimize the impacts of weathering.

3.3.1.3 Excavation

Excavation is the process of removing soils and other materials with construction equipment such as front-end loaders, backhoes, and excavators. Excavation is a well-developed technology commonly used in the mining and construction industry and is commonly used for remediation of shallow subsurface soils. Excavation equipment is commercially available with optional equipment for unique applications (e.g., a telescopic excavator boom for long-reach). Standard

excavation equipment is capable of handling a wide range of materials (including rock, gravel, and bulk materials) at relatively high capacities.

This CADD assumes that the soils are capable of being excavated without the use of specialized earth moving equipment. Removal of contaminated soils would continue until post-excavation "verification" soil samples taken at the bottom of the excavation meet corrective action objectives. The excavated areas would be backfilled with uncontaminated soils and recontoured to eliminate topographic depressions.

3.3.1.4 Off-Site Disposal

Off-site disposal would include the packaging, transportation, and disposal of pesticide-contaminated soils generated during corrective action activities to an off-site, approved landfill or treatment facility (i.e., incinerator). Landfill disposal sites for nonhazardous and hazardous waste are located throughout the United States. This remedial technology is generally accepted by the EPA and is commonly used in industry. Off-site disposal costs are dependent on the distance to the disposal facility and the classification of the waste. General heavy equipment (i.e., baseline, front-end loaders) and manual labor (i.e., shoveling) would be used to load the waste into the appropriate containers.

3.3.2 Corrective Action Alternatives

The corrective action technologies presented in Section 3.3.1 are viable for use in the remediation of the Roller Coaster Lagoons CAS and have been proven effective at other sites with similar contaminants and conditions. A combination of these candidate technologies has been assembled into specific corrective action alternatives that have the potential to meet the stated corrective action objectives.

Based on a review of existing data and current operations at the TTR, the following four corrective action alternatives have been developed for consideration in the remediation of the Roller Coaster Lagoons.

- Alternative 1 - No Action (for baseline comparison only)
- Alternative 2 - Access Restrictions
- Alternative 3 - Excavation and Covering
- Alternative 4 - Covering

An overview of these alternatives is presented below.

3.3.2.1 Alternative 1 - No Action

This alternative is used as a starting point to establish a baseline for comparison with the other alternatives. This alternative does not meet the general standards for overall protection of human health and the environment and does not meet the objectives for attaining media cleanup standards; and, therefore, it will not be compared with the decision factors.

3.3.2.2 Alternative 2 - Access Restrictions

This alternative consists primarily of installation of placards. Under this alternative, signs will be placed at the lagoons and trench to prohibit illegal dumping. In addition, deed restrictions may be required on the land to prevent intrusive activities.

3.3.2.3 Alternative 3 - Excavation and Covering

The major components of this alternative consist of the following tasks:

- Excavation, packaging, transportation, and disposal of pesticide-contaminated soils from the West Lagoon to an off-site location
- Installation of engineered, vegetative covers

Under this alternative, commercially available equipment will be used to excavate an estimated 258 m³ (9,335 ft³) of pesticide-impacted soils from the West Lagoon, which are above EPA Region IX industrial PRGs (EPA, 1996) (i.e., top one foot of soils). These soils will be packaged and transported to an appropriate, off-site, approved landfill (depending on the sample results).

The pesticide-contaminated soils at the East Lagoon are above EPA Region IX residential PRGs (EPA, 1996). Therefore an engineered, vegetated cover will be placed over the soils to remove potential exposure pathways. Soils at the North Disposal Trench are not above EPA Region IX PRGs industrial or residential (EPA, 1996). This CAS is, however, an attractive area for unrestricted debris disposal; therefore, under this alternative a vegetative cover will be placed over the North Disposal Trench soils to remove this nuisance. If appropriate, the North Disposal Trench could be regraded to eliminate the surface depression.

Approximately 5,434 m³ (7,100 yd³) of clean borrow soil will be removed from an on-site location (or if not available, imported from an off-site location) and transported to both lagoon locations and the trench location. The clean borrow soil will be placed in the surface depressions

caused by the lagoons and trench, compacted, and brought to grade. Approximately 543 m³ (710 yd³) of clean top soil seeded with native vegetation will be placed over the borrow material. Placement of the top soil and vegetation will mitigate future exposure pathways to underlying pesticide-impacted soils and minimize erosion and dust.

Because impacted soils are left in place, deed restrictions on the land may be required to prevent intrusive activities.

3.3.2.4 Alternative 4 - Covering

The major component of this alternative will consist of installing engineered, vegetative covers.

The soils at the West Lagoon are above EPA Region IX PRGs (EPA, 1996) under a residential and industrial scenario; the soils at the East Lagoon are above EPA Region IX residential PRGs (EPA, 1996). Therefore, an engineered, vegetative cover will be placed over the lagoon soils to remove potential exposure pathways.

The soils at the North Disposal Trench are not above EPA Region IX industrial or residential PRGs (EPA, 1996). This CAS is an attractive area for unrestricted debris disposal; therefore, under this alternative a vegetative cover will be placed over the North Disposal Trench soils to remove the nuisance. If appropriate, the North Disposal Trench could be regraded to eliminate the surface depression.

Under this alternative, commercially available equipment will be used to excavate approximately 5,172 m³ (6,765 yd³) of clean borrow soil from an on-site location and transport it to the lagoons and trench locations. The clean borrow soil will be placed in the surface depressions caused by the lagoons and trenches, compacted, and brought to grade. Approximately 543 m³ (710 yd³) of clean top soil seeded with native vegetation will be placed over the borrow material. Placement of the top soil and vegetation will mitigate future exposure pathways to underlying pesticide-impacted soils and will minimize dust and erosion.

Because the impacted soils are left in place, deed restrictions on the land may be required to prevent activities such as intrusive digging, farming, and ranching.

3.4 *Evaluation and Comparison of Alternatives*

The detailed analysis consisted of comparing each corrective action alternative to the corrective action general standards and decision factors screening criteria details in Section 3.2. The comparative analysis consists of comparing each corrective action alternative to the other alternatives. In this way the advantages and disadvantages of each alternative are assessed in order to select a preferred alternative. Tables 3-1 and 3-2 present a summary of the detailed and comparative evaluations, respectively.

Table 3-1
Detailed Evaluation of the Corrective Action Alternatives
(Page 1 of 3)

Evaluation Criteria	Alternative 1 No Action	Alternative 2 Access Restrictions	Alternative 3 Excavation and Covering	Alternative 4 Covering
General Standards				
Overall Protection of Human Health and the Environment	Pesticide-impacted soils have been detected above EPA risk-based health screening criteria at the West and East Lagoons. Protection to the public will remain high because TTR is a restricted access facility and there are no populated areas near the subject areas. At sites with impacted soils, risks to the environment exist due to potential contaminant migration from precipitation infiltration and to humans from direct contact or inhalation. This alternative does not mitigate these potential threats.	Pesticide-impacted soils have been detected above EPA risk-based health screening criteria at the West and East Lagoons. Protection of the public will remain high because TTR is a restricted access facility and there are no populated areas near the subject areas. At sites with impacted soils, risks to the environment exist due to potential contaminant migration from precipitation infiltration and to humans from direct contact or inhalation. Fencing around the lagoons will effectively restrict access as well as hinder illegal dumping at this CAS.	Pesticide-impacted soils have been detected above EPA risk-based health screening criteria at the West and East Lagoons. Impacted soils will be removed from the West Lagoon and transported to an off-site landfill. In addition, clean soil will be backfilled into the West Lagoon and East Lagoon to mitigate/reduce potential exposure pathways. Worker exposure to the contaminants and worker safety during implementation will be controlled through appropriate health and safety procedures. Protection of the public will remain high because the TTR is a restricted-access facility, and no residential areas are nearby. Protection of the environment is achieved by removing the source of contamination from the West Lagoon and limiting contaminant migration at the East Lagoon by installing a vegetative cover.	Pesticide-impacted soils have been detected above EPA risk-based health screening criteria at the West and East Lagoons. A vegetative cover will be placed over the impacted soils to mitigate/reduce potential exposure pathways (i.e., inhalation and ingestion), eliminate erosion, and minimize precipitation infiltration. Worker exposure to the contaminants and worker safety will be controlled during implementation through appropriate health and safety procedures. Protection of the public will remain high because the TTR is restricted access facility, and no residential areas are near the subject areas. Protection of the environment is achieved by limiting contaminant migration by installing a vegetative cover.
Attain Media Cleanup Standards	This alternative does not involve remediation or removal of the pesticide-contaminated soils. Therefore, no cleanup standards will be achieved.	This alternative does not involve remediation or removal of the pesticide-contaminated soils. Therefore, no cleanup standards will be achieved.	Pesticide-impacted soils will be removed from the West Lagoon. Soils remain in the East Lagoon above EPA Region IX PRGs (EPA, 1996).	Pesticide-impacted soils above the EPA Region IX PRGs will remain in place at the East and West Lagoons.
Control the Sources of the Releases	There is no control of the release of contamination to humans or the environment.	There is no control of the release of contamination to humans or the environment.	At the completion of excavation activities, all pesticide-contaminated soils that pose a threat to human health will be permanently removed from the West Lagoon and the underlying soils resampled to verify that cleanup goals have been achieved. Pesticide-contaminated soils remain in place at the East Lagoon.	The pesticide-contaminated soils will remain in place. However, potential exposure pathways (inhalation and ingestion) will be mitigated through placement of an engineered vegetative cover.

Table 3-1
Detailed Evaluation of the Corrective Action Alternatives
 (Page 2 of 3)

Evaluation Criteria	Alternative 1 No Action	Alternative 2 Access Restrictions	Alternative 3 Excavation and Covering	Alternative 4 Covering
Comply with Standards for Management of Wastes	Contaminated soils are neither removed nor remediated.	Contaminated soils are neither removed nor remediated.	Impacted soils will be removed from the West Lagoon and disposed at an off-site landfill. Impacted soils remain in the East Lagoon; however, clean soil and placement of a vegetative cover will reduce potential exposure pathways.	Pesticide-contaminated soils are not removed from the lagoons. Soils remaining in the lagoons will be covered with clean soil and a vegetative cover which will reduce potential exposure pathways.
Selection Decision Factors				
Short-Term Reliability and Effectiveness	Not applicable - Not protective and not considered further.	There is no remediation proposed with this alternative; therefore, corrective action objectives will not be achieved. Impacts to human health and the environment will exist due to elevated levels of pesticide contamination.	Potential for releases of fugitive dust or contact with the soil during remediation activities will be mitigated by implementing appropriate health and safety procedures. All corrective action objectives will be achieved upon completion of the excavation and construction activities.	Potential for releases of fugitive dust or contact with the soil during remediation activities will be mitigated by implementing appropriate health and safety procedures. All corrective action objectives will be achieved upon completion of the construction activities.
Reduction of Toxicity, Mobility, and/or Volume	Not applicable	There is no reduction of toxicity, mobility, or volume of contaminants because remediation is not proposed.	The toxicity, mobility, and volume of pesticide-contaminated soil will be reduced to PRGs at the West Lagoon since the impacted soils (i.e., based on the cleanup goals) are removed and disposed off site. The toxicity and volume of pesticide-contaminated soils at the East Lagoon will not be reduced since the corrective action does not include removal or treatment. The vegetative cover will reduce the mobility of the contaminants by limiting precipitation infiltration.	The toxicity and volume of pesticide-contaminated soils will not be reduced since the corrective action does not include removal or treatment. The vegetative cover will reduce the mobility of the contaminants by limiting precipitation infiltration.

Table 3-1
Detailed Evaluation of the Corrective Action Alternatives
 (Page 3 of 3)

Evaluation Criteria	Alternative 1 No Action	Alternative 2 Access Restrictions	Alternative 3 Excavation and Covering	Alternative 4 Covering
Long-Term Reliability and Effectiveness	Not applicable	Elevated pesticide levels remain in the soils. The fact that TTR is a restricted access facility effectively controls the potential risk to human receptors. Fencing will be erected for added security and deed restrictions on the land may be required. Risks to the environment will exist due to potential contaminant migration from precipitation infiltration.	Post-closure care of the vegetative cover will be performed in accordance with applicable regulations. The fact that TTR is a restricted access facility effectively controls any potential risks to human receptors. Deed restrictions on the land may be required to prohibit certain land uses.	Post-closure care of the vegetative cover will be performed in accordance with applicable regulations. The fact that TTR is a restricted access facility effectively controls any potential risks to human receptors. Deed restrictions on the land may be required to prohibit certain land uses.
Implementability	Not applicable	Easily implementable. No remediation is proposed. Many vendors are available to install fencing and placards.	Easily implementable. A risk management decision is required to determine if cleanup is required based on a residential or occupational scenario; however, the corrective action will not increase the risk. Appropriate health and safety regulations will be implemented during construction activities. No adverse impacts are anticipated due to excavation and construction activities.	Easily implementable. A risk management decision is required to determine if cleanup is required based on a residential or occupational scenario; however, the corrective action will not increase the risk. Appropriate health and safety regulations will be implemented during construction activities. No adverse impacts are anticipated due to construction activities.
Cost	Not applicable	\$52,848	\$416,295	\$284,180

PRG = Preliminary Remediation Goal
 TTR = Tonopah Test Range
 EPA = U.S. Environmental Protection Agency
 CAS = Corrective Action Site

Note: The referenced EPA risk-based screening criteria are EPA Region IX Preliminary Remediation Goals (EPA, 1996).

Table 3-2
Comparative Evaluation of the Corrective Action Alternatives

Evaluation Criteria	Alternative 2 Access Restrictions	Alternative 3 Excavation and Covering	Alternative 4 Covering
General Standards			
Overall Protection of Human Health and the Environment	Alternative 2 offers the least degree of protection to human health and the environment and does not achieve the corrective action objectives. Pesticide-contaminated soils remain in place above regulatory levels (i.e., EPA Region IX PRGs).	Alternative 3 offers the highest level of protection for receptors on site. Pesticide-contaminated soils above regulatory levels in the West Lagoon are removed and disposed off site. Some degree of risk is present for receptors along the transportation routes and at the disposal facility selected for final disposition of the wastes. A vegetative cover will mitigate contact to the remaining soil and prevent erosion at the East Lagoon.	Alternative 4 offers a higher level of protection for receptors on site than Alternatives 2, but not as high as Alternative 3. Pesticide-contaminated soils that are above regulatory levels (i.e., EPA Region IX PRGs) remain in place. Placement of an engineered, vegetative cover will mitigate contact with the soils, prevent erosion, and limit precipitation infiltration.
Attain Media Cleanup Standards	Alternative 2 offers the least degree of attainment of media cleanup standards. This alternative does not involve cleanup or removal of the contamination.	Alternative 3 is the most effective in achieving cleanup standards. Pesticide-contaminated soils above regulatory levels are removed from the West Lagoon. Pesticide-contaminated soils remain in the East Lagoon; however, potential exposure pathways will be mitigated with placement of a vegetative cover.	Alternative 4 is more effective than Alternative 2, but not as effective as Alternative 3. Pesticide-contaminated soils remain which are above regulatory levels (i.e., Region IX PRGs). However, potential exposure pathways will be mitigated with the placement of a vegetative cover.
Control the Source of the Release	Alternative 2 offers the least degree of effectiveness. This alternative does not involve source control; however, fencing and deed restrictions will mitigate potential exposure to the soils. The fact that TTR is a restricted access facility effectively controls the source of releases to human receptors (i.e., the public).	Alternative 3 is the most effective in achieving cleanup standards. Pesticide-contaminated soils above regulatory levels (i.e., EPA Region IX PRGs) are removed from the West Lagoon. Pesticide-contaminated soils remain in the East Lagoon. Potential exposure pathways will be mitigated with placement of an engineered, vegetative cover.	Alternative 4 is more effective than Alternatives 1 and 2, but not as effective as Alternative 3. Pesticide-contaminated soils remain which are above regulatory levels (i.e., EPA Region IX PRGs). However, potential exposure pathways will be mitigated with the placement of an engineered, vegetative cover.
Comply with Standards for Management of Wastes	Alternative 2 does not achieve the corrective action objectives. This alternative does not involve remediation or removal of contamination.	Less effective than Alternative 4. If the soils are excavated from the lagoons, the pesticide concentrations will make the soils hazardous waste and they must be managed in accordance with 40 CFR 260 (CFR, 1996).	Standards for management of waste are most easily satisfied by this alternative. Pesticide contamination was likely due to application for weed control (DOE/NV, 1996a). If the soils remain in place, it can be argued that they are not subject to solid waste requirements. If the soils are excavated from the lagoons, the pesticide concentrations would make the soils hazardous waste.
Selection Decision Factors			
Short-Term Reliability and Effectiveness	Alternative 2 is less effective than Alternatives 3 and 4. Corrective action objectives are not achieved because no remediation is proposed.	Alternatives 3 and 4 are judged to offer a high degree of short-term effectiveness. No adverse impacts are anticipated to the public or workers. Appropriate health and safety procedures will minimize impacts to workers during construction activities.	
Reduction of Toxicity, Mobility, and/or Volume	Alternative 2 is less effective than Alternatives 3 and 4. There is no reduction of toxicity, mobility, or volume of contaminants.	Alternative 3 is the most effective in reducing toxicity, mobility, and volume of the contaminants on site. Pesticide-contaminated soils located in the West Lagoon above regulatory levels will be removed and disposed off site. At the East Lagoon, pesticide-contaminated soils above regulatory levels remain in place. However, installation of an engineered, vegetative cover will reduce potential migration of the contaminants.	Alternative 4 is more effective in reducing toxicity, mobility, and volume of the contaminants on site than Alternative 2, but not as effective as Alternative 3. Pesticide-contaminated soils above regulatory levels remain in place. However, installation of an engineered, vegetative cover will reduce potential migration of the contaminants.
Long-Term Reliability and Effectiveness	Alternative 2 is less effective than Alternatives 3 and 4 because corrective action objectives are not achieved.	Both alternatives are judged to offer a high degree of long-term effectiveness. Post-closure care of the vegetative cover will be in accordance with applicable regulations.	
Implementability	Alternatives 2, 3, and 4 are considered readily implementable using existing resources and technologies.		
Cost	\$52,848	\$416,295	\$284,180

PRG = Preliminary Remediation Goal
TTR = Tonopah Test Range
Note: All PRGs are EPA Region IX values (EPA, 1996)

4.0 Recommended Alternative

Based on the results of the detailed and comparative analysis of the potential corrective action alternatives presented in this document, the alternative recommended for implementation at the Roller Coaster Lagoons and North Disposal Trench is Alternative 4, "Covering." Alternative 4 was chosen as the preferred alternative for the following reasons:

- An engineered, vegetative cover protects human health and the environment by preventing contact to the impacted soils, provides erosion control, and limits precipitation infiltration.
- Potential adverse human health risks to workers are mitigated by leaving the pesticide-impacted soils in place (i.e., no intrusive activities).
- The vegetative cover is considered to be readily implementable with existing resources and technologies.
- The CASs will be returned to their original grade, effectively removing the "attractive nuisance" created by the surface depressions which attract future, unpermitted debris disposal. Regrading will also promote drainage from the site and prevent infiltration and the potential for migration of constituents to underlying soils.
- At completion of the construction activities, the CAU will be closed in place.
- Standards for management of waste are more easily satisfied. Pesticide contamination was likely due to application for weed control (DOE/NV, 1996a). If the soils remain in place, it can be argued that they are not subject to solid waste requirements. If the soils are excavated from the lagoons, the pesticide concentrations may require handling the soils as hazardous waste.

The preferred corrective action alternative was evaluated on its technical merits with focus on performance, reliability, implementability, and safety. The alternative was judged to meet all requirements in the technical components evaluated and is the most cost-effective closure option.

During corrective action implementation, this alternative will present a minimal potential threat to site workers and the environment, and as a future work precaution, appropriate safety procedures will be addressed in the Corrective Action Plan. After completion of the recommended corrective action alternative, the CAU will not pose a threat to human health or the environment because potential exposure pathways are removed.

5.0 References

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Appendix A
Roller Coaster Lagoons and North Disposal Trench
Investigation Report, Corrective Action Unit No. 404,
Tonopah Test Range

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List of Acronyms and Abbreviations

CAIP	Corrective Action Investigation Plan
CAS	Corrective Action Site(s)
CAU	Corrective Action Unit(s)
cm	Centimeter(s)
COC	Constituent(s) of concern
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane
DOE	U.S. Department of Energy
DQO	Data Quality Objective(s)
EPA	U.S. Environmental Protection Agency
FADL	Field Activity Daily Log(s)
FFACO	<i>Federal Facility Agreement and Consent Order</i>
ft	Foot (feet)
in.	Inch(es)
IT	IT Corporation
ITLV	IT Corporation, Las Vegas Office
m	Meter(s)
MS/MSD	Matrix spike/matrix spike duplicates
PRG	Preliminary Remediation Goal(s)
QA	Quality assurance
QAPP	Quality Assurance Project Plan
QC	Quality control
RCRA	Resource Conservation and Recovery Act
RPD	Relative percent difference
SNL	Sandia National Laboratories
SVOC	Semivolatile organic compounds
TC	Toxicity Characteristics
TCLP	Toxicity Characteristic Leaching Procedure(s)
TPH	Total petroleum hydrocarbon(s)
TTR	Tonopah Test Range
VCA	Voluntary Corrective Action(s)
VOA	Volatile Organic Analytes

A.1.0 Introduction

This investigation report describes the implementation of the *Corrective Action Investigation Plan* (CAIP) (DOE, 1996a) for Corrective Action Unit (CAU) No. 404 in accordance with the *Federal Facility Agreement and Consent Order* (FFACO, 1996), the CAU Work Plan for the Tonopah Test Range (TTR) (DOE, 1996b), and the *Industrial Sites Quality Assurance Project Plan* (QAPP) (DOE, 1994). CAU No. 404 consists of two Corrective Action Sites (CASs): the Roller Coaster Lagoons (CAS No. TA-03-001-TA-RC) and North Disposal Trench (CAS No. TA-21-001-TA-RC), which includes the Voluntary Corrective Action (VCA) spill area. These areas are located on the TTR (Figures A.1-1, A.1-2, A.1-3) which is part of the Nellis Air Force Range in Nye County, Nevada. The TTR is operated by the U.S. Department of Energy and the U.S. Department of Defense.

A.1.1 Project Objectives

The objective of this investigation is contained in the following three actions:

- Collect data to confirm the presence or absence of contamination.
- Evaluate the potential for contaminant migration.
- Provide sufficient information to develop a closure strategy for the CAU.

Surface samples were collected within the East and West Lagoons and North Disposal Trench, and subsurface samples were collected from a single boring in the West Lagoon. In addition, a verification sample was also collected at the VCA spill area. These activities were conducted to:

- Evaluate the condition of the surface soils and determine if constituents of concern (COCs) were present.
- Estimate the extent of contaminant migration (if present) from the lagoons and North Disposal Trench.
- Assess the potential for migration of potential COCs downward from the lagoons through the underlying soils.

At the East and West Lagoons and North Disposal Trench CASs, twenty-seven surface samples were collected from randomly selected sample grid points on sample grids. Fourteen

Figure A.1-1
Tonopah Test Range Location Map

LEGEND

- Tonopah Test Range boundary
- Primary roadway
- ▨ Operation Roller Coaster sites
- Area/gate
- ♀ Spring
- BLM Bureau of Land Management
- NAFR Nellis Air Force Range
- TTR Tonopah Test Range

Source: Adapted from DOE/AL, 1992

Figure A.1-2
Location of the Roller Coaster Lagoons and
North Disposal Trench CAU at the Tonopah Test Range

Figure A.1-3
Roller Coaster Lagoons, North Disposal Trench,
and VCA Spill Area Map

biased surface samples were also collected from stained areas or from areas where specific debris once existed. Three subsurface samples were also collected at 1.5-meter (m) (5-foot [ft]) intervals to 9.1 m (30 ft) from a single soil boring (RC-1) in the West Lagoon. Additionally, one surface soil sample was collected at the VCA spill area. The purpose of the sample was to confirm the presence or absence of residual hydrocarbons. If hydrocarbons remained, additional cleanup would be required.

A.1.2 Report Content

This investigation report is divided into four sections: Section 1.0 - Introduction, Section 2.0 - Field Investigation and Sampling Activities, Section 3.0 - Sampling Analytical Results, and Section 4.0 - Quality Assurance.

To make this investigation report more concise, the following field documentation and laboratory data were not included; however, they are available in the IT Corporation (IT) project files and will be available upon request:

- Field Activity Daily Logs (FADLs)
- Sample Collection Logs
- Analysis Requests/Chain of Custody forms
- Soil sample descriptions
- Laboratory certificates of analyses
- Headspace Petroflag™ hydrocarbon screening results
- Surveillance results

Additional descriptions of the site history, waste, inventories, and spill information are discussed in the CAIP for this CAU (DOE, 1996a).

A.2.0 Field Investigation and Sampling Activities

Field activities were performed from July 31 to September 16, 1996, by IT. Samples were collected and documented by following established sampling procedures, field activity documentation, sample collection documentation, decontamination, chain of custody, shipping, radiation screening protocols, and field instructions as prescribed in the CAIP (DOE, 1996a). Field activities were performed in accordance with an approved Site-Specific Health and Safety Plan (IT, 1996a; 1996b). Quality control (QC) samples (e.g., field blanks, equipment rinsate blanks, trip blanks, and sample duplicates) were collected as required by the *Industrial Sites Quality Assurance Project Plan* (DOE, 1994) and approved contractor procedures (IT, 1994). All field and sample documentation is maintained in IT project files. During the field activities, waste minimization practices were followed, including segregation of personal protective equipment into bags (based upon daily use) and segregation of the rinsate waters from decontamination operations.

A.2.1 Site Description and Conditions

The Roller Coaster Lagoon CAS consists of two large unlined sewage lagoons. The sewage lagoons received liquid sanitary wastes from the Operation Roller Coaster man camp for approximately two months in 1963. The two lagoons are approximately 36.6 x 23 x 3 m (120 x 75 x 10 ft) in size (Figure A.2-1). The two lagoons are connected by a single, 15.2-centimeter (cm) (6-inch [in.]) diameter clay overflow pipe. Subsequent to Operation Roller Coaster, the lagoons received debris from construction and range cleanup activities conducted on the TTR.

The North Disposal Trench (CAS) and VCA spill area are located north of the eastern most lagoon (Figure A.2-2). The trench was installed to receive solid waste and construction debris from the Operation Roller Coaster man camp. The base of the trench is 30 x 3.7 x 3 m (100 x 12 x 10 ft) in size. The VCA is a remediated site that was sampled to verify that the spill was removed. This site measures 3.5 m x 5 m (11.5 ft x 16 ft).

Subsequent to Operation Roller Coaster, the lagoons and trench continued to receive construction debris and range cleanup debris (including ordnance) from Sandia National Laboratories (SNL) and other operators.

Figure A.2-1
Map Showing the East and West Lagoons

Figure A.2-2
Map of North Disposal Trench and VCA Spill Area

A.2.2 Soil Sampling Logistics

This section describes the soil sampling activities for the Roller Coaster Lagoons, North Disposal Trench, and the VCA Spill Area.

A.2.2.1 Site Preparations

Prior to gridding or sampling activities, the wall of the disposal trench was sloped to reduce the potential for wall collapse. Care was taken not to cover or alter the bottom areas of the trench where the sampling would take place. The trench walls were sloped to approximately 0.3 m (1 ft) of rise and 0.6 m (2 ft) of run.

Before drilling in the West Lagoon could commence, a ramp was cut into the northeast corner of the lagoon to give the drill rig access to the borehole (RC-1) surface location (Figure A.2-1).

The ramp construction occurred after all surface sampling was completed. Only a minimum of the surface sample locations were covered due to construction.

A.2.2.2 Surface Sampling

Random and biased samples were collected at the CASSs. Random samples were collected from grids established in the bottom of the East and West Lagoons. In the East Lagoon, the outside of the grid measured approximately 13.7 x 35 m (45 x 115 ft). The distance between each point on the grid was about 2.7 x 4.6 m (9 x 15 ft) (Figure A.2-3). In the West Lagoon, the outside of the grid measured approximately 12.2 x 34.4 m (40 ft x 113 ft). The distance between each point on the grid was about 2.4 x 4.3 m (8 x 14 ft) (Figure A.2-4). Sampling points were located at randomly selected grid intersections for each sample site.

In the North Disposal Trench, a grid was established along the bottom of the trench. The outside of this grid measured approximately 3.7 x 29.3 m (12 x 96 ft), with each grid division measuring 1.8 x 3.7 m (6 x 12 ft), respectively (Figure A.2-5).

The VCA spill area was divided into quadrants over the area that was previously remediated (an area 3 x 5 m [12 x 12 ft] in size and to a 30-cm [12-in.] depth) as an initial cleanup level (Figure A.2-5). A single, biased sample point was selected from the center of the northeast quadrant of the VCA spill area.

Figure A.2-3
Map of the East Lagoon Showing Grids and Sample Locations

Figure A.2-4
Map of the West Lagoon Showing Grids and Sample Locations

Figure A.2-5
Map of the North Disposal Trench and VCA Spill Area Showing
Grids and Sample Locations

Prior to sampling, each sample location was surveyed for radiation using a pancake probe (Model 3 rate meter/44-9 probe) for gamma/beta and a Ludlum (Model 43-5) for alpha. Surface samples were collected using plastic disposable scoops that were decontaminated prior to the sampling effort; each sample was collected from the surface to a depth of 30 cm (12 in.). Sample bottles were selected for the designated analytes and pre-marked to show the sample number, date, and time of sample collection. When samples were collected, care was taken to remove surface debris and weathering of the soil surface. Sample bottles prepared for sampling were stored in an ice chest to prevent pre-warming of the bottles.

Samples for volatile components (total volatile organic analytes [VOAs] and total petroleum hydrocarbons [TPHs] as gasoline) for on-site and headspace screening and off-site laboratory analysis were collected first. Care was taken to minimize volatilization from the soil by placing the excavated soil directly into the sample bottles and filling the bottles completely to minimize headspace. Rims of the sample bottles were carefully wiped to ensure that the lid and the jar sealed properly. Each sample was immediately placed on ice following collection. Headspace samples were collected, covered with foil, and set in the sun for five minutes before screening for volatiles using a photoionization detector.

Samples were collected for analysis of semivolatile organic compounds (SVOCs), pesticides, TPH as diesel, and Toxicity Characteristic Leaching Procedure (TCLP) Resource Conservation and Recovery Act (RCRA) metals by homogenizing the soil from each sample collection point to 30 cm (12 in.) in a decontaminated stainless bowl. Otherwise, these samples were collected with the same care as samples collected for volatile components.

As samples were collected, weather conditions, date and time of sample collection, and sample quantities were recorded on sample collection logs.

A.2.2.3 Subsurface Sampling - West Lagoon

Borehole RC-1, located at the discharge point of the outfall pipe in the West Lagoon (Figure A.2-2), was drilled to 9.1 m (30 ft) to determine if any COCs had migrated vertically. Subsurface samples were collected at 1.5-m (5-ft) intervals from ground surface to 9.1 m (30 ft) using a 3.5-in. outside diameter hollow-stem auger and 2.5-in. California Modified split-spoon sampler with brass sleeves. The samples were collected directly within the brass sleeves. A boring log is included in Attachment A.

A typical sample collection occurred as follows: The sampling team member would decontaminate and assemble the split-spoon sampler. When the driller reached the sampling depth, the split-spoon sampler was attached to the drive-hammer by the sample team member; the driller ran the split-spoon sampler to the sample depth. The split-spoon sampler was driven below the drilled depth with a 140-pound drive-hammer using a 31-in. drop. The number of hammer blows, required to drive the split-spoon sampler each 15 cm (6 in.) was recorded. Generally, fifty blows for less than 15 cm (6 in.) was considered resistance; however, in some cases, additional blows were specified to maximize the sample recovery. The time of sample collection was noted as the time the split-spoon sampler was driven to its limit. Finally, the driller drilled over the split-spoon sampler to free it from the surrounding formation and brought the split-spoon sampler to the surface.

Once at the surface, a sampling team member removed the split-spoon sampler from the hammer while the shoe and hammer sub were loosened by the driller. The split-spoon sampler was carried to the sampling table and disassembled to expose the brass sleeves. The sleeves were collected in order of deepest to shallowest. The ends of each brass sleeve were sealed with Teflon™ sheets and plastic caps. Each cap was annotated with the date, time, depth, and vertical orientation. The deepest brass sleeve was typically collected for total VOAs and TPH as gasoline; the second for total VOAs, total pesticides, TPH as diesel, and total RCRA metals. The third sleeve was collected for Petroflag™ screening. Material from the shoe of the spoon was collected for headspace screening and geologic logging and assessment.

In the event that a sample sleeve was not full or a potential for headspace occurred in the sleeve, that sample was transferred to a sample jar.

Samples were immediately placed on ice until Petroflag™ screening was completed. Based upon the screening results, an impacted sample was selected and was shipped to the off-site laboratory along with the last two samples. The samples were assigned sample numbers, labeled, custody taped, and bagged for shipment to the IT Las Vegas office. At the IT Las Vegas office, the samples were re-packed for FedEx shipment to Quanterra Laboratories in St. Louis, Missouri.

A.2.2.4 Petroflag™ Screening

All samples collected from the Roller Coaster CAS were screened for petroleum hydrocarbons using the Petroflag™ Hydrocarbon Analyzer manufactured by the Dexsil Corporation. Petroflag™

methodology uses a solvent to extract any potential hydrocarbons from the soil. The extract is filtered into a developer and allowed to develop for 10 to 15 minutes. If hydrocarbons are present, the developer clouds. The amount of hydrocarbons present (reported in parts per million) is determined using an optical analyzer that correlates the optical response value to pre-selected response factors in the instrument. A response factor for diesel hydrocarbons was selected because it minimized the possibility of false positives which occur when analyzing for gasoline in the presence of diesel.

At the beginning of each sampling day, a diesel calibration standard was processed and run through the analyzer. Additional calibrations were run if daily temperatures varied greater than 10 degrees Celsius.

A.2.2.5 Geologic Analysis

As samples were collected, the following soil characteristics were noted: sand and gravel content, relative amounts of pebbles and cobbles, absence or presence of clays, and any unusual variations. This information was recorded in field notes for the project. In addition to a visual description, information about the soil hardness and drilling conditions was also noted.

In general, surface samples were fine-grained, silt to fine-sand, well-sorted, and moderately to well-cemented. Organic matter, such as plant materials, was also encountered. Care was taken to minimize collection of the organic matter.

Subsurface samples collected in boring RC-1 showed stratigraphically variable lithology. From ground surface to a depth of 4.6 m (15 ft) below ground surface, fine sands and silts with gravel and moderate to low clay content were present. From 4.6 m (15 ft) to 9.1 m (30 ft), the sand and gravel became more coarse with looser packing (with less clay present). A soil boring log is included in Attachment A.

A.3.0 Sampling Analytical Results

The analytical results from the East and West Lagoons, the North Disposal Trench, and the VCA spill area have been compiled and analyzed to determine the presence and/or extent of soil contamination. The analytical results are summarized in the following sections. The complete laboratory result data packages are available in the IT project files. Section A.4.0 of this report presents a discussion and summary of QC samples.

During the sampling and drilling activities, 54 soil and quality assurance (QA) samples were collected for analysis. A list of the characterization sample numbers (including a field duplicate sample) and locations is presented in Table A.3-1. Gaps in the numeric sample sequence represent rinsate, field, and trip blank (QC) samples and are not included in the table, but they are discussed in Section A.4.2. The complete laboratory result data packages are maintained in the IT project files.

The sample analytical parameters and laboratory analytical methods for the subsurface soil investigation are presented in Table A.3-2. The sample analytical parameters were selected through the application of site process knowledge and preliminary sampling according to the U.S. Environmental Protection Agency's (EPA's) Data Quality Objectives (DQOs) process (EPA, 1994). The results of the DQO process are documented, in part, in the CAIP (DOE, 1996a) with the remainder of the documentation retained in the IT project files. Samples were analyzed by Quanterra Environmental Services in Earth City, Missouri. The parameters selected for analysis were based on the anticipated COCs associated with the activities known to have been conducted at the site, the results of previous sampling at the site, and a wide range of other contaminant types potentially encountered on the TTR.

A.3.1 Data Quality Assessment

The data quality was assessed to determine if the sampling objectives fully addressed the DQOs established in the CAIP (DOE, 1996a). The DQOs established that the following two potential sources of contamination existed at the site: the first was associated with the sanitary wastewater discharged to the lagoons, and the second was from potential residue associated with debris spills. Each source is thought to have two potential exposure routes: inhalation of dust and ingestion of soil. Therefore, two viable contamination release mechanisms were possible: resuspension of surface soils and intrusion into the subsurface soils.

Table A.3-1
Roller Coaster Lagoons Sample List
(Page 1 of 3)

Sample Number	Sample Type	Sample Location	Depth (ft)	UTM Northing (NAD83)	UTM Easting (NAD83)
TTR00075	Random-Soil	RCL-EAST	Surface*	4175179.750	523941.744
TTR00076	Random-Soil	RCL-EAST	Surface	4175184.637	523942.822
TTR00077	Random-Soil	RCL-EAST	Surface	4175185.998	523930.733
TTR00078	Random-Soil	RCL-EAST	Surface	4175190.892	523932.086
TTR00079	Random-Soil	RCL-EAST	Surface	4175194.837	523930.657
TTR00080	Random-Soil	RCL-EAST	Surface	4175206.560	523938.336
TTR00081	Random-Soil	RCL-EAST	Surface	4175208.058	523928.861
TTR00081DUP	Random-Soil	RCL-EAST	Surface	4175208.058	523928.861
TTR00081MS	Random-Soil	RCL-EAST	Surface	4175208.058	523928.861
TTR00081MSD	Random-Soil	RCL-EAST	Surface	4175208.058	523928.861
TTR00082	Random-Soil	RCL-EAST	Surface	4175207.050	523926.200
TTR00083	Random-Soil	RCL-EAST	Surface	4175209.997	523922.088
TTR00084	Random-Soil	RCL-WEST	Surface	4175172.904	523920.711
TTR00085	Random-Soil	RCL-WEST	Surface	4175170.912	523916.214
TTR00086	Random-Soil	RCL-WEST	Surface	4175175.979	523917.088
TTR00087	Random-Soil	RCL-WEST	Surface	4175169.862	523913.728
TTR00088	Random-Soil	RCL-WEST	Surface	4175178.935	523913.322
TTR00089	Random-Soil	RCL-WEST	Surface	4175181.980	523909.665
TTR00090	Random-Soil	RCL-WEST	Surface	4175185.988	523908.237
TTR00091	Random-Soil	RCL-WEST	Surface	4175192.679	523913.766
TTR00092	Random-Soil	RCL-WEST	Surface	4175194.875	523907.714
TTR00093	Random-Soil	RCL-WEST	Surface	4175194.003	523905.334
TTR00094	Random-Soil	RCL-WEST	Surface	4175193.217	523903.166
TTR00095	Random-Soil	RCL-WEST	Surface	4175177.117	523908.974
TTR00096	Trip blank	RCL	NA	NA	NA

Table A.3-1
Roller Coaster Lagoons Sample List
 (Page 2 of 3)

Sample Number	Sample Type	Sample Location	Depth (ft)	UTM Northing (NAD83)	UTM Easting (NAD83)
TTR00097	Trip blank	RCL	NA	NA	NA
TTR00098	Trip blank	RCL	NA	NA	NA
TTR00099	Trip blank	RCL	NA	NA	NA
TTR00100	Trip blank	RCL	NA	NA	NA
TTR00101	Trip blank	RCL	NA	NA	NA
TTR00102	Trip blank	RCL	NA	NA	NA
TTR00103	Equipment Rinsate	RCL	NA	NA	NA
TTR00104	Random-Soil	RCL-NT	Surface	4175265.408	523936.888
TTR00105	Random-Soil	RCL-NT	Surface	4175261.657	523938.186
TTR00106	Random-Soil	RCL-NT	Surface	4175261.382	523936.134
TTR00106DUP	Random-Soil	RCL-NT	Surface	4175261.382	523936.134
TTR00106MS	Random-Soil	RCL-NT	Surface	4175261.382	523936.134
TTR00106MSD	Random-Soil	RCL-NT	Surface	4175261.382	523936.134
TTR00107	Random-Soil	RCL-NT	Surface	4175254.395	523937.294
TTR00108	Random-Soil	RCL-NT	Surface	4175253.834	523935.385
TTR00109	Random-Soil	RCL-NT	Surface	4175250.434	523935.866
TTR00110	Biased-Soil	RCL-NT	Surface	4175258.190	523936.556
TTR00111	Biased-Soil	RCL-NT	Surface	4175247.714	523939.588
TTR00112	Biased-Soil-Duplicate	RCL-NT	Surface	4175247.714	523939.588
TTR00113	Biased-Soil	RCL-WEST	Surface	4175202.774	523904.045
TTR00114	Biased-Soil	RCL-WEST	Surface	4175196.156	523914.429
TTR00115	Biased-Soil	RCL-WEST	Surface	4175188.829	523906.100
TTR00116	Biased-Soil	RCL-WEST	Surface	4175188.342	523913.029
TTR00117	Biased-Soil	RCL-WEST	Surface	4175172.810	523911.182
TTR00118	Biased-Soil	RCL-WEST	Surface	4175207.097	523933.375

Table A.3-1
Roller Coaster Lagoons Sample List
 (Page 3 of 3)

Sample Number	Sample Type	Sample Location	Depth (ft)	UTM Northing (NAD83)	UTM Easting (NAD83)
TTR00119	Biased-Soil	RCL-WEST	Surface	4175182.144	523945.310
TTR00120	Field blank	RCL	NA	NA	NA
TTR00131	Biased-Soil	RCL-WEST	7	4175188.949	523911.799
TTR00132	Biased-Soil	RCL-WEST	27	4175188.949	523911.799
TTR00133	Biased-Soil	RCL-WEST	32	4175188.949	523911.799
TTR00134	Equipment Rinsate	RCL-WEST	NA	NA	NA
TTR00135	Field blank	RCL-WEST	NA	NA	NA
TTR00136	Trip blank	RCL	NA	NA	NA
TTR00137	Trip blank	RCL	NA	NA	NA
TTR00180	Biased-Soil	VCA	Surface	4175243.585	523913.359

*Surface indicates 0- to 12-in. depth.

UTM - Universal Transverse Mercator
 NAD83 - North American Datum 1983
 RCL - Roller Coaster Lagoon
 NA - Not applicable
 NT - North (Disposal) Trench

DUP - Field Duplicate
 MS - Matrix Spike
 MSD - Matrix Spike Duplicate
 VCA - Voluntary Corrective Action

Table A.3-2
Chemical Analytical Methods Used for Roller Coaster Investigation Samples

Analytical Parameter	Analytical Method
Total Volatile Organic Compounds	EPA ^a 8240
Total Semivolatile Organic Compounds	EPA 8270
Total Pesticides	EPA 8080
Total Petroleum Hydrocarbons - Gasoline, Diesel, and Motor Oil	EPA 8015 (modified)
TCLP ^b RCRA ^c Metals ^d Mercury	EPA 1311/6010A/7000 EPA 1311/7470
^e Total RCRA Metals Mercury	EPA 6010A/7000 EPA 7470

^aU.S. Environmental Protection Agency SW-846 (EPA, 1996a)

^bToxicity Characteristic Leaching Procedure

^cResource Conservation and Recovery Act

^dArsenic, barium, cadmium, lead, mercury, selenium, silver, chromium

^eAnalysis applied only to samples from Boring RC-1

Sampling included random, biased, and subsurface sampling that generated sufficient data to achieve the following: (1) identify the presence of contaminants and their concentrations; (2) ascertain the extent of contamination; and (3) determine the appropriate closure recommendation.

Additionally, a sample was collected to determine that a spill which occurred in the VCA spill area during cleanup operations (in 1995) was successfully remediated.

All required sampling took place within the following established investigation boundaries:

- The sides and bottom of the Roller Coaster Lagoons
- The bottom of the North Disposal Trench
- Within the Roller Coaster Lagoons and North Disposal Trench from the surface to a 0.3-m (1-ft) depth
- In the vicinity of the outfall pipe in the West Lagoon from ground surface to a depth of approximately 9.1 m (30 ft)
- The surface of the VCA spill area

All samples were collected as required by the CAIP (DOE, 1996a). Decision rules established by the DQO process and described in the CAIP were used for the decision criteria. A combination of field screening, process knowledge, and the decision criteria were used to supplement and guide the sampling process.

Once analytical results were received for the samples collected, a statistical determination was made to establish that an adequate number of random samples were collected. The sampling effort attained an appropriate number of samples to meet these statistical parameters.

A.3.2 West Lagoon

The results for analytes detected in the West Lagoon are shown on Figure A.3-1 and Table A.3-3. The most prominent and significant detections were pesticide derivatives. Traces of volatiles and semivolatiles were also detected. Barium, a common metal found in the desert soils (SNL, 1994), was also detected. No TPH as gasoline or diesel were found. Common laboratory contaminants (methylene chloride, bis[2-ethylhexyl]phthalate and other plasticizers) were also

Figure A.3-1
Map of the West Lagoon Showing
DDT, DDE, and DDD Pesticide Results

Table A.3-3
West Lagoon Analytes Detected

SAMPLE NUMBER	TYPE	Barium (mg/L)	2-Butanone (MEK) (µg/kg)	Acetone (µg/kg)	bis (2-Ethylhexyl) Phthalate (µg/kg)	DDD (µg/kg)	DDE (µg/kg)	DDT (µg/kg)	delta-BHC (µg/kg)	di-N-Butylphthalate (µg/kg)	di-N-Octylphthalate (µg/kg)	Dieldrin (µg/kg)	Dimethylphthalate (µg/kg)	Endrin (µg/kg)	Endrin Aldehyde (µg/kg)	Endosulfan I (µg/kg)	Ethylbenzene (µg/kg)	Heptachlor (µg/kg)	Methoxychlor (µg/kg)	Methylene Chloride (µg/kg)	Naphthalene (µg/kg)	Styrene (µg/kg)	Toluene (µg/kg)	Xylene (total) (µg/kg)
		5271	7100000	2100000	31738	1851	1307	1307	5610	5610	5610	5610	5610	5610	5610	5610	5610	5610	5610	5610	5610	5610	5610	5610
		1000000	2700000000	88000000	136253	7948	5610	5610	5610	5610	5610	5610	5610	5610	5610	5610	5610	5610	5610	5610	5610	5610	5610	5610
		1.2	17 (J)	5900 (E)	830	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500
TTR00084	RANDOM SOIL		20 (J)	4200 (D)																				
TTR00085	RANDOM SOIL		29 (J)	9600 (E)	620	970	1200	1200																
TTR00086	RANDOM SOIL		34 (J)	7500 (E)	340	880	970	970	8.8															
TTR00087	RANDOM SOIL		40 (J)	5700 (D)																				
TTR00088	RANDOM SOIL		46 (J)	11000 (E)	3800	3500	9900	9900	9.5															
TTR00089	RANDOM SOIL		29 (J)	7800 (D)																				
TTR00090	RANDOM SOIL	0.96	41 (J)	570	26	180	130	130																
TTR00091	RANDOM SOIL	0.99	4 (BJ)	500	23	25	16	16																
TTR00092	RANDOM SOIL		34 (J)																					
TTR00093	RANDOM SOIL		28 (J)	340	11	100	100	100																
TTR00094	RANDOM SOIL		27 (J)	480																				
TTR00095	RANDOM SOIL	0.93	62 (J)																					
TTR00096	RANDOM SOIL	0.85	3 (BJ)	1300	160	160	50	4.7																
TTR00097	RANDOM SOIL	0.92	10 (J)	300 (J)	7.1	74	21	21																
TTR00098	RANDOM SOIL	0.9	18 (BJ)	160 (BJ)																				
TTR00099	RANDOM SOIL	0.85	23 (BJ)	3200 (E)	2300	8400	7900	7900																
TTR00100	BIASED SOIL	0.86	27 (J)	1700	5400	15000	14000	14000	16															
TTR00101	BIASED SOIL	0.86	11 (BJ)																					
TTR00102	BIASED SOIL	0.84	33 (BJ)	1700	190	990	900	900	7.2															
TTR00103	BIASED SOIL	0.84	96 (BJ)	400	21	540	450	450																
TTR00104	BIASED SOIL	1.1	19 (J)																					
TTR00105	BIASED SOIL		52 (J)	940	270	420	310	9																
TTR00106	BIASED SOIL		17 (J)																					
TTR00107	BIASED SOIL		17 (J)																					
TTR00108	BIASED SOIL	2.2	53 (J)	320 (BJ)																				
TTR00109	BIASED SOIL																							
TTR00110	BIASED SOIL																							
TTR00111	BIASED SOIL																							
TTR00112	BIASED SOIL																							
TTR00113	BIASED SOIL																							
TTR00114	BIASED SOIL																							
TTR00115	BIASED SOIL																							
TTR00116	BIASED SOIL																							
TTR00117	BIASED SOIL																							
TTR00118	BIASED SOIL																							
TTR00119	BIASED SOIL																							
TTR00120	BIASED SOIL																							
TTR00121	BIASED SOIL																							
TTR00122	BIASED SOIL																							
TTR00123	BIASED SOIL																							
TTR00124	BIASED SOIL																							
TTR00125	BIASED SOIL																							
TTR00126	BIASED SOIL																							
TTR00127	BIASED SOIL																							
TTR00128	BIASED SOIL																							
TTR00129	BIASED SOIL																							
TTR00130	BIASED SOIL																							
TTR00131	BIASED SOIL																							
TTR00132	BIASED SOIL																							
TTR00133	BIASED SOIL																							
TTR00134	BIASED SOIL																							
TTR00135	BIASED SOIL																							
TTR00136	BIASED SOIL																							
TTR00137	BIASED SOIL																							

(E) Concentrations exceed the calibration range of the GC
(J) Result is quantitatively estimated

(B) Analyte found in associated blank
(D) Sample is duplicate

Bold Indicates results above Residential PRGs (EPA, 1996)
Indicates results above Industrial PRGs

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

noted, but they did not occur at significant levels. With the exception of pesticides, the detected analytes were significantly below the EPA Region IX soil preliminary remediation goals (PRGs) (EPA, 1996b).

Specific analytes of pesticides detected are listed in decreasing order of concentration as follows: dichlorodiphenyldichloroethylene (DDE), dichlorodiphenyltrichloroethane (DDT), dichlorodiphenyldichloroethane (DDD), benzene hexachloride (delta-BHC), endrin, endrin aldehyde, heptachlor, methoxychlor, and dieldrin. Only DDE, DDT, and DDD were found at levels that exceeded the EPA Region IX PRGs (EPA, 1996b). These detected pesticide analytes were mostly distributed around the perimeters of the West Lagoon.

Traces of pesticides, volatiles, and semivolatiles were detected in samples from borehole RC-1. The analytical results for total metals detected in borehole RC-1 are higher because samples were erroneously analyzed for total metals rather than TCLP metals.

A.3.3 East Lagoon

Detected analytes found in the East Lagoon (Table A.3-4 and Figure A.3-2) are similar, but at lower levels, to the results of the West Lagoon. Only DDE and DDT were found at levels above the EPA Region IX PRGs (EPA, 1996b).

A.3.4 North Disposal Trench

At the North Disposal Trench, similar results (Table A.3-5 and Figure A.3-3) of the East and West Lagoons were found. However, in all cases, the analytes detected were far below the EPA Region IX PRGs (EPA, 1996b).

A.3.5 VCA Spill Area

A sample was collected from the VCA spill area and analyzed for TPH. The sample was a verification sample collected to determine if the previously impacted soil had been completely removed or if further remediation was required. The sample analysis for gasoline and diesel resulted in non-detects; therefore, no residual contamination remains.

Table A.3-4
East Lagoon Analytes Detected

SAMPLE NUMBER	TYPE	Acetone (µg/kg)	Barium (µg/L)	bis (2-Ethylhexyl) Phthalate (µg/kg)	Butylbenzylphthalate (µg/kg)	DDD (µg/kg)	DDE (µg/kg)	DDT (µg/kg)	di-N-Butylphthalate (µg/kg)	di-N-Octylphthalate (µg/kg)	Endosulfan I (µg/kg)	Ethylbenzene (µg/kg)	Methylene Chloride (µg/kg)	Styrene (µg/kg)	Toluene (µg/kg)	Xylene (total) (µg/kg)
		RESIDENTIAL SOIL PRELIMINARY REMEDIAL GOALS (PRGS)														
		2100000	5271	31738	930000	1851	1307	1307	6500000	1300000	391059	230000	7807	680000	790000	320000
		INDUSTRIAL SOIL PRELIMINARY REMEDIAL GOALS (PRGS)														
		8800000	100000	136253	930000	7948	5610	5610	68000000	10000000	4087586	230000	17797	680000	880000	320000
TTR00075	RANDOM-SOIL	13 (J)	0.91	260 (J)		50	95	92	210 (J)				11			
TTR00076	RANDOM-SOIL	13 (J)	0.9	190 (J)		410	980	1900	200 (J)		18		3 (J)			4 (J)
TTR00077	RANDOM-SOIL		1.2	190 (J)		530	1600	2600	220 (J)		22		18			
TTR00078	RANDOM-SOIL		0.83	200 (J)	210 (J)	34	170	130	230 (J)				3 (J)			2 (J)
TTR00079	RANDOM-SOIL	33 (J)		510			3.7	2.2	250 (J)	280 (J)			9 (B)			
TTR00079RE	RANDOM-SOIL	25 (J)											26 (B)			
TTR00080	RANDOM-SOIL	47 (J)	1.1	200 (J)	210 (J)		12	5	230 (J)			3 (J)	47			14
TTR00080RE	RANDOM-SOIL	110											10 (B)			9
TTR00081	RANDOM-SOIL	7 (J)	1.2				3.5	2.5					4 (J)			6
TTR00081DUP	RANDOM-SOIL		1.1													
TTR00082	RANDOM-SOIL	44 (J)	1.2				4.2		250 (J)				59	3 (J)		25
TTR00082RE	RANDOM-SOIL	48 (J)										2 (J)	39 (B)			12
TTR00083	RANDOM-SOIL	180	1.2	240 (J)	210 (J)		10	5.6	200 (J)			6	71	4 (J)	3 (J)	25
TTR00083RE	RANDOM-SOIL	73 (J)										1 (J)	9 (B)	2 (J)	2 (J)	8

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

Bold Indicates results above PRGs
 Indicates results above Industrial PRGs

(B) Analyte found in associated blank
 (J) Analyte found at concentrations below detection limit

Figure A.3-2
Map of East Lagoon Showing
DDT, DDE, and DDD Pesticide Results

Table A.3-5
North Trench Analytes Detected

TYPE	Barium (µg/L)	2-Butanone (MEK) (µg/kg)	Acetone (µg/kg)	bis (2-Ethylhexyl) Phthalate (µg/kg)	DDD (µg/kg)	DDE (µg/kg)	DDT (µg/kg)	di-N-Butylphthalate (µg/kg)	Methylene Chloride (µg/kg)	Styrene (µg/kg)	Toluene (µg/kg)	Xylene (total) (µg/kg)
RESIDENTIAL SOIL PRELIMINARY REMEDIAL GOALS (PRGs)												
5271	7100000	2100000	31738	1851	1307	1307	6500000	7807	680000	790000	320000	
INDUSTRIAL SOIL PRELIMINARY REMEDIAL GOALS (PRGs)												
100000	270000000	8800000	136253	7948	5610	5610	68000000	17797	680000	880000	320000	
TTR00104		6 (J)	18 (BJ)			8.2	2.1					
TTR00105		7 (J)	35 (BJ)					190 (J)		3 (J)		
TTR00106				200 (J)								
TTR00107						6.2	1.8					
TTR00108	0.84	11 (J)	32 (BJ)			7.7						1 (J)
TTR00109	0.58		50 (BJ)		3.8	29	9.8					
TTR00110		12 (J)	99 (BJ)		6.2	98	44					
TTR00110RE			50 (J)						6			
TTR00111			18 (BJ)			12	11					
TTR00112						12	10					

mg/L = Milligrams per liter

µg/kg = Micrograms per kilogram

µg/L = Micrograms per liter

(B) Analyte found in associated blank

(J) Result is quantitatively estimated

Figure A.3-3
Map of North Disposal Trench and VCA Spill Area Showing
DDT, DDE, and DDD Pesticide Results

A.3.6 Radiological Screening

Before samples were collected, each sample location was surveyed for radiological activity. Process knowledge did not indicate any reason to suspect elevated levels of radionuclides, as the area was not located within any known radioactively-contaminated zone on the Tonopah Test Range.

The radiological detection instrumentation used at the Roller Coaster Lagoons was calibrated in accordance with contractor procedure ITLV-0425, "Measuring and Testing Equipment Calibration, Maintenance, and Control" (IT, 1994). Two instruments were used: a Ludlum Model 3/44-9 (#126675) for the detection of beta/gamma energies and a Ludlum Model 3/43-5 (#127388) for the detection of alpha energies.

Both instruments were calibrated as follows: (1) the instrument was turned on and a battery function check was performed; (2) a background count was performed (ten 1-minute counts in an area that was upwind and approximately 75 feet away from the lagoons; each 1-minute counting session consisted of an approximately 100-cm² area surface contact survey) and an average was obtained; (3) a source check was then performed (instrument #126675 used a ¹³⁷Cs source [serial #5060], while instrument #127388 used a ²³⁰Th source [serial #5061]), a net count rate was obtained (source check - background = net count rate [units are counts per minute]); and a daily efficiency was computed (counts per minute/disintegrations per minute). Calibration was performed daily on each instrument before each work shift.

Each sample location was surveyed for radioactive contamination. All locations indicated less than 100 disintegrations per minute. The samples were also surveyed before they were prepared for off-site shipment.

Because radiological activity was not indicated, analysis by gamma spectroscopy was not requested as per the CAIP (DOE/NV, 1996a).

A.3.7 Results Summary

Within the Roller Coaster Lagoons, pesticide-contaminated soils were identified above human health risk screening levels set forth in the EPA Region IX PRGs (EPA, 1996b). None of the surface sample locations showed any visual indications of staining. Based upon results of the

sample collected from borehole RC-1 in the West Lagoon, the vertical extent of the contaminants is limited to the surface of the lagoon.

Results of the samples taken at the Roller Coaster CASs are consistent with the conceptual model proposed in the CAIP (DOE, 1996a). No contaminants were found with the exception of pesticides. The potential for vertical migration is extremely low since the sewage lagoons are dry and annual precipitation is low. The pesticides are limited to the surface of the lagoons and trench, and occur at low concentrations. The lateral extent of the pesticide contamination is limited and will allow designation of boundaries for closure.

A.4.0 Quality Assurance

The results of QA and QC on characterization sampling activities for the Roller Coaster Lagoons CAS and North Disposal Trench CAS are summarized in the following text. Also included is a discussion on the measurement of QA and QC objectives and documentation of nonconformances. Detailed information about the QA program for this sampling event is contained in the Industrial Sites QAPP (DOE, 1994).

A.4.1 Quality Control Samples

Quality Control samples were collected and analyzed throughout the sample collection process. A list of collected field QC samples is presented in Table A.4-1. Six field blanks, two equipment rinsate blanks, three matrix spike/matrix spike duplicates (MS/MSDs), and one field duplicate were taken for analysis by an off-site laboratory. Nine trip blanks were obtained for analysis by the off-site laboratory. Field blanks were taken by placing distilled water into appropriate sample bottles and preserving them according to the requirements specified in the Industrial Sites QAPP (DOE, 1994). Equipment rinsate blanks were obtained by collecting the final rinse solution (i.e., distilled water), pouring it over the decontaminated sampling equipment into the appropriate sample bottles, and preserving it, as applicable. Sealed and preserved trip blanks were received from the off-site laboratory and were placed in each cooler of samples sent to the off-site laboratory. The results of the QC samples are discussed in the following sections.

A.4.1.1 Field Quality Control Samples

Review of the field blank analytical data for the characterization sampling indicated that cross-contamination from field methods did not occur during sample collection. The field blanks were analyzed for the parameters listed in Table A.3-1, and none of the COCs, other than common laboratory contaminants (i.e., acetone and methylene chloride at significantly less than five times the detection limit), was identified above the laboratory instrument detection limits.

Equipment rinsate blanks were collected from the sampling equipment and the heavy equipment used during the characterization. These samples were analyzed for the parameters listed in Table A.4-2. None of the COCs was identified above the detection limits in the equipment

Table A.4-1
Field Quality Control Samples
Collected for Laboratory Analysis

Sample Number	Sample Type	Notes
TTR00096	Trip blank	VOC analysis only
TTR00097	Trip blank	VOC analysis only
TTR00098	Trip blank	VOC analysis only
TTR00099	Trip blank	VOC analysis only
TTR00100	Trip blank	VOC analysis only
TTR00101	Trip blank	VOC analysis only
TTR00102	Trip blank	VOC analysis only
TTR00103	Equipment blank	Sampling equipment
TTR00106DUP	Random sample	Lab duplicate
TTR00106MS	Random sample	Matrix spike
TTR00106MSD	Random sample	Matrix spike duplicate
RRE00112	Biased soil	Field duplicate
TTR00120	Field blank	Environmental effect sample
TTR00134	Equipment blank	Sampling equipment
TTR00135	Field blank	Environmental effect sample
TTR00136	Trip blank	VOC analysis only
TTR00137	Trip blank	VOC analysis only

rinsate and source blanks with the exception of low levels (i.e., less than five times the detection limit) of common laboratory contaminants (e.g., bis[2-ethylhexyl]phthalate and butylbenzylphthalate) which were detected in some equipment blanks.

During the actual sampling event, a sample and field duplicate (TTR00111 and TTR00112) were collected and analyzed for the same site characterization parameters listed in Table A.3-2. The field duplicate sampling result is listed in Table A.3-5.

Table A.4-2
Analytical Methods Used for Analysis of Quality Control Samples

Analytical Parameter	Analytical Method
Total Volatile Organic Compounds	EPA ^a 8240
Total Semivolatile Organic Compounds	EPA 8270
TCLP ^b Metals	EPA 1311/6010/7470
Total Metals (Only soil samples from soil boring RC-1)	EPA 6010 and 7470
Total Petroleum Hydrocarbons (diesel and gasoline individually)	EPA 8015 (modified)
Gamma Spectroscopy	HASL ^c 300 4.5.2.3
Pesticides	EPA 8080

^aU.S. Environmental Protection Agency SW-846 (EPA, 1996a)

^bToxicity Characteristic Leaching Procedure

^cHealth and Safety Laboratory

Trip blanks were analyzed for total VOCs only. None of the COCs were identified above the detection limit in any of the trip blanks.

Review of the analytical data for the trip, field, and rinsate blanks indicates that the soil samples were not contaminated during field activities or shipment. Cross-contamination due to incomplete decontamination did not occur.

A.4.1.2 Laboratory Quality Control Samples

Analysis of method QC blanks and laboratory control samples was performed for each parameter analyzed by Quanterra. Laboratory duplicate analysis was performed on two samples from the characterization activities (TTR00081 and TTR00106, see Table A.3-1). Two samples were also designated for MS/MSD analyses. In general, the laboratory duplicate results were considered to be in agreement with the original sample results. The complete QC sample results are maintained in the IT project files.

A.4.2 Quality Assurance Objectives Measurements

The QA objectives ensure that the analytical data collected are meaningful, defensible, and useable for the desired purposes. Measurement of specific QA objectives is discussed in the following sections.

A.4.2.1 Precision

Precision is a quantitative measure of the variability of a group of measurements from their average value. Precision is assessed by collecting and analyzing duplicate field samples and comparing the results with the original sample. Precision is also assessed by creating, analyzing, and comparing laboratory duplicates from one or more field samples. It is reported as relative percent difference (RPD), which is calculated as the difference between the measured concentrations of duplicate samples divided by the average of the two concentrations and multiplied by 100. For the soil sampling project, the accepted precision goals for the off-site laboratory analyses are specified in the Industrial Sites QAPP (DOE, 1994) and are listed in Table A.4-3, which also presents the results of measurement of precision for the Roller Coaster soil sampling data. All of the precision measurements were within the specified parameter-specific target ranges. Additional information regarding the measurement of precision may be found in the Industrial Sites QAPP (DOE, 1994).

A.4.2.2 Accuracy

Analytical accuracy is defined as the nearness of a measurement to the true or accepted reference value. It is the composite of the random and systematic components of the measurement system and measures bias in a measurement system. The random component of accuracy is measured and documented through the analyses of spiked samples. Sampling accuracy is assessed by evaluating the results of spiked samples and laboratory control samples. Accuracy measurements are calculated as percent recovery by dividing the measured sample concentration by the true concentration and multiplying the quotient by 100.

The target accuracy ranges established for the soil samples analyzed by the off-site laboratory and the actual accuracies achieved are shown in Table A.4-4 for both matrix spike and laboratory control samples. Based on these results, 100 percent of all QC sample recoveries were within the acceptable limits, which indicates excellent analytical accuracy.

Table A.4-3
Laboratory Precision Measurements for
Surface and Subsurface Soil Sampling Data

Parameter	Field and Laboratory Duplicate Totals						Total
	Off-Site Analysis						
	Total VOAs ^a	Total Semi-VOAs	TCLP ^b Metals	Pesticides	TPH-G ^c	TPH-D ^d	
Total Number of RPD ^e Precision Measurements	16	34	16	16	2	2	86
Actual Range of Precision RPD Results in Percent	1.00 - 22.05	0 - 20.16	0 - 8.70	0 - 13.53	17.50 - 22.05	1.36 - 18.99	NA ^f
Target Range for Precision RPD ^g	0 - 24	0 - 50	0 - 20	0 - 40	0 - 40	0 - 40	NA
Number of Precision RPD Measurements within Target Range	16	34	16	16	2	2	86
Percent of Precision RPD Measurements within Target Range	100	100	100	100	100	100	100

^aVolatile organic compounds

^bToxicity Characteristic Leaching Procedure

^cTotal petroleum hydrocarbon - gasoline range

^dTotal petroleum hydrocarbon - diesel range

^eRelative percent difference

^fNot applicable

^gAs per the Industrial Sites QAPP (DOE, 1994)

Field accuracy is assessed by confirming that the documents of record track the sample from its origin, through transfer of custody, to its disposal. The goal of field accuracy is for all samples to be collected from the correct locations at the correct time, to be placed in a correctly labeled container with the correct preservative, and to be sealed with custody tape to prevent tampering. Any deviations from these requirements must be documented and explained, and the related data must be qualified accordingly. During the investigation activities, all field accuracy goals were met.

A.4.2.3 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition (EPA, 1987). Sample representativeness is achieved through the implementation of a sampling program designed to ensure proper sampling locations, the number of samples, and the use of validated analytical methods. Representativeness may also be assessed through analysis of replicate samples.

Table A.4-4
Laboratory Accuracy Measurements for
Surface and Subsurface Soil Sampling Data

Parameter	Analysis						Total
	Total VOAs ^a	Total Semi-VOAs	Total Metals	Pesticides	TPH ^b Gasoline	TPH Diesel	
Total Number of %R ^c Measurements	104	187	61	32	26	18	428
Matrix Spike Samples (range of actual %R)	84-146	54-96	90-109	60-124	73-110	81-105	NA ^d
Laboratory Control Samples (range of actual %R)	81-151	27-92	70 -116	NA	80-104	79-128	NA
%R Target Range ^e (Water)	37 - 160	10 - 230	80 - 120	30 - 147	64 - 145	40 - 140	NA
%R Target Range (Soil)	37 - 160	10 - 230	80 - 120	30 - 147	64 - 125	61 - 144	NA
Number of %R Measurements within the Target Range	104	187	57	32	26	18	428
Percent of %R Measurements within the Target Range	100	100	93	100	100	100	100

^a Volatile organic compounds

^b Total petroleum hydrocarbons

^c Percent recovery

^d Not applicable

^e As per the Industrial Sites QAPP (DOE, 1994)

To verify that an appropriate number of random samples were collected, the results were statistically analyzed. This determination was made using the procedures described in Chapter 9 of the EPA Publication SW-846, *Test Methods of Evaluating Solid Waste, Physical/Chemical Methods* (EPA, 1996a). In this calculation, the mean concentration and standard deviation of each targeted analyte in the soils were used to calculate the number of samples necessary to make that determination at the 90 percent confidence level. These calculations determined that an appropriate number of samples were collected from the Sewage Lagoons and the North Disposal Trench to sufficiently characterize the site.

The surface and subsurface soil samples identified the COCs present in the soils encountered and accurately and precisely quantified their concentrations. Samples were collected from predetermined intervals; collection and analysis was performed in accordance with approved procedures (IT, 1994). Both field and laboratory duplicates were analyzed. As a result, the Roller Coaster soil sampling data may be qualified as acceptably representative of site-specific environmental conditions. Additional information about the measurement of representativeness is found in the Industrial Sites QAPP (DOE, 1994).

A.4.2.4 Completeness

Completeness is defined as a percentage of measurements made which are judged to be valid. In general, the Roller Coaster surface and subsurface soil sampling data are complete except for the single nonconformance discussed in Section A.4.3. The subsurface soil sampling and analytical program was executed in accordance with the Field Sampling Instructions (IT, 1996c; IT, 1996d) and associated Records of Technical Change. The specified sampling intervals were used as planned. All specified samples were collected, and all sample containers reached the laboratory intact and properly preserved (if applicable). For all samples, sample temperature was maintained during shipment to the laboratory, and sample chain of custody was maintained during sample storage and shipment.

A.4.2.5 Comparability

Comparability is a qualitative parameter expressing the confidence with which one dataset can be compared to another (EPA, 1987). A standardized sampling approach and analytical methodology are used to achieve data comparability. To ensure comparability, all field and laboratory activities were performed and documented in accordance with approved procedures (e.g., IT, 1994). Approved, standardized methods and procedures were also used to analyze and

report the data (e.g., EPA, 1996a). This approach ensures the data from this project can be compared to other datasets.

A.4.3 Field Deficiencies/Nonconformance

A single nonconformance occurred during the sampling effort at the Roller Coaster Lagoon. On September 16, 1996, total metals were inadvertently requested by the sampling team on the Analysis Request/Chain-of-Custody Form instead of TCLP metals. This resulted in higher metal values reflected as background in the site soils. This nonconformance did not affect the overall sample analysis results.

A.4.4 Laboratory Nonconformances

Laboratory nonconformances are generally due to inconsistencies in analytical instrumentation operation and fluctuations in internal standard and calibration results. Several laboratory nonconformances were noted during analysis of the samples. However, the noted nonconformances did not affect the overall quality of the sampling event results. Laboratory and validation data qualifiers (if applicable) were assigned to identify those isolated samples that may have impacted the data quality. The laboratory data packages which detail nonconformances are maintained in the IT project files.

A.5.0 References

DOE, see U.S. Department of Energy.

EPA, see U.S. Environmental Protection Agency.

FFACO, see *Federal Facility Agreement and Consent Order*.

Federal Facility Agreement and Consent Order of 1996. Agreed to by the Nevada Division of Environmental Protection, the U.S. Department of Energy, and the U.S. Department of Defense.

IT, see IT Corporation.

IT Corporation. 1994. *Standard Quality Practices*. Las Vegas, NV.

IT Corporation. 1996a. *Site-Specific Health and Safety Plan, Corrective Action Investigation, Roller Coaster Lagoons and North Disposal Trench - Surface Sampling, Tonopah Test Range*. Las Vegas, NV.

IT Corporation. 1996b. *Site-Specific Health and Safety Plan, Part "II," Tonopah Test Range, Roller Coaster Lagoons and North Disposal Trench - Subsurface Sampling*. Las Vegas, NV.

IT Corporation. 1996c. *Field Instructions for Surface Soil Sampling and Hazard Categorization (HnBOAT) of Drums #4 and #5 at Roller Coaster Sewage Lagoons, Tonopah Test Range*. Las Vegas, NV.

IT Corporation. 1996d. *Field Instruction for Subsurface Soil Characterization: The Second Gas Station Underground Storage Tanks and the Roller Coaster Sewage Lagoons Outfall Pipe Area*. Tonopah Test Range, NV.

SNL, see Sandia National Laboratories.

Sandia National Laboratories. 1994. *1993 Site Environmental Report, Tonopah Test Range, Tonopah, Nevada*, SAND94-1292, UC-630. Albuquerque, NM.

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- U.S. Environmental Protection Agency. 1987. *Data Quality Objectives for Remedial Response Activities*, EPA/540/G-87-003. Washington, DC.
- U.S. Environmental Protection Agency. 1994. *Guidance for the Data Quality Objectives Process*, EPA QA/G-4. Washington, DC.
- U.S. Environmental Protection Agency. 1996a. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846, Third Edition. Washington, DC.
- U.S. Environmental Protection Agency. 1996b. *Region IX Preliminary Remediation Goals (PRGs) 1996*. Memorandum from Stanford J. Smucker, Ph.D., Regional Toxicologist, Technical Support Team to the PRG Table Mailing List, 1 August.

Attachment A
Boring Log

SOIL BORING LOG		BORING NUMBER: RC-1	Page#1 of 1	Section: Attachment
PROJECT NAME: TTR ROLLER COASTER		ENVIRONMENTAL CONTRACTOR: IT CORPORATION		Revision: 0
PROJECT NUMBER: 764034.03020100		DRILLING METHOD: 3.5" HS-Auger		Date: 03/26/97
UTM EASTING: 523911.79		DRILLING CONTRACTOR: Spectrum Drilling		
UTM NORTHING: 4175188.95		ELEVATION DATUM: Mean Sea Level		
GEOLOGIST: M. Doe		HOLE SURFACE ELEVATION: 1686.90		
QA CHECK: M. Unruh		TOTAL DEPTH OF HOLE: 32.00		
DATE HOLE STARTED: 09/16/96		COMMENTS:		
DATE HOLE COMPLETED: 09/16/96				

Depth (feet)	Depth (meters)	Legend	UCCS	Classification (Description)	DDT (ppb)	DDE (ppb)	Blow Counts (per 6 in.)	Sample No.
0	0		GM	Fine silts and sands with degraded plant matter.	0	50	0	
				Gravelly sand. Sand: m-vc, moist, dark tan. Pebbles to 1/2 inch				
			SP				19,000 45,000 51,000	TTR00131
2				Sand, m-c, ms, sa-sr, tan, moderate to loose compaction, some moisture.	5	2		
							20,000 35,000 31,000	
10								
				Sand, m-vc, ps, sa-sr, tan, moderate to loose packing. Some moisture.			19,000 50,000 51,000	
4								
				Sand with gravel (40%), f-vc, ps, sa-sr, tan, clay present in low amounts. Gravels to 1/4 inch. Moist.				
			GP				37,000 40,000 55,000	
20	6							
				Coarse, pebbly sand, ps, c-vc, sa-a. Pebbles to 1 inch well compacted. Low to moderate moisture.			36,000 52,000 50,000	TTR00132
					4	1		
8								
				Gravelly sand, ps, c-vc, with pebbles to 1.5 inches. Loose to moderate compaction.			36,000 41,000 35,000	TTR00133
					4	1		
30								

Appendix B

Cost Estimates

ROLLER COASTER LAGOONS CADD

BASIS OF ESTIMATE

1. The average soil density is 100 pounds per cubic foot.
2. The soil volume includes 20 percent for expansion.
3. The contaminated volume to be excavated is 258 cubic meters (m^3) (335 cubic yards [yd^3]).
4. The volume of fill required for the Roller Coaster Lagoons and North Trench is 5,434 m^3 (7,111 yd^3).
5. The volume of seeded top soil is 543 m^3 (706 yd^3).
6. Two fences will be required for a total length of 310 meters (1,020 feet) (cost from R.S. Means).
7. The soil contamination is DDD, DDT, and DDE at 9,900 ppb.
8. Disposal site is Laidlaw Environmental in Utah. Disposal fee is \$45 per ton (recent quote).
9. Transportation will be by subcontract carrier, with truck and driver at \$75 per hour, 12 hours per day (recent quote).
10. Fifteen trucks are required with a 15 yd^3 per load capacity. The cycle time for disposal is 2 days.
11. The average truck speed is 45 miles per hour, and the distance is 505 miles one way.
12. The cycle time for each truck for the local fill is 8 loads per day.
13. The cycle time for each truck for the top soil is 2 loads per day.
14. The crew and equipment (excluding the 15 dump trucks) are Bechtel Nevada, FY 1997 rates.
15. A G&A adder of 13 percent is included for the subcontracted work.

ROLLER COASTER LAGOON CADD COST SUMMARIES

ALTERNATIVE 1 NO ACTION

NO COSTS

ALTERNATIVE 2 INSTITUTIONAL CONTROLS

1.0 FENCE AND SIGNS

	\$ 36,447
CONSTRUCTION	\$ 36,447
CONTINGENCY 25%	\$ 9,112
PERMITTING 5%	\$ 1,822
ENGINEERING & OVERSIGHT 15%	\$ 5,467
TOTAL	\$ 52,848

ALTERNATIVE 3 EXCAVATE & COVER

1.0 SIGNS

2.0 EXCAVATE 335 CY, FILL 7,111 CY, TOP SOIL 706 CY

	\$ 6,780
	\$ 280,320
CONSTRUCTION	\$ 287,100
CONTINGENCY 25%	\$ 71,775
PERMITTING 5%	\$ 14,355
ENGINEERING & OVERSIGHT 15%	\$ 43,065
TOTAL	\$ 416,295

ALTERNATIVE 4 COVERING

1.0 SIGNS

1.0 FILL 6,776 CY, TOP SOIL 706 CY

	\$ 6,780
	\$ 189,206
CONSTRUCTION	\$ 195,986
CONTINGENCY 25%	\$ 48,997
PERMITTING 5%	\$ 9,799
ENGINEERING & OVERSIGHT 15%	\$ 29,398
TOTAL	\$ 284,180

IT CORPORATION ESTIMATE SHEET

CADD CAU No. 404
 Section: Appendix B
 Revision: 0
 Date: 03/26/97

PROJECT: ROLLER COASTER LAGOONS
LOCATION: TTR

DATE 12/18/96
REV A

ITEM	DESCRIPTION	QUAN	UNIT	MATL	LABOR	SUBCONT	TOTAL	G&A
1.0	FENCING & SIGNS							
1.1	6" Industrial Chainlink Fencing with Barbed Wire	1,020	L.F.			\$ 22.50	\$ 22,950	\$ 2,984
	Aluminized Corner Posts	8	EA			\$ 128	\$ 1,024	\$ 133
	20' Swing Gate	2	EA			\$ 1,140	\$ 2,280	\$ 296
1.2	Signs	12	EA			\$ 500	\$ 6,000	\$ 780
1.3	Subcontract G&A						\$ 4,193	
	FENCING & SIGNS SUBTOTAL						\$ 36,447	
2.0	EXCAVATE (335 CY) ; FILL(7111 CY) & TOP SOIL (706 CY)							
2.1	MOBILIZATION							
	Dump Trucks @ 15	2	DAY			\$ 13,500	\$ 27,000	\$ 3,510
	Water Truck @ 1	2	DAY	\$ 133			\$ 266	
	Compactor @ 1	2	DAY	\$ 136			\$ 272	
	Grader @ 1	2	DAY	\$ 136			\$ 272	
	Front End Loader @ 2	2	DAY	\$ 272			\$ 544	
	SUBTOTAL						\$ 28,354	
2.2	EXCAVATION/LOAD/TRANSPORT							
	Dump Trucks & Driver & Per Diem @ 15 x \$900	9	DAY			\$ 13,500	\$ 121,500	\$ 15,795
	Liners for Contaminated Soil	47	EA	\$ 75			\$ 3,525	\$ 458
	Disposal Fee	450	TON			\$ 45	\$ 20,250	\$ 2,633
	Analytical-Pesticides	12	EA			\$ 150	\$ 1,800	\$ 234
	Water Truck @ 1	9	DAY	\$ 133			\$ 1,197	
	Front End Loader @ 2	9	DAY	\$ 272			\$ 2,448	
	Compactor @ 1	9	DAY	\$ 136			\$ 1,224	
	Grader @ 1	9	DAY	\$ 136			\$ 1,224	
	Seed	3,500	SY	\$ 0.30			\$ 1,050	
	Superintendent @ 1	9	DAY		\$ 990		\$ 8,910	
	Equipment Operator @ 4	9	DAY		\$ 2,880		\$ 25,920	
	Driver @ 1 for Water Truck	9	DAY		\$ 720		\$ 6,480	
	TTR Per Diem @ 6 x \$36/day	9	DAY	\$ 216			\$ 1,944	
	SUBTOTAL						\$ 197,472	
2.3	DEMOBILIZATION							
	Dump Trucks @ 15	2	DAY			\$ 13,500	\$ 27,000	\$ 3,510
	Water Truck @ 1	2	DAY	\$ 133			\$ 266	
	Compactor @ 1	2	DAY	\$ 136			\$ 272	
	Grader @ 1	2	DAY	\$ 136			\$ 272	
	Front End Loader @ 2	2	DAY	\$ 272			\$ 544	
	SUBTOTAL						\$ 28,354	
2.4	Subcontract G&A						\$ 26,140	
	EXCAVATION, COVERING & FILL SUBTOTAL						\$ 280,320	
3.0	FILL(6776 CY) & TOP SOIL (706 CY)							
3.1	MOBILIZATION							
	Dump Trucks @ 15	2	DAY			\$ 13,500	\$ 27,000	\$ 3,510
	Water Truck @ 1	2	DAY	\$ 133			\$ 266	
	Compactor @ 1	2	DAY	\$ 136			\$ 272	
	Grader @ 1	2	DAY	\$ 136			\$ 272	
	Front-end Loader @ 2	2	DAY	\$ 272			\$ 544	
	SUBTOTAL						\$ 28,354	
3.2	EXCAVATION/LOAD/TRANSPORT							
	Dump Trucks & Driver & Per Diem @ 15 x \$900	6	DAY			\$ 13,500	\$ 81,000	\$ 10,530
	Water Truck @ 1	6	DAY	\$ 133			\$ 798	
	Front End Loader @ 2	6	DAY	\$ 272			\$ 1,632	
	Compactor @ 1	6	DAY	\$ 136			\$ 816	
	Grader @ 1	6	DAY	\$ 136			\$ 816	
	Seed	3,500	SY	\$ 0.30			\$ 1,050	
	Superintendent @ 1	6	DAY		\$ 990		\$ 5,940	
	Equipment Operator @ 4	6	DAY		\$ 2,880		\$ 17,280	
	Driver @ 1 for Water Truck	6	DAY		\$ 720		\$ 4,320	
	TTR Per Diem @ 6 x \$36/day	6	DAY	\$ 216			\$ 1,296	
	SUBTOTAL						\$ 114,948	
3.3	DEMOBILIZATION							
	Dump Trucks @ 15	2	DAY			\$ 13,500	\$ 27,000	\$ 3,510
	Water Truck @ 1	2	DAY	\$ 133			\$ 266	
	Compactor @ 1	2	DAY	\$ 136			\$ 272	
	Grader @ 1	2	DAY	\$ 136			\$ 272	
	Front End Loader @ 2	2	DAY	\$ 272			\$ 544	
	SUBTOTAL						\$ 28,354	
3.4	Subcontract G&A						\$ 17,550	
	EXCAVATION, COVERING & FILL SUBTOTAL						\$ 189,206	

Appendix C
Comment/Response Form

NEVADA ENVIRONMENTAL RESTORATION PROJECT DOCUMENT REVIEW SHEET

1. Document Title/Number <u>Draft Corrective Action Decision Document for Roller Coaster Lagoons and North Disposal Trench (Corrective Action Unit No. 404)</u>	2. Document Date <u>January 1997</u>
3. Revision Number <u>Draft</u>	4. Originator/Organization <u>Searls/IT</u>
5. Responsible DOE/NV ERP Subproject Mgr. <u>Cable/Appenzeller-Wing</u>	6. Date Comments Due <u>February 25, 1997</u>
7. Review Criteria <u>Technical Review</u>	
8. Reviewer/Organization/Phone No. <u>Karen Beckley, NDEP</u>	
9. Reviewer's Signature _____	

10. Comment Number/ Location	11. Type ^a	12. Comment	13. Comment Response	14. Accept
1. p. 2-1, Appendix A	M	Appendix A in the document sent to NDEP contains a boring log and not the corrective action investigation results.	The tab for the appendix was in the wrong place in the draft. The tab will be moved in the final CADD. There is an Attachment A (boring logs) to Appendix A (characterization report).	
2. p. 2-1, Appendix A	M	Radiological sampling results need to be presented in the document and should be compared to the POC (if applicable by constituent) or to background levels.	Sampling was not done for radiological constituents because the screening did not identify radiological contamination. Discussion of the radiological screening results has been added to Appendix A, Section A.3.6.	
3. General	M	The document states that deed restrictions will be placed on the land. Has the Air Force been involved with document review for the corrective action activities at this location, and do they concur with this proposal?	DOE will record land-use restrictions as applicable with respect to closures in place in the same manner that the Air Force presently uses for this purpose.	