RECORD OF TECHNICAL CHANGE

Technical Change No. 1 Page 1 of 3

Project/Job No. IS04 - 270 Date 3/10/04

Project/Job Name Corrective Action Investigation Plan for CAU 529: Area 25 Contaminated Materials.

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

Al Wickline (Name) Task Manager (Title)

Description of Change

1. **Section 3.3 Preliminary Action Levels**. Change the 4th bullet in the section to the following:

   - "The PALs for radiological contaminants are based on the National Council on Radiation Protection and Measurement (NCRP) Report No. 129 recommended screening limits for construction, commercial, industrial land use scenario (NCRP 1999) scaled from 25 to 15 millirem (mrem) per year dose and the generic guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993). The PALs for the CAU 529 Corrective Action Investigation (CAI) are listed in Table 3-5."

   - Replace Table 3-5 with the new Table 3-5 attached.

2. **Section 3.4 DQO Process Discussion**: Change the last two sentences in the section to the following:

   - "The Minimum Detectable Concentrations (MDCs) for radiological analytes have been developed considering the PALs. The MDC for each radiological analytes is less than or equal to the corresponding PAL."

3. **Section A.1.3.2 Determine the Basis for the Preliminary Action Levels**. Change the 4th bullet to the following:

   - "The PALs for radiological contaminants are based on the National Council on Radiation Protection and Measurement (NCRP) Report No. 129 recommended screening limits for construction, commercial, industrial land use scenario (NCRP 1999) scaled from 25 to 15 millirem (mrem) per year dose and the generic guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993). The PALs for the CAU 529 Corrective Action Investigation (CAI) are listed in Table 3-5."

Eliminate Potassium-40 as a radionuclide COPC within the Gamma Spectrometry analysis.

3. **Sections 8.0 and A.1.9 References**. Add the following references:

   - National Council on Radiation Protection and Measurements. 1999. *Recommended Screening Limits for Contaminated Surface Soil and Review of Factors Relevant to Site-Specific Studies*. NCRP Report No. 129. National Council on Radiation Protection and Measurements, Bethesda, MD.

   - US Department of Energy (DOE). 1993. "Radiation Protection of the Public and the Environment". DOE Order 5400.5 Change 2. January 7, 1993.

Justification for change

Through ongoing discussions between DOE and NDEP it was determined that the PALs currently being used for the site investigations are not practical and should be replaced with dose-based action levels. In an agreement between NDEP and DOE (approved March 9, 2004) the PALs to be used for evaluating the potential radioactive contamination in soils will be based on an acceptable dose as specified by the NCRP Report No. 129 and DOE 5400.5 guidance rather than a comparison to background values. The use of the new radiological PALs has been accepted and approved for use in the planning and evaluation phase of the site investigations.

Potassium-40 (K-40) is a naturally occurring unstable isotope of potassium with a half-life of 1.3 x 10E+09 years. The abundance of K-40 is approximately 0.0118% of natural potassium. Because of the high abundance of potassium in the environment, K-40 is the predominant radionuclide in soil, foods, and human tissues. The average human male contains approximately 100,000 pCi of K-40. The human body strictly regulates the potassium content within the body and is not influenced by variations in environmental levels. Therefore, the internal dose from K-40 remains constant.

Potassium-40 is not considered to be a contaminant of potential concern due to its predominance in the environment. In addition, the only mechanism for K-40 to be a contaminant is through concentration.

There are no reported activities at the NTS that would have concentrated K-40 or released it as a contaminant.

The CAI will not be expanded to delineate the extent of K-40, nor will K-40 be evaluated in the Corrective Action Decision Document.

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

Applicable Project-Specific Document(s): **Corrective Action Investigation Plan for Corrective Action Unit 529: Area 25 Contaminated Materials Nevada Test Site, Nevada, Revision 0, February 2003.**

CC:

Approved By: Kevin Cabble Date 3-15-04
Kevin Cabble, Acting Project Manager
Industrial Sites Project

Date 3/15/04
Janet Appenzeller-Wing, Acting Division Director
Environmental Restoration Division

NDEP Concurrence Yes___ No___ Date _____

NDEP Signature _____

Contract Change Order Required Yes___ No ____

Contract Change Order No. _____

There are no reported activities at the NTS that would have concentrated K-40 or released it as a contaminant.

The CAI will not be expanded to delineate the extent of K-40, nor will K-40 be evaluated in the Corrective Action Decision Document.

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

Applicable Project-Specific Document(s): Corrective Action Investigation Plan for Corrective Action Unit 529: Area 25 Contaminated Materials Nevada Test Site, Nevada, Revision 0, February 2003.

CC:

Approved By: Kevin Cabble Date 3-15-04
Kevin Cable, Acting Project Manager
Industrial Sites Project

Date 3/15/04
John Appenzeller, Acting Division Director
Environmental Restoration Division

NDEP Concurrence: Yes X No __ Date 3/19/04
NDEP Signature: Don Cole

Contract Change Order Required Yes__ No__

Contract Change Order No. _____

Table 3-5
Preliminary Action Levels for Radionuclides in Samples Collected at CAU 529

Radionuclide	PAL (pCi/g)[a]	Radionuclide	PAL (pCi/g)
Cobalt-60	1.61E+00	Strontium-90	5.03E+02
Nobium-94	2.43E+00	Cesium-137	7.30E+00
Europium-152	3.40E+00	Europium-154	3.24E+00
Europium-155	8.11E+01	Thorium-230[b]	5/15[c]
Throium-232[d]	5/15[c]	Uranium-234	8.59E+01
Uranium-235	1.05E+01	Uranium-238	6.32E+01
Plutonium-238	7.78E+00	Plutonium-239	7.62E+00
Plutonium-240	7.62E+00	Americium-241	7.62E+00

[a] pCi/g is Picocuries per gram

[b] Thorium-230 and it's daughters Radium-226, Radon-222, Polonium-218, Lead-214, Bismuth-214, Polonium-214, Lead-210, Bismuth-210, Polonium -210 are considered to be in equilibrium and will use the DOE 5400.5 general guidance of 5 and 15 pCi/g for the PALs.

[c] The 5/15 pCi/g concentrations represent the PALs for these radionuclides in the surface soil (0-0.5 ft) and the subsurface soil (> 0.5 ft), respectively.

[d] [c] Thorium-232 and it's daughters Radium-228, Actinium-228, Thorium-228, Radium-224, Radon-220, Polonium-216, Polonium-212, Lead-212, Bismuth-212, and Thallium-208 are considered to be in equilibrium and will use the DOE 5400.5 general guidance of 5 and 15 pCi/g for the PALs.

Nevada
Environmental
Restoration
Project

DOE/NV--870

Corrective Action Investigation Plan for Corrective Action Unit 529: Area 25 Contaminated Materials Nevada Test Site, Nevada

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CORRECTIVE ACTION INVESTIGATION PLAN FOR CORRECTIVE ACTION UNIT 529: AREA 25 CONTAMINATED MATERIALS NEVADA TEST SITE, NEVADA

U.S. Department of Energy
National Nuclear Security Administration
Nevada Site Office
Las Vegas, Nevada

Controlled Copy No.: ___

Revision No.: 0

February 2003

Approved for public release; further dissemination unlimited.

CORRECTIVE ACTION INVESTIGATION PLAN
FOR CORRECTIVE ACTION UNIT 529:
AREA 25 CONTAMINATED MATERIALS
NEVADA TEST SITE, NEVADA

Approved by: Signature Approved Date: 2/21/03

Janet Appenzeller-Wing, Project Manager
Industrial Sites Project

Approved by: Signature Approved Date: 2/21/03

Runore C. Wycoff, Division Director
Environmental Restoration Division

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List of Acronyms and Abbreviations

AEC	U.S. Atomic Energy Commission
BCSA	Buried Contaminated Soil Area
bgs	Below ground surface
BN	Bechtel Nevada
BPBS	Borrow Pit Burial Site
CADD	Corrective Action Decision Document
CAIP	Corrective Action Investigation Plan
CAS	Corrective Action Site
CAU	Corrective Action Unit
CFR	*Code of Federal Regulations*
CLP	Contract Laboratory Program
COC	Contaminant of concern
COPC	Contaminant of potential concern
CSM	Conceptual site model
CSSA	Contaminated Soil Storage Area
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
dpm/100cm^2	Disintegrations per minute per 100 square centimeters
DQI	Data quality indicator
DQO	Data quality objective
DRO	Diesel-range organics
EPA	U.S. Environmental Protection Agency
FADL	Field activity daily log

Acronyms and Abbreviations *(Continued)*

FFACO	*Federal Facility Agreement and Consent Order*
FSL	Field-screening level
FSR	Field-screening results
ft	Foot (feet)
GPS	Global positioning system
HASP	Health and Safety Plan
HWAA	Hazardous Waste Accumulation Area
IDW	Investigation-derived waste
in.	Inch(es)
ISMS	Integrated Safety Management System
ITLV	IT Corporation, Las Vegas Office
LCS	Laboratory control sample
LCSD	Laboratory control sample duplicate
MDC	Minimum detectable concentration
mg/kg	Milligrams per kilogram
mrem/yr	Millirem per year
MRL	Minimum reporting limit
MS	Matrix spike
MSD	Matrix spike duplicate
M&O	Management and Operating
NAC	*Nevada Administrative Code*
NASA	National Aeronautics and Space Administration
ND	Normalized difference
NDEP	Nevada Division of Environmental Protection

Acronyms and Abbreviations *(Continued)*

NEPA	*National Environmental Policy Act*
NNSA/NSO	U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office
NRDS	Nuclear Rocket Development Station
NTS	Nevada Test Site
NTSWAC	*Nevada Test Site Waste Acceptance Criteria*
PAL	Preliminary action level
PCB	Polychlorinated biphenyls
pCig	Picocuries per gram
PPE	Personal protective equipment
ppm	Parts per million
PRG	Preliminary remediation goal
QA	Quality assurance
QAPP	Quality Assurance Project Plan
QC	Quality control
RCA	Radiologically controlled area
RCRA	*Resource Conservation and Recovery Act*
RESRAD	Residual Radiation
RMA	Radioactive materials area
ROTC	Record of technical change
RPD	Relative percent difference
RWMS	Radioactive Waste Management Site
SDWS	*Safe Drinking Water Standards*
SNPO	Space Nuclear Propulsion Office

Acronyms and Abbreviations *(Continued)*

SVOC	Semivolatile organic compounds
TCC	Test Cell C
TNT	Transient Nuclear Test
TPH	Total petroleum hydrocarbon
TSCA	*Toxic Substance Control Act*
VOC	Volatile organic compounds
%R	Percent recovery
µCi/g	Microcuries per gram

Executive Summary

This Corrective Action Investigation Plan contains information for conducting site investigation activities at Corrective Action Unit 529, Area 25 Contaminated Materials. This information includes facility descriptions and environmental sample collection objectives and criteria. The results of the field investigation will support a defensible evaluation of corrective action alternatives that will be presented in the Corrective Action Decision Document.

Corrective Action Unit 529 is comprised of a single Corrective Action Site (CAS) 25-23-17, Contaminated Wash. The CAS is located in Area 25 of the Nevada Test Site, which is approximately 65 miles northwest of Las Vegas.

The CAS was divided into parcels based on the separate and distinct releases associated with this CAS as shown in Table ES.1-1.

Table ES.1-1
Parcels and Associated Releases and Conceptual Site Models

Parcels	Releases Associated with Parcel	Conceptual Site Model(s)
Kiwi Transient Nuclear Test (TNT) 16,000-foot Arc Area	Aerial dispersion of contaminants associated with the Kiwi TNT excursion and the coolant failing during the Phoebus 1A Test	Aerial Dispersion and Sedimentation
Phoebus 1A Test 8,000-foot Arc Area		
Topopah Wash at Test Cell C (TCC)		
Buried Contaminated Soil Area (BCSA) 1	Buried contaminated materials associated with the BCSA 1 and 2, and Borrow Pit Burial Site (BPBS)	Buried Material and Sedimentation
Buried Contaminated Soil Area (BCSA) 2		
Borrow Pit Burial Site (BPBS)		
Drain/Outfall Discharges	Drain and outfall discharges associated with the various drains into Topopah Wash from TCC operations	Drain/Outfall Discharges and Sedimentation
Contaminated Soil Storage Area (CSSA)	Residual surface contamination associated with the CSSA where a contaminated soil pile was stored and subsequently removed	Residual Surface Contamination and Sedimentation
Main Stream/Drainage Channels	Migration of surface contamination from other parcels due to ephemeral flooding	Sedimentation

A Conceptual Site Model was developed for each of the parcels to address all suspected releases associated with the CAS. A conceptual site model was also developed to address translocation of contaminants from each of the releases due to erosion and sedimentation within the Topopah Wash.

The data quality objective (DQO) process was used to identify and define the type, quantity, and quality of data needed to complete the investigation phase of the corrective action process. The DQOs address the primary problem that sufficient information was not available to determine the appropriate corrective action for the site. To be able to determine the corrective action alternative, two critical decisions were defined:

1. Does contamination from any of the releases exceed preliminary action levels?

2. Is the extent of contamination above action levels sufficiently delineated to determine potential waste volumes and evaluating potential corrective actions?

For the purpose of determining distinct data needs, resolution of the first decision is addressed as Phase I and resolution of the second decision is addressed as Phase II. Phase I data will be generated and evaluated at each parcel. Phase II data will be generated and evaluated for each parcel with at least one contaminant concentration exceeding preliminary action levels. Corrective action closure alternatives (i.e., no further action, closure in place, or clean closure) will be recommended for each parcel based on an evaluation of all the DQO-required data.

Based on existing data and process knowledge, the contaminants of potential concern for Corrective Action Unit 529 include semivolatile organics, volatile organics, petroleum hydrocarbons, polychlorinated biphenyls, metals, and radionuclide analyses.

The general technical approach for investigation of Corrective Action Unit 529 will consist of the following activities:

- Perform radiological surveys.

- Collect environmental soil samples and submit for laboratory analysis to determine if contaminants of concern are present or migrating. In general, field activities will consist of collecting soil samples at biased locations according to approved procedures.

- Collect required quality control samples.
- Collect additional environmental soil samples to define the lateral and vertical extent of contaminants of concern and associated concentrations, as needed to evaluate the corrective action alternatives.

This Corrective Action Investigation Plan has been developed in accordance with the *Federal Facility Agreement and Consent Order* that was agreed to by the State of Nevada, the U.S. Department of Energy, and the U.S. Department of Defense. Under the *Federal Facility Agreement and Consent Order*, this CAIP will be submitted to the Nevada Division of Environmental Protection for approval. Fieldwork will be conducted following approval of this plan.

1.0 Introduction

This Corrective Action Investigation Plan (CAIP) contains information for conducting site investigation activities at Corrective Action Unit (CAU) 529: Area 25 Contaminated Materials, Nevada Test Site (NTS), Nevada. This information includes facility descriptions and environmental sample collection objectives and criteria.

This CAIP has been developed in accordance with the *Federal Facility Agreement and Consent Order* (FFACO) (1996) that was agreed to by the U.S. Department of Energy (DOE), the State of Nevada, and the U.S Department of Defense (DoD).

Corrective Action Unit 529 is comprised of corrective action site (CAS) 25-23-17, Contaminated Wash, which is located in Area 25 of the NTS. The NTS is approximately 65 miles northwest of Las Vegas, Nevada (Figure 1-1).

1.1 Purpose

Corrective Action Unit 529 is being investigated because disposed waste may be present without appropriate controls (i.e., use restrictions, adequate cover) and hazardous and/or radioactive constituents may be present or migrating at concentrations and locations that could potentially pose a threat to human health and the environment. Existing information and process knowledge on the expected nature and extent of contamination are insufficient to select preferred corrective actions (i.e., no further action, closure in place, or clean closure). Therefore, additional information will be obtained by conducting a corrective action investigation at CAU 529, CAS 25-23-17.

1.1.1 Background

The NTS has been used for various research and development projects including nuclear weapons testing. The CAS in CAU 529 was part of the Nuclear Rocket Development Station (NRDS) facilities and used for testing, material storage, waste storage, and waste disposal. The CAS was divided into parcels based on releases that are associated with the CAS (Table 1-1). Descriptions of

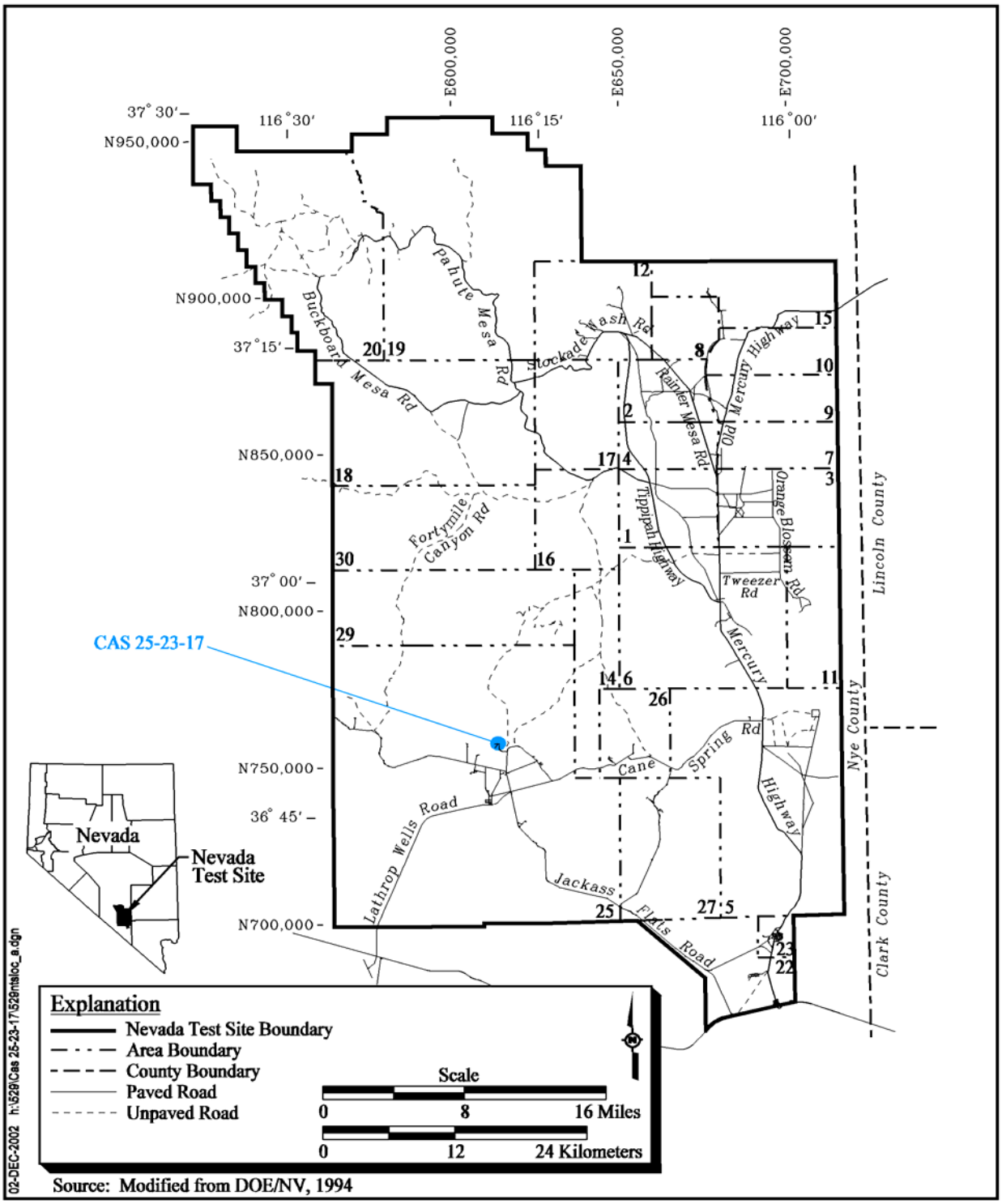

Figure 1-1
Nevada Test Site and CAU 529 Site Map

Table 1-1
Parcels and Associated Releases and Conceptual Site Models

Parcels	Releases Associated with Parcel	Conceptual Site Model(s)
Kiwi Transient Nuclear Test (TNT) 16,000-foot Arc Area	Aerial dispersion of contaminants associated with the Kiwi TNT excursion and the coolant failing during the Phoebus 1A Test	Aerial Dispersion and Sedimentation
Phoebus 1A Test 8,000-foot Arc Area		
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Drain/Outfall Discharges	Drain and outfall discharges associated with the various drains into Topopah Wash from TCC operations	Drain/Outfall Discharges and Sedimentation
Contaminated Soil Storage Area (CSSA)	Residual surface contamination associated with the CSSA where a contaminated soil pile was stored and subsequently removed	Residual Surface Contamination and Sedimentation
Main Stream/Drainage Channels	Migration of surface contamination from other parcels due to ephemeral flooding	Sedimentation

the CAS 25-23-17 releases and impacted areas are presented in greater detail in Section 2.0 of the CAIP. The following is a brief description of each parcel under CAS 25-23-17:

- Kiwi Transient Nuclear Test (TNT) 16,000-foot Arc Area - This parcel addresses contamination associated with the TNT excursion and consists of an estimated 90-acre area located approximately 16,000 feet (ft) southwest of the Kiwi TNT Ground Zero at an angle of 215°. This parcel is one of the areas where the highest recorded aerial deposition of fallout from the Kiwi TNT occurred. (AEC, 1968)

- Phoebus 1A Test 8,000-ft Arc Area - This parcel addresses contamination associated with the Phoebus 1A Test and consists of an estimated 51-acre area located approximately 8,000 ft northwest of the Phoebus 1A Test Ground Zero at an angle of 315°. This parcel is the area of highest recorded aerial deposition of fallout from the Phoebus 1A Test. (Lee, 1965)

- Topopah Wash at Test Cell C (TCC) - This parcel consists of the area within the Topopah Wash 500 ft north and 2,500 ft south of the railroad tracks test pad (i.e., Kiwi TNT Ground Zero) that was affected by the Kiwi TNT exhaust plume and reactor explosion. (AEC, 1968)

- Buried Contaminated Soil Area (BCSA) 1 - This parcel consists of the area west of TCC and adjacent to the east bank of the wash where contaminated soil associated with the Phoebus 1A Test was buried.

- Buried Contaminated Soil Area 2 - This parcel is located northwest of TCC and is suspected to be another burial site for contaminated surface soil associated with the Phoebus 1A test.

- Borrow Pit Burial Site (BPBS) - This parcel consists of the area at the borrow pit near TCC that may have been used as a burial site for contaminated soil and debris associated with Kiwi TNT cleanup operations.

- Drain/Outfall Discharges - This parcel consists of the area affected by the five drains and one outfall at TCC that were used to discharge surface water runoff, wash-down water, and process water (e.g., the 211,000-gallon release of borated water from a storage tank).

- Contaminated Soil Storage Area - This parcel consists of the area west of TCC and south of the berm within the wash where a pile of contaminated soil associated with the Phoebus 1A Test was stored. Although oil was sprayed on the soil to prevent wind erosion, no soil stains were observed at the location.

- Main Stream/Drainage Channels - This parcel consists of the active stream channel(s) within Topopah Wash including the channel bottom and sediment bars within the defined banks of the active channel and immediately adjacent portions of the Topopah Wash floodplain affected during high flow events. These features represent the areas most likely to have been subject to erosion and deposition during the runoff events in Topopah Wash.

1.1.2 DQO Summary

The CAS will be investigated based on data quality objectives (DQOs) developed by representatives of Nevada Division of Environmental Protection (NDEP) and the DOE National Nuclear Security Administration Nevada Site Office (NNSA/NSO). The DQOs were used to identify and define the type, quantity, and quality of information needed to identify, evaluate, and recommend potentially viable corrective actions. A phased approach has been selected to generate the data needed to satisfy the DQOs. Phase I data will be generated and evaluated at each parcel to determine the presence of contaminants of concern (COCs). Contaminants of concern are defined as contaminants of potential concern (COPCs) that are present in samples at concentrations above preliminary action levels (PALs) defined in Section 3.3. Phase II data will be generated and evaluated for each parcel with at least one contaminant concentration exceeding PALs to determine the extent of COCs. Corrective action closure alternatives (i.e., no further action, closure in place, or clean closure) will be recommended for each parcel based on an evaluation of the DQO-required data.

1.2 Scope

The scope of the CAU 529 investigation is to generate the information needed to resolve the decision statements identified in the DQO process and includes the following activities to address the criteria for each decision statement:

- Conduct land radiological surveys over the areas of highest aerial deposition from the activities associated with Kiwi TNT and the Phoebus 1A Test (AEC, 1968; Lee 1965).
- Conduct field-screening activities to determine sample locations and intervals.
- Collect environmental samples for laboratory analyses to determine if COCs exceeding PALs are present.
- Collect additional environmental samples and submit for laboratory analyses to define the vertical and lateral extent of migration where a COC has been identified.
- Collect quality control (QC) samples for laboratory analyses to evaluate the performance of measurement systems and controls based on the requirements of the data quality indicators (DQIs).
- Comply with regulatory requirements for waste disposal through the collection and analysis of investigation-derived waste (IDW) samples, as needed.

1.3 CAIP Contents

Section 1.0 presents the purpose and scope of this CAIP and Section 2.0 provides the background information for the CAU. The objectives, including the conceptual site models (CSMs), are presented in Section 3.0. Field sampling activities and CAS diagrams are discussed in Section 4.0, and waste management issues are discussed in Section 5.0. General field and laboratory quality assurance (QA) and QC issues (including collection of QC samples) are presented in Section 6.0 of this CAIP and also in the *Industrial Sites Quality Assurance Project Plan* (QAPP) (NNSA/NV, 2002a). The project schedule and records-availability information for this document are discussed in Section 7.0. Section 8.0 provides a list of references. Appendix A provides the DQO summary and Appendix B contains information on the project organization. Public involvement activities are documented in the "Public Involvement Plan," Appendix V, of the FFACO (1996). The managerial aspects of this project are discussed in the *Project Management Plan* (DOE/NV, 1994) and the site-specific field management plan that will be developed prior to field activities. The health

and safety aspects of this project are documented in the IT Corporation, Las Vegas Office (ITLV) *Health and Safety Plan* (HASP) (IT, 2001), and will be supplemented with a site-specific health and safety plan (SSHASP) written prior to the start of field work.

2.0 Facility Description

Corrective Action Site 25-23-17, Contaminated Wash, was designated the sole site under CAU 529 based on its size and complexity. The following sections provide an overview and background information regarding the physical setting, operational history, waste inventory, release information, and investigative background of the site.

2.1 Physical Setting

The CAS is located in Area 25, which is in the southwestern portion of the NTS, and consists of portions of the Topopah Wash and the surrounding area impacted by select TCC operational releases (Figure 1-1). The Topopah Wash is a small desert drainage that originates in the Calico Hills and bisects the Jackass Flats alluvial valley, north to south (Drollinger et al., 2000). The ephemeral stream drains south to Jackass Flats, then southwest by south through the middle of the flats, and then parallel to Forty Mile Wash to the confluence with the Amargosa River (USGS and DOE, 1980). The CAS extends out to approximately 8,000 ft north and approximately 16,000 ft south of Kiwi TNT ground zero as shown in Figure 2-1. The average annual precipitation on the valleys of the NTS ranges from 3 to 6 inches (in.) while precipitation on the ridges and mesas of the NTS averages less than 10 in. per year. The following section provides a general overview of the topography, geology, and hydrogeology pertaining to Area 25.

2.1.1 Area 25

The CAS is located in Area 25 within Jackass Flats. Jackass Flats is an intermontane basin, typical of the Basin and Range Physiographic Province. The basin is surrounded on the southwest by a low-lying drainage divide, on the northwest by the southeastern slopes of Lookout Peak, on the north and northeast by small rugged hills, and on the south by the northern slopes of Skull Mountain. (DRI, 1988) The erosion of the surrounding Tertiary and Paleozoic uplands fills the basin and has created a layer of alluvium and colluvium with a depth up to 1,025 ft (DOE, 1988; USGS, 1964). The alluvium is underlain by welded and semi-welded ash-flow and ash-fall tuffs of Tertiary age. Beneath the tuff layers lie the Paleozoic carbonate and clastic sediments with a depth of 22,000 ft in some areas. The Paleozoic rocks are made up of shales, quartzites, and carbonates of lower- to

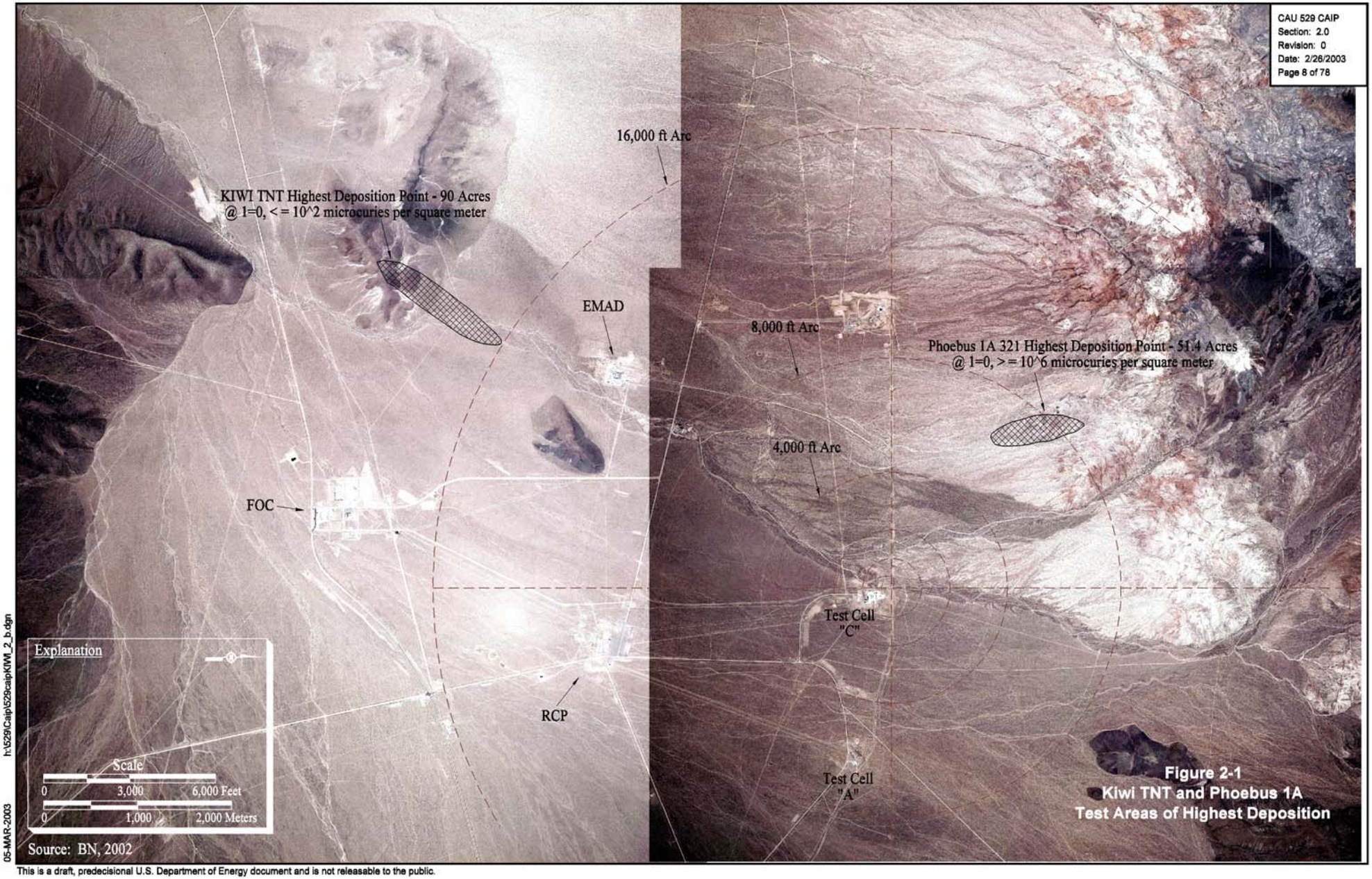

Figure 2-1
Kiwi TNT and Phoebus 1A
Test Areas of Highest Deposition

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This is a draft, predecisional U.S. Department of Energy document and is not releasable to the public.

middle-Cambrian age; carbonate and thin shale layers of middle Cambrian to Devonian age; and argillites, cherty limestones, and conglomerates of Devonian to Permian age. (SNPO, 1970)

Jackass Flats lies within the Alkali Flat-Furnace Creek Ranch subbasin. Groundwater levels range from 709 to 1,185 ft below surface (USGS, 2002). The groundwater contained within the limestone and dolomite units are at a depth too great to be an economic source of water; however, the welded-tuff aquifer (the Topopah Spring member of the Paintbrush tuff) is a water-producing aquifer with transmissivities ranging from 68,000 to 488,000 gallons per day per cubic ft (DRI, 1988). The movement of the groundwater within Jackass Flats is southwest, and ultimately discharges into areas within the Amargosa River Valley (DRI, 1988; DOE, 1988).

The nearest natural-water source to TCC is Topopah Springs about 8 miles north at the head of Topopah Wash. However, several NTS wells supplied water for the facilities when the NRDS was in operation. The first of these, J-11 (located approximately 15,000 ft south of TCC) and J-12 (approximately 40,000 ft southwest of TCC) were drilled in 1957. The third one, J-13 (located approximately 33,000 ft south of the CAS site marker at TCC), was drilled in 1962 when the casing failed on the first well. The wells served two interconnected water delivery systems, one for the northern area of the NRDS and the other for the southern (Drollinger et al., 2000). Average depth to water in these wells between 1990 and 2002 were measured as follows: J-11 approximately 1,040 ft below ground surface (bgs); J-12 approximately 740 ft bgs; and J-13 approximately 928 ft bgs (USGS, 2002).

2.2 Operational History

The U.S. Atomic Energy Commission (AEC) participated jointly with the National Aeronautics and Space Administration (NASA) in the development of nuclear rocket engines from 1959 to 1973. The Space and Nuclear Propulsion Office (SNPO) was formed as a result of the interagency agreement to establish and manage a test area known as the NRDS. The NRDS, located in Area 25, was used from the 1960s until 1973 to conduct full-scale testing of reactors, engines, and rocket stages to evaluate the feasibility of developing nuclear reactors for the U.S. space program (DOE/NV, 2000a). Test Cell C was one of several installations within Area 25 built to support NRDS activities and was used to conduct ground tests and static firings of nuclear engine reactors. These activities released contaminants to the environment. The most notable test releases at TCC occurred as the result of the

intentional excursion of the Kiwi TNT reactor that occurred on January 12, 1965, and the accidental coolant failure of the Phoebus 1A reactor that occurred on June 18, 1965.

2.3 Waste Inventory

Available documentation, interviews with former site employees, process knowledge, and general historical NTS practices were used to identify wastes that may be present. These sources did not indicate that the CAS addressed by this CAIP was, or was not, used to dispose of material considered to be hazardous waste as defined by current standards. There is sufficient process knowledge to indicate that radiological COPCs were released and chemical COPCs may have been released to the environment. Available information was evaluated during the DQO process, and a list of potential contaminants was developed and is provided in Section 3.2.

No disposal records were identified during the preliminary assessment of this CAU; therefore, the specifics of the waste are dependent upon the sources of information previously mentioned. The types of waste suspected to be present in each of the parcels are summarized in the following sections.

2.3.1 Kiwi TNT 16,000-foot Arc Area

This parcel consists of an estimated 90-acre area located approximately 16,000 ft southwest of the Kiwi TNT Ground Zero at an angle of 215° as shown in Figure 2-1. This parcel is one of the areas of highest recorded aerial deposition of fallout (i.e., fission products, core fuel) from the Kiwi TNT (Figure 2-1) (AEC, 1968).

2.3.2 Phoebus 1A Test 8,000-foot Arc Area

This parcel consists of an estimated 51-acre area located approximately 8,000 ft northwest of the Phoebus 1A Test Ground Zero at an angle of 315°. This parcel is the area of highest recorded aerial deposition of fallout (i.e., fission products, core fuel) from the Phoebus 1A Test (Figure 2-1) (Lee, 1965).

2.3.3 Topopah Wash at TCC

This parcel consists of the area within the Topopah Wash 500 ft north and 2,500 ft south of the railroad tracks test pad (i.e., Kiwi TNT Ground Zero) that was affected by the Kiwi TNT exhaust

plume and reactor explosion (Figure 2-2). The northern portion of the parcel within the wash is a Radioactive Materials Area (RMA). Following the test, reactor components and visible fuel fragments were recovered from the impacted area and residual contaminated soil was reportedly disposed of in the borrow pit within the wash near TCC.

2.3.4 Buried Contaminated Soil Area 1

This parcel consists of the area west of TCC and adjacent to the east bank of the wash where contaminated soil associated with the Phoebus 1A Test was buried (Figure 2-2). Visible fuel fragments were recovered shortly after the Phoebus 1A accident. Contaminated soil adjacent to the TCC test pad (i.e., Phoebus 1A Test Ground Zero) was pushed over and deposited along the east bank of the wash and covered with a clean layer of soil.

2.3.5 Buried Contaminated Soil Area 2

This parcel is a former drainage ditch located northwest of TCC and is a suspected burial site for contaminated surface soil associated with the Phoebus 1A test (Figure 2-2). Contaminated soil along the concrete pads at TCC was removed with a front-end loader and pushed into a gully northwest of TCC. Available information did not indicate that the soil was removed at a later date or covered with clean layer of soil; however, it is expected that the area was covered with a clean layer of soil to prevent wind erosion.

2.3.6 Borrow Pit Burial Site

This parcel consists of the area at the borrow pit near TCC that may have been used as a burial site for contaminated soil and contaminated debris associated with Kiwi Transient Nuclear Test (TNT) cleanup operations. Residual contaminated surface soil in the wash north and south of the railroad track test pad (i.e., Kiwi TNT Ground Zero) was bladed into a borrow pit in the Topopah Wash and sprayed with oil to prevent wind erosion (Figure 2-2). Contaminated debris (e.g., wood parts from signs and hopper holders) associated with the Kiwi TNT was also reportedly disposed of in the borrow pit (Sanders, 1965). Although available information did not indicate that the soil was removed at a later date or covered with clean layer of soil, it is expected that the area was covered with a clean layer of soil to prevent wind erosion.

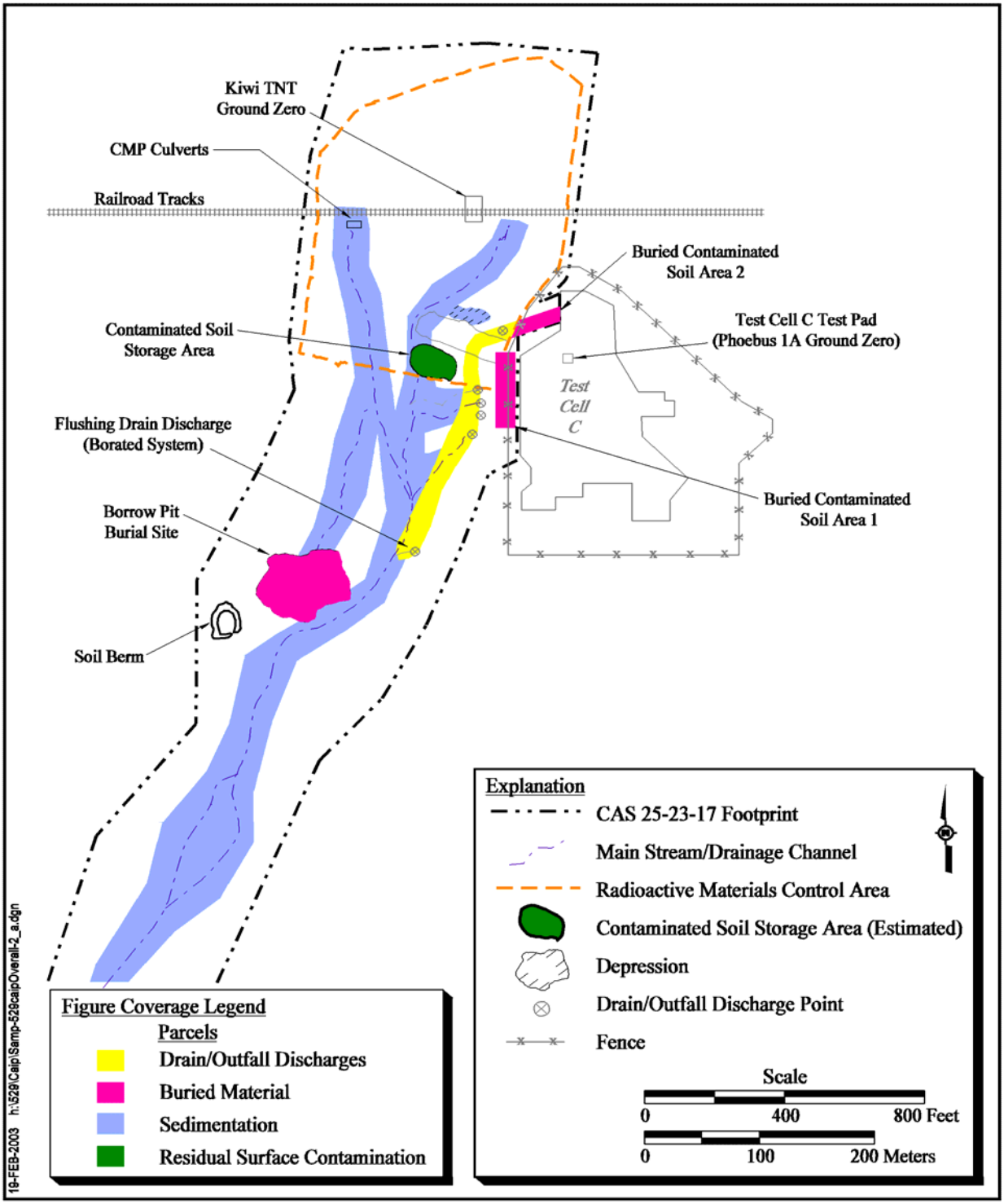

Figure 2-2
CAS 25-23-17 Parcels at Topopah Wash in the Immediate Vicinity of TCC

2.3.7 Drain/Outfall Discharges

This parcel consists of the area affected by the five drains and one outfall at TCC that were used to discharge surface water runoff, wash-down water, and process water (e.g., the 211,000-gallon release of borated water) (Figure 2-2). According to available plans, the drains were associated with various TCC concrete pads (e.g., the dewar pads and the concrete pad extending north of the facility) and the borated water closed-loop system in the case of the flushing drain (REECo, 1984a). During a recent site visit on January 14, 2002, the field team could not locate the Drain Pipe discharge directly north of the TCC concrete outfall. Based on the observations from the site visit and a review of site photographs, it was determined that the drainage system was removed. Therefore, the estimated location of the discharge will be determined in the field and sampled.

With the exception of the borated water release, available documentation did not provide information on the quantities of liquid discharged from the facility during its period of operation. In addition, available documentation did not provide any information on the removal of the drain pipe discharge located directly north of the TCC concrete outfall.

2.3.8 Contaminated Soil Storage Area

This parcel consists of the area west of TCC and south of the berm within the wash. Contaminated soil associated with the Phoebus 1A Test was stored in a pile and sprayed with oil to prevent wind erosion (Figure 2-2). The soil pile was eventually moved and 2,340 cubic yards of contaminated soil was disposed of at the Area 3 Radioactive Waste Management Site (RWMS) (REECo, 1984b).

2.3.9 Main Stream/Drainage Channels

This parcel consists of the active stream channel(s) within Topopah Wash including the channel bottom and sediment bars within the defined banks of the active channel and immediately adjacent portions of the Topopah Wash floodplain. These features represent the areas most likely to have been subject to erosion and deposition during the infrequent runoff events in Topopah Wash. Contaminated soil and radioactive debris may have been transported downstream and deposited at various collection points (i.e., depressions and low energy flow portions of the wash).

2.4 Release Information

Primary sources of potential environmental contaminants released to the Topopah Wash and surrounding area from past TCC operations include:

- Fallout and explosion debris from the Kiwi TNT
- Fallout from Phoebus 1A Test
- Storage/disposal of contaminated soil and debris from the Kiwi TNT and Phoebus 1A Test within and adjacent to the wash
- Oil application over contaminated soil to prevent wind erosion
- Liquid discharges of surface water runoff, wash-down water, and process water (i.e., the release of 2 percent borated water during the Rover reactor tests) via the test cell's drains and outfall

No other releases from adjacent localities are known to have impacted this CAS.

2.4.1 Fallout and Explosion Debris from the Kiwi-Transient Nuclear Test (TNT)

The Kiwi-TNT excursion was conducted on the railroad tracks test pad (i.e., Kiwi TNT ground zero) located approximately 640 ft north of TCC on January 12, 1965 (Tinney, 2001a). The planned excursion produced sufficient energy to damage the reactor and disperse debris (i.e., fission products, core fuel) into the atmosphere. Radioactive debris from the excursion of the Kiwi TNT was carried along the Topopah Wash for several miles. Additionally, the heavier particles contained within the effluent cloud dropped out within a few thousand feet of the test cell. The Topopah wash was directly along the path of the effluent cloud. The effluent cloud (not radioactive debris) was tracked via aircraft to a distance of 250 miles (i.e., as far as the Pacific Ocean) from Test Cell C. The highest recorded deposition of fallout from the Kiwi TNT occurred within two primary areas: within the 4,000-ft arc and over an estimated 90-acre area approximately 16,000 feet to the southwest of Kiwi TNT Ground Zero at an angle of 215° (Figure 2-1). The explosion scattered reactor components and fuel over a 2,000-ft radius of Kiwi TNT Ground Zero; however, the majority of the debris was contained within a 500-ft radius. Impacted media includes surface soil.

2.4.2 Fallout from Phoebus 1A Test

On June 18, 1965, a loss of coolant accident occurred during a high-power test of the Phoebus 1A reactor at the TCC test pad (i.e., Phoebus 1A Ground Zero) which severely damaged the reactor core. Rapid overheating resulted in the ejection of approximately 5 to 8 percent of the core through the nozzle, scattering fuel fragments over the surrounding area. In addition, radioactive debris (i.e., fission products, core fuel) was dispersed into the atmosphere. This material was carried north of the TCC test pad (i.e., Phoebus 1A Ground Zero); however, the highest recorded deposition of fallout occurred over an estimated 51-acre area approximately 8,000 ft northwest (at an angle of 315°) of TCC due to prevailing northwesterly winds (Figure 2-1). Although subsequent reactor tests at TCC (notably Phoebus 1B and Phoebus 2A) released over 200,000 curies of fission product activity through their exhaust plumes, the highest recorded aerial deposition of fallout at the site occurred during the Kiwi TNT and Phoebus 1A Test. Impacted media includes surface soil impacted by fallout.

2.4.3 Storage/Disposal of Contaminated Soil and Debris

Contaminated soil and contaminated debris (e.g., wood parts from signs and hopper holders) associated with Kiwi TNT cleanup operations was reportedly disposed of in the borrow pit within the wash at TCC (Sanders, 1965). In addition, contaminated soil associated with Phoebus 1A cleanup operations was reportedly buried within, and adjacent to, the wash as well as stored in a pile within the wash in the immediate vicinity of TCC. Impacted media includes the disposed contaminated soil and debris, soil adjacent to this contaminated media.

2.4.4 Oil Application Over Contaminated Soil

It was reported that oil was sprayed over the contaminated soil disposed of at the borrow pit within the wash at TCC to control wind erosion. This soil was associated with Kiwi TNT and Phoebus 1A cleanup operations. The contaminated soil and the soil adjacent to it were impacted by the application of oil.

2.4.5 Liquid Discharges

The borated water closed-loop system was used as a neutron absorber to reduce the neutron flux to the reactor-facing surfaces of the TCC during the Project Rover tests. On April 26, 1972, the main borated water storage tank was discovered empty with a resultant loss of 211,000 gallons of 2 percent borated water to the Topopah Wash through the facility flushing drain (Figure 2-2). Water from the borated water system may have contained dissolved elements such as chlorine, sulphur, and lithium. In addition, borated water is corrosive to the metal in the boiler, pipe walls, pumps, privy roof, and fixtures of the closed-loop system; therefore, the borated water may have selectively removed minute quantities of iron, nickel, manganese, carbon, silicon, cobalt-60, europium-152, and europium-154 from the steel components. Additionally, four other drains and one outfall discharge to the wash from TCC, including a stormwater drain, a stormwater outfall, a test pad drain, a process water drain, and a washdown drain (Figure 2-2). Surface water runoff, wash-down water, and process water were discharged to the wash via the TCC drains and outfall and may have released radionuclides and chemical constituents; thereby, impacting soil in the wash.

During a site visit conducted on January 14, 2003, the Drain Pipe discharge immediately north of the concrete outfall at TCC could not be located. Based on review of site photographs and observations made during the recent site visit, it appears that the Drain Pipe discharge has been removed. Details regarding the removal of the drain were not found in available documentation.

2.4.6 Exposure Pathways

Site workers, military personnel, and the public may be exposed to potentially contaminated sediment along Topopah Wash downstream from the site. The exposure pathways may include ingestion, inhalation, external (radiological), or dermal contact (adsorption) of sediment during disturbance of the media. This exposure pathway is unlikely to result in significant public exposure to contaminated sediments from the site based on restricted access to NTS, off-site institutional controls (i.e., zoning restrictions for the 100-year flood plain), the ephemeral nature of the wash, and the diffusion of contaminants during the erosion and deposition process.

2.5 Investigative Background

Multiple radiological surveys and cleanup activities have been conducted at various locations of the wash near TCC from 1965 to 2000. In addition, surface soil samples were collected at TCC in November and December 2002 to support the data collection effort for the CAU 528 preliminary assessment. Notable reports regarding survey and cleanup activities include the *Nevada Test Site Area 25 Radiological Survey and Cleanup Project 1974-1983* (REECo, 1984b) *and the Nevada Test Site Contaminated Land Areas* (DOE/NV, 2000b and c). The first report provides the results from a survey grid surrounding the railroad tracks test pad (i.e., the Kiwi-TNT Ground Zero). Contamination resulted from the deposition of small solid-fuel fragments over the terrain. During the area survey, fuel element fragments were found imbedded at and near the surface of the wash. Two hundred soil profile samples were collected from six, 4-ft deep holes to verify that fuel element debris was restricted to the surface. Soil activity was in the 10^{-4} to 10^{-6} microcuries per gram (µCi/g) range (REECo, 1984b).

Most of the land decontamination involved the removal of small areas of surface soil by hand shovel. Front-end loaders and road graders were used to remove two large piles of fuel element debris. Approximately 2,340 cubic yards of the contaminated soil were disposed of at the Area 3 RWMS. Soil samples and survey results indicated that surface contamination in the area had been removed (REECo, 1984b).

The information provided by the demarcation surveys performed by Bechtel Nevada in the Topopah Wash is limited to the area surrounding the railroad tracks that exit TCC to the west (i.e., near Kiwi TNT Ground Zero). Volume I of *Nevada Test Site Contaminated Land Areas Report* (DOE/NV, 2001b) indicates that a 613,000 square foot area in the wash is posted as an RMA. The raw data collected and analyzed is listed in Volume II of the report (DOE/NV, 2001c). This limited data indicates that the site conditions do not exceed the removable contamination or total contamination action levels as defined by Table 4-2 of the *NV/YMP Radiological Control Manual* (DOE/NV, 2000d). The maximum total contamination levels are 248 disintegrations per minute per 100 square centimeters (dpm/100cm^2) for alpha and 1,921 dpm/100cm^2 for beta. The maximum removable contamination levels are 115 dpm/100cm^2 for alpha and 21 dpm/100cm^2 for beta. The maximum dose rate is 30 microRem. The methodology for demarcation survey was based on the

assumption that foot or light-duty vehicle traffic on a dry soil surface would be the only area access scenario. (DOE/NV, 2000b; DOE/NV, 2000c; Wyler, 2002)

Soil sampling surface soil activities were conducted in November and December 2002 to support the preliminary assessment for CAU 529. Two samples (i.e., PA25270311 and PA25270312) were collected from 0 to 0.5 feet bgs in the vicinity of the concrete outfall discharge to Topopah Wash. The preliminary assessment sample locations are shown in Figure 2-3 and the results for the samples collected in the wash are presented in Tables 2-1 and 2-2. The PCB concentrations for samples collected from Topopah Wash exceed the PAL of 1,000 µg/kg. The suspected sources for PCBs are believed to be associated with (1) oil application activities conducted at TCC for dust suppression/wind erosion during construction, and (2) operational activities and releases associated with PCB-containing transformers located at the site. In addition, VOCs, metals, and radionuclides also were detected in these samples. Metals and VOCs were detected at concentrations above the minimum reporting limits but well below their PALs. Radionuclides that were detected and exceeded PALs include cesium-137, plutonium-239, and uranium-234, -235. Based on this recent information, plutonium-239 and VOCs were added as COPCs for the Drain/Outfall Discharges and Main Stream/Drainage Channels Parcels.

2.5.1 National Environmental Policy Act

In accordance with the NNSA/NSO *National Environmental Policy Act* (NEPA) Compliance Program, a NEPA checklist will be completed prior to commencement of site investigation activities at CAU 529. This checklist is used by NNSA/NSO project personnel to evaluate their proposed projects against a list of several potential impacts which include, but are not limited to, air quality, chemical use, waste generation, noise level, and land use. Completion of the checklist results in a determination of the appropriate level of NEPA documentation by the NNSA/NSO NEPA Compliance Officer.

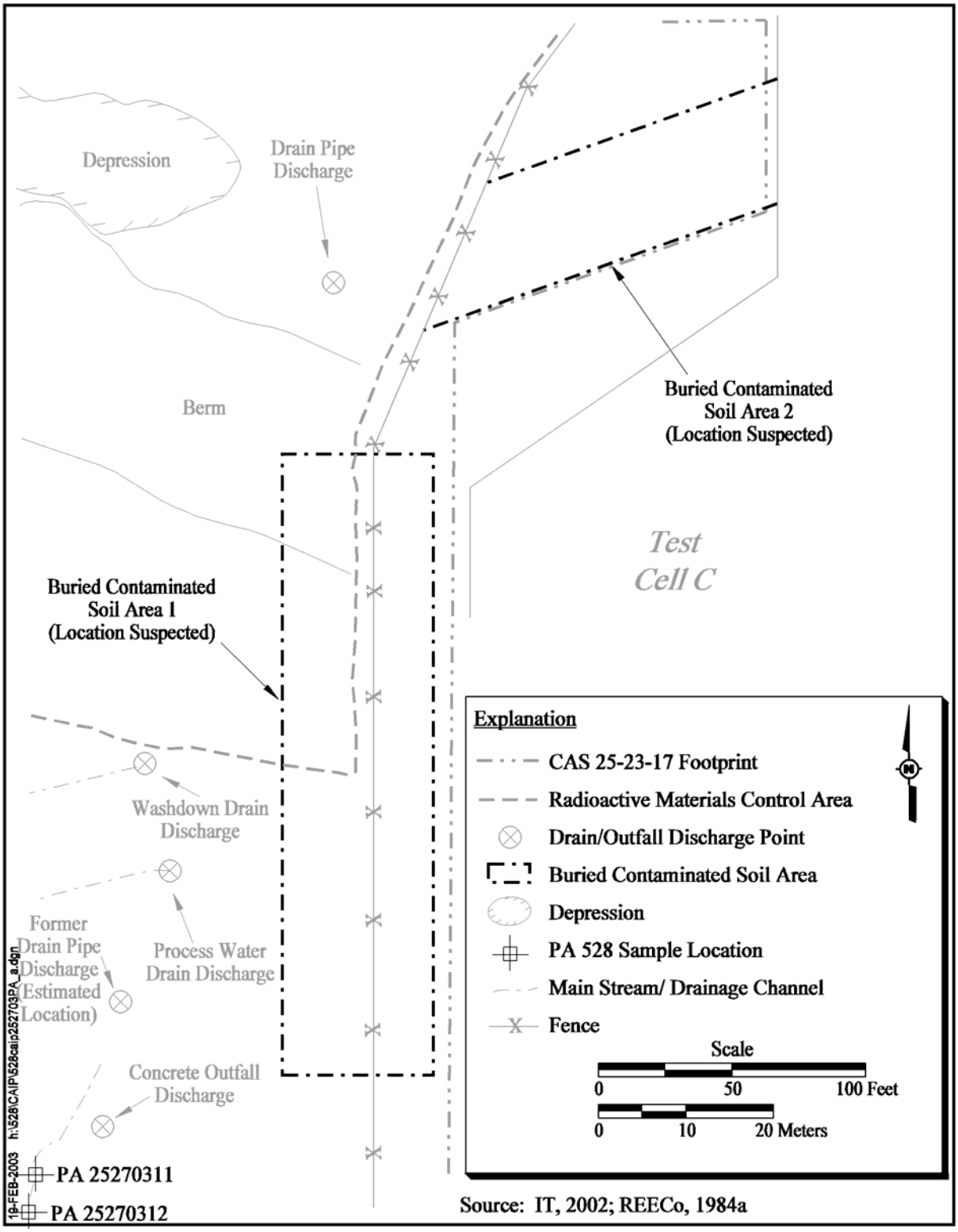

Figure 2-3
CAU 528, CAS 25-27-03, Preliminary Assessment Sample Locations

Table 2-1
Soil Sample Summary for Chemical Parameters at CAU 528, CAS 25-27-03

Parameters	Units	Reporting Limit	PA25270311 (11/19/2002)	PA25270312 (11/19/2002)
VOCs[a]				
Ethylbenzene	µg/kg	5	2.1 J	5 U
M+P-xylene	µg/kg	5	11	5 U
O-xylene	µg/kg	5	4.2 J	5 U
PCBs[b]				
Aroclor-1260	µg/kg	130	8,900 J	1,200 J
Metals[c]				
Arsenic	mg/kg	1	2.5	2.4
Barium	mg/kg	10	78	91
Beryllium	mg/kg	0.5	0.37 B	0.37 B
Cadmium	mg/kg	0.5	2.5	1.7
Chromium	mg/kg	1	9.9	5.7
Lead	mg/kg	0.3	15	19
Mercury	mg/kg	0.1	0.028 B	0.026 B
Selenium	mg/kg	0.5	0.33 B	0.5 U

[a]Samples were analyzed using SW 846-8260B per the EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods
[b]Samples were analyzed using SW 846-8082 per the EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods
[c]Samples were analyzed using SW 846-6010B per the EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods

J = Estimated values
U = Nondetect
B = < CRDL Contract required detection limit

Table 2-2
Soil Sample Summary for Radionuclides at CAU 528, CAS 25-27-03

Radionuclide	Units	PA25270311 (11/19/2002)				PA25270312 (11/19/2002)			
		Result	Qualifier	MDC	Error	Result	Qualifier	MDC	Error
Ac-228	pCi/g	1.86		0.58	0.50	1.38		0.55	0.42
Bi-214	pCi/g	0.86		0.32	0.29	0.9		0.41	0.32
Cs-137	pCi/g	37.2	J	0.16	6.2	15.2	J	0.27	2.6
Pb-212	pCi/g	1.57		0.37	0.37	1.39		0.3	0.32
Pb-214	pCi/g	ND				0.73		0.4	0.27
Pu-239	pCi/g	0.86		0.011	0.16	ND			
Sr-90	pCi/g	0.82		0.24	0.23	0.64		0.26	0.22
Tl-208	pCi/g	0.45		0.16	0.15	0.63		0.19	0.18
U-234	pCi/g	47.8		0.029	5.9	1.88		0.017	0.27
U-235	pCi/g	4.7	J	0.02	0.61	0.09		0.02	0.034
U-238	pCi/g	1.53		0.019	0.22	0.69		0.017	0.12

J = Estimated values
ND = Nondetect

3.0 Objectives

This section presents an overview of the DQOs for CAU 529 and the development of the CSMs. Also presented are the COPCs and PALs for the investigation.

3.1 Conceptual Site Models

A CSM describes the most probable scenario for current conditions at a site and defines the assumptions that are the basis for identifying appropriate sampling strategy and data collection methods. Five CSMs have been developed for CAU 529 using assumptions formulated from the physical setting, historical background information, potential contaminant sources/release information, and data from previous efforts. The name and a brief description of each CSM developed for this investigation is presented below:

- Aerial Dispersion - Environmental contaminants released to Topopah Wash and the surrounding area from the aerial deposition of radioactive debris (i.e., fission products and core fuel) due to nuclear reactor testing activities (in particular from the Kiwi TNT and Phoebus 1A Test). (Figure 3-1)

- Buried Material - Contamination associated with the disposal of contaminated soil and debris. According to documentation, contaminated soil consolidated during the cleanup operations associated with reactor testing activities was buried at locations within and adjacent to the wash. (Figure 3-2)

- Drain/Outfall Discharges - Contamination associated with surface water runoff, wash-down water, and process water (e.g., the 211,000-gallon release of borated water) discharge from five drains and one outfall at TCC. (Figure 3-3)

- Residual Surface Contamination - Contamination associated with residual surface contamination as a result of past waste storage activities. Contaminated soil was stored in a pile within the wash and sprayed with oil to prevent wind erosion. (Figure 3-4)

- Sedimentation - Translocated surface and subsurface contamination resulting from the erosion and sedimentation process. Contaminated soil and debris at the surface and subsurface that was transported, deposited, and/or covered due to intermittent surface water flow within the Topopah Wash. (Figure 3-5)

Site-specific information is presented in Section 2.0. A discussion in Section A.1.1.3 also provides information on the CSMs.

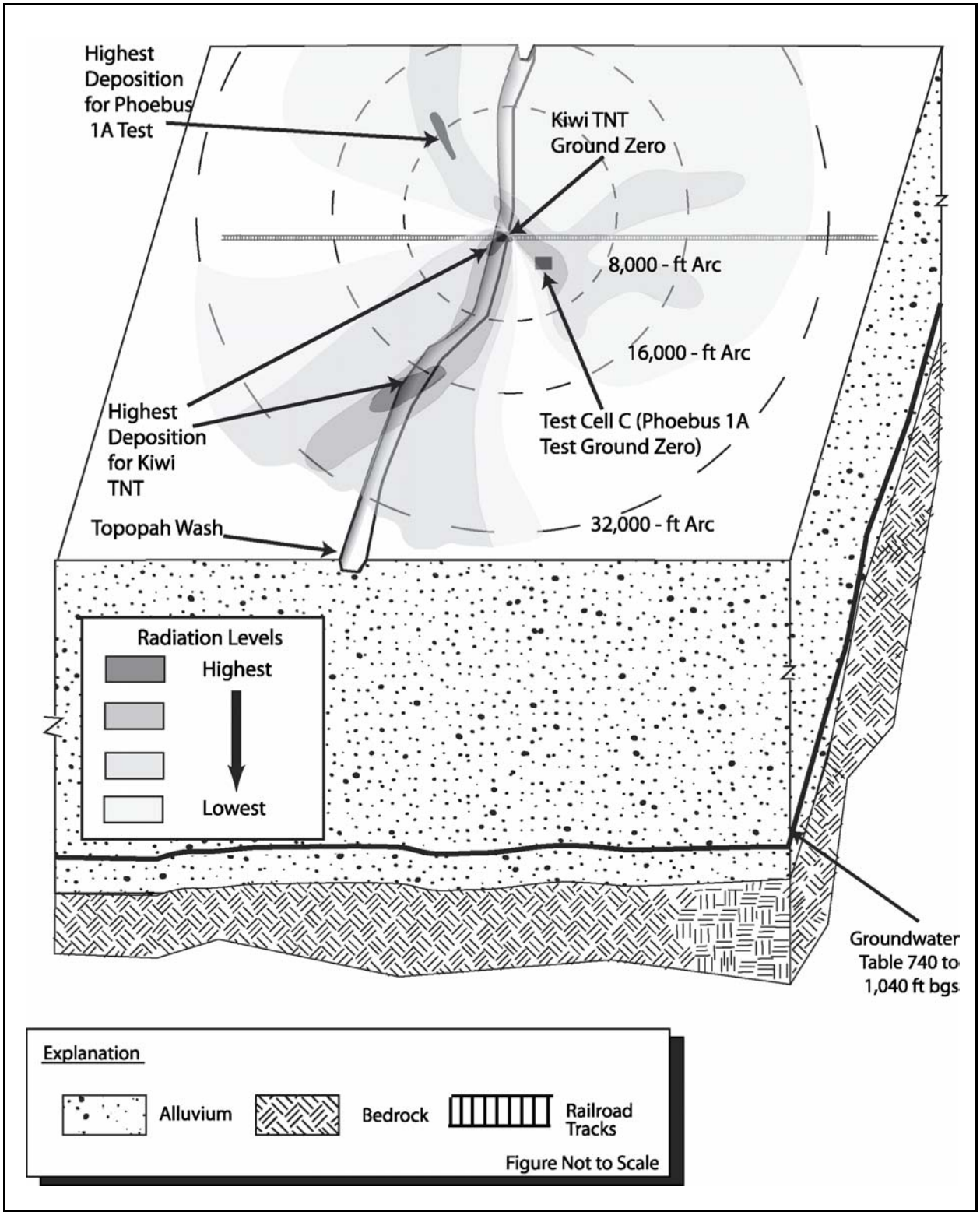

Figure 3-1
CAU 529 Aerial Dispersion Conceptual Site Model,
Applicable to Kiwi TNT 16,000-foot Arc Area, Phoebus 1A Test 8,000-foot Arc Area, and the Wash at Test Cell C Parcels

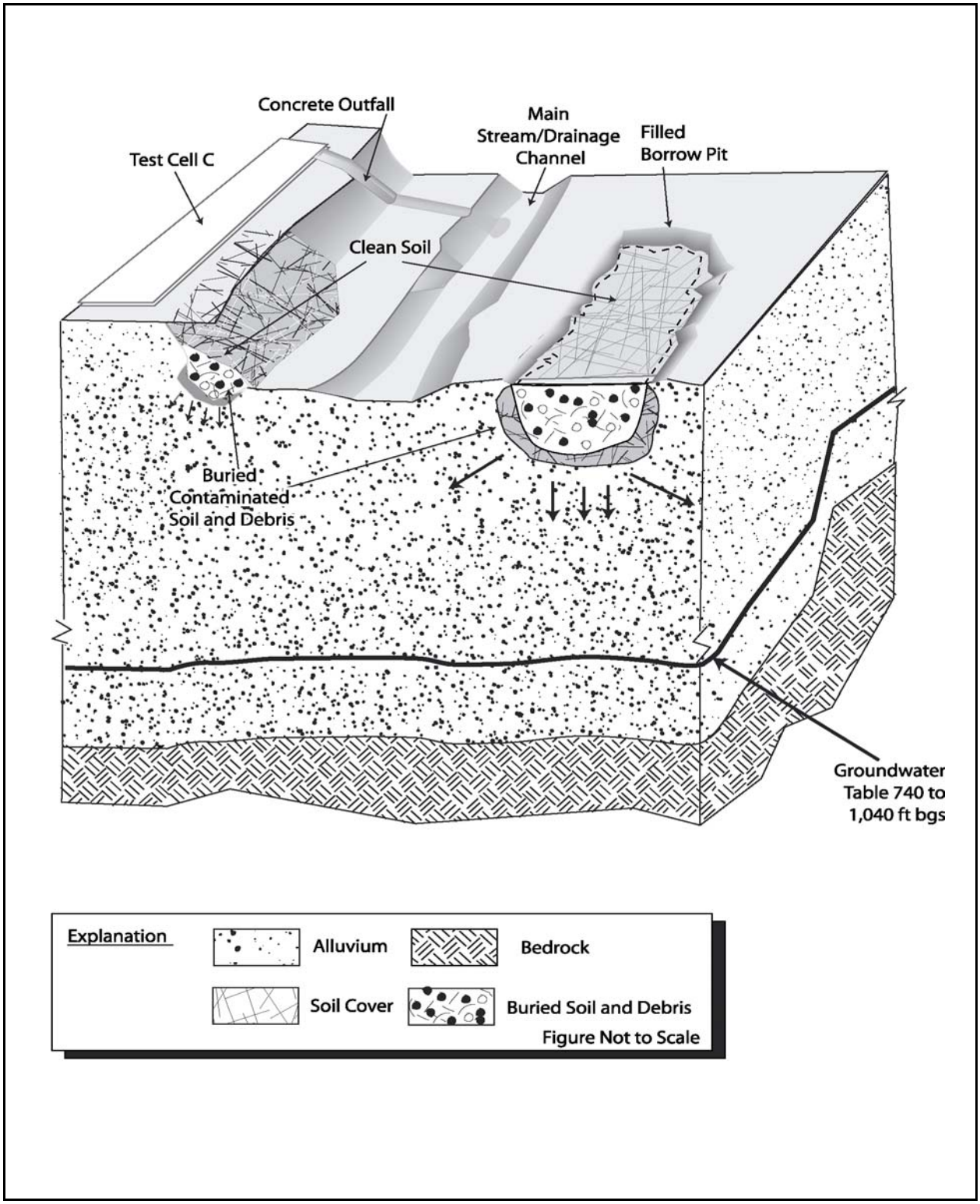

Figure 3-2
CAU 529 Buried Material Conceptual Site Model, Applicable to Buried Contaminated Soil Areas 1 and 2, and Borrow Pit Burial Site Parcels

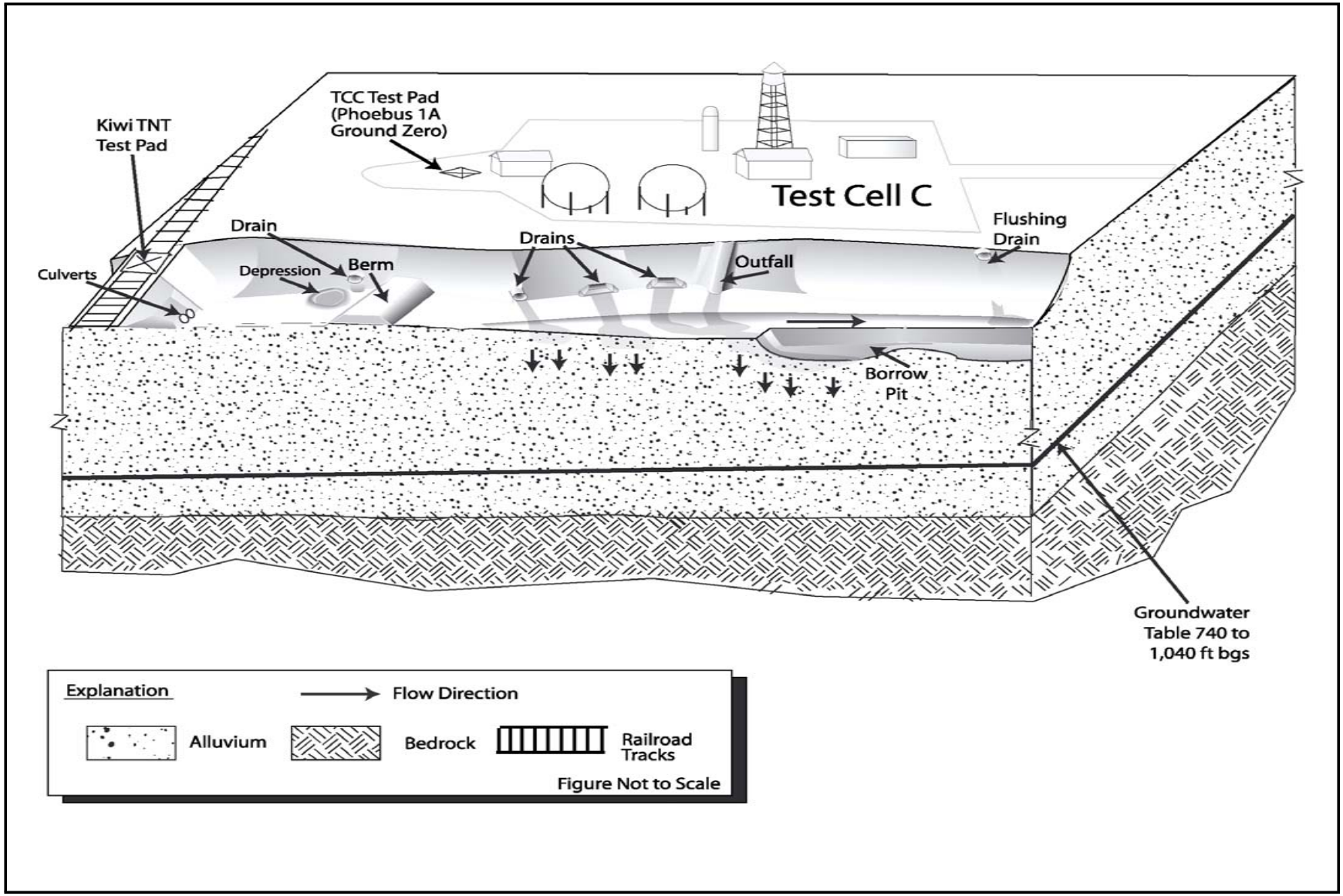

Figure 3-3
CAU 529 Drain/Outfall Discharges Conceptual Site Model,
Applicable to the Drain/Outfall Discharges Parcel

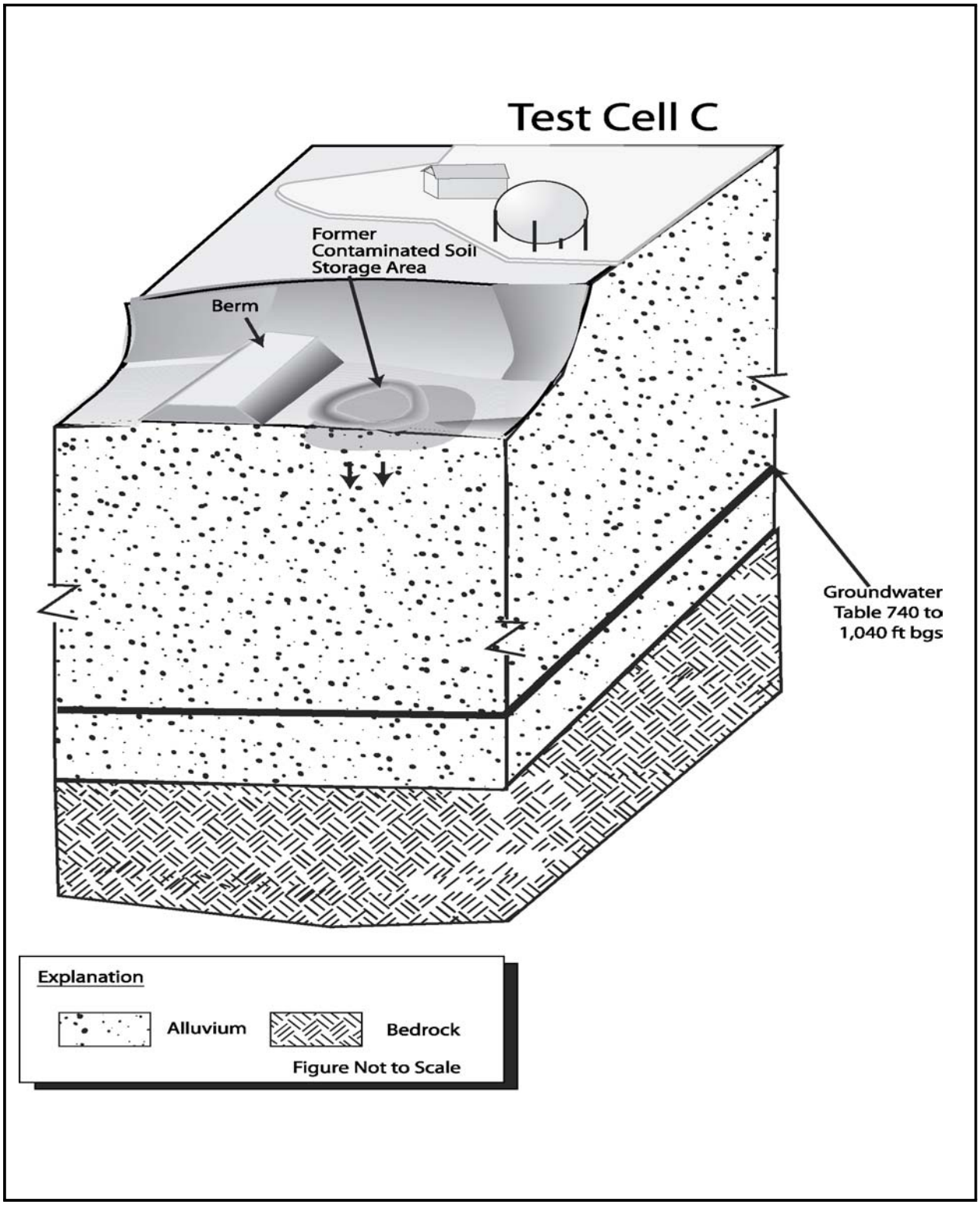

Figure 3-4
CAU 529 Residual Surface Contamination Conceptual Site Model, Applicable to the Contaminated Soil Storage Area Parcel

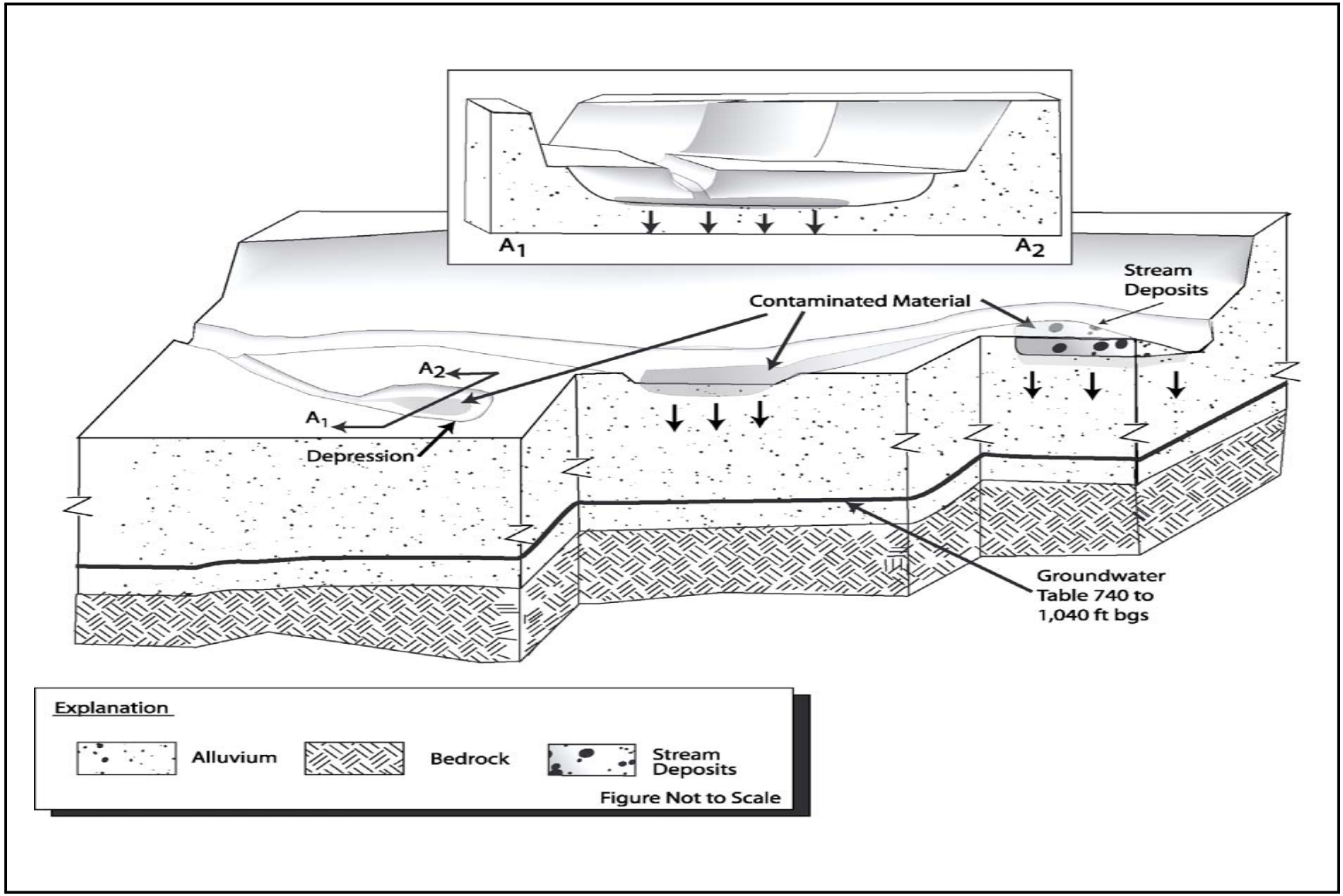

Figure 3-5
CAU 529 Sedimentation Conceptual Site Model Applicable to All Parcels

3.1.1 Future Land Use

Future land-use scenarios limit uses of the CAS to various nonresidential (i.e., industrial) uses. The future land-use scenarios for CAU 529 are research, test, and experiment. This area is designated for small-scale research and development projects and demonstrations; pilot projects; outdoor tests; and experiments for the development, quality assurance, or reliability of material and equipment under controlled conditions. This also includes compatible defense and nondefense research, development and testing projects and activities. (DOE/NV, 1998)

Although the future land use for areas downstream of TCC and beyond the NTS boundary would most likely be a residential scenario, exposure to the public is unlikely based on access restrictions to NTS (i.e., fenced areas, security patrols) and off-site institutional controls (i.e., zoning restrictions for the 100-year floodplain). In addition, the diffusion of contaminants would occur as they migrate downstream as a result of mixing action that occurs during the erosion and deposition process.

3.1.2 Contaminant Sources and Release Mechanisms

Table 3-1 correlates the contaminant sources and release mechanisms to the various CSMs. The contaminant sources and release mechanisms are associated with the environmental releases described in Section 2.4.

Aerial Dispersion

The Kiwi-TNT and the Phoebus 1A reactor excursions propelled fuel fragments and radioactive debris into the air that then dispersed onto the surrounding area. The relative spatial distribution of these particles was that larger pieces fell near to the source while smaller particles were more entrained in the resulting hot gasses (from the exhaust and explosion) and carried further from the source in the prevailing winds. The larger pieces close to the sources were removed as part of cleanup activities following each of the excursions.

Contamination addressed by this CSM is expected to generally decrease with distance from the sources. However, subsequent cleanup activities have reduced the near-source contamination and the fallout of the entrained smaller particles were focused in the direction of prevailing winds and at a distance associated with precipitation of the entrained particles out of the cooling gasses.

Table 3-1
Conceptual Site Models, Sources, and Release Mechanisms

CSM	Contaminant Sources	Release Mechanisms
Aerial Dispersion	Kiwi-TNT, Phoebus 1A Test	Atmospheric dispersion
Buried Material	Disposal of debris and soil in the borrow pit and wash	Direct placement
Drain/Outfall Discharges	Stormwater runoff from contaminated exterior surfaces at TCC Borated water and other TCC process waters	Discharge through outfalls into Topopah Wash
Residual Surface Contamination	Temporary storage of contaminated soil from cleanup operations Spraying of oil on temporary pile	Direct placement, liquid spraying
Sedimentation	All of the above	Dispersion into down-gradient sedimentation catchments

Buried Material

The contaminant sources addressed by this CSM are the contaminated soil and debris buried within, and adjacent to, the wash. This material was generated from cleanup activities following the Kiwi TNT and Phoebus 1A excursions.

The release mechanisms for contaminants was placement of contaminated soil into direct contact with native soils in the borrow pit and along the banks of Topopah Wash by earth-working machinery.

Drain/Outfall Discharges

The contaminant source for this CSM is associated with the release from the borated water closed-loop system. Water from the borated water system may have contained dissolved elements such as chlorine, sulphur, and lithium. An additional contaminant source is stormwater runoff from contaminated surfaces within TCC that may have contained radionuclides and chemical constituents.

The release mechanism for contaminants under the Drain/Outfall Discharges CSM is the discharge of potentially-contaminated liquids into Topopah Wash via the TCC facility drainage system.

Residual Surface Contamination

The source for this CSM is associated with the contaminated soil that was temporarily placed within Topopah Wash following Phoebus 1A clean-up activities. Potential contaminants are those associated with the contaminated soil pile (radioisotopes) and the oil that was sprayed on the pile to prevent wind erosion (total petroleum hydrocarbons [TPH] and polychlorinated biphenyls [PCBs]).

The release mechanisms include the direct placement of contaminated soil on clean, native soils and the spraying of oil on the pile.

Sedimentation

The contaminant sources for this CSM are those associated with all of the CAU 529 releases. The release mechanisms for contaminants under the Sedimentation CSM would be the translocation and accumulation of contaminated particles or materials into clean, native, downstream sediment accumulation areas during precipitation events.

3.1.3 Migration Pathways and Exposure Points

Migration pathways include the lateral migration of potential contaminants across surface soils/sediments and vertical migration of potential contaminants through subsurface soils. Contaminants released into the Topopah Wash are subject to much higher transport mechanisms than contaminants released to other surface areas. Topopah Wash is generally dry but is subject to infrequent, potentially intense, stormwater flows. These stormwater flow events provide an intermittent mechanism for both vertical and horizontal transport of contaminants. Contaminated sediments entrained by these stormwater events would be carried by the streamflow to locations where the flowing water loses energy and the sediments drop out. These locations are readily identifiable by hydrologists as sedimentation areas.

Areas within the CAS that are not subject to stormwater flow are not expected to exhibit significant vertical or horizontal migration of contaminants. The annual average precipitation on the valleys of the NTS ranges from 3 to 6 inches. The potential annual evapotranspiration from lake and reservoir surfaces was estimated to range from 60 to 82 in. per year, or roughly 5 to 25 times the annual

precipitation (USGS, 1975). Therefore, migration of contaminants to groundwater is not considered a significant pathway.

The exposure points for potential site receptors (i.e., military personnel, industrial workers, and construction workers) are primarily contaminated surface soils throughout the CAS. Exposure to subsurface materials would result from excavation activities or through erosion of subsurface materials that were subsequently deposited on the surface.

3.1.4 Additional Information

Additional topographic information will be limited to the Wash at TCC and the parcels of highest aerial deposition (i.e., Kiwi TNT 16,000-ft Arc Area and Phoebus 1A Test 8,000-ft Arc Area). The information to be gathered primarily consists of survey data associated with sample locations to help evaluate the potential off-site transportation of potential contamination.

General surface and subsurface soil descriptions will be observed and recorded during the corrective action investigation.

Climatic conditions for the CAU are well documented and have been addressed in the CSM. No further information is required.

Hydrogeologic data including depth to groundwater for the CAU are known and have been addressed in the CSM. No further information is required.

Existing floodplain studies are available and will be considered during corrective action, as necessary. In addition, areas of erosion and deposition within the wash will be qualitatively evaluated by a hydrologist to provide any additional information on potential off-site migration of contamination. Movement of the active stream channel in the last 40 years, may be identified based on a comparison of historical photographs and visual observations where erosion and deposition has occurred within the wash.

No buildings or structures will be evaluated during the investigation. However, a utility survey will be conducted over each parcel to avoid underground utilities and to maintain a safe work environment.

3.2 Contaminants of Potential Concern

Types of contaminants that might be present were identified through a review of site history documentation, personal interviews, process knowledge, and inferred activities associated with the CAU. Chemical COPCs are defined as the analytes detected using the analytical methods listed in Table 3-4 for which the U.S. Environmental Protection Agency (EPA) Region IX has established Preliminary Remediation Goals (PRG) (EPA, 2002b) or for which toxicity data are listed in the EPA Integrated Risk Information System (IRIS) database (EPA, 2002a). Radiological COPCs are defined as the radionuclides detected using the analytical methods listed in Table 3-5. Table 3-2 provides a list of the Phase I COPCs and critical COPCs associated with each parcel being investigated.

3.2.1 Critical Contaminants of Potential Concern

Critical COPCs for Phase I samples are the potential chemical and radionuclide constituents that are reasonably suspected to be present at the site based on documented use or process knowledge. These critical analytes are given greater importance in the decision making process relative to other COPCs and have a completeness goal of 100 percent. When these data for critical COPCs are not available, it is likely that a final decision on the CAS can not be made without further final justification, and/or supporting documentation.

Critical analytes for Phase II samples are the COCs identified based on prior analytical results. The completeness goal for Phase II COCs is 100 percent for those samples that define the extent of contamination.

The types of waste suspected to be present at the CAS as a result of past site activities include cesium-137, cobalt-60, europium-152 europium-155, niobium-94, strontium-90, uranium-234, uranium-235, uranium-238, TPH-Diesel Range Organics (DRO), PCBs, semivolatile organics (SVOCs), and metals (i.e., arsenic, barium, beryllium, cadmium, chromium, lead, manganese, mercury, nickel, selenium, silver). Plutonium-239 and VOCs have been added as COPCs based on the analytical results of soil samples collected during the CAU 528 preliminary assessment.

Table 3-2
Phase I Contaminants of Potential Concern

COPC	CAU 529 Parcels								
	Kiwi TNT 16,000-foot Arc Area	Phoebus 1A Test 8,000-foot Arc Area	Topopah Wash at TCC	Buried Contaminated Soil Area (BCSA) 1	Buried Contaminated Soil Area (BCSA) 2	Borrow Pit Burial Site	Drain/Outfall Discharges	Contaminated Soil Storage Area	Main Stream/ Drainage Channels
Organics									
Total Petroleum Hydrocarbons - Diesel-Range Organics (TPH-DRO) (C_{10}-C_{38})						C	X	C	X
Polychlorinated Biphenyls[1]	X	X	X	X	X	C	X	C	X
Semivolatile Organic Compounds[1]						X	X	X	X
Volatile Organic Compounds[1]							X		X
Benzene							C		X
Toluene							C		X
Ethylbenzene							C		X
Xylenes							C		X
Metals									
Beryllium	C	C	C	C	C	C	C	C	C
Nickel							X		X
Manganese							X		X
Resource Conservation and Recovery Act (RCRA) Metals[1]						X	X	X	X
Radionuclides									
Cesium-137	C	C	C	C	C	C	C	C	C
Cobalt-60	C	C	C	C	C	C	C	C	C
Europium-152	X	X	X	X	X	X	X	X	X
Europium-155	X	X	X	X	X	X	X	X	X
Niobium-94	C	C	C	C	C	C	C	C	C
Plutonium-239							C		X
Strontium-90	C	C	C	C	C	C	C	C	C
Uranium-234	C	C	C	C	C	C	C	C	C
Uranium-235	X	X	X	X	X	X	X	X	X
Uranium-238	X	X	X	X	X	X	X	X	X

[1]COPCs defined as analytes reported by method that have PRGs or listed in IRIS database.
C = Critical COPC X = Noncritical COPC

3.3 Preliminary Action Levels

Laboratory analytical results for soil samples will be compared to the following PALs to evaluate if COCs are present or migrating:

- EPA *Region IX Risk-Based Preliminary Remediation Goals* (PRGs) for Industrial Soils (EPA, 2002b). The population parameter for Phase I chemical data is the maximum observed concentration of each COC within the target population.

- Background concentrations for metals when natural background exceeds the PRG, as is often the case with arsenic. Background is considered the mean plus two times the standard deviation of the mean for sediment samples collected by the Nevada Bureau of Mines and Geology throughout the Nellis Air Force Range (NBMG, 1998; Moore, 1999).

- TPH action level of 100 milligrams per kilogram (mg/kg) per the *Nevada Administrative Code* (NAC) 445A.2272 (NAC, 2002e).

- The PALs for radionuclides are isotope-specific and defined as the maximum concentration for that isotope found in samples collected from undisturbed background locations in the vicinity of the NTS (McArthur and Miller, 1989; US Ecology and Atlan-Tech, 1992). The PAL is equal to the minimum detectable concentration (MDC) for isotopes not reported in soil samples from undisturbed background locations. The PAL is also equal to the MDC if the maximum background concentration is less than the MDC.

The comparison of laboratory results to PALs will be discussed in the Corrective Action Decision Document (CADD). While laboratory results above action levels indicate the presence of COCs at levels that may require corrective action, these are not necessarily the final cleanup criteria.

The population parameter for Phase II will be the observed concentration of each unbounded chemical COC in any sample and the observed concentration of each unbounded radiological COC for biased radiological samples. The evaluation of potential corrective actions and the justification for a preferred action will be included in the CADD based on the results of this field investigation. Proposed cleanup levels will be presented in the CADD.

3.3.1 Field-Screening Levels

Field screening for radiological constituents, TPH, and VOCs may be instituted to provide semiquantitative measurements. The field-screening results (FSRs), along with other biasing factors,

may help guide the selection of the most appropriate sampling location for collection of laboratory samples. The following action levels may be used for on-site field screening:

- The radiological (alpha and beta/gamma) field-screening level (FSL) for soil samples is the mean background activity plus two times the standard deviation of the mean background activity.
- TPH FSRs greater than 75 parts per million (ppm) measured using an appropriate field-screening method (e.g., a field gas chromatograph or an equivalent method).
- VOC FSRs greater than 20 parts per million (ppm) or 2.5 times background, whichever is greater.

Samples with contaminant concentrations exceeding FSLs for radionuclides, SVOCs, and VOCs indicate potential contamination at that sample location. This information will be documented and the investigation will be continued in order to delineate the extent of contamination. Additionally, this data may also be used to select samples to be submitted for laboratory analysis.

3.4 DQO Process Discussion

The DQOs are qualitative, semiquantitative, and quantitative statements that define the type, quantity, and quality of data required to support evaluations of potential closure alternatives for CAU 529. The DQOs were developed to identify data needs and clearly define the intended use of the environmental data, and to design a data collection program that will satisfy these purposes.

Details of the DQO process are presented in Appendix A. During the DQO discussion for this CAU, the informational inputs or data needs to resolve problem statements and decision statements were documented. Criteria for data collection activities were assigned. The analytical methods and reporting limits prescribed through the DQO process, as well as the DQIs for laboratory analysis such as precision and accuracy requirements, are provided in more detail in Section 6.0 of this CAIP. Laboratory data will be assessed to confirm or refute each conceptual model and determine if the DQOs were met based on the DQIs of precision, accuracy, representativeness, completeness, and comparability. Other DQIs, such as sensitivity, may also be used.

The DQO strategy for CAU 529 was developed at a meeting held on October 31, 2002. The DQOs were developed to identify data needs, clearly define the intended use of the environmental data, and

to design a data collection program that will satisfy these purposes. During the DQO discussions for this CAU, the informational inputs or data needs to resolve the problem statement and decision statements were documented.

The problem statement for the investigation is: "There is an insufficient amount of information to characterize the nature and extent of contamination released to the wash and surrounding areas to determine if there is a risk to human health and the environment." To address this problem, resolution of two decision statements is required:

- Decision I is to "Determine if a COC is present" by identifying any contamination above the PALs. Sample data must be collected in areas most likely to contain a COC and the analytical suite selected must be sufficient to detect any COCs present in the samples. If PALs are not exceeded, then the investigation is complete. If PALs are exceeded, then Decision II must be resolved.

- Decision II is to "Determine the lateral and vertical extent of a COC." Sample data must be collected and analyzed at locations to bound the lateral and vertical extent of COCs. The data required to satisfy the information needed for each COC is a sample result that is below the PAL.

Laboratory analysis of environmental soil samples will provide the means for quantitative measurement of the COPCs. Phase I chemical and radiological parameters of interest have been selected for each parcel of CAS 25-23-17. The Phase I analyses for soil samples to be collected at each parcel are listed in Table 3-3.

Analytical methods and minimum reporting limits (MRLs) for each chemical parameter are provided in Table 3-4. The MRL is a practical reporting limit that ensures data generated by the laboratory will be usable by the investigation.

The MDCs and PALs for radionuclides are provided in Table 3-5. The MDC is the lowest concentration of a particular parameter that can be detected in a sample with an acceptable level of error. The MDCs listed in Table 3-5 are typical default levels available for a commercial radioanalytical laboratory. The MDCs will be used as MRLs.

Table 3-3
Phase I Analyses per Parcel [a]

Analyses	CAU 529 Parcels								
	Kiwi TNT 16,000-foot Arc Area	Phoebus 1A Test 8,000-foot Arc Area	Topopah Wash at TCC	Buried Contaminated Soil Area 1	Buried Contaminated Soil Area 2	Borrow Pit Burial Site	Drain/Outfall Discharges	Contaminated Soil Storage Area	Main Stream/Drainage Channels
Organics									
TPH - DRO (C_{10}-C_{38})						X	X	X	X
PCB	X	X	X	X	X	X	X	X	X
SVOC						X	X	X	X
VOC							X		X
Benzene							X		X
Toluene							X		X
Ethylbenzene							X		X
Xylenes							X		X
Metals									
Beryllium	X	X	X	X	X	X	X	X	X
Manganese							X		X
Nickel							X		X
RCRA Metals						X	X	X	X
Radionuclides									
Gamma Spectroscopy	X	X	X	X	X	X	X	X	X
Isotopic Plutonium							X		X
Isotopic Uranium	X	X	X	X	X	X	X	X	X
Isotopic Strontium	X	X	X	X	X	X	X	X	X

[a]For those analyses identified that include multiple parameters, the parameters with PALs will be evaluated.

X = Analyses

Table 3-4
Analytical Requirements for CAU 529
(Page 1 of 3)

Parameter/Analyte	Medium or Matrix	Analytical Method	Minimum Reporting Limit	RCRA Hazardous Waste Regulatory Limit	Laboratory Precision [a]	Percent Recovery (%R) [b]
ORGANICS						
Total Volatile Organic Compounds (VOCs)	Aqueous Soil	8260B [c]	Parameter-specific estimated quantitation limits [d]	Not applicable (NA)	Lab-specific [e]	Lab-specific [e]
Toxicity Characteristic Leaching Procedure (TCLP) VOCs						
Benzene	Aqueous	1311/8260B [c]	0.050 mg/L [d]	0.5 mg/L [f]	Lab-specific [e]	Lab-specific [e]
Carbon Tetrachloride			0.050 mg/L [d]	0.5 mg/L [f]		
Chlorobenzene			0.050 mg/L [d]	100 mg/L [f]		
Chloroform			0.050 mg/L [d]	6 mg/L [f]		
1,2-Dichloroethane			0.050 mg/L [d]	0.5 mg/L [f]		
1,1-Dichloroethene			0.050 mg/L [d]	0.7 mg/L [f]		
Methyl Ethyl Ketone			0.050 mg/L [d]	200 mg/L [f]		
Tetrachloroethene			0.050 mg/L [d]	0.7 mg/L [f]		
Trichloroethene			0.050 mg/L [d]	0.5 mg/L [f]		
Vinyl Chloride			0.050 mg/L [d]	0.2 mg/L [f]		
Total Semivolatile Organic Compounds (SVOCs)	Aqueous Soil	8270C [c]	Parameter-specific estimated quantitation limits [d]	NA	Lab-specific [e]	Lab-specific [e]
TCLP SVOCs						
o-Cresol	Aqueous	1311/8270C [c]	0.10 mg/L [d]	200 mg/L [f]	Lab-specific [e]	Lab-specific [e]
m-Cresol			0.10 mg/L [d]	200 mg/L [f]		
p-Cresol			0.10 mg/L [d]	200 mg/L [f]		
Cresol (total)			0.30 mg/L [d]	200 mg/L [f]		
1,4-Dichlorobenzene			0.10 mg/L [d]	7.5 mg/L [f]		
2,4-Dinitrotoluene			0.10 mg/L [d]	0.13 mg/L [f]		
Hexachlorobenzene			0.10 mg/L [d]	0.13 mg/L [f]		
Hexachlorobutadiene			0.10 mg/L [d]	0.5 mg/L [f]		
Hexachloroethane			0.10 mg/L [d]	3 mg/L [f]		
Nitrobenzene			0.10 mg/L [d]	2 mg/L [f]		
Pentachlorophenol			0.50 mg/L [d]	100 mg/L [f]		
Pyridine			0.10 mg/L [d]	5 mg/L [f]		
2,4,5-Trichlorophenol			0.10 mg/L [d]	400 mg/L [f]		
2,4,6-Trichlorophenol			0.10 mg/L [d]	2 mg/L [f]		

Table 3-4
Analytical Requirements for CAU 529
(Page 2 of 3)

Parameter/Analyte	Medium or Matrix	Analytical Method	Minimum Reporting Limit	RCRA Hazardous Waste Regulatory Limit	Laboratory Precision [a]	Percent Recovery (%R) [b]
Polychlorinated Biphenyls (PCBs)	Aqueous	8082 [c]	Parameter-specific (CRQL) [g]	NA	Lab-specific [e]	Lab-specific [e]
	Soil					
TPH - DRO (C10-C38)	Aqueous	8015B [c] modified	0.5 mg/L	NA		
	Soil		25 mg/kg [h]		Lab-specific [e]	Lab-specific [e]
INORGANICS						
Total Metals						
Arsenic	Aqueous	6010B [c]	10 µg/L [h, i]	NA	20 [i]	
	Soil		1 mg/kg [h, i]		35 [j]	Matrix Spike Recovery 75-125 [i] Laboratory Control Sample Recovery 80 - 120 [i]
Barium	Aqueous	6010B [c]	200 µg/L [h, i]		20 [i]	
	Soil		20 mg/kg [h, i]		35 [j]	
Beryllium	Aqueous	6010B [c]	5 µg/L [i]		20 [i]	
	Soil		0.5 mg/kg [i, j]		35 [j]	
Cadmium	Aqueous	6010B [c]	5 µg/L [h, i]		20 [i]	
	Soil		0.5 mg/L [h, i]		35 [j]	
Chromium	Aqueous	6010B [c]	10 µg/L [h, i]		20 [i]	
	Soil		1 mg/kg [h, i]		35 [j]	
Lead	Aqueous	6010B [c]	3 µg/L [h, i]		20 [i]	
	Soil		0.3 mg/kg [h, i]		35 [j]	
Mercury	Aqueous	7470A [c]	0.2 µg/L [h, i]		20 [i]	
	Soil	7471A [c]	0.1 mg/kg [h, i]		35 [j]	
Nickel	Aqueous	6010B [c]	40 µg/L [h, i]		20 [i]	
	Soil		4 mg/kg [i]		35 [j]	
Selenium	Aqueous	6010B [c]	5 µg/L [h, i]		20 [i]	
	Soil		0.5 mg/kg [h, i]		35 [j]	
Silver	Aqueous	6010B [c]	10 µg/L [h, i]		20 [i]	
	Soil		1 mg/kg [h, i]		35 [j]	
Manganese	Aqueous	6010B [c]	15 µg/L [i]		20 [i]	
	Soil		1.5 mg/kg [i]		35 [j]	

Table 3-4
Analytical Requirements for CAU 529
(Page 3 of 3)

Parameter/Analyte	Medium or Matrix	Analytical Method	Minimum Reporting Limit	RCRA Hazardous Waste Regulatory Limit	Laboratory Precision [a]	Percent Recovery (%R) [b]
TCLP RCRA Metals						
Arsenic	Aqueous	1311/6010B [c]	0.10 mg/L [h, i]	5 mg/L [f]	20 [i]	Matrix Spike Recovery 75-125 [i] Laboratory Control Sample Recovery 80 - 120 [i]
Barium	Aqueous	1311/6010B [c]	2 mg/L [h, i]	100 mg/L [f]		
Cadmium	Aqueous	1311/6010B [c]	0.05 mg/L [h, i]	1 mg/L [f]		
Chromium	Aqueous	1311/6010B [c]	0.1 mg/L [h, i]	5 mg/L [f]		
Lead	Aqueous	1311/6010B [c]	0.03 mg/L [h, i]	5 mg/L [f]		
Mercury	Aqueous	1311/7470A [c]	0.002 mg/L [h, i]	0.2 mg/L [f]		
Selenium	Aqueous	1311/6010B [c]	0.05 mg/L [h, i]	1 mg/L [f]		
Silver	Aqueous	1311/6010B [c]	0.1 mg/L [h, i]	5 mg/L [f]		
Radiochemistry, see Table 3-5						

[a] Relative percent difference (RPD) is used to calculate precision.
Precision is estimated from the RPD of the concentrations measured for the matrix spike and matrix spike duplicate or of laboratory, or field duplicates of unspiked samples. It is calculated by: $RPD = 100 \times \{(|A_1-A_2|)/[(A_1+A_2)/2]\}$, where A_1 = Concentration of the parameter in the initial sample aliquot, A_2 = Concentration of the parameter in the duplicate sample aliquot.

[b] The %R is used to calculate accuracy. Accuracy is assessed from the recovery of parameters spiked into a blank or sample matrix of interest, or from the recovery of surrogate compounds spiked into each sample. The recovery of each spiked parameter is calculated by: $\%R = 100 \times (A_s-A_u/A_n)$, where A_s = Concentration of the parameter in the spiked sample, A_u = Concentration of the parameter in the unspiked sample, A_n = Concentration increase that should result from spiking the sample.

[c] The EPA *Test Methods for Evaluating Solid Waste Physical/Chemical Methods*, 3rd Edition, Parts 1-4, (SW-846) CD ROM, Washington, DC (EPA,1996).

[d] Estimated Quantitation Limit as given in SW-846 (EPA, 1996).

[e] In-House generated RPD and %R performance criteria. It is necessary for laboratories to develop in-house performance criteria and compare them to those in the methods. The laboratory begins by analyzing 15 to 20 samples of each matrix and calculating the mean %R for each parameter. The standard deviation (SD) of each %R is then calculated, and the warning and control limits for each parameter are established at ± 2 SD and ± 3 SD from the mean, respectively. If the warning limit is exceeded during the analysis of any sample delivery group (SDG), the laboratory institutes corrective action to bring the analytical system back into control. If the control limit is exceeded, the sample results for that SDG are considered unacceptable. These limits are reviewed after every quarter and are updated when necessary. The laboratory tracks trends in both performance and control limits by the use of control charts. The laboratory's compliance with these requirements is confirmed as part of an annual laboratory audit. Similar procedures are followed in order to generate acceptance criteria for precision measurements.

[f] Title 40 *Code of Federal Regulations* (CFR) Part 261, "Identification and Listing of Hazardous Waste" (CFR, 2002a)

[g] EPA *Contract Laboratory Program (CLP) Statement of Work for Organic Analysis* (EPA, 1988b; 1991; and 1994c)

[h] *Industrial Sites Quality Assurance Project Plan* (NNSA/NV, 2002a)

[i] EPA *Contract Laboratory Program Statement of Work for Inorganic Analysis* (EPA, 1988a; 1994b; and 1995)

[j] Sampling and Analysis Plan (Field Sampling and Quality Assurance Project Plan) with guidance EPA Region IX (EPA, 2000)

*These analytes are not listed in QAPP.

Definitions:
mg/L = Milligrams per liter
mg/kg = Milligrams per kilogram
µg/kg = Micrograms per kilogram
µg/L = Micrograms per liter
CRQL = Contract-required quantitation limits

Table 3-5
Requirements for Radionuclides in Samples Collected at CAU 529

Radionuclide	Matrix	Analytical Method	MDC[a]	PAL[b]	Laboratory Precision	Percent Recovery
Gamma Spectrometry					Relative Percent Difference (RPD) 20% water 35% Soil Normalized Difference (ND) -2<ND<2[e]	Laboratory Control Sample Recovery 80-120[f] %R Chemical Yield 30-105[g]%R
Cesium-137	Aqueous	EPA 901.1 [h]	10.0 pCi/L	10.0 pCi/L		
	soil	HASL-300[d]	0.5 pCi/g	7.0 pCi/g		
Cobalt 60	Aqueous	EPA 901.1 [h]	10.0 pCi/L	10.0 pCi/L		
	soil	HASL-300[d]	0.5 pCi/g	0.5 pCi/g		
Europium-152	Aqueous	EPA 901.1 [h]	75.0 pCi/L	75.0 pCi/L		
	soil	HASL-300[d]	4.0 pCi/g[c]	4.0 pCi/g		
Europium-155	Aqueous	EPA 901.1 [h]	20.0 pCi/L	20.0 pCi/L		
	soil	HASL-300[d]	1.0 pCi/g[c]	1.35 pCi/g		
Niobium-94	Aqueous	EPA 901.1 [h]	10.0 pCi/L	10.0 pCi/L		
	soil	HASL-300[d]	0.5 pCi/g[c]	0.5 pCi/g		
Other Radionuclides						
Plutonium 239	Aqueous	HASL-300[d]	0.1 pCi/L	9.0 pCi/L		
	soil		0.05 pCi/g	0.106 pCi/g		
Uranium-234	Aqueous	HASL-300[d]	0.1 pCi/L	8.92 pCi/L		
	soil		0.05 pCi/g	3.47 pCi/g		
Uranium-235	Aqueous	HASL-300[d]	0.1 pCi/L	0.36 pCi/L		
	soil		0.05 pCi/g	0.07 pCi/g		
Uranium-238	Aqueous	HASL-300[d]	0.1 pCi/L	9.39 pCi/L		
	soil		0.05 pCi/g	3.47 pCi/g		
Strontium-90	Aqueous	ASTM D5811-00	1.0 pCi/L	1.0 pCi/L		
	soil	HASL-300[d]	0.5 pCi/g	1.17 pCi/g		

[a]MDC is the minimum detectable concentration. It is the lowest concentration of a radionuclide, if present in a sample, that can be detected with a 95 percent confidence level.
[b]PAL is the preliminary action level and is defined as the maximum concentration listed in the literature for a sample taken from an undisturbed background location. (McArthur and Miller, 1989; US Ecology and Atlan-Tech, 1992).
[c]MDCs vary depending on the presence of other gamma-emitting radionuclides in the sample.
[d]*Environmental Measurements Laboratory Procedures Manual*, HASL-300 (DOE, 1997)
[e]Normalized Difference (ND) is not RPD, it is another measure of precision used to evaluate duplicate analyses. The ND is calculated as the difference between two results divided by the square root of the sum of the squares of their total propagated uncertainties. *Evaluation of Radiochemical Data Usability* (Paar and Porterfield, 1997)
[f]EPA *Contract Laboratory Program Statement of Work for Inorganic Analysis* (EPA, 1988a; 1994b; and 1995)
[g]*General Radiochemistry and Routine Analytical Services Protocol (GRASP)* (EG&G Rocky Flats, 1991). The chemical yield only applies to uranium and strontium.
[h]*Prescribed Procedures for Measurements of Radioactivity in Drinking Water*, EPA-600/4-80-032 (EPA, 1980)
[i]American Society for Testing and Materials

Definitions:
pCi/g = Picocuries per gram
pCi/L = Picocuries per liter

4.0 Field Investigation

This section of the CAIP contains the approach for investigating CAU 529.

4.1 Technical Approach

The technical approach for CAU 529 consists of activities to be conducted prior to and during the corrective action investigation. This technical approach consists of, but is not limited to, the following activities:

- Conduct radiological land surveys to determine the presence of radionuclides at the locations of highest aerial deposition.
- Collect Phase I samples from biased locations and submit for laboratory analysis as described in Section 3.2 and Section 3.4.
- Collect Phase II samples to define extent of COCs identified in Phase I, if necessary.
- Collect required QC samples.
- Collect waste characterization samples, as needed.

4.2 Field Activities

This section provides a description of the field activities for CAU 529. Biased sampling will be conducted during the investigation to address both Phase I and Phase II data needs. Process knowledge indicates that COCs, if any, should be confined to the spatial boundaries of the sites as defined in the DQO process and the CSMs. If Phase I determines that COCs are present or migrating in a parcel, the extent of contamination will be determined (Phase II) before evaluating corrective action alternative requirements. Only unbounded COCs will be considered during Phase II.

Modifications to the investigative strategy may be required should unexpected field conditions be encountered. Significant modifications will be justified in a record of technical change (ROTC). The NDEP's concurrence with the ROTC is required prior to proceeding with investigation activities significantly different from those described in this document. If contamination is more extensive than

anticipated (e.g., the maximum investigation depth is limited by the capabilities of the equipment used to collect subsurface soil samples), the investigation will be rescoped.

Samples will be collected at biased sampling locations using various drilling methods (e.g., rotosonic, hollow-stem auger, or other applicable methods), direct push, hand/power augering, hand tools (e.g., trowels, spoons), and/or excavation, as appropriate. Table 3-4 and Table 3-5 provide the analytical methods to be used when analyzing for the COPCs. All sampling activities and QA/QC requirements for field and laboratory environmental sampling will be conducted in compliance with the Industrial Sites QAPP (NNSA/NV, 2002a) and other applicable procedures. Other governing documents include a current version of the ITLV HASP (IT, 2001) and an approved site-specific health and safety plan prepared prior to the field effort.

As required by the DOE Integrated Safety Management System (ISMS) (DOE/NV, 1997), these documents outline the requirements for protecting the health and safety of the workers and the public, and procedures for protecting the environment. The ISMS program requires that site personnel take every reasonable step to reduce or eliminate the possibility of injury, illness, or accidents, and to protect the environment during all project activities. The following safety issues will be taken into consideration when evaluating the hazards and associated control procedures for field activities discussed in the SSHASP:

- Potential hazards to site personnel and the public include, but are not limited to: radionuclides, chemicals (e.g., petroleum hydrocarbons, PCBs, SVOCs, and heavy metals), adverse and rapidly changing weather, remote location, and motor vehicle and heavy equipment operations.
- Proper training of all site personnel to recognize and mitigate the anticipated hazards.
- Work controls to reduce or eliminate the hazards including engineering controls, substitution of less hazardous materials, and personal protective equipment (PPE).
- Occupational exposure monitoring to prevent overexposures to hazards such as radionuclides, chemicals, and physical agents (e.g., heat, cold, high wind).
- Emergency and contingency planning and communications to include medical care and evacuation, decontamination, and spill control measures, and appropriate notification of project management.

4.2.1 Site Preparation Activities

Site preparation will be conducted by the NTS Management and Operating (M&O) Contractor prior to the investigation. Site preparation may include, but not be limited to, removal and proper disposal of surface debris (e.g., surface metal, wood debris, and concrete) in the vicinity of the drain discharge locations as well as preparation of sample location access points (e.g., fence removal, road improvement).

4.2.2 Phase I Activities

The objective of the Phase I strategy is to determine if radiological or chemical COCs are present at any parcel. Land radiological surveys will be conducted to determine the presence of surficial gamma- and high-energy beta-emitting radiological contaminants exceeding PALs. The presence of radiological constituents will be determined by biased sampling and confirmed with laboratory analyses. The radiological data acquired from the laboratory samples will be used to correlate the counts per minute measurement of the survey to an isotope-specific pCi/g equivalent. The survey results will be compared to PALs to determine if radiological COCs are present.

The presence of chemical COCs will be determined by biased sampling and laboratory analyses. A comparison of laboratory analytical results from this phase against PALs will be used to confirm the presence or absence of chemical COCs.

Biased sampling locations will be determined based on the results of surveys and other biasing factors. The Site Supervisor has the ability to modify these locations and minimize samples submitted for laboratory analyses, but only if the decision needs and criteria stipulated in Section A.1.3 are satisfied.

The Phase I sampling strategy targets locations and media most likely to be contaminated by COCs. Appendix A lists the target populations for Phase I. Section A.1.3.1 and Table A.1-7 identify the primary biasing factors and information needs in selecting data collection locations for Phase I decisions. Proposed Phase I sample locations are shown in site-specific figures, which are provided following the sampling description for each parcel of the CAS.

4.2.2.1 Radiological Surveys

Land radiological surveys will be conducted over an estimated 90-acre area near the Kiwi TNT 16,000-ft Arc, an estimated 51-acre area near the Phoebus 1A Test 8,000-ft Arc, and the area 500 ft north and 2,500 ft south of the railroad tracks test pad (i.e., Kiwi TNT Ground Zero) within the Topopah Wash including the RMA. The surveys will be conducted to determine the presence of surficial gamma- and high-energy beta-emitting radiological contaminants exceeding PALs. A combination of walk-over surveys using hand-held instruments and drive-over surveys using a vehicle-mounted detector will be performed resulting in a nearly 100 percent survey as permitted by site accessibility, terrain, and field conditions. A plastic scintillator will be used as the instrument for the walk-over and drive-over surveys. Additional equipment and software that will be used in the radiological data collection and processing include a Trimble™ global positioning system (GPS) receiver, laptop computer to log and process the walk-over and drive-over radiological data, and Surfer™ to plot the data.

4.2.2.2 Intrusive Investigation

Select samples will be submitted for laboratory analysis for the Phase I chemical and radiological parameters identified for each parcel in Section 3.2. Analytical requirements are listed in Table 3-4 and Table 3-5. Laboratory volume requirements are laboratory-specific and will be described in the Field Instructions specific for CAU 529. Quality assurance and quality control requirements for sample collection are discussed in Section 6.0.

Sampling at the Areas of Highest Aerial Deposition

These areas include Phoebus 1A Test 8,000-ft Arc Area, the Kiwi TNT 16,000-ft Arc Area, and the Topopah Wash at TCC (i.e., the area 500 feet north of and 2,500 feet south of the Kiwi TNT Ground Zero including the Radioactive Materials Area) parcels. Radiological land area surveys will be conducted as described in Section 4.2.2.1. Based on the results of the radiological land area survey, a 10- by 10-meter area of the highest contamination will be selected. The 10- by 10-meter area will then be divided into a 3- by 3-meter grid. A surface sample (0- to 0.5-ft bgs) will be collected from the approximate center of each grid. The samples will be sent to an off-site laboratory for isotopic uranium, isotopic strontium, gamma spectroscopy, beryllium, and PCBs analyses.

Sampling at the Buried Contaminated Soil Areas

Samples will be collected from a total of 10 locations. Five locations will be located at BCSA 1 and five locations will be located at the BCSA 2 (Figure 4-1). Samples will be collected continuously from each sample location from land surface to 20 ft bgs at BCSA 1 and to 15 ft bgs at BCSA 2 and screened for radiological parameters. Based on radiological FSRs and other biasing factors, six soil samples from two sample locations within each area (i.e., a total of 12 samples) will be sent to an off-site laboratory for analysis. In the absence of biasing factors at BCSA 1, samples will be selected from just below land surface (i.e., 2 to 3 ft bgs), total depth (i.e., 19 to 20 feet bgs), and the interval considered to be the midpoint (i.e., 9 to 10 feet bgs) of the soil column. In the absence of biasing factors at BCSA 2, samples will be selected below land surface (i.e., 3 to 4 ft bgs), total depth (i.e., 14 to 15 feet bgs), and the interval considered to be the midpoint (i.e., 7 to 8 feet bgs) of the soil column.

Sampling at the Borrow Pit Burial Site

Three trenches will be excavated in an east and west direction over the suspected location of BPBS and field screening activities will be conducted (Figure 4-2). Radiological screening results and other biasing factors will be used to collect three samples from each trench for laboratory analysis. One soil sample will be collected from the 0- to 0.5-ft bgs interval at each trench to determine if surface contamination is present. Two subsurface soil samples will be collected from each trench based on biasing factors. In the absence of biasing factors, the subsurface samples will be collected from the total depth (i.e., 9 to 10 feet bgs) and the interval considered to be the midpoint (i.e., 5 to 6 feet bgs) of the soil column. The sample for the midpoint interval will be collected from one of the trench walls using the backhoe bucket.

Sampling at the Drain/Outfall Discharges

Biased soil samples will be collected from the soil in the immediate vicinity of each discharge point within the wash for the four drains, the former drain pipe discharge (Section 2.3.7), and one outfall (Figure 4-3). Three soil samples will be collected from the surface to a depth of 10 feet bgs at each sample location and sent off site for laboratory analysis. One soil sample will be collected from the 0- to 0.5-ft bgs interval to determine if contamination is present at the surface. The two subsurface soil samples will be collected at each sample location based on biasing factors. In the absence of biasing factors, the subsurface samples will be collected from the total depth (i.e., 9 to 10 feet bgs) of

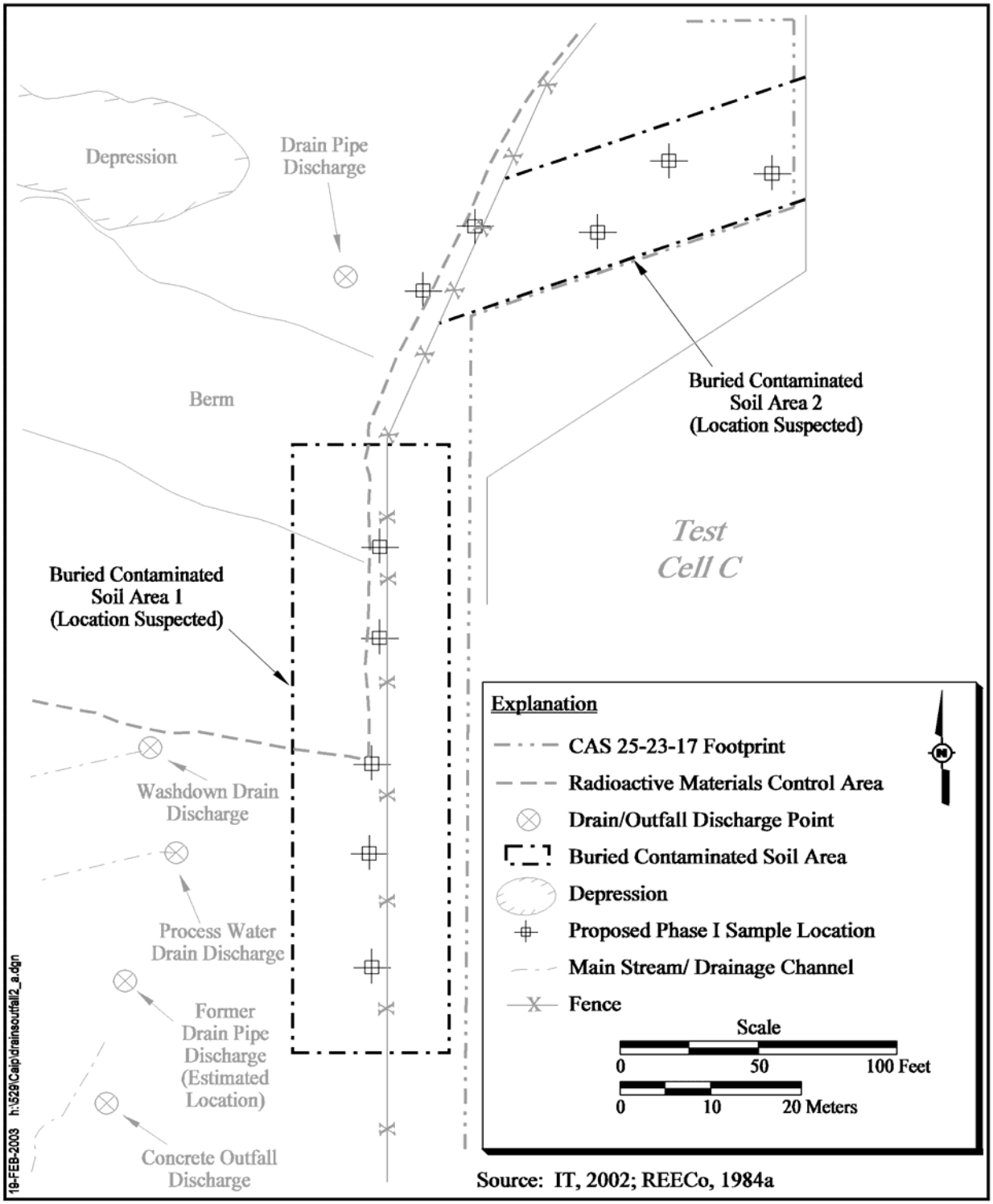

Figure 4-1
CAU 529, CAS 25-23-17
Parcel - Buried Contaminated Soil Areas 1 and 2

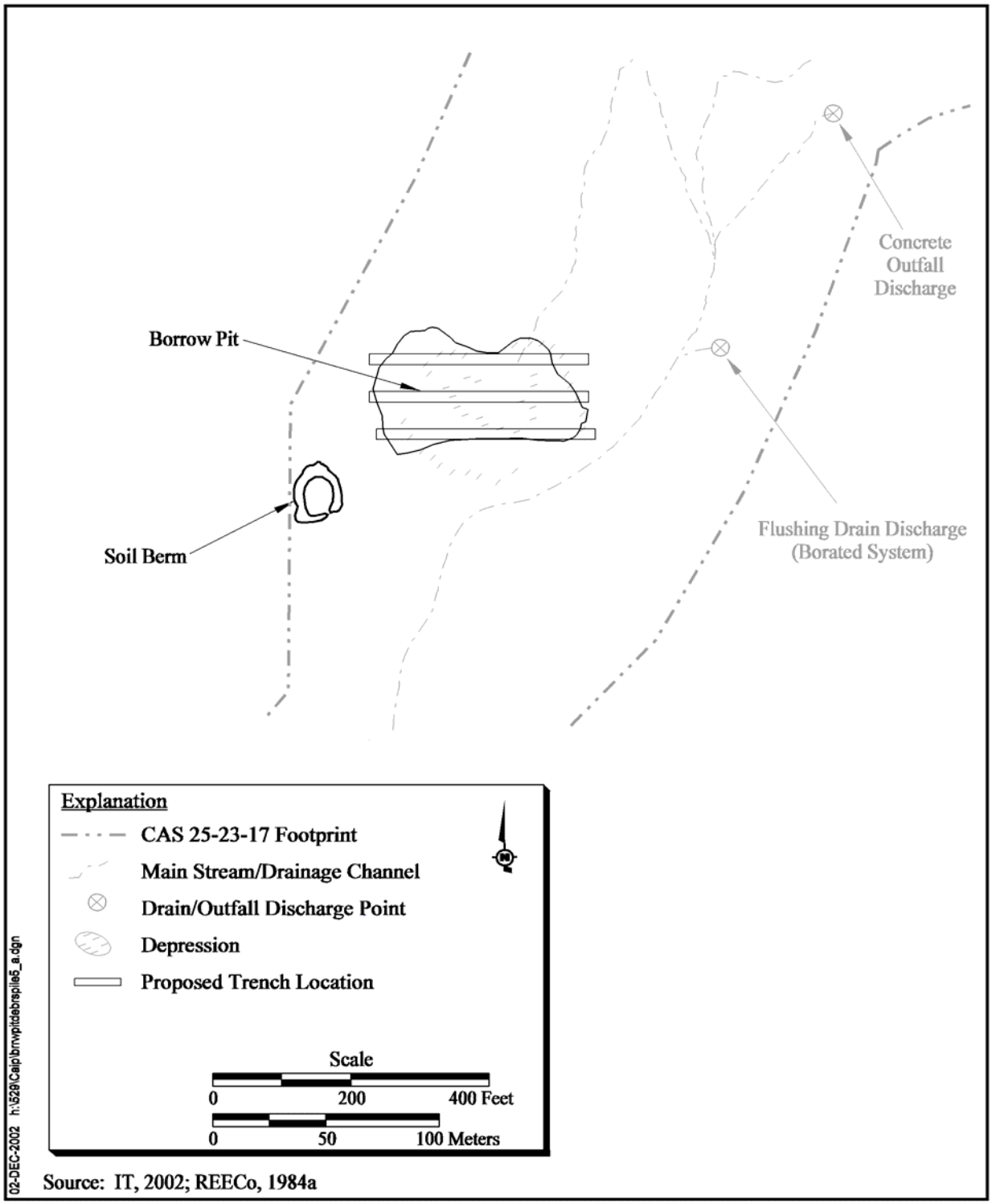

Figure 4-2
CAU 529, CAS 25-23-17
Parcel - Borrow Pit Burial Site

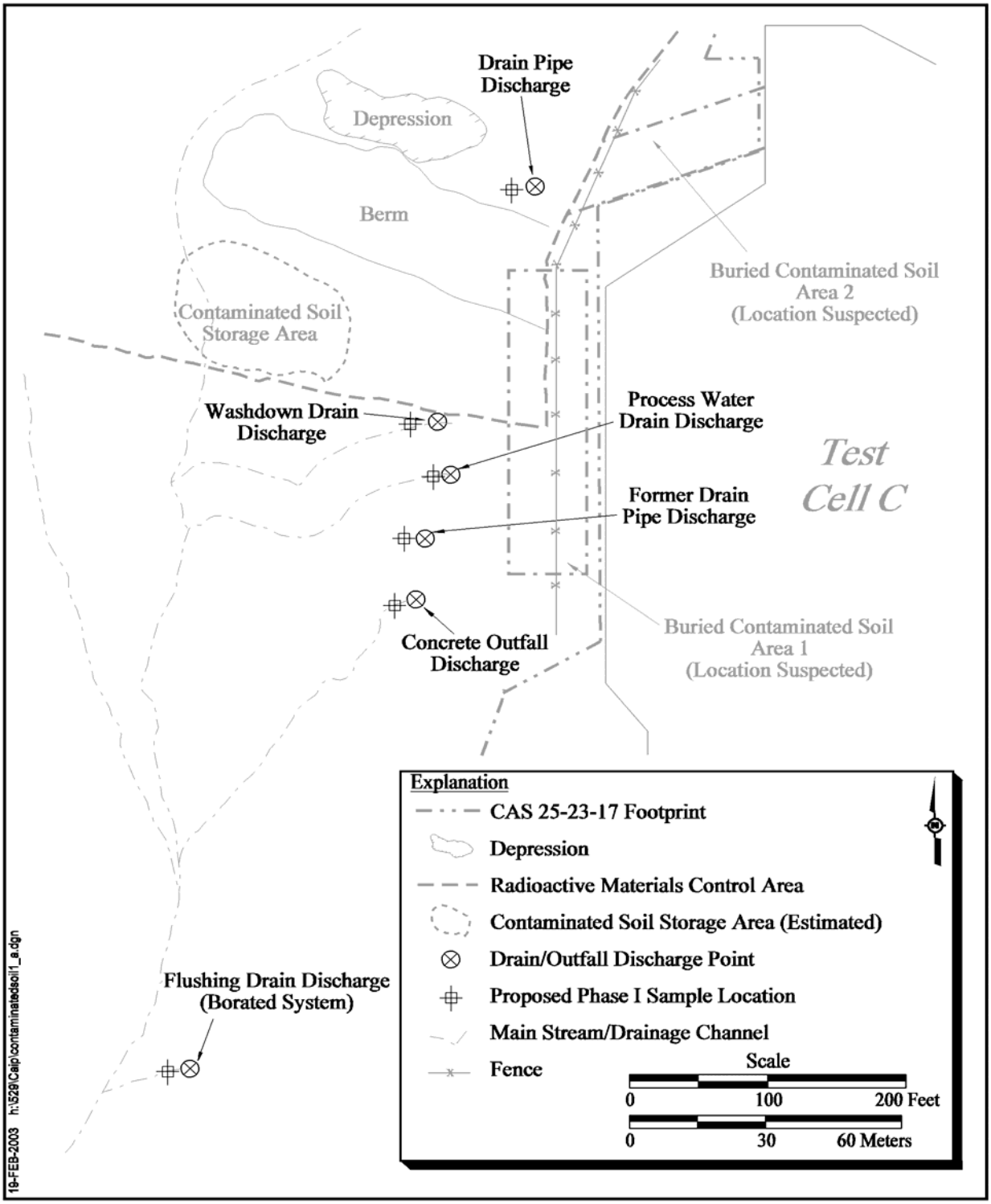

Figure 4-3
CAU 529, CAS 25-23-17
Parcel-Drain/Outfall Discharges

the sample location and from the interval considered to be the midpoint (i.e., 5 to 6 feet bgs) of the soil column at the sample location.

Sampling at the Contaminated Soil Storage Area

The suspected location of the CSSA will be quartered by establishing a north-to-south transect and an east-to-west transect through the parcel (Figure 4-4). One sample location will be placed in each quarter based on biasing factors and sampled. If there are no biasing factors, a sample location will be located in the approximate center of each quarter. Samples will be collected continuously at 1-ft intervals from land surface to a depth of 4 ft bgs from each sample location and field screened for DRO and radiological parameters. Four confirmatory soil samples will be collected from the two sample locations with the highest screening results and sent to an off-site laboratory for analysis. Two of the confirmatory samples will be collected from the 0- to 0.5-ft interval to determine if surface contamination is present. In the absence of biasing factors, the SS will determine the two borings to be sampled for off-site laboratory analysis and the subsurface samples will be collected from the 3- to 4-ft interval.

Sampling of the Main Stream/Drainage Channels

Soil samples will be collected from 10 biased sample locations (Figure 4-5). A hydrologist will identify and locate infiltration points and areas of sedimentation within the wash where contaminated sediments could have been deposited.

Seven of the ten Phase I sample locations will be located within the area of the wash between the 500-ft and 2,500-ft boundaries. This is considered to be the area impacted the most from past TCC releases. The remaining three sample locations will coincide with areas of sedimentation near the Kiwi TNT Arcs (e.g., the 4,000-, 8,000-, and 16,000-ft arcs). Continuous screening will be conducted for radiological parameters and biasing factors from land surface to a depth of 10 ft bgs at each sample location. Three soil samples will be collected for laboratory analysis from each sample location. One soil sample will be collected from the 0- to 0.5-ft bgs interval to determine if contamination is present at the surface. Two subsurface soil samples will be collected based on biasing factors. In the absence of biasing factors, the subsurface samples will be collected from the total depth (i.e., 9 to 10 feet bgs) of the sample location and from the interval considered to be the midpoint (i.e., 5 to 6 feet bgs) of the soil column at the sample location.

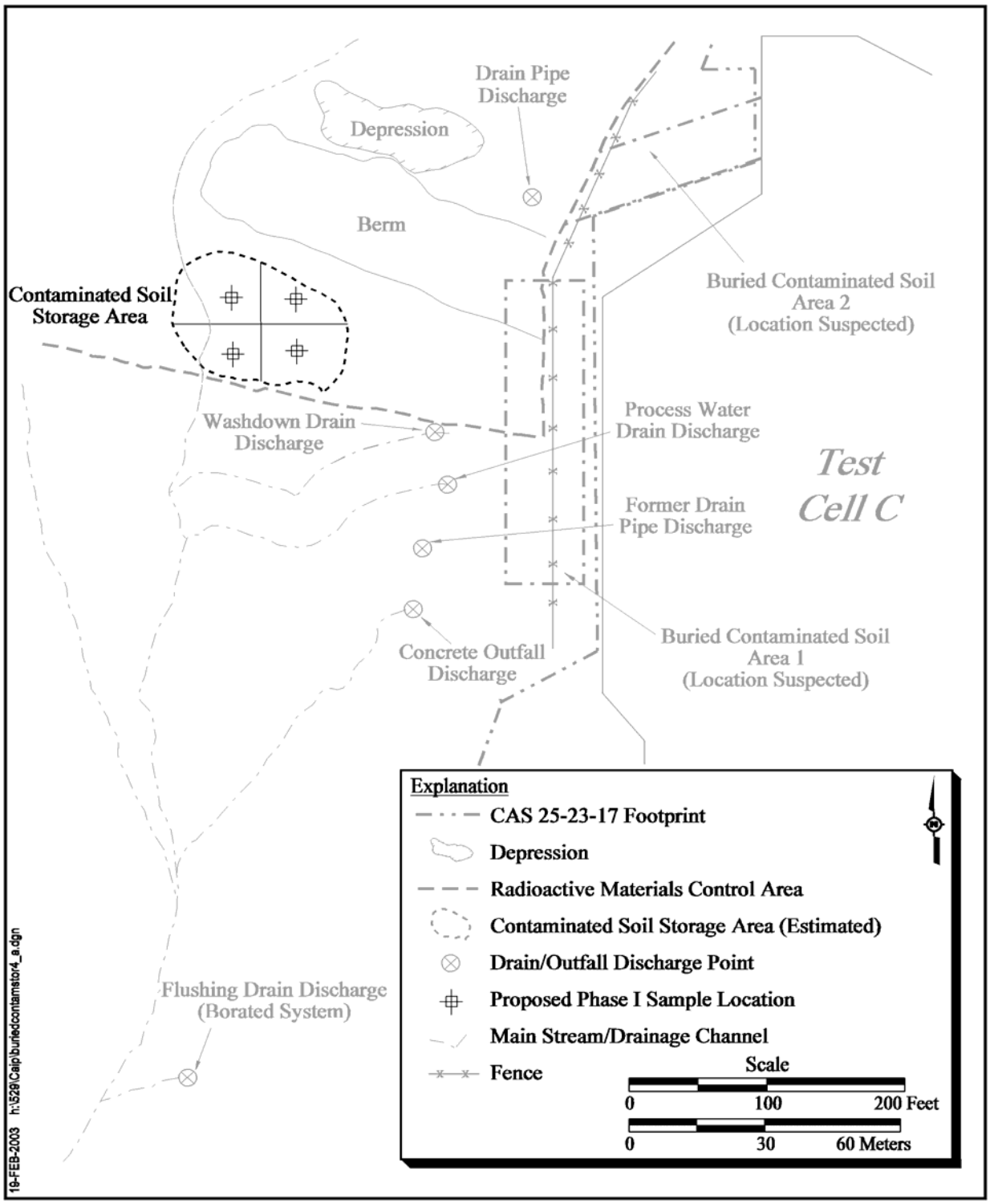

Figure 4-4
CAU 529, CAS 25-23-17
Parcel-Contaminated Soil Storage Area

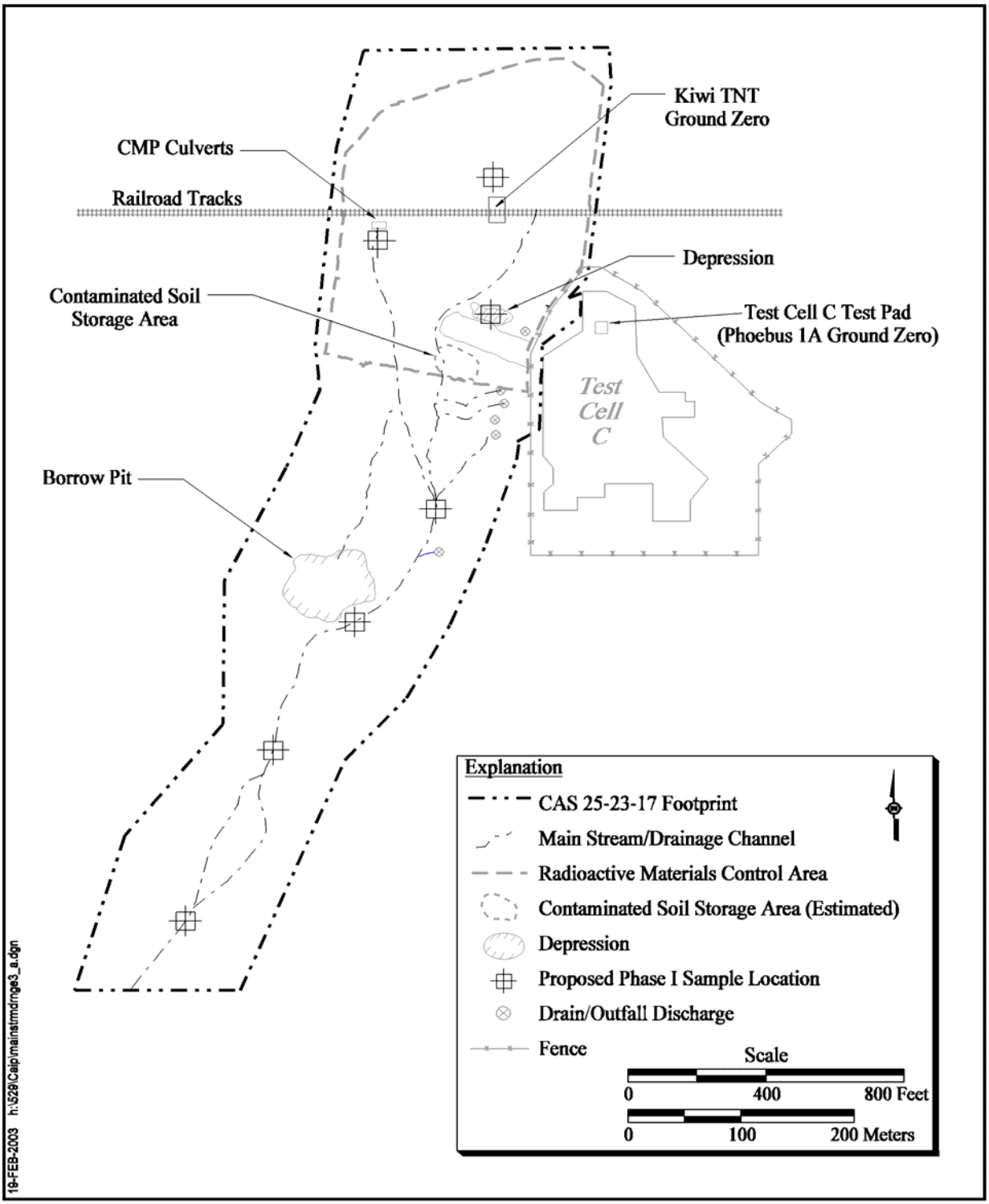

Figure 4-5
CAU 529, CAS 25-23-17
Parcel-Main Stream/Drainage Channels

4.2.3 Phase II Activities

Phase II will define the extent of COC contamination. The lateral and vertical extent of contamination will be bounded by a laboratory analytical soil sample showing COC concentrations below PALs.

The spatial boundaries that apply to this CAS Phase II are defined in Appendix A, Section A.1.4.2. If the nature and/or extent of contamination is inconsistent with the CSM or if contamination extends beyond the identified spatial boundaries, work will be temporarily suspended, NDEP will be notified, and the investigation strategy will be reevaluated. As long as contamination is consistent with the CSM and is within the spatial boundaries, sampling will continue to define extent.

Biased soil samples collected from step-out sample locations at each parcel will be selected based on the outer boundary sample locations where COCs were detected, other biasing factors, and field/site conditions (e.g., limitations posed by steep terrain). If biasing factors indicate COCs extend beyond Phase II sample locations, further step-out locations may be necessary. As field data are generated, the Site Supervisor has the authority to modify these locations but only if the modified locations meet the decision needs and criteria stipulated in Appendix A, Section A.1.3. At each Phase II location, soil samples will be collected at the depth(s) and 2 ft below the lowest depth where COCs were encountered, except at the Drain/Outfall Discharges parcel. At the Drain/Outfalls Discharge parcel, samples will be collected from 4 ft below the lowest depth where COCs were encountered. If the step-out locations from different original locations approach each other, the Site Supervisor may consider this as one area, and collect samples only in the outward directions.

5.0 Waste Management

Management of investigation-derived waste (IDW) will be based on regulatory requirements, field observations, process knowledge, and the results of laboratory analysis of CAU 529 investigation samples.

Disposable sampling equipment, PPE, and equipment rinsate are considered potentially contaminated waste only by virtue of contact with potentially contaminated media (e.g., soil) or potentially contaminated debris (e.g., construction materials). Therefore, sampling and analysis of IDW, separate from analyses of site investigation samples, may not be necessary for all IDW. However, if associated investigation samples are found to contain contaminants above regulatory levels, direct samples of IDW may be taken to support waste characterization.

Sanitary, hazardous, radioactive, and/or mixed waste, if generated, will be managed and disposed of in accordance with DOE Orders, U.S. Department of Transportation (DOT) regulations, state and federal waste regulations, and agreements and permits between DOE and NDEP.

Materials that are thought to potentially contain the hantavirus will be managed and disposed in accordance with appropriate health and safety procedures.

5.1 Waste Minimization

Investigation activities are planned to minimize IDW generation. This will be accomplished by incorporating the use of process knowledge, visual examination, and/or radiological survey and swipe results. When possible, disturbed media (such as soil removed during trenching) or debris will be returned to its original location. Contained media (e.g., soil managed as waste) as well as other IDW will be segregated to the greatest extent possible to minimize generation of hazardous, radioactive, or mixed waste. Hazardous material used at the sites will be controlled in order to limit unnecessary generation of hazardous or mixed waste. Administrative controls, including decontamination procedures and waste characterization strategies, will minimize waste generated during investigations.

5.2 Potential Waste Streams

Waste generated during the investigation activities will include the following:

- PPE and disposable sampling equipment (e.g., plastic, paper, sample containers, aluminum foil, spoons, bowls)
- Decontamination rinsate
- Environmental media (e.g., soil)
- Field screening waste (e.g., soil, spent solvent, rinsate, disposable sampling equipment, and PPE contaminated by field-screening activities)

Each waste stream generated will be reviewed and segregated at the point of generation.

5.3 Investigation-Derived Waste Management

The on-site management and ultimate disposition of IDW may be guided by several factors, including, but not limited to: the analytical results of samples either directly or indirectly associated with the waste, historical site knowledge, knowledge of the waste generation process, field observations, field-monitoring/screening results, and/or radiological survey/swipe results. Table 4-2 of the *NV/YMP Radiological Control Manual* (DOE/NV, 2000d) shall be used to determine if such materials may be declared nonradioactive. On-site IDW management requirements by waste type are detailed in the following sections. Applicable waste management regulations and requirements are listed in Table 5-1.

5.3.1 Sanitary Waste

The IDW that is known to be sanitary waste only may be segregated and dispositioned as it is generated if it meets the waste acceptance criteria for sanitary waste disposal facilities. Sanitary IDW generated at each CAS will be collected in plastic bags, sealed, labeled with the CAS number from each site in which it was generated, and dated. The waste will then be placed in a rolloff box located in Mercury, or other approved rolloff box location. The number of bags of sanitary IDW placed in the rolloff box will be counted as they are placed in the rolloff box, noted in a log, and documented in the field activity daily log (FADL). These logs will provide necessary tracking information for ultimate disposal in the 10c Industrial Waste Landfill or other approved landfill.

Table 5-1
Waste Management Regulations and Requirements

Waste Type	Federal Regulation	Additional Requirements
Solid (nonhazardous)	NA	NRS 444.440 - 444.620[a] NAC 444.570 - 444.7499[b] NTS Landfill Permit SW13.097.04[c] NTS Landfill Permit SW13.097.03[d]
Liquid/Rinsate (nonhazardous)	NA	Water Pollution Control General Permit GNEV93001, Rev. 3iii[e]
Hazardous	RCRA[f]	NRS 459.400 - 459.600[g] NAC 444.850 - 444.8746[h] POC[i]
Low-Level Radioactive	NA	DOE Orders and NTSWAC[j]
Mixed	RCRA[f]	NTSWAC[j] POC[i]
Hydrocarbon	NA	NAC 445A.2272[k] NTS Landfill Permit SW13.097.02[l]
Polychlorinated Biphenyls	TSCA[m]	NRS 459.400 - 459.600[g] NAC 444.940 - 444.9555[o]
Asbestos	TSCA[n]	NRS 618.750-618.801[p] NAC 444.965-444.976[q]

[a]*Nevada Revised Statues* (1998a)
[b]*Nevada Administrative Code* (2002a)
[c]Area 23 (NDEP, 1997a)
[d]U10c Crater located in Area 9 (NDEP, 1997c)
[e]Nevada Test Site Sewage Lagoons (NDEP, 1999)
[f]*Resource Conservation and Recovery Act* (CFR, 2002a)
[g]*Nevada Revised Statues* (1998b)
[h]*Nevada Administrative Code* (2002b)
[i]*Performance Objective for the Certification of Nonradioactive Hazardous Waste* (BN, 1995)
[j]Nevada Test Site Waste Acceptance Criteria, Revision 4 (NNSA/NV, 2002b)
[k]*Nevada Administrative Code* (2002e)
[l]Area 6 Hydrocarbon Landfill (NDEP, 1997b)
[m]*Toxic Substance Control Act* (CFR, 2002b)
[n]*Toxic Substance Control Act* (CFR, 2002c)
[o]*Nevada Administrative Code* (2002c)
[p]*Nevada Revised Statutues* (1998c)
[q]*Nevada Administrative Code* (2002d)

NA = Not applicable
TSCA = *Toxic Substance Control Act*

5.3.2 Hydrocarbon

Hydrocarbon waste is defined as waste containing more than 100 mg/kg of TPH contamination (NAC, 2002e). Hydrocarbon waste will be managed on site in a drum or other appropriate container until fully characterized. Hydrocarbon waste may be disposed of at a designated hydrocarbon landfill (NDEP, 1997b), an appropriate hydrocarbon waste management facility (e.g., recycling facility), or other method in accordance with applicable regulations.

5.3.3 Low-Level Waste

Radiological swipe surveys and/or direct-scan surveys may be conducted on reusable sampling equipment and the PPE and disposable sampling equipment waste streams exiting a radiologically controlled area. This allows for the immediate segregation of radioactive waste from waste that may be unrestricted regarding radiological release. Removable contamination limits, as defined in Table 4-2 of the current version of the *NV/YMP RadCon Manual* (DOE/NV, 2000d), will be used to determine if such waste may be declared unrestricted regarding radiological release versus being declared radioactive waste. Direct sampling of the waste may be conducted to aid in determining if a particular waste unit (e.g., drum of soil) contains low-level radioactive waste, as necessary. Waste that is determined to be below the values of Table 4-2, by either direct radiological survey/swipe results or through process knowledge, will not be managed as potential radioactive waste but will be managed in accordance with the appropriate section of this document. Wastes in excess of Table 4-2 values will be managed as potential radioactive waste and be managed in accordance with this section and any other applicable sections of this document.

Low-level radioactive waste, if generated, will be managed in accordance with the contractor-specific waste certification program plan, DOE Orders, and the requirements of the current version of the Nevada Test Site Waste Acceptance Criteria (NTSWAC) (NNSA/NV, 2002b). Potential radioactive waste drums containing soil, PPE, disposable sampling equipment, and/or rinsate may be staged at a designated RMA or radiologically controlled area (RCA) when full or at the end of an investigation phase. The waste drums will remain at the RMA/RCA pending certification and disposal under NTSWAC requirements (NNSA/NV, 2002b).

5.3.4 Hazardous Waste

The CAU will have waste storage areas that are properly controlled for access and equipped with spill kits and appropriate spill containment. Suspected hazardous wastes will be placed in DOT-compliant containers (CFR, 2001f). All containerized waste will be handled, inspected, and managed in accordance with Title 40 *Code of Federal Regulations* (CFR) 265, Subpart I (CFR, 2001a). These provisions include managing the waste in containers compatible with the waste type, and segregating incompatible waste types so that in the event of a spill, leak, or release, incompatible wastes shall not contact one another. Satellite accumulation areas will be managed consistent with the requirements of 40 CFR 262.34(c)(1) (CFR, 2002a; and NAC, 2002b).

Hazardous Waste Accumulation Areas (HWAAs) will be inspected weekly and will be covered under a site-specific emergency response and contingency action plan until such time that the waste is determined to be nonhazardous or all containers of hazardous waste have been removed from the storage area. Hazardous wastes will be characterized in accordance with the requirements of Title 40 CFR 261 *Resource Conservation and Recovery Act* (RCRA) "listed" waste has not been identified at CAU 529. Hazardous wastes will be transported by an approved hazardous waste transporter to an appropriate, permitted treatment, storage, and disposal facility. Analyses that may be required for the disposal of IDW and respective regulatory levels are identified in Table 3-4. (CFR, 2002a).

Personal Protective Equipment - PPE and disposable sampling equipment will be visually inspected for stains, discoloration, and gross contamination as the waste is generated. Any materials that display these characteristics will be segregated and managed as potentially "characteristic" hazardous waste. This segregated population of waste will either be (1) assigned the characterization of the soil/sludge that was sampled, (2) sampled directly, or (3) undergo further evaluation using the soil/sludge sample results to determine how much soil/sludge would need to be present in the waste to exceed regulatory levels. Waste that is determined to be hazardous will be entered into an approved waste management system, where it will be managed and dispositioned according to RCRA requirements or subject to agreements between NNSA/NSO and the State of Nevada. The PPE/equipment that is not visibly stained, discolored, or grossly contaminated will be managed as nonhazardous waste in accordance with the appropriate section of this document.

Decontamination Rinsate **-** Rinsate at this CAU will not be considered hazardous waste unless there is evidence that the rinsate would display a RCRA characteristic. Evidence may include such things as the presence of a visible sheen, pH, or association with equipment/materials used to respond to a release/spill of a hazardous waste/substance. Decontamination rinsate that is potentially hazardous (using associated sample results and/or process knowledge) will be managed as "characteristic" hazardous waste (CFR, 2002a). The regulatory status of the potentially hazardous rinsate will be determined through the application of associated sample results or through direct sampling. If determined to be hazardous, the rinsate will be entered into an approved waste management system, where it will be managed and dispositioned according to RCRA requirements or subject to agreements between NNSA/NSO and the State of Nevada. If the associated samples do not indicate the presence of hazardous constituents, then the rinsate will be considered to be nonhazardous.

The disposal of nonhazardous rinsate will be consistent with guidance established in current NNSA/NSO Fluid Management Plans for the NTS as follows:

- Rinsate that is determined to be nonhazardous and contaminated to less than 5x *Safe Drinking Water Standards* (SDWS) is not restricted as to disposal. Nonhazardous rinsate which is contaminated at 5x to 10x SDWS will be disposed of in an established infiltration basin or solidified and disposed of as sanitary waste or low-level waste in accordance with the respective sections of this document.

- Nonhazardous rinsate which is contaminated at greater than 10x SDWS will be disposed of in a lined basin or solidified and disposed of as sanitary waste or low-level waste in accordance with the respective sections of this document.

Soil **-** This waste stream consists of soil produced during soil sampling, excavation, and/or drilling. This waste stream is considered to have the same COPCs as the material remaining in the ground. The preferred method for managing this waste stream is to place the material back into the borehole/excavation in the same approximate location from which it originated. If this cannot be accomplished, the material will either be managed on site by berming and covering next to the excavation, or by placement in a container(s). Material that is containerized at a site where hazardous constituents are COPCs will be labeled "Hazardous Waste Pending Analysis." The disposition of containerized material may be deferred until implementation of corrective action at the site.

Field Screening Waste - The use of field test kits and/or instruments may result in the generation of small quantities of hazardous wastes. If hazardous waste is produced by field screening, it will be segregated from other IDW and managed in accordance with the hazardous waste regulations (CFR, 2002a).

On radiological sites, this may increase the potential to generate mixed waste; however, the generation of a mixed waste will be minimized as much as practicable. In the event a mixed waste is generated, the waste will be managed in accordance with Section 5.3.5 of this document.

5.3.5 Mixed Waste

Mixed waste, if generated, shall be managed and dispositioned according to the requirements of RCRA (CFR, 2002a) or subject to agreements between NNSA/NSO and the State of Nevada, as well as DOE requirements for radioactive waste. The waste will be marked with the words "Hazardous Waste Pending Analysis and Radioactive Waste Pending Analysis." Waste characterized as mixed will not be stored for a period of time that exceeds the requirements of RCRA unless subject to agreements between NNSA/NSO and the State of Nevada. The mixed waste shall be transported via an approved hazardous waste/radioactive waste transporter to the NTS transuranic waste storage pad for storage pending treatment or disposal. Mixed waste with hazardous waste constituents below Land Disposal Restrictions may be disposed of at the NTS Area 5 RWMS if the waste meets the requirements of the NTSWAC (NNSA/NV, 2002b). Mixed waste not meeting Land Disposal Restrictions will require development of a treatment and disposal plan under the requirements of the Mutual Consent Agreement between DOE and the State of Nevada (NDEP, 1995).

5.3.6 Polychlorinated Biphenyls and Radioactive Polychlorinated Biphenyls Waste

The management of PCBs is governed by the *Toxic Substances Control Act* (TSCA) (USC, 1976) and its implementing regulations at 40 CFR 761 (CFR, 2002b). Polychlorinated biphenyls contamination may be found as a sole contaminant or in combination with any of the types of waste discussed in this document. For example, PCBs may be a co-contaminant in soil that contains a RCRA "characteristic" waste (PCB/hazardous waste), or in soil that contains radioactive wastes (PCB/radioactive waste), or even in mixed waste (PCB/radioactive/hazardous waste). The IDW will initially be evaluated using analytical results for media samples from the investigation. If any type of

PCB waste is generated, it will be managed according to 40 CFR 761 (CFR, 2002b) as well as State of Nevada requirements (NAC, 2002c), guidance, and agreements with NNSA/NSO.

5.3.7 Asbestos-Containing Materials

Asbestos-containing materials generated during this investigation will be managed and disposed of in accordance with federal regulations (CFR, 2002a) and State of Nevada (NAC, 2002d) regulations.

6.0 Quality Assurance/Quality Control

The primary objective of the corrective action investigation described in this CAIP is to collect accurate and defensible data to support the selection and implementation of a closure alternative for the single CAS in CAU 529. The following two subsections (Section 6.1 and Section 6.2) discuss the QA and QC of the field sampling performance, including the collection of field QC samples, and the QA/QC requirements for laboratory performance and data quality (i.e., acceptability and usability) for use in the decision-making process to achieve closure. Data collected during the corrective action investigation will be evaluated against DQI-specific performance criteria to verify that the DQOs established during the DQO process (Appendix A) have been satisfied.

Unless otherwise stated in this CAIP or required by the results of the DQO process (Appendix A), this investigation will adhere to the QA/QC requirements in the Industrial Sites QAPP (NNSA/NV, 2002a).

The discussion of the DQIs, including the datasets, will be provided in the CAU 529 CADD to be developed at the completion of the corrective action investigation.

6.1 Quality Control Field Sampling Activities

Field QC samples will be collected in accordance with approved procedures. Field QC samples are collected and analyzed to aid in determining the validity of sample results. The number of required QC samples depends on the types and number of investigation (i.e., environmental and waste characterization) samples collected. The minimum frequency of collecting and analyzing QC samples established for this investigation include:

- Trip blanks (1 per sample cooler containing VOC environmental samples)
- Equipment blanks (1 per sampling event for each type of decontamination procedure)
- Source blanks (1 per source lot per sampling event)
- Field duplicates (minimum of 1 per matrix per 20 environmental samples)

- Field blanks (minimum of 1 per 20 environmental samples or 1 per sampling day, whichever best exemplifies field conditions)

- Matrix spike (MS)/matrix spike duplicate (MSD), (minimum of 1 each per matrix per 20 environmental samples), as required by method.

Additional QC samples may be submitted based on site conditions and technical judgement of the Site Supervisor. Field QC samples shall be analyzed using the same analytical procedures implemented for associated environmental samples. Additional details regarding field QC samples are available in the Industrial Sites QAPP (NNSA/NV, 2002a).

6.2 Laboratory and Analytical Quality Assurance

Criteria for Phase I and Phase II, as stated in the DQOs (Appendix A) (except where noted) require valid quality data be used for making critical decisions. Rigorous QA/QC will be implemented for all laboratory samples including documentation, data verification and validation of analytical results, and an assessment of DQIs as they relate to laboratory analysis.

6.2.1 Data Validation

Data verification and validation will be performed in accordance with the Industrial Sites QAPP (NNSA/NV, 2002a) and applicable procedures. All organic and inorganic laboratory data from samples collected and analyzed will be evaluated for data quality according to *EPA Contract Laboratory Program National Functional Guidelines* (EPA, 1994a and 1999). Radiological laboratory data from samples that are collected and analyzed will be evaluated for data quality according to company-specific procedures. The data will be reviewed to ensure that all critical samples were appropriately collected and analyzed, and that the results met data validation criteria. Validated data will be assessed to determine if they meet the DQO requirements of the investigation and the performance criteria for the DQIs. The results of this assessment will be documented in the CAU 529 CADD. If the DQOs are not met, impact to the corrective action alternatives for closure will be evaluated. Based on the evaluation, the appropriate corrective action will be selected and implemented (e.g., refine CSM or resample) to fill data gaps.

6.2.2 Data Quality Indicators

Data quality indicators are quantitative and qualitative descriptors used in determining the degree of acceptability or usability of data. The DQIs established to evaluate the quality of CAU 529 data are precision, accuracy, representativeness, comparability, completeness, and sensitivity. Data quality indicators are used to evaluate the entire measurement system, the laboratory measurement processes (i.e., analytical method performance), and individual analytical results (i.e., parameter performance).

Representativeness and comparability are qualitative measures. Completeness, accuracy, and precision are quantitative measurements. Precision and accuracy are used to assess the overall analytical method and field-sampling performance as well as to assess the need to qualify the usability of individual parameter results when corresponding QC sample results are not within established control limits. Therefore, performance metrics have been established for both analytical methods and individual analytical results.

Table 6-1 provides the established analytical method/measurement system performance criteria for each of the DQIs and the potential impacts to the decision if the criteria are not met. The Industrial Sites QAPP (NNSA/NV, 2002a) requires conditions that adversely affect data quality (i.e., nonconformances), both in the field and the laboratory, be documented. Corrective actions required to mitigate adverse field conditions are tracked to verify successful implementation. All DQI performance criteria deficiencies will be evaluated for data usability and impacts to the DQO decisions. These evaluations will be discussed and documented in the data assessment section of the CAU 529 CADD. The following subsections discuss each of the DQIs that will be used to assess the quality of laboratory data.

6.2.3 Precision

Precision is used to assess the variability of sample collection, handling, preservation, and storage along with the variability of the analysis process. It is used to evaluate the performance of analytical methods as well as to evaluate the usability of individual analytical results. Precision is a measure of agreement among a replicate set of measurements of the same property under similar conditions. This agreement is expressed as the relative percent difference (RPD) between duplicate measurements (EPA, 1996).

Table 6-1
Laboratory and Analytical Performance Criteria for CAU 529 Data Quality Indicators

Data Quality Indicator	Performance Criteria	Potential Impact on Decision if Performance Criteria Not Met
Precision	Variations between duplicates (laboratory and field) and original sample should not exceed analytical method-specific criteria discussed in Section 6.2.3.	Data that do not meet the performance criteria will be evaluated for purposes of evaluating completeness. Decisions may not be valid if analytical method performance criteria for precision are not met.
Accuracy	Laboratory control sample (LCS) results and matrix spike (MS) results should be within Section 6.2.4. and surrogates.	Data that do not meet the performance criteria will be evaluated for purposes of evaluating completeness. Decisions may not be valid if analytical method performance criteria for accuracy are not met.
Sensitivity	Detection limits of laboratory instruments must be less than or equal to respective PALs.	Cannot determine if COCs are present at levels of concern; therefore, the affected data will be assessed for usability and potential impacts on meeting site characterization objectives.
Comparability	Consistent sampling, handling, preparation, analysis, reporting, and validation criteria will be used. Approved standard methods and procedures will be used to analyze and report the data.	Inability to compare investigation results to established databases and PALs.
Representativeness	Correct analytical method performed for appropriate COPC; valid data reflects appropriate target population.	Cannot identify COC or estimate concentration of COC; therefore, cannot make decision(s) on target population.
Phase I Completeness	Critical COPCs have valid results on 100% of the samples. The remaining COPCs have valid results on 80% of the CAS-specific samples.	Cannot make decision on whether COCs are present above PALs with high confidence.
Phase II Completeness	100% of the CAS-specific samples and analyses used to define extent of COCs.	Decision of whether or not extent of contamination has been bounded cannot be determined.

Determinations of precision will be made for field duplicate samples and/or laboratory duplicate samples. Field duplicate samples will be collected simultaneously with samples from the same source under similar conditions in separate containers. The duplicate sample is treated independently of the original sample in order to assess field impacts and laboratory performance on precision through a comparison of results. Laboratory precision is evaluated as part of the required laboratory internal QC program to assess performance of analytical procedures. The laboratory sample duplicates are an aliquot, or subset, of a field or QC sample generated in the laboratory. They are not a separate sample but a split, or portion, of an existing sample. Typically, laboratory duplicate QC samples include MSDs or laboratory control sample duplicates (LCSDs) for organic and radiological analyses. Duplicate, MSDs, and LCSD are typically used for inorganic analyses.

6.2.3.1 Precision for Chemical Analysis

The RPD criteria for precision of organics are based on laboratory-specific control limits and are evaluated at the laboratory on a quarterly basis by monitoring the historical data and performance for each method. The precision criteria for inorganics is 20 percent for water samples and 35 percent for solid samples. No review criteria for field duplicate RPD comparability have been established; therefore, the laboratory sample duplicate criteria for RPD will be applied to the review of field duplicates as a guideline.

The parameter performance criteria for precision will be compared to RPD results of duplicate samples. This will be accomplished as part of the data validation process. Precision values for organic and inorganic analyses that are within the established control criteria indicate that analytical results for associated samples are valid. The RPD values that are outside the criteria for organic analysis do not necessarily result in the qualification of analytical data. It is only one factor in making an overall judgment about the quality of the reported analytical results. However, inorganic laboratory sample duplicate RPD values outside the established control criteria may result in the qualification of associated analytical results as estimated. Qualified data does not necessarily indicate that the data are not useful for the purpose intended; however, it is an indication that data precision should be considered for the overall assessment of the data quality and potential impact on data applicability in meeting the DQOs.

The criteria to evaluate analytical method performance for precision (Table 6-1) will be assessed based on the analytical method-specific (e.g., volatile organic compounds [VOCs]) precision measurements. Each analytical method-specific precision measurement will be assessed for potential impacts on meeting the DQOs, and results of the assessment will be documented in the CADD.

6.2.3.2 Precision for Radiological Analysis

The parameter performance criteria for precision will be compared to the RPD or normalized difference (ND) results of duplicate samples. This assessment will be accomplished as part of the data validation process. Precision values that are within the established control limit indicate that analytical results for associated samples are valid. The RPD control limit for radiological measurements has been set at 35 percent for soil and 20 percent for water. Out of control RPD or ND values do not necessarily indicate that the data are not useful for the purpose intended; however, it is an indication that data precision should be considered for the overall assessment of the data quality and the potential impact on data applicability in meeting site characterization objectives.

If the RPD or ND criteria are exceeded, samples will be qualified. Field duplicates will be evaluated, but field samples will not be qualified based on their results. The MSD results outside of the control limits may not result in qualification of the data. An assessment of the entire analytical process, including the sample matrix, is conducted to determine if qualification is warranted.

The evaluation of precision based on duplicate RPD requires that both the sample and its duplicate have concentrations of the target radionuclide exceeding five times their MDC. This excludes many measurements because the samples contain nondetectable or low levels of the target radionuclide. However, the ND method may be used for evaluating duplicate data where the results are less than five times their MDCs. This is based on the measurement uncertainty associated with results. The ND test is calculated using the following formula:

Normalized Difference = $$S - D / \sqrt{(TPU_S)^2 + (TPU_D)^2}$$

Where:

S = Sample result
D = Duplicate result

TPU = Total propagated uncertainty
TPUs = 2 sigma TPU of the sample
TPUd = 2 sigma TPU of the duplicate

The control limit for the ND is -1.96 to 1.96, which represents a confidence level of 95 percent.

The criteria to evaluate analytical method performance for precision will be based on the analytical method-specific (e.g., gamma spectrometry) precision measurements. Analytical method-specific precision measurement is reported as a range and mean of the RPD or ND criteria, or other appropriate reporting method.

Each analytical method-specific precision measurement will be assessed for potential impacts on meeting the DQOs, and results of the assessment will be documented in the CADD.

6.2.4 Accuracy

Accuracy is a measure of the closeness of an individual measurement or the average of a number of measurements to the true value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that result from sampling and analytical operations. Accuracy is used to assess the performance of laboratory measurement processes as well as to evaluate individual groups of analyses (i.e., sample delivery groups).

Accuracy is determined by analyzing a reference material of known parameter concentration or by reanalyzing a sample to which a material of known concentration or amount of parameter has been added (spiked). The measure of accuracy is expressed as the percent recovery (%R) (NNSA/NV, 2002a). This is calculated by dividing the measured sample concentration by the true concentration and multiplying the quotient by 100.

6.2.4.1 Accuracy for Chemical Analyses

For organics, limits are developed by the laboratory and reviewed after every quarter and are updated when necessary. The laboratory tracks trends in both performance and control limits by the use of control charts. The laboratory's compliance with these requirements is confirmed as part of a laboratory audit. Similar procedures are followed in order to generate acceptance criteria for precision measurements. The acceptable control limits for inorganic analyses are established in the

EPA *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA, 1994a). The %R criteria for inorganics is 75 to 125 percent for MS and 80 to 120 percent for LCS.

Accuracy for chemical analyses will be evaluated based on results from three types of spiked samples: MS, LCS, and surrogates (organics only).

The %R parameter performance criteria for accuracy will be compared to %R results of spiked samples. Surrogate %R is used to evaluate the individual sample accuracy and, therefore, not used to evaluate overall method performance accuracy. This will be accomplished as part of the data validation process. Accuracy values for organic and inorganic analysis that are within the established control criteria indicate that analytical results for associated samples are valid. The %R values that are outside the criteria do not necessarily result in the qualification of analytical data. It is only one factor in making an overall judgment about the quality of the reported analytical results. Factors beyond the laboratory's control, such as sample matrix effects, can cause the measured values to be outside of the established criteria. Therefore, the entire sampling and analytical process must be evaluated when determining the quality of the analytical data provided.

The criteria to evaluate accuracy (Table 6-1) will be based on the analytical method-specific (e.g., VOCs) MS, LCS, and surrogate accuracy measurements.

6.2.4.2 Accuracy for Radiological Analysis

Accuracy for radiological analyses will be evaluated based on results from LCS and MS samples. The LCS is prepared by adding a known concentration of the radionuclide being measured to a sample that does not contain radioactivity (i.e., distilled water). This sample is analyzed with the field samples using the same sample preparation, reagents, and analytical methods employed for the samples. One LCS is prepared with each batch of samples for analysis by a specific measurement.

The MS samples are prepared by adding a known concentration of a target parameter to a specified field sample with a measured concentration. The MS samples are analyzed to determine if the measurement accuracy is affected by the sample matrix. The MS samples are analyzed with sample batches when requested.

The %R criteria to be used for assessment of accuracy will be the control limits for radiological analyses listed in Table 3-5. These criteria will be used to assess qualification of data associated with each spiked sample. This will be accomplished as part of the data validation process.

The criteria to evaluate accuracy (Table 6-1) will be assessed based on the analytical method-specific (e.g., gamma spectrometry) accuracy measurements.

6.2.5 Representativeness

Representativeness is the degree to which sample data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, or an environmental condition (EPA, 1987). Representativeness is assured by a carefully developed sampling strategy, collecting the specified number of samples from proper sampling locations, and analyzing them by the approved analytical methods. Representativeness may be assured by reviewing field documentation, operating in accordance with approved procedures and plans, conducting field surveillances, and field-collected blank data. Biased samples are designed to be representative of the target population being investigated as opposed to the entire population. Therefore, during the DQO process, the target populations identified are those locations deemed most likely to contain contaminants.

6.2.6 Completeness

The criterion for meeting completeness is defined as generating sufficient data of the appropriate quality to satisfy the data needs identified in the DQOs. The quantitative measurement to be used to evaluate completeness is presented in Table 6-1 and is based on the percentage of sample locations sampled, percentage of samples analyzed, and the measurements made that are judged to be valid. Percent completeness for measurement usability (not rejected) is determined by dividing the total number of valid analyses by the total number of analyses per CAS required to meet DQO data needs and multiplying by 100. Problems that may affect completeness include total number of samples sent to the laboratory but not analyzed due to problems with samples (e.g., broken bottles, insufficient quantity, insufficient preservation), samples that were collected and sent but never received by the laboratory, and rejected data. If these criteria are not achieved, the datasets will be assessed for potential impacts on meeting DQOs.

6.2.7 Comparability

Comparability is a qualitative parameter expressing the confidence with which one dataset can be compared to another (EPA, 1987). For this investigation, comparability must exist with the PAL and regulatory level datasets. To ensure comparability, all samples will be subjected to the same sampling, handling, preparation, and validation criteria in accordance with approved procedures. Approved standard methods and procedures will also be used to analyze and report the data (e.g., Contract Laboratory Program [CLP] and/or CLP-like data packages). An evaluation of this qualitative criterion will be presented in the CAU 529 CADD.

6.2.8 Sensitivity

Sensitivity is a quantitative parameter that evaluates the capability of a method or instrument to measure parameter concentrations at or near decision levels. The evaluation criteria for this parameter will be that measurement detection limits are lower than the corresponding PALs. If this criterion is not achieved, the affected data will be assessed for usability and potential impacts on meeting site characterization objectives.

7.0 Duration and Records Availability

7.1 Duration

After the submittal of the CAIP to NDEP (FFACO milestone date of April 30, 2003), the following is a tentative schedule of activities (in calendar days):

- Day 0: Preparation for field work will begin.
- Day 67: The field work, including sample collection activities, will commence. Samples will be shipped to meet laboratory holding times.
- Day 166: The field investigation will be completed.
- Day 220: The quality-assured laboratory analytical data will be available for NDEP review.
- The FFACO date for the CADD has not been established.

7.2 Records Availability

Historic information and documents referenced in this plan are retained in the NNSA/NSO project files in Las Vegas, Nevada, and can be obtained through written request to the NNSA/NSO Project Manager. This document is available in the DOE public reading rooms located in Las Vegas and Carson City, Nevada, or by contacting the appropriate DOE Project Manager. The NDEP maintains the official Administrative Record for all activities conducted under the auspices of the FFACO.

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Appendix A

Data Quality Objectives

A.1.0 Seven-Step DQO Process

The DQO process is a strategic planning approach based on the scientific method that is used to prepare for site characterization data collection. The DQOs are designed to ensure that the data collected will provide sufficient and reliable information to identify, evaluate, and technically defend potentially viable corrective actions (i.e., no further action, closure in place, or clean closure). The existing information about the nature and extent of contamination at CAU 529, CAS 25-23-17, Contaminated Wash is insufficient to evaluate and select preferred corrective actions. The CAU 529 investigation will be based on DQOs developed by representatives of the NDEP and the NNSA/NSO.

Due to the large area impacted by past CAS 25-23-17 operations, the CAS was divided into smaller units (i.e., parcels) based on the type of releases that occurred at the site. This approach focuses primarily on areas impacted the most by past TCC activities (i.e., the worst-case scenario). Descriptions of the CAS 25-23-17 releases and impacted areas are summarized below and presented in greater detail in Section 2.0 of the CAIP.

- Aerial Dispersion - Area impacted by environmental contaminants released to Topopah Wash and the surrounding area from effluent plume fallout due to nuclear reactor testing activities (in particular from the Kiwi-TNT and Phoebus 1A). The Kiwi TNT excursion produced a cloud of debris that contained more than half of the core fuel. The cloud carried southwest of the test pad along the Topopah Wash. The highest recorded deposition of fallout from the Kiwi TNT occurred in two primary areas: within the 4,000-ft arc and over an estimated 90-acre area approximately 16,000 ft to the southwest of Kiwi TNT Ground Zero. During the Phoebus 1A test, an accidental loss of coolant resulted in a cloud of debris that was primarily carried in a northwest direction by prevailing winds. The highest recorded area of deposition of fallout from the Phoebus 1A cloud occurred approximately 8,000 ft northwest of TCC. The areas of highest deposition are shown in Figure A.1-1.

- Buried Material - Area impacted by the disposal of contaminated soil and debris. According to documentation, contaminated soil generated during the decontamination operations associated with reactor testing activities was buried at locations within and adjacent to the wash. Two suspected burial locations for contaminated soil have been identified and designated as BCSA 1 and BCSA 2 (see Figure A.1-2). It was reported that contaminated soil and debris may have been disposed of in a borrow pit within the wash; however, the exact location of the burial site is unknown. The suspected location of the buried material has been identified as the Borrow Pit Burial Site (BPBS) (see Figure A.1-2).

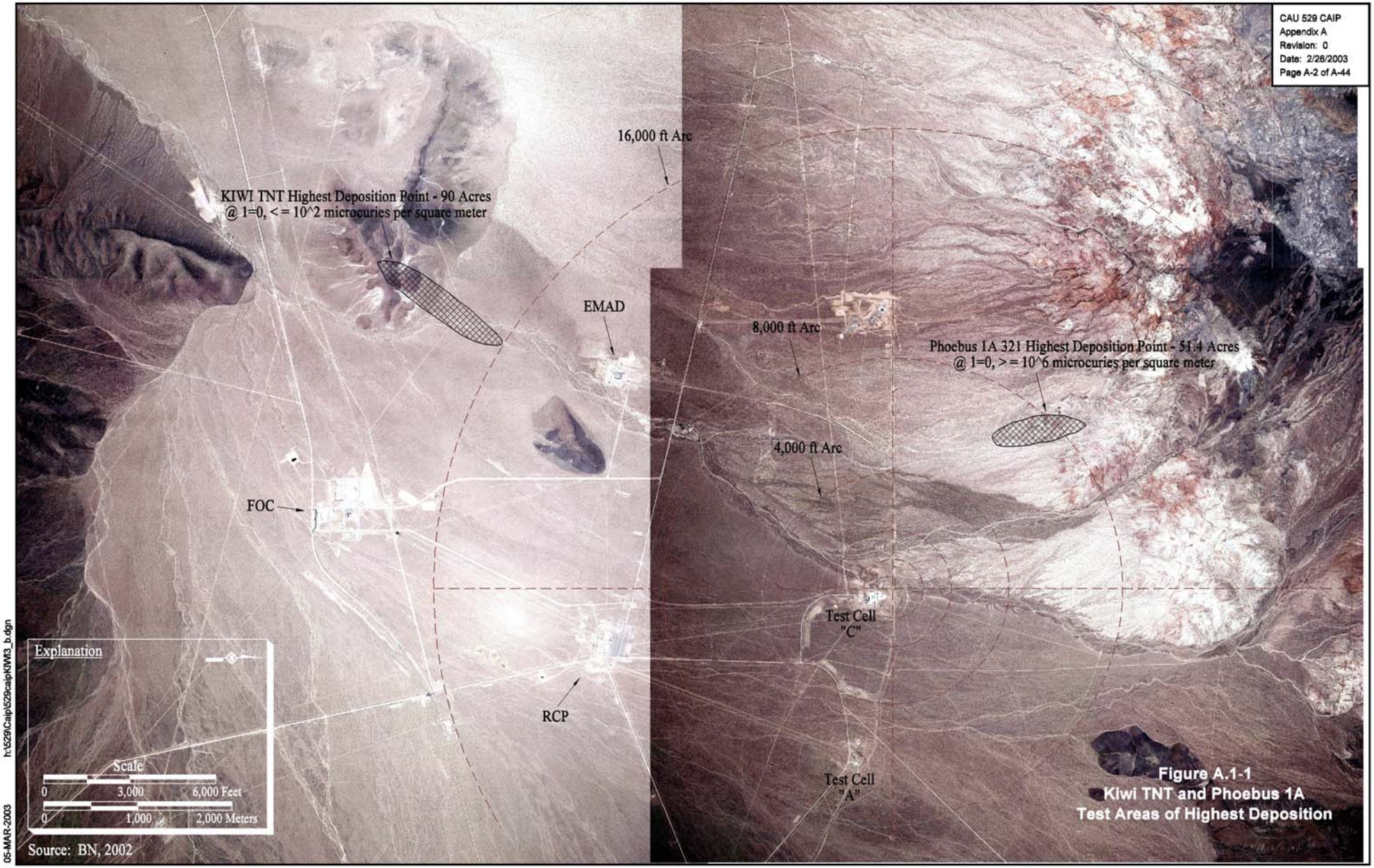

Figure A.1-1
Kiwi TNT and Phoebus 1A
Test Areas of Highest Deposition

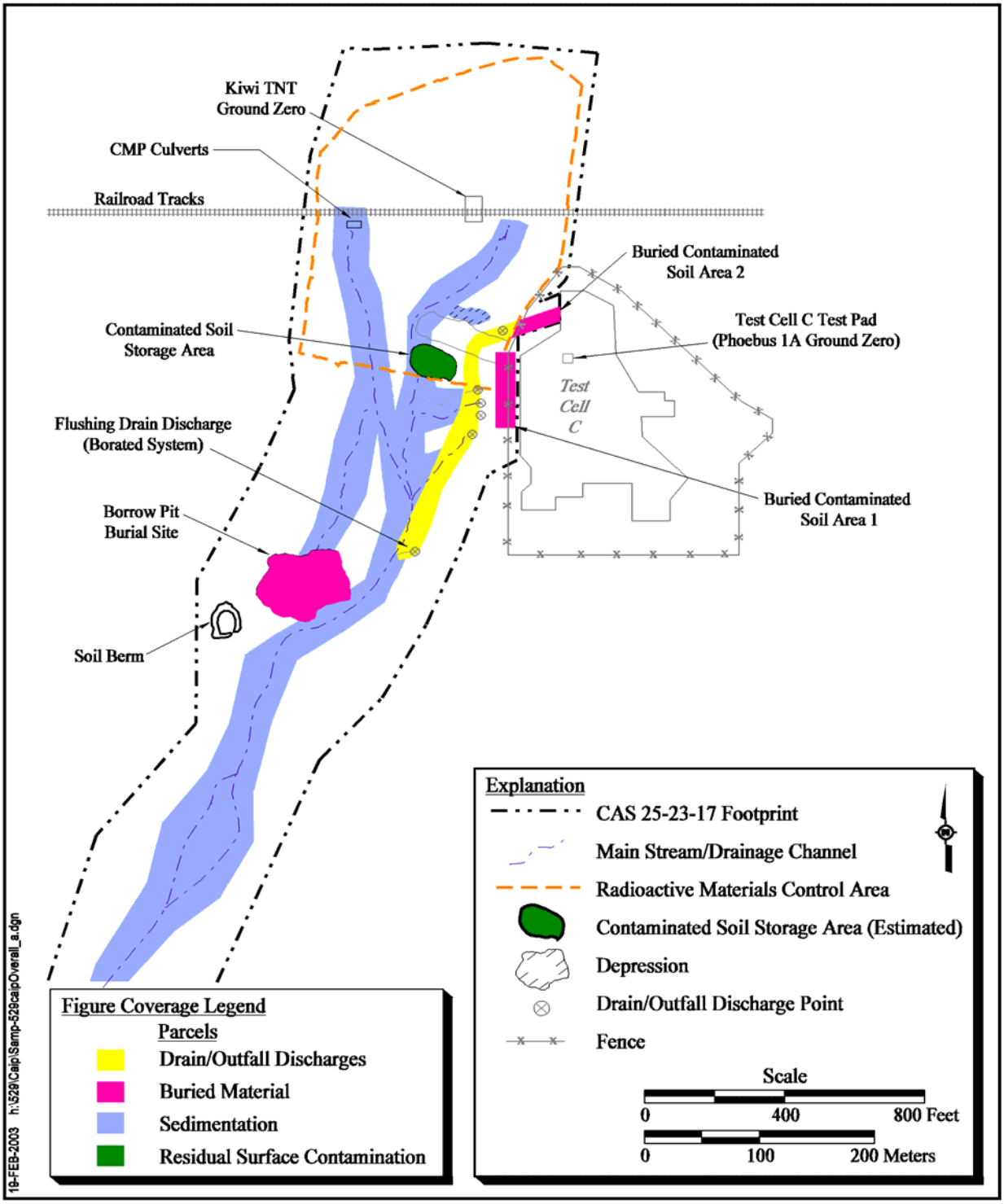

Figure A.1-2
CAU 529, CAS 25-23-17 Parcel Locations Map

- Drain/Outfall Discharges - Area impacted by surface water runoff from TCC, and process water (e.g., the 211,000-gallon release of borated water) discharge from 5 drains and 1 outfall at TCC as shown in Figure A.1-2.

- Residual Surface Contamination - Area impacted by residual surface contamination as a result of past waste storage and disposal activities. Contaminated soil was stored in a pile within the wash and sprayed with oil to prevent wind erosion. This area has been designated the CSSA and is located within the banks of the wash directly west of the TCC dewars pad and south of the bermed area as shown in Figure A.1-2.

Each parcel of the CAS will begin with Phase I investigation activities. If a COPC is detected in any Phase I laboratory sample at a concentration above its corresponding PAL, the COPC will be identified as a COC. Phase II investigation activities will be associated with defining the lateral and vertical extent of COCs. The following sections present the seven-step DQO process for Phase I and Phase II investigation activities to be conducted at CAS 25-23-17.

A.1.1 Step 1 – State the Problem

This step identifies the DQO planning team members, describes the problem that has initiated the CAU 529 investigation, and develops the CSMs.

A.1.1.1 Planning Team Members

The DQO planning team consists of representatives from NDEP, NNSA/NSO, ITLV, and BN. The primary decision-makers include NDEP and NNSA/NSO representatives. Table A.1-1 lists representatives from each organization in attendance for the October 31, 2002, DQO Kickoff meeting.

A.1.1.2 Describe the Problem

Corrective Action Unit 529 is being investigated because:

- Hazardous and/or radioactive constituents may be present at concentrations and locations that could potentially pose a threat to human health and the environment.

- Disposed waste may be present without appropriate controls (i.e., use restrictions, adequate cover).

Table A.1-1
DQO Meeting Participants

Participant	Affiliation
Steven Adams	ITLV
Stacey Alderson	ITLV
Kevin Cabble	NNSA/NSO
Dudley Emer	BN
John Fowler	ITLV
Syl Hersh	ITLV
Bridget Iverson	ITLV
Lynn Kidman	ITLV
Joe Peters	ITLV
Wayne Stoner	ITLV
Allison Urbon	BN
Jeanne Wightman	ITLV
Dustin Wilson	ITLV
John Wong	NDEP
Julie Snelling-Young	ITLV

BN - Bechtel Nevada
ITLV - IT Corporation, Las Vegas Office
NDEP - Nevada Division of Environmental Protection
NNSA/NSO - U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office

A.1.1.3 Develop Conceptual Site Model

Five CSMs have been developed for CAU 529 using assumptions formulated from the physical setting, potential contaminant sources/release information, and historical background information. The CSMs are termed *Aerial Dispersion*, *Buried Material*, *Drain/Outfall Discharges*, *Residual Surface Contamination*, and *Sedimentation*. The applicability of the CSMs to each parcel of the site is summarized in Table A.1-2.

Conceptual Site Models describe the most probable scenarios for current conditions at specific sites and define the assumptions that are the basis for identifying appropriate sampling strategy and data

Table A.1-2
Conceptual Site Models and Associated Parcels

Conceptual Site Models	CAU 529 Parcels								
	Kiwi TNT 16,000-foot Arc	Phoebus 1A Test 8,000-foot Arc	Topopah Wash at TCC	Buried Contaminated Soil Area 1	Buried Contaminated Soil Area 2	Borrow Pit Burial Site	Drain/Outfall Discharges	Contaminated Soil Storage Area	Main Stream/Drainage Channels
Aerial Dispersion	X	X	X						
Buried Material				X	X	X			
Drain/Outfall Discharges							X		
Residual Surface Contamination								X	
Sedimentation	X	X	X	X	X	X	X	X	X

collection methods. Accurate CSMs are important as they serve as the basis for all subsequent inputs and decisions throughout the DQO process.

An important element of a CSM is the expected fate and transport of contaminants, which infer how contaminants move through site media and where they can be expected in the environment. The expected fate and transport is based on distinguishing physical characteristics of the contaminants and media. Contaminant characteristics include solubility, density, and particle size. Media characteristics include permeability, saturation, sorting, chemical composition, and adsorption coefficients. In general, contaminants with low solubility and high density can be expected to be found relatively close to release points. Contaminants with high solubility and low density can be expected to be found further from release points or in areas where deposition may occur.

Groundwater contamination is not considered a likely scenario at CAU 529 based on the low annual average precipitation rates, high potential evapotranspiration, and low mobility of expected COPCs (e.g., radionuclides, PCBs, petroleum hydrocarbons, SVOCs, and metals). Soil samples were

collected for VOCs, SVOCs, radionuclides, PCBs, petroleum hydrocarbons, and metals during previous investigations conducted at TCC (i.e., CAU 262 CASs) (DOE/NV, 2001). With the exception of VOCs, the concentrations of COPCs generally decreased with depth and COCs were not detected at a depth greater than 9 ft bgs. This amount of vertical migration is insignificant when compared to the estimated depth of groundwater at the site which, ranges from approximately 740 to 1,045 ft bgs. (USGS, 2002) The lateral migration of contaminants at CAU 529 is a more likely scenario due to surface erosion and channelized flow resulting from severe weather conditions (i.e., storms or flash floods).

Future Land-Use Scenarios

Future land-use scenarios limit uses of the CAS to various nonresidential (i.e., industrial) uses. The future land-use scenarios for CAU 529 are research, test, and experiment. This area is designated for small-scale research and development projects and demonstrations; pilot projects; outdoor tests; and experiments for the development, quality assurance, or reliability of material and equipment under controlled conditions. This also includes compatible defense and nondefense research, development, and testing projects and activities. (DOE/NV, 1998)

Exposure to contamination at sites within the NTS boundaries is limited to industrial and construction workers as well as military personnel conducting training. These human receptors may be exposed to COPCs through ingestion, inhalation, or dermal contact (absorption) of soils and/or debris (e.g., equipment, concrete) due to inadvertent disturbance of these materials.

Although the future land use for areas downstream of TCC and beyond the NTS boundary would most likely be a residential scenario, exposure to the public is unlikely based on access restrictions to NTS (i.e., fenced areas, security patrols) and off-site institutional controls (i.e., zoning restrictions for the 100-year floodplain). In addition, the diffusion of contaminants would occur as they migrate downstream as a result of mixing action that occurs during the erosion and deposition process.

A.1.1.3.1 Aerial Dispersion Conceptual Site Model

The *Aerial Dispersion* CSM applies to CAU 529 where contaminants were deposited at the surface as a result of accidental or intentional releases. The following parcels were the areas of highest recorded deposition under this CSM and are shown in Figure A.1-1:

- Kiwi TNT 16,000-ft Arc Area
- Phoebus 1A Test 8,000-ft Arc Area
- Topopah Wash at TCC

Historical documentation and interviews indicate that contaminants were released to the surface soils at Topopah Wash and surrounding area as a result of the exhaust plumes associated with reactor testing activities conducted at TCC. The *Aerial Dispersion* CSM shown in Figure A.1-3 provides a generalized representation of site surface conditions.

CSM Parameters

Affected Media

Surface soils are the potentially affected media and any contamination would be attributable to the release of contaminants through aerial dispersion.

Location of Contamination/Release

The surface soils where exhaust plumes touched down at CAU 529 and fallout has occurred are the most likely places to find contamination. Specifically, the highest recorded deposition of fallout from the Kiwi TNT occurred in two primary areas: within the 4,000-ft arc and over an estimated 90-acre area approximately 16,000 ft to the southwest of Kiwi TNT Ground Zero at an angle of 215°. The highest recorded deposition of fallout from the Phoebus 1A Test occurred over a 51-acre area approximately 8,000 ft northwest of TCC at an angle of 315°.

Transport Mechanisms

The degree of vertical contaminant migration at the site is unknown, but expected to be minimal based on the average annual precipitation (i.e., 3 to 6 in. on the valleys of the NTS ranges and less than 10 in. on most of the ridges and mesas in the higher elevations of the NTS), high potential evapotranspiration, and low mobility of COPCs (USGS, 1975). Contaminants could be transported laterally as a result of surface runoff and channelized flow.

Prevailing wind direction at the time of the releases impacted aerial dispersion.

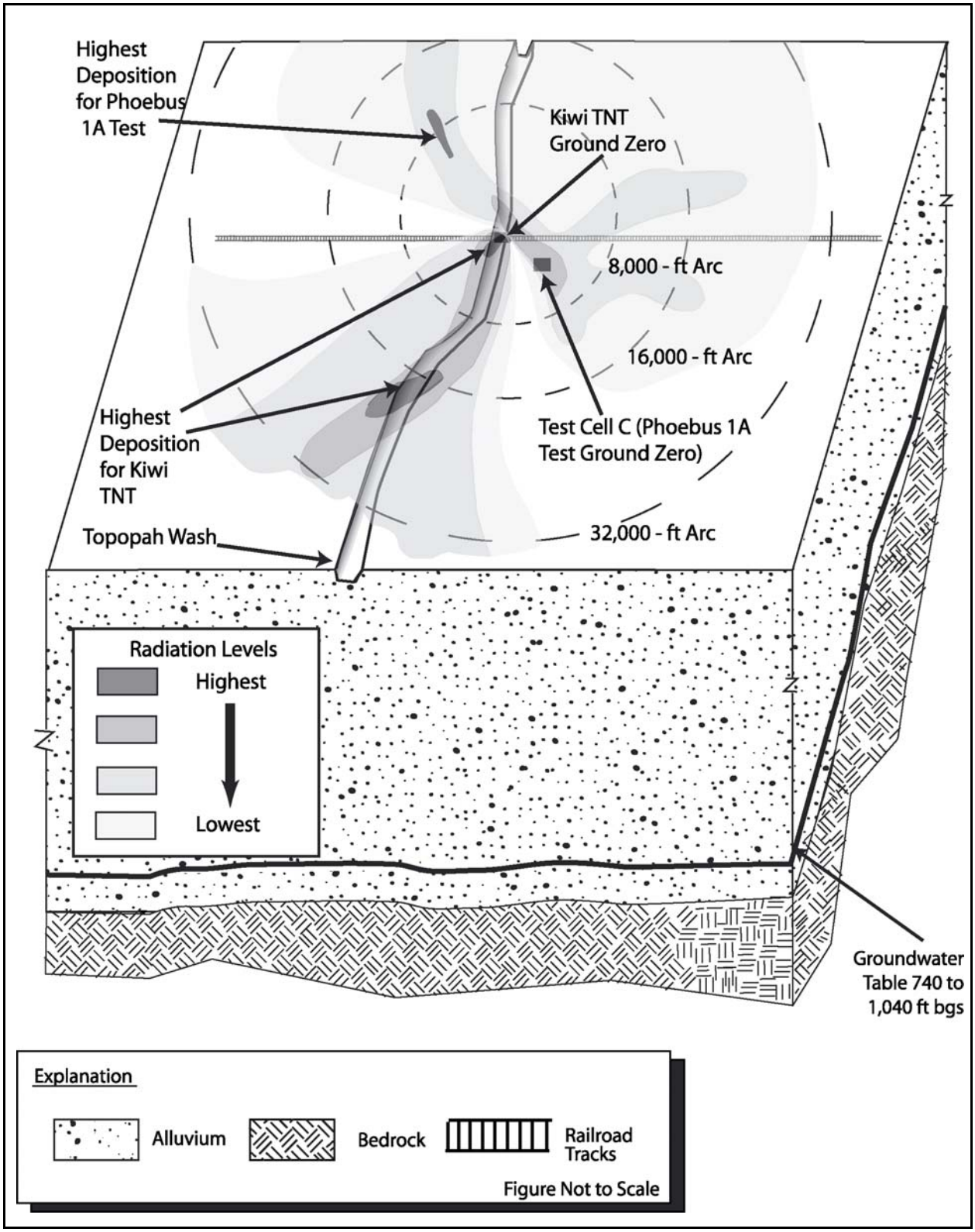

Figure A.1-3
CAU 529 Aerial Dispersion Conceptual Site Model

Preferential Pathways

The preferential pathway for contamination migration would be erosion resulting from surface water runoff and channelized flow.

Surface Migration

Surface migration occurs as a result of erosion/deposition and run-off. Surface migration of contaminants is addressed under the *Sedimentation* CSM presented in Section A.1.1.3.5.

Lateral and Vertical Extent of Contamination

The concentrations of potential contaminants at the site as a result of aerial dispersion generally decrease with distance from the source with the exceptions of where the exhaust plumes touched down at the surface (i.e., Kiwi TNT 16,000-foot Arc; Phoebus 1A test 8,000-foot Arc). Contaminant concentrations are expected to decrease with depth based on the type of release, the low annual precipitation rates, high potential evapotranspiration, and low mobility of COPCs (i.e., radionuclides and beryllium).

COPCs/Released Material

Exhaust plumes consisting of beryllium, radioactive debris, and fission products were released during the Kiwi TNT and Phoebus 1A test based on survey and sample data collected after each test. The hydraulic system of the platform used to transport the Kiwi reactor to the test pad may have contained a PCB-based oil. During the excursion, the hydraulic system was destroyed and the oil was released.

The following COPCs were identified for the parcels associated with this CSM based on historical documents, interviews, and survey/sample data:

- Beryllium
- Radionuclides - cesium-137, cobalt-60, europium-152, and -155, niobium-94, strontium-90, uranium-234, -235, and -238
- PCBs

Although a potential release of PCBs may have occurred during the excursion, appreciable concentrations of chlorinated dibenzo-p-furans (furans) and chlorinated dibenzo-p-dioxins (dioxins) due to the combustion of PCBs are not expected to be present at CAU 529. Based on information from the Kiwi TNT, the heat created during the excursion would have consumed the necessary levels of oxygen required to form appreciable concentrations of furans and dioxins from the combustion of PCBs (Tinney, 2001).

Although the possibility does exist for trace levels of furans and/or dioxins to have been present in the original hydraulic fluid as contaminants produced during the manufacture of the fluid, the ensuing explosion from the Kiwi TNT excursion spread the fluid over a large area (i.e. 4,000 ft in diameter). These trace-level contaminants would have been dispersed and resulting in soil concentrations well below any measurable levels. Therefore, furans and dioxins will not be considered COPCs for this CAU.

The noncritical COPCs and critical COPCs pertinent to each parcel associated with this CSM are shown in Table A.1-3. A detailed list of the COPCs are included in Table A.1-4, Table A.1-5, and Table A.1-6. Critical COPCs are defined as the potential chemical and radionuclide constituents that are suspected to be present at the site based on available information and used to determine the presence of contamination (Decision I). Because information such as documented use or process knowledge exists for critical COPCs, these analytes are given greater importance in the decision making process relative to other COPCs and have a completeness goal of 100 percent. When data for critical COPCs are not available, it is likely that a final decision on the CAS cannot be made without further justification and/or supporting documentation. Critical analytes for samples collected to define the extent of contamination (Decision II) will be defined as unbounded COCs.

A.1.1.3.2 Buried Material Conceptual Site Model

The *Buried Material* CSM applies to the following parcels at CAU 529 where contaminated material or debris may have been intentionally buried:

- BCSA 1
- BCSA 2
- BPBS

Table A.1-3
Phase I Contaminants of Potential Concern[a]

COPC	CAU 529 Parcels								
	Kiwi TNT 16,000-foot Arc Area	Phoebus 1A Test 8,000-foot Arc Area	Topopah Wash at TCC	Buried Contaminated Soil Area 1	Buried Contaminated Soil Area 2	Borrow Pit Burial Site	Drain/Outfall Discharges	Contaminated Soil Storage Area	Main Stream/ Drainage Channels
Organics									
Total Petroleum Hydrocarbons (DRO)						C	X	C	X
PCBs	X	X	X	X	X	C	X	C	X
SVOCs						X	X	X	X
VOCs							X		X
Benzene							C		X
Toluene							C		X
Ethylbenzene							C		X
Xylenes							C		X
Metals									
Beryllium	C	C	C	C	C	C	C	C	C
Nickel							X		X
Manganese							X		X
RCRA Metals						X	X	X	X
Radionuclides									
Cesium-137	C	C	C	C	C	C	C	C	C
Cobalt-60	C	C	C	C	C	C	C	C	C
Europium-152	X	X	X	X	X	X	X	X	X
Europium-155	X	X	X	X	X	X	X	X	X
Niobium-94	C	C	C	C	C	C	C	C	C
Plutonium-239							C		X
Strontium-90	C	C	C	C	C	C	C	C	C
Uranium-234	C	C	C	C	C	C	C	C	C
Uranium-235	X	X	X	X	X	X	X	X	X
Uranium-238	X	X	X	X	X	X	X	X	X

[a]For those COPCs identified that include multiple parameters, the parameters with PALs will be evaluated.
C = Critical COPC X = Noncritical COPC

Table A.1-4
Proposed SVOCs for Analysis

1,2,4-Trichlorobenzene[a]	Acenaphthylene	Di-n-butyl Phthalate
1,2-Dichlorobenzene[a]	Aniline	Di-n-octyl Phthalate
1,3-Dichlorobenzene[a]	Anthracene	Fluoranthene
1,4-Dichlorobenzene[a]	Benzo(a)anthracene	Fluorene
2,4,5-Trichlorophenol	Benzo(a)pyrene	Hexachlorobenzene
2,4,6-Trichlorophenol	Benzo(b)fluoranthene	Hexachlorobutadiene[a]
2,4-Dichlorophenol	Benzo(g,h,i)perylene	Hexachlorocyclopentadiene
2,4-Dimethylphenol	Benzo(k)fluoranthene	Hexachloroethane
2,4-Dinitrophenol	Benzoic Acid	Indeno(1,2,3-cd)pyrene
2,4-Dinitrotoluene	Benzyl Alcohol	Isophorone
2,6-Dinitrotoluene	Bis(2-chloroethoxy) methane	Naphthalene[a]
2-Chloronaphthalene	Bis(2-chloroethyl)ether	Nitrobenzene
2-Chlorophenol	Bis(2-chloroisopropyl)ether	N-Nitroso-di-n-propylamine
2-Methylphenol	Bis(2-ethylhexyl) phthalate	N-Nitrosodimethylamine
2-Nitroaniline	Butyl benzyl phthalate	N-Nitrosodiphenylamine
3,3'-Dichlorobenzidine	Carbazole	Pentachlorophenol
4-Bromophenyl phenyl ether	Chrysene	Phenanthrene
4-Chloroaniline	Dibenzo(a,h)anthracene	Phenol
4-Methylphenol	Dibenzofuran	Pyrene
4-Nitrophenol	Diethyl Phthalate	Pyridine
Acenaphthene	Dimethyl Phthalate	

[a]May be reported with VOC

Table A.1-5
Proposed Radionuclides, Total Petroleum Hydrocarbon, PCB, and Metals for Analyses

Radionuclides	TPH	PCB	Metals
cesium-137	TPH	Aroclor-1016	arsenic
cobalt-60	Diesel range (C_{10}-C_{38})	Aroclor-1221	barium
europium-152 and -155		Aroclor-1232	beryllium
niobium-94		Aroclor-1242	cadmium
plutonium-239		Aroclor-1248	chromium
strontium-90		Aroclor-1254	lead
uranium-234, -235, and -238		Aroclor-1260	manganese
			mercury
			nickel
			selenium
			silver

Table A.1-6
Proposed VOC's for Analyses

1,1,1-Trichloroethane	2-Butanone	Ethylbenzene
1,1,1,2-Tetrachloroethane	2-Chlorotoluene	Isopropylbenzene
1,1,2,2-Tetrachloroethane	4-Methyl-2-pentanone	Methyl tertiary butyl ether
1,1,2-Trichloroethane	Acetone	Methylene chloride
1,1-Dichloroethane	Benzene	N-Butylbenzene
1,1-Dichloroethene	Bromobenzene	N-Propylbenzene
cis-1,2-Dichloroethene	Bromochloromethane	sec-Butylbenzene
trans-1,2-Dichloroethene	Bromodichloromethane	Styrene
1,2-Dichloroethane	Bromoform	tert-Butylbenzene
1,2-Dichloropropane	Bromomethane	Tetrachloroethene
1,2,3-Trichloropropane	Carbon disulfide	Toluene
1,2,4-Trimethylbenzene	Carbon tetrachloride	Trichloroethene
1,2-Dibromo-3-chloropropane	Chlorobenzene	Trichlorofluoromethane
1,2-Dibromoethane	Chloroethane	Trichlorotrifluoroethane
1,3,5-Trimethylbenzene	Chloroform	Vinyl acetate
cis-1,3-Dichloropropene	Chloromethane	Vinyl chloride
trans-1,3-Dichloropropene	Dibromochloromethane	Xylene
	Dibromomethane	
	Dichlorodifluoromethane	

Available documentation indicates that contaminated soil from Phoebus 1A test cleanup operations may have been buried at two potential areas at TCC (i.e., BCSA 1 and BCSA 2). In addition, contaminated soil and contaminated debris (i.e., wood debris from signs and hopper holders) may have been disposed of in a borrow pit (i.e., the BPBS) south of Kiwi TNT Ground Zero (Sanders, 1965). The contaminated soil disposed of at BPBS was sprayed with oil to prevent wind erosion.

Figure A.1-4 shows a representation of the *Buried Material* CSM, and the following text provides additional details to supplement the model.

CSM Parameters

Affected Media

Affected media includes subsurface soil surrounding the buried contaminated material and any remaining buried material.

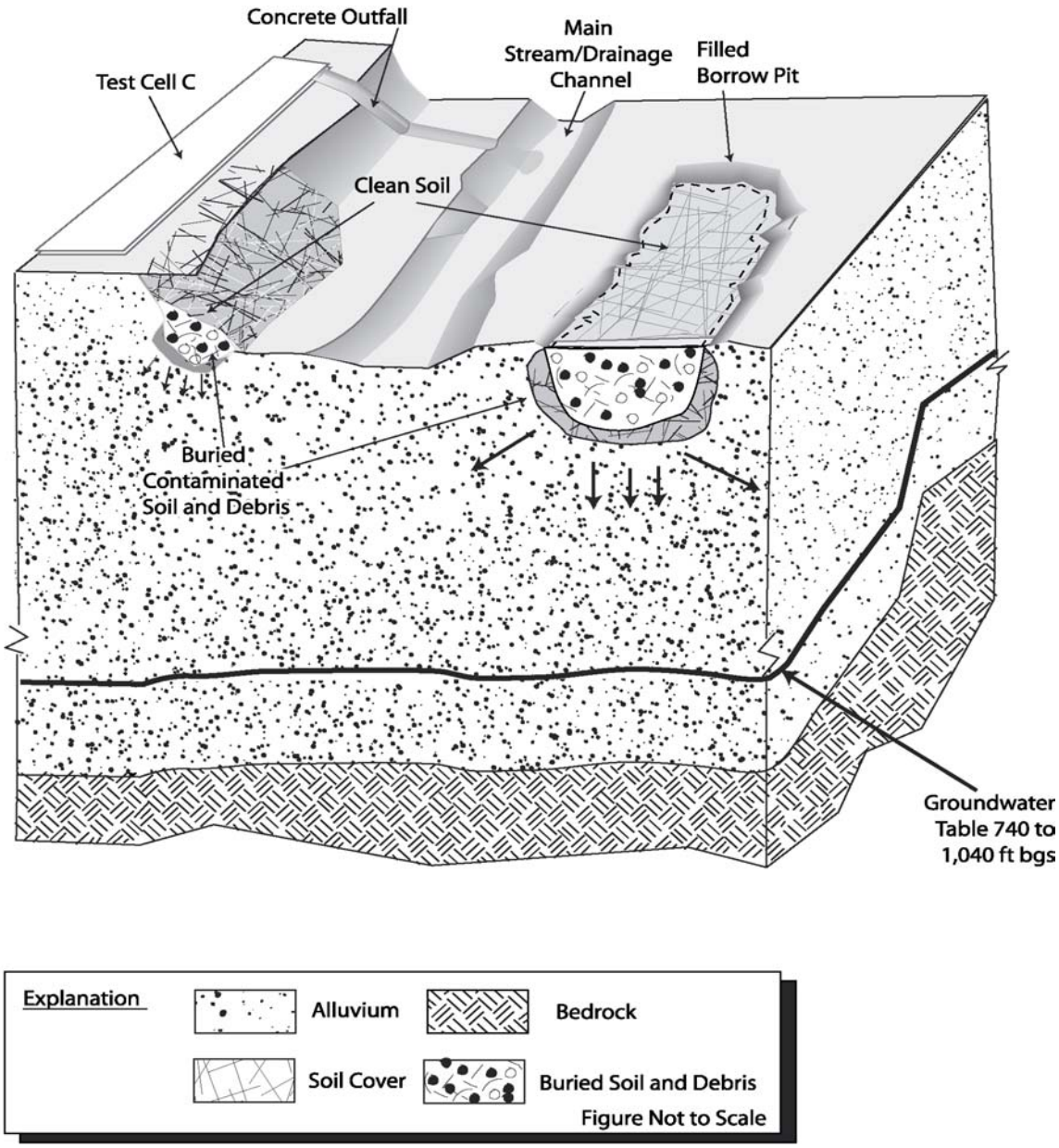

Figure A.1-4
CAU 529 Buried Material Conceptual Site Model

Location of Contamination/Release

Contaminated soil and debris may have been buried at three suspected locations (i.e., BCSA 1, BCSA 2, and BPBS) within and adjacent to the wash at TCC. BCSA 1 is the suspected burial location of contaminated soil associated with decontamination operations for the Phoebus 1A test that was pushed over the edge and into the east side of the wash and covered with clean fill (AEC, 1967). BCSA 2 may be the gully northwest of TCC where contaminated soil associated with Phoebus 1A decontamination operations was reported to have been placed (AEC, 1967). Based on current documentation, the exact location of the gully or information confirming that the contaminated soil was removed for disposal could not be verified.

A portion of the borrow pit located within the wash south of Kiwi TNT Ground Zero and identified as the BPBS may have been used as a burial site for contaminated debris and contaminated soil from the Kiwi TNT according to available documentation. The contaminated soil was bladed into the borrow pit and sprayed with oil to prevent wind erosion. Although not specifically mentioned in the historical documentation, based on the process followed for BCSA 1, it is expected that the contaminated soil and debris disposed of in BPBS and BCSA 2 were covered with a clean layer of soil to reduce exposure risks.

As a result of disposal activities conducted within and adjacent to the wash, radionuclides, beryllium, SVOCs, TPH, metals, and PCBs may have leached from the contaminated soil and debris. Any contaminants released to the affected media, regardless of physical or chemical characteristics, are expected to be directly beneath the buried material and/or extending in a downstream direction if affected by surface erosion.

Transport Mechanisms

The degree of contaminant migration at the site is unknown, but expected to be minimal based on the average annual precipitation (i.e., 3 to 6 in. on the valleys of the NTS ranges and less than 10 in. on most of the ridges and mesas in the higher elevations of the NTS), high potential evapotranspiration, and low mobility of COPCs (USGS, 1975). Therefore, the effect of infiltration of precipitation through soil would be minimal. However, the parcels are located within or adjacent to the boundaries of an ephemeral stream and severe weather conditions (i.e., storms or flash floods) could affect contaminant migration as well as the distribution of potential site contaminants.

Preferential Pathways

The preferential pathway for lateral contamination migration would be erosion from surface water runoff and channelized flow.

Surface Migration

Surface migration occurs as a result of erosion/deposition and run-off. Surface migration of contaminants is addressed under the *Sedimentation* CSM presented in Section A.1.1.3.5.

Lateral and Vertical Extent of Contamination

Contamination, if present, is expected to be contiguous to the source(s) for areas within and outside of the wash, except where significant surface erosion has occurred. No evidence was found during the site visits or review of aerial photographs that indicated extensive erosion has occurred at the BPBS or BCSA 2 (i.e., Former Drainage Ditch). However, surface erosion at the wash bank near BCSA 1 was observed. As a result, the potential for buried contaminated materials to be uncovered and transported downstream is higher at this location. Generally, the lateral extent of contamination is expected to decrease with distance from the source(s) due to dispersion of contaminants during severe weather conditions (i.e., storms or flash floods). The vertical extent of contamination would decrease with depth at source locations unaffected by surface erosion.

COPCs/Released Material

The COPCs specific to the parcels associated with this CSM are discussed in the following paragraphs. The COPCs and critical COPCs pertinent to each parcel associated with this CSM are shown in Table A.1-3.

Buried Contaminated Storage Area 1 and Buried Contaminated Storage Area 2

These parcels are suspected burial sites for contaminated soil from Phoebus 1A Test decontamination operations. The following COPCs identified for these two parcels are based on historical documents, interviews, and process knowledge:

- Beryllium

- Radionuclides - cesium-137, cobalt-60, europium-152, and -155, niobium-94, strontium-90, uranium-234, -235, and -238
- PCBs

Borrow Pit Burial Site

This parcel is a suspected burial site for radioactive contaminated soil and debris (e.g., wood debris from signs and hoppers) from the Kiwi TNT. In addition, contaminated soil was sprayed with oil to prevent wind erosion. The following COPCs identified for this parcel are based on historical documents, interviews, and process knowledge:

- Beryllium, RCRA metals
- Radionuclides - cesium-137, cobalt-60, europium-152, and -155, niobium-94, strontium-90, uranium-234, -235, and -238
- Total petroleum hydrocarbons (DRO only)
- SVOCs
- PCBs

A.1.1.3.3 Drain/Outfall Discharges Conceptual Site Model

The *Drain/Outfall Discharges* CSM applies to the parcel of the same name at CAU 529 where contaminants may have been deposited at the surface and permitted to infiltrate as a result of accidental or intentional releases. Historical documentation and interviews indicate that the closed-loop borated water system was used as a neutron absorber to reduce the neutron flux to the reactor-facing surfaces of the TCC during the Project Rover tests. In 1972, a release of 211,000 gallons of 2 percent borated water (a corrosive liquid) from the main storage tank was discharged to Topopah Wash through the facility's flushing drain. Additionally, surface water runoff and process water were discharged to the wash at TCC from four other drains and one outfall. The *Drain/Outfall Discharges* CSM shown in Figure A.1-5 provides a generalized representation of site conditions.

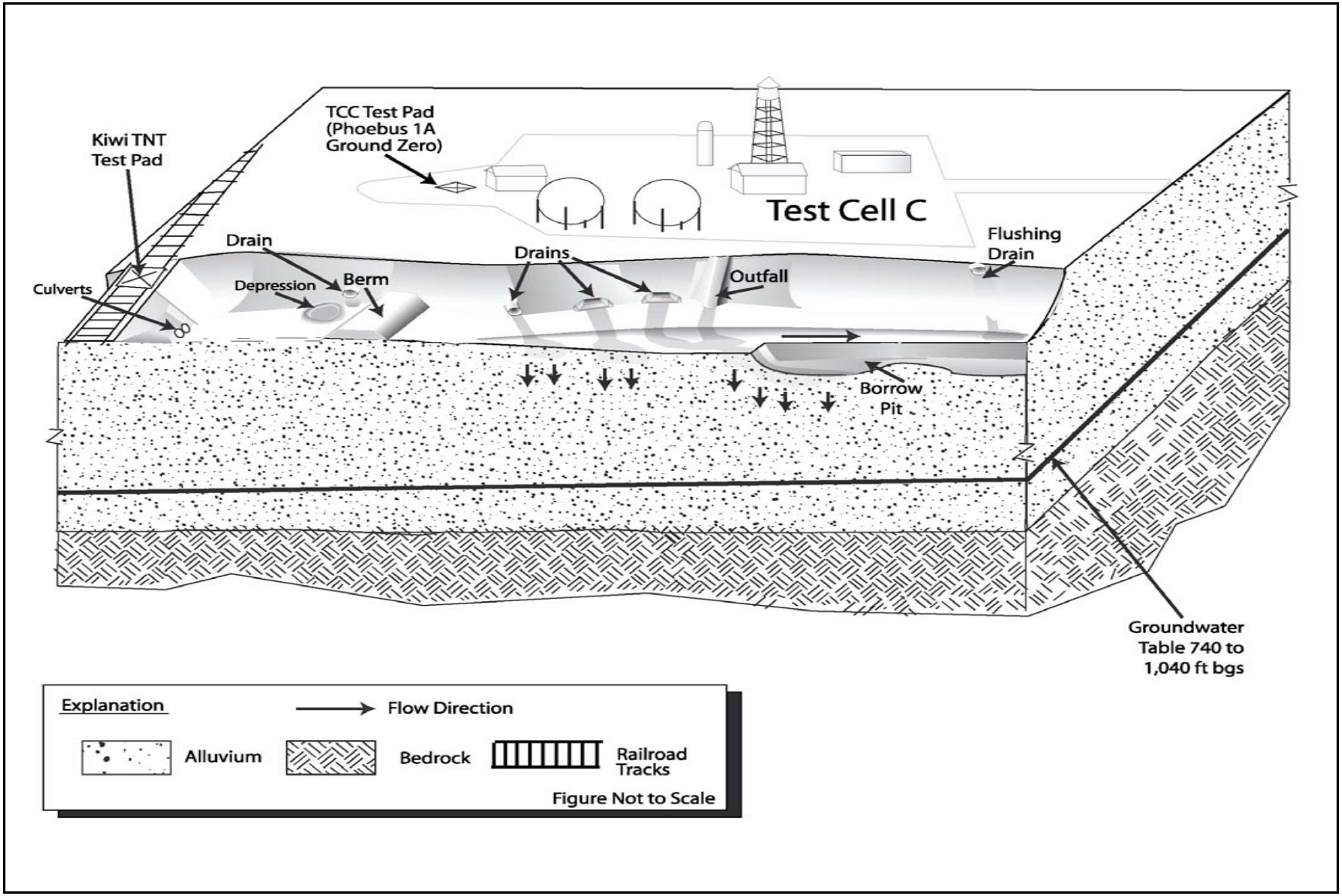

Figure A.1-5
CAU 529 Drain/Outfall Discharges Conceptual Site Model

Affected Media

Surface and subsurface soils are the potentially affected media where liquid discharges may have contributed contamination. Any contamination would be attributable to the release of contaminants through direct release to the surface, precipitation of contaminants from liquids, or infiltration.

Location of Contamination/Release

The surface and subsurface soils are the most likely places to find contamination at the Drain/Outfall Discharges based on the type of release (i.e., liquid discharge). The distribution of suspected contaminants would tend to be associated with point source discharge and somewhat localized. Any contaminants released to the affected media, regardless of chemical or physical properties, would tend to migrate in the vertical direction and follow surface drainage patterns.

Transport Mechanisms

The degree of vertical contaminant migration at the site is unknown, but expected to be minimal based on the average annual precipitation (i.e., 3 to 6 in. on the valleys of the NTS ranges and less than 10 in. on most of the ridges and mesas in the higher elevations of the NTS), high potential evapotranspiration, and low mobility of COPCs (USGS, 1975). However, portions of the CAS are located within the boundaries of an ephemeral stream and severe weather conditions (i.e., storms or flash floods) would affect contaminant migration as well as the distribution of potential site contaminants.

Preferential Pathways

The preferential pathway for contamination migration would be downward, surface drainage patterns, and erosion resulting from surface water runoff and channelized flow.

Surface Migration

Surface migration occurs as a result of erosion/deposition and run-off. Surface migration of contaminants is addressed under the *Sedimentation* CSM presented in Section A.1.1.3.5.

Lateral and Vertical Extent of Contamination

Surface contamination, if present, is not expected to be contiguous to the release point(s) due to the effects of ephemeral flooding. However, subsurface contamination unaffected by surface erosion is expected to be contiguous to the source(s). In both cases, concentrations are generally expected to decrease with distance and depth from the source(s) due to the low annual precipitation rates, high potential evapotranspiration, low mobility of COPCs, and dispersion from flood events.

COPCs/Released Material

The following COPCs identified for this parcel are based on historical documents, interviews, sampling data, and process knowledge:

- Beryllium, lead, nickel, manganese, RCRA metals
- Radionuclides - cesium-137, cobalt-60, europium-152, and -155, niobium-94, plutonium-239, strontium-90, uranium-234, -235, and -238
- Total petroleum hydrocarbons (DRO only)
- SVOCs
- VOCs, benzene, toluene, ethylbenzene, xylenes
- PCBs

The COPCs and critical COPCs specific to this parcel are shown in Table A.1-3.

A.1.1.3.4 Residual Surface Contamination Conceptual Site Model

The *Residual Surface Contamination* CSM applies to the CSSA at CAU 529 where contaminants were deposited at the surface. Historical documentation and interviews indicate that contaminants were released to the surface soils at Topopah Wash as a result of waste storage activities associated with reactor testing activities conducted at TCC. The *Residual Surface Contamination* CSM shown in Figure A.1-6 provides a generalized representation of site conditions.

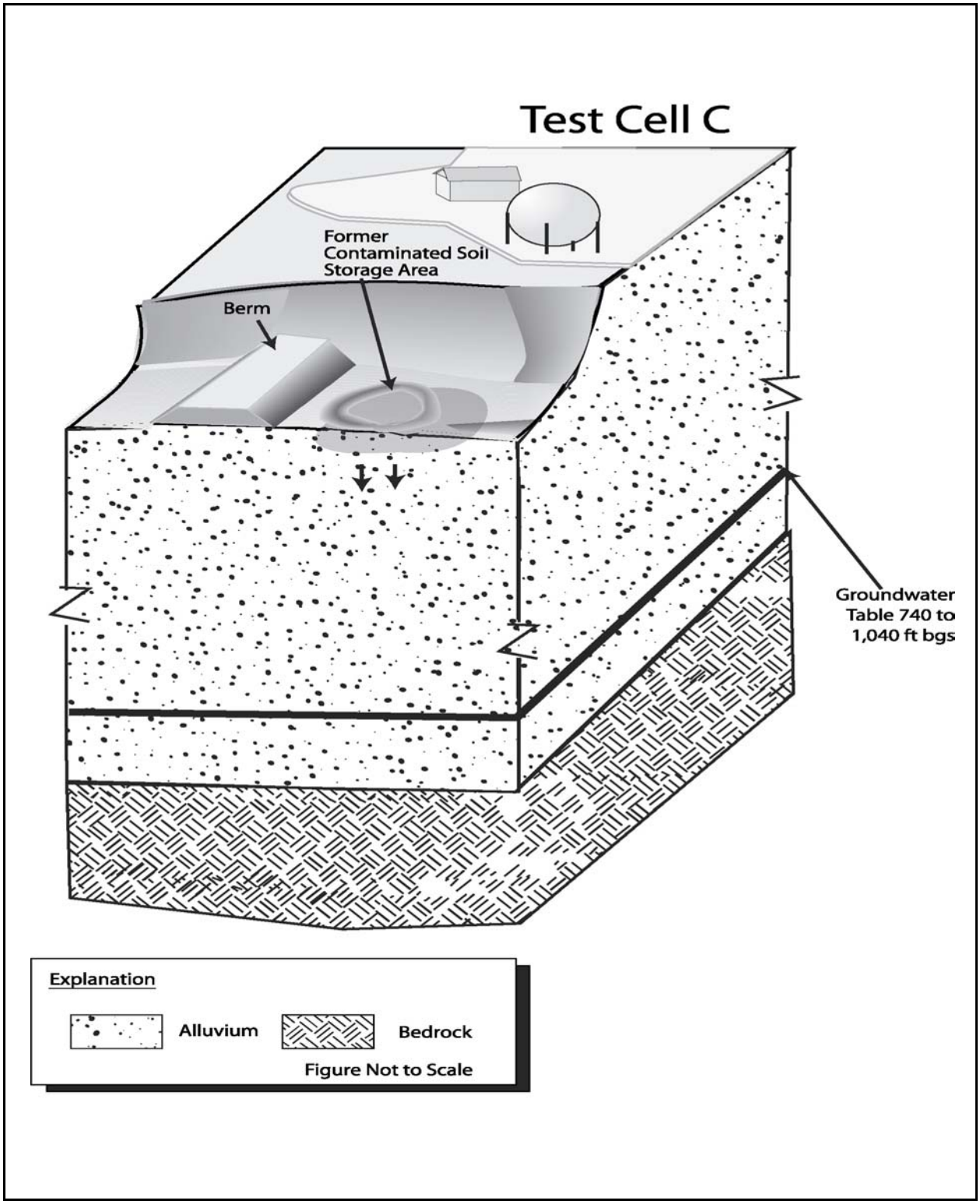

Figure A.1-6
CAU 529 Residual Surface Contamination Conceptual Site Model

Affected Media

Surface and near-surface soils are the potentially affected media where contaminated soil and liquid materials/wastes (i.e., oil) may have contributed contamination. Any contamination would be attributable to release of contaminants through direct release to the surface, storage activities, and leaching of contaminants from materials.

Location of Contamination/Release

The surface and near surface soils are the most likely places to find contamination based on the types of releases and low mobility of the COPCs (radionuclides, petroleum hydrocarbons, PCBs, SVOCs, metals) at the site. Contaminated soil from the Phoebus 1A test was stored in a pile at a location within the wash that was west of the new TCC Dewars Pad and south of the berm as shown in Figure A.1-2. The soil pile was sprayed with oil to prevent the wind from transporting dust back into the test cell. This parcel is identified as the CSSA. The contaminated soil was removed from the wash sometime prior to 1983. As a result, the location of the residual contamination would be in the surface and shallow subsurface at the former storage location.

Any contaminants released from waste storage activities, regardless of chemical or physical properties, would be located primarily in the surface and any migration to the near surface or subsurface is expected to be in the vertical direction or follow surface drainage patterns. Contaminants may also be slightly buried and resurface in the future due to ephemeral flooding.

Transport Mechanisms

The degree of vertical contaminant migration at the site is unknown, but expected to be minimal based on the average annual precipitation (i.e., 3 to 6 in. on the valleys of the NTS ranges and less than 10 in. on most of the ridges and mesas in the higher elevations of the NTS), high potential evapotranspiration, and low mobility of COPCs (USGS, 1975). However, the parcel associated with this CSM is located within the boundaries of an ephemeral stream and severe weather conditions (i.e., storms or flash floods) would affect contaminant migration as well as the distribution of potential site contaminants.

Preferential Pathways

The preferential pathway for contamination migration would be erosion resulting from surface water runoff and channelized flow.

Surface Migration

Surface migration occurs as a result of erosion/deposition and run-off. Surface migration of contaminants is addressed under the *Sedimentation* CSM presented in Section A.1.1.3.5.

Lateral and Vertical Extent of Contamination

Although potential contamination may not be contiguous to the release point(s), contamination is expected to decrease generally with distance from the release as a result of dispersion during flood events. The vertical extent of contaminants are generally expected to decrease with depth due to the low annual precipitation rates, high potential evapotranspiration, and low mobility of COPCs.

COPCs/Released Material

The following COPCs identified for CSSA are based on historical documents, interviews, and process knowledge.

- Beryllium, RCRA metals
- Radionuclides - cesium-137, cobalt-60, europium-152, and -155, niobium-94, strontium-90, uranium-234, -235, and -238
- Total petroleum hydrocarbons (DRO only)
- SVOCs
- PCBs

The COPCs and critical COPCs specific to this parcel are shown in Table A.1-3.

A.1.1.3.5 Sedimentation Conceptual Site Model

The *Sedimentation* CSM is used to address contaminants that may have been accumulated, buried, or transported to downstream locations from the aforementioned parcels and released to the surface or

subsurface soils. As previously mentioned in Sections A.1.1.3.1 through A.1.1.3.4, contaminants were released to the surface and subsurface soils at Topopah Wash and the surrounding area as a result of aerial dispersion, waste storage and disposal activities, dust suppression, and liquid discharges (i.e., surface water runoff, wash down water, and process water) associated with reactor testing activities conducted at TCC. The *Sedimentation* CSM shown in Figure A.1-7 provides a generalized representation of the erosion and deposition processes affecting CAU 529 parcels.

Affected Media

Surface and subsurface soils are the potentially affected media where contaminants have been accumulated, buried, or transported as a result of the erosion and deposition process. Any contamination would be attributable to the erosion and deposition of contaminants released through aerial dispersion, direct release to the surface, release of contaminants through disposal and storage activities, and leaching of contaminants from materials.

Location of Contamination/Release

The most likely places to find contamination are the surface and subsurface soils within the wash at collection points (e.g., depressions) and areas of sedimentation along the main stream/drainage channels (i.e., the low energy flow portions of the stream/channel).

Transport Mechanisms

Surface migration and the redistribution of contaminants would occur as a result of ephemeral flooding. The degree of vertical contaminant migration under this CSM is not expected to differ greatly from the CSMs previously mentioned for the same reasons (i.e., low average annual precipitation, high potential evapotranspiration, and low mobility of COPCs).

Preferential Pathways

The preferential pathway for contamination migration would be erosion and sedimentation resulting from surface water runoff and channelized flow.

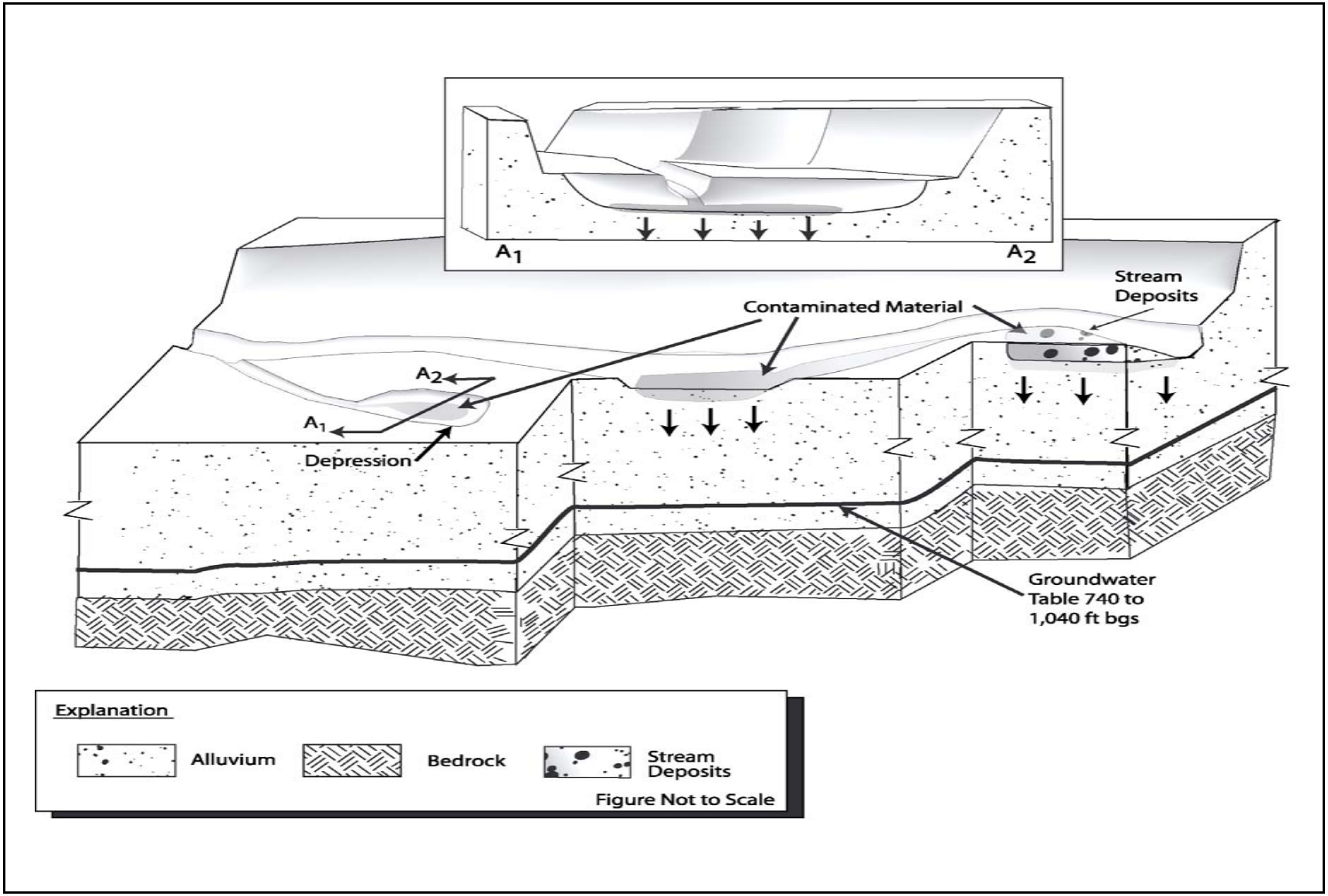

Figure A.1-7
CAU 529 Sedimentation Conceptual Site Model

Surface Migration

Surface migration occurs as a result of erosion/deposition and run-off. Surface migration is a biasing factor considered in the selection of sampling points.

Lateral and Vertical Extent of Contamination

The lateral extent of contamination is not expected to be contiguous to the initial release point(s); however, contaminant concentrations generally are expected to decrease with distance from the source(s) due to dispersion during flood events. Low energy flow areas along the main stream/drainage channels and depressions within the wash are potential collection points for contaminants. Although contaminants may accumulate in these areas of higher deposition, the lateral extent of contamination is expected to decrease in the downstream direction. The vertical extent of contaminants generally is expected to decrease with depth due to the lack of vertical driving forces (e.g., low precipitation rates, high potential evapotranspiration, and low mobility COPCs).

COPCs/Released Material

The COPCs and critical COPCs identified for the parcels under this CSM are presented in Table A.1-3.

A.1.2 Step 2 - Identify the Decision

This step develops a decision statement and defines alternative actions. The following subsections identify decisions and alternative actions appropriate for Phase I and Phase II.

A.1.2.1 Develop a Decision Statement

Problem Statement: There is an insufficient amount of information to characterize the nature and extent of contamination released to the wash and surrounding areas to determine if there is a risk to human health and the environment.

The Decision I statement is to determine if a COC is present.

The Decision II statement is to determine the lateral and vertical extent of a COC to support the evaluation of potential corrective action alternatives.

A.1.2.2 Alternative Actions to the Decision

If a COC is not present, further assessment of the CAS is not required. If a COC is present, resolve Decision II.

If the extent of a COC is defined in both the lateral and vertical directions, further assessment of the CAS is not required. If the extent of a COC is not defined, reevaluate site conditions and collect additional samples.

A.1.3 Step 3 - Identify the Inputs to the Decision

This step identifies the information needed, determines sources for information, determines the basis for establishing the action level, and identifies sampling and analysis methods that can meet the data requirements. To determine if a COC is present, each sample result or population parameter (Section A.1.5.1) is compared to the PAL (Section A.1.3.2). If any sample result or population parameter is greater than the PAL, then the CAS is advanced to Decision II for that analyte. This approach does not use a statistical mean/average for comparison to the PAL, but rather the individual result, to identify COCs.

A.1.3.1 Information Needs and Information

In order to determine if a COC is present at the CAS, sample data must be collected and analyzed following these two criteria: (1) samples must be collected in areas most likely to contain a COC and (2) the analytical suite selected must be sufficient to detect any COCs present in the samples. Biasing factors to support these criteria include:

- Documented process knowledge on source and location of release
- Field observations
- Radiological surveys
- Field-screening results
- Historical sample results
- Experience and data from investigations of similar sites
- Professional judgement

In order to determine the extent of a COC for Decision II, sample data must be collected and analyzed at locations to bound the lateral and vertical extent of COCs. The data required to satisfy the information needed for each COC is a sample result that is below the PAL. Step-out locations as

defined in Section A.1.7 will be selected. Samples will only be analyzed for those parameters that exceeded PALs (i.e., COCs) in prior samples. Biasing factors to support these information needs may include the factors previously listed and Phase I sample results.

Table A.1-7 lists the information needs, the source of information for each need, and the proposed methods to collect the data. The last column addresses the QA/QC data type and associated metric. The data type is determined by the intended use of the resulting data in decision making.

Data types are discussed in the following text. All data to be collected are classified into one of three measurement quality categories: quantitative, semiquantitative, and qualitative. The categories for measurement quality are defined below.

Quantitative Data

Quantitative data results from direct measurement of a characteristic or component within the population of interest. These data require the highest level of QA/QC in collection and measurement systems because the intended use of the data is to resolve primary decision (i.e., rejecting or accepting the null hypothesis) and/or verifying closure standards have been met. Laboratory analytical data are usually assigned as quantitative data.

Semiquantitative Data

Semiquantitative data is generated from a measurement system that indirectly measures the quantity or amount of a characteristic or component of interest. Inferences are drawn about the quantity or amount of a characteristic or component because a correlation has been shown to exist between results from the indirect measurement and the quantitative measurement. The QA/QC requirements on semiquantitative collection and measurement systems are high but may not be as rigorous as a quantitative measurement system. Semiquantitative data contribute to decision making, but are not generally used alone to resolve primary decisions. The data are often used to guide investigations toward quantitative data collection.

Qualitative Data

Qualitative data identifies or describes the characteristics or components of the population of interest. The QA/QC requirements for qualitative data are the least rigorous on data collection methods and

Table A.1-7
Information Needs to Resolve the Phase I and Phase II Decision

Information Need	Information Source	Collection Method	Data Type/Metric
Decision I: Determine if a COC is present. Criteria I: Samples must be collected in areas most likely to contain a COC.			
Source and location of release points	Process knowledge compiled during the PA process and previous investigations of similar sites	Information documented in CSM and public reports – no additional data needed	Qualitative – CSM has not been shown to be inaccurate
	Site visit and field observations	Conduct site visits and document field observations	Qualitative - CSM has not been shown to be inaccurate
	Aerial photographs	Review and interpret aerial photographs	Semiquantitative - Sampling based on biasing criteria stipulated in DQO Step 3
	Radiological surveys	Review and interpret radiological surveys	Semiquantitative - Sampling based on biasing criteria stipulated in DQO Step 3
	Field screening	Review and interpret field-screening results	Semiquantitative - Sampling based on biasing criteria stipulated in DQO Step 3
Decision I: Determine if a COC is present. Criteria 2: Analyses must be sufficient to detect any COCs in samples.			
Identification of all potential contaminants	Process knowledge compiled during PA process and previous investigations of similar sites	Information documented in CSM and public reports - no additional data needed	Qualitative - CSM has not been shown to be inaccurate
Analytical results	Data packages of biased samples	Appropriate sampling techniques and approved analytical methods will be used	Quantitative - Detection limits will be less than PALs
Decision II: Determine the lateral and vertical extent of a COC			
Identification of applicable COCs	Data packages of prior samples	Review analytical results to select COCs	Quantitative – Only COCs identified will be analyzed in future sampling events
Extent of Contamination	Field observations	Document field observations	Qualitative – CSM has not been shown to be inaccurate
	Field screening	Conduct field screening with appropriate instrumentation	Semiquantitative – FSRs will be compared to FSLs
	Analytical results	Appropriate sampling techniques and approved analytical methods will be used to bound COCs	Quantitative - Validated analytical results will be compared to PALs to determine COC extent

measurement systems. Professional judgement is often used to generate qualitative data. The intended use of the data is for information purposes, to refine conceptual models, and guide investigations rather than resolve primary decisions. This measurement of quality is typically associated with historical information and data where QA/QC may be highly variable or not known.

Metrics provide a tool to determine if the collected data support decision making as intended. Metrics tend to be numerical for quantitative and semiquantitative data, and descriptive for qualitative data.

A.1.3.2 Determine the Basis for the Preliminary Action Levels

Site workers and military personnel may be exposed to contaminants through oral ingestion, inhalation, external (radiological), or dermal contact (absorption) of soil during disturbance of this media. Laboratory analytical results for soils will be compared to the following PALs to evaluate if COPCs are present at levels that may pose an unacceptable risk to human health and/or the environment (i.e., COCs):

- EPA *Region IX Risk-Based Preliminary Remediation Goals* for Industrial Soils (EPA, 2002).
- Background concentrations for metals when natural background exceeds the PRG, as is often the case with arsenic. Background is considered the mean plus two times the standard deviation of the mean for sediment samples collected by the Nevada Bureau of Mines and Geology throughout the Nellis Air Force Range (NBMG, 1998; Moore, 1999).
- TPH action level of 100 mg/kg per the NAC 445A.2272 (NAC, 2002).
- The PALs for radionuclides are isotope-specific and defined as the maximum concentration for that isotope found in samples from undisturbed background locations in the vicinity of the NTS (McArthur and Miller, 1989; US Ecology and Atlan-Tech, 1992). The PAL is equal to the minimum detectable concentration (MDC) for isotopes not reported in soil samples from undisturbed background locations. The PAL is also equal to the MDC if the maximum background concentration is less than the MDC (see Table 3-5 of the CAIP).

A.1.3.3 Potential Sampling Techniques and Appropriate Analytical Methods

Radiological Surveys

Radiological surveys will be used to determine presence/lateral extent of applicable waste. Radiological surveys will follow standard procedures. Further information is provided in Section A.1.7.1.

Field Screening

Field screening activities will be conducted for radiological constituents (all parcels), petroleum hydrocarbons diesel-range organics (DRO), and VOCs. Field screening for TPH will be conducted at parcels (i.e., CSSA and BPBS) where oil was applied to radioactive contaminated soil to prevent wind erosion. Field screening for VOCs will be conducted at the Drain/Outfall Discharges and Main Stream/Drainage Channels parcels based on sample results from the CAU 528 PA (see Section 2.5 of the CAIP). These techniques will provide semiquantitative data that can be used to guide additional soil sampling activities.

Soil Sampling

Augering, direct push, hand tool, excavation, drilling, or other appropriate sampling methods will be used to collect soil samples for laboratory analysis. Sample collection and handling activities will follow standard procedures.

The CAIP provides the analytical methods and laboratory requirements (e.g., detection limits, precision, and accuracy) to be followed in Section 3.0 and Section 6.0, respectively. Sample volumes are laboratory- and method-specific and will be determined in accordance with laboratory requirements. Specific analyses required for the disposal of IDW are identified in Section 5.0 of this CAIP.

To assure that laboratory analyses are sufficient to detect contamination in soil samples at concentrations exceeding the MRL, COPC parameters of interest have been selected. The analyses to be conducted for samples collected at this CAS and associated analytical methods for a soil matrix are summarized below:

- Total petroleum hydrocarbons - Diesel-Range Organics (TPH-DRO) - 8015B - modified
- PCBs - 8082
- SVOCs - 8270C
- VOCs - 8260B
- RCRA metals, beryllium, lead, manganese and nickel - 6010B and 7471A
- Gamma spectroscopy, isotopic uranium, isotopic plutonium, and strontium-90 - HASL-300

A.1.4 Step 4, Define the Boundaries of the Study

The purpose of this step is to define the target population of interest, specify the spatial and temporal features of the population that are pertinent for decision making, determine practical constraints on data collection, and define the scale of decision making relevant to target populations for Phase I and Phase II.

A.1.4.1 Define the Target Population

Decision I target populations represent locations within the CAS that will contain COCs, if present. Decision II target populations are locations adjacent to the COC plume where COC concentrations are less than PALs.

A.1.4.2 Identify the Spatial and Temporal Boundaries

The spatial boundaries that apply to the CAS in Phase I are the sample locations selected for Phase I. In general, geographic boundaries are defined by the impacted soil. Intrusive activities are not intended to extend into the boundaries of neighboring CASs. The spatial boundary that applies to Phase II activities encompasses the area within a 32,000 ft radius of Kiwi TNT Ground Zero.

Temporal boundaries are those time constraints set up by weather conditions and project schedules. Significant temporal constraints due to weather conditions are not expected. Moist weather may place constraints on sampling and field screening contaminated soils because of the attenuating effect of moisture in samples (e.g., alpha-emitting radionuclides). There are no time constraints on collecting samples as environmental conditions at all sites will not significantly change in the near future and conditions would have stabilized over the years since the site was last used.

A.1.4.3 Identify Practical Constraints

The NTS-controlled activities may affect the ability to characterize this site. Underground utilities may exist at the site, which may limit intrusive sampling locations. Other practical constraints include rough terrain, and access restrictions. Access restrictions include both scheduling conflicts on the NTS with other entities and areas posted as contamination areas requiring appropriate work controls, physical barriers (e.g., fences, steep slopes), and areas requiring authorized access.

A.1.4.4 Define the Scale of Decision Making

The scale of decision making in Phase I is defined as any parcel within the CAS. The scale of decision making in Phase II is defined as a contiguous area contaminated with any COC.

A.1.5 Step 5 - Develop a Decision Rule

This step integrates outputs from the previous step with the inputs developed in this step into a decision rule ("If..., then...") statement. This rule describes the conditions under which possible alternative actions would be chosen.

A.1.5.1 Specify the Population Parameter

The population parameter for Phase I chemical data is the maximum observed concentration of each COC within the target population. For radiological surveys, the maximum observed count rate will be the population parameter. The population parameter for Phase I radiological data collected from biased sample locations is the maximum observed concentration of each COC within the target population. The population parameter for Phase I radiological data collected from radiological survey areas is the average of COPC concentrations (detected or MDC) over 100 square meters within the target population compared to the risk based PAL.

The population parameter for Phase II will be the observed concentration of each unbounded chemical COC in any sample and the observed concentration of each unbounded radiological COC for biased radiological samples.

A.1.5.2 Choose an Action Level

The preliminary action levels for CAS 25-23-17 are defined in Section A.1.3.2.

A.1.5.3 Decision Rule

If the population parameter of any COPC in a target population exceeds the PAL for that COPC during Phase I, then that COPC is identified as a COC and Phase II will be conducted. If the Site Supervisor determines that sufficient indicators are present, then Phase II samples will be collected. If COPC concentrations are less than the corresponding PAL, then the decision will be no further action.

If the observed population parameter of any COC in a sample exceeds the PALs during Phase II, then additional samples will be collected to define extent. If all observed COC population parameters are less than PALs, then the decision will be that the extent of contamination has been defined in the lateral and/or vertical direction(s).

If contamination is inconsistent with the CSM or extends beyond the spatial boundaries, work will be suspended and the investigation strategy will be reevaluated. If contamination is consistent with the CSM and is within spatial boundaries, the decision will be to continue sampling to define the extent.

A.1.6 Step 6 - Specify the Tolerable Limits on Decision Errors

The sampling approach for Phase I and II activities relies on biased sampling locations; therefore, statistical analysis is not appropriate. Only validated analytical results (quantitative data) will be used to determine if COCs are present (Phase I) or the extent of a COC (Phase II), unless otherwise stated. The baseline condition (i.e., null hypothesis) and alternative condition for Phase I are:

- Baseline condition – A COC is present
- Alternative condition – A COC is not present

The baseline condition (i.e., null hypothesis) and alternative condition for Phase II are:

- Baseline condition – The extent of a COC has not been defined
- Alternative condition – The extent of a COC has been defined

Decisions and/or criteria have an alpha (false rejection) or beta (false acceptance) error associated with their determination (discussed in the following subsections). Since quantitative chemical data are individually compared to action levels, statistical evaluations of the chemical data such as averages or confidence intervals are not appropriate. Quantitative radiological data collected from biased sample locations will be compared to the PAL.

A.1.6.1 False Rejection Decision Error

The false rejection (alpha) decision error would mean either of the following:

- Deciding in Phase I that a COC is not present when it is
- Deciding in Phase II that the extent of a COC has been defined when it has not

In both cases, the consequence is the increased risk to human health and environment.

In Phase I, a false rejection decision error (where consequences are more severe) is controlled by meeting these criteria: (1) having a high degree of confidence that the sample locations selected will identify COCs if present anywhere within the CAS and (2) having a high degree of confidence that analyses conducted will be sufficient to detect any COCs present in the samples. This error is reduced in Phase II by: (1) having a high degree of confidence that the sample locations selected will identify the extent of COCs and (2) having a high degree of confidence that analyses conducted will be sufficient to detect any COCs present in the samples.

To satisfy the first criterion, Phase I data and samples will be collected in areas most likely to be contaminated by any COCs. In Phase II, data collection will sample areas that represent the lateral and vertical extent of contamination. The following characteristics are considered during both phases to accomplish the first criterion:

- Source and location of release
- Chemical nature and fate properties
- Physical transport pathways and properties
- Hydrologic drivers

These characteristics were considered during the development of the CSMs and selection of sampling locations. The biasing factors listed in Section A.1.3.1 will be used to further ensure that these criteria are met.

To satisfy the second criterion, all Phase I samples will be analyzed for the chemical and radiological parameters listed in Section A.1.3.3. Phase II samples will be analyzed for those chemical and radiological parameters that identified unbounded COCs. Strict adherence to established procedures and QA/QC protocol protects against false negatives.

A.1.6.2 False Acceptance Decision Error

The false acceptance (beta) decision error would mean deciding that a COC is present when it is not or a COC is unbounded when it is, resulting in increased costs for unnecessary characterization.

The false acceptance decision error is controlled by protecting against false positive analytical results. False positive results are typically attributed to laboratory and/or sampling/handling errors. Quality assurance/quality control samples such as field blanks, trip blanks, laboratory control samples, and method blanks are used to determine if a false positive analytical result may have occurred. Other measures include proper decontamination of sampling equipment and using certified clean sample containers to avoid cross contamination.

A.1.6.3 Quality Assurance/Quality Control

Radiological survey instruments will be calibrated using a known source. Daily performance checks will be performed in accordance with approved procedures.

Quality control samples will be collected as required by established procedures. The required QC samples include:

- Trip blanks (1 per sample cooler containing VOC environmental samples)
- Equipment blanks (1 per sampling event for each type of decontamination procedure)
- Source blanks (1 per source lot per sampling event)
- Field duplicates (minimum of 1 per matrix per 20 environmental samples)
- Field blanks (minimum of 1 per 20 environmental samples or 1 per sampling day, whichever best exemplifies field conditions)
- Matrix spike/matrix spike duplicate (minimum of 1 per matrix per 20 environmental samples), not needed for some radioanalytical measurements (e.g., gamma spectrometry)

Additional QC samples may be submitted based on site conditions.

Data Quality Indicators of precision, accuracy, comparability, completeness, and representativeness are defined in the Industrial Sites QAPP (NNSA/NV, 2002). In addition, sensitivity has been

included as a DQI for laboratory analyses. Site-specific DQIs are discussed in more detail in Section 6.0 of the CAIP.

A.1.7 Step 7 - Optimize the Design for Obtaining Data

Radiological surveys and intrusive soil sampling for field-screening and laboratory analysis will be conducted at CAU 529. Sampling locations will be determined based on the biasing factors listed in Section A.1.3.1. The Site Supervisor has the discretion to modify the biased locations, but only if the modified locations meet the decision needs and criteria stipulated in Section A.1.3. The following sections provide general Phase I and II activities.

A.1.7.1 Radiological Survey Methodologies and Instruments

Land radiological surveys will be conducted to determine the presence of surficial gamma and high-energy beta-emitting radiological contaminants.

A combination of walk-over surveys using handheld instruments and drive-over surveys using a vehicle-mounted detector will be performed on the CAU 529 investigation area resulting in an approximate 100 percent survey as permitted by terrain and field conditions. A plastic scintillator will be used as the instrument for the walk-over and drive-over surveys. Additional equipment and software used in the radiological data collection and processing included a Trimble™ GPS receiver, laptop computer used to log and process the walk-over and drive-over radiological data, and Surfer™ to plot the data.

A.1.7.2 Intrusive Investigation

Intrusive investigations will be conducted at CAU 529 during Phase I and Phase II to resolve the decision statements discussed in Section A.1.2.1. Drilling, direct push, handheld augers, excavation, or other appropriate collection techniques will be used during sampling efforts to access sample intervals for laboratory analysis at select locations. Phase I and II biased locations for these activities are determined based on the biasing factors listed in Section A.1.3.1.

During Phase II, step-out sample locations at each parcel will be selected based on the outer boundary sample locations where COCs were detected, other biasing factors, and field/site conditions (e.g., limitations posed by steep terrain). If biasing factors indicate COCs extend beyond the

proposed Phase II sample locations, further step-out locations may be necessary. If the step-out locations from different original locations approach each other, then the Site Supervisor may consider this as one area, and collect samples only in the outward directions.

In general, samples submitted for laboratory analysis would be those that define the lateral and vertical extent of COCs.

The following sections describe the Phase I and II field activities to be conducted at the following parcels of CAS 25-23-17. Samples will be collected from the proposed biased locations as discussed in the following sections and shown in Figures 4-1 through 4-5 of Section 4.0 of the CAIP.

Sampling of the Areas of Highest Aerial Deposition

These areas include Phoebus 1A Test 8,000-ft Arc Area, the Kiwi TNT 16,000-ft Arc Area, and the Topopah Wash at TCC (i.e., the area 500 ft north of and 2,500 ft south of the Kiwi TNT Ground Zero) parcels. Radiological land area surveys will be conducted over approximately 100 percent as permitted by terrain and field conditions of the area of highest recorded aerial deposition. Based on the results of the radiological land area survey, a 10- by 10-meter area of the highest contamination will be selected. The 10- by 10-meter area will then be divided into a 3- by 3-meter grid. A surface sample (0- to 0.5-ft bgs) will be collected from the approximate center of each grid. The samples will be sent to an off-site laboratory for isotopic uranium, isotopic strontium, gamma spectroscopy, beryllium, and PCBs analyses. The radiological data acquired from the laboratory samples will be used to correlate the counts per minute measurement of the survey to an isotope-specific pCi/g equivalent. The survey results will be compared to PALs to determine if radiological COCs are present.

Sampling at the Buried Contaminated Soil Areas

Samples will be collected from a total of 10 sample locations. Five sample locations will be located at BCSA 1 and five sample locations will be located at the BCSA 2. Samples will be collected continuously from each sample location from land surface to 20 ft bgs at BCSA 1 and to 15 ft bgs at BCSA 2 and screened for radiological parameters. Based on radiological FSRs and other biasing factors, six soil samples from two sample locations at each area (i.e., a total of 12 samples) will be sent off site for laboratory analysis. In the absence of biasing factors at BCSA 1, samples will be

selected from just below land surface (i.e., 2 to 3 ft bgs), total depth (i.e., 19 to 20 ft bgs), and the interval considered to be the midpoint (i.e., 9 to 10 ft bgs) of the soil column. In the absence of biasing factors at BCSA 2, samples will be selected below land surface (i.e., 3 to 4 ft bgs), total depth (i.e., 14 to 15 ft bgs), and the interval considered to be the midpoint (i.e., 7 to 8 ft bgs) of the soil column.

During Phase II, step-out sample locations will be selected based on biasing factors and where COCs were detected. At each Phase II location, soil samples will be collected at the depth where COCs were encountered in Phase I and at 2 ft below the lowest depth where COCs were encountered.

Sampling at the Borrow Pit Burial Site

Three trenches will be excavated in an east and west direction over the suspected location of BPBS and field screening activities will be conducted. Screening results and other biasing factors will be used to collect three samples from each trench for laboratory analysis. One soil sample will be collected from the 0- to 0.5-ft bgs sample interval at each trench to determine if surface contamination is present. Two subsurface soil samples will be collected from each trench based on biasing factors. In the absence of biasing factors, the subsurface samples will be collected from the total depth (i.e., 9 to 10 ft bgs) and the interval considered to be the midpoint (i.e., 5 to 6 ft bgs) of the soil column. The sample for the midpoint interval will be collected from one of the trench walls using the backhoe bucket.

During Phase II activities at the BPBS, step-out sample locations will be selected based on biasing factors and where COCs were detected. At each Phase II sample location, soil samples will be collected at the depth where COCs were encountered in Phase I and at 2 ft below the lowest depth where COCs were encountered.

Sampling at the Drain/Outfall Discharges

Biased soil samples will be collected from the soil in the immediate vicinity of each discharge point within the wash for the four drains, the former drain pipe discharge (Section 2.3.7), and one outfall. Three soil samples will be collected from the surface to a depth of 10 ft bgs at each sample location and sent off site for laboratory analysis. One soil sample will be collected from the 0- to 0.5-ft bgs interval to determine if contamination is present at the surface. The two subsurface soil samples will

be collected at each sample location based on biasing factors. In the absence of biasing factors, the subsurface samples will be collected from the total depth (i.e., 9 to 10 ft bgs) of the sample location and from the interval considered to be the midpoint (i.e., 5 to 6 ft bgs) of the soil column at the sample location.

At each Phase II location, soil samples will be collected at the depth where COCs were encountered in Phase I samples and at 4 ft below the lowest depth where COCs were encountered.

Sampling at the Contaminated Soil Storage Area

The suspected location of the CSSA will be quartered by establishing a north-to-south transect and an east-to-west transect through the parcel. One sample location will be placed in each quarter based on biasing factors and sampled. If there are no biasing factors, a sample location will be located in the approximate center of each quarter. Samples will be collected continuously at 1-ft intervals from land surface to a depth of 4 ft bgs from each sample location and field screened for DRO and radiological parameters. Four confirmatory soil samples will be collected from the two sample locations with the highest screening results and sent to an off-site laboratory for analysis. Two of the confirmatory samples will be collected from the 0- to 0.5-ft sample interval to determine if surface contamination is present. In the absence of biasing factors, the SS will determine the two borings to be sampled for off-site laboratory analysis and the subsurface samples will be collected from the 3- to 4-ft interval.

At each Phase II location, soil samples will be collected at the depth where COCs were encountered in Phase I samples and at 2 ft below the lowest depth where COCs were encountered.

Sampling of the Main Stream/Drainage Channels

Soil samples will be collected from 10 biased sample locations. A hydrologist will identify and locate infiltration points and areas of sedimentation within the wash where contaminated sediments could have been deposited.

Seven of the ten Phase I sample locations will be located within the area of the wash between the 500-ft and 2,500-ft boundaries. This is considered to be the area impacted the most from past TCC releases. The remaining three sample locations will coincide with areas of sedimentation near the Kiwi TNT Arcs (e.g., the 4,000-, 8,000-, and 16,000-ft arcs). Continuous screening will be conducted

for radiological parameters and biasing factors from land surface to a depth of 10 ft bgs at each sample location. Three soil samples will be collected for laboratory analysis from each sample location. One soil sample will be collected from the 0- to 0.5-ft bgs interval to determine if contamination is present at the surface. Two subsurface soil samples will be collected based on biasing factors. In the absence of biasing factors, the subsurface samples will be collected from the total depth (i.e., 9 to 10 ft bgs) of the sample location and from the interval considered to be the midpoint (i.e., 5 to 6 ft bgs) of the soil column at the sample location.

At each Phase II location, soil samples will be collected at the depth where COCs were encountered in Phase I samples and at 2 ft below the lowest depth where COCs were encountered.

A.2.0 References

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BN, see Bechtel Nevada.

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Moore, J., Science Applications International Corporation. 1999. Memorandum to M. Todd (Science Applications International Corporation) entitled, "Background Concentrations for NTS and TTR Soil Samples," 3 February. Las Vegas, NV.

NAC, see *Nevada Administrative Code.*

NBMG, see Nevada Bureau of Mines and Geology.

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Tinney, J. 2001. *Contamination of the Topopah Wash from the KIWI Transient Nuclear Test, the Phoebus 1A Accident.* Prepared for IT Corporation Las Vegas. Las Vegas, NV.

U.S. Atomic Energy Commission. 1967. *Decontamination of Test Cell "C" at the Nuclear Reactor Development Station After a Reactor Accident.* 18 January. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Operations Office. 2002. *Industrial Sites Quality Assurance Project Plan, Nevada Test Site, Nevada*, Rev. 3, DOE/NV-372. Las Vegas, NV.

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USGS, see U.S. Geological Survey.

U.S. Geological Survey. 1975. *Hydrogeologic and Hydrochemical Framework, South-Central Great Basin, Nevada-California, with Special Reference to the Nevada Test Site*, USGS-PR-712-C. Prepared by I.J. Winogard and W. Thordarson on behalf of the U.S. Atomic Energy Commission. Denver, CO.

U.S. Geological Survey. 2002. *"USGS/DOE Nevada Water Use Wells."* As accessed at http://nevada.usgs.gov/doe on 12 November.

Appendix B

Project Organization

B.1.0 Project Organization

The NNSA/NV Project Manager is Janet Appenzeller-Wing, and her telephone number is (702) 295-0461.

The identification of the project Health and Safety Officer and the Quality Assurance Officer can be found in the appropriate plan. However, personnel are subject to change and it is suggested that the appropriate DOE Project Manager be contacted for further information. The Task Manager will be identified in the FFACO Biweekly Activity Report prior to the start of field activities.

Appendix C

NDEP Comment Responses

NEVADA ENVIRONMENTAL RESTORATION PROJECT
DOCUMENT REVIEW SHEET

1. Document Title/Number: Draft Corrective Action Investigation Plan for Corrective Action Unit 529: Area 25 Contaminated Materials Nevada Test Site, Nevada	2. Document Date: December 2002
3. Revision Number: 0	4. Originator/Organization: IT Corporation
5. Responsible NNSA/NSO ERP Project Mgr.: Janet Appenzeller-Wing	6. Date Comments Due: January 2, 2003
7. Review Criteria: Full	
8. Reviewer/Organization/Phone No.: John A. Wong, NDEP, 486-2866	9. Reviewer's Signature:

10. Comment Number/ Location	11. Type*	12. Comment	13. Comment Response	14. Accept
1) General Comment		Based on preliminary findings (sampling and analysis) and discussions during the January 14, 2003 site visit, remember to add volatile organic compounds (VOCs) to list of COPCs in Table 3-2 and applicable sections.	VOC analysis was added to the "Drain/Outfall Discharges" and "Main Stream/Drainage Channels" parcels.	Yes
2) Section 3.1.4 5th Paragraph		Explain in greater detail how *"sedimentation rates within the wash will be qualitatively evaluated,"* and used to obtain useful off-site contamination migration information. In the existing floodplain studies, is there data on sedimentation rates that can be *quantitatively* evaluated to determine potential migration? If so, perhaps it would be beneficial to discuss.	Sedimentation rates were not found in available documentation regarding flood plain studies. For additional clarification, the paragraph will be changed from, "Existing floodplain studies are available and will be considered during corrective action, as necessary. In addition, the sedimentation rates within the wash at sample locations will be qualitatively evaluated to provide any additional information on potential off-site migration of contamination." to read, "Existing floodplain studies are available and will be considered during corrective action, as necessary. In addition, areas of erosion and deposition within the wash will be qualitatively evaluated by a hydrologist to provide any additional information on potential off-site migration of contamination. Movement of the active stream channel in the last 40 years, may be identified based on a comparison of historical photographs and visual observations where erosion and deposition has occurred within the wash."	Yes

NEVADA ENVIRONMENTAL RESTORATION PROJECT
DOCUMENT REVIEW SHEET

10. Comment Number/ Location	11. Type*	12. Comment	13. Comment Response	14. Accept
3) Section 4.2 1st Paragraph		The objective of Phase II is to define extent of contamination; how is NNSA/NV defining bounded and unbounded COCs; also, justify or explain why *"only unbounded COCs will be considered during Phase II."*	The first paragraph under section 4.2 that states "Phase II will define the extent of COC contamination. The lateral and vertical extent of contamination will be bounded by a laboratory analytical soil sample showing COC concentrations below PALs." If COCs are bounded by analytical samples, it is implied that the extent of the COC has been delineated. Because the CAS covers such a large area and different transport mechanisms the delineation may result in multiple areas of contamination.	Yes
4) Section 4.2.2 1st Paragraph		Provide the conversion factors and/or mathematical equations that will enable NNSA to correlate radiological data/results from laboratory analyses, reported in pCi/g, with field survey results obtained in counts per minute. Perhaps an example can also be provided as well.	A direct correlation between the radiological survey data and corresponding analytical results will be used. Data distribution (e.g., lognormal) will determine best method to be used for the correlation of the two data sets.	Yes
5) Section 4.2.2.2 1st Paragraph		Throughout the entire subsection, specify the depths of sample collection where applicable, including those designated as "surface samples" (i.e., 0-6 in., 1-2 ft.).	Section revised per comment.	Yes

NEVADA ENVIRONMENTAL RESTORATION PROJECT
DOCUMENT REVIEW SHEET

10. Comment Number/ Location	11. Type*	12. Comment	13. Comment Response	14. Accept
6) Section 4.2.2.2 1st Paragraph		The Nevada Division of Environmental Protection, Bureau of Federal Facilities staff (NDEP) provided review comments on the Draft CAIP for Corrective Action Unit 529 in a letter dated January 21, 2003. In that letter, we failed to note that NNSA/NV changed their cleanup strategy for establishing Preliminary Action Levels (PALs) for radionuclides. The standard language used in all previous CAIP's read: *"The PALs for radionuclides are isotope-specific and defined as the maximum concentration for that isotope found in samples from undisturbed background locations in the vicinity of the NTS."* The language used in the CAU 529 CAIP read as follows: *"CAU-specific radiological PALs were derived using the RESRAD version 6.21 based upon a 25 mrem/yr dose constraint for three land use scenarios (Alderson, 2002)."* Please provide NDEP with a copy of the reference (Alderson, 2002) in this CAIP used to create the 25 mrem/year dose constraint. NDEP does not concur with using RESRAD and a 25mrem/yr standard to derive radiological PALs. NNSA/NV must justify the use of a new PAL strategy outside the scope of this document. NDEP will disapprove all FFACO documents containing this standard at this time.	The background comparisons for the radionuclides has been changed to the method requested. The text in the document will be changed to reflect the previous language in the CAIPs.	Yes

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

Return Document Review Sheets to NNSA/NSO Environmental Restoration Division, Attn: QAC, M/S 505.

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Sabrina Lawrence Environmental Restoration Division U.S. Department of Energy National Nuclear Security Administration Nevada Site Office P.O. Box 98518, M/S 505 Las Vegas, NV 89193-8518	1 (Controlled)*
Janet Appenzeller-Wing Environmental Restoration Division U.S. Department of Energy National Nuclear Security Administration Nevada Site Office P.O. Box 98518, M/S 505 Las Vegas, NV 89193-8518	1 (Uncontrolled)*

Kevin Cabble Environmental Restoration Division U.S. Department of Energy National Nuclear Security Administration Nevada Site Office P.O. Box 98518, M/S 505 Las Vegas, NV 89193-8518	1 (Uncontrolled)*
Jeffrey L. Smith Bechtel Nevada P.O. Box 98521, M/S NTS306 Las Vegas, NV 89193-8521	1 (Uncontrolled)*
Allison Urbon Bechtel Nevada P.O. Box 98521, M/S NTS306 Las Vegas, NV 89193-8521	1 (Uncontrolled)*
Alfred Wickline IT Corporation/Las Vegas P.O. Box 93838 Las Vegas, NV 89193	1 (Controlled)*
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