

RECORD OF TECHNICAL CHANGE

Technical Change No. DOE/NV--1467-ROTC 1 Page 1 of 4
Activity Name Streamlined Approach for Environmental Restoration (SAFER) Plan for Corrective Action Unit (CAU)
465: Hydronuclear Date July 24, 2012

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

Mark Burmeister

(Name)

CAU 465 Task Manager

(Title)

Description of Change:

Site investigation activities at CAU 465: Hydronuclear, Corrective Action Site (CAS) 00-23-02: Hydronuclear Experiment (Dog Site) began in September 2011. As part of the investigation, visual surveys were conducted with the purpose of identifying surface debris, soil staining, or other suspect conditions that could be associated with a release of contaminants. An area of fill material distinguishable from the surrounding soil and scattered surface debris was observed in the southeast portion of the site outside of the fenced compound. Of note were three partially buried lead plates in the northeast portion of the area and an aggregate of metal surface debris at the southwestern end. On February 28, 2012, a geophysical survey of the suspect area was conducted with an EM-61 instrument. Analysis of the survey data identified a pattern of buried metallic material suggestive of a landfill or disposal trench. In order to visually confirm the presence of buried debris, one exploratory excavation was dug into the feature on May 7, 2012. Large pieces of lead and steel, including pipes, were identified and removed from the excavation with a backhoe. The metal debris was screened for radioactivity and some of the pipes were found to have elevated beta/gamma radiation levels. Field operations were immediately suspended and the situation was reviewed. It was determined that the presence of a landfill/disposal trench located outside the fenced compound containing radioactively contaminated debris was an unexpected condition not considered in the data quality objectives (DQOs) process and not represented in the SAFER Plan conceptual site model (CSM). As such, further excavation was ceased in accordance with Section 3.2.5 of the SAFER Plan and participants in the DQO process were notified, and a path forward was proposed, discussed and agreed upon.

Each CAS was separated into two components in the SAFER Plan: surface release and subsurface release. Because the landfill/disposal trench is below the ground surface and any releases from the landfill would occur to subsurface soil, this feature is considered part of the subsurface CAS component for CAS 00-23-02 (Dog Site). Subsurface releases as described in the original SAFER Plan are potential releases of radiological and other contaminants from the subsurface hydronuclear experiments and disposal boreholes. The landfill/disposal trench is an additional contaminant source in the subsurface release component of CAS 00-23-02. It is presumed that the waste disposed in the landfill/disposal trench is associated with the hydronuclear experiments. The practice of burying uncontaminated and/or contaminated materials onsite at the Nevada National Security Site (NNSS) test sites was not uncommon during the testing era. The disposal of nonradioactive wastes in the twelve disposal boreholes at CAS 00-23-02 is direct evidence of this practice.

Discovery of a landfill/disposal trench at CAS 00-23-02 requires a change to the original CSM for CAU 465. The basic elements of the CSM as shown in Table B.2-1 are still valid, but the model will be supplemented through the addition of the landfill/disposal trench as part of the subsurface release component. The contaminants in the landfill/disposal trench are presumed to be similar to those identified for the subsurface experiment boreholes and disposal boreholes (i.e., radionuclides and lead). Thus, no additional contaminants of potential concern were added to the CAS due to the discovery of the landfill/disposal trench. The potential transport mechanisms, migration pathways, and exposure routes would also be the same as previously identified in the SAFER Plan.

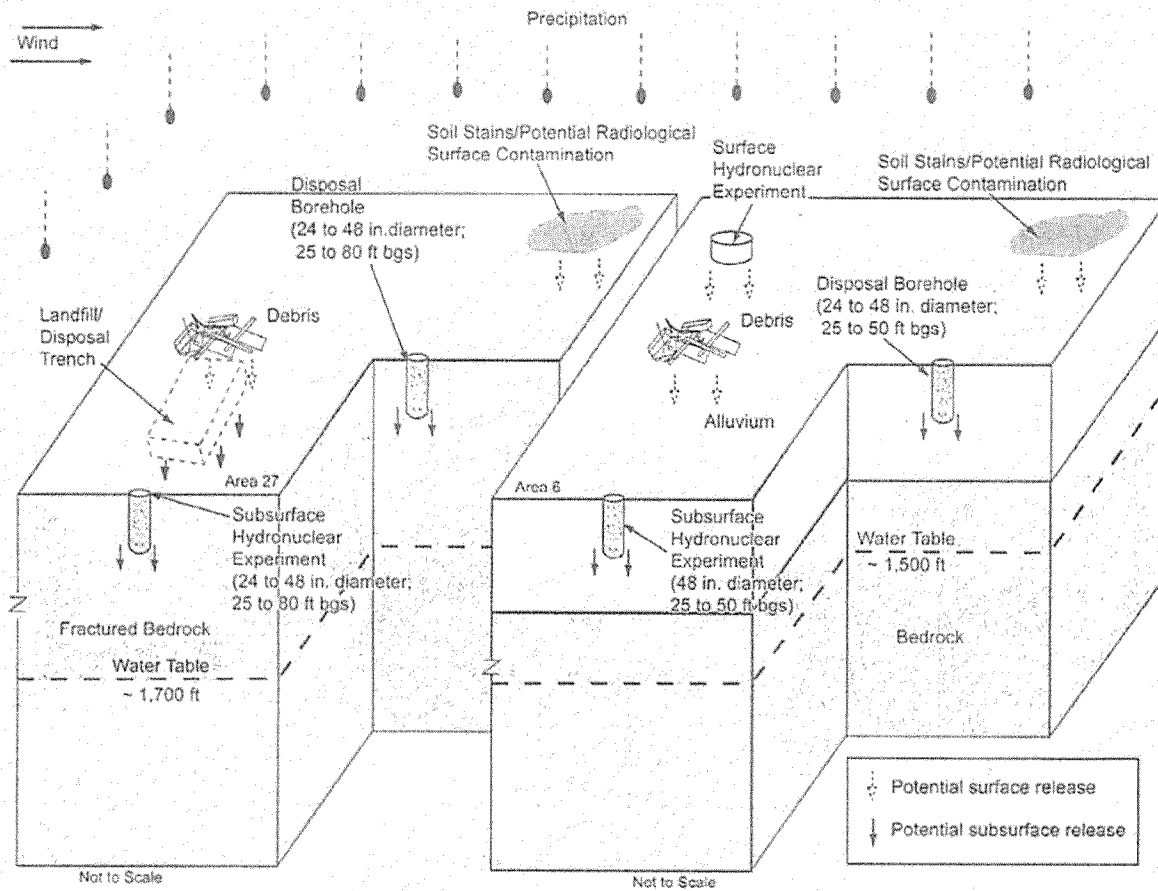
The general closure strategy for the subsurface release component of CAS 00-23-02 does not require revision based on the

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discovery of the landfill/disposal trench. The SAFER Plan states, "the subsurface CAS component consists of the remaining inventory (radiological and other metals) in the hydronuclear experiment and disposal boreholes. For the subsurface component, wastes will be left in place, and a corrective action of closure in place with use restrictions (URs) will be established to ensure protection of human health and the environment. Flow and transport models will be prepared to evaluate the potential for radiological and other metal contaminants to reach the groundwater below each of the CASs." The conservative radiological and chemical inventories utilized to complete the flow and transport analyses for the subsurface component bound the contaminants of potential concern associated with the disposal boreholes and landfill/disposal trench.

The SAFER Plan is revised as follows (revisions are in bold):

- Section 2.1.2, *CAS 00-23-02, Hydronuclear Experiment*. The first sentence is changed to read, "Corrective Action Site 00-23-02 (Dog Site) consists of 28 test boreholes that were used to conduct hydronuclear experiments, 12 disposal boreholes that were used to dispose of nonradioactive, classified materials associated with the hydronuclear experiments, and a landfill/disposal trench outside the fenced compound also used to dispose of material associated with the experiments."
- Section 3.1, *Summary of DQO Analysis*. The first bullet on the page is revised to read, "The subsurface release component addresses releases of radiological and other contaminants from the subsurface hydronuclear experiments, disposal boreholes, and the landfill/disposal trench (CAS 00-23-02 only)."
- Figures 3-3 and B.2-1 (CAU 465 Conceptual Site Model) are revised to include the landfill/disposal trench (see attached revised figure at the end of this Record of Technical Change [ROTC]).
- Section 4.2, *Remediation* is revised to add the following bullet to the closure strategy for subsurface releases: "Confirm the presence and determine the extent of buried debris in the landfill/disposal trench outside the fenced compound at CAS 00-23-02 (Dog Site) through visual and geophysical surveys and exploratory excavation, as needed."
- Appendix B, Section B.2.0, *Step 1 – State the Problem*. The problem statement for the subsurface component of CAU 465 is as follows: "Additional information on the potential impacts of the hydronuclear experiments, disposal boreholes, and the landfill/disposal trench (outside the fenced compound) to groundwater is needed to evaluate and recommend [Corrective Action Alternatives] CAAs."
- Appendix B, Table B.2-1, *Conceptual Site Model Description of Elements for Each CAS in CAU 465*. The statement in the second column next to "Location of Contamination/Release Point" is changed to read, "Surface soil at or near location(s) of release or stored waste/materials, and subsurface soil from hydronuclear experiments, disposal boreholes, and the landfill/disposal trench outside the fenced compound (CAS 00-23-02 only)."
- Appendix B, Section B.2.2.1, *Contaminant Release*. The first bullet is revised to read, "Releases to groundwater due to the remaining inventory of radiological and nonradiological materials in the boreholes utilized for hydronuclear experiments, the disposal boreholes, and the landfill/trench (CAS 00-23-02 only) (subsurface releases)."
- Appendix B, Section B.6.1, *Population Parameters, Subsurface Releases*. The following paragraph is added after the first paragraph: "The lateral extent of potential contamination for the experiment and disposal boreholes is defined as a six foot radius from the center of each borehole. The lateral extent of the potential contamination for the landfill/disposal trench at CAS 00-23-02 is defined as the landfill dimensions as determined by geophysical surveys and exploratory excavation, plus a three foot buffer surrounding the landfill."
- Appendix B, Section B.6.3.1, *Decision Rules, Subsurface Releases*. A third bullet is added to the subsurface release decision rules as follows: "If further assessment of the CAS is not required, then the CAA of closure in place with URs will be selected. The lateral extent of potential contamination as defined in Section B.6.1, will be used as the UR boundary for each CAS."



Conceptual Site Model for CAU 465 CASs

→→M

Justification:

The SAFER Plan states in Section 4.3, *Verification*: "If an unexpected condition indicates that conditions are significantly different than the corresponding CSM, the activity will be rescoped, and the decision makers will be notified." This ROTC is required based on the discovery of an unexpected condition (i.e., the existence of a landfill/disposal trench outside the fenced compound) at CAS 00-23-02 (Dog Site). The landfill/disposal trench is considered another potential release source for the subsurface release component of CAS 00-23-02 which requires revision to the CSM.

The task time will be Increased by approximately 60 days.

Applicable Activity-Specific Document(s):

Approved By:	<u>/s/ Tiffany A. Lantow</u>	Date	<u>8/6/2012</u>
	Activity Lead		
	<u>/s/ Robert F. Boehlecke</u>	Date	<u>8/7/12</u>
	Manager, EM Operations		
	<u>/s/ Jeff Mac Dougall</u>	Date	<u>8/7/12</u>
	NDEP		

Nevada
Environmental
Restoration
Project

DOE/NV--1467



Streamlined Approach for Environmental Restoration (SAFER) Plan for Corrective Action Unit 465: Hydronuclear Nevada National Security Site, Nevada

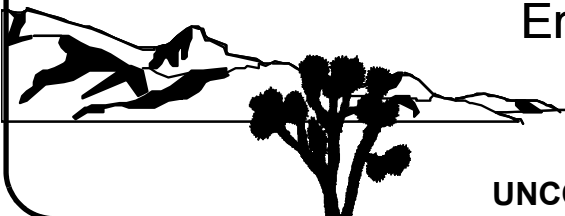
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STREAMLINED APPROACH FOR ENVIRONMENTAL RESTORATION (SAFER) PLAN FOR CORRECTIVE ACTION UNIT 465: HYDRONUCLEAR NEVADA NATIONAL SECURITY SITE, NEVADA

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

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Reviewed and determined to be UNCLASSIFIED.
Derivative Classifier: <u>Joseph P. Johnston/N-I CO</u> <small>(Name/personal identifier and position title)</small>
Signature: <u>/s/ Joseph P. Johnston</u>
Date: <u>11/1/2011</u>

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**STREAMLINED APPROACH FOR ENVIRONMENTAL RESTORATION (SAFER)
PLAN FOR CORRECTIVE ACTION UNIT 465: HYDRONUCLEAR
NEVADA NATIONAL SECURITY SITE, NEVADA**

Approved by: /s/ Kevin Cabble

Date: 11-1-11

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Date: 11/1/11

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Table of Contents

List of Figures	v
List of Tables	vi
List of Acronyms and Abbreviations	viii
Executive Summary	ES-1
1.0 Introduction.....	1
1.1 SAFER Process Description.....	4
1.2 Summary of Corrective Actions and Closures	5
2.0 Unit Description	9
2.1 Area 27 Hydronuclear Experiments	10
2.1.1 CAS 00-23-01, Hydronuclear Experiment.....	12
2.1.2 CAS 00-23-02, Hydronuclear Experiment.....	13
2.1.3 CAS 00-23-03, Hydronuclear Experiment.....	17
2.2 Area 6 Hydronuclear Experiments	19
3.0 Data Quality Objectives.....	26
3.1 Summary of DQO Analysis	26
3.2 Results of the DQO Analysis	30
3.2.1 Action Level Determination and Basis.....	30
3.2.1.1 Chemical PALs	34
3.2.1.2 Radionuclide PALs	34
3.2.1.3 Groundwater PALs	36
3.2.2 Hypothesis Test	36
3.2.3 Statistical Model.....	37
3.2.4 Design Description/Option.....	37
3.2.5 Conceptual Site Model and Drawing.....	38
4.0 Field Activities and Closure Objectives	41
4.1 Contaminants of Potential Concern	42
4.2 Remediation	43
4.3 Verification	44
4.3.1 Site Preparation	47
4.4 Closure	47
4.5 Duration	48
5.0 Reports and Records Availability	49

Table of Contents (Continued)

6.0	Investigation/Remediation Waste Management	50
6.1	Waste Minimization	50
6.2	Potential Waste Streams	51
6.2.1	Industrial Waste	51
6.2.2	Low-Level Radioactive Waste	51
6.2.3	Hazardous Waste	52
6.2.4	Hydrocarbon Waste	52
6.2.5	Mixed Low-Level Waste	52
6.2.6	Polychlorinated Biphenyls	52
7.0	Quality Assurance/Quality Control	54
7.1	Sample Collection Activities	54
7.2	Applicable Laboratory/Analytical Data Quality Indicators	55
7.2.1	Precision	55
7.2.2	Accuracy	57
7.2.3	Representativeness	58
7.2.4	Completeness	59
7.2.5	Comparability	59
7.2.6	Sensitivity	60
8.0	References	61

Appendix A - Project Organization

A.1.0	Project Organization	A-1
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Appendix B - Data Quality Objective Process

B.1.0	Introduction	B-1
B.2.0	Step 1 - State the Problem	B-3
B.2.1	Planning Team Members	B-3
B.2.2	Conceptual Site Model	B-3
B.2.2.1	Contaminant Release	B-7
B.2.2.2	Potential Contaminants	B-7
B.2.2.3	Contaminant Characteristics	B-9
B.2.2.4	Site Characteristics	B-9
B.2.2.5	Migration Pathways and Transport Mechanisms	B-11
B.2.2.6	Land Use and Exposure Scenarios	B-11

Table of Contents (Continued)

B.3.0	Step 2 - Identify the Goal of the Study	B-13
B.3.1	Decision Statements	B-13
B.3.2	Alternative Actions to the Decisions	B-17
B.3.2.1	Alternative Actions to Decision I	B-17
B.3.2.2	Alternative Actions to Decision II	B-18
B.4.0	Step 3 - Identify Information Inputs	B-19
B.4.1	Information Needs	B-19
B.4.2	Sources of Information	B-20
B.4.2.1	Sample Locations	B-20
B.4.2.1.1	Judgmental Approach for Sampling Location Selection	B-21
B.4.2.2	Analytical Methods	B-22
B.5.0	Step 4 - Define the Boundaries of the Study	B-23
B.5.1	Target Populations of Interest	B-23
B.5.2	Spatial Boundaries	B-23
B.5.3	Practical Constraints	B-24
B.5.4	Define the Sampling Units	B-24
B.6.0	Step 5 - Develop the Analytic Approach	B-25
B.6.1	Population Parameters	B-25
B.6.2	Action Levels	B-25
B.6.2.1	Subsurface Releases	B-26
B.6.2.2	Surface Releases	B-27
B.6.2.2.1	Chemical PALs	B-27
B.6.2.2.2	Radionuclide PALs	B-27
B.6.3	Decision Rules	B-29
B.6.3.1	Subsurface Releases	B-29
B.6.3.2	Surface Releases	B-29
B.7.0	Step 6 - Specify Performance or Acceptance Criteria	B-31
B.7.1	Decision Hypotheses	B-31
B.7.2	False Negative Decision Error	B-31
B.7.2.1	Subsurface Releases	B-31
B.7.2.1.1	False Negative Decision Error for CAU Groundwater Models	B-32
B.7.2.2	Surface Releases	B-32
B.7.2.2.1	False Negative Decision Error for Judgmental Sampling	B-32

Table of Contents (Continued)

B.7.3	False Positive Decision Error	B-34
B.7.3.1	Subsurface Releases	B-34
B.7.3.2	Surface Releases	B-35
B.8.0	Step 7 - Develop the Plan for Obtaining Data	B-36
B.8.1	Subsurface Releases: Development of the Flow and Contaminant Transport Models	B-36
B.8.2	Surface Releases: Field Sampling	B-37
B.8.2.1	Decision I Sampling	B-37
B.8.2.2	Decision II Sampling	B-39
B.9.0	References	B-40

List of Figures

Number	Title	Page
1-1	Nevada National Security Site.	2
1-2	CAU 465, CAS Location Map	3
1-3	CAU 465 Closure Decision Process (Subsurface Component).	6
1-4	CAU 465 Closure Decision Process (Surface Component)	7
2-1	Hydronuclear Experiment CAS Locations in Area 27	11
2-2	CAS 00-23-01, Hydronuclear Experiment (Charlie Site), Site Layout.	14
2-3	CAS 00-23-02, Hydronuclear Experiment (Dog Site), Site Layout	16
2-4	CAS 00-23-03, Hydronuclear Experiment (Charlie Prime Site), Site Layout	20
2-5	CAS 00-23-03, Hydronuclear Experiment (Anja Site), Site Layout.	21
2-6	Hydronuclear Experiment CAS Location in Area 6	22
2-7	CAS 06-99-01, Hydronuclear (Trailer 13 Site), Site Layout	25
3-1	Risk-Based Corrective Action Decision Process	33
3-2	Conceptual Site Model Diagram for CAU 465	39
3-3	CAU 465 Conceptual Site Model	40
B.2-1	Conceptual Site Model for CAU 465 CASs	B-6
B.3-1	SAFER Closure Decision Process for CAU 465 CASs (Subsurface Component).	B-14
B.3-2	SAFER Closure Decision Process for CAU 465 CASs (Surface Component).	B-15

List of Tables

Number	Title	Page
2-1	Total Inventory of Radiological and Other Materials for Area 27 Hydronuclear Experiments	10
2-2	Hydronuclear Experiments Conducted at CAS 00-23-01 (Charlie Site)	12
2-3	Hydronuclear Experiments Conducted at CAS 00-23-02 (Dog Site)	15
2-4	Hydronuclear Experiments Conducted at CAS 00-23-03 (Charlie Prime Site)	18
2-5	Hydronuclear Experiments Conducted at CAS 00-23-03 (Anja Site)	18
2-6	Total Inventory of Radiological and Other Materials for Area 6 Hydronuclear Experiments	23
2-7	Hydronuclear Experiments Conducted at CAS 06-99-01 (Trailer 13 Site).	23
3-1	Analytical Program for Surface Releases	28
3-2	Constituents Reported by Analytical Methods	29
3-3	Analytical Requirements for Radionuclides for CAU 465	31
3-4	Analytical Requirements for Chemical COPCs for CAU 465	32
3-5	Residual Radioactive Material Guideline Values	35
4-1	Sampling Approach for Surface Component at CAU 465 CASs.	46
4-2	SAFER Field Activities	48
7-1	Laboratory and Analytical Performance Criteria for CAU 465 DQIs	56

List of Tables (Continued)

Number	Title	Page
B.2-1	Conceptual Site Model Description of Elements for Each CAS in CAU 465	B-5
B.2-2	Analytical Program	B-8
B.2-3	Land Use and Exposure Scenarios	B-12
B.5-1	Spatial Boundaries of CAU 465 CASs	B-24
B.6-1	Residual Radioactive Material Guideline Values	B-28

List of Acronyms and Abbreviations

Ac	Actinium
Am	Americium
ASTM	ASTM International
bgs	Below ground surface
BMP	Best management practice
CAA	Corrective action alternative
CAI	Corrective action investigation
CAS	Corrective action site
CAU	Corrective action unit
CFR	<i>Code of Federal Regulations</i>
cm	Centimeter
Co	Cobalt
COC	Contaminant of concern
COPC	Contaminant of potential concern
CR	Closure report
Cs	Cesium
CSM	Conceptual site model
DNT	Dinitrotoluene
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DQI	Data quality indicator
DQO	Data quality objective
EPA	U.S. Environmental Protection Agency
Eu	Europium
FAL	Final action level
FFACO	<i>Federal Facility Agreement and Consent Order</i>

List of Acronyms and Abbreviations (Continued)

FSR	Field-screening result
ft	Foot
g	Gram
HE	High explosive
HMX	High-melting explosive
IDW	Investigation-derived waste
in.	Inch
JASPER	Joint Actinide Shock Physics Experimental Research
K	Potassium
kg	Kilogram
lb	Pound
LCS	Laboratory control sample
LLNL	Lawrence Livermore National Laboratory
MDC	Minimum detectable concentration
m ²	Square meter
mi	Mile
mrem/yr	Millirem per year
MS	Matrix spike
MSD	Matrix spike duplicate
NAC	<i>Nevada Administrative Code</i>
NAD	North American Datum
Nb	Niobium
ND	Normalized difference
NDEP	Nevada Division of Environmental Protection
N-I	Navarro-Intera, LLC
NNSA/NSO	U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office

List of Acronyms and Abbreviations (Continued)

NNSS	Nevada National Security Site
PAL	Preliminary action level
Pb	Lead
PCB	Polychlorinated biphenyl
pCi/g	Picocuries per gram
PPE	Personal protective equipment
PSM	Potential source material
Pu	Plutonium
QA	Quality assurance
QAPP	Quality Assurance Project Plan
QC	Quality control
RBCA	Risk-based corrective action
RBSL	Risk-based screening level
RCRA	<i>Resource Conservation and Recovery Act</i>
RDX	Research department explosive
REOP	Real Estate/Operations Permit
RESRAD	Residual Radioactive
RL	Reporting limit
RMA	Radioactive material area
RPD	Relative percent difference
RRMG	Residual radioactive material guideline
SAFER	Streamlined Approach for Environmental Restoration
SDWA	<i>Safe Drinking Water Act</i>
Sr	Strontium
SSTL	Site-specific target level
SVOC	Semivolatile organic compound

List of Acronyms and Abbreviations (Continued)

TBD	To be determined
TCLP	Toxicity Characteristic Leaching Procedure
TED	Total effective dose
Th	Thorium
Tl	Thallium
TLD	Thermoluminescent dosimeter
TPH	Total petroleum hydrocarbons
TSCA	<i>Toxic Substances Control Act</i>
U	Uranium
UGTA	Underground Test Area
UR	Use restriction
UTM	Universal Transverse Mercator
VOC	Volatile organic compound
WAC	Waste Acceptance Criteria
%R	Percent recovery

Executive Summary

This Streamlined Approach for Environmental Restoration (SAFER) Plan addresses the actions needed to achieve closure for Corrective Action Unit (CAU) 465, Hydronuclear, identified in the *Federal Facility Agreement and Consent Order* (FFACO). Corrective Action Unit 465 comprises the following four corrective action sites (CASs) located in Areas 6 and 27 of the Nevada National Security Site:

- 00-23-01, Hydronuclear Experiment
- 00-23-02, Hydronuclear Experiment
- 00-23-03, Hydronuclear Experiment
- 06-99-01, Hydronuclear

The sites will be investigated based on the data quality objectives (DQOs) developed on July 6, 2011, by representatives of the Nevada Division of Environmental Protection (NDEP) and the U.S. Department of Energy (DOE), National Nuclear Security Administration Nevada Site Office. The DQO process was used to identify and define the type, amount, and quality of data needed to determine and implement appropriate corrective actions for each CAS in CAU 465.

The DQO process developed for this CAU identified the following expected closure option:

- Characterization of the nature and extent of contamination leading to closure in place with use restrictions

For CAU 465, two potential release components have been identified. The subsurface release component includes potential releases of radiological and nonradiological contaminants from the subsurface hydronuclear experiments and disposal boreholes. The surface release component consists of other potential releases of radiological and nonradiological contaminants to surface soils that may have occurred during the pre- and post-test activities. This plan provides the methodology for collection of the necessary information for closing each CAS component. There is sufficient information and process knowledge from historical documentation, contaminant characteristics, existing regional and site groundwater models, and investigations of similar sites regarding the expected nature and extent of potential contaminants to recommend closure of CAU 465 using the SAFER process.

For potential subsurface releases, flow and transport models will be developed to integrate existing data into a conservative description of contaminant migration in the unsaturated zone from the hydronuclear experiments and disposal boreholes. For the potential surface releases, additional information will be obtained by conducting a field investigation before selecting the appropriate corrective action for each CAS component. It is anticipated that results of the flow and transport models, the field investigation, and implementation of the corrective action of closure in place will support a defensible recommendation that no further corrective action is necessary. This will be presented in a closure report that will be prepared and submitted to NDEP for review and approval.

The following text summarizes the SAFER activities that will support the closure of CAU 465:

- Perform site preparation activities (e.g., utilities clearances, and radiological and visual surveys).
- Move or remove and dispose of debris at various CASs, as required.
- Collect environmental samples from designated target populations (e.g., stained soil) to confirm or disprove the presence of contaminants of concern as necessary to supplement existing information.
- Evaluate and analyze existing data to develop conservative flow and transport models to simulate the potential for contaminant migration from the hydronuclear experiments and disposal boreholes to the water table within 1,000 years.
- Confirm the preferred closure option (closure in place with use restrictions) is sufficient to protect human health and the environment.

This SAFER Plan has been developed in accordance with the FFACO that was agreed to by the State of Nevada; DOE, Environmental Management; U.S. Department of Defense; and DOE, Legacy Management. Under the FFACO, this SAFER Plan will be submitted to NDEP for approval. Fieldwork will be conducted following approval of the plan.

1.0 Introduction

This Streamlined Approach for Environmental Restoration (SAFER) Plan addresses the actions necessary for the closure of Corrective Action Unit (CAU) 465: Hydronuclear, Nevada National Security Site (NNSS), Nevada. It has been developed in accordance with the *Federal Facility Agreement and Consent Order* (FFACO) (1996, as amended) that was agreed to by the State of Nevada; U.S. Department of Energy (DOE), Environmental Management; U.S. Department of Defense; and DOE, Legacy Management.

Corrective Action Unit 465 is located in Areas 6 and 27 of the NNSS, which is approximately 65 miles (mi) northwest of Las Vegas, Nevada ([Figure 1-1](#)). Corrective Action Unit 465 comprises the four corrective action sites (CASs) shown on [Figure 1-2](#) and listed below:

- 00-23-01, Hydronuclear Experiment, located in Area 27 of the NNSS and known as the Charlie site.
- 00-23-02, Hydronuclear Experiment, located in Area 27 of the NNSS and known as the Dog site.
- 00-23-03, Hydronuclear Experiment, located in Area 27 of the NNSS and known as the Charlie Prime and Anja sites.
- 06-99-01, Hydronuclear, located in Area 6 of the NNSS and known as the Trailer 13 site.

The hydronuclear sites consist of a series of shallow boreholes ranging from 25 to 80 feet (ft) deep used to conduct hydronuclear experiments (in which conventional explosives were used to assess the safety of nuclear weapons). These experiments are also sometimes referred to as “equation of state” experiments. As a result of the hydronuclear experiments, radiological materials—including plutonium (Pu); depleted, enriched, and natural uranium (U); and uranium oxide—along with metals (e.g., silver, lead) are present at the bottom of the boreholes. Several of the boreholes at two CAS locations are known to have been utilized for the disposal of nonradioactive classified materials associated with the hydronuclear experiments. As such, the contaminants of concern (COCs) associated with these materials are the same as those associated with the experiments. A total of 99 experiments were conducted: 76 experiments in Area 27, and 23 experiments in Area 6. All but one experiment was conducted subsurface.

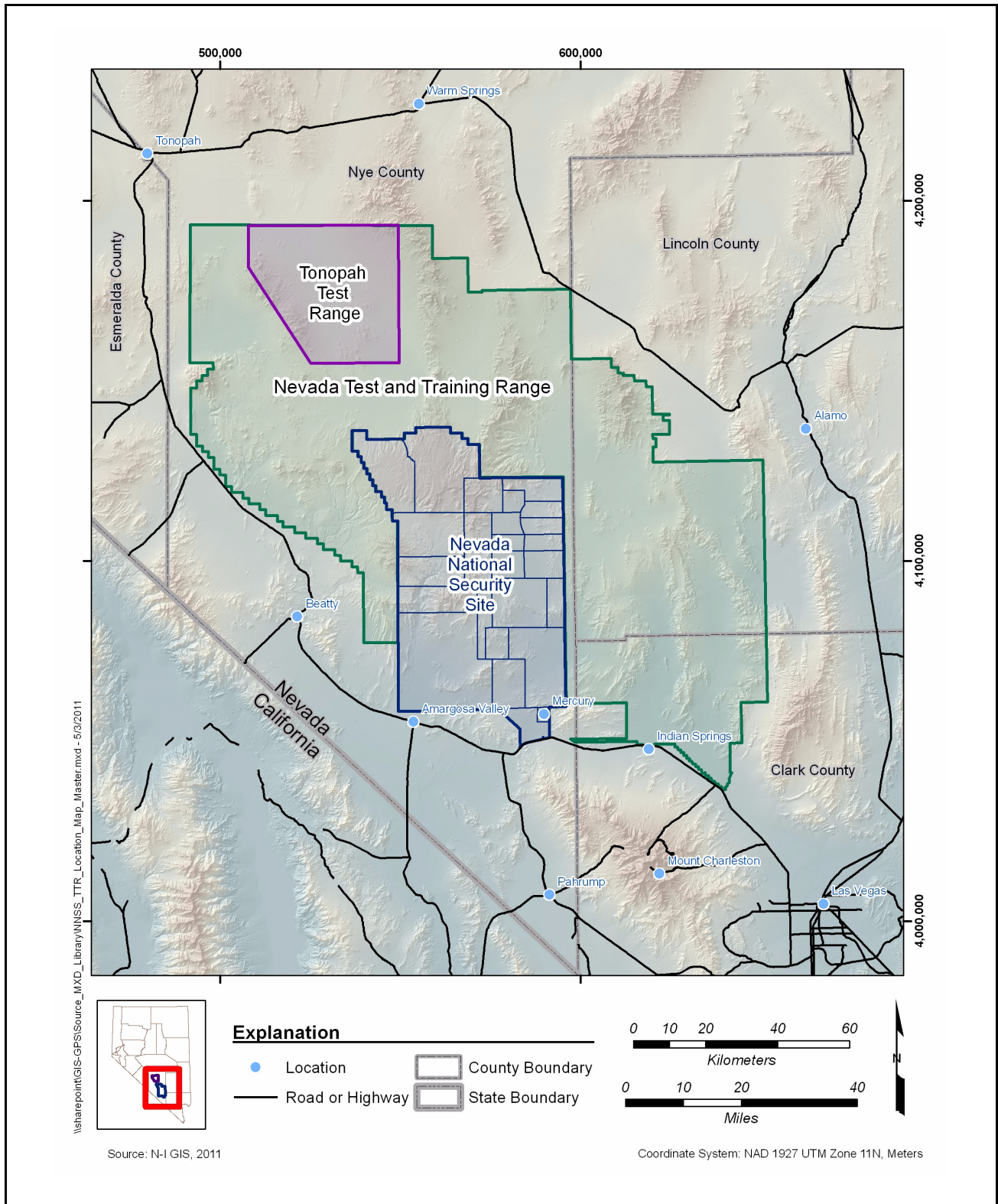


Figure 1-1
Nevada National Security Site

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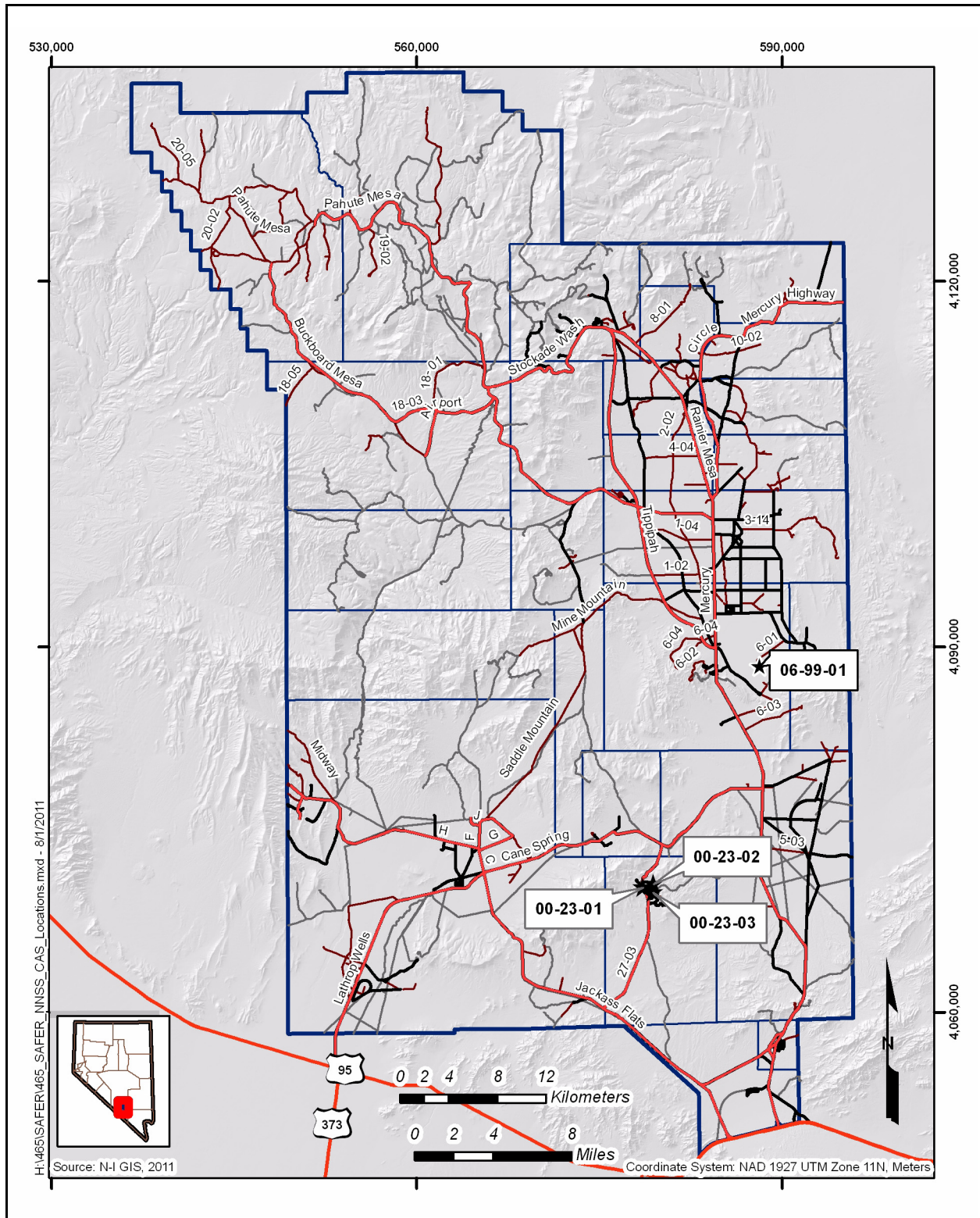


Figure 1-2
CAU 465, CAS Location Map

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A SAFER may be performed when the following criteria are met:

- Conceptual corrective actions are clearly identified (although some degree of investigation may be necessary to select a specific corrective action before completion of the Corrective Action Investigation [CAI]).
- Uncertainty of the nature, extent, and corrective action must be limited to an acceptable level of risk.
- The SAFER Plan includes decision points and criteria for making data quality objective (DQO) decisions.

The purpose of this SAFER Plan will be to document and verify the adequacy of existing information; to affirm the decision for the corrective action of closure in place of the hydronuclear experiment and disposal boreholes at CASs 00-23-01, 00-23-02, 00-23-03, and 06-99-01; and to provide sufficient data to implement the corrective actions. This SAFER Plan identifies decision points developed in cooperation with the Nevada Division of Environmental Protection (NDEP), where the DOE, National Nuclear Security Administration Nevada Site Office (NNSA/NSO) will reach consensus with NDEP before beginning the next phase of work.

There is sufficient information and process knowledge from historical documentation and investigations of similar sites (i.e., the expected nature and extent of contaminants of potential concern [COPCs]) to recommend closure of CAU 465 using the SAFER process described in the FFACO (1996, as amended).

1.1 SAFER Process Description

Corrective action units that may be closed using the SAFER process have conceptual corrective actions that are clearly identified. Consequently, corrective action alternatives (CAAs) can be chosen before completing a CAI, given anticipated investigation results.

The SAFER process combines elements of the DQO process and the observational approach to plan and conduct closure activities. The DQOs are used to identify the problem and define the type and quality of data needed to complete closure of each CAS. The purpose of the CAI phase is to verify the adequacy of existing information used to determine the chosen corrective action and to confirm that closure objectives were met.

Use of the SAFER process allows for technical decisions to be made based on incomplete but sufficient information and the experience of the decision maker. Based on a detailed review of historical documentation, there is sufficient process knowledge to close CAU 465 using the SAFER process. Any uncertainties are addressed by documented assumptions that are verified by sampling and analysis, data evaluation, and onsite observations, as necessary. Closure activities may proceed simultaneously with site characterization as sufficient data are gathered to confirm or disprove the assumptions made during selection of the corrective action. If, at any time during the closure process, new information is discovered that indicates that closure activities should be revised, closure activities will be reevaluated as appropriate.

1.2 Summary of Corrective Actions and Closures

For CAU 465, each CAS consists of two distinct CAS components: a subsurface component and a surface component. Different investigation strategies have been selected for each CAS component.

The subsurface CAS component consists of the remaining inventory (radiological and other metals) in the hydronuclear experiment and disposal boreholes. For the subsurface component, wastes will be left in place, and a corrective action of closure in place with use restrictions (URs) will be established to ensure protection of human health and the environment. Flow and transport models will be prepared to evaluate the potential for radiological and other metal contaminants to reach the groundwater below each of the CASs. For contaminants with a potential to reach the water table, contaminant concentrations in the groundwater beneath the CAS will be evaluated and compared to the appropriate final action levels (FALs). If the modeled contamination in groundwater exceeds FALs within 1,000 years, then additional engineering controls and/or corrective actions such as installation of run-on or infiltration controls, placement of a soil cover, and/or other surface water diversion controls will be evaluated for each CAS with contaminants above FALs. Refer to [Figure 1-3](#) for a summary of the decision process for the subsurface component of CAU 465.

The surface CAS component consists of environmental releases to surface soils from historical operations conducted at each site in support of the hydronuclear experiments. The decision process for closure of the surface component of CAU 465 is summarized in [Figure 1-4](#). This process starts with the initial CAI in which the appropriate target populations within each CAS (defined in the DQO process; see [Appendix B](#)) are evaluated and compared to FALs. If contaminants are detected at

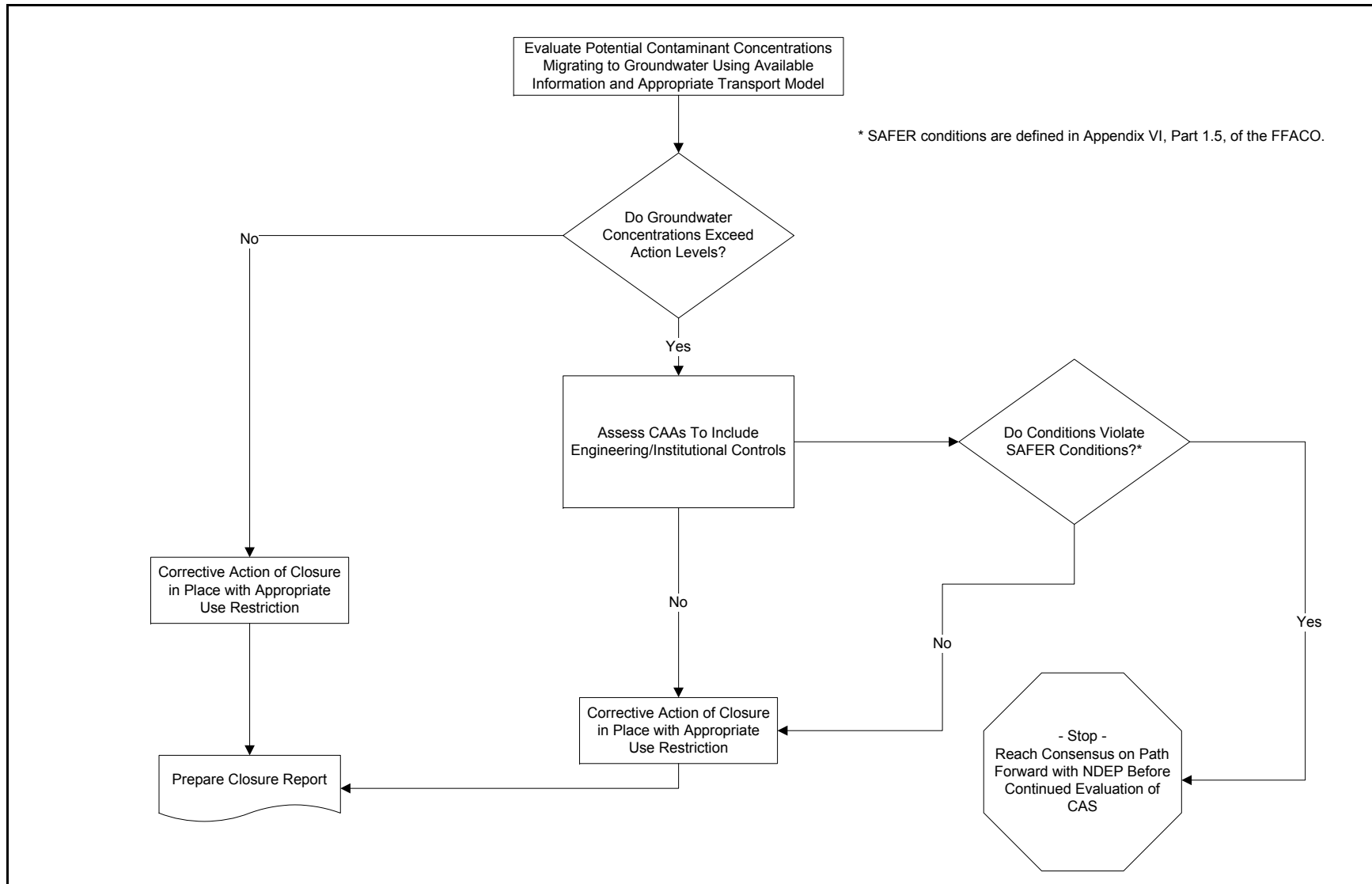


Figure 1-3
CAU 465 Closure Decision Process (Subsurface Component)

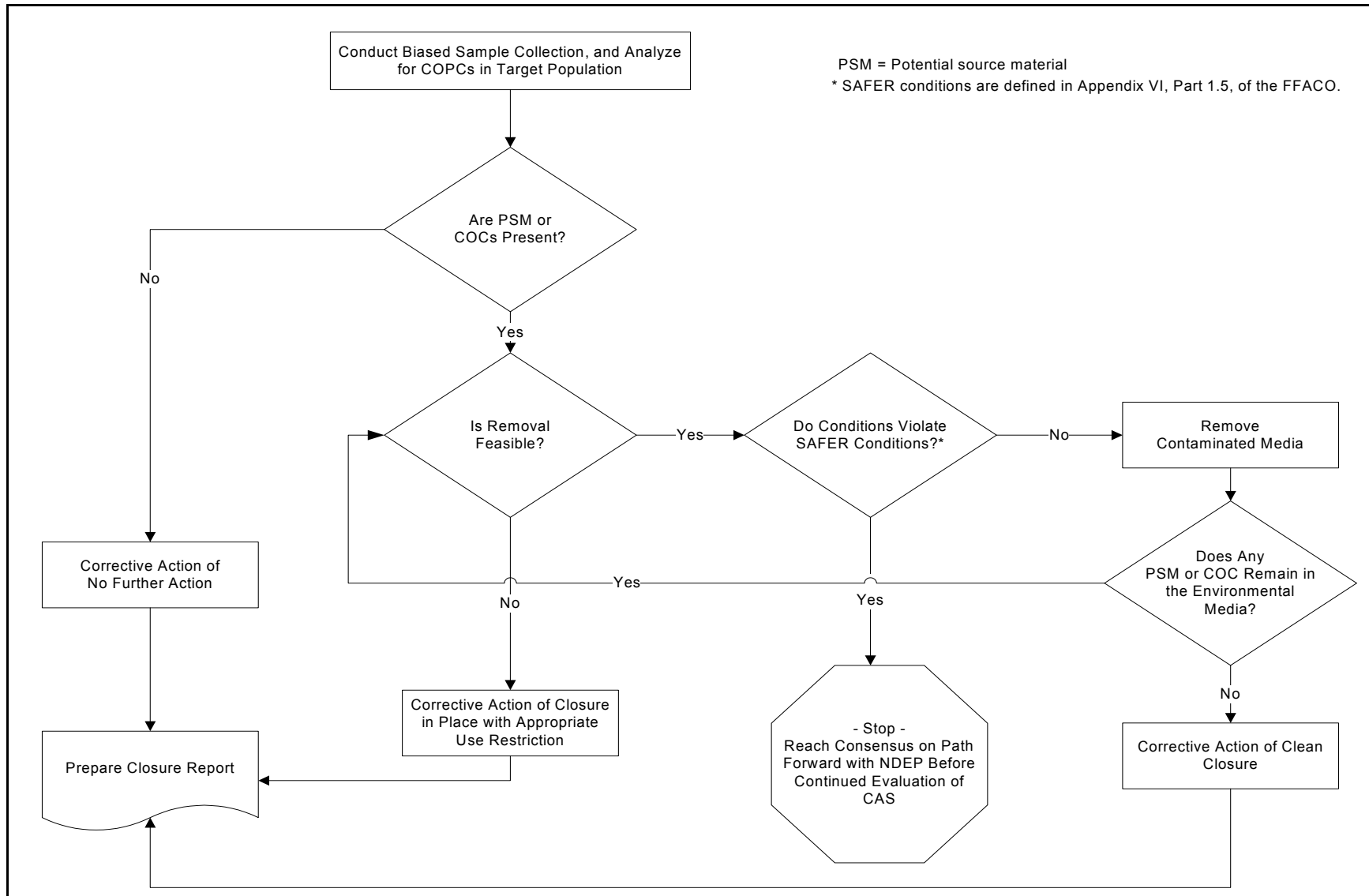


Figure 1-4
CAU 465 Closure Decision Process (Surface Component)

concentrations that are above the FALs and removal is feasible, the nature and extent of contamination will be delineated. However, contingencies are built into the process in the event new information is identified which indicates that the selected closure option should be revised. The targeted corrective action for the surface component is clean closure and will include removal of contaminated media and identified potential source materials (PSMs). The alternative corrective action of closure in place with implementation of appropriate URs will be performed only if complete removal of COCs and PSMs cannot be accomplished during the SAFER (e.g., dependent on site conditions, if removal is feasible). The process ends with closure of the site based on laboratory analytical results of the environmental samples and the preparation of a closure report (CR).

Decision points that require NNSA/NSO and NDEP to reach a consensus before continuing are indicated in [Figures 1-3](#) and [1-4](#).

In addition to the previously discussed hold/decision points, work may be temporarily suspended until the issue can be satisfactorily resolved if any of the following unexpected conditions occur:

- Conditions outside the scope of work are encountered.
- Unexpected conditions, including unexpected waste and/or contamination, are encountered.
- Out-of-scope work activities are required because of the detection of other COCs that would require reevaluating a disposal pathway, such as with hazardous or low-level waste.
- Unsafe conditions or work practices are encountered.

2.0 Unit Description

The operational history, process knowledge, and existing information for CAU 465 is summarized in this section. This information has been obtained through review of historical documents, engineering drawings and maps, and interviews with past and present NNSS employees. Although some uncertainty remains regarding general knowledge of past operations for CAU 465, assumptions were made based on the available information to formulate a conceptual site model (CSM) that describes the most probable scenario for the current conditions at each CAS. [Section 3.2.5](#) provides additional information on the CSM developed for the CASs in CAU 465.

Each CAS consists of a series of shallow boreholes ranging from 25 to 80 ft deep used to conduct hydronuclear experiments (in which conventional explosives were used to assess the safety of nuclear weapons). According to the bulletin titled “Historical Hydronuclear Experiments Conducted at the Nevada Test Site,” Lawrence Livermore National Laboratory (LLNL) conducted a total of 99 experiments: 23 experiments (including 1 on the surface and 2 in previously used holes) were conducted in Area 6 (Trailer 13), and 76 experiments (all subsurface) were performed in Area 27 (Charlie, Dog, Charlie Prime, and Anja) (DOE/NV, 2001).

The potential environmental concern at each site is predominantly attributable to the presence of *Resource Conservation and Recovery Act* (RCRA) metals, high explosives (HEs), and radionuclides, specifically plutonium and several forms of uranium, due to the experiments and the associated instruments, which are believed to remain downhole (DOE/NV, 2001). A review of historical information has also indicated that an additional set of shallow boreholes (12 at the Dog site, and 1 at the Trailer 13 site) were utilized for disposal of nonradioactive classified materials following the experiments. Because these boreholes were utilized for disposal of materials used to conduct the hydronuclear experiments, no additional contaminants are expected. Past radiological surveys have not indicated any surface radiological contamination at any of the sites.

2.1 Area 27 Hydronuclear Experiments

A total of 76 subsurface hydronuclear experiments were conducted in Area 27 of the NNSS at the following three CASs:

- 00-23-01, Hydronuclear Experiment (Charlie site)
- 00-23-02, Hydronuclear Experiment (Dog site)
- 00-23-03, Hydronuclear Experiment (Charlie Prime and Anja sites)

Depth of boreholes ranged from 45 to 80 ft below ground surface (bgs). The experiments performed at the Charlie, Dog, Charlie Prime, and Anja sites were conducted between August 1960 and January 1966. The total inventory of radiological and other materials used to conduct the experiments is provided in [Table 2-1](#) (DOE/NV, 2001). All four sites are located off the 27-03 Road near the Super Kukla Facility and the Joint Actinide Shock Physics Experimental Research (JASPER) Facility complexes in Area 27 of the NNSS ([Figure 2-1](#)). The date, specific area location, borehole number, and depth of borehole for each experiment are provided in the following sections.

**Table 2-1
 Total Inventory of Radiological and Other Materials
 for Area 27 Hydronuclear Experiments**

Material Description	Mass
High explosives	3,962 lb
Plutonium	38 kg
Enriched uranium	11 kg
Depleted uranium	433 kg
Natural uranium	117 kg
Uranium oxide	66 kg
Other metals (e.g., lead, silver)	Unknown

Source: DOE/NV, 2001

kg = Kilogram
 lb = Pound

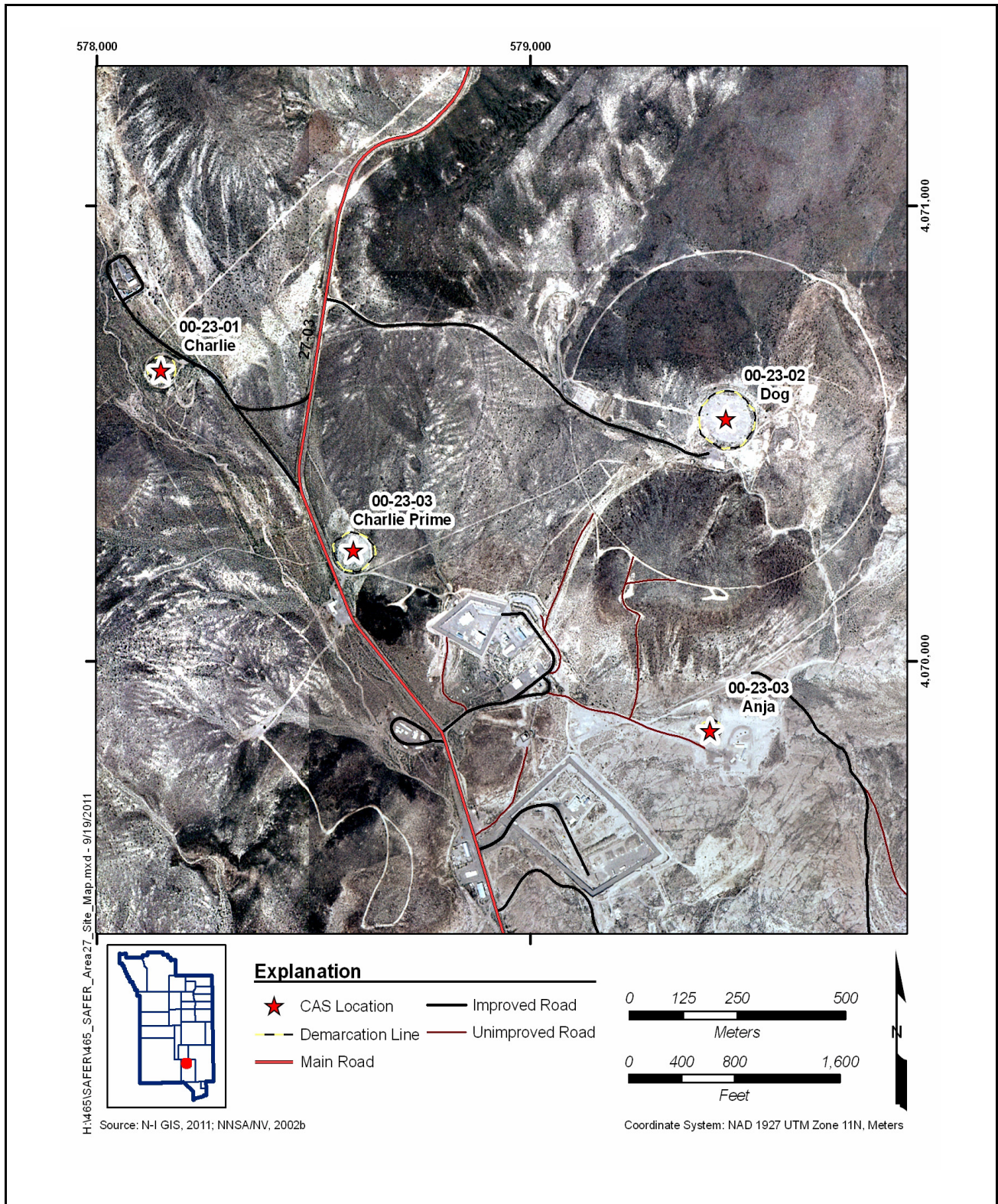


Figure 2-1
Hydronuclear Experiment CAS Locations in Area 27

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2.1.1 CAS 00-23-01, Hydronuclear Experiment

Corrective Action Site 00-23-01 (Charlie site) is located west of the 27-03 Road and southeast of the Super Kukla Facility in Area 27 of the NNSS. A total of 24 hydronuclear experiments in 24 boreholes were conducted at CAS 00-23-01 between August 1960 and March 1962. Boreholes were drilled to a depth of 50 ft bgs. [Table 2-2](#) provides the borehole number, the date of the experiment, and depth of each borehole at the Charlie site (DOE/NV, 2001).

**Table 2-2
 Hydronuclear Experiments Conducted at CAS 00-23-01 (Charlie Site)**

Borehole Number	Date of Experiment	Depth of Borehole (ft bgs)
1	08/26/1960	50
2	08/28/1960	50
3	08/30/1960	50
4	09/26/1960	50
5	09/27/1960	50
6	10/20/1960	50
7	10/25/1960	50
8	11/11/1960	50
9	12/01/1960	50
10	02/24/1961	50
11	05/25/1961	50
12	08/02/1961	50
13	08/16/1961	50
14	09/28/1961	50
15	10/07/1961	50
16	11/02/1961	50
17	11/05/1961	50
18	11/18/1961	50
19	12/16/1961	50
20	12/20/1961	50
21	01/18/1962	50
22	01/26/1962	50
23	02/08/1962	50
24	03/08/1962	50

Source: DOE/NV, 2001

The site is approximately 260 ft in diameter and surrounded with fencing. Signs have been placed on the fencing approximately 50 ft apart and read as follows: “Caution Buried Radioactive Material—Digging Prohibited.” A monument has been placed at the center of the site with a stainless-steel plaque. The boreholes and borehole casings are not visible, as the site was covered with 6 to 8 ft of native soil in 1962 and is presently well vegetated.

Figure 2-1 shows the CAS location with respect to the surrounding roads, buildings, and other physical features. Figure 2-2 shows the CAS boundaries and the physical layout of the site based on historical information.

2.1.2 CAS 00-23-02, Hydronuclear Experiment

Corrective Action Site 00-23-02 (Dog site) consists of 28 test boreholes that were used to conduct hydronuclear experiments and 12 disposal boreholes that were used to dispose of nonradioactive classified materials associated with the hydronuclear experiments. Borehole depth ranges from 45 to 80 ft bgs. The hydronuclear experiments were conducted at CAS 00-23-02 between September 1960 and March 1962. Table 2-3 provides the borehole number, the date of the experiment, and depth of each borehole at the Dog site (DOE/NV, 2001).

The site is located approximately 0.5 mi east of the 27-03 Road and accessible through Gate 27-4C in Area 27 of the NNSS. The site is approximately 328 ft in diameter and surrounded with fencing. Signs have been placed on the fencing approximately 50 ft apart and read as follows: “Caution Buried Radioactive Material—Digging Prohibited.” A monument has been placed at the center of the site with a stainless-steel plaque.

Of the 28 test boreholes, 26 are visible on the surface; the locations of the remaining 2 boreholes could not be identified. All boreholes used for hydronuclear experiments appear to have been sealed with concrete. The area inside the fencing appears to have been covered with asphalt, which has degraded and allowed vegetation to grow through. Outside the fence line are several small concrete pads that appear to have been foundations for small buildings or other equipment. Figure 2-1 shows the CAS location with respect to the surrounding roads, buildings, and other physical features.

Figure 2-3 shows the CAS boundaries and the physical layout.

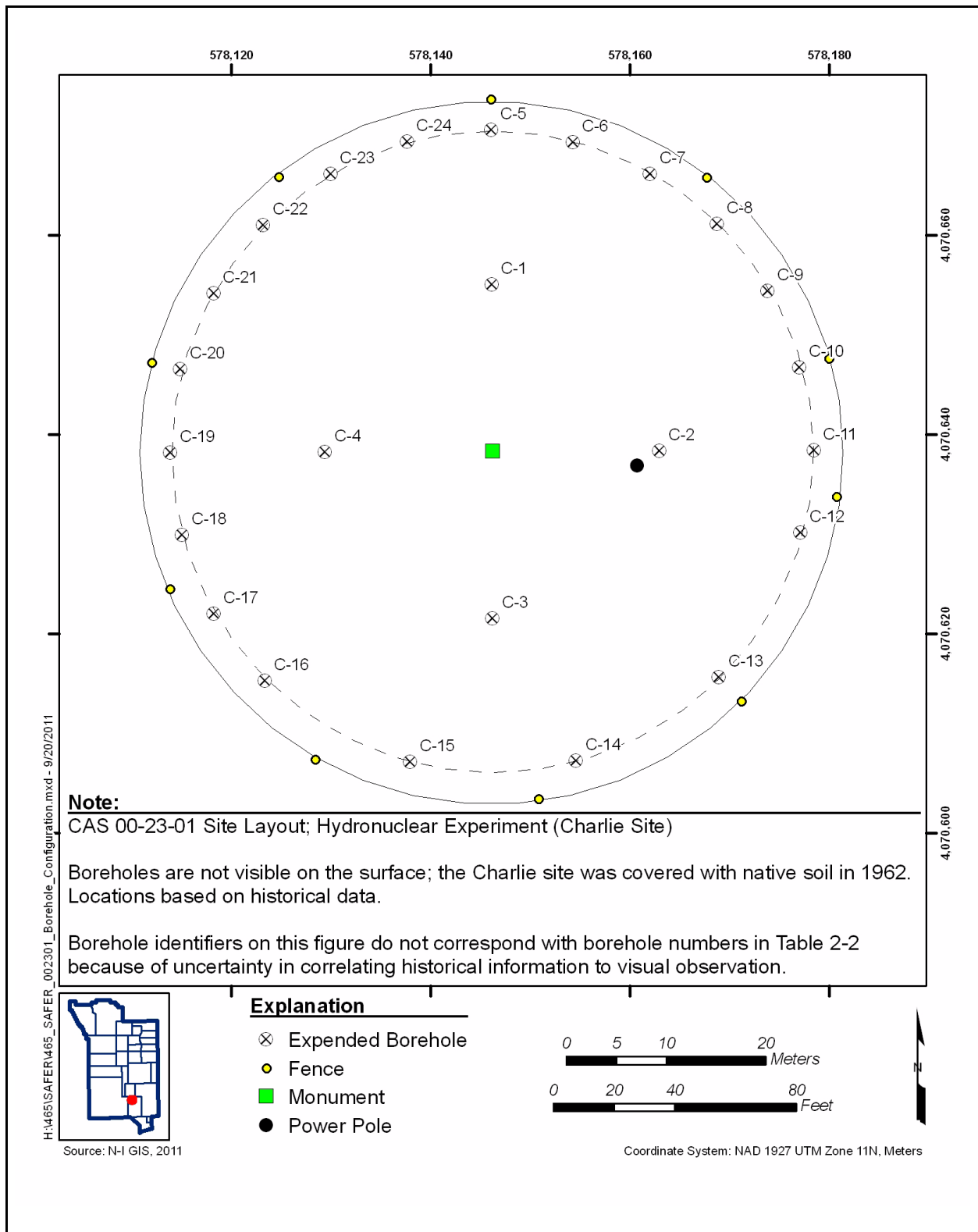


Figure 2-2
CAS 00-23-01, Hydronuclear Experiment (Charlie Site), Site Layout

**Table 2-3
 Hydronuclear Experiments Conducted at CAS 00-23-02 (Dog Site)**

Borehole Number	Date of Experiment	Depth of Borehole (ft bgs)
63	09/1960	80
65	09/1960	80
68	10/1960	80
69	12/1960	80
34	12/1960	80
35	01/1961	80
70	01/1961	80
67	01/1961	80
68-A	02/1961	80
36	03/1961	80
69-A	05/1961	80
66	06/1961	80
33	07/1961	80
61	07/1961	80
32	08/1961	80
63-A	08/1961	45
72	09/1961	80
63-B	09/1961	45
26	10/1961	55
26-A	10/1961	55
25	11/1961	55
27	11/1961	55
28	11/1961	55
24	12/1961	55
23	02/1962	55
22	03/10/1962	55
22-A	03/22/1962	55
21	03/29/1962	55

Source: DOE/NV, 2001

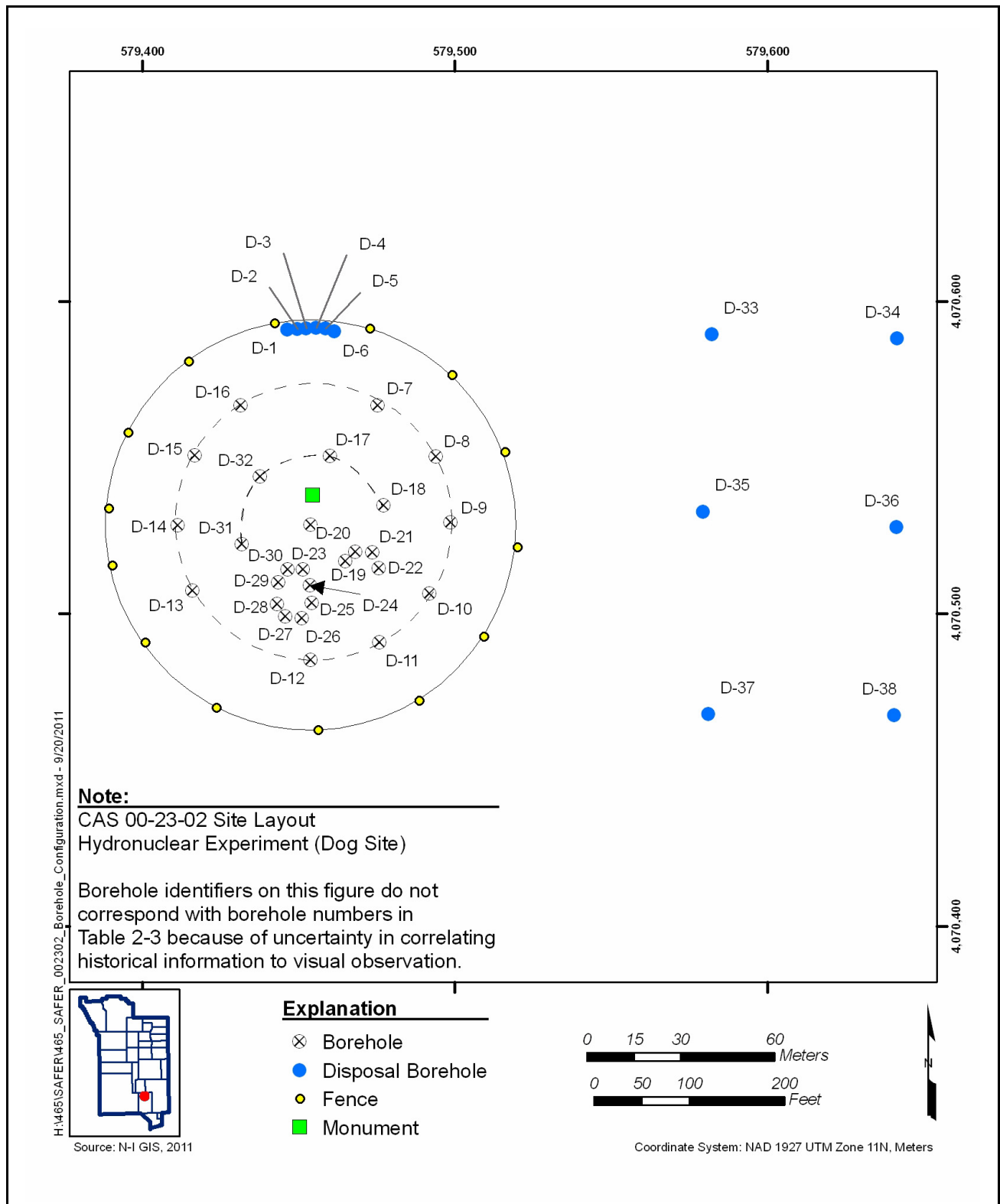


Figure 2-3
CAS 00-23-02, Hydronuclear Experiment (Dog Site), Site Layout

In addition to the boreholes utilized for the hydronuclear experiments at the Dog site, six additional boreholes located inside the fence line at the north side of the site and six boreholes located outside the fence to the northwest were reportedly utilized for disposal of nonradioactive classified materials associated with the hydronuclear experiments. All 12 disposal boreholes are visible on the surface. The six disposal boreholes located inside the fence have been sealed with concrete to surface grade level. The larger diameter boreholes located outside the fence appear to have been backfilled; however, some settling has occurred in two of them. While depths of the disposal boreholes are undocumented, the boreholes were constructed during the same time period as the hydronuclear experiments and are expected to be similar in depth.

2.1.3 CAS 00-23-03, Hydronuclear Experiment

Corrective Action Site 00-23-03 (Charlie Prime and Anja sites) consists of two separate and distinct sites. The Charlie Prime site is located north of the JASPER Facility and east of the 27-03 Road. The Charlie Prime site consists of 12 test boreholes, 10 of which were used to conduct hydronuclear experiments. All of the boreholes are 48 inches (in.) in diameter and 50 ft deep. Recent inspection of the site identified nine boreholes visible on the surface, including the two unexpended (open) boreholes; the locations of the remaining three boreholes have not been identified at this time. All expended boreholes have been backfilled and sealed with concrete. [Table 2-4](#) provides the borehole number, the date of the experiment, and depth of each borehole at the Charlie Prime site (DOE/NV, 2001). The site is approximately 230 ft in diameter and surrounded with fencing. Signs have been placed on the fencing and read as follows: “Caution Buried Radioactive Material—Digging Prohibited.” A monument has been placed at the center of the site with a stainless-steel plaque. A degraded asphalt cover partially covers the site.

The Anja site is located west of the JASPER Facility in Area 27 of the NNSS. Sixteen boreholes were drilled at the Anja site. Of these, 14 were used to conduct subsurface hydronuclear experiments, leaving 2 unexpended boreholes. Recent field survey of the site confirmed two open boreholes; all others have been capped with concrete. Of the 16 boreholes, 14 are visible on the surface; the locations of the remaining 2 boreholes are unknown at this time. All boreholes are 26 in. in diameter and 50 ft deep. [Table 2-5](#) provides the borehole number, the date of the experiment, and depth of each borehole. The site is approximately 230 ft in diameter and surrounded with fencing. Signs have been

Table 2-4
Hydronuclear Experiments Conducted at CAS 00-23-03 (Charlie Prime Site)

Borehole Number	Date of Experiment	Depth of Borehole (ft bgs)
1	03/10/1962	50
2	03/15/1962	50
3	04/03/1962	50
4	05/10/1962	50
5	07/18/1962	50
6	08/16/1963	50
7	10/21/1963	50
8	04/04/1964	50
9	07/09/1964	50
10	01/06/1966	50

Source: DOE/NV, 2001

Table 2-5
Hydronuclear Experiments Conducted at CAS 00-23-03 (Anja Site)

Borehole Number	Date of Experiment	Depth of Borehole (ft bgs)
2	03/06/1964	50
3	03/10/1964	50
4	03/12/1964	50
5	03/20/1964	50
6	03/20/1964	50
7	03/24/1964	50
8	03/26/1964	50
1	08/11/1965	50
10	08/13/1965	50
11	08/19/1965	50
12	08/20/1965	50
13	08/24/1965	50
14	08/26/1965	50
15	09/01/1965	50

Source: DOE/NV, 2001

placed on the fencing and read as follows: “Caution Buried Radioactive Material—Digging Prohibited.” A monument has been placed at the center of the site with a stainless-steel plaque.

Figure 2-1 shows the locations of the Charlie Prime and Anja sites with respect to the surrounding roads, buildings, and other physical features. Figures 2-4 and 2-5 show the CAS boundaries and physical layouts of the Charlie Prime and Anja sites, respectively.

2.2 Area 6 Hydronuclear Experiments

Corrective Action Site 06-99-01 (Trailer 13 site) is located in Area 6 of the NNSS on the southeast side of Yucca Dry Lake (Figure 2-6). A total of 23 hydronuclear experiments were conducted at CAS 06-99-01. The experiments performed at this CAS were conducted between September 1954 and August 1960. The total inventory of radiological and other materials used to conduct the experiments is provided in Table 2-6 (DOE/NV, 2001).

Of the 23 experiments conducted at this site, 22 were conducted subsurface in boreholes, including 2 experiments that utilized previously used boreholes. The boreholes are all 48 in. in diameter and range in depth from 25 to 50 ft bgs. Table 2-7 provides the borehole number, the date of the experiment, and depth of each borehole at the Trailer 13 site.

In addition to the boreholes utilized for the hydronuclear experiments at the Trailer 13 site, one additional borehole located inside the fence line at the northwest side of the site was utilized for disposal of nonradioactive classified materials associated with the hydronuclear experiments. All the boreholes have been backfilled and capped with concrete plugs. Recent field survey of the site identified 21 boreholes visible on the surface, including the single disposal borehole. The locations of the remaining two boreholes are unknown at this time. Figure 2-7 shows the CAS boundaries and physical layout of the Trailer 13 site.

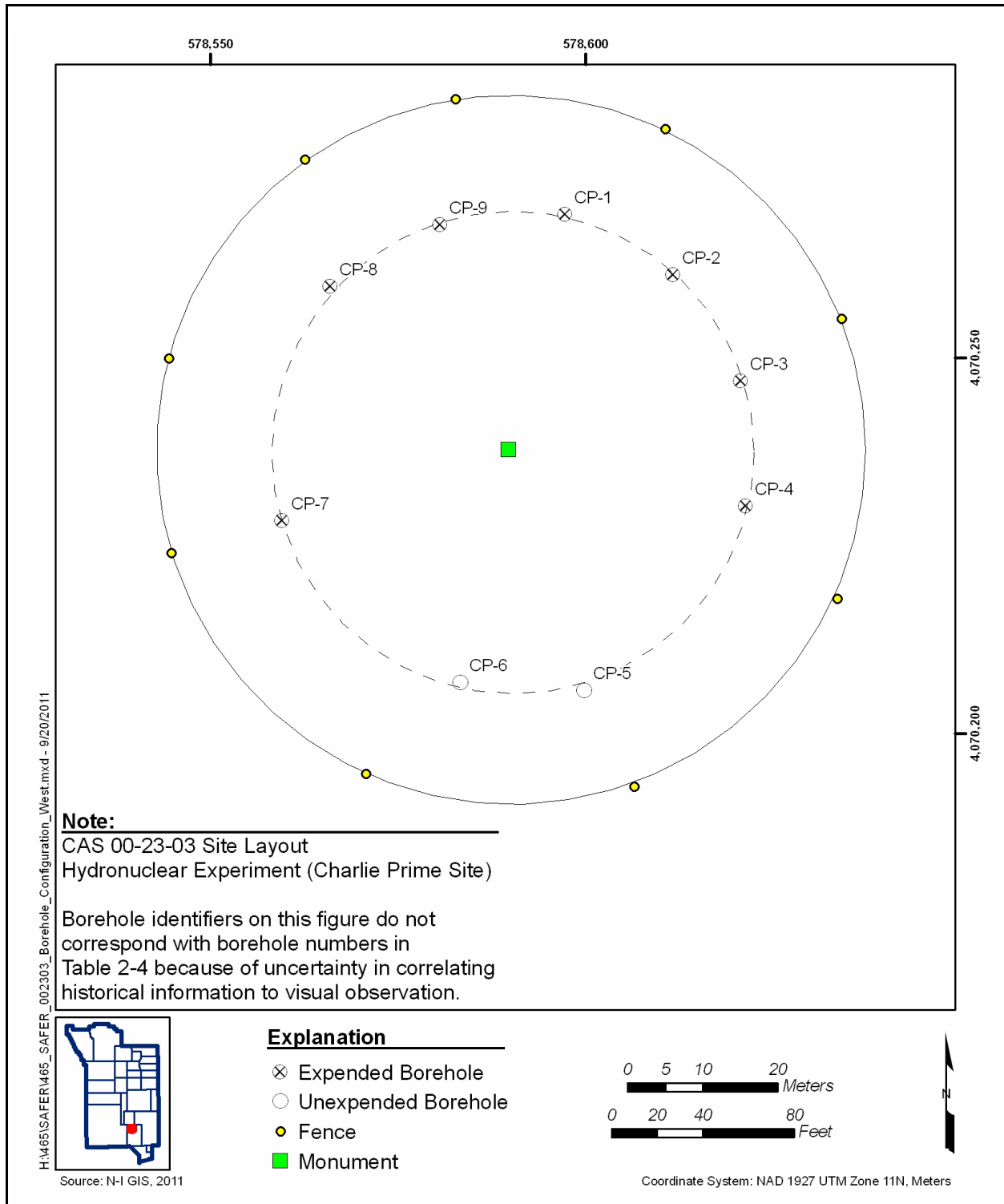


Figure 2-4
CAS 00-23-03, Hydronuclear Experiment (Charlie Prime Site), Site Layout

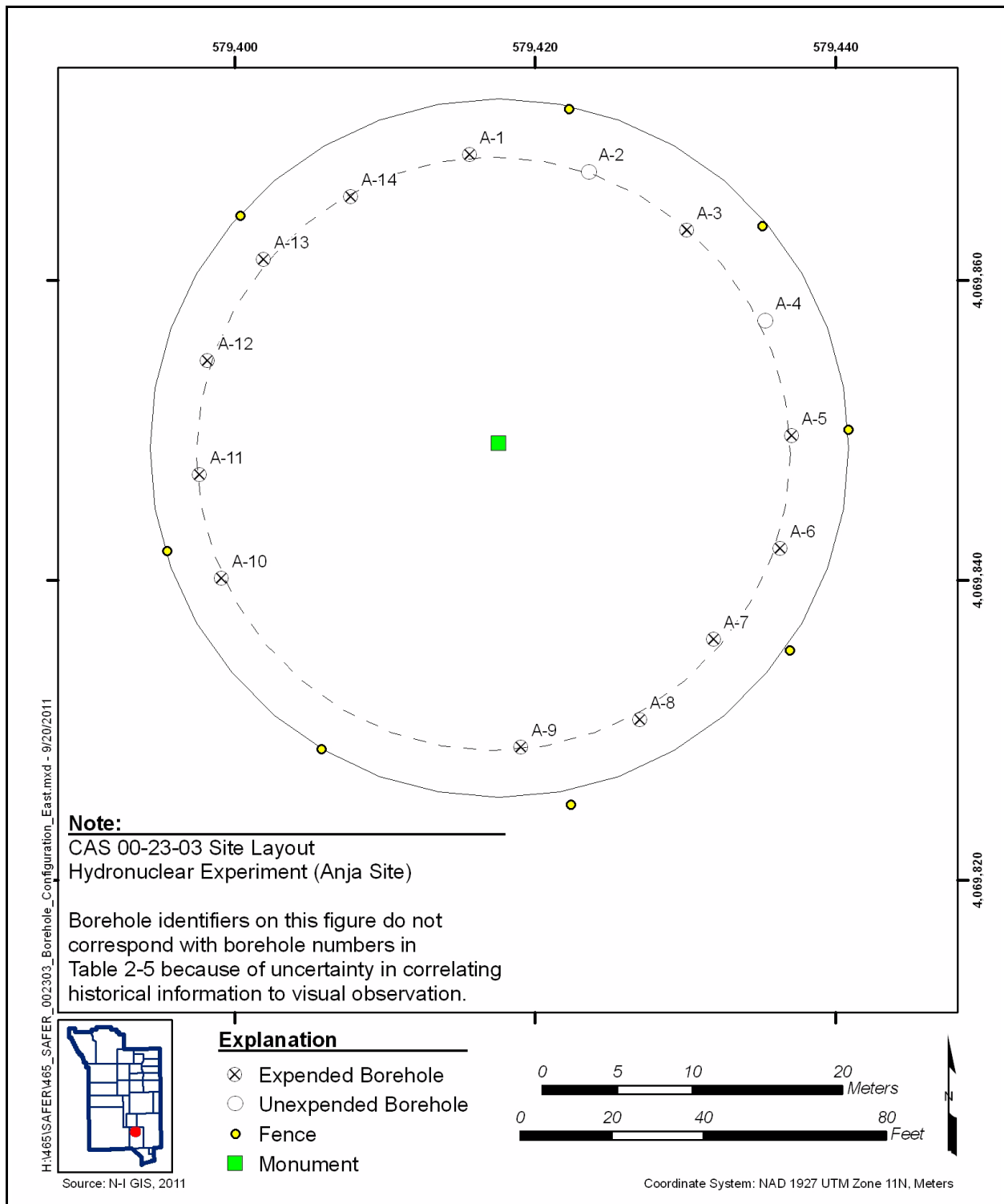


Figure 2-5
CAS 00-23-03, Hydronuclear Experiment (Anja Site), Site Layout

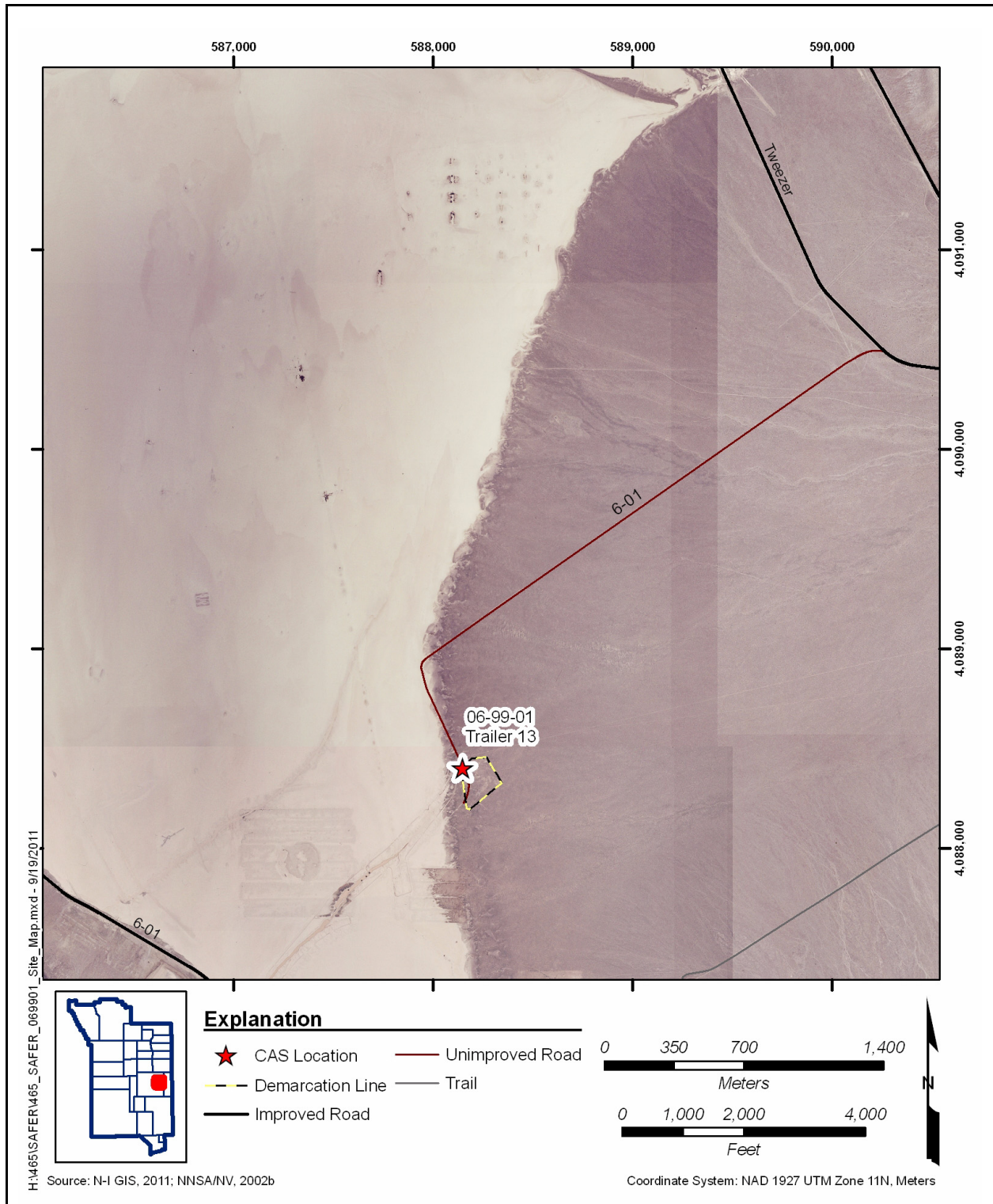


Figure 2-6
Hydronuclear Experiment CAS Location in Area 6

**Table 2-6
 Total Inventory of Radiological and Other Materials
 for Area 6 Hydronuclear Experiments**

Material Description	Mass
High explosives	930 lb
Plutonium	<100 g
Depleted uranium	172 kg
Other metals (e.g., lead, silver)	Unknown

Source: DOE/NV, 2001

g = Gram

**Table 2-7
 Hydronuclear Experiments Conducted at CAS 06-99-01 (Trailer 13 Site)
 (Page 1 of 2)**

Borehole Number	Date of Experiment	Depth of Borehole (ft bgs)
T-A	09/15/1954	40
T-B	07/22/1955	50
T-C	08/26/1955	50
Surface	12/18/1958	Surface
T-B	02/27/1959	25
T-C	03/27/1959	25
T-D	06/11/1959	50
T-E	08/21/1959	50
14	09/05/1959	50
11	10/28/1959	50
9	11/19/1959	50
5	12/17/1959	50
3	01/21/1960	50
6	03/31/1960	50

Table 2-7
Hydronuclear Experiments Conducted at CAS 06-99-01 (Trailer 13 Site)
(Page 2 of 2)

Borehole Number	Date of Experiment	Depth of Borehole (ft bgs)
15	08/12/1960	50
16	08/16/1960	50
1	08/19/1960	50
4	06/24/1960	50
2	07/07/1960	50
10	07/21/1960	50
8	07/29/1960	50
12	08/02/1960	50
13	08/05/1960	50

Source: DOE/NV, 2001

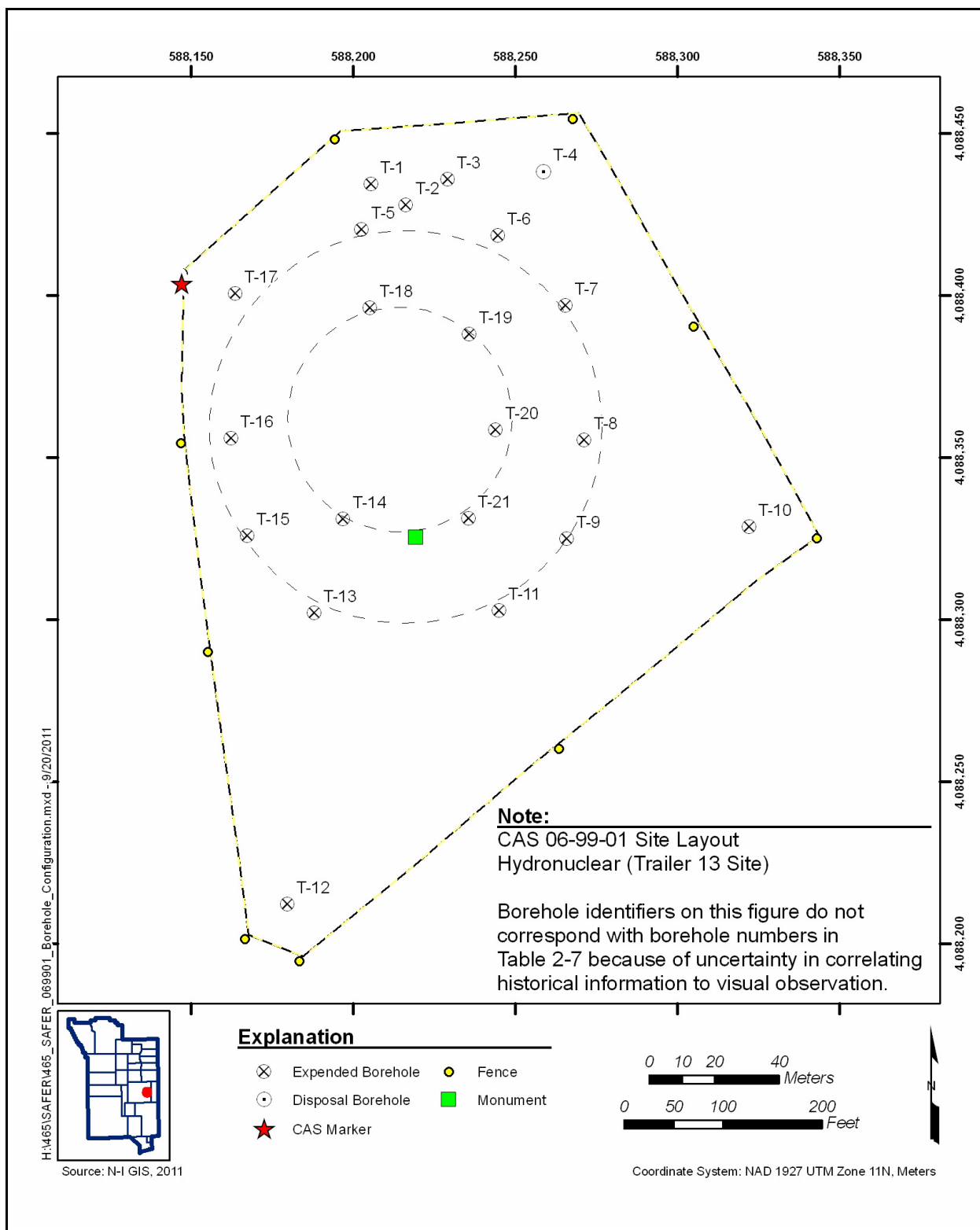


Figure 2-7
CAS 06-99-01, Hydronuclear (Trailer 13 Site), Site Layout

3.0 Data Quality Objectives

3.1 Summary of DQO Analysis

This section contains a summary of the DQO process that is presented in [Appendix B](#). The DQO process is a strategic planning approach based on the scientific method that is designed to ensure that the data collected will provide sufficient and reliable information to identify, evaluate, and technically defend the recommendation of viable corrective actions (e.g., no further action, clean closure, or closure in place).

The DQO strategy for CAU 465 was developed at a meeting on July 6, 2011. The DQOs were developed to identify data needs, clearly define the intended use of the environmental data, and 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 problem statements and decision statements were documented.

The DQOs for CAU 465 have been divided into two CAS components to appropriately address the two types of potential releases at CAU 465:

- The subsurface release component addresses releases of radiological and other contaminants from the subsurface hydronuclear experiments and disposal boreholes.
- The surface release component addresses potential releases of radiological and nonradiological contaminants (e.g., lead bricks) to surface soils that may have occurred during the pre- and post-test activities.

Subsurface Releases

The problem statement for the subsurface release component of CAU 465 is as follows: “Additional information on the potential impacts of the hydronuclear experiments and disposal boreholes to groundwater is needed to evaluate and recommend CAAs.” To address this question, the resolution of one decision statement is required:

- Decision I: “If there is a potential impact on groundwater, then implement engineering controls.” To resolve this decision, existing data and assumptions will be utilized to develop flow and transport models for forecasting the maximum potential concentration of a COPC in

groundwater within 1,000 years. If, through modeling, a COPC is estimated to exceed FALs at the groundwater surface within 1,000 years, then additional engineering or institutional controls and/or corrective actions will be evaluated. If additional controls (e.g., installation of infiltration controls, soil cover) are determined to mitigate the COC contamination, adequate controls will be put in place.

Surface Releases

The problem statement for the surface release component of CAU 465 is as follows: “Existing information on the nature and extent of contamination from surface releases at CAU 465 is insufficient to evaluate and recommend CAAs.” To address this question, the resolution of the following decision statements is required:

- Decision I: “If sample results are above action levels (i.e., a COC is present), then Decision II samples will be collected,” and “if a waste is present that has the potential to release contaminants to the environment (i.e., PSM), then a corrective action will be determined.”
- Decision II: “If Decision II sample results are above FALs, then additional samples will be collected to determine the extent of contamination,” and “if waste characterization samples have valid analytical results, then remediation waste types will be determined.”

A corrective action may also be required if a waste present within a CAS contains contaminants that, if released, could cause the surrounding environmental media to contain a COC. Such a waste would be considered PSM. To evaluate wastes for the potential to result in the introduction of a COC to the surrounding environmental media, the conservative assumption was made that any physical waste containment would fail at some point and release the contaminants to the surrounding media. The following will be used as the criteria for determining whether a waste is PSM:

- A waste, regardless of concentration or configuration, may be assumed to be PSM and handled under a corrective action.
- Based on process knowledge and/or professional judgment, some waste may be assumed not to be PSM if it is clear that it could not result in soil contamination exceeding a FAL.
- If assumptions about the waste cannot be made, then the waste material will be sampled, and the results will be compared to FALs based on the following criteria:
 - For non-liquid wastes, the concentration of any chemical contaminant in soil (following degradation of the waste and release of contaminants into soil) would be equal to the mass

of the contaminant in the waste divided by the mass of the waste. If the resulting soil concentration exceeds the FAL, then the waste would be considered PSM.

- For non-liquid wastes, the dose resulting from radioactive contaminants in soil (following degradation of the waste and release of contaminants into soil) would be calculated using the activity of the contaminant in the waste divided by the mass of the waste (for each radioactive contaminant) and calculating the combined resulting dose using the Residual Radioactive (RESRAD) code (Murphy, 2004). If the resulting soil concentration exceeds the FAL, then the waste would be considered PSM.
- For liquid wastes, the resulting concentration of contaminants in the surrounding soil would be calculated based on the concentration of contaminants in the waste and the liquid-holding capacity of the soil. If the resulting soil concentration exceeds the FAL, then the liquid waste would be considered PSM.

For the investigation of surface releases, Decision I samples will be submitted to analytical laboratories for the analyses listed in [Table 3-1](#). The constituents reported for each analytical method are listed in [Table 3-2](#).

**Table 3-1
 Analytical Program for Surface Releases**

Analyses	CAS 00-23-01	CAS 00-23-02	CAS 00-23-03	CAS 06-99-01
Organic Analyses				
HEs	X	X	X	X
PCBs	X	X	X	X
SVOCs	X	X	X	X
VOCs	X	X	X	X
Inorganic Analyses				
RCRA metals	X	X	X	X
Beryllium	X	X	X	X
Radionuclide Analyses				
Gamma spectroscopy ^a	X	X	X	X
Isotopic U	X	X	X	X
Isotopic Pu	X	X	X	X

^aResults of gamma analysis will be used to determine whether further isotopic analysis is warranted.

X = Required analytical method

PCB = Polychlorinated biphenyl

SVOC = Semivolatile organic compound

VOC = Volatile organic compound

**Table 3-2
 Constituents Reported by Analytical Methods**

VOCs		SVOCs		PCBs	Metals	Explosives	Radionuclides
1,1,1,2-Tetrachloroethane	Carbon tetrachloride	2,3,4,6-Tetrachlorophenol	Di-n-octyl phthalate	Aroclor 1016	Arsenic	1,3,5-Trinitrobenzene	Pu-238
1,1,1-Trichloroethane	Chlorobenzene	2,4,5-Trichlorophenol	Dibenzo(a,h)anthracene	Aroclor 1221	Barium	2,4,6-Trinitrotoluene	Pu-239/240
1,1,2,2-Tetrachloroethane	Chloroethane	2,4,6-Trichlorophenol	Dibenzofuran	Aroclor 1232	Beryllium	2-Amino-4,6-DNT	U-234
1,1,2-Trichloroethane	Chloroform	2,4-Dimethylphenol	Diethyl phthalate	Aroclor 1242	Cadmium	4-Nitrotoluene	U-235
1,1-Dichloroethane	Chloromethane	2,4-Dinitrotoluene	Dimethyl phthalate	Aroclor 1248	Chromium	HMX	U-238
1,1-Dichloroethene	Chloroprene	2-Chlorophenol	Fluoranthene	Aroclor 1254	Lead	RDX	
1,2,4-Trichlorobenzene	cis-1,2-Dichloroethene	2-Methylnaphthalene	Fluorene	Aroclor 1260	Mercury	3-Nitrotoluene	Gamma-Emitting
1,2,4-Trimethylbenzene	Dibromochloromethane	2-Methylphenol	Hexachlorobenzene	Aroclor 1268	Selenium	4-Amino-2,6-DNT	Ac-228
1,2-Dibromo-3-chloropropane	Dichlorodifluoromethane	2-Nitrophenol	Hexachlorobutadiene		Silver	2-Nitrotoluene	Am-241
1,2-Dichlorobenzene	Ethyl methacrylate	3-Methylphenol ^a (m-cresol)	Hexachloroethane			Tetryl	Co-60
1,2-Dichloroethane	Ethylbenzene	4-Methylphenol ^a (p-cresol)	Indeno(1,2,3-cd)pyrene				Cs-137
1,2-Dichloropropane	Isobutyl alcohol	4-Chloroaniline	n-Nitroso-di-n-propylamine				Eu-152
1,3,5-Trimethylbenzene	Isopropylbenzene	4-Nitrophenol	Naphthalene				Eu-154
1,3-Dichlorobenzene	Methacrylonitrile	Acenaphthene	Nitrobenzene				Eu-155
1,4-Dichlorobenzene	Methyl methacrylate	Acenaphthylene	Pentachlorophenol				K-40
1,4-Dioxane	Methylene chloride	Aniline	Phenanthrene				Nb-94
2-Butanone	n-Butylbenzene	Anthracene	Phenol				Pb-212
2-Chlorotoluene	n-Propylbenzene	Benzo(a)anthracene	Pyrene				Pb-214
2-Hexanone	sec-Butylbenzene	Benzo(a)pyrene	Pyridine				Th-234
4-Isopropyltoluene	Styrene	Benzo(b)fluoranthene					Tl-208
4-Methyl-2-pentanone	tert-Butylbenzene	Benzo(g,h,i)perylene					U-235
Acetone	Tetrachloroethene	Benzo(k)fluoranthene					
Acetonitrile	Toluene	Benzoic acid					
Allyl chloride	Total Xylenes	Benzyl alcohol					
Benzene	Trichloroethene	Bis(2-ethylhexyl)phthalate					
Bromodichloromethane	Trichlorofluoromethane	Butyl benzyl phthalate					
Bromoform	Vinyl acetate	Carbazole					
Bromomethane	Vinyl chloride	Chrysene					
Carbon disulfide		Di-n-butyl phthalate					

^aMay be reported as 3,4-Methylphenol or m,p-cresol.

Ac = Actinium
 Am = Americium
 Co = Cobalt
 Cs = Cesium
 DNT = Dinitrotoluene
 Eu = Europium
 HMX = High-melting explosive

K = Potassium
 Nb = Niobium
 Pb = Lead
 RDX = Research department explosive
 Th = Thorium
 Tl = Thallium

The list of analyses is intended to encompass all the contaminants that could potentially be present at each CAS (as a result of both surface and subsurface releases). The COPCs listed in [Section 4.1](#) were identified during the planning process through the review of site history, process knowledge, personal interviews, and inferred activities associated with the CASs. Other COPCs (and subsequently the analyses requested) will be determined for surface and subsurface releases identified during the SAFER based upon the nature of the potential release.

Decision II samples will be submitted for the analysis of all unbounded COCs. In addition, samples will be submitted for analyses as needed to support waste management or health and safety decisions.

The data quality indicators (DQIs) of precision, accuracy, representativeness, completeness, comparability, and sensitivity needed to satisfy DQO requirements are discussed in [Section 7.2](#). Laboratory data will be assessed in the CR to confirm or refute the CSM and determine whether the DQO data needs were met.

To satisfy the DQI of sensitivity (presented in [Section 7.2.6](#)), the analytical methods must be sufficient to detect contamination that is present in the samples at concentrations equal to the corresponding FALs. Analytical methods and minimum detectable concentrations (MDCs) for each CAU 465 COPC are provided in [Tables 3-3](#) and [3-4](#). The MDC is the lowest concentration of a chemical or radionuclide parameter that can be detected in a sample within an acceptable level of error. The criteria for precision and accuracy in [Tables 3-3](#) and [3-4](#) may vary from information in the *Industrial Sites Quality Assurance Project Plan* (QAPP) (NNSA/NV, 2002a) as a result of the laboratory used or updated/new methods.

3.2 Results of the DQO Analysis

3.2.1 Action Level Determination and Basis

The preliminary action levels (PALs) presented in this section are to be used for site-screening purposes. They are not necessarily intended to be used as cleanup action levels or FALs. However, they are useful in screening out contaminants that are not present in sufficient concentrations to warrant further evaluation and therefore streamline the consideration of remedial alternatives. The risk-based corrective action (RBCA) process used to establish FALs is described in the *Industrial*

**Table 3-3
 Analytical Requirements for Radionuclides for CAU 465**

Analysis ^a	Medium or Matrix	Analytical Method	MDC ^b	Laboratory Precision	Laboratory Accuracy
Gamma-Emitting Radionuclides					
Gamma spectroscopy	Aqueous	EPA 901.1 ^c	< PALs	RPD 35% (non-aqueous) ^d 20% (aqueous) ^d	LCS Recovery (%R) 80–120 ^f
	Non-aqueous	GA-01-R ^g		ND –2 < ND < 2 ^e	
Other Radionuclides					
Isotopic U	All	U-02-RC ^g	< PALs	RPD 35% (non-aqueous) ^d 20% (aqueous) ^d	Chemical Yield Recovery (%R) 30–105 ^h
Isotopic Pu	Aqueous	Pu-10-RC ^g		ND –2 < ND < 2 ^e	LCS Recovery (%R) 80–120 ^h
	Non-aqueous	Pu-02-RC ^g			

^aA list of constituents reported for each method is provided in [Table 3-2](#).

^bThe MDC is the minimum concentration of a constituent that can be measured and reported with 95% confidence (Standard Methods).

^c*Prescribed Procedures for Measurement of Radioactivity in Drinking Water* (EPA, 1980).

^d*Sampling and Analysis Plan Guidance and Template* (EPA, 2000).

^e*Evaluation of Radiochemical Data Usability* (Paar and Porterfield, 1997).

^f*Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (EPA, 2011b).

^g*The Procedures Manual of the Environmental Measurements Laboratory* (DOE, 1997).

^hProfessional judgment and other industry acceptance criteria are used.

ⁱ*Standard Methods for the Examination of Water and Wastewater* (Clesceri et al., 1998).

EPA = U.S. Environmental Protection Agency

LCS = Laboratory control sample

ND = Normalized difference

PAL = Preliminary action level

RPD = Relative percent difference

%R = Percent recovery

Sites Project Establishment of Final Action Levels (NNSA/NSO, 2006). This process conforms with *Nevada Administrative Code* (NAC) Section 445A.227, which lists the requirements for sites with soil contamination (NAC, 2008a). For the evaluation of corrective actions, NAC Section 445A.22705 (NAC, 2008b) requires the use of ASTM International (ASTM) Method E1739 (ASTM, 1995) to “conduct an evaluation of the site, based on the risk it poses to public health and the environment, to determine the necessary remediation standards or to establish that corrective action is not necessary.” For the evaluation of corrective actions, the FALs are established as the necessary remediation standards.

**Table 3-4
 Analytical Requirements for Chemical COPCs for CAU 465**

Analysis ^a	Medium or Matrix	Analytical Method	MDC ^b	Laboratory Precision	Laboratory Accuracy
Organics					
VOCs	All	8260 ^c	< PALs	Lab-specific ^d	Lab-specific ^d
TCLP VOCs	Leachate	1311/8260 ^c	< Regulatory Levels	Lab-specific ^d	Lab-specific ^d
SVOCs	All	8270 ^c	< PALs	Lab-specific ^d	Lab-specific ^d
TCLP SVOCs	Leachate	1311/8270 ^c	< Regulatory Levels	Lab-specific ^d	Lab-specific ^d
PCBs	All	8082 ^c	< PALs	Lab-specific ^d	Lab-specific ^d
HEs	All	8330 ^c	< PALs	Lab-specific ^d	Lab-specific ^d
Inorganics					
Metals, plus beryllium	All	6010/6020 ^c	< PALs	RPD 35% (non-aqueous) 20% (aqueous) ^e	MS Recovery (%R) 75–125 ^c
Mercury	Aqueous	7470 ^c			< Regulatory Levels
	Non-aqueous	7471 ^c			
TCLP metals	Leachate	1311/6010/7470 ^c			

^aA list of constituents reported for each method is provided in [Table 3-2](#).

^bThe MDC is the minimum concentration of a constituent that can be measured and reported with 99% confidence (SW-846)^c.

^c*Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (EPA, 2011b).

^dPrecision and accuracy criteria are developed in-house using approved laboratory standard operating procedures in accordance with industry standards and the N-I Statement of Work requirements (NNES, 2009).

^e*Sampling and Analysis Plan Guidance and Template* (EPA, 2000).

^f*USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA, 2004).

MS = Matrix spike

RL = Reporting limit

N-I = Navarro-Intera, LLC

TCLP = Toxicity Characteristic Leaching Procedure

This RBCA process, summarized in [Figure 3-1](#), defines three tiers (or levels) of evaluation involving increasingly sophisticated analyses:

- Tier 1 evaluation—Sample results from source areas (highest concentrations) are compared to action levels based on generic (non-site-specific) conditions (i.e., the PALs established in this SAFER Plan). The FALs may then be established as the Tier 1 action levels, or the FALs may be calculated using a Tier 2 evaluation.

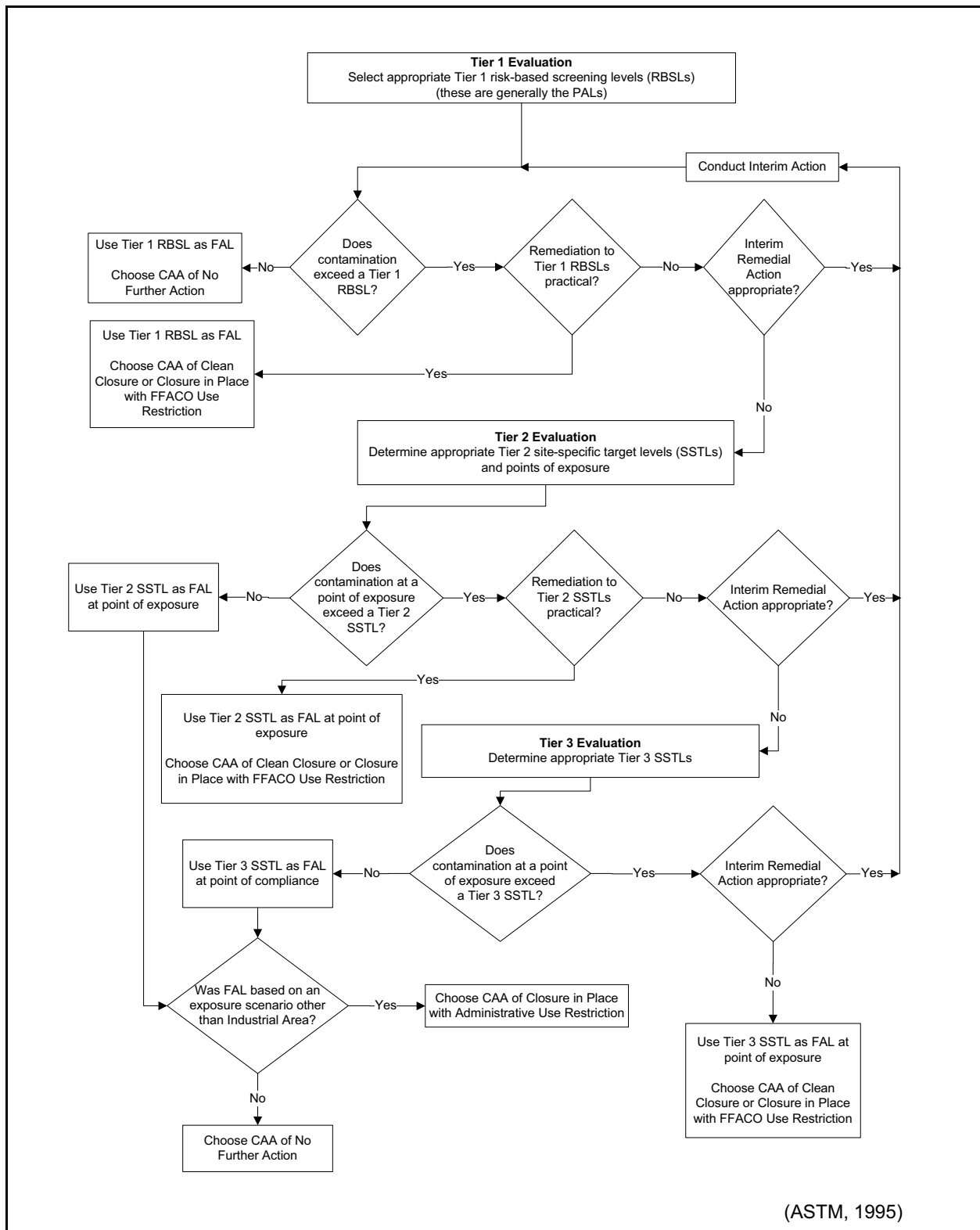


Figure 3-1
Risk-Based Corrective Action Decision Process

- Tier 2 evaluation—Conducted by calculating Tier 2 site-specific target levels (SSTLs) using site-specific information as inputs to the same or similar methodology used to calculate Tier 1 action levels. The Tier 2 SSTLs are then compared to individual sample results from reasonable points of exposure (as opposed to the source areas as is done in Tier 1) on a point-by-point basis. Total concentrations of total petroleum hydrocarbons (TPH) will not be used for risk-based decisions under Tier 2 or Tier 3. Rather, the individual chemicals of concern will be compared to the SSTLs.
- Tier 3 evaluation—Conducted by calculating Tier 3 SSTLs on the basis of more sophisticated risk analyses using methodologies described in Method E1739 that consider site-, pathway-, and receptor-specific parameters.

The comparison of laboratory results to FALs and the evaluation of potential corrective actions will be included in the investigation report. The FALs will be defined (along with the basis for their definition) in the investigation report.

3.2.1.1 Chemical PALs

Except as noted herein, the chemical PALs are defined as the U.S. Environmental Protection Agency (EPA) Region 9 Regional Screening Levels for chemical contaminants in industrial soils (EPA, 2011a). Background concentrations for RCRA metals will be used instead of screening levels when natural background concentrations exceed the screening level (e.g., arsenic on the NNSS). Background is considered the average concentration plus two standard deviations of the average concentration for sediment samples collected by the Nevada Bureau of Mines and Geology throughout the Nevada Test and Training Range (formerly the Nellis Air Force Range) (NBMG, 1998; Moore, 1999). For detected chemical COPCs without established screening levels, the protocol used by the EPA Region 9 in establishing screening levels (or similar) will be used to establish PALs. If used, this process will be documented in the investigation report.

3.2.1.2 Radionuclide PALs

The PAL for radioactive contaminants is a total effective dose (TED) of 25 millirem per year (mrem/yr) based upon the Industrial Area exposure scenario. The Industrial Area exposure scenario is described in the *Industrial Sites Project Establishment of Final Action Levels* (NNSA/NSO, 2006). For subsurface releases, the TED is calculated as the sum of external dose and internal dose. External dose is determined directly from thermoluminescent dosimeter (TLD) measurements. Internal dose is

determined by comparing analytical results from soil samples to residual radioactive material guidelines (RRMGs) that were established using the RESRAD computer code (Murphy, 2004). The RRMGs presented in Table 3-5 are radionuclide-specific values for radioactivity in surface soils. The RRMG is the value, in picocuries per gram (pCi/g) for surface soil, for a particular radionuclide that would result in an internal dose of 25 mrem/yr to a receptor (under the appropriate exposure scenario) independent of any other radionuclide (assuming that no other radionuclides contribute dose). The internal dose associated with any specific radionuclide would be established using the following equation:

$$\text{Internal dose (mrem/yr)} = [\text{Analytical result (pCi/g)} / \text{RRMG}] \times 25 \text{ mrem/yr}$$

When more than one radionuclide is present, the internal dose will be calculated as the sum of the internal doses for each radionuclide. In the RESRAD calculation, several input parameters are not specified so that site-specific information can be used. Specific input parameters used to calculate the RRMGs for each exposure scenario where an area of contamination equal to 1000 square meters (m²) and a depth of contamination equal to 5 centimeters (cm).

Table 3-5
Residual Radioactive Material Guideline Values
 (Page 1 of 2)

Radionuclide	Exposure Scenario (pCi/g)		
	Industrial Area	Remote Work Area	Occasional Use Area
Am-241	2,816	16,120	45,550
Co-60	551,300	7,229,000	74,210,000
Cs-137	140,900	1,955,000	27,560,000
Eu-152	1,177,000	13,240,000	81,740,000
Eu-154	846,900	9,741,000	63,530,000
Eu-155	5,588,000	66,450,000	475,100,000
Nb-94	3,499,000	39,660,000	249,200,000
Pu-238	2,423	13,880	39,220
Pu-239/240	2,215	12,680	35,820
Sr-90	59,470	807,500	9,949,000
Th-232	2,274	13,410	38,520

**Table 3-5
 Residual Radioactive Material Guideline Values
 (Page 2 of 2)**

Radionuclide	Exposure Scenario (pCi/g)		
	Industrial Area	Remote Work Area	Occasional Use Area
U-234	19,600	137,900	447,000
U-235	20,890	149,600	492,200
U-238	21,200	155,400	336,100

Sr = Strontium

3.2.1.3 Groundwater PALs

The PALs for contaminated groundwater are based on the radiological standards of the *Safe Drinking Water Act* (SDWA) (CFR, 2011a). For any potential release of radiological or nonradiological contaminants to the water table, vadose zone flow and contaminant transport models will be used to forecast contaminant concentrations for each area potentially exceeding the SDWA radiological standards over the next 1,000 years.

3.2.2 Hypothesis Test

The baseline condition (i.e., null hypothesis) and alternative condition are as follows:

- Baseline condition—Closure objectives have not been met.
- Alternative condition—Closure objectives have been met.

Sufficient evidence to reject the null hypothesis is as follows:

- The identification of the lateral and vertical extent of COC contamination in media, if present.
- Sufficient information to properly dispose of investigation-derived waste (IDW) and remediation waste.

3.2.3 Statistical Model

Development of flow and contaminant transport models for the subsurface component will be completed utilizing existing data; there are no planned sampling or other field collection activities. A judgmental sampling design will be implemented to select environmental sample locations and evaluate DQO decisions for the surface component of CAU 465.

3.2.4 Design Description/Option

There are no sampling or other field collection activities planned for the subsurface release component; therefore, this subsection does not apply to the subsurface component.

Because individual sample results, rather than an average concentration, will be used to compare to FALs for the surface component at CASs 00-23-01, 00-23-02, 00-23-03, and 06-99-01, statistical methods to generate site characteristics will not be used. Adequate representativeness of the entire target population may not be a requirement to developing a sampling design. If good prior information is available on the target site of interest, then the sampling may be designed to collect samples only from areas known to have the highest concentration levels on the target site. If the observed concentrations from these samples are below the action level, then a decision can be made that the site contains safe levels of the contaminant without the samples being truly representative of the entire area (EPA, 2006).

All sample locations will be selected to satisfy the DQI of representativeness in that samples collected from selected locations will best represent the populations of interest as defined in [Section B.5.1](#). To meet this criterion for judgmentally sampled sites, a biased sampling strategy will be used for Decision I samples to target areas with the highest potential for contamination, if it is present anywhere in the CAS. Sample locations will be determined based on process knowledge, previously acquired data, or the field-screening and biasing factors listed in [Section B.4.2.1](#). If biasing factors are present in soils below locations where Decision I samples were collected, additional Decision I soil samples will be collected at depth intervals selected by the Site Supervisor based on biasing factors to a depth where the biasing factors are no longer present. The Site Supervisor has the discretion to modify the judgmental sample locations, but only if the modified locations meet the decision needs and criteria stipulated in this DQO.

Decision II step-out sampling locations will be selected based on the CSM, biasing factors, and existing data. Analytical suites will include those parameters that exceeded FALs (i.e., COCs) in prior samples. Biasing factors to support Decision II sample locations include Decision I biasing factors plus available analytical results.

3.2.5 Conceptual Site Model and Drawing

The CSM describes the most probable scenario for current conditions at each site and defines the assumptions that are the basis for identifying the future land use, contaminant sources, release mechanisms, migration pathways, exposure points, and exposure routes. The CSM was used to develop appropriate sampling strategies and data collection methods. The CSM was developed for CAU 465 using information from the physical setting, potential contaminant sources, release information, historical background information, knowledge from similar sites, and physical and chemical properties of the potentially affected media and COPCs. [Figure 3-2](#) depicts a tabular representation of the conceptual pathways to receptors from CAU 465 sources. [Figure 3-3](#) depicts a graphical representation of the CSM. If evidence of contamination that is not consistent with the presented CSM is identified during CAI activities, the situation will be reviewed, the CSM will be revised, the DQOs will be reassessed, and a recommendation will be made as to how best to proceed. In such cases, participants in the DQO process will be notified and given the opportunity to comment on and/or concur with the recommendation. A detailed discussion of the CSM is presented in [Appendix B](#).

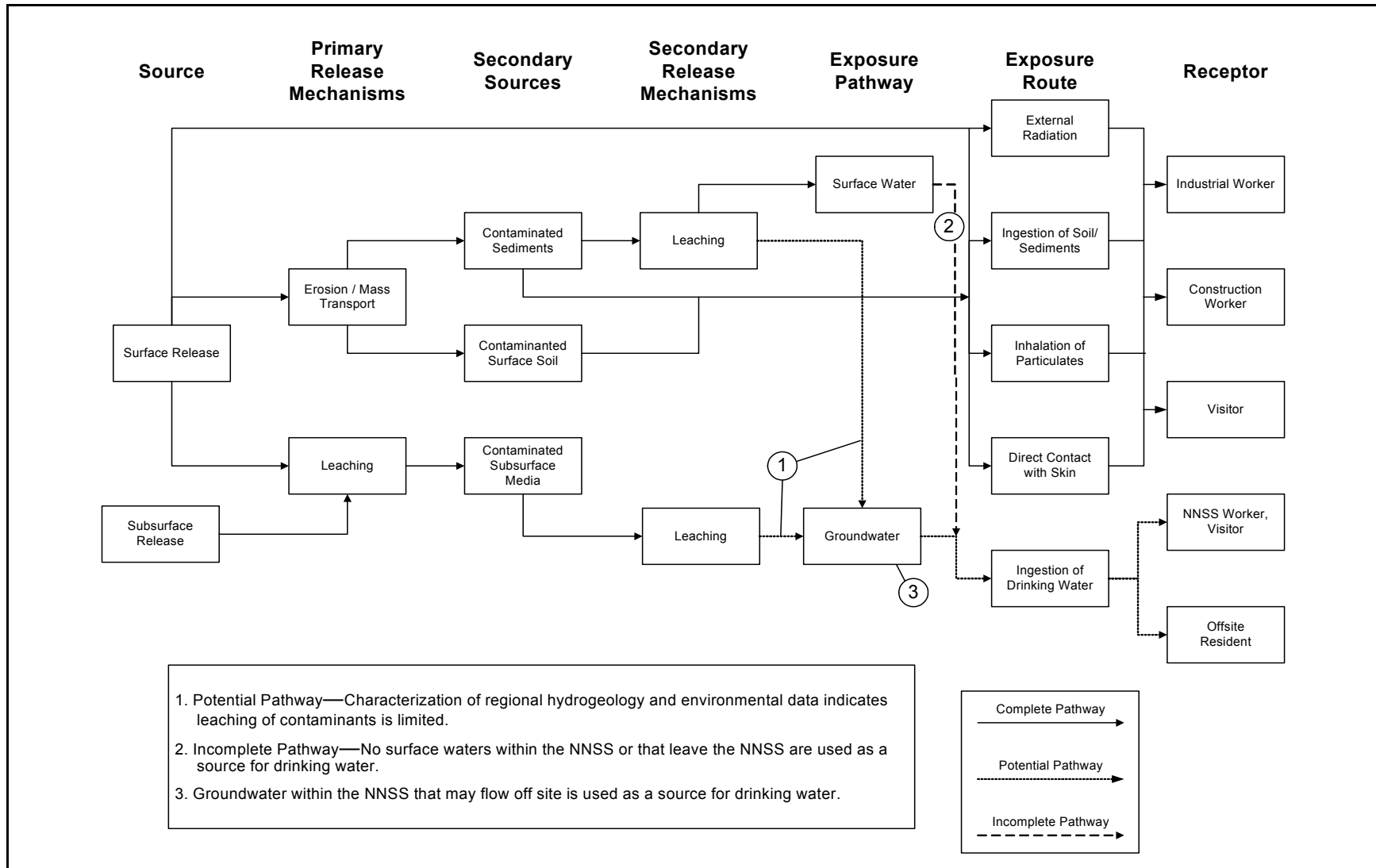


Figure 3-2
Conceptual Site Model Diagram for CAU 465

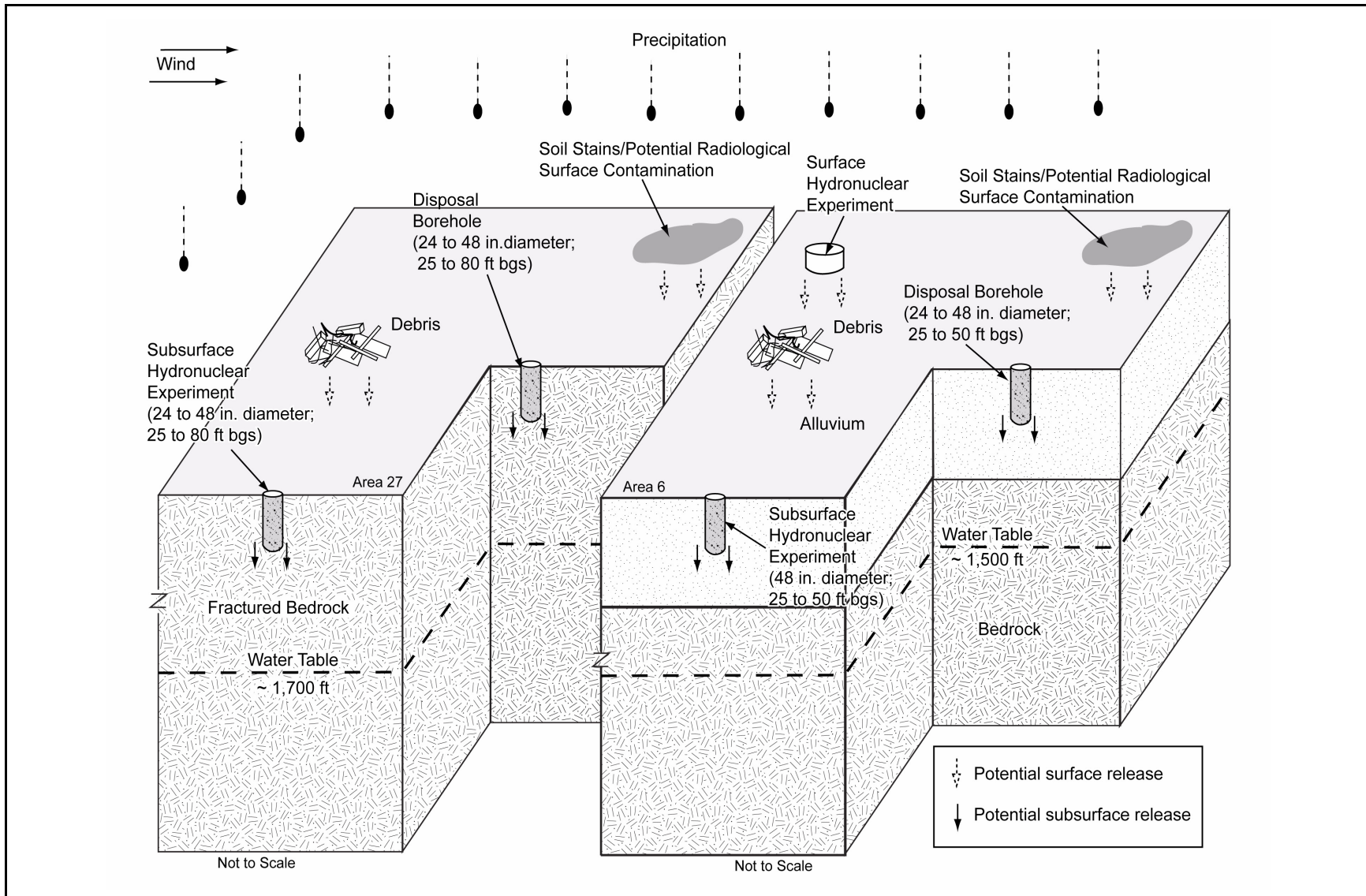


Figure 3-3
CAU 465 Conceptual Site Model

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4.0 Field Activities and Closure Objectives

This section of the SAFER Plan provides a description of the field activities and closure objectives for CAU 465. The objectives for the field activities are to determine whether COCs exist in surface soils. If removal is determined to be feasible, then the extent of COCs will be determined so that a closure alternative may be implemented. All sampling activities will be conducted in compliance with the Industrial Sites QAPP (NNSA/NV, 2002a) and other applicable, approved procedures and instructions.

One additional objective of the SAFER is to develop two one-dimensional vadose zone flow and contaminant transport models, one representative of hydrogeologic conditions near CASs 00-23-01, 00-23-02, and 00-23-03 in Area 27, and one representative of hydrogeologic conditions at CAS 06-99-01 in Area 6. These models will be developed to represent the physical and chemical features of the vadose zone flow and contaminant transport using existing data. The selection of the model and specific input parameters to the selected model will be developed as part of the SAFER activity in conjunction with NDEP. The selection of the model and input parameters will be documented in the final CR for CAU 465.

Two separate models are necessary to analyze the two locations due to the differences in the hydrogeology between the two locations. The region between the water table and the bottom of the hydronuclear experiment boreholes in Area 27 is characterized as predominantly fractured tuffs. The depth to groundwater at this location is approximately 1,735 ft bgs based on observations at Well TW-F (USGS/DOE, 2011). The region between the water table and the bottom of the hydronuclear experiment boreholes in Area 6 is characterized as predominantly playa and alluvial deposits. The depth to groundwater in the vicinity of CAS 06-99-01 is approximately 1,504 ft bgs based on observations at Well TW-B (USGS/DOE, 2011).

A summary of the modeling objectives is presented below:

- Simulate the potential for contaminant arrival at the water table within the next 1,000 years using reasonably bounded assumptions of infiltration rate, fracture-matrix interaction (if appropriate), and sorption.

- Simulate the concentrations of individual contaminants that are forecast to reach the water table within 1,000 years at the downgradient boundary of each CAS over a time period of 1,000 years.

4.1 Contaminants of Potential Concern

The COPCs for CAU 465 are identified below. These COPCs were identified during the planning process through the review of site history, process knowledge, personal interviews, past investigation efforts (where available), and inferred activities associated with the CASs. Contaminants detected at other similar NNSS sites also are included in the COPC list to reduce the uncertainty about potential contamination at the CASs because complete information regarding activities performed at the CAU 465 sites is not available.

For subsurface releases (hydronuclear experiments and disposal boreholes), the COPCs include the following radionuclides: Am-241, U-234/235, U-238, Pu-239/240, and Pu-241. Other radionuclides may be present at low activity concentrations, but are not considered significant because of the inventory of known radiological materials. Lead also is included as a potential contaminant because it is known to have been used in significant quantities in underground nuclear testing for shielding and as a component in instrumentation. Lead as a potential contaminant is assumed to be representative of other inorganic, nonradioactive, hazardous constituents, and is therefore considered a COPC.

For potential surface releases, the COPCs include radionuclides (gamma, isotopic U, and isotopic Pu), RCRA metals, VOCs, SVOCs, PCBs, and HEs. The specific COPC is dependent upon the type of release identified and other biasing factors. Lead is a COPC because of the identified presence of lead bricks. Other potential releases involving organic constituents (e.g., diesel spills) may be present; VOCs, SVOCs, and PCBs are groups of compounds that would contain organic COPCs. High explosives were utilized to initiate the hydronuclear experiments. Although it is highly likely that the explosives were completely consumed by the detonations, they are a potential COPC.

4.2 Remediation

The DQOs developed for CAU 465 identified data gaps that require additional data collection before the preferred closure alternative can be identified and implemented. A decision point approach, based on the DQOs, for making remediation decisions is summarized in [Figures 1-3](#) (subsurface) and [1-4](#) (surface). The presence of contamination is assumed to be confined to the spatial boundaries of the sites as defined in the DQO process and CSM.

The judgmental sampling strategy for surface releases is to collect biased samples based on the biasing criteria listed in [Appendix B](#). The strategy for the development of the flow and transport models also is presented in [Appendix B](#). The flow and transport models will be used to integrate existing data into a conservative description of contaminant migration in the unsaturated zone from hydronuclear experiments and disposal boreholes in CAU 465.

The closure strategy for CAU 465 under this SAFER process consists of the following:

- Subsurface releases
 - Use contaminant transport models to estimate the maximum concentrations of individual contaminants at the groundwater surface beneath hydronuclear experiment locations in CAU 465 during a time period of 1,000 years.
 - Evaluate impacts of engineering controls (e.g., soil cover, run-on controls, surface water diversion controls) on the migration of contaminants in the CAU.
 - As a best management practice (BMP), backfill/seal unexpended (open) boreholes.
- Surface releases
 - Sample environmental media for COCs.
 - Identify and sample PSMs.
 - Remove identified and assumed PSMs.
 - Perform verification sampling.
- Closure in place of CAU 465 with URs

If COCs or PSMs are identified at the modeled groundwater surface for subsurface releases or on the surface for surface releases, that CAS will be further assessed before closure activities may be implemented. If COCs are not present in the groundwater surface or in surface soils at

concentrations exceeding FALs, the CAS will be recommended for closure in place with URs. The objective of the initial investigation strategy is to determine whether COCs or PSMs are present. Laboratory analytical results will be used to confirm the presence or absence of COCs for surface releases at the selected locations. The modeled concentrations of individual contaminants at the groundwater surface beneath the hydronuclear experiments will be utilized to determine whether COCs could be present in groundwater within 1,000 years.

For surface releases, if COCs or PSMs are present, a corrective action of removal for disposal may be implemented, and additional verification samples will be collected. If COCs are determined to be present at the groundwater surface based upon data presented in the groundwater model, additional corrective actions and/or engineering controls (e.g., soil cover, infiltration controls) or other institutional controls will be implemented.

4.3 Verification

The information necessary to satisfy the closure criteria will be generated for CAU 465 as follows:

- Surface releases—Collect and analyze soil samples generated during a field investigation.
- Subsurface releases—Complete flow and transport models.

For surface releases, if a COC is present and removal of the COC is deemed appropriate, the COC will be removed, and verification sampling of remaining environmental media will be required. The verification samples will be collected from the approximate center of the bottom of the excavation below the stained area and at lateral boundaries. The final locations and numbers of verification samples to be collected will be determined in the field based on the presence of any biasing factors as listed in [Section B.4.2.1](#), the size of the excavation, site conditions, and the professional judgment of the Site Supervisor. All verification sample locations must meet the DQO decision needs and criteria stipulated in [Appendix B](#). The number and location of verification samples will be justified in the CR.

If a COC is present and removal of the COC is not deemed appropriate, information on the extent of COC contamination will be obtained by collecting step-out (Decision II) samples. Decision II sampling will consist of further defining the extent of contamination where COCs have been confirmed. Step-out (Decision II) sampling locations at each CAS will be selected based on the

CSM, biasing factors, field-survey results, existing data, and the outer boundary sample locations where COCs were detected. In general, step-out sample locations will be arranged in a triangular pattern around areas containing a COC at distances based on site conditions, COC concentrations, process knowledge, and other biasing factors. If COCs extend beyond step-out locations, additional Decision II samples will be collected from locations farther from the source. If a spatial boundary is reached, the CSM is shown to be inadequate, or the Site Supervisor determines that the extent of the sampling needs to be reevaluated, work will be temporarily suspended, NDEP will be notified, and the investigation strategy will be reevaluated.

For subsurface releases, removal of COCs is not feasible. If a COC is estimated to exceed FALs at the groundwater surface within 1,000 years, then additional engineering or institutional controls and/or corrective actions will be evaluated. If engineering (e.g., installation of infiltration controls, soil cover), institutional (e.g., inclusion in existing Underground Test Area [UGTA] monitoring program), and/or other corrective actions are determined to mitigate the COC contamination, adequate controls will be put in place. Final corrective actions and/or engineering or institutional controls will be documented in the CR.

Modifications to the investigation strategy may be required should unexpected field conditions be encountered at any CAS. Significant modifications shall be justified and documented in a Record of Technical Change before implementation. If an unexpected condition indicates that conditions are significantly different than the corresponding CSM, the activity will be rescoped, and the decision makers will be notified. Field activities at CAU 465 include site preparation, sample location selection, sample collection activities, waste characterization, photodocumentation, and collection of geocoordinates.

[Table 4-1](#) summarizes the sampling approach for surface releases to achieve closure objectives for each of the CASs in CAU 465.

**Table 4-1
 Sampling Approach for Surface Component at CAU 465 CASs**

CAS	Total Number of Samples	Sample Location	Minimum Number of Sample Locations	Minimum Number of Samples per Location	Sample Collection Requirements ^{a,b}	Samples Submitted for Analysis ^c	Sampling Method Alternatives
00-23-01 (Charlie) 00-23-03 (Charlie Prime and Anja) 06-99-01 (Trailer 13)	TBD ^d	Use biasing factors (stains, elevated field readings)	TBD ^d	1	Representative sample of soil or PSM	Sample collected directly within each biased location	Hand sampling
00-23-02 (Dog)	TBD ^d	Use biasing factors (stains, elevated field readings)	TBD ^d	1	Representative sample of soil or PSM	Surface sample collected directly within each biased location	Hand sampling
		Lead bricks	TBD ^d	1	Representative sample of soil below lead brick(s)	Shallow subsurface sample	Hand sampling
		Soil from beneath the heaviest stained soil, stained concrete, and other PSM	TBD ^d	1	Representative sample of stained media	Sample collected directly within each biased location	Hand sampling

^aFor worker protection, field screening will not be conducted if a strong odor and/or visual evidence suggests contamination is present.

^bAdditional samples may be collected at the discretion of the Site Supervisor.

^cAdditional samples may be submitted at the discretion of the Site Supervisor.

^dSamples will be collected only at locations where biasing factors are observed during visual surveillance and/or radiological walkover surveys.

TBD = To be determined

4.3.1 Site Preparation

Site preparation activities to be completed before field sampling activities for CAU 465 include the following:

- Inspect surface features of the site for staining, debris, and other biasing factors.
- Collect debris and set aside for housekeeping and disposition.
- Conduct radiological surveys over the surface of the site to identify areas of elevated radiation above local background levels. Areas with elevated radiological survey results will be marked as sample locations, and samples will be collected and submitted for analysis.

Detailed information regarding sampling activities at CAU 465 is presented in [Appendix B](#).

4.4 Closure

For the closure of the subsurface component of CAU 465, removal of COCs is not feasible. The corrective action of closure in place with URs has been selected as the preferred closure alternative. As a BMP, unexpended (open) boreholes will be backfilled/sealed. If, through modeling, COC concentrations are estimated to exceed FALs at the groundwater surface within 1,000 years, then additional engineering or institutional controls and/or corrective actions such as installation of run-on or infiltration controls, placement of a soil cover, and/or other surface water diversion controls will be evaluated. If additional controls (e.g., installation of infiltration controls, soil cover) are determined to mitigate the COC contamination, adequate controls will be put in place. The decision logic for closure of the subsurface component is provided in [Figure 1-3](#).

The following activities, at a minimum, have been identified for closure of the surface component of CAU 465:

- If no COCs or PSM are detected, the CAS will be closed with no further action.
- If COCs are present and clean closure cannot be accomplished during the SAFER, then a hold point will have been reached, and NDEP will be consulted to determine whether the remaining contamination will be closed under the alternative corrective action of closure in place. The appropriate URs will be implemented and documented in the CR.

- If COCs are present and clean closure can be accomplished during the SAFER, clean closure will be the preferred CAA. The material to be remediated will be removed and disposed of as waste, and verification samples will be collected in remaining soil. Verification analytical results will be documented in the CR.

The decision logic behind the activities is provided in [Figure 1-4](#)

After completion of CAI and waste management activities, the following actions will be implemented before closure of the site Real Estate/Operations Permit (REOP):

- Remove all equipment, wastes, debris, and materials associated with the CAI.
- Remove all temporary signage and fencing (unless part of a corrective action or demarcation signs).
- Inspect the site and certify that restoration activities have been completed.

4.5 Duration

[Table 4-2](#) provides a tentative duration of activities (in calendar days) for SAFER activities:

**Table 4-2
SAFER Field Activities**

Duration (days)	Activity
10	Site Preparation
5	Site Mobilization
30	Fieldwork
30	Sample Analysis
42	Data Validation and Assessment
195	Closure Report
180	Waste Management and Disposition

5.0 Reports and Records Availability

Reports generated during ongoing field activities will be provided to NDEP upon request. Historical 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 Federal Sub-Project Director. This document is available in the DOE Public Reading Facilities located in Las Vegas and Carson City, Nevada, or by contacting the appropriate DOE Federal Sub-Project Director.

6.0 Investigation/Remediation Waste Management

Management, transportation, and disposal of the waste generated during the CAU 465 field investigation will be in accordance with all applicable DOE orders, federal and state regulations, and agreements and permits between DOE and NDEP. Wastes will be characterized based on these regulations using process knowledge, field-screening results (FSRs), and analytical results from investigation and waste samples. Waste types that may be generated during the CAI include sanitary, industrial, low-level radioactive, hazardous, hydrocarbon, *Toxic Substances Control Act* (TSCA)-regulated, or mixed wastes.

Disposable sampling equipment, personal protective equipment (PPE), and rinsate are considered potentially contaminated waste only by virtue of contact with potentially contaminated media (e.g., soil) or potentially contaminated debris (e.g., metal and concrete). 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, conservative estimates of total waste contaminant concentrations may be made based on the mass of the waste, the amount of contaminated media contained in the waste, and the maximum concentration of contamination found in the media. Direct samples of IDW may also be taken to support waste characterization. There are no known listed chemicals; therefore, all wastes will be characterized based on their attributes. Materials left in place are not considered to be generated wastes and are not subject to RCRA or the requirements of the sections below.

6.1 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 (e.g., soil removed during sampling) 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.

6.2 Potential Waste Streams

The waste streams that are expected to be generated during the CAU 465 field investigation include industrial and low-level radioactive IDW from the sampling activities. However, because of the uncertainty about what wastes are present within the CAS boundaries (e.g., lead debris, batteries, historical spills), the following waste streams have been included as potential waste streams that may require management and disposal:

- Industrial waste
- Low-level radioactive waste
- Hazardous waste
- Hydrocarbon waste
- Mixed low-level waste
- Polychlorinated biphenyls

6.2.1 Industrial Waste

Industrial IDW, if generated, will be collected, managed, and disposed of in accordance with the solid waste regulations and the permits for operation of the NNSS Solid Waste Disposal Sites. Industrial 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 roll-off box located in Mercury or other approved roll-off box location. The number of bags of industrial IDW placed in the roll-off box will be counted as they are placed in the roll-off box, noted in a log, and documented in the field activity daily log. These logs will provide necessary tracking information for ultimate disposal in the U10c Industrial Waste Landfill.

6.2.2 Low-Level Radioactive Waste

Low-level radioactive wastes, 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 NNSS Waste Acceptance Criteria (WAC) (NNSA/NSO, 2010). Potential radioactive waste drums containing soil, PPE, disposable sampling equipment, and/or rinsate may be staged and managed at a designated radioactive material area (RMA).

6.2.3 Hazardous Waste

Suspected hazardous wastes, if generated, will be placed in U.S. Department of Transportation (DOT)-compliant containers. All containerized hazardous waste will be managed in accordance with Title 40 *Code of Federal Regulations* (CFR) 262.34 (CFR, 2011b). Hazardous waste will be characterized in accordance with the requirement of 40 CFR 261. Any waste determined to be hazardous will be managed and transported in accordance with RCRA and DOT requirements to a permitted treatment, storage, and disposal facility.

6.2.4 Hydrocarbon Waste

Hydrocarbon soil wastes, if generated, 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 or an appropriate hydrocarbon waste management facility (e.g., recycling facility), or with other method in accordance with the State of Nevada regulations (NDEP, 2006).

6.2.5 Mixed Low-Level Waste

Mixed waste, if generated, shall be managed and dispositioned in accordance with the requirements of RCRA (CFR, 2011b), agreements between NNSA/NSO and the State of Nevada, and DOE requirements for radioactive waste. Waste characterized as mixed will not be stored for a period of time that exceeds the requirements of RCRA. Mixed waste with hazardous waste constituent concentrations below Land Disposal Restrictions may be disposed of at the NNSS Area 5 Radioactive Waste Management Site if the waste meets the requirements of the NNSS WAC (NNSA/NSO, 2010).

6.2.6 Polychlorinated Biphenyls

The management of PCBs is governed by TSCA (USC, 2006) and its implementing regulations at 40 CFR 761 (CFR, 2011c), and agreements between EPA and NDEP. Polychlorinated biphenyl 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 CAI. If any type of PCB

waste is generated, it will be managed in accordance with 40 CFR 761 (CFR, 2011c) as well as State of Nevada requirements (NAC, 2008b).

7.0 Quality Assurance/Quality Control

The overall objective of the characterization activities described in this SAFER Plan is to collect accurate and defensible data to support the selection and implementation of a closure alternative for each CAS in CAU 465. [Sections 7.1](#) and [7.2](#) discuss the collection of required quality control (QC) samples in the field and quality assurance (QA) requirements for laboratory/analytical data to achieve closure. Unless otherwise stated in this SAFER Plan or required by the results of the DQO process (see [Appendix B](#)), this CAI will adhere to the Industrial Sites QAPP (NNSA/NV, 2002a).

7.1 Sample Collection Activities

Field QC samples will be collected in accordance with established procedures. Field QC samples are collected and analyzed to aid in determining the validity of environmental sample results. The number of required QC samples depends on the types and number of environmental samples collected. The minimum frequencies of collecting and analyzing QC samples for this CAI, as determined in the DQO process, are as follows:

- Radiological samples
 - Field duplicates (1 per 20 environmental samples, or 1 per CAS per matrix if less than 20 collected)
 - Laboratory QC samples (1 per 20 environmental samples, or 1 per CAS per matrix if less than 20 collected)
- Chemical samples (if collected)
 - Trip blanks (1 per sample cooler containing VOC environmental samples)
 - Equipment rinsate blanks (1 per sampling event for each type of decontamination procedure)
 - Source blanks (1 per uncharacterized lot of source material that contacts sampled media)
 - Field duplicates (1 per 20 environmental samples, or 1 per CAS per matrix if less than 20 collected)

- Field blanks
- Laboratory QC samples (1 per 20 environmental samples, or 1 per CAS per matrix if less than 20 collected)

Additional QC samples may be submitted based on site conditions at the discretion of the Task Manager or 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).

7.2 Applicable Laboratory/Analytical Data Quality Indicators

The DQIs are qualitative and quantitative descriptors used in interpreting the degree of acceptability or utility of data. The DQIs are used to evaluate the entire measurement system and laboratory measurement processes (i.e., analytical method performance) as well as individual analytical results (i.e., parameter performance). The quality and usability of data used to make DQO decisions will be assessed based on the following DQIs:

- Precision
- Accuracy/bias
- Representativeness
- Completeness
- Comparability
- Sensitivity

[Table 7-1](#) provides the established analytical method/measurement system performance criteria for each of the DQIs and the potential impacts on the decision if the criteria are not met. The following subsections discuss each of the DQIs that will be used to assess the quality of laboratory data. The criteria for precision and accuracy in [Tables 3-3](#) and [3-4](#) may vary from information in the QAPP as a result of the laboratory used or updated/new methods (NNSA/NV, 2002a).

7.2.1 Precision

Precision is a measure of the repeatability of the analysis process from sample collection through analysis results. It is used to assess the variability between two equal samples.

**Table 7-1
 Laboratory and Analytical Performance Criteria for CAU 465 DQIs**

DQI	Performance Metric	Potential Impact on Decision If Performance Metric Not Met
Precision	At least 80% of the sample results for each measured contaminant are not qualified for precision based on the criteria for each analytical method-specific and laboratory-specific criteria presented in Section 7.2.1 .	The affected analytical results from each affected CAS will be assessed to determine whether there is sufficient confidence in analytical results to use the data in making DQO decisions.
Accuracy	At least 80% of the sample results for each measured contaminant are not qualified for accuracy based on the method-specific and laboratory-specific criteria presented in Section 7.2.2 .	The affected analytical results from each affected CAS will be assessed to determine whether there is sufficient confidence in analytical results to use the data in making DQO decisions.
Representativeness	Samples contain contaminants at concentrations present in the environmental media from which they were collected.	Analytical results will not represent true site conditions. Inability to make appropriate DQO decisions.
Decision I Completeness	80% of the CAS-specific COPCs have valid results.	Cannot support/defend decision on whether COCs are present.
Decision II Completeness	100% of COCs used to define extent have valid results.	Extent of contamination cannot be accurately determined.
Comparability	Sampling, handling, preparation, analysis, reporting, and data validation are performed using standard methods and procedures.	Inability to combine data with data obtained from other sources and/or inability to compare data to regulatory action levels.
Sensitivity	The MDCs are less than or equal to respective FALs.	Cannot determine whether COCs are present or migrating at levels of concern.

Determinations of precision will be made for field duplicate samples and 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 will be 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 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 may include matrix spike duplicate (MSD) and laboratory control sample (LCS) duplicate samples for organic, inorganic, and radiological analyses.

Precision is a quantitative measure used to assess overall analytical method and field-sampling performance as well as the need to “flag” (qualify) individual parameter results when corresponding QC sample results are not within established control limits.

The criteria used for the assessment of inorganic chemical precision when both results are greater than or equal to 5x reporting limit (RL) is 20 and 35 percent for aqueous and soil samples, respectively. When either result is less than 5x RL, control limits of $\pm 1x$ RL and $\pm 2x$ RL for aqueous and soil samples, respectively, are applied to the absolute difference. The parameters to be used for the assessment of precision for duplicates are listed in [Table 3-4](#).

The criteria used for the assessment of organic chemical precision is based on professional judgment using laboratory-derived control limits.

The criteria used for the assessment of radiological precision when both results are greater than or equal to 5x MDC are 20 and 35 percent for aqueous and soil samples, respectively. When either result is less than 5x MDC, the normalized difference (ND) should be between -2 and +2 for aqueous and soil samples. The parameters to be used for assessment of precision for duplicates are listed in [Table 3-3](#).

Any values outside the specified 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. The performance metric for assessing the DQI of precision on DQO decisions ([Table 7-1](#)) is that at least 80 percent of sample results for each measured contaminant are not qualified because of duplicates exceeding the criteria. If this performance is not met, an assessment will be conducted in the CR of the impacts on DQO decisions specific to affected contaminants and CASs.

7.2.2 Accuracy

Accuracy is a measure of the closeness of an individual measurement to the true value. It is used to assess the performance of laboratory measurement processes.

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). Accuracy will be evaluated based on results from three types of spiked samples:

matrix spike (MS), LCS, and surrogates (organics). The LCS is analyzed with the field samples using the same sample preparation, reagents, and analytical methods employed for the samples. One LCS will be prepared with each batch of samples for analysis by a specific measurement.

The criteria used for the assessment of inorganic chemical accuracy are 75 to 125 percent for MS recoveries and 80 to 120 percent for LCS recoveries. For organic chemical accuracy, MS and LCS laboratory-specific percent recovery criteria developed and generated in-house by the laboratory according to approved laboratory procedures are applied. The criteria used for the assessment of radiochemical accuracy are 80 to 120 percent for LCS and MS recoveries.

Any values outside the specified 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 laboratory control, such as sample matrix effects, can cause the measured values to be outside the established criteria. Therefore, the entire sampling and analytical process may be evaluated when the usability of the affected data is being determined.

The performance metric for assessing the DQI of accuracy on DQO decisions ([Table 7-1](#)) is that at least 80 percent of the sample results for each measured contaminant are not qualified for accuracy. If this performance is not met, an assessment will be conducted in the CR of the impacts on DQO decisions specific to affected contaminants and CASs.

7.2.3 Representativeness

Representativeness is the degree to which sample characteristics accurately and precisely represent characteristics of a population or an environmental condition (EPA, 2002). Representativeness is ensured by carefully developing the CAI sampling strategy during the DQO process such that false negative and false positive decision errors are minimized. Meeting the criteria listed below will ensure that sample results will adequately represent actual site characteristics:

- For Decision I judgmental sampling, having a high degree of confidence that the sample locations selected will identify COCs if present anywhere within the CAS.
- For Decision I probabilistic sampling, having a high degree of confidence that the sample locations selected will represent contamination of the CAS.

- Having a high degree of confidence that analyses conducted will be sufficient to detect any COCs present in the samples.
- For Decision II, having a high degree of confidence that the sample locations selected will identify the extent of COCs.

These are qualitative measures that will be used to assess measurement system performance for representativeness. The assessment of this qualitative criterion will be presented in the CR.

7.2.4 Completeness

Completeness is defined as generating sufficient data of the appropriate quality to satisfy the data needs identified in the DQOs. For judgmental sampling, completeness will be evaluated using both a quantitative measure and a qualitative assessment. The quantitative measurement to be used to evaluate completeness is presented in [Table 7-1](#) and is based on the percentage of measurements made that are judged to be valid. For the judgmental sampling approach, the completeness goal for COPCs is 80 percent. If this goal is not achieved, the dataset will be assessed for potential impacts on making DQO decisions.

The qualitative assessment of completeness is an evaluation of the sufficiency of information available to make DQO decisions. This assessment will be based on meeting the data needs identified in the DQOs and will be presented in the CR. Additional samples will be collected if it is determined that the number of samples does not meet completeness criteria.

7.2.5 Comparability

Comparability is a qualitative parameter expressing the confidence with which one dataset can be compared to another (EPA, 2002). The criteria for the evaluation of comparability will be that all sampling, handling, preparation, analysis, reporting, and data validation were performed using approved standard methods and procedures. This will ensure that data from this project can be compared to regulatory action levels that were developed based on data generated using the same or comparable methods and procedures. An evaluation of comparability will be presented in the CR.

7.2.6 Sensitivity

Sensitivity is the capability of a method or instrument to discriminate between measurement responses representing different levels of the variable of interest (EPA, 2002). The evaluation criterion for this parameter will be that measurement sensitivity (detection limits) will be less than or equal to the corresponding FALs. If this criterion is not achieved, the affected data will be assessed for usability and potential impacts on meeting site characterization objectives. This assessment will be presented in the CR.

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Appendix A
Project Organization

A.1.0 Project Organization

The NNSA/NSO Federal Sub-Project Director is Kevin Cabble. He can be contacted at (702) 295-5000.

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 NNSA/NSO Federal Sub-Project Director be contacted for further information. The Task Manager will be identified in the FFACO Monthly Activity Report prior to the start of field activities.

Appendix B

Data Quality Objective Process

B.1.0 Introduction

The DQO process described in this appendix is a seven-step strategic systematic planning method used to plan data collection activities and define performance criteria for the CAU 465, Hydronuclear, investigation. The DQOs are designed to ensure that the data collected will provide sufficient and reliable information to determine the appropriate corrective actions, to verify the adequacy of existing information, to provide sufficient data to implement the corrective actions, and to verify that closure was achieved.

The CAU 465 CAI will be based on the DQOs presented in this appendix as developed by representatives of NDEP and NNSA/NSO. The seven steps of the DQO process presented in [Sections B.2.0](#) through [B.8.0](#) were developed in accordance with *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA, 2006) and the CAS-specific information presented in [Section B.2.0](#).

The DQO process presents a judgmental approach for data collection (use of existing information to develop groundwater flow and transport models and field sampling). In general, the procedures used in the DQO process provide the following:

- A method to establish performance or acceptance criteria, which serve as the basis for designing a plan for collecting data of sufficient quality and quantity to support the goals of a study.
- Criteria that will be used to establish the final data collection design, such as
 - the nature of the problem that has initiated the study and a conceptual model of the environmental hazard to be investigated,
 - the decisions or estimates that need to be made and the order of priority for resolving them,
 - the type of data needed, and
 - an analytic approach or decision rule that defines the logic for how the data will be used to draw conclusions from the study findings.
- Acceptable quantitative criteria on the quality and quantity of the data to be collected, relative to the ultimate use of the data.

- A data collection design that will generate data meeting the quantitative and qualitative criteria specified. A data collection design specifies the type, number, location, and physical quantity of samples and data, as well as the QA and QC activities that will ensure that sampling design and measurement errors are managed sufficiently to meet the performance or acceptance criteria specified in the DQOs.

B.2.0 Step 1 - State the Problem

Step 1 of the DQO process defines the problem that requires study, identifies the planning team, and develops a conceptual model of the environmental hazard to be investigated. Corrective Action Unit 465 consists of the following potential release components:

- Subsurface releases—Potential releases of radiological and other contaminants from the subsurface hydronuclear experiments and disposal boreholes.
- Surface releases—Potential releases of radiological and nonradiological contaminants to surface soils that may have occurred during pre- and post-test activities.

The problem statement for the subsurface component of CAU 465 is as follows: “Additional information on the potential impacts of the hydronuclear experiments and disposal boreholes to groundwater is needed to evaluate and recommend CAAs.”

The problem statement for the surface component of CAU 465 is as follows: “Existing information on the nature and extent of contamination from surface releases at CAU 465 is insufficient to recommend CAAs.”

B.2.1 Planning Team Members

The DQO planning team consists of representatives from NDEP and NNSA/NSO. The DQO planning team met on July 6, 2011, for the DQO meeting. The primary decision makers are the NDEP and NNSA/NSO representatives.

B.2.2 Conceptual Site Model

The CSM is used to organize and communicate information about site characteristics. It reflects the best interpretation of available information at any point in time. The CSM is a primary vehicle for communicating assumptions about release mechanisms, potential migration pathways, or specific constraints. It provides a summary of how and where contaminants are expected to move and what impacts such movement may have. It is the basis for assessing how contaminants could reach receptors both in the present and future. The CSM describes the most probable scenario for current conditions at each site and defines the assumptions that are the basis for identifying appropriate

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

The CSM was developed for CAU 465 using information from the physical setting, potential contaminant sources, release information, historical background information, knowledge from similar sites, and physical and chemical properties of the potentially affected media and COPCs.

The CSM consists of the following:

- Potential contaminant releases, including media subsequently affected.
- Release mechanisms (the conditions associated with the release).
- Potential contaminant source characteristics, including contaminants suspected to be present and contaminant-specific properties.
- Site characteristics, including physical, topographical, and meteorological information.
- Migration pathways and transport mechanisms that describe the potential for migration and where the contamination may be transported.
- The locations of points of exposure where individuals or populations may come in contact with a COC associated with a CAS.
- Routes of exposure where contaminants may enter the receptor.

If additional elements are identified during the CAI that are outside the scope of the CSM, the situation will be reviewed and a recommendation will be made as to how to proceed. In such cases, NDEP and NNSA/NSO will be notified and given the opportunity to comment on, and concur with, the recommendation.

The applicability of the CSM to each CAS is summarized in [Table B.2-1](#) and discussed below. [Table B.2-1](#) provides information on CSM elements that will be used throughout the remaining steps of the DQO process. [Figure B.2-1](#) represents site conditions applicable to the CSM and depicts the various potential surface and subsurface releases associated with CAU 465.

**Table B.2-1
Conceptual Site Model Description of Elements for Each CAS in CAU 465**

CAS Identifier	00-23-01	00-23-02	00-23-03	06-99-01
CAS Description	Hydronuclear Experiment	Hydronuclear Experiment	Hydronuclear Experiment	Hydronuclear
Site Status	Sites are inactive and/or abandoned.			
Exposure Scenario	Occasional Use			
Sources of Potential Soil Contamination	Release of radiological and nonradiological contaminants to surface and subsurface soils			
Location of Contamination/Release Point	Surface soil at or near location(s) of release or stored waste/materials, and subsurface soil from hydronuclear experiments and disposal boreholes			
Amount Released	Unknown			
Affected Media	Surface and subsurface soil; debris such as concrete, steel, and wood			
Potential Contaminants	Radionuclides (gamma spectroscopy, isotopic U, isotopic Pu, VOCs, SVOCs, PCBs, HEs, metals plus beryllium)			
Transport Mechanisms	Percolation of precipitation through subsurface media serves as the driving force for the potential migration of contaminants to the water table. Surface water runoff may provide for the transportation of some contaminants within or outside the footprints of the CASs.			
Migration Pathways	Vertical transport expected to dominate over lateral transport because of small surface gradients			
Lateral and Vertical Extent of Contamination	Contamination, if present, is expected to be contiguous to the release points. Concentrations are expected to decrease with distance and depth from the source. Groundwater contamination is not expected. Lateral and vertical extent of COC contamination is assumed to be within the spatial boundaries.			
Exposure Pathways	The potential for contamination exposure is limited to industrial and construction workers, and military personnel conducting training. These human receptors may be exposed to COPCs through oral ingestion or inhalation of, or dermal contact with or absorption of, soil and/or debris due to inadvertent disturbance of these materials, or irradiation by radioactive materials.			

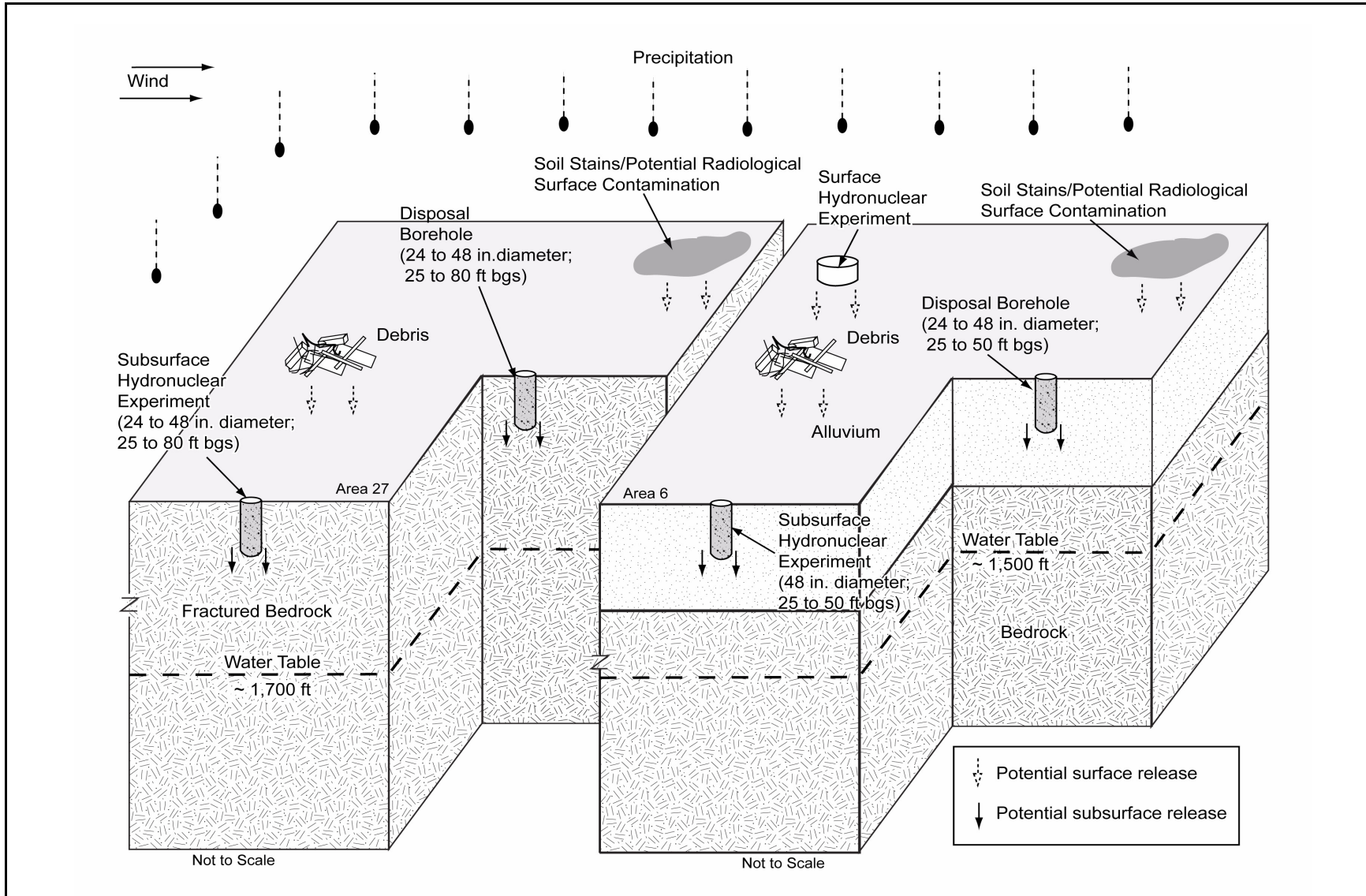


Figure B.2-1
Conceptual Site Model for CAU 465 CASs

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B.2.2.1 Contaminant Release

Any contaminants released from CAU 465, regardless of physical or chemical characteristics, are expected to exist in the soil adjacent to their sources in lateral and vertical directions. The CSM accounts for the following potential releases:

- Releases to groundwater due to the remaining inventory of radiological and nonradiological materials in the boreholes utilized for hydronuclear experiments and the disposal boreholes (subsurface releases).
- Releases to surface soils due to spills, wastes, and other PSM (e.g., lead bricks) from historical operations conducted at each site in support of the hydronuclear experiments (surface releases).

B.2.2.2 Potential Contaminants

The COPCs were identified during the planning process through the review of site history, process knowledge, personal interviews, and inferred activities associated with the CASs. Because complete information regarding activities performed at the CAU 465 sites is not available, contaminants detected at similar NNSS sites were included in the contaminant list to reduce uncertainty. The list of COPCs is intended to encompass all the contaminants that could potentially be present at each CAS. The COPCs applicable to Decision I environmental samples for the surface component from each of the CASs of CAU 465 are defined as the constituents reported from the analytical methods stipulated in [Table B.2-2](#). Because development of the flow and contaminant transport models will be completed utilizing existing data, there are no planned sampling or other field collection activities for the subsurface component. However, the COPCs associated with potential subsurface releases are identified in [Table B.2-2](#).

For subsurface releases, a list of potential contaminants for the 1,000-year CAI time period was derived from the reported list of radioactive materials utilized to conduct the hydronuclear experiments: Pu-239/240, Am-241, U-235, and U-238 (DOE/NV, 2001). This group of radionuclides was considered the most significant for forecasting the 4-millirem (mrem) contaminant boundary over a 1,000-year time period. Lead also is included as a potential contaminant because it is known to have been used in significant quantities in underground nuclear testing for shielding and as a component in instrumentation. It was assumed that HEs and any VOC or SVOC RCRA

**Table B.2-2
Analytical Program^a**

Constituents	CAU 465 (Subsurface Releases)	CAU 465 (Surface Releases)
Organic COPCs		
HE	--	X
PCBs	--	X
SVOCs	--	X
VOCs	--	X
Inorganic COPCs		
RCRA metals	X ^b	X
Total beryllium	--	X
Radionuclide COPCs		
Gamma spectroscopy ^c	X ^d	X
Isotopic U	X ^d	X
Isotopic Pu	X ^d	X

^aThe COPCs are the constituents reported from the analytical methods listed.

^bLead only.

^cResults of gamma analysis will be used to determine whether further isotopic analysis is warranted.

^dThe radiological COPCs for subsurface releases are Am-241, U-234/235, U-238, Pu-239/240, and Pu-241.

X = Required analytical method

-- = Not required

constituents would be consumed during the explosion; therefore, only metals could remain as potential contaminants.

For potential surface releases, the COPCs include radionuclides (gamma, isotopic U, and isotopic Pu), RCRA metals, VOCs, SVOCs, PCBs, and HEs. The specific COPC is dependent upon the type of release identified and other biasing factors. For example, lead is a COPC because of the identified presence of lead bricks. Other potential releases identified by biasing factors (e.g., visual, radiological field screening) include those involving organic constituents (e.g., diesel spills); VOCs, SVOCs, and PCBs are groups of compounds that would contain organic COPCs. High explosives were utilized to initiate the hydronuclear experiments. Although it is highly likely that the explosives were completely consumed by the detonations, they are a potential COPC. Beryllium is included in the list of COPCs because beryllium is common to some test components.

B.2.2.3 Contaminant Characteristics

Contaminant characteristics include, but are not limited to, solubility, density, and adsorption potential. In general, contaminants with large particle size, low solubility, high affinity for media, and/or high density can be expected to be found relatively close to release points. Contaminants with small particle size, high solubility, low affinity for media, and/or low density are found farther from release points or in low areas where evaporation of ponding will concentrate dissolved constituents.

B.2.2.4 Site Characteristics

Site characteristics are defined by the interaction of physical, topographical, and meteorological attributes and properties. Physical properties include permeability, porosity, hydraulic conductivity, degree of saturation, sorting, chemical composition, and organic content. Topographical and meteorological properties and attributes include slope stability, precipitation frequency and amounts, precipitation runoff pathways, drainage channels and ephemeral streams, and evapotranspiration potential. Migration pathways and transport mechanisms relevant to the present investigation are discussed in [Section B.2.2.5](#).

The NNSS lies in the southern part of the Great Basin section of the Basin and Range physiographic province. There are numerous north–south-trending linear mountain ranges separated by broad, flat-floored, and gentle-sloped valleys. The general geology of the NNSS can be described in terms of three major rock units. The lowermost and oldest units are complexly folded and faulted sedimentary rocks of Paleozoic age. These are overlain in many places by volcanic tuffs and lavas of Tertiary age. Finally, the valleys or flats are covered by alluvium of late Tertiary and Quaternary age, which was derived from erosion of Tertiary and Paleozoic rocks (ERDA, 1977).

Area 6

Area 6 is located within Yucca Flat along the east side of the NNSS. Tertiary volcanics and Paleozoic carbonate rocks outcrop along the western edge of Area 6. Broad Quaternary alluvial plains and associated playa deposits, dominated by the Yucca Lake playa, are found in the central and eastern portions of Area 6. Corrective Action Site 06-99-01 (Trailer 13) is located along the southeast edge of Yucca Lake.

The hydrostratigraphic units in the vicinity of CAS 06-99-01 consist of a sequence of interbedded alluvial and playa deposits overlying a thick sequence of unsaturated volcanic rocks that overlie the regionally extensive Paleozoic carbonate aquifer (BN, 2006).

Corrective Action Site 06-99-01 is located in the Ash Meadows groundwater basin, where groundwater generally percolates downward through the alluvium and volcanic rocks to the Paleozoic carbonate aquifer. Groundwater generally flows to the south and southwest and eventually discharges at the large springs in Ash Meadows, about 25 mi southwest of Mercury (Winograd and Thordarson, 1975). The depth to groundwater at CAS 06-99-01 is approximately 1,500 ft bgs based on observations at Well TW-B (USGS/DOE, 2011).

Area 27

Geographically, Area 27 is located in the southern part of the NNSS, approximately midway between Jackass Flats and Frenchman Flat. Topographically, the CAU 465 CASs within Area 27 are located in a saddle between Skull Mountain to the west and rugged terrain to the east. The saddle is a drainage divide between Wahmonie Flat to the north and Rock Valley to the south. Area 27 is located in the transition zone between the northern edge of the Mojave Desert and the southern portion of the Great Basin Desert.

The rock formation that underlies Area 27 is, in general, an extrusive rock called the Oak Spring formation. The rocks are mostly volcanic in origin and are of Tertiary age. They may have covered the area completely at one time, but faulting and erosion have exposed older strata.

The Oak Spring formation has variations in color and lithology over short distances. In many places, these hills are composed of white slope-forming tuffaceous beds interbedded with, or capped by, thin, dark resistant extrusive masses. The Oak Spring formation consists of rhyolitic lava flows, tuff beds, and many other volcanic rock types (Johnson and Hibbard, 1957). The groundwater flux system in Area 27 generally directs subsurface flow to the southwest within the Ash Meadows component of the Death Valley groundwater basin. After crossing the NNSS boundary, the drainage passes near Amargosa Valley, Nevada, and Death Valley Junction, California. The depth to groundwater beneath the Area 27 CASs is estimated at approximately 1,700 ft bgs based on observations at Well TW-F (USGS/DOE, 2011).

Neither perennial streams nor wetlands exist in the vicinity of CAU 465, with the exception of Cane Spring located in Area 27. Cane Spring represents discharge from a perched aquifer that is recharged from fractures in the nearby mountains (NSTec, 2008).

B.2.2.5 Migration Pathways and Transport Mechanisms

Migration pathways include the lateral migration of potential contaminants across surface soils/sediments and vertical migration of potential contaminants through subsurface soils. In Area 6, surface water flow from the Trailer 13 site (CAS 06-99-01) is to the south-southwest into the Yucca Lake dry lake bed. The drainage patterns in Area 27 direct surface flow to the southwest. Rainfall typically collects in drainage channels that flow to lower elevations, infiltrates soil, or evaporates. Surface water flow from the CASs in Area 27 also is generally to the south. Both areas are generally dry but subject to infrequent, potentially intense, stormwater flows. Stormwater flow events can 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.

Infiltration and percolation of precipitation serves as a driving force for downward migration of contaminants. However, due to high potential evapotranspiration (annual potential evapotranspiration at the Area 3 Radiological Waste Management Site has been estimated at 62.6 in. [Shott et al., 1997]) and limited precipitation for this region (average of 5.64 in. per year as measured at Station A06 in Area 6 and approximately 7.74 in. per year as measured at Station CS in Area 5 [ARL/SORD, 2011]), percolation of infiltrated precipitation at the NNSS does not provide a significant mechanism for vertical migration of contaminants to groundwater (DOE/NV, 1992). Environmental contamination is, therefore, expected to be limited to the area near release points.

B.2.2.6 Land Use and Exposure Scenarios

Human receptors may be exposed to COPCs through oral ingestion or inhalation of, or dermal contact with or absorption of, groundwater, soil, or debris due to inadvertent disturbance of these materials, or irradiation by radioactive materials. Onsite workers and possibly site visitors may be potential receptors of contaminants from onsite water supply wells. These onsite receptors may be potentially

exposed to radionuclides and other hazardous materials in groundwater through ingestion, dermal contact, irradiation, or inhalation. The existing monitoring program of the water supply wells limits the potential for this exposure scenario.

The land use and exposure scenarios for the CAU 465 CASs are listed in [Table B.2-3](#). These are based on current and future land use at the NNSS (DOE/NV, 1998). Although the CAU 465 CASs are located in areas near structures used for current activities, these sites are controlled access areas that preclude use as assigned work areas. Therefore, these sites are classified as Occasional Use Areas.

**Table B.2-3
Land Use and Exposure Scenarios**

CAS	Record of Decision Land Use Zone	Exposure Scenario
00-23-01 00-23-02 00-23-03	<p style="text-align: center;">Defense Industrial Zone</p> This land area is designated for stockpile management of weapons, including production, assembly, disassembly or modification, staging, repair, retrofit, and surveillance. Also included in this zone are permanent facilities for stockpile stewardship operations involving equipment and activities such as radiography, lasers, materials processing, and pulsed power.	<p style="text-align: center;">Occasional Use Area</p> Worker will be exposed to the site occasionally (up to 100 hours per year for 5 years). Site structures are not present for shelter and comfort of the worker.
06-99-01	<p style="text-align: center;">Reserved Zone (within the NNSS areas)</p> This land area includes areas and facilities that provide widespread flexible support for diverse short-term testing and experimentation. The reserved zone is also used for short-duration exercises and training, such as the Nuclear Emergency Search Team and Federal Radiological Monitoring and Assessment Center training and U.S. Department of Defense land-navigation exercises and training.	<p style="text-align: center;">Occasional Use Area</p> Worker will be exposed to the site occasionally (up to 100 hours per year for 5 years). Site structures are not present for shelter and comfort of the worker.

B.3.0 Step 2 - Identify the Goal of the Study

Step 2 of the DQO process states how environmental data will be used in meeting objectives and solving the problem, identifies study questions or decision statements, and considers alternative outcomes or actions that can occur upon answering the questions. [Figures B.3-1](#) (subsurface releases) and [B.3-2](#) (surface releases) depict the sequential flow of questions, answers, and action alternatives required to fulfill the objectives of the SAFER process.

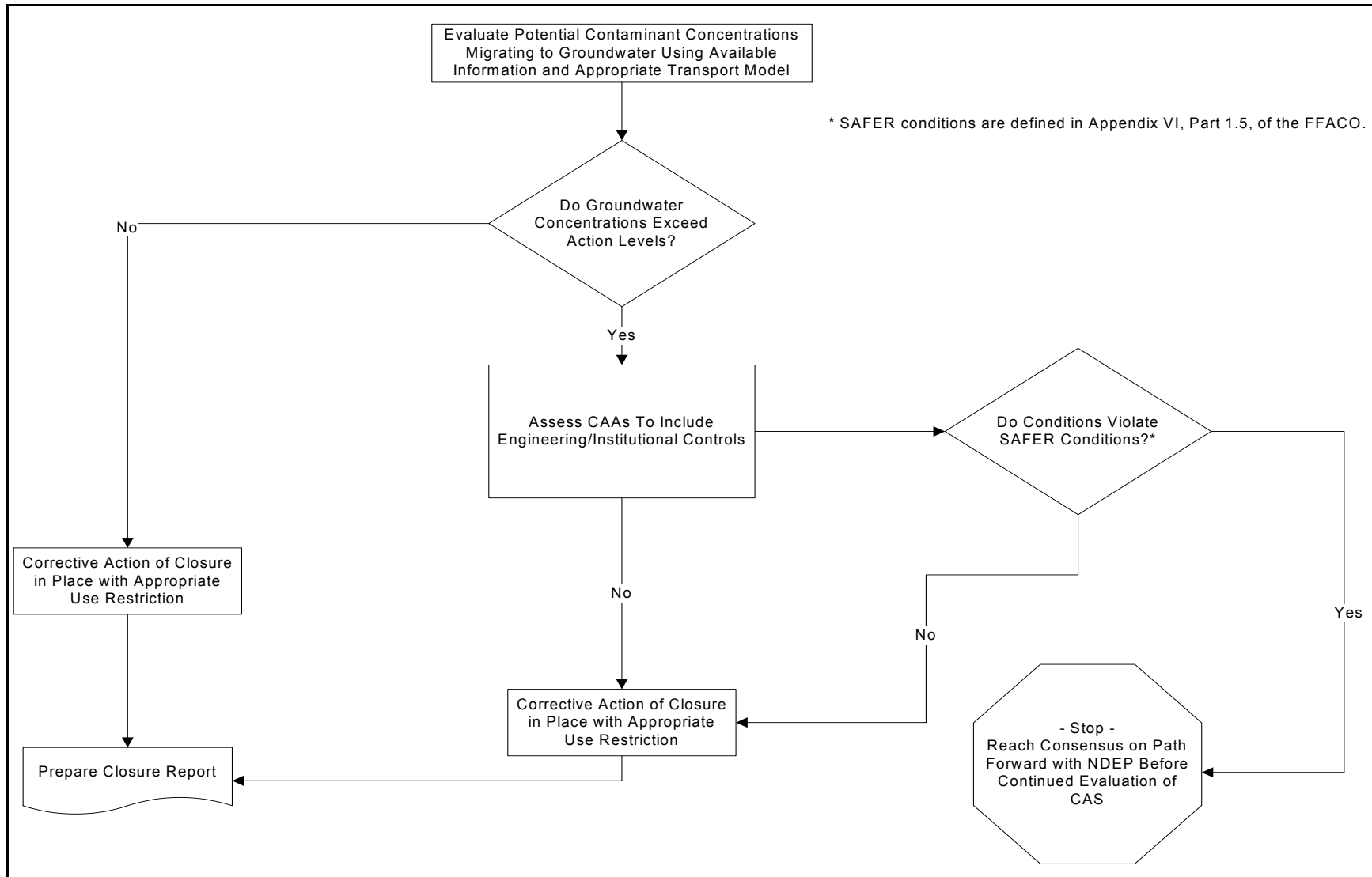
B.3.1 Decision Statements

Subsurface Releases

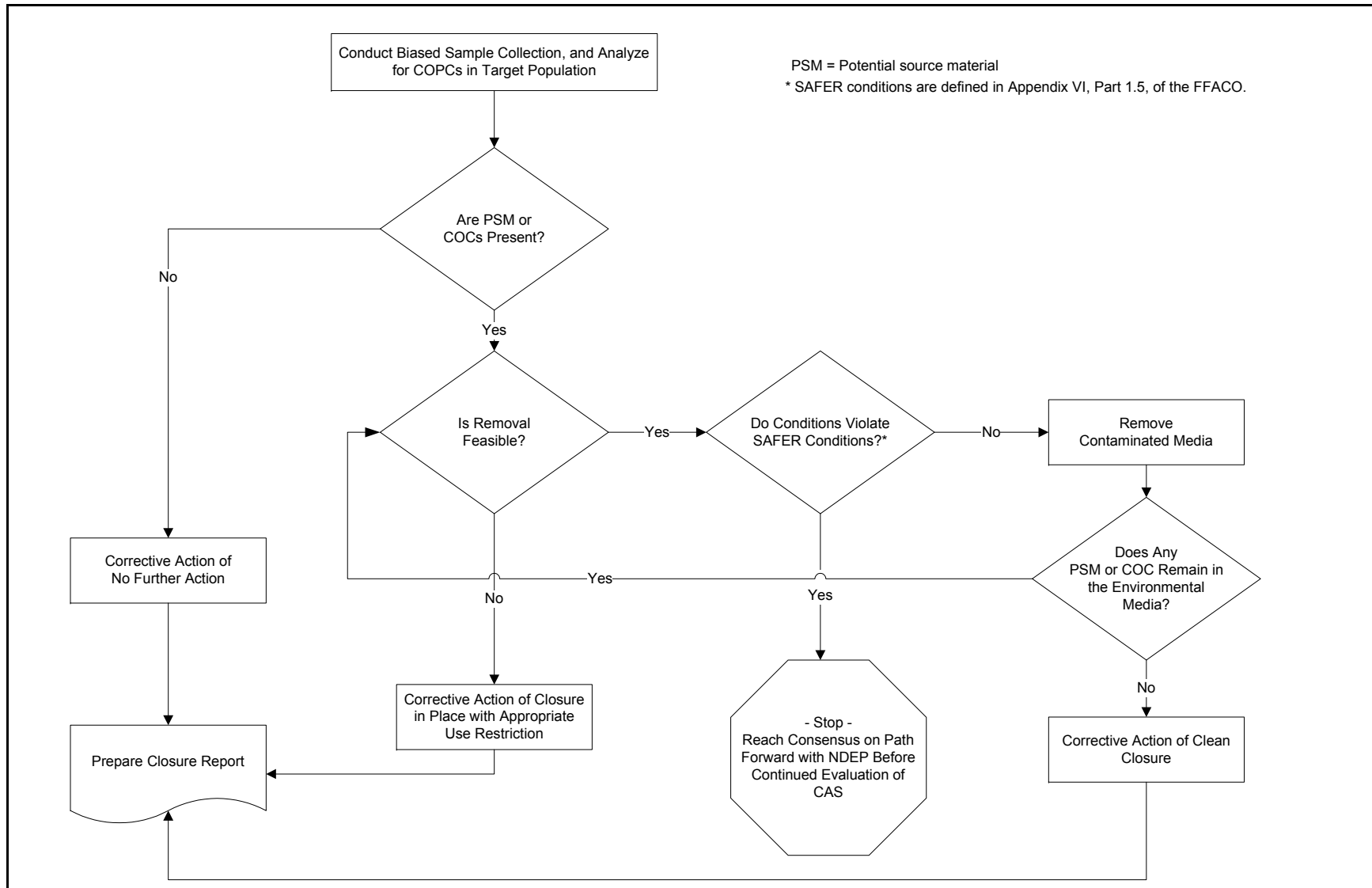
For the subsurface component of CAU 465, the Decision I statement is as follows: “If there is a potential impact on groundwater, then implement engineering controls.” For purposes of the flow and transport models, any COPC in groundwater determined to have a potential to exceed a FAL will result in that COPC being designated as a COC. A COC may also be defined as a contaminant that, in combination with other like contaminants, is determined to jointly pose an unacceptable risk based on a multiple constituent analysis (NNSA/NSO, 2006). If, through modeling, a COC is estimated to exceed FALs at the groundwater surface within 1,000 years, then additional engineering or institutional controls and/or corrective actions will be evaluated. If additional controls (e.g., installation of infiltration controls, soil cover) are determined to mitigate the COC contamination, adequate controls will be put in place.

Surface Releases

The Decision I statement for the surface component is as follows: “Is any COC present in environmental media within the CAS?” A COC may also be defined as a contaminant that, in combination with other like contaminants, is determined to jointly pose an unacceptable risk based on a multiple constituent analysis (NNSA/NSO, 2006). If a COC is detected, then Decision II must be resolved.



**Figure B.3-1
 SAFER Closure Decision Process for CAU 465 CASs (Subsurface Component)**



**Figure B.3-2
 SAFER Closure Decision Process for CAU 465 CASs (Surface Component)**

The Decision II statement is as follows: “If a COC is present, is sufficient information available to meet the closure objectives?” Sufficient information is defined to include the following:

- The information that identifies the volume of media containing any COC bounded by analytical sample results in lateral and vertical directions.
- The information needed to characterize IDW for disposal.
- The information needed to determine potential remediation waste types.

A corrective action may also be required if a waste present within a CAS contains contaminants that, if released, could cause the surrounding environmental media to contain a COC. Such a waste would be considered PSM. To evaluate wastes for the potential to result in the introduction of a COC to the surrounding environmental media, the conservative assumption was made that any physical waste containment would fail at some point and release the contaminants to the surrounding media. The following will be used as the criteria for determining whether a waste is PSM:

- A waste, regardless of concentration or configuration, may be assumed to be PSM and handled under a corrective action.
- Based on process knowledge and/or professional judgment, some waste may be assumed not to be PSM if it is clear that it could not result in soil contamination exceeding a FAL.
- If assumptions about the waste cannot be made, then the waste material will be sampled, and the results will be compared to FALs based on the following criteria:
 - For non-liquid wastes, the concentration of any chemical contaminant in soil (following degradation of the waste and release of contaminants into soil) would be equal to the mass of the contaminant in the waste divided by the mass of the waste. If the resulting soil concentration exceeds the FAL, then the waste would be considered PSM.
 - For non-liquid wastes, the dose resulting from radioactive contaminants in soil (following degradation of the waste and release of contaminants into soil) would be calculated using the activity of the contaminant in the waste divided by the mass of the waste (for each radioactive contaminant) and calculating the combined resulting dose using the RESRAD computer code (Murphy, 2004). If the resulting soil concentration exceeds the FAL, then the waste would be considered PSM.

- For liquid wastes, the resulting concentration of contaminants in the surrounding soil would be calculated based on the concentration of contaminants in the waste and the liquid-holding capacity of the soil. If the resulting soil concentration exceeds the FAL, then the liquid waste would be considered PSM.

If sufficient information is not available to meet the closure objectives, then site conditions will be reevaluated and additional samples collected (as long as the scope of the CAI is not exceeded and any CSM assumption has not been shown to be incorrect).

B.3.2 Alternative Actions to the Decisions

This section identifies actions that may be taken to solve the problem depending on the possible outcomes of the CAI.

B.3.2.1 Alternative Actions to Decision I

Subsurface Releases

For the subsurface component of CAU 465, if the modeled contaminant concentrations in groundwater below the hydronuclear experiment and disposal boreholes do not exceed a FAL within 1,000 years, then the CAA of closure in place will be selected. If the modeled COC contamination in groundwater exceeds FALs within 1,000 years, then additional engineering or institutional controls and/or corrective actions will be evaluated for each CAS with COCs above FALs. If the implementation of engineering controls (e.g., soil cover, run-on controls, surface water diversion controls) is sufficient to reduce COC contamination below FALs, then closure in place and implementation of the necessary engineering controls will be implemented. If the implementation of engineering controls is shown not to reduce COC contamination below FALs, and/or engineering controls are not feasible, then work will stop and a consensus be reached with NDEP on the path forward before the investigation of the CAS may continue.

Surface Releases

For the surface component of CAU 465, if no COC associated with a release from the CAS is detected, then further assessment of the CAS component is not required, and the CAA of no further action will be selected. If a COC associated with a release from the CAS is detected, then additional sampling will be conducted to determine the extent of COC contamination. If the extent of the

contamination is defined and additional removal feasible, then clean close the site by removing the contaminated media until all contamination has been removed. If the extent of contamination has been determined and additional removal is not feasible, then the extent of contamination will be defined and the contaminated area closed in place with appropriate URs.

If the collection of verification samples confirms that all the contaminated media has been removed, then the clean closure objectives will have been met. If contamination still exists and additional removal would violate the conditions of the SAFER, then work will stop and a consensus be reached with NDEP on the path forward before the investigation of the CAS may continue.

B.3.2.2 Alternative Actions to Decision II

For the surface component, if sufficient information is available to define the extent of COC contamination and confirm that closure objectives were met, then further assessment of the CAS is not required. If sufficient information is not available to define the extent of contamination or confirm that closure objectives were met, then additional samples will be collected until the extent is defined.

B.4.0 Step 3 - Identify Information Inputs

Step 3 of the DQO process identifies the information needed, determines sources for information, and identifies sampling and analysis methods that will allow reliable comparisons with FALs.

B.4.1 Information Needs

Subsurface Releases

For the subsurface component of CAU 465, resolution of Decision I (evaluate potential impacts on groundwater) requires development of flow and contaminant transport models. Model development requires collection and/or analysis of the following:

- Existing geologic data
- Existing groundwater data
- Meteorological data
- Quantitative information on remaining source term
- Properties of contaminants

The selection of the model and specific input parameters to the selected model will be developed as part of the SAFER activity in conjunction with NDEP. The selection of the model and input parameters will be documented in the final CR for CAU 465.

Surface Releases

To resolve Decision I (determine whether a COC is present at a given CAS), samples need to be collected and analyzed following these two criteria:

- Samples must be collected in areas most likely to contain a COC (judgmental sampling).
- The analytical suite selected must be sufficient to identify any COCs present in the samples.

To resolve Decision II (determine whether sufficient information is available to confirm that closure objectives were met at each CAS), samples must be collected and analyzed to meet the following criteria:

- Samples must be collected in areas contiguous to the contamination but where contaminant concentrations are below FALs.

- Samples of the waste or environmental media must provide sufficient information to characterize the IDW for disposal.
- Samples of the waste or environmental media must provide sufficient information to determine potential remediation waste types.

B.4.2 Sources of Information

Subsurface Releases

The information necessary to satisfy Decision I for the subsurface component of CAU 465 exists in current UGTA regional and site groundwater models, knowledge of source term and the contaminant characteristics, and understanding of contaminant transport mechanisms. This information will be integrated into models used to simulate contaminant transport in subsurface media.

Surface Releases

Information to satisfy Decision I and Decision II will be generated by collecting environmental samples using grab sampling, hand auguring, direct push, backhoe excavation, or other appropriate sampling methods. These samples will be submitted to analytical laboratories meeting the quality criteria stipulated in the Industrial Sites QAPP (NNSA/NV, 2002). Only validated data from analytical laboratories will be used to make DQO decisions. Sample collection and handling activities will follow standard procedures.

B.4.2.1 Sample Locations

Development of the flow and contaminant transport models will be completed utilizing existing data. It is not anticipated that any sampling or other field collection activities are necessary. Therefore, the following subsections apply only to the surface component.

Design of the sampling approaches for the surface component of CAU 465 must ensure that the data collected are sufficient for selection of the CAAs (EPA, 2002). To meet this objective, the samples collected from each site should be from locations that most likely contain a COC, if present (judgmental). These sample locations, therefore, can be selected by means of biasing factors used in judgmental sampling (e.g., a stain, likely containing a spilled substance). Because sufficient data are available to develop a judgmental sampling plan, this approach was used to develop plans for

sampling environmental media and PSM. Biasing factors include areas of elevated radiological readings, lead bricks, and stained soil and concrete.

B.4.2.1.1 Judgmental Approach for Sampling Location Selection

Decision I sample locations at CAU 465 will be determined based upon the likelihood of the soil containing a COC, if present at the CAS. These locations will be selected based on field-screening techniques, biasing factors, the CSM, and existing information. Analytical suites for Decision I samples will include the COPCs identified in [Table B.2-2](#).

Field-survey techniques will be used to select appropriate sampling locations by providing semiquantitative data that can be used to comparatively select samples to be submitted for laboratory analyses from several screening locations. Field screening may also be used for health and safety monitoring and to assist in making certain health and safety decisions. The following field-screening methods and biasing factors may be used to select biased sample locations at CAU 465:

- Walkover radiological surveys: A radiological survey instrument will be used over approximately 100 percent of the CAS boundaries, as permitted by terrain and field conditions, to detect locations of elevated radioactivity.
- Preselected areas based on process knowledge of the site: Locations for which evidence such as historical photographs, experience from previous investigations, or input from interviewees, exists that a release of hazardous or radioactive substances may have occurred.
- Experience and data from investigations of similar sites.
- Visual indicators such as discoloration, textural discontinuities, disturbance of native soils, or any other indication of potential contamination. Stains are any discolored soil, material, or other surface and typically indicate the presence of an organic liquid such as oil.
- Presence of debris, waste, or equipment.
- Odor.
- Physical and chemical characteristics of contaminants.
- Other biasing factors: Factors not previously defined for the CAI, but become evident once the investigation of the site is under way.

Decision II sample step-out locations will be selected based on the CSM, biasing factors, and existing data. Analytical suites will include those parameters that exceeded FALs (i.e., COCs) in prior samples. Biasing factors to support Decision II sample locations include Decision I biasing factors plus available analytical results.

B.4.2.2 Analytical Methods

Analytical methods are available to provide the data needed to resolve the decision statements. The analytical methods and laboratory requirements (e.g., detection limits, precision, and accuracy) are provided in [Tables 3-3](#) and [3-4](#).

B.5.0 Step 4 - Define the Boundaries of the Study

Step 4 of the DQO process defines the target population of interest and its relevant spatial boundaries, specifies temporal and other practical constraints associated with sample/data collection, and defines the sampling units on which decisions or estimates will be made.

B.5.1 Target Populations of Interest

Subsurface Releases

The population of interest to resolve Decision I for the subsurface component at CAU 465 is the groundwater extending vertically beneath the hydronuclear experiment and disposal boreholes within the CAS boundary that contains contaminant concentrations above a FAL.

Surface Releases

The population of interest to resolve Decision I (“Is any COC present in environmental media within the CAS?”) is any location within the site that is contaminated with any contaminant above a FAL. The populations of interest to resolve Decision II (“If a COC is present, is sufficient information available to evaluate potential CAAs?”) are as follows:

- Each one of a set of locations bounding contamination in lateral and vertical directions.
- IDW or environmental media that must be characterized for disposal.
- Potential remediation waste.
- Environmental media where natural attenuation or biodegradation or construction/evaluation of barriers is considered.

B.5.2 Spatial Boundaries

Spatial boundaries are the maximum lateral and vertical extent of expected contamination at each CAS, as shown in [Table B.5-1](#). Contamination found beyond these boundaries may indicate a flaw in the CSM and may require reevaluation of the CSM before the investigation could continue. Each CAS is considered geographically independent, and intrusive activities are not intended to extend into the boundaries of neighboring CASs or existing URs from previously investigated CAUs.

**Table B.5-1
 Spatial Boundaries of CAU 465 CASs**

CAS	Spatial Boundaries
00-23-01	The lateral boundary for surface releases is 500 ft (to allow for migration due to erosion); the vertical boundary (depth) is limited to 10 ft bgs.
00-23-02 00-23-03 06-99-01	The lateral boundary for subsurface releases is the CAS boundary; the vertical boundary is the depth to the groundwater interface.
	The boundary for lead bricks is within 5 ft laterally and 10 ft bgs vertically from the bricks.

B.5.3 Practical Constraints

Practical constraints such as military activities at the NNSS, nature of classified materials, and/or access restrictions may affect the ability to investigate CAU 465.

B.5.4 Define the Sampling Units

The scale of decision making in Decision I is defined as the CAS component. Any COC detected at any location within the CAS component will cause the determination that the CAS component is contaminated and needs further evaluation. The scale of decision making for Decision II is defined as a contiguous area contaminated with any COC originating from the CAS. Resolution of Decision II requires this contiguous area to be bounded laterally and vertically.

B.6.0 Step 5 - Develop the Analytic Approach

Step 5 of the DQO process specifies appropriate population parameters for making decisions, defines action levels and generates an “If ... then ... else” decision rule that defines the conditions under which possible alternative actions will be chosen. This step also specifies the parameters that characterize the population of interest, specifies the FALs, and confirms that the analytical detection limits are capable of detecting FALs.

B.6.1 Population Parameters

Subsurface Releases

For the CAU 465 subsurface component, the population parameter is the maximum forecasted radionuclide concentration in groundwater within 1,000 years. The maximum forecasted result of each individual radionuclide contaminant will be compared to the FALs to determine resolution of Decision I.

Surface Releases

For judgmental sampling results, the population parameter is the observed concentration of each contaminant from each individual analytical sample. Each sample result will be compared to the FALs to determine the appropriate resolution to Decision I and Decision II. For Decision I, a single sample result for any contaminant exceeding a FAL would cause a determination that a COC is present within the CAS component.

The Decision II population parameter is an individual analytical result from a bounding sample. For Decision II, a single bounding sample result for any contaminant exceeding a FAL would cause a determination that the contamination is not bounded.

B.6.2 Action Levels

The PALs presented in this section are to be used for site-screening purposes. They are not necessarily intended to be used as cleanup action levels or FALs. However, they are useful in screening out contaminants that are not present in sufficient concentrations to warrant further

evaluation and therefore streamline the consideration of remedial alternatives. The RBCA process used to establish FALs is described in the *Industrial Sites Project Establishment of Final Action Levels* (NNSA/NSO, 2006). This process conforms with Section 445A.227 of the NAC, which lists the requirements for sites with soil contamination (NAC, 2008a). Section 445A.22705 of the NAC (NAC, 2008b) requires the use of ASTM Method E1739 (ASTM, 1995) to “conduct an evaluation of the site, based on the risk it poses to public health and the environment, to determine the necessary remediation standards or to establish that corrective action is not necessary.” For the evaluation of corrective actions, the FALs are established as the necessary remediation standards.

This RBCA process defines three tiers (or levels) of evaluation involving increasingly sophisticated analyses:

- Tier 1 evaluation—Sample results from source areas (highest concentrations) are compared to action levels based on generic (non-site-specific) conditions (i.e., the PALs established in the SAFER Plan). The FALs may then be established as the Tier 1 action levels or the FALs may be calculated using a Tier 2 evaluation.
- Tier 2 evaluation—Conducted by calculating Tier 2 SSTLs using site-specific information as inputs to the same or similar methodology used to calculate Tier 1 action levels. The Tier 2 SSTLs are then compared to individual sample results from reasonable points of exposure (as opposed to the source areas as is done in Tier 1) on a point-by-point basis. Total concentrations of TPH will not be used for risk-based decisions under Tier 2 or Tier 3. Rather, the individual chemicals of concern will be compared to the SSTLs.
- Tier 3 evaluation—Conducted by calculating Tier 3 SSTLs on the basis of more sophisticated risk analyses using methodologies described in Method E1739 that consider site-, pathway-, and receptor-specific parameters.

The comparison of maximum forecasted results derived from the groundwater flow and transport models, and laboratory results to FALs and the evaluation of potential corrective actions will be included in the investigation report. The FALs will be defined and presented (along with the basis for their definition) in the investigation report.

B.6.2.1 Subsurface Releases

The radionuclide PALs for groundwater are defined as the concentrations of radionuclides corresponding to a human dose of 4 mrem/yr, or concentrations equal to drinking water standards (maximum contaminant levels) for other contaminants. The 4-mrem/yr dose regulatory limit is based

on the SDWA (CFR, 2011), and multiple radionuclides may contribute to the total dose. The total dose is the sum of the doses of all contributing radionuclides using a drinking water scenario (Adams, 1996a, 1996b). The individual contributions from each contaminant to the dose must be less than the regulatory limit. The PAL for lead was obtained from 40 CFR 141.80 (CFR, 2011).

B.6.2.2 Surface Releases

B.6.2.2.1 Chemical PALs

Except as noted herein, the chemical PALs are defined as the EPA Region 9 Regional Screening Levels for chemical contaminants in industrial soils (EPA, 2011). Background concentrations for RCRA metals and zinc will be used instead of screening levels when natural background concentrations exceed the screening level (e.g., arsenic on the NNSS). Background is considered the average concentration plus two standard deviations of the average concentration for sediment samples collected by the Nevada Bureau of Mines and Geology throughout the Nevada Test and Training Range (formerly the Nellis Air Force Range) (NBMG, 1998; Moore, 1999). For detected chemical COPCs without established screening levels, the protocol used by the EPA Region 9 in establishing screening levels (or similar) will be used to establish PALs. If used, this process will be documented in the investigation report.

B.6.2.2.2 Radionuclide PALs

The PAL for radioactive contaminants is a TED of 25 mrem/yr based upon the Industrial Area exposure scenario. The Industrial Area exposure scenario is described in the *Industrial Sites Project Establishment of Final Action Levels* (NNSA/NSO, 2006). For subsurface releases, the TED is calculated as the sum of external dose and internal dose. External dose is determined directly from TLD measurements. Internal dose is determined by comparing analytical results from soil samples to RRMGs that were established using the RESRAD computer code (Murphy, 2004). The RRMGs presented in [Table B.6-1](#) are radionuclide-specific values for radioactivity in surface soils. The RRMG is the value, in picocuries per gram for surface soil, for a particular radionuclide that would result in an internal dose of 25 mrem/yr to a receptor (under the appropriate exposure scenario) independent of any other radionuclide (assuming that no other radionuclides contribute dose). The

internal dose associated with any specific radionuclide would be established using the following equation:

$$\text{Internal dose (mrem/yr)} = [\text{Analytical result (pCi/g)} / \text{RRMG}] \times 25 \text{ mrem/yr}$$

When more than one radionuclide is present, the internal dose will be calculated as the sum of the internal doses for each radionuclide. In the RESRAD calculation, several input parameters are not specified so that site-specific information can be used. Specific input parameters used to calculate the RRMGs for each exposure scenario where an area of contamination equal to 1000 m² and a depth of contamination equal to 5 cm.

**Table B.6-1
Residual Radioactive Material Guideline Values**

Radionuclide	Exposure Scenario (pCi/g)		
	Industrial Area	Remote Work Area	Occasional Use Area
Am-241	2,816	16,120	45,550
Co-60	551,300	7,229,000	74,210,000
Cs-137	140,900	1,955,000	27,560,000
Eu-152	1,177,000	13,240,000	81,740,000
Eu-154	846,900	9,741,000	63,530,000
Eu-155	5,588,000	66,450,000	475,100,000
Nb-94	3,499,000	39,660,000	249,200,000
Pu-238	2,423	13,880	39,220
Pu-239/240	2,215	12,680	35,820
Sr-90	59,470	807,500	9,949,000
Th-232	2,274	13,410	38,520
U-234	19,600	137,900	447,000
U-235	20,890	149,600	492,200
U-238	21,200	155,400	336,100

B.6.3 Decision Rules

B.6.3.1 Subsurface Releases

The decision rules applicable to Decision I are as follows:

- If the population parameter of any radionuclide COPC in the Decision I population of interest (defined in Step 4) exceeds the corresponding FAL within 1,000 years, then additional engineering controls and/or corrective actions will be evaluated. If the implementation of engineering controls (e.g., soil cover, run-on controls, surface water diversion controls) is sufficient to reduce COC contamination below FALs, then implement the necessary engineering controls. If the implementation of engineering controls is shown not to reduce COC contamination below FALs, and/or engineering controls are not feasible, then work will stop and a consensus be reached with NDEP on the path forward before the investigation of the CAS may continue.
- If no COC associated with a release for the CAS is forecasted by the flow and transport models, then further assessment of the CAS is not required.

B.6.3.2 Surface Releases

The decision rule applicable to both Decision I and Decision II is as follows:

- If COC contamination is inconsistent with the CSM or extends beyond the spatial boundaries identified in [Section B.5.2](#), then work will be suspended and the investigation strategy reconsidered, else the decision will be to continue sampling to define the extent.

The decision rules for Decision I are as follows:

- If the population parameter of any COPC in the Decision I population of interest (defined in Step 4) exceeds the corresponding FAL, then that contaminant is identified as a COC, the contaminated material will be removed, or Decision II samples will be collected until an estimate of the extent of contaminated material has been made.
- If no COC associated with a release from the CAS is detected, then further assessment of the CAS is not required, and the CAA of no further action will be selected. If a COC associated with a release from the CAS is detected, then additional sampling will be conducted to determine the extent of COC contamination. If the extent of the contamination is defined and additional removal feasible, then clean close the site by removing the contaminated media until all contamination has been removed. If the extent of contamination has been determined and additional removal is not feasible, then the contaminated area will be closed in place with appropriate URs and the extent of contamination defined.

- If a waste is present that, if released, has the potential to cause the future contamination of site environmental media, then a corrective action will be determined, else no further action will be necessary.

The decision rules for Decision II are as follows:

- If the population parameter (the observed concentration of any COC) in the Decision II population of interest (defined in Step 4) exceeds the corresponding FAL, then additional samples will be collected to complete the Decision II evaluation. If sufficient information is available to define the extent of COC contamination and confirm that closure objectives were met, then further assessment of the CAS is not required. If sufficient information is not available to define the extent of contamination or confirm that closure objectives were met, then additional samples will be collected until the extent is defined.
- If valid analytical results are available for the waste characterization samples defined in [Section B.8.0](#), then the decision will be that sufficient information exists to characterize the IDW for disposal and determine potential remediation waste types, else collect additional waste characterization samples.

B.7.0 Step 6 - Specify Performance or Acceptance Criteria

Step 6 of the DQO process defines the decision hypotheses, specifies controls against false rejection and false acceptance decision errors, examines consequences of making incorrect decisions from the test, and places acceptable limits on the likelihood of making decision errors.

B.7.1 Decision Hypotheses

The baseline condition (i.e., null hypothesis) and alternative condition for Decision I are as follows:

- Baseline condition—A COC is present.
- Alternative condition—A COC is not present.

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

- 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 false negative or false positive errors associated with their determination. The impact of these decision errors and the methods that will be used to control these errors are discussed in the following subsections. In general terms, confidence in DQO decisions based on judgmental sampling results will be established qualitatively by the following:

- Develop and achieve concurrence of CSMs (based on process knowledge) by stakeholder participants during the DQO process.
- Conduct validity testing of CSMs based on investigation results.
- Evaluate data quality based on DQI parameters.

B.7.2 False Negative Decision Error

B.7.2.1 Subsurface Releases

The false negative decision error would mean deciding that the forecasted maximum concentration of a COPC in groundwater within 1,000 years is less than FALs when it is actually greater. If this were the case, the potential consequence is an increased risk to human health and the environment.

B.7.2.1.1 False Negative Decision Error for CAU Groundwater Models

The objective of the flow and contaminant transport models is to forecast the concentrations of subsurface contaminants using a mathematical model. The forecast of a credible contaminant transport scenario must rely on the mathematical model being representative of reality, which depends on the accuracy of the conceptual model. The validity of the current conceptual model is believed to be sufficiently accurate based upon existing characterization and geologic information, and professional judgment.

The false negative decision error for the flow and contaminant transport models is controlled by meeting the following criteria:

- Use of conservative inputs to the model (e.g., hydrologic properties, transport mechanisms)
- Use of a robust and proven model
- Use of conservative estimates for source term (i.e., assumed the worst-case scenario of source term based on historical information)
- Use of a model that represents the hydrogeologic framework, hydraulic properties, and contaminant characteristics to achieve a reasonable degree of correspondence between model simulations and observations of the groundwater system

B.7.2.2 Surface Releases

The false negative decision error would mean deciding that a COC is not present when it actually is (Decision I), or deciding that the extent of a COC has been defined when it has not (Decision II). In both cases, the potential consequence is an increased risk to human health and the environment.

B.7.2.2.1 False Negative Decision Error for Judgmental Sampling

In judgmental sampling, the selection of the number and location of samples is based on knowledge of the feature or condition under investigation and on professional judgment (EPA, 2002).

Judgmental sampling conclusions about the target population depend upon the validity and accuracy of professional judgment.

The false negative decision error (where consequences are more severe) for judgmental sampling designs is controlled by meeting these criteria:

- For Decision I, having a high degree of confidence that the sample locations selected will identify COCs if present anywhere within the CAS. For Decision II, having a high degree of confidence that the sample locations selected will identify the extent of COCs.
- Having a high degree of confidence that analyses conducted will be sufficient to detect any COCs present in the samples.
- Having a high degree of confidence that the dataset is of sufficient quality and completeness.

To satisfy the first criterion, Decision I samples must be collected in areas most likely to be contaminated by COCs (supplemented by random samples where appropriate). Decision II samples must be collected in areas that represent the lateral and vertical extent of contamination (above FALs). The following characteristics must be considered to control decision errors for 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 field-screening methods and biasing factors listed in [Section B.4.2.1](#) will be used to further ensure that appropriate sampling locations are selected to meet these criteria. Radiological survey instruments and field-screening equipment will be calibrated and checked in accordance with the manufacturer's instructions and approved procedures. The investigation report will present an assessment of the DQI of representativeness that samples were collected from those locations that best represent the populations of interest as defined in [Section B.5.1](#).

To satisfy the second criterion, Decision I samples will be analyzed for the chemical and radiological parameters listed in [Section 3.2](#). Decision II samples will be analyzed for those chemical and radiological parameters that identified unbounded COCs. The DQI of sensitivity will be assessed for all analytical results to ensure that all sample analyses had measurement sensitivities (detection limits) that were less than or equal to the corresponding FALs. If this criterion is not achieved, the

affected data will be assessed (for usability and potential impacts on meeting site characterization objectives) in the investigation report.

To satisfy the third criterion, the entire dataset, as well as individual sample results, will be assessed against the DQIs of precision, accuracy, comparability, and completeness as defined in the Industrial Sites QAPP (NNSA/NV, 2002) and in [Section 7.2](#). The DQIs of precision and accuracy will be used to assess overall analytical method performance as well as the need to potentially “flag” (qualify) individual contaminant results when corresponding QC sample results are not within the established control limits for precision and accuracy. Data qualified as estimated for reasons of precision or accuracy may be considered to meet the constituent performance criteria based on an assessment of the data. The DQI for completeness will be assessed to ensure that all data needs identified in the DQO have been met. The DQI of comparability will be assessed to ensure that all analytical methods used are equivalent to standard EPA methods so that results will be comparable to regulatory action levels that have been established using those procedures. Strict adherence to established procedures and QA/QC protocols protects against false negatives. Site-specific DQIs are discussed in more detail in [Section 7.2](#).

To provide information for the assessment of the DQIs of precision and accuracy, the following QC samples will be collected as required by the Industrial Sites QAPP (NNSA/NV, 2002):

- Field duplicates (minimum of 1 per matrix per 20 environmental samples)
- Laboratory QC samples (minimum of 1 per matrix per 20 environmental samples, or 1 per CAS per matrix if less than 20 collected)

B.7.3 False Positive Decision Error

B.7.3.1 Subsurface Releases

The false positive decision error would mean deciding that a COC is present when it is not, or a COC is unbounded when it is not, resulting in increased costs for additional modeling or implementation of unnecessary engineering or institutional controls.

False positive results could be due to overly conservative estimates for the source term and/or inaccurate inputs to the models (e.g., representation of hydrogeologic properties, groundwater levels).

To control against false positive error,

- determination of source term will be based on available historical and technical data regarding quantities of radionuclides utilized in performance of the hydronuclear experiments, and
- readily accepted, established, and approved procedures will be utilized to generate the flow and contaminant transport models.

B.7.3.2 Surface Releases

The false positive decision error would mean deciding that a COC is present when it is not, or a COC is unbounded when it is not, resulting in increased costs for unnecessary sampling and analysis.

False positive results are typically attributed to laboratory and/or sampling/handling errors that could cause cross contamination. To control against cross contamination, decontamination of sampling equipment will be conducted in accordance with established and approved procedures, and only clean sample containers will be used. To determine whether a false positive analytical result may have occurred, the following QC samples will be collected as required by the Industrial Sites QAPP (NNSA/NV, 2002):

- Trip blanks (one per sample cooler containing VOC environmental samples)
- Equipment blanks (one per sampling event for each type of decontamination procedure)
- Source blanks (one per source lot per sampling event)
- Field blanks (minimum of one per CAS, additional if field conditions change)

B.8.0 Step 7 - Develop the Plan for Obtaining Data

Step 7 of the DQO process selects and documents a design that will yield data that will best achieve performance or acceptance criteria. In order to resolve Step 7 of the DQO process, the following actions will be implemented:

- Flow and contaminant transport models will be generated to evaluate impacts on groundwater.
- A judgmental sampling scheme will be implemented to select sample locations and evaluate analytical results for CAU 465.

[Section B.8.1](#) contains information about collecting the necessary existing data to generate the flow and contaminant transport models. [Section B.8.2](#) contains general information about collecting Decision I and Decision II samples under judgmental sampling designs and information about CAS-specific sampling activities, including proposed sample locations.

B.8.1 Subsurface Releases: Development of the Flow and Contaminant Transport Models

The objective of the CAI is to compile and evaluate current relevant data to forecast the concentrations of subsurface contaminants using a mathematical model. The stated purpose of the flow and transport models is to forecast maximum contaminant concentrations at the groundwater surface beneath the CAU 465 CASs during a period of 1,000 years. For each contaminant, the model will forecast the concentration at selected time steps from 0 to 1,000 years.

Due to both geographic and geologic differences, two models will be generated: one model for CASs 00-23-01, 00-23-02, and 00-23-03 in Area 27; and one model for CAS 06-99-01 in Area 6. The COPCs are based upon the known inventories of radiological materials ([Tables 2-1 and 2-6](#)). Although some components containing lead and other metals are known to have been left in the boreholes following the experiments, they are not believed to be in sufficient quantity and composition (e.g., leachable) to impact groundwater. Lead as a potential contaminant is assumed to be representative of other inorganic, nonradioactive, hazardous constituents, and is therefore considered a COPC.

The relevant data for the flow and transport models will come from the following sources:

- Data used to prepare this SAFER Plan, including data from relevant wells and springs
- Historical and technical data from the Weapons Program
- Data from ongoing groundwater monitoring activities

Following data gathering and compilation, the data are screened for quality. The screening process includes data documentation evaluation and data quality evaluation. The selection of the model and specific input parameters to the selected model will be developed as part of the SAFER activity in conjunction with NDEP. The selection of the model and input parameters will be documented in the final CR for CAU 465.

B.8.2 Surface Releases: Field Sampling

B.8.2.1 Decision I Sampling

A judgmental sampling design will be implemented for the Decision I investigation of the CAU 465 CASs. Because individual sample results, rather than an average concentration, will be used to compare to FALs at the CASs, statistical methods to generate site characteristics will not be used. Adequate representativeness of the entire target population may not be a requirement to developing a sampling design. If good prior information is available on the target site of interest, then the sampling may be designed to collect samples only from areas known to have the highest concentration levels on the target site. If the observed concentrations from these samples are below the action level, then a decision can be made that the site contains safe levels of the contaminant without the samples being truly representative of the entire area (EPA, 2006).

All sample locations will be selected to satisfy the DQI of representativeness in that samples collected from selected locations will best represent the populations of interest as defined in [Section B.5.1](#). To meet this criterion for judgmentally sampled sites, a biased sampling strategy will be used for Decision I samples to target areas with the highest potential for contamination, if it is present anywhere in the CAS. Sample locations will be determined based on process knowledge, previously acquired data, or the field-screening and biasing factors listed in [Section B.4.2.1](#). If biasing factors are present in soils below locations where Decision I samples were collected, additional Decision I soil samples will be collected at depth intervals selected by the Site Supervisor based on biasing

factors to a depth where the biasing factors are no longer present. The Site Supervisor has the discretion to modify the judgmental sample locations, but only if the modified locations meet the decision needs and criteria stipulated in this DQO.

The samples collected from each CAU 465 CAS should be from locations that most likely contain a COC, if present. Decision I sample locations at all of the CAU 465 CASs will be determined based upon the likelihood of the soil containing a COC, if present at the CAS. These locations will be selected based on field-survey techniques, biasing factors, the CSM, and existing information.

The following field-survey techniques will be used to select sample locations at CAU 465:

- Walkover surface area radiological surveys—A radiological survey instrument will be used over approximately 100 percent of the CAS boundary in Areas 6 and 27, as permitted by terrain and field conditions, to detect locations of elevated radioactivity.
- Visual field surveys—Visual field surveys will be conducted to select appropriate sampling locations to identify other areas of contamination and PSM.

Stains, Spills, and Debris

Collect a minimum of one sample within each identified area of potential contamination. Samples will be submitted for analysis according to the following:

- Lead brick(s) identified at CAS 00-23-02 will be removed and staged for disposition. Collect a minimum of one soil sample for total lead. If there are other biasing factors (e.g., elevated field radiological readings), then sample for gamma, isotopic Pu, and isotopic U.
- Collect a minimum of one sample each of stained soil and stained concrete pad at CAS 00-23-02. Decision I samples for soil will include VOCs, SVOCs, metals, PCBs, and HEs. Decision I samples for concrete will include VOCs, SVOCs, metals, and PCBs. If there are other biasing factors (e.g., elevated field radiological readings), then sample for gamma, isotopic Pu, and isotopic U.
- Other areas at all CAS locations where a potential release has been identified based upon biasing factors, including stains, spills, and debris (PSM). Collect a minimum of one sample at each location. Samples will be submitted for analysis based upon site conditions and process knowledge.

Drainages

Collect a minimum of one sample within each identified area of potential contamination as follows:

- In areas at all CAS locations where a potential release has been identified based upon visual and/or radiological surveys, investigate downgradient washes and drainages. Collect a minimum of one sample at each soil/sediment accumulation area. Samples will be submitted for analysis based upon site conditions and process knowledge.

B.8.2.2 Decision II Sampling

To meet the DQI of representativeness for Decision II samples (i.e., Decision II sample locations represent the population of interest as defined in [Section B.5.1](#)), judgmental sampling locations at each CAS will be selected based on the outer boundary sample locations where COCs were detected, the CSM, and other field-screening and biasing factors listed in [Section B.4.2](#). In general, sample locations will be arranged in a triangular pattern around the Decision I location or area at distances based on site conditions, process knowledge, and biasing factors. If COCs extend beyond the initial step-outs, Decision II samples will be collected from incremental step-outs. Initial step-outs will be at least as deep as the vertical extent of contamination defined at the Decision I location, and the depth of the incremental step-outs will be based on the deepest contamination observed at all locations. A clean sample (i.e., COCs less than FALs) collected from each step-out direction (lateral or vertical) will define the extent of contamination in that direction. The number, location, and spacing of step-outs may be modified by the Site Supervisor, as warranted by site conditions.

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Appendix C

Nevada Division of Environmental Protection Comments

(5 Pages)

**NEVADA ENVIRONMENTAL RESTORATION PROJECT
DOCUMENT REVIEW SHEET**

1. Document Title/Number:		Draft Streamlined Approach for Environmental Restoration (SAFER) Plan for CAU 465: Hydronuclear Nevada National Security Site, Nevada		2. Document Date:	9/1/2011
3. Revision Number:		0		4. Originator/Organization:	Navarro-INTERA
5. Responsible NNSA/NSO Federal Sub-Project Director:		Kevin J. Cabble		6. Date Comments Due:	
7. Review Criteria:		Full			
8. Reviewer/Organization/Phone No:				9. Reviewer's Signature:	
		Jeff MacDougall, NDEP, 702-486-2850			
10. Comment Number/Location	11. Type*	12. Comment	13. Comment Response	14. Accept	
1.) Section 1.2 (page 5), and section 4.4 (page 47)	Mandatory	For the subsurface component, if modeled contamination in groundwater exceeds FALs, specify potential/actual remedies, engineering controls, or applicable corrective actions that will be considered and implemented. ?	<p>Revise the 2nd paragraph of Section 1.2 as follows: The subsurface component.....groundwater below each of the CASs. For contaminants with a potential to reach the water table, contaminant concentrations in the groundwater beneath the CAS will be evaluated and compared to the appropriate final action levels (FALs). If the modeled contamination in groundwater exceeds FALs within 1,000 years, then additional engineering controls and/or corrective actions <i>such as installation of run-on or infiltration controls, placement of a soil cover, and/or other surface water diversion controls</i> will be evaluated for each CAS with contaminants above FALs. Refer to Figure 1-3 for a summary of the decision process for the subsurface component of CAU 465.</p> <p>Revise the 1st paragraph of Section 4.4 as follows: For the closure of the subsurface will be backfilled/sealed. If, through modeling, COC concentrations are estimated to exceed FALs at the groundwater surface within 1,000 years, then additional engineering or institutional controls and/or corrective actions <i>such as installation of run-on or infiltration controls, placement of a soil cover, and/or other surface water diversion controls</i> will be evaluated. If additional controls (e.g., installation of infiltration controls, soil cover) are determined to mitigate the COC contamination, adequate controls will be put in place. The decision logic for closure of the subsurface component is provided in Figure 1-3.</p>		

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DOCUMENT REVIEW SHEET**

1. Document Title/Number:		Draft Streamlined Approach for Environmental Restoration (SAFER) Plan for CAU 465: Hydronuclear Nevada National Security Site, Nevada		2. Document Date:		9/1/2011	
3. Revision Number:		0		4. Originator/Organization:		Navarro-INTERA	
5. Responsible NNSA/NSO Federal Sub-Project Director:		Kevin J. Cabble		6. Date Comments Due:			
7. Review Criteria:		Full		9. Reviewer's Signature:			
8. Reviewer/Organization/Phone No:		Jeff MacDougall, NDEP, 702-486-2850					
10. Comment Number/Location	11. Type*	12. Comment	13. Comment Response	14. Accept			
2.) figure 1-3 (page 6)		Explain the following, with respect to the decision logic diagram for the subsurface component: if groundwater concentrations exceed FALs, and if engineering controls are not feasible, then closure in place with a UR will be selected...; this decision logic appears to contradict what is contained in Section 1.2 and other applicable sections where objectives for the subsurface component are discussed. Also, in the logic diagram, what are "SAFER conditions" (i.e., how is this being defined). ?	<p>The corrective action of closure in place with use restrictions will be implemented regardless of the selected corrective action alternative. If groundwater concentrations exceed FALs, corrective action alternatives including implementation of engineering/institutional controls will be evaluated and implemented as feasible. In the case in which engineering controls are not feasible or ineffective, URs might include additional administrative controls on water resources at the NNSS, and potentially inclusion within UGTA contaminant plumes and therefore subject to drilling restrictions and/or monitoring. Figures 1-3 and B.3-1 have been revised to reflect this logic.</p> <p>"SAFER conditions" are defined in Appendix VI, Part 1.5 of the FFACO which defines the appropriateness of the three corrective action processes (e.g., housekeeping process, SAFER process, complex process). The SAFER process is selected when all parties agree that enough information exists about the nature and extent of contamination to propose an appropriate corrective action before a CAI is completed. Include a footnote for figures 1-3, 1-4, B.3-1, and B.3-2 to refer to FFACO, Appendix VI, Part 1.5.</p>				

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3.) Section 2.0 (page 9)	Mandatory	While it is understandable that plutonium and uranium contamination exists down hole, how has NSO established that "...other contaminants may also be present in minor amounts..."? What is the basis for this assertion? What are the suspected other contaminants, and why are they "not expected to be an environmental concern..."? Explain or provide a technical basis for this reasoning.	<p>While there is always the potential for other unidentified components used during the hydronuclear experiments, unclassified historical documentation indicates Pu and U as potential contaminants used during the experiments. This information is also consistent with a review of classified documents. No other contaminants of environmental concern have been identified. Based upon the available process and historical knowledge, remove the sentence "Other contaminants may also be present in minor amounts, but are not expected to be an environmental concern", and revise the 3rd paragraph of Section 2.0 as follows:</p> <p>The potential environmental concern at each site is predominantly attributable to the presence of <i>Resource Conservation and Recovery Act</i> (RCRA) metals, high explosives (HEs), and radionuclides, specifically plutonium and several forms of uranium, due to the experiments and the associated instruments, which are believed to remain downhole (DOE/NV, 2001). A review of historical information has also indicated that an additional set of shallow boreholes (12 at the Dog site, and 1 at the Trailer 13 site) were utilized for disposal of nonradioactive classified materials following the experiments. Because these boreholes were utilized for disposal of materials used to conduct the hydronuclear experiments, no additional contaminants are expected. Past radiological surveys have not indicated any surface radiological contamination at any of the sites.</p> <p>Remove the sentence "Other radionuclides may be present</p>		

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	Mandatory		<p>at low activity concentrations, but are not considered significant because of the inventory of known radiological materials", and revise the 2nd paragraph of Section B.2.2.2 as follows:</p> <p>For subsurface releases, a list of potential contaminants for the 1,000-year CAI time period was derived from the reported list of radioactive materials utilized to conduct the hydronuclear experiments: Pu-239/240, Am-241, U-235, and U-238 (DOE/NV, 2001). This group of radionuclides was considered the most significant for forecasting the 4-millirem (mrem) contaminant boundary over a 1,000-year time period. Lead also is included as a potential contaminant because it is known to have been used in significant quantities in underground nuclear testing for shielding and as a component in instrumentation. It was assumed that HEs and any VOC or SVOC RCRA constituents would be consumed during the explosion; therefore, only metals could remain as potential contaminants.</p>		

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4.) General	Mandatory	The SAFER Plan provides information on evaluating subsurface contaminant transport by modeling, but very little information on the model inputs. If possible, please provide more information on what values for contaminants will be used in the subsurface transport models, and what data source was used to obtain these starting values.	<p>Selection of an appropriate flow and contaminant transport model and input parameters will be developed in conjunction with NDEP. Input parameters and details regarding the selected model will be documented in the CAU 465 final Closure Report. Insert the following text in:</p> <ul style="list-style-type: none"> • Section 4.0 at the end of the 2nd paragraph, • Section B.4.1 at the end of the subsection entitled "Subsurface Releases", and • Section B.8.1 at the end of the last paragraph. <p>"The selection of the model and specific input parameters to the selected model will be developed as part of the SAFER activity in conjunction with NDEP. The selection of the model and input parameters will be documented in the final CR for CAU 465."</p>				

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