RECORD OF TECHNICAL CHANGE

Technical Change No. 1

Project/Job Name: Cactus Spring Waste Trenches (CAU 426) Date 7-25-97

Applicable Project-Specific Document(s): Corrective Action Decision Document for The Cactus Spring Waste Trenches (CAU 426) (Revision 1), June 1997.

The following technical changes (including justification) are requested by:

Kenneth C. Beach, Jr. (Name) — Project Manager (Title)

Delete:

Section 2.3 Need for Corrective Action

Analytes detected as the result of the corrective action investigation were evaluated to determine potential COCs for the Cactus Spring Waste Trenches. On the basis of this evaluation, no constituents were identified above applicable regulatory limits (i.e., *EPA Region IX Preliminary Remediation Goals* [EPA, 1996] and the *Offsite Radiation Exposure Review Project, Phase II Soils Program* [DOE/NV, 1996b]); therefore, no COCs were identified. However, process knowledge of the site indicates that it was used for waste disposal. During investigation activities, general waste (including wood, glass, metal, animal bone fragments, and paint chips) was found, which confirms that waste remains in the trenches. Soil moisture levels do not indicate that waste constituents are migrating from the trenches in infiltrated water. The trenches will be classified as a Class III solid waste disposal facility and will be closed under the FFACO in accordance with all applicable state and federal rules and regulations (e.g., *Nevada Administrative Code* [NAC] 444 and 445A and Title 40 *Code of Federal Regulations* [CFR] 258). However, the CAU is eligible for a reduction or waiver of minimum requirements under NAC 444.731 because it has not received waste since the mid 1960's; it has not received inert waste; it was placed in a landfill incidental to the DOE's operation; it is on property controlled by the DOE; and it is unlikely to produce pollutants or contaminants that may degrade waters of the state. This CADD assumes that corrective action proposed in the following text need only meet minimum requirements.

Add:

Section 2.3 Need for Corrective Action

No constituents were identified above regulatory limits (i.e., *EPA Region IX Preliminary Remediation Goals* [EPA, 1996] and the *Offsite Radiation Exposure Review Project, Phase II Soils Program* [DOE/NV, 1996b]) from the corrective action investigation; therefore, no COCs were identified for the Cactus Spring Waste Trenches. Although the site received waste prior to the regulations pertaining to Class III solid waste facilities (e.g., *Nevada Administrative Code* [NAC] 444 and 445A and Title 40 *Code of Federal Regulations* [CFR] 258) and, therefore, does not technically fall under these requirements, it does exhibit characteristics of a Class III landfill. The CAU will be closed under the FFACO in accordance with applicable or relevant and appropriate state and federal rules and regulations for a Class III solid waste facility.

During investigation activities, general waste (including wood, glass, metal, animal bone fragments, and paint chips) was found, which confirms process knowledge that the site was used for waste disposal. Monitoring is not required because the CAU is eligible for a reduction or waiver of minimum requirements under NAC 444.741. The CAU is eligible for waivers of the minimum standards for closure requirements and cap design under NAC 444.731 because the CAU has not received waste since the mid-1960s; it has only received inert waste; it was constructed and used solely for wastes generated from the Operation Roller Coaster tests; it was used prior to DOE's involvement at TTR; it is in an area controlled jointly by DOE and the Air Force; and it will not release pollutants or contaminants that will degrade waters of the state.

Justification: Section 2.3 did not clearly state that a correction action is needed for the Cactus Spring Waste Trenches. In addition, the section did not clearly state that no COCs were found at the Cactus Spring Waste Trenches and that the site was a landfill prior to DOE involvement with TTR. The section incorrectly states:

- That the site is a Class III solid waste disposal facility, when in fact it only exhibits characteristics for one
- That the site did not receive inert waste when in fact the site received only inert waste.

The project time will be (Increased)(Decreased)***(Unchanged)*** by approximately 0 days

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Approved By: /s/ Kevin Cabble for Date 7-22-97

Janet Appenzeller-Wing, Project Manager
Industrial Sites Subproject

Approved By: /s/ Bobbie McClure for Date 7-24-97

Stephen A. Mellington, Project Manager
Nevada Environmental Restoration Project

Contract Change Order Required Yes ______ No X

Contract Change Order No. ____________

DOE/NV--473
UC-700

Nevada
Environmental
Restoration
Project

Corrective Action Decision Document for the Cactus Spring Waste Trenches (Corrective Action Unit No. 426)

UNCONTROLLED

Controlled Copy No.: ______

Revision No.: 1

June 1997

Environmental Restoration
Division

U.S. Department of Energy
Nevada Operations Office

DOE/NV--473
UC-700

CORRECTIVE ACTION DECISION DOCUMENT FOR THE CACTUS SPRING WASTE TRENCHES (CORRECTIVE ACTION UNIT NO. 426)

DOE Nevada Operations Office
Las Vegas, Nevada

Controlled Copy No.: ____

Revision No.: 1

June 1997

CORRECTIVE ACTION DECISION DOCUMENT
FOR THE CACTUS SPRING WASTE TRENCHES
(CORRECTIVE ACTION UNIT NO. 426)

Approved by: /s/ Janet Appenzeller-Wing
Janet L. Appenzeller-Wing, Project Manager
Industrial Sites Subproject

Date: 6/18/97

Approved by: /s/ Monica Sanchez
Stephen A. Mellington, Project Manager
Nevada Environmental Restoration Project

Date: 6/18/97

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List of Acronyms and Abbreviations

CADD	Corrective Action Decision Document
CAIP	Corrective Action Investigation Plan
CAS	Corrective Action Site(s)
CAU	Corrective Action Unit(s)
CFR	*Code of Federal Regulations*
cm	Centimeter(s)
COC	Chemical(s) of concern
CRDL	Contract-Required Detection Limit
DOE	U.S. Department of Energy
DOE/AL	U.S. Department of Energy, Albuquerque Operations Office
DOE/NV	U.S. Department of Energy, Nevada Operations Office
DOT	U. S. Department of Transportation
EPA	U.S. Environmental Protection Agency
FFACO	*Federal Facility Agreement and Consent Order*
ft	Foot (feet)
in.	Inch(es)
km	Kilometer(s)
m	Meter(s)
m^3	Cubic meter(s)
mi	Mile(s)
NAC	*Nevada Administrative Code*
NDEP	Nevada Division of Environmental Protection
PCB	Polychlorinated biphenyl(s)
RCRA	*Resource Conservation and Recovery Act*
SVOC(s)	Semivolatile organic compound(s)
TPH(s)	Total petroleum hydrocarbon(s)
TTR	Tonopah Test Range
VOC(s)	Volatile organic compound(s)
yd^3	Cubic yard(s)

1.0 Introduction

The *Corrective Action Decision Document (CADD) for the Cactus Spring Waste Trenches* (Corrective Action Unit [CAU] No. 426) has been prepared for the U.S. Department of Energy's (DOE) Nevada Environmental Restoration Project. This CADD has been developed to meet the requirements of the *Federal Facility Agreement and Consent Order* (FFACO) *of 1996*, stated in Appendix VI, "Corrective Action Strategy" (FFACO, 1996).

The Cactus Spring Waste Trenches Corrective Action Site (CAS) No. RG-08-001-RG-CS is included in CAU No. 426 (also referred to as the "trenches"); it has been identified as one of three potential locations for buried, radioactively contaminated materials from the Double Tracks Test. The trenches are located on the east flank of the Cactus Range in the eastern portion of the Cactus Spring Ranch at the Tonopah Test Range (TTR) in Nye County, Nevada, on the northern portion of Nellis Air Force Range. The TTR is approximately 225 kilometers (km) (140 miles [mi]) northwest of Las Vegas, Nevada, by air and approximately 56 km (35 mi) southeast of Tonopah, Nevada, by road (Figures 1-1 and 1-2). The trenches were dug for the purpose of receiving waste generated during Operation Roller Coaster, primarily the Double Tracks Test.

This test, conducted in 1963, involved the use of live animals to assess the biological hazards associated with non-nuclear detonation of plutonium-bearing devices (i.e., inhalation uptake of plutonium aerosol). The CAS consists of four trenches that received solid waste and had an overall impacted area of approximately 36 meters (m) (120 feet [ft]) long x 24 m (80 ft) wide x 3 to 4.5 m (10 to 15 ft) deep. The average depressions at the trenches are approximately 0.3 m (1 ft) below land surface.

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 investigation activities at the Cactus Spring Waste Trenches CAU.

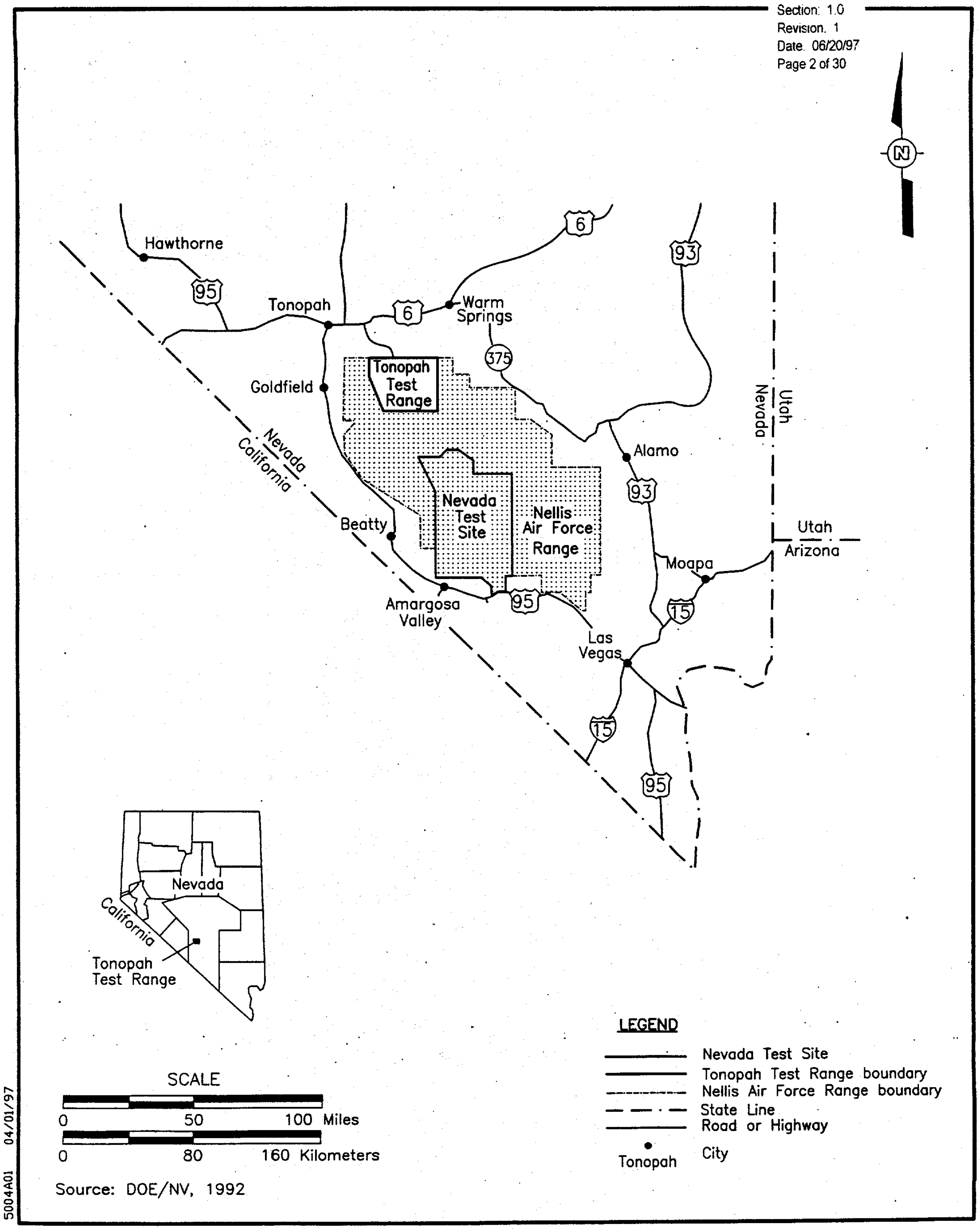

Figure 1-1
Tonopah Test Range Location Map

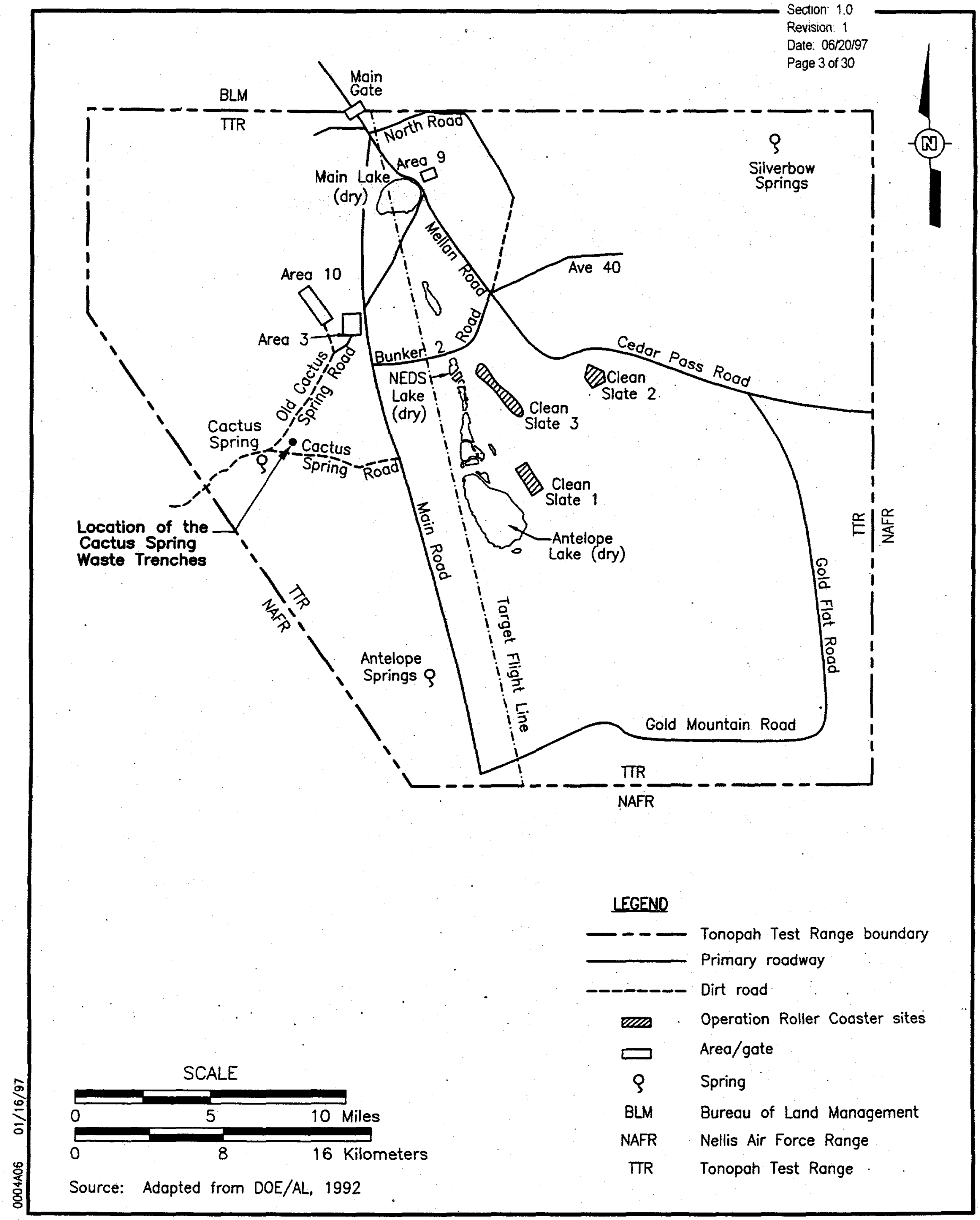

Figure 1-2
Location of the Cactus Spring Waste Trenches, Tonopah Test Range

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 Cactus Spring Waste Trenches CAU. 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 corrective action alternative screening criteria (corrective action standards and remedy selection decision factors).
- Develop corrective action alternatives.
- Evaluate (detailed and comparative evaluations) how well the corrective action alternatives achieve the corrective action objectives based on the screening criteria 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 historical use of the CAS. It also summarizes the results of the investigation field 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 includes the following:
    - Identification of corrective action objectives
    - Identification of corrective action screening criteria
    - Development and screening of corrective action alternatives
    - Evaluation and comparison of corrective action alternatives

- Section 4.0 - Recommended Alternative
  - Presents the preferred corrective action alternative and the rationale for its selection based on the corrective action objectives and alternative 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: Cactus Spring Waste Trenches, 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, 1996c).

- Appendix A - Cactus Spring Waste Trenches Corrective Action Investigation Report

- 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 Cactus Spring Waste Trenches CAU. Based on this information, corrective action objectives were identified to aid in the formation of corrective action alternatives.

2.1 Investigation Activities

In September 1996, IT performed a corrective action investigation that consisted of the following activities as set forth in the *Corrective Action Investigation Plan* (CAIP) (DOE/NV, 1996a).

- Drilled sixteen borings (15 investigation and one exploratory) to a maximum depth of 12 m (40 ft) in the trenches and nearby area and collected samples for field screening and laboratory analysis (Appendix A and Figure 2-1)
- Collected continuous cores for visual inspection from the surface to total depth in all borings
- Screened soil samples using headspace analysis for volatiles, colorimetric testing for total petroleum hydrocarbons (TPHs), and screened for alpha and beta/gamma radiation
- Analyzed environmental samples for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), *Resource Conservation and Recovery Act* (RCRA) metals, TPHs, pesticides, polychlorinated biphenyls (PCBs), and alpha and gamma radioactivity
- Evaluated the condition of the soils to determine if chemicals of concern (COCs) were present
- Assessed the potential downward migration of COCs through the underlying soils

In addition, historical documents, interviews, and process knowledge were used to assist in the identification of potential contaminants at the trenches (see Appendix A).

2.2 Results

The corrective action investigation results indicated the following:

- Visual inspection of the cores indicated no evidence of hazardous materials or radioactively contaminated material. The materials encountered in the trenches included wood, glass, metal, animal bone fragments, and paint chips.

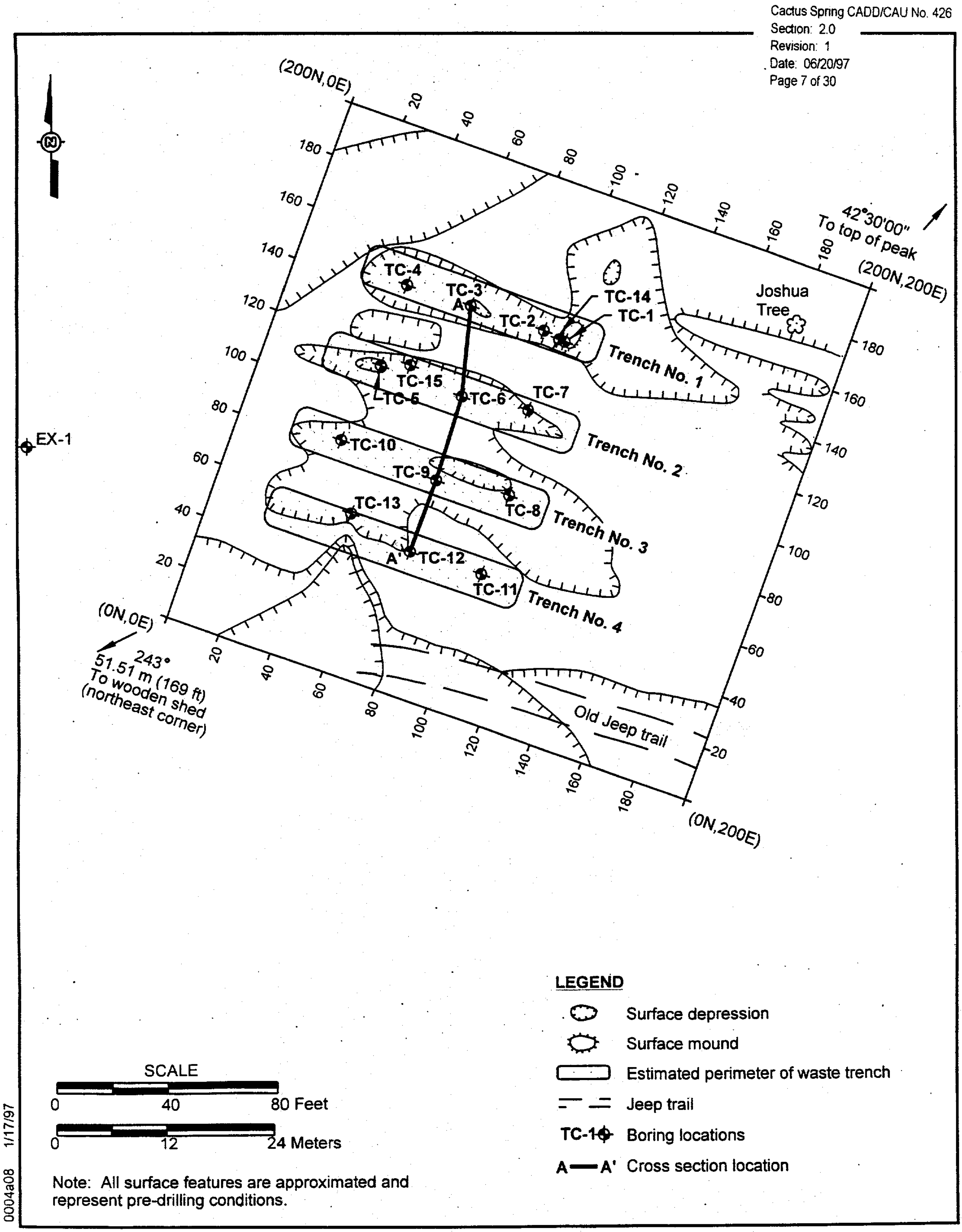

Figure 2-1
Site Map for the Cactus Spring Waste Trenches, Tonopah Test Range

- Visual inspection and moisture testing indicated that the soils in and below the trenches are not saturated. Infiltration and leachate production has not occurred to date and is not expected to in the future.

- Most VOC parameters were not detected. The levels of those parameters which were detected were well below the action levels outlined in the CAIP (DOE/NV, 1996a).

- TPH levels for the soil samples were below the Contract-Required Detection Limit (CRDL) (see Appendix A) with the following exception. Sample TTR00217 had an elevated TPH as diesel level that appears to be spurious.

- Most SVOCs were not detected. All the SVOCs that were reported had levels that were quantitatively estimated, some of which were associated with a blank.

- All reported levels for RCRA metal samples (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver) are below the screening levels established in the CAIP (DOE/NV, 1996a). The analytical results are indicative of the naturally occurring background levels for this area.

- No pesticides or PCBs were detected.

- Radiological results were within background levels.

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

2.3 Need for Corrective Action

Analytes detected as the result of the corrective action investigation were evaluated to determine potential COCs for the Cactus Spring Waste Trenches. On the basis of this evaluation, no constituents were identified above applicable regulatory limits (i.e., *EPA Region IX Preliminary Remediation Goals* [EPA, 1996] and the *Offsite Radiation Exposure Review Project, Phase II Soils Program* [DOE/NV, 1996b]); therefore, no COCs were identified. However, process knowledge of the site indicates that it was used for waste disposal. During investigation activities, general waste (including wood, glass, metal, animal bone fragments, and paint chips) was found, which confirms that waste remains in the trenches. Soil moisture levels do not indicate that waste constituents are migrating from the trenches in infiltrated water. The trenches will be classified as a Class III solid waste disposal facility and will be closed under the FFACO in accordance with all applicable state and federal rules and regulations (e.g., *Nevada Administrative Code* [NAC] 444 and 445A and Title 40 *Code of Federal Regulations* [CFR] 258). However, the CAU is eligible for a reduction or waiver of minimum requirements under

NAC 444.731 because it has not received waste since the mid 1960s; it has not received inert waste; it was placed in a landfill incidental to the DOE's operation; it is on property controlled by the DOE; and it is unlikely to produce pollutants or contaminants that may degrade waters of the state. This CADD assumes that corrective action proposed in the following text need only meet minimum requirements.

3.0 Evaluation of Alternatives

The purpose of this section is to present the corrective action objectives for the Cactus Spring Waste Trenches CAU; to present and describe the general standards and decision factors used to screen the corrective action alternatives; to identify a baseline of viable, proven technologies; and to develop and evaluate a set of corrective action alternatives that could 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, the following corrective action objectives have been identified for the Cactus Spring Waste Trenches CAU:

- Prevent or mitigate human exposure to subsurface soils containing waste.
- Remediate the site per applicable state and federal regulations (NAC 444 and 445A and 40 CFR 258).
- Prevent adverse impacts to groundwater quality.

3.1.1 Chemicals of Concern

Analyses conducted as the result of the corrective action investigation were evaluated to determine COCs for the Cactus Spring Waste Trenches CAU. Based on the results of this evaluation, no constituents were identified above applicable regulatory limits (i.e., *EPA Region IX Preliminary Remediation Goals* [EPA, 1996] and the *Offsite Radiation Exposure Review Project, Phase II Soils Program* [DOE/NV, 1996b]); therefore, no COCs were identified.

3.1.2 Potential Exposure Pathways

As part of the CAIP (DOE/NV, 1996a), a conceptual model for the Cactus Spring Waste Trenches CAU was developed which identified the following as potential exposure pathways: inhalation of vapors, dermal contact of soils, and ingestion of soils under residential and occupational scenarios. Constituents above regulatory levels were not detected, and hazardous constituents are present only in isolated detections at very low levels. Therefore, there is no known source, and there are no existing exposure pathways. However, nonhazardous solid waste remains in the trenches, and the corrective action alternatives should prevent or mitigate human exposure to subsurface soils containing waste and provide a method to close the site per applicable state and federal regulations (NAC 444 and Title 40 CFR 258).

3.2 Screening Criteria

The screening criteria used to evaluate and select the preferred corrective action alternative consisted of a variety of general standards and decision factors described in the Title 40 CFR 260-271, the U.S. Environmental Protection Agency (EPA) *Guidance on Resource Conservation and Recovery Act Corrective Action Decision Documents* (EPA, 1991), and the Final *Resource Conservation and Recovery Act Corrective Action Plan* (EPA, 1994).

The developed corrective action alternatives 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.

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 applicable standards for management of wastes and with the corrective action standards (40 CFR 258 and NAC 444).

The remedy selection decision factors are:

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

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

3.2.1 Overall Protection of 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 (i.e., meet acceptable levels for removal of contaminants). The Cactus Spring Waste Trenches CAU does not have risk-based cleanup standards because no contaminants were found (Appendix A). The trenches are solid waste disposal trenches; and, therefore, the corrective action alternative must comply with the minimum standards for characterization, monitoring, and maintenance set forth in NAC 444.733 to 444.747, inclusive (i.e., NAC 444, "Solid Waste Disposal"). However, the CAU is eligible for a reduction or waiver of minimum requirements under NAC 444.731 because it has not received waste since the mid 1960s. It has received only inert waste; waste was placed in the landfill incidental to the DOE's operation; it is on property controlled by the DOE; and it is unlikely to produce pollutants or contaminants that may degrade waters of the state. This CADD assumes that the corrective action proposed in the following text need only meet minimum requirements.

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. Therefore, each corrective action alternative must use an effective source control program to ensure the long-term effectiveness and protectiveness of the corrective action.

3.2.4 Comply with Applicable Standards for Management of Wastes

Each corrective action alternative must conduct all waste management activities in compliance with all applicable state and federal regulations (e.g., RCRA, solid waste disposal regulations [NAC 444 and Title 40 CFR 258]). The requirements for management of the waste, if any, derived from the corrective action will be determined based on NAC 444, Title 40 CFR 258, field observations, process knowledge, and the results of laboratory analysis. Administrative controls (e.g., decontamination procedures and corrective action strategies) will minimize waste generated during field activities. The soil has been field-screened, sampled, and analyzed. Waste generated through sampling is traceable to its source and to individual samples. Administrative controls (e.g., decontamination procedures and corrective action strategies) will minimize waste generated during site corrective action activities. Decontamination activities will be performed in accordance with approved procedures and will be designated according to the COCs present at the site.

3.2.4.1 Waste Minimization

The corrective action activities have been designed to minimize the amount of investigation-derived waste produced. Waste produced will include drill cuttings (soil), used personal protective equipment, and decontamination waste.

3.2.4.2 Potential Waste Streams

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

3.2.4.3 Waste Determination

Solid materials other than soil waste are waste only by the virtue of contact with contaminated media. Therefore, sampling and analysis, separate from verification analysis, should not be required.

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 process 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 that may result from construction and implementation
- The amount of time until the corrective action objectives 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 that medium.

3.2.7 *Long-Term Reliability and Effectiveness*

Each corrective action alternative must be evaluated in terms of risk remaining at the CAU after corrective action alternatives are achieved. 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" 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).

- "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 each component:

- Capital Costs: These costs 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 include such items as engineering design, permits and/or fees, start-up costs, and any contingency allowances.

- Operation and Maintenance: These costs include labor, training, sampling and analysis, maintenance materials, utilities, 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. Details of the cost estimates for this CADD are provided in Appendix B.

3.3 Development of Corrective Action Alternatives

This section identifies and briefly describes the viable corrective action technologies and the corrective action alternatives considered for the affected media.

3.3.1 Identification of Corrective Action Technologies

Viable technologies considered for implementation at the Cactus Spring Waste Trenches CAU are:

- Access restrictions
- Capping
- Monitoring
- Excavation
- Embankments
- Compacting

These technologies, as well as other frequently used technologies and innovative technologies, were considered for this CADD; however, these technologies were chosen for evaluation because they use standard construction equipment and activities. Other common waste treatment technologies (e.g., waste stabilization, barriers such as slurry walls, or excavation and off-site disposal) are not considered because they are applicable to hazardous wastes or waste sites with migrating constituents. The Cactus Spring Waste Trenches CAU has no evidence of migrating constituents or hazardous wastes (Appendix A).

3.3.1.1 Access Restrictions

Institutional controls are physical and administrative controls such as fencing and land-use restrictions, which can preclude the access to or use of specified lands. Access restrictions have been commonly used at other DOE facilities nationwide. The TTR, which includes the Cactus Spring Waste Trenches CAS, 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.

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

3.3.1.2 Capping

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

For estimation purposes, this CADD assumes that groundwater at the site has not been impacted because no contaminants were found in the soils directly beneath the wastes and that a cap, consisting of clean fill soil and a vegetative cover, will be used. The impacted area will 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. The vegetative cover will consist of approximately one foot of clean top soil placed over the backfilled soils. The top soil will be compacted and seeded with shallow-rooted native grasses (to prevent plant uptake of the contaminants) that will prevent erosion, provide increased drainage, prevent contact with the waste, minimize the impacts of weathering, and provide a zone of evapotransportation for precipitation.

3.3.1.3 Monitoring

Based on an analysis of the data collected at the CAU and the minimum standards for a Class III site, a waiver of monitoring requirements as specified in NAC 444.731 and NAC 444.741 is appropriate at this site. No hazardous materials were identified in the characterization. Process knowledge does not indicate the potential for significant amounts of hazardous materials to have been disposed to the CAU. The site is eligible for a waiver of the minimum requirements under NAC 444.741 because there is no reasonable potential for migration of pollutants or contaminants from the site to waters of the state. The following information supports the protection of groundwater and, subsequently, the waiver of monitoring requirements.

The depth to groundwater at the site is unknown; however, bedrock was encountered 1.8 to 5 m (6 ft to 17 ft) from the surface during the investigation. If contaminants were to leach from the waste trenches, the bedrock would act as an aquitard to the downward migration.

The soils used in the trenches are native soils consisting of alluvial materials. The hydrologic/geotechnical analysis determined that the alluvial/fill material has very low hydraulic conductivity and soil moisture content within the low range. Both these factors limit the migration potential through the soils.

Annual precipitation averages 13 to 15 centimeters (cm) (5 to 6 inches [in.]) at TTR (DOE/NV, 1996c). Annual evaporation is between 147 and 168 cm (58 and 66 in.) (DOE/NV, 1996c). The high evaporation and low precipitation create a negative water balance for the area; therefore, no driving force associated with precipitation is available to mobilize contaminants to groundwater.

No evidence of contaminants above regulatory limits was found. The waste encountered during the investigation consisted of general waste, such as wood, glass, metal, animal bone fragments, and paint chips. No COCs were identified. The leaching potential from this type of waste is limited due to its form. The levels of contamination do not present any significant migration potential or associated effect on waters of the state.

Based on the investigation, the extent of the contamination is limited to the solid waste in the trenches. Soil moisture and sampling results show no indication of downward migration of contaminants.

Presently, the CAS is located in a government-controlled facility with the potential land use of livestock grazing. The TTR is a restricted area that is guarded on a 24-hour, 365-day-per-year basis; unauthorized personnel are not admitted to the facility.

No contaminants were identified with the potential for a hazard related to fire, vapor, or explosion.

No other site-specific information is available that could substantiate the potential for contaminant migration. Closure of the trenches as a Class III landfill per NAC 444 would require the emplacement of a cover. This cover would act as an additional barrier to water infiltration. Based on this information, neither vadose nor groundwater monitoring is considered necessary for this site.

3.3.1.4 Excavation

Excavation is the process of removing soil 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 industries. Excavation equipment is commercially available with optical equipment for unique situations, for example, telescopic excavation 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.

For purposes of this CADD, excavation will be used to remove clean borrow soil from an on-site location for placement at the trenches.

3.3.1.5 Embankments

Embankments or "berms" are physical barriers used to prevent the encroachment or escape of fluid material. At the southernmost trench, berms may be used to protect the trench area from runoff waters or floodwaters from the nearby arroyo. This technology will most likely be used in conjunction with other technologies (such as a cap).

Berming is a well-developed technology which can be implemented with commercially available equipment, such as backhoes and front-end loaders. Berm construction can be tailored to the installation. Simple berms may consist of lifts of rip rap (i.e., large boulders commonly greater than two feet in diameter) and sand aggregate placed in a single layer, whereas more complex berms may consist of multiple aggregate lifts systematically compacted. If required, berms could be constructed with low permeability cores of clays or synthetic materials (e.g., 60- or 80-milliliter, High-Density Polyethylene liner material).

3.3.1.6 Compaction

Compaction is a physical process used to reduce volume and to make the soil less permeable and less subject to erosion. Compaction could consist of using equipment (such as hydraulic rams and sheeps-foot compactors) to compress the soils, thereby removing void space and reducing the volume. Compaction equipment is available from many commercial vendors. Compaction will be used in combination with other technologies such as capping.

3.3.2 Corrective Action Alternatives

The corrective action technologies presented in Section 3.3.1 are viable for use at the Cactus Spring Waste Trenches CAU and have proven effective at other sites with similar 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.

The following four corrective action alternatives have been developed for consideration at the Cactus Spring Waste Trenches CAU based on future land use and current operations at the TTR.

- Alternative 1 - No Action (for baseline comparison only)
- Alternative 2 - Access Restrictions
- Alternative 3 - Capping
- Alternative 4 - Capping and Embankment Protection (i.e., Rip Rap Protection)

3.3.2.1 Alternative 1 - No Action

Under the no-action alternative, no corrective action activities will be implemented. This alternative is used as a starting point to establish a baseline for comparison with the other corrective action alternatives. This alternative does not meet the general standards for overall protection of human health and the environment and is not a permanent solution (i.e., does not provide site closure); therefore, it will not be compared to the other alternatives using the decision factors.

3.3.2.2 Alternative 2 - Access Restrictions

This alternative consists primarily of the installation of placards. Under this alternative, signs will be placed at the trenches to prohibit illegal dumping. In addition, approximately 293 linear m (1,000 linear ft) of chain-link fencing will be installed around the perimeter of the trenches to prevent access to the trenches and to mitigate potential contact to the waste. Covenants will be placed on the land to prohibit intrusive activities, farming, and ranching. In addition, land-use restrictions may be required on the land to prevent intrusive activities.

3.3.2.3 Alternative 3 - Capping

The major components of this alternative consist of the installation of a cap using clean fill soil and an engineered, vegetative cover.

Based on visual field evidence, the trenches were used primarily for solid waste disposal, and the nonhazardous solid waste remains buried in the trenches. The laboratory analytical results confirm this knowledge. Under this alternative, commercially available equipment will be used to excavate an estimated 115 cubic meters (m^3) (165 cubic yards [yd^3]) of clean borrow soil from an on-site location and transport it to the trench locations. The clean borrow soil will be placed in the surface depressions caused by the trenches and compacted; the area will then be brought to grade. After placement and compaction of the borrow material, approximately one foot of clean top soil (304 m^3 [435 yd^3]) seeded with native vegetation will be placed over the borrow material. This soil cap will prevent inadvertent intrusion to the solid waste and act as a means to limit infiltration of water into the trenches.

Signs will be placed around the perimeter of the trenches to prohibit unauthorized access and illegal dumping. Because impacted soils are left in place, land-use restrictions on the land may be required to prevent intrusive activities.

3.3.2.4 Alternative 4 - Capping and Embankment Protection (i.e., Rip Rap Protection)

The major components of this alternative consist of:

- Installation of a cap (clean fill soil and an engineered, vegetative cover)
- Installation of rip rap (large stones) along the southernmost trench boundary

Under this alternative, commercially available equipment will be used to excavate an estimated 115 m^3 (165 yd^3) of clean borrow soil from an on-site location and transport it to the trench locations. The clean borrow soil will be placed in the surface depressions caused by the trenches and compacted; the area will then be brought to grade. After placement and compaction of the borrow material, approximately one foot of clean top soil (304 m^3 [435 yd^3]) seeded with native vegetation will be placed over the borrow material. This soil cap will act as a means to limit infiltration of water into the trenches, thereby reducing the amount of leachate generated and removing any potential exposure pathways to the buried waste.

There is a potential for the arroyo located near the southernmost trench to flood and possibly erode the soils, thus exposing the buried waste. In order to prevent the creation of a potential future exposure pathway, approximately 24 linear m (80 linear ft) of the southernmost trench boundary will be covered with an embankment consisting of rip rap (large stones used to prevent erosion).

In addition, approximately 293 linear m (1,000 linear ft) of chain-link fencing will be installed around the perimeter of the trenches to prevent access to the trenches and to mitigate potential contact to the waste. Covenants will be placed on the land to prohibit intrusive activities, farming, and ranching.

Signs will be placed around the perimeter of the trenches to prohibit unauthorized access and illegal dumping. Because impacted soils are left in place, land-use restrictions on the land may be required.

3.4 Evaluation and Comparison of Alternatives

The general corrective action standards and remedy selection decision factors described in Section 3.2 were used to conduct a detailed evaluation of each corrective action alternative. An analysis compared 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 analysis evaluations, respectively. Cost estimate details are provided in Appendix B.

Table 3-1
Detailed Evaluation of the Corrective Action Alternatives
(Page 1 of 4)

Evaluation Criteria	Alternative 1 No Action	Alternative 2 Access Restrictions	Alternative 3 Capping and Monitoring	Alternative 4 Capping, Monitoring, and Embankment Protection
General Standards				
Overall Protection of Human Health and the Environment	No chemicals of concern have been identified; however, solid waste remains in the trenches. The southernmost trench is near an arroyo; flood waters may potentially cause erosion and expose waste at the surface.	No chemicals of concern have been identified; however, solid waste potentially remains in the trenches. The southernmost trench is near an arroyo; flood waters may potentially cause erosion and expose waste at the surface. Signs will warn that access to the trenches is prohibited; fencing will prevent access; and land-use restrictions will prohibit activities that cause human or animal contact with the waste.	No chemicals of concern have been identified; however, solid waste potentially remains in the trenches. By capping the trenches with clean borrow soil, potential exposure to the waste will be eliminated. In addition, the soil cap will limit precipitation infiltration to the trenches and limit soil erosion. Worker exposure will be controlled through the implementation of appropriate health and safety procedures. The southernmost trench is near an arroyo; floodwaters may potentially cause erosion and expose waste at the surface. This may result in potential exposure to the waste. Signs will warn that access to the trenches is prohibited, and land-use restrictions may be required to prevent human or animal contact with the waste.	No chemicals of concern have been identified; however, solid waste potentially remains in the trenches. By capping the trenches with clean borrow soil, potential exposure to the waste will be eliminated. In addition, the soil cap will limit precipitation infiltration to the trenches and limit soil erosion. The southernmost trench is near an arroyo; floodwaters may potentially cause erosion and expose waste at the surface. In order to minimize these potential impacts, an embankment (i.e., rip rap) will be installed to prevent erosion of the soils and remove potential future exposure pathways to the waste. Worker exposure will be controlled through the development and implementation of appropriate health and safety procedures. Signs will warn that access to the trenches is prohibited, and land-use restrictions may be required to prevent human or animal contact with the waste.

Table 3-1
Detailed Evaluation of the Corrective Action Alternatives
(Page 2 of 4)

Evaluation Criteria	Alternative 1 No Action	Alternative 2 Access Restrictions	Alternative 3 Capping and Monitoring	Alternative 4 Capping, Monitoring, and Embankment Protection
Attain Media Cleanup Standards	No risk-based cleanup standards have been identified for the trenches because contaminant concentrations indicate contamination was not found in the trenches or underlying soils. Media cleanup standards will be regulatory requirements (NAC 444), not health-based numbers. However, this CAU may be eligible for a reduction or waiver of the minimum regulatory requirements of NAC 444.	No risk-based cleanup standards have been identified for the trenches because contaminant concentrations indicate contamination was not found in the trenches or underlying soils. Media cleanup standards will be regulatory requirements (NAC 444), not health-based numbers. However, this CAU may be eligible for a reduction or waiver of the minimum regulatory requirements of NAC 444.	No risk-based cleanup standards have been identified for the trenches because contaminant concentrations indicate contamination was not found in the trenches or underlying soils. Media cleanup standards will be regulatory requirements (NAC 444), not health-based numbers. However, this CAU may be eligible for a reduction or waiver of the minimum regulatory requirements of NAC 444.	No risk-based cleanup standards have been identified for the trenches because contaminant concentrations indicate contamination was not found in the trenches or underlying soils. Media cleanup standards will be regulatory requirements (NAC 444), not health-based numbers. However, this CAU may be eligible for a reduction or waiver of the minimum regulatory requirements of NAC 444.
Control the Sources of the Release	No contamination has been identified above regulatory limits. However, solid waste will remain in the trenches. There is no control of potential contact with the waste to humans or the environment.	No contamination has been identified above regulatory limits. However, solid waste will remain in the trenches. There is no control of potential contact with the waste to humans or the environment.	No contamination has been identified above regulatory levels. However, by capping the trenches with clean soil, any potential exposure pathways to the waste will be removed, and any release of contaminants will be limited.	No contamination has been identified above regulatory levels. However, by capping the trenches with clean soil, any potential exposure pathways to the waste will be removed, and any release of contaminants will be limited. Additionally, an embankment (i.e., rip rap) placed along the southernmost trench boundary will remove an exposure pathway that could be caused by erosion from potential flooding of the arroyo.
Comply with Standards for Management of Wastes	No wastes are remediated at or removed from the site. However, this CAU may be eligible for a reduction or waiver of the minimum regulatory requirements of NAC 444.	No wastes are remediated at or removed from the site. However, this CAU may be eligible for a reduction or waiver of the minimum regulatory requirements of NAC 444.	Waste that remains in the trenches will be capped with clean soil, and the site will be closed per applicable State of Nevada closure regulations for landfills (NAC 444). However, this CAU may be eligible for a reduction or waiver of the minimum regulatory requirements of NAC 444.	Waste which remains in the trenches will be capped with clean soil, and the site will be closed per applicable State of Nevada closure regulations for landfills (NAC 444). However, this CAU may be eligible for a reduction or waiver of the minimum regulatory requirements of NAC 444.

Table 3-1
Detailed Evaluation of the Corrective Action Alternatives
(Page 3 of 4)

Evaluation Criteria	Alternative 1 No Action	Alternative 2 Access Restrictions	Alternative 3 Capping and Monitoring	Alternative 4 Capping, Monitoring, and Embankment Protection
Selection Decision Factors				
Short-Term Reliability and Effectiveness	This was not evaluated further because it does not meet standards.	There is no remediation proposed with this alternative; therefore, corrective action objectives will not be achieved. There are no risks to workers or the community.	The potential for releases of fugitive dusts or contact with the waste during construction activities will be mitigated by implementing appropriate health and safety procedures. No contaminants have been identified above regulatory levels; therefore, risk is within acceptable levels. All corrective action objectives will be achieved upon completion of the construction activities.	The potential for releases of fugitive dusts or contact with the waste during construction activities will be mitigated by developing and implementing appropriate health and safety procedures. No contaminants have been identified above regulatory levels; therefore, risk is within acceptable levels. All corrective action objectives will be achieved upon completion of the construction activities.
Reduction of Toxicity, Mobility, and/or Volume	Not evaluated further because it does not meet standards.	There is no reduction of toxicity, mobility, or volume of contaminants because remediation is not proposed. Currently, all constituents are below regulatory levels.	Currently, all constituents are below regulatory levels, and their toxicity and volume will not be further reduced during the corrective action since the corrective action does not include removal or treatment. Waste will remain in the subsurface soils; however, the soil cap will eliminate any potential exposure pathways. Degradation will slowly reduce the total mass of solid waste over time.	Currently, all constituents are below regulatory levels, and their toxicity and volume will not be further reduced because the corrective action does not include removal or treatment. Waste will remain in the subsurface soils; however, the soil cap will eliminate any potential exposure pathways. Degradation will slowly reduce the total mass of solid waste.

Table 3-1
Detailed Evaluation of the Corrective Action Alternatives
(Page 4 of 4)

Evaluation Criteria	Alternative 1 No Action	Alternative 2 Access Restrictions	Alternative 3 Capping and Monitoring	Alternative 4 Capping, Monitoring, and Embankment Protection
Long-Term Reliability and Effectiveness	This was not evaluated further because it does not meet standards.	No contamination has been identified above regulatory levels; however, solid waste will remain in the subsurface soils. Solid waste present will naturally attenuate and degrade. As this occurs, already acceptable risk levels will be further reduced. Potential impacts to groundwater are unlikely based on the low level of contamination identified and limited migration potential.	No contamination has been identified above regulatory levels; however, solid waste will remain in the subsurface soils. Solid waste present will naturally attenuate and degrade. As this occurs, already acceptable risk levels will be further reduced. The soil cap will effectively eliminate potential exposure pathways to the waste. These control technologies are considered highly reliable. Potential impacts to groundwater are unlikely based on the lack of contamination and limited migration potential (DOE/NV, 1996a). Post-closure care of the vegetative cover will be performed in accordance with applicable regulations. In addition, signs will warn that access to the trenches is prohibited, and land-use restrictions may be required to prevent human or animal contact with the waste.	No contamination has been identified above regulatory levels; however, waste will remain in the subsurface soils. Solid waste present will naturally attenuate and degrade. As this occurs, already acceptable risk levels will be further reduced. The soil cap will effectively eliminate potential exposure pathways to the waste. These control technologies are considered highly reliable. Potential impacts to groundwater are unlikely based on the low level of contamination identified; however, groundwater monitoring will be conducted to assess this potential. Post-closure care of the vegetative cover will be performed in accordance with applicable regulations as long as groundwater monitoring is in effect. In addition, signs will warn that access to the trenches is prohibited, and land-use restrictions may be required to prevent human or animal contact with the waste.
Implementability	Not evaluated further because it does not meet standards.	Easily implementable. Currently, risks are acceptable to humans and the environment; this will not change because no remediation is proposed.	Easily implementable. Currently, risks are acceptable to humans and the environment. There is a possibility of encountering debris during construction and drilling activities, but no adverse impacts are anticipated.	Easily implementable. Currently, risks are acceptable to humans and the environment. Many vendors are available to install a groundwater monitoring well, moisture sensors, and an embankment. There is a possibility of encountering debris during construction and drilling activities, but no adverse impacts are anticipated.
Cost	$ 0	$39,413	$38,709	$45,204

Note: All references to regulatory limits and levels are from NAC 444.

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

Evaluation Criteria	Alternative 1 No Action	Alternative 2 Access Restrictions	Alternative 3 Capping and Monitoring	Alternative 4 Capping, Monitoring, and Embankment Protection
General Standards				
Overall Protection of Human Health and the Environment	Alternative 1 offers the least degree of protection to human health or the environment and does not achieve the corrective action objectives. Solid waste remains buried in the trenches; however, no constituents were identified above regulatory levels.	Alternative 2 offers a higher level of protection than Alternative 1, but not as high as Alternatives 3 and 4. No COCs have been identified; solid waste remains buried in the trenches. Access restrictions may mitigate potential exposure to the waste.	Alternative 3 offers a higher level of protection than Alternatives 1 and 2, but not as high as Alternative 4. No COCs have been identified. Solid waste will remain in the trenches; however, there will be no worker exposure to the waste. A vegetative cover will mitigate contact to the waste.	Alternative 4 offers the highest level of protection. No COCs have been identified. Solid waste will remain in the trenches; however, there will be no worker exposure to the waste. A vegetative cover will mitigate contact to the waste. In addition, rip rap along the southernmost trench boundary will mitigate potential future exposure to the waste caused by flooding of the arroyo.
Attain Media Cleanup Standards	Alternatives 1 and 2 do not achieve the corrective action objectives. No risk-based cleanup standards have been identified for the trenches. However, these alternatives do not address regulatory requirements for closure of solid waste landfills (NAC 444).		Alternatives 3 and 4 achieve the corrective action objectives. No risk-based cleanup standards are necessary for the trenches. These alternatives meet the regulatory standard (NAC 444).	
Control the Sources of the Release	Alternative 1 offers the least degree of effectiveness in controlling the exposure to the solid waste by humans or the environment and does not achieve the corrective action objectives. Because of the limited potential for migration from the trenches, no significant source of release exists.	Alternative 2 offers a higher degree of effectiveness than Alternative 1, but not as high as Alternatives 3 and 4 in controlling exposure to the solid waste by humans or the environment. Because of the limited potential for migration from the trenches, no significant source of release exists. Fencing and land-use restrictions may mitigate potential exposure pathways to the waste.	Alternatives 3 and 4 achieve the corrective action objectives. Potential exposure pathways to the solid waste will be removed with the placement of a cap.	
Comply with Standards for Management of Wastes	Alternatives 1 and 2 do not involve treatment or removal of contamination.		Alternatives 3 and 4 will achieve the corrective action objectives at the completion of construction activities. The cap will mitigate exposure to the waste and will achieve applicable closure requirements (NAC 444).	

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

Evaluation Criteria	Alternative 1 No Action	Alternative 2 Access Restrictions	Alternative 3 Capping and Monitoring	Alternative 4 Capping, Monitoring, and Embankment Protection
Selection Decision Factors				
Short-Term Reliability and Effectiveness	Alternatives 1 and 2 are effective in the short-term because no actions are taken that would expose workers to the waste. Risks to workers and the public are low because no COCs are identified and access to the site is currently restricted.		Alternatives 3 and 4 are judged to offer a high degree of short-term effectiveness, and no adverse effects or 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	No significant reduction of toxicity, mobility, or volume of contaminants results from corrective actions because the contaminant concentrations are already below regulatory levels of concern and the potential for contaminant migration is very low.			
Long-Term Reliability and Effectiveness	Less effective than Alternatives 3 and 4 because corrective action objectives are not achieved.		Alternatives 3 and 4 are judged to offer a high degree of long-term effectiveness. Under both alternatives, the waste will remain in place and will be covered with a vegetative cover to prevent access.	
Implementability	Alternative 1 is easily implementable because no actions are proposed.	Alternatives 2, 3, and 4 are considered to be readily implementable using existing resources and technologies.		
Cost	$ 0	$39,413	$38,709	$46,204

Note: All references to regulatory limits and levels are from NAC 444.

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 preferred corrective action alternative selected for implementation at the Cactus Spring Waste Trench CAU is Alternative 3. Alternative 3 was chosen as the preferred alternative for the following reasons:

- A cap (clean fill soil and an engineered, vegetative cover) prevents contact to the waste and provides erosion controls. The cap can also limit precipitation infiltration; however, for this site, precipitation control is a lessor factor.
- A cap is considered to be readily implementable with existing resources and technologies.
- The CAU is returned to original grade with a natural, vegetated surface.
- At completion of the construction activities, all applicable state and federal solid waste regulations (NAC 444 and Title 40 CFR 258) for closure of the CAU will be achieved.
- The alternative provides the most cost-effective method for achieving protectiveness and for meeting closure requirements.

The preferred corrective action alternative was evaluated on its technical merits, focusing on performance, reliability, implementability, and safety. The alternative was judged to meet all requirements for the technical components evaluated. This alternative meets all applicable state and federal regulations for closure of the site and will reduce potential future exposure pathways to the solid waste (NAC 444 and Title 40 CFR 258).

During corrective action implementation, this alternative will present a minimal potential threat to site workers in contact with the waste. However, appropriate safety procedures will be developed and implemented.

5.0 References

CFR, see *Code of Federal Regulations.*

Code of Federal Regulations. 1996. Title 40 CFR Parts 258 - 271. Washington, DC: U.S. Government Printing Office.

DOE, see U.S. Department of Energy.

DOE/NV, see U.S. Department of Energy, Nevada Operations Office.

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.

NAC, see *Nevada Administrative Code*.

Nevada Administrative Code. 1996. NAC 444, "Solid Waste." Carson City, NV.

Nevada Administrative Code. 1996. NAC 445A, "Water Control." Carson City, NV.

U.S. Department of Energy, Nevada Operations Office. 1994. *Industrial Sites Quality Assurance Project Plan*, DOE/NV-425. Las Vegas, NV: IT Corporation.

U.S. Department of Energy, Nevada Operations Office. 1996a. *Corrective Action Investigation Plan: Cactus Spring Waste Trenches*, Rev. 1. Las Vegas, NV: IT Corporation.

U.S. Department of Energy, Nevada Operations Office. 1996b. *Offsite Radiation Exposure Review Project.* Las Vegas, NV: IT Corporation.

U.S. Department of Energy, Nevada Operations Office. 1996c. Draft, *Corrective Action Unit Work Plan for the Tonopah Test Range*, DOE/NV-426. Las Vegas, NV: IT Corporation.

U.S. Environmental Protection Agency, Office of Research and Development. 1991. *Guidance on Resource Conservation and Recovery Act (RCRA) Corrective Action Decision Documents*, EPA/540/G-91/011. Washington, DC.

U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. 1994. *Final RCRA Corrective Action Plan,* EPA/520-R-94-004. Washington, DC.

U.S. Environmental Protection Agency. 1996. *Region IX Preliminary Remediation Goals (PRGs)*. San Francisco, CA.

Appendix A
Cactus Spring Waste Trenches
Corrective Action Investigation Report
Tonopah Test Range

Table of Contents

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List of Acronyms and Abbreviations

%R	Percent recovery
CADD	Corrective Action Decision Document
CAI	Corrective Action Investigation
CAIP	Corrective Action Investigation Plan
CAS	Corrective Action Site
CAU	Corrective Action Unit
COC	Constituent(s) of concern
CRDL	Contract-required detection limit
CSWT	Cactus Spring Waste Trenches
DOE	U.S. Department of Energy
dpm	Disintegration(s) per minute
DQO	Data Quality Objective(s)
EPA	U.S. Environmental Protection Agency
EX-1	Exploratory hole
FADL	Field Activity Daily Log(s)
ft	Foot (feet)
ICP	Inductively coupled plasma
IT	IT Corporation
K	Potassium
m	Meter(s)
mg/kg	Milligram(s) per kilogram
mg/L	Milligram(s) per liter
MS/MSD	Matrix spike/matrix spike duplicate(s)
NA	Not applicable
ORERP	Offsite Radiation Exposure Review Project
PCB	Polychlorinated biphenyl(s)
PID	Photoionization detector
ppm	Part(s) per million
PRG	Preliminary Remedial Goal(s)
Pu	Plutonium
QA	Quality Assurance

List of Acronyms and Abbreviations (Continued)

QAPP	Quality Assurance Project Plan
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RCT	Radiological Control Technician
RPD	Relative percent difference
SVOC	Semivolatile organic compound(s)
TC	Toxicity Characteristic
TCLP	Toxicity Characteristic Leaching Procedure
TPH	Total petroleum hydrocarbon(s)
TPH-D	Total petroleum hydrocarbon in the diesel range
TPH-G	Total petroleum hydrocarbon in the gasoline range
TTR	Tonopah Test Range
U	Uranium
VOA	Volatile organic analysis
VOC	Volatile organic compound(s)

A.1.0 Introduction

The report contained in this appendix presents the investigation activities and analytical results from the Corrective Action Investigation (CAI) conducted at the Cactus Spring Waste Trenches (CSWT), Corrective Action Unit (CAU) 426 (Corrective Action Site [CAS] RG-08-001-RG-CS). The CAI was conducted in accordance with the requirements set forth in the *Corrective Action Investigation Plan: Cactus Spring Waste Trenches* (CAIP) (DOE/NV, 1996a) that were developed under the *Federal Facility Agreement and Consent Order* (FFACO, 1996).

The waste trenches are located at the Cactus Spring Ranch, Tonopah Test Range (TTR), Nye County, Nevada (see Figures A.1-1, A.1-2, and A.1-3). The trenches were excavated in 1963 to receive waste generated from the animal holding facility built for the care and maintenance of the experimental animals involved in the U.S. Department of Energy's (DOE's) Double Tracks Test during Operation Roller Coaster. The Double Tracks Test included the use of live animals to investigate the biological hazard associated with a non-nuclear detonation of a plutonium-bearing device. Process knowledge indicated the potential for various types of contaminated waste, including radioactive materials, to be associated with the trenches because of unregulated disposal practices (DOE/NV, 1996a).

Additional information relating to the site history, planning, and scope of the CAI is presented in the CAIP (DOE/NV, 1996a), the "Field Sampling Instructions for Subsurface Soil Characterization: The Cactus Spring Waste Trenches, Tonopah Test Range, Nevada" (CSWT Field Instructions) (IT, 1996a), and the Draft *Corrective Action Unit Work Plan for the Tonopah Test Range, Nevada* (DOE/NV, 1996b) and is not repeated in this report.

A.1.1 Project Objectives

The primary objectives for this project are to investigate the subsurface conditions at the CSWT CAS and to assess the potential for downward migration of constituents of concern (COCs). The successful achievement of these objectives will provide sufficient information and data to develop appropriate corrective action strategies for the site.

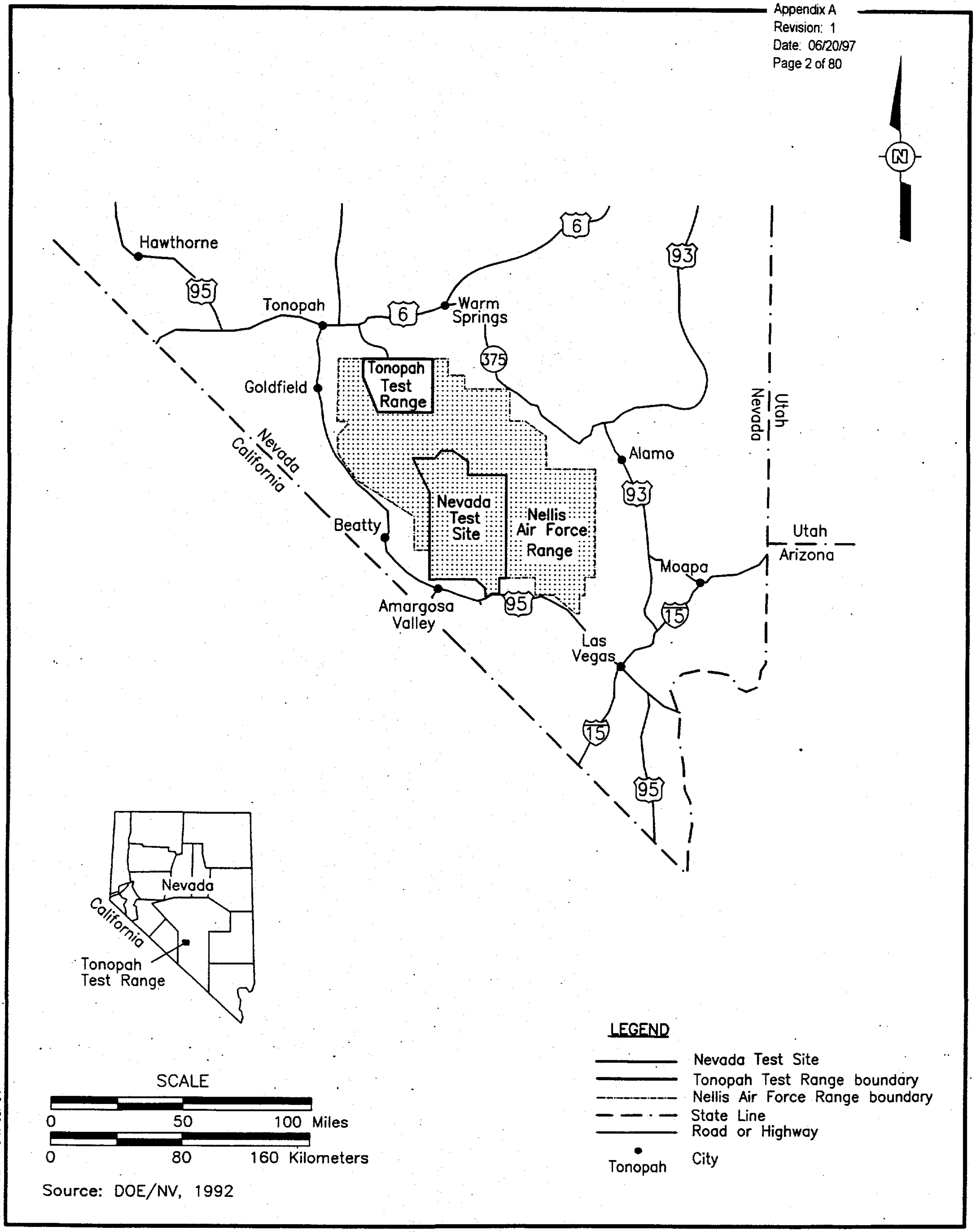

Figure A.1-1
Tonopah Test Range Location Map

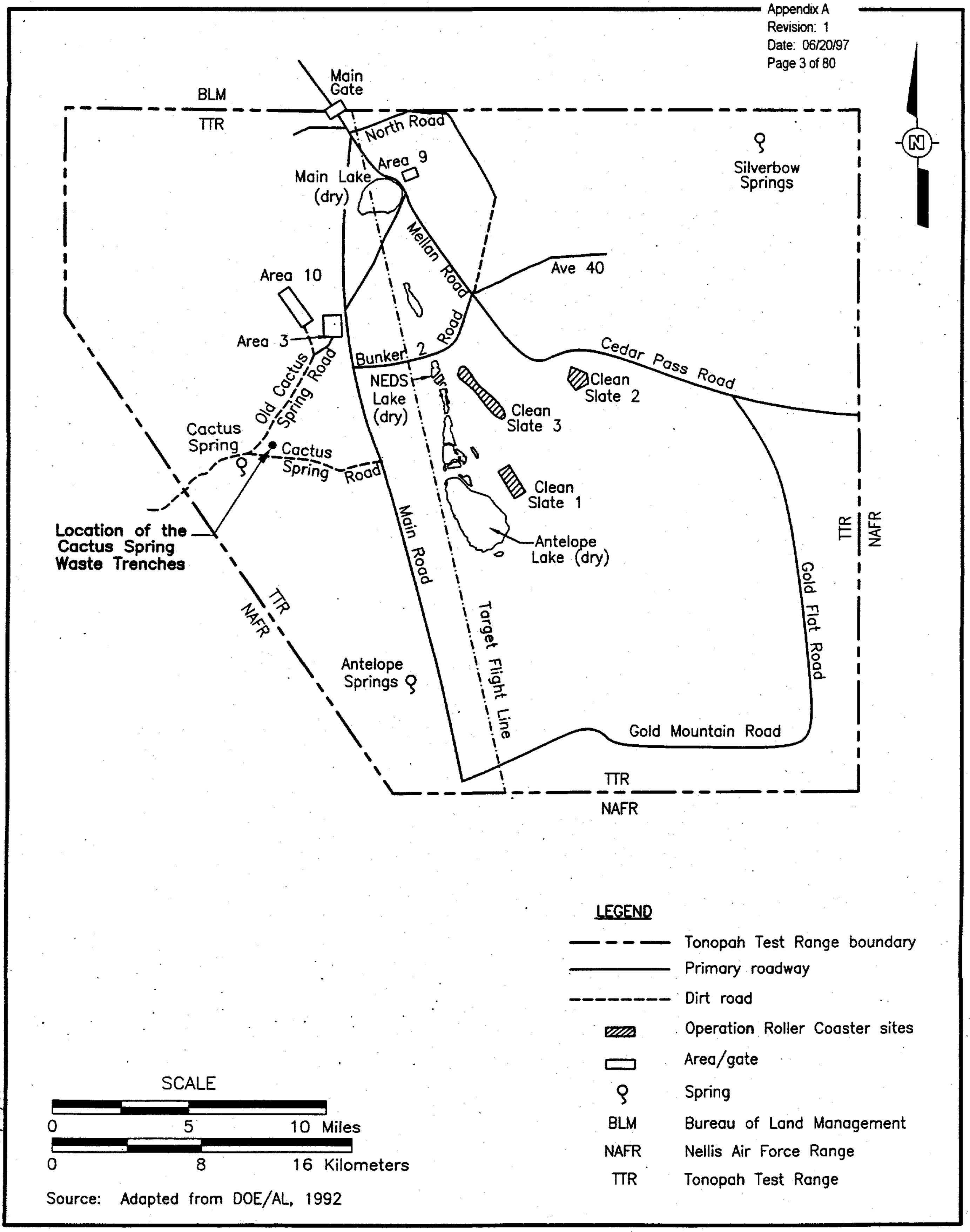

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Figure A.1-2
Cactus Spring Waste Trenches, Tonopah Test Range

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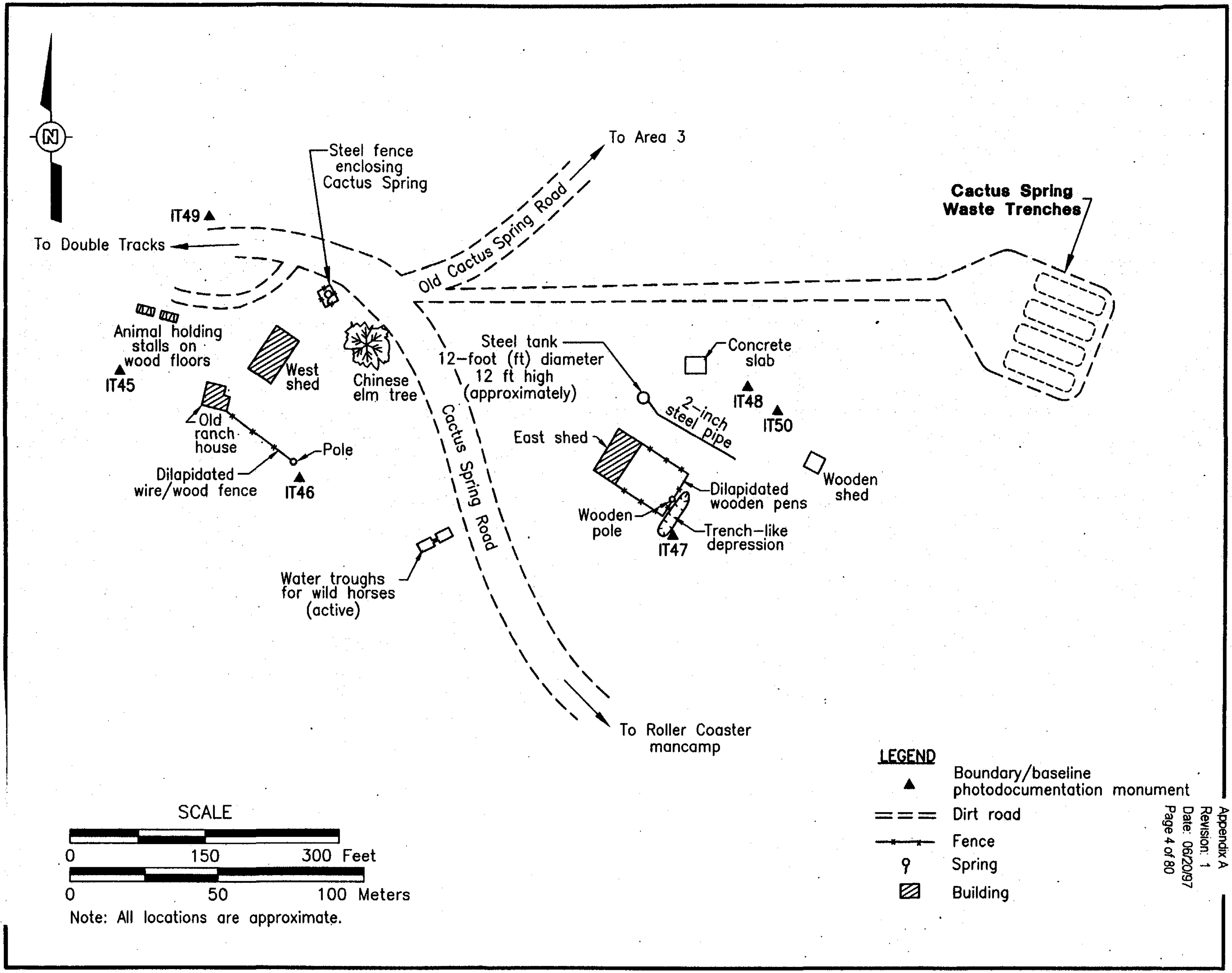


Figure A.1-3
Map of the Cactus Spring Ranch and Cactus Spring Waste Trenches

As part of the Data Quality Objective (DQO) process outlined in the CAIP (DOE/NV, 1996a), a conceptual model was developed to postulate potential exposure pathways from likely contaminant sources at the trenches. The conceptual model was tested by conducting a subsurface drilling program and by collecting environmental samples for laboratory analysis. To optimize the sampling program, the drilling locations were selected to accomplish the following tasks:

- Investigate the contents of each of the trenches to determine if possible sources for contamination are present.
- Characterize the unsaturated interval beneath the trenches to determine whether a leachate plume has developed.

Sixteen holes were drilled at the CSWT CAS to characterize the subsurface soils. Sonic drilling methods provided a continuous core for sampling and analysis. Soil samples were collected from specified core intervals for laboratory- and field-screening analyses, and detailed field observations of the subsurface conditions, including lithologic description of the core, were made during the investigation activities.

A.1.2 Report Content

This CAI report is intended to provide information and data in sufficient detail to support the selection of one of the preferred corrective action alternatives presented in the Corrective Action Decision Document (CADD).

- Section A.1.0 describes the investigation background, objectives, and the report content.
- Section A.2.0 provides information on the field activities and sampling method.
- Section A.3.0 summarizes the results of the laboratory analysis from the investigation sampling.
- Section A.4.0 discusses the quality assurance (QA) and quality control (QC) procedures that were followed and the results of the QA and QC activities.
- Section A.5.0 discusses contaminant plume modeling.

- Section A.6.0 is a summary of the significant results and conclusions pertaining to the CSWT investigation program.

- Attachment 1 includes the soil boring logs and information pertinent to the corrective action decision process.

To make this report more concise, complete field documentation and laboratory data such as Field Activity Daily Logs (FADLs), Sample Collection Logs, Analysis Request/Chain-of-Custody Forms, laboratory certificates of analysis, field-screening data sheets, and surveillance results are not included. These documents are retained in project files and will be supplied upon request.

A.2.0 Field Investigation and Sampling Activities

Field investigation and sampling activities were conducted from September 10, 1996, to September 26, 1996, to provide environmental and geotechnical samples for the CSWT CAS investigation. The investigation and sampling programs were managed in accordance with the requirements set forth in the CAIP (DOE/NV, 1996a) and the criteria outlined in the CSWT Field Instructions (IT, 1996a). The primary elements of the field investigation and sampling program include the following:

- Drilling one exploration hole and fifteen trench characterization holes by the sonic method
- Conducting continuous field screening
- Collecting environmental quality samples for laboratory analysis
- Collecting geotechnical samples for laboratory analysis
- Core logging to assess soil and waste characteristics

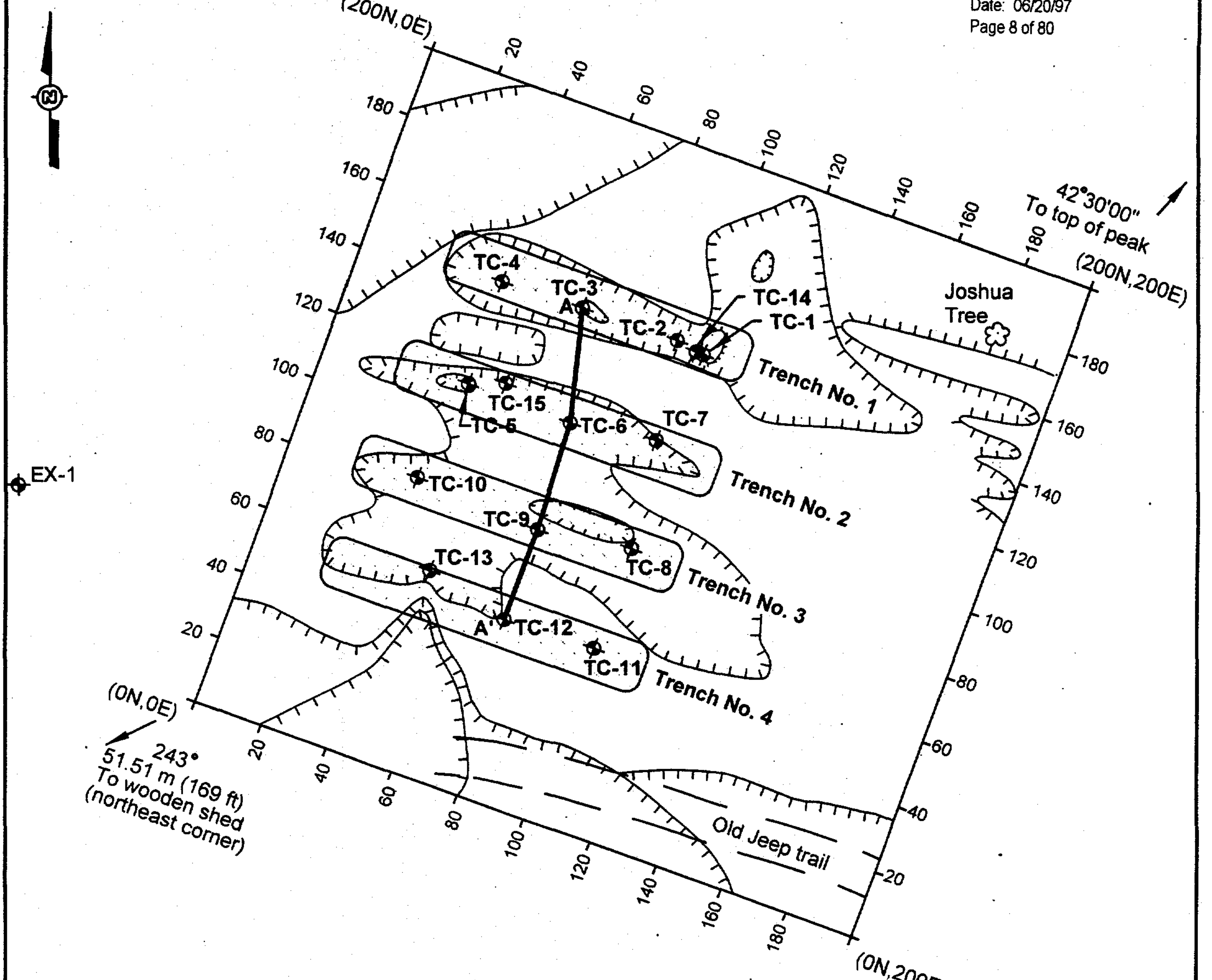
A.2.1 Drilling

The sonic drilling method was selected to advance the drill holes for the site investigation program because it provided, by continuous core, a representative vertical profile of the trench contents and the *in situ* soil beneath the trenches for field screening and environmental sampling. One exploratory hole and fifteen trench investigation holes (approximately three investigation holes per trench) were continuously cored from the ground surface to a minimum depth of 7.6 meters (m) (25 feet [ft]). The drill hole locations are indicated on Figure A.2-1.

A.2.2 Field Screening

Field-screening methods were used to collect semiqualitative data and to determine if drilling should continue deeper than the established minimum depth of investigation (7.6 m [25 ft]). Field screening was performed at 3.0-m (10-ft) intervals for the exploratory hole (EX-1) and at 1.5-m (5-ft) intervals for the trench investigation holes. The screening methods included the following:

- Radiological screening for alpha and beta/gamma radiation
- Headspace testing for volatile organic compounds (VOCs)
- Petroflag field testing for total petroleum hydrocarbons (TPH)



Note: All surface features are approximated and represent pre-drilling conditions.

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Figure A.2-1
Cactus Spring Waste Trenches Drill Hole Locations

The radiological screening was performed over the entire length of each core interval using an Electra instrument supplemented with swipe tests. The VOC analysis was conducted by measuring headspace at every sample interval with a Photoionization Detector. The TPH levels were also tested at every sample interval using a Petroflag Hydrocarbon Analyzer field test kit (manufactured by Dexil Corporation).

The field-screening results recorded at the exploratory drill hole were designated as "background" levels and used as a baseline for characterization sampling. The background levels established by the VOC field screening fluctuated between 0 and 10 parts per million (ppm); it is assumed that elevated photoionization detector (PID) readings were caused by excess water vapor within the headspace container, which can cause a false positive PID response. The TPH background level was recorded at 40 ppm. The Radiological Control Technician (RCT) reported that the background levels for alpha radiation ranged from 0 to approximately 50 disintegrations per minute (dpm); the background levels for beta/gamma radiation ranged from approximately 1,100 to 1,700 dpm.

The action level for TPH field screening was established at 100 ppm in accordance with the Nevada Division of Environmental Protection screening levels for TPH (NAC, 1996). The action level for VOC field screening was determined to be any sustained level above background. The action levels for radiation monitoring were established by the RCT and are included in the Radiological Work Permit.

The action levels were established to guide the vertical advancement of the drill hole and to provide a basis for collecting environmental samples. At a minimum, two samples from each trench investigation hole and one sample from Borehole EX-1 were collected for laboratory analysis; the details of the sampling procedures are discussed later in this report. When contamination was detected by field screening, the following operations took place:

- The screening results for the hole were examined to determine which samples would be sent for laboratory analysis. (Details are discussed in Section A.2.5.)

- Vertical advancement of the drill hole continued until two consecutive non-detects were established. This action was intended to provide a means by which to establish the vertical limit of potential contamination. This action proved to be problematic and will be discussed further in Section A.2.4.

The field activities were performed in accordance with an approved *Site-Specific Health and Safety Plan* (IT, 1996b). The samples were collected and documented by following approved sampling, field activity documentation, sample collection documentation, decontamination, chain of custody, shipping, and radiation screening protocols, procedures, and field sampling instructions as indicated in the CAIP (DOE/NV, 1996a). Quality control 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* (QAPP) (DOE/NV, 1994) and approved procedures (IT, 1994). During the field activities, efforts were made to minimize waste, which included segregation of the waste from each drill hole, separation of personal protective equipment into bags (based upon daily use), and collection and segregation of the rinsate waters from decontamination operations.

A.2.3 Exploratory Hole Results

The exploratory hole was located approximately 27.4 m (90 ft) west of the trenches in a slightly higher topographical position (see Figure A.2-1 for location). The hole was included in the investigation plan primarily to determine the site geologic and hydrologic conditions before drilling into the trenches. EX-1 was continuously cored in 3-m (10-ft) intervals and field-screened in accordance with criteria presented in the CSWT Field Instructions (IT, 1996a). The hole was terminated at approximately 7.6 m (25 ft) due to the presence of bedrock.

A sample for laboratory analysis was collected from the core at approximately 3 m (10 ft) to establish background levels and to determine waste characterization. Geologic/hydrologic samples were attempted, but were not obtained because the Shelby sampling tube could not be advanced through the alluvial material.

A.2.3.1 Geology

A geologic analysis and a field description were performed by the field geologist on each 3-m core interval and recorded on a Visual Classification of Soil Log. In addition to the field description, information about the difficulty of the drilling and condition of the core was also noted. All required reporting criteria established in the CSWT Field Instructions (IT, 1996a) were included on the log with the exception of the average rate of penetration. The systematic recording of penetration rates was discontinued after initial field observations indicated that the penetration rate associated with sonic drilling was irrelevant due to controlled drilling techniques. However, in response to DOE audit findings, a post-field reconstruction of the average rate of penetration was compiled using information recorded in the FADL, the driller's log book, and the RCT's log book.

Bedrock was encountered at a considerably shallower depth than anticipated. The presence of bedrock significantly impacted the subsequent drilling and site investigation activities program and is discussed later in this report. The soil boring log for EX-1 is included in Attachment 1 and is summarized as follows:

- Well-graded, unconsolidated (common) to moderately consolidated, heterogeneous alluvium from the surface to approximately 4.6 m (15 ft) in depth
- Well-indurated paleocolluvium with common volcanic detritus from 4.6 m to approximately 5.5 m (15 to 18 ft) in depth
- Bedrock consisting of moderately welded ash-flow tuff with zeolitic and argillic alteration and minor beds of non-welded, ash-fall tuff from approximately 5.5 m to total depth (7.6 m [25 ft])

A representative Stratigraphic Type Section Log (based on the EX-1 hole and the trench investigation holes) for the site area is presented as Figure A.2-2.

A.2.3.2 Hydrology

Unsaturated vadose zone conditions were clearly indicated in EX-1 from the ground surface to approximately 5.5 m (18 ft) in depth. Unfortunately, difficult drilling conditions were encountered at 5.5 m (top of volcanic tuff bedrock) which necessitated the use of water to advance the sample tube to total depth. The water saturated the core, which obscured the visual assessment of the *in situ* moisture content of the volcanic tuff bedrock. However, a qualitative assessment of hydraulic conductivity indicated that the bedrock has typical aquitard characteristics. In volcanic tuffs, the degree of welding directly affects the matrix permeability. For example, the interstitial coefficient of permeability associated with a moderately welded tuff of this nature ranges from approximately 0.002 to 0.0002 gallons per day per square foot (Winograd and Thordarson, 1975), thereby limiting the effective hydraulic conductivity to fracture flow. Fracture permeability, as indicated in EX-1, appears to be extremely low to nonexistent; fracture information was determined through observation of 3.5-in.-diameter core. The distribution of fractures consisted of the following: (1) common, high to medium-angle, iron oxide-filled (no aperture or openness) hairline fractures and (2) one set of high-angle

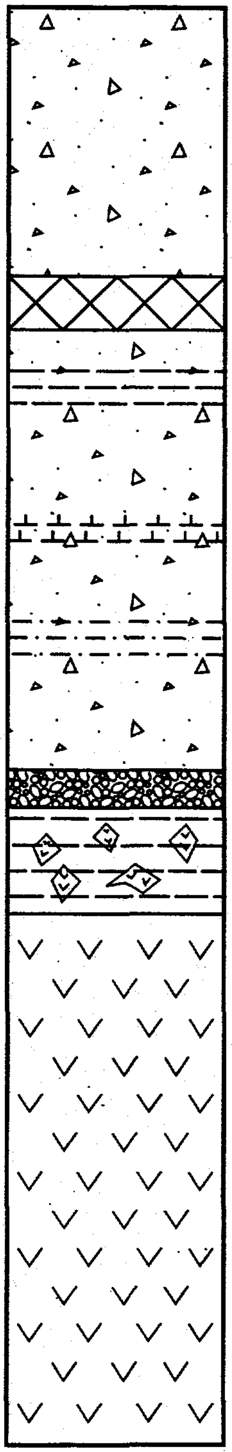

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Figure A.2-2
Generalized Stratigraphic Type Section Log

fractures (at approximately 6.9 m [22.5 ft]) exhibiting minimal aperture and openness. There is, however, evidence that the aperture and openness associated with this set resulted from "plucking" (or the removal of the fracture filling material due to stress from the drilling process) during the drilling process and does not represent *in situ* conditions.

A.2.4 Trench Investigation Hole Results

The trench investigation holes, numbered TC-1 through TC-15, were drilled in numerical order at the locations presented on Figure A.2-1. The locations deviated slightly from the proposed locations presented in the CAIP (DOE/NV, 1996a) because of new information collected in the field. For instance, based on information provided by drilling TC-1, the trenches did not extend as far to the east as originally interpreted, and the remaining locations were adjusted accordingly.

Unlike EX-1, water was not used to advance the sample tube during the process of drilling the trench investigation holes. The holes were continuously cored and examined in 1.5-m (5-ft) intervals. Field screening and sampling were conducted following the requirements and criteria presented in the CAIP (DOE/NV, 1996a) and the CSWT Field Instructions (IT, 1996a). With the exception of TC-1 (prematurely abandoned), TC-14 (subsequent twin to TC-1), and TC-15 (drilled as an additional hole for a shallow objective), all the trench investigation holes were drilled to either the minimum total depth (7.6 m [25 ft]) or deeper to establish the vertical extent of contamination based on field-screening results. (See Section A.4.4 for more details pertaining to these holes.) The radiological and VOC field-screening tests indicated only background levels at every sample point. The TPH field-screening tests, however, indicated several instances of elevated levels above 100 ppm. Five trench investigation holes (TC-5, 6, 7, 9, and 10) were drilled deeper than the 7.6-m (25-ft) minimum depth due to the presence of elevated TPH levels.

The elevated TPH levels were detected in 9 of the 15 holes (16 separate sample points), approximately 69 percent of which occurred in the volcanic tuff bedrock. Based on the low probability that TPH will migrate in impermeable bedrock, several attempts were made to verify the TPH readings, including recalibrating the analyzer and rerunning samples; all attempts resulted in positive verification. Table A.2-1 presents the TPH field-screening results at each sample point for each drill hole. The shaded areas indicate the sample intervals that correspond with volcanic bedrock. As a consequence of the elevated TPH readings, four holes (TC-5, 6, 7,

Table A.2-1
TPH Field Screening Results for Trench Investigation Holes

		Drill Holes														
		TC-1	TC-2	TC-3	TC-4	TC-5	TC-6	TC-7	TC-8	TC-9	TC-10	TC-11	TC-12	TC-13	TC-14	TC-15
Sample Interval (meters)	1.5	**261**	23	43	0	96	71	**153**	25	14	18	43	37	22	0	0
	3	8	73	37 57**	1	67	2	27	29	**265*** 42	41	49	**129**	13	65	20
	4.6		51	**104**	36	58	2	82	40	23	52	**149**	77	93	14	28
	6.1		11	33	73	**206 130****	**141**	**163**	26	40	**125**	87	**121**	59		
	7.6		0*** 9	80	19	**240 180****	3	99	67	**195**	**129**	3	34	21		
	9.1					79	41	79		**107**	**102**					
	10.7					79				47						
	12.2									22						

Shaded regions indicate volcanic intervals.
Bold indicates action level exceedance.
Total depth of each hole is equal to the last sample interval.
*Discretionary sample taken from an interval with high organic content
**Indicates rerun samples
***Discretionary sample taken from fluvial gravels

and 9) were advanced deeper into the bedrock to obtain the required two consecutive non-detects in accordance with DQO procedures. On the tenth investigation hole, the Technical Leader determined that there was a high probability that the TPH levels were spurious and that further advancement based solely on the TPH values was not warranted. At that point, drill hole TC-10 was finalized at a total depth of 9.1 m (30 ft), and the remaining scheduled drill holes were completed after reaching the minimum total depth.

Samples for laboratory analysis were collected from each drill hole based on field-screening results and criteria established in the CAIP (DOE/NV, 1996a) and the CSWT Field Instructions (IT, 1996a). Geotechnical/hydrological samples could only be obtained as grab samples from the core because attempts to advance the Shelby tube were unsuccessful. Samples for geotechnical/hydrological analysis included one sample of alluvial or trench-fill material from each trench; care was taken to collect samples representing the heterogeneity of the soil.

A.2.4.1 Geology

A geologic analysis and a field description were performed by the field geologist on each 1.5-m core interval and recorded on a Visual Classification of Soil Log. In addition to the field description of any drilling difficulty and the condition of the core, general geologic information was also noted. Required reporting criteria established in the CSWT Field Instructions (IT, 1996a) were included on the log.

The geology at the CSWT CAS was similar to the units encountered in the EX-1 drill hole. For a general description of the representative lithologies, see Figure A.2-2 or Attachment 1. The following subsurface interpretation applies to the CAS area and is based on data collected from the dense population of investigation drill holes. Figure A.2-3 presents a north-south structural cross section for reference.

A paleo-topographic surface of volcanic bedrock unconformably lies under a relatively thin veneer of alluvium. The volcanic material consists of moderately welded ash-flow tuff with common zeolitic and argillic alteration and minor beds of non-welded, ash-fall tuff or tuffaceous clay. Common lithics, fiamme, and iron oxide-filled fractures (no open fractures were observed) were also associated with the ash-flow tuff.

Overlying the bedrock are deposits of alluvial material, trench fill, or paleocolluvium, depending on the local elevation of the paleo-topography. The paleocolluvium deposits, consisting of angular weathered fragments of bedrock material in a clay matrix, were restricted to the paleo lows, with stratigraphic thinning occurring on the flanks of the highs. Also noted along the nadir of the paleo lows was a thin, conspicuous layer of fluvial gravels. The trench-fill material, consisting of unconsolidated reworked alluvium, was in direct contact with the bedrock in areas where the bedrock elevations were near the ground surface. Near the northeast corner of the trench site, for example, the bedrock was within approximately 1.8 m (6 ft) of the ground surface (see Figure A.2-3).

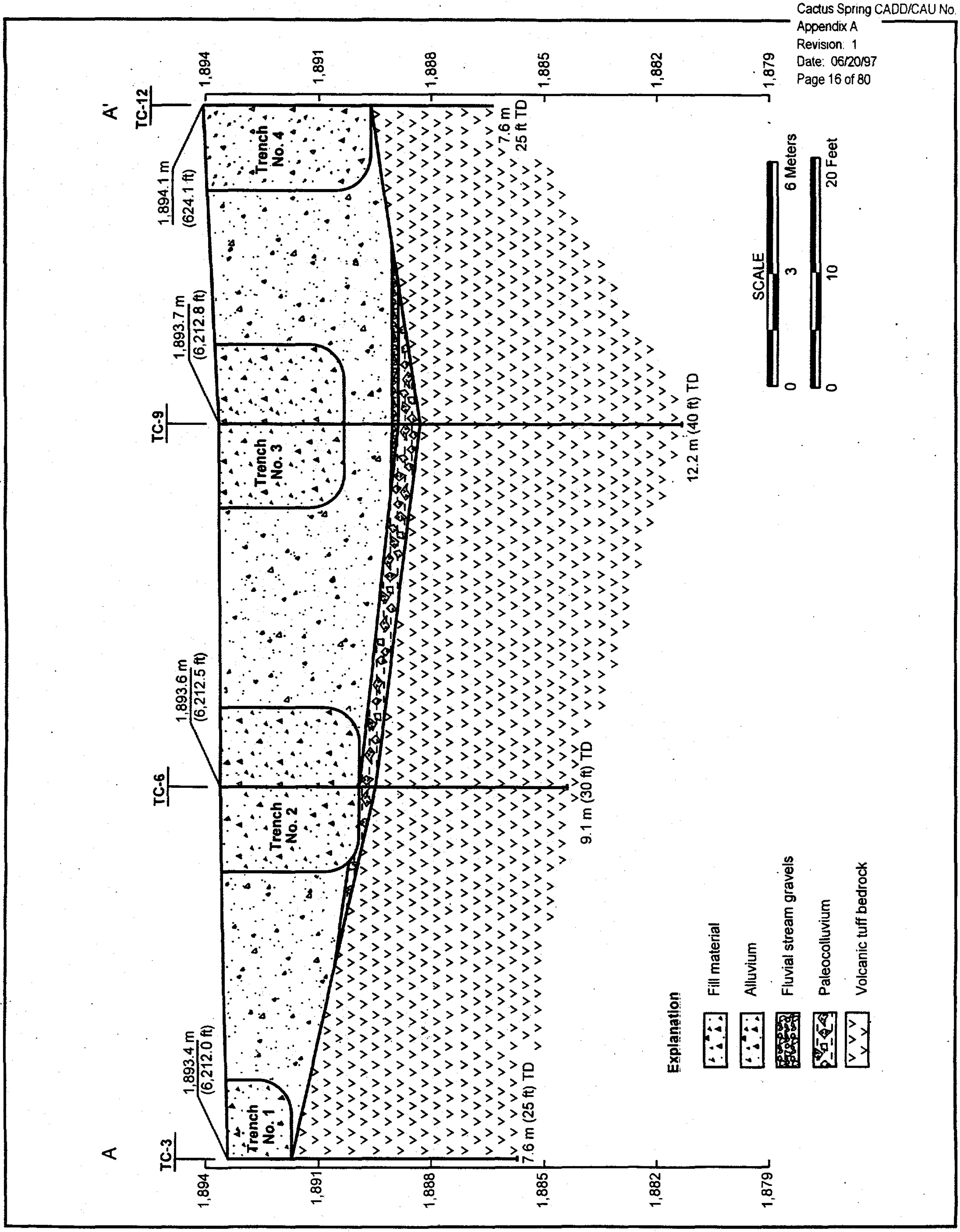

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Figure A.2-3
North-South Structural Cross Section

The alluvial material, shed from the surrounding mountains, was deposited throughout the area either directly on the bedrock or on the paleocolluvium surfaces. Since the trenches were excavated from (and backfilled with) alluvial material, the trench-fill material was sometimes difficult to distinguish from the *in situ* alluvium. For example, there was little difference in the degree of induration from ground surface to approximately 1.8 m (6 ft). In some cases, subtle evidence in the form of small stick fragments, traces of decomposed organic matter, and unnatural odors was all that was available to indicate trench-fill material. Fortunately, however, the majority of the drill holes encountered obvious components of sanitary trash (see Table A.2-2 for a list of the common trash constituents encountered during the investigation). The majority of sanitary trash was found between approximately 0.9 m to 2.1 m (3 ft to 7 ft) in depth. This consistency in depth indicates that the vertical extent of the trenches may have only been approximately 2.1 m (7 ft). There was, however, subtle evidence of intrusion in the form of unnatural odors and organic material below 3 m (10 ft) in three of the trenches (TC-7, 9, and 12). The field examination of each core interval revealed no evidence of the presence of radioactively contaminated animal shrouds or other radioactively contaminated materials in the trenches.

A.2.4.2 Hydrology

As with the geology, the hydrologic conditions at the trench site are comparable to those that exist at the EX-1 site. The volcanic bedrock has the same apparent low hydraulic conductivity as evidenced by the preponderance of iron oxide-filled hairline fractures with no apparent aperture. Indications of unsaturated, vadose zone conditions were noted from the ground surface to the top of the bedrock in most of the drill holes. However, high relative moisture content was noted in discreet intervals of moderately to well-consolidated core section. Unfortunately, an accurate determination of whether the moisture content represented *in situ* conditions could not be made because of significant uncertainties associated with the use of water during the sonic drilling process.

Although water was not used while advancing the sample tube, significant volumes of water were used to advance the outer casing (see Schier, personal memo [1996] for more details on the problems associated with water during the drilling process). Depending on formation parameters (i.e., anisotropy), a portion or all of the water that remained in the hole (after running casing) infiltrated into the formation and compromised *in situ* moisture properties.

Table A.2-2
Common Constituents of Sanitary Trash in Cactus Spring Waste Trenches

Trench-Investigation Hole Number	Sticks	Wood Pieces	Tooth Picks	Glass	Metal	Bone Fragments	Decom-posed Flesh	Foul Odor	Burn Odor	Organic Odor	Organic Matter	Unidentified Powder	Burn Material	Paint Chips	No Visible Trash
TC-1	X														
TC-2	X	X	X						X						
TC-3		X								X	X				
TC-4						X		X				X	X		
TC-5							X	X			X				
TC-6															X
TC-7	X	X											X		
TC-8	X	X													
TC-9	X	X		X	X						X	X			
TC-10															X
TC-11			X												
TC-12		X	X						X		X			X	
TC-13															X
TC-14															X
TC-15		X									X				

In an effort to obtain information on the status of groundwater, two drill holes (TC-4 and 5) were intentionally left open for periodic observation. Different heads of water remained in each drill hole from the drilling process. The water in TC-5 was pumped out to approximately 0.6 m (2 ft) from the bottom; the water in TC-4 was left in the hole (approximately 3.3 m [11 ft] of head). At the completion of the drilling program, the water levels remained at or near the original levels. Therefore, no determination could be made as to the status of groundwater; however, a qualitative determination as to the low composite permeability of the formation could be speculated.

A.2.5 Soil Sampling Logistics

Environmental samples were collected from every 1.5-m (5-ft) continuous core run for each trench investigation drill hole. The bottom 0.6 m (2 ft) of each continuous core run comprised the sampling interval. The samples were collected, and the core was field-screened according to the criteria and procedures presented in the CSWT Field Instructions (IT, 1996a).

The field screening was used to determine which samples would be shipped for laboratory analysis. If field screening indicated no readings above action levels, then only the samples from approximately a 3-m (10-ft) total depth were shipped for a confirmational analysis. If field screening indicated levels at or above action levels, samples from the following intervals were shipped for laboratory analysis:

- The interval with the highest field-screening level
- Two consecutive "clean" (as indicated by field screening), 1.5-m (5-ft) intervals (in order to bound the vertical limit of contamination)

Subsurface samples were also collected for hydrologic/geotechnical analysis. Ideally, these samples were to be collected *in situ* with minimal disturbance by pushing a Shelby tube ahead of the bit. Unfortunately, the high fraction of coarse clastic material in the alluvial materials prevented advancing the Shelby tube. Therefore, taking grab samples from the core was the only available option for collecting. This possibility was considered prior to commencing field operations, and a contingency was provided to allow for collecting grab samples. The grab samples were collected using care to select the best representative and least disturbed samples.

A.2.5.1 Collection Procedure

A routine sample collection procedure was performed for each core interval, and a generalized description of the sampling procedure follows.

While the sampling tube was being advanced, the sample collection team set out the required sample containers for the sampling interval. The sample containers were annotated for their sample number, respective analyses, date, and sample interval. After the core was extruded into the plastic sleeve from the sample tube and laid on the drill floor, the RCT would conduct an initial field screen for beta/gamma radiation over the entire core interval (background levels were reported for all screened intervals). Next, a rig crew member would mark the approximate core depths on the plastic sleeve, and a sampling team member would qualitatively check and note the temperature of the core (by hand sensitivity) at the sampling interval. The core was then placed in a 3-m (10-ft) rack specifically designed to protect the core and to provide segregation during analysis. The time was noted by the lead sampler, and the bottom 0.6-m (2-ft) sampling interval was slit open with a decontaminated razor blade to reveal the core. The RCT performed a final radiation screening to check for alpha emitters and to verify the beta/gamma levels. Again, only background levels of alpha and beta/gamma radiation were observed.

The sample collection method differed somewhat depending on the sample media. Samples of the alluvial and/or fill material were taken from the best representative *in situ* portion of the 0.6-m (2-ft) sample interval (i.e., dry and cool). The samples collected from the bedrock intervals sometimes required slight modification. Because of the varying degrees of induration (i.e., moderately welded tuff to tuffaceous clay) inherent with the bedrock, the 0.6-m (2-ft) sampling interval was increased, in some instances, to include a section of the core that contained tuffaceous clay, nonwelded tuff, and/or pulverized rock flour. In most cases, however, there was adequate bedrock material within the sample interval to fill the required sample containers (including sample duplicates). When the need to expand the sample interval occurred, the new sample point was noted on the Visual Classification of Soils Log. In all circumstances, the samples were scooped directly from the core and into the appropriate sample container using a decontaminated spoon.

Sample quality varied somewhat between the bedrock and alluvium/fill samples because of the drilling method (Schier, 1996). In almost every case, the sample interval containing the alluvium/fill material had adequate undisturbed samples from which to collect. On the other hand, bedrock samples were frequently altered by drilling fluid (from driving casing) and were consequently collected in either a damp or totally saturated form. These observations were carefully noted on the Visual Classification of Soils Log.

The sampling procedure for the laboratory analysis was conducted in two steps. In order to minimize the unnecessary waste of sample glassware, only the analytical samples that were sensitive to volatilization and the field-screening samples were collected during the first step. The following is the sequence that the samples were collected in, by container, for the first step:

- Total volatile organic analytes (VOAs)
- TPH-gasoline (TPH-G)
- Total semi-VOA, total pesticides and polychlorinated biphenyls (PCBs), and TPH-diesel (TPH-D)
- TPH field-screen test
- Headspace field-screen test for VOCs

In accordance with the field sampling instructions (IT, 1996a), care was taken to optimize each sample for its specific type of analysis. The VOC samples were collected with as little soil disturbance as possible to minimize volatilization, and large rock fragments and pebbles within the sample were removed when possible. Sample containers were filled to eliminate or minimize headspace, and the rim was cleaned using the sampling tool or by hand (using gloves to ensure a good seal when closing the container).

The sample containers were marked with the sampling time and held on ice until the drill hole reached total depth. At that point, the results from the field-screening tests were used to determine what sample intervals would be selected for laboratory analysis. During this waiting period, the exposed sampling interval of the core was taped shut and covered with a clean or decontaminated plastic sheet to prevent cross contamination. When the appropriate sample intervals for laboratory analysis were selected, the sample suite was completed by collecting samples for the following analyses:

- Toxicity Characteristic Leaching Procedure (TCLP) metals, gross alpha/beta, and plutonium/uranium isotopes
- Gamma Spectroscopy

After the entire sample suite was collected for laboratory analysis, the Sample Collection Log was completed; sample labels with the sample number, Chain-of-Custody number, collection date/time, sampling team members, preservative, medium type, and requested analysis were attached to each of the sample containers; and each sample container was wrapped in protective bubble wrap, placed into a Ziploc™ bag, and returned to the iced cooler with a trip blank (if applicable). Also, a Chain-of-Custody form was maintained and updated for each sample. Section A.3.0 of this report discusses the results of the sample analyses.

A.2.6 Technical Changes

Two Records of Technical Change were implemented prior to conducting field operations; they are presented as Appendix C of the CAIP (DOE/NV, 1996a). A third Record of Technical Change was developed after field operations were completed. The third change was in response to a DOE surveillance report finding which indicated that the height of the perimeter fence surrounding the heavy equipment decontamination sump was not the required five feet as outlined in the CSWT Field Instructions (IT, 1996a). Adequate justification was provided for allowing the fence to remain as constructed, and a Record of Technical Change was agreed to as the appropriate corrective action.

A.3.0 Sampling Analytical Results

The analytical results are summarized in the following sections, and the complete laboratory data packages are available in the project files. During the investigation activities, 43 soil samples were sent for laboratory analysis, and five samples were sent for hydrologic/ geotechnical analysis. A list of the sample numbers (including field duplicate samples) and their relationship to the drill holes and trenches is presented in Table A.3-1. Gaps in the numeric sample sequence represent rinsate, field, and trip blank (QC) samples not included on this table, but they are discussed in Section A.4.0.

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 according to the U.S. Environmental Protection Agency's (EPA) *Guidance for the Data Quality Objectives Process* (EPA, 1994). The results of the DQO process are documented, in part, in the CAIP (DOE/NV, 1996a), with the remainder of the documentation retained in the IT project files. Samples were analyzed at the Quanterra Laboratory in Earth City, Missouri.

A.3.1 Laboratory Analyses

Plate 1 presents the laboratory analyses data for all analytes that were detected above the contract-required detection limits (CRDLs) (see the Industrial Sites QAPP [DOE/NV, 1994]), including samples with reported estimated values and other laboratory qualifiers. The plate is a table that compares the analytical results to the action levels outlined in the CAIP (DOE/NV, 1996a) for determining the course of action for the site. For comparison purposes, the table also includes the EPA's Preliminary Remediation Goals (PRGs).

The water samples presented in the table comprise a portion of the QC samples, which will be discussed further in Section A.4.0. The water samples designated "source water" were collected from the rig water supply to adjust background levels if cross contamination due to the drilling method was suspected (see Table A.4-2 for more information). However, after careful examination of the analytical data, cross contamination from the source water did not appear to have impacted the samples. There does not appear to be a correlation between COCs occurring in the source water and the COCs in the soil samples. For example, although arsenic was

Table A.3-1
Subsurface Soil Samples for Cactus Spring Waste Trenches

Sample #	Hole #	Depth m	Depth ft	Location
Laboratory Analysis				
TTR00187	EX-1	3.0	10.0	Exploratory Hole
TTR00188	TC-1	1.5	5.0	Trench #1
TTR00189	TC-1	3.0	10.0	Trench #1
TTR00190	TC-2	3.0	10.0	Trench #1
TTR00192	TC-2	6.1	20.0	Trench #1
TTR00194	TC-3	4.6	15.0	Trench #1
TTR00195	TC-3	6.1	20.0	Trench #1
TTR00196	TC-3	6.7	22.0	Trench #1
TTR00200	TC-4	3.0	10.0	Trench #1
TTR00201	TC-4	7.6	25.0	Trench #1
TTR00202	TC-5	3.0	10.0	Trench #2
TTR00203*	TC-5	3.0	10.0	Trench #2
TTR00205	TC-5	7.6	25.0	Trench #2
TTR00207	TC-5	9.1	30.0	Trench #2
TTR00208	TC-5	10.7	35.0	Trench #2
TTR00210	TC-6	6.1	20.0	Trench #2
TTR00211	TC-6	7.6	25.0	Trench #2
TTR00212	TC-6	8.2	27.0	Trench #2
TTR00214	TC-7	1.5	5.0	Trench #2
TTR00215	TC-7	6.1	20.0	Trench #2
TTR00216	TC-7	7.6	25.0	Trench #2
TTR00217	TC-7	9.1	30.0	Trench #2
TTR00219	TC-8	3.0	10.0	Trench #3
TTR00220	TC-8	7.6	25.0	Trench #3
TTR00222	TC-9	7.6	25.0	Trench #3
TTR00223	TC-9	10.7	35.0	Trench #3
TTR00224	TC-9	12.2	40.0	Trench #3
TTR00228	TC-10	6.1	20.0	Trench #3
TTR00229	TC-10	7.6	25.0	Trench #3
TTR00230	TC-10	9.1	30.0	Trench #3
TTR00234	TC-11	4.6	15.0	Trench #4
TTR00235	TC-11	6.1	20.0	Trench #4
TTR00236	TC-11	7.6	25.0	Trench #4
TTR00238	TC-12	3.0	10.0	Trench #4
TTR00239*	TC-12	3.0	10.0	Trench #4
TTR00240	TC-12	4.6	15.0	Trench #4
TTR00241	TC-12	7.6	25.0	Trench #4
TTR00245	TC-13	3.0	10.0	Trench #4
TTR00246	TC-13	7.6	25.0	Trench #4
TTR00250	TC-14	4.6	15.0	Trench #1
TTR00251	TC-15	3.0	10.0	Trench #2
TTR00252*	TC-15	3.0	10.0	Trench #2
TTR00253	TC-15	4.6	15.0	Trench #2
Hydrologic/Geotechnical Analysis				
TTR00254	TC-3	1.8	6.0	Trench #1
TTR00255	TC-6	3.0	10.0	Trench #2
TTR00256	TC-7	3.7	12.0	Trench #2
TTR00257	TC-10	3.7	12.0	Trench #3
TTR00258	TC-12	2.1	7.0	Trench #4

*Field duplicate samples

Table A.3-2
Laboratory Analytical Methods Used for Cactus Spring Waste Trenches Investigation Samples

Analytical Parameter	Analytical Method
Total Volatile Organic Compounds	EPA[a] 8240
Total Petroleum Hydrocarbons - Gasoline, Diesel, and Motor Oil	EPA 8015 (modified)
Total Semivolatile Organic Compounds	EPA 8270
TC[b] Metals: ICP[c] (Arsenic, Barium, Cadmium, Chromium, Lead, Selenium, Silver) TC Metals: Mercury	EPA 1311/6010 EPA 1311/7470
Total Pesticides/Polychlorinated Biphenyls	EPA 8080
Plutonium-238,239,240/Uranium-238	NAS-NS-3058[d]
Gross Alpha/Beta	SM 7110[e]
Gamma Scan	HASL 300, 4.5.2.3[f]

[a]U.S. Environmental Protection Agency SW-846 (EPA, 1986)
[b]Toxicity characteristic
[c]Inductively coupled plasma
[d]National Academy of Science, Nuclear Series (Coleman, 1965)
[e]*Standard Methods for the Examination of Water and Waste Water* (APHA, 1992)
[f]*Environmental Methods Laboratory Procedure Manual*, HASL-300 (DOE, 1992)

detected in both source water samples, the associated soil samples did not have anomalous levels to suggest cross contamination. The following sections summarize the analytical results.

A.3.1.1 Total Volatile Organic Compounds

The results of the analyses indicate that constituents were either not present above the CRDL or the reported levels, if present, were well below the action levels outlined in the CAIP (DOE/NV, 1996a). With the exception of bromoform (detected in one source water sample), all the reported COCs had levels that were estimated and/or present in the trip blank samples and, therefore, are directly attributable to common laboratory contaminants (i.e., methylene chloride, acetone, and toluene). The bromoform detected in the source water sample is not representative of site conditions since it was not detected in any soil samples.

One sample, TTR00223, had tetrachloroethene reported with an "X" qualifier. According to laboratory documentation, the result was due to contamination from a previously analyzed sample. The sample was reanalyzed twice (TTR00223RE1 and TTR00223RE2), and no tetrachloroethene was detected; therefore, it was determined to be present due to laboratory contamination.

A.3.1.2 Total Petroleum Hydrocarbons

The results of the TPH analysis indicate that the TPH levels for the soil samples were, with one exception, below the CRDL. Sample TTR00217 had an elevated TPH-D reading (5,300 milligrams per kilogram [mg/kg]) that was attributed to cross contamination, based on the following observations:

- Within the dense grid of sample hole locations, there was only one isolated instance of TPH contamination.
- The medium from which the sample was collected consisted of impermeable, volcanic bedrock material (permeability characteristics were previously discussed in Section A.2.3.2). The depth of the sample interval (9.1 m [30 ft]) was approximately 5.5 m (18 ft) below the top of the bedrock.
- There was no corresponding indication of TPH from the TPH field-screening tests conducted at the sample interval and the interval above. The results from both sample intervals had levels below the field-screening action level of 100 ppm.
- There was no observed indication of TPH (i.e., odor, staining) during the field examination. A level of 5,300 mg/kg of diesel is likely to have associated, observable indicators.
- Diesel fuel was present at the CSWT site for drill rig operation.

A.3.1.3 Total Semivolatile Organic Compounds

The results of the semivolatile organic compound (SVOC) analyses indicate that constituents are either not present above the CRDL or the reported levels, if present, are well below the action levels outlined in the CAIP (DOE/NV, 1996a). All the COCs that were reported had levels that were quantitatively estimated, some of which were associated with a blank. With the exception of one sample that had an estimated level for benzoic acid, all the reported COCs are phthalates which are directly associated with laboratory contamination. The isolated occurrence of benzoic acid appears to be anomalous and is not representative of environmental conditions at the site.

A.3.1.4 Toxicity Characteristic Metals

The soil samples were analyzed for Toxicity Characteristic metals (i.e., arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver). With the exception of barium, approximately 90 percent of the reported inorganic levels were qualified as being below the CRDL, but they were above the instrument detection level. Barium was the only analyte reported above the CRDL in the majority of the samples. In all samples and for all parameters, the reported levels are below the established screening levels outlined in the CAIP (DOE/NV, 1996a). The analytical results are indicative of the naturally occurring background levels for this area. Table A.3-3 presents a summary of typical TTR background concentrations for barium, cadmium, chromium, lead, and silver for comparison purposes. The concentrations were converted from total concentrations to maximum theoretical TCLP concentrations (assuming no moisture and 100 percent leachability) by dividing the total concentration by 20 in accordance with EPA guidance (EPA, 1987). A comparison of the analytical results with the TTR background levels indicates that the barium, cadmium, chromium, lead, and silver concentrations are within the normal background range.

Table A.3-3
Summary of Average Metals Concentration (Select) at the Tonopah Test Range

RCRA Metal	Average of Mean Concentration[a] From Three Sample Points on TTR (ppm)	Maximum Theoretical Extract Concentration[b] (mg/L)[c]
Barium	122 + 129 + 153 x 1/3 = 134.7	**134.7 x 1/20 = 6.7**
Cadmium	0.5 + 0.5 + 0.5 x 1/3 = 0.5	**0.5 x 1/20 = 0.025**
Chromium	28 + 11.99 + 9 x 1/3 = 16.33	**16.33 x 1/20 = 0.817**
Lead	84.3 + 10 + 13 x 1/3 = 35.8	**35.8 x 1/20 = 1.79**
Silver	0.5 + 0.5 + 0.5 x 1/3 = 0.5	**0.5 x 1/20 = 0.025**

[a]From Table 5-3 of the *1993 Site Environmental Report Tonopah Test Range, Tonopah, Nevada* (Culp et al., 1994)
[b]Formula from EPA guidance letter stating how to convert total inorganic concentrations to theoretical TCLP concentrations (EPA, 1987)
[c]Milligram per liter

A.3.1.5 Total Pesticides/Polychlorinated Biphenyls

There were no pesticides or PCBs detected in the soil and QA samples.

A.3.1.6 Radiological Analysis

The radiological analysis consisted of isotopic plutonium (Pu) and uranium (U), gross alpha and beta, and gamma scan. Based on process knowledge, the radioactive isotopes of concern were Pu^{238}, $Pu^{239/240}$, and U^{238}. A reanalysis of all the samples for isotopic Pu and one sample for isotopic U was deemed necessary after an IT health physicist determined that the results included numerous false positives. The false positive results were suspected of being caused by a laboratory contamination event that occurred at the lab just prior to the arrival of the CSWT samples (see Adams, personal memo [1996] for more details). The results of the reanalysis (performed at a different laboratory) confirmed that suspicion and are presented in Plate 1. The results of the reanalysis indicated all non-detects for the Pu isotopes and a background level for the U^{234} sample. The results of the gamma spectroscopy indicated the presence of naturally occurring radioisotopes (i.e., potassium [K^{40}]). The results of the gross alpha/beta analyses were comparable to the background levels presented in the *1993 Site Environmental Report, Tonopah Test Range, Tonopah Nevada* (Culp et al., 1994).

A.3.2 Hydrologic/Geotechnical Analysis

Five samples, selected specifically to represent the heterogeneity of the alluvial/fill material, were sent for hydrologic/geotechnical analysis. The data were collected to provide input for future modeling efforts. The summary of the results of the study is included as Attachment 2. Although careful consideration was taken in the field to select representative *in situ* samples with minimal disturbance, the samples cannot be considered totally undisturbed due to the potential for adverse effects caused by the drilling method (the use of water during the drilling process and the sonic action on the sample core). Therefore, the data should only be considered approximate. In summary, the data indicate the following:

- The alluvial/fill material has very low hydraulic conductivity; the reported values are in the range of those that are considered suitable for landfill liner material.

- Soil moisture content varies within the low range.

A.3.3 Data Quality Assessment

A qualitative assessment was performed for all field and laboratory data generated at the CSWT CAS. The data assessment involved:

- Careful scrutiny of the results for each analytical parameter
- Comparison of the field data to the analytical data
- Determination of whether the sampling objectives sufficiently addressed the DQOs

The VOC, SVOC, and pesticides/PCB laboratory analytical data were carefully reviewed by an IT chemist experienced with environmental data. The low levels of VOCs and SVOCs were assessed as laboratory contaminants. The field data, inorganic analytical data, and the geotechnical results were assessed by IT geologists (experienced with the background characteristics at the TTR) and were found to be within expected ranges. The radiological data were reviewed by an IT health physicist for reasonableness and accuracy. With the exception of the radiological data, the analytical and field data were deemed sound and credible for site characterization purposes and adequate for use in remedial design. The radiological data, however, were found to have erroneous isotopic plutonium and uranium results (false positives) caused by laboratory contamination (Adams, 1996). The IT health physicist determined that the data were unusable, and a reanalysis of the samples by a second laboratory (Lockheed Analytical) was initiated. The results of the reanalysis were determined to be valid and are presented in Plate 1.

The data quality was also assessed to determine if the data fully addressed the objectives of the DQOs established in the CAIP (DOE/NV, 1996a). The DQO sampling plan included biased subsurface sampling that generated sufficient data to:

- Identify the presence of contaminants and their constituents
- Ascertain the extent of contamination
- Determine the appropriate corrective action recommendation

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

A.4.0 Quality Assurance

The results of the QA and QC activities for the CSWT investigation sampling event, including a discussion on measurement of the QA/QC objectives and documentation of nonconformances, are summarized in the following text. Detailed information about the QA program for this sampling event is contained in the Industrial Sites QAPP (DOE/NV, 1994) as specified in the CAIP (DOE/NV, 1996a).

A.4.1 Quality Control Samples

QC samples from the field and laboratory were collected and analyzed throughout the CSWT sample collection process. The laboratory QC samples consisted of the following:

- Laboratory duplicates
- Laboratory spikes
- Laboratory blanks
- Laboratory control samples
- Matrix spike/matrix spike duplicates (MS/MSDs)

The QC samples collected in the field are presented in Plate 1. Three field blanks, three equipment rinsate blanks, two source water (water used during drilling process) samples, 23 trip blanks, and three field duplicates were collected for laboratory analysis. The field blanks were taken by filling the appropriate sample bottles with distilled water during the sample collection process and preserving them according to the requirements specified in the Industrial Sites QAPP (DOE/NV, 1994). The equipment rinsate blanks were obtained by collecting the final rinse solution (i.e., distilled water) of the sampling equipment and decanting the solution into the appropriate sample bottles (with preservatives as applicable). The trip blanks, which were received, sealed, and preserved from the laboratory, were placed in each cooler containing samples for VOC analysis. The results of the QC samples are discussed in the following sections.

A.4.2 Field Quality Control Samples

The field blanks were analyzed for the parameters listed in Table A.3-2. Review of the field blank analytical data indicated that there may have been low levels (estimated values indicative of background levels) of U^{234}, arsenic, barium, and lead present during the sample collection activity. Also, common laboratory contaminants (i.e., methylene chloride and toluene at estimated values and present in blanks) and low estimated concentrations of chloroform (probably either a laboratory contaminant or from the source water) were identified in the field blanks.

Equipment rinsate samples were collected from the light sampling equipment (i.e., spoons) and the heavy sampling equipment (i.e., sampling tubes) used during the investigation process. The samples were analyzed for the parameters listed in Table A.3-2. The results indicated that only COCs associated with common laboratory contaminants (i.e., methylene chloride and toluene found in the laboratory blanks and at estimated values) and low estimated concentrations of chloroform were found. Since the chloroform was not present in the CSWT soil samples, it probably was also due to laboratory contamination.

Samples were collected for laboratory analysis from the source of water that was used during the drilling process. The samples were analyzed to determine the potential impact the water may have had on the characterization samples. The results indicated low concentrations of COCs (estimated values below screening criteria), most of which are commonly associated with laboratory contaminants (i.e., methylene chloride and toluene which were found in the laboratory blanks at estimated values and 2-butanone which was reported as estimated). Bromoform was also detected at a concentration below the screening level in one of the two source water samples. Since the COC was not detected in the CSWT soil samples, it did not represent environmental conditions at the site; furthermore, since the COC was only detected in one source water sample, its presence probably did not represent the condition of the water and was probably attributed to laboratory contamination. The presence of chloroform (at estimated values) and arsenic was also reported in both source water samples. Again, since the COCs were not detected in the CSWT soil samples, they did not reflect environmental conditions at the site.

During the sampling event, the field duplicates were sent as blind samples to the laboratory to be analyzed for the characterization parameters listed in Table A.3-2. The SVOC and VOC results indicated estimated levels of COCs that are commonly associated with laboratory contamination. The inorganic and radiological COC levels were reported below the screening criteria and are indicative of background conditions.

The trip blanks were analyzed for total VOCs only. Methylene chloride was found in varying concentrations in all but one of the trip blanks. Toluene was reported at low estimated levels in approximately 70 percent of the trip blanks. The results support the probability that minor laboratory contamination may have affected the CSWT analysis.

A.4.2.1 Laboratory Quality Control Samples

Analysis of method QC blanks and laboratory control samples was performed for each parameter analyzed by Quanterra. Laboratory duplicate (split-sample) analysis was performed on three samples from the characterization activities. Three samples were also designated for MS/MSD analyses at the laboratory. 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.4.3 Quality Assurance Objectives Measurements

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

A.4.3.1 Precision

Precision is a quantitative measure of the variability of a group of measurements from their average value. Additional information regarding the measurement of precision may be found in the Industrial Sites QAPP (DOE/NV, 1994). 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 subsurface sampling project, the accepted precision goals for the laboratory analyses are specified in the Industrial Sites QAPP (DOE/NV, 1994) and are listed in Table A.4-1, which also presents the results of measurement of precision for the CSWT sampling data. The table lists the total number of RPD precision measurements by analysis type, the acceptable (i.e., target) RPD range per the Industrial Sites QAPP (DOE/NV, 1994), and the number and percent of precision RPD measurements within the acceptance range.

Table A.4-1
Laboratory Precision Measurements for Subsurface Sampling Data

Parameter	Off-Site Analysis								Total
	Total VOCs[a]	Total Semi-VOCS	TC[b] Metals	TPH-G[c]	TPH[d]	Pesticides/ PCBs[e]	Gross Alpha/ Beta	Gamma Scan	
Total Number of RPD[f] Precision Measurements	15	42	24	3	3	18	6	22	**133**
Actual Range of Precision RPD Results	0 - 40.3	0 - 17.2	0 - 53.3	2.4 - 5.3	1.0 - 5.1	0 - 6	0.3 - 19.7	2.7 - 134.9	NA[g]
Target Range for Precision RPD[h]	0 - 24	0 - 50	0 - 20	0 - 50	0 - 40	0 - 40	0 - 40	0 - 40	NA
Number of Precision RPD Measurements within Target Range	14	42	18	3	3	18	6	10	**114**
Percent of Precision RPD Measurements within Target Range	93	100	75	100	100	100	100	45	**86**

[a]Volatile organic compounds
[b]Toxicity characteristics
[c]Total petroleum hydrocarbon - gasoline range
[d]Total petroleum hydrocarbon
[e]Polychlorinated biphenyls
[f]Relative percent difference
[g]Not applicable
[h]As per the Industrial Sites QAPP (DOE/NV, 1994)

The values shown in Table A.4-1 indicate the precision between field samples and laboratory duplicates. Approximately 86 percent of the precision measurements were within the specified parameter-specific target ranges.

A.4.3.2 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 subsurface soil samples analyzed by the off-site laboratory and the actual accuracies achieved are shown in Table A.4-2 for both matrix spike and laboratory control samples. Based on the results shown in this table, 98 percent of all QC sample recoveries were within the acceptable limits, indicating excellent analytical accuracy. Additional information about measurement of accuracy for these samples is found in the Industrial Sites QAPP (DOE/NV, 1994). Parameter-specific accuracy (percent recovery) measurements may be found in the laboratory analytical report data package maintained in the IT project files.

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 using approved procedures (IT, 1994), placed in a correctly labeled container with the correct preservative, and 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 CSWT sampling project, all field accuracy goals were met.

A.4.3.3 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. Sample representativeness is achieved through the implementation of a sampling program designed to ensure the proper sampling locations, the proper number of samples, and the use of validated analytical methods. Representativeness may also be assessed through analysis of duplicate samples.

The CSWT subsurface soil sampling project identified the COCs present in the soils and accurately and precisely quantified their concentrations. Samples were collected from predetermined intervals; collection and analysis were performed in accordance with approved procedures (IT, 1994); and both field and laboratory duplicates were analyzed. As a result, the CSWT soil sampling data may be qualified as acceptably representative of site-specific

Table A.4-2
Laboratory Accuracy Measurements for Subsurface Soil Sample Data

Parameter	Laboratory Analysis									Total On-Site
	TPH[a] Gasoline	TPH Diesel	Total VOCs[b]	Total Semi-VOCs	TC[c] Metals	Total Metals	Pesticides/ PCBs[d]	Gross Alpha/ Beta	Gamma Scan	
Total Number of %R[e] Measurements	11	18	65	238	56	8	104	8	15	**523**
Matrix Spike Samples (range of actual %R)	73 - 86	91 - 100	89 - 189	45 - 104	14 - 111	NA[f]	70 - 127	NA	NA	NA
Laboratory Control Samples (range of actual %R)	84 - 104	74 - 108	88 - 144	27 - 115	68 - 103	71 - 106	44 - 131	70 - 129	96 - 114	NA
%R Target Range[g] (Water)	64 - 145	40 - 140	37 - 160	10 - 230	80 - 120	80 - 120	10 - 215	75 - 125	80 - 120	NA
%R Target Range (Soil)	64 - 125	61 - 144	37 - 160	10 - 230	80 - 120	75 - 125	10 - 215	75 - 125	80 - 120	NA
Number of %R Measurements within the Target Range	11	18	63	238	51	7	104	6	15	**513**
Percent of %R Measurements within the Target Range	100	100	97	100	91	87	100	75	100	**98**

[a]Total petroleum hydrocarbons
[b]Volatile organic compounds
[c]Toxicity characteristic
[d]Polychlorinated biphenyls
[e]Percent recovery
[f]Not applicable
[g]As per the Industrial Sites QAPP (DOE/NV, 1994)

environmental conditions. Additional information about the measurement of representativeness is found in the Industrial Sites QAPP (DOE/NV, 1994)

A.4.3.4 Completeness

Completeness is defined as a percentage of measurements made that are judged to be valid. The CSWT subsurface soil sampling data exhibit a high degree of completeness when the reanalyses (Pu and U) are taken into consideration. The subsurface soil sampling and analytical program was executed in accordance with the CSWT Field Instructions (IT, 1996a) 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.4.3.5 Comparability

Comparability is a qualitative parameter expressing the confidence with which one dataset can be compared to another. A standardized sampling approach and analytical methodology are used to achieve data comparability. To ensure comparability, all CSWT 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, 1986). This approach provides consistency and ensures that the data from this project can be compared to other datasets.

A.4.4 Field Deficiencies/Nonconformance

On September 12, 1996, during subsurface soil sampling field operations at CSWT, a surveillance of the field operation was conducted by the DOE to verify that sampling activities were performed in accordance with applicable requirements (e.g., IT, 1994; IT, 1996a). The results of the surveillance indicated the following three findings:

- The fence installed around the sump to prevent the wild horse population from watering there was not the specified height.
- The "average rate of penetration" for the drilling process was being entered inconsistently in the field log book.
- The waste drums did not have tampering indicator devices on them.

While none of the findings compromised sample quality, the root cause of each finding was addressed, and subsequent corrective actions were initiated.

From the standpoint of sample quality, only one problem occurred in the field that had the potential to jeopardize quality. The sonic drilling method required the use of water while advancing the hole; this requirement was not communicated to the environmental contractor or the DOE prior to the rig mobilizing to the site. In an attempt to reduce the possibility of bias caused by the introduction of water during the drilling process, the following were agreed to in the field:

- The use of water would be limited to driving the casing only.
- Samples of the source water would be taken for laboratory analysis.

The results of the laboratory analyses indicated that there was no relationship of detected analytes between the source water and soil samples (see Section A.3.1 and Table A.4-2). In conclusion, the use of water during the drilling activity did not adversely impact the quality of the samples for this site.

During the drilling operation, it became necessary to drill three additional holes to sufficiently investigate the site. The first hole that was drilled, TC-1, was prematurely abandoned at a depth of 3 m (10 ft) when it was determined that the drill hole penetrated the edge of the slope that forms the east end of the trench. TC-2 was drilled west of TC-1 as a replacement to characterize the east portion of Trench #1 (see Figure A.2-1 for hole locations). While performing field-screening activities, it was discovered by field screening that the TPH result at the 1.5-m (5-ft) sample interval in TC-1 exceeded the field-screening action level. Although the result from the 3-m (10-ft) sample point indicated a background ("clean") level, a second confirmation sample was required as per the CAIP (DOE/NV, 1996a) and the CSWT Field Instructions (IT, 1996a). Drill hole TC-14 was subsequently located approximately 0.3 m (1 ft) west of TC-1, advanced to 4.6 m (15 ft), and sampled. Field-screening results indicated no elevated levels at the 1.5-m, 3-m, and 4.6-m (5-ft, 10-ft, and 15-ft) sampling points. TC-15 was drilled, with DOE concurrence, to investigate the extent of possible decomposed animal remains which were discovered in drill hole TC-5. TC-5 was one of two holes that had any obvious indication of animal remains (animals were associated with Operation Roller Coaster). TC-15 was drilled to 4.6 m (15 ft) with no further visible indication of animal remains.

A.5.0 Contaminant Plume Modeling

Based on the results of the CSWT characterization study conducted in accordance with the DQO process, there is no evidence for the presence of a contaminant plume of any type within the CAU.

A.6.0 Summary

Analysis of data collected during the subsurface investigation activities at the CSWT CAS indicates the following:

- Only minor quantities of sanitary trash (consisting mostly of wood, glass, metal, and burned materials) are buried in the CSWT. The more conspicuous trash layer is situated in an interval approximately 0.9 m to 2.1 m (3 to 7 ft) below the ground surface.
- There was no visual or radiological indication of animal shrouds (associated with Operation Roller Coaster) being disposed of in the CSWT.
- There are no viable concentrations of COCs that exceed the screening levels outlined in the CAIP (DOE/NV, 1996a). Most of the detected COCs were estimated values associated with common laboratory contamination or were naturally occurring. The single TPH-diesel detection of 5,300 ppm was assessed as a spurious data point.
- The alluvial/fill material comprising the trench cover and the *in situ* material below the trenches have relatively low hydraulic conductivity.
- The results of the investigation indicate compliance with the constraints and conceptual models specified in the DQOs for the project presented in the CAIP (DOE/NV, 1996a).

Based on these findings, the information and data presented in this report are appropriate for use in evaluating corrective action alternatives for the CSWT CAU.

A.7.0 References

APHA, see American Public Health Association.

Adams, Steve. IT Corporation. 1996. Personal memorandum to Brad Schier, D. B. Stephens and Associates, Inc., about radionuclide analyses of Cactus Spring soil samples, 18 November. Las Vegas, NV.

American Public Health Association. 1992. *Gross Alpha and Gross Beta Radioactivity, Standard Methods for the Examination of Water and Waste Water*, 18th Edition. Washington, DC.

Coleman, G. H. 1965. *The Radiochemistry of Plutonium*, NAS-NS3058. National Academy of Science.

Culp, T., et al. 1994. *1993 Site Environmental Report Tonopah Test Range Tonopah, Nevada,* SAND94-1292. Sandia National Laboratories.

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. "Field Sampling Instructions for Subsurface Soil Characterization: The Cactus Spring Waste Trenches, Tonopah Test Range, Nevada," ITLV/10972-179. Las Vegas, NV.

IT Corporation. 1996b. *Site-Specific Health and Safety Plan*. Las Vegas, NV.

Schier, B. D. B. Stephens and Associates. 1996. Personal communication to Randy Dubiskas, IT Corporation, about critique of sonic process at Cactus Spring Waste Trenches, 12 December. Las Vegas, NV.

U.S. Department of Energy. 1992. *Environmental Measurements Laboratory Procedures Manual, HASL-300*, 27th Edition, Volume 1. New York, NY.

U.S. Department of Energy, Nevada Operations Office. 1994. *Industrial Sites Quality Assurance Project Plan, Nevada Test Site, Nevada*, Rev. 0. Las Vegas, NV: IT Corporation.

U.S. Department of Energy, Nevada Operations Office. 1996a. *Corrective Action Investigation Plan: Cactus Spring Waste Trenches*, Rev. 1. Las Vegas, NV: IT Corporation.

U.S. Department of Energy, Nevada Operations Office. 1996b. *Corrective Action Unit Work Plan for the Tonopah Test Range, Nevada*, DOE/NV-443. Las Vegas, NV: IT Corporation.

U.S. Department of Energy, Albuquerque Operations Office. 1992. *Environmental Monitoring Plan for Tonopah Test Range, Nevada*. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1992. Tonopah Test Range Tour, 28 April. Las Vegas, NV.

U.S. Environmental Protection Agency. 1986. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846, 3rd Edition. Washington, DC.

U.S. Environmental Protection Agency. 1987. Written correspondence between Gail Ann Ronsen (Environmental Health Scientist, Methods Section) and Joanna Cole (Dallas, TX).

U.S. Environmental Protection Agency. 1994. *Guidance for the Data Quality Objectives Process*, EPA QA/G-4. Washington, DC.

Winograd, I.J., and W. Thordarson. 1975. *Hydrogeologic and Hydrochemical Framework, South-Central Great Basin, Nevada-California, with Special Reference to the Nevada Test Site*, Geological Professional Paper 712-C.

Attachment 1

Soil Boring Logs

SOIL BORING LOG	BORING NUMBER: EX-1	Page1 of 2
PROJECT NAME: TTR CACTUS SPRING WASTE TRENCHES	ENVIRONMENTAL CONTRACTOR: IT CORPORATION	
PROJECT NUMBER: 768700	DRILLING METHOD: Sonic Drilling 4 in	Cactus Spring CADD/CAU No. 426
UTM EASTING: 516313.06	DRILLING CONTRACTOR: Alliance Env. Inc.	Appendix A, Attachment 1
UTM NORTHING: 4174960.84	ELEVATION DATUM: Mean Sea Level	Revision: 1
GEOLOGIST: B. Schier	HOLE SURFACE ELEVATION (meters):1895.90	Date: 06/20/97
QA CHECK: M. Unruh	TOTAL DEPTH OF HOLE (feet):25.00	Page 43 of 80
DATE HOLE STARTED: 09/11/96	COMMENTS: Located in Trench #4	
DATE HOLE COMPLETED: 09/12/96		

Depth (feet)	Depth (meters)	Legend	USCS	Classification (Description)	VOC (ppm) 0.0–50.0	TPH (ppm) 0.0–300.0	Beta/Gamma (dpm) 0.0–4000.0	Alpha (dpm) 0.0–50.0	Sample No.	Sample Type	Remarks
0.0	0.0		GC	Unconsolidated alluvium; brown to gray; well graded; sand, gravel, silt, small cobbles in clay size (volc?) detritus; moderate rounding to subangular.							
	1.0			Poorly sorted sand; moderately indurated; minor gravel; moderately round to subangular.							
5.0			SM								
			GC	Alluvium; brown to gray; as above with greater induration in portions of the sample; minor cobbles.							
	2.0				0.0	40.0	1255.0	21.0	TTR00187	CONT. CORE	
10.0	3.0		CL	As above with thin (less than 3") clay beds with minor sand and silt; moderate induration.							
				As above with minor clay and silt beds.							

Depth (feet)	Depth (meters)	Legend	USCS	Classification (Description)	VOC (ppm) 0.0–50.0	TPH (ppm) 0.0–300.0	Beta/Gamma (dpm) 0.0–4000.0	Alpha (dpm) 0.0–50.0	Sample No.	Sample Type	Remarks
	4.0										
15.0			GC	Paleo-colluvium; well consolidated clay, sand and gravel size detritus; white "caliche" coating ($CaCO_3$?) in part; rounded to subangular grains of varicolored welded volcanic tuff. Volcanic clasts have common hairline, FeO_2-filled fractures.							
	5.0		GW	Increasing volcanic fragments with decreasing transported detritus; 80% volc material, 20% detritus and clay.							
			BEDROCK	Volcanic material; large, cobble-size, angular fragments of tuff, abundant tuffaceous clay, ash or rock flour; common gravel with minor coarse sand.	0.0	0.0	1268.0	21.0			Radiological field screening only. Note: Core interval available at USGS core library at NTS.
20.0	6.0			Intact core at 19 ft of moderately welded ash-flow tuff; pink, red-brown, white, green, tan; common large pumice, flatten in part (fiamme); zeolitic in part; devitrivied in part, conspicuous quartz phenocrysts and common felsic phenocrysts; common argillic alteration; interbedded with nonwelded ash fall tuff or tuffaceous clay; lithics are common; very common FeO_2 filled hairline fracture at 45 degrees and 70 degrees; possible high angle fault at 20 ft; fiamme have approximate 30 degree dip.							
	7.0			As above; volcanic breccia; abundant FeO_2 filled fractures.							

SOIL BORING LOG

SOIL BORING LOG	**BORING NUMBER: TC-2** — Page1 of 2
PROJECT NAME: TTR CACTUS SPRING WASTE TRENCHES	ENVIRONMENTAL CONTRACTOR: IT CORPORATION
PROJECT NUMBER: 768700	DRILLING METHOD: Sonic Drilling 4 in
UTM EASTING: 516370.26	DRILLING CONTRACTOR: Alliance Env. Inc.
UTM NORTHING: 4174973.78	ELEVATION DATUM: Mean Sea Level
GEOLOGIST: B. Schier	HOLE SURFACE ELEVATION (meters):1892.90
QA CHECK: M. Unruh	TOTAL DEPTH OF HOLE (feet):25.00
DATE HOLE STARTED: 09/16/96	COMMENTS: Located in Trench #4
DATE HOLE COMPLETED: 09/16/96	

Depth (feet)	Depth (meters)	USCS	Classification (Description)	VOC (ppm) 0.0–50.0	TPH (ppm) 0.0–300.0	Beta/Gamma (dpm) 0.0–4000.0	Alpha (dpm) 0.0–50.0	Sample No.	Sample Type	Remarks
0.0	0.0	ML	Silt and clay, Gray to tan, white in part; pliable, soft; "plastic-like"; sticks, wood, toothpick(?); coarse sand and gravel in part.							Sticks and wood pieces.
		CL	Sandy clay with gravel, hard, consolidated; gravels are angular to subangular, black, gray, tan volc, detritus.							
	1.0		Unconsolidated sand and gravel with abundant clay; colors vary from black, gray, tan, pink; angular to subangular volcanic material.	2.5	23.0	1188.0	0.0			
5.0			Semi-consolidated coarse sand and gravel, large cobbles of volcanic rock; subangular to angular; clay; plywood pieces.							Plywood pieces.
	2.0	BEDROCK	Volcanic rock: moderately welded ash-flow tuff, zeolitized, common hairline fracs filled with Fe02; same as EX-1 volc section. Sample is rubbled from drilling, large angular fragments with abundant clay and rock flour.	2.2	73.0	1188.0	0.0	TTR00190	CONT. CORE	
10.0	3.0		Non-welded ash-fall tuff intercalated with ash-flow tuff; argillic in part; some fragments rounded in part from drilling.							

Depth (feet)	Depth (meters)	Legend	USCS	Classification (Description)	VOC (ppm) 0.0–50.0	TPH (ppm) 0.0–300.0	Beta/Gamma (dpm) 0.0–4000.0	Alpha (dpm) 0.0–50.0	Sample No.	Sample Type	Remarks
	4.0								TTR00191	CONT CORE	
					1.9	51.0	1188.0	0.0			
15.0											
	5.0										
				Unconsolidated sand, well sorted, medium grained; subangular to subrounded, pink, tan, white, black grains; quartz and volcanic detritus; zeolite in part, no clay.	25.8	11.0	1188.0	0.0			
	6.0										
20.0			SP		2.5	0.0	1188.0	0.0			
			BEDROCK	Moderate to well consolidated clay with pyroclastic material, bedded or reworked tuff(?) with large cobbles, gravels, angular to subrounded, and coarse sands.							
	7.0								TTR00192	CONT. CORE	
					28.0	9.0	1188.0	0.0			

SOIL BORING LOG

PROJECT NAME: TTR CACTUS SPRING WASTE TRENCHES	BORING NUMBER: TC-3 — Page1 of 2
PROJECT NUMBER: 768700	ENVIRONMENTAL CONTRACTOR: IT CORPORATION
UTM EASTING: 516362.09	DRILLING METHOD: Sonic Drilling 4 in
UTM NORTHING: 4174976.58	DRILLING CONTRACTOR: Alliance Env. Inc.
GEOLOGIST: B. Schier	ELEVATION DATUM: Mean Sea Level
QA CHECK: M. Unruh	HOLE SURFACE ELEVATION (meters):1893.40
DATE HOLE STARTED: 09/17/96	TOTAL DEPTH OF HOLE (feet):25.00
DATE HOLE COMPLETED: 09/17/96	COMMENTS: Located in Trench #4

Depth (feet)	Depth (meters)	Legend	USCS	Classification (Description)	VOC (ppm) 0.0–50.0	TPH (ppm) 0.0–300.0	Beta/Gamma (dpm) 0.0–4000.0	Alpha (dpm) 0.0–50.0	Sample No.	Sample Type	Remarks
0.0	0.0		CL	Unconsolidated fill material; clay, sand, gravel, and cobble size detritus; angular to subrounded; small decomposed sticks.							
	1.0			As above with soft wood and organic material.	6.3	43.0	1188.0	0.0			
5.0			OL	Clay and decomposed organic material; wood; strong organic odor from 5 to 6 ft.	7.1	37.0	1668.0	45.0	TTR00254	CONT CORE	
	2.0		BEDROCK	Volcanic rock; red, green, pink, tan; moderately welded ash-flow; tuffaceous clay and non-welded tuff interbedded with ash-flow tuff; zeolitic; pumice; phenocrysts; hairline frac with FeO2 filling; rubble, frags and rock flour with intact core.	5.7	57.0	1188.0	0.0			
10.0	3.0										

Depth (feet)	Depth (meters)	Legend	USCS	Classification (Description)	VOC (ppm) 0.0–50.0	TPH (ppm) 0.0–300.0	Beta/Gamma (dpm) 0.0–4000.0	Alpha (dpm) 0.0–50.0	Sample No.	Sample Type	Remarks
	4.0				3.1	104.0	1268.0	0.0	TTR00194	CONT CORE	
15.0			SP	Unconsolidated sand; well sorted to moderately sorted; angular to subrounded; red, green, tan; no clay.							
			BEDROCK								
	5.0			Volcanic rock as above.							
					5.0	33.0	1244.0	0.0	TTR00195	CONT. CORE	
20.0	6.0										
					7.1	80.0	1268.0	0.0	TTR00196	CONT. CORE	
	7.0			As above, consolidated core.							

SOIL BORING LOG

PROJECT NAME: TTR CACTUS SPRING WASTE TRENCHES	BORING NUMBER: TC-4 — Page1 of 2
PROJECT NUMBER: 768700	ENVIRONMENTAL CONTRACTOR: IT CORPORATION
UTM EASTING: 516355.10	DRILLING METHOD: Sonic Drilling 4 in
UTM NORTHING: 4174978.85	DRILLING CONTRACTOR: Alliance Env. Inc.
GEOLOGIST: B. Schier	ELEVATION DATUM: Mean Sea Level
QA CHECK: M. Unruh	HOLE SURFACE ELEVATION (meters):1893.80
DATE HOLE STARTED: 09/18/96	TOTAL DEPTH OF HOLE (feet):25.00
DATE HOLE COMPLETED: 09/18/96	COMMENTS: Located in Trench #4

Depth (feet)	Depth (meters)	Legend	USCS	Classification (Description)	VOC (ppm) 0.0–50.0	TPH (ppm) 0.0–300.0	Beta/Gamma (dpm) 0.0–4000.0	Alpha (dpm) 0.0–50.0	Sample No.	Sample Type	Remarks
0.0	0.0		CL	Unconsolidated fill material; gravel, sand, and abundant clay; subangular to subrounded detritus; bone fragments and foul odor.							Bone fragments
	1.0		OL	Common organic clay; fine laminae in part; minor sand.	8.3	0.0	1330.0	0.0			
5.0			CL	Semi-consolidated clay with coarse sand and gravel; minor coarse gravel; no cobbles; black burned material and white powder (lime?) intercalated with clay and coarse sand, black, gray, white, green, red subangular to subrounded alluvial detritus.							
	2.0				8.5	1.0	1244.0	0.0	TTR00200	CONT. CORE	
				As above with common cobbles.							
10.0	3.0										

Depth (feet)	Depth (meters)	Legend	USCS	Classification (Description)	VOC (ppm) 0.0–50.0	TPH (ppm) 0.0–300.0	Beta/Gamma (dpm) 0.0–4000.0	Alpha (dpm) 0.0–50.0	Sample No.	Sample Type	Remarks
				As above with minor cobbles.							
	4.0				7.2	36.0	1268.0	0.0			
				As above with large cobbles.							
15.0											
			BEDROCK	Volcanic material; red, green, pink, tan; ash-flow tuff; moderately welded; phenocrysts, pumice, hairline fractures with FeO2 filling; abundant beds of tuffaceous clay or non-welded tuff; sample is rubbled into fragments and rock flour from drilling; intact core in part.							
	5.0										
					6.7	73.0	1244.0	0.0			
	6.0										
20.0											
	7.0								TTR00201	CONT. CORE	
					2.2	19.0	1244.0	0.0			

SOIL BORING LOG	BORING NUMBER: TC-5 Page1 of 2
PROJECT NAME: TTR CACTUS SPRING WASTE TRENCHES	ENVIRONMENTAL CONTRACTOR: IT CORPORATION
PROJECT NUMBER: 768700	DRILLING METHOD: Sonic Drilling 4 in
UTM EASTING: 516352.16	DRILLING CONTRACTOR: Alliance Env. Inc.
UTM NORTHING: 4174969.90	ELEVATION DATUM: Mean Sea Level
GEOLOGIST: B. Schier	HOLE SURFACE ELEVATION (meters):1893.90
QA CHECK: M. Unruh	TOTAL DEPTH OF HOLE (feet):35.00
DATE HOLE STARTED: 09/18/96	COMMENTS: Located in Trench #4
DATE HOLE COMPLETED: 09/18/96	

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Depth (feet)	Depth (meters)	Legend	USCS	Classification (Description)	VOC (ppm) 0.0–50.0	TPH (ppm) 0.0–300.0	Beta/Gamma (dpm) 0.0–4000.0	Alpha (dpm) 0.0–50.0	Sample No.	Sample Type	Remarks
0.0	0.0		CL	Unconsolidated fill material; clay, sand, gravel; subangular to subrounded; small pieces of dried, brown flesh(?); strong foul odor.							Possible animal remains
	1.0				3.0	96.0	1381.0	22.0			
5.0				As above with abundant coarse sand and gravel; subangular to rounded; organic clay in part.							
	2.0				6.5	67.0	1244.0	0.0	TTR00202	CONT CORE	
			BEDROCK	Conspicuous contact between fill material and bedrock. Bedrock is volcanic; pink, white, green; zeolitic; moderately welded ash-flow tuff; abundant quartz phenocrysts, minor mafic phenocrysts; hairline fractures filled with FeO2; argillic; lithics.							
10.0	3.0										
				Reddish-brown tuffaceous clay beds and non-welded tuff intercalated with moderately welded tuff beds; common fragments, rubble, and rock flour from drilling; rare intact core of moderately welded tuff.							
	4.0				2.8	58.0	1244.0	0.0			
15.0											
	5.0										

Depth (feet)	Depth (meters)	Legend	USCS	Classification (Description)	VOC (ppm) 0.0–80.0	TPH (ppm) 0.0–300.0	Beta/Gamma (dpm) 0.0–4000.0	Alpha (dpm) 0.0–50.0	Sample No.	Sample Type	Remarks
~17.5–20.0	~5.3–6.1				3.0	20[illegible]	1244.0	0.0			
20.0	6.0			As above with abundant tuffaceous clay beds and non-welded tuff; reddish-brown.							
~23.0–25.0	7.0				2.3	2[illegible]	1244.0	0.0	TTR00205	CONT. CORE	
25.0	8.0										
~28.0–30.0	~8.5–9.0			As above with common intact core of moderately welded ash-flow tuff; minor clay and non-welded tuff; smooth, conspicuous fracture plane with FeO2 and zeolite coating.	2.0	79.0	1236.0	0.0	TTR00207	CONT. CORE	
30.0	9.0										
~33.0–35.0	10.0				7.0	79.0	1236.0	0.0	TTR00208	CONT. CORE	

SOIL BORING LOG	BORING NUMBER: TC-6 Page1 of 3
PROJECT NAME: TTR CACTUS SPRING WASTE TRENCHES	ENVIRONMENTAL CONTRACTOR: IT CORPORATION
PROJECT NUMBER: 768700	DRILLING METHOD: Sonic Drilling 4 in
UTM EASTING: 516361.03	DRILLING CONTRACTOR: Alliance Env. Inc.
UTM NORTHING: 4174966.45	ELEVATION DATUM: Mean Sea Level
GEOLOGIST: B. Schier	HOLE SURFACE ELEVATION (meters):1893.60
QA CHECK: M. Unruh	TOTAL DEPTH OF HOLE (feet):30.00
DATE HOLE STARTED: 09/19/96	COMMENTS: Located in Trench #4
DATE HOLE COMPLETED: 09/19/96	

Depth (feet)	Depth (meters)	Legend	USCS	Classification (Description)	VOC (ppm) 0.0–50.0	TPH (ppm) 0.0–300.0	Beta/Gamma (dpm) 0.0–4000.0	Alpha (dpm) 0.0–50.0	Sample No.	Sample Type	Remarks
0.0	0.0		GC	Fill material; coarse sand, gravel and small cobble size detritus in part; rounded to subangular; tan, gray, brown; no odor or trash.							Lost top 3 ft of sample during extraction.
	1.0				3.9	71.0	1236.0	0.0			
5.0				As above with common small cobbles; no trash or odor.							
	2.0				3.7	2.0	1236.0	0.0			
10.0	3.0			As above with common coarse sand and large cobbles in part; semi-consolidated in part; no odor or trash.							
			CL	Semi-consolidated volcanic rock and clay,							

SOIL BORING LOG	BORING NUMBER: TC-6	Page2 of 3
PROJECT NAME: TTR CACTUS SPRING WASTE TRENCHES	ENVIRONMENTAL CONTRACTOR: IT CORPORATION	
PROJECT NUMBER: 768700	DRILLING METHOD: Sonic Drilling 4 in	

Depth (feet)	Depth (meters)	Legend	USCS	Classification (Description)	VOC (ppm) 0.0–50.0	TPH (ppm) 0.0–300.0	Beta/Gamma (dpm) 0.0–4000.0	Alpha (dpm) 0.0–50.0	Sample No.	Sample Type	Remarks
				paleocolluvium; round to subrounded; some cobbles show surface weathering.							
	4.0		BEDROCK	Volcanic rock; reddish-brown; moderately welded ash-flow tuff; abundant pumice and lithics; quartz and mafic phenocrysts; abundant fractures with FeO2 filling; zeolitic; argillic; core is rubbled, fragments and rock flour from drilling with intact core in part.	2.0	2.0	1236.0	0.0			
15.0											
	5.0			Brown, tan, semi-consolidated tuffaceous clay and non-welded tuff commonly intercalated with moderately welded tuff.							
					2.6	141	1236.0	0.0	TTR00210	CONT. CORE	
	6.0										
20.0											
	7.0				2.6	3.0	1236.0	0.0	TTR00211	CONT. CORE	
25.0											

SOIL BORING LOG	BORING NUMBER: TC-6	Page3 of 3
PROJECT NAME: TTR CACTUS SPRING WASTE TRENCHES	ENVIRONMENTAL CONTRACTOR: IT CORPORATION	
PROJECT NUMBER: 768700	DRILLING METHOD: Sonic Drilling 4 in	

Depth (feet)	Depth (meters)	Legend	USCS	Classification (Description)	VOC (ppm) 0.0 – 50.0	TPH (ppm) 0.0 – 300.0	Beta/Gamma (dpm) 0.0 – 4000.0	Alpha (dpm) 0.0 – 50.0	Sample No.	Sample Type	Remarks
									TTR00212	CONT CORE	
	8.0										
					6.3	41.0	1236.0	0.0			
				As above; consolidated core.							
	9.0										

SOIL BORING LOG	BORING NUMBER: TC-7	Page1 of 3
PROJECT NAME: TTR CACTUS SPRING WASTE TRENCHES	ENVIRONMENTAL CONTRACTOR: IT CORPORATION	
PROJECT NUMBER: 768700	DRILLING METHOD: Sonic Drilling 4 in	
UTM EASTING: 516368.47	DRILLING CONTRACTOR: Alliance Env. Inc.	
UTM NORTHING: 4174964.61	ELEVATION DATUM: Mean Sea Level	
GEOLOGIST: B. Schier	HOLE SURFACE ELEVATION (meters):1893.30	
QA CHECK: M. Unruh	TOTAL DEPTH OF HOLE (feet):30.00	
DATE HOLE STARTED: 09/19/96	COMMENTS: Located in Trench #4	
DATE HOLE COMPLETED: 09/20/96		

Depth (feet)	Depth (meters)	Legend	USCS	Classification (Description)	VOC (ppm) 0.0–50.0	TPH (ppm) 0.0–300.0	Beta/Gamma (dpm) 0.0–4000.0	Alpha (dpm) 0.0–50.0	Sample No.	Sample Type	Remarks
0.0	0.0		CL	Unconsolidated fill material; clay, coarse sand, gravel, minor small cobbles; rounded to subangular; sticks in top 2 ft							
									TTR00214	CONT. CORE	Wood trash.
	1.0			Wood and burned material common from 4-6 ft; no odor	5.1	153	1236.0	0.0			
5.0											
	2.0			As above without cobbles, abundant, coarse grained detritus; no odor.							
					4.8	27.0	1236.0	0.0			
10.0	3.0										
				As above; no trash; slight organic odor; conspicuous contact with bedrock at 12 ft.							
			BEDROCK	Volcanic rock; red/brown, tan, buff, white,							

SOIL BORING LOG	BORING NUMBER: TC-7 Page2 of 3
PROJECT NAME: TTR CACTUS SPRING WASTE TRENCHES	ENVIRONMENTAL CONTRACTOR: IT CORPORATION
PROJECT NUMBER: 768700	DRILLING METHOD: Sonic Drilling 4 in

Depth (feet)	Depth (meters)	Legend	USCS	Classification (Description)	VOC (ppm) 0.0–50.0	TPH (ppm) 0.0–300.0	Beta/Gamma (dpm) 0.0–4000.0	Alpha (dpm) 0.0–50.0	Sample No.	Sample Type	Remarks
	4.0			green; moderately welded ash flow tuff; *large fiamme; lithics; zeolitic; quartz and* mafic phenocrysts; interbedded with unconsolidated tuffaceous clay and non-welded ash-fall tuff; common FeO2-filled fractures.	8.7	82.0	1261.0	22.0			
15.0											
	5.0			Same section as EX-1 with more clay or ash beds; core is mostly intact with intervals of rubble, fragments, and rock flour.							
									TTR00215	CONT CORE	
				As above with common tuffaceous clay and non-welded tuff interbedded with moderately welded tuff. Highly fractured at 20 ft with FeO2 and zeolite coating and filling.	6.9	183[illegible]	1261.0	22.0			
20.0	6.0										
	7.0										
									TTR00216	CONT. CORE	
				As above with common intervals of rubble, fragments, and rock flour from drilling.	4.7	99.0	1261.0	22.0			
25.0											

SOIL BORING LOG	BORING NUMBER: TC-7	Page3 of 3
PROJECT NAME: TTR CACTUS SPRING WASTE TRENCHES	ENVIRONMENTAL CONTRACTOR: IT CORPORATION	
PROJECT NUMBER: 768700	DRILLING METHOD: Sonic Drilling 4 in	

Depth (feet)	Depth (meters)	Legend	USCS	Classification (Description)	VOC (ppm) 0.0 – 50.0	TPH (ppm) 0.0 – 300.0	Beta/Gamma (dpm) 0.0 – 4000.0	Alpha (dpm) 0.0 – 50.0	Sample No.	Sample Type	Remarks
	8.0										
					0.0	79.0	1261.0	22.0	TTR00217	CONT. CORE	
	9.0										

SOIL BORING LOG

PROJECT NAME: TTR CACTUS SPRING WASTE TRENCHES	BORING NUMBER: TC-8 — Page1 of 2
PROJECT NUMBER: 768700	ENVIRONMENTAL CONTRACTOR: IT CORPORATION
UTM EASTING: 516366.31	DRILLING METHOD: Sonic Drilling 4 in
UTM NORTHING: 4174955.39	DRILLING CONTRACTOR: Alliance Env. Inc.
GEOLOGIST: B. Schier	ELEVATION DATUM: Mean Sea Level
QA CHECK: M. Unruh	HOLE SURFACE ELEVATION (meters):1893.50
DATE HOLE STARTED: 09/20/96	TOTAL DEPTH OF HOLE (feet):25.00
DATE HOLE COMPLETED: 09/20/96	COMMENTS: Located in Trench #4

Depth (feet)	Depth (meters)	Legend	USCS	Classification (Description)	VOC (ppm) 0.0–50.0	TPH (ppm) 0.0–300.0	Beta/Gamma (dpm) 0.0–4000.0	Alpha (dpm) 0.0–50.0	Sample No.	Sample Type	Remarks
0.0	0.0		GC	Alluvial fill material; tan, buff; gravel, coarse sand, minor small cobble size detritus.							
	1.0										Abundant wood pieces
			CL	As above with slightly higher clay content from 4 to 5 ft; abundant wood pieces; no odor.	2.3	25.0	1260.0	22.0			
5.0				As above with slight increase of small cobbles; slightly darker clay indicates possible higher moisture content; small sticks at 9 ft.							
	2.0								TTR00219	CONT. CORE	small sticks
				Well consolidated clay and gravel from 10 to 11 ft.	2.3	29.0	1260.0	22.0			
10.0	3.0			Well graded sand, gravel, cobble, and abundant clay; moderately round to subangular; black, gray, white, red-brown detritus.							

Depth (feet)	Depth (meters)	Legend	USCS	Classification (Description)	VOC (ppm) 0.0–50.0	TPH (ppm) 0.0–300.0	Beta/Gamma (dpm) 0.0–4000.0	Alpha (dpm) 0.0–50.0	Sample No.	Sample Type	Remarks
	4.0		SC	Well consolidated alluvium as above without cobbles; possible caliche zone with apparent calcite coating from 14.5 to 15 ft.	2.4	40.0	1260.0	22.0			
15.0			GP	Unconsolidated, poorly to moderately sorted stream gravel; gray, brown-red, buff-white, black gravels; well-rounded to subangular; very minor clay content.							
	5.0		BEDROCK	Volcanic rock, moderately to poorly welded tuff; white, green, red-brown in part; zeolitic; lithics; phenocrysts; interbedded with tuffaceous clay and non-welded tuff; FeO2 filled fracture increasing with depth; intact core in part, rubble in part.	3.1	26.0	1260.0	22.0			
20.0	6.0										
	7.0				2.1	67.0	1260.0	22.0	TTR00220	CONT. CORE	

SOIL BORING LOG

PROJECT NAME: TTR CACTUS SPRING WASTE TRENCHES	BORING NUMBER: TC-9 — Page1 of 2
PROJECT NUMBER: 768700	ENVIRONMENTAL CONTRACTOR: IT CORPORATION
UTM EASTING: 516358.19	DRILLING METHOD: Sonic Drilling 4 in
UTM NORTHING: 4174957.07	DRILLING CONTRACTOR: Alliance Env. Inc.
GEOLOGIST: B. Schier	ELEVATION DATUM: Mean Sea Level
QA CHECK: M. Unruh	HOLE SURFACE ELEVATION (meters):1893.70
DATE HOLE STARTED: 09/23/96	TOTAL DEPTH OF HOLE (feet):40.00
DATE HOLE COMPLETED: 09/23/96	COMMENTS: Located in Trench #4

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Depth (feet)	Depth (meters)	USCS	Classification (Description)	VOC (ppm) 0.0–50.0	TPH (ppm) 0.0–300.0	Beta/Gamma (dpm) 0.0–4000.0	Alpha (dpm) 0.0–50.0	Sample No.	Sample Type	Remarks
0.0	0.0	CL	Unconsolidated fill material; tan, red; coarse sand, gravel and minor small cobbles, abundant clay and silt; rounded to subangular; organic fiber material and sticks at 4 ft.							
	1.0		As above with abundant "peat" material, broken glass, rusted can; powdery substance.	5.1	14.0	1236.0	0.0			
5.0		OL								Abundant Trash
	2.0	GC	Coarse gravel and small cobbles grading into finer material (gravel and sand); as above with abundant coarse sand and fine gravel; small fiber and plant material from 10-11 ft.	0.0	[illegible]	[illegible]	0.0			
				5.6	42.0	1236.0	0.0			
10.0	3.0									
		CL	Semi-consolidated alluvium from 11-15 ft; abundant clay with sand and gravel; minor cobbles; unconsolidated from 13-14 ft; Partial coatings of $CaCO_3$ on clays and gravel on portions of sample.							
	4.0		Description similar to above with very high percentage of coarse sand and fine gravel.	4.3	23.0	1236.0	0.0			
15.0		GC								
		CL	Paleocolluvium; angular to subangular volcanics, detritus; abundant clay; minor cobbles.							
	5.0	BEDROCK	Volcanic bedrock at 17 ft; tuff; white, tan, reddish brown; quartz phenocrysts; pumice; lithics; tuffaceous clay in part; hairline fractures filled with FeO_2; intact core, with zones of rubble, fragments, and rock flour.	4.0	40.0	1236.0	0.0			
	6.0									

Depth (feet)	Depth (meters)	Legend	USCS	Classification (Description)	VOC (ppm) 0.0–50.0	TPH (ppm) 0.0–300.0	Beta/Gamma (dpm) 0.0–4000.0	Alpha (dpm) 0.0–50.0	Sample No.	Sample Type	Remarks
	7.0				6.1	[illegible]	1236.0	0.0	TTR00222	CONT. CORE	
25.0											
	8.0				4.1	107.0	1236.0	0.0			
	9.0										
30.0				As above; mostly consolidated with tuffaceous clay beds or argillized tuff; fiamme; rubble in part.							
	10.0				4.1	47.0	1236.0	0.0	TTR00223	CONT. CORE	
35.0											
	11.0			As above with decreased clay content; well consolidated core; decreasing fiamme and large pumice; slight increase in lithics.	3.6	22.0	1236.0	0.0	TTR00224	CONT. CORE	
	12.0										

SOIL BORING LOG	BORING NUMBER: TC-10	Page1 of 2
PROJECT NAME: TTR CACTUS SPRING WASTE TRENCHES	ENVIRONMENTAL CONTRACTOR: IT CORPORATION	
PROJECT NUMBER: 768700	DRILLING METHOD: Sonic Drilling 4 in	
UTM EASTING: 516347.78	DRILLING CONTRACTOR: Alliance Env. Inc.	Cactus Spring CADD/CAU No 426
UTM NORTHING: 4174961.59	ELEVATION DATUM: Mean Sea Level	Appendix A, Attachment 1
GEOLOGIST: B. Schier	HOLE SURFACE ELEVATION (meters):1894.30	Revision: 1
QA CHECK: M. Unruh	TOTAL DEPTH OF HOLE (feet):30.00	Date: 06/20/97
DATE HOLE STARTED: 09/24/96	COMMENTS: Located in Trench #4	Page 63 of 80
DATE HOLE COMPLETED: 09/24/96		

Depth (feet)	Depth (meters)	Legend	USCS	Classification (Description)	VOC (ppm) 0.0–50.0	TPH (ppm) 0.0–300.0	Beta/Gamma (dpm) 0.0–4000.0	Alpha (dpm) 0.0–50.0	Sample No.	Sample Type	Remarks
0.0	0.0		CL	Unconsolidated alluvium or fill material; clay, sand, gravel, and cobbles; rounded to subangular; some volcanic detritis. No indication of trash or disturbed soil.							Attempted to advance 2 ft Shelby tube; collapsed; recovered 12 inches
	1.0				5.4	18.0	1236.0	0.0			
5.0			GC	Large boulder encountered at 5 ft. Unconsolidated gravel and coarse sand with minor clay content from 5 to 6 ft.							
			CL	Semi-consolidated clay and sand with minor small cobbles from 6 to 7 ft.							
	2.0			Unconsolidated alluvium/fill as above; appears to be in situ, cannot make determination.	5.2	41.0	1236.0	0.0			Attempted to advance 2 ft Shelby tube at 10 ft; recovered 4 inches.
10.0	3.0		SC	Semi-consolidated gravel and sand with clay from 10 to 11 ft.							
			GC	Well consolidated, "caliche-like" alluvium, gravel, clay and minor small cobbles; rounded to subangular; calcite coating on detritus from 11 to 13 ft.							
	4.0		CL	Paleocolluvium at 13 ft; consolidated fragments of volcanic rock and clay. Volcanic rock is white, tan, buff, red-brown, pink, green; zeolitic.	4.9	52.0	1236.0	0.0			
			BEDROCK	Volcanic rock at 14 ft; red-brown, tan,							

Depth (feet)	Depth (meters)	Legend	USCS	Classification (Description)	VOC (ppm)	TPH (ppm)	Beta/Gamma (dpm)	Alpha (dpm)	Sample No.	Sample Type	Remarks
					0.0 50.0	0.0 300.0	0.0 4000.0	0.60.0			
15.0	5.0			white, green; moderately welded ash-flow tuff; common pumice; minor fiamme; common lithics; common quartz and mafic phenocrysts; tuffaceous clay and non-welded ash-fall tuff beds in part; common FeO2 filled fracture; rubble, fragments and rock flour; intact core.							
					4.9	125.	1236.0	0.0	TTR00228	CONT. CORE	
20.0	6.0										
				As above with increasing tuffaceous clay and non-welded tuff beds; numerous FeO2-filled fractures; rubble and fragments in part; intact core in part.							
	7.0				4.7	129.	1236.0	0.0	TTR00229	CONT. CORE	
25.0	8.0			As above; most intact core; moderately welded tuff has increased pumice content, and becoming more argillaceous.							
	9.0				3.6	102.0	1236.0	0.0	TTR00230	CONT. CORE	

SOIL BORING LOG	BORING NUMBER: TC-11 — Page1 of 2
PROJECT NAME: TTR CACTUS SPRING WASTE TRENCHES	ENVIRONMENTAL CONTRACTOR: IT CORPORATION
PROJECT NUMBER: 768700	DRILLING METHOD: Sonic Drilling 4 in
UTM EASTING: 516363.13	DRILLING CONTRACTOR: Alliance Env. Inc.
UTM NORTHING: 4174946.54	ELEVATION DATUM: Mean Sea Level
GEOLOGIST: B. Schier	HOLE SURFACE ELEVATION (meters):1893.80
QA CHECK: M. Unruh	TOTAL DEPTH OF HOLE (feet):25.00
DATE HOLE STARTED: 09/24/96	COMMENTS: Located in Trench #4
DATE HOLE COMPLETED: 09/25/96	

Depth (feet)	Depth (meters)	Legend	USCS	Classification (Description)	VOC (ppm) 0.0–50.0	TPH (ppm) 0.0–300.0	Beta/Gamma (dpm) 0.0–4000.0	Alpha (dpm) 0.0–50.0	Sample No.	Sample Type	Remarks
0.0	0.0		CL	Unconsolidated fill material; clay, sand, gravel, and small cobble size alluvial detritus, buff, tan; rounded to subangular; toothpick noted at 5 ft.							
	1.0				4.4	43.0	1236.0	0.0			
5.0				As above with distinct zones of color and clay content; from 6 to 6.5 ft: yellow-brown with increasing clay content; from 6.5 to 7 ft, light grey with decreasing clay content; from 7 to 10 ft: tan, yellow-brown with increasing clay and finer sand and gravel size detritus. No trash or odor.							Toothpick
	2.0				4.1	49.0	1236.0	0.0			
10.0	3.0			As above; tan, yellow-brown; common small cobbles.							

Depth (feet)	Depth (meters)	Legend	USCS	Classification (Description)	VOC (ppm) 0.0–50.0	TPH (ppm) 0.0–300.0	Beta/Gamma (dpm) 0.0–4000.0	Alpha (dpm) 0.0–50.0	Sample No.	Sample Type	Remarks
	4.0			Paleocolluvium at 13 ft; white-gray, consolidated; clay with red-brown, pink, white, green volc detritus; angular to subangular.	3.9	149	1236.0	0.0	TTR00234	CONT. CORE	
15.0			BEDROCK	Volcanic rock at 14.5 ft; red-brown, pink, white, green; moderately welded ash-flow tuff with beds of tuffaceous clay and non-welded ash-fall tuff.							
	5.0			As above with increasing soft tuffaceous beds intercalated with moderately welded tuff; intact core from 14.5 to 17.5; sample is rubbled and fragmented with rock flour from 17.5 to 19 ft.	4.4	87.0	1236.0	0.0	TTR00235	CONT. CORE	
20.0	6.0										
	7.0				6.7	3.0	1236.0	0.0	TTR00236	CONT. CORE	

SOIL BORING LOG

PROJECT NAME: TTR CACTUS SPRING WASTE TRENCHES	BORING NUMBER: TC-12 — Page1 of 2
PROJECT NUMBER: 768700	ENVIRONMENTAL CONTRACTOR: IT CORPORATION
UTM EASTING: 516355.31	DRILLING METHOD: Sonic Drilling 4 in
UTM NORTHING: 4174949.08	DRILLING CONTRACTOR: Alliance Env. Inc.
GEOLOGIST: B. Schier	ELEVATION DATUM: Mean Sea Level
QA CHECK: M. Unruh	HOLE SURFACE ELEVATION (meters):1894.10
DATE HOLE STARTED: 09/25/96	TOTAL DEPTH OF HOLE (feet):25.00
DATE HOLE COMPLETED: 09/25/96	COMMENTS: Located in Trench #4

Depth (feet)	Depth (meters)	Legend	USCS	Classification (Description)	VOC (ppm) 0.0–50.0	TPH (ppm) 0.0–300.0	Beta/Gamma (dpm) 0.0–4000.0	Alpha (dpm) 0.0–50.0	Sample No.	Sample Type	Remarks
0.0	0.0		CL	Unconsolidated fill material; clay, sand, gravel, and small cobble size alluvial detritus; light tan to brown; moderately rounded to subangular; consolidated in part; plant fibers common.							
	1.0				3.4	37.0	1630.0	0.0			
5.0				Consolidated in part from 5 to 6.5 ft; common wood pieces, orange paint chips, unidentified decayed material, toothpicks; no odor.							Abundant trash material.
	2.0										
				As above; unconsolidated fill to 9 ft; no trash.	4.1	129.	1236.0	0.0	TTR00238	CONT. CORE	TTR00239 Duplicate
				Small consolidated pieces of yellowish-brown clay and sand from 9 to 10 ft.							
10.0	3.0		GC	As above with increasing gravel content; no trash.							

Depth (feet)	Depth (meters)	Legend	USCS	Classification (Description)	VOC (ppm) 0.0–50.0	TPH (ppm) 0.0–300.0	Beta/Gamma (dpm) 0.0–4000.0	Alpha (dpm) 0.0–50.0	Sample No.	Sample Type	Remarks
	4.0			Gravel, sand, and clay at 13 ft has a distinct, unnatural (burn(?)) odor; no trash.	4.4	77.0	1236.0	0.0	TTR00240	CONT. CORE	
15.0			BEDROCK	Volcanic rock at 14 ft; moderately welded ash-flow tuff intercalated with beds of tuffaceous clay and non-welded tuff; red-brown, pink, white, green; mostly rubbled and fragmented from drilling.							
	5.0										
	6.0				3.4	121.[illegible]	1236.0	0.0			
20.0											
	7.0				3.2	34.0	1236.0	0.0	TTR00241	CONT. CORE	

SOIL BORING LOG	BORING NUMBER: TC-13	Page1 of 2
PROJECT NAME: TTR CACTUS SPRING WASTE TRENCHES	ENVIRONMENTAL CONTRACTOR: IT CORPORATION	
PROJECT NUMBER: 768700	DRILLING METHOD: Sonic Drilling 4 in	
UTM EASTING: 516348.85	DRILLING CONTRACTOR: Alliance Env. Inc.	Cactus Spring CADD/CAU No. 426
UTM NORTHING: 4174953.38	ELEVATION DATUM: Mean Sea Level	Appendix A, Attachment 1
GEOLOGIST: B. Schier	HOLE SURFACE ELEVATION (meters):1894.40	Revision: 1
QA CHECK: M. Unruh	TOTAL DEPTH OF HOLE (feet):25.00	Date: 06/20/97
DATE HOLE STARTED: 09/25/96	COMMENTS: Located in Trench #4	Page 69 of 80
DATE HOLE COMPLETED: 09/25/96		

Depth (feet)	Depth (meters)	Legend	USCS	Classification (Description)	VOC (ppm) 0.0–50.0	TPH (ppm) 0.0–300.0	Beta/Gamma (dpm) 0.0–4000.0	Alpha (dpm) 0.0–50.0	Sample No.	Sample Type	Remarks
0.0	0.0		CL	Unconsolidated clay, sand, gravel, and small cobbles; alluvial detritus; moderately rounded to subangular; tan-buff; minor plant fibers; no trash or odor. Unable to determine if fill or in situ alluvium.							
	1.0				3.9	22.0	1500.0	0.0			
5.0				As above with increasing clay content; yellow-brown.							
	2.0										
				More consolidated at 8 ft (could be in situ alluvium); slightly darker brown; clay, sand, gravel, with minor coarse gravel size detritus.	3.6	13.0	1236.0	0.0	TTR00245	CONT CORE	
10.0	3.0			As above; yellow-brown; consolidated and intact core; increasing clay content.							
				As above, increasing consolidated							

Depth (feet)	Depth (meters)	Legend	USCS	Classification (Description)	VOC (ppm) 0.0–50.0	TPH (ppm) 0.0–300.0	Beta/Gamma (dpm) 0.0–4000.0	Alpha (dpm) 0.0–50.0	Sample No.	Sample Type	Remarks
	4.0			fragments of clay, sand, gravel, and fine cobble size detritus; no trash or odor.	3.6	93.0	1236.0	0.0			
15.0	5.0		BEDROCK	Volcanic rock at 16.5 ft; white, pink, red-brown, green; moderately welded ash-flow tuff; pumice; fiamme; common lithics; hairline fractures filled with FeO2; tuffaceous clay beds. Sample is mostly rubbled, fragmented with rock flour from drilling.	3.9	59.0	1236.0	0.0			
20.0	6.0, 7.0			As above with increasing tuffaceous clay and non-welded tuff beds. Mostly intact core to 24 ft.	4.4	21.0	1236.0	0.0	TTR00246	CONT. CORE	

SOIL BORING LOG

SOIL BORING LOG	BORING NUMBER: TC-14 — Page1 of 1
PROJECT NAME: TTR CACTUS SPRING WASTE TRENCHES	ENVIRONMENTAL CONTRACTOR: IT CORPORATION
PROJECT NUMBER: 768700	DRILLING METHOD: Sonic Drilling 4 in
UTM EASTING: 516371.95	DRILLING CONTRACTOR: Alliance Env. Inc.
UTM NORTHING: 4174972.81	ELEVATION DATUM: Mean Sea Level
GEOLOGIST: B. Schier	HOLE SURFACE ELEVATION (meters):1893.10
QA CHECK: M. Unruh	TOTAL DEPTH OF HOLE (feet):15.00
DATE HOLE STARTED: 09/26/96	COMMENTS: Located in Trench #4
DATE HOLE COMPLETED: 09/26/96	

Depth (feet)	Depth (meters)	USCS	Classification (Description)	VOC (ppm) 0.0–50.0	TPH (ppm) 0.0–300.0	Beta/Gamma (dpm) 0.0–4000.0	Alpha (dpm) 0.0–60.0	Sample No.	Sample Type	Remarks
0.0	0.0	CL	Unconsolidated fill; brown, tan; clay, sand, gravel, and small cobble size alluvial detritus; small percentage of medium sized, subangular to subrounded cobbles; rare plant fibers.	0.0	0.0	1630.0	0.0			
5.0			Consolidated alluvium; clay, sand, fine to medium grained gravel, small cobbles in part.							
	2.0	BEDROCK	Volcanic rock at 7 ft; white, tan, buff, pink; moderately welded ash-flow tuff intercalated with tuffaceous clay and non-welded tuff; zeolitic; lithics; rare pumice; common clay beds; mostly intact core with rubble in parts.	0.0	65.0	1244.0	0.0			
10.0	3.0		As above with common hairline fractures filled with FeO2; rubble and frags with rock flour and tuffaceous clay.							
	4.0		As above; red-brn, white, tan, buff, green tuff; common pumice; rubble and fragments from drilling.	0.0	14.0	1244.0	0.0	TTR00250	CONT. CORE	

SOIL BORING LOG

SOIL BORING LOG	BORING NUMBER: TC-15 — Page1 of 1
PROJECT NAME: TTR CACTUS SPRING WASTE TRENCHES	ENVIRONMENTAL CONTRACTOR: IT CORPORATION
PROJECT NUMBER: 768700	DRILLING METHOD: Sonic Drilling 4 in
UTM EASTING: 516355.41	DRILLING CONTRACTOR: Alliance Env. Inc.
UTM NORTHING: 4174969.95	ELEVATION DATUM: Mean Sea Level
GEOLOGIST: B. Schier	HOLE SURFACE ELEVATION (meters):1893.80
QA CHECK: M. Unruh	TOTAL DEPTH OF HOLE (feet):15.00
DATE HOLE STARTED: 09/26/96	COMMENTS: Located in Trench #4
DATE HOLE COMPLETED: 09/26/96	

Depth (feet)	Depth (meters)	USCS	Classification (Description)	VOC (ppm) 0.0–50.0	TPH (ppm) 0.0–300.0	Beta/Gamma (dpm) 0.0–4000.0	Alpha (dpm) 0.0–50.0	Sample No.	Sample Type	Remarks
0.0	0.0	CL	Unconsolidated fill material; partially consolidated at 3.5 to 4.5 ft; clay, sand, gravel and cobble size detritus; tan; subangular to subrounded.							
	1.0		As above with decreasing clay content, increasing coarse sand and gravel size detritus from 5.5 to 7 ft; subangular to moderately rounded; trace of wood fragments and rare black decomposed organic material; no odor.	5.2	0.0	1244.0	0.0			Wood material
5.0		GC								
	2.0	CL	As above; well consolidated with increasing clay content.							TTR00252 Duplicate
			Paleocolluvium; consolidated, volcanic rock interbedded with clay; volcanic fragments is white, tan, pink, red-tan, green, tuff; angular to subangular; gravel to cobble sized.	3.9	20.0	1244.0	0.0	TTR00251	CONT. CORE	
10.0	3.0	BEDROCK	Volcanic rock; moderately welded ash-flow tuff interbedded with tuffaceous clay and non-welded tuff; pumice; lithics; quartz and mafic phenocrysts; mostly intact core with rubble and fragments in part.							
	4.0			3.6	28.0	0.0	0.0	TTR00253	CONT. CORE	

Attachment 2

Summary of Geotechnical/Hydrologic Analytical Data

Table 1. Summary of Tests Performed

Sample Number	Initial Moisture Content	Dry Bulk Density	Porosity	Saturated Hydraulic Conductivity	Moisture Characteristics	Unsaturated Hydraulic Conductivity	Particle Size Classification
TTR00254	X	X	X	X	X	X	X
TTR00255	X	X	X	X	X	X	X
TTR00256	X	X	X	X	X	X	X
TTR00257	X	X	X	X	X	X	X
TTR00258	X	X	X	X	X	X	X

Table 2. Summary of Initial Moisture Content, Dry Bulk Density Wet Bulk Density, and Calculated Porosity

Sample Number	Initial Moisture Content Gravimetric (%, g/g)	Initial Moisture Content Volumetric (%, cm^3/cm^3)	Dry Bulk Density (g/cm^3)	Wet Bulk Density (g/cm^3)	Calculated Porosity (%)
TTR00254	9.7	16.5	1.70	1.87	35.8
TTR00255	5.9	10.5	1.76	1.86	33.7
TTR00256	8.9	14.3	1.61	1.75	39.3
TTR00257	8.5	15.4	1.81	1.96	31.9
TTR00258	10.7	21.6	2.02	2.24	23.6

Table 3. Summary of Saturated Hydraulic Conductivity Tests

Sample Number	K_{sat} (cm/sec)	Method of Analysis	
		Constant Head	Falling Head
TTR00254	4.7E-08		X
TTR00255	7.0E-04	X	
TTR00256	3.0E-06		X
TTR00257	5.9E-04		X
TTR00258	2.5E-08		X

Table 4. Summary of Moisture Characteristics of the Initial Drainage Curve

Sample Number	Pressure Head (-cm water)	Moisture Content (%, cm^3/cm^3)
TTR00254	1	39.6
	52	38.4
	100	38.1
	1010	35.7
	3671	32.2
	5609	29.9
	33959	21.9
TTR00255	1	37.1
	19	32.2
	50	26.6
	151	22.5
	520	18.0
	2244	14.5
	17133	11.4
TTR00256	1	38.3
	27	35.2
	127	28.7
	520	24.5
	2142	19.9
	22742	13.9
TTR00257	1	35.7
	22	34.2
	51	32.9
	154	30.5
	507	27.5
	1015	25.3
	2753	20.2
	48950	12.4

Table 4. Summary of Moisture Characteristics of the Initial Drainage Curve (Continued)

Sample Number	Pressure Head (-cm water)	Moisture Content (%, cm^3/cm^3)
TTR00258	1	28.0
	52	26.3
	100	25.9
	1010	23.8
	3671	18.5
	4181	16.9
	41404	13.1

Table 5. Summary of Calculated Unsaturated Hydraulic Properties

Sample Number	α (cm^{-1}) Calculated Value	α 95% Confidence Limits Lower	α 95% Confidence Limits Upper	N (dimensionless) Calculated Value	N 95% Confidence Limits Lower	N 95% Confidence Limits Upper	θr (%)	θs (%)
TTR00254	0.0005	-0.0003	0.0013	1.7617	1.2257	2.2976	21.9	39.6
TTR00255	0.0657	0.0047	0.1266	1.3400	1.2017	1.4783	11.4	37.1
TTR00256	0.0292	-0.0247	0.0830	1.3068	1.0770	1.5367	13.9	38.3
TTR00257	0.0061	-0.0004	0.0125	1.3875	1.1661	1.6088	12.4	35.7
TTR00258	0.0010	0.0000	0.0020	1.8402	1.1302	2.5503	13.1	28.0

Table 6. Summary of Particle Size Characteristics

Sample Number	d_{10} (mm)	d_{50} (mm)	d_{60} (mm)	C_u	C_c	Method	Classification
TTR00254	0.0040	0.30	1.2	300	0.060	WS/H	Classification by ASTM 2487 requires Atterberg test
TTR00255	0.014	2.7	4.1	300	9.0	WS/H	Classification by ASTM 2487 requires Atterberg test
TTR00256	--	0.73	1.3	--	--	WS/H	Classification by ASTM 2487 requires Atterberg test
TTR00257	--	5.6	10.0	--	--	WS/H	Classification by ASTM 2487 requires Atterberg test
TTR00258	--	0.26	0.81	--	--	WS/H	Classification by ASTM 2487 requires Atterberg test

d_{50} = median particle diameter

* d_{10} not reached with test specified

-- value dependent upon d_{10}

$$C_u = \frac{d_{60}}{d_{10}}$$

$$C_c = \frac{(d_{30})^2}{(d_{10})(d_{60})}$$

DS = Dry sieve

H = Hydrometer

WS = Wet sieve

Appendix B
Cost Estimates

CACTUS SPRING WASTE TRENCHES CADD

BASIS OF ESTIMATE

1. The average soil density is 100 pounds per cubic foot (ft^3).
2. The soil volume includes 20 percent for expansion.
3. The volume of fill required for the fill and covering is 419 cubic meters (m^3) (600 cubic yards [yd^3]).
4. The total length of fence required is 293 meters (m) (1,000 feet [ft]); costs are from R.S. Means.
5. The monitoring well is assumed to be 150 ft deep; costs are based on quotes from recent contracts.
6. The 3 neutron probes are assumed to be installed to a depth of 30 ft.
7. Well sampling will be performed 4 times per year for 3 years.
8. Two dump trucks with a 15-yd^3 capacity are needed.
9. The crew and equipment including the 2 dump trucks are Bechtel Nevada FY 1997 rates.
10. The cycle time for each truck for the local fill is 8 loads per day.

CACTUS SPRING WASTE TRENCHES CADD COST SUMMARIES

ALTERNATIVE 1 NO ACTION

NO COSTS

ALTERNATIVE 2 INSTITUTIONAL CONTROLS

1.0	FENCE AND SIGNS (1,000 LF)		$ 28,152
		CONSTRUCTION	$ 28,152
		CONTINGENCY 25%	$ 7,038
		ENGINEERING & OVERSIGHT 15%	$ 4,223
		TOTAL	**$ 39,413**

ALTERNATIVE 3 COVERING

1.0	COVERING 600 CY OF FILL & TOP SOIL		$ 23,649
2.0	SIGNS ONLY		$ 4,000
3.0	1 150-FOOT MONITORING WELL AND 3 NEUTRON PROBES		$ 28,150
4.0	WELL SAMPLING @ QUARTERLY FOR 3 YEARS		$48,864
		CONSTRUCTION	$ 104,663
		CONTINGENCY 25%	$ 26,166
		ENGINEERING & OVERSIGHT 15%	$ 15,700
		TOTAL	**$ 146,529**

ALTERNATIVE 4 COVERING AND RIP RAP PROTECTION

1.0	COVERING 600 CY OF FILL & TOP SOIL		$ 23,649
2.0	SIGNS ONLY		$ 4,000
3.0	RIP RAP (80 LF)		$ 5,354
4.0	1 150-FOOT MONITORING WELL AND 3 NEUTRON PROBES		$ 28,150
5.0	WELL SAMPLING @ QUARTERLY FOR 3 YEARS		$ 48,864
		CONSTRUCTION	$ 110,018
		CONTINGENCY 25%	$ 27,504
		ENGINEERING & OVERSIGHT 15%	$ 16,503
		TOTAL	**$ 154,025**

IT CORPORATION
ESTIMATE SHEET

PROJECT: CACTUS SPRING WASTE TRENCHES **DATE 12/18/96**
LOCATION: TTR **REV A**

ITEM	DESCRIPTION	QUAN	UNIT	MATL	LABOR	SUBCONT	TOTAL	ADJUST
1.0	**FENCING & SIGNS**							
1.1	6-foot industrial chain-link fencing with barbed wire	1,000	L.F.			$ 22.50	$ 22,500	
	Aluminized corner posts	4	EA			$ 128	$ 512	
	20-foot swing gate	1	EA			$ 1,140	$ 1,140	
1.2	Signs	8	EA			$ 500	$ 4,000	
	FENCING & SIGNS SUBTOTAL						**$ 28,152**	
2.0	**MONITORING WELLS**							
2.1	MOBILIZATION	2	DAY			$ 1,600	$ 3,200	
2.2	DRILLING 4" DIA. MONITORING WELL 150 FEET							
	Drilling	150	L.F.			$ 60	$ 9,000	$ 1,170
	Well construction	150	L.F.			$ 15	$ 2,250	$ 293
	Well materials	150	L.F.			$ 30	$ 4,500	$ 585
	Install 3 neutron probe tubes 30 feet deep	90	L.F.			$ 20	$ 1,800	$ 234
	Decontamination	8	HR			$ 150	$ 1,200	$ 156
	55 gallon drum	5	EA	$ 50			$ 250	$ 33
	40 mil plastic liner	4	EA	$ 100			$ 400	$ 52
	Well monument	1	EA	$ 400			$ 400	$ 52
	TTR per diem @ 4 men	6	DAY	$ 144			$ 864	$ 112
	SUBTOTAL						$ 20,664	
2.3	DEMOBILIZATION	1	DAY			$ 1,600	$ 1,600	
2.4	Subcontract G&A						$ 2,686	
	MONITORING WELLS SUBTOTAL						**$ 28,150**	
3.0	**WELL SAMPLING (performed quarterly)**							
	2 technicians @ 2 days	64	HR		$ 40		$ 2,560	
	TTR per diem @ 2 men	4	DAY			$ 72	$ 288	
	Analytical volatiles/semivolatiles/metals	4	EA			$ 700	$ 2,800	
	Report	8	hr		$ 70		$ 560	
	SAMPLING SUBTOTAL						**$ 6,208**	
4.0	**COVERING 600 CY FILL & TOP SOIL**							
4.1	MOBILIZATION							
	Dump trucks @ 2	1	DAY			$ 144	$ 144	
	Water truck @ 1	1	DAY			$ 133	$ 133	
	Compactor @ 1	1	DAY			$ 136	$ 136	
	Front-end loader @ 1	1	DAY			$ 136	$ 136	
	SUBTOTAL					$ 549	$ 549	
4.2	EXCAVATION/LOAD/TRANSPORT							
	Dump trucks @ 2	3	DAY			$ 144	$ 432	
	Water truck @ 1	5	DAY			$ 133	$ 665	
	Front-end loader @ 1	5	DAY			$ 136	$ 680	
	Compactor @ 1	3	DAY			$ 136	$ 408	
	Seed	2,200	SY	$ 0.30			$ 660	
	Superintendent @ 1	5	DAY		$ 990		$ 4,950	
	Equipment operator @ 1	5	DAY		$ 720		$ 3,598	
	Teamster @ 2	3	DAY		$ 1,440		$ 4,320	
	Equipment operator @ 1	3	DAY		$ 720		$ 2,159	
	Driver @ 1 for water truck	5	DAY		$ 720		$ 3,600	
	TTR per diem @ 6 x $36/day	5	DAY	$ 216			$ 1,080	
	SUBTOTAL						$ 22,551	
4.3	DEMOBILIZATION							
	Dump trucks @ 2	1	DAY			$ 144	$ 144	
	Water truck @ 1	1	DAY			$ 133	$ 133	
	Compactor @ 1	1	DAY			$ 136	$ 136	
	Front-end loader @ 1	1	DAY			$ 136	$ 136	
	SUBTOTAL					$ 549	$ 549	
	COVERING & FILL SUBTOTAL						**$ 23,649**	

IT CORPORATION
ESTIMATE SHEET

PROJECT: CACTUS SPRING WASTE TRENCHES **DATE 12/18/96**
LOCATION: TTR **REV A**

ITEM	DESCRIPTION	QUAN	UNIT	MATL	LABOR	SUBCONT	TOTAL	ADJUST
5.0	**RIP RAP PROTECTION 80 feet**							
	Assume same equipment as covering & fill; add 1 day							
	Dump trucks @ 2	1	DAY			$ 144	$ 144	
	Water truck @ 1	1	DAY			$ 133	$ 133	
	Front-end loader @ 1	1	DAY			$ 136	$ 136	
	Compactor @ 1	1	DAY			$ 136	$ 136	
	Superintendent @ 1	1	DAY		$ 990		$ 990	
	Equipment operator @ 1	1	DAY		$ 720		$ 720	
	Teamster @ 2	1	DAY		$ 1,440		$ 1,440	
	Equipment operator @ 1	1	DAY		$ 720		$ 720	
	Driver @ 1 for water truck	1	DAY		$ 720		$ 720	
	TTR per diem @ 6 x $36/day	1	DAY	$ 216			$ 216	
	RIP RAP SUBTOTAL						**$ 5,354**	

Appendix C
Comment/Response Form

NEVADA ENVIRONMENTAL RESTORATION PROJECT
DOCUMENT REVIEW SHEET

1. Document Title/Number Corrective Action Decision Document for Cactus Spring Waste Trenches (Corrective Action Unit No. 426)
2. Document Date January 1997
3. Revision Number Draft
4. Originator/Organization Searls/IT Corporation
5. Responsible DOE/NV ERP Subproject Mgr. Cabble/Appenzeller-Wing
6. Date Comments Due March 3, 1997
7. Review Criteria Technical Review
8. Reviewer/Organization/Phone No. Karen Beckley, NDEP
9. Reviewer's Signature

10. Comment Number/ Location	11. Type[a]	12. Comment	13. Comment Response	14. Accept
1. p. 2-3	M	NDEP has requested a copy of the Offsite Radiation Exposure Review Project (ORERP), Phase II Soils Program report as referenced in the CADD..	The report has been provided to NDEP.	
2. p. 2-4	M	"It is on property controlled by the DOE". The Air Force is the entity that has withdrawn the land and therefore, must acknowledge covenants placed on this site. Final closure of this site will not be considered without this action.	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.	
3. p. 3-2, section 3.1.1	M	"therefore no COCs were identified." Analytical results for radiological constituents should also be evaluated based on the Performance Objective for Certification of Nonradioactive Hazardous Waste (POC) to demonstrate that these levels were not exceeded.	Analytical results for radiological constituents were not evaluated based on the Performance Objective for Certification of Nonradioactive Hazardous Waste (POC) because the data indicated non-detects for Pu and background for U-234. The gross alpha/beta analyses were comparable to the background levels.	

10. Comment Number/ Location	11. Type[a]	12. Comment	13. Comment Response	14. Accept
4. p. 3-5, section 3..2.4.4	M	"the waste managed as radioactive..." NDEP is requesting clarification as to how DOE will manage radioactive waste at this site, should it be discovered.	Based on the characterization results, radiological contamination is not anticipated. The section you reference in your comment is required per the FFACO. The preferred alternative is capping; therefore, there should not be any waste generated at this site. Further specifics for management of waste will be in the CAP.	

[a]Comment Types: M = Mandatory,, S = Suggested.

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